

Climate Resilience Template for Buildings

ABOUT THIS TEMPLATE

This template serves as a guide for commercial real estate property owners and managers to help prepare their individual facilities for climate change. It compiles existing best practice resources and includes new guidance to aid decision-making and resilience project implementation. This includes a vendor list for climate resiliency services compiled by A Better City based on the results of a December 2018 Request for Information (RFI) and an excel worksheet that organizations can use to capture the data specific to their properties' climate risks and vulnerabilities. While the content focuses on Boston, Massachusetts, best practices are referenced throughout the document that may be helpful for any organization planning for resilience or seeking resources for different types of resilience initiatives or vendors.

This template and its associated workbook are appropriate for commercial real estate property owners and managers considering resilience at a building level. Although it is primarily focused on preparing existing buildings and their daily operations for climate change, it can inform risk planning for new construction or major rehabilitation projects. Incorporating resiliency into new construction or property portfolios requires additional considerations, beyond the scope of this guide including: incorporating climate risk management into property acquisition and due diligence processes; utilizing resilience principles in building design and construction best practices; or establishing an organizational-level resilience strategy and educating senior leadership and Boards of Directors. Although not currently included, A Better City and the Boston Green Ribbon Commission are committed to developing additional tools and research to support the incorporation of resilience into organizational management and new acquisitions or construction projects in future years.

INTRODUCTION

Boston is already experiencing the impacts of climate change. Results from surveys to a small group of A Better City members have indicated that building owners and operators across Boston have or plan to update operating plans to respond to days of extreme precipitation, heat and flood risks.¹ Each of these trends—extreme precipitation, extreme temperature, sea level rise, and storm surge—is expected to worsen in the coming decades. As such, planning for climate resilience is a business necessity. The *Federal Emergency Management Natural Hazard Mitigation Saves: 2017 Interim Report* shows that for every \$1 spent on hazard mitigation, \$6 is saved.²

Whether owners and operators chose to conduct in-house vulnerability assessments or pursue a resilience audit, the process of identifying risks, developing solutions and prioritizing preparedness investments will lead to better outcomes for tenants, investors, and operators in the near- and long-term.

Boston's Climate Impacts

The City of Boston has conducted a comprehensive analysis to determine how global climate change will impact neighborhoods and residents in Boston. The results included in the comprehensive 2016 Climate Ready Boston study report provide important context for building owners and developers as they consider near- and long-term investments in the safety of their buildings.³

The major climate factors all building owners and operators should be aware of are highlighted below.

Extreme Temperature

The average summer temperature in Boston will continue to increase, resulting in a greater number of days with extreme heat.

- **Days over 90 Degrees:** By 2030, there may 20 - 40 days over 90 degrees—as compared with the 11 on average between 1971 and 2000.⁴ Under a Business as Usual scenario in which little is done globally to reduce GHG emissions, nearly the entire summer—or 90 days—may be over 90 degrees by 2070, including many days over 100 degrees.
- **Average Temperatures:** By 2050 average summer temperatures could be as high as 76 degrees—compared with 69 degrees now—leaving Boston with a summer climate closer to Washington D.C. By 2100, the summertime average may reach 84 degrees.

¹ In early 2018, A Better City surveyed a subset of its members impacted by Winter Storm Grayson determining that there was an awareness of and planning for climate impacts.

² Please see: <https://www.fema.gov/natural-hazard-mitigation-saves-2017-interim-report>

³ Note: Climate Ready Boston data is updated every five years.

⁴ All figures are presented in Fahrenheit.

THE CASE FOR NEAR-TERM ACTION

Regardless of the additional level of carbon emissions in the coming decade, anticipated climate impacts through 2030 are fairly uniform across projections. Given this, building owners and operators can base near-term investments with a high level of certainty. After 2030, the volume of greenhouse gas emissions will have significant bearing on the magnitude of climate impacts. Larger impacts and higher recovery costs are associated with higher levels of greenhouse gas emissions. These impacts can be avoided through continuing to aggressively invest in efficiency and renewable energy, alongside resiliency. While these long-term impacts may not seem pertinent to near-term decision-making, the significant variation in anticipated impacts between business as usual and reduced emissions scenarios reinforces the importance of adapting to climate change and reducing emissions, simultaneously where possible.

- **Urban Heat Island:** These temperature extremes may vary across the city due to the urban heat island effect, which refers to areas with higher temperatures due to the presence of concrete, steel, and other building materials that retain heat. This means communities or districts without open space, tree cover, or proximity to water may feel the impacts of rising temperatures more dramatically.
- **Overnight Lows:** According to the National Oceanographic and Atmospheric Administration’s August 2018 National Climate Report, summer minimum temperatures (also called overnight lows) in 2018 were “exceptionally warm,” and broke the previous record for average minimum temperatures set in 2016. Since NOAA’s observations began in 1895, they have observed that “summer overnight low temperatures are warming at a rate nearly twice as fast as afternoon high temperatures for the U.S.”⁵ This means that, despite temperatures being cooler overnight on a day-to-day basis, when compared with previous averages, nighttime temperatures have increased more dramatically than daytime temperatures.
- **Building Implications:** These temperature changes will impact the reliability of power supplies, stress mechanical equipment, and limit the ability for outdoor maintenance. They can also affect the health of tenants, especially those that walk or bike to work or must miss work due to heat-related complications. The average temperature increase in overnight lows may have implications for HVAC systems that have historically rested overnight.

Sea Level Rise

The pace of sea level rise (SLR) in Boston is accelerating and could reach over 3 feet by 2070.

- **Historic SLR:** Boston experienced nine inches of SLR in the 20th century.
- **Anticipated SLR:** An additional four to eight inches are expected by 2030, relative to 2000. By 2050, SLR may reach 1.5 feet above 2000 levels. By 2070, Boston could experience 3 feet of SLR above 2000 levels, depending on the level of greenhouse gas reductions globally.
- **Building Implications:** Building owners and developers in the current floodplain and beyond need to prepare for a near-term scenario in which flooding exacerbated by SLR is more common. Climate Ready Boston predicts flood progression will impact buildings as follows:
 - **Near-Term (2030s-2050s):** A 1% annual flood—or “[a flood event having a 1-percent chance of being equaled or exceeded in any given year.](#)” often referred to as a 100 year flood—can be expected to inundate 2,100 buildings, representing \$20 billion in real estate value. This flooding is expected to amount to \$2.3 billion in physical damages to buildings and property and other economic losses from relocation and loss of productivity—70 percent of which will be concentrated in Downtown and South Boston.
 - **Medium- to Long-Term (2050s – 2100s):** In the latter half of the century, sea level rise will threaten areas beyond the current floodplain. Over a fifth of Boston’s land mass and ten percent of Boston’s existing buildings will be exposed to the 1% annual flood—nearly three times the area exposed today—while 25 percent could be exposed during severe storms. Routine inundation at high tide is also anticipated, threatening nearly five percent of Boston’s real estate market.

BPDA SLR – FLOOD HAZARD AREA

The BPDA SLR – Flood Hazard Area is modeled as 1% annual chance flood event with 40 inches of SLR.

⁵ See “Climate Highlights – summer (June-August) in August 2018 National Climate Report Summary available at: <https://www.ncdc.noaa.gov/sotc/national/201808>.

- **Geographic Area:** SLR impacts are particularly important for developers and owners in the neighborhoods bordering the waterfront, including the North End, Downtown, Seaport, Dorchester, South Boston, East Boston, and Charlestown.
- **Article 80:** The Boston Planning and Development Agency (BPDA) currently requires that developments within the BPDA SLR – Flood Hazard Area consider adding 24” of freeboard above Base Flood Elevation (BFE) for critical facilities and 12” for all other buildings and uses (defined as Design Flood Elevation or DFE). They recommend that buildings are planned and designed to reduce or eliminate flood risk and potential damage and identify any future adaptation planning activities. Information on what parcels fall into the Flood Hazard Area can be found in the BPDA’s Zoning Viewer (see page 9). The BPDA has also recently released a Climate Resiliency Design Reference Guide for New Developments, which defines key terms like BFE and DFE. BPDA is also developing a Flood Resiliency Overlay District based on 40 inches of SLR.

Extreme Precipitation

The Northeast is experiencing a greater increase in precipitation than any other region in the country.

- **Historic Increases:** Between 1958 and 2010 the amount of precipitation that fell on the days with the heaviest rain or snowfall increased 70 percent.
- **Anticipated Increases:** [The average 10-year, 24-hour storm events have increased to 5.25” and may reach over 5.5.” by 2035. There is significant probability that by the end of the century, it will increase to 6”.](#) River flooding is also likely to increase, meaning flooding events are possible beyond just the waterfront communities in Boston.
- **Building Implications:** This increase in extreme precipitation will be particularly challenging to Boston’s stormwater drainage system which is designed to handle 4.8” of rain in 24 hours.
 - The BPDA recommends in their Climate Resiliency Checklist that buildings design for a 6”, 10-year, 24-hour design storm be used as the minimum performance target for extreme precipitation events to avoid the risk of flooding and damage.

24-HOUR STORM

A 24-hour design storm is a method to estimate the intensity of precipitation over a 24-hour period. This is used to determine parameters for infrastructure investment. The design storm can be based on historical averages for a locality.

Storms

Rising seas mean that floods and storm surge resulting from any future storm will be more severe than current impacts.

- Currently, Nor’easters produce most of the storm-induced flooding in the Boston region. While these storms are more common in cold winter months, they can occur at any time of year. It is not clear how climate change will impact these storms, although there is emerging consensus that tropical cyclones (which can become hurricanes if they reach a sustained wind speed of 74 miles per hours) are likely to increase in intensity over the decades ahead.
- **Building Implications:** The flooding potential of all storms will increase as Boston Harbor rises, bringing additional properties into the floodplain.

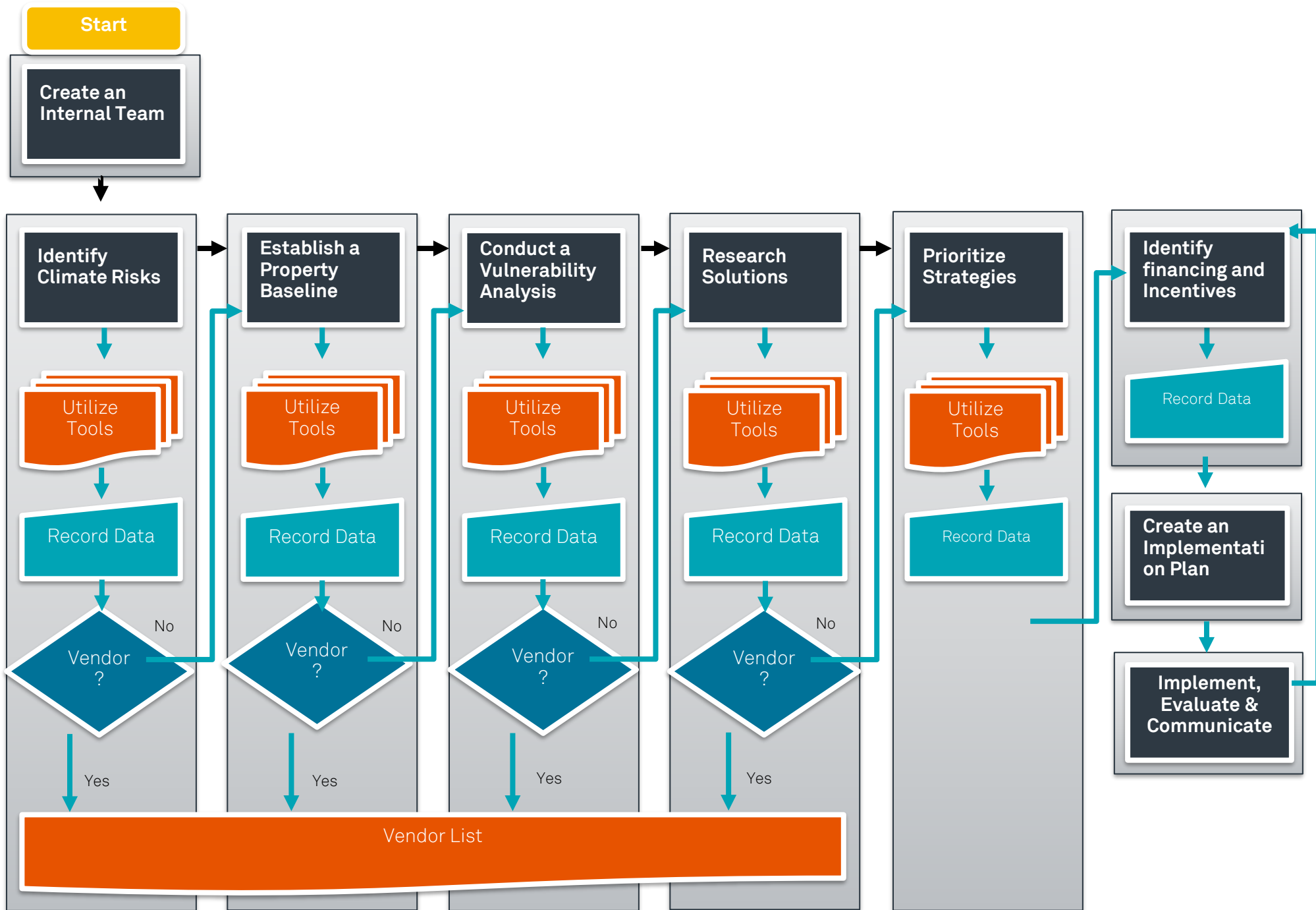
| Climate Factor | Summary | 2030 | 2050 | BPDA Planning Thresholds |
|------------------------------|--|--|--|--|
| Extreme Heat | <ul style="list-style-type: none"> • Rate of increase is accelerating • Number of days with extreme heat will increase • Heat waves will be hotter, last longer, and occur with greater frequency | <ul style="list-style-type: none"> • 20 to 40 days over 90 degrees • 5 days over 100 degrees | <ul style="list-style-type: none"> • Average summer temperature of 76 degrees | <ul style="list-style-type: none"> • Plan for average annual temperature of 56 degrees (as opposed to 46 today) and 90 days over 90 degrees. • Minimize heating and cooling requirements with passive cooling strategies |
| Sea Level Rise | <ul style="list-style-type: none"> • Pace of SLR is accelerating | <ul style="list-style-type: none"> • Additional 8 inches above 2000 levels | <ul style="list-style-type: none"> • Additional 1.5 feet above 2000 levels | <ul style="list-style-type: none"> • If in BPDA Flood Hazard Area, add additional 24" of freeboard above base flood elevation for critical facilities and 12" for all other buildings and uses |
| Extreme Precipitation | <ul style="list-style-type: none"> • Northeast experiencing greater increase in precipitation than anywhere else in the country | <ul style="list-style-type: none"> • 24-hour storm of 5.5." by 2035 | | <ul style="list-style-type: none"> • Use 6" 10-Year, 24-Hour Design Storm precipitation level • Plan to manage more intense events and reduce infrastructure burdens |

PLANNING FOR RESILIENCE

Ultimately, planning for climate resiliency can be integrated into standard operating procedures. For property owners or managers just beginning to consider climate resiliency, it is important to devote dedicated attention to identifying vulnerabilities, considering solutions, and integrating resilience plans into existing processes. It can be helpful to gather a core team with diverse perspectives on the building's operation that can collectively devise strategies in response to climate vulnerabilities. Once team members understand the risks posed to their assets by climate change, they will be better equipped to make decisions that increase climate resiliency.

A typical resilience planning process should include the following key steps:

1. **Create an internal team** that understands the building's operations and assets from diverse perspectives.
2. **Identify climate risks** in Boston that are relevant to the property.
3. **Establish a property baseline** to ensure all team members understand the building's characteristics and assets.
4. **Conduct a vulnerability analysis** to determine the exposure and sensitivity of building assets to climate impacts, as well as the likelihood and magnitude of the risk posed to the property.
5. **Research solutions** to mitigate unbearable risk.
6. **Prioritize strategies** that are best suited to the property's unique characteristics.
7. **Identify financing and incentives** to implement strategies.
8. **Create an implementation plan** that includes the timeline and management processes to achieve all strategies.
9. **Implement, evaluate and communicate** to ensure strategies are implemented effectively and updated as new relevant information becomes available.



I. CREATE AN INTERNAL TEAM

Increasing climate resiliency requires property owners and managers to think holistically about building assets and operating procedures. Taking a “whole system” approach—or one that considers all the factors that could put an asset at risk—is easiest when a team is assembled that represents the full scope of a facility’s various functions. Ideally, each representative will bring a different area of expertise—from facilities management to finance—that can help identify risks and inform solutions. [The U.S. Green Building Council-LA has created a building resilience primer](#) that provides a comprehensive overview of setting up a team and thinking through its work, which may be helpful for property managers or owners interested in additional information.

Select Core Team Members

Property owners and managers know their staff best but may want to consider including representatives below.

| Team Member | Sample Tasks/Activities |
|--|---|
| Energy Manager | <ul style="list-style-type: none">• Identify critical heating and cooling loads, location of critical infrastructure, and management of back-up power systems, if available• Pursue opportunities available through energy efficiency or other incentive programming |
| Maintenance and Operations staff | <ul style="list-style-type: none">• Identify critical infrastructure and lifecycle of systems• Determine what emergency management efforts may need to be pursued in the near-term |
| Grounds keeping and custodial staff | <ul style="list-style-type: none">• Identify emergency management efforts, which may need to be pursued in the near-term or immediate-term |
| Security Manager (and Emergency Management staff, if different) | <ul style="list-style-type: none">• Identify what emergency management efforts may need to be pursued in the near-term• Assist with occupant awareness and compliance with emergency protocols |
| Finance staff | <ul style="list-style-type: none">• Determine costs and benefits of strategies• Identify available funding and financing sources• Determine how to budget for upgrades |
| Sustainability Manager | <ul style="list-style-type: none">• Determine how to align sustainability and resiliency efforts |
| Communications staff | <ul style="list-style-type: none">• Develop and execute communications plans for internal and external stakeholders |
| Personnel or tenant engagement staff | <ul style="list-style-type: none">• Ensure tenants are included in necessary planning efforts |

Ideally these representatives will have decision-making authority within their departments, as well as time to devote to dedicated climate resiliency planning in the near-term. Over time, this process will help each representative incorporate climate resiliency planning into

business as usual approaches in their departments, creating a culture of climate resiliency across the organization.

Assign Roles and Responsibilities

As with any task, it can be helpful to designate a project manager and set expectations for core team members. This should include expectations about how regularly the group will convene and what information or materials members should plan to contribute. The team can also determine how to engage internal and external stakeholders throughout their work.

Communicate with Team

Once a property manager or owner has determined the staff that should be included in the core team planning for climate resiliency, they should send an introductory email to all team members sharing the goals, schedule, and responsibilities of the team.

Action Steps

- Determine representatives from each relevant department
 - Include them in Climate Resilience Worksheet Tab 1. Create a Team.
- Assign Roles and Responsibilities
 - Include information under “Task” column in Climate Resilience Worksheet Tab 1. Create a Team
- Communicate with team
 - Schedule first meeting.
- Move on to Step 2: Identify Climate Risks

2. IDENTIFY CLIMATE RISKS

Once an internal team is assembled, the group should establish a shared understanding of the climate risks posed to their facility. This step will equip team members with information to determine the potential threats to their commercial buildings and planned developments in the near-, medium-, and long-term. Actions to take include determining exposure to extreme heat, sea level rise (SLR), extreme precipitation, and storms.

The City of Boston has completed extensive analysis to determine the risks posed to its neighborhoods. The 2016 [Climate Ready Boston study report](#) analyzes four major climate risks: **extreme temperatures, sea level rise, extreme precipitation, and storms** (see introduction for more information). To support education and outreach on these impacts, Boston created a [Climate Ready Boston Map Explorer](#) that features spatial data. In addition, the BPDA has also developed a sea-level rise [zoning viewer](#) that includes a layer to determine whether a building or parcel is in the flood hazard area for a 1% storm with 40 inches of SLR. Details on how teams can use these tools are described throughout this section.

The Commonwealth of Massachusetts has also created a [Resilient Massachusetts](#) mapping tool, which can be used for longer-term planning. Each layer contains baseline information, as well as projections for 2030s, 2050s, 2070s, and 2090s, annually and in each season. Each projection also includes a “likely range.” While the spatial data is not as granular as the Climate Ready Boston Map (i.e. data is presented at the county level, so there is no variation across neighborhoods or at the parcel level), there are some instances where the detailed projections in the ResilientMA map may be helpful for planning. These instances are also described throughout this section. Teams that have properties throughout the Boston region or beyond may also find this tool particularly helpful.

It should be noted that while these tools are informative, they are not intended to substitute for a technical model of a specific parcel or building. Teams should use these tools to familiarize themselves with likely risks but may wish to contact a third-party vendor to conduct more detailed analysis upon which to base planning or capital decisions. As noted above, to assist commercial real estate owners and operators seeking to advance resiliency work, ABC issued an RFI in December 2018 that requested information from qualified professionals able to help implementing the steps outlined in this template. Users can review ABC’s resulting Vendor List and request more information from ABC on any submission.

RECOMMENDED TOOLS TO IDENTIFY CLIMATE IMPACTS

[BPDA Zoning Viewer](#)

- **Sea Level Rise:** SLR-BFE layer to determine Base Flood Elevation for parcels at risk of 1% annual flood with 40 inches of SLR.

[Climate Ready Boston Climate Explorer](#)

- **Extreme Heat:** Heat: Daytime Land Surface Temperature layer.
- **Sea Level Rise:** 1% and 10% Annual Coastal Flood Risk and High Tide for 2030s, 2050s, 2070s layers.
- **Extreme Precipitation:** Near-, Medium-, and Long-term Stormwater Flooding layers.

[Resilient MA Climate Clearing House](#)

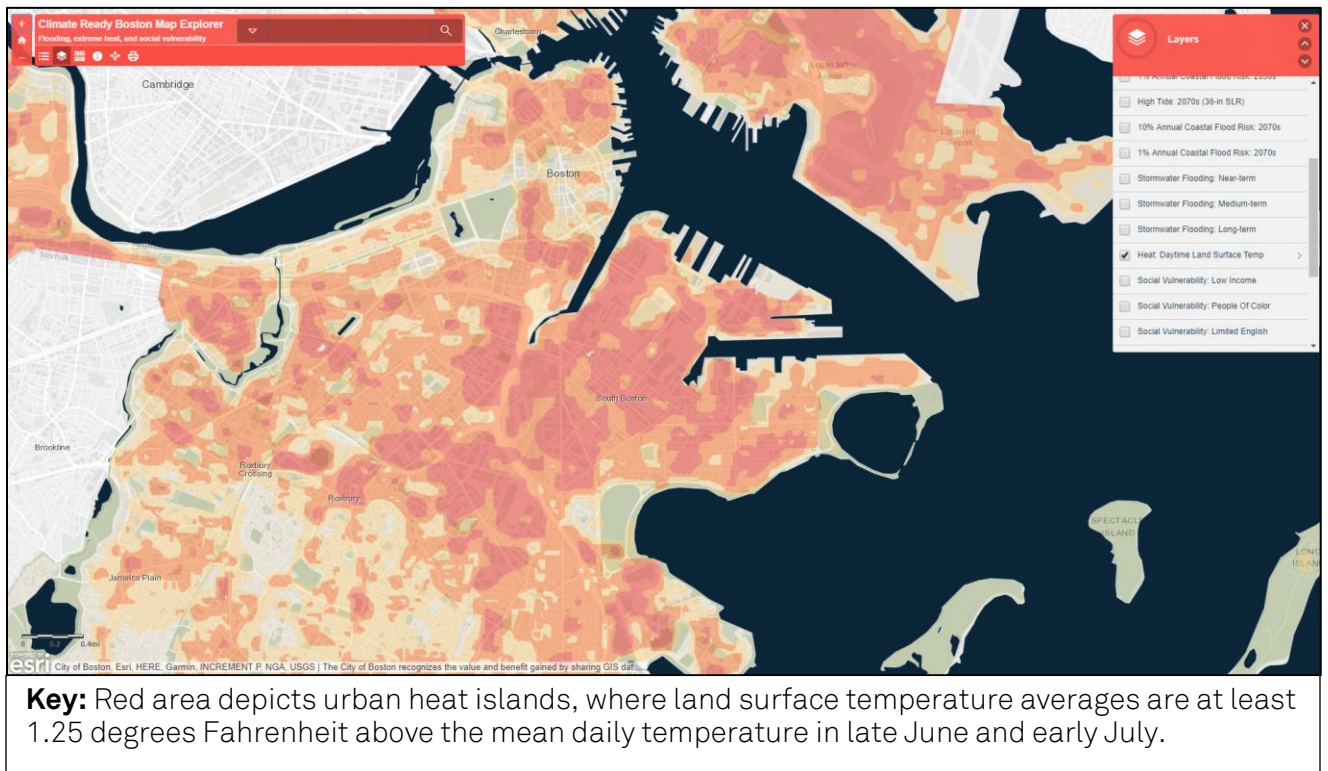
- **Extreme Heat:** Average Temperature, Cooling Degree Days, Days over 90, 95, and 100 degrees Fahrenheit, and Maximum temperature layers.
- **Extreme Precipitation:** Extreme Precipitation greater than 1”, 2”, 4” and Total Precipitation layers.
- **Storms:** Hurricane Surge Inundation Zones layer.

Extreme Temperature and Buildings

The average summer temperature in Boston will continue to increase, resulting in a greater number of days with extreme heat and nights with above average nighttime lows. These increases have significant implications for heating, ventilation and air conditioning (HVAC) systems demand and controls, energy costs, and the resiliency of the energy system overall. Higher daytime temperatures also have implications for any grounds or maintenance crews that need to conduct work outside, as well as tenants who walk or bike to work. Temperature extremes may vary across the city due to the urban heat island effect.

To determine the likely implications of Boston’s temperature increases on individual properties, teams can utilize the City of Boston’s Climate Ready Boston Explorer. This tool includes a layer for Heat: Daytime Land Surface Temperature based on Metropolitan Area Planning Council and the Trust for Public Land data. This shows areas across Boston that will experience moderate, high, or very high temperatures. Very high correlates with urban heat island effects, which average at least 1.25 degrees Fahrenheit above the mean daily late June/early July temperature.

Figure 1– Climate Ready Boston Heat: Daytime Land Surface Temperature Layer



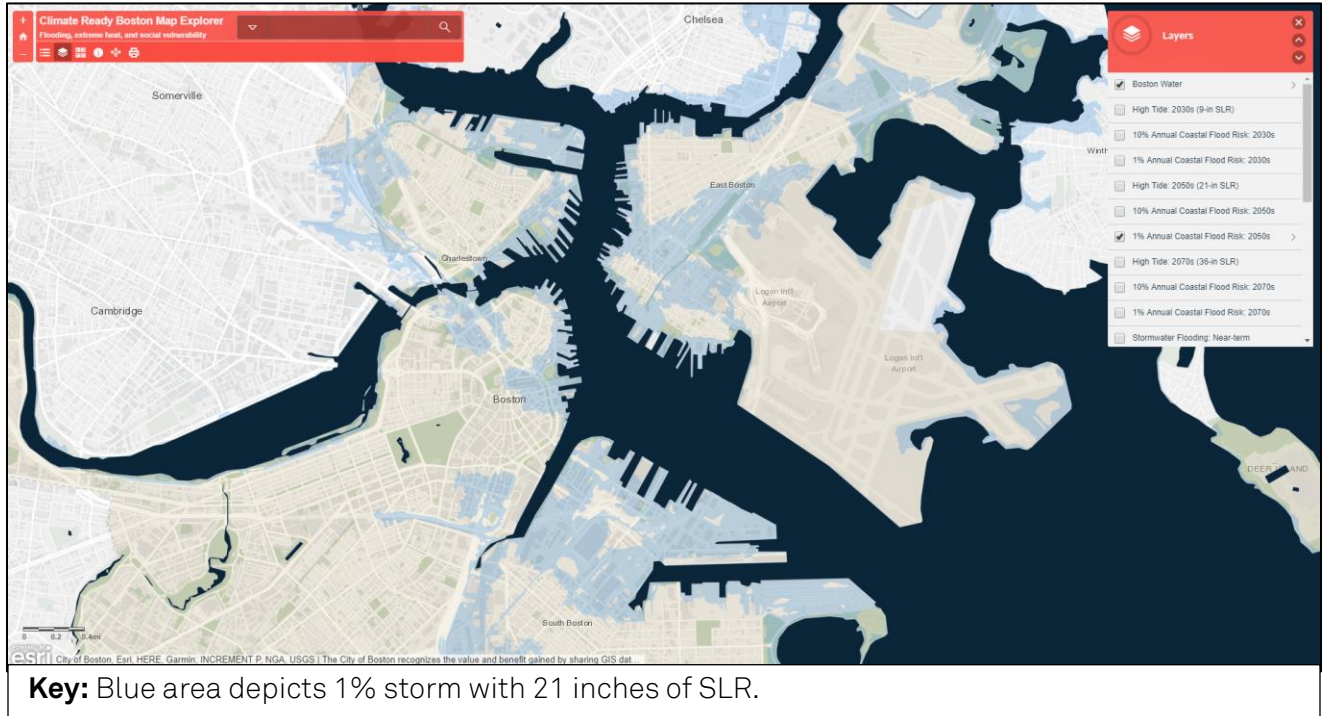
The Commonwealth of Massachusetts [ResilientMA Map](#) includes temperature projections for the state, including layers for projected average temperature, Cooling Degree Days, days over 90, 95, and 100 degrees Fahrenheit, and maximum temperatures (note: this map also includes information on cold temperatures and heating degree days as well).

Sea Level Rise and Buildings

Boston has already experienced SLR, and its pace is accelerating. Building owners and developers in the current floodplain and beyond need to prepare for a near-term scenario in which flooding is more common. SLR impacts are particularly important for developers and

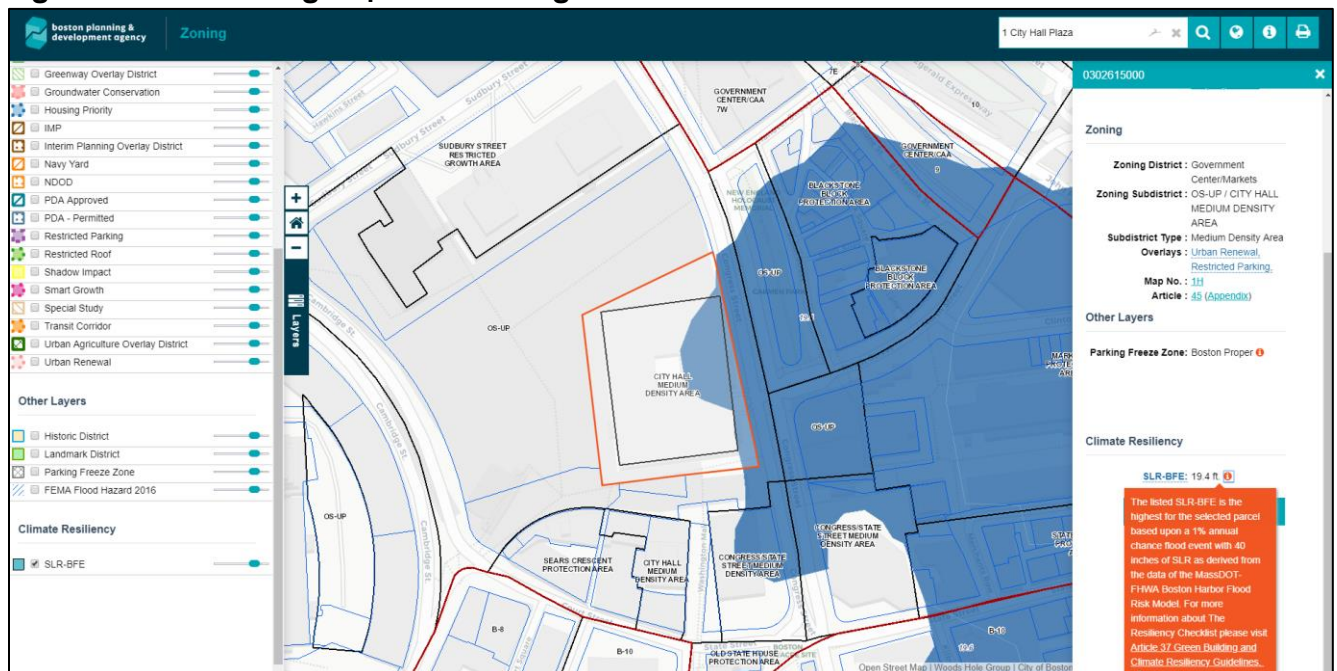
owners in the neighborhoods bordering the waterfront, including the North End, Downtown, Seaport, Dorchester, South Boston, East Boston, and Charlestown. The CRB Explorer includes layers for the 1% and 10% annual flood risks and high tides in the 2030s, 2050s, and 2070s.

Figure 2– Climate Ready Boston SLR: 1% Annual Coastal Flood Risk 2050s



The Boston Planning and Development Agency (BPDA) currently requires that developments within the area impacted during a 1% annual change of coastal flood events with 40 inches of SLR—defined as the BPDA SLR Flood Hazard Area—consider adding 24” of freeboard above Base Flood Elevation for critical facilities and 12” for all other buildings and uses (defined as Design Flood Elevation). The Boston Planning and Development Agency has a Zoning Viewer which includes a layer for the BPDA SLR Base Flood Elevation in the SLR Flood Hazard Area. Users can search the viewer by address or parcel ID.

Figure 3– BPDA Zoning Map: Determining Base Flood Elevation



Key: The BPDA Zoning Map can be used to determine Base Flood Elevation. The agency recommends adding 12” (24” for critical facilities) on top of the BFE to find the Design Flood Elevation.

Extreme Precipitation and Buildings

The Northeast is experiencing a greater increase in precipitation than any other region in the country and it is predicted that the increase in extreme precipitation will overwhelm the current capacity of Boston’s stormwater system. The BPDA recommends a 6”, 10-year, 24-hour design storm be used as the minimum performance target for extreme precipitation events to avoid the risk of flooding and damage to properties. The CRB Explorer includes mapping of stormwater flooding in the near- (2030s – 2040s), medium-(2050s – 2100s), and long-term (2070s and later).

Storms and Buildings

While there is less certainty in how climate change will impact the frequency or intensity of Nor’easters and Hurricanes in the Northeast, **rising seas mean that the flooding and storm surge for any future storm will be more severe than it is today.** Buildings will need to be prepared for impacts that are new or more extreme than those they’ve experienced in the past. ResilientMA includes a data layer for Hurricane Surge Inundation Zones for Categories 1 through 4 storms.

Roles for Third-Party Vendors

Some teams may decide that a third-party vendor will be able to assist in their efforts to align specific climate risks with their assets. ABC’s Vendor List, compiled from their 2018 RFI described above, includes ten firms that can assist with this work.

Action Steps

The steps below can be completed by the full project team or by a designated point person. In either case, it is important to ensure that all team members agree on the climate factors and timelines the team will be using throughout the resilience planning process. In addition, the

team should review if there are any relevant district-level projects within [the Resilient Harbor Plan](#) occurring near facilities that may mitigate risks or exposure in the near-to-medium term. This foundation will inform next steps, as well as what practices, products, or designs will be implemented to keep physical assets safe.

- Determine exposure to extreme heat
 - Add factor assessment to Resilience Template Worksheet.
- Determine exposure to sea level rise
 - Add factor assessment to Resilience Template Worksheet.
- Determine exposure to extreme precipitation
 - Add factor assessment to Resilience Template Worksheet.
- Determine exposure to storm surge
 - Add factor assessment to Resilience Template Worksheet.
- Consider contracting with a third-party vendor to conduct more in-depth assessment of climate risks on a parcel basis.
- Move on to Step 3: Establish a Property Baseline.

3. ESTABLISH A PROPERTY BASELINE

Once the team has determined the likely climate risks to their assets, the next step is to determine a property baseline, including the building characteristics, systems, and management plans that may intersect with the identified climate risks. This will help determine the asset’s specific vulnerabilities—or exposure to harm—that should be addressed.

Collect Relevant Information

Property owners and managers likely have a range of data on their property readily available. Property baselining information can be found in:

- Architectural drawings
- Engineering drawings
- Tenant fit-out contracts
- Commissioning documents
- System operations plans
- Operations & maintenance plans

Develop Baseline

Once existing information is gathered, teams can begin developing a property baseline by populating information already available and identifying gaps in knowledge that should be filled.

The [Boston Planning and Development Agency’s Climate Resiliency Guidelines](#) can be helpful in producing this baseline. The Climate Resiliency Guidelines are required for developments subject to Boston Zoning Article 80 Large Project, Planned Development Area, and Institutional Master Plan Review, but the Climate Resiliency Checklist can help guide property owners and managers as they think through the type of information they should collect to understand their property as it relates to climate change. For example, the guidelines ask for information regarding the base flood elevation, site elevation at building, first flood elevation, and accessible route elevation.

RECOMMENDED TOOLS TO ESTABLISH A PROPERTY BASELINE

BPDA Climate Resiliency Guidelines and Checklist

A framework utilized by the BPDA to require that all projects consider present and future environmental impacts including: extreme heat; sea level rise; and extreme precipitation; and consider ways to mitigate them.

In addition to reviewing the Guidelines, teams may wish to ask the following questions:⁶

- Site Characteristics
 - Is building located in the BPDA Flood Hazard Area or the Federal Emergency Management Agency’s (FEMA) Flood Zone?
 - What affect might surrounding stromwater catch basins have on the property?
 - Is sewer system separate from the stormwater system or combined?
 - What proportion of the site is impervious surface or compacted soil?
 - Could neighboring structures impact site?
- Building characteristics
 - What are the critical assets in or around the building that should be protected?
 - What is the building’s base flood elevation (BFE)?

⁶ Adapted from Enterprise Green Communities Ready to Respond Toolkit and the Strategies for Multifamily Building Resilience: <https://www.enterprisecommunity.org/solutions-and-innovation/green-communities/tools-and-services/ready-to-respond>

- Are there usable areas located below BFE – for example, first floor tenants?
 - Are there building systems located below BFE – for example, utility or mechanical equipment?
 - Are there penetrations to the building envelope below BFE – for example ventilation ducts?
 - What is the vulnerability of elevator systems to flooding?
- What mission critical functions would need energy in the event of power failure?
- Is heating, ventilation, and air conditioning equipment centralized for whole building or distributed throughout tenant spaces?
- Are stormwater and sewer systems adequate and in good repair?
- What materials are used for exterior siding, foundation, structural supports and roofing?
- What is the condition of the building? Is anything in need of repair?
- Is roof likely to absorb or reflect heat?
- Do windows have adequate shading?
- Overview of existing resiliency efforts
 - Does the building have adequate backup generation?
 - Have investments been made to address any issues identified above?
 - Does the building have an emergency management plan and are operators and tenants trained on it?

Roles for Third-Party Vendors

Alternatively, teams could decide to hire a third-party operator to conduct this type of assessment on their behalf. As noted above, ABC has compiled responses to their December 2018 vendor RFI.

Action Steps

- Collect relevant information
- Develop property baseline
 - Fill out each element in the Climate Resilience Worksheet
- Identify gaps in information, collect additional material, add them to property baseline
- Assess role for third-party vendors to assist in developing a property baseline
- Move on to Step 4: Conduct a Vulnerability Analysis

4. CONDUCT A VULNERABILITY ANALYSIS

After learning the different projected climate risks and having a firm understanding of property systems and existing assets, property owners or managers should conduct a vulnerability analysis to understand the vulnerabilities and areas for potential focus. This can be achieved by considering the relationship between each essential building asset and the climate impacts that may affect it. Teams may have started to consider this in the property baseline step, but any preliminary ideas should be refined here.

The [U.S. Climate Resilience Toolkit](#) recommends that building owners assess vulnerability in three steps:

- (1) Determine which assets are exposed to harm;
- (2) Assess each asset’s vulnerability; and
- (3) Estimate the risk to each asset.⁷

Determine Exposure and Vulnerability

Teams should consider each building characteristic included in the baseline in relationship to the climate risks identified for their asset. For example, if a building is in the BPDA’s Flood Hazard Area, it is *exposed* to flooding. The team may also want to consider how stressors—or factors that can exacerbate the hazard—may impact exposure. For example, if a building is currently next to open space that is slated for development, the increase in impermeable pavement could increase the likelihood of flooding. In contrast, buildings which are located near proposed district-scale resilience projects from [the Resilient Harbor Plan](#) may experience reduced exposure. Finally, it can be helpful to consider tipping points, or the points at which incremental changes create a new, irreversible response—for example, flooding that disables mechanical systems—that might impact operations.

The U.S. Climate Toolkit recommends categorizing the “sensitivity” and “adaptive capacity” of each asset to determine its vulnerability.

- They define sensitivity as the degree to which an asset is susceptible or resistant to impacts from climate events. For example, two buildings in the floodplain may have the same exposure to flooding, but the one with elevated mechanicals will have a lower sensitivity.
- They define adaptive capacity as the ability of a system to cope with stress or adjust to new situations. For example, a building with a backup power generation has a higher adaptive capacity to extreme weather.

KEY TERMS

Exposure – “The presence of people, assets, and ecosystems in places where they could be adversely affected by hazards”.

Vulnerability – “The propensity or predisposition of assets to be adversely affected by hazards. Vulnerability encompasses exposure, sensitivity, potential impacts, and adaptive capacity.”

Sensitivity – “The degree to which a system, population, or resource is or might be affected by hazards.”

Adaptive Capacity – “The ability of a person, asset, or system to adjust to a hazard, take advantage of new opportunities, or cope with change.”

Risk – “The potential total cost if something of value is damaged or lost, considered together with the likelihood of that loss occurring. Risk is often evaluated as the probability of a hazard occurring multiplied by the consequence that would result if it did happen.”

⁷ <https://toolkit.climate.gov/steps-to-resilience/assess-vulnerability-risks>

Once the team is aware of the exposure and vulnerability of assets, they can assign an overall vulnerability rating accordingly. This will assist in identifying the most vulnerable or most important assets to protect.

Estimate Risks

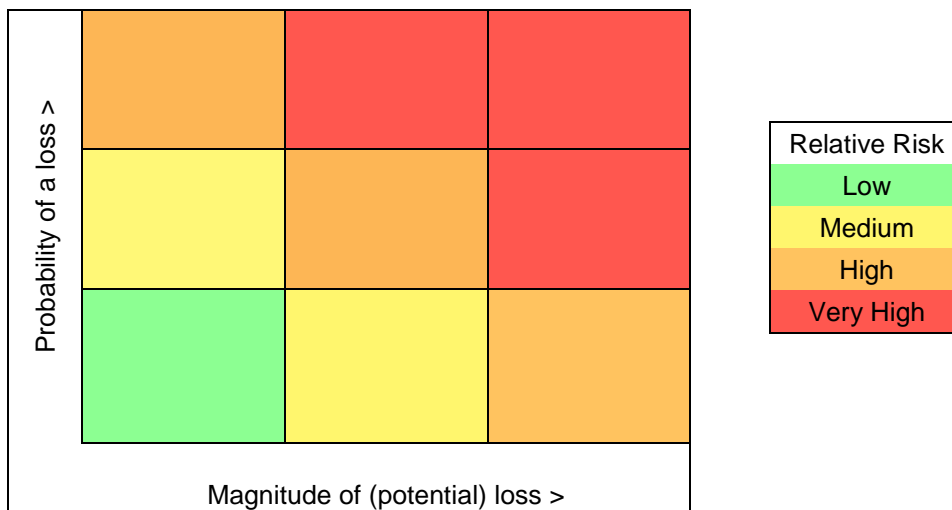
Once teams understand the vulnerability of their assets, they will likely want to understand each asset’s risk exposure. This is important because different assets have different value to building owners and operators. For example, while a parking lot may be very vulnerable to flooding it may not pose nearly as much risk as the flooding of mechanical systems, which would incapacitate a building’s energy supply.

The U.S. Climate Resilience Toolkit recommends assessing risk by:

- Determining the probability of loss.
 - To determine probability, teams can consider [past events in the Boston area](#), as well as the future climate projections researched above.
- Determining the magnitude of the loss relevant to each asset.
 - To determine magnitude, it is important to consider if human lives are at stake, the financial losses based on value of assets or property, and the potential interruptions to business operations.

The [U.S. Climate Resilience Toolkit](#) recommends estimating probability and risk on a high, medium, and low scale in a risk matrix. This can help teams visualize the assets that are subject to high probability of losses and high magnitude of losses—in other words the assets most likely to be damaged and most costly to the organization in terms of capital costs or lost productivity. Their matrix is included below.

Figure 4– U.S. Climate Resilience Toolkit Risk Matrix⁸ : Risk Characterization



Those interested in a more rigorous assessment may wish to conduct quantitative analysis. In this case, teams will want to assign a statistical probability to the climate impact and determine the value of each asset in monetary terms. These can be utilized to determine the likely monetary impact to the asset—which can be used to determine the benefit of resilience

⁸ https://toolkit.climate.gov/sites/default/files/Documenting_Steps_to_Resilience_170405.xlsx

strategies in later steps. Those interested in more information on how to conduct this type of quantitative analysis could benefit from the work of the United Kingdom Climate Impacts Programme (UKCIP), which has developed a standard for estimating the cost of climate impacts.⁹ The Project Team can also consult with the list of third-party professionals who can use the qualitative information developed by the internal team as the basis for a robust vulnerability assessment.

Once the team has a sense of which assets are most vulnerable, building owners and operators can decide whether they can bear the risk climate presented to the asset. If they cannot, it will be necessary to look for solutions that decrease vulnerability.

Roles for Third-Party Vendors

Conducting a vulnerability assessment is one of the most challenging steps in the climate resiliency process. It requires analyzing the climate factors and building assets in relation to one another and determining the likelihood and magnitude of potential events in order to determine the vulnerabilities of the asset. This is often the point at which teams engage with outside experts. All respondents to ABC's December 2018 RFI described above indicated their ability to assist clients with this work (see Vendor List).

Action Steps

- Determine expose of each building asset
 - Include in Resilience Template Worksheet.
- Determine vulnerability of each building asset
 - Include in Resilience Template Worksheet.
- Determine risks
 - Include in Resilience Template Worksheet.
- Assess role for third-party vendors in conducting a vulnerability analysis
- Move on to Step 4: Research Solutions

⁹ https://www.ukcip.org.uk/wp-content/PDFs/Costings_overview.pdf

5. RESEARCH SOLUTIONS

Once the core team knows which assets they need to protect, they can begin developing solutions to mitigate harm. Teams that are less familiar with the options for increasing climate resiliency in their buildings could benefit from reviewing [A Better City's Building Resilience Toolkit](#), which provides recommendations on potential structural interventions for increasing climate resiliency of commercial buildings. The toolkit highlights climate resiliency measures for flooding and sea level rise, stormwater management, and urban heat island. Each measure is described in terms of function, cost, application, service life, benefits and drawbacks, regulatory impacts and requirements, financing options, incentives, and rebates, and sample suppliers. In August 2018, the BPDA released a [Climate Resiliency Design Reference Guide for New Developments, which is intended to be a step-by-step guide to completing their Resiliency Checklist and](#) suggests ways to mitigate various climate hazards.

While considering options for a whole building or building portfolio, it can be helpful to consider a full range of solutions before settling on a preferred path. The U.S. Climate Resilience Toolkit recommends developing a wide-ranging list of strategies, and suggests that building owners ask:¹⁰

- Without budget constraints, what solution would I pursue?
- Is there a solution that can be phased over time?
- Are there steps to take that are no-cost?
- Would increased awareness help decrease risk?

Owners and operators looking for more information can also utilize case studies to help generate solutions. In addition, there are several resilience certifications, which have a series of suggested actions that can be used as a reference tool to understand options beyond physical technology investments, such as considerations for operational procedures, supply management, and emergency planning. These certifications are reviewed and contrasted in A Better City's resource on [voluntary resilience standards](#). Notably, ReLi and PEER have publicly available checklists on commercial building resilience and energy preparedness, respectively, which will ultimately be combined into a singular resilience standard.¹¹

Once research of solutions is complete, teams can assess which solutions are feasible for a particular building's context to generate a final list for evaluation.

Roles for Third-Party Vendors

It can be helpful to engage a third-party in generating solutions, particularly those that are appropriately suited to a building's unique context. Property owners and managers should be prepared to discuss their critical assets and priorities with third-party vendors to guide research. See ABC's Vendor List for more information.

¹⁰ <https://toolkit.climate.gov/steps-to-resilience/investigate-options>

¹¹ A summary of RELi, PEER and reference material is available on page 7 and 8 of A Better City's resource on resilience standards. (http://www.abettercity.org/assets/images/Voluntary_Resilience_Standards.pdf)

RECOMMENDED TOOLS FOR RESEARCHING SOLUTIONS

Building Resilience Toolkit

This guidance document from A Better City details a variety of resilience strategies for commercial buildings. This document covers flooding, sea level rise, and extreme heat risks. <http://www.abettercity.org/docs/resiliency%20report%20web%20FINAL.pdf>

Action Steps

- Research solution for reach vulnerable asset identified during Vulnerability Analysis
 - Enter solution options into Resilience Template Worksheet Solutions sheet.
- Review case studies where additional information is desired.
- Assess role for third-party vendors in researching and determining solutions.

6. PRIORITIZE STRATEGIES

Based on the vulnerability analysis and solutions research, the team will be equipped to make decisions on which assets and strategies to pursue in the short-, medium- and long-term. This can be achieved by determining which strategies are relevant to the building's unique characteristics, determining the costs and benefits of each strategy, and evaluating tradeoffs that must be made when it comes to implementation.

The U.S. Climate Resilience Toolkit recommends that teams consolidate actions into a cohesive plan and assess the expected value of each step.¹² The toolkit suggest that actions should be prioritized for investment if the investment **reduces the probability and/or magnitude of a climate risk and if the anticipated avoided costs exceed the implementation costs**. ABC's Building Resilience Toolkit can provide owners with an estimate of the range of costs for investments within their building. However, in addition to the impact and cost benefit of the strategy, owners and operators will likely also want to consider logistical considerations like **timeline for implementation, tenant disruption, and budgetary constraints**.

Given past experiences like Hurricane Sandy, resilience investments that reduce business interruption risk are likely to be viewed as particularly impactful. These investments can also signal a value proposition to tenants who want to ensure business continuity.

Once the team has a sense of which actions they consider priorities, they can evaluate if these actions can be pursued as one, or if they need to be phased over time. If the latter, teams will want to determine which actions are associated with the most immediate risks.

Roles for Third-Party Vendors

If a team has engaged a third-party vendor, they will play a significant role in this step. Teams will want to be sure this is a collaborative process.

Action Steps

- Determine priority of action based on ability to minimize probability or magnitude of risk.
 - Fill in Resilience Template Worksheet
- Determine expected value of prioritized actions based on associated costs and benefits.
 - Fill in Resilience Template Worksheet

¹² <https://toolkit.climate.gov/steps-to-resilience/prioritize-plan>

7. IDENTIFY FINANCING AND INCENTIVES

Any time commercial developers seek to construct or upgrade a building, they must secure financing, typically through a mix of equity, debt, and incentives. In determining development costs, considerations are made for the site, location, design, and construction. These costs are typically balanced against anticipated net operating income—or the revenue the building is anticipated to produce less the ongoing operating costs. Over time this produces a financial picture of the investment that underpins the terms of the financing available. Already, costs and benefits of specific elements are weighed, and operating costs are estimated, including energy use and the safety and security—and therefore insurability of the property.

Investing in Resilience

Climate change adds a layer of complexity to these calculations; the historical projections that have typically been used to design and insure infrastructure investments no longer accurately represent the risk posed over the lifespan of the building. This has the potential to shift the need for greater capital resources upfront—to design to a higher standard—to reduce operating costs and risk to property, life, and community in the long run. As the White House Office of Management and Budget has noted, "Long-term physical resilience requires upfront capital investments in order to realize future savings in the form of reduced losses, lower insurance costs, and enhanced market value, among other economic benefits."¹³

Over time upfront costs are likely to come down as buildings that are energy efficient and resilient become the norm and data on operating cost reductions and disaster reductions grows. In the interim property owners will need to examine their cash flow and modeling assumptions to determine the most appropriate way to finance additional measures. Fortunately, investing in climate resiliency presents a range of benefits for building owners. According to a recent OMB report, "Investments in resilience have the potential to pay dividends through reduced direct losses when disasters strike, as well as reduced or avoided disaster-related costs such as humanitarian relief, alternative housing, and business disruption."¹⁴ Given the impacts to commercial real estate predicted in Climate Ready Boston, investing in resilience upfront is a wise business decision.

NOTABLE RESILIENCE INVESTMENTS IN BOSTON

[6 New Street, East Boston:](#) 6 New Street reduced their potential flood losses from \$10m to \$1m. Building without this reduction would have increased their insurance premiums by 10x. The building owner credits the sustainability and resiliency measures for the building outperforming the market in terms of increased rent, faster leasing, higher renewal rate, and improved occupancy.

[Spaulding Rehabilitation Center:](#) Spaulding achieved rapid payback on investments, such as resilient building envelope, through decreased utility costs. Operating cost reductions are expected to be \$500,000 annually.

[University of Massachusetts-Boston:](#) UMass Boston installed energy storage to increase resilience, decrease utility bills, and increase capacity building and education around storage technologies. This project was supported through the Accelerated Commonwealth Energy Storage (ACES) program.

¹³

https://obamawhitehouse.archives.gov/sites/default/files/omb/reports/omb_resilience_finance_report.pdf, p. 5

¹⁴

https://obamawhitehouse.archives.gov/sites/default/files/omb/reports/omb_resilience_finance_report.pdf, p.6

This is supported through strong analytical evidence, including the [National Institute for Building Standard's Multihazard Mitigation Council's estimate that investment in resilience yields a 6:1 return](#). There are examples of resilient investments yielding returns in terms of decreased premiums, increased property value and decreased utility burden in Boston (see Call Out Box on Page 18). Team members that represent the building's financial office should consider how to plan for climate resiliency upgrades in capital planning and development cycles. This could include incorporating questions about climate resiliency into the process for approving capital planning projects to help pinpoint investment opportunities, which could have resilience co-benefits in addition to improving other values of real estate assets.

External Support

Utilities will consider requests to elevate utilities on a case by case basis and are looking to provide more consistent support for islandable combined heat and power systems. While mitigating potential harm is best, should a storm impact Boston, financial assistance to repair or replace uninsured, private sector disaster losses is often made available from the Small Business Administration. Businesses may borrow up to \$2 million to repair or replace assets, including damaged or destroyed real estate.¹⁵

Action Steps

- Create budget assessment of prioritized actions.
- Track funding opportunities.

15

https://obamawhitehouse.archives.gov/sites/default/files/omb/reports/omb_resilience_finance_report.pdf, p.17

8. CREATE AN IMPLEMENTATION PLAN

Once teams have determined the strategies they wish to pursue, they will want to create an implementation plan that identifies the timeline, lead, and budget source for each step. Teams should identify implementation program managers or a department manager, who are responsible for ensuring priority solutions are implemented.

In determining these steps, it can be helpful to assess if there are existing organizational processes that can support these efforts. For example, the team may wish to ask:

- Do existing plans need to be revised to incorporate climate resiliency?
- Are there upcoming planning processes that should incorporate this new information?
and
- Are there new stakeholders that need to be included to achieve success?

Externally, the Team should examine if there are proposed or upcoming resources from the state or federal government that could influence the sequencing of actions taken. In example, if the Team prioritizes energy storage as an investment, they may want to time the installation to maximize the federal investment tax credit, which is set to decline over time. As such, they may prioritize obtaining and installing an energy storage system in the near-term. Time-limited public or private programs may also help drive implementation of projects.

To the extent possible, qualitative and quantitative metrics should be collected on each of the resilience investments, and how they improve facility performance during and outside of emergencies. In example, energy efficiency investments in insulation may improve occupant comfort during a power outage, but they may also provide energy bill savings outside of emergencies. This data can help inform and revise future steps in the implementation plan.

Action Steps

- Determine timeline for each priority action
 - Record in Resilience Template Worksheet
- Determine lead for each priority action;
 - Record in Resilience Template Worksheet
- Determine budget source for each priority action;
 - Record in Resilience Template Worksheet
- Consider existing organizational processes that should be revised
 - Record in Resilience Template Worksheet

9. IMPLEMENT, EVALUATE AND COMMUNICATE

As property owners and managers make progress towards addressing the vulnerabilities of their facilities and district, it will be important to continue to communicate about these efforts, evaluate progress, and reassess the implementation plan over time. It is important to continue communicating with the core team to ensure that resilience strategies are being implemented as intended. It can be helpful to ask for feedback from the staff responsible for implementing measures across various departments. For example, if a building owner decides to install a new flood barrier, they may wish to speak to the facility managers responsible for deploying it during times of heavy precipitation/nor'easters/hurricanes, the finance team to determine how the final product aligned with initial estimates, and tenants to determine how they are experiencing the changes. As with any plan, approaches to resilience may need to change as new information becomes available. This should be routinely incorporated into assessments and updates made to business practices.

Building owners and managers should also develop a plan to communicate beyond the core team and staff engaged directly in implementation. Communications plans should include how to include other employees and tenants in resiliency efforts – both to keep them informed of the improvements being made to the building that protect their safety, but also to help mainstream climate resilience thinking across all operations and organizations. Ideally, the core team will have a communications representative who can help think through the best way to engage external parties and ensure the value of resiliency investments is articulated across the board.

Finally, it can be helpful to share best practices beyond building tenants. Resilience ultimately needs to become business as usual, but in the meantime, organizations across Boston are still looking for leaders from which to learn. Sharing climate resiliency plans externally can help others achieve similar success.

Action Steps

- Communicate with internal team to evaluate progress
- Update plans as necessary
- Share resilience plans internally and externally

CONCLUSION

As Boston experiences hotter summers, more intense precipitation and accelerating SLR, acting in the near-term to prevent climate impacts to properties now and in the future is becoming increasingly urgent. While climate resilience planning is a continuous process, once team members are integrated into climate decision-making, it is likely to become part of standard operating procedures. As the climate evolves, all team members should prioritize adapting buildings to respond to new threats.

Investing in resilience is not only the right thing to do for tenants, employees, and communities, it is the right thing to do for the bottom line. Investing in resilience saves money in the long-run and resilience can signal competitive advantages. The market is proving that high-performance buildings attract higher value tenants invested in the property.

This template is just one of a suite of resources developed by A Better City and the GRC to assist as building owners and operators across Boston begin to take action or scale up efforts. For more detailed information on certain topics, users can utilize:

- [Enhancing Resilience in Boston: A Guide for Large Buildings and Institutions](#) and associated [Toolkit](#) – resilience measures and actions
- [Voluntary Resilience Standards: An Assessment of Market Options for Boston's Large Commercial Buildings](#) – available building certifications
- Climate Resilience Template for Building Vendor List – respondents to ABC's December 2018 RFI to identify experienced professionals who can assist commercial real estate developers, owners, and managers

In addition to these existing resources, the City of Boston continues to pursue ways to assist building owners in assessing and acting upon their risks. The BPDA is in the process of developing design guidance for new construction with vulnerability to flooding and recently released a Resilient Harbor plan to protect Boston neighborhoods all along the coast. These resources and continued collaboration across sectors have already helped the commercial real estate community to understand their risks and increase their resiliency. Working internally with a core team to develop a comprehensive plan can help ensure properties across Boston are prepared for the climate future, creating a stronger, more resilient Boston prepared to thrive throughout the twenty-first century.

APPENDIX: TOOLS REFERENCED IN THE CLIMATE RESILIENCE TEMPLATE FOR BUILDINGS

Table 1: Summary of Tools Referenced by Step

| Process Step | Recommended Tool(s) |
|--|--|
| Create an internal team | <ul style="list-style-type: none"> • Building Resilience in LA: A Primer for Facilities |
| Identify climate risks | <ul style="list-style-type: none"> • BPDA Zoning Viewer • Climate Ready Boston Climate Explorer • Resilient MA Climate Clearing House |
| Establish a property baseline | <ul style="list-style-type: none"> • BPDA Climate Resilience Guidelines |
| Conduct a vulnerability analysis | <ul style="list-style-type: none"> • U.S. Climate Resilience Toolkit |
| Research solutions | <ul style="list-style-type: none"> • ABC Building Resilience Toolkit • <i>BPDA Climate Resilience Guidelines</i> • <i>Enterprise Community Partners Strategies for Multifamily Building Resilience</i> • <i>Insurance Institute for Business and Home Safety FORTIFIED Standards</i> • <i>New York City Resilience Guidelines</i> • <i>Resiliency (RELi) Action List</i> • <i>Resilient MA Climate Clearing House</i> |
| Prioritize strategies | <ul style="list-style-type: none"> • BPDA Climate Resilience Guidelines • <i>Building Resilience in LA: A Primer for Facilities</i> • <i>Enterprise Community Partners Strategies for Multifamily Building Resilience</i> • <i>New York City Resilience Guidelines</i> |
| Identify financing and incentives | <ul style="list-style-type: none"> • BurroHappold Resilience Insight Tool • Enterprise Community Partners Strategies for Multifamily Building Resilience |
| Create an implementation plan | <ul style="list-style-type: none"> • <i>Building Resilience in LA: A Primer for Facilities</i> • <i>Resilient MA Climate Clearing House</i> |
| Implement, evaluate, and communicate | <ul style="list-style-type: none"> • <i>Building Resilience in LA: A Primer for Facilities</i> • <i>Resilient MA Climate Clearing House</i> |
| <p>Key: The italics represent additional tools for further research, which were not directly mentioned in the copy.</p> | |

DESCRIPTION OF TOOLS

A Better City Building Resilience Toolkit

Summary: This guidance document from A Better City details a variety of resilience strategies for commercial buildings. This document covers flooding, sea level rise, and extreme heat risks.

Use: Property owners can use this tool for the **Research solutions** step.

Weblink: <http://www.abettercity.org/docs/resiliency%20report%20web%20FINAL.pdf>

Boston Planning and Development Authority Climate Resilience Guidelines.

Summary: The Boston Redevelopment Authority requires all development projects subject to Boston Zoning Article 80 to consider and analyze the impacts of climate change and develop associated resiliency measures. The Climate Resiliency Checklist includes an assessment of the building's assets, vulnerabilities and risk mitigation possibilities.

Use: Property owners can use this checklist, even if not submitting a proposal to the BPDA, to help with **identifying climate risks, establishing a property baseline, researching solutions and Prioritizing strategies.**

Weblink: <http://www.bostonplans.org/getattachment/5d668310-ffd1-4104-98fa-eef30424a9b3>

Boston Planning and Development Agency Zoning Viewer.

Summary: This tool contains parcel-level data on zoning districts, relevant zoning regulations, and property-level sea level rise projections.

Use: Property owners can use this tool to **identify climate risks and establish a property baseline.**

Weblink: <http://maps.bostonredevelopmentauthority.org/zoningviewer/>

Building Resilience in LA: A Primer for Facilities.

Summary: This resource, released in October 2016, outlines a process for (1) incorporating resilience into operations and (2) initiating the institutional changes required to support preparedness planning. The facilities guide and training developed by BRLA has been piloted by the Los Angeles business community, key community organizations, and nonprofits. The BRLA program is designed for private-sector actors and is one of the few standards reviewed with a specific focus on existing buildings.

Use: This tool will likely be helpful for anyone **creating an internal team** for resilience planning or anticipating multi-party stakeholder engagement. This tool can also be utilized to **conduct a vulnerability analysis, prioritize strategies, create an implementation plan, and implement, evaluate, and communicate** steps.

Weblink:

https://static1.squarespace.com/static/57dc2456e58c62e05fee0316/t/58177cb7725e25ba06357b20/1477934275541/10-24-2016_BuildingResiliency-LA.pdf

BuroHappold Resilience Insight Tool

Summary: This resilience assessment tool assists private and public-sector stakeholders in assessing current and future climate resiliency demands, capabilities, and gaps. The tool has two modules for identifying vulnerabilities and quantifying risks that can be applied to the business context. The emphasis of this tool is protecting value and identifying unforeseen opportunities from risks and vulnerabilities, and it takes a holistic approach.

Use: Property owners can use this tool to **identify climate risks, establish a property baseline, conduct a vulnerability analysis and identify financing.**

Weblink: <https://www.burohappold.com/what-we-do/specialisms/risk-and-resilience/resilience-insight-tool/>

ClimateReady Boston Climate Explorer.

Summary: This tool features spatial data from Climate Ready Boston, allowing users to better understand the potential impacts of extreme heat, sea level rise, flooding, and extreme precipitation across the City of Boston. It also includes population demographics, open space, and planned climate resiliency projects in the city.

Use: Property owners can use this tool for **identifying climate risks.** The City notes that the tool is intended for educational and outreach purposes, not technical planning, so additional resources should be sought for conducting asset-level vulnerability analysis.

Weblink: <https://www.boston.gov/departments/environment/climate-ready-boston-map-explorer>

Enterprise Community Partners Strategies for Multifamily Building Resilience.

Summary: This guidance document provides resilience-minded retrofit strategies that have wide applicability to building resilience, including ways to reduce a building's vulnerability to extreme weather, strategies to increase adaptability to changing climate conditions, and recommendations to provide for critical needs in the event of a disaster. The document includes estimates of strategies and covers strategies for team members to include and financing to pursue.

Use: Property owners can use this tool for **to create an internal team, research solutions, prioritize strategies, and identify financing and incentives steps.**

Weblink: <https://www.enterprisecommunity.org/resources/ready-respond-strategies-multifamily-building-resilience-13356>

Insurance Institute for Business and Home Safety FORTIFIED Standards

Summary: IIBHS FORTIFIED Commercial program is a voluntary construction program based on standards that go above code requirements. These standards help developers build new commercial buildings that are more resilient in the event of severe weather, including hurricanes, high winds and hail.

Use: IIBHS's checklist can be used to **research solutions**.

Weblink: <http://disastersafety.org/fortified/commercial/>

New York City Climate Resilience Guidelines.

Summary: This set of guidelines is a step-by-step guide to sequential planning processes for New York City agencies and their designers to incorporate forward-looking climate change data into all city capital projects. It provides information on planning across a project's useful life, managing uncertainty, and project considerations, including financing requirements. The guidelines include methodology to estimate project benefits.

Use: Property owners can use this document for **research solutions and prioritize strategies** step.

Weblink: https://www1.nyc.gov/assets/orr/pdf/NYC_Climate_Resiliency_Design_Guidelines_v2-0.pdf

Resiliency Action List (RELI).

Summary: This set of voluntary resilience standards takes a comprehensive approach towards increasing resilience in new building design and planning for. Like LEED, RELI uses credits and prerequisites that draw on existing standards. RELI has more than sixty actions, addressing facility planning, design, operations, and maintenance. Other categories include site selection, emergency operations and planning (e.g., back-up power and thermal safety), and adaptive design based on a variety of specific hazards or groupings of related hazards. The actions range from planning for future risks (e.g., avoiding areas on the basis of projected sea-level rise) to adapting to or mitigating existing hazards and incorporating longer-term community cohesion, health, and economic vitality. RELI's is designed to be an underwriting standard and quantifies the tangible value from resilience investments to reduce the costs of capital and financing and support underwriting for bonds and mortgages for resilience.

Use: Property owners can use this guidance document for **researching solutions**.

Weblink: <http://online.anyflip.com/zyqc/ojoi/mobile/index.html>

Resilient MA Climate Clearing House.

Summary: This resource supports Massachusetts' Municipal Vulnerability Preparedness (MVP) program, by aggregating climate data specific to Massachusetts and produced by the Northeast Climate Adaptation Science Center at UMass-Amherst. It also includes an interactive map and recommendations for managing implementation.

Use: Property owners can use this resource to **identify climate risks, research solutions, create an implementation plan, and implement, evaluate and communicate** steps.

Weblink: <http://resilientma.org/>

U.S. Climate Resilience Toolkit

Summary: The U.S. Climate Resilience Toolkit is a repository of information developed by the federal government that outlines the steps to take to build resilience, case studies, tools, expertise, and information by region and by topic area.

Use: The steps in this guide mirror the steps in this template but are not Boston-specific. Use of this tool is particularly recommended at the Conduct Vulnerability Assessment stage.

Weblink: <https://toolkit.climate.gov/>