

BR 1: CREATE & USE 2080 FLOOD MAP BASED ON CLIMATE CHANGE PREDICTIONS

New York City Charter; New York City Building Code
Proposal developed by the Climate Adaptation Committee

Summary

Issue:

Current flood maps are based entirely on historical data and do not account for the predicted sea-level rise due to climate change and the coastal flooding that would ensue.

Recommendation:

Develop flood maps that reflect sea-level rise and increases in coastal flooding through 2080. New developments susceptible to future 100-year floods should meet the same standards as buildings in the current 100-year flood zone.

Proposed Legislation, Rule or Study

Amendments to the New York City Charter:

1. Add a new Section 498 as follows:

Section 498. Flood Protection

a. The department of emergency management shall create, maintain, and regularly update a New York City Climate Change Flood Map, which shall map the New York City coastline at high tide and the projected flood plains and flood levels of the 100 year flood with a layer showing lots and blocks and the 100-year flood level averaged across each affected block. The coastline and flood projections shall be based on:

(1) The 90th percentile sea-level rise projections as developed by the New York City Panel on Climate Change, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the Intergovernmental Panel on Climate Change or other scientific body designated by the Office of Long Term Planning and Sustainability;

(2) The 90th percentile storm surge projections developed by the New York City Panel on Climate Change, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the Intergovernmental Panel on Climate Change or other scientific body designated by the Office of Long Term Planning and Sustainability; and

(3) The topography of the city of New York as documented in the current FEMA map or other map designated by the Office of Long Term Planning and Sustainability.

b. The first New York City Climate Change Flood Map shall be based on projected conditions in 2080, and updates shall be based on projected conditions no earlier than 2080 or 50 years in the future, whichever is later. The New York City Climate Change Flood Map shall be updated regularly, but no less often than every 10 years.

Amendments to Appendix G of the New York City Building Code:

1. Add a new paragraph (7) to Section G101.1 as follows:

7. Take into account the scientific projections of climate change impacts on flooding, including sea-level-rise and storm frequency and intensity.

2. Add new paragraphs (9) and (10) to Section G101.2 as follows:

9. Ensure that properties are habitable for a reasonable period in the event of service disruptions.

10. Decrease the period during which properties are not habitable after floods.

3. Add new paragraph (3) to section 102.2 as follows:

3. New York City Climate Change Flood Map

4. Amend sections G102.2, G102.3, G102.3.1 and G102.3.2 as follows:

G102.2 Establishment of areas of special flood hazard. The following flood hazard map and supporting data are adopted as referenced standards and declared to be a part of this appendix:

1. FEMA FIS 360497.
2. FEMA FIRMs 360497.
3. New York City Climate Change Flood Map (NYC CCM).

G102.2.1 Applicability of maps. The flood hazard map that results in the greatest degree of flood protection measures shall apply. Until such time as the Office of Emergency Management develops a New York City Climate Change Flood Map, the city's 100-year flood plain requirements shall apply to developments and properties within the 500-year flood plain in the current FEMA map.

G102.3 Letters of map change. Map changes to FEMA FIRMs 360497 or NYC CCM shall be administered in compliance with Sections G102.3.1 and G102.3.2.

G102.3.1 Letters of map amendment (LOMA). Where FEMA FIRMs 360497 or NYC CCM indicates that a structure or tax lot is within a delineated area of special flood hazard, but the pre-FIRM ground elevations adjacent to the structure or throughout the tax lot are at or above the base flood elevation, the commissioner shall deem such structure or tax lot as being within the area of special flood hazard and shall not approve plans except in compliance with this appendix, unless a letter of map amendment (LOMA) is issued by FEMA removing such structure or tax lot from the area of special flood hazard.

G102.3.2 Letter of map revision based on fill (LOMR-F). Where FEMA FIRMs 360497 or NYC CCM indicates that a structure or tax lot is within a delineated area of special flood hazard, but post-FIRM compacted fill is proposed to be added adjacent to the structure or throughout the tax lot to an elevation at or above the base flood elevation, the commissioner shall deem such structure or tax lot as being within the area of special flood hazard and shall not approve plans except in compliance with this appendix, unless a conditional or final letter of map revision based on fill (LOMR-F) is issued by FEMA removing such structure or tax lot from the area of special flood hazard. The commissioner shall promulgate rules establishing procedures for processing letters of map revision based on fill (LOMR-F).

5. Add a new definition to G201.2 to read as follows:

NEW YORK CITY CLIMATE CHANGE FLOOD MAP (NYC CCM). The flood map or maps developed, maintained, and updated by the City of New York that depicts the coastline at high tide and the flood plains and flood levels of the 100 year flood based on the most current FEMA topographic maps and the scientific projections of climate change impacts a minimum of 50 years in the future.

Supporting Information

Issues – Expanded

New York City is facing real and significant risks due to climate change; with 580 miles of coastline, it will be impacted the most among US cities by sea level rise. To get a clear sense of how climate change will impact New York, in August 2008 the Mayor convened The New York City Panel on Climate Change (NPCC), a group of experts including climate scientists from NASA GISS. The NPCC projects that New York City's climate will become more like present-day North Carolina's as temperatures increase by an average of 4 to 7.5 degrees Fahrenheit toward the end of the century and annual precipitation increases by 5 to 10 percent. In addition, the City's sea levels could rise by 12 to 23 inches by 2080, with a possibility of up to 41 to 55 inches in the extreme ice meltdown scenario.¹

FEMA's Flood Insurance Rate Maps (FIRMs) are based on historic weather data (at least 20 years old) and inaccurate topography and bathymetry. In addition, these maps do not show how sea level rise will impact flooding. Without such accurate maps, the city cannot create a viable adaptation strategy.

The City is already updating its maps to reflect current conditions -- partnering with FEMA to develop updated FIRMs that will more accurately delineate flood zones in the city based on current weather information and improved topographical and bathymetrical data, including sea level rise that has already occurred. In addition, the City should develop maps based on the topography of the updated maps that will depict projected impacts of climate change, including sea level rise and an associated increase in coastal flooding, out to 2080. Climate change impact data specific

to New York City has been developed by the New York City Panel on Climate Change (NPCC)ⁱⁱ

New development projects, major renovations, extensions, and repurposing of existing buildings should be evaluated using these updated maps to determine if they are in the current 100-year flood zone or will be susceptible to future floods based on climate change projections. Such buildings or projects located within the 100-year flood zone of the NYC CCM should be required to meet the same standards as buildings or projects currently located within the FEMA 100-year flood zone.

Environmental & Health Benefits

Basing code requirements on scientific climate change predictions for 2080 will prevent loss of life and property when floods occur. It will also allow properties to recover more quickly and resume operation, thereby reducing economic losses due to loss of use. This measure will also prevent toxic spills, which can occur if hazardous chemicals within flood prone areas are not stored safely. Finally, this measure will protect buildings (and their inhabitants) located within these future flood zones from the negative health impacts of waterborne diseases and mold – both of which are prevalent during and after floods. Potential health effects and symptoms associated with mold exposures include allergic reactions, asthma, and other respiratory complaints.ⁱⁱⁱ

Cost / Savings

This proposal is for a study which will have no direct impact on construction costs.

Precedents

London, Seattle, San Francisco, and other major world cities are currently developing flood maps based on climate change and exploring the feasibility of tying the building code to these flood maps.

To help regional planning bodies and local planning authorities assess vulnerability to climate change and plan appropriate adaptation strategies, the UK government established the UK Climate Impacts Programme (UKCIP) which in a 2002 report published 4 scenarios providing alternative descriptions of how climate in the UK would evolve over the course of a century. Global mean sea level projections up to 2080 were taken from the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report (TAR) high estimates. Reports have been updated yearly (most recently 2008).^{iv}

LEED

Newly updated maps may redefine the current floodplain location, which could negatively impact properties being eligible for LEED credits that address proximity to floodplains. These credits include LEED ND-SLL prerequisite 6 Floodplain Avoidance; LEED NC-SS cr.1 Site Selection; LEED for Schools SS cr.1 Site Selection; LEED for Homes LL cr.2 Site Selection.

LEED ND specifies that the floodplain is defined and mapped by the Federal Emergency Management Agency or state or local floodplain management entity, whichever has been done most recently. This proposal requires regular updates of flood maps by New York City, ensuring that LEED registrants will be referencing current information.

LEED does not recognize a projected floodplain. Therefore, studies taking into account potential future conditions would not affect LEED certification.

Implementation & Market Availability

There are no known implementation issues for this proposal.

ENDNOTES:

ⁱ NEW YORK CITY PANEL ON CLIMATE CHANGE, CLIMATE RISK INFORMATION, (2009), http://www.nyc.gov/html/planyc2030/downloads/pdf/nyc_climate_change_report.pdf.

ⁱⁱ Ibid.

ⁱⁱⁱ U.S. EPA, Mold Resources, <http://www.epa.gov/mold/moldresources.html> (last visited Jan. 26, 2010).

^{iv} U.K. Climate Impacts Programme, LCLIP: A Local Climate Impacts Profile, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=236&Itemid=330 (last visited Jan. 26, 2010); and U.K. CLIMATE IMPACTS PROGRAMME, U.K. 21ST CENTURY CLIMATE SCENARIOS 2008 (2008), available at http://www.ukcip.org.uk/images/stories/Pub_pdfs/08_booklet.pdf.

BR 2: SAFEGUARD TOXIC MATERIALS STORED IN FLOOD ZONES

Rules of the City of New York

Proposal developed by the Climate Adaptation Committee

Summary

Issue:

The New York City Department of Environmental Protection requires facilities that store hazardous chemicals to file a risk management plan, but it does not require any special provisions for chemicals stored within the 100-year floodplain.

Recommendation:

Require toxic materials within the 100-year floodplain to be stored in a floodproof area.

Proposed Legislation, Rule or Study

Amendments to the Rules of the City of New York

1. Add a new paragraph (5) to subdivision (a) of section 41-05 as follows:

(5) Determination whether the facility, or portions of the facility, lie within the area of special flood hazard (100 year floodplain) as mapped by the Federal Emergency Management Agency on the Flood Insurance Rate Map.

2. Add a new paragraph (5) to subdivision (b) of Section 41-10 as follows:

(5) Determination whether the facility or portions of the facility lie within the area of special flood hazard (100 year floodplain) as mapped by the Federal Emergency Management Agency on the Flood Insurance Rate Map.

3. Add a new paragraph (9) to subdivision (b) of Section 41-11 as follows:

(9) If the facility or portions thereof lies within the area of special flood hazard (100 year floodplain) as mapped by the Federal Emergency Management Agency on the Flood Insurance Rate Map, the risk management plan shall include engineering measures that flood proof any chemicals, processes, and or operations within the floodplain, or operating measures to ensure that chemicals, processes, and or operations shall be located in portions of the facility that are above or beyond the floodplain.

After revision of these rules, the City of New York should modify the Facility Information Forms (FIF), Risk Management Plans (RMP), and the regulatory review procedure at both the Department of Environmental Protection and the New York Fire Department to take into account: the location of facilities in the floodplain; and the potential mitigation measures or prohibition of storage of certain categories of chemicals within the 100 year flood plain. Consider expanding the categories of chemicals or buildings required to file RMPs.

Supporting Information

Issue - Expanded

Storing hazardous materials within floodplains in non-flood proof spaces can lead to serious environmental contamination and threaten health, especially when there is severe flooding. During the great floods in Mississippi (1993) and New Orleans (2005), for example, water became severely contaminated. In New Orleans, floodwaters were found to contain bacteria associated with sewage at least ten times higher than the acceptable safety levels as well as elevated lead levels. Contamination made it dangerous for rescue workers and remaining residents, especially children, to have direct contact with water.ⁱ According to experts, the toxic chemicals in the flood waters in New Orleans will make the city unsafe for full human habitation for a decade.ⁱⁱ

In light of these far reaching consequences, it is crucial that New York City addresses the issue of safe storage of hazardous materials with the 100 year floodplain. Currently, several programs in New York City address toxic chemicals. However, they still do not contain provisions for toxic chemicals within the floodplain. It is anticipated that less than 750 buildings out of the city's million buildings will be impacted if such provisions are incorporated within the existing programs (see Cost/Savings section for information).

New York City Department of Environmental Protection (DEP) has a regulatory program called the Community Right-to-Know for the storage of hazardous chemicals. It requires the annual filing of a Facility Inventory Form (FIF). Buildings that exceed minimum threshold quantities must also submit an annual Risk Management Plan (RMP). The professional who files the RMP must conduct a Risk Assessment, develop an appropriate risk reduction plan, and include appropriate emergency response procedures. DEP reviews the RMP, inspects the facility and forwards the RMP to the New York City Fire Department for their review.

In addition, Building Code Appendix G Flood Resistant Construction has rules for construction in or around the 100-year floodplain. However, there are no provisions for the storage of hazardous materials within the floodplain. Requirements are limited to the construction and location of tanks and sewage facilities and they apply only to newly constructed facilities and sometimes to altered facilities, depending on the extent of the alteration.

Since programs addressing the storage of hazardous materials are already in place in New York City, minimal work is necessary to implement this proposal. Doing so would require an additional determination by the RMP filer as to whether or not the facility lies within the 100 year floodplain. DEP would then inspect the facility to determine the adequacy of the chemical storage as a part of their current inspection practices.

Environmental & Health Benefits

This proposal would mitigate the risk of the release of hazardous chemicals during a significant flood, protecting water supplies and the general public.

This proposal was found to have no significant positive environmental impact.

This proposal was found to have a low positive health impact per building and to impact a small number of buildings. It was thus given a health score of 1.

Cost & Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal is not expected to have any significant impact on capital costs.

Precedents

There are numerous jurisdictions and municipalities through out the United States that prohibit hazardous materials from being stored below the floodplain.

LEED

Under most rating systems, LEED prohibits new construction on previously undeveloped land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA (Federal Emergency Management Agency). Therefore, the measures outlined in this proposal do not apply to LEED for these conditions.

Under the LEED for Neighborhood Development rating system, SLL Prerequisite 6 Floodplain Avoidance, a project located on an infill site or a previously developed site must follow the National Flood Insurance Program (NFIP) requirements for developing any portions of the site that lie within the 100-year floodplain. Projects registered for certification under LEED-ND must research NFIP to determine compliance with LEED. Any such regulations regarding toxic materials storage are relevant to this proposal, and these measures will therefore result in a positive impact on LEED ND certification.

Implementation and Market Availability

Since programs addressing the storage of toxic chemicals already exist in New York City, the implementation of the proposal will require minimal additional effort. Modification to the DEP program will involve: 1) revisions to the notification and filing provisions of the RMPs; 2) DEP staff modifying their forms and procedures to require the RMP filing to address this issue; 3) the RMP filing to include a determination as to location vis-à-vis the 100 year floodplain, and if so, appropriate storage procedures; 4) DEP staff evaluation to include knowledge of flood plain boundaries; and 5) the DEP determination of appropriate storage procedures, if the facility is located in the 100 year flood plain.

ENDNOTES:

ⁱ Christine Lagorio, EPA: Danger in the Drinking Water, CBS NEWS, Sept. 7, 2005, available at <http://www.cbsnews.com/stories/2005/09/07/katrina/main823891.shtml>.

ⁱⁱ Geoffrey Lean, Cover-up: toxic waters 'will make New Orleans unsafe for a decade, THE INDEPENDENT, Sept. 11, 2005, available at <http://www.waterconserve.org/shared/reader/welcome.aspx?linkid=46033>.

BR 3: STUDY ADAPTIVE STRATEGIES TO FLOODING

Study

Proposal developed by the Climate Adaptation Committee

Summary

Issue:

Current building codes and zoning regulations have not been examined and modified as necessary in the context of rising sea levels and increased frequency of flooding. In addition, strategies that could increase safety may have the unintended consequence of undermining urban design quality.

Recommendation:

The city should undertake a study to determine how the building code and zoning resolution should be strengthened to protect buildings from sea-level rise and flooding. Also, the city should study urban-design strategies to ensure that streetscape vitality is not a casualty of these proactive measures.

Proposed Legislation, Rule or Study

New York City should undertake a study of building codes, zoning resolutions, and urban design in relation to the 100 year flood map projected out to 2080 and hurricane SLOSH zones. The study should be a multi-agency effort, to include the Office of Long Term Planning and Sustainability (OLTPS), the Office of Emergency Management (OEM), the Department of Buildings (DOB), and the Department of City Planning (DCP) as main contributors, with Department of Transportation, Department of Parks and Recreation, Department of Environmental Protection, and Department of Design and Construction acting in consulting and reviewing capacities. The study should be coordinated by the OLTPS with the assistance of the OEM. DOB should be the lead agency for the study on building code revisions, and the DCP should be the lead agency for the studies on zoning revisions and urban planning implications.

Building code revisions to consider shall include but are not limited to:

- Foundation requirements – Rising sea levels will create a rise in the water table. This will have a direct impact on structures and buildings due to buoyancy and water infiltration.
- Freeboard and/or frame and wash-away structures at first floors.
- Areas of refuge – In the event of a citywide power outage, water and electricity would not be available and train lines would be unusable. There are no code requirements to provide temporary emergency habitation during a failure of city services.
- Hurricane resistant buildings – As storms intensify due to climate change, new construction in Hurricane SLOSH zones should be built to withstand severe storms.
- Mold resistant construction.

Zoning revisions to consider shall include but are not limited to:

- Raising “measuring points” within the flood zone.
- Zoning uses to be included within flood zones.
- Requirements for shelter areas and/or areas of refuge.

The urban design study should include:

- An assessment of the design impacts of prudent building code and zoning revisions.
- A catalogue of historic strategies developed by flood-prone communities, such as Venice, Nantucket, Chicago, Holland, and elsewhere.
- Forensic analysis of buildings in recently flooded American cities such as New Orleans or Cedar Rapids, to assess which design or construction strategies proved most resilient.
- An assessment of new technologies and design strategies to mitigate flood damage that are under development.
- A toolkit for designers to include technical and design solutions for the range of urban conditions that will be impacted, including various types of neighborhoods, various scales of development, and new developments vs. infill projects in existing neighborhoods.

Supporting Information

Issue - Expanded

The report, Climate Risk Information, issued in February 2009 by the New York Panel on Climate Change, predicts that by 2080 annual precipitation in New York City will increase by 5 to 10% and that sea level will rise between 12 and 23 inches above current levels, with a possibility of up to 41 to 55 inches in the extreme ice-melt scenario. A one to two foot sea level rise will have minimal impact on the city's coastline in terms of areas that are permanently under water. But it will significantly increase the areas of the city that would be exposed to flooding during infrequent but severe storms, and it will increase the frequency of flooding in those areas. For example, an area that would currently experience a flood every hundred years, might experience flooding every twenty years by 2080.

These increases in flooding will occur because of sea level rise alone. According to the Panel, the jury is still out as to whether extreme storm events are becoming more severe and/or more frequent. If there are also increases in storm severity or frequency, the impacts of flooding will be more widespread.

New York City's new construction codes include Appendix G, which establishes requirements for flood-resistant construction within the flood plane. A separate Task Force proposal would apply these requirements proactively to areas of the city that will be subject to floods by 2080, since buildings that are built now will likely experience 2080 climate conditions. This proposal proposes to review Appendix G to ensure that it provides adequate protection within the flood plane at any time.

In addition to the construction code, zoning and urban design issues also need to be considered. New York City has over 580 miles of coastline, much of which had been used for industrial purposes. That land is ripe for redevelopment, and is needed to house New York City's expanding population. How can these waterfront areas be adequately protected from future flooding without sacrificing the use of those areas, raising costs unduly, or destroying the vitality of the streetscape during the vast majority of the time when there is no flooding? For example, if ground floor levels are required to rise by several feet, it could make ground floor retail difficult, if not impossible. And how can all these codes ensure that, if there is flooding, the damage is minimal, and buildings will be up and running again quickly?

To answer these questions, this study proposes an analysis of potential zoning requirements along with a study of urban design impacts and strategies. The urban design study includes the development of a toolkit to enable designers to address flooding while preserving other urban design values.

Environmental & Health Benefits

While there are no direct environmental or health benefits for this proposal, with almost 600 miles of coastline in New York City¹ understanding the life safety needs for a building could affect survival rates in the event of a natural disaster.

This proposal was found to have no significant positive environmental impact.

This proposal was found to have a positive, indirect health impact.

Cost / Savings

This proposal is for a study that will have no direct impact on construction costs.

Precedents

Both the Intergovernmental Panel on Climate Change (IPCC) and the New York City Panel on Climate Change (NPCC) have completed studies looking at the impacts of climate change on coastal regions. However, neither one addresses the specific building, zoning and urban design impacts that this study proposes to address.

LEED

There are no LEED credits affiliated with this proposal to undertake a study. Should actual code revisions be implemented, the ability to achieve various LEED credits could be influenced.

Implementation & Market Availability

There are no known implementation or market availability issues for this proposal.

ENDNOTES:

ⁱ Association of Metropolitan Water Agency, Climate Change: New York City, New York, 2009, available at <http://www.amwa.net/cs/climatechange/newyorkcity>.

BR 4: STUDY ADAPTIVE STRATEGIES TO NON-FLOOD CLIMATIC RISKS

Study

Proposal developed by the Climate Adaptation Committee

Summary

Issue:

Current building codes and zoning regulations are based on historic data and do not consider the potential impacts of climate change on existing and future development.

Recommendation:

Based on the hazard zone maps and risk assessments developed in the study on non-flood climatic hazards, undertake a further study to recommend building code and zoning changes to diminish the impacts of those hazards.

Proposed Legislation, Rule or Study

The city's construction codes and zoning regulations are based on the climate that New York experienced in the past. Because they do not incorporate the predicted climate, they cannot protect New York City's buildings from the impacts of its future climate. Using the results from the study on non-flood climatic hazards to 2080 called for in BR 4, New York City should undertake a further study to recommend zoning and building code changes to mitigate the potential hazards, other than flooding, that will result from climate change.

For each hazard, the study should assess whether any code changes are required for new and/ or existing buildings. If changes are required, the analysis should:

- propose differing requirements, as appropriate, based on the low, medium, and high hazard zones as defined and mapped in the non-flood climatic hazards study;
- analyze the cost impacts of the proposal and the associated avoided risk to property (monetized) across a variety of building types and hazard zones; and
- assess whether the requirements should be phased in according to when the impacts are projected to occur.

Supporting Information

Issue - Expanded

The New York City Panel on Climate Change Report forecasts climate change projections over a 70 year timeframe between now and 2080. These changes will occur gradually over an extended period. Based on the premise that the lifespan of a typical building ranges between 50 and 100 years, it is prudent to begin studies on adaptation to potential hazards, in order to align with the typical cycle of building upgrades, reconstruction, and planning of future developments. This will ensure a gradual adaptation of the building stock while minimizing associated costs.

Environmental & Health Benefits

There are no known environmental or health benefits for this proposal.

This proposal was found to have no significant positive environmental impact.

This proposal was found to have a positive, indirect health impact.

Cost & Savings

This proposal is for a study which will have no direct impact on construction costs.

Precedents

There are no known precedents for this proposal.

LEED

There are no LEED credits affiliated with this proposal.

Implementation & Market Availability

There are no known implementation issues for this proposal.

BR 5: FORECAST NON-FLOOD CLIMATIC HAZARDS TO 2080

Code Location, Study, Regulation

Proposal developed by the Climate Adaptation Committee

Summary

Issue:

New York City will face a series of risks associated with climate change whose impact has not been adequately studied. These risks include rises in the groundwater table, increased wind velocities, changes in rainfall, heat waves, electrical grid disruptions, increased humidity and other extreme weather events.

Recommendation:

Study climate risks to buildings through 2080. Determine whether impacts will vary across the city or have a uniform impact; then, define and map hazard zones in the city based on the risk of these climatic effects.

Proposed Study

The New York City Panel on Climate Change has studied the impacts of climate change in the city, predicting increases in mean annual temperatures, total annual precipitation, rising sea levels and the frequency and severity of short-term climate hazards such as heat waves, droughts and flooding through 2080. From these primary effects of climate change will come a cascade of secondary effects that will ultimately impact New York's buildings. For example, rising sea levels will cause rising ground water tables and an encroachment of salinity which may have an impact on basement flooding, drainage, or the durability of underground pipes; similarly longer and more frequent heat waves may cause more frequent brownouts or blackouts.

Flooding issues have been addressed in these proposals with two separate studies, one of which proposes the creation of predictive flood maps, while the other proposes a study of the building and zoning changes required to adapt to the new flood conditions, along with the urban design strategies that can help the city adapt gracefully to the new requirements. But non-flood hazards, such as heat waves or increased wind velocities, also need to be analyzed and mapped. The impacts of these non-flood hazards could vary across the city because either the hazard itself varies or because the risk varies due to the variation in the density of vulnerable properties or populations. An example of the former is rising groundwater tables, which exhibit local variations depending on elevation and geology. An example of the latter would be a heat wave, which is fairly constant throughout the city, but would have greater impact on certain communities, such as those with a high concentration of elderly people who lack air conditioning.

The study should analyze and map the projected impact of the following non-flood hazards through 2080:

Even hazard	Variable hazard
Rainfall quantity, frequency, intensity, and seasonal modifications	Rise in groundwater table, encroachment of salinity
Heat waves	Increased wind velocities
Increased humidity	Electrical grid disruptions due to extreme weather events
Increased temperatures	Interaction of increased temperatures with the urban heat island effect
Probability of other extreme weather events (ice storms, etc.)	Impact of increased temperature, changes in precipitation and humidity on air quality

For hazards with impacts that will vary across the city, the map should delineate high, medium, and low impact zones. For hazards that will impact the city uniformly, this study should establish the impact level for the entire city. Finally, the study should assess the relative severity of each hazard relative to the others.

Supporting Information

Issue - Expanded

Current building codes and reference standards such as ASHRAE consider historical weather data, including temperature, humidity, cloud cover, wind velocities, and precipitation variations, when establishing parameters for building design. In addition to impacting storm surge and causing sea level rise, climate change may modify design factors such as energy loads, lateral forces, thermal resistance, water infiltration and humidity control, temperature control, snow loads, ventilation requirements, and durability of materials. Analysis of impacts may also affect city planning strategies and planning for emergency measures such as areas of refuge.

The New York City Panel on Climate Change published a Climate Risk Information study for New York City.ⁱ This document provides climate change projections for New York City and identifies some of the potential risks to the City's critical infrastructure posed by climate change. Key findings include the following:

- Warmer temperatures are extremely likely in New York City and the surrounding region. Mean annual temperatures are projected by global climate models (GCMs) to increase by between 1.5 - 3 °F by the 2020s and 4 - 7.5 °F by the 2080s
- Total annual precipitation in New York City and the surrounding region will likely increase. Mean annual precipitation increases projected by GCMs are 0 - 5% by the 2020s to 5 - 10% by the 2080s
- Rising sea levels are extremely likely. GCM-based projections for mean annual sea level rise in New York City are 2 - 5 inches by the 2020s and 12 - 23 inches by the 2080s

The study also notes short-duration climate hazards that can pose particular threats to infrastructure. These events include more frequent, intense and longer heat waves; increase in brief intense precipitation events that can cause inland flooding; increase in storm-related coastal flooding due to sea level rise; and increased severity of droughts.

In addition, the U.S. Global Change Research Program has recently published a study on Global Climate Change Impacts in the United States. The study notes problems in the Northeast such as increased health risks due to extreme heat, declining air quality and increased flooding due to sea level rise and heavy downpours.ⁱⁱ

Environmental & Health Benefits

While there are no direct environmental or health benefits for this proposal, the study aims to address specific regions within New York City and determine where various resources would be best implemented. This could have an indirect effect on environmental and health issues in that resources would be strategically distributed to areas where they are needed rather than requiring them in areas that do not need them.

This proposal was found to have no significant positive environmental impact.

This proposal was found to have a positive, indirect health impact.

Cost & Savings

This proposal is for a study which will have no direct impact on construction costs.

Precedents

The Intergovernmental Panel on Climate Change (IPCC), the New York City Panel on Climate Change (NPCC)ⁱⁱⁱ, and the U.S. Global Change Research program^{iv} have completed studies looking at the impacts of climate change on coastal regions. However, neither one addresses the specific regional impacts that this study proposes to address.

LEED

There are no LEED credits directly affiliated with this proposal though outcomes of the report may affect LEED credits in Sustainable Sites, Water Efficiency, Energy and Atmosphere, and Indoor Environmental Quality categories.

Implementation & Market Availability

There are no known implementation or market availability issues for this proposal.

ENDNOTES:

ⁱ NEW YORK CITY PANEL ON CLIMATE CHANGE, CLIMATE RISK INFORMATION, Feb. 17, 2009, available at http://www.nyc.gov/html/planyc2030/downloads/pdf/nyc_climate_change_report.pdf.

ⁱⁱ THOMAS R. KARL, ET AL., GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES, CAMBRIDGE UNIVERSITY PRESS (2009).

ⁱⁱⁱ NEW YORK CITY PANEL ON CLIMATE CHANGE, CLIMATE RISK INFORMATION, Feb. 17, 2009, available at http://www.nyc.gov/html/planyc2030/downloads/pdf/nyc_climate_change_report.pdf.

^{iv} THOMAS R. KARL, ET AL., GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES, CAMBRIDGE UNIVERSITY PRESS (2009).

BR 6: ANALYZE STRATEGIES TO MAINTAIN HABITABILITY DURING POWER OUTAGES

Study

Proposal developed by the Climate Adaptation Committee

Summary

Issue:

Research on climate change indicates that there will be an increase in the frequency and severity of events that can disrupt the city's power, water, sewer and transportation infrastructure. In the event that city services are not usable, passive and dual-mode functions will be critical

Recommendation:

Undertake a comprehensive study of passive survivability and dual-mode functionality, then propose code changes to incorporate these concepts into the city's building codes. Also include a study on refuge areas in sealed buildings.

Proposed Legislation, Rule or Study

If New York City's power system were seriously disrupted, millions of New Yorkers would likely be stranded within buildings because of the difficulty of quickly evacuating more than eight million people from a series of islands, and also because the subway system, which relies on electric power, would be paralyzed. In order to house the population safely, a certain percentage of the city's building stock would need to maintain conditions of habitability for a period of days, without access to electric power from the grid.

This issue is not a hypothetical concern for New York. The city has experienced power outages due to heat waves and electrical glitches in the past decade; an act of terrorism or a serious flood could also cause a black-out, as occurred in New Orleans. Gradually, climate change may increase the frequency and severity of extreme weather events, and this could increase the occurrence of power outages, particularly if preventative action is not taken. This problem is exacerbated because buildings built over the past fifty years have become increasingly dependent on a continuous supply of energy in order to provide such basic requirements as fresh air.

How much habitability (or survivability or resilience) needs to be provided within New York's building stock, and how should it best be provided? The current approach entails installing diesel back-up generators in buildings containing critical functions. The downside of extending this approach is that these generators are highly polluting, they are expensive, and there are logistical challenges involved in getting fuel to a large number of buildings in an emergency scenario. Other potential strategies include:

- **Passive survivability:** Designing buildings so that they maintain habitability through passive means, such as well-insulated envelopes and access to light and fresh air.
- **Dual mode functionality:** Reducing the emergency energy needs of the building by designing it to function in dual modes, one being the "standard mode", and the other a "low energy" mode.
- **On-site energy generation:** Utilizing a gas-based co-generation system and/or solar or wind installations to meet some portion of the building's emergency energy needs.
- **Providing areas of refuge:** Reducing the emergency energy needs of the building by designating that only some portion of the building - "areas of refuge" -- need remain habitable.
- **Hybrid systems:** Any combination of the above strategies.

Given the array of options, and the large variety of building types and systems within New York, the City should undertake a study of how best to ensure sufficient habitability during the period before service is restored or the population can be evacuated.

The study should include the following:

1. An analysis of the various strategies to ensure habitability during a power outage, to include, at a minimum, the following strategies: emergency back-up generators, passive survivability, dual-mode functionality, on-site generation, areas of refuge, and hybrid systems. Across a representative selection of building types, the study should analyze the effectiveness, feasibility, cost (including both first-cost and life cycle cost), and design implications of each strategy. The study should also consider any collateral damages or benefits of each strategy.

2. An analysis of the performance of New York's existing building stock from various eras under emergency conditions. The analysis should determine how new buildings compare with older, pre-1950, buildings (the latter generally consuming less energy and being more likely to be inhabitable without power). It should also determine what principle design strategies enabled the older generation of buildings to function with less power and the impact of the older generation of codes (1916 Zoning Ordinance, Tenement Laws, etc.) on their design.
3. A review of requirements for emergency power, passive survivability, or basic habitability in other jurisdictions, both national and international.
4. A review of the habitability needs for various building types (commercial, residential, institutional, etc.). The study should consider how long each building type would need to support habitation, how much of the building would need to remain habitable, and what building functions would need to be maintained.
5. An assessment of how parallel efforts to increase the resilience of the city's infrastructure could decrease the requirements for building habitability.
6. An analysis of the code changes necessary to achieve the desired levels of survivability. The study should assess the requirements for both new and existing buildings. It should also recommend whether the requirements should be prescriptive (i.e. should there be specific requirements for certain passive survivability techniques, back up generators etc?) or performance (i.e. should the building be required to demonstrate that it could support certain functions or a certain population for a given length of time).
7. Draft code language for any recommended code changes.

Supporting Information

Issue - Expanded

Under the direction of the Mayor's Office of Long Term Planning and Sustainability, New York has become a national leader in addressing the consequences of climate change. It convened the New York Panel on Climate Change (NPCC) to assess the impacts of climate change through the end of this century in New York. The Panel's findings were published in February 2009 in Climate Risk Information. In addition, the Office convened an Adaptation Task Force, which includes the agencies, public authorities, and private sector companies that manage the city's infrastructure, including Consolidated Edison, to assess how infrastructure can be made more resilient in the face of climate change.

This proposal would complement the efforts to enhance the city's infrastructure by making the buildings capable of supporting the city's population in the event that the electrical grid should fail.

Environmental & Health Benefits

The health benefits of this proposal could be significant if New York experienced an extended power outage because it would enable a large number of people to ride out such a crisis within buildings that maintained habitable conditions.

This proposal was found to have no significant positive environmental impact.

This proposal was found to have a positive, indirect health impact.

Cost & Savings

This proposal is for a study which will have no direct impact on construction costs.

Precedents

In the aftermath of Hurricane Katrina, 30,000 residents of New Orleans sought refuge in the Superdome for several days. This rapidly turned into a nightmare because without electricity and air conditioning, temperatures within the building became almost unendurably hot. In contrast, the people who stayed in the French Quarter were relatively comfortable. This is because the older buildings in the Quarter were designed for some degree of passive cooling since they were built before air conditioning was available.

This contrast led Alex Wilson, editor of Environmental Building News and a member of the technical sub-committee on Adaptation in the NYC Green Code Task Force, to formulate the concept of "passive survivability". The basic idea behind passive survivability is that buildings should be designed and built so that they can remain habitable in the absence of an outside power supply.

LEED

There are no LEED credits affiliated with this proposal.

BR 6: ANALYZE STRATEGIES TO MAINTAIN HABITABILITY DURING POWER OUTAGES

Implementation and Market Availability

There are no known implementation or market availability issues for this proposal.

BR 7: ENSURE TOILETS & SINKS CAN OPERATE DURING BLACKOUTS

New York City Plumbing Code

Proposal developed by the Climate Adaptation Committee

Summary

Issue:

Some toilets and faucets can function only with utility power; this presents a sanitation risk in the event of a long-term power outage.

Recommendation:

Require that toilets and faucets be capable of operating without building power for at least two weeks

Proposed Legislation, Rule or Study

Amendments to the New York City Plumbing Code

1. Add a new Section 424.7 as follows:

424.7 Lavatory sensor control devices. Sensor control devices used for lavatory faucets shall be able to continue normal operation in the event of a loss of building power for a period of at least two weeks, without connection to the building power supply.

2. Add a new Section 425.6 as follows:

425.5 Water closet and urinal flushing sensor control devices. Sensor control devices used for flushing toilets or urinals shall be able to continue normal operation in the event of a loss of building power for a period of at least two weeks, without connection to the building power supply. Sensor control devices shall be based on infrared detection and have a minimum delay of 2 seconds.

Supporting Information

Issue - Expanded

Studies demonstrate that bacteria in bathrooms, even those that are functioning properly, contribute to the spread of infectious illnesses such as the common cold and gastrointestinal illness.ⁱ When lavatories and toilets cannot function properly and people cannot wash their hands, remove waste or clean regularly, bathrooms can become a major vector for illness.ⁱⁱ

Automatic fixtures were created in part to reduce human contact with bathroom surfaces that might spread disease. However, the need of many such fixtures for electricity leaves them vulnerable to disruptions in the power grid, potentially crippling building sanitation during blackouts. The effect of losing sanitation in an occupied building was graphically demonstrated in the aftermath of Hurricane Katrina when lack of water pressure caused toilets to fail in the Superdome, quickly making the building uninhabitable. In addition, the sensors on many automatic fixtures, particularly toilets, malfunction and flush repeatedly, wasting a substantial quantity of water.

Environmental & Health Benefits

This proposal will ensure the proper functioning of building sanitation, even during prolonged power disruptions. In addition, it will improve sensor controls for toilets and urinals, leading to a reduction in water consumption.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have a low positive health impact per building and to impact a small number of buildings. It was thus given a health score of 1.

Cost & Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the

BR 7: ENSURE TOILETS & SINKS CAN OPERATE DURING BLACKOUTS

context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to lower capital costs if implemented.

Precedents

There are no known precedents for this proposal.

LEED

There are no LEED credits affiliated with this proposal.

Implementation & Market Availability

There are no known implementation issues for this proposal. Lavatory faucet sensors and toilet sensors with the required battery life are readily available. Some flushometer toilets with sensors also provide a manual override.

ENDNOTES:

ⁱ School Network for Absenteeism Prevention, It's a Snap: Statistics, <http://www.itsasnap.org/snap/statistics.asp> (last visited Jan. 21, 2010).

ⁱⁱ Shae Crisson, *Letting toilet water mellow should not pose a health risk*, ASSOCIATED PRESS, Dec. 19, 2007, available at <http://abclocal.go.com/wtvd/story?section=news/local&id=5845834>.

BR 8: ENHANCE BUILDING WATER SUPPLY DURING BLACKOUTS

New York City Plumbing Code

Proposal developed by the Climate Adaptation Committee

Summary

Issue:

Water towers are an energy-efficient method for providing water pressure and ensuring access to potable water during short power losses. The building codes do not require water towers for new construction, and they allow the towers to be removed from existing buildings.

Recommendation:

Prohibit the removal of existing water towers, and require water towers in all new and renovated buildings.

Proposed Legislation, Rule or Study

Amendments to the New York City Plumbing Code:

1. Amend Section 606.5.6 as follows:

606.5.6 Emergency Water Supply to be Provided.

606.5.6.1 Maintain Existing Gravity Tanks. An existing gravity tank shall not be removed unless it is replaced by a gravity tank of greater or equal capacity; it may not be removed and replaced by potable water pressure tanks.

Exception: A gravity tank may be replaced by a gravity tank of smaller size if it can be demonstrated that the water requirements of the building have diminished by more than 30% due to a change of use or occupancy.

606.5.6.2 New Construction. New buildings shall either install a gravity tank or comply with performance standards that shall be established by the department for minimum emergency water supplies according to building occupancy.

Supporting Information

Issue-Expanded

The wooden water towers on New York City's rooftops constitute a signature feature of the City's skyline; in addition, they provide resilience to the City's buildings in the event of power outages, by ensuring that there is some water available. In many older buildings, water from the city system is pumped up to the roof and stored in a water tank, where it is then distributed throughout the building via gravity. Newer systems often do not use such rooftop gravity tanks. Instead they use one or more water pressure tanks, which store very little water and continuously supply water at the necessary pressure by pumping.

In terms of building resilience, the rooftop storage units offer several advantages. If the building's electrical or water systems were to be disrupted, the building would at least have the water stored in the tank. Similarly, because these tanks work by gravity, water could still be distributed through the building without any power supply. In addition to resilience, gravity tanks generally use less energy than water pressure tanks. In the former, pumping is only required intermittently when more water is needed to fill the tank, whereas with the latter, more frequent pumping is needed to maintain the availability of water at the right pressure.

Nonetheless, some building owners are abandoning their old water tanks, often because of maintenance issues. And new buildings often opt for water pressure tanks because they don't impact the design of the roof and they do not require structural supports needed by the gravity fed tanks.

This proposal would prohibit the removal of existing tanks, since they are on buildings that were designed to support them. It would also require new buildings to either install water tanks or comply with emergency water supply standards developed by the Department of Buildings.

Environmental & Health Benefits

Having water available in power outages has obvious health and safety benefits, since water is necessary for drinking and hygiene. In addition, gravity tanks generally use less electric energy for pumping.

This proposal was found to have a low, positive environmental impact per building and to impact a small number of buildings. It was thus given an environmental score of 1.

This proposal was found to have a low positive health impact per building and to impact a small number of buildings. It was thus given an health score of 1.

Cost & Savings

As described in the Executive Summary, Bovis Lend Lease prepared cost estimates for each Task Force proposal in the context of well-defined construction projects in specific buildings. Where possible, members of the Technical Committees prepared savings estimates for some of these projects and buildings. These cost and savings estimates are presented in the February 1st draft version of Appendix A. The innate uncertainty in how construction and operation will vary from one building to another, the complexity of the Task Force proposals, and the wide range of applications in which the proposals may be realized mean these figures are truly estimates.

This proposal was estimated to increase first capital costs by 0.03%. It was thus categorized as incurring a low capital cost increment.

Precedents

There are no known precedents for this proposal.

LEED

There are no LEED credits affiliated with this proposal.

Implementation & Market Availability

This is a mature technology and is available.

Notes

This proposal is consistent with BR 6 - Analyze Strategies to Maintain Habitability During Power Outages.

BR 9: INCLUDE CLIMATE CHANGE IN ENVIRONMENTAL IMPACT STATEMENTS

Proposal developed by the Climate Adaptation Committee

Summary

Issue:

"CEQR" is the process by which city agencies review proposed actions in order to identify the effects those actions may have on the environment. CEQR guidelines are currently being updated to include an assessment of the impact of climate change on proposed actions.

Recommendation:

The technical committee supports the amendments to the CEQR guidelines underway in the Mayor's Office of Environmental Coordination, which will incorporate climate change. The Mayor's Office began implementing this proposal independently of the Task Force, prior to the issuance of this report.

Proposed Legislation, Rule or Study

Expression of Support for the NYC Mayor's Office of Environmental Coordination's effort to provide guidance for analyzing climate change in environmental assessment conducted pursuant to CEQR.

The Committee endorses the City's effort to provide guidance for both (1) an analysis of an action's greenhouse gas the Committee supports the use of a methodology which pro-rates emissions per square footage and adjusts for building type. Some alternative methodologies are based on total carbon emissions, which can have the unintended consequence of discouraging density, which is typically the least carbon intensive way to build since it facilitates mass transit options. The former type of analysis is proper one as it will promote efficient development without inhibiting high densities. emissions emissions and (2) an analysis of climate change and an action's adaptation to climate change. In particular,

Supporting Information

Issue - Expanded

The City Environmental Quality Review, or "CEQR" is a process by which City agencies review proposed discretionary actions for the purpose of identifying the potential effects those actions may have on the environment, and in some instances, the effects the environment may have on the proposed action. The goal of CEQR is to ensure disclosure of all the potential environmental impacts of an action under consideration so that the decisionmakers are fully informed of its effects before determining whether to directly undertake, approve, or fund that action.

The CEQR Technical Manual (the Manual) provides guidance for City agencies, project sponsors and the public in the procedures and substance of the CEQR process. Chapter 3 of the Manual currently includes a discussion of 22 analysis areas, including land use, zoning and public policy, open space, infrastructure, energy, air quality, solid waste and sanitation services, hazardous materials, etc. For each of the areas, guidance is provided in assessing the existing and future environmental settings, defining study areas, evaluating existing conditions, predicting future changes, identifying significant impacts and developing mitigation measures for any significant adverse impacts. Possible assessment methodologies are explained for each technical area.

The Manual was last updated and published in 2001. This version of the Manual did not include any discussion of, or the need for, assessment of climate change and the effects that such change will have on any proposed action. The Mayor's Office of Environmental Coordination (MOEC) is currently undertaking a complete revision of the Manual, set to be released in 2010. The Committee has been informed by MOEC that this revision will provide guidance for an analysis of climate change. The climate change analysis guidance is being developed by MOEC in collaboration with the New York City Panel on Climate Change; the Mayor's Office of Long Term Planning and Sustainability; the Law Department; the Department of City Planning; the Parks Department; and the Department of Environmental Protection.

Environmental & Health Benefits

This proposal was found to have no significant positive environmental impact.

This proposal was found to have no significant positive health impact.

BR 9: INCLUDE CLIMATE CHANGE IN ENVIRONMENTAL IMPACT STATEMENTS

Cost & Savings

This proposal was not part of the cost analysis.

Precedents

There are no known precedents for this proposal.

LEED

There are no LEED credits affiliated with this proposal.

Implementation & Market Availability

There are no known implementation or market availability issues for this proposal.