Zoning for Coastal Flood Resilience

By Joseph DeAngelis

Flooding poses a considerable threat to the well-being of coastal cities and towns. Most coastal communities are well acquainted with the flood risks from the array of potential tropical disturbances, less impactful but more frequent coastal storm events, and increasingly common nuisance flooding due to rainstorms and high and king tides. Impacts associated with sea-level rise have ceased to be a prospect and are now becoming a reality for municipalities on the coast.

While the integration of hazards and climate resilience into comprehensive planning efforts has been a welcome development in recent years, local implementation processes are where coastal adaptation measures must take root. Where a hazard mitigation and emergency management plan may have sufficed in the past, the integration of coastal flood adaptation into the standard repertoire of local implementation techniques is vital to long term resilience. Zoning techniques is one of the major tools at the disposal of municipalities that are looking to reduce the exposure and vulnerability of its citizens and structures to coastal flooding. From lot-level design requirements and standards to overlay districts, rezonings, and map amendments, the zoning code and map are powerful ways of addressing flood resilience at a variety of scales.

This edition of Zoning Practice will summarize the spectrum of risk coastal flooding poses to cities, discuss zoning and land-use approaches that can help communities to adapt, and highlight relevant zoning reform efforts in Mandeville, Louisiana; Norfolk, Virginia; and New York City.

HIGH AND DRY ON THE WATERFRONT—FIVE YEARS LATER

2017 was a landmark year for coastal storms. Three of the five costliest hurricanes in U.S. history all came in the space of a single, mercilessly active hurricane season. September 2017 alone was rated as the most powerful month for Atlantic coastal storms on record. Hurricanes Irma, Maria, and Harvey covered the spread of major hurricane impacts. Hurricane Irma’s winds topped out at 185 mph, making it the most powerful Atlantic storm on record. Hurricane Maria brought devastating wind, rain, and coastal flooding to Puerto Rico, where the death toll likely lingers in the range of 500 to 1,000 people, far in excess of the official toll of 64. Hurricane Harvey brought biblical rainfall to the sprawling Houston metropolitan area. In Nederland, Texas, Harvey dumped 60.58 inches of rain, the largest volume of rainfall attributable to a single storm in the lower 48.

These storms, together with Hurricanes Katrina and Sandy, signal that the billion-dollar future isn’t just more likely, but imminent. Taken with rising sea levels due to climate change, the risks to coastal cities and towns are clear: Flooding is likely to increase in regularity and worsen in intensity in the near and medium-term future. While the role of the federal government is considerable, particularly in the context of the National Flood Insurance Program (NFIP), the Federal Emergency Management Agency’s (FEMA) ubiquitous Flood Insurance Rate Maps, and the Natural Hazard Mitigation Grant Program, state and local governments must ensure that they are doing all they can to mitigate coastal flooding. Zoning is one of the major tools at the disposal of municipalities that are looking to reduce the exposure and vulnerability of its citizens and structures to coastal flooding. From lot-level design requirements and standards to overlay districts, rezonings, and map amendments, the zoning code and map are powerful ways of addressing flood resilience at a variety of scales.

The November 2013 issue of Zoning Practice, “High and Dry on the Waterfront” by Jim Schwab, FAICP, looked at the impact of FEMA’s new Advisory Base Flood Elevation Maps for the City of New York, and the city’s initial steps in addressing coastal flood adaptation through the zoning code. This issue also came on the one-year anniversary of Hurricane Sandy, an event that put New York City’s vulnerability to extreme coastal flooding in stark relief. In this context, the city grappled with how the zoning code and the city’s built environment actively conflicted with the basics of coastal flood adaptation. How do height limits in lower density parts of the city interfere with elevation requirements in the wake of new FEMA flood maps? What about residential buildings with accessory basement residences? How do you even begin to discuss the elevation of attached and multifamily buildings? What happens to a commercial district when two dozen buildings with ground-floor retail uses require dry or wet floodproofing?

As Schwab acknowledges in the article, while New York City is often considered an outlier around issues such as zoning codes and the built environment, the challenges outlined above are not exclusive to New York. Given the direct flood impacts of Hurricanes Maria and Harvey on major metropolitan areas with diverse building stocks and wide ranges of density, the lessons learned in New York City post-Sandy have a surprisingly wide applicability. Later in this article I will dig deeper into the evolution of New York City’s zoning and land-use strategy for coastal flood adaptation since “High and Dry on the Waterfront” and look at how the city’s unique focus on both lot-scale interventions and zoning map changes may be a model for other cities.

COASTAL FLOOD RISK AND ZONING CONSIDERATIONS

According to FEMA, 39 percent of the U.S. population lives in counties that are adjacent to open ocean, major estuaries, or one of the Great Lakes. A much smaller percentage live within FEMA’s one percent annual chance (or 100-year) floodplain. (A one percent annual chance (or 100-year) flood means that there is an equal chance annually of major flooding, not that major flooding is only allowed to occur once every 100 years within a specific geographically defined area.) FEMA’s flood insurance rate maps follow historical precedent, and future flood events tend not to consider the lines drawn on regulatory maps. That maps follow the historic paths of floods and not vice-versa is a surprisingly common realization for both the public and practitioners, and one I encountered often as a community planner for the East Shore of Staten Island after Hurricane Sandy.

Of course, coastal inundation flooding is not solely the domain of tropical disturbances. Nor’easters and similar offshore events can also cause storm surge and inundation of populated coastal areas. High tide and “king tide” (the annual highest tide
event) flooding is increasingly common due to both sea-level rise and recent coastal development.

There is no specific point in time that sea-level rise will suddenly take effect and permanently inundate a community. Rather, in the near to medium term, a gradual rise in sea levels will have cumulative impacts in the form of more regular nuisance flooding and more extreme coastal flood events. According to the National Oceanic and Atmospheric Administration’s (NOAA) 2017 publication *Global and Regional Sea Level Rise Scenarios for the United States*, the intermediate-high scenario of 14 inches of local sea-level rise by 2030 (which NOAA considers increasingly likely) will increase instances of damaging or disruptive flooding 25-fold over the present baseline. This means that regular inundation during high tides, more extreme inundation during king tides, and inundation further inland during and after tropical disturbances are the likelyest impacts that communities will need to plan for. The good news is coastal communities may already be experienced in planning for coastal flooding. The bad news is that future flooding is likely to be of the more regular, and more extreme, variety.

Zoning is a convenient and effective means of addressing coastal flood adaptation. At the building or lot scale, the zoning code can ensure that new and existing buildings are permitted to adapt to FEMA floodplain regulations. The zoning code can also build in additional requirements for buildings both in and outside of the floodplain to encourage additional adaptation to potential future sea-level rise or more extreme flood scenarios. The zoning code can also serve to enhance the local pedestrian experience in the case of building elevations or dry floodproofing through design standards and incentives built into the zoning code.

To this end, Mandeville, Louisiana, has developed a series of design standards for the elevation of buildings in historic districts intended to mitigate against the visual and practical impacts of elevation, and ensure that the character of the community and the experience of the citizen are preserved. At the district scale, zoning can play a considerable role in directing and incentivizing development away from high flood-hazard areas and toward parts of the jurisdiction capable of supporting growth. Whether through existing zoning districts, new flood-specific overlays, or some combination of the two, map and code changes can effectively mitigate against the impact of flooding upon the community. Norfolk, Virginia, is deeply engaged in the use of zoning to direct development away from its highest hazard areas, particularly in light of local sea-level rise impacts. In many cases, some combination of the two above strategies may be necessary.

Over the last five years, New York City has taken a comprehensive look at how local zoning regulations can best permit attractive, contextual, and resilient as-of-right development, while developing ways to accommodate coastal retreat and dedensification in the highest risk areas.

**MANDEVILLE, LOUISIANA**

Mandeville, Louisiana, is a city of about 12,000 people located north of New Orleans directly across Lake Pontchartrain. Though initially settled in the mid-19th century, the city experienced explosive growth toward the end of the 20th century with the completion of the Lake Pontchartrain Causeway, a pair of 24-mile-long bridges connecting Mandeville with the outskirts of New Orleans. With growth came considerable challenges, particularly around flood hazards. Much of the recent development was typical of mid-century slab-on-grade development popular elsewhere in the U.S., and few were elevated to accommodate floodwaters. Likewise, many new residents were unfamiliar with flood hazards associated with Lake Pontchartrain. Much of Mandeville is located within a FEMA Special Flood Hazard Area, meaning both the enforcement of NFIP regulations and purchase of flood insurance for mortgage holders is required. Hurricane Katrina significantly impacted Mandeville, with 9.5 feet of storm surge off Lake Pontchartrain resulting in 423 NFIP claims and local damage costs of nearly $24 million.

The historic context of Mandeville poses particular challenges for flood hazard mitigation. However, existing precedent for elevated pre-causeway historic homes did point a way forward. The problem to solve is essentially twofold: How does the local zoning code interfere with elevation, and what design standards are necessary to mitigate the visual impact of elevation? These questions have wide applicability beyond historic districts. Height requirements in residential districts would likely preclude elevation in...
many cases, or severely restrict the building envelope in others. Further, questions of setback, siting, the location of parking, ingress and egress, and direct access to the structure all must be considered if homes are to be raised or built to their FEMA-required elevations (or higher). The mitigation of these changes likewise may mean specific design interventions to maintain either historic context or neighborhood character.

The Old Mandeville Business District Area Plan, developed in the wake of Hurricane Katrina, spells out a series of design regulations and guidelines for homes and businesses within the district. The goals of the plan are straightforward: Enable historic Mandeville to retain its historic context while allowing for structural elevation that will mitigate flood impacts and ensure compliance with FEMA regulations.

Following adoption, the city incorporated the plan’s design regulations and guidelines into its zoning code by reference (§7.5.10.5.1). Design regulations in the plan are heavily focused on screening, regulating the use of space below elevated buildings, and mitigating perceptions of height. They also tend to be sensitive to the particulars of individual sites. The following constitutes a brief summary of both site and building design regulations:

- **Site design requirements**: Ensuring proper use of the public frontage including the provision of pedestrian and on-street parking space where rights of way exist; landscaping with shrubs, trees, and greenery; the use of hedges and fencing to separate private and public realms; and screening on-site parking located beneath the structure with foundation plantings and vegetative screens. Requirements also include the screening of piers and columns that have been used to raise structures with paneling and plantings of at least half the height of the piers. Finally, building entries must face the street on which the building fronts, and walkways should provide direct access from the sidewalk to the front door.

- **Building design requirements**: Uses below the building Base Flood Elevation are restricted to access, parking, and storage. Given the increased height of buildings due to elevation, specific elements such turrets, towers, and cupolas cannot exceed 50 feet in height. Front entry porches must use materials, colors, and proportions appropriate for the local architectural context. Large and multi-family buildings must use treatments similar to single-family housing to ensure local architectural consistency.

Design guidelines included in the plan function as recommended practices that go beyond code requirements. These include guidelines for specific design elements such as canopies, galleries, and locally significant materials and colors, and design strategies for mitigating height and size perception.

The impacts of Hurricane Isaac on Mandeville in 2012 are notable for entirely different reasons than Katrina in 2005. While Mandeville experienced a similar storm-surge event during Isaac, NFIP claims were reduced by half and financial losses by 71 percent. While much of this is likely attributable to post-Katrina flood mitigations (home elevation, community preparedness, etc.), having a zoning code and design guidelines that consider NFIP elevation requirements in addition to neighborhood context no doubt played a role.

**NORFOLK, VIRGINIA**

Norfolk, Virginia, is at the leading edge of incorporating sea-level rise information into its local planning processes. Notably, the integration of coastal flood resilience has gone beyond the inclusion of flood-hazard and sea-level rise data in various plans and documents, but has also focused on how flood-hazard and sea-level rise information can inform implementation processes such as the capital improvements program or the zoning code.

Located in the Chesapeake Bay, and home to both the world’s largest naval base and the second largest port network on the East Coast, Norfolk has a long and enduring relationship with water. Yet this reliance on the water has obvious drawbacks, particularly in an age of sea-level rise. Norfolk’s awareness of its own exposure and vulnerability is the driving force behind its considerable adaptation efforts, which have recently included a 2013 comprehensive plan update, investment in local flood-resilient infrastructure, and participation in both the Dutch Dialogues and Rockefeller’s 100 Resilient Cities initiative. An enduring theme of the 2013 comprehensive plan update revolved around ensuring that flood resilience can be operationalized within the city’s array of implementation processes. To that end, the plan update called for a revised zoning ordinance that considered the risks of sea-level rise on the built environment. The code revision, titled ZoneNorfolk and adopted unanimously by Norfolk’s city council in January 2018, seeks to tackle the problem with a strategy that fuses site-specific requirements with a districtwide overlay approach.

At the site scale, Norfolk built its most recent revisions atop earlier elevation requirements adopted in 2013. These rules require an additional three feet of freeboard above the base flood elevation for buildings within the Special Flood Hazard Area, and 18 inches of freeboard in the “shaded X” area, which includes buildings between the 100-year (or one percent annual chance) floodplain and the 500-year (or point-two percent annual chance) floodplain (§3.9.7). As a part of the most recent code revision, the city now requires builders to elevate all new single-family detached dwellings outside of defined flood hazard areas between 16 and 24 inches (§5.9.3.D). This approach is notable as it considers the likelihood of more extreme flooding inside of and more extensive flooding outside of the FEMA-defined flood hazard area, which is generally based on historic flooding and doesn’t consider sea-level rise.
A hallmark of the recent code revision is the “Resilience Quotient” concept, a point-based system that requires risk mitigation, sustainable energy, and stormwater management measures for all new development (§5.12). Each new proposed development may elect to undergo evaluation for inclusion of these considerations during the site plan review process or to forego that portion of the review process and select from a menu of specific interventions. Each proposed development is required to have a certain number of points, ranging from four points for one-to-five-unit developments, to 10 points for large multifamily development. With regard to flood risk mitigation, the menu options include elevating mechanical systems, on-site stormwater retention, and the installation of permeable surfaces.

Norfolk has also developed a series of zoning map overlays that serve to classify local flood risk citywide and prescribe specific interventions for each overlay.

- Coastal Resilience Overlays are applied to areas with the highest flood risk (§3.9.18). These areas require higher elevations of the first floor, limit parking and hard pavement, and require additional landscaping and open space.
- Upland Resilience Overlays are applied to lower-risk areas that are more capable of accommodating growth (§3.9.19). New construction within an Upland Resilience Overlay is also permitted to reduce its own resilience requirements in exchange for placing conservation easements on higher-risk properties.
- Neighborhood Resilience Overlays are also lower-risk areas, and are intended for more typical cases. They allow for customized design standards that are appropriate to the local context (§3.9.16).

Norfolk’s multifaceted approach of utilizing the zoning code to not only encourage but require flood-resilient development is likely a harbinger of things to come for coastal municipalities. Norfolk’s model proves a way forward for medium-sized coastal cities looking to turn coastal adaptation and resilience goals identified in a climate adaptation or comprehensive plan into zoning reality.

**NEW YORK CITY**

New York City—fresh off a multiyear post-Hurricane Sandy planning effort—has taken an approach similar to Norfolk, though on a decidedly larger scale. Given the diverse local building stock and its unique vulnerability to catastrophic coastal flooding and sea-level rise, the city’s efforts are wide ranging and comprehensive from a zoning and land-use perspective.

In “High and Dry on the Waterfront,” Schwab described New York’s initial post-Sandy flood zoning measures to ease the structural flood mitigations and ensure that these mitigations weren’t disruptive to the existing urban fabric. These measures largely mirrored Mandeville’s approach; that is, explicit zoning relief to permit elevation (or dry floodproofing) and design guidelines to screen and integrate newly elevated properties into the streetscape.

Soon after the publication of that article, the city engaged in a community-based, five-borough planning effort led by the Department of City Planning (DCP) to take these initial measures several steps further. The Resilient Neighborhoods Initiative, as it later came to be known, identified communities in all five boroughs that had been hit particularly hard by Hurricane Sandy. They would be subject to FEMA’s new Advisory

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**NORFOLK’S RESILIENT POINT SYSTEM FOR RESIDENTIAL DEVELOPMENT**

<table>
<thead>
<tr>
<th>Resilient Development Activity for Risk Reduction</th>
<th>Points Earned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct building to meet 110-mile wind-load design requirements of the Virginia Uniform Statewide Building Code</td>
<td>2.00</td>
</tr>
<tr>
<td>Elevate the ground-story finished floor and all significant electrical and mechanical equipment no less than three feet above highest adjacent grade</td>
<td>1.00 plus 0.50 per ft. above 3 ft.</td>
</tr>
<tr>
<td>Construct an impact-resistant (hail, tree damage) roof</td>
<td>0.50</td>
</tr>
<tr>
<td>Install impact- (hurricane or wind) resistant windows</td>
<td>0.50</td>
</tr>
<tr>
<td>Install operable storm shutters</td>
<td>0.50</td>
</tr>
<tr>
<td>Establish operating procedures for how the project will handle loss of off-site or grid power, transition to a backup source of power, and transition back to normal operation</td>
<td>0.50</td>
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</tbody>
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of the Resilient Neighborhoods Initiative, I worked as a community planner as part of the effort to understand the impacts of sea-level rise with limited adaptive capacity. This meant exposure to coastal inundation and potential impacts on tourism, recreation, and shipping. Consequently, this meant exposure to coastal inundation and sea-level rise with limited adaptive capacity.

The effort is notable in that many of the coastal communities impacted by Sandy bear a more than passing resemblance to other coastal communities throughout the nation. The East Shore of Staten Island, Gerritsen Beach, Howard Beach, Sheepshead Bay, and the Rockaways all feature smaller-scale single- and two-family residences (including a large proportion of historic beach bungalows), and neighborhood retail, much of it based on late-19th and early-20th century settlement and development patterns. These communities, much like other coastal communities nationwide, have significant historic connections with the water, particularly around tourism, recreation, and shipping. Consequently, this means exposure to coastal inundation and sea-level rise with limited adaptive capacity.

The East Shore of Staten Island, where I worked as a community planner as part of the Resilient Neighborhoods Initiative, is a convenient case study for wider zoning and land-use applicability. My former planning director would often remark that Staten Island is more like the rest of the country than the rest of New York City, a sentiment that rings particularly true on the topic of coastal flood adaptation. The East Shore was hit particularly hard by Sandy, with coastal inundation up to a mile inland, and thousands of significantly damaged or destroyed homes and businesses. These impacts transformed the community into something of a hub of federal, state, and local government activity, with federally sponsored seawall construction, state-sponsored property buyouts, and city reconstruction and elevation efforts all under way concurrently. In this environment, DCP sought to develop a series of locally calibrated zoning recommendations tailored to this post-Sandy environment.

Zoning for long-term retreat formed the core of these recommendations. Several neighborhoods along the East Shore that suffered near-total housing losses due to their proximity to the water and extremely low elevation had elected to participate in a large-scale federally funded (and state-administered) voluntary property buyout program following the storm. Although the program was notable for its high participation rate, it also led to some significant issues. Any property purchased by the state would need to remain as open space in perpetuity, but what would happen to those home owners who elected not to participate? What about vacant land in these buyout areas with development potential? What would the zoning permit property owners to build in an area that both the state and federal government consider too high risk for long-term development? How would the city supply services to a dwindling population? What would this patchwork of open space, new development, and property holdouts look like?

To begin answering these questions, DCP created the East Shore Special Coastal Risk District, a map and code revision specifically tailored to the boundaries of the local property buyout areas and with the intent of only permitting contextual development and incentivizing long-term coastal retreat (§137). Generally, the overlay applies more intense planning commission scrutiny to any future development, reduces permitted development from two-family and attached structures to only single-family detached, modifies existing bulk regulations to increase wetland buffers, and eases regulatory burdens on home elevation and rebuilding for those few home owners who choose to stay.

Lessons learned on Staten Island’s East Shore fed directly into New York’s work on their Citywide Flood Resilient Text Amendment, a measure meant to allow for and mitigate the impacts of flood-resilient construction. While the text amendment is not yet final, proposed changes are undergoing vetting through a comprehensive citywide public engagement process. Proposed changes from DCP include:

- Allowing property owners to reallocate lost floor area from the ground floor and sub-grade spaces elsewhere in the structure
- Reducing required side or rear yards relative to overall height to allow squatter and more proportional residential buildings
- Enacting new height limits where possible that are based on the new local Design Flood Elevation (one to two feet over the Base Flood Elevation) where side- and rear-yard relief is possible
- Permit relief from height limits, where possible, for developers and property owners who wish to go above the Design Flood Elevation
- Require design interventions to screen and mitigate elevation impacts on the local streetscape
Widespread damage and some areas with near total housing losses led many residents on the East Shore to lobby for property buyouts. Three neighborhoods, including the one pictured here, eventually participated in a federally funded program that purchased homes in predetermined areas at prestorm value.

• Make permanent, with modifications, the standards of temporary 2013 Flood Resilience Text Amendment

CONCLUSION
There are a few key takeaways from the three case studies here that may be helpful for other coastal municipalities:

Your zoning code can be used to enable local elevation and mitigate its impacts through design standards and bulk regulations. Design standards can help to encourage a continuity of local character and give developers and home owners a menu of potential options that can mitigate increased height, exposed piers and piles, and open spaces beneath the structure.

The zoning and building code can be used to add additional freeboard above the FEMA Base Flood Elevation to account for sea-level rise.

Scoring systems built into the site plan review process add predictability for developers and home owners.

Zoning overlays, like those used in Norfolk and New York City, can be complicated, but they are also versatile tools to designate and apply regulations to areas of special concern (high risk, long-term retreat, capable of accommodating future density, etc.).

Coastal municipalities are starting to take significant steps toward aligning their coastal flood adaptation goals with local implementation processes, and zoning remains one of the most powerful tools at their disposal in guiding the overall form of and general direction of development. The three cities included here demonstrate that even at a wide range of scales, zoning can greatly aid the goals of long-term flood resilience.

ABOUT THE AUTHOR
Joseph DeAngelis is a planner, researcher, and coeditor of Zoning Practice with the American Planning Association in Chicago. Previously, he was a resiliency planner for the New York City Department of City Planning, where he worked on long-term planning and zoning solutions for communities impacted by Hurricane Sandy.

RESOURCES


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DOES YOUR ZONING CODE ENCOURAGE FLOOD RESILIENCE?