

Floodplain Building Elevation Standards

Current Requirements & Enhancement Options for Connecticut Shoreline Municipalities

William R. Rath
Legal Research Fellow

Christopher P. Kelly
Legal Writing Fellow

Kristie A. Beahm
Legal Writing Fellow

May 1, 2018

This White Paper is sponsored by CIRCA, the Connecticut Institute for Resilience and Climate Adaptation. This work is made possible through a grant from the State of Connecticut Department of Housing Community Development Block Grant Disaster Recovery Program and the US Department of Housing and Urban Development.

DISCLAIMER: This white paper addresses issues of general interest and does not give any specific legal advice pertaining to any specific circumstance. Parties should obtain advice from a lawyer or other qualified professional before acting on the information in this paper.

Executive Summary.....	2
I. Introduction.....	2
II. Legal Authority.....	4
III. Elevation Requirements.....	5
A. Overview and Flood Zone Terminology	
B. FEMA NFIP Elevation Requirements	
C. Connecticut State Building Code Elevation Requirements for Residential Structures	
D. Connecticut State Building Code Elevation Requirements for Non-Residential Structures	
E. Connecticut Shoreline Municipality Elevation Requirements	
IV. Sea Level Rise Concerns	8
V. Enhancement Options	9
A. Increase Building Elevation Requirements	
B. Establish a “Coastal A” Zone	
C. Participate in the NFIP Community Rating System	
VI. Conclusion.....	11
Appendix A – Summary of Elevation and Flood-Proofing Requirements – FEMA, Connecticut State Building Codes, and Connecticut Shoreline Municipalities.....	12
Appendix B – FEMA Flood Zone Definitions	17
Endnotes.....	19

Executive Summary

Elevating buildings above flood levels is a common and effective way to minimize damage from floodwaters, and is a key flood protection provision of the National Flood Insurance Program (NFIP). All Connecticut municipalities participate in the NFIP, and all have enacted floodplain regulations that meet or exceed NFIP requirements. Furthermore, Connecticut municipalities must also comply with the floodplain building elevation requirements of the Connecticut State Building Code, which in some cases exceed the minimum requirements of the NFIP.

The elevation requirements of both the NFIP and the Connecticut State Building Code are based upon the “BFE shown on federal flood insurance rate maps. These maps are prepared by the Federal Emergency Management Agency and the BFEs identified on the maps are based upon historical floods. This is problematic because the National Oceanic and Atmospheric Administration estimates that global sea levels could rise from one to more than eight feet above current levels by the year 2100. Locally, the Connecticut Institute for Resilience and Climate Adaptation recommends planning for a Long Island Sound sea level rise of one foot, eight inches by 2050. Given these projections for future sea level rise, elevating buildings to a BFE that is based upon historical flood levels is unlikely to keep them above damaging floodwaters.

Fortunately, the elevation requirements of the NFIP and the Connecticut State Building Code are expressed as *minimum* elevations, so municipalities are free to specify higher and more protective elevation requirements for floodplain buildings. As described in this paper, municipalities have the legal authority to mandate elevation in excess of the NFIP and Connecticut State Building Code minimums, and the incremental cost of adding additional height to an existing elevation project is low. Therefore, even though the NFIP and the Connecticut State Building Code do not consider sea level rise when establishing building elevation requirements, it is well within the ability and authority of shoreline communities to account for the effect of rising seas when establishing elevation requirements for buildings located within their floodplains.

This paper describes the following actions within existing municipal authority that will help Connecticut shoreline communities accommodate the Long Island Sound sea level rise projected for 2050, assure compliance with the elevation requirements of the Connecticut State Building Code, and enhance community resilience to flood events:

- increase building elevation and flood-proofing requirements,
- establish “Coastal A” zones to allow for more protective standards in the portions of “A” zones that are subject to wave effects, velocity flows, and erosion, and
- participate in the NFIP Community Rating System to improve overall floodplain resilience and to take advantage of NFIP premium discounts of up to forty-five percent.

These relatively minor changes to local floodplain regulations can help Connecticut shoreline municipalities comply with the State Building Code while improving resilience by adapting to the rising seas.

I. Introduction

Coastal flooding represents a tremendous threat to Connecticut infrastructure. According to estimates by the Federal Emergency Management Administration (FEMA), a “100 year flood” in Connecticut’s four shoreline counties could cause property losses of more than \$13 billion.¹ To further exacerbate this threat, climate scientists estimate that by 2050 this “100 year flood” will revisit the Connecticut coast, on average, not once every 100 years, but once every twelve-and-a-half to twenty-five years.²

The National Flood Insurance Program (NFIP) offsets some of the risk faced by floodplain property owners by reducing the probability of flood damage and by providing financial compensation should flood damage occur.³ This program, administered by FEMA, makes federal flood insurance available to property owners in communities that impose a minimum standard of floodplain management regulation, generally imposed through zoning ordinances.⁴ These floodplain management ordinances must adopt the FEMA Flood Insurance Rate Map (FIRM), implement a permit system for floodplain development, specify construction standards to ensure development does not interfere with natural flood and drainage patterns, and adopt building codes to assure that new and substantially improved buildings are protected from flood damage.⁵ Every Connecticut municipality currently participates in the NFIP, and all have adopted at least the minimum floodplain management regulations required by the program.⁶

Among the building codes that must be adopted are requirements to elevate new and significantly improved structures above predicted floodwaters. Figure 1 identifies some of the key features of an elevated building, which start with a floodwater elevation called the *Base Flood Elevation* (BFE). BFE is the anticipated flood elevation that has a one percent chance of being equaled or exceeded any given year, and is sometimes called the "100 year flood."⁷ The *base flood depth* is the distance between the grade and the BFE, where *grade* is the ground level immediately adjacent to the building.⁸ The *building elevation* is the difference between the grade and the lowest floor of the building or, in areas subject to high velocity storm waves, the difference between the grade and the *lowest supporting horizontal structural member*. Finally, *freeboard* is any amount of building elevation above the BFE.⁹

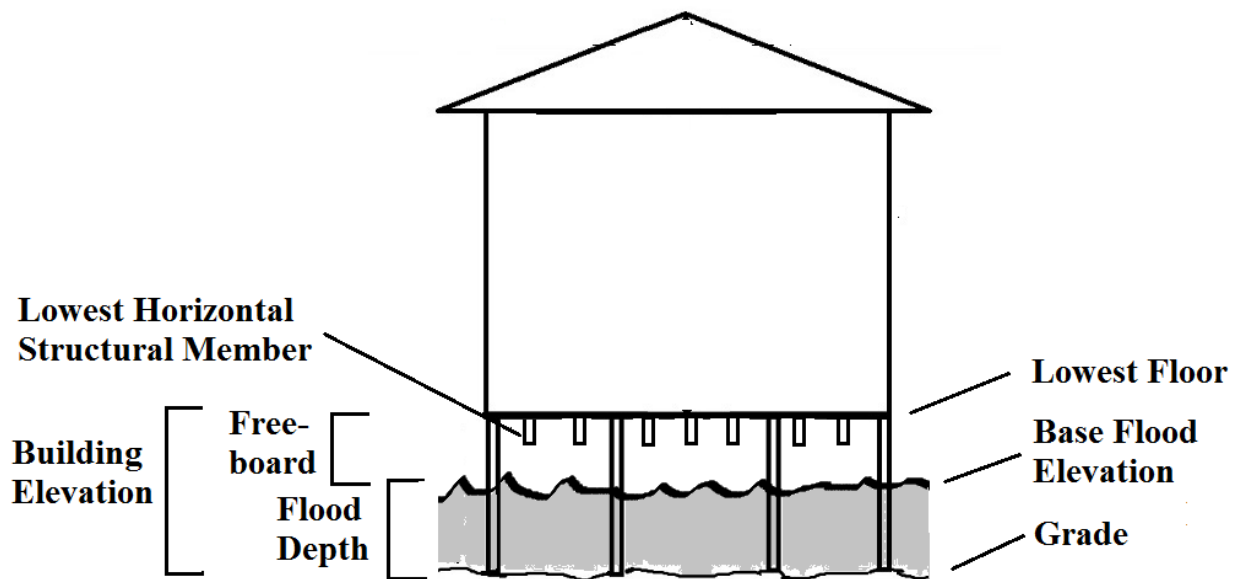


Figure 1 – Shoreline House Elevated on Pilings

The elevation requirements of the NFIP are relatively straightforward: habitable portions of new and substantially improved residential structures must be elevated to or above the BFE.¹⁰ Non-residential structures must also be elevated to BFE or, as an alternative, flood-proofed to BFE.¹¹ In coastal areas subject to high velocity storm waves, both residential and non-residential structures are further protected by a requirement to elevate not just the lowest floor, but also the lowest supporting horizontal structural member to or above BFE.¹² Because all Connecticut towns participate in the NFIP, all shoreline towns have ordinances that meet these minimum elevation requirements for new and substantially improved structures.

In addition to the federal requirements of the NFIP, the state also specifies elevation requirements for floodplain buildings through the Connecticut State Building Code, which is the mandatory building code for all Connecticut

cities, towns, and boroughs.¹³ These code requirements vary depending on the use of the building and the severity of flooding, but the elevation and flood-proofing requirements of the Connecticut State Building Code are higher than BFE for all categories of buildings except for residential buildings in flood zones not subject to high velocity storm waves.¹⁴ Interestingly, many shoreline communities still specify the less-restrictive NFIP elevation requirements in local floodplain management regulations, which may put them at odds with the minimum requirements of the state building code.¹⁵

It should be noted that both the NFIP and the Connecticut State Building Code identify *minimum* elevation requirements for new and substantially improved buildings in floodplains,¹⁶ and that significant and cost-effective additional protection can be achieved by adding freeboard above these minimum requirements.¹⁷ Studies indicate that adding freeboard at the time of initial construction is relatively inexpensive, with four feet of freeboard costing only about one to two percent more than the cost of elevating to BFE with a pile or masonry pier foundation.¹⁸ Furthermore, adding freeboard significantly reduces insurance premiums, and FEMA estimates that the cost of adding freeboard can be recovered through reduced insurance premiums in six years in A Zones and in three years or less in V zones.¹⁹ The significant benefits and low costs of adding freeboard are powerful incentives to increase municipal elevation requirements above the regulatory minimums.

This paper surveys the current floodplain building elevation requirements of Connecticut shoreline municipalities and identifies changes that can improve municipal flood resilience within the limitations of legal authorities. Section II starts this discussion with an evaluation of the legal authority that allows Connecticut municipalities to adopt floodplain management ordinances. Section III describes building elevation regulatory requirements and includes an explanation of the various types of flood zones that determine which of these requirements are invoked. Section IV identifies concerns related to sea level rise and Section V offers options that will allow Connecticut shoreline communities to accommodate sea level rise, assure compliance with the Connecticut State Building Code, and enhance the resilience of floodplain buildings. The conclusion in Section VI is followed by Appendix A, which identifies the elevation requirements of the NFIP, the current Connecticut State Building Code, the proposed 2018 Connecticut State Building Code, and Connecticut's twenty-four shoreline communities. Finally, Appendix B reproduces the FEMA definitions of the flood zones encompassed by the NFIP.

II. Legal Authority

The legal authority for communities to regulate land use through zoning ordinances is long and well established. The threshold case affirming this authority was in 1926, when the United States Supreme Court held that local land use zoning is a valid exercise of police power as long as the zoning ordinances are not “clearly arbitrary and unreasonable, having no substantial relation to the public health, safety, morals, or general welfare.”²⁰

In Connecticut, municipalities derive their zoning authority from the state through a general zoning enabling act passed in 1925 and revised and reenacted in 1949.²¹ These acts, now codified in Title 8 of the Connecticut General Statutes, empower municipalities to establish zoning commissions, designate zoning districts, and enact zoning ordinances that, “regulate the erection, construction, reconstruction, alteration or use of buildings or structures and the use of land.”²² In fact, section 8-2 of the Connecticut General Statutes specifically allows zoning ordinances that regulate to “secure safety from ... flood and other dangers.”²³ This statutory language gives Connecticut municipalities the explicit authority to specify construction standards for buildings erected in floodplains.

Communities that adopt zoning ordinances must also establish a zoning board of appeals that is empowered to review municipal zoning decisions and grant variances where special circumstances unique to a particular parcel of land would cause “exceptional difficulty or unusual hardship” if the zoning ordinances were enforced as written.²⁴

This variance process provides an important protection for land owners who, through no fault of their own, are confronted with unique circumstances that don't allow them to comply with certain provisions of local zoning ordinances.

The combination of explicit delegation of state authority and a guarantee of due process through the variance process provides a strong legal authority for municipal zoning ordinances that specify construction standards for buildings erected in floodplains. This authority is so strong, in fact, that it has never been challenged in the Connecticut Appellate or Supreme Courts.

III. Elevation Requirements

A. Overview and Flood Zone Terminology

The NFIP and the Connecticut State Building Code specify mandatory minimum elevation and flood-proofing requirements for all new and substantially improved buildings located in floodplains.²⁵ Non-mandatory consensus standards and FEMA guidelines recommend more protective elevation and flood-proofing levels that are above these mandatory minimums.²⁶ Connecticut municipalities are required to meet the mandatory requirements of the NFIP and Connecticut State Building Code, but because these requirements are minimums, municipalities are free to adopt more stringent standards for elevation and flood-proofing.²⁷

All of these elevation and flood-proofing standards, irrespective of the source, specify different protective requirements for different types of flood hazards. These different types of flood hazards are conveniently identified as different categories of “flood zones” on a FEMA Flood Insurance Rate Map, or FIRM.²⁸ A copy of the FEMA definitions for the various types of flood zones identified on a FIRM is provided in Appendix B of this paper.

Flood zones on the FIRMs for Connecticut shoreline municipalities are categorized as “Special Flood Hazard Areas,” “Coastal High Hazard Areas,” or “Other Flood Areas.” Special Flood Hazard Areas are areas with a one percent annual chance flood (“100 year flood zones”),²⁹ and are designated as zones AE and AO on FIRMs.³⁰ Coastal High Hazard Areas are Special Flood Hazard Areas along an open coast that are subject to high velocity wave action from storms,³¹ and are designated as zone VE on FIRMs.³² Other Flood Areas, also known as “Areas of Moderate Flood Hazards,” are areas with a 0.2 percent annual chance flood (“500 year flood zones”),³³ and are designated zone X on FIRMs.³⁴

The flood elevation in Special Flood Hazard Areas is called the “Base Flood Elevation” or, as noted earlier, “BFE.”³⁵ This BFE is indicated on the FIRMs for AE and VE zones.³⁶

In addition to the flood zones described above, NFIP communities may wish to adopt a “Coastal A” zone to provide greater protection for AE Zone structures that are subject to additional damage by wave action. If adopted, a Coastal A zone is the area on a FIRM that lies between the landward edge of the VE zone and an advisory line on the FIRM that indicates the limit of the predicted 1.5 foot wave height during the base flood.³⁷

The remainder of this section describes the elevation requirements specified for these flood zones by FEMA under the NFIP, the Connecticut State Building Code, and Connecticut Shoreline Municipalities.

B. FEMA NFIP Elevation Requirements

The FEMA standards for floodplain building elevation and flood-proofing requirements are set forth in Title 44 of the Code of Federal Regulations. In AO zones, where BFEs are not specified, these regulations require the lowest floor of new and substantially improved residential structures to be elevated at least as high as the shallow flood depth shown on the FIRM or, if no flood depth is specified, at least two feet above the highest adjacent grade.³⁸ The lowest floors of non-residential structures in AO zones have the same elevation requirements, or, as an alternative to elevation, the lowest floors of non-residential structures may be flood-proofed to the same levels specified for elevation.³⁹

In AE zones, the FEMA standards require the lowest floor of new and substantially improved residential structures must be elevated to or above the BFE.⁴⁰ The lowest floors of non-residential structures in AE zones are also required to be elevated to or above the BFE, or alternatively, flood-proofed to or above the BFE.⁴¹

In coastal high-hazard VE Zones, the same FEMA requirements apply to all structures, both residential and non-residential. In these zones, the lowest supporting horizontal structural member of the lowest floor must be elevated to or above the BFE.⁴²

It should be noted that the mandatory elevation requirements set forth in Title 44 of the Code of Federal Regulations are regulatory minimums, and that FEMA encourages elevating buildings above these minimums. For example, the FEMA “Home Builder’s Guide to Coastal Construction” recommends elevating new and substantially improved residential buildings to achieve three feet of freeboard above the freeboard specified in American Society of Civil Engineers standard ASCE 24-14, “Flood Resistant Design and Construction.”⁴³ Implementing this recommendation will result in four feet of freeboard above BFE for most residential buildings.

C. Connecticut State Building Code Elevation Requirements for Residential Structures

The current Connecticut State Building Code, adopted in 2016, invokes the 2012 International Residential Code (IRC) for residential structures, which includes one- and two-family detached structures and townhouses.⁴⁴ The IRC elevation standards are based upon a “Design Flood Elevation” (DFE) that is equivalent to either the BFE or a higher elevation designated on a community’s flood hazard map.⁴⁵ The DFE concept recognizes that flood-prone communities may want to enhance protection against floods by adopting flood elevations that exceed the BFE published on FIRMs.

In AO zones, the 2012 IRC requires the lowest floor of new and substantially improved residential structures to be elevated at least as high as the shallow flood depth shown on the FIRM, or if no flood depth is specified, at least two feet above the highest adjacent grade.⁴⁶ In AE zones, the lowest floor must be elevated to or above the DFE,⁴⁷ and in Coastal A Zones the lowest floor must be elevated to or above the DFE, or to the BFE plus one foot, whichever is higher.⁴⁸ In VE Zones, the lowest structural member of a residential structure must be elevated to or above the DFE if the member is parallel to the direction of wave approach, or if the member is perpendicular to the direction of wave approach, to or above the DFE or the BFE plus one foot, whichever is higher.⁴⁹

The proposed 2018 Connecticut State Building Code invokes the 2015 revision of the IRC,⁵⁰ which increases the elevation requirements for AE, Coastal A, and VE zones above those specified by the 2016 Connecticut State Building Code.⁵¹ The elevation requirements for AO Zones remain unchanged, but in AE zones the 2015 IRC requires the lowest floor of new and substantially improved residential structures to be elevated to or above the DFE, or to or above the BFE plus one foot, whichever is higher.⁵² In this revision of the IRC, the elevation specifications for residential structures in Coastal A zones are now the same as for residential structures in VE zones, and the

lowest supporting horizontal structural member in both zones must be elevated or above DFE, or BFE plus one foot, whichever is higher.⁵³

D. Connecticut State Building Code Elevation Requirements for Non-Residential Structures

The current 2016 Connecticut State Building Code adopts the 2012 International Building Code (IBC) for all structures other than one- and two-family dwellings and townhouses.⁵⁴ For buildings and structures located in floodplains, the 2012 IBC invokes American Society of Civil Engineers standard ASCE 24-05, “Flood Resistant Design and Construction.”⁵⁵ Included among the standards in ASCE 24-05 are elevation requirements for buildings and structures located in floodplains.

ASCE 24-05 identifies four different “Flood Design Classes” based upon the use and occupancy of buildings in flood hazard areas.⁵⁶ The information provided here for “Non-Residential Structures” is for “Flood Design Class 2” buildings, which represent the majority of non-residential buildings in flood hazard areas. Importantly, ASCE 24-05 specifies more stringent requirements for buildings and structures that pose a high risk to the public and for essential facilities necessary for emergency response and recovery. Refer to ASCE 24-05 for elevation requirements for those facilities.

ASCE 24-05 requires the lowest floor of most non-residential buildings in AE zones to be elevated to the DFE, or to the BFE plus one foot, whichever is higher.⁵⁷ Alternatively, such buildings have the option of flood-proofing to either the DFE, or to the BFE plus one foot, whichever is higher.⁵⁸ In high-velocity Coastal A and VE Zones, these non-residential structures are required to elevate the bottom of the lowest supporting horizontal structural member to or above the DFE if the member is parallel to the direction of wave approach, or if the member is perpendicular to the direction of wave approach, to or above the DFE or the BFE plus one foot, whichever is higher.⁵⁹ Flood-proofing in lieu of elevation is not an option for non-residential structures in Coastal A or VE zones.⁶⁰

The proposed 2018 Connecticut State Building Code invokes the 2015 revision of the IBC,⁶¹ which in turn invokes ASCE 24-14, an updated version of ASCE 24-05.⁶² The non-residential building elevation and flood-proofing requirements invoked by ASCE 24-14 are similar to those invoked by ASCE 24-05 except that the Coastal A and VE zone elevation requirements are not dependent upon the orientation of the lowest supporting horizontal structural member. Under ASCE 24-14, and by extension the proposed 2018 Connecticut State Building Code, the lowest supporting horizontal structural member of non-residential buildings and structures in Coastal A and VE zones must be elevated to the DFE or to BFE plus one foot, whichever is higher, irrespective of the wave orientation of that member.⁶³

E. Connecticut Shoreline Municipality Elevation Requirements

All Connecticut shoreline municipalities participate in the NFIP,⁶⁴ so by necessity each of those municipalities has floodplain building ordinances that meet the minimum NFIP elevation requirements. However, not all communities have updated their building elevation ordinances to remain current with changes in the Connecticut State Building Code. As a result, many shoreline communities specify NFIP elevation requirements in local floodplain management ordinances that do not meet the minimum requirements of the Connecticut State Building Code.⁶⁵

Appendix A to this paper summarizes the elevation and flood-proofing requirements of the NFIP, the 2016 Connecticut State Building Code, the proposed 2018 Connecticut State Building Code, and Connecticut shoreline municipalities. Of the twenty-four shoreline municipalities shown on this summary, eleven have floodplain

ordinances that meet or exceed the elevation standards of both the NFIP and the Connecticut State Building Code and thirteen have floodplain management ordinances that meet NFIP requirements but are less restrictive than the current requirements of the Connecticut State Building Code.

Most of the discrepancies between local ordinances and the Connecticut State Building Code are related to elevation and flood-proofing requirements for non-residential structures as specified in ASCE 24-05. The requirements of ASCE 24-05 are more stringent than the older FEMA NFIP standards, and apply to buildings in Connecticut floodplains because the current 2016 Connecticut State Building Code invokes the 2012 IBC, which in turn invokes ASCE 24-05.⁶⁶ Therefore, municipalities that have not updated their elevation requirements for non-residential buildings to the specifications of ASCE 24-05 have elevation requirements that are less stringent than those specified by the current Connecticut State Building Code.

The other point of discrepancy between local floodplain management ordinances and the Connecticut State Building Code is the elevation requirement for residential buildings in high velocity VE zones. The Connecticut State Building Code invokes the requirements of the 2012 IRC,⁶⁷ which requires the lowest supporting horizontal structural member to be elevated to the DFE if the member is parallel to the direction of wave approach, or to the BFE plus one foot or the DFE (whichever is higher) if the member is perpendicular to the direction of wave approach.⁶⁸ This elevation requirement is more stringent than the requirement of the FEMA NFIP, which calls for the lowest supporting horizontal structural member to be elevated to BFE irrespective of the direction of wave approach.⁶⁹

IV. Sea Level Rise Concerns

The BFEs identified on FEMA FIRMs are based upon the flood levels associated with a historical “100 year flood.”⁷⁰ These historical flood levels are a good starting point for flood planning, but there is scientific consensus that sea levels are rising above these historic levels. Tide gauge records indicate an average global sea level rise of 190 millimeters, or about seven-and-a-half inches, between 1901 and 2010.⁷¹ Recent measurements with more sophisticated instruments indicate an average rise of 3.2 millimeters a year between 1993 and 2010, which is nearly twice the average annual rise of the entire period between 1901 and 2010.⁷² Simply extrapolating this 3.2 millimeters per year out to 2100 indicates a sea level rise of another 262 millimeters - more than ten inches. When the latest climate science is factored in, the National Oceanic and Atmospheric Administration (NOAA) estimates that global sea levels could rise from 0.3 to 2.5 meters by 2100 – a rise from one to more than eight feet above current levels.⁷³ Locally, the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) recommends planning for a Long Island Sound sea level rise of 0.5 meters – twenty inches - by 2050.⁷⁴ Given these predictions for future sea level rise, it is reasonable to expect that elevating buildings to historical flood levels is unlikely to keep them above damaging floodwaters in the future.

The local conditions of Long Island Sound also argue against using historical data as the sole basis for determining floodplain building elevation requirements. As noted above, studies by CIRCA indicate a 0.5 meter sea level rise in Long Island Sound by the year 2050.⁷⁵ These studies also indicate that this rise in sea level will increase the return rate of the “100 year flood” levels experienced by shoreline municipalities and, because of the geography and geometry of the Sound and the adjacent Connecticut shoreline, disproportionately affect municipalities depending upon their location east to west.⁷⁶ As shown in Figure 2, a 0.5 meter increase in sea level could result in a fourfold increase in flooding to the current “100 year flood” level in western sound communities, and an eightfold increase in floods to this level in eastern sound communities. These data suggest that flooding to the current BFEs, which are based upon the historical “100 year flood,” will be revisited, on average, somewhere between once every twenty-

five years to once every twelve-and-a-half years, depending upon where the community is located on Long Island Sound.

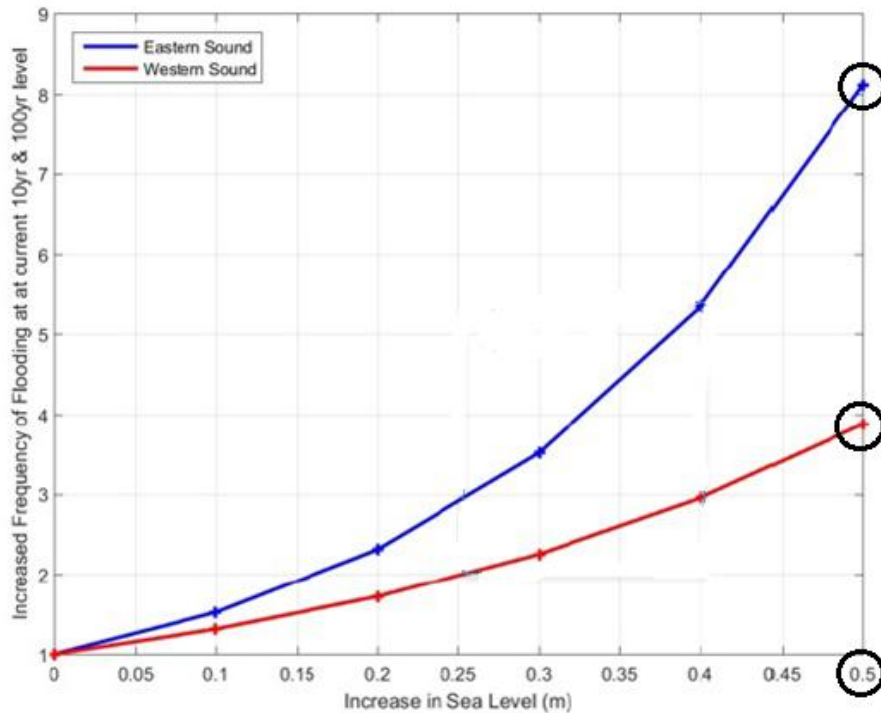


Figure 2 – Increase Flood Frequency with Long Island Sound Sea Level Rise⁷⁷

Given the projected sea level rise in Long Island Sound and the increased frequency of flooding to the current “100 year” levels, it is reasonable to expect that elevating buildings to the current BFE will not provide adequate protection against likely future conditions

V. Enhancement Options

As described earlier in this paper, it is well within the legal authority of Connecticut municipalities to enact zoning ordinances that “secure safety from . . . flood and other dangers.”⁷⁸ This paper describes the following municipal actions within that authority that can help Connecticut shoreline communities accommodate the Long Island Sound sea level rise projected for 2050, assure compliance with the elevation requirements of the Connecticut State Building Code, and enhance community resilience to flood events:

- increase building elevation requirements,
- establish a “Coastal A” zone, and
- participate in the NFIP community rating system.

These actions are further described below.

A. Increase Building Elevation Requirements

Elevating buildings above flood levels is an effective means of minimizing damage from floodwaters,⁷⁹ and FEMA regulations specify minimum elevation requirements for new and substantially improved buildings in communities that participate the NFIP.⁸⁰ FEMA recognizes, however, the limitations of these regulatory requirements and recommends elevating buildings above the NFIP minimums.⁸¹ This paper offers three options for municipal actions to increase floodplain building elevation requirements above NFIP minimums: (1) Adopt the minimum elevation standards specified in the Connecticut State Building Code, (2) consider adopting the elevation standards specified in ASCE 24-14, and (3) consider adding at least two feet of freeboard above the FIRM BFE.

1. Adopt the Minimum Elevation Requirements of the Connecticut State Building Code

The Connecticut State Building Code is the mandatory building code for all Connecticut towns, cities, and boroughs.⁸² Municipalities that have floodplain ordinances that do not meet current Connecticut State Building Code elevation requirements should consider revising those ordinances to comply with the requirements of the state code.

2. Consider Adopting the Elevation Standards Specified in ASCE 24-14

ASCE 24-14 is a consensus standard for “Flood Resistant Design and Construction” adopted by the American Society of Civil Engineers. This standard, which is revised at least once every five years, is a compilation of recognized engineering principles and is developed and adopted in accordance with a consensus standard process that has been accredited by the American National Standards Institute.⁸³ The flood protection requirements of ASCE 24-14 exceed the NFIP minimums and meet or exceed the minimum requirements of the Connecticut State Building Code. Municipalities should consider adopting the elevation and other requirements ASCE 24-14 because FEMA deems ASCE 24-14 to meet or exceed the minimum National Flood Insurance Program (NFIP) requirements for buildings and structures and notes that, “Buildings and structures designed according to ASCE 24 are better able to resist flood loads and flood damage.”⁸⁴ The Connecticut shoreline towns of Clinton, Old Saybrook, and Waterford have already imposed elevation standards for new or substantially improved structures that meet the requirements of ASCE 24-14 for most floodplain buildings.⁸⁵

3. Consider Adding at Least Two Feet of Freeboard Above the FIRM Base Flood Elevation

As noted in Section IV of this paper, FEMA building elevation requirements are based upon the flood levels associated with the historical “100 year flood,” and those flood levels do not account for future conditions such as sea level rise.⁸⁶ Given that studies by the Connecticut Institute for Resilience and Climate Adaptation indicate a Long Island Sound sea level rise of twenty inches (0.5 meters) by the year 2050,⁸⁷ municipalities should consider adopting a freeboard requirement of at least two feet above the current FIRM BFE for residential structures with a service life of at least thirty years and even greater freeboard requirements for infrastructure facilities with longer anticipated service lives. The viability of such a freeboard requirement is demonstrated by the Connecticut shoreline city of New London, which has already adopted two feet of freeboard above the current BFE as the elevation standard for all new or substantially improved structures in flood hazard areas.

B. Establish a “Coastal A” Zone

Coastal A Zones encompass the area on FIRMs between the landward side of V or VE Zones and a further landward line denoting the “limit of moderate wave action.”⁸⁸ Coastal A Zones are not marked on FIRMs because they are not a separate insurance zone under the NFIP,⁸⁹ but FEMA encourages communities to identify Coastal A Zones and regulate them in the same manner as V and VE Zones.⁹⁰ This is because ordinary A Zone construction standards do

not provide adequate protection in areas that are subject to the wave effects, velocity flows, and erosion conditions that are typical of Coastal A zones.⁹¹ Furthermore, the international codes invoked by the 2016 Connecticut State Building Code require the establishment of a Coastal A Zones and set forth elevation and other requirements for new and substantially improved building and structures within Coastal A Zones.⁹² Shoreline communities that have not already done so should therefore consider establishing Coastal A zones to improve the resilience of A Zone buildings subject wave effects, velocity flows, and erosion and to support compliance with the requirements of the Connecticut State Building Code. Coastal A zones are already in place in the Connecticut shoreline communities of Clinton, Groton, Old Saybrook, Waterford, and Westbrook.

C. Participate in the NFIP Community Rating System

The Community Rating System (CRS) is a program designed to encourage communities to implement floodplain management and loss control activities that go beyond the minimum requirements of the NFIP.⁹³ Communities can earn flood insurance discounts of up to forty-five percent by accumulating “credits” for activities that improve floodplain mapping, tighten regulatory requirements, enhance public information activities, reduce flood damage, and improve flood preparedness.⁹⁴ Freeboard requirements alone can achieve a five percent discount on flood insurance,⁹⁵ so any community considering increasing floodplain elevation requirements above the BFE should consider the financial benefits of participating in the Community Rating System. The Connecticut shoreline communities of East Haven, East Lyme, Fairfield, Milford, Norwalk, Stamford, Stonington, Westbrook, and Westport currently participate in the Community Rating System.⁹⁶

VI. Conclusion

Connecticut shoreline communities have adopted floodplain building elevation standards as a condition of participation in the NFIP. All of these communities meet the minimum elevation requirements of the program, but those minimums are unlikely to provide adequate protection in the face of rising seas and increasing flood return rates. Communities that increase floodplain building elevation standards beyond the minimums, adopt Coastal A Zones, and participate in the Community Rating System will be better prepared for a more resilient future.

APPENDIX A

MINIMUM ELEVATION AND FLOOD PROOFING REQUIREMENTS (For New and Substantially Improved Construction as of September 1, 2017)

AUTHORITY	ZONE	RESIDENTIAL STRUCTURES	NON-RESIDENTIAL STRUCTURES	CODE, ORDINANCE, OR REGULATION
NFIP / FEMA	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE	44 CFR 60.3.c.2. c.3
	V / VE	Lowest Horizontal Structural Member Elevated to BFE	Lowest Horizontal Structural Member Elevated to BFE	44 CFR 60.3.e.4
2016 Connecticut State Building Code (IRC 2012) (IBC 2012) (See Footnote ⁹⁷)	A / AE	Lowest Floor Elevated to DFE	Lowest Floor Elevated to BFE + 1' or DFE (Whichever is Higher) OR Flood-proofed to BFE + 1' or DFE (Whichever is Higher)	
	Coastal A / AE	Lowest Floor Elevated to BFE + 1' or DFE (Whichever is Higher)	Lowest Horizontal Structural Member Elevated to: <ul style="list-style-type: none"> • DFE if Parallel to Wave Approach OR • BFE + 1' or DFE, Whichever is Higher, if Perpendicular to Wave Approach 	
	V / VE	Lowest Horizontal Structural Member Elevated to: <ul style="list-style-type: none"> • DFE if Parallel to Wave Approach OR • BFE + 1' or DFE (Whichever is Higher) if Perpendicular to Wave Approach 	Lowest Horizontal Structural Member Elevated to: <ul style="list-style-type: none"> • DFE if Parallel to Wave Approach OR • BFE + 1' or DFE (Whichever is Higher) if Perpendicular to Wave Approach 	
Proposed 2018 Connecticut State Building Code (IRC 2015) (IBC 2015) (See Footnote ⁹⁸)	A / AE	Lowest Floor Elevated to BFE + 1', or DFE	Lowest Floor Elevated to BFE + 1' or DFE (Whichever is Higher) OR Flood-proofed to BFE + 1' or DFE (Whichever is Higher)	
	Coastal A / AE	Lowest Supporting Horizontal Structural Member Elevated to BFE + 1', or DFE, Whichever is Higher	Lowest Supporting Horizontal Structural Member Elevated to BFE + 1' or DFE (Whichever is Higher)	
	V / VE	Lowest Supporting Horizontal Structural Member Elevated to BFE + 1', or DFE, Whichever is Higher	Lowest Supporting Horizontal Structural Member Elevated to BFE + 1' or DFE (Whichever is Higher)	
Branford	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Branford Code of Ordinances 161-18
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Horizontal Structural Member Elevated to BFE + 1'	Lowest Supporting Horizontal Structural Member Elevated to BFE + 1'	Branford Code of Ordinances 161-19
Bridgeport	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE + 1'	Bridgeport Code of Ordinances 15.44.150.B.1, B.3
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Member Elevated to BFE	Lowest Supporting Member Elevated to BFE	Bridgeport Code of Ordinances 15.44.150.C.2

APPENDIX A

MINIMUM ELEVATION AND FLOOD PROOFING REQUIREMENTS (For New and Substantially Improved Construction as of September 1, 2017)

AUTHORITY	ZONE	RESIDENTIAL STRUCTURES	NON-RESIDENTIAL STRUCTURES	CODE, ORDINANCE, OR REGULATION
Clinton	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Clinton Zoning Regulations 17.6
	Coastal A / AE	Lowest Supporting Member to BFE + 1'	Lowest Supporting Member to BFE + 1'	Clinton Zoning Regulations 17.8, 17.9
	V / VE	Lowest Supporting Member Elevated to BFE + 1'	Lowest Supporting Member Elevated to BFE + 1'	Clinton Zoning Regulations 17.8
Darien	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE	Darien Zoning Regulations 825.d.6, 825.d.7
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Structural Member Elevated to BFE + 1'	Lowest Structural Member Elevated to BFE + 1'	Darien Zoning Regulations 825.f.2
East Haven	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE + 1'	East Haven Ordinances 9-78(a)
	Coastal A / AE	No specific standards for Coastal A / AE	No specific standards for Coastal A / AE	
	V / VE	Lowest Horizontal Structural Member Elevated to BFE	Lowest Horizontal Structural Member Elevated to BFE	East Haven Ordinances 9-78(b)
East Lyme	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE	East Lyme Zoning Regulations 15.5.2
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Horizontal Structural Member Elevated to BFE	Lowest Horizontal Structural Member Elevated to BFE	East Lyme Zoning Regulations 15.5.3
Fairfield	A			
	AE	Lowest Floor Elevated to BFE (See Footnote ⁹⁹)	Lowest Floor Elevated to BFE OR Flood-proofed to BFE + 1'	Fairfield Zoning Regulations 32.3
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Structural Member Elevated to BFE	Lowest Structural Member Elevated to BFE	Fairfield Zoning Regulations 32.5
Greenwich	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Greenwich Municipal Code §6-139.1.f.11
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Greenwich Municipal Code §6-139.1.f.12

APPENDIX A

MINIMUM ELEVATION AND FLOOD PROOFING REQUIREMENTS (For New and Substantially Improved Construction as of September 1, 2017)

AUTHORITY	ZONE	RESIDENTIAL STRUCTURES	NON-RESIDENTIAL STRUCTURES	CODE, ORDINANCE, OR REGULATION
Groton	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE	Groton Zoning Regulations 6.6-4
	Coastal A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE OR Flood-proofed to BFE	Groton Zoning Regulations 6.6-5
	V / VE	Lowest Floor's Structural Members Elevated to BFE + 1'	Lowest Floor's Structural Members Elevated to BFE + 1'	Groton Zoning Regulations 6.6-7
Guilford	A / AE	Lowest Floor Elevated Above BFE	Lowest Floor Elevated Above BFE OR Flood-proofed Above BFE	Guilford Ordinances 174-18
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Horizontal Member Elevated to BFE	Lowest Supporting Horizontal Member Elevated to BFE	Guilford Ordinances 174-19
Madison	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE	Madison Floodplain Management Ordinances 9-33
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Horizontal Member Elevated to BFE	Lowest Supporting Horizontal Member Elevated to BFE	Madison Floodplain Management Ordinances 9-34
Milford	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE	Milford Zoning Regulations 5.8.13
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Member Elevated to BFE	Lowest Supporting Member Elevated to BFE	Milford Zoning Regulations 5.8.14
New Haven	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	New Haven Flood Damage Prevention Ordinances 5.3.1
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Structural Horizontal Member Elevated to BFE + 1'	Lowest Structural Horizontal Member Elevated to BFE + 1'	New Haven Flood Damage Prevention Ordinances 5.3.4
New London	A / AE	Lowest Floor Elevated to BFE + 2'	Lowest Floor Elevated to BFE + 2' OR Flood-proofed to BFE + 1'	New London Zoning Regulations 830.D.4, D.5
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Member Elevated to BFE + 2'	Lowest Supporting Member Elevated to BFE + 2'	New London Zoning Regulations 830.E.2

APPENDIX A

MINIMUM ELEVATION AND FLOOD PROOFING REQUIREMENTS (For New and Substantially Improved Construction as of September 1, 2017)

AUTHORITY	ZONE	RESIDENTIAL STRUCTURES	NON-RESIDENTIAL STRUCTURES	CODE, ORDINANCE, OR REGULATION
Norwalk	A			
	AE (See Foot-note ¹⁰⁰)	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Norwalk Zoning Regulations Article 110.C.4, 5
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Horizontal Structural Member Elevated to BFE + 1'	Lowest Horizontal Structural Member Elevated to BFE + 1'	Norwalk Zoning Regulations Article 110.C.6
Old Lyme	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Old Lyme Zoning Regulations 4.4.6.4
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Horizontal Supporting Member Elevated to BFE + 1'	Lowest Horizontal Supporting Member Elevated to BFE + 1'	Old Lyme Zoning Regulations 4.4.6.5
Old Saybrook	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Old Saybrook Ordinances 128-20
	Coastal A / AE	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Old Saybrook Ordinances 128-20
	V / VE	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Old Saybrook Ordinances 128-20
Stamford	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Stamford Zoning Regulations 7.1.D.1
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Horizontal Member Elevated Above BFE + 1'	Lowest Supporting Horizontal Member Elevated Above BFE + 1'	Stamford Zoning Regulations 7.1.D.3
Stonington	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Stonington Zoning Regulations 7.7.8.2
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Stonington Zoning Regulations 7.7.8.3
Stratford	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE	Stratford Ordinances 102-18
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Horizontal Supporting Member Elevated to BFE + 1'	Lowest Horizontal Supporting Member Elevated to BFE + 1'	Stratford Ordinances 102-19

APPENDIX A

MINIMUM ELEVATION AND FLOOD PROOFING REQUIREMENTS (For New and Substantially Improved Construction as of September 1, 2017)

AUTHORITY	ZONE	RESIDENTIAL STRUCTURES	NON-RESIDENTIAL STRUCTURES	CODE, ORDINANCE, OR REGULATION
Waterford	A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Waterford Zoning Regulations 25.3.5.D
	Coastal A / AE	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Waterford Zoning Regulations 25.3.5.G
	V / VE	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Lowest Supporting Horizontal Member Elevated to BFE + 1'	Waterford Zoning Regulations 25.3.5.G
West Haven	A / AE	Lowest Floor Elevated to BFE	Lowest Floor Elevated Above BFE OR Flood-proofed to BFE	West Haven Zoning Regulations 70.15
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Supporting Horizontal Member Elevated to BFE	Lowest Supporting Horizontal Member Elevated to BFE	West Haven Zoning Regulations 70.16
Westbrook	A / AE	Lowest Floor Elevated Above BFE	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Westbrook Zoning Regulations 5.16.01
	Coastal A / AE	Lowest Floor Elevated to BFE + 1'	Lowest Floor Elevated to BFE + 1' OR Flood-proofed to BFE + 1'	Westbrook Zoning Regulations 5.16.01
	V / VE	Lowest Horizontal Structural Member to BFE + 1'	Lowest Horizontal Structural Member to BFE + 1'	Westbrook Zoning Regulations 5.17.02
Westport	A			
	AE (See Foot-note ¹⁰¹)	Lowest Floor Elevated to BFE	Lowest Floor Elevated to BFE OR Flood-proofed to BFE	Westport Zoning Regulations 31-11.3.3, 11.3.4
	Coastal A / AE	No Specific Standards for Coastal A / AE	No Specific Standards for Coastal A / AE	
	V / VE	Lowest Horizontal Structural Member Elevated to BFE	Lowest Horizontal Structural Member Elevated to BFE	Westport Zoning Regulations 31-11.3.5

Municipal Participation in Community Rating System (October 2016) (Shoreline Towns Only)¹⁰²

Municipality	CRS Class	Flood Ins. Discount (%)	Municipality	CRS Class	Flood Ins. Discount (%)
East Haven	10	0	Stamford	7	15
East Lyme	8	10	Stonington	10	0
Fairfield	8	10	Westbrook	10	0
Milford	9	5	Westport	8	10

Appendix B

FEMA FLOOD ZONE DEFINITIONS

Definitions of FEMA Flood Zone Designations

Flood zones are geographic areas that the FEMA has defined according to varying levels of flood risk. These zones are depicted on a community's Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map. Each zone reflects the severity or type of flooding in the area.

Moderate to Low Risk Areas

In communities that participate in the NFIP, flood insurance is available to all property owners and renters in these zones:

ZONE	DESCRIPTION
B and X (shaded)	Area of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.
C and X (unshaded)	Area of minimal flood hazard, usually depicted on FIRMs as above the 500-year flood level. Zone C may have ponding and local drainage problems that don't warrant a detailed study or designation as base floodplain. Zone X is the area determined to be outside the 500-year flood and protected by levee from 100-year flood.

High Risk Areas

In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all of these zones:

ZONE	DESCRIPTION
A	Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
AE	The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
A1-30	These are known as numbered A Zones (e.g., A7 or A14). This is the base floodplain where the FIRM shows a BFE (old format).
AH	Areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
AO	River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam). Mandatory flood insurance purchase requirements will apply, but rates will not exceed the rates for unnumbered A zones if the structure is built or restored in compliance with Zone AR floodplain management regulations.
A99	Areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.

Appendix B

FEMA FLOOD ZONE DEFINITIONS

High Risk - Coastal Areas

In communities that participate in the NFIP, mandatory flood insurance purchase requirements apply to all of these zones.

ZONE	DESCRIPTION
V	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. No base flood elevations are shown within these zones.
VE, V1 - 30	Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.

Undetermined Risk Areas

ZONE	DESCRIPTION
D	Areas with possible but undetermined flood hazards. No flood hazard analysis has been conducted. Flood insurance rates are commensurate with the uncertainty of the flood risk.

From FEMA Map Service Center:

<http://msc.fema.gov/webapp/wcs/stores/servlet/info?storeId=10001&catalogId=10001&langId=-1&content=floodZones&title=FEMA%20Flood%20Zone%20Designations>

Endnotes

This White Paper is sponsored by CIRCA, the Connecticut Institute for Resilience and Climate Adaptation. This work is made possible through a grant from the State of Connecticut Department of Housing Community Development Block Grant Disaster Recovery Program and the US Department of Housing and Urban Development.

DISCLAIMER: *This white paper addresses issues of general interest and does not give any specific legal advice pertaining to any specific circumstance. Parties should obtain advice from a lawyer or other qualified professional before acting on the information in this paper.*

¹ ADAPTATION SUBCOMM. TO THE GOVERNOR'S STEERING COMM. ON CLIMATE CHANGE, THE IMPACTS OF CLIMATE CHANGE ON CONNECTICUT AGRICULTURE, INFRASTRUCTURE, NATURAL RESOURCES AND PUBLIC HEALTH 88 (2010).

² James O'Donnell, Ph.D., Exec. Dir., Conn. Inst. for Resilience & Climate Adaptation, Presentation at the Connecticut Department of Energy and Environmental Protection (April 12, 2017) [hereinafter *O'Donnell DEEP Presentation*].

³ *National Flood Insurance Program*, DEP'T OF ENERGY & ENVTL. PROT., [hereinafter *DEEP-NFIP*], <http://www.ct.gov/deep/cwp/view.asp?Q=446992> (last visited June 1, 2017).

⁴ *Id.*

⁵ 44 C.F.R. § 60.3 (2017).

⁶ *DEEP-NFIP*, *supra* note 3.

⁷ *Designing for Flood Levels Above the BFE*, FED. EMERGENCY MGMT. AGENCY 1 (2010), https://www.fema.gov/media-library-data/20130726-1537-20490-8057/fema499_1_6_rev.pdf.

⁸ *Definitions*, FED. EMERGENCY MGMT. AGENCY, <https://www.fema.gov/national-flood-insurance-program/definitions> (last visited June 8, 2017).

⁹ *Id.*

¹⁰ 44 C.F.R. § 60.3 (2017).

¹¹ *Id.*

¹² *Id.*

¹³ CONN. GEN. STAT. § 29-253 (2017).

¹⁴ CONN. DEP'T OF ADMIN. SERV., CONN. STATE BLDG. CODE (2016).

¹⁵ *See infra* Appendix A.

¹⁶ CONN. DEP'T OF ADMIN. SERV., CONN. STATE BLDG. CODE (2016); 44 C.F.R. § 60.3 (2017).

¹⁷ FED. EMERGENCY MGMT. AGENCY, FACT SHEET, BUILDING HIGHER IN FLOOD ZONES: FREEBOARD – REDUCE YOUR RISK, REDUCE YOUR PREMIUM 2 (2014).

¹⁸ CHRISTOPHER P. JONES, ET. AL., FED. EMERGENCY MGMT. AGENCY, EVALUATION OF THE NATIONAL FLOOD INSURANCE PROGRAM'S BUILDING STANDARDS 86–87 (2006).

¹⁹ FED. EMERGENCY MGMT. AGENCY, FACT SHEET, *supra* note 31, at 2.

²⁰ *Vill. of Euclid, Ohio v. Ambler Realty Co.*, 272 U.S. 365 (1926).

²¹ 1925 Conn. Pub. Acts 4037.

²² CONN. GEN. STAT. § 8-2 (2017).

²³ *Id.*

²⁴ CONN. GEN. STAT. § 8-6 (2017).

²⁵ CONN. DEP'T OF ADMIN. SERV., CONN. STATE BLDG. CODE (2016); 44 C.F.R. § 60.3 (2017).

²⁶ *See, e.g.*, AM. SOC'Y OF CIV. ENG'RS, ASCE/SEI 24-14 FLOOD RESISTANT DESIGN AND CONSTRUCTION (2015); FED. EMERGENCY MGMT. AGENCY, HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION, TECHNICAL FACT SHEET SERIES P-499, TECHNICAL FACT SHEET NO. 1.6 1 (2010).

²⁷ *See, e.g.*, CITY OF NEW LONDON, CONN., ZONING REGS. § 830.

²⁸ *See, e.g.*, FED. EMERGENCY MGMT. AGENCY, FLOOD INSURANCE RATE MAP, NEW HAVEN COUNTY, CONN., PANEL 487 OF 635 (2013).

²⁹ 44 C.F.R. § 59.1 (2017).

³⁰ *Id.* § 64.3.

Endnotes

-
- ³¹ *Id.* § 59.1.
- ³² *Id.* § 64.3.
- ³³ *Flood Zones, Definitions / Descriptions*, FED. EMERGENCY MGMT. AGENCY, <https://www.fema.gov/flood-zones> (last visited June 8, 2017).
- ³⁴ 44 C.F.R. § 64.3 (2017).
- ³⁵ *Definitions*, FED. EMERGENCY MGMT. AGENCY, *supra* note 2.
- ³⁶ 44 C.F.R. § 64.3 (2017).
- ³⁷ FED. EMERGENCY MGMT. AGENCY, HOMEOWNER'S GUIDE TO COASTAL CONSTRUCTION, *supra* note 40, at 5-1.
- ³⁸ 44 C.F.R. § 60.3 (2017).
- ³⁹ 44 C.F.R. § 60.3 (2017).
- ⁴⁰ *Id.*
- ⁴¹ *Id.*
- ⁴² *Id.*
- ⁴³ FED. EMERGENCY MGMT. AGENCY, HOME BUILDER'S GUIDE TO COASTAL CONSTRUCTION, TECHNICAL FACT SHEET SERIES P-499, TECHNICAL FACT SHEET NO. 1.6 2 (2010) [hereinafter *FEMA Home Builder's Guide*].
- ⁴⁴ CONN. DEP'T OF ADMIN. SERV., CONN. STATE. BLDG. CODE (2016) [hereinafter *Connecticut State Building Code*].
- ⁴⁵ INT'L CODE COUNCIL, INT'L RESIDENTIAL CODE, R322.1.4 (2012) [hereinafter *IRC 2012*].
- ⁴⁶ *Id.* at R322.2.1.3.
- ⁴⁷ *Id.* at R322.2.1.1.
- ⁴⁸ *Id.* at R322.2.1.2.
- ⁴⁹ *Id.* at R322.3.2.
- ⁵⁰ CONN. DEP'T ADMIN. SERV., BUILDING AND FIRE CODE ADOPTION PROCESS, PROPOSED CODES, <http://portal.ct.gov/DAS/Office-of-State-Building-Inspector/Building-and-Fire-Code-Adoption-Process> (last visited September 13, 2017).
- ⁵¹ INT'L CODE COUNCIL, INT'L RESIDENTIAL CODE, R322.2.1.2 (2015) [hereinafter *IRC 2015*].
- ⁵² *IRC 2015*, *supra* note 51, at R322.2.1.1.
- ⁵³ *Id.* at R322.3.2.1.
- ⁵⁴ *Connecticut State Building Code*, *supra* note 44.
- ⁵⁵ INT'L CODE COUNCIL, INT'L BLDG. CODE, 1612.4 (2012) [hereinafter *IBC 2012*].
- ⁵⁶ AM. SOC'Y OF CIV. ENG'RS, ASCE/SEI 24-05 FLOOD RESISTANT DESIGN AND CONSTRUCTION (2015).
- ⁵⁷ *Id.*
- ⁵⁸ *Id.*
- ⁵⁹ *Id.*
- ⁶⁰ *Id.*
- ⁶¹ CONN. DEP'T ADMIN. SERV., BUILDING AND FIRE CODE ADOPTION PROCESS, PROPOSED CODES, <http://portal.ct.gov/DAS/Office-of-State-Building-Inspector/Building-and-Fire-Code-Adoption-Process> (last visited September 13, 2017).
- ⁶² INT'L CODE COUNCIL, INT'L BLDG CODE, 1612.4 (2015) [hereinafter *IBC 2015*].
- ⁶³ AM. SOC'Y OF CIV. ENG'RS, ASCE/SEI 24-14 FLOOD RESISTANT DESIGN AND CONSTRUCTION (2014) [hereinafter *ASCE 24-14*].
- ⁶⁴ *DEEP-NFIP*, *supra* note 3.
- ⁶⁵ See *infra* Appendix A.
- ⁶⁶ 44 C.F.R. § 60.3 (2017); *Connecticut State Building Code*, *supra* note 44; *IBC 2012*, *supra* note 55, at 1612.4.
- ⁶⁷ *Connecticut State Building Code*, *supra* note 44.
- ⁶⁸ *IRC 2012*, *supra* note 45, at R322.3.2.
- ⁶⁹ 44 C.F.R. § 60.3 (2017).
- ⁷⁰ FED. EMERGENCY MGMT. AGENCY, FLOOD INSURANCE STUDY REPORT NEW HAVEN COUNTY, CONNECTICUT 109 (2017).
- ⁷¹ IPCC, CLIMATE CHANGE 2013 – THE PHYSICAL SCIENCE BASIS 11(2013).
- ⁷² *Id.*
- ⁷³ NAT'L OCEANIC ATMOSPHERIC ADMIN., TECHNICAL REPORT NOS CO-OPS 083, GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES vi (2017).

Endnotes

-
- ⁷⁴ James O'Donnell, *Sea Level Rise and Coastal Flood Risk in Connecticut: An Overview* (Sept. 2017) (unpublished) https://circa.uconn.edu/wp-content/uploads/sites/1618/2017/09/ExecSummarySeaLevelRise_J_ODonnell_Sept-2017-1.pdf.
- ⁷⁵ *Id.*
- ⁷⁶ *O'Donnell DEEP Presentation, supra* note 2.
- ⁷⁷ *Id.*
- ⁷⁸ CONN. GEN. STAT. § 8-2 (2017).
- ⁷⁹ FED. EMERGENCY MGMT. AGENCY, SELECTING APPROPRIATE MITIGATION MEASURES FOR FLOOD PRONE STRUCTURES, FED. EMERGENCY MGMT. AGENCY 551, 8-1 (2007).
- ⁸⁰ 44 C.F.R. § 60.3 (2017).
- ⁸¹ *See, e.g., FEMA Home Builder's Guide, supra* note 43.
- ⁸² CONN. GEN. STAT. § 29-253 (2017).
- ⁸³ ASCE 24-14, *supra* note 63, at ii-iii.
- ⁸⁴ FED. EMERGENCY MGMT. AGENCY, HIGHLIGHTS OF THE ASCE 24-14, 1 (2005).
- ⁸⁵ The Clinton, Old Saybrook, and Waterford elevation standards meet the requirements of ASCE 24-14 for “Flood Design Class 2” buildings and structures, which include the majority of buildings and structures in flood hazard areas. Importantly, ASCE 24-14 specifies more stringent requirements for buildings and structures that pose a high risk to the public and for essential facilities necessary for emergency response and recovery, and these types of building and structures are not singled out by the standards in these towns. Refer to ASCE 24-14 for elevation requirements for Class 1, 3, and 4 facilities.
- ⁸⁶ *FEMA Home Builder's Guide, supra* note 43 at 1.
- ⁸⁷ *O'Donnell DEEP Presentation, supra* note 2.
- ⁸⁸ FED. EMERGENCY MGMT. AGENCY, NATIONAL FLOOD INSURANCE PROGRAM COMMUNITY RATING SYSTEM COORDINATOR'S MANUAL FIA-15/2017, 430–33 (2017) [hereinafter *FEMA Coordinator's Manual*].
- ⁸⁹ 44 C.F.R. § 60.3 (2017).
- ⁹⁰ *FEMA Coordinator's Manual, supra* note 88, at 430–32.
- ⁹¹ *Id.*
- ⁹² Section R322.2 of the 2012 International Residential Code specifically requires the establishment of Coastal A Zones (IRC R322.2) and establishes elevation requirements for those zones. *IRC 2012, supra* note 45, at R322.2. ASCE 24-14, as invoked by the International Building Code, does not specifically require the establishment of a “Coastal A Zone,” but it does define “Coastal A Zone” (ASCE 24-14 § 1.2) and specifies construction requirements for zones with wave heights “greater than or equal to 1.5 feet.” ASCE 24-14 §3.1.
- ⁹³ *FEMA Coordinator's Manual, supra* note 88, at 430–33.
- ⁹⁴ FED. EMERGENCY MGMT. AGENCY, NATIONAL FLOOD INSURANCE PROGRAM COMMUNITY RATING SYSTEM, A LOCAL OFFICIAL'S GUIDE TO SAVING LIVES, PREVENTING PROPERTY DAMAGE, REDUCING THE COST OF FLOOD INSURANCE, FED. EMERGENCY MGMT. AGENCY B-573, 3 (2015).
- ⁹⁵ *Id.* at 4-7.
- ⁹⁶ FED. EMERGENCY MGMT. AGENCY, COMMUNITY RATING SYSTEM (CRS) COMMUNITIES AND THEIR CLASSES CRS-7 (2016).
- ⁹⁷ The 2016 Connecticut Building Code invokes the 2012 International Building Code (IBC) for non-residential structures. The 2012 IBC invokes ASCE 24-05, “Flood Resistant Design and Construction” for design and construction of buildings and structures in flood hazard areas. ASCE 24-05 identifies four different risk categories for structures in flood hazard areas based upon the use and occupancy of those structures. The information provided here for “Non-Residential Structures” is for Risk Category II structures, which represent the majority of non-residential buildings in flood hazard areas. Importantly, ASCE 24-05 specifies more stringent requirements for buildings and structures that pose a high risk to the public and for essential facilities necessary for emergency response and recovery. Refer to ASCE 24-05 for elevation requirements for those buildings and structures.
- ⁹⁸ The Proposed 2018 Connecticut Building Code invokes the 2015 International Building Code (IBC) for non-residential structures. The 2015 IBC invokes ASCE 24-14, “Flood Resistant Design and Construction” for design and construction of buildings and structures in flood hazard areas, which is an update to the ASCE 24-05 invoked by the 2012 IBC and, by extension, the 2016 Connecticut State Building Code. In a manner similar to ASCE 24-05, ASCE 24-14 identifies four different “Flood Design Classes” for buildings and structures in flood hazard areas

Endnotes

based upon the use and occupancy of those buildings and structures. The information provided here for “Non-Residential Structures” is for Flood Design Class 2 buildings, which represent the majority of non-residential buildings in flood hazard areas. Importantly, ASCE 24-14 specifies more stringent requirements for buildings and structures that pose a high risk to the public and for essential facilities necessary for emergency response and recovery. Refer to ASCE 24-14 for elevation requirements for those buildings and structures.

⁹⁹ In A Zones, non-residential structures are only required to be flood-proofed to BFE.

¹⁰⁰ In A Zones, non-residential structures are only required to elevate the lowest floor or flood-proof to BFE.

¹⁰¹ In A Zones, all non-residential structures are required to be flood-proofed at or above BFE.

¹⁰² FED. EMERGENCY MGMT. AGENCY, COMMUNITY RATING SYSTEM (CRS) COMMUNITIES AND THEIR CLASSES 7 (2016).