

adaptation

CASE STUDIES IN Floodplain Regulation

Challenges and Opportunities in
Preparing for Climate Change

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Prepared for the Georgetown Climate Center

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SUMMARY

Coastal and riverine communities alike continue to struggle with the increasing effects of climate change and sea-level rise, including major flood events. The Georgetown Climate Center is working to identify and promote best practices in adapting to these impacts, here considered through the lens of floodplain regulation. These case studies consider the actions taken by two communities to increase their resilience after devastating flood events. We hope that through an analysis of these actions, we can help other communities consider different adaptation strategies and offer unique insights into the process and challenges of building resilience through floodplain regulations.

As a result of rising seas and extreme weather events, coastal communities will increasingly experience large-scale flood events.¹ The Georgetown Climate Center (GCC) has been working to help communities prepare for and respond to increasing impacts. Local governments have primary authority to regulate development in their communities. Strong floodplain regulations can dramatically increase a community's resilience. By increasing regulations, communities can raise awareness of flood risks, promote flood-resilient construction, and shift growth out of flood-prone areas.

For many communities, implementing any new land-use regulations can be politically challenging. In this report, we highlight the efforts of two communities to strengthen regulations after catastrophic flood events: Cedar Falls, Iowa and Waveland, Mississippi. In both cases, community officials capitalized on the political support after the disaster to push forward stronger floodplain regulations. The floodplain managers who spearheaded the regulatory changes for both communities shared their experiences in a webinar hosted by the GCC in December 2012.² Through these case studies, we discuss the regulatory reforms they implemented and the lessons that can be learned from their experience.

An Introduction to Floodplain Regulation and the National Flood Insurance Program

To analyze local floodplain regulation, it is necessary to understand the overarching federal program that drives local regulation—the National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA). Congress enacted the NFIP in 1968 to encourage local regulation of floodplain development.³ The program has three core components: mapping, insurance, and regulations.

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Many thanks to Marty Ryan, City Planner of Cedar Falls, Iowa; and Mike Smith, Fire Chief of Waveland, Mississippi for their input on these case studies and for their participation in our webinar. Thanks also to our other webinar contributors: Julie LaBranche, Senior Planner for the Rockingham Planning Commission in New Hampshire; and Derek Sowers and Cameron Wake of the University of New Hampshire.

¹ National Climate Change Assessment and Development Advisory Committee, *Federal Advisory Draft Climate Assessment Report*, January 14, 2013, available at <http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap2-climate.pdf>.

² Georgetown Climate Center, *Georgetown Climate Center Webinar*, December 7, 2012, available at <http://www.georgetownclimate.org/floodplain-regulation-challenges-and-opportunities-in-preparing-for-climate-changes>.

³ FEMA, NATIONAL FLOOD INSURANCE PROGRAM: PROGRAM DESCRIPTION, August 1, 2002.

FEMA develops Flood Insurance Rate Maps (FIRMs) that designate areas that are susceptible to flood impacts. FIRMs divide the floodplain based on flood-risk into the “100-year floodplain” and the “500-year floodplain”. The 100-year floodplain is the area that, based on historic data, has a one percent or more chance of flooding in any given year.⁴ The 500-year floodplain is the area that, based on the same historic data, has a 0.2 percent to one percent chance of flooding.⁵

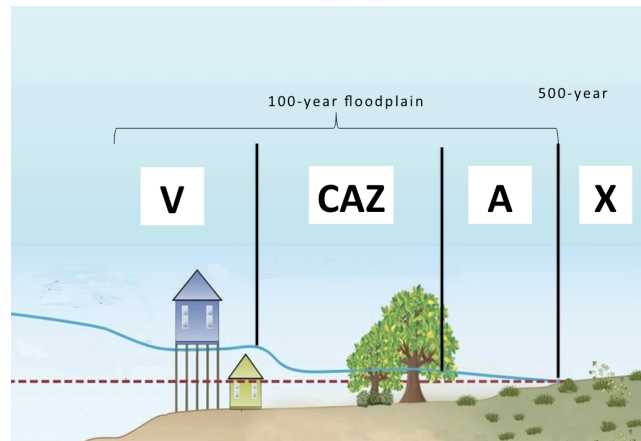
FIRMs then trigger the regulation and insurance components of the NFIP. To encourage participation, the NFIP provides federally subsidized flood insurance. To participate, communities must adopt minimum regulations in the 100-year floodplain.⁶ Landowners in participating communities can then purchase the flood insurance required to obtain a federally-backed mortgage. Most communities adopt the minimum regulations recommended in FEMA-adopted model ordinances, such as a requirement that structures be elevated to at or above the 100-year flood elevation (also known as the Base Flood Elevation or BFE).⁷

However, the NFIP does not prevent communities from imposing more restrictive local regulations. In fact, a subprogram of the NFIP—the Community Rating System (CRS)—encourages communities to adopt stronger floodplain management practices by offering insurance premium discounts to landowners in CRS-rated communities. The city of Waveland used CRS incentives to build political support for enhancing floodplain regulations after Hurricane Katrina.

These case studies are designed to help communities consider how they can regulate floodplains in light of climate change. The current minimum standards required by the NFIP, described above, will be insufficient as sea levels rise and increased precipitation exacerbates flooding. Because FIRMs are based upon historical flood data, they do not project how future conditions will change flood risks. Flood elevations and wave heights will increase and storm surges will be driven further inland. Therefore, homes developed to current standards will not be sufficiently elevated to protect them against future flood heights. And, inland homes, which are not currently subject to floodplain regulations, will increasingly sustain flood damage.

Additionally, Congress recently passed reforms to the NFIP that may provide opportunities for communities to promote adaptation (the Biggert-Waters Flood Insurance Reform Act of 2012 (Reform Act)). First, the Reform

Figure 1 *FEMA Designated Flood Zones*



⁴ Coastal FIRMs subdivide the 100 year floodplains into V, A, and CAZ zones depending on the amount of wave action. For full definitions of technical terms and FIRM zones, please see the glossary. FEMA, Circular 549, *Hurricane Katrina in the Gulf Coast: Mitigation Assessment Team Report, Building Performance Observations, Recommendations, and Technical Guidance*, Ch. 2, July 2006, available at <http://www.fema.gov/library/viewRecord.do?id=1857>.

⁵ FIRMs designate the 500-year floodplain as the X zone.

⁶ This is particularly attractive as most private insurance companies refuse to underwrite flood insurance for properties in a floodplain. See, FEMA FEMA, F-084, ANSWERS TO QUESTIONS ABOUT THE NFIP, 17, March 2011, p. 17.

⁷ See, e.g., FEMA REGION 10, MODEL ORDINANCE FOR FLOODPLAIN MANAGEMENT UNDER THE NATIONAL FLOOD INSURANCE PROGRAM AND THE ENDANGERED SPECIES ACT, January 2012. available at https://www.fema.gov/pdf/about/regions/regionx/nfip_esa_faq/nfip_esa_model_ordinance_final.pdf. Base Flood Elevation is formally defined as the elevation shown on the Flood Insurance Rate Map (FIRM) for A and V Zones that indicates the water surface elevation resulting from the base flood (a flood that has a one percent chance of equaling or exceeding that level in any given year).

Act phases out many of the insurance subsidies that were provided by the original Act.⁸ This means that flood insurance costs will increase significantly over the next decade, up to 20 percent per year.⁹ The CRS may provide an opportunity for communities to alleviate the financial burden of these increases on residents. By participating in the CRS and enacting progressive floodplain regulations, communities can qualify residents for insurance premium discounts. Second, the Reform Act allows FEMA to consider “future changes in sea level, precipitation, and intensity of hurricanes,” when developing FIRMs.¹⁰ This language allows FEMA, for the first time, to map sea-level rise projections on FIRMs. Communities can also contribute 100 percent of the funding to develop updated maps (previously FEMA had to contribute 50 percent).¹¹ This means that communities can work with FEMA to map how sea-level rise will change their flood risks over time. Communities can use these new maps to determine where to allow development, how to flood-proof structures, and where to site infrastructure and public facilities.

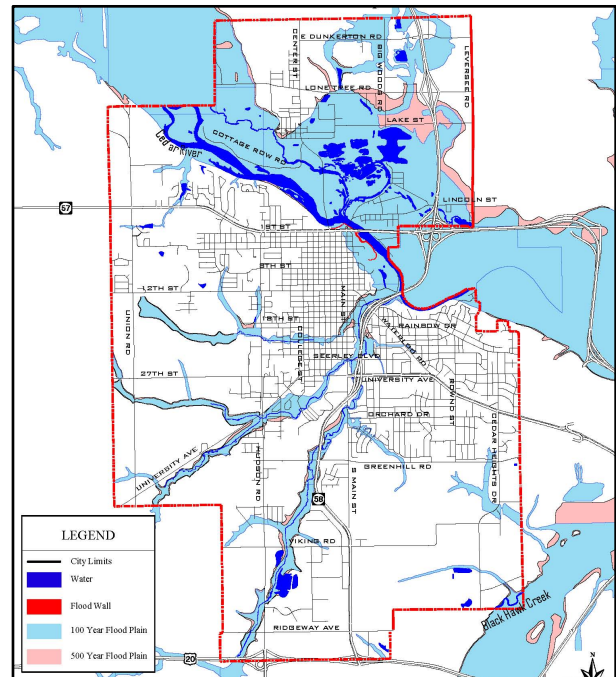
As part of the December webinar, the GCC showcased Cedar Falls, Iowa and Waveland, Mississippi as communities that confronted major flood events and adopted stronger floodplain regulations in response. In the webinar, planners Marty Ryan from Cedar Falls and Mike Smith from Waveland discussed their newly adopted policies and shared practical lessons for enhancing regulation. Their insight can be instructive for communities that are currently grappling with questions of how to adapt to climate change.

Cedar Falls, Iowa

Following major flooding in 2008, the Cedar Falls community pushed for disaster preparedness, which drove amendments to the city’s floodplain ordinance. The new ordinance was passed in 2009 and finalized with the adoption of a new FIRM in July 2011. The amendments extend regulations to the 500-year floodplain, limit development in high-risk areas, and prohibit the construction of critical facilities in the 500-year floodplain. The city also developed new hazard mitigation and comprehensive plans in the wake of the 2008 flood, which include a “greenbelt” designation to prevent new development in the 500-year floodplain. Finally, the community revitalized a buyout program to assist residents relocating out of the 500-year floodplain.

Cedar Falls is a moderate sized city in Eastern Iowa with an approximate population of 40,000. The city lies on the banks of the Cedar River, seventy-five miles west of the Mississippi River. It should not be confused with its larger sister city of Cedar Rapids, which often experiences similar flood events. Since 1990, Black Hawk County, which includes Cedar Falls, has had six federally declared flood disasters.

Figure 2 Cedar Falls Floodplain Map



⁸ THE BIGGERT-WATERS FLOOD INSURANCE REFORM ACT OF 2012, Pub. L. No: 112-141, H.R. 4348, 112th Cong. §§ 100205, (2012), available at <http://thomas.loc.gov/cgi-bin/query/F?c112:5:/temp/~c112ljh5jH:e1638923>: (Amending 42 U.S.C § 4017). [hereinafter *Reform Act*].

⁹ Jessica Grannis, Georgetown Climate Center, *Analysis of How the Flood Insurance Reform Act of 2012 May Affect State and Local Adaptation Efforts*, 2, August 14, 2012, available at <http://www.georgetownclimate.org/analysis-of-the-flood-insurance-reauthorization-and-reform-law-2012>

¹⁰ REFORM ACT, *supra* note 8, at §§ 100219.

¹¹ *Id.*

The Cedar River runs through the northern portion of the city. The densely populated city center resides south of the river and is protected by a levee that was constructed in 1999. The northern section, commonly referred to as “North Cedar,” is unprotected and low level flooding in the area is common. Major flood events in 1960, 1993 and the early 2000s caused significant damage.¹² Most of the city’s floodplain, which covers roughly one third of the city, lies in North Cedar. North Cedar is less developed and largely industrial, with the exception of the established residential section known as “Cedar City.” Cedar City is just north of Main Street and adjacent to the river, and was still home to nearly 120 residential property owners as of 2008.¹³ There is less development pressure and lower real estate values in North Cedar. The lack of dense residential neighborhoods and lack of development pressure in the North Cedar area played a key role in Cedar Falls’ ability to limit development in this area.

Prior to the 2008 flood event, only homes in the 100-year floodplain were required to be elevated to one foot above the base-flood elevation. In some cases, homes were “removed” from the floodplain—meaning that the property was filled in order to elevate the land above the base flood elevation. These landowners received “Letters of Map Revision” from FEMA, which exempted them from both the local floodplain regulations, as well as insurance purchase requirements.¹⁴

The 2008 Flood

In June 2008, sustained rainfall, snowmelt, and a series of large storm systems converged to cause dramatic flooding throughout the entire Upper Mississippi River basin, including the Cedar River.¹⁵ At its peak, the flood reached record levels, with the river cresting at thirty feet above flood stage and breaking the previous flood record by twelve feet.¹⁶ Homes and structures that were elevated to one foot above the base flood elevation flooded with up to five feet of water on the main floor. The downtown flood levee escaped overtopping by a mere six inches. Citizen volunteers worked through the night sandbagging the levee and the

buildings beyond.

When the waters finally receded, the public pushed city officials and city planners to better prepare the city for future flood events.¹⁷ While public support for stronger flood regulation remained high, officials considered options to strengthen the city’s flood resilience. The city endorsed a range of activities, including amending the city’s floodplain regulations, buying out properties in North Cedar, updating the city’s Hazard Mitigation Plan, strengthening the levee, and seeking participation in the

Figure 3 North Cedar Falls During 2008 Flood



Image courtesy of Denny Bowman.

¹² FEMA, BUYOUTS DRAMATICALLY DEMONSTRATE AVOIDED FLOOD DAMAGE: TWO CITIES, ONE TALE 4, 2001, available at <http://mitigation.eeri.org/files/resources-for-success/00016.pdf>.

¹³ *Id.*

¹⁴ Letters of Map Revisions (LOMR) are a way for property owners to remove their property from the floodplain. Owners grade and fill their land until the elevation is above the base flood elevation. They then submit a survey to that effect and become exempt from the NFIP regulations. Once popular, this practice has become discouraged in recent years. FEMA, *Letter of Map Amendment & Letter of Map Revision-Based on Fill Process*, January 2013, available at <http://www.fema.gov/letter-map-amendment-letter-map-revision-based-fill-process>.

¹⁵ NOAA, 2008 MIDWESTERN U.S. FLOODS, 9 July 2008, available at <http://www.ncdc.noaa.gov/special-reports/2008-floods.html#impacts>.

¹⁶ Christopher Maag, *In Eastern Iowa, The City That ‘Would Never Flood’ Goes Six Feet Under*, N.Y. Times, June 13, 2008, available at http://www.nytimes.com/2008/06/13/us/13flood.html?_r=0.

¹⁷ Mary Ryan, Cedar Falls City Planner, Georgetown Climate Center Webinar (December 7, 2012) available at <http://www.georgetownclimate.org/floodplain-regulation-challenges-and-opportunities-in-preparing-for-climate-changes>.

CRS program. For the purposes of this case study, we focus on the regulatory changes that were implemented in the aftermath of the 2008 flood.

Regulatory Changes

Cedar Falls applied its new floodplain regulations through the use of overlay zones, which is a common practice. By using overlay zones, Cedar Falls can integrate the floodplain regulations with local zoning laws in a more flexible manner. The base zoning still applies, but the 2011 zoning ordinance created three flood overlay districts: the “general floodplain,” the “floodway district” and the “floodway fringe.” The “general floodplain” includes all areas of the floodplain out to the limits of the 500-year boundary and is then divided into the “floodway district” and the “floodway fringe.” The floodway district is the river channel and associated areas that could reasonably be expected to carry floodwaters and the floodway fringe is the area adjacent to the floodway out to the boundaries of the 500-year floodplain.¹⁸ Cedar Falls has set restrictions on use, construction and permitting in all three zones. This allows regulators to condition new development and require developers to mitigate potential flood impacts.

Adopt 500-year Floodplain as the Regulatory Boundary

The most significant change in Cedar Falls’ 2011 floodplain ordinance was the extension of regulations out to the 500-year floodplain. The city received updated FIRMs before the flood event. After the 2008 floods, the city focused on extending floodplain regulations beyond the 100-year floodplain. The new ordinance extends regulation out to the 500-year floodplain. City planner Marty Ryan attributes the shift to a realization that the 100-year floodplain was “not an adequate level of protection.”¹⁹ The Cedar Falls amendments do not explicitly reference climate change. However, the city used the 500-year floodplain in recognition of increasing flood risks, such as altered precipitation patterns and river flows attributed to climate change.²⁰

Limit New Development in the 500-year Floodplain

The 2011 ordinance limits new development by prohibiting the platting of new lots or new subdivisions within the 500-year floodplain. As a result, no new large-scale residential subdivisions can be built in the 500-year floodplain. New development may only occur on lots that existed as of 2010. All new and substantially improved structures in this area must also be elevated to one foot above the 500-year flood elevation, which planners determine by reference to the city’s Flood Insurance Study (FIS).²¹ New critical public facilities (such as emergency response, schools and fire stations) must be located outside the 500-year floodplain. These restrictions will shift development out of the floodplain and into lower-risk areas or areas in South Cedar Falls that are protected by the 1999 levee. The ordinance also contains language designed to protect natural resources and wetlands in the 500-year floodplain.²²

Restrict Fill and Prohibit Letters of Map Revision

The 2011 ordinance also places stronger restrictions on altering the natural topography in the floodplain. The city planner and city engineer must approve any fill in the 500-year floodplain and approved fill may not increase the

¹⁸ “Floodway means the channel of a river or stream and those portions of the floodplain adjoining the channel which are reasonably required to carry and discharge floodwaters or flood flows associated with the regulatory flood, so that confinement of flood flows to the floodway area will not result in substantially higher flood levels and flow velocities.” CEDAR FALLS CODE OF ORDINANCES, §29-2.; *Id.* at §29-156.

¹⁹ November 2012 E-mail from Marty Ryan, Cedar Falls city planner, to Jessica Grannis, Staff Attorney, Georgetown University Law Center (December 5, 2012 13:43 EST) (notes on file with the author) [hereinafter *Marty Ryan*].

²⁰ Marty Ryan *supra* note 19.

²¹ *Id.*; CEDAR FALLS CODE OF ORDINANCES, §29-156.

²² “Stream, watercourse, drainage channel or other water channel embankment stabilization, filling, alterations or relocations, including removal of vegetation, must be designed to maintain the flood-carrying capacity within the altered area, and shall not be allowed or undertaken without all required permits from and approvals by the state department of natural resources, and shall not proceed without approval of the city planner and oversight by the city engineer.” *Id.* at §29-155(c)(10), echoed in §29-156 and §29-157.

height of the land by more than three feet.²³ This prohibits large-scale fill projects that may result in unstable foundations likely to wash out in major flooding. Additionally, Letters of Map Revision (LOMR) may no longer be used to “remove” properties from the floodplain. Property owners who receive a LOMR from FEMA must still comply with local floodplain regulations (although these property owners may not have to purchase insurance because insurance requirements are controlled by federal law).

Comprehensive Plan

In coordination with updating their floodplain ordinance, Cedar Falls also finalized an updated comprehensive plan in 2012. The twenty-year plan reinforces the policy decisions in the floodplain ordinance by designating large sections of the floodplain a “greenbelt,” or areas “unsuitable for development” in the Land Use Map.²⁴ The Plan also complements the natural resource language in the zoning ordinance.

Buyout Program

As part of the response to the 2008 flood, Cedar Falls revived an acquisition program in North Cedar. The original buyout program was created after flooding in 1993 and focused on the Cedar City neighborhood. It was funded primarily through the Hazard Mitigation Grant Program (HMGP), the Community Development Block Grant (CDBG) program, and additional local funding.²⁵ Most of the bought-out residents resettled locally, although Cedar Falls estimates that roughly 50 percent moved outside the Cedar Falls city limits.²⁶ Prior to 2008, the city had acquired 165 properties.

Following the 2008 floods, Cedar Falls re-offered the buyout option to 238 frequently flooded properties in the North Cedar area.²⁷ Of those, 166 were willing to relocate immediately, with other property owners accepting over the next few years. The new phase of the program drew on the same funding sources, with roughly 80 percent of the funding drawn from HGMP and 20 percent from CDBG.²⁸ The community covered a portion of the administrative costs with state assistance.

All told, the city has acquired over 330 properties since 1993 along with two mobile home parks. All structures on the acquired lots have been demolished and land is permanently deeded to the city in public ownership as designated green space. The city also relocated several commercial properties to a newly established industrial park outside the 500-year floodplain. The buyout program is still operating on a limited scale with some federal funding and a small annual local budget.

Lessons Learned

According to Cedar Falls planner Marty Ryan, residents have offered sustained public support for the new floodplain regulations. The momentum of the support after the 2008 floods led to few challenges from developers or commercial interests. One existing plat with lots crossing the 500-year floodplain sought exceptions to allow basements on those lots, but city officials refused. Other subdivisions have reorganized their lots so that the floodplain sections are yards or open space to avoid conflict with new construction standards. Ryan notes that the lack of conflict can be partially attributed to the fact that Cedar Falls has a lot of undeveloped space where growth

²³ *Id.* at §29-156.

²⁴ RDG PLANNING & DESIGN AND APPLIED ECOLOGICAL SERVICES, COMPREHENSIVE PLAN FOR THE CITY OF CEDAR FALLS, May 2012, 35, available at <http://www.cedarfalls.com/DocumentCenter/View/2418>.

²⁵ FEMA, *supra* note 12, at 4.

²⁶ *Id.*; See also, Marty Ryan *supra* note 19,

²⁷ Erin Musiol and Marty Ryan, *Case Study: Cedar Falls, Iowa*. American Planning Association, 2012, available at <http://www.planning.org/research/postdisaster/casestudies/cedarfalls.htm>.

²⁸ Marty Ryan, *supra* note 19.

could be redirected. Cedar Falls also created a Floodplain Advisory Committee to study the impact and reception of the new ordinance following its adoption. This group met regularly in 2010, but stopped meeting shortly thereafter. They felt the lack of conflict or problems with the ordinance rendered the committee unnecessary.

As a riverine community, Cedar Falls will not be impacted by sea-level rise. Nevertheless, the best practices employed by Cedar Falls could be utilized by both coastal and riverine communities to prepare for climate change impacts. Cedar Falls illustrates how communities can use the 500-year floodplain to extend floodplain regulations to potentially vulnerable portions of the community. This extension allows communities to create a horizontal buffer of flood protection to both compensate for shortcomings in outdated FIRMs and prepare for increased precipitation from climate change. By applying these changes through overlay zones, communities can give regulators greater flexibility in determining where and how to permit new development in flood-prone areas.

Cedar Falls' buyout program also provides an example of how to successfully couple regulatory changes with incentive programs to promote retreat from vulnerable areas. Many low-lying coastal communities may eventually be forced to confront retreat as a necessary strategy. Buyout programs offer homeowners the financial means to relocate out of flood-prone portions of the community. By combining funding from federal, state and local sources, communities can create a cost-effective program to encourage voluntary relocation. Cedar Falls used the destruction of the 2008 floods as an opportunity to build resilience to future hazards in a rational, prospective manner that efficiently used available resources. Strategically, this can serve as a lesson for any community looking to rebuild in the aftermath of a natural disaster.

Waveland, Mississippi

Following Katrina's devastation in 2005, new maps and a greater appreciation of flood risks led Waveland, Mississippi and surrounding Hancock County to strengthen their floodplain regulations. After Katrina, FEMA issued advisory FIRMs that included updated flood data from Katrina. These advisory FIRMs extended the boundary of the 100-year floodplain inland and significantly increased base flood elevations. The community used the advisory FIRMs to amend their floodplain ordinance and increase their elevation requirements. These changes also allowed them to recertify as a class 5 CRS community.

Waveland is a small city of approximately

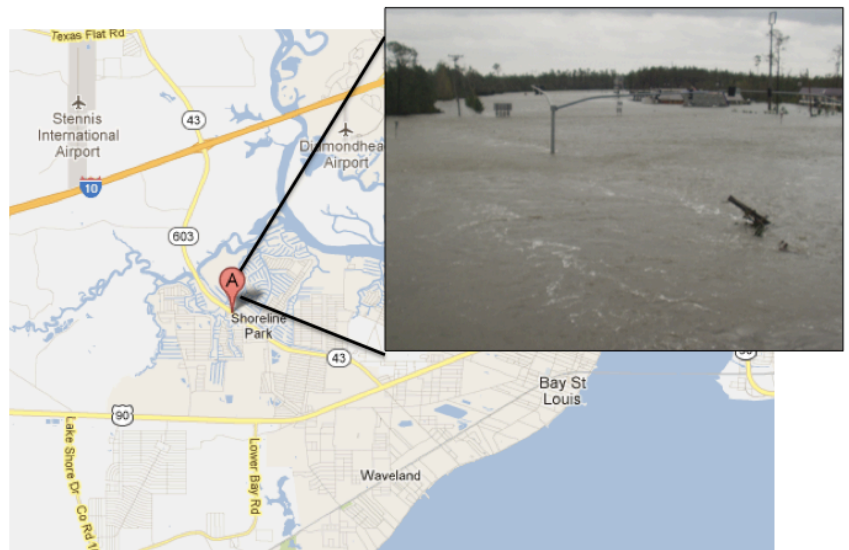
6,500 residents in Hancock County on the South East coast of Mississippi and directly on the Gulf of Mexico. As a gulf coast community, Waveland was no stranger to coastal flooding. The city was heavily damaged by Hurricane Camille in 1969 and frequently experienced storm-related flooding. Waveland also had a strong floodplain ordinance (based on their 1981 FIRM), and was one of the highest rated CRS communities in Mississippi before the storm hit.

Hurricane Katrina

On August 29th, 2005, Hurricane Katrina

hit Waveland during high tide, adding two feet to a twenty-six foot storm surge. Before the storm, officials only required residents

Figure 4 *Inundation by Katrina*



Intersection of I-10 and Hwy 43 at Shoreline Park was completely inundated by Katrina. The intersection marked is twelve miles inland from the Waveland coast, outside the 500-year floodplain. Photographer unknown.

to evacuate in the immediate floodplain (i.e., the 100-year floodplains). Many residents in outlying areas did not evacuate because they thought they would be safe, as these areas did not flood during Hurricane Camille.²⁹ Hurricane Katrina, however, completely submerged the entire city with water levels far exceeding the 500-year elevation.³⁰ Twenty-three residents of Waveland perished in the storm, and the majority of the casualties came from outer zones. Waveland also lost approximately 85 to 90 percent of its housing stock. In part, as a result of the infrastructure and property losses sustained in Katrina, Waveland has seen their population drop from over 7,000 to the current census estimate of 6,400 residents.

Post-Katrina Mapping

Following Katrina, FEMA released advisory FIRMs, with flood data from Katrina, as well as updated Digital Flood Insurance Rate Maps (DFIRMs)—both showed a drastic change in the floodplain. Prior to Katrina, only 20 percent of Waveland was in a Special Flood Hazard Area. In the new maps, roughly 90 percent of the city falls in the SFHA and the base flood elevations for some properties increased by as much as twelve feet.³¹ Because of these drastic changes, Waveland had to grapple with how to not only extend floodplain regulations to many more properties, but also require property owners to rebuild to much higher elevations.

Regulatory Change

In rewriting their Flood Damage Prevention Ordinance, both Waveland and the surrounding Hancock County placed strong emphasis on mitigating future hazards. Hancock County raised the required building elevation requirements to four feet above base flood elevation.³² The city of Waveland adopted a four foot freeboard requirement immediately after Katrina.³³ FEMA issued advisory BFEs after Katrina, which were an average of eight to twelve feet higher than the BFEs on pre-Katrina FIRMs.³⁴ As a result of the new BFEs, some landowners in Waveland were required to elevate their buildings six to thirteen feet above previous building requirements. When Waveland adopted their new DFIRMS in 2009, they returned to one foot of required freeboard. In Hancock County, which still retains a four foot freeboard requirement, some homeowners had to rebuild with ten to seventeen feet of additional elevation, with the practical effect that homeowners would have to rebuild up to twenty feet above ground level.³⁵

The freeboard requirements primarily impact new construction, but also apply to cumulative substantial improvements (i.e., when over 50 percent of the structure is renovated or rebuilt within a ten-year period). Waveland considered setting the “substantial improvement” threshold at 25 percent; however officials were concerned that it would be too costly and difficult to enforce, particularly when so much development in the city was impacted by the storm. Even at 50 percent, the new regulations would have encompassed most of the

²⁹ Over the standard zones designated by their FIRMS, Waveland had designated evacuation zones. B and C zones are considered part of the 500-year flood plain, with a .2% chance of flooding in any given year. The V and A zones were fully excavated, but many residents in the B and C zones choose not to evacuate.

³⁰ Larry Copeland, *The Town That Vanished*, USA Today, September 14, 2005, available at http://usatoday30.usatoday.com/news/nation/2005-09-14-waveland-cover_x.htm.

³¹ FEMA-549, HURRICANE KATRINA RECOVERY ADVISORIES, 5, July 2006, available at <http://www.fema.gov/library/viewRecord.do?id=2633>.

³² In the floodplain management context, this required elevation above the BFE is known as freeboard. Freeboard refers to a factor of safety, usually expressed in feet above the base flood elevation. It is used to compensate for the many unknown factors that could result in flood heights greater than those calculated for the base flood elevation. FEMA, *Freeboard*, June 2012, available at <http://www.fema.gov/national-flood-insurance-program-2/freeboard>.

³³ CITY OF WAVELAND, MISSISSIPPI FLOOD DAMAGE PREVENTION ORDINANCE 342 Art. 5 §A (2009)

³⁴ FEMA-549, *supra* note 39.

³⁵ Mike Smith, Waveland City Planner, Georgetown Climate Center Webinar (December 7, 2012) available at <http://www.georgetownclimate.org/floodplain-regulation-challenges-and-opportunities-in-preparing-for-climate-changes>.

buildings in Waveland after Katrina, so homeowners were given a two-year waiver to rebuild before the regulations took effect.³⁶

Both Waveland and Hancock County's updated ordinances also prohibit critical facilities in the 100-year floodplain.³⁷

Funding

As in Cedar Falls, the changes to Waveland's floodplain ordinance imposed costs on property owners who had to comply with the new requirements. Elevating a structure can cost anywhere from \$30 to \$90 per square foot for an eight foot elevation.³⁸ Elevating an entire home can cost over \$80,000 without including changes to the foundation, electrical systems or plumbing.³⁹ The cost is less when elevating a new home during construction.

To assist with rebuilding efforts, Waveland created an Increased Cost of Compliance Fund (ICC) and provided administrative support to those applying for grants. ICC grants are provided through FEMA to help the owners of substantially damaged, repetitive loss properties to rebuild in compliance with new building standards. ICC grants may be used to increase building elevation, among other retrofits.⁴⁰ Normally the construction associated with the grants must be completed within three years. Projects receiving grants to rebuild after Katrina were granted a seven-year extension.⁴¹ However, both Waveland and Hancock County find that ICC grants are often insufficient to raise structures to the elevation requirements. Many homeowners would prefer to elevate their homes on concrete slab, which costs approximately \$75 per square foot, and are finding ICC funding will not cover those costs. Waveland is exploring other options, including elevation grants, to assist those homeowners.

The FIRM updates in the wake of Katrina also placed many more properties in the 100-year floodplain, which significantly raised insurance costs for a large portion of Waveland residents. Pre-Katrina, Waveland participated in FEMA's Community Ratings System program (CRS), which was a point of pride, and the associated insurance discounts were highly valued in the community. Post-Katrina, Waveland planners considered backing away from their CRS rating, concerned that it might be difficult to sustain during the rebuilding process. Pressure from the community eventually led to a renewed commitment to the community's CRS rating, which was brought back to a level 5 in the years following Katrina.⁴² Waveland is currently the highest rated community in Mississippi.⁴³

Lessons Learned

Waveland's experience has given members of the town a new respect for the potential flood impacts of strong hurricanes. They also recognize that current trends point toward stronger, more intense storms with higher storm

³⁶ Interview with Mike Smith, Waveland Planner, October 25, 2012 16:45 EST. (notes on file with the author).

³⁷ CITY OF WAVELAND, FLOOD DAMAGE PREVENTION ORDINANCE NUMBER 342, Art. 5, § F.

³⁸ FEMA P-312, *The Homeowner's Guide to Retrofitting: Six Ways to Protect Your Home From Flooding*, 60, December 2009, available at <http://www.fema.gov/library/viewRecord.do?id=1420>. These cost estimates are based on average prices as of 2009 and vary widely with the structure of the house, materials used and foundation types.

³⁹ Leslie Garisto Pfaff, *How Much Will Safer Shore Homes Cost?*, New Jersey Monthly, December 11, 2012, available at <http://njmonthly.com/articles/jerseyshore/what-price-safer-shore-homes.html>.

⁴⁰ Jim Wilkins, *Increased Cost of Compliance Program: The Basics*, Louisiana Sea Grant. LA Sea Grant, available at http://www.laseagrant.org/pdfs/FEMA_IncreasedCost.pdf.

⁴¹ *Id.*

⁴² FEMA 1604-705, *Mississippi Communities Saving More than One Million Per Year in Flood Insurance Premiums*, March 17, 2009, available at <http://www.fema.gov/news-release/2009/03/17/mississippi-communities-saving-more-1-million-year-flood-insurance-premiums>.

⁴³ FEMA F-1604-464, *Waveland Upgrades to Downgrade Future Flood Loss*, Oct. 16, 2006, available at <http://www.fema.gov/news-release/2006/10/16/waveland-upgrades-downgrade-future-flood-loss>.

surges. Higher freeboard requirements give communities a significant vertical buffer to account for both storm surges and sea-level rise, which is not currently anticipated by historic-looking FIRMs. This is a strategy that could be widely applied among coastal communities.

Waveland is also considering how sea-level rise will exacerbate their risk of flooding in the future. The city received a grant from the Mississippi-Alabama Sea Grant Consortium to consider sea-level rise in their hazard mitigation plan.⁴⁴ Waveland is also hoping to work with FEMA to determine how CRS credits can be allocated to communities that incorporate climate change in hazard mitigation plans.

Finally, Waveland and Hancock County can be a practical study in the advantages and disadvantages of high freeboard requirements. The protection that comes from high building elevations offers communities extra protection against extreme flood events. The 2013 CRS Coordinator's Manual offers 375 points for a three foot freeboard requirement and up to 500 points if a three foot requirement is coupled with prohibitions on fill.⁴⁵ That said, Waveland and Hancock County residents have struggled to comply with the higher freeboards, often finding it prohibitively expensive. Because of the cost of reconstruction and rising insurance costs, a number of former residents opted to relocate instead of rebuilding.⁴⁶

Looking Ahead for Adaptation

Mapping and Additional Studies

These case studies show that many opportunities exist for communities seeking to implement adaptation strategies. Communities are just beginning to explore the question of how to map and incorporate sea-level rise and climate change into their floodplain management practices. Waveland is currently working on a Hazard Mitigation Plan that incorporates sea-level rise estimates. The plan is currently in draft review stage and expected to be released for public review soon.

As part of the GCC webinar, planners from Seabrook, New Hampshire shared how they are mapping how sea-level rise will change flood risks in their community. Seabrook planners are exploring ways to incorporate this information on their regulatory floodplain maps so that they can begin to regulate development in consideration of future risks. Their project is in the early stages of completion and has yet to be fully translated into a regulatory context, but the methodology they develop may serve as a model for communities seeking to develop prospective maps.

Confronting Retreat

Many communities may eventually have to confront the unfortunate necessity of retreat strategies. Retreat is often difficult to implement through regulations because of political resistance and the threat of litigation. Instead, incentive-based strategies, such as Cedar Falls' buyout program, could be coupled with more progressive regulations to finance retreat from the most vulnerable parts of the floodplain. These programs could be used to avoid losses and to slowly shift the community core away from high-risk areas. Prohibiting critical facilities in the floodplain can also help move infrastructure and public services away from high-risk areas, making these areas less desirable for development.

Community Rating System

Finally, Waveland is an excellent example of an effective use of the CRS program to encourage community support for enhanced regulations and limit the potential for political backsliding. As community identity becomes

⁴⁴ Mississippi-Alabama Sea Grant Consortium, *Smith 2012 Project Information*, available at <http://masgc.org/page.asp?id=740>.

⁴⁵ Point values are from FEMA's 2012 CRS Coordinator's Manual adopted in March 2013.

⁴⁶ Larry Copeland, *For Miss. Town, Storm More Pause Than Setback*, USA Today, September 3, 2008, available at, http://usatoday30.usatoday.com/news/nation/2008-09-02-mississippi_N.htm.

tied to a high CRS rating (and the popular insurance discounts!), community support for floodplain regulations increases. This community support then discourages any legislative action to weaken or eliminate regulations. Cedar Falls is still working through the application process for the CRS program, but has also found community support for the benefits. Utilizing the CRS program can help drive support for new regulations while also providing financial incentives to residents.

Moving Forward

The current circumstances are ideal for communities that have not yet experienced major flood events to consider strengthening their floodplain regulations. First, flood events are only expected to increase in frequency and severity in the coming years. Taking action before impacts occur can help communities avoid losses and ensure that they can more quickly recover. Second, FEMA is in the process of updating and modernizing FIRMs. As communities receive updated FIRMS, they will have to be adopted through legislative processes. For most communities, this includes updating their floodplain ordinance. As long as communities are engaged in a legislative process, they should consider increasing development standards in floodplains to increase their community's resilience to future flood impacts. Finally, recent NFIP reforms passed as part of the Biggert Waters Flood Insurance Reform Act will result in higher insurance costs over the next decade. Those reforms can be harnessed as momentum to encourage community participation in the CRS. The CRS rewards communities for developing better floodplain maps, and for increasing regulatory standards in floodplains. Combined, these developments create a ripe opportunity for communities to begin to reconsider how they regulate development in floodplains in light of future threats posed by climate change.

Glossary

100-year Flood – Areas that are expected to be inundated by the flood event with a 1-percent probability of being equaled or exceeded in any given year. This flood is also referred to as the base flood

500-year Flood – Areas subject to inundation by the flood that has a 0.2 percent probability of being equaled or exceeded during any given year

Base Flood - The flood having a one percent chance of being equaled or exceeded in any given year based upon historical flood data.

Base Flood Elevation (BFE) - The elevation shown on the Flood Insurance Rate Map (FIRM) for A and V Zones that indicates the water surface elevation resulting from the base flood (a flood that has a one percent chance of equaling or exceeding that level in any given year).

Community Rating System (CRS) - A program developed by the FEMA Mitigation Division to provide incentives for those communities in the National Flood Insurance Program that have gone beyond the minimum floodplain management requirements to develop extra measures to provide protection from flooding.

Conditional Use – A use allowed under zoning regulations only in accordance with conditions set by local zoning authorities.

Digital Flood Insurance Rate Maps (dFIRMs) – The conversion and/or modernization of existing FIRMs to digital form using GIS databasing.

Federal Emergency Management Agency (FEMA) - The federal agency within the Department of Homeland Security that is tasked with responding to, planning for, recovering from, and mitigating against man-made and natural disasters and administering the National Flood Insurance Program.

Flood Insurance Rate Map (FIRM) - Official map of a community on which the Mitigation Division Administrator has delineated both the special hazard areas and the risk premium zones applicable to the community.

Flood Zone⁴⁷ - A geographical area shown on a Flood Insurance Rate Map that reflects the severity or type of flooding in the area. FIRM zones include:

- **Special Flood Hazard Area (SFHA):** Zones A and V comprise a special area known as the special flood hazard area (SFHA). On new DFIRMs, Coastal A Zones are also in the SFHA. The SFHAs are expected to be inundated by the flood event with a 1-percent probability of being equaled or exceeded in any given year. This flood is also referred to as the base flood or 100-year flood.
 - **V Zones.** The portion of the SFHA that extends from offshore to the inland limit of a primary frontal dune along an open coast, and any other area subject to high-velocity wave action (3 feet and higher) from storms or seismic sources. The FIRMs use Zones V and V1-30 to designate these Coastal High Hazard Areas.
 - **A Zones.** The portion of the SFHA not mapped as a V Zone. Although FIRMs depict A Zones in both riverine and coastal floodplains (as Zones A, AE, A1-30, and AO), the flood hazards and flood forces acting on buildings in those different floodplains can be quite different. In coastal areas, A Zones are subject to wave heights less than 3 feet and wave run-up depths less than 3 feet.

⁴⁷ The flood zone definitions are adapted from FEMA Circular 549, *Hurricane Katrina in the Gulf Coast: Mitigation Assessment Team Report, Building Performance Observations, Recommendations, and Technical Guidance*, Ch. 2, July 2006, available at <http://www.fema.gov/library/viewRecord.do?id=1857>.

For formal NFIP flood zone definitions, see 44 C.F.R. § 59.1 (2010).

- **Coastal A Zones.** Though not shown on FIRMS, Coastal A Zones are referenced in ASCE24-05 and ASCE7-05. This is an area within the SFHA, landward of a V Zone, where flood forces in A Zones in coastal areas are not as severe as in V Zones, but are still capable of damaging or destroying buildings on shallow foundations. During the base flood conditions, the potential for breaking wave heights shall be greater than or equal to 1.5 feet. For this reason, different design and construction standards are recommended (by the MAT and others) in Coastal A Zones that are different than those used in Riverine A Zones.
- **Zones X, B, and C.** These zones identify areas outside of the SFHA. Zone B and shaded Zone X identify areas subject to inundation by the flood that has a 0.2 percent probability of being equaled or exceeded during any given year. This flood is often referred to as the 500-year flood. Zone C and “unshaded” Zone X identify areas above the level of the 500-year flood. The NFIP has no minimum design and construction requirements for buildings in Zones X, B, and C.

Freeboard – An additional amount of height incorporated into the Base Flood Elevation to account for uncertainties in the determination of flood elevations.

Increased Cost of Compliance (ICC) - Coverage for expenses a property owner must incur, above and beyond the cost to repair the physical damage the structure actually sustained from a flooding event, to comply with mitigation requirements of state or local floodplain management ordinances or laws. Acceptable mitigation measures are elevation, flood proofing, relocation, demolition, or any combination thereof.

Letter of Map Amendment (LOMA) – An official revision to a FEMA map done by describing the property affected and alleging an error or oversight in the initial mapping process. Generally issued when the property has been inadvertently included in the floodplain.

Letter of Map Revisions (LOMR) – An official revision to a FEMA map done by describing the property affected. Generally issued when a physical change such as grading or fill has raised the property out of the floodplain.

National Flood Insurance Program (NFIP) - A federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

Performance Standards – A series of standards, often incorporating local building codes, that requires a quantitative measurement of the effect or impact as it pertains to a public objective.

Repetitive Loss Property - Any insurable building that has had two or more claims paid out by the NFIP within 10 years.

Substantial Improvement – Any reconstruction, rehabilitation, addition or other improvement to a structure, the total cost of which equals or exceeds 50 percent of the market value of the structure before the start of construction of the improvement. Cumulative substantial improvement standards measure the sum of all reconstructions, rehabilitations and additions over the life of the structure.

Glossary adapted from glossaries prepared by FEMA and the National Association of Floodplain Managers.

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