A Rising Tide Lifts All Damage Costs: The Need for a Federal Flood Protection Standard

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Hurricanes Harvey, Irma, Maria, Florence, and Michael; communities across the Midwest covered by water for months; and Tropical Storm Imelda inundating the same Texas towns as Hurricane Harvey just two years prior—these events portend a future characterized by more frequent and severe flooding due to climate change. And all have occurred after the Trump administration revoked Executive Order 13,690 and the Federal Flood Risk Management Standard (FFRMS) in August 2017, leaving new infrastructure projects less prepared to withstand future flood events.

Heavier rains, intensifying coastal storms, and rising seas—the impacts of climate change—all serve to make flooding more frequent and severe. FFRMS was created in 2015 by the Obama administration to address this growing threat of flood loss. The standard would have required federally funded infrastructure projects to either be located outside of high-flood risk areas or, if not practicable, to be protected against a higher level of flooding than traditional practices require.

The revocation of that standard means federally funded infrastructure built today, according to standards based on the floods of the past, will be ill-prepared for the floods of the future. Millions who live, work, or travel in coastal and inland areas susceptible to flooding will face growing challenges as the public infrastructure—the nation's roads, schools, seaports, and wastewater treatment plants—on which they rely will be increasingly at risk of failing as floods worsen.

In addition, maintaining, repairing, and replacing public infrastructure in the face of such floods will be costly, a significant share of which will be borne by the federal government in the form of disaster assistance. Enacting a new flood protection standard would help better protect people and property, and could ease the federal government's growing financial exposure by ensuring federally financed infrastructure is better prepared for and adapted to flooding exacerbated by climate change.

Climate Change Impacts on Infrastructure

The climate is changing due to anthropogenic emissions of greenhouse gases. As the climate changes, the nation will become more vulnerable to flooding. Climate change increases flood risk through a number of factors, including heavier precipitation events, sea level rise, and greater tidal and storm surge events.

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The Fourth National Climate Assessment, a comprehensive report on climate change and its impacts in the United States, finds that heavy precipitation events have increased in both intensity and frequency in most parts of the country. Unfortunately, climate change will continue to make the occurrence of such events more likely. The primary reason: a warmer atmosphere holds more moisture. For every 2 degrees Celsius of temperature rise, the atmosphere holds 8 percent more moisture. *See*, Climate Central, *Warmer Air Means More Evaporation and Precipitation* (Sept. 6, 2017), climatecentral.org.

More rain can correlate with more flooding. A Federal Emergency Management Agency (FEMA) sponsored study conducted by AECOM, a multinational engineering firm, estimates riverine environments may experience, on average, a 45 percent expansion of the typical 100-year floodplain by 2100. AECOM, *The Impact of Climate Change and Population Growth on the National Flood Insurance Program Through 2100*, at ES-7 (2013). This enlargement of the floodplain is largely attributed to changing precipitation patterns.

Sea level rise threatens coastal communities. Since 1880, global sea levels, on average, have risen 8 to 9 inches and will continue rising long into the future. National Oceanic and Atmospheric Administration, NOAA Technical Report NOS CO-OPS 083, *Global and Regional Sea Level Rise Scenarios for the United States* 1 (2017). Under the worst-case modeled future climate change scenarios, the oceans could rise by an average of 8.2 feet above current levels by the end of the twenty-first century, with significant regional variation that could push sea levels even higher in certain areas. *Id.* at 22. For example, along the East Coast of the United States, the Atlantic Ocean could rise by as much as 9.8 feet. *Id.* at 24–26. As the seas rise, low-lying coastal areas and vital infrastructure located therein (e.g., roads, bridges, and wastewater treatment facilities) could gradually become permanently inundated.

Unfortunately, such infrastructure will likely be affected by repeated tidal and storm surge flooding long before being permanently lost. Sea level rise has already increased the number of tidal floods each year that impact more than 25 U.S. Atlantic and Gulf Coast cities. According to the National Oceanic and Atmospheric Administration (NOAA), in the southeastern United States the average number of days with tidal floods has more than doubled since 2000, to three per year, while the number in the Northeast has increased by about 75 percent, to six per year. See National Oceanic and Atmospheric Administration, NOAA Technical Report NOS CO-OPS 086, *Patterns and Projections of High Tide Flooding Along the U.S. Coastline Using a Common Impact Threshold*, viii (2018). By the end of

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the century, parts of the coastal Northeast could witness tidal flooding from 45 to 130 days annually. *Id.*

Higher sea levels will also allow storm surge to travel farther inland than in the past, impacting more infrastructure and property. Storm surges, which are abnormally higher water levels generated by hurricanes, cyclones, and nor'easters than normal high tide, can cause extreme coastal and inland flooding. Thus, the impacts associated with major storm events, like Superstorm Sandy, which resulted in the loss of life and billions of dollars in damage to transportation systems, utilities, and other critical infrastructure, will be more common and intense.

Flooding already is the most common and costly natural disaster in the United States. Since 2000, flood-related disasters in the United States accounted for more than $800 billion in losses. *See* NOAA National Centers for Environmental Information, *Billion-Dollar Weather and Climate Disasters: Table of Events* (2020), ncdc.noaa.gov/billions. Communities already struggle to maintain aged and inadequate infrastructure. Flooding exacerbated by climate change will only continue this trend.

More frequent and severe floods will further stress the nation's "aging and deteriorating" infrastructure, which could have "cascading impacts" that threaten the economy, essential services, and public safety. U.S. Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-Brief*, 17 (David Reidmiller et al., eds., 2018). In coastal areas, over $1 trillion in coastal real estate and public infrastructure is vulnerable from ongoing increases in tidal flooding due to rising sea levels. *Id.* at 82. Inland infrastructure in every region will be impacted by increases in the frequency and severity of heavy rainstorms. *Id.* at 17.

Drinking and wastewater systems, which are are critical for community health and well-being, provide a prime example of our nation's growing vulnerability. In particular, wastewater systems are highly susceptible to floods as they are typically located in low-lying areas for collection and discharge. *See* Michelle A. Hummel et al., *Sea Level Rise Impacts on Wastewater Treatment Systems Along the U.S. Coasts*, 6 Earth's Future 622, 622 (Apr. 2018). If sea levels rise between three to six feet, 10.4 million to 31.6 million Americans could lose wastewater services due to the associated increase in coastal flooding. *Id.* at 626. That amount is more than fivefold the number of people whose homes would be directly inundated. *Id.* And the price tag for drinking and wastewater systems to be adapted—or even relocated—due to the impacts of climate change could reach nearly $1 trillion by 2050. *See* National Association of Clean Water Agencies and Association of Metropolitan Water Agencies, *Confronting Climate Change: An Early Analysis of Water and Wastewater Adaptation Costs* ES-1 (Oct. 2009).

The federal government faces growing fiscal exposure from future flooding, due to its assumption of an increasing proportion of the financial responsibility for disaster relief. Between 1998 and 2014, FEMA spent $48.6 billion through its Public Assistance program in the wake of floods and coastal storms to repair or replace public buildings ($12.6 billion); public utilities ($7.4 billion); roads and bridges ($5.5 billion); and water-control facilities like levees, dams, and pumps ($1 billion)—with the remainder spent on cleanup and emergency actions. Rob Moore, *The Need for Flood Protection Standards*, NRDC (Nov. 30, 2015). The Public Assistance program represents just a small portion of federal expenditures that have been spent on flood recovery efforts in recent years.

Purpose of the Federal Flood Risk Management Standard

Designing infrastructure based on expected future conditions can reduce exposure and vulnerability. Current building standards require designing according to past climate conditions as an indication of future climate stresses. Climate change is the wrench thrown into the gears of that approach when it comes to flood risk, making the nation's aging infrastructure increasingly vulnerable flood damage.

The Obama administration sought to address this problem by issuing FFRMS, Executive Order 13,690. *See* Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, 80 Fed. Reg. 6425. FFRMS directed federal agencies to use more protective siting and design requirements for infrastructure projects that receive federal funding, such as affordable housing, emergency response facilities, and water and wastewater systems. Projects were required to be located outside of low-lying areas vulnerable to flooding whenever practicable, or, when not practicable, they were to be built to be more resilient against future flood conditions, including the impacts from sea level rise. Agencies had the flexibility to select one of the following three approaches for establishing the flood elevation and corresponding horizontal flood hazard area to be used in siting, design, and construction of federally funded projects:

- Climate-Informed Science Approach: Under this option, a federal agency would have determined future flood conditions, based on the best available climate science data, and elevated or floodproofed new or substantially reconstructed structures above that future flood level;
- Freeboard Value Approach: If a federal agency selected this approach, new or substantially damaged structures and facilities funded by the agency would have been required to be elevated or floodproofed a minimum of two feet for standard projects or a minimum of three feet for critical projects above the 100-year flood level; or the
- 500-Year Elevation Approach: A federal agency selecting this approach would have been required to elevate or floodproof new or substantially damaged structures to the 500-year flood level (a flood with a 0.2 percent chance of occurring in any given year).

FEMA, in response to Executive Order 13,690, had proposed that all FEMA-funded non-critical facilities—including facilities rebuilt after a major disaster—that had to be located in a high-flood hazard area be constructed with a higher elevation and/or floodproofing standard than the current requirement of building to the height of the 100-year flood. In addition, FEMA proposed all FEMA-funded "critical infrastructure facilities" (defined as a facility for which even a slight chance of flooding would be too great) account for future flood conditions, like the impacts of sea level rise, over the lifetime of the facility.

Similarly, based on Executive Order 13,690, the Department of Housing and Urban Development (HUD) proposed higher elevation requirements than the current standard for

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new or substantially improved HUD-financed infrastructure located in a 100-year floodplain. For noncritical infrastructure, like affordable housing, HUD's proposed rule would have required infrastructure to be two feet above the height of the 100-year flood. For "critical infrastructure," such as hospitals and nursing homes, the elevation requirement would have been the greater of three feet above the height of the 100-year flood or the height of the 500-year flood. In contrast, current HUD standards only require HUD-financed infrastructure to be elevated to the height of the 100-year flood if located in the floodplain. Presently, over 11,000 HUD-funded public housing units are located in the 100-year floodplain. *See* Office of the Inspector General, Department of Housing and Urban Development, 2015-OE-0007S, *Buildings at Three Public Housing Authorities Did Not Have Flood Insurance Before Hurricane Sandy* 4 (2015).

Both proposed rules would have accounted for more extreme flooding events, an improvement over current practices. For federally funded infrastructure projects in flood-prone areas, the height of the 100-year flood is the standard. FEMA's flood insurance rate maps are the primary source for determining the height of the 100-year flood. Yet, nearly two-thirds of these maps are either outdated or inaccurate, raising questions about their reliability to depict true flood vulnerability. *See* Office of the Inspector General, Department of Homeland Security, OIG-17–110, *FEMA Needs to Improve Management of Its Flooding Mapping Programs* 3 (2017). For example, many areas that flooded when Superstorm Sandy struck in 2012 had maps that were almost 30 years old.

New research suggests FEMA flood maps may vastly underestimate America's flood risk. According to the study, *Estimates of Present and Future Flood Risk in the Conterminous United States*, 41 million U.S. residents that live along the nation's rivers are at risk of flooding, which is about 2.6 to 3.1 times higher than the amount determined based on the regulatory flood maps produced by FEMA. In addition, the study estimates the total value of assets within the 100-year floodplain is $5.5 trillion, with $1.2 trillion of this at potential risk from flood damage. The study cited the varying age of FEMA maps, levels of quality, and "notably poor coverage of smaller catchments" as reasons for the disparity. Inaccurate depictions of the 100-year floodplain (the size of a 1 percent annual chance flood) result in infrastructure not being located and designed to properly withstand flooding.

Further, these maps do not take into account climate change, and instead assume that historical flood records are representative of future conditions. However, as the climate changes, historical patterns—particularly those related to extreme weather events—no longer provide reliable predictions of the future. Given that infrastructure is typically designed to withstand and operate within these historical patterns, current infrastructure designs likely underestimate their true risk of exposure to flood damage. Continuing to build or rebuild federally funded infrastructure to the height of the 100-year flood could adversely affect the longevity of such infrastructure's design life. In contrast, FFRMS was purposely crafted to address these uncertainties and future climate impacts.

On August 15, 2017, President Trump revoked Executive Order 13,690 and the FFRMS nearly immediately implicating the reconstruction of flood-damaged infrastructure. *See* Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure Projects, 82 Fed. Reg. 40,463. Just 10 days after the Standard was revoked, Hurricane Harvey struck southeast Texas with five feet of rain. Catastrophic flooding ensued, inundating over 300,000 structures. FEMA released over $500 million in Public Assistance grants for the rebuilding of Harvey-damaged infrastructure, an amount that likely will continue to grow as money from three congressional special appropriations continues to be released. If FEMA had promulgated its proposed rule based on the Standards before Harvey struck, those Public Assistance dollars would require that damaged infrastructure be rebuilt with a higher margin of safety to future flooding.

Continuing to build or rebuild federally funded infrastructure to the height of the 100-year flood could adversely affect the longevity of such infrastructure's design life.

Since Hurricane Harvey, more than 100 flood-related presidential Disaster Declarations have been issued. *See* FEMA, *Disasters*, fema.gov/disasters (2020). Billions of dollars have been spent to help impacted communities recover. However, FFRMS is not in place to guide the use of that funding to ensure that flood-damaged infrastructure is rebuilt smarter and stronger. Without a new federal flood protection standard, the nation's infrastructure will only become more vulnerable to flood damage.

A New Federal Standard Is Needed to Reduce Flood Exposure

Heavier rains, intensifying coastal storms, and rising seas—the impacts of climate change—are no longer a far-off possibility. Many communities across the United States are already suffering from more frequent and severe floods. These impacts are expected to increase over time and will only exacerbate the accuracy and changing flood condition issues that affect the current standard. A new federal flood protection standard that requires a higher margin of safety for siting and design for federally funded infrastructure projects would better protect these communities, their residents, and the infrastructure on which they rely.

As noted above, FEMA's flood maps, which are the primary source for determining the 100-year flood elevation, currently do not account for sea level rise and other climate impacts. Failure to evaluate potential sea level rise impacts over the lifetime of a critical structure or facility could lead to an underestimation of risk. To achieve a higher margin of safety, such a standard should continue to prioritize alternative site assessments to locating in the 100-year floodplain as currently required by Executive Order 11,998, the predecessor to Executive Order 13,690. It should require structures and facilities to

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be elevated or floodproofed a minimum of two feet above the 100-year flood height for noncritical infrastructure and three feet or the height of the 500-year flood, whichever is greater, for critical infrastructure. And if a structure or facility, especially one deemed to be "critical," is to be located in a coastal area, sea level rise projections, if possible, must be assessed for the lifetime of the infrastructure to fully account for future flood risk. The last requirement is vital given the potential impacts from rising seas. "Critical" means "any agency [funded infrastructure projects] with respect to which the head of the agency determines a slight chance of flooding would present an unacceptable amount of risk." 44 CFR § 9.4.

Congress could enact legislation establishing a federal flood protection standard. There is recent precedent for congressionally mandated flood standards. In 2018, Congress directed the Department of Defense (DOD) to incorporate future flood risk into infrastructure investments on all military bases. The John S. McCain National Defense Authorization Act for Fiscal Year 2019 requires the disclosure of flood risk of new construction and prohibits new military projects from being developed in the 100-year floodplain. If the floodplain cannot be avoided, the infrastructure project must be built two to three feet above the height of a 100-year flood.

The National Defense Authorization Act for FY 2020, which became law late last year, takes the flood protection standard contained in the previous year's bill one step further. The enacted FY 2020 bill now requires the DOD to ensure that future or substantially improved critical infrastructure in coastal areas account for potential sea level rise impacts over the lifetime of the facility, which would be more protective than merely elevating a structure two to three feet above the height of the 100-year flood.

The House and Senate are considering bipartisan legislation to codify HUD's Community Development Block Grant Disaster Recovery (CDBG-DR) program. *See* Reforming Disaster Recovery Act of 2019, H.R. 3702, 116th Cong. (2019); Reforming Disaster Recovery Act, S. 2301, 116th Cong. (2019). Both versions would require any structure located in the 100-year floodplain being rebuilt or repaired with CDBG-DR funds to be elevated to at least two feet above the 100-year flood height.

Until Congress passes national flood protection legislation, federal agencies should act to require higher flood protections for agency-funded construction projects, even without the directive of the withdrawn Executive Order 13,960. Executive Order 11,988, which Executive Order 13,960 amended, stipulates that agencies must "take action to reduce the risk of flood loss" and "to minimize the impact of floods on human safety, health and welfare" by issuing or amending existing regulations and procedures, and that those floodplain regulations must be updated as necessary. Exec. Order No. 11,988 §§ 1, 2(d).

Most agencies' regulations implementing Executive Order 11,988 do not require agency-funded construction projects to be built higher than the elevation of the 100-year flood. Given the shortcomings associated with that standard in light of climate change threats, updating federal agency regulations to require a more stringent elevation or floodproofing standard is arguably necessary to achieve reductions in flood loss and the threat to public safety.

Adopting a New Federal Flood Protection Standard Would Provide Long-Term Cost Savings

The potential cost of a new federal flood protection standard is a prudent investment. Pre-disaster mitigation efforts, which include building to a more protective standard against flooding, are proven to reduce the associated costs of post-disaster recovery. For example, in Maricopa County, Arizona, state legislatures enacted legislation requiring builders and developers to comply with strict standards for flood control and storm water management. The statute applied to residential, commercial, and industrial properties, and required all buildings to be built one foot above the height of the 100-year flood. Due to the more protective building standard, it is estimated $2.9 billion was saved in avoided damages after an October 2000 flood. *See* Ass'n of State Floodplain Managers, *Mitigation Success Stories in The United States*, 3–4 (4th ed. 2002).

In addition, the National Institute of Building Sciences finds, on average, six dollars can be saved in disaster recovery for every dollar invested in disaster mitigation. The report analyzed the impacts of 23 years of federal mitigation grants provided by FEMA, HUD, and the Economic Development Administration, and found that the benefits of mitigation extend well beyond simply protecting property; mitigation also helps to reduce casualties and free up resources to focus on other aspects of disaster recovery. The report evaluated five federal grants to elevate roads and railroads to better resist flooding and four grants to protect water and wastewater treatment plants from future flooding. The grants had a total benefit-cost ratio of 4:1, with benefits mostly accruing from reductions in deaths, injuries, post-traumatic stress disorder, and indirect business interruption.

Further, numerous states and local communities have already implemented flood protection standards for buildings and structures located in the 100-year floodplain. Five states—Indiana, Maryland (for state-owned structures), Montana, New York, and Wisconsin—have a minimum statewide freeboard standard of two feet. In addition, over 230 local jurisdictions have similarly adopted standards, with 42 local jurisdictions requiring a freeboard standard of three feet for all infrastructure. *See* Ass'n Of State Floodplain Managers, States And Other Communities In FEMA CRA With Building Freeboard Requirement (2015). Implementing a new federal flood protection standard, thus, is neither a novel nor an untested approach.

As the climate changes, major flooding events will happen with greater frequency, significant flood losses in areas outside the identified 100-year floodplain will occur more often, and the federal share of disaster recovery costs will continue to grow. Yet, the nation's infrastructure continues to be built as if the future will be like the past. This assumption is no longer acceptable. How and where the country's public hospitals, roads, schools, seaports, and wastewater treatment plants are built must change to account for a warming world. Building such infrastructure is expensive. It should last as long as intended. A new federal flood protection standard would help ensure that it does.

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