ALLIANCE FOR INNOVATION AND INFRASTRUCTURE

Infrastructure Resiliency

Preventing Damage Through Critical Investments

Introduction

In the last two years, Texas has experienced extensive flooding with estimates of more than 70 trillion gallons of rain hitting the state.[1, 2] This volume of rain equates to the entire state being covered in 16 inches of water. The flooding has led to loss of life and unprecedented damage to crops, private property, and public infrastructure. The nearly $10 billion in damaged property is a significant drag on the local economy and will likely have lasting devastating impacts on individuals and businesses within the state.

Despite scientific advances in modeling, specific weather-related disasters are still nearly impossible to predict. The only reliable method to protect against damage caused by these events is to build a strong and resilient infrastructure that can reduce the potential for property damage. In order to achieve this, governments at all levels – federal, state, and local – must make intelligent and strategic investments in flood mitigation. For example, strong storm walls can prevent flooding, wider capacity storm drains and sewers can carry water away from city infrastructure, and porous concrete can help to absorb water and expedite receding floodwaters.

Statistics

In April, May, and June of both 2015 and 2016, Texas was host to enormous quantities of rain. In May 2015 alone, 37 trillion gallons of water saturated the state, causing the governor to declare 23 counties to be in "disaster", at least 23 fatalities, and billions of dollars in public and private property losses.[3] Statistically, floods of this magnitude occur once every 500 years, and are thus referred to as "500-year floods." Unfortunately, Texas has experienced three "500-year floods" in a period of twelve months.[4] There are two primary reasons for these epic events. First, the sheer quantity of rain that deluged the state caused rivers and lakes to breach their levees and banks. Second, poor flood mitigation infrastructure, including levees, storm drains, and large amounts of concrete exacerbated the flooding and slowed the water from receding.

+70 Trillion gallons of rainfall in Texas over the past two years

[1] Ingraham, C. (2015, May 27). Visualized: How the insane amount of rain in Texas could turn Rhode Island into a lake. Retrieved June 15, 2016, from https://www.washingtonpost.com/news/wonk/wp/2015/05/27/the-insane-amount-of-rain-thats-fallen-in-texas-visualized/

[2] Mersereau, D. (2016, April 19). How Parts Of Houston, Texas, Saw Five Months' Worth Of Rain In One Night. Retrieved May, 2016, from http://www.forbes.com/sites/dennismersereau/2016/04/19/how-parts-of-houston-texas-saw-five-months-worth-of-rain-in-one-night/#6e139e1ac86e

[3] Pearson, M. (2015, June 7). Another body found in Texas flood debris. Retrieved June 15, 2016, from http://www.cnn.com/2015/06/07/us/texas-flooding/

[4] Berlinger, J. (2016, June 2). 5 Fort Hood soldiers dead, 4 missing amid Texas flooding. Retrieved June 15, 2016, from http://www.cnn.com/2016/06/02/us/texas-floods/

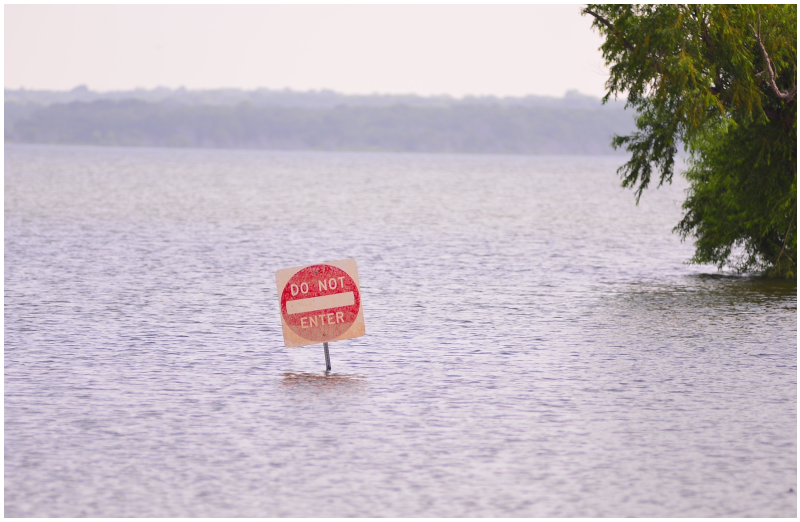
Root Cause

According to Dr. Sam Brody, a professor of city and regional planning at Texas A&M, the Texas Gulf is at a disadvantage due to its urbanization and natural geography.[5] He explained that, "Between 1996 to 2011, this area has increased pavement by 25 percent. The water has nowhere to run other than people's home and businesses." This is an example of the infrastructure actually trapping water when it should be holding it back, diverting it, or encouraging absorption.

According to Dr. Brody, for every square meter of pavement added in the Houston area, $4,000 of flood damage can be expected. This high cost is the result of Houston's sprawl while resting on a natural wetland and a lack of comprehensive city planning and zoning.

To overcome the statewide infrastructural deficiencies, policymakers at the state and local levels must identify where floods arise, which structures are failing to prevent them, and which are counterproductively holding water from receding. With that knowledge, they must act to correct the problem.

The latest Infrastructure Report Card from the American Society of Civil Engineers (ASCE) issued in 2013 gave Texas a "D" for flood control.[6] The ASCE considers the "D" rating to be "poor" and is only one step higher than "F" for "failing". Among infrastructural deficits, one factor contributing to the low mark is that Texas does not have a statewide floodplain management plan. As a result, Texas leads all other states in the cost paid out for flood claims.



The lack of a coordinated state-level plan for flood control combined with aging infrastructure, or in some cases, counterproductive infrastructure, flooding in the state comes as little surprise. For a state with such a large coastline, high population-dense coastal cities, and a valuable energy hub, failure to invest in adequately resilient infrastructure seems shortsighted.

Solutions

The role of government should include planning and preparedness, infrastructure investments, and incentivizing risk reduction strategies.[7]

Texas authorities should develop a statewide floodplain management plan. Mapping the geography of the state and highlighting high-risk areas can help prioritize infrastructure projects and encourage efficient allocation of resources across the state. The state should also consider joining

[5] Bojorquez, M. (2016, April 21). As Texas waters continue to rise, so do the damage estimates. Retrieved June 15, 2016, from http://www.cbsnews.com/news/as-texas-waters-continue-to-rise-so-do-the-repair-bills/

[6] ASCE. (2013). Texas. Retrieved June 15, 2016, from http://www.infrastructurereportcard.org/texas/texas-overview/

[7] Kousky, C. (2012, July 4). Informing climate adaptation a review of the economic costs of natural disasters. Retrieved June 15, 2016, from http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-12-28.pdf

the National Flood Insurance Program. Many cities in Texas have joined the program, but the state as a whole has not.[8]

Texas must improve the 1,465 miles of levees across the state. This may require higher standards for height and seepage among other requirements.[9] Seawalls, dikes, and coastal levees should be evaluated and improved, along with natural and man-made levees along the rivers and lakes throughout the state.

Serious discussions among state and local officials as well as researchers and policymakers in Texas has led to proposals for new seawalls, higher levees, and greater focus on storm protection.[10] Two proposals have been made to protect the Texas Gulf Coast, which hosts significant energy resources for the nation. While the recent proposals differ in strategy, the goal of each is clear: to protect life and property from unnecessary damage caused by storms.[11]

These infrastructure investments are restraint mechanisms, meant to hold water back from population centers where homes and businesses rest. They are the front line of protection from the large quantities of water in lakes, rivers, and the sea. Heavy rain can overwhelm these structures or cause flooding behind them. For these instances, planners should develop larger capacity storm drains and sewers. The ability to carry larger volumes of water is essential for preventing flooding. If a levee fails and water flows into a city, storm drains should be capable of consuming that water before it can pool.

Urbanization brings with it large amounts of concrete, which is by nature non-permeable. The Houston area represents close to 13,000 acres of wetlands that have been paved over.[12] In order for floodwaters to receded naturally, cities must rely on topography, storm drains, or for the ground to absorb the water. With wide coverage of concrete, some urban centers have little grass or dirt areas where such absorption is possible. Incorporating porous concrete addresses this problem directly

[8] FEMA. (2016, June 15). Federal Emergency Management Agency, Community Status Book Report. Retrieved June 15, 2016, from https://www.fema.gov/cis/TX.html

[9] ASFM. (2013). Levee Safety in Texas: 2013. Retrieved from http://www.floods.org/Files/Conf2013_ppts/D5/D5_Skipwith.pdf

[10] Collier, K. (2016, March 10). New Houston Hurricane Plan Stirs the Pot. Retrieved June 15, 2016, from https://www.texastribune.org/2016/03/10/new-houston-hurricane-plan-stirs-pot/

[11] Christian, C. (2016, March 4). Galveston levees would cost less, work better than proposed 'Ike Dike,' report finds. Retrieved June 15, 2016, from http://www.chron.com/neighborhood/bayarea/news/article/Galveston-levees-would-cost-less-work-better-6868734.php

[12] Editorial Board. (2016, June 3). Flood history. Retrieved June 15, 2016, from http://www.houstonchronicle.com/opinion/editorials/article/Flood-history-7962722.php

by creating a permeable layer that channels water straight into the ground. While there may be a slightly higher cost relative to traditional concrete, the durability is similar and the long-term savings from reduced flooding is significant.[13]

There has been $10 billion in storm damage across Texas over the past two years, not including halted economic activity and uninsured losses. Estimated across a 10-year period, similar storm damage and the loss of aging infrastructure could result in close to $60 billion in losses for Texans. Conversely, improving the statewide infrastructure to prevent flooding damage for the same period is estimated to cost roughly $20 billion – a potential $40 billion in savings. Austin has begun weighing a $2-4 billion project,[14] while Houston expects a cost of $12 billion to expand its drainage channels.[15] Including private investment and incentives to plan more effectively using porous concrete, the cost of investment is significantly cheaper than the expected damage from taking no action.

Conclusion

Texas was hit particularly hard over the past two years and the damages are devastating. It is impossible to predict whether Texas will experience similar storms in future years, but with better infrastructure planning and development, future storms of this magnitude will cause significantly less damage. Resilient infrastructure can withstand inclement weather and better protect citizens and property. With a flood management plan, strategically strengthened levees, widened storm drains, and porous concrete laid, the same volume of rain hitting the same locations, would lead to significantly lower damages and potentially save lives.

Investments in infrastructure resiliency would pay off in cost savings when the next weather event occurs, not only because the damage would be lessened, but because critical functions that would otherwise be shuttered by flooding could continue to function. The economic cost of flooding is not limited to property loss, but must factor in business that cannot function because employees and consumers could not make it on public roads or freeways.[16] In this way, hydro-meteorological events can not only cause economic deadweight loss through damage, but also hinder economic growth by preventing economic activity.[17] Strong infrastructure like well-maintained roads, bridges, and storm walls make sense for day-to-day life as much as for times of disaster.

The Alliance for Innovation and Infrastructure (Aii) is an independent, non-profit alliance focusing on infrastructure innovation through awareness and education.

[13] Economic Benefits, The Concrete Network. (2016). Retrieved June 15, 2016, from http://www.concretenetwork.com/pervious/economic_benefits.html

[14] Lim, A. (2016, May 16). Report: Flood fixes would cost Austin $2 billion to $4 billion. Retrieved June 15, 2016, from http://www.mystatesman.com/news/news/local/report-flood-fixes-would-cost-austin-2-billion-to-/nrNpq/

[15] Frosch, D., & McWirter, C. (2016, May 19). Houston's Rapid Growth, Heavy Rains, Heighten Flood Risk. Retrieved June 15, 2016, from http://www.wsj.com/articles/houstons-rapid-growth-heavy-rains-heighten-flood-risk-1463680866

[16] Negative socio-economic Impacts of Floods. (2016). Retrieved June 15, 2016, from http://daad.wb.tu-harburg.de/tutorial/integrated-flood-management-ifm-policy-and-planning-aspects/social-aspects-and-stakeholder-involvement/social-aspects/negative-socio-economic-impacts-of-floods/

[17] Kousky, C. (2012, July 4). Informing climate adaptation a review of the economic costs of natural disasters. Retrieved June 15, 2016, from http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-12-28.pdf