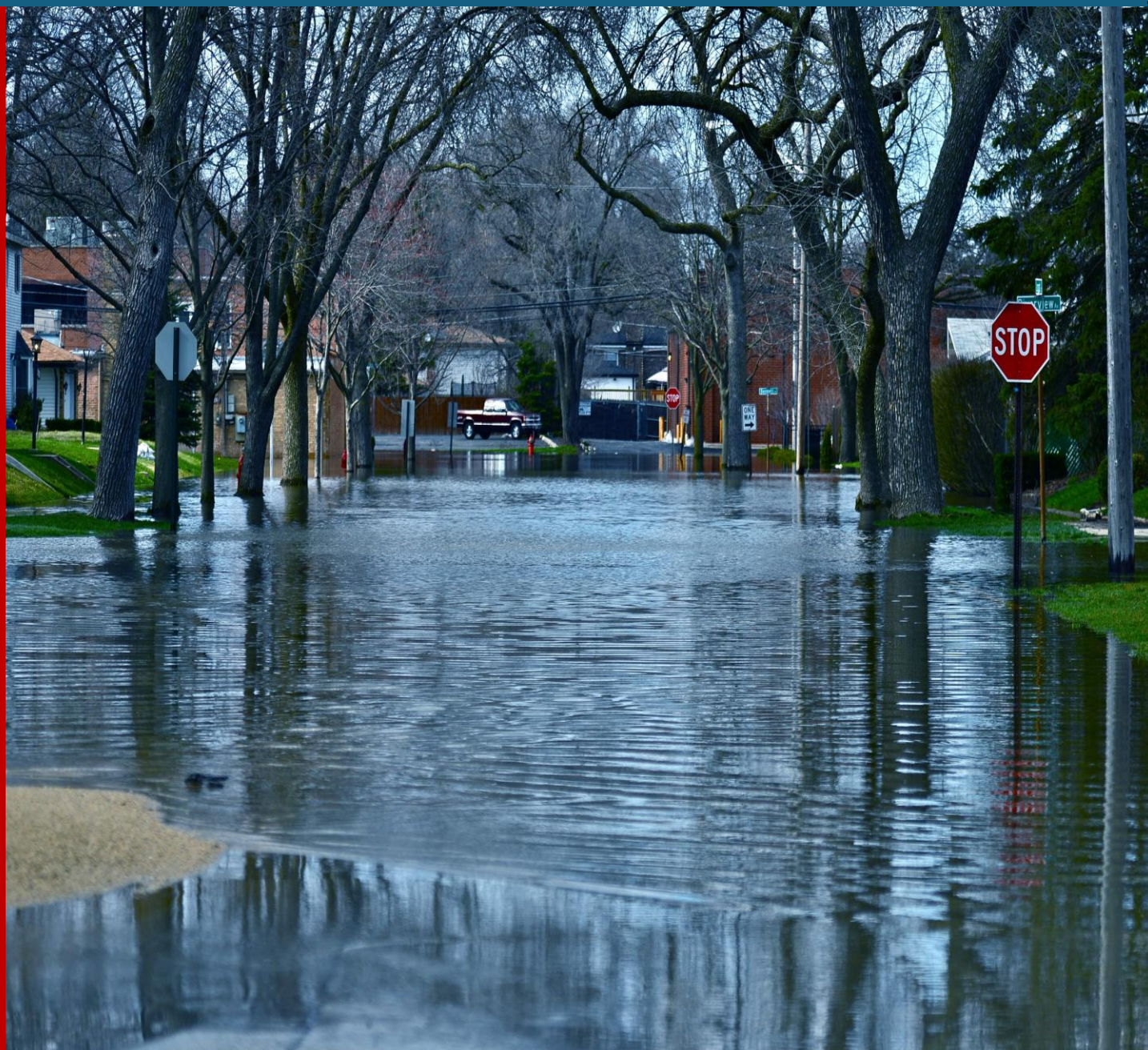# Things Fell Apart; the destruction, the rebuilding, and the lessons from the Denham Springs 2016 Flood

Planning For Disaster Mitigation and Recovery

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Executive summary

Nine years ago in 2016, Louisiana witnessed what is regarded as historically catastrophic flood event that spans days. This unfortunate incident was triggered by excessive rainstorm that began in the second week of August. Several communities, especially those in the Amite River watershed were substantially affected. Severe among those communities was Denham Springs, a historically vibrant town in Livingston Parish. Nevertheless, after destruction comes recovery. This white paper examines the experience of Denham Springs, particular attention to their recovery plan. The study found that the recovery planning process was resilient-driven and heavily relied on civic engagements while being guided by the National Disaster Recovery Framework. Key among the recovery projects that were identified are sustainable stormwater management, resilient infrastructure, land use regulation, and other disaster mitigation and recovery strategic measures. Lessons drawn from Denham Springs proactively informs our city to proactively put in place a land use plan and ordinance that prevents development in flood prone areas, emergency operations plan, better collaborative relations with other cities or states, effective communication about flood zones and risk involved. Considering these lessons for our city would put our city in a better situation in times of such unfortunate events.

Introduction

Since the beginning of time, disasters have been a consistent phenomenon that hits and destruct communities, posing great threats to both living and non-living things, and the built and natural environments. Common among these catastrophic events is flooding. Flooding is one of the primary natural hazards in the United States (US). Since 1900, over 10,000 individuals have lost their lives as a result of inundation disasters (Lotfata & Ambinakudige, 2019). If a disaster-affected area has a higher concentration of socially vulnerable individuals, there is an increased risk of loss of life and fatalities. For example, in the United States, the 2005 Hurricane Katrina and the 2016 Louisiana catastrophe resulted in significant destruction and a higher number of fatalities. These unfortunate events substantially affected people across different cohorts, especially those within socially vulnerable communities.

The certainty of the uncertainty of these hazards prompts local governments including cities, and counties to prepare adequately to successfully manage them as and when they occur. Putting in place disaster mitigation plans helps these local governments to identify vulnerabilities, risk, potentials and opportunities that could be of aid to prevent, minimize and/or effectively recover from the impacts of such catastrophic events. Vulnerabilities could be human beings such as vulnerable population, or community asserts which are

often termed as critical asserts. Therefore, identifying these vulnerabilities and measuring the risk involved strongly prepares communities to be more resilient and sustainable. This goes a long way to saving lives and properties, strengthening economic growth, and ensuring livable communities.

As communities are all susceptible to the intricacies of such natural hazards like flooding, it is imperative to proactively learn lessons from the painful experience of others to better protect our communities in the case of such events. Therefore, the purpose of this paper is to study, evaluate, and draw lessons from the disaster recovery plan of the city of Denham Springs in Livingston Parish, Luisiana. Denham Springs was one of the over 20 communities that were impacted by the 2016 Louisiana flood. Denham Springs is a vibrant historic city with a population of about 9,321 people, and a median age of 44 years. The disaster recovery plan describes the city as "Denham Springs is a family-focused, well connected, clean, safe, active and resilient community." (Clark, 2017) On the economic front, the median household income in the is $71, 616 and a per capita income of $35,451 (ACS-23 5-year estimates). On average, a housing unit in the city is valued at $223,796. About 5.8% of its residents are living in poverty. On race, 70.6% are whites, 12.6% Hispanic, 9.9% Black, 6.1% with two or more races, and other races are about 0.4%. Hypothetically, these features of the city are way similar to our city, which justifies it to be studied as the lessons from the study could be justifiably replicated in our city. Hence the choice of Denham Spring as case study and considering our shared characteristics and their long-standing experience (9 years) in dealing with flood impacts and recovery.

3. Disaster Description

This historical catastrophic flood that left an unforgettable memory for the people of Denham Spring and Louisiana at large started as a storm system that formed in the US Gulf Coast region during the second week of August. This storm caused heavy precipitation in south Louisiana, namely in the area in and around Livingston Parish (Van Der Wiel et al., 2017). The three days of August 12–14 had the maximum precipitation concentration. The storm's largest total precipitation magnitude and widest surface region of intense precipitation occurred on Saturday, August 13. The unified gauge-based gridded analysis of daily precipitation by the National Oceanic and Atmospheric Administration (NOAA) Climate Prediction Center (CPC) shows 25° × 25° km area boxes with precipitation maxima up to 534.7mm (21.1 inches) over the course of three days.

This intense rainstorm was followed by historic freshwater floods in the area around Baton Rouge and Livingston parish, of which Denham Spring is part of. According to preliminary reports from August 18, 2016, stream gauges overseen by the United States Geological Survey (USGS) registered above flood stage levels at 30 locations. About 50 of the 261

locations in Louisiana were submerged by the floodwater (Burton and Demas,2016). This was a complicated occurrence in which rivers reacted to both upstream and downstream circumstances and local precipitation. Amite River water levels farther downstream surpassed both the previous height record (established on April 25, 1977) and the National Weather Service's flood levels from August 13 to 23. Since drainage from the Comite and other upstream streams reached peak flood stage days earlier, their levels decreased more slowly and did not drop below flood stage until late on August 23 (Burton and Demas, 2016). further exacerbating the situation for places such as Denham Springs as the river forms part of its boundary to the west. Figure 1 show the Amite watershed in Louisiana, and sub-watersheds.
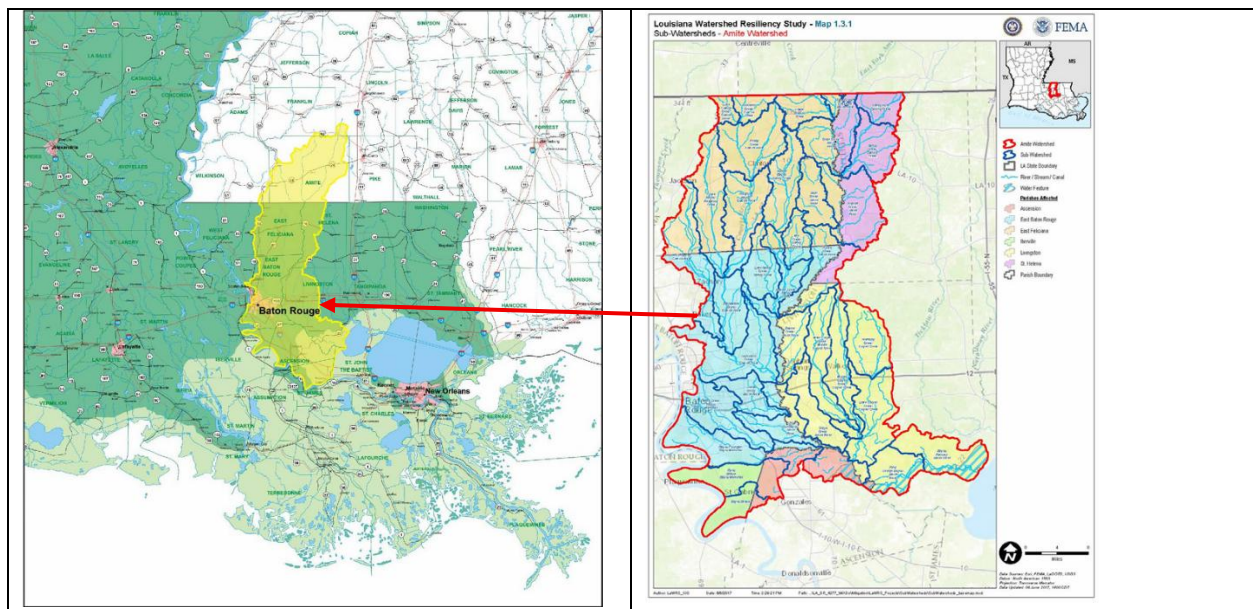

Figure 1: Location map of Amite river basin/watershed.

Sources: Drainage and water conservation district, Baton Rouge, Louisiana and Baker strategic recovery plan.

4.1 Disaster Impacts on Denham Springs

According to the city, Denham Springs was more severely affected by the historic August 2016 flood than other southern Louisiana towns. The flood immediately impacted about three-quarters of the city's residential buildings, which made up a significant chunk of the property tax base. To this effect, numerous residences were damaged and people displaced. It is estimated that the rainfall in Denham Springs was up to 25.75 inches. Due to this, the Amite River rose reaching a record level of 42.6 feet which overwhelms and outpowered community. Thousands of people were left stranded with rescue teams including law enforcement and other rescue agencies being overwhelmed by the situation. The Denham Springs Police Department, Water Department, Street Department, two fire stations, Animal

Shelter, and the City Hall were all flooded, leaving rescue equipment damaged. Moreover, all schools in the city were flooded.

In the cause of this flood, a total of 4,025 structures were affected. Out of this, 3,114 were damaged, which is about 77%. Moreso, about 508 damaged structures could cost more than 50% of their market value. Considering the fact housing structures dominate the city, assuming 70% (2180) of this structure where houses, and taking into consideration the average house value in the city is $223,796. This shows that it is costing more than $487,875,280. This when calculated with other costs might have cost the city millions of dollars. However, these assumptions are made to quantify the financial cost of the level of destruction that happened, because there is no available data for this purpose. Fortunately, in the case of all these destructions, no single life was lost in Denham Springs. However, as already discussed, vulnerable populations are largely affected in the case of these catastrophic events, and Denham Springs was not an exception. Figure 2 shows the map of Denham Springs being submerged by the flood water, and figure 3 present galleries of the level of destruction.

4.2 Immediate interventions

In the heat of this, workers on essential services such as water, gas utilities, and wastewater remain resilient and committed, working around the clock to ensure the continued supply of these services. These services were powered by power generators. In the rescue of people from their homes, volunteerism took a center stage. In addition to the efforts of public safety and rescue personnel, local boat owners in the city, often called Cajun Navy, volunteered to rescue and transport stranded individuals to nearby highlands. Owners of houses that were not flooded offered and hosted friends and relatives. However, the impacted population outweighed the available volunteers. A year after the flood, many people were still living in temporary shelters. Unfortunately, the fact the fact the flood was widespread beyond the 100-year floodplain, it caused huge impact on large proportion of the population because they did not have flood insurance. This reaffirms the crucial need for flood insurance.
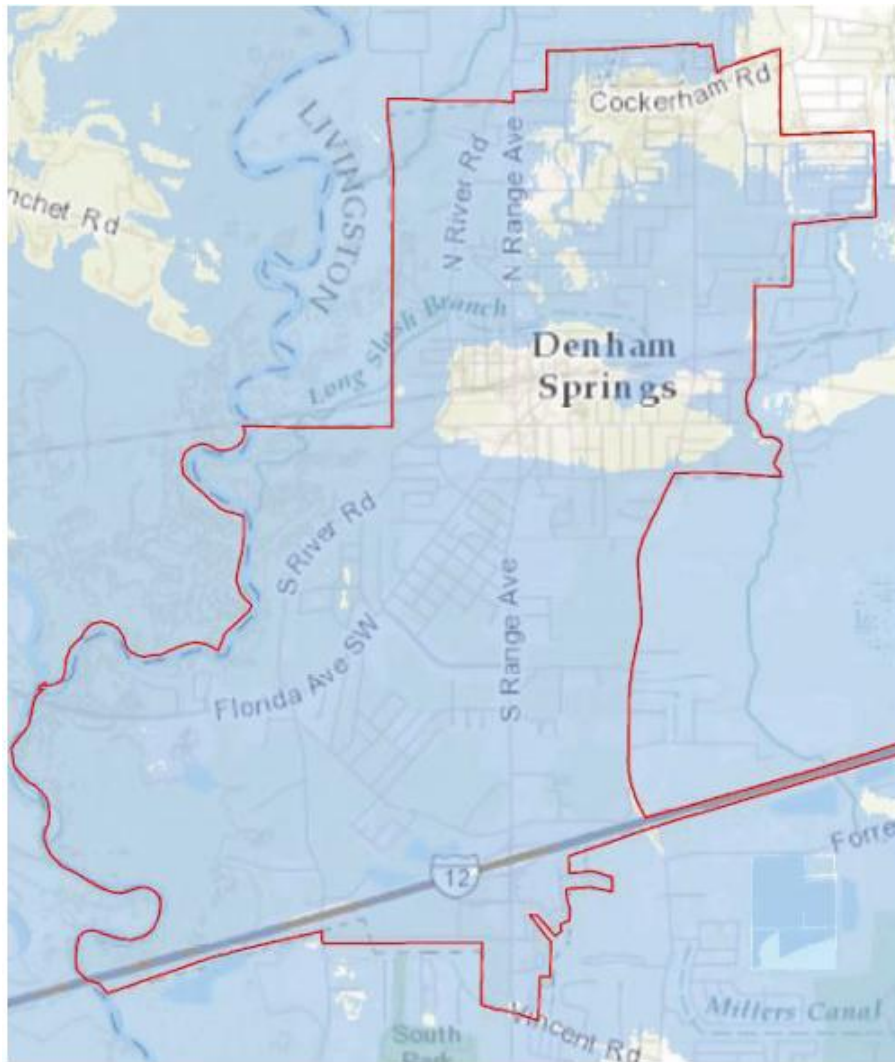
Figure 2; Flooded areas in Henham Springs

Source: Long-Term Community Recovery Plan, 2017.

Figure 3: Denham Springs flood galleries

Source: Long-Term Community Recovery Plan, 2017.

How the community developed the recovery plan

The Denham Springs Long-Term Community Recovery Plan was done through a careful, collaborative, and data-driven approach consistent with recognized national recovery frameworks. Frameworks such as the National Disaster Recovery Framework (NDRF) was adopted by using mainly the framework's six Recovery Support Functions for organizing, assessing needs and identification of recovery project goals. This integration with the

national tenets of recovery is important, demonstrating the importance of recovery communities adopting defined frameworks, which provide for a well-integrated long-term recovery process, as well as better intergovernmental recovery dynamics.

Most importantly, the planning process was informed by a robust engagement strategy. More than 1,000 community members were involved through 84 subcommittee meetings, community assemblies, interviews, focus group sessions, and online engagement, which indicated the high level of civic engagement of the community members in the future of their own community. According to the literature, stakeholder engagement through participatory planning practices brings about the benefits of legitimacy, alignment, and resilience, especially in disaster recovery planning. Denham Springs, accordingly, addressed this issue by ensuring resident inputs influenced project prioritization, vision, and issue identification. The recovery plan, hence, was not only a paper-based document, which is often the expectation of the federal administration, but also a representation of a common identity that springs out of shared experiences and visions. The community vision states that "Denham Springs is a family-focused, well-connected, clean, safe, active, and resilient community."

Who was in charge, and how the recovery was organized

The Denham Strong initiative, which included community members and city staff served as the leading body that coordinated the recovery planning process. This committee was created specifically for this purpose. However, the city mayor, the city council, and community recovery coordinator strongly supported this committee. This recovery organizational structure complies with a fundamental recovery principle, which states that political will and a distinct organization capable of coordinating many stakeholders are both necessary for long-term recovery as required by FEMA.

In order for experts, members, and partners to plausibly evaluate problems and suggest solutions, the recovery process was structured operationally around thematic subcommittees for the following major sectors: Community Planning, Housing, Economic Development, Infrastructure, Natural and Cultural Resources, and Health and Social Services. This strategy is based on best practices that have been developed elsewhere, such as in disaster-affected areas of the nation, such as the cities of Cedar Rapids, Iowa, and Joplin, Missouri, where recovery coordination for various sectors brought local objectives and federal assistance funds into alignment. Figure 4 presents a picture of the Denham Strong team.

Figure 4: Denham Strong Team

Source: Long-Term Community Recovery Plan, 2017.

What mitigation measures were included in the recovery plan

The recovery strategy for Denham Springs incorporates 24 mitigation actions projects that take into consideration short-term recovery strategies and long-term strategies for come a stronger come back and to minimize risk. Key among these approaches is the focus on stormwater management. This has been identified by the residents of Denham Springs as the number one issue for recovery. The strategies used for mitigation include the update of the stormwater ordinance, the design of the drainage master plan, the encouragement of green infrastructure, and regional coordination efforts for the Amite River Basin, which reflect the current best practices for flood mitigation on a watershed scale. Such approaches specifically take into consideration the hydrological system risks that contributed to the flood of 2016.

Additional other mitigation and recovery actions identified and included are Improve Blighted Properties; Utility Resilience; Protect Critical Facilities; Enhance Community Planning ; Emergency Preparedness; Improve Communication Systems; Improve Communication Systems; Increase Services And Activities For Youth; Support Food Distribution Programs; Attract Additional Health Services; Increase Opportunities For Affordable Housing ; Protect And Maintain City Infrastructure; Improve Street Safety And Mobility; Revitalize Florida Boulevard; Main Street Revitalization; Enhance The Farmers' And

Artisans' Market; Park Enhancement And Beautification; Shop Local Campaign; Local Trolley Loop; And Triangle Business District.

As noted, besides physical approaches, the recovery plan utilizes policy-based mitigation strategies, for example, the formulation of a comprehensive plan, the enhancement of zoning ordinances, and improvements in development ordinances that will diminish the use of impervious surfaces and promote disaster resilient urban design. Additionally, the recovery plan documents mitigation strategies concerning critical facilities and utilities, for instance, the enhancement of control structures, the use of backup power, and the floodproofing of critical facilities, most especially power infrastructure.

How the community was involved in recovery planning

Community engagement is one of the major underlying facets of the recovery efforts in many recovery planning efforts as required by best practices. In Denham, involvement of the residents is well-emphasized in the recovery plan. The planning committee took input from over 1,000 residents. These community engagements included community meetings, subcommittees meetings, interviews, focus groups, and Web-based engagement (through social and traditional media). The wide-scale engagement of the community resonates with findings in literature that emphasize comprehensive engagement efforts in planning contribute to increased buy-in, better representation of priorities, and ultimately better long-term recovery outcomes. The community's participation also helped formulate the vision statement: "family-focused, well-connected, clean, safe, active, and resilient," which acted as the guiding principle for project selection.

Additionally, the direct engagement of the community helped shape the priorities of the project. The residents considered the need for management of stormwater their prioritized need, which placed flood mitigation projects at the top of the list of recovery processes. This fits well with the idea that local knowledge, or practical experience, is a very important type of expertise, especially in relation to knowledge of disaster impacts, which cannot always be identified through expert analysis. The volunteer-based approach of the Denham Strong initiative suggests that the community has good social capital, which is considered a good indicator of the rate of recovery.

Significantly, the plan also records engagement with particular stakeholder segments, including youth, businesspeople, social service organizations, and vulnerable sectors. This multi-cohort stakeholder approach reveals the recognition that the effects of disasters vary demographically and that it is necessary that these differences are factored during the recovery process. Overall, the level of engagement with the community reveals that a stakeholder participation brings about legitimacy and resilience, along with recovery

strategies that meet the needs and aspirations of the community. Figure 5 below shows a picture at a community engagement during the planning process.

Figure 5: Community engagement

Source: Long-Term Community Recovery Plan, 2017.

How effective the recovery process and plan was in building community resilience

It is observable that the recovery phase made significant strides in bolstering the resilience of Denham Springs by integrating short- and long-term recovery goals. The fact that the Denham Springs Recovery Plan integrates flood recovery, disaster resilience, and community development initiatives explains the multi-prong strategy that aligns with resilience concepts, which view the recovery of communities through the integration of physical, social, and economic systems. Initiatives that enhance drainage, utility resilience, and the resilience of critical facilities actually make the community less vulnerable and more resilient for the 'next disaster' that may strike the community.

This process also helped enhance resilience at the institutional and societal level. By fostering decision-making through communal interaction, societal committees, and engagement, the community developed governance systems that could effectively deal with the recovery process over time. Studies have shown that resilience needs equal attention to institutional, social, and infrastructural development (Sellberg et al., 2018). By fostering the Denham Strong, partners, the volunteers, and the involvement of the residents, the community developed their social capital, which is very important for the recovery phase. Finally, the plan highlights the lessons that have been learned, which include better emergency communication and readiness, showing the learning approach needed for resilience.

However, the city also recognized that it is resource-constrained. the main funding source for most of their projects is FEMA Public Assistance program. The implementation will

require commitment and cooperation between governments and private partners. The resilience that is developed, therefore, not only a wishlist but also depends on follow-through steps and commitment. However, the recovery process offers a great example of how it is possible for resilience to be developed through approaches that are community-led.

Conclusion and recommendations

Even though the recovery plan provides a clear path for the future of resilience, it also highlights important pre-disaster vulnerabilities that made the 2016 flood effects worse. For instance, the recovery plan highlights that the main vulnerabilities identified for the area are the old zoning ordinances, the need for better stormwater regulations, poor drainage infrastructure, and the fact that there is not a comprehensive plan for the area. Such foundational disaster recovery strategies are important because, without them, the effects of the floods, especially the areas that experience rapid growth, could have been minimized. According to best practices, the use of land use strategies that prevent development in flood-prone areas, together with the use of green infrastructure, is among the strategies that can provide the greatest flood mitigation for the lowest cost.

Shortcomings in emergency preparedness were also identified among the factors that make the community vulnerable. According to the recovery plan, the community lacks the capability for flood warning systems, the development of the Emergency Operations Plan specifically for the city, and the availability of communication systems. These strengthens emergency response. It is, therefore, essential that warning systems, emergency personnel training, and recovery ordinances regarding floods get the needed attention for pre-disaster investment. Inconsistencies in the availability of flood insurance beyond the 100-year flood plain also highlight the need for better risk communications. There also the need for better collaborative relations with other cities or states, that could be of aide in terms of shelter, food, and rescue equipment.

Notwithstanding, it is commendable that their water, gas, and wastewater infrastructure were resilient and continued to operate regardless of the devastating nature of the flood though they were powered by a generator. Overall, the disaster recovery plan clearly shows the need for resilience building prior to the occurrence of a disaster. However, according to the Denham Strong website, most of the major projects have not been done. For instance, they still don't have a comprehensive plan, and they have not completed the stormwater management project.

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