

Chapter 12

Regional Resilience: Building Adaptive Capacity and Community Well-Being Across Louisiana's Dynamic Coastal–Inland Continuum



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12.1 Introduction

Climate change impacts pose significant risk to both coastal and inland communities. This is particularly true in Louisiana, which has lost 1900 mi² of coastal wetlands since 1930, and another 1750 mi² are estimated at risk of loss over the next 50 years (Couvillion et al. 2017; CPRA 2012, 2017b). Coastal Louisiana is a young and dynamic landscape, built over the last 8000 years through regular Mississippi River spring floods, which left rich sediment behind as the waters receded (Couvillion et al. 2017). As the river migrated east or west searching for the path of least resistance to the Gulf of Mexico, wetlands developed along coastal edges, bayous, and estuarine landscapes (see Fig. 2.2 in Boesch). Land loss is a result of several complex factors, but the primary culprits are levees separating the deltaic plain from the sediment-rich Mississippi River, hydrological alteration from oil and gas exploration, and accelerating eustatic sea level rise (Day et al. 2007).

Land loss is profoundly changing the nature of Louisiana's social and natural environments, and diminishing many of its benefits, including storm protection, fisheries habitats, and distinct cultural practices (Costa 2018; Groves and Sharon 2013). Land loss increases community flood risk because healthy coastal wetlands, swamps, barrier islands, and ridges provide a critical buffer against slow-onset and abrupt climate change impacts. While migration away from the most vulnerable areas is ongoing, 47% of Louisiana's population still lives in the coastal zone.

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When extended to encompass coastal watersheds, more than 70% of Louisiana's population are coastal dwellers – in large part because this is home to the bulk of the state's economy. Louisiana's coastal zone is a major locus of seafood, oil and gas, maritime, and petrochemical industries for the nation – what Laska et al. (2005) refer to as “immovable industries.” This includes major cities, vast suburbs, and small villages along south Louisiana's rivers and bayous – all of which rely on healthy coastal marshes and forests for flood protection. Coastal flood risks include sudden catastrophic impacts from tropical storms and hurricanes, as well as less severe but more common blue sky tidal flooding exacerbated by low topography, relative sea level rise, and land loss.

Inland communities far from the coastal edge but connected ecologically, infra-structurally, and culturally as part of the Lower Mississippi River Delta Plain also face risks from severe rain that overwhelms riverine floodplains. This is exacerbated by the increasing convergence of coastal and inland processes from a retreating coastline (Birch and Carney 2019). This was made apparent by a series of floods experienced by inland communities across the state from March to August 2016. Research across disciplines suggests these impacts will continue to increase in frequency and intensity over time (Kolker et al. 2011; Prein et al. 2016; Vermeer and Rahmstorf 2009). However, entrenched industry coupled with residents' deep place attachment developed through generational tenure and intimate knowledge of local environments requires adaptation for survival in the face of coastal change (Burley et al. 2007). Sustainability of the overall ecological, infrastructural, economic, and social systems of this and other coupled coastal–inland regions rely on local capacity for incremental adaptation and replicable design strategies, in addition to the larger-scale structural protection and ecological restoration efforts.

In the face of these challenges, the Louisiana Coastal Protection and Restoration Authority (CPRA) developed *Louisiana's Comprehensive Master Plan for a Sustainable Coast* (2017 Coastal Master Plan), defining a 50-year strategy for coastal flood risk reduction and sustainable natural landscape production. The Master Plan reflects the state's environmental complexity and climate change reality, proposing economic, ecological, and hydrological adaptation priorities to ensure long-term coastal resilience and viability. Built on a platform of infrastructural protection, hydrological and ecological restoration, and hazard mitigation, the plan proposes to reduce community and economic risk through engineered defenses, both built and natural. However, a heavy reliance on ecological and engineered solutions calls into question whether the Master Plan provides an effective framework for community-scaled resilience. This chapter highlights resilience thinking as a critical but underdeveloped element of risk reduction and protection in the state. Coordinated community planning and innovative design may hold the greatest long-term risk reduction potential against the impacts of climate change but are generally underutilized (Lyles et al. 2014). This chapter examines coastal design and planning in Louisiana, providing an overview of existing large-scale efforts with an eye to their achievements and barriers. Further, there is an investigation of current community-based frameworks addressing resilience and adaptation gaps at the architectural, neighborhood, and community scales. Finally, the authors identify

points of opportunity to further integrate community planning and design into the coastal protection and restoration framework to protect the health, safety, and welfare of coastal and inland communities. While Louisiana's situation is extreme (in both the scale of the problem and the extent of the proposed solution), it provides a meaningful bellwether to planners, designers, and others for identifying both coastal vulnerability, restoration approaches, and community level impacts. As coastal hazards increase, regions from Texas to New York are contemplating large-scale restoration and protection efforts proportional to those in Louisiana, and much can be learned from this experience.

12.2 Literature on Resilience Thinking for Community Resilience and Adaptation

In the face of increasingly costly human and environmental disasters, resilience has risen to prominence in community planning and design scholarship related to mitigating hazards and enhancing capacity to cope with environmental change and disturbance. While a recent addition to the disciplinary lexicon, it is not a new concept. Coming from the Latin root *resi-lire*, meaning to spring or bounce back, it was first used by physical scientists to describe the stability of nonliving materials and resistance to external shocks. Through this lens, resilience measures structural elasticity and the speed by which an engineered design returns or bounces back to a previous equilibrium after a disturbance (Gunderson 2000). It is widely recognized that Holling (1973) extended the concept of resilience to include ecosystem stability and change. Rather than bouncing back to a previous state, Holling (1973, 1996) emphasized ecological complexity and the evolutionary capacity of natural systems to adapt and transform over time. Hence, this measure of resilience rejects a single state of equilibrium, measuring not just how long it takes a system to return to resume normal functions but also how much disturbance a system can take before it fundamentally changes (Davoudi 2012). Davoudi (2012, p. 301) notes what underpins both perspectives is the “belief in the existence of equilibria in systems, be it a pre-existing one to which a resilient system bounces back (engineering) or a new one to which it bounces forth (ecological).” An increased awareness of the interconnections between environment and society, resilience has since been redefined and extended to encompass ecological, socio-ecological, and economic systems (Folke 2006; Holling 2001; Walker and Salt 2006). Equilibrium resilience has been highly influential across a range of social science disciplines, including environmental psychology, economic geography, disaster studies, and environmental planning, as a way to predict or model socio-ecological change.

Resilience thinking proposes a systems approach to human–environmental relations, having evolved mainly through the application of ecological concepts to social systems (Cote and Nightingale 2012). Resilience thinking emerged out of a dissatisfaction with models of ecosystem dynamics that (a) focused too heavily on

a return to previous states and (b) paid too little attention to interactive dynamics between human and biophysical systems (Berkes and Folke 1998; Berkes et al. 2000). Within this work, humans and their environment are not conceived as separate systems but rather as a single dynamic, adaptable, and interrelated socio-ecological system (SES). In this perspective, resilience is understood not as a fixed asset, but as a continually changing process as systems are confronted with disturbance and stress. This means that, for example, people might become more resilient not in spite of adversities but because of them. Emphasis on the fundamental role of adaptive capacity and transformation in the analysis of SES allows change to happen and systems to adapt rather than trying to control and avoid it (Folke et al. 2010).

Within resilience and SES thinking, there is a recognition that resilience is an important counter-narrative to conventional anthropocentric approaches such as “maximum yield” or “carrying capacity,” which separate human actions from ecosystem impacts. As noted by Cote and Nightingale (2012, p. 478), resilience thinking plays an important role in shifting the focus away from the quantitative availability of resources and toward a more dynamic and forward-looking approach to human–environmental change that is defined by ecological rather than political boundaries. Innovations in resilience thinking provide genuine promise to the domain of planning for changing urban and environmental conditions. This is due mainly to the field’s emerging commitment to complexity as seen through the integration of a diversity of knowledge holders (Cote and Nightingale 2012).

While expressed in new nomenclature, the resilience discourse is in fact similar to the positivist methods applied across the planning fields to address urban infrastructure (Mehmood 2016). Planning is inherently a systems-based endeavor – promoting the scientific, aesthetic, and orderly disposition of land, resources, facilities, and services with a view to securing systemic physical, economic, and social efficiencies. In particular, land-use planning and design is intended to promote more desirable social and environmental outcomes while minimizing conflicts between uses. However, within multijurisdictional regions, planning is also highly fragmented across decision-making bodies with different goals. Each has authority to determine its own land uses, development practices, and management strategies to achieve locally determined objectives. Financial solvency, for example, is a primary concern of each jurisdiction and results in radically different land-use strategies. As noted by Brody (2008, p. 21), while natural systems are “intricately connected over broad spatial and temporal scales, the land-use decision-making framework is limited to local jurisdictions and some limited input from regional planning councils. Uncoordinated local land use decisions have cumulative negative impacts on the system as a whole.” Fragmented planning has often yielded undesirable results including wasteful land-use patterns, degraded air and water, loss of biodiversity, displacement of the poor, and natural disaster losses. Also noted by Brody (2008, p. 22) is that “having the ability to look at the entire ecological system, even if it extends beyond a planner’s jurisdiction is a critical aspect to effectively managing ecosystems.”

While the translation of resilience from ecology to social systems can be problematic, as we will discuss, it provides a framework to embrace complexity and extend planning boundaries to ecosystems rather than maintaining the politically defined units that perplex planning. The incorporation of adaptation and transformation as the rule rather than the exception undermines the assumptions of the steady state on which the linear extrapolations of planners often rely. This provides opportunities for collaboration and innovation as components of any system must be conceived to allow change to happen, rather than requiring control to avoid it (Davoudi 2012).

Another promising aspect of resilience thinking is the genuine commitment to integrating professional disciplines and nontraditional stakeholders. Resilience scholars recognize that an ecosystem of knowledge includes information and experiences from researchers and decision-makers, as well as knowledge gained through extensive personal observation shared among local resource users. The inclusion of local ecological knowledge (LEK) is key to understanding ecological and institutional change, which can in turn modify the way resources are managed, and thereby the landscape itself (Berkes and Folke 1998; Folke 2006; Cote and Nightingale 2012). LEK is a cumulative body of knowledge handed down through generations about the relationship of living beings (including humans) with one another and with their environment (Berkes and Folke 1998, p. 3). The use of LEK in coordinated land-use and community design can play a key role in augmenting ongoing scientific modeling efforts, galvanizing support for coastal restoration projects, employing traditional adaptive measures, and developing compromises given the reality of limited resources (Tompkins et al. 2008). LEK builds upon the historic human experiences and adapts to social, economic, environmental, spiritual, and political change. Grumbine (1994, 1997) notes that ecosystem management must include recognition that people are embedded within natural systems and that societal values play a dominant role in ecosystem management. Ecosystem frameworks entail understanding natural system properties and processes and understanding systems as dynamic while promoting stakeholder engagement and coordination between partners (Armitage et al. 2009).

While there is great promise, it is important to note that the application of ecological concepts to social concerns in the name of resilience problematically assumes that social and ecological dynamics are essentially similar. Recent extensions of ecological resilience to social systems have given rise to the concept of social resilience, defined as “the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change” (Adger 2000, p. 347). The rise of social resilience in theory has also given rise to critical literature due to the perceived overemphasis on the role of physical shocks and an underemphasis on history, economy, and power dynamics that perpetuate inequality (Davoudi 2012; Fainstein 2015). In ecological literature, there are no rewards or punishments, just consequences. In society, there are always rewards and punishments. Resilience building means that some will gain while others lose. Cote and Nightingale (2012, p. 475) argue that an analysis of the SES capacity to adapt and change must be framed within an understanding of cultural values,

historical context, and ethical standpoints of the kinds of actors involved. It is less about “getting the rules right” and more about subjective identities, effective relationships, and lay knowledge as a better way of understanding human–environmental processes and change – the resilience of what and for whom. Planners and designers must engage in discussions of power and social difference that are central to critical social science research, because resilience planning has as much to do with who shapes the challenges as it does how to responding to them (Davoudi 2012). With regard to community development, the heavy focus on adaptive capacity is more likely to encourage small incremental change rather than significant systemic transformation, which disadvantages socially marginalized groups (Cretney 2014).

While reconceptualization of planning to embrace some sort of evolution and change broadens the potential for resilience thinking across disciplines, some argue clarity and practical relevance have suffered (Brand and Jax 2007; Cutter 2016a; Davoudi 2012; Fainstein 2015). The intent and foundation of resilience as both a state of bouncing back and jumping forward has given way to a blending of contradictory descriptive aspects that make definition, operationalization, and assessment difficult – what Markusen (2003) refers to as “fuzzy conceptualization.” Cutter (2016b, p. 110) observes “such vagueness has its merits, especially in the policy world where the goals and motivations of proponents are highly variable and politicized.” However, Markusen (2003) points out that fuzzy conceptualization also makes implementation challenging. Matyas and Pelling (2014, p. S1) note the ambiguity surrounding resilience means “it is a concept caught between the abstract and the operational.” From the planning and design perspective, resilience frameworks call into question whether traditional planning tools (i.e., toolkits, etc.) are adequate to address complex challenges – or whether they are doomed to solving yesterday’s problems (Taylor 2005). Others note that malleability creates flexibility and opportunity to foster communication between science and planning practice (Brand and Jax 2007; Davoudi 2012).

Communities, however, face challenging economic, social, and environmental changes requiring attention. There is a growing need for effective ways to support adaptation-related decision-making due to both slow-onset and rapid environmental change. Government agencies, businesses, and individuals increasingly find themselves fundamentally unprepared for meeting the challenges of climate change. Typically, local decision-making such as infrastructure construction and the types of zoning and development regulations implemented assume environmental stability. Yet many coastal and inland communities are faced with increasing uncertainty and vulnerability associated with climate change. Local governments also have core regulatory powers in the land-use, transportation, and waste sectors critical to comprehensive climate change responses (Trisolini 2010). Building flexibility, adaptability, and durability into local decision-making is key to building resilience (Beatley 2009; Godschalk 2003; Vale and Campanella 2005). The National Research Council (2012) notes enhancing community resilience and sustainability requires both “bottom-up” approaches at the individual and community level and the “top-down” strategies at the federal and state levels. Further, Beatley (2009) notes the

qualities of resilient communities include hazard mitigation of the built environment, strong and diverse economic conditions, and a robust social infrastructure including strong social systems and networks. The following discusses how the State of Louisiana is attempting to build resilience into ecological and social systems through both top-down and bottom-up approaches.

12.3 Louisiana's Comprehensive Master Plan for a Sustainable Coast

As early as the 1970s, researchers and coastal residents recognized that flood protection and industrial interventions in the Louisiana landscape were increasing coastal land loss (Barrett 1970; Chabreck 1972; Gagliano 1973; Gagliano and Van Beek 1975). In response to land loss, Louisiana has developed a series of restoration plans since the 1990s prioritizing hydrological and ecological restoration as the centerpiece of ecosystem management (CPRA 2007, 2012, 2017b; LCWCRTF 1998; USACE 2004). Each successive plan has added new data, science, and innovation to emphasize the perilous state of the coast and the need for restoration to prevent total ecological and economic collapse (CPRA 2017b, p. ES-10). However, the dual impacts of Hurricanes Katrina and Rita in 2005 proved too much for established coastal governance in the state. After these devastating impacts, which affected coastal and inland communities alike, Louisiana consolidated the tasks of coastal restoration and hurricane protection under one agency called the CPRA. At the same time, the state redefined the coastal zone to include all lands subject to storm or tidal surge. The expanded inland boundary was determined by a range of landscape-based calculations (e.g., tidal influence, vegetation, topography) and varies from 20 to more than 100 miles inland (La. Rev. Stat. § 49:214.24 2015) (see Fig. 7.3 in Chap. 7.)

The authority to *protect* coastal property and *restore* coastal ecosystems first came together in CPRA's 2007 *Louisiana's Comprehensive Master Plan for a Sustainable Coast* (2017 Coastal Master Plan) and has been expanded in subsequent 5-year updates (2012 and 2017). The Master Plan builds upon the Multiple Lines of Defense Strategy, which proposes a coastal management structure of both natural and man-made features to hold back storm surge, maintain threatened habitats, and promote landscape resilience (Lopez 2009). Written primarily by engineers and ecologists, somewhat logically the Master Plan embraces both the "bounce-back" and "bounce-forward" resilience scenarios of its authors (Bahadur et al. 2010; Pendall et al. 2009). In particular, coastal protection measures are designed to resist storm impacts and maintain structural integrity, while enhanced coastal landscapes can adapt and transform over time to absorb climate change impacts. There are eight protection and restoration typologies (Fig. 12.1) providing a range of proposed projects phased in near- (1–10 years), mid- (11–31 years), and long-term (31–50 years) timeframes. Projects in the near-term are relatively close to engineering and

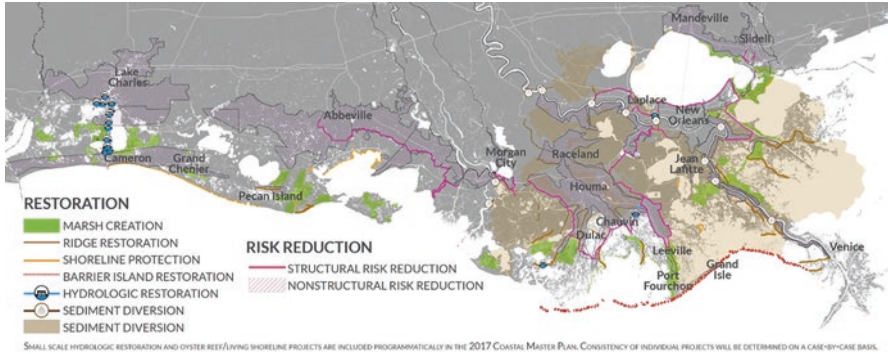


Fig. 12.1 2017 Master Plan proposed projects. (Image source: Louisiana Coastal Protection and Restoration Authority (CPRA))

construction, while middle- and long-term proposals are more speculative. The effort is supported by state and federal resources, but settlements from the 2010 BP oil spill provide a significant down payment of \$8B on the plan's \$50B price tag. Following the 2012 Master Plan, the CPRA estimates roughly \$1B annually has been spent on restoration and protection measures across the state's coastal zone (CPRA 2017b). As noted by the CPRA (2017b, p.ES-2), "the master plan identifies a long-term program of construction, operations, and maintenance, and adaptive management...to be implemented as funds become available." The state recognizes, however, that even if all Master Plan projects are implemented, land will continue to erode and landscapes will change in unexpected ways due to impacts from restoration projects (CPRA 2017b). Further, risk to both coastal and inland communities will continue as coastal waters encroach and thus stronger, engineered protection measures will be needed to maintain community and economic interests in the coastal zone.

The Master Plan takes a systems approach to coastal restoration and management, broadening the scope of traditional coastal planning to consider a wide range of ecological and economic interactions within an ecologically defined region (Boesch 2006). Restoration and management units are defined by watershed and habitat boundaries and functions rather than political designations, requiring greater intergovernmental coordination to manage complex restoration scenarios. The Master Plan computationally models, synthesizes, and evaluates projects designed to protect coastal infrastructure, habitats, and settlements against natural hazards (Groves and Sharon 2013). Restoration actions are intended to reestablish coastal landscapes to protect regional ecology and major economic interests (Colten 2017). This ecosystem approach emphasizes regional biophysical ecology and hydrologic processes, but has generally not been expanded to include social and cultural dimensions (Colten 2017; Peyronnin et al. 2013). While significant scientific knowledge of landscape change is employed to project how the natural system – hydrology, flora, and fauna – will transform and adapt, the properties of human-centered systems are far less studied and modeled in a systems context. Structural protection

focuses on building or enhancing physical barriers against storm surge and sea level rise to protect existing communities and infrastructure. Nonstructural hazard mitigation reduces risk to human settlement through flood proofing, elevation, and limited voluntary acquisition of at-risk structures (CPRA 2017b, p. ES-15). Yet there are few if any proposed changes to traditional community development patterns or future growth scenarios. CPRA contends this is the largest risk reduction program in the country, recommending mitigation of 26,000 structures coast-wide – with an estimated \$6B price tag (CPRA 2017a, p. 18). Unlike other proposed Master Plan projects, however, community-based components are voluntary, relying on local political will and policy change for implementation. A number of problems emerge from this strategy, including a lack of planning and design capacity in underserved communities, disincentives for local communities to reduce population in the floodplain and potentially displace residents from their community, and a dearth of accurate information related to environmental and social conditions. Further, no funds budgeted for coastal protection and restoration have been awarded for nonstructural projects since 2007. And it is unclear whether BP oil spill funds will be dedicated to this effort. Using federal disaster recovery funds appears to be the only possible source.

To support the Master Plan, CPRA developed a modeling approach reflecting both the environmental complexity and climate reality of the state (Groves and Sharon 2013). Modeling efforts reflect ecological, hydrological, and geological components of the region, but there is no comparable accounting of acceptable restoration compromises given limited resources or societal disruptions that will accompany ecological restoration. Local community members often possess abundant ecological knowledge. As noted by Burley (2010), Louisiana is one of a handful of locations in the USA where most trace their familial ties generations back, and many are engaged in natural resource-based activities providing a lifetime of environmental observation and experience. However, current models of stakeholder engagement generate extensive transcripts of public opinion but are limited in terms of scope and genuine stakeholder contribution (Bethel et al. 2014). Public meetings often present technical information in a form to which laypersons do not easily relate and in an atmosphere that can limit useful input into the process – a complaint voiced by residents regarding the 2012 Coastal Master Plans (Colten 2014). As a result, public hearings and stakeholder group meetings may do little to empower the public in helping to shape decision-making. Further, there seems to be an increasing mistrust in scientific findings about resource management. Such skepticism undermines the public perception regarding the integrity of scientists and the scientific process (Ko et al. 2017).

A resilience thinking approach to Louisiana's coastal ecosystem therefore involves not only a shift in resource management practices but also a fundamental restructuring of the historical practices of community engagement, land use, and urban design (Beatley 2000; Brody 2003; Montgomery et al. 1995). The ability to overcome the politics of land use and the exclusion of local knowledge holders to achieve collaborative solutions will be the key to successful ecosystem restoration and community resilience in the coastal zone. While some states provide mandates

and resources for local planning and design, the majority (including Louisiana) leave decisions of land use and community development to local authorities. The Master Plan (2017a, p. 4) fully supports local planning, recognizing that improved land use and community design “should emphasize resilience, systems thinking, community engagement, equity, implementation, and adaptation in order to meet the challenges today’s communities face.” However, a lack of dedicated funding underscores the disjunction between community resilience and an agency whose mandate and expertise are more closely aligned with engineering and natural sciences (2017a, p. 10). Rather, CPRA makes policy recommendations and calls upon other state agencies to develop programmatic initiatives and write community resilience policies. Despite statements of protection and restoration in the name of preserving coastal communities, the Master Plan’s primary focus on ecological restoration and avoidance of community-based planning and design in many ways overlooks key elements of social resilience. Colten (2017, p. 699) notes managing Louisiana’s coastal wetlands is a human endeavor, “but the responsible government bodies sometimes carry out their task as if the environmental processes they direct were detached from the local society.” Without resources and technical support for resilience, there is a lost opportunity to drive elements critical to comprehensive risk reduction, such as (1) where to (and not to) develop in coastal areas based on future loss and restoration strategies, (2) need-based capital expenditures and infrastructure investment, and (3) LEK, priorities, and acceptable trade-offs.

In Louisiana, there is much debate about governmental responsibility for working with communities on issues related to resilience and retreat. In 2010, following Hurricanes Gustav and Ike, the US Department of Housing and Urban Development and the Louisiana Office of Community Development, Disaster Recovery Unit (OCD-DRU) set aside \$10M in disaster recovery funds to enhance community resilience through innovative planning and design. This competitive grant program – a precursor to ensuing design competitions such as Resilient by Design and the NDRC – supported hazard mitigation and sustainability measures. Thirty impacted communities received funding for projects ranging from comprehensive planning and zoning to design-driven housing and water resource management. Notably, these funds were used to write the Greater New Orleans Urban Water Plan, a comprehensive, integrated, and sustainable water management strategy for the New Orleans region.

In 2016, Governor John Bel Edwards issued an executive order calling for all state agencies to align major infrastructure investments and coastal restoration objectives. This effort prioritizes interagency and intergovernmental coordination to support community planning, floodplain management, and hazard mitigation. Following the 2016 floods, the state recognized weaknesses in floodplain management that stopped at the coastal zone boundary, and it is in the nascent stages of expanding intergovernmental coordination across watersheds reaching hundreds of miles inland. In a state with a relatively weak history of planning, these are positive steps, but questions remain about which agencies and policies are capable of coordinating community resilience, floodplain management, and coastal restoration moving forward. This also recognizes that the Master Plan is not likely to be the

place where community resilience is addressed, nor is it able to address regional issues with origins outside the coastal zone. Parishes and city governments recognize a lack of capacity and resources to implement resilience planning measures within their own boundaries and little if any ability to address systems outside their jurisdiction (Manning-Broome et al. 2015). There is a call for useful guidance on impacts and mitigation measures for both projected land loss and coastal restoration measures. There is also a belief that there will be less backlash from constituents if community design directives come from the state rather than local government agencies (Manning-Broome et al. 2015). While there is a trade-off between exercising strong state government authority and allowing greater local autonomy, Louisiana has chosen the latter in matters of coastal ecosystem restoration. In light of this, it is imperative that the state establish an effective and enforceable framework supporting land-use planning, risk reduction, and the development of best practices for regional urban and ecosystem management.

Community-based planning and design are in many ways the best tools available to address regional infrastructure coordination, coastal restoration impacts, and necessary compromises that are equitable, just, and adaptable for Louisiana communities. However, traditional land-use planning is not without critiques in its ability to simultaneously address regional environmental and community development issues. In comparison with the restoration and protection processes put forth by the CPRA, there remains a question of whether traditional methods of urban planning and design are sufficiently scalable to reduce risk coast-wide. Successful solutions achieved through architecture and urban design are time intensive and unique to specific conditions of place. Often, the desirable “bottom-up” qualities of design, without a mechanism for scalability, make large-scale implementation unfeasible. Projects underway through the NDRC and research emerging from the grant *Inland from the Coast (IFC)* provide two innovative planning and design frameworks being implemented in Louisiana that may serve as precedents for others as they tackle climate change, ecological restoration, and flood recovery issues. Within the context of the Master Plan, these planning and design methodologies provide improved information and guidance related to community-level hazard mitigation, strengthening of economic conditions, and strong social network support.

12.4 National Disaster Resilience Competition: Sowing the Seeds for Adaptive Planning and Community Design in Coastal Louisiana

Following devastating disasters such as Hurricanes Katrina in 2005 and Sandy in 2012, federal, state, and local emphasis has shifted to developing community risk reduction strategies through building-, community-, and regional-scaled design. Following the success of Rebuild by Design (2013) and the ongoing 100 Resilient Cities initiative, the US Department of HUD and the Rockefeller Foundation

developed the NDRC to provide meaningful support for enhancing community resilience. NDRC was a two-phase competitive process awarding \$1B to help communities across the USA with disaster recovery and the development of replicable resilience frameworks. The competition encouraged “American communities to consider not only the infrastructure needed to become resilient, but also the social and economic characteristics that allow communities to quickly bounce back after disruption” (HUD 2015, p. 2). The competition encouraged multidisciplinary approaches that considered equity and long-term environmental stability alongside innovative engineering and design responses to hazard mitigation. In January 2016, HUD awarded the State of Louisiana \$92M to address climate change impacts in coastal communities facing sea level rise, wetlands loss, and severe hurricane damage. Of that, \$41M was dedicated to adaptation planning efforts known as *Louisiana’s Strategic Adaptations for Future Environments* (LA SAFE) and \$48M for the relocation of the Isle de Jean Charles Band of the Biloxi–Chitimacha–Choctaw tribe (See Chap. 6, Jesse, of this book). HUD also awarded the City of New Orleans \$141M for the Gentilly Resilience District – a neighborhood-scale effort to reduce flood risk, slow land subsidence, and encourage revitalization. The following provides a general overview of these efforts and how each incorporates key elements of resilience thinking.

12.4.1 Louisiana’s Strategic Adaptations for Future Environments (LA SAFE)

In its application for NDRC funding, the state recognized that structural and ecological proposals contained in the Master Plan are essential to long-term occupation of the coastal landscape, but it is also crucial to develop a process of locally determined design, planning, and decision-making (OCD-DRU 2015). LA SAFE introduced CPRA ecosystem management approaches into community-based design processes to create a replicable framework for developing catalytic adaptation projects. The community planning and design effort was led by Louisiana’s OCD-DRU in partnership with nonprofits and design professionals. The challenge facing coastal and inland planners is providing for the movement of coastal residents incrementally as land loss continues or in larger waves of migration following storms. Out-migration will have significant impact on communities as they depopulate but will also have effects across the entire state as pressures to accommodate additional population mount (see also Chap. 7, Peterson, of this book for discussion of this latter challenge). The state, through LA SAFE, recognizes the need to migrate, though this discussion has primarily focused on moving people within the coastal zone (OCD-DRU 2015). As seas rise and homes and communities are abandoned, research shows that people are likely to migrate along existing infrastructure pathways taking them inland and away from coastal areas rather than moving incrementally a few miles at a time (Black et al. 2011; Findlay 2011). Considering the flexibility and adaptive capacity of the overall coastal region requires a systems approach that considers communities as part of the complex coastal ecosystem.

Enabling communities to move within a regional network following storms, economic disruptions, or long-term change can help the region thrive even as the environment becomes increasingly dynamic.

Between 2017 and 2018, LA SAFE engaged six parishes (counties) – Jefferson, Lafourche, Plaquemines, St. John the Baptist, St. Tammany, and Terrebonne – all recently impacted by coastal storms and facing significant land loss. In a context of tremendous Master Plan investment in coastal ecosystems, LA SAFE sought to fill the gap between increased risk and the eventual benefits of coastal protection and restoration projects (OCD-DRU 2015). The program set goals to teach people about their current and future vulnerabilities: (a) build projects to address this and (b) change the minds of development community to reimagine development patterns for the long-term (OCD-DRU 2015). By 2022, LA SAFE will culminate in the construction of six adaptation projects, each developed by community-based planning and design processes within each of the six parishes. LA SAFE adopted a codesign planning process that integrated planning expertise, science, and LEK to develop a range of adaptation strategies. Meetings were facilitated by local community members to build trust and gather LEK, and proposed projects were chosen through community consensus. Projects include a business incubator, resilient housing prototypes, and a wetland education center. While most assessments of LA SAFE are favorable, there are concerns about the larger framework. First, from the very beginning, there was not the political will to cross parish boundaries or consider fundamental shifts in development patterns that might move people away from the coastal zone (Birch and Brand 2019). When faced with the realities of climate change and projected land loss, consensus between community members and decision-makers was to focus on the narrow problems of today rather than dealing with the problems of tomorrow (OCD-DRU 2015). Given the project-based nature of the funding dictated by HUD, LA SAFE projects can neither systematically address climate impacts nor breach the imperative need for large-scale resettlement. Second, the “reshape, retrofit, or resettle” concept of adaptation was developed before a series of inland floods, calling into question whether areas below 3’ BFE (Base Flood Elevation) are appropriate for densification (Fig. 12.2). The reality is that climate impacts are moving many from coastal locations further inland to urban centers such as Baton Rouge, Hammond, Lafayette, and Houston, low-lying inland communities that have flooded since 2016 due to severe rain events. As this program moves from planning to construction, additional questions have emerged about economic development priorities related to the projects, pilot project scale related to the scale of climate-related issues, and lack of overall regional coordination.

12.4.2 Gentilly Resilience District

When HUD awarded NDRC funds to the City of New Orleans for the Gentilly Resilience District, it validated over a decade of innovative water resource planning supporting the city’s ongoing recovery. Following Hurricane Katrina, New Orleans recognized the devastating impacts of the “levee effect,” where flood risk is actually

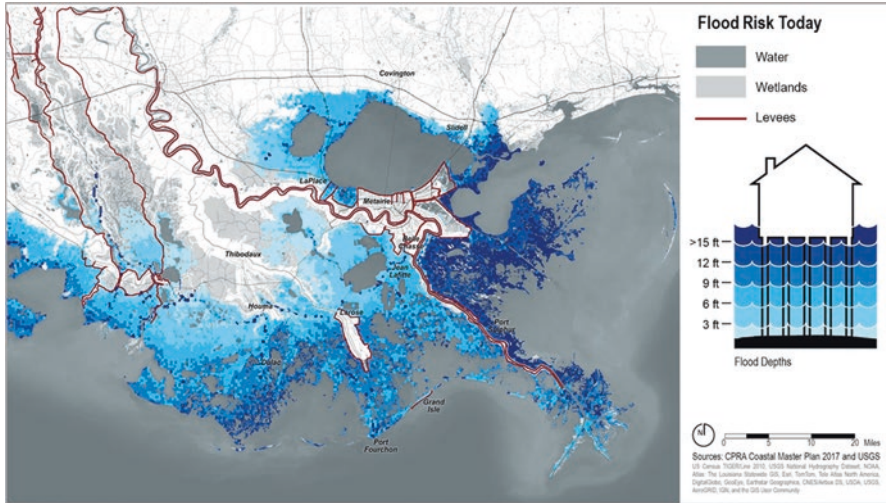


Fig. 12.2 Current flood risk in participating LA SAFE parishes influencing reshape, retrofit, or resettle scenarios. (Image source: Louisiana Office of Community Development-Disaster Response Unit)

increased by the compaction/sinking of land behind the levees which also offer a false sense of security, despite well-documented environmental, technical, and social weaknesses (Tobin 1995). In an effort to sustain the city in spite of increased climate risk, the design community in partnership with philanthropic organizations, set out to reimagine New Orleans' management of, and relationship with, water. Beginning with the 2006 Dutch Dialogues®, teams of practitioners developed a series of ambitious water management and resilience strategies culminating in the federally funded projects *Greater New Orleans Urban Water Plan* and subsequent *Resilient NOLA*. These efforts were realized primarily through a sustained period of engagement between city government and community design professionals to develop fundable landscape-scale mitigation interventions. The Gentilly Resilience District includes multiple water management and community development projects designed to reduce flood risk, slow land subsidence, and encourage neighborhood revitalization. The centerpiece of this effort is the Mirabeau Water Garden – a 25-acre site formerly owned by the Catholic Church – redesigned to provide open space and storage for 10M gallons of neighborhood stormwater (see Fig. 12.3). In total, the seven water management projects showcase efforts to improve social well-being in some of New Orleans' most floodprone areas. Though reflective of nearly a decade of urban design and planning, the effort to present landscape-scale solutions has been criticized for lacking meaningful local community engagement in decision-making throughout the process (Anguelovski et al. 2018). Such a critique highlights the significant challenge this work presents to design practitioners. Together, these projects represent an emergent ecosystem approach embracing design and renewal projects. However, the strength of these efforts appears more



Fig. 12.3 The Mirabeau Water Garden, currently in the design phase, in New Orleans' Gentilly neighborhood, during both dry (left) and rainy (right) conditions. (Image source: Office of Resilience and Sustainability and 100 Resilient Cities)

dependent on individual *designers* than on integrative, replicable, and scalable *design processes*. The design competition and design workshop models demonstrated through these projects have achieved significant progress in resilience planning and design. However, it remains unclear how these processes can be scaled up, repeated, and quantitatively valued for implementation through mechanisms like the Master Plan.

12.5 Inland from the Coast: Providing Opportunities for Coupled Coastal–Inland Resilience Thinking

In August 2016, a low-pressure system dropped 22–31” of rain in 2 days across Louisiana’s capital region. Resultant flooding took 13 lives and caused damage to an estimated 145,000 structures. The region was brought to a standstill due to multi-day closures of Interstates 10 and 12, leading to transportation and economic disruption across the Gulf Coast. Touted as a “one-in-1000-year flood,” this was the third such event in 2016 to hit the southeastern USA and one of nine since 2010 (NOAA NWS 2016). Climate change predictions indicate these severe precipitation events are likely to increase in frequency and intensity in the future (Prein et al. 2016). Through the Coastal Master Plan, Louisiana has demonstrated large-scale risk reduction through structural protection and ecological restoration. However, significant inland flooding places like Baton Rouge indicate that coastal restoration and protection alone are not sufficient to reduce flood risk within coupled coastal–inland systems (Birch and Carney 2019). While there has been an expansion of resiliency-based design projects, there remains a sizable gulf between demonstrated community needs and the systematic deployment of new practices at sufficient scale. Recognizing a need to bridge the gap between restoration, protection, and adaptation, the authors, through the Louisiana State University Coastal Sustainability Studio (LSU CSS), launched a multidisciplinary research effort known as *Inland from the Coast: A Multi-Scalar Approach to Regional Climate Change Responses*

(IFC). Founded in 2009 in the wake of a series of devastating hurricanes, LSU CSS is a transdisciplinary research center engaging a core group of architects, landscape architects, planners, coastal scientists, and civil engineers to research and respond to issues of resettlement, restoration, and socioeconomic sustainability. In 2017, the Gulf Research Program of the National Academies of Science, in partnership with the Robert Wood Johnson Foundation, funded IFC as part of the *Thriving Communities III* program. The three-year grant expanded the LSU CSS collaborative model to include faculty and students from geography, psychology, and social work. The expanded group also includes researchers from the University of New Orleans Department of Planning and Urban Studies, Louisiana Sea Grant's Law and Policy Program, and the Florida Institute for Built Environment Resilience (FIBER) at the University of Florida. The grant requires innovative approaches to applying research directly through practice. To achieve this, the collaboration also includes members from the local chapters of American Institute of Architects, American Planning Association, and American Society of Landscape Architects.

IFC poses three fundamental research questions to address specific needs not currently met by the Master Plan or other planning efforts: (1) How is climate change impacting or likely to impact communities connected across a coupled coastal–inland system? (2) How can greater understanding of environmental risk and community well-being increase adaptive capacity? (3) How can well-being and adaptation scholarship be incorporated into community design? The project takes a multi-scalar approach to present and future environmental conditions modeling, community well-being research, and applied community design for ongoing flood recovery and long-term resilience. Unlike the Master Plan and NDRC projects, which are relegated to the coast and near-coast inland Parish of St. John the Baptist, IFC addresses ecological, social, and infrastructural issues across the Amite River basin, which spans a region that includes coastal, transitional, and inland communities (Bilskie and Hagen 2018). Efforts are structured to develop adaptive design opportunities in flood-damaged communities facing increased coastal and riverine flooding. The project takes an iterative approach, linking university researchers with design professionals, policy makers, and community members throughout the process to (1) improve understanding of coastal–inland environmental conditions and vulnerabilities, (2) define current and future community health and well-being, and (3) develop design and planning best practices for reducing risk and increasing regional adaptive capacity.

12.5.1 Modeling Coupled Systems for Stormwater Management

On August 12, 2019, meteorologists began sounding the alarm that a low-pressure system would move inland from the Gulf of Mexico and deliver significant rainfall over the south central portion of the state. While tropical in nature, had this unnamed storm been a hurricane, there would have been advance warning and time to let

people prepare. Instead, the storm moved inland quickly and paralyzed the Baton Rouge and Lafayette regions with historic rainfall and flooding. While considered today to be unprecedented, this was actually the second storm of 2016 to catch state and local agencies and residents off guard. In March 2016, a one-in-500-year event impacted areas slightly east of Baton Rouge – in many cases flooded the same residents twice. It is notable that many of the communities flooded in 2016 have experienced significant growth in recent years, in part due to in-migrations from vulnerable coastal communities who, along with community development professionals, presumed these areas were safe from flooding (Fig. 12.4). In reality, as many as 91% of homes damaged were not identified by FEMA as within Special Flood Hazard Areas, thus requiring flood insurance. As a result, the majority of impacted homeowners lacked flood insurance coverage. Bookended by Hurricanes Matthew in 2016 and Harvey in 2017, this storm has largely faded from national consciousness, but its impact provides evidence that migration inland from vulnerable coastal areas does not necessarily reduce overall risk (OCD-DRU 2015). The Amite River is a shallow, slow-moving river running from southern Mississippi through southeast Louisiana before emptying into Lake Pontchartrain and the Gulf of Mexico (Fig. 12.5). Over time, channelization, resource extraction, and urban development have drastically altered the capacity of the river. One of the greatest impacts to the system not previously accounted for was the construction of Interstate 12 (I-12) through the region. As the Amite River moves north–south through the region, it is intersected by I-12, greatly restricting natural flow and capacity and acting as a levee in many areas. In August 2016, this constraint of the river was apparent as extreme rainfall north of the roadway filled drainageways and was unable to

Fig. 12.4 Suburban expansion of Baton Rouge starting from the historic core along the Mississippi River high-ground to the lowlands of the Amite River watershed. (Image source: LSU CSS)





Fig. 12.5 Three scales of the *Inland from the Coast Project*: coastal–inland flood interface, watershed–parish boundary conflicts, and local projects. East Baton Rouge, Livingston, and Assension Parish are all within the Amite River watershed. (Adapted from LSU Coastal Sustainability Studio)

drain, causing significant backwater flooding into communities north of the interstate. Ultimately, I-12 was overtaken in numerous spots by stormwater flows, stranding those trying to evacuate flooded communities.

To address uncertainty about current and future environmental conditions, IFC researchers from the LSU Center for Coastal Resiliency and Center for River Studies are developing a hydrodynamics model of the Amite River watershed to inform stormwater management. Concurrently, cultural geographers completed focus groups with LEK experts (e.g., floodplain managers, planners, long-time residents, elected officials) to understand how the system reacts under varied conditions. Conversations with local experts provide more than a check on the veracity of a model – they are being used to inform and improve mathematical assumptions by inserting information related to landscape obstruction, temporal change, and cumulative impacts. This approach enables researchers to model future hydrological conditions at a level of detail appropriate for design intervention at the scale of the neighborhood and building and to test these models against the experience of residents.

12.6 Understanding Current and Future Community Well-Being

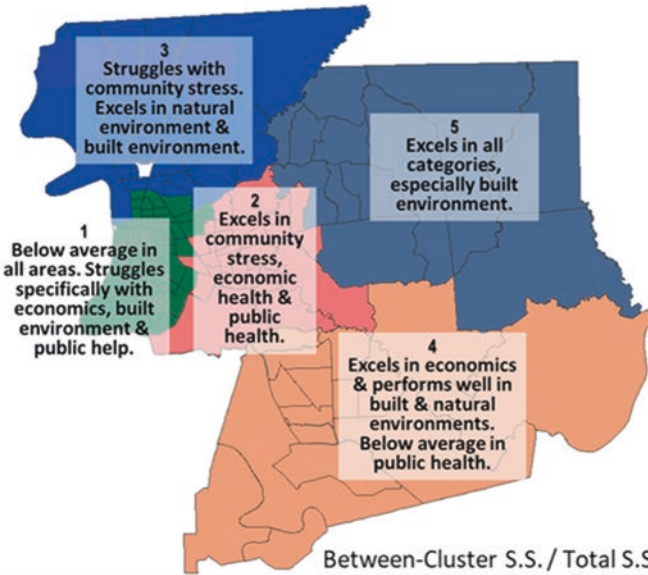
When disasters strike, disparities in community health and resilience become glaringly apparent. In few places has this been better demonstrated than south Louisiana, where coastal land loss, human-made disasters, and extreme weather impact the

region at regular intervals. The circumstances that people are born into, grow up with, and live in greatly impact well-being and overall ability to cope and adapt over time. Prolonged or repeated exposure to negative environmental impacts or crises result in physical and mental tolls to both individuals and communities. Repeated impacts from catastrophic events produce a social crisis context that disrupts all aspects of daily life, in line with what Picou et al. (2004) refer to as “corrosive communities.” Building adaptive capacity to respond to disruption and become more resilient requires a framework that allows communities to define their own well-being and prioritize those environmental, cultural, and social values essential for recovery. Community well-being is a complex combination of physical, mental, emotional, political, and socioeconomic conditions contributing to one’s ability to cope with the normal stresses of life (McCrea et al. 2015; Wiseman and Brasher 2008). Central to IFC is that community well-being is spatially related to flood risk. In Baton Rouge, large-scale alteration of the environment, through flood control projects and unrestricted suburban development, has resulted in significant alteration of the environment and a “muddling” of residents’ understanding of environmental conditions and risk. This leads to reduced capacity among community members to respond to and effectively cope with flooding leading to reduced community resilience.

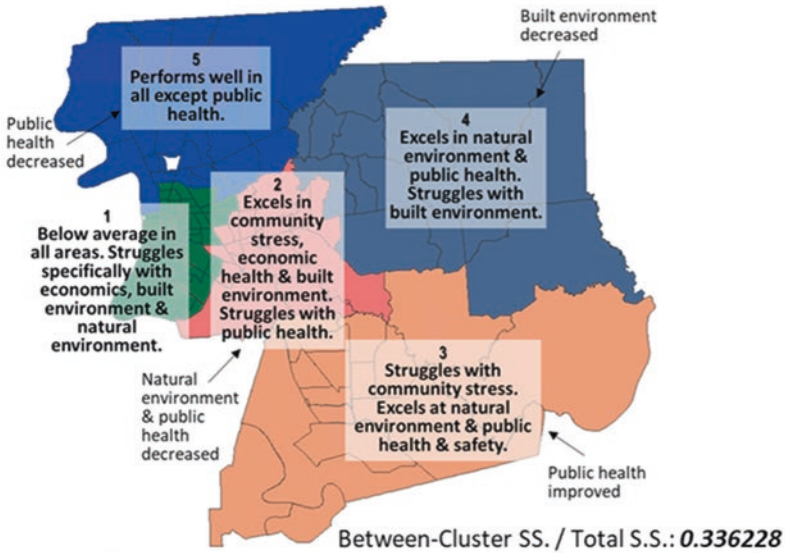
Improved modeling of the Amite River watershed allows floodplain managers to address flood risk and planners to guide development as described previously. Similarly, enhanced knowledge of specific indicators of community well-being informs and enhances future recovery and resilience needs. IFC researchers developed a Community Well-being Index weighing social, environmental, and health indicators to provide a quantifiable measure of a communities’ pre- and post-disaster capacity to recover. The foundation of this index uses the methods of Burton (2015) and Cutter et al. (2010) (Fig. 12.6). However, IFC researchers determined that simply measuring social vulnerability is too narrow, missing many vulnerabilities associated with disaster risk and impacts. For example, many heavily flooded communities north of I-12 appear to be fairly resilient according to traditional social vulnerability indices due to higher incomes, education, and property values. However, these are also the areas where more than 90% of homeowners were without flood insurance, and thus income alone likely doesn’t capture economic stress experienced by residents. IFC researchers compiled through literature review, geo-spatial data analysis, and survey results over 100 variables relating to well-being in East Baton Rouge (EBR), Ascension, and Livingston parishes at the census-tract level. Missing were measures related to disaster impacts (i.e., mental health concerns, financial impacts to those without flood insurance) included in the IFC index. Geo-spatial data sources measuring pre-flood baseline conditions and post-flood recovery progress include US Census counts and estimates, environmental quality measures, public health data, mental health survey results, and both personal and community-wide economic figures. Data gathered and analyzed by IFC researchers was useful in creating well-being profiles for communities that consider unique characteristics as well as commonalities across the region and in providing new evidence of risk factors threatening well-being and community resilience.

K-Means Clusters

Pre-flood



Post-flood



**Minimum cluster size is set to 10% of the population*

Fig. 12.6 The resilience index builds a composite understanding of well-being both before and after the 2016 floods. (Image: LSU Coastal Sustainability Studio)

12.7 Design Application and Policy Framework

Connecting research and practice requires prolonged and sustained engagement of stakeholders, including vulnerable populations, with locally engaged practitioners committed to the long-term resilience of the community (Abendroth and Bell 2015). Applying new concepts and techniques (e.g., coastal–inland flood modeling, place-based well-being research, and design best practices) within communities, especially following a disaster, requires trust and community support. Design and planning professionals with knowledge of the local context and culture offer a bridge to community members through a professional lens that can measurably improve community resilience and build future professional capacity to implement projects (Nassauer and Opdam 2008; Perkes 2009). This component of IFC engages faculty and students from architecture, planning, landscape architecture, and law with design professionals affiliated with the AIA, ASLA, and APA, regional policy makers, and community members who participate in design workshops applying flood conditions and community well-being priorities at the design project level. Communities are engaged at the site, neighborhood, and city scales in specific, locally championed, design projects to identify opportunities for increasing adaptive capacity in inland communities.

Local engagements (particularly with vulnerable populations) in design activities considering community-driven definitions of well-being are important to urban resilience and successful adaptation to the impacts of climate change (Beatley 2009; Doherty and Clayton 2011). IFC public agency partners include the EBR Redevelopment Authority, the cities of Baker and Denham Springs, Ascension Parish, and the Capital Area Transit System. Working groups are organized around specific local and regional design challenges to infuse the consideration of stormwater management, public health, and social equity into community planning and design decision-making. While the projects are ongoing, outcomes will include six community-specific strategic urban design and implementation plans, each addressing an issue generalizable to other communities (e.g., green infrastructure, stream restoration, or corridor redevelopment). Results will be compiled into a regional best practices compendium – highlighting interventions at architectural, neighborhood, and community scales.

Throughout the course of the project, changes to the National Flood Insurance Program, including its proposed reauthorization (expected October 2020) and new Community Rating System Manual are being researched and evaluated for community impacts. In-depth legal research and outreach includes potential local government liability for development decisions in light of improved hydrologic modeling, policy options for translating mapping into land use directives, and issues related to takings and stormwater management. Though local governments have broad legislative authority to implement land-use decisions based on public health, safety, and welfare, the ability of local governments to regulate based on future climate conditions is less clear. The processes and partnerships developed through the design, planning, and policy work are intended to build capacity and implement

change at the site, neighborhood, and community scales. Also, and perhaps most important, is the evaluation of such interventions for their scalability and collective impact on the greater region. To achieve a measurable impact on the resilience of the coupled coastal–inland system, successful projects cannot afford to be limited to individual success; they must be scalable and translate through improved governance policies coast-wide.

12.8 Discussion and Conclusion

In this work, we examined several planning and design efforts addressing issues of risk and resilience in Louisiana. This includes top-down and bottom-up strategies focused in varying degrees on physical hazard mitigation and building social infrastructure. Given current and future risk facing Louisiana’s coastal and inland communities, and the emphasis on risk reduction and resilience at state and federal levels, we evaluated *Louisiana’s Comprehensive Master Plan for a Sustainable Coast* (2017 Coastal Master Plan) as an effective framework for community resilience and how effectively other community planning and design frameworks are being employed in Louisiana to fill resilience gaps. While the Master Plan is unequivocal in its support of local planning and design, the lack of committed resources underscores the disconnect between community resilience and the actions of an agency whose structure and mandate is more closely aligned with engineered solutions. Unlike protection and restoration efforts which can be modeled to inform future risk reduction and selected by a cost/benefit ratio, the translation of architectural- and urban-scaled design into broader quantified values is more difficult. Social dynamics present sometimes contradictory responses to seemingly straightforward challenges and rational solutions. Such “wicked problems” will not be easily resolved through the technical apparatus of the Master Plan and may challenge the cost/benefit model driving Master Plan decision-making in the future. Social challenges are often not solved through such rational solutions but through education, consensus, and trust (Lazarus 2009; Rittel and Webber 1973).

The LA SAFE focus on reshaping, retrofitting, and resettlement demonstrates the state is willing to take on difficult community-based associated with climate change and land loss. The Gentilly Resilience District in New Orleans demonstrate a skillful approach to complex design challenges and an ability to follow through. However, these approaches alone are not sufficient to reduce risk in coupled coastal–inland systems (OCD-DRU 2015). As demonstrated by the Baton Rouge flood of 2016, the process of inland migration has already begun, and movement away from the coast does not automatically reduce risk. To overcome this gap, CSS’s IFC research initiative has adopted a multi-scalar regional to local systems-based approach, recognizing the integrally linked nature of coastal and inland environmental processes (Birch and Carney 2019). IFC is enhancing hydrological modeling to understand the region’s complex environmental flows, adding fidelity to the

layers of community wellness and social complexity surrounding risk and the benefits of resilience to the overall process of adaptation. Most importantly, the project engages designers not in the final expression of scientifically based decision-making but as a partner throughout the process. Through this work, the tools, the knowledge, and the ability to demonstrate greater resilience through design is emerging (Birch and Carney 2019).

The Rockefeller Foundation (2018) defines resilience as “the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.” There is no one answer to achieving community resilience, beyond the shared recognition that physical environment and social communities reach temporary thresholds between stability and change. Engineering resilience and ecological resilience illustrate different perspectives that, when bound together, form an improved basis for a robust *and* adaptive built environment. Louisiana’s Master Plan proposes a range of top-down engineering and ecological solutions to encourage coastal sustainability. What is needed are equitable bottom-up approaches that support community-based resilience and adaptation planning and design at the architectural, neighborhood, and community scales. A range of frameworks, including IFC, are being implemented in Louisiana addressing architectural and urban challenges and providing community-based resilience benefits. While none of these approaches meet all of the needs of coastal and inland residents, they provide meaningful paths forward for bridging large-scale ecosystem restoration together with community-based design and adaptation.

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