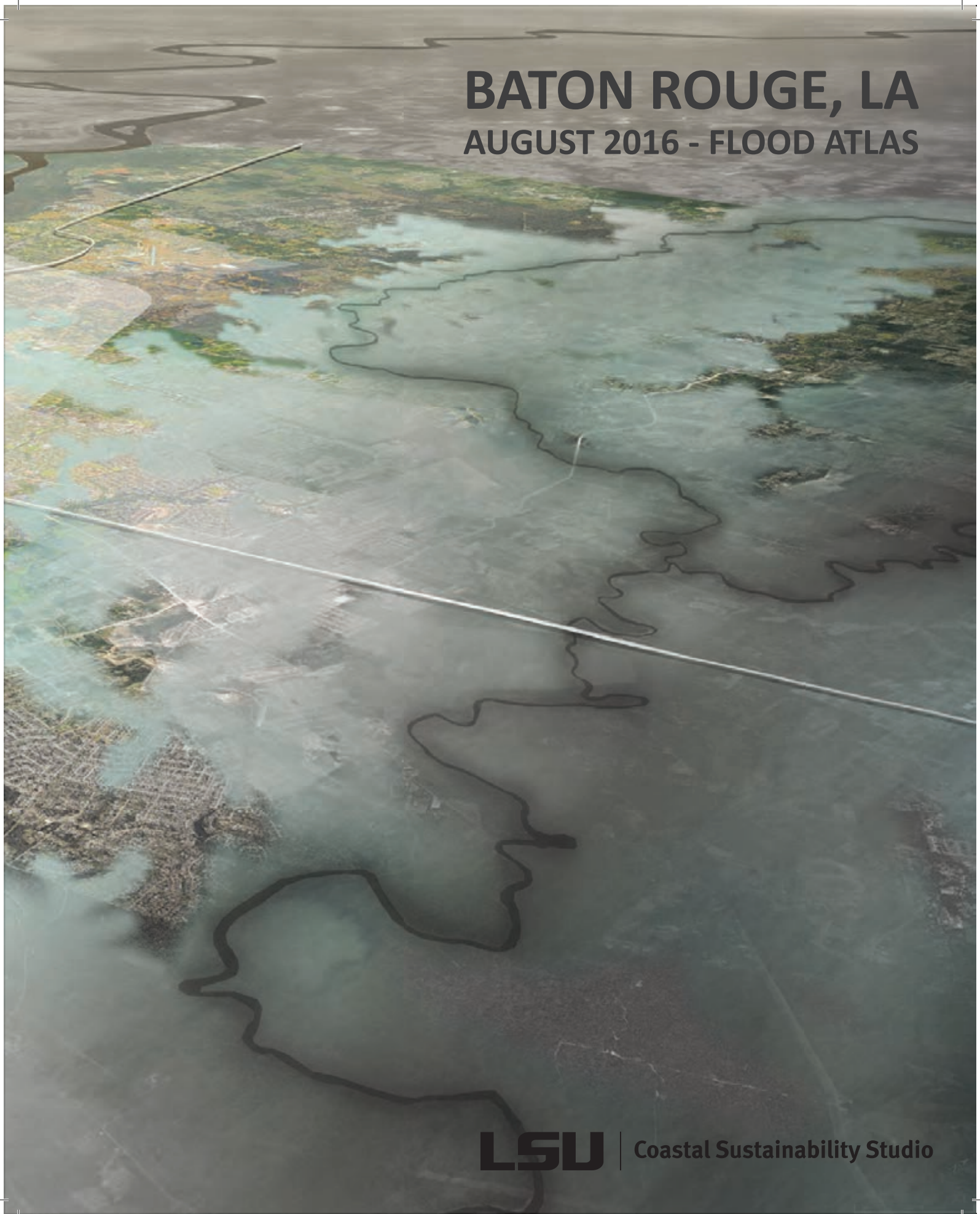

BATON ROUGE, LA

AUGUST 2016 - FLOOD ATLAS

LSU | Coastal Sustainability Studio

BATON ROUGE, LA
AUGUST 2016 - FLOOD ATLAS

LSU | Coastal Sustainability Studio

WHO WE ARE

The LSU Coastal Sustainability Studio (CSS) emerged in 2009 as a leading voice to bridge the efforts of scientists, engineers, architects, and landscape architects working to envision a better future for coastal Louisiana. CSS recognizes that Louisiana communities face unprecedented challenges, many of which are not being resolved due to the sheer enormity of the situation exceeding the scope of a single discipline. It provides a collaborative space for these disparate disciplines to come together to intensively study and respond to issues facing deltaic communities, coastal ecosystems, and flood protection systems. Its ultimate goal is to prepare communities to be resilient to the fluctuations of an uncertain environment. Css was created as a trans-disciplinary institute for this reason.

The results of this design work provide a sound basis for major policy decisions for adaptation through more sustainable land-use planning, flood protection, ecosystem restoration, and public education. CSS has significant skill in the restoration, protection, and design of biological and human systems, but its greatest strength is its ability to bridge across these disciplines, translating complex science, engineering, and design to actionable and comprehensive design thinking. It has won local and national awards for work that challenges long-held assumptions and visualizes solutions to the difficult conditions communities are facing. CSS and its leadership continue to push the envelope through integrated science, engineering, and design that are applied tot he needs of communities across the Louisiana coast and the greater Gulf Coast region.

BATON ROUGE, LA
AUGUST 2016 - FLOOD ATLAS

PROJECT TEAM:
Jeff Carney, AIA, AICP
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PROJECT FUNDING PROVIDED BY:

TABLE OF CONTENTS:

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Mobil
PAYLESS
STORAGE
efcu
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12

AUGUST 2016

In 2016 the state of Louisiana experienced severe storms and flooding in both March and August – collectively referred to as the 2016 Severe Storms and Flooding – resulting in 56 of the state's 64 parishes receiving a federal disaster declaration (4263 and 4277). The National Weather Service designated the August flood that dropped an unprecedented 7 trillion gallons of rainwater in South Louisiana as a "1,000-year" rainfall event. It resulted in the flooding of more than 68,380 homes and 23,248 renters, for a total of 91,628 households. The August storm claimed 13 lives. (DOA)

During the August storm heavy rainfall occurred across Louisiana and southwestern Mississippi during August 11–14, 2016, as a result a slow-moving sheared inland tropical depression, which gained energy and moisture as it moved as a low pressure system across the Gulf Coast into Louisiana and southern Mississippi. The system tapped into deep tropical moisture resulting in intense rainfall and thunderstorms across a large part of the area causing major flooding across southern Louisiana. Both the Amite and Comite rivers overtopped, as well as numerous bayous, lakes and canals located within these drainage basins. Governor John Bel Edwards declared a state of emergency for several parishes and sent the National Guard to help with search-and-rescue missions. The damage to infrastructure, businesses and homes across the southern region of the state was extensive, and large sections of state roads remained under water for extended periods.

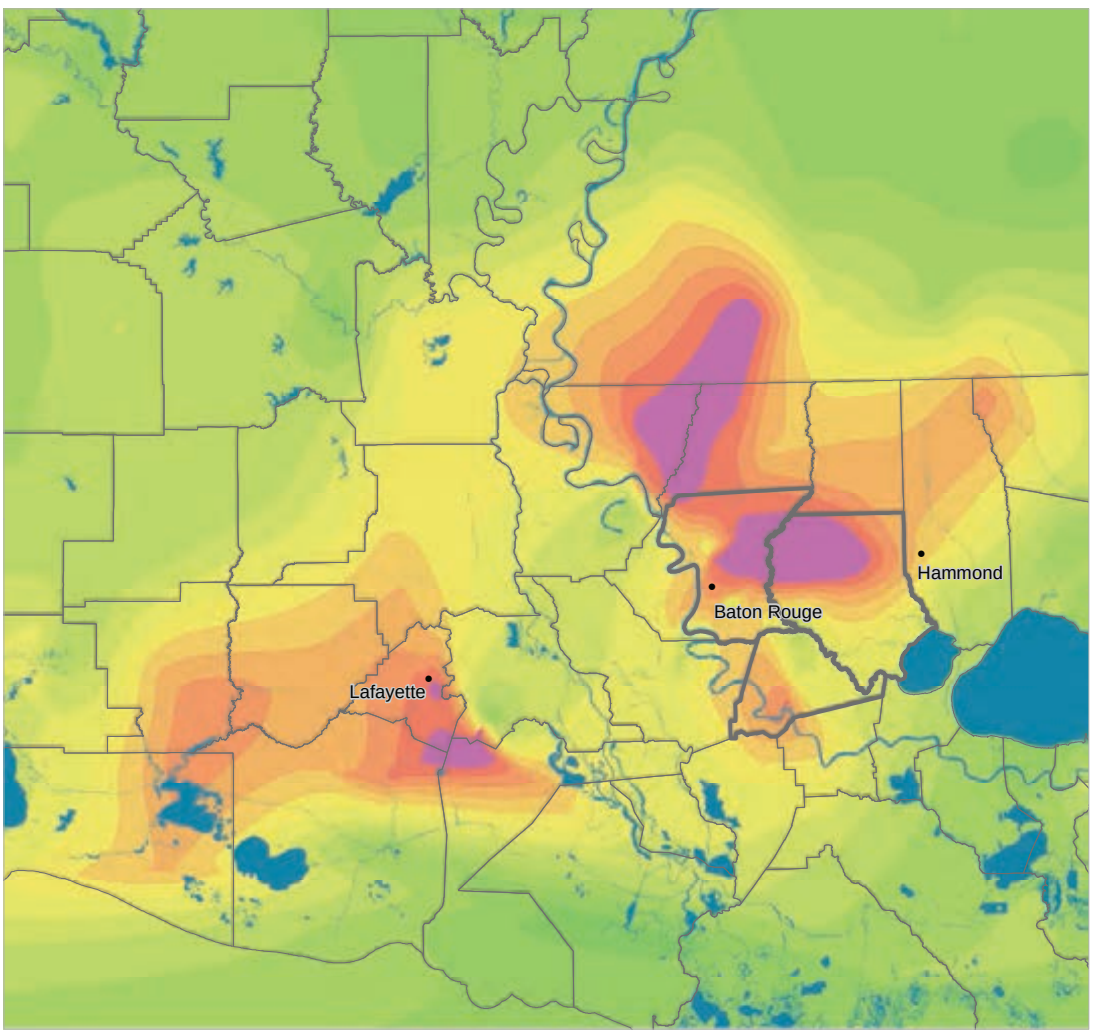
The NOAA rainfall data showed the heaviest rainfall occurred across a swath of East Baton Rouge, Livingston, and St. Helena Parishes, where 20 to more than 31 inches fell over a 48-hour period, topping the 0.2-percent annual exceedance probability (AEP) (NOAA, 2016a). The city of Watson, La. received 31.39 in. of rain during August 11–14, and the town of Livingston recorded 17 in. of rain in a single day (NOAA, 2016b). Two-day rainfall totals of 20 in. or more were common across areas around Baton Rouge and Lafayette.

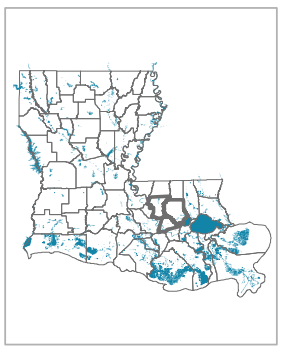
The heavy rainfall led to widespread flash flooding and record river flooding. Many of the broken records had been previously set during the flooding of April 1983. The event was also responsible for an estimated total of $10 billion in damages across southern Louisiana and southwestern Mississippi (NOAA, 2016c). This estimate includes impacts of the initial flash flooding and the resultant river flooding. August 2016 was the wettest month on record for Louisiana with a statewide average of 12.9 in., topping the previous record of 9.71 in. set in August 1940 (NOAA, 2016b).

Reference:

USGS: https://pubs.usgs.gov/sir/2016/5162/sir20165162.pdf
DOA: http://www.doa.la.gov/Pages/ocd-dru/Disasters.aspx

August 2016 rainfall





Legend

- Major Bodies of Water
- Major Cities Affected

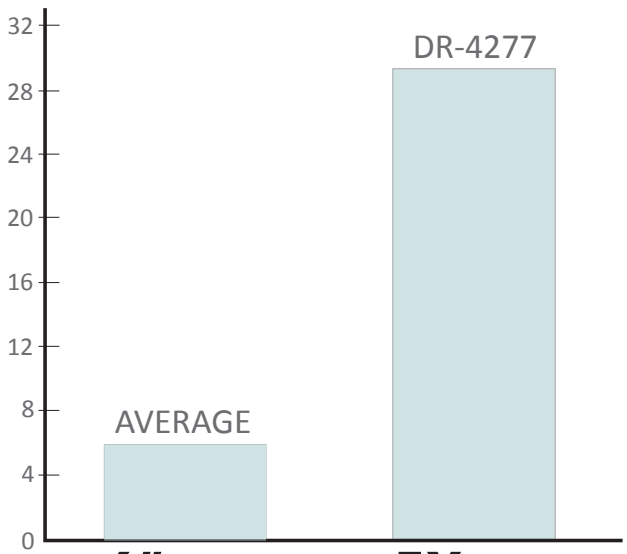
Total Rainfall (Inches)

- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14
- 14 - 16
- 16 - 18
- 18 - 20
- 20 - 22
- 22 - 24

Over 20 inches of rainfall fell over parts of Louisiana. The heaviest rain fell near some of Louisiana's largest cities - Lafayette, Baton Rouge, and Hammond.

AUGUST 2016

INFORMATION FROM THE AUGUST 12th - 14th, 2016 FLOODS



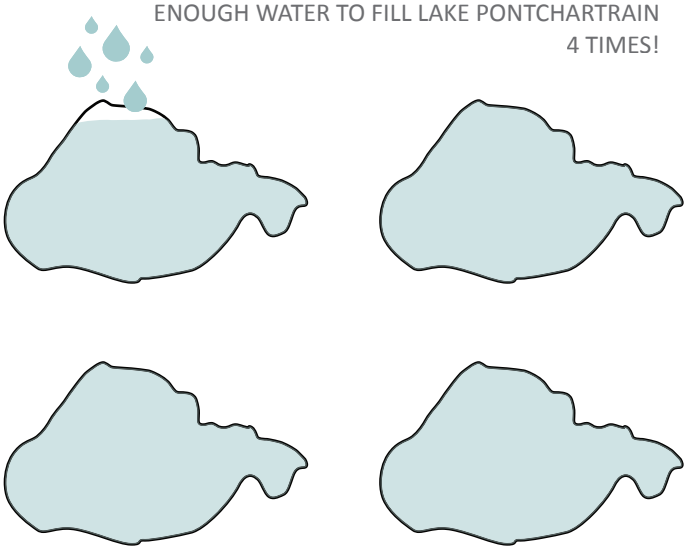
6"
AVERAGE
Monthly August rainfall for Louisiana

5X
THE PRECIPITATION TOTAL
Some places received 5 times the monthly average in 72 hours

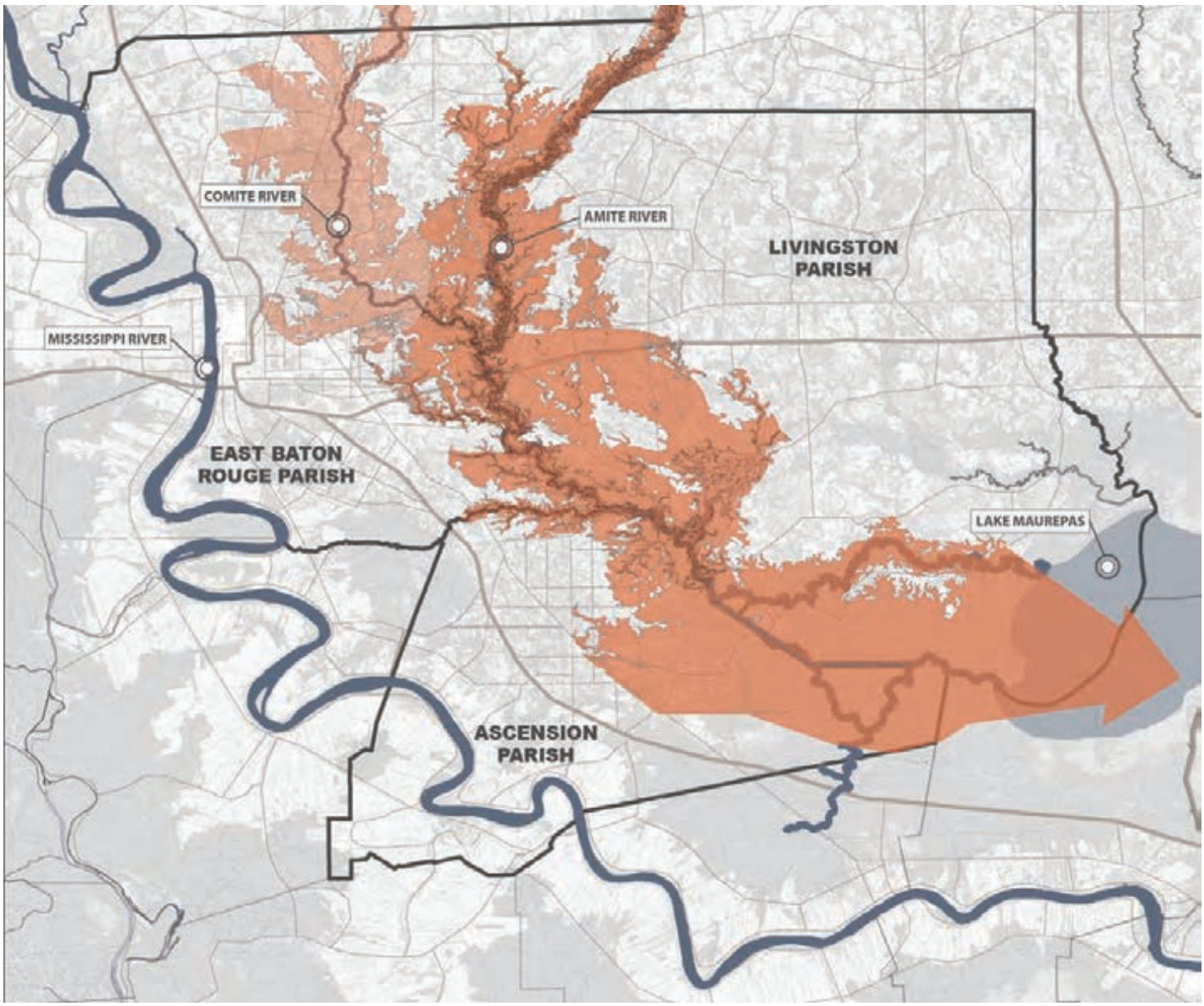
TOTALING

7.1 TRILLION GALLONS

ENOUGH WATER TO FILL LAKE PONTCHARTRAIN 4 TIMES!



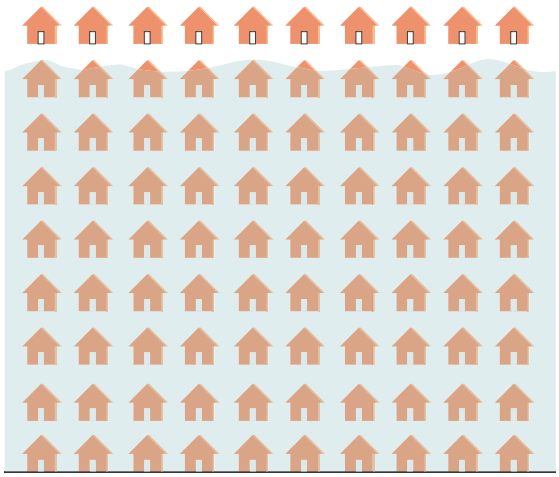
water knows no *boundaries*



Flood extents of the Amite and Comite Rivers

ON AUGUST 16th, LOUISIANA OFFICIALS REPORTED THE FOLLOWING:

ONLY 11%
OF HOUSEHOLDS WERE CARRYING FLOOD INSURANCE



+90,000
HOMES WERE DAMAGED
The flood elevation of water reached 8 feet at its highest point.

=1,000 HOUSEHOLDS

+11,000
SHELTERED
11,000 Citizens, approximately 1/3 of those affected, were sheltered at the peak of the flood.

+30,000
RESCUED FROM HOMES & CARS
The flooding caused the death of 13 people. Red Cross called this the worst U.S. natural disaster since Hurricane Sandy in 2012.

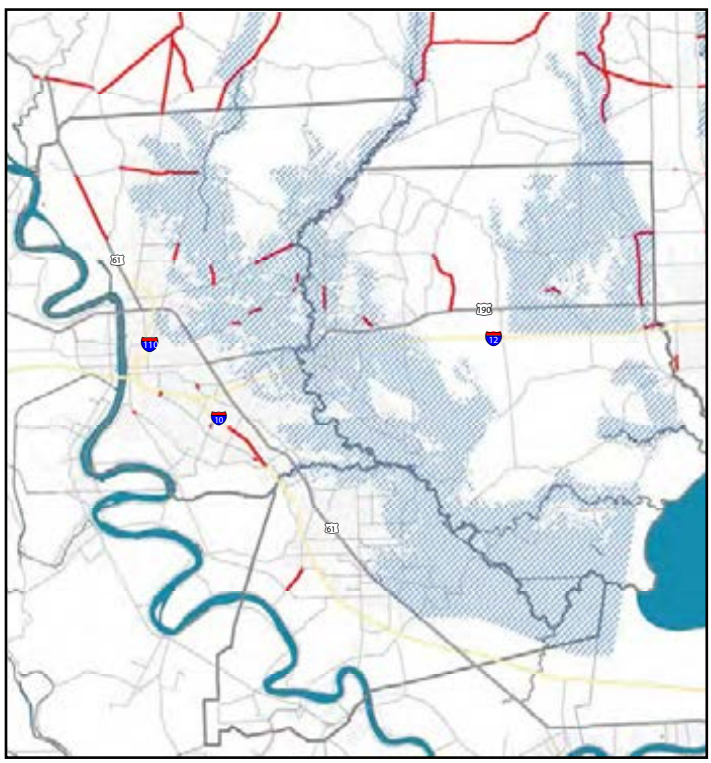
+6,000
BUSINESSES FLOODED
Damages include more than $2.2 billion to buildings, equipment, inventory and agriculture.

References:
-http://www.washingtontimes.com/news/2016/sep/3/louisiana-flood-damage-at-least-87-billion-governo/
-U.S. Department of Housing and Urban Development: State of Louisiana Proposed Master Action Plan for the Utilization of Cummunity Development Block Grant Funds in Response to the Great Floods of 2016
-State of Louisiana proposed Master Action Plan for the utilization of Community Development Block Grant Funds in response to the Great Floods of 2016

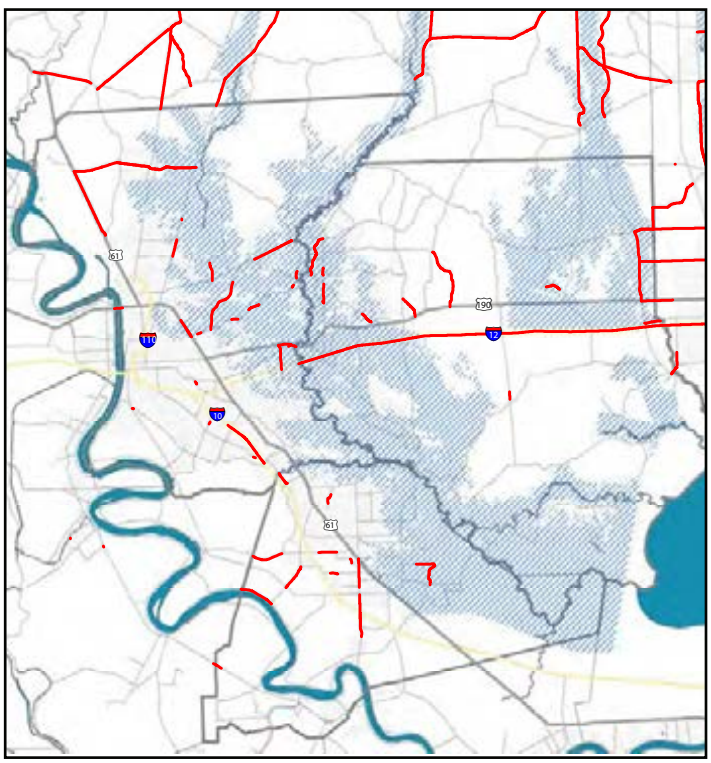
"A slow-moving storm impacted multiple South Louisiana parishes with sustained heavy rain. In what was a 1,000-year flood, within two days more than two feet of rain was measured in some areas, causing extensive surface and river flooding. Both the Amite and Comite rivers overtopped, as well as numerous bayous, lakes and canals located within these drainage basins. The damage to infrastructure, businesses and homes across the southern region of the state was extensive."

- Louisiana Office of Community Development

Road Closures - AUG 2016

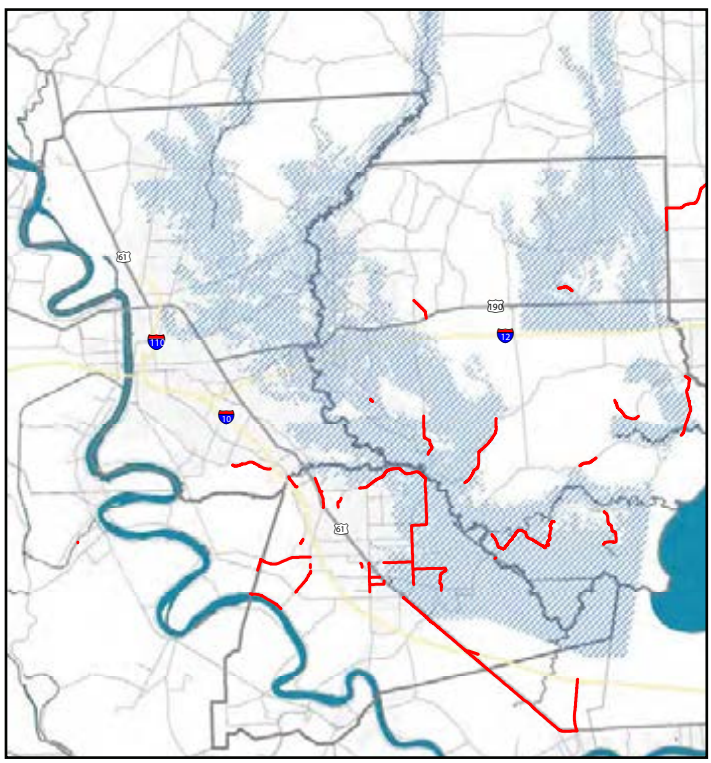


August 12th

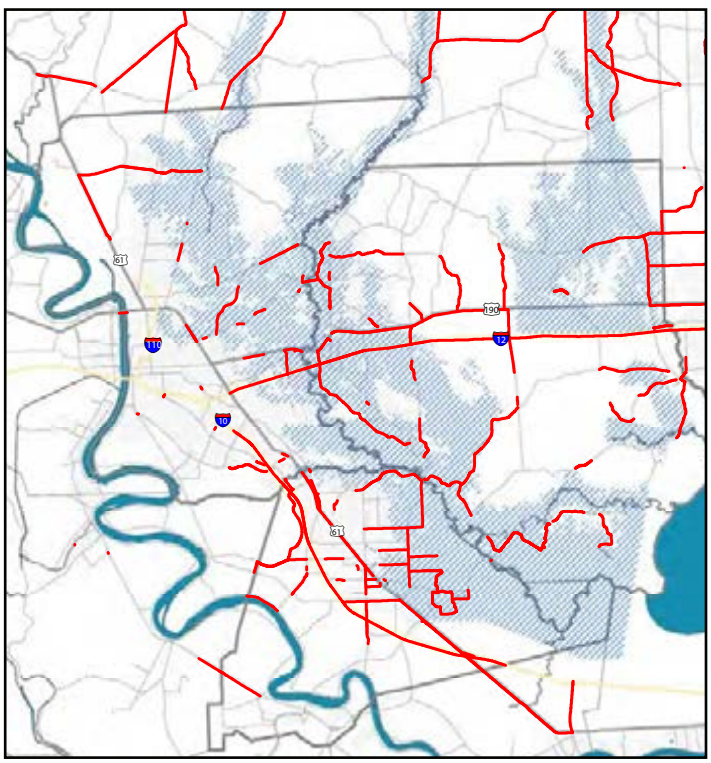


August 13th

Transportation Systems were disrupted across the region including a multi-day shutdown of the interstate highway sytem through Louisiana. This extended teh cost of the flood to spread far beyond Louisiana and the Gulf coast in a matter of days.

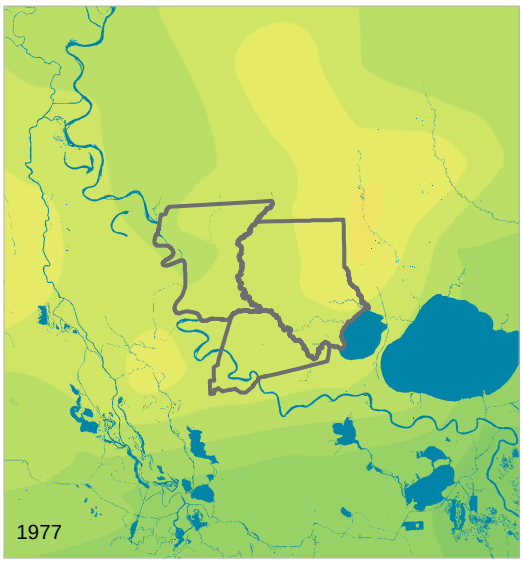


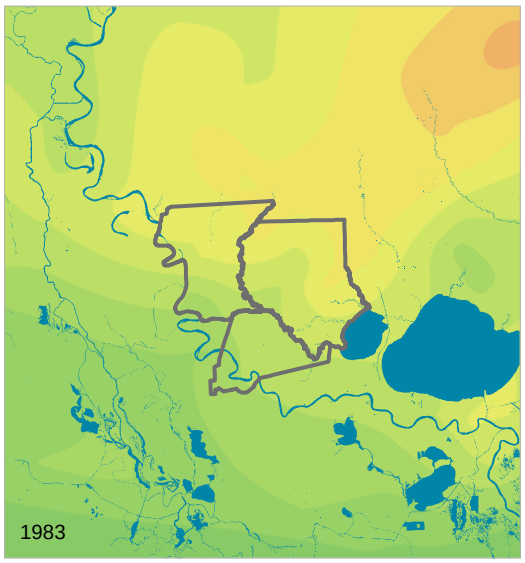
August 19th

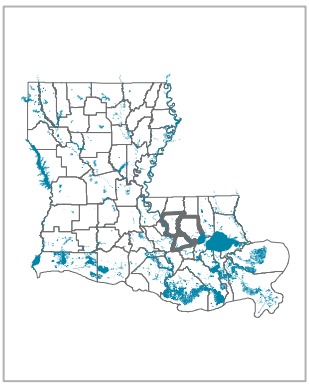


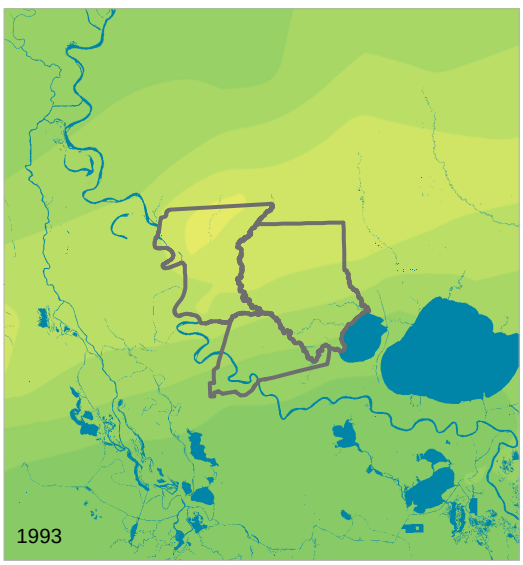
Total Road Closures August 12th-22th

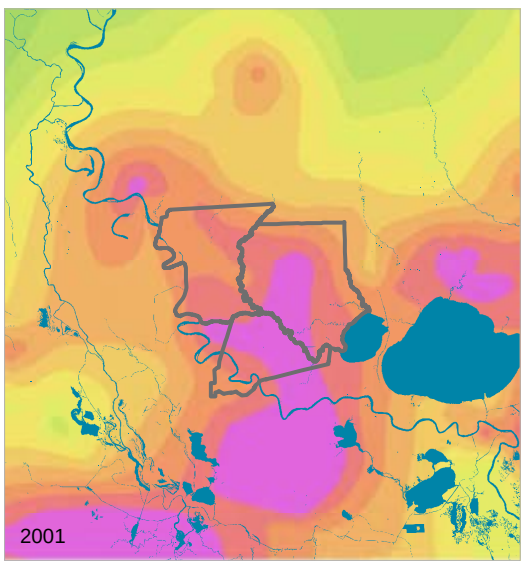
Historic Rainfall









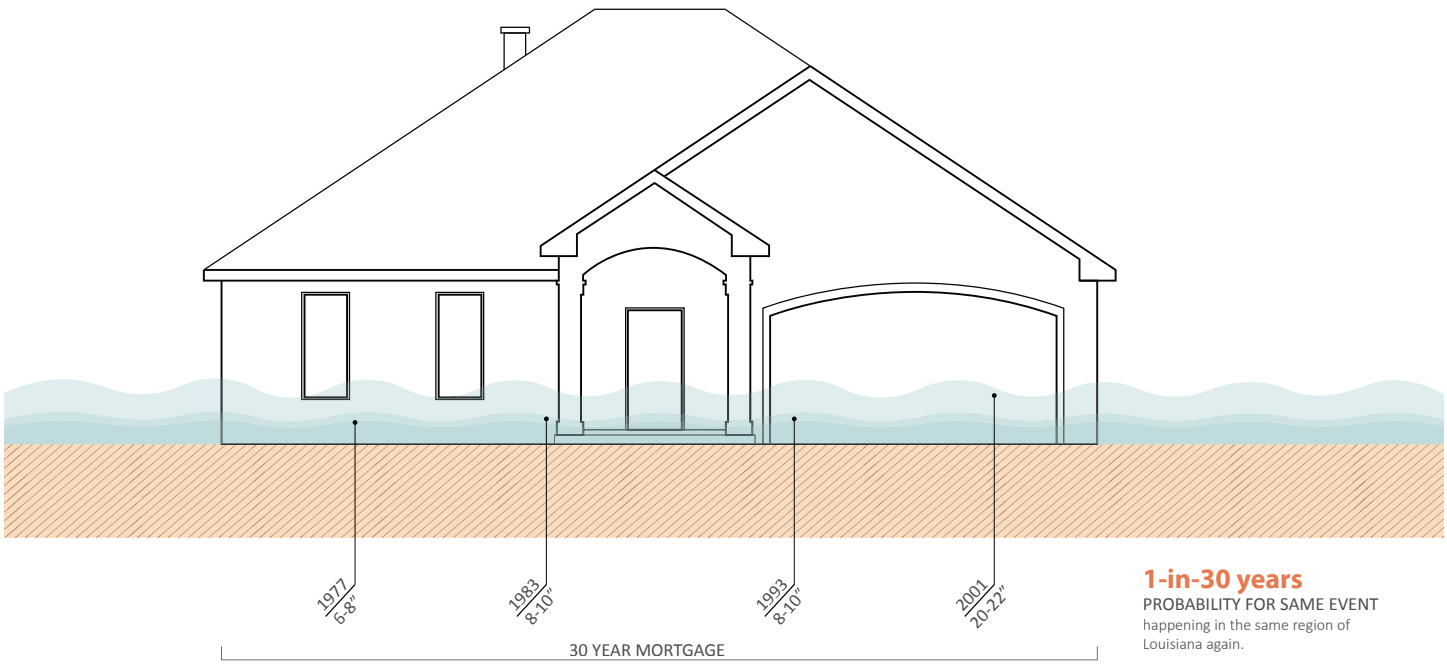


Legend

Major Bodies of Water

Total Rainfall (Inches)

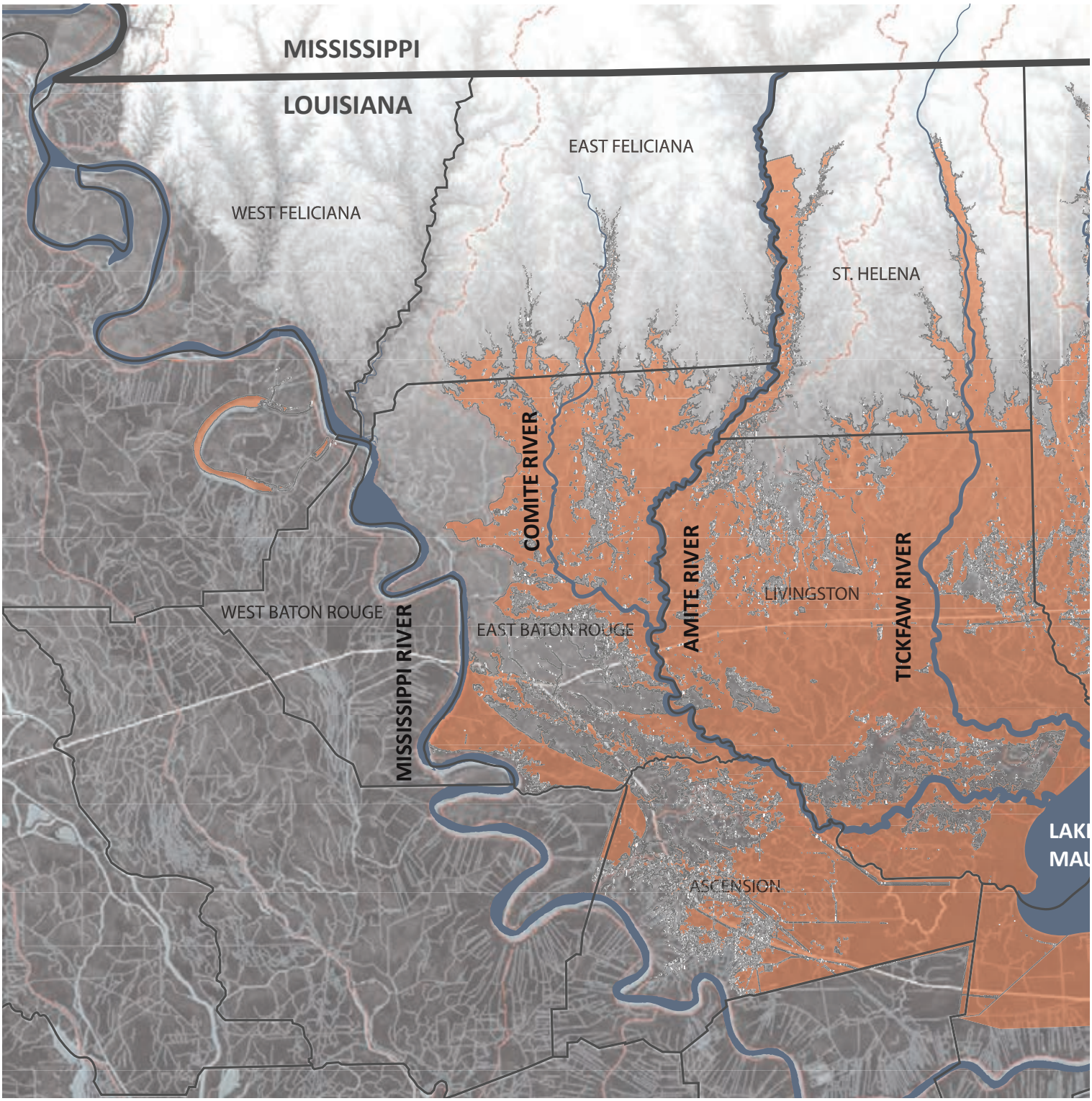
- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12
- 12 - 14
- 14 - 16
- 16 - 18
- 18 - 20
- 20 - 22
- 22 +

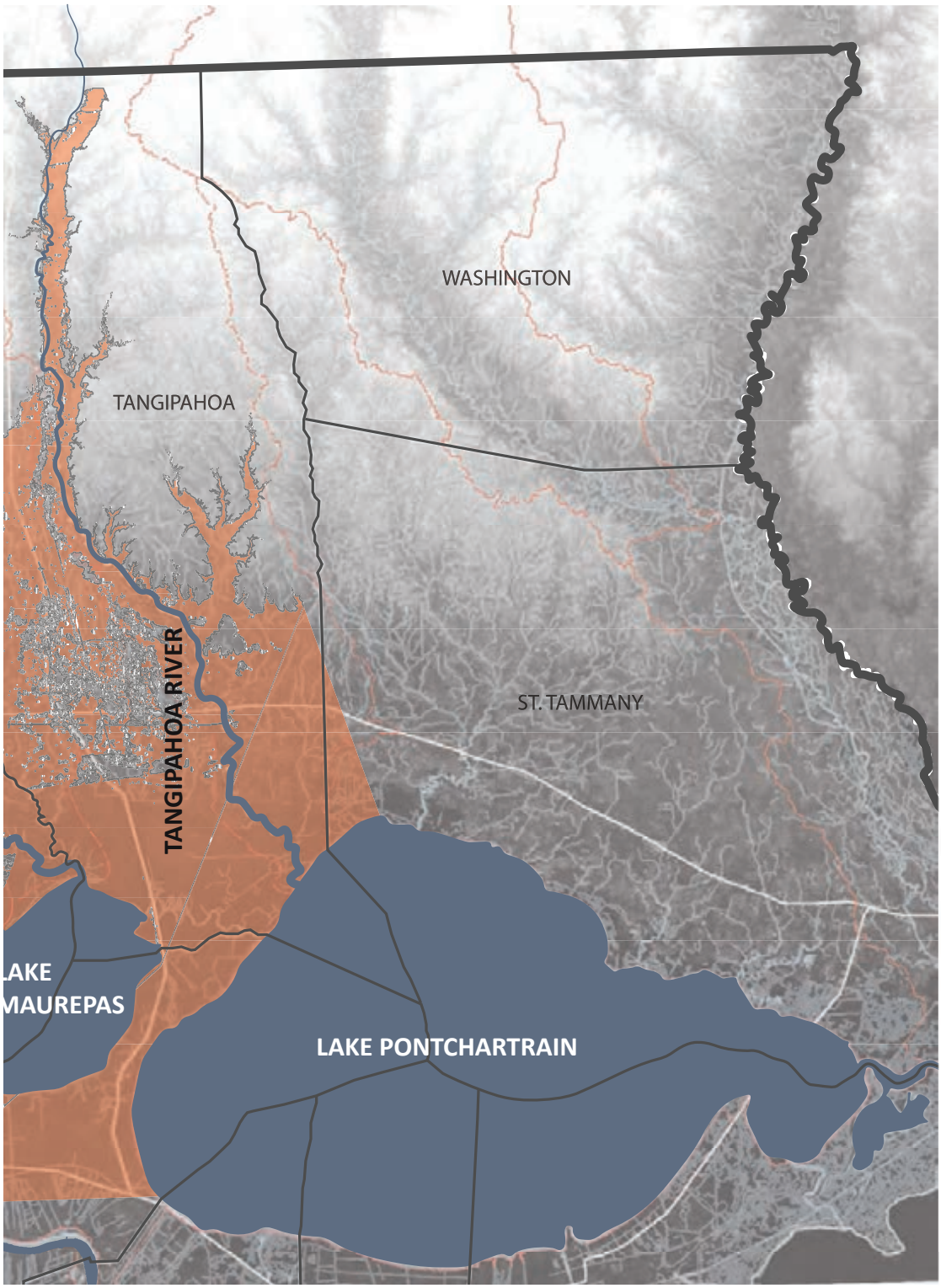


"Six parishes identified by HUD as most impacted, including three of the state's largest metropolitan areas, Baton Rouge, Lafayette and Monroe, as well as two parishes currently experiencing significant population growth, Ascension and Livingston. It is important to note that the population residing within the six most impacted parishes comprises roughly one quarter (25.98 percent) of the state's total population.

- Louisiana Office of Community Development

FEMA flood extents - AUG 2016





The extent of flooding in the Amite and Comite River basins was similar to flooding in the watersheds of the Tickfaw and Tangipahoa rivers.

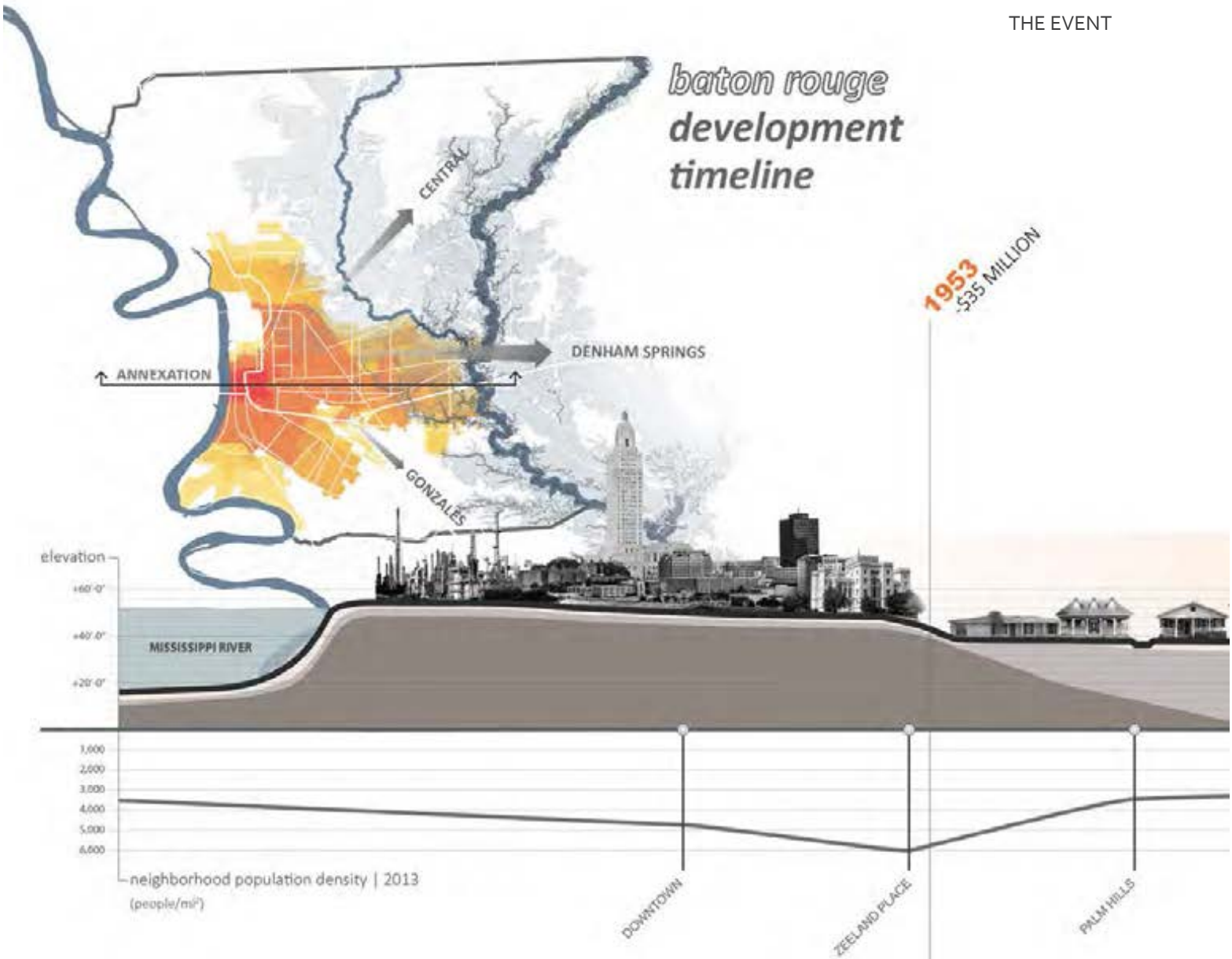
Legend

- August 2016 FEMA Flood Data
- Major Inland Water Bodies
- Streams
- Parish Boundaries

1":200,000'

Reference:
https://data.femadata.com/DR4277_Severe_Storms_Flooding_LA/Flood_Extent/

baton rouge development timeline



1721
BATON ROUGE SETTLEMENT
French colonists establish a military post by the Mississippi River. City expansion and development grows from this area.

1850
SWAMP ACTS OF 1850
Legislation giving the right to sell unfit floodlands to residents for farming and using the money to build levees surrounding those areas.

1880s-1920s
INDUSTRIAL REVOLUTION
Spurs on city population increasing the need for land reclamation and better stormwater infrastructure i.e. levees

1908
RECLAMATION
12,002,101 acres of swamplands, natural drainage for the high ground, are reclaimed and sold by the state government to be used to enhance the farming economy, based on Swamp Acts of 1850.

1928
FLOOD CONTROL ACT
Great Flood of 1927 causes authorized construction of levees along the Mississippi River

1931
FLOOD PREVENTION
Bonnet Carre Spillway constructed to relieve flood pressure.

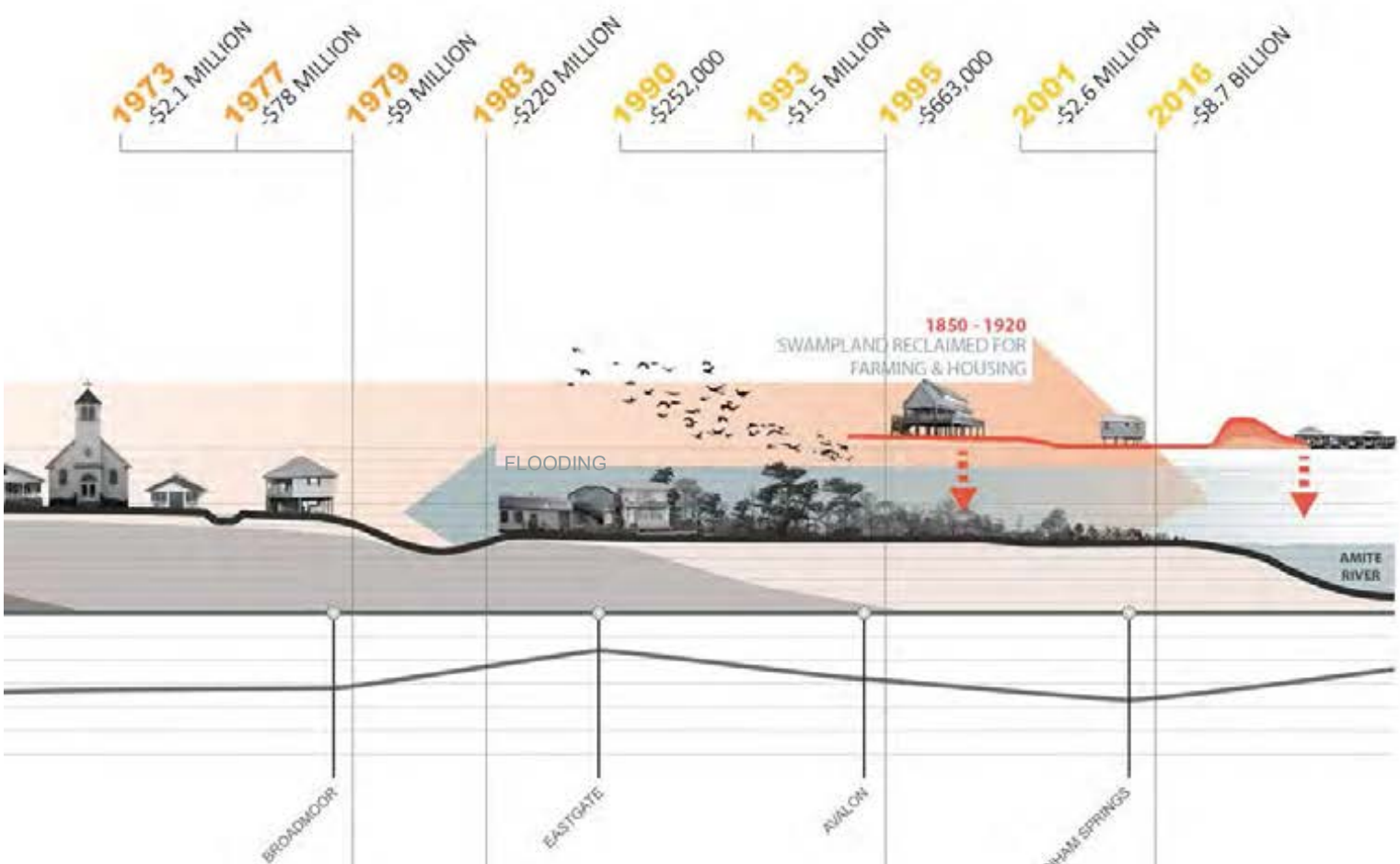
1937
FLOOD CONTROL ACT
Great Flood of 1937 causes federal involvement in protection from flooding through structural flood-control projects, such as dams and levees.

1950
FLOOD CONTROL ACT
US Army Corps of Engineers given authority over Mississippi River flood control in Louisiana

1953
NATURAL DISASTER
Amite River flood due to heavy rainfall

1957
PUBLIC INFRASTRUCTURE
Interstate 12 constructed on top of a natural floodplain in Livingston and East Baton Rouge Parish

References:
'Assessing Risk and Building for Change' LSU Coastal Sustainability Studio - 2013-14
'Baton Rouge, Louisiana Population History 1950-2015' www.biggestuscities.com/city/baton-rouge-louisiana - May 24, 2016
www.city-data.com/city/Baton-Rouge-Louisiana.html
https://water.usgs.gov/floods/events/2016/aug_la/
http://gov.louisiana.gov/assets/docs/RestoreLA/SupportingDocs/Meeting-9-28-16/2016 August Flood-Economic-Impact Report_09-01-16.pdf
http://floodhelp.una.edu/uploads/br%20analysis%20-%20final.pdf
https://pubs.usgs.gov/wsp/1320c/report.pdf
U.S. Army Corps of Engineers: Amite River and Tributaries, Louisiana Feasibility Study, Volume 1



1965
FLOOD CONTROL ACT
US Army Corps of Engineers given authority over Mississippi River flood control in Louisiana

1968
FLOOD INSTURANCE ACT
US Army Corps of Engineers given authority over Mississippi River flood control in Louisiana

1973
FLOOD PROTECTION ACT
Largest volume of water to flow down Mississippi River since 1927 flood. Bonnet Carre Spillway and Morganza Spillway both opened for a record 75 days. Required buildings in identified hazard areas to carry insurance to recieve federal disaster assistance.

1977
NATURAL DISASTER
Amite River floods due to heavy rainfall

1979
NATURAL DISASTER
Amite River floods due to heavy rainfall

1983
NATURAL DISASTER PROTECTION
Livingston/East Baton Rouge Parish flood due to heavy rainfall. Levee system then established along the Amite River.

1990
NATURAL DISASTER
Amite River floods due to heavy rainfall

1993
NATURAL DISASTER
Amite River floods due to heavy rainfall

1995
NATURAL DISASTER
Amite River floods due to heavy rainfall

2001
NATURAL DISASTER
Amite River floods due to heavy rainfall

2016
NATURAL DISASTER
Amite River floods in Livingston and East Baton Rouge Parish

Baton Rouge

AUGUST 19, 2016

Twenty-two Louisiana parishes were declared eligible for FEMA IA: Acadia, Ascension, Avoyelles, East and West Baton Rouge, East Feliciana, Evangeline, Iberia, Iberville, Jefferson Davis, Lafayette, Livingston, Pointe Coupee, St. Helena, St. James, St. Landry, St. Martin, St. Tammany, Tangipahoa, Vermilion, Washington and West Feliciana. Of all the parishes impacted by the storms of 2016 East Baton Rouge Parish provides the most diverse scenarios of those effected by the storms. Additionally, East Baton Rouge Parish experienced the most households with damage from the August 2016 storm which included: 24,255 Homeowners and 12,683 Renters for a total of 36,938 effected households.

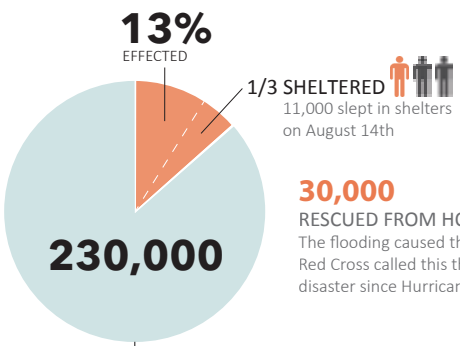
Areas with greatest need are going to be those that have both high concentrations of damage as well as a high level of pre-existing social vulnerability. Social vulnerability is measured by assessing pre-existing vulnerabilities to environmental hazards, and can contribute to a reduction in a community's ability to prepare for, respond to and recover from hazards. Utilizing this two variable approach identifies specific corridors of concern. For owner-occupied household populations, a concentration of need is found in corridors throughout the Baton Rouge Capital Region. There are a total of six census tracts in the 51 IA declared parishes classified as having high levels of damage as well as high levels of social vulnerability. All six of these census tracts are located within the Capital Region. Five of the census tracts are located within East Baton Rouge Parish, specifically, and one is located in Livingston Parish. These census tracts are all within a five-mile area and five of the six census tracts are located in a line along the I-12/Florida Boulevard corridor that runs between Baton Rouge and Denham Springs.

As flooding impacted different areas at different times, the peak number of businesses and employees impacted by the flood is larger than was seen at any specific point in time. In total, approximately 19,900 businesses in Louisiana experienced temporary closures, or significant operational reductions. These businesses employ approximately 278,500 workers. While many employers may have continued paying employees during closures, some hourly workers may have experienced reduced pay. LED and LSU estimated that 45,000 to 75,000 of these employees work at businesses that experienced flooding and periods without pay, or with reduced pay. East Baton Rouge Parish alone experienced "Lost Labor Productivity" totaling approximately $213,000,000, making East Baton Rouge Parish by far the largest overall number of businesses impacted.

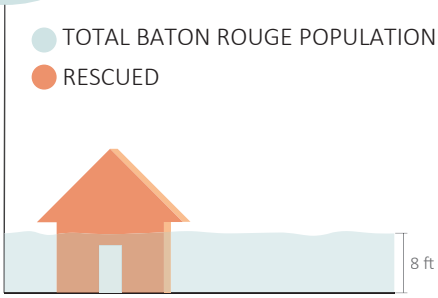
MAPPING

The following maps are generated from a range of sources ranging from first hand documentation, to online data resources, to USGS and other providers of data. The intent of the maps is to not only show the overwhelming scope fo the flood but to shine a light on the specific vulnerabilities that this region faces in the face of such risk.

ON AUGUST 16th, LOUISIANA OFFICIALS REPORTED THE FOLLOWING:



30,000
RESCUED FROM HOMES & CARS
The flooding caused the death of 13 people. Red Cross called this the worst U.S. natural disaster since Hurricane Sandy in 2012.



+90,000
HOMES WERE DAMAGED
The flood elevation of water reached 8 feet at its highest point.

80%
LACKED FLOOD INSURANCE
Most of the homes affected were outside the 100-year flood plain.

+6,000
BUSINESSES FLOODED
Damages include more than $2.2 billion to buildings, equipment, inventory and agriculture.

References:
-http://www.washingtontimes.com/news/2016/sep/3/louisiana-flood-damage-at-least-87-billion-governo/
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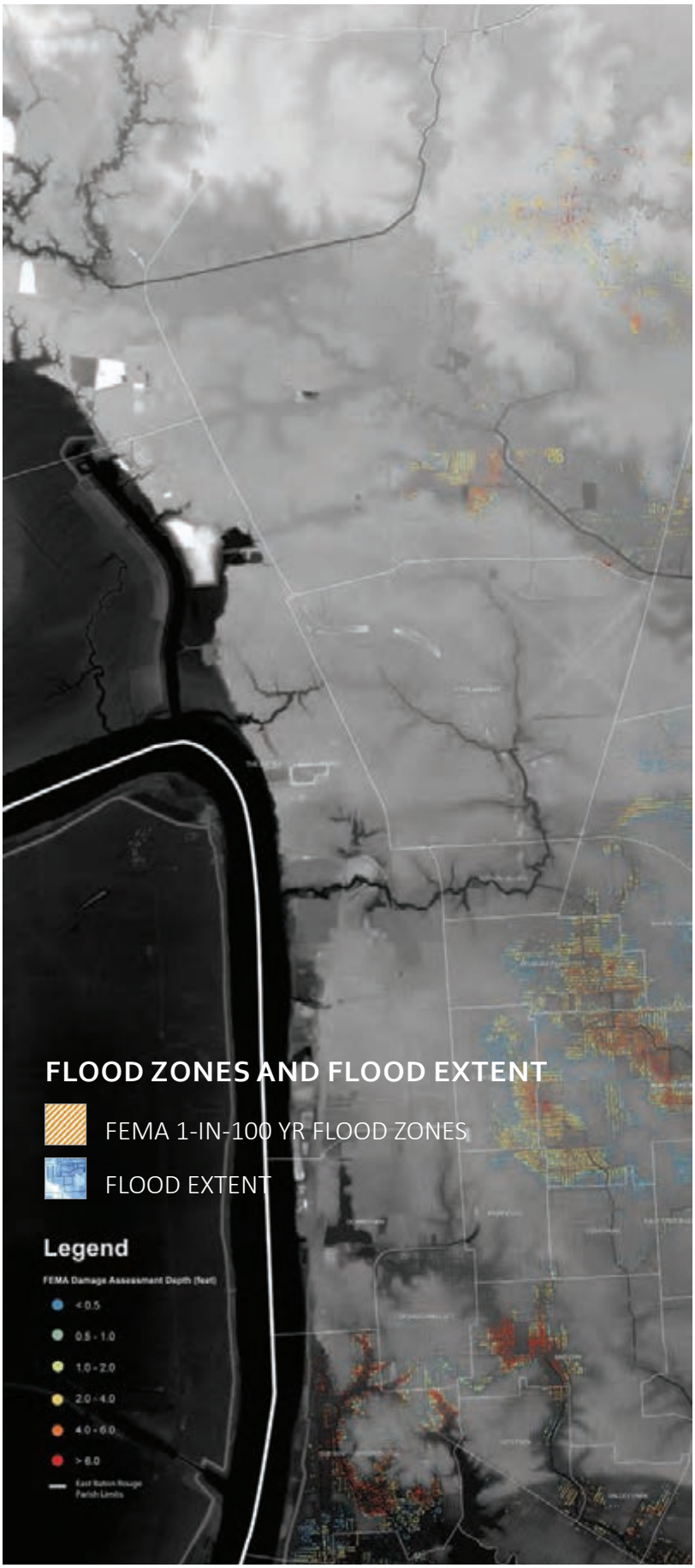
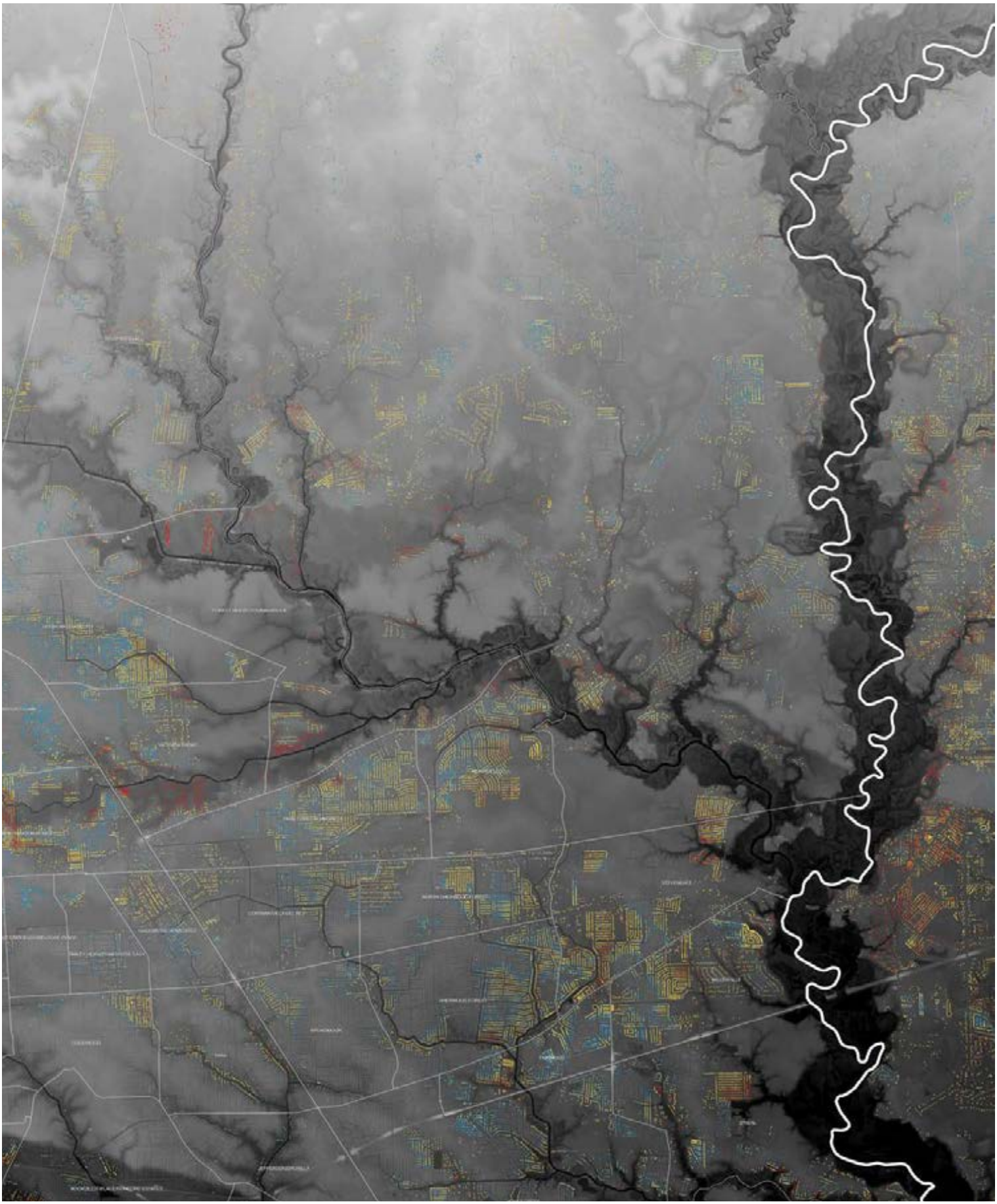
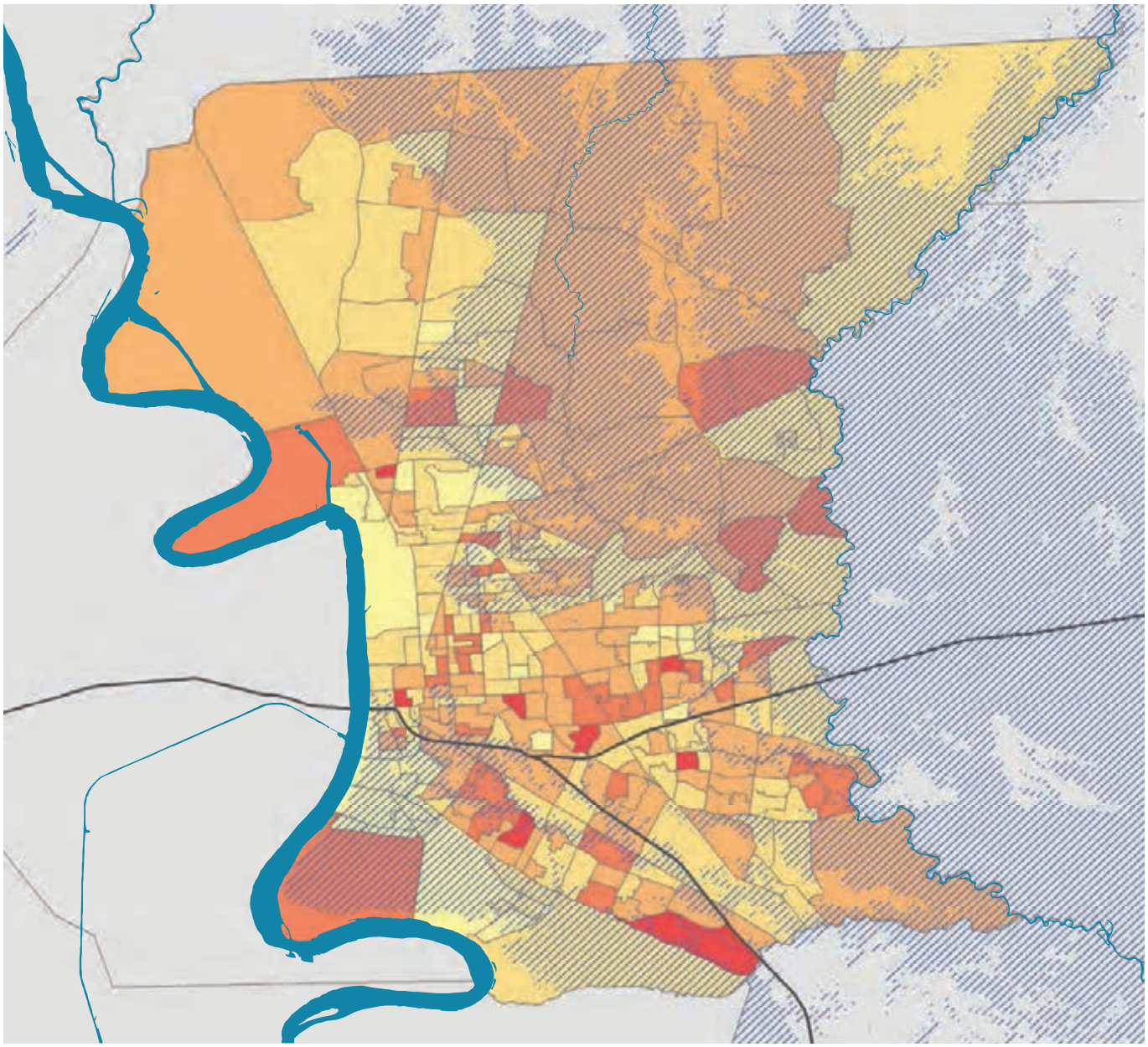




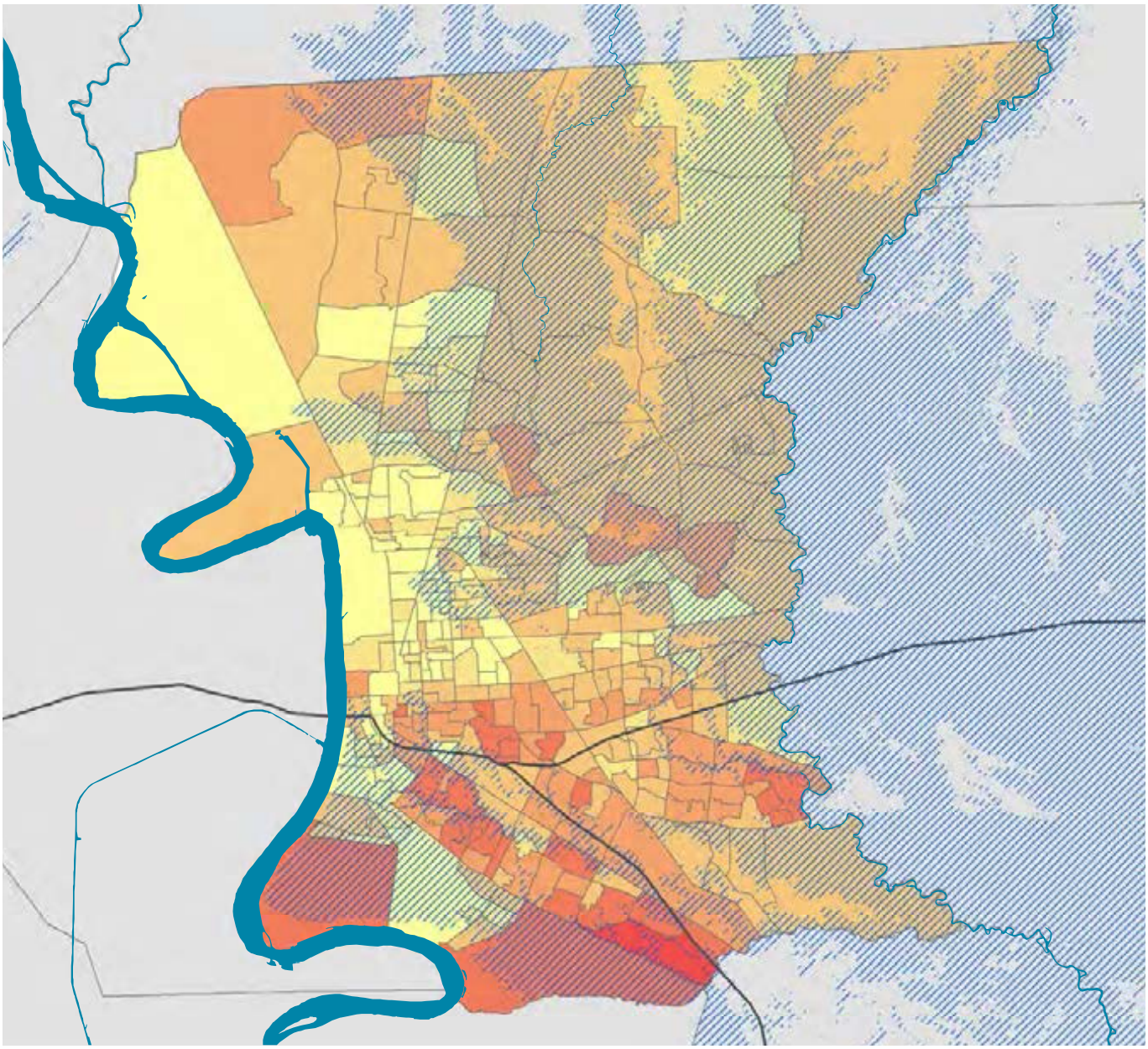


MEDIAN AGE

Major Bodies of Water
August 2016 Flood Extent
Interstate Highways

Median Age
2015 ACS 5-yr estimates

0 - 25
26 - 35
36 - 45
46 - 55
55 +

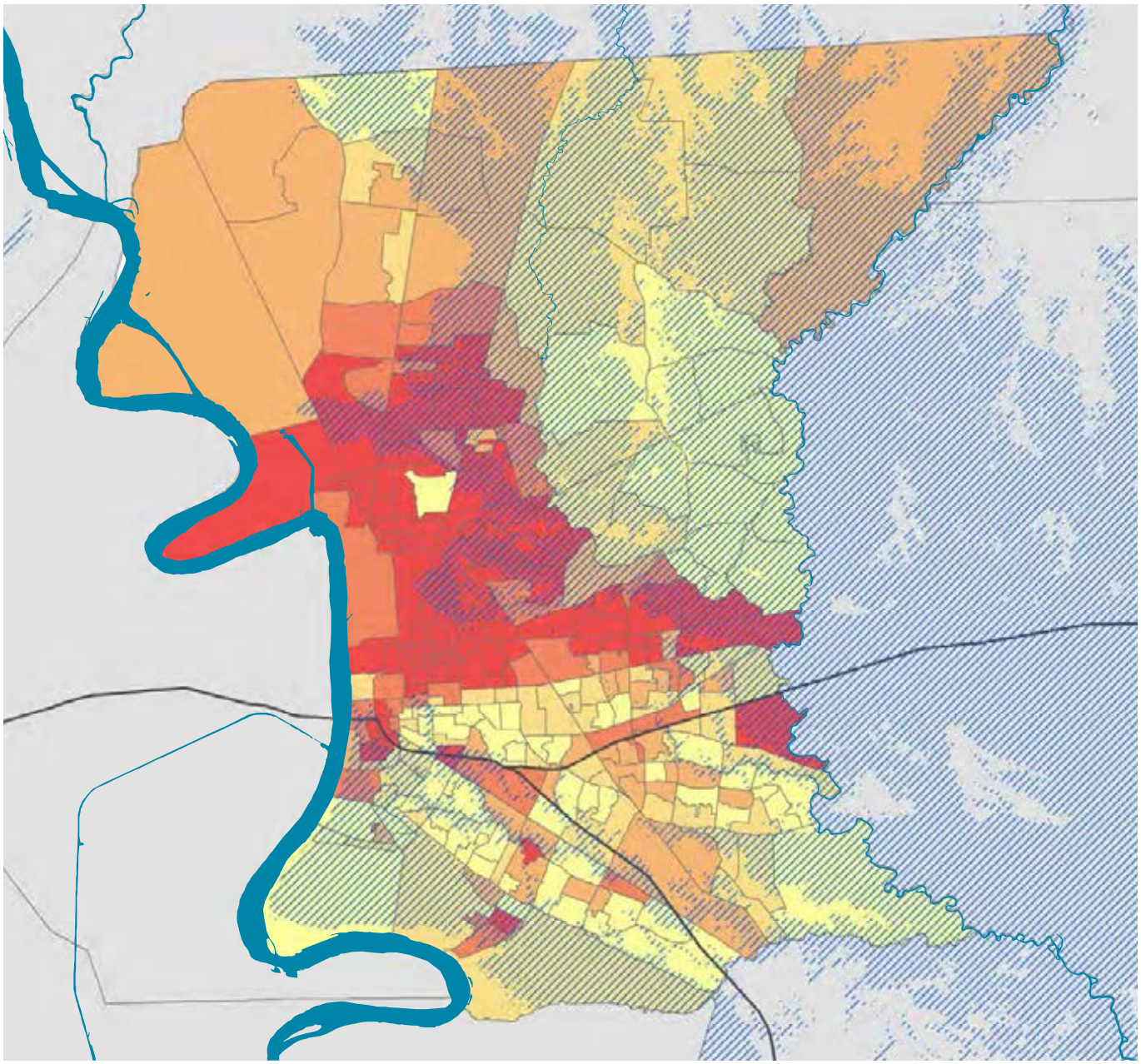


PER CAPITA INCOME

Major Bodies of Water
August 2016 Flood Extent
Interstate Highways

Per Capita Income
2015 ACS 5-yr estimates

$0 - $15,000
$15,000 - 20,000
$20,000 - 35,000
$35,000 - 50,000
$50,000 - 75,000
$75,000 +

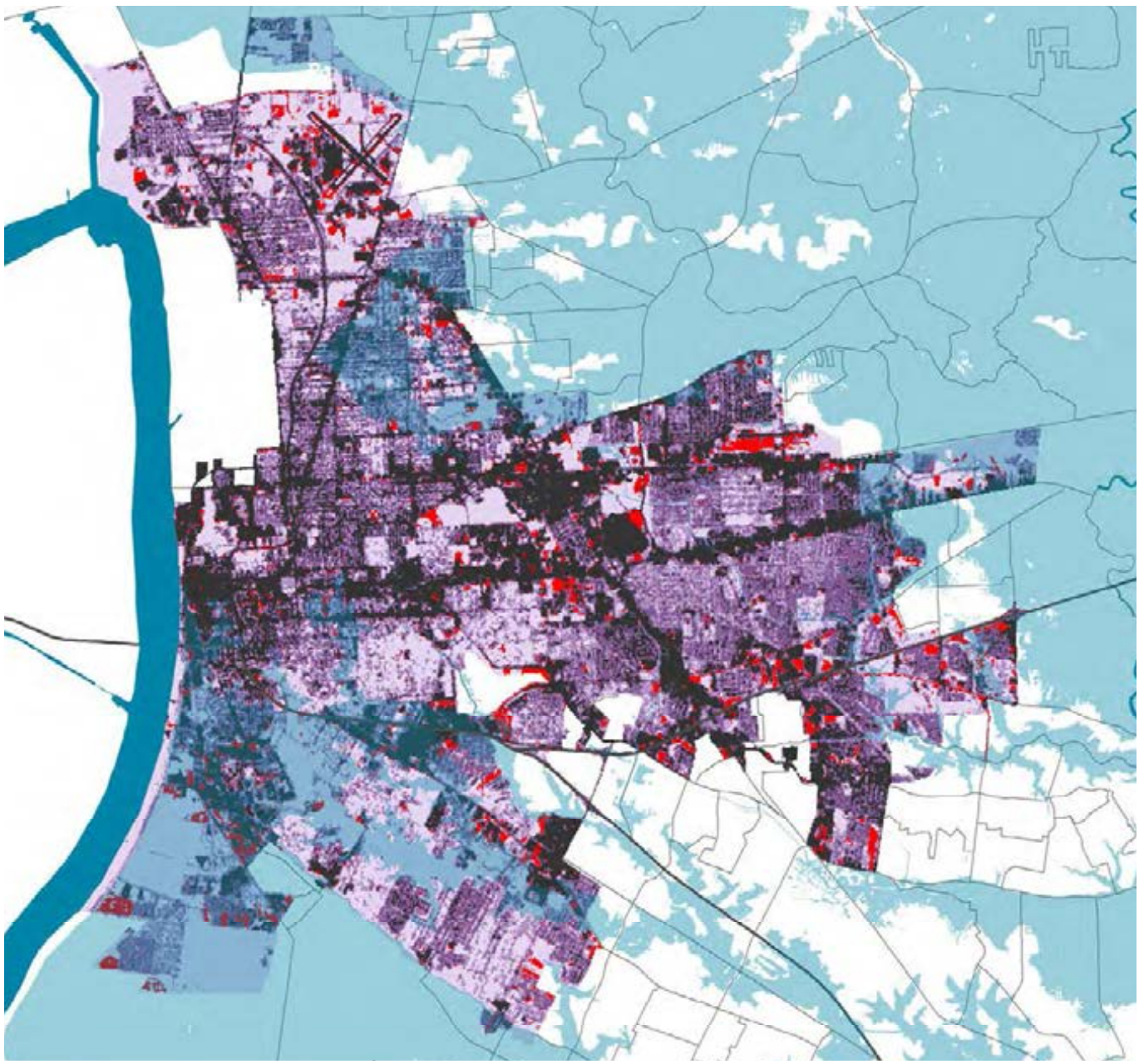


MINORITY POPULATIONS

Major Bodies of Water
August 2016 Flood Extent
Interstate Highways

Minority Populations (%)
2015 ACS 5-yr estimates

0 - 20
20 - 40
40 - 60
60 - 80
80 - 100

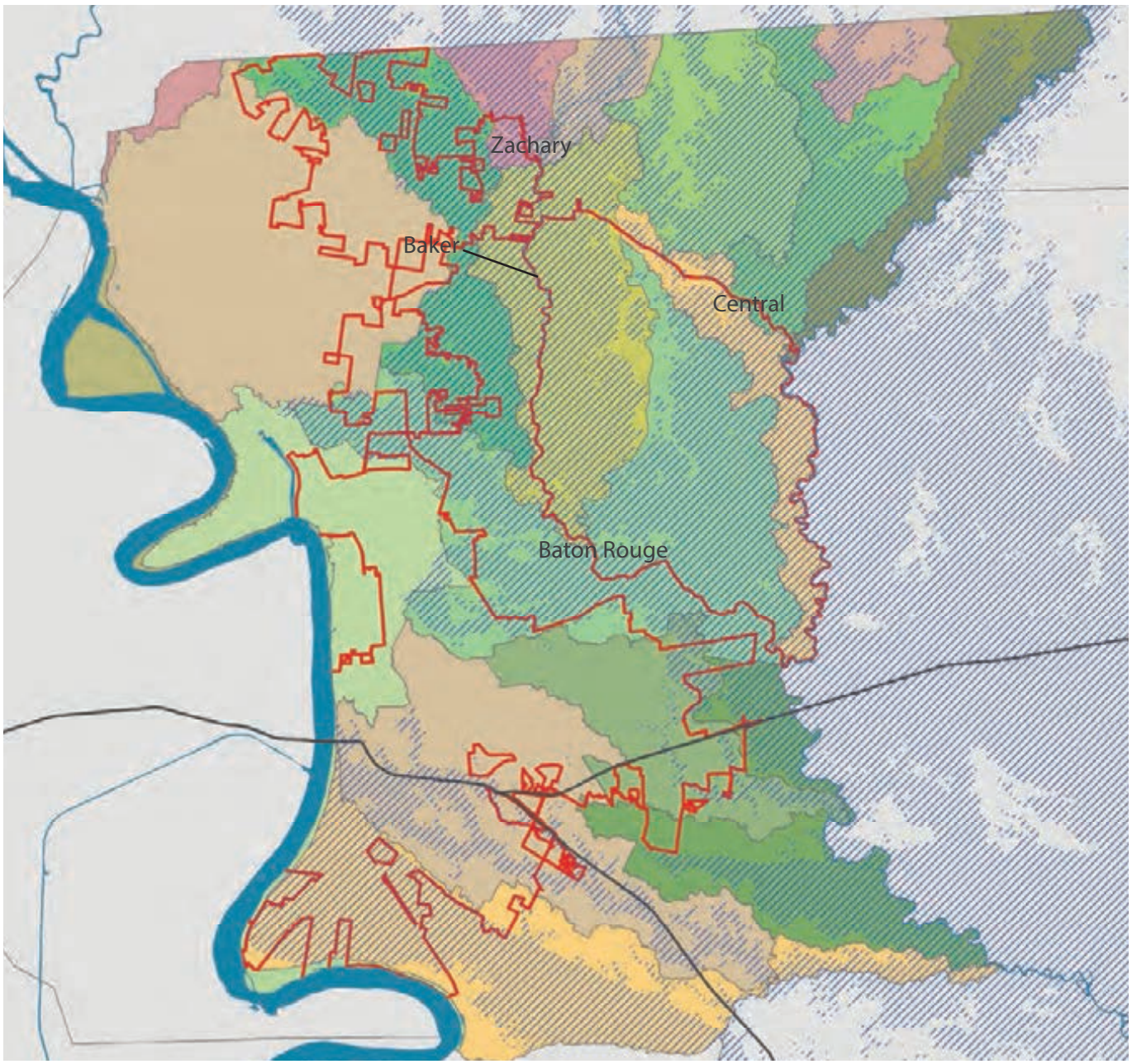


IMPERVIOUS SURFACE

August 2016 Flood Extent
Major Bodies of Water
Interstate Highways
2001-2011 Impervious Surface Increase (≥ 30%)

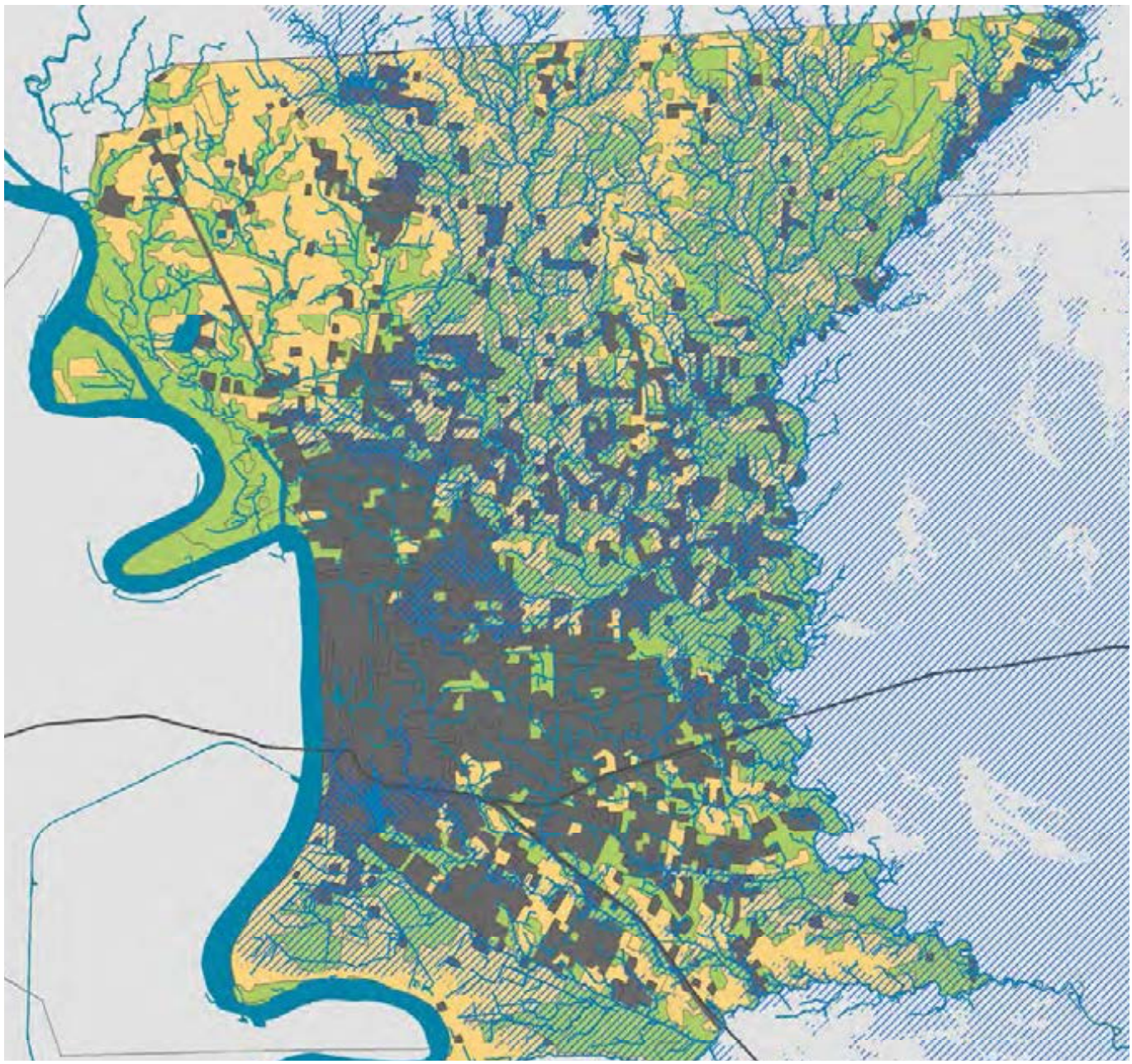
2001 Impervious Surface (%)

0 - 10
10 - 30
30 - 50
50 - 100



WATERSHEDS

- August 2016 Flood Extent
- Interstate Highways
- Major Bodies of Water
- City Boundary



LAND USE

August 2016 Flood Extent

Interstate Highways

Major Bodies of Water

Land Use

Developed

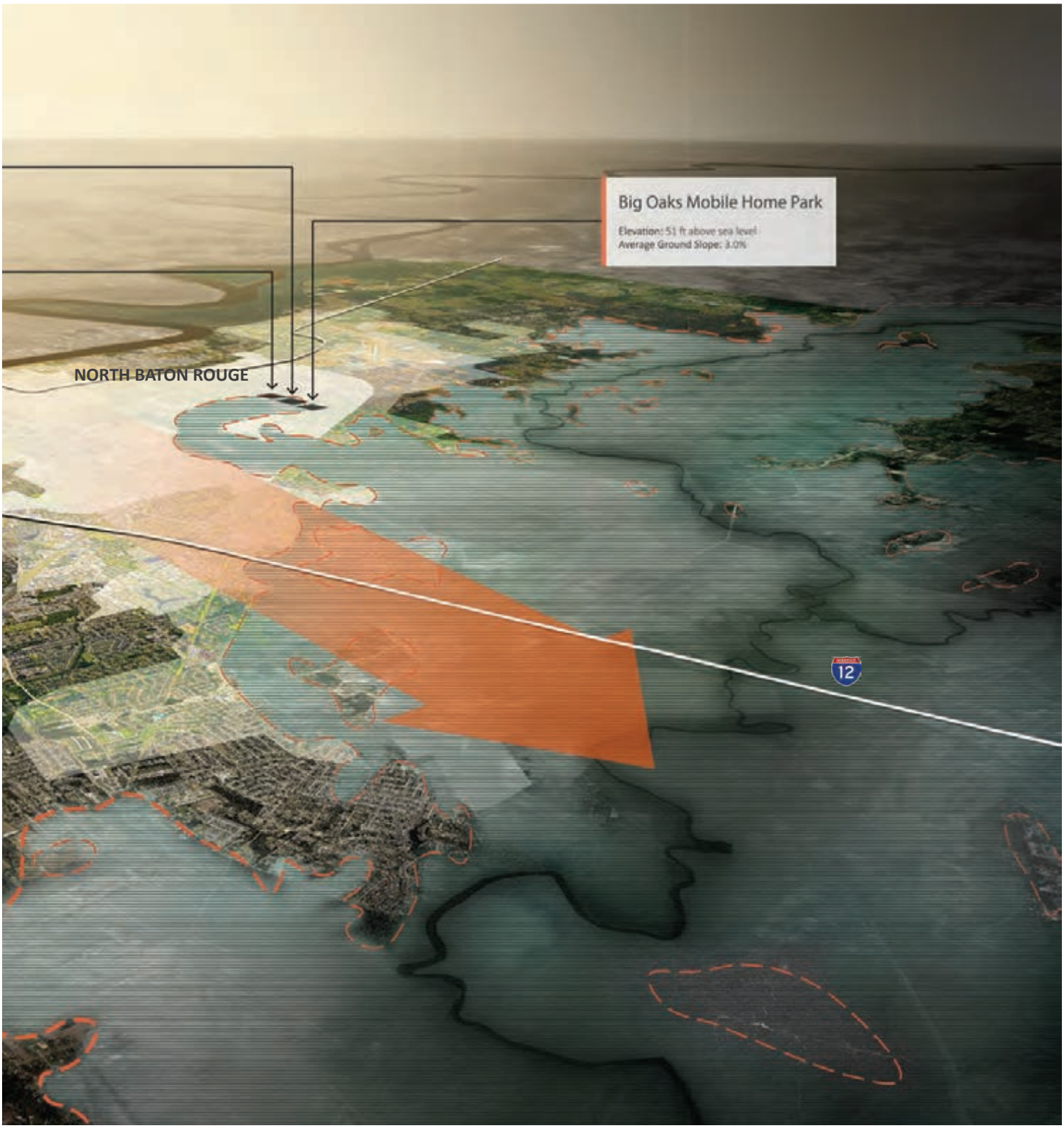
Agriculture

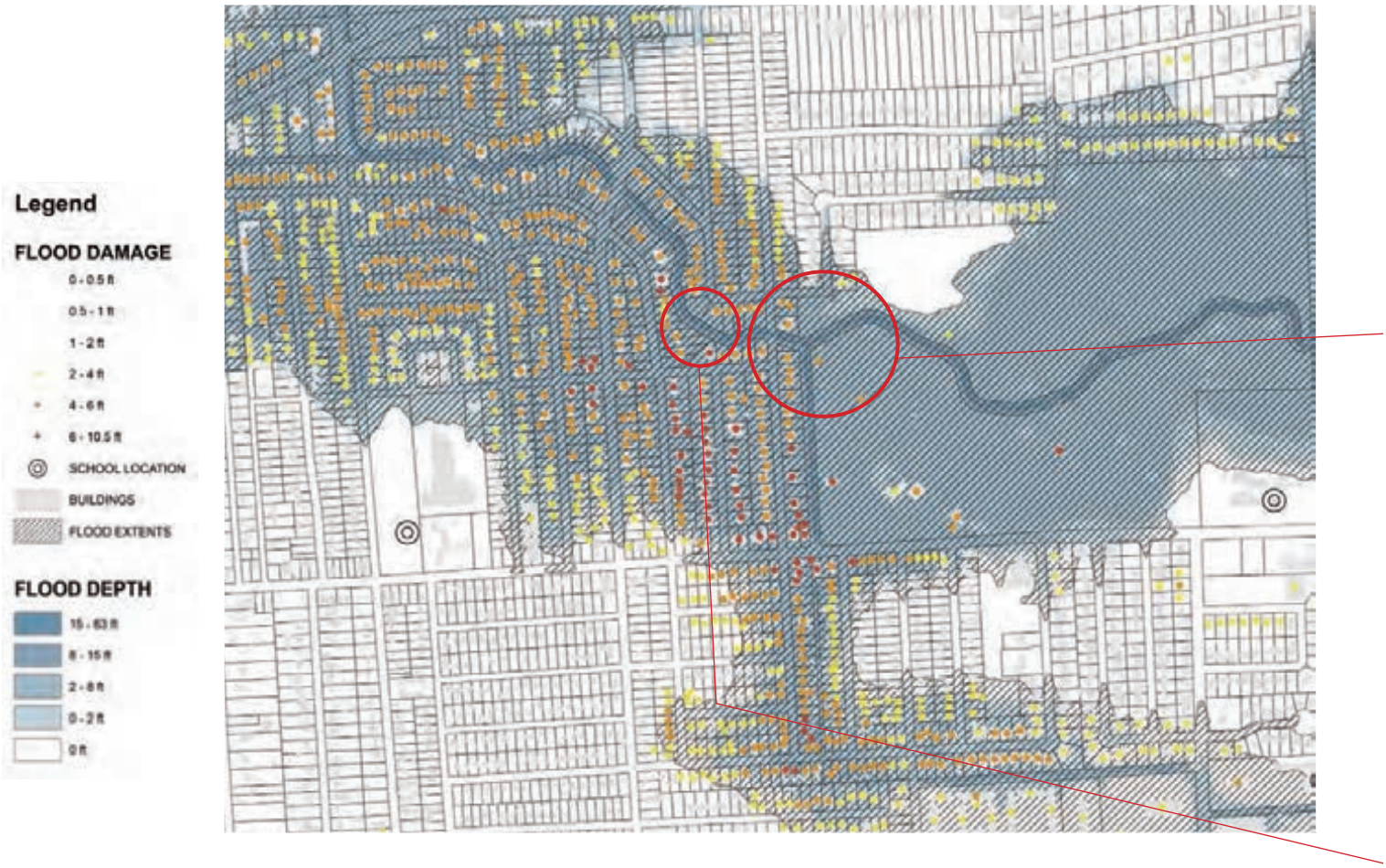
Undeveloped

CASE STUDIES

By cross-referencing East Baton Rouge Parish annexation and history of suburban development with August 2016 flood data, a disturbing trend emerges: Baton Rouge's flood risk is largely self-inflicted. over just a few generations the region has paved and sprawled far into the traditional floodplain reducing capacity of the natural system to hold large amounts of flood water.

Three impacted areas have been selected as case studies showing how sprawling development has exascerbated the Parish's flooding challenges. Novel ecosystem restoration and the use of surrounding public land can help mitigate stormwater effects if the will to retrofit our existing communities could be generated.

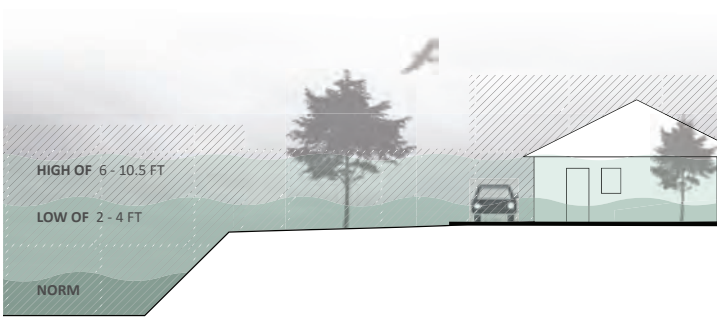

Big Oaks Mobile Home Park
Elevation: 51 ft above sea level
Average Ground Slope: 3.0%
NORTH BATON ROUGE
12



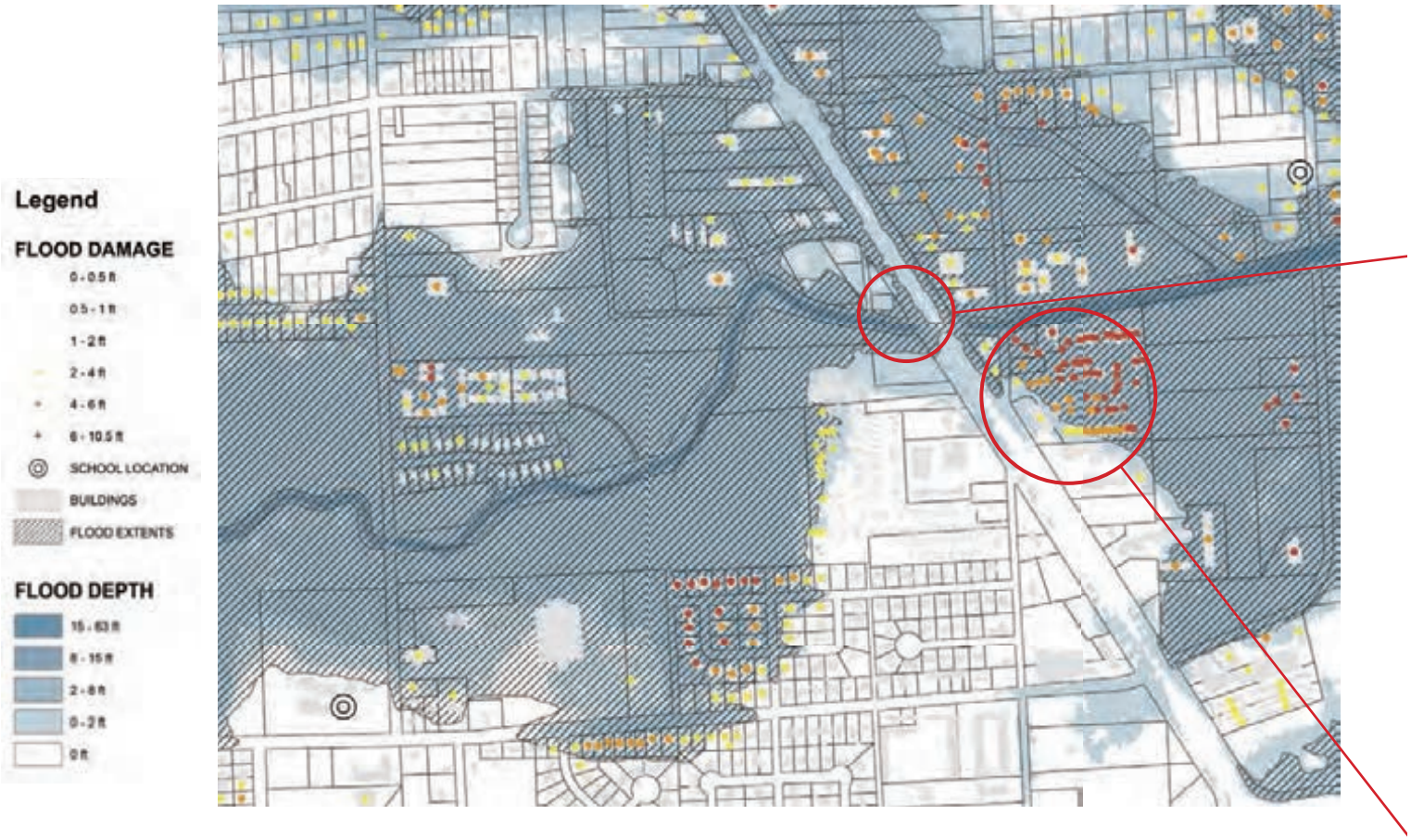
Howell Park Neighborhood

The neighborhood received severe flooding during the 2016 flood. The neighborhood sits adjacent to Howell park and as illustrated above, the flood extents largely filled the park in the same footprint as it flooded the neighborhood. The original flood-plain that predates the neighborhood re-emerged as outlined by the special flood hazard area and caused significant damage.

Channelized river in designated flood zone. No space for the floodplain remains. Subdivision age: 1946.

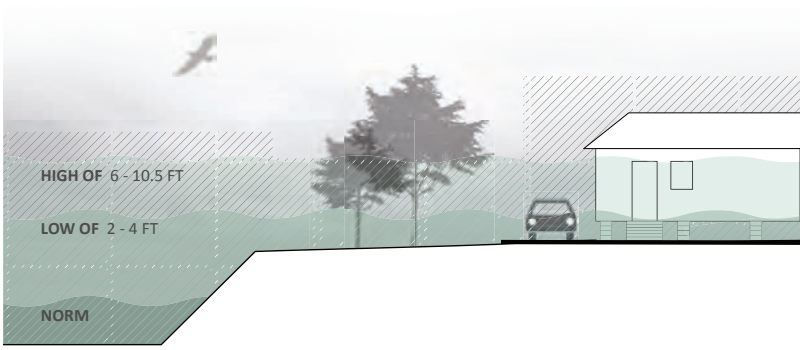


FLOOD DEPTH

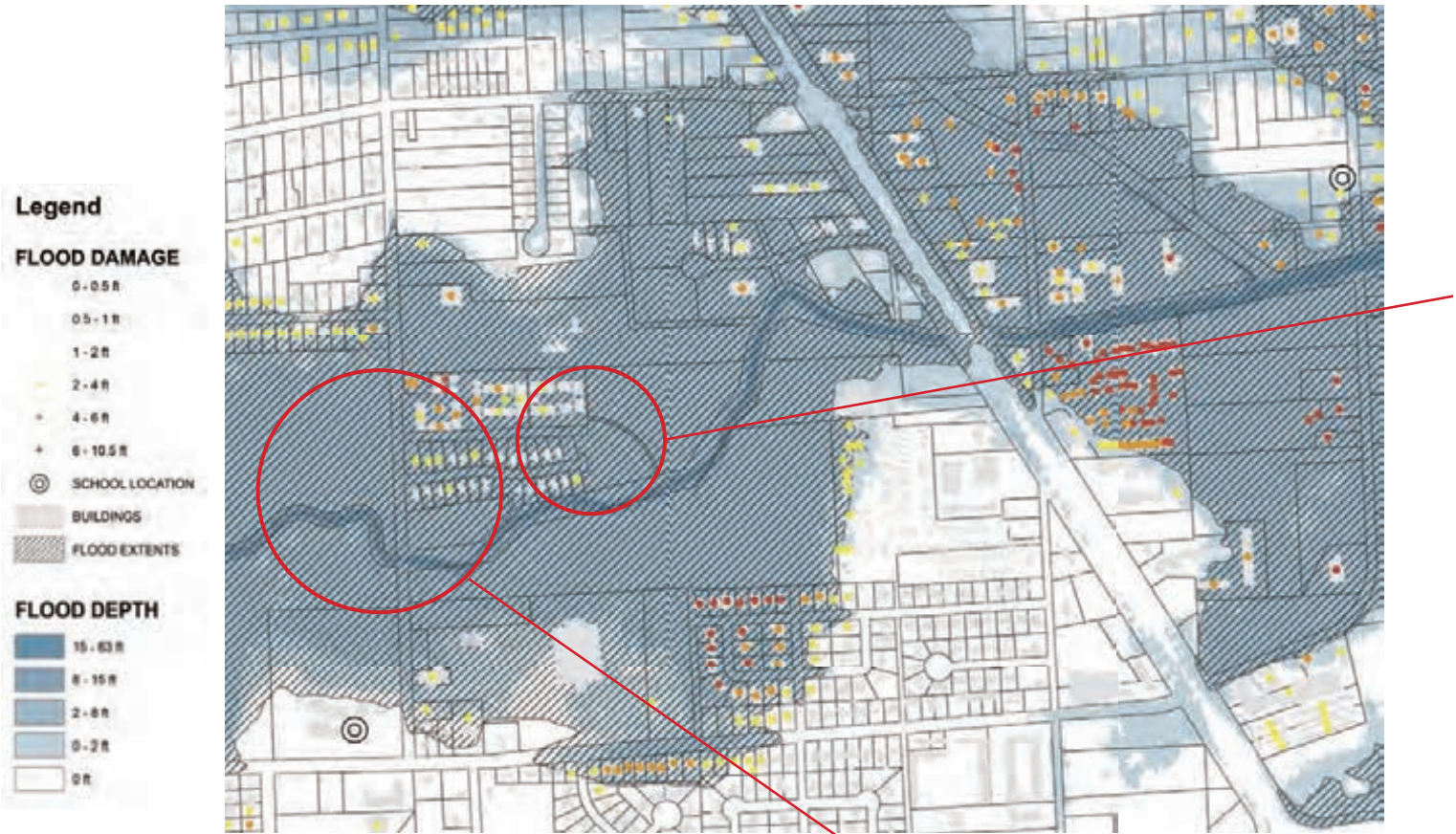


Big Oaks Mobile Home Park

Like many places flooded in 2016, the Big Oaks Mobile Home Park is representative of unplanned yet affordable housing located in an extremeley vulnerable location. This community and others like it tend to be located in floodplains and face tremendous risk from flooding.

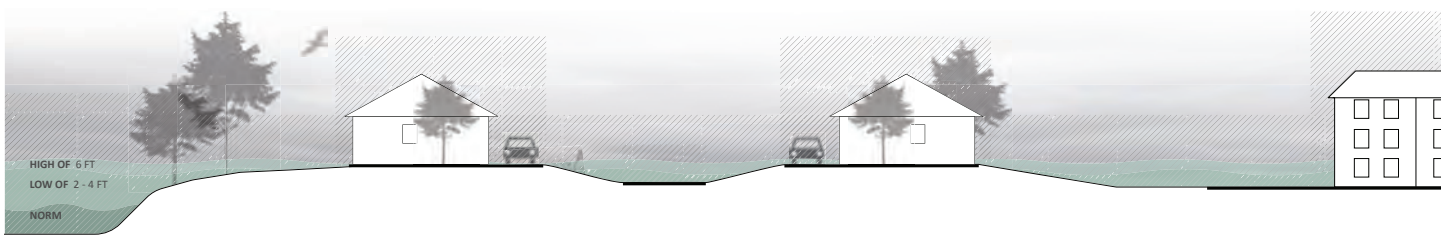


FLOOD DEPTH

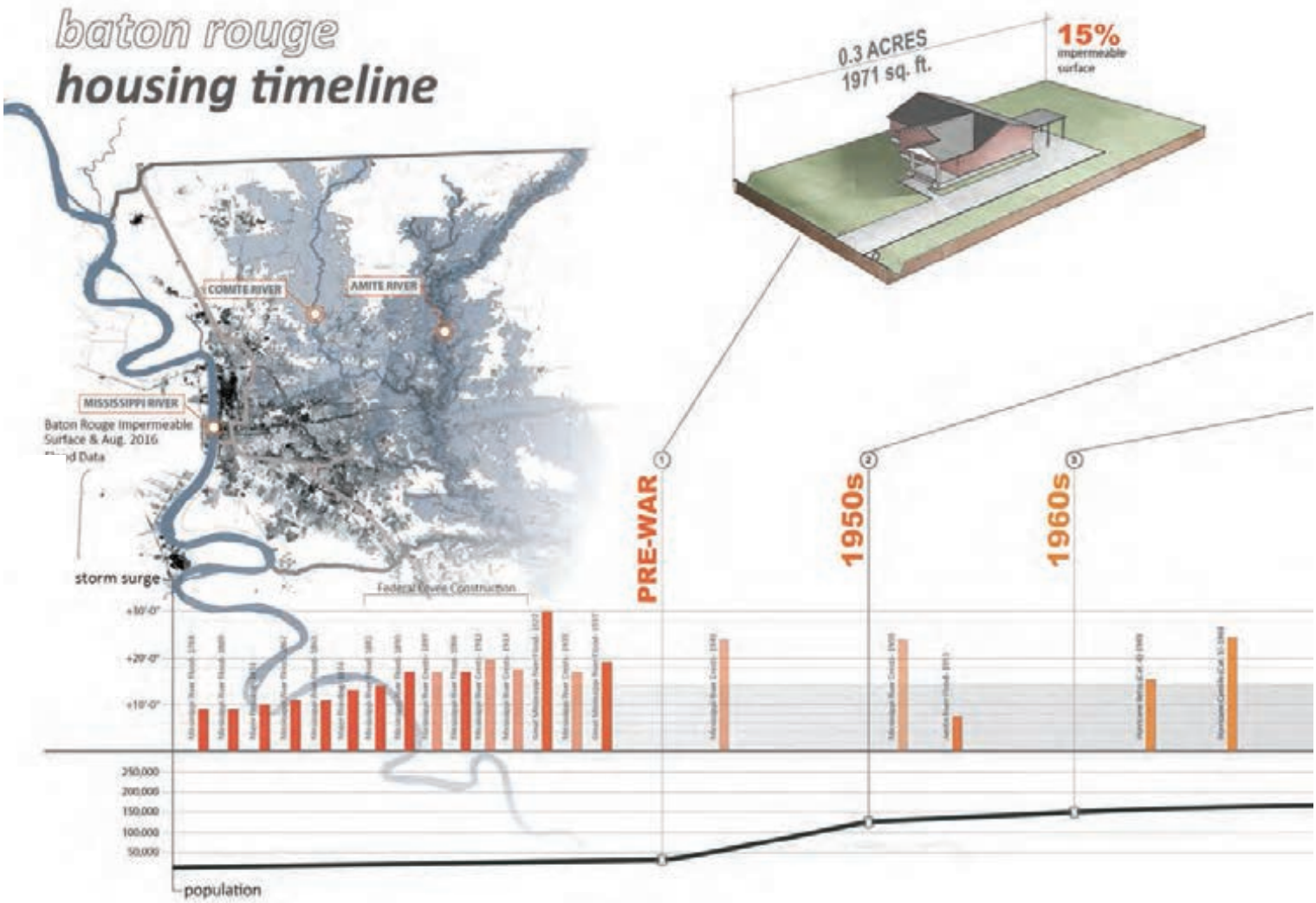


Winbourne Subdivision

This community was built after flood restrictions were put in place in Baton Rouge. The community is clearly elevated on fill above the height of the neighboring community. Consequently, the Winbourne subdivision stayed dry while the adjacent neighboring development was badly flooded.



FLOOD DEPTH



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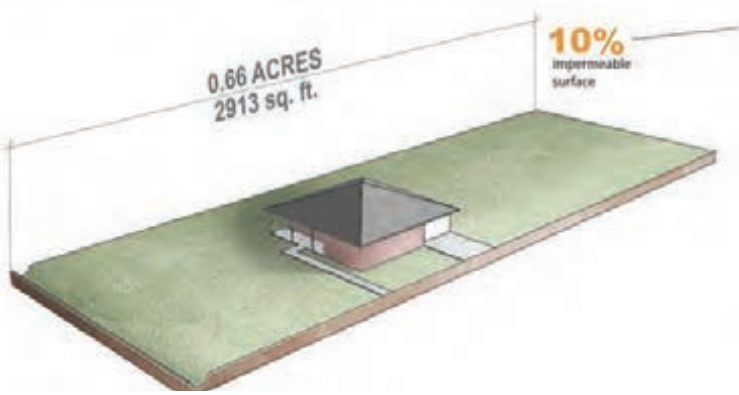
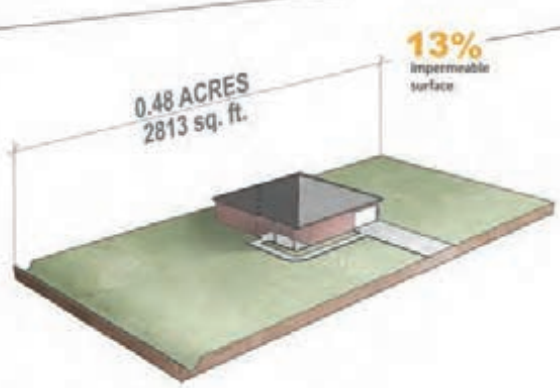
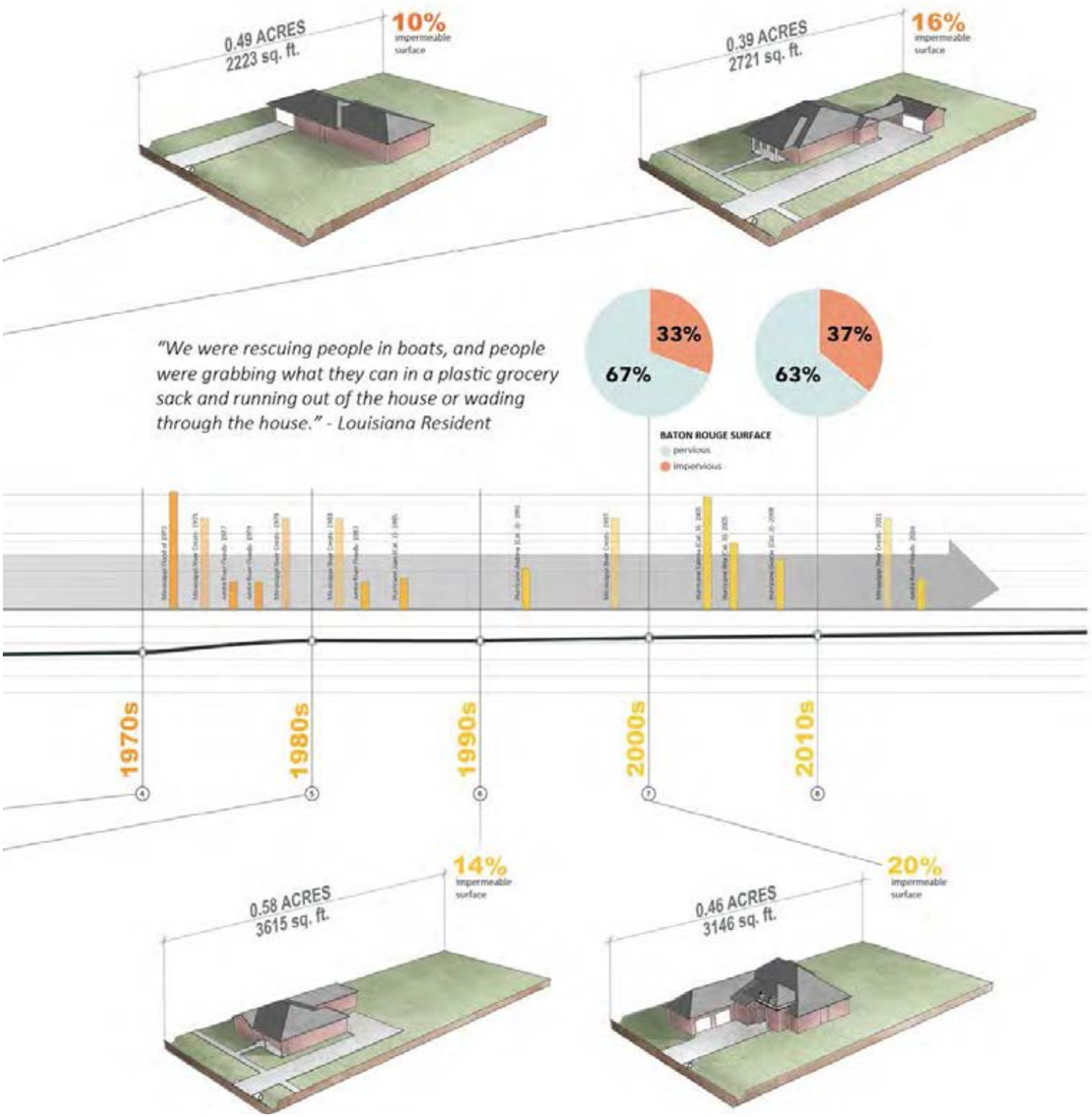
https://www.theatlantic.com/politics/archive/2016/08/america-is-ignoring-another-natural-disaster-near-the-gulf/496355/







IN 80 YEARS AVERAGE HOME SIZE INCREASED BY 60%

DESIGN RECOMMENDATIONS

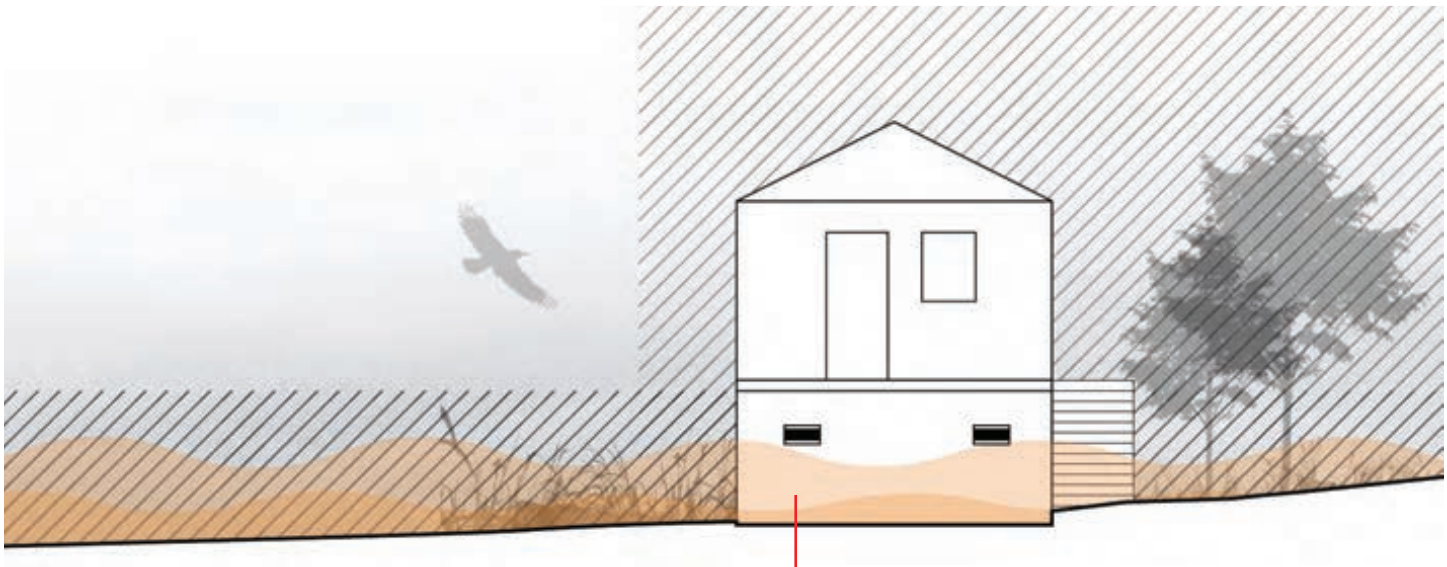
While it may be impossible to eliminate all risks associated with flood hazards and storms, individuals and communities can plan for these risks and become more resilient, or better able to withstand and recover from extreme events and environmental change. FEMA administers the National Flood Insurance Program (NFIP), through which individual property owners are required to maintain flood insurance to obtain mortgages, as well as to be eligible for federal disaster assistance. At the same time, coastal communities participating in the NFIP are required to match their local codes with FEMA's requirements for flood-resistant construction for new and substantially improved buildings in designated flood zones. These standards require buildings to incorporate flood-resistant techniques below the Base Flod Elevation (BFE)in anticipation of flood waters.

Elevating or otherwise floodproofing buildings is inarguably beneficial in floodprone areas, but it is important to recognize the challenges created by flood-resistanat construction requirements both in terms of affordability and potential impacts to accessibility and urban design. The character of streets, neighborhoods, and public spaces is influenced by the buildings at their edges. While buildings and neighborhoods should be designed to survive a flood event, urban design concepts such as visual connectivity, inviting access, and neighborhood character are important fuctional considerations during normal non-flood conditions. While a community may participate in the NFIP, there may be local regulations such as zoning and building codes that create obstacles for building and retrofitting buildings in floodprone areas.

ADAPTATION CONSIDERATIONS

1. Building Strength
2. Flood Warning Time
3. Flood Characteristics
4. Level of Protection
5. Building Location
6. Operational Considerations
7. Utilities and Access to Alternate Power
8. Topographic and Site Considerations

HIGH ELEVATION

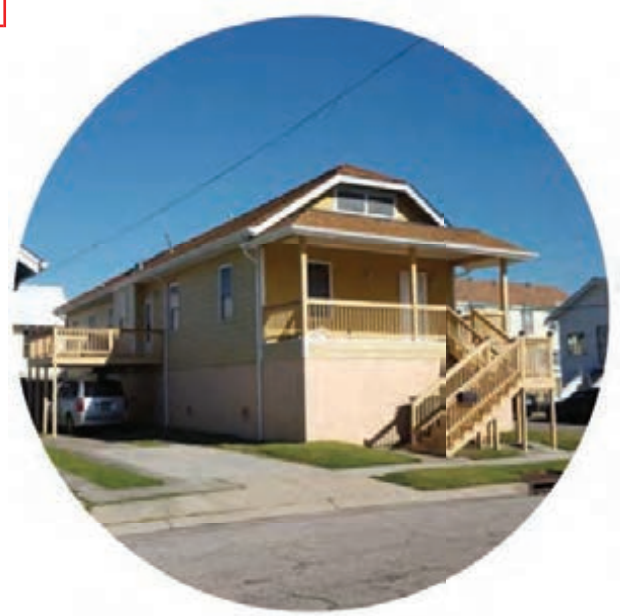


STRUCTURAL REINFORCEMENT

A local or areawide district established to accomodate a special set of uses or for specific purposes. Examples include open space, conservation, cultural, historic preservation, and planned development districts. The establishment of special districts can be used to encourage the sustainable redevelopment of depressed or hazard impacted areas.

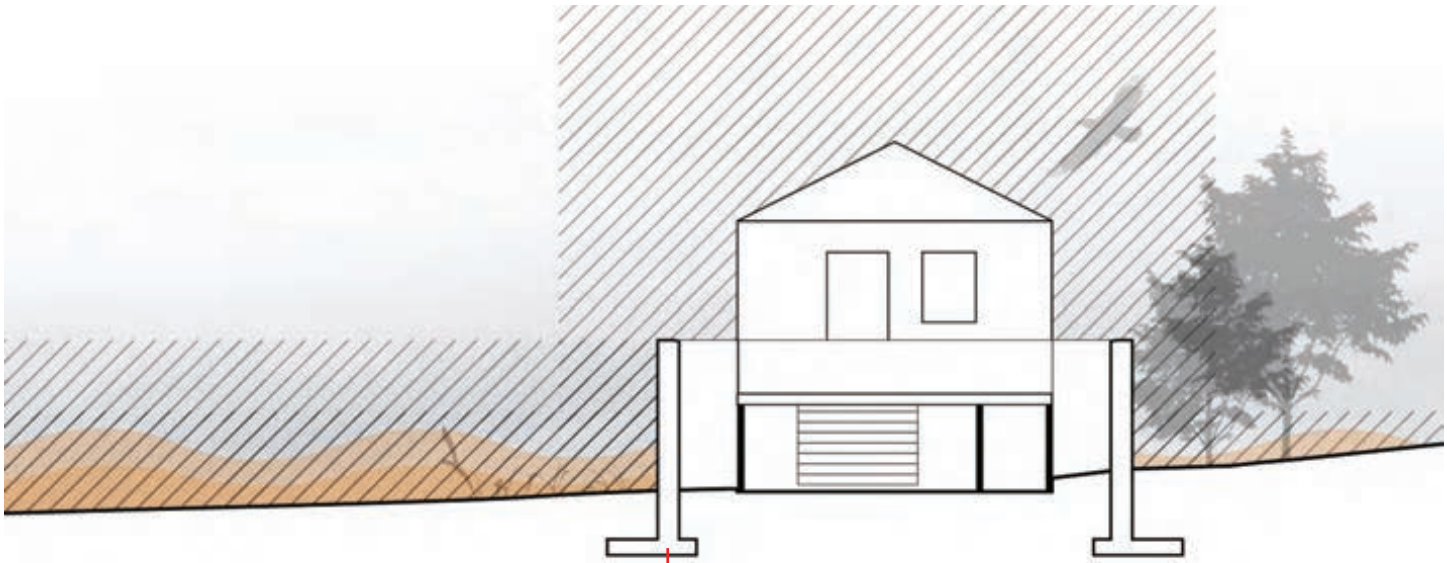
APPLICATION

In areas where flood velocities exceed five feet per second, reinforcement measures may be required. This includes strengthening walls to withstand flood forces, using deeper foodings to prevent scouring, using extra olts to connect the sill to the foundation, or installing rods to connect the cap to the sill.



BUILDING FOUNDATION

Foundations refer to the built up portion of the structure between the ground and the finished floor elevation. Best practices developed by the City include appropriate enclosure, materials, screening, scale, and blockface cohesion.



MINOR FLOOD CONTROL

Floodwalls and berms are free standing barriers that surround individual or small groups of buildings to prevent floodings. Floodwalls are freestanding, permanent structures designed to prevent flood water and debris from entering a building. Berms are small earthen levees (<4') more commonly used to protect large areas such as subdivisions or agricultural uses.

APPLICATION

Like floodproofing, small flood control measures have limited applications, and are best used under specific circumstances. Construction requires enough space between structures to accomodate the berm or floodwall. In addition, if the property is accessed through a gap or low spot in the protective barrier, this needs to be filled before a flood.

ENTRYWAYS

Elevated structures risk losing their relationship to the street. Well-designed porches and stairways can help to mitigate this potential disconnection and help ensure elevated houses contribute to the community fabric.

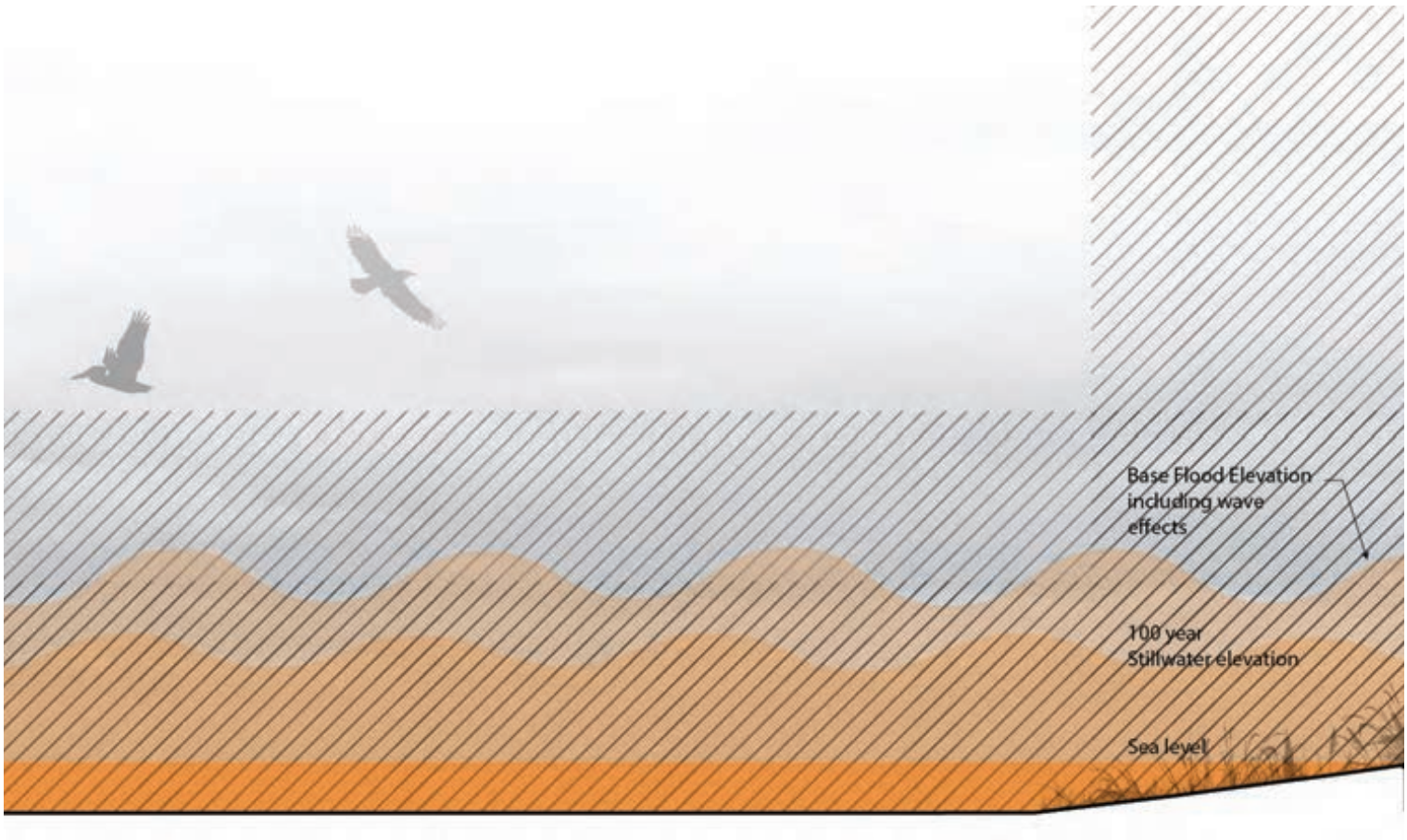
FLOODPROOFING

Floodproofing is any combination of structural or nonstructural modifications to reduce or eliminate damage to buildings in floodprone areas. Dry floodproofing makes a structure watertight below the level that needs flood protection. Wet floodproofing consists of modifying uninhabited portions of a structure to allow floodwater to flood in and out.

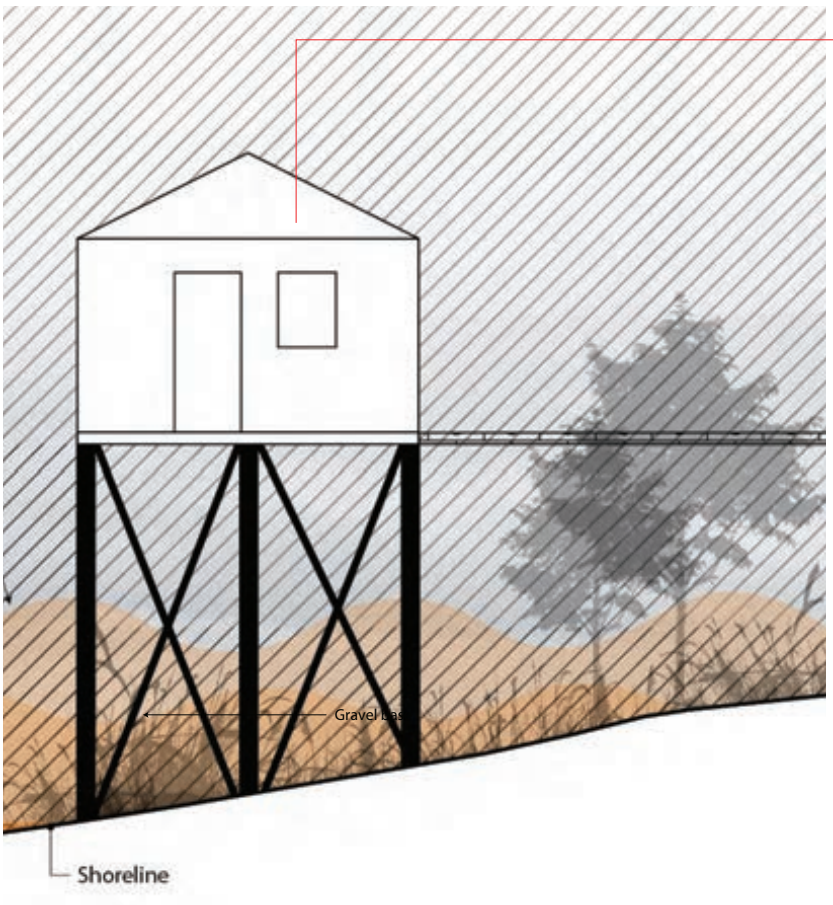
APPLICATION

Floodproofing measures can be used in limited situations to maintain structures in flood hazard areas. Development of a floodproofing strategy should include considerations of regulatory requirements, flood characteristics (e.g. duration, wave loads, frequency, etc.) site factors, functional use of the building, operational abilities, and economic factors.

MID ELEVATION



LOW ELEVATION



BUILDING ELEVATION

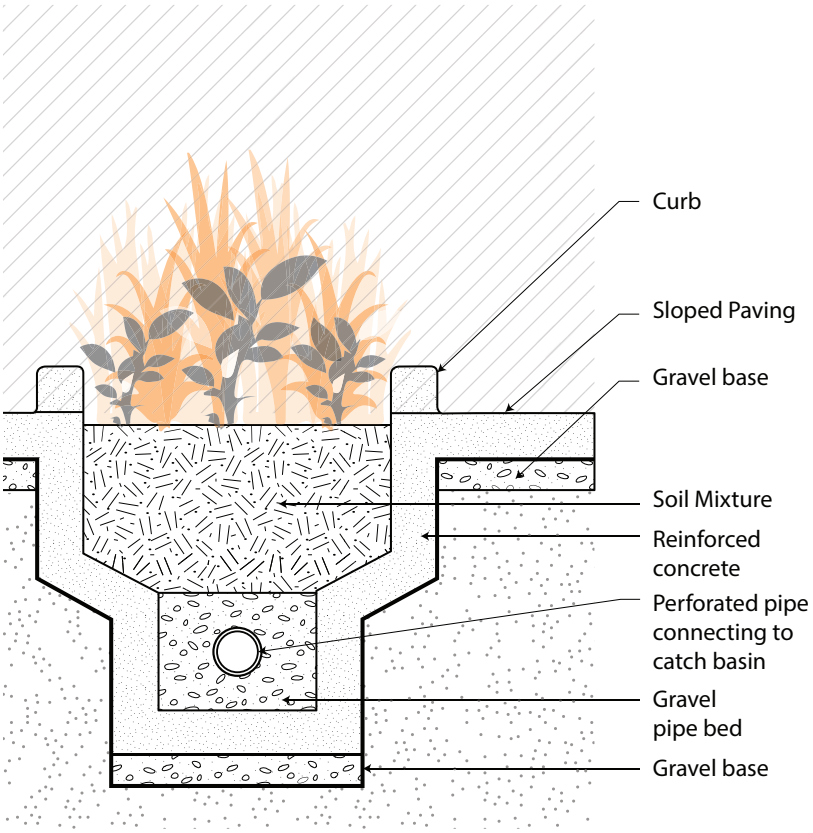
This option involves raising a structure's lowest flood so floodwater can flow freely beneath. Base flood is the elevation to which water is anticipated to rise during a hazard event. Base Flood Elevation (BFE) is shows on a community's Digital Flood Insurance Rate Map (DFIRM). BFE is the regulatory requirement for elevating or floodproofing structures.

APPLICATION

Elevation is being used with increased frequency in floodprone areas, the frequency of recent flooding events have shown the value of this tried and true method. There are some downsides, however, The higher a structure is raised, the more vulnerable the roof and walls become to storm winds. Elevated structures must incorporate design elements that maintain accessibility.

SITE DESIGN

BIOSWALES - SMALL SCALE



APPLICATION

Bioswales are landscape elements designed to concentrate or remove silt and pollution from surface runoff water. They consist of a swaled drainage course with gently sloped sides (less than 6%) and filled with vegetation, compost and/or riprap. The water's flow path, along with the wide and shallow ditch, is designed to maximize the time water spends in the swale, which aids the trapping of pollutants and silt. Depending upon the geometry of land available, a bioswale may have a meandering or almost straight channel alignment. Biological factors also contribute to the breakdown of certain pollutants.

A common application is around parking lots, where substantial automotive pollution is collected by the paving and then flushed by rain. The bioswale, or other type of biofilter, wraps around the parking lot and treats the runoff before releasing it to the watershed or storm sewer.

BENEFITS INCLUDE:

-Protection of local waterways from storm water pollutants.

-Creates habitat for wildlife, including birds and butterflies.

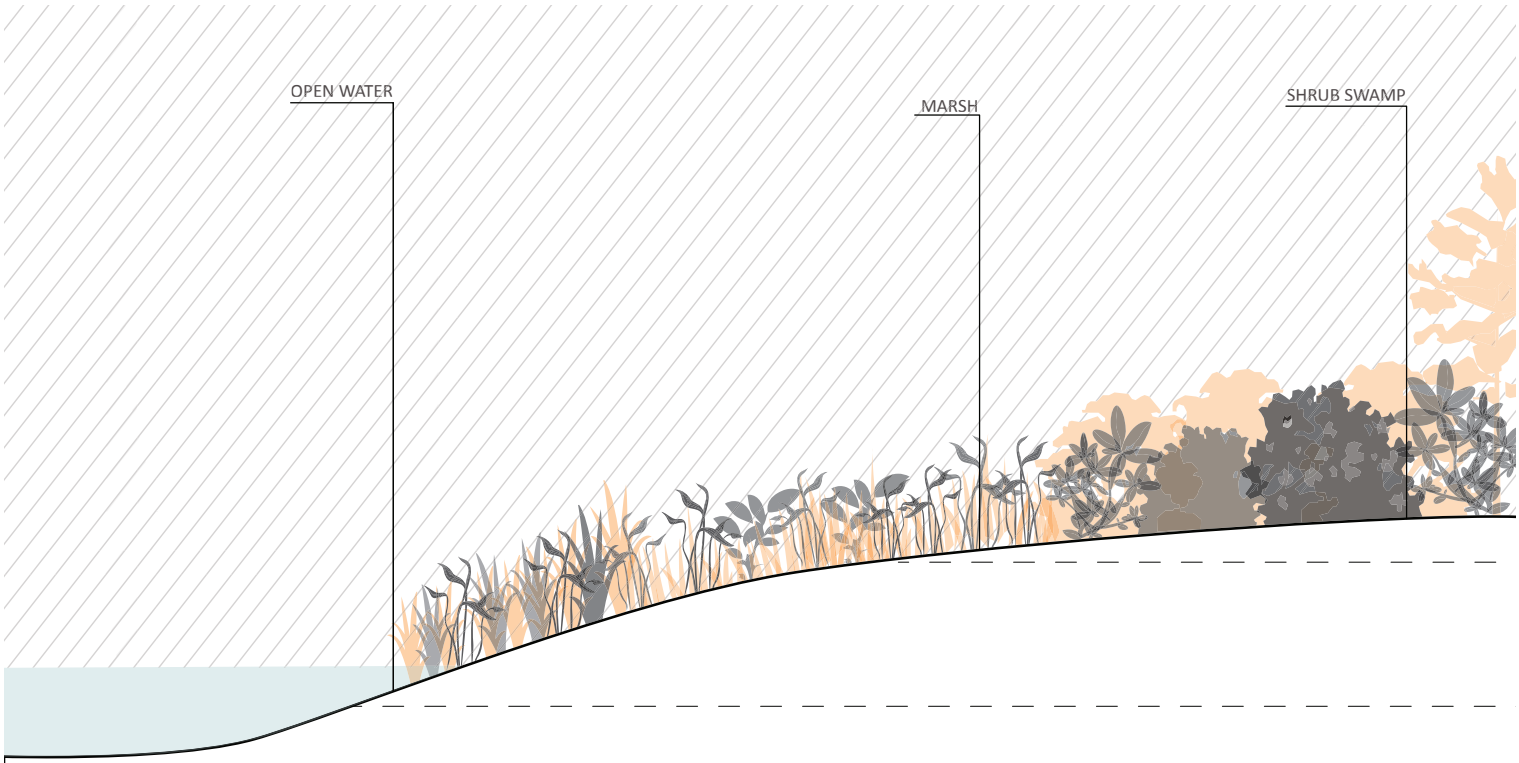
-Reduces non-point pollution by filtering stormwater.

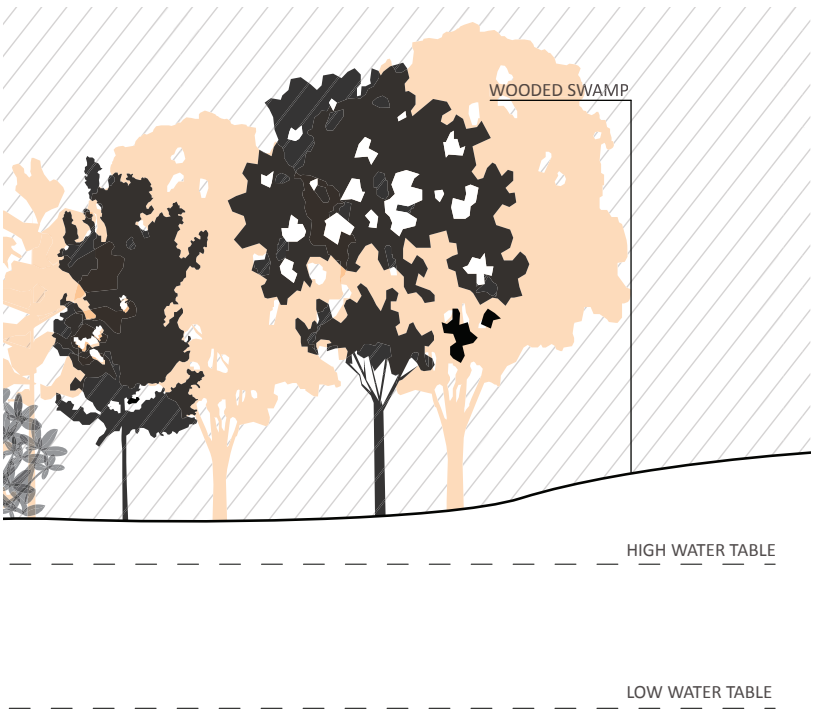
-Reduces standing water that can attract mosquitoes.

Creates colorful gardens with a variety of plants and flowers.

-Requires little maintenance after establishment.

WETLANDS - LARGE SCALE





APPLICATION

A wetland is a land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem. The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants, adapted to the unique hydric soil. Wetlands play a number of roles in the environment, principally water purification, flood control, carbon sink and shoreline stability. Wetlands are also considered the most biologically diverse of all ecosystems, serving as home to a wide range of plant and animal life.

The wetland system of floodplains is formed from major rivers downstream from their headwaters. Converting wetlands through drainage and development have contributed to the issue of irregular flood control through forced adaption of water channels to narrower corridors due to loss of wetland area. These new channels must manage the same amount of precipitation causing flood peaks to be [higher or deeper] and floodwaters to travel faster.

BENEFITS INCLUDE:

-Protection of local waterways from storm water pollutants.

-Creates habitat for wildlife, including birds and butterflies.

-Reduces non-point pollution by filtering stormwater.

-Reduces standing water that can attract mosquitoes.

Environmental Protection

Hazards are part of the world around us. Floods, droughts, hurricanes and other events are natural phenomena that we cannot control, but result in great change in the environment. However, human activities can significantly impact the functioning of natural systems. Poorly planned development can contribute to hazard impacts from floods or droughts by removing vegetation that absorbs water, replacing it with impervious surfaces that increase quantity and speed of runoff during storms. As development increases in hazardous areas, the conversion of water retaining habitats such as wetlands reduces the ability to control water flow.

Though the occurence of natural hazards is inevitable, their effects can be mitigated by protecting natural resources and sustainaing healthy landscapes. In coastal areas, estuaries and wetlands act as physical barriers that reduce storm surge and protect adjacent property. Preserving or restoring trees mitigates the effects of heat-related hazards by reducing temperatures, thus decreasing heat-related illness and mortality. Trees and plants also act as a sponge, absorbing storm water and reducing flooding. Ideally, planners think in terms of regional systems of green infrastructure- integrated networks of wetlands, forests, and green spaces that together provide community-wide benefits. Environmental protection provides additional benefits such as increased recreational and educational opportunites, habitat for endangered species, improved environmental quality, and increased property values.

CROSBY ARBORETUM

Picayune, MS

The Arboretum is a non=profit institution dedicated to preserving the unique and endangered Pearl River ecosystems in Mississippi and Louisiana. The facility offers educational and recreational programs, as well as 700 acres dedicated to scientific research and native plant conservancy.

PRESERVATION

Preservation is the setting aside of natual resources to maintain them in their present condition. In areas with high flood risk, preservation is particularly effective in reducing a community's future vulnerability, especially in areas where development has not occurred or capital imprevements have not been substantial.

RESTORATION

Restoration is the process of assisting the recovery of a system that has been degraded, damages, or destroyed. Projects have the capacity to repair ecological damage, as well as renew economic opportunites and improve local communities. Restoration can be large or small scale, and is a key element for sustainable development.

CREATION

Creation involves construction of an environmental feature (often wetlands) on a site where it did not previously exist, but where conditions exist that can product and sustain the landscape. The most common reasons for landscape creation are 1) treating wastewater, 2) mitigating loss elsewhere, and 3) providing wildlife habitat.

ENHANCEMENT

Environmental enhancement is the increase of one or more of the functions performed by the landscape feature beyond what currently or previously existed. The purpose is to increase the capacity of specific functions, such as habitat for endangered species or stormwater management, to achieve a desired end goal.

WALDO GIACOMINI RANCH

Marin County, CA

In 2006, this project was undertaken to restore 563 acres of marsh previously dyked for ranching. This public/private partnership was developed to reestablish tidal wetlands to improve local water quality, floodwater retention, and support a stable coho salmon population.

HUIE CONSTRUCTED TREATMENT WETLAND

Clayton County, GA

In 2000, Clayton County determined that urbanization had adversely impacted surface water quality and supply. To ensure adequate supply for future growth, they built densely vegetated surface flow wetlands to efficiently filter stormwater and replenish water sources.

JAMAICA BAY

New York, NY

In 2014, the US DOI provided $11.1M in competitive Super Storm Sandy grants to enhance Jamaica Bay in NY. Projects focused on expanding salt marsh, planting maritime forests, and seeding oyster beds to improve enviromental quality and protect against future storms.

Policy & Local Ordinances

Comprehansive planning provides the "big picture" perspective of a community today, and where that community envisions going in the future. Its intent is to guide day-to-day land use decisions and capital facilities expenditures. Strong comprehansive plans consider social, economic, and environmental conditions, and contain goals, objectives, and strategies that are deveoped with community input. Comprehensive plans provide heightened legal support for the implementation mechanisms, such as zoning and other regulations, that support community goals and objectives.

Through the planning process, communities identify priority areas for resource protection or development. The plan may identify high hazard areas, such as those prone to flooding, as areas for limited development, while earmarking other more stable areas for higher density development. Plans and other land use ordinances can also allow developers more flexibility in arranging improvements on a parcel of land through the planned development approach, which promotes development patterns that are less at risk from hazards.

ZONING

Zoning ordinances legally determine where, what, and how development occurs on private property. Traditional zoning divides a municipality into various zones and designates a range of uses and characteristics of allowable development. Zoming is among the most effective planning tools that can be used to limit damage from natural hazards.

APPLICATION
Zoning with resiliency in mind promotes development and redevelopment patterns (i.e. type, location, density) that are less at risk from known hazards. Contemporary zoning approaches that employ a range of resilience techniques include: Mixed-use zoning, overlay zones, floating zones, form-based codes, and stormwater management in landscape standards.

VIRGINIA BEACH, VA

The Virginia Beach area is experiencing the highest rates of sea level rise on the U.S. East Coast. As a result, the city has adopted zoning regulations that maintain and enhance wetlands, native vegetation, and other living shoreline habitats along waterways to protect property and reduce erosion.

BUILDING CODES

Building codes provide minimum safeguards for health, safety, and welfare with regard to building safety and fire prevention. Standard codes, such as the International Building Code (IBC), typically serve as the model. Particularly after a disaster, codes can be updated to mandate development that withstands hazards such as wind, fire, and flood.

APPLICATION
Local codes can exceed minimum life safety standards to mitigate hazards and encourage sustainability. Exceeding IBC NFIP/DFIRM elevation requirements, energy efficiency standards, materials durability, and encouraging innovative design that increases disaster resilience can all be included to minimize hazards and enhance community development.

STATE OF LOUISIANA

Following a series of devastating storms, Louisiana adopted the IBC and the International Residential Code to cover all single and two-family structures. In 2014, Louisiana become only the second state to also mandate codes for commercial buildings with specific coastal and high wind requirements.

SUBDIVISION REGULATIONS

Local ordinances specifying the standards and conditions needed to ensure orderly development of land, required improvements, and infrastructure. Originally directed at street layout and construction specifications, many now include standards for environmentally sensitive design, stormwater management, and structural hazard mitigationi.

APPLICATION
Resilient subdivision ordinances regulate the division of land in ways that avoid or minimize the effects of known hazards. They often require development applicants to submit plans that identify hazards and mitigate their potential effects. This is also where incentives for creative designs that encourage conservation or minimize hazards impacts are included.

ST. LOUIS COUNTY, MO

The Sustainable Subdivision and Zoning Ordinance Revisions project was designed to make St. Louis County more resilient and energy efficient. Codes were updated to address renewable energy, land use and transportation, stormwater management, housing choice, and local food production.

SPECIAL DISTRICTS

A local or areawide district established to accomodate a special set of uses or for specific purposed. Examples include open space, conservation, cultural, historic preservation, and planned development districts. The establishment of special districts can be used to encourage the sustainable redvelopment of depressed or hazard impacted areas.

APPLICATION
Special districts allow governments to designate an area for revitalization by creating a hub of activity. Economic development is encouraged by offering creative incentives and tax credits to private property owners. Blight reduction is encouraged by drawing investors and renewal into designated districts.

DURHAM, NC

Downtown Durham, NC struggled for decades after the loss of the tobacco industry. Leaders designated a historic district to encourage redevelopment of historic buildings through local support, state and federal historic tax credits, and private investment in the now thriving American Tobacco Campus.

FUNCTIONAL PLANS

Functional plans focus on specific functions or services such as stormwater management, transportation, conservation, or historic preservation. These plans may consider the entire community, have a regional focus, or be related to the boundaries of a special district. Functional plans provide multiple opportunities for hazard mitigation integration.

APPLICATION
Restoring or protecting existing natural systems can both lessen risk to nearby or adjacent communities and enhance ecosystem benefits. Wetland restoration, forest management, stream corridor restoration, and erosion control are all examples of protecting environmentally sensitive areas which in turn protect human cohabitants.

NEW YORK, NY

The City of New York's Waterfront Revitalization Program establishes guidelines and policies for redevelopment and new development along the coastline, including policies to minimize the loss of life, structures, and natural resources caused by flooding and erosion.


Google earth