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# WATER MARKS

Louisiana Coastal Wetlands Planning, Protection and Restoration News

August 2015 Number 52

## Mapping Louisiana's Disappearing Coast

**August 2015**
Number 52

*WaterMarks* is published two times a year by the Louisiana Coastal Wetlands Conservation and Restoration Task Force to communicate news and issues of interest related to the Coastal Wetlands Planning, Protection and Restoration Act of 1990. This legislation funds wetlands restoration and enhancement projects nationwide, designating nearly $80 million annually for work in Louisiana. The state contributes 15 percent of total project costs.

***WaterMarks* Editor**
**Sarah Haymaker**
3737 Government Street
Alexandria, LA 71302
(318) 473-7613

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**ABOUT THIS ISSUE'S COVER . . .**

*Comparing contemporary satellite imagery of Louisiana's coast to a map drawn in the 1860s shows the deterioration of barrier islands, the expansion of bays and other water bodies, and the conversion of wetlands to water. Modern mapping techniques play an essential role in determining land loss and rates of subsidence and in formulating restoration strategies.*

*Credit: National Oceanic and Atmospheric Administration*



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Brass Marker: U.S. Geological Survey, USGS museum staff • Map: Library of Congress

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### Drawing lines in a fluid landscape

# Maps Lay the Groundwork for Living on the Coast

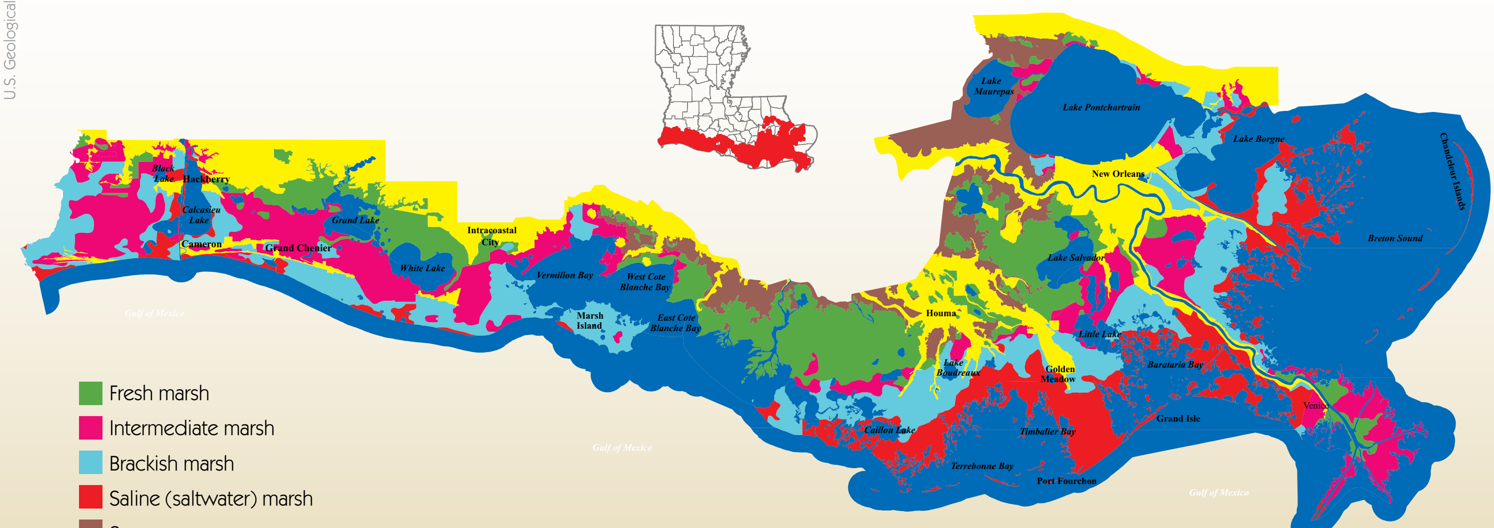
It's a cliché to say that "you can't go home again," but for most of us it is possible at least to go back to where home was — to stand at the house site, recognize something familiar in the lay of the land and orient ourselves using a map from a bygone era.

Not so in Louisiana. Although accurate maps are essential to the viability of living and working on Louisiana's coast, maps more than 10 years old are likely to show places that no longer exist. Comparing old maps to new ones shows how chunks of wetlands have disappeared under the surface of water, how the protective band of marsh between inland communities and the Gulf of Mexico is shrinking, how the zones of fecund habitat for fish and wildlife are contracting. Maps verify the state's land loss, quantify rates of erosion and subsidence, and depict changes in elevation above and below the water's surface. Maps of Louisiana are the foundation for

- **Successful environmental restoration projects**
  From start to finish, maps play a role in restoration projects undertaken through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). "At the outset of a project, maps provide the basis for modeling design options and their likely outcomes," says Tim Osborn, the National Oceanic and Atmospheric Administration's navigation manager for the Central Gulf Coast. "During construction, engineers rely on frequently updated maps to adapt their plans to changing conditions; tides, waves, winds,

Using data collected on aerial surveys and from plant sampling sites that determined species identification and abundance, the map represents various marsh types in different colors. Land-cover analyses provide baselines against which to measure wetland loss, effects of climate change, sea-level rise, urbanization and other environmental stressors. Understanding past trends contributes to projecting future patterns and supports informed decisions among landscape managers and community policy-makers.

U.S. Geological Survey




**Vegetation Types in Coastal Louisiana in 2013**

By Charles E. Sasser,[1] Jenneke M. Visser,[2] Edmond Mouton,[3] Jeb Linscombe,[3] and Steve B. Hartley[4] 2014

[1]Louisiana State University. [2]University of Louisiana at Lafayette. [3]Louisiana Department of Wildlife and Fisheries. [4]U.S. Geological Survey.

storms and water's chemical composition all affect design. Once a project is complete, maps track its effectiveness and chart outcomes such as wetland expansion, land accretion or alterations in marsh vegetation."

And it's not just maps of the marsh surface that are important. CWPPRA projects depend on thoroughly understanding the water in and around each one. "Maps of bottom conditions are indispensable to thoroughly understanding a project site," says Osborn. "The deeper the water, the bigger the waves and the more severe the erosion. The larger the bay, the greater the tidal exchange and the farther the reach of salt water."

- **Securing public safety**

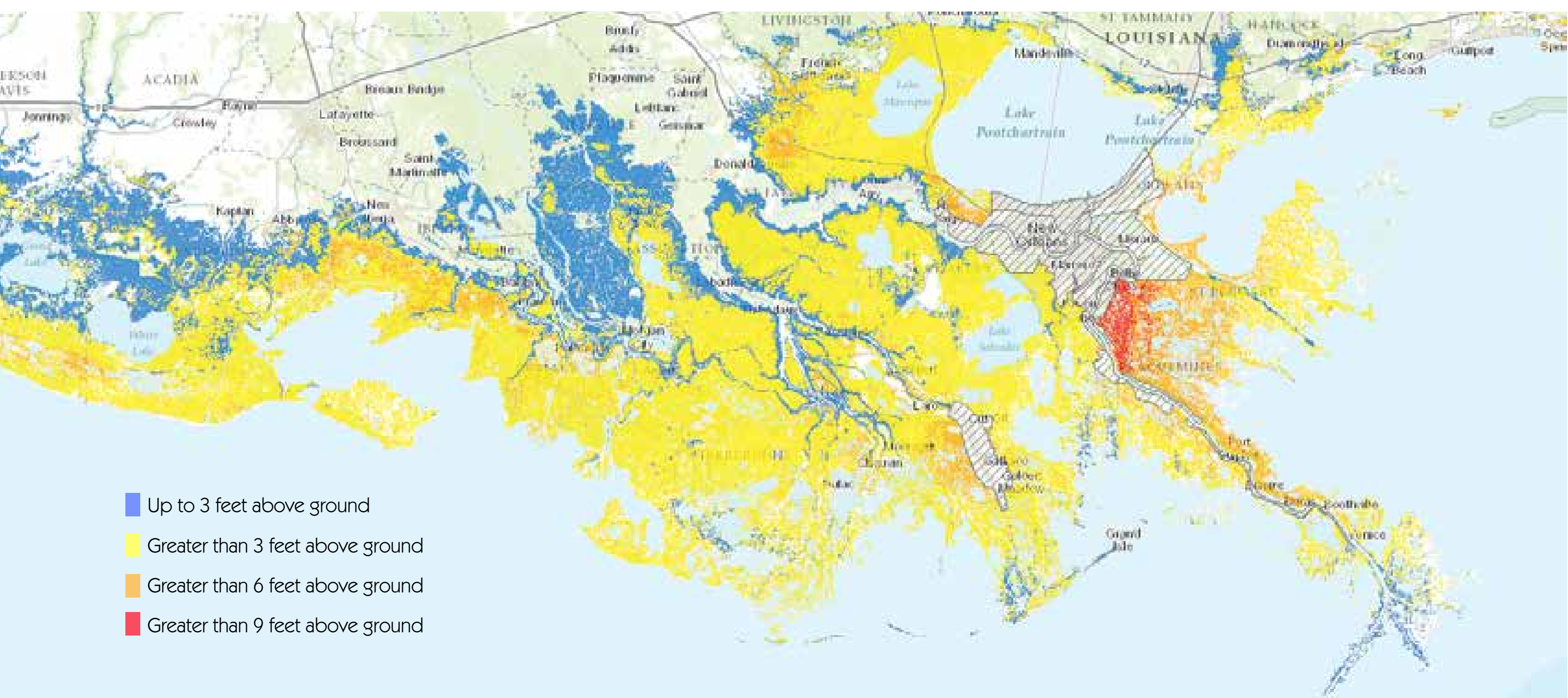
  Louisiana's fluid landscape adds to the usual challenges of securing public safety, but detailed maps help coastal managers make sound decisions. Maps displaying projections of land subsidence and sea-level rise guide construction and management of bridges, dams, levees and other infrastructure projects. Up-to-date geographic data are the basis for calculating the appropriate height of levees and designating safe evacuation routes under flood conditions. Accurate flood zone maps determine insurance rates and eliminate the cost of unnecessary flood hazard certificate fees. If conditions such as mean tides or projected storm surges are miscalculated, the result can be costly over-building or disastrous under-preparedness.

- **Safe marine navigation**

  Since the early 1800s, the federal government has issued maps of the United States' shoreline to promote safe navigation. The shoreline maps help vessels large and small figure out where they are, how to reach their destinations and how to avoid dangers, seen and unseen, along the way. While buoys and beacons may clearly mark shipping channels and marine boundaries, maps may be a seafarer's only source of information

The result of modeling the maximum height of storm surges from perfect* Category One hurricanes, the map depicts a worst-case scenario to help residents and public officials determine a location's flood risk. While the map shows all inundation possible from Category One storms, their tracks, size, intensity and forward speed combine with terrestrial characteristics at landfall to determine actual conditions on the ground. *A rare combination of adverse meteorological factors creating an unusually bad storm.*

National Oceanic and Atmospheric Administration



about underwater obstacles, from sunken ships to submerged pipelines. Especially for the working coast of Louisiana, with its complex of oil and gas infrastructure and its high volume of commercial shipping traffic, do such maps provide information critical for safe navigation.

## Challenges of mapping Louisiana's coast

"Our coast is a dynamic, living coast, and water changes it continuously," says Osborn. "Other places along the Gulf shoreline that are not as low-lying are less susceptible to natural forces. Storms, fronts, hurricanes, tides, winds and waves are constantly shaping and reshaping our wetlands, passes and islands. Saltwater intrusion causes fish and vegetation zones to shift; increased salinity kills salt-intolerant plants and hastens conversion of marsh to open water. Mapping these forces can indicate future conditions upon which to base plans for protecting and restoring the coast, and accurate depictions of the coast must include accurate depictions of its waters."

Hurricane Katrina demonstrated how rapidly and unpredictably the coast can change: In 2005, this single event destroyed more than 200 square miles of wetlands. In 2012 a smaller storm, Hurricane Isaac, lingering for days, caused widespread floods, swamped coastal communities and inundated the Chandeleur Islands. Such abrupt transformations can render maps obsolete overnight.

"While good maps don't restore lost places or past connections," says Osborn, "they are essential if we are to get the best possible results from our efforts to protect the coastal population and to work with nature to restore the areas that we are managing." WM

## CWPPRA maps restoration

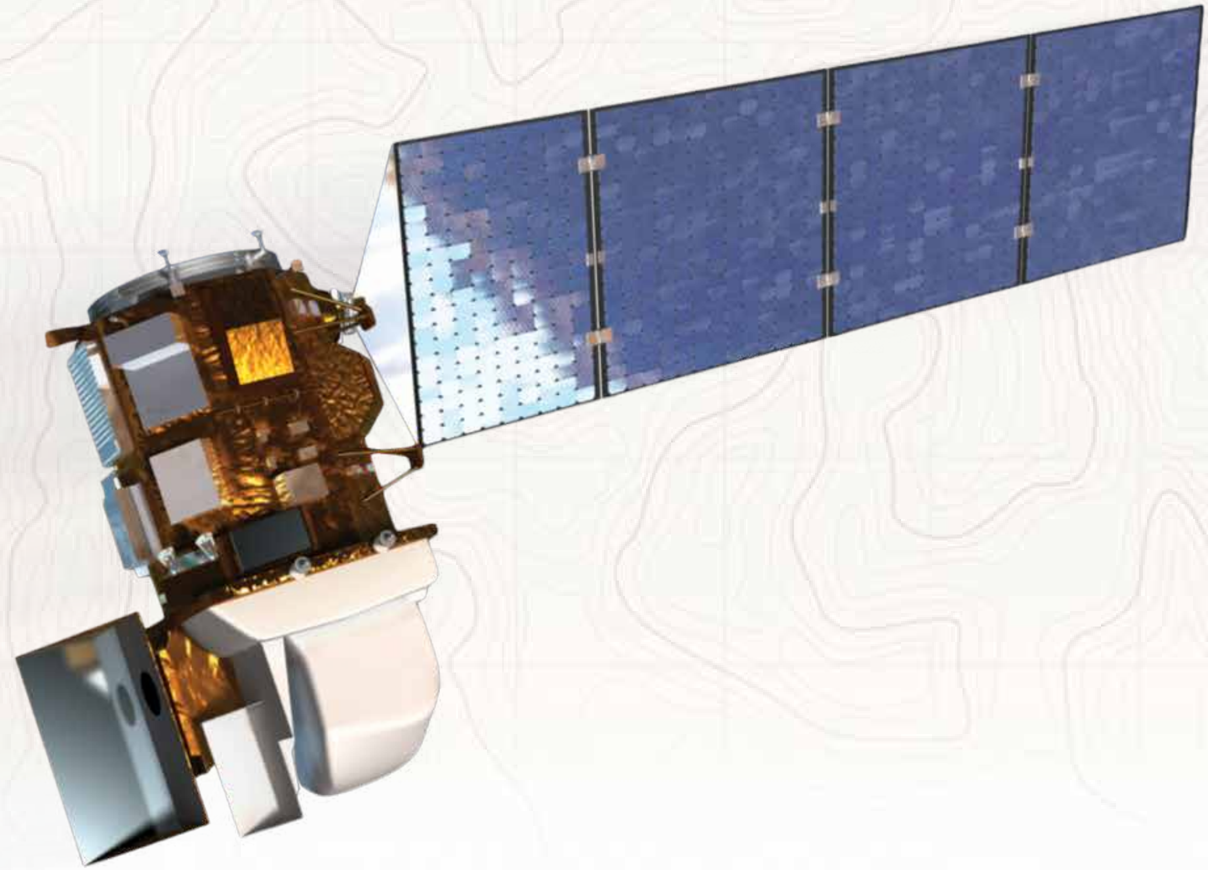
Open a fact sheet for any project undertaken through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) and it will include a map of the project area, so essential is the geographic orientation of environmental restoration. Yet location is but one aspect for which CWPPRA uses maps; depictions of vegetative cover, water currents, submerged obstacles, water depths, land elevations and built infrastructure may also be relevant in project design and implementation.

"Early in the process of planning a restoration project, we use maps to show site details and draw out our preliminary concept," says Quin Kinler, a resource conservationist with the USDA Natural Resources Conservation Service (NRCS) and project manager for CWPPRA BA-27, Barataria Basin Landbridge Shoreline Protection project,

Dale Garber, a civil engineer with USDA NRCS, adds, "As the design process progresses, we overlay the maps with more precise survey data, including topography, bathymetry and horizontal shoreline position. This survey data, combined with data describing water levels, winds, waves and soil substrates, are used by the engineering staff to design the project features."


U.S. Geological Survey

Every CWPPRA project fact sheet includes a map superimposed on a digital aerial or satellite photo. The map identifies the project's location within the state, shows the project area and describes the project's boundaries (white line). The map above depicts the Barataria Landbridge Shoreline Stabilization project. Other project maps might include additional features such as dune and beach areas, channels, marsh creation areas, earthen berms, sediment fences, culverts, spoil gaps, weirs, terraces and dredge canals.



Courtesy of NASA Goddard Space Flight Center and U.S. Geological Survey

## Center for GeoInformatics provides cutting-edge answers

# Mapping Points in Motion

There are places in the world where the old way of calculating elevation, using metal disks sunk into the ground or mounted on prominent architectural features as benchmarks, still works satisfactorily. But in Louisiana the ground is sinking, and such benchmarks sink along with it. Without stable reference points, determining property lines and boundaries, placement of roads and bridges, even sites of streams and summits is problematic. “Projects conducted under the Coastal Planning, Protection and Restoration Act (CWPPRA) depend on precise descriptions of locations and measures of elevation to construct islands, marshes and ridges for protecting shorelines and restoring functional habitat,” says Mel Landry, a marine habitat resource specialist at the National Oceanic and Atmospheric Administration’s (NOAA) Restoration Center. “But these elements of project design are not easy to determine when your point of reference sinks every year.”

As well as the challenge of correctly siting a project without stable benchmarks, project engineers in Louisiana must also remain acutely aware of a location’s vertical characteristics. “Louisiana is very flat, with few topographical features,” says Joshua Kent, the Geographic Information Systems manager at the Center for GeoInformatics (C4G), a research center affiliated with Louisiana State University’s College of Engineering. “Small increases in water levels from storm surges or climate change can inundate communities; even slight subsidence can disrupt floodwater drainage patterns. Measurements of topography that are accurate to less than half a meter are just not good enough here."

Using science and technology, C4G implemented a system to help overcome these problems. The center established a statewide network of Continuously Operating Reference Stations (CORS) that use Global Positioning System (GPS) receivers to define the latitude, longitude, height, scale, gravity and orientation at each station. In the field, network subscribers connect to the system's server through the internet to obtain a real-time refinement of their positions. CORS function as reference benchmarks but, unlike static plates secured to the ground, each station updates its vertical position every second of every day with a precision of within centimeters. "Atmospheric conditions can distort the satellite signals that GPS depends on, especially in the coastal region," says Kent. "Our network tracks the degree of error and subtracts it from the signal to correctly determine elevations throughout the system."

## CORS' precise data fine-tunes coastal programs

While the work of professionals using CORS network data may appear specialized and obtuse to the resident or visitor who thinks of GPS only in terms of getting directions, the work of these geographers, geoscientists, cartographers and engineers support numerous activities essential to daily life on the coast.

*Restoring the coast:* "CORS give us tools that help us resolve the challenges of measuring land change and

U.S. Geological Survey, photo by Terry Carr

Above left: A drawing of Landsat 8, a satellite that collects images of the Earth's surface and facilitates observations of land use and land change on a planetary scale. Landsat data informs decision-making in numerous disciplines, including coastal planning, human health, agriculture, climate, energy, fire, natural disasters, urban growth, water management, ecosystems and biodiversity, and forest management.

Right: Until the introduction of aerial photography, mapping was accomplished as it was in the early days of the nation: by climbing the mountains and plumbing the seas. This painting from 1940 depicts mapmakers; tools for determining distances and elevations and a plane-table for sketching contour lines; a brass benchmark is visible near the top of the land mass. The 4'x6' painting by USGS field man Hal Shelton is displayed in the USGS library, Menlo Park, California.


U.S. Geological Survey; Nancy Dewitt, photographer

Scientists from the U.S. Geological Survey (USGS) and the University of New Orleans (UNO) set up a global positioning system station near a pelican rookery on Raccoon Island. Left to right, Jeff Motti (UNO), BJ Reynolds (USGS), and Phil McCarty (UNO).

pinpointing the location and speed of subsidence," says Landry. "We use this knowledge to determine the necessity for and the viability of a restoration project in any given area. Once a project is selected, using the CORS network provides a common language among engineers, designers, partners and contractors to confirm that we're placing the project where we think we are and that we're building it to the elevation we desire."

"Conditions on the coast can change dramatically and frequently," says Tim Osborn, the National Oceanic and Atmospheric Administration's navigation manager for the Central Gulf Coast. "Having records of aspects such as tidal ranges, seasonal variations and the influence of winds on water levels helps to determine the spectrum of normal coastal conditions. We can then plan restoration projects accordingly."

*Protecting the coast:* "Elevation is the prime concern when designing levee systems that protect our coastal communities," says Kent. "But a number of factors can cause elevation to rise or fall, including the frequency and duration of inundation, sediment accretion, fluid extraction, regional tectonic changes, local hydrologic changes, vegetative cover and soil compaction. CORS' constant monitoring of conditions throughout coastal Louisiana provides data that guide engineering decisions and inform the modeling of proposed structures."

*Maintaining roads and infrastructure:* "Strong rains and poor drainage make Louisiana's coast particularly vulnerable to flooding," says Kent. "CORS furnish the state's Department of Transportation and Development with information about the vertical condition of highways so it can monitor evacuation routes and issue advisories based on real-time conditions. The department also relies on CORS to watch specific locations, such as sinkholes, for movement, enabling it to know quickly when to close a highway."

*Coastal mapping and charts:* "Real-time positioning with

CORS is hugely important for coastal mapping and surveying," says Osborn. "The network is part of a system in place that allows us to alter and update maps quickly and often."

C4G's geographic data is used to develop specialized maps important to coastal residents, such as those depicting flood zones, road elevations and subsidence vulnerability; to model future coastal conditions under various scenarios that contribute to formulating strategies to protect and preserve coastal communities; and to depict currents and underwater conditions. In a region so closely tied to water by proximity, tradition and livelihood, maps of Louisiana's benthic zones are as essential as land maps. "Among other benefits," says Osborn, "accurate coastal maps provide ships with safe under-keel and overhead clearance, thus reducing accidents and collisions."

## C4G part of national system

CORS operated by C4G are the infrastructure used by the Louisiana Spatial Reference Center in establishing the official federal geographic reference system within the state; in 2006, the state legislature adopted the vertical control standard developed by the center.

C4G's CORS are part of the National Spatial Reference System (NSRS), which provides consistency and coordination in locating geographic points and describing each reference station's geophysical characteristics. Managed by the National Geodetic Survey (NGS), an office of the National Oceanic and Atmospheric Administration's National Ocean Service, NSRS comprises more than a million and a half permanently marked points that support geophysical applications throughout the United States and other select locations. The NSRS is used for accurate positioning that ensures that maps and features of interest match up to portray the geographic identity of the country. Especially along the national shoreline – subject to dynamic, geophysical processes that affect spatial measures –consistent, accurate and permanently marked reference points are critical to establishing location and determining change. WM

Joshua Kent, C4G, Louisiana State University

Perched on a rooftop, this GPS CORS unit is part of the 66-station network maintained by C4G. Under C4G's auspices, the Louisiana Spatial Reference System provides the foundation for surveying in the state and supports transportation and communication, geoinformation system development, topographic mapping, precision farming, navigation and other scientific applications.

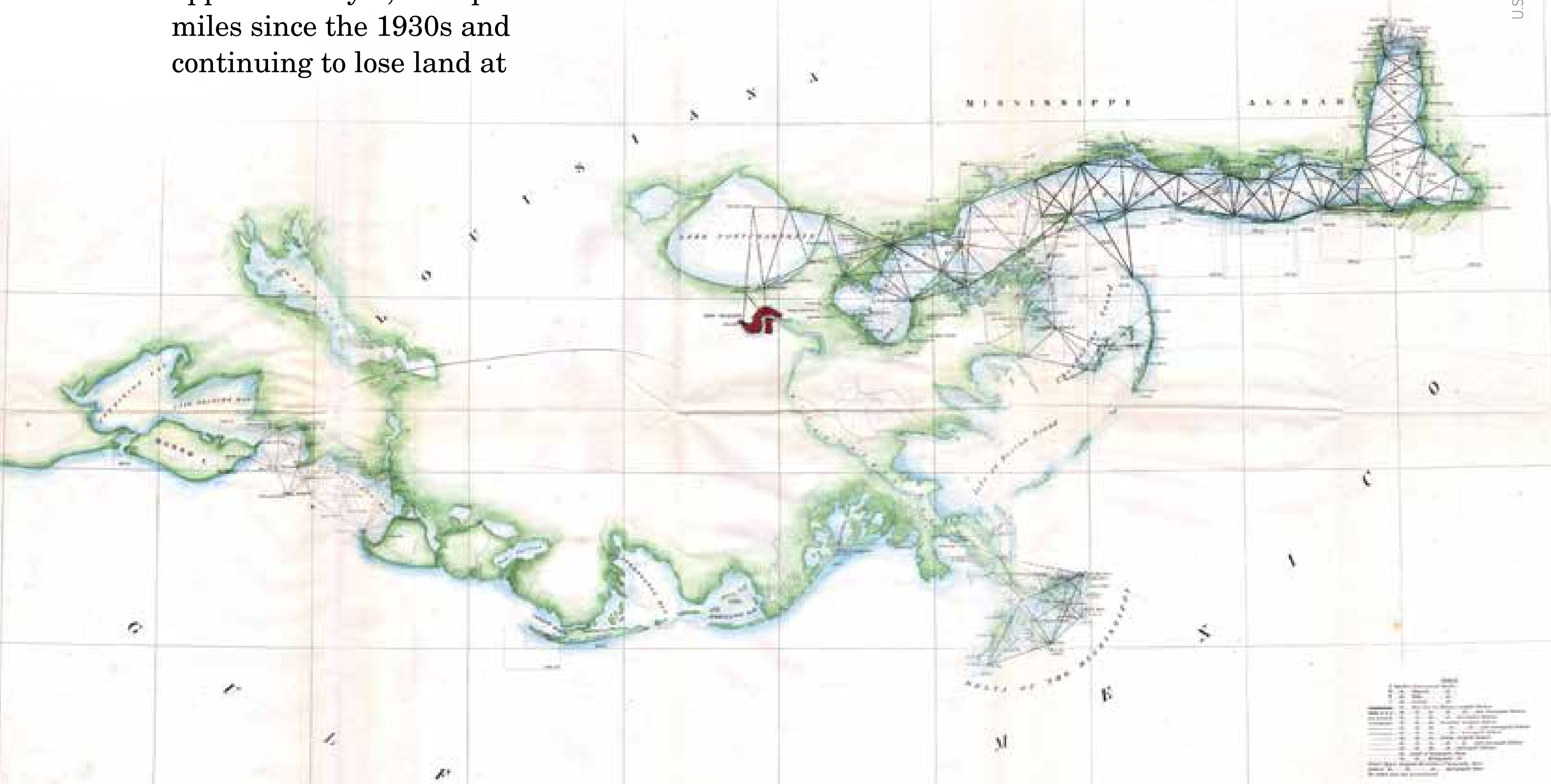
**Vanished from the Face of the Earth**

# Map Erasures Certify Louisiana's Losses

All places on Earth are subject to change, but few places are changing so swiftly and profoundly as coastal Louisiana. Signs of its rapid decline abound: ghostly skeletons of trees stand knee-deep in saline waters; waves lap at the remains of fishing camps stranded far from the marsh's edge; roads once immune to all but hurricane forces disappear under full-moon tides and gusty winds. Natives as well as strangers can lose their way as shorelines, beaches, islands and bays vanish, and even sophisticated technology indicates the presence of land where there is now only water. Having lost approximately 1,880 square miles since the 1930s and continuing to lose land at a rate exceeding 16 square miles a year, Louisiana has relinquished not only vast stretches of protective and fecund wetlands, but places of memory and history, storehouses of tradition and culture.

Revising maps to depict current coastal landforms is the responsibility of the Office of Coast Survey in the National Oceanic and Atmospheric Administration, and updating names on maps is the task of the Board of Geographic Names, which operates under the auspices of the United States Geological Survey. The board maintains a database of geographic features, both natural and man-made, in the United States and Antarctica. If a feature disappears or no longer performs its original function, its name is retired to historical status.

Within the past decade, Louisiana has seen a notable number of places erased from its maps as land forms erode, shorelines crumble and water bodies merge. In

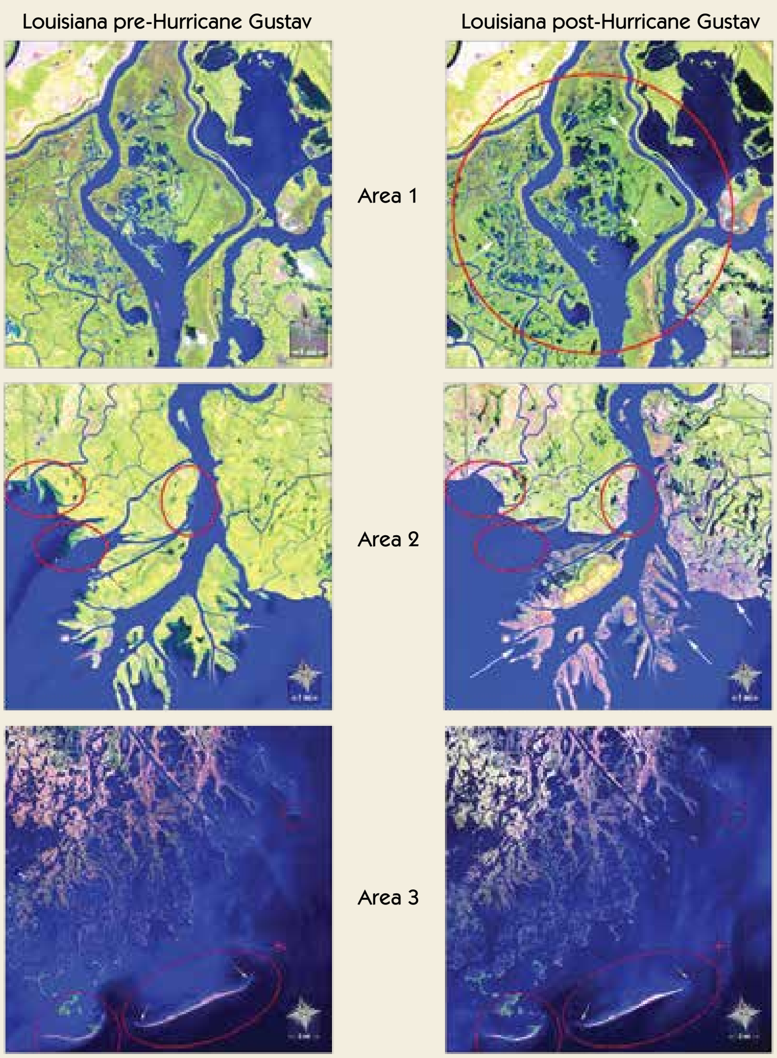


The coast of the northern Gulf of Mexico, from Vermilion Bay to the west to Mobile Bay to the east, depicted by the U.S. Coast Survey in 1857. Even allowing for less precision than modern map-making tools provide, the depiction displays a markedly more intact coastline with more solid ground, more contained water bodies and more stoutly defensive barrier islands than do today's maps of the coast. While landscapes across the globe are ever-changing, the rapidity of the decline of the Mississippi River delta since the construction of levees along the river is readily evident.

U.S. Coast Survey

## Maps and mapping techniques that depict coastal Louisiana include

- LiDAR (Light detection and ranging): uses airborne lasers to emit pulses of light and receiver units to time their return to the source. LiDAR determines distance and location to produce accurate, three-dimensional measurements of the shape and surface of the Earth, vegetation and built infrastructure.
- SONAR (SOund Navigation and Ranging): a technique of acoustic location and measurement, usually underwater, that emits pulses of sound and listens for echoes.
- Aerial photography: uses photographic images made from airborne platforms to collect geophysical data; used widely in drawing topographic maps, land-use planning and environmental studies.
- Landsat: images of Earth recorded and collected by U.S. Landsat satellites, capable of multispectral sensing to detect various features such as vegetative cover or bathymetry.
- Raster Navigational Charts: produced by NOAA, geo-referenced electronic files enabling computer-based navigation.




National Oceanic and Atmospheric Administration Landsat, Mike Taylor

Plaquemines Parish alone, more than 40 places have been removed since 2010. Some of these places were named by early explorers; some bore national historical significance and some were dependable landmarks to generations of coastal residents. Their removal from the map underscores the problems that the wetlands' demise causes in Louisiana: reduced protection against storm surge, increased threats to infrastructure and deterioration of fish and wildlife habitat.

## Harbinger of coastal futures

While its rate of subsidence is among the fastest in the world, Louisiana is not alone in confronting the challenges of land loss and the perils of sea-level rise resulting from climate change. How Louisiana deals with its crisis – how it does such things as use available resources to stem land loss, restore natural wetland buffers between land and sea, construct infrastructure, modify building codes, educate its population and formulate public policy to ensure a viable future for the coast – could provide a model for other coastal regions to follow.

Landsat images showing land mass before (on left) Hurricane Gustav made landfall on August 30, 2008 and following the hurricane (on right) in October. Vegetation is depicted as green; bare or low vegetation as pink to white; water as shades of blue; wetlands or flooded vegetation as purple. Note disappearance of land mass in Areas 1 and 2 and visible beach erosion on barrier islands, Area 3.

While concern focuses on the state's phenomenal loss of land, in some areas the ancient process of sediment accretion is creating new land. Computer models of projects proposed in Louisiana's Master Plan for Coastal Protection and Restoration even show a possible net gain in land mass by 2060. The models, however, incorporate three assumptions:

- Projects in the Master Plan will be fully funded and completed on schedule.
- Sea-level rise will not occur at the rate projected by the worst-case scenario.
- The untested technique of river diversions will result in accreting land as proponents expect.

Along with the possibility of building new land in the delta region will come the opportunity to name new places. Those names, like the ones now consigned to history, will surely become treasured by future Louisianans as references to renowned events and cherished memories. WM

## Naming a new landscape feature

On Mardi Gras Day, 2012, floodwaters in the Bohemia Spillway crested a bank of the Mississippi River and cut a new channel between the river and the Gulf of Mexico. The resulting breach is the first river distributary to form naturally in southeastern Louisiana in many decades. As well as opening new navigation routes between the river and the gulf, the breach, or pass, carries fresh, sediment-laden river water into existing canals for distribution over a large area of adjacent wetlands.

The pass provides a rare opportunity for scientists to study the effects of a river diversion on land accretion, hydrologic regimes, fish migrations and wetland ecology. Diversions are a lynchpin in Louisiana's Master Plan for Coastal Protection and Restoration; in addition to its value as a case study, the pass could possibly be managed as an alternative to constructing a nearby proposed diversion, saving taxpayers money.

Dubbed Mardi Gras Pass by locals for the date of its emergence, Louisiana's Department of Transportation and Development has requested the U.S. Board on Geographic Names to formally designate it as such and to add it to maps of Louisiana.



Landsat imagery courtesy of NASA Goddard Space Flight Center and U.S. Geological Survey

While much of the Mississippi River delta is subsiding, the Atchafalaya River is delivering sediment to its delta and building land. Landsat images show the increase in land between 1980 and 2014.

# WaterMarks Interview with Mark Schleifstein

Mark Schleifstein has served as the environment reporter for NOLA.com | The Times-Picayune since 1984, a period of time during which many changes have occurred in Louisiana's wetlands and in Louisiana's approach to coastal issues. Mr. Schleifstein shares his observations with WaterMarks.

## State of Change

**WATERMARKS: In the years you've been reporting on Louisiana's coastal issues, national perceptions of wetlands loss have changed significantly. What's been the cause?**

**Schleifstein**: People's understanding of the threats confronting Louisiana's coastal environment have steadily increased. However, Hurricane Katrina caused a sea change in public awareness by making clear the direct relationship between coastal erosion and storm-surge flooding. Katrina focused attention on the problem and accelerated the state's planning to address coastal issues.

**WATERMARKS: Prior to Katrina, were there other events that influenced state coastal policies?**

**Schleifstein**: Two key events shaped Louisiana's approach to coastal restoration before Katrina: In 1998 a combination of state agencies and environmental groups issued the report Coast 2050. It was the first attempt to identify projects to include in a restoration plan and it set the tone for what needed to be done. Then a couple of years later, a well known New Orleans banker, King Milling, brought the issue into the mainstream by suggesting the state should make significant investments in restoring the coast. Subsequently Governor Mike Foster formed the state's first governor's advisory committee on the issue, which became the forerunner of Louisiana's Coastal Protection and Restoration Authority (CPRA).

But it was Katrina that accelerated progress. Within two years of the storm, in 2007, Louisiana put forth its first master plan for coastal protection and restoration. The passage of a state constitutional amendment dedicating oil revenue to coastal protection and restoration signified that among Louisianans there was widespread recognition of the coastal crisis and support for remedial actions.

**WATERMARKS: How did developing a master plan change Louisiana's approach to coastal restoration?**

**Schleifstein**: Because of the rules existing before Katrina, many proposed projects focused on restoring the natural environment. Following Katrina, the state required that every coastal project comply with the master plan by incorporating protection from storm surge. The presumption was that such protection would concurrently benefit the natural environment. But while calling for spending equally on levee construction and restoration, the master plan itself provided funds for neither.

By law the master plan is updated every five years. The first two plans laid out the general objectives and approaches to coastal protection and restoration. The 2017 update, underway now, is working out details of implementation and looking to resolve conflicts among various stakeholders. For instance, the seafood industry – not without reason – is concerned about projects' effects on their livelihoods. Scientists and state officials contend the threats are less than feared, while pointing out that inaction is much more threatening to the larger inland population than action is to the seafood industry.

**WATERMARKS: Even with the 1990 passage of the Coastal Wetlands Planning, Protection and Restoration Act, which designated federal money for coastal restoration, securing adequate funds to address Louisiana's crisis has always been difficult. Are there recent milestones in that history?**

**SCHLEIFSTEIN**: Following Katrina, Congress approved billions of dollars in supplemental appropriations for rebuilding levees and improving drainage in the New Orleans area. The state also received millions of dollars a year in federal grants for restoration projects. Additionally a portion of three years' state tax surpluses were used to get major levee and restoration projects off the ground. Other funding sources have been the Louisiana Coastal Area program, authorized under the Water Resources Development Act; and payments from FEMA for storm-damaged projects.

But by 2012, the attention of Congress had shifted away from Louisiana towards other parts of the nation suffering natural disasters, including Hurricane Sandy and other storms, and to levee systems identified as below standard in surveys conducted since Katrina. The state has been relying, instead, on its share of federal offshore oil revenue from the Gulf of Mexico, which it hopes will increase significantly – to about $200 million a year in 2017 – and on payments related to the Deepwater Horizon oil spill. Louisiana has already received about $2 billion in voluntary payments from BP, early Natural Resources Damage Assessment (NRDA) payments, criminal fines and penalties. How much more oil spill money the state gets will strongly influence what it can do from this point forward.

**WaterMarks: Is it realistic to think we can – or should – save Louisiana's coastal communities?**

**SCHLEIFSTEIN**: Louisiana's coast is truly a working coast. People live off the ancient pursuit of fishing or off modern jobs in oil and gas. The closer they are to their source of income, the easier life is for them. But coastal communities are vulnerable if they lie outside the levees. With the loss of each community, we lose part of our culture. The loss is significant, especially in Cajun-speaking areas, and it will continue.

In reality, that is nothing new. We've lost communities from coastal erosion and from hurricanes for more than a hundred years. In the nineteenth century Biloxi marsh communities




U.S. Geographical Survey

in St. Bernard Parish were wiped out; similar communities chose to move inland. In 1893 a hurricane wiped out Cheniere Caminada. It is part of living on the coast.

Changes to the landscape occur everywhere. The difference is, here, change is driven not by the economy but by nature, even when the natural effect is the result of human attempts to control the landscape.

New Orleans exists now for the same reason that it was founded: it is the place closest to the mouth of the Mississippi River, with proximity to natural resources, where a large population is defensible. Then it was against the English; now it is against storm surge.

**WATERMARKS: With that in mind, are you at all optimistic about Louisiana's coast?**

**Schleifstein**: I guess I'm a glass half-full, half-empty kind of guy. State and federal officials finally recognize the risks of inaction and are moving to build restoration projects. It's not fast enough, though I do see the potential for limited success that I didn't see 10 years ago. But current restoration funding -- from the Deepwater Horizon oil spill – is not a reliable, long-term solution.

Future sea-level rise can throw off all bets. If it exceeds the mid-level projections, even New Orleans, sitting below sea level, will have to reconsider how to survive.

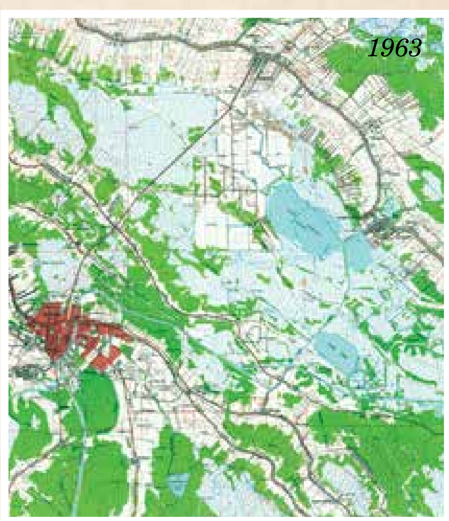
**WATERMARKS: If you could, how would you change public perception of Louisiana's crisis?**

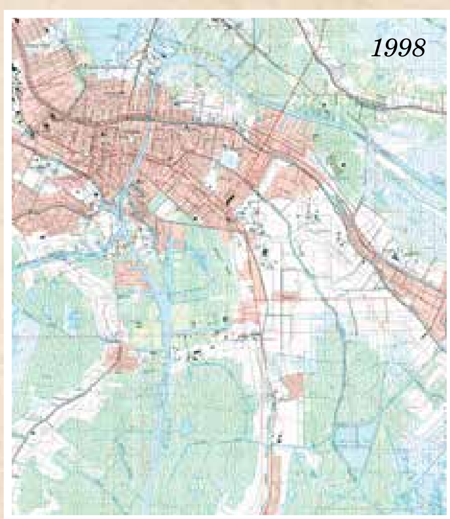
**Schleifstein**: We need to communicate that this is a national issue, not a south Louisiana issue nor a state issue nor a Gulf Coast issue. The nation will have to confront that.

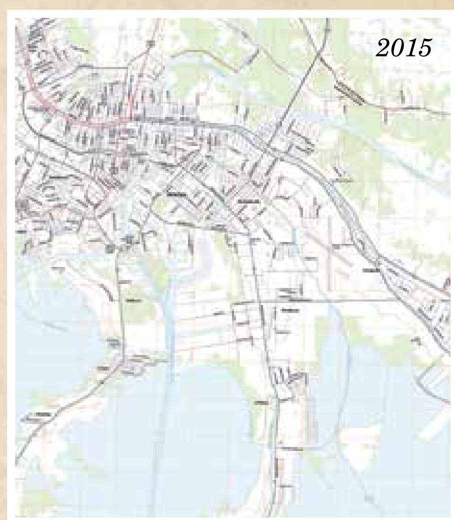
Louisiana's Coastal Protection and Restoration study estimated that losses from a Category 5 hurricane would run between $85 and $135 billion. That's a major hit to the nation's economy. The Port of New Orleans is the nation's fourth largest; the South Louisiana Port is the largest bulk cargo port in the country. There are 175 major chemical plants between Baton Rouge and New Orleans, and oil and gas production and distribution along the coast and off shore are equally important to the economy.

What affects Louisiana's coast affects the entire country. As an early mentor said to me, "When people eat Kentucky Fried Chicken, they don't realize they are eating birds fed on menhaden from Louisiana's wetlands." That's the message we need to bring home to the nation. WM

Maps of Houma, Louisiana tell the story of encroaching water and land loss. While the town grew and impinged on the wetlands, the wetlands shrank and increasingly exposed the town to open water.



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NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
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NEW ORLEANS, LOUISIANA 70160-0267


OFFICIAL BUSINESS



## Gone with the Water

Changes in transportation routes. Closure of local employment. Destruction from natural disasters. There are numerous reasons that places everywhere are vacated and subsequently removed from the map. But Louisiana has lost a disporportionate number of places as water washes away hundreds of square miles of its land. Among the dozens of landscape features removed from the map in the 21st century, these places, all in Louisiana's bird's foot delta, have disappeared within just the past 10 years.


Landsat imagery courtesy of NASA Goddard Space Flight Center and U.S. Geological Survey