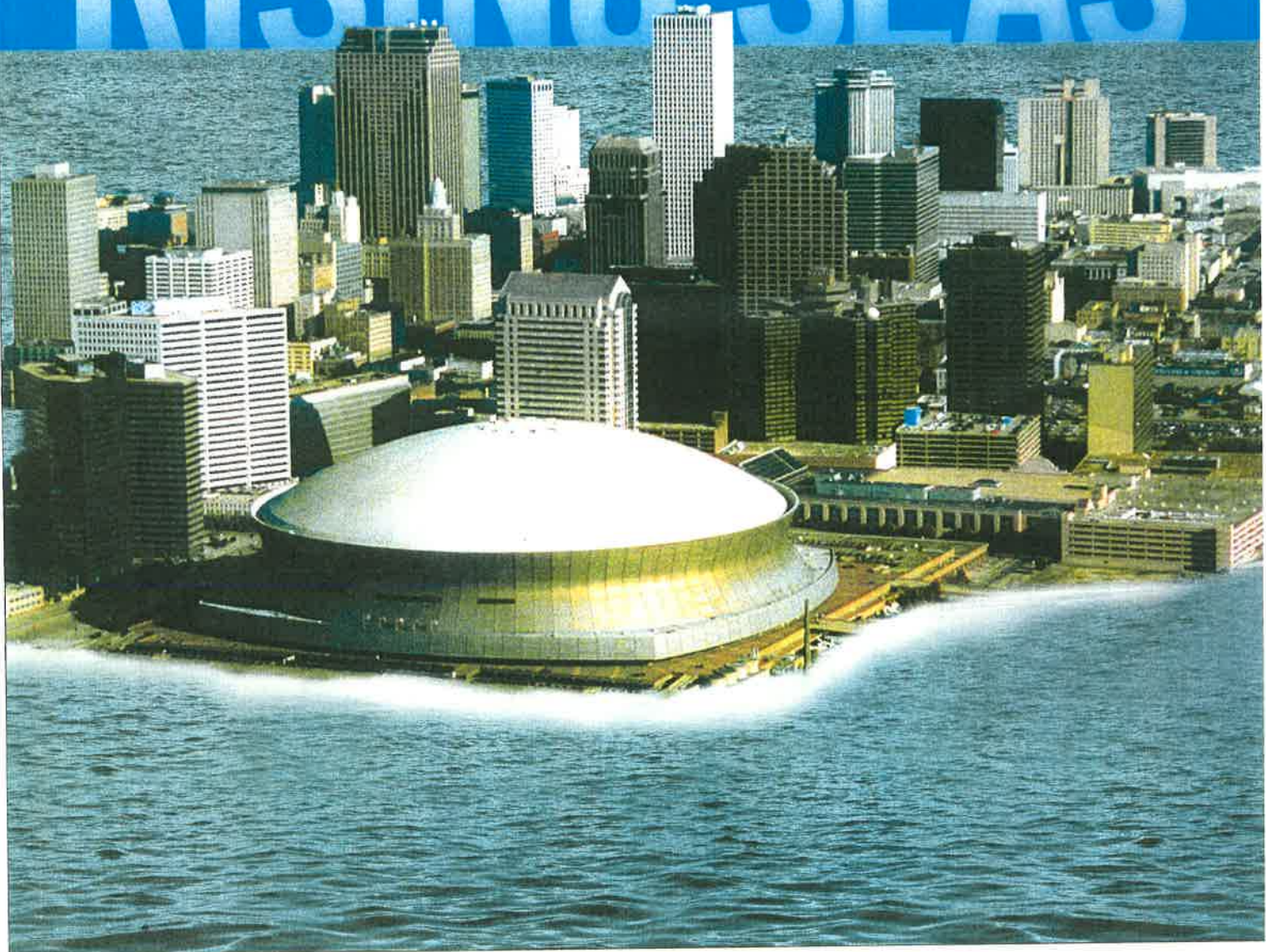


Scientists around the world believe much of New Orleans could be under water in 90 years.

What's being done about it?

BY PENNY FONT

RISING SEAS





COURTESY HARRY ROBERTS

Projected future land loss of 10,500-13,500 km²

NEW ORLEANS BAY: Is this what the Louisiana coast will look like in 2100? It's possible, according to research presented in 2009 by LSU professor Harry Roberts and his colleague, Michael Blum.

IMAGINE IF LOUISIANA and Florida were completely submerged in the Gulf of Mexico, Lake Pontchartrain lay beneath a vast bay and the state of Mississippi became a series of islands.

It's a worst-case scenario, of course, but one that isn't entirely out of the realm of possibility.

Blame the rising seas.

Regardless of whether or not you're a believer in global warming, this is an indisputable fact: The world's ice sheets and glaciers are melting. They're filling the oceans with trillions of gallons a year more water, causing sea levels to rise.

For the last 6,000 years, sea levels have risen at an almost imperceptible rate.

Scientists long believed that the collapse of gigantic ice sheets in Greenland and Antarctica would take thousands of years, with sea level possibly rising as little as 7 inches in this century, about the same amount as in the 20th century.

But in the mid-1800s, that began to change. Sea levels began to rise an average of 8 inches a century. Then, in 1993, the rate suddenly doubled.

Four years ago, the Intergovernmental Panel on Climate Change, a scientific body that advises the United Nations, estimated the world's seas could rise almost 2 feet by the end of this century.

That prediction was short lived.

Those who study climate change are now saying 3 feet is more likely, with some calculations suggesting the rise could conceivably exceed 6 feet.

With just a 3.3-foot rise, models by the National Oceanic and Atmospheric Administration show places like Holly Beach, Cypremont and Delacroix would be under water, New Orleans would be surrounded by the Gulf—protected only by its levees—and Baton Rouge, Denham Springs, Hammond, Mandeville, Slidell and Lake Charles would become coastal cities, facing the ocean's fury.

"According to the most recent sea-level-rise science, that's where we're heading," says Jeremy L. Weiss, a senior research specialist in the University of Arizona's Department of Geosciences. "Impacts from sea-level rise could

be erosion, temporary flooding and permanent inundation."

This science isn't purely hypothetical.

For much of the past 7,000 years, sea levels have risen at rates of less than 1 millimeter a year. But during the 20th century, the rate averaged 1.7 millimeters a year. Since 1993, the rate has increased to some 3 millimeters a year.

Consider that the 11,700-year-old ice cap on Mount Kilimanjaro—the highest mountain in Africa—shrank from 4.3 square miles in 1912 to 0.94 square miles in 2000. It is projected to disappear altogether by 2020.

In Peru, the Quelccaya ice cap retreated at a rate of more than 600 feet a year between 2000 and 2002—up from just 15 feet a year in the 1960s and 1970s—leaving a vast lake where none had existed.

The U.S. Geological Survey, which has been measuring three benchmark glaciers in Alaska and Washington for five decades, has concluded that America's glaciers are melting at the fastest rate in recorded history—a rate that has been sharply rising in the past decade or so. One glacier in Washington has doubled its annual melt rate.

And in March, a 20-year NASA-funded satellite study showed that the two biggest ice sheets on Earth—Greenland and Antarctica—are losing mass at an accelerating rate. Over the course of the study, the average combined mass

THE COST

\$14.2 billion

Current average yearly Gulf Coast hurricane damage costs

\$18.8 billion

2030 projected annual average

\$21.5 billion to \$23.4 billion

2030 annual average with climate change taken into account

\$350 billion

Cumulative economic damages over the next two decades

Source: Building A Resilient Energy Gulf Coast, by America's Energy Coast, America's Wetlands Foundation & Entergy Corp, October 2010.

lost by the ice sheets rose by 36.3 gigatons each year. Researchers concluded that if that melting continues at its present rate, sea levels could rise 5.9 inches by 2050.

"What is surprising is this increased contribution by the ice sheets is already happening," says Eric Rignot of NASA's Jet Propulsion Laboratory in California. "If present trends continue, sea level is likely to be significantly higher than levels initially projected."

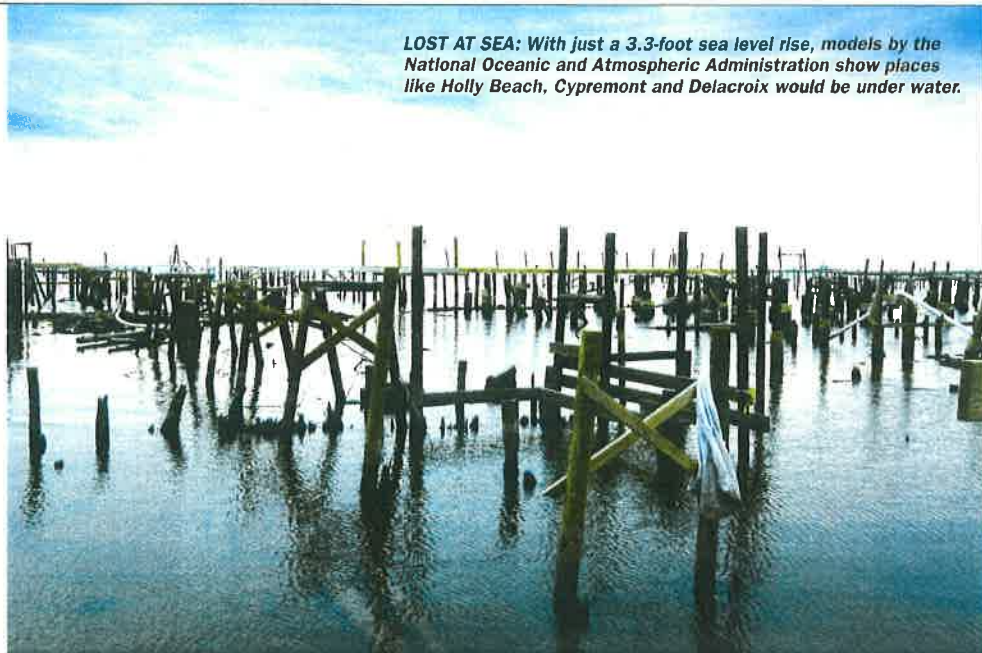
While Peru and Antarctica may sound like far-away places, south Louisiana has much at stake in what happens there.

"It is not our experience to think about what happens on the other side of the world affecting us," says James Davis of Columbia University, who studies the effects of gravitation on sea level. "But it does."

Rising sea levels could threaten an average of 9% of the land within 180 coastal cities by 2100. The Gulf and southern Atlantic coasts could be particularly hard hit. Miami, New Orleans, Tampa and Virginia Beach could lose more than 10% of their land area.

New Orleans is doubly at risk, given that at the same time the seas are rising, this city built on soft sediment at the mouth of the Mississippi River is actually sinking. Large chunks of the city are already sitting several feet below sea level, protected only by levees. Anyone who has ever driven one of its pockmarked roads or walked one of its rollercoaster sidewalks has seen evidence of this.

The U.S. Geological Survey has reported that wetlands in southern Lafourche Parish are losing one inch of elevation every 30 months. Do the math, and it means a loss of 1.5 feet in 50 years, twice the rate of the



LOST AT SEA: With just a 3.3-foot sea level rise, models by the National Oceanic and Atmospheric Administration show places like Holly Beach, Cypremont and Delacroix would be under water.

Intergovernmental Panel on Climate Change's initial worldwide predictions for sea level rise.

"Beyond a hundred years out, it starts to look really challenging," says Richard B. Alley of Pennsylvania State University. "You start thinking about every coastal city on the planet hiding behind a wall, with storms coming."

SO WHAT CAN BE DONE—and perhaps more importantly, what is being done to ensure Louisiana can hold back a rising ocean? There are those who say current coastal restoration projects just aren't going to cut it.

Harry Roberts of LSU's Coastal Studies Institute says that, even under best-case scenarios for building massive engineer-

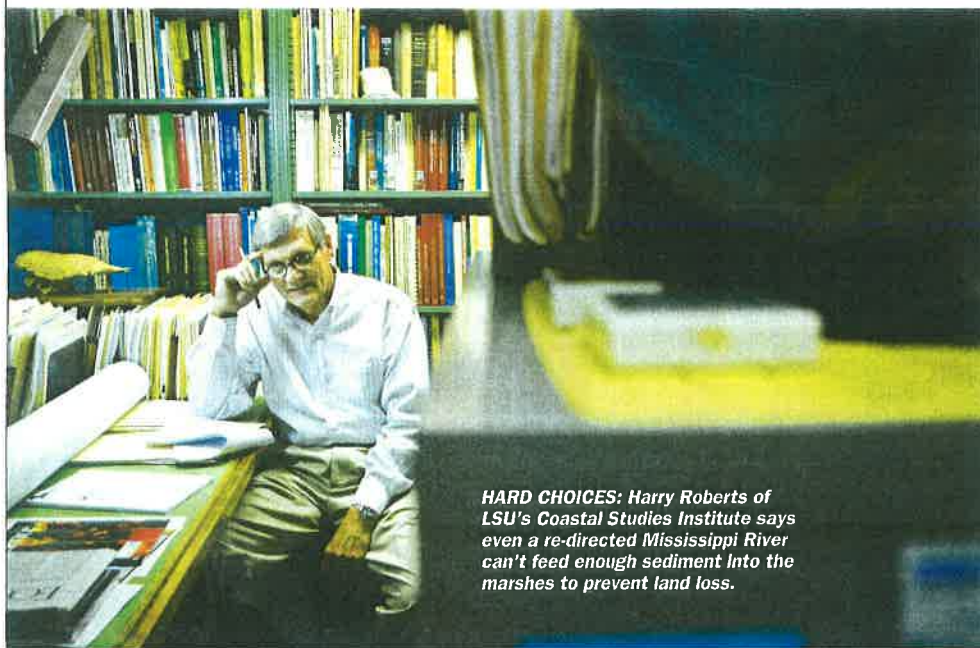
ing projects to restore the coastline, the Mississippi River can't feed enough sediment into the marshes to prevent the land loss. In a 2009 study, he and a colleague predict water levels will rise between 2.6 feet and 3.9 feet along the coast, and the state will lose another 4,054 to 5,212 square miles of coastline—an area roughly the size of Connecticut—by the end of the century. (See illustration on page 31).

Sustaining the existing delta size would require 18 billion to 24 billion tons of sediment, which the researchers say is significantly more than can be drawn from the river in its current state. "We conclude that significant drowning is inevitable, even if sediment loads are restored," they wrote, "because sea level is now rising at least three times faster than during delta-plain construction."

"When you look at the numbers you come to the conclusion that the resources are just not there to restore all the coast," Roberts said at the time his study was released. "I think every geologist who has worked on this problem realizes the future does not look very bright unless we can come up with some innovative ways to get that sediment in the right spot. This is going to force people squarely in the restoration business to make some very hard decisions about which areas to save and which areas you can't save."

Since Hurricane Katrina, Sen. Mary Landrieu has become a major proponent of the U.S. adopting the ways of the Netherlands. She has led three delegations to that country to study their system, which consists of a system of levees and gates to protect communities that allows canals and water storage areas to be public resources.

"We are going to stay [in coastal areas]," she



HARD CHOICES: Harry Roberts of LSU's Coastal Studies Institute says even a re-directed Mississippi River can't feed enough sediment into the marshes to prevent land loss.

BRIAN BAIAMONTE



WEISS AND OVERPECK/UNIVERSITY OF ARIZONA

change, the Gulf Coast faces an increase in risks from natural hazards going forward," the authors write. "Approximately half the increase in loss faced by the Gulf Coast is driven entirely by economy growth (baseline growth in risky areas) and subsidence (sinking land)."

IN MANY WAYS, we are to blame for where we find ourselves today.

Our journey along this path began in 1927 after a massive flood of the Mississippi River. Huge levees were erected along the river so homes could be built safely on the ground. But on land that never floods, no new sediment is added as natural subsidence occurs. The Mississippi and Atchafalaya rivers today carry only half the sediment they did a century ago—just 205 million tons a year today, compared to 400 million to 500 million tons a year then. Even in the politically implausible scenario that the dams were torn down today and the river's sediment allowed to flow, it would be too little, too late, Roberts and his colleague concluded.

The problem was compounded in the 1930s, when the logging of cypress trees in the coastal swamps for their valuable wood brought saltwater intrusion. That meant no new cypress trees grew, destroying the buffer against storms that the coastal swamps provided for urban areas.

As oil and gas became critical resources for the nation, access was provided by navigation canals and pipelines crisscrossing south Louisiana's marshes. Spoil banks were left randomly throughout the area, altering the natural hydrology of the region. Saltwater intrusion increased, and more land was lost.

says. "We are going to build bigger cities and stronger cities. We're not going to shrink our footprint. We're going to expand our footprint and do it in ways that mimics the Netherlands model."

Money is most certainly an issue. Last fall, a report commissioned by Entergy Corp. and the America's Wetland Foundation estimated economic losses along the coasts of Louisiana, Texas, Mississippi and Alabama caused by rising seas and other factors could total \$350 billion by 2030, if nothing is done to counteract them.

Past 2030, the researchers suggest the consequences are even direr, with annual costs climbing to \$26 billion-\$40 billion, depending on how climate change scenarios play out.

Taking the necessary steps to counteract rising seas and land loss, meanwhile, could cost \$50 billion—and reduce the losses by \$135 billion over the lifetime of the improvements.

Proactive steps suggested by the researchers of the Entergy/America's Wetland Foundation report include stronger building codes and roof improvements for residential and commercial buildings; 20-foot levees around power plants, refineries, natural gas processing facilities and chemical plants; levees around

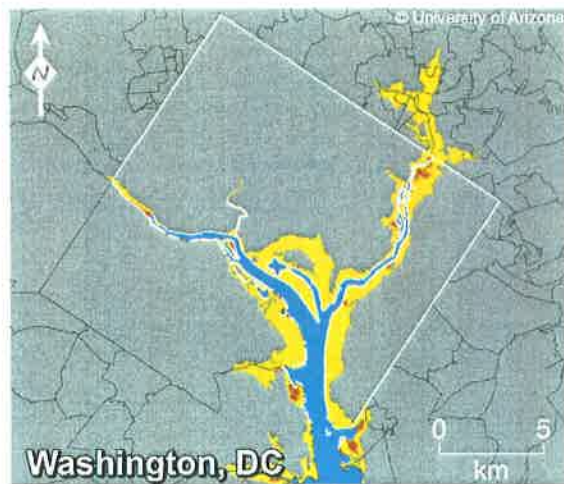
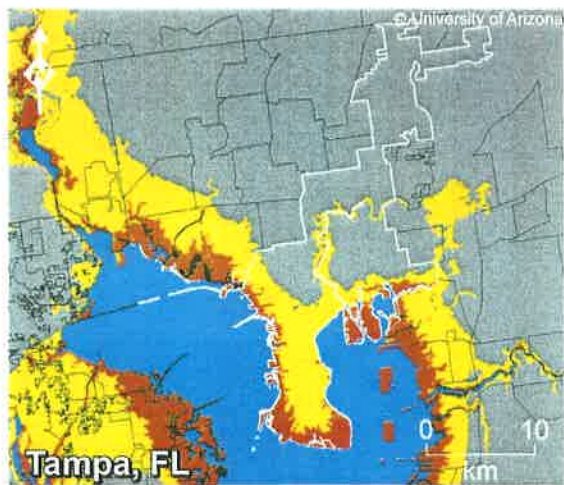
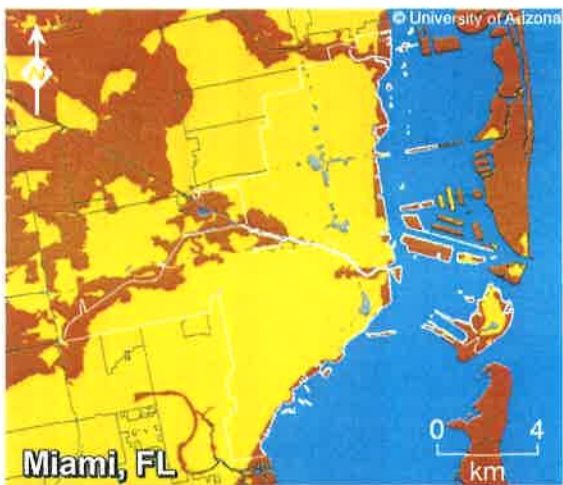
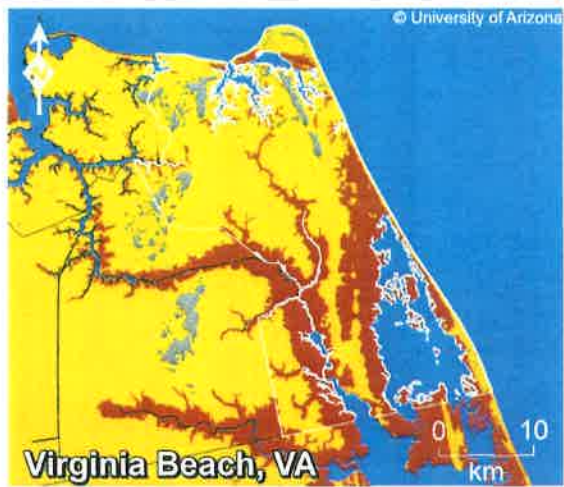
high-risk clusters of residences and businesses; strengthened designs of offshore oil exploration and production facilities; and a variety of coastal restoration measures.

"A key point is that regardless of climate



WORKING MODEL: At the Dutch research institute Deltares, scientists use tools like this giant hydrology lab to explore water management solutions.

CITIES AT RISK



■ ≤ 1 m
 ■ ≤ 6 m
 municipal boundary
 land
 waterbody

These maps show where increases in sea level could affect New Orleans, Virginia Beach, Miami, Tampa, New York and Washington, D.C. The colors indicate areas along the coast that are elevations of 1 meter or less (red) or 6 meters or less (yellow) and have connectivity to the sea. Some scientists currently predict a rise in sea level of more than 1 meter by 2100.

In the 1940s, nutria—an invasive species of rodent from South America that is a voracious eater of wetland vegetation roots—annihilated miles of protective marshland.

Mother Nature hasn't helped. In 2005, hurricanes Katrina and Rita brought storm surges and floods, swallowing 79 square miles of the Pontchartrain Basin and 217 square miles of the Louisiana coast.

IF THERE IS ANY UPSIDE

to the prospect of large swaths of Louisiana being under water by the end of the century, it is the economic opportunity inherent in finding a solution.

Water management is one of the target industries identified by Louisiana Economic Development's Blue Ocean economic development strategy as having the greatest growth



INSTITUTING A SOLUTION: As planning for a south Louisiana Water Institute continues, officials from the Baton Rouge Area Foundation and the Coastal Protection and Restoration Authority took a study trip to the Netherlands in June. Shown are CPRA deputy director Kyle Graham, BRAF CEO John Davies, BRAF consultant Christel Slaughter and BRAF legal counsel Edmund Giering visiting the Eastern Scheldt storm surge barrier.

COURTESY BRAF

potential in the state.

potential in the state.

LED Secretary Stephen Moret sees the state emerging as "The Netherlands of the U.S."

when it comes to taking a leadership role in that sector, referring to the European coastal

and in the management of wastewater and drinking water, he says, can find opportunities statewide.

The Baton Rouge Area Foundation is taking a critical first step.

nation, which has used science and technology in the fight to protect its shorelines. He notes that coastal restoration and defense are becoming increasingly important to communities around the world, and there is no clear regional leader for the nascent industry.

Louisiana alone will spend \$3 billion to \$4 billion on coastal restoration, hurricane protection and flood control in the next 20 years. Moret forecasts the potential for 10,000 to 20,000 new state jobs in the sector. Businesses involved in the creation of dams and reservoirs



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At Landrieu's urging, the organization is working on a master plan for what will come to be known as the Water Institute. South Louisiana stakeholders in Louisiana's Coastal Protection & Restoration Authority are involved, including Garrett Graves, director of Gov. Bobby Jindal's Office of Coastal Activities.

The model for such a think tank is Deltares—an independent entity staffed with scientists in the areas of water, soil and the subsurface whose goal is to help people live safely and sustainably in deltas, coastal zones and river basins. Deltares played a leadership role in protecting the Netherlands from the North Sea.

It provides that knowledge to governments and businesses through technology, spatial planning, policy agendas, and consulting on legal and economic processes.

At BRAF's annual meeting this spring, CEO John Davies

described the goal as "the sustainable shaping of the living environment, using high-grade technological solutions that have the support of society in general."

Examples include the types of tools deployed in the Netherlands, including dams, seawalls and changes in river delta manage-

ment. Already, Davies and other BRAF officials have participated in two study trips to the Netherlands to visit Deltares, get a first-hand look at flood-protection strategies, and gather input from scientists and policy experts.

BRAF expects to deliver a plan for the Water Institute later this year.

Landrieu's hope is that, faced with the specter of rising seas and sinking lands, Louisiana can find a way to live in harmony with the water and make it work to the state's advantage.

"The concept that the Baton Rouge Area Foundation is exploring will help foster new ideas to restore our coasts and protect our coastal communities," she says. "By bringing together sound science and innovative engineering, we can discover new solutions to overcome the challenges we face living in a delta, and expand opportunities for economic growth that will create jobs." **1012**

MAKING ROOM: Model at the Blesbosch Museum in the Netherlands demonstrating the Room for the River/Norrdwold Polder project, a unique program that removes dikes to allow rivers to return to their natural flood plains.



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