

A lifeline built on shifting sands

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RODANTHE, N.C. — In August, when Hurricane Irene sliced across the Outer Banks, it cut Highway 12, Hatteras Island's lifeline, in two places. Engineers rushed to repair the damage, filling and repaving a washed-out stretch of roadway here and building a bridge over a newly formed inlet a few miles to the north.

The road reopened Oct. 11, to the cheers of anglers, would-be vacationers and the innkeepers, restaurateurs and merchants whose livelihoods had taken a blow.

But the winds and waves that shape the coast were already gnawing at the new bridge. By January, engineers were reinforcing its southern approach with sandbags and rock trucked in from the mainland in hopes of keeping the road open until a more permanent fix could be designed and built.

The Outer Banks are home to some of the nation's most celebrated beach communities. The road that links them, also called NC 12, offers an extreme example of the difficulty of maintaining houses, condos, roads and other infrastructure in the face of a climate-driven rise in sea level.

By some estimates, at least 70 percent of the ocean coastline of the lower 48 states is threatened by erosion. But the outlook here is unusually gloomy. In 2009, a federal report on erosion in the Middle Atlantic states predicted that if the sea level rises 2 feet this century — an estimate that many experts call optimistic — "it is likely that some barrier islands in this region will cross a threshold" and begin to break up.

The report, produced by the Environmental Protection Agency, the U.S. Geological Survey and other agencies, said the Outer Banks were particularly threatened.

Already, Highway 12 floods repeatedly and is often cut by storms. Maintaining it "is totally a lost cause," said Stanley R. Riggs, a coastal scientist at East Carolina University who is an author of a new book, "The Battle for North Carolina's Coast," which describes in depressing detail the difficulties of keeping the road open.

"It will bankrupt the state," he said.

But people who live and work on the Outer Banks say abandoning the road would make life impossible.

"You would see people with nothing left," said Eddie Williams, who was born and raised on Hatteras Island.

He manages the Paint Box, a gift shop in the village of Hatteras.

"It would be devastating," he said.

Beth Smyre, an engineer for the state Department of Transportation who is leading the planning effort, acknowledged the pessimism coastal geologists bring to the issue.

"We try to take into account all these different opinions," she said. But she added: "There are people living out there, there are tourists visiting out there. We have to provide a reliable and safe transportation system out there."

According to a 2011 state report, coastal tourism brought \$2.6 billion to the state's economy in 2009, supporting 50,000 jobs.

"We have an obligation to keep this access in place," Jerry Jennings, a district engineer with the Transportation Department, said in October as he watched crews put the finishing touches on the \$11 million-plus repair projects he described as temporary fixes.

He added, "Our employees, fortunately or unfortunately, have a lot of experience dealing with Highway 12."

Irene's attack on Highway 12 came as North Carolina was already confronting a number of issues relating to the fate of the Outer Banks.

Last summer, the state confronted what engineers called "advanced deterioration" of the Herbert C. Bonner Bridge, which carries the highway from Nags Head to the Pea Island National Wildlife Refuge, on the north end of Hatteras Island.

Some geologists suggested replacing the bridge with a system of ferries from the mainland. Others suggested maintaining a road link with a causeway or "long bridge," looping into Pamlico Sound, an idea that the federal Fish and Wildlife Service endorsed as the best long-term option.

The state opted for a replacement bridge that will run alongside the existing span; planning is under way.

Robert S. Young, a coastal geologist who is head of the Program for the Study of Developed Shorelines at Western Carolina University, calls the project "our own little bridge to nowhere."

"They can engineer that bridge so well that it can withstand a Category 3 or 4 hurricane," Young said in a telephone interview. "The barrier island it is connected to cannot."

North Carolina has long been a leader in coastal protection through its ban on coastal armor — like seawalls and revetments — which, while it may protect a particular house or condo, almost

inevitably degrades or even destroys sandy beaches. But last summer the state General Assembly voted to loosen that prohibition, allowing owners of threatened buildings to protect them with "terminal groins," structures built out into the surf to trap sand.

Young said he feared that the move was the beginning of the end for the armor ban. Meanwhile, he is among the coastal scientists who have been recruited to help assess beach damage caused by the groins, a prospect he said was "just so depressing."

Efforts continue to maintain beaches by dredging up sand and pumping it onshore, a chronic activity on the Banks and elsewhere on the coast. When Irene struck, a project was under way in Nags Head, where houses routinely end up in the surf when a storm passes. As expected, Irene washed some of the new sand away.

Barrier islands like the Outer Banks are inherently unstable. Waves typically strike these islands at a slight angle, creating currents that pick up sand and carry it along the coast. The wave energy along the Outer Banks is unusually strong; by some estimates 700,000 cubic yards of sand, enough to fill 70,000 average-size dump trucks, moves along that stretch of coast every year.

At the new bridge, evidence of this process appeared even on opening day, in the form of long-necked black water birds called cormorants perching on a spit of sand that had formed near the north side of the bridge. That spit had not been there a few days before, said Pablo Hernandez, the Transportation Department engineer who managed the work.

"It's very difficult," he said. "This whole thing has been constantly moving and shifting."

As he spoke, waves were already starting to cut sharply into the sand at the bridge's southern flank, an area the engineers later reinforced. In nature, barrier islands respond to rising seas by gradually moving inland. They erode on the ocean side but expand on the bay side, as storms wash sand across them or as inlets form and the current carries sand toward the bay.

Since the middle of the 20th century, though, people here have done a lot to thwart this process.

During the Depression, the Civilian Conservation Corps built an artificial dune that survives today along much of the length of the Banks, blocking the overwash of sand. When the islands do wash over, leaving Highway 12 covered in sand, people bulldoze the sand back to the beach. When inlets form, they fill them.

The results have been predictable: Eroding on the ocean side and unable to move inland, Hatteras Island has narrowed.

"Every year and every storm, the vulnerability just increases," Young said.

Andrew S. Coburn, associate director of the shoreline program at Western Carolina University, noted in an interview that Irene was barely hurricane strength when it struck the Banks.

"It was a pretty weak storm, but that's not discussed," he said. "You don't hear that. Nobody talks about the fact."

A weak storm — or even an unusually high tide — can cause big trouble for Hatteras Island, where Highway 12 is a two-lane road usually only a few feet above sea level. The reconstruction job in Rodanthe (pronounced roe-DAN-thee) is the second here in two years; a stretch was similarly repaired in 2009 when surging waves stranded oceanfront houses in the surf, including the house featured in the movie "Nights in Rodanthe." The house was moved.

The state has moved the highway itself four times since the 1950s, said Riggs of East Carolina University. His book offers a "minimal estimate" of \$93 million for the cost of maintaining it since 1983, a figure that does not include the new work.

Replacing the Bonner Bridge will leave the state "locked into trying to protect that highway for 60 to 70 miles," he said. "They cannot do that. It will not last."

Smyre said that the state considered moving the Rodanthe section of the road so far from the beach that it would end up in the sound and added that the temporary bridge would probably be replaced by a larger structure in about the same place.

In the coming decades, Riggs predicted, major storms will turn many parts of the Banks into underwater shoals or flats that are above water only at low tide. If Highway 12 were abandoned and the islands allowed to find their natural equilibrium, he writes, the resulting villages would be "situated like a string of pearls on a vast network of inlet and shoal environments."

They could be reached by ferries, as are two other islands on the Banks, Ocracoke and Bald Head.

Young noted that until Bonner Bridge opened in the 1960s, all travel to Hatteras Island was by boat.

"Martha's Vineyard, Nantucket, Block Island, Puget Sound — people love to ride the ferry," he said.

Not everyone agrees. NC-20, an organization of government bodies and business people from 20 waterfront counties, acknowledges that sea level has risen about 7 inches in the past 100 years but rejects the idea that the situation is worsening. And it says that altering road or other infrastructure plans would be "unscientific" and "portends financial disaster."

In 2010, however, a panel of experts convened by the North Carolina Coastal Resources Commission concluded that a sea level rise of about 3 feet is likely and should be "adopted as the amount of anticipated rise by 2100, for policy development and planning purposes."

But people do not like to hear that message, especially after a storm, said Coburn, also a ferry advocate.

"Are we at the point where we cannot sustain it? With Highway 12, I don't think we are there yet," he said. "But there will come a day."