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# LOCAL STRATEGIES FOR ADDRESSING CLIMATE CHANGE



**NOAA Coastal Services Center**  
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY



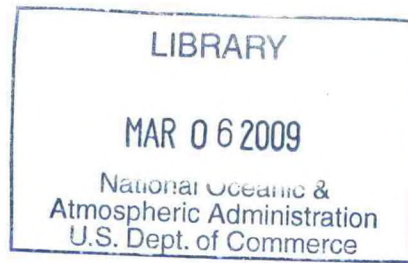
## **About *Coastal Services* and *Local Strategies for Addressing Climate Change***

The National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center produces the *Coastal Services* magazine, a trade journal for the nation's coastal resource managers. This award-winning publication contains articles about important coastal issues and profiles of innovative coastal programs. *Local Strategies for Addressing Climate Change* is a compilation of articles recently published in this magazine. To subscribe or review back issues, visit [www.csc.noaa.gov/magazine/](http://www.csc.noaa.gov/magazine/).

Printed February 2009



Printed on 100% recycled, 50% post-consumer waste, chlorine-free processed paper.



QC  
983  
.N63 .17  
2009  
v.1

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## From the Director

### **The time to address the impacts of climate change is now.**

While this may seem like an overwhelming charge, there are many things that coastal resource managers around the country are already doing that are specifically or indirectly addressing the effects of climate change.

The purpose of this document, which contains articles that previously ran in the National Oceanic and Atmospheric Administration's (NOAA) Coastal Services Center publication *Coastal Services*, is to bring together a few examples of the tools, programs, and projects that are already in place.

Some of these examples may be surprising. Climate change is far-reaching, potentially increasing the intensity of everything from nonpoint source pollution to natural hazards, such as hurricanes and flooding.

Our intention is that this publication help expand thinking about existing programs and projects. By adjusting the focus of a project slightly, could it help address an impact of climate change?

For instance, articles look at states that are working to be more resilient in the face of natural hazards. They now have tools in place that could help address some impacts of climate change.

Smart or green growth efforts can target mitigation and adaptation to climate change, and reducing runoff and working to improve water quality may help address potential climate change impacts to water.

A national guide for how coastal communities can plan and adapt is featured in this publication, as are examples of how coastal managers are addressing climate challenges head-on, such as sea level rise in Rhode Island and coral bleaching caused by rising sea temperatures in Florida.

A few of the NOAA Coastal Services Center's data and tools that can best help coastal managers get their hands around climate change issues are also highlighted.

The list of potential impacts from climate change can be long and overwhelming, but there is much we are already doing. The time to do more is now. ❖



**Margaret A. Davidson**  
NOAA Coastal Services Center

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# Climate Change:

## How Coastal Communities Can Plan and Adapt

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**S**ea level rise, drought and flooding, invasive species that are harmful to humans and the environment—the list of potential impacts from climate change is long and can be overwhelming for local, regional, and state decision makers trying to plan for the future. A new guidebook that uses familiar planning resources and tools is designed to help states and communities across the country adapt to the changing climate.

“Planning for climate change is not necessarily about being green. It really is about managing risk,” says Lara Whitely Binder, outreach specialist for the Climate Impacts Group, one of eight regional climate impact assessment groups in the nation funded by the National Oceanic and Atmospheric Administration (NOAA).

Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments was developed by the Climate Impacts Group and King County, Washington, which is located on Puget Sound.

ICLEI – Local Governments for Sustainability was a contributing partner and is distributing the guidebook nationally to its more than 350 U.S. member cities, towns, and counties. The Climate Impacts Group and King County are also distributing the guidebook.

The guidebook is “a roadmap of action for local, regional, and state governments,” says Jim Lopez, deputy chief of staff to elected King County Executive Ron Sims. “It enables them to ask the climate question with respect to priority planning areas and initiating a climate resiliency effort.”

While many of the examples in the guidebook are from King County, ICLEI brought a national perspective to the project, which included piloting the guidebook in communities in New Hampshire and Alaska.

“This is a great tool for people in municipalities trying to figure out how to do this,” says Mikaela Engert, planner for the City of Keene, New Hampshire. “It helps you think through the process and understand what you need to look at in your community.”

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*Many areas in the U.S. are vulnerable to flooding, coastal erosion, drought, heat waves, health impacts, and intense hurricanes and wildfires caused by climate change.*

*This guide uses familiar planning resources and tools to help communities adapt.*

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### THE COMING CHANGE

Within a few decades, climate in many parts of the country is expected to be significantly warmer. Reports released in 2000 by the U.S. Global Change Research Program and in 2007 by the Intergovernmental Panel on Climate Change indicate that many areas in the U.S. are vulnerable to flooding, coastal erosion, drought, heat waves, health impacts, and intense hurricanes and wildfires caused by climate change.

King County is one of these areas. Covering an area of 2,134 square miles, King County is nearly twice as large as the average county in the U.S. With almost 1.8 million people—including the city of Seattle—it ranks as the 14th most populous county in the nation.

King County is vulnerable to many projected climate change impacts, including declining mountain snowpack (which is directly linked to water supplies) and increased risk of drought, sea level rise, and flooding in coastal and freshwater river systems.

### LEARNING AND ACTING

The idea for the guidebook came out of a 2005 conference that King County sponsored on the regional effects of climate change.

“It was packed,” says Lopez. “There was enormous enthusiasm to learn and act on what was expected to be the climate change impacts in our region.”

Lopez says the team wrote the guidebook with the understanding that the potential impacts of climate change and resulting issues would be different for each region of the country. "It's not prescriptive of any specific policy. It creates a framework that each region can use to create a plan based on that region's issues."

### **INFORMATION AND GUIDANCE**

The guidebook includes information on creating a climate change preparedness team, identifying community vulnerabilities to climate change, and identifying, selecting, and implementing adaptation options—all the steps necessary in creating a climate change preparedness plan.

Guidance on where to find and how to evaluate climate change information is provided, as is a checklist on "How to Prepare for Climate Change." Information on implementing the resulting climate change plan and measuring its progress are also included in the guidebook.

"This really provides a step-by-step approach," says Lopez, "answering many of the most important questions about what a community needs to do."

### **OLD TOOLS, NEW LENS**

"The central message of the guidebook," notes Whitely Binder, "is that planning for climate change is no different than planning for the current stresses in the environment and community. It's really about looking at these issues through a slightly different lens. It's not about having to learn a whole new vocabulary, or how to use a whole new suite of tools."

For instance, she says, if managers are updating their coastal management plans, they need to be "updating it with the potential for sea level rise and the resulting change in habitat and flood risk, inundation of coastal aquifers, and erosion processes. These are all issues they are already dealing with. The key is looking at how climate change may affect these stresses."

She adds that there will "not be a silver bullet or one strategy that will fix all the issues. Adapting to climate change requires a diverse array of adaptation responses."

### **PART OF THE PLAN**

The guidebook was adopted by ICLEI as part of its Climate Resilient Communities program, a NOAA-funded initiative that helps local governments develop tools to protect their communities from the impacts and costs associated with climate change. A sister ICLEI program, Cities for Climate Protection, offers a framework for local governments to reduce greenhouse gas emissions and improve livability.

While part of the bigger program, "the guidebook really is something that anyone can pick up and run with," says Annie Strickler, ICLEI's communications director.

"Planning for climate change can be done," adds Lopez. "The information is there to do the work that can be made into meaningful policy." ❖

*To download *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*, go to [www.cses.washington.edu/cig/fpt/guidebook.shtml](http://www.cses.washington.edu/cig/fpt/guidebook.shtml), or [www.kingcounty.gov/exec/globalwarming/](http://www.kingcounty.gov/exec/globalwarming/). For more information on ICLEI's Climate Resilient Communities program, go to [www.iclei.org/index.php?id=6687](http://www.iclei.org/index.php?id=6687). For more information on the guidebook, contact Jim Lopez at (206) 263-9628, or [Jim.Lopez@kingcounty.gov](mailto:Jim.Lopez@kingcounty.gov), Lara Whitely Binder at (206) 616-5349, or [lwb123@u.washington.edu](mailto:lwb123@u.washington.edu), or Annie Strickler at (510) 844-0699, ext. 328, or [annie.strickler@iclei.org](mailto:annie.strickler@iclei.org). For more information on the City of Keene, New Hampshire's plan, contact Mikaela Engert at (603) 352-5474, ext. 6036, or [mengert@ci.keene.nh.us](mailto:mengert@ci.keene.nh.us).*

**Article was originally published in the January/February 2008 edition of *Coastal Services*.**

# Making Massachusetts' Coast StormSmart

A major hurricane hasn't hit the Gulf of Maine's densely developed coastline in two generations, but many experts agree it's just a matter of time before a big storm hits the region. To help communities prepare for and bounce back from a hurricane, flooding, or other natural disaster, coastal resource managers in Massachusetts are working to ensure that local decision makers have the information and tools they need.

"We've provided one-stop shopping for local authorities," says Andrea Cooper, shoreline and floodplain management coordinator for the Massachusetts Office of Coastal Zone Management. "We are translating highly technical information into tools or strategies that they can use to make real-world changes."

Launched as a website in May 2008, StormSmart Coasts consolidates and simplifies information from around the U.S. on everything from hazard identification and mapping to legal information and funding. Fact sheets explain the tools and showcase success stories that provide real-world examples of complicated concepts.

Over that summer, staff members began a series of regional workshops to make it easier for planners, board members, and others from the state's 78 coastal communities to find the information they need to prepare for natural hazards.

"This is about changing things on the ground, not state policy stuff," says Wes Shaw, the phase one project manager of StormSmart Coasts. "It's the local people who will be impacted by floods, sea level rise, and storms. Things need to happen right at the community level."

In the second phase of the project, the Massachusetts coastal program will select three to five communities to directly implement StormSmart strategies. The lessons learned will then be translated and packaged for use by other coastal communities within the state and nation.

## COMING STORM?

Flood damage in the United States continues to escalate. Even when the hurricanes of 2005—Katrina, Rita, and Wilma—are not included, flood damage

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*Massachusetts is preparing communities to "bounce back" after natural disasters. Hazards, such as flooding resulting from sea level rise and an increase in the severity of tropical storms and hurricanes, are a predicted consequence of climate change.*

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increased six-fold from the early 1900s to the year 2007 and now averages over \$6 billion annually, according to the Association of State Floodplain Managers.

Coastal managers know that a major hurricane or other natural hazard could devastate a community, potentially resulting in loss of life, extensive property damage, destruction of public infrastructure, and environmental impacts from the release of sewage, oil, debris, and other contaminants.

In areas with intense coastal development, such as the 1,500-mile shoreline of Massachusetts, even damage from less severe storms can be costly. These potential impacts may be compounded by relative sea level rise and impacts from climate change.

"Towns often have limited staff and lack the technical know-how and resources to prepare for storms," notes Cooper, "yet coastal resiliency and storm readiness rest largely in their hands."

## NEED TO PREPARE

The StormSmart Coasts program was created after a 2007 report by the state's Coastal Hazards Commission stressed the need to help specific communities prepare for future climate change.

One of the commission's top four priority recommendations was that Massachusetts establish a storm-resilient communities program to provide case studies for effective coastal smart growth planning and implementation.

The state's Office of Coastal Zone Management also recognized the need to provide technical assistance to

communities, submitting an application to the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center for a coastal management fellow. In 2006, Shaw joined the program to lead phase one of what is now StormSmart Coasts.

### **TRANSLATION PLEASE**

The first step in developing StormSmart Coasts was looking at information that already existed. Cooper, who served as Shaw's mentor during the project, says they "quickly recognized that there was a myriad of information out there that was extremely difficult to access and understand."

She asks, "If our staff could barely get through it and understand it, how are local officials supposed to make use of it?"

The focus then became translating the information into user-friendly terminology and tools that local officials in Massachusetts need to make decisions.

For instance, Shaw downloaded a 134-page technical document from a government agency website. Buried in the document was research showing that spending \$3,000 extra during construction to elevate a home three feet can save \$100,000 in flood insurance costs over the life of a mortgage.

While some information was clearly beneficial to local officials, a critical part of the project was determining what information local officials actually needed. Shaw used three networks of local officials on the North Shore, South Shore, and Cape Cod as sounding boards in the development of all the StormSmart products.

### **FULLY OPERATIONAL**

Over two years, Shaw and coastal staff members pulled information onto a user-friendly website and developed fact sheets that explain available tools and provide case studies of towns in Massachusetts that have implemented mitigation efforts.

"There is something on the website for everybody," Shaw says. "There is a whole menu

of options, and the best thing to do is pick and choose what's best for your community."

After the website was launched, Shaw led four regional StormSmart workshops, with about 100 local officials attending each one.

Following the workshops, 15 communities expressed interest in participating in phase two, requiring the coastal program to develop criteria for selecting the communities, Cooper says. "That to me is a good sign that the project is successful."

### **TEST DRIVE**

The Massachusetts coastal program also was recently awarded a second coastal management fellow, Daniella Hirschfeld, who will lead the StormSmart program in the next phase. Hirschfeld will provide direct technical assistance and training to three to five communities to help them choose and implement the different tools and strategies.

"We're going to take it for a two-year test drive," Cooper says. "We want to make sure that what we think is workable is actually ground-truthed." The lessons learned will then be packaged for use by all Massachusetts coastal communities and other states.

Shaw is going to continue his StormSmart focus, adapting the same approach for the Gulf of Mexico Alliance starting this fall.

"Creating storm-resilient communities is a national priority," Shaw says, "but all change has to happen at the local level, ultimately, or it's not going to happen at all."

He adds, "Everything comes back to the local level eventually." ❖

*To view the StormSmart website, point your browser to [www.mass.gov/czm/stormsmart/](http://www.mass.gov/czm/stormsmart/). For more information, contact Andrea Cooper at (617) 626-1222, or [Andrea.Cooper@state.ma.us](mailto:Andrea.Cooper@state.ma.us). You may reach Wes Shaw at (360) 639-6954.*

**Article was originally published in the September/October 2008 edition of *Coastal Services*.**



# State Money Helping Homeowners Prepare for Hurricanes in Florida

**A**fter eight hurricanes and \$38 billion in insured losses in Florida during the 2004 and 2005 hurricane seasons, insurance companies in the state began dropping policyholders, and those lucky enough to maintain insurance were faced with skyrocketing premiums. To address the looming insurance crisis, the state set aside \$250 million to help property owners prepare their homes to better withstand future storms.

The My Safe Florida Home program provided free wind inspections and grants reimbursing eligible homeowners up to \$5,000 for “hardening” their homes by protecting or replacing windows, doors, or garage doors, and bracing gable ends.

“More than 55 percent of homeowners who got a wind inspection were eligible for an average savings of \$218 on their hurricane insurance without the first nail being hammered,” says Tami Torres, special programs administrator for the Florida Department of Financial Services, and coordinator of the My Safe Florida Home program.

Under the program, homeowner Todd Hopkins got \$5,000 back after spending \$13,000 on upgrades. “Then I got my home insurance reduced by \$1,300 a year,” he says. “This was a wonderful thing.”

## UNDER INSPECTION

In the two-part program, eligible homeowners received a free home inspection by state-trained and -certified inspectors. The resulting report included information on work that could be done to strengthen the home. The report also estimated insurance premium discounts, if the homeowner was eligible.

Homeowners who were approved for a grant to make the suggested retrofits were eligible for up to a \$5,000 matching grant. The grants, Torres says, reimbursed homeowners for a portion of the money they spent.

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*Climate change has the potential for increasing the severity of coastal storms, which can impact insurability. Florida is helping homeowners prepare their homes to better withstand future storms and reduce insurance rates.*

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Homeowners did not have to do all the improvements recommended in their inspection reports to qualify for a grant, but they did have to protect all windows or protect all doors to get reimbursed. “You couldn’t just protect one or two windows,” Hopkins notes.

To be eligible for the program, homeowners had to make Florida their primary residence and live in a single-family home built on-site before March 1, 2002. The home had to have an insured value of \$300,000 or less, and be in the wind-borne debris region, typically within one mile of the coast. Low-income homeowners were eligible for a grant of up to \$5,000 with no match required.

## GROUP EFFORT

When the state legislature set aside the money in 2006, it assigned the program’s creation to the Florida Department of Financial Services, which traditionally assists consumers after hurricanes but is not the agency charged with mitigation and recovery, Torres says.

“From the legislature’s perspective, we are the fiscal watchdog for the public,” she explains.

One of the first things agency staff members did was turn to the Federal Alliance for Safe Homes, a nonprofit organization that promotes disaster safety and property loss mitigation, and the Florida Department of Community Affairs, which has mitigation and recovery experience.

“We could not embark on this by ourselves because to some degree, a lot of what we were doing is new in state government,” Torres says.

### **PILOT PHASE**

Part of the challenge, says Torres, was the enormity of the program—not only the amount of funding, but also the fact that there are 4.4 million single-family homes in Florida. A secondary goal was to educate people who were not participating in the program on the benefits of hardening their homes and how to do it.

The agency began with a pilot phase that focused on assisting 12,000 homeowners statewide over six months.

In four months, a survey tool and supporting technology were created for inspectors to use to collect data on homes, two inspection firms were hired, and a training manual and classes were developed to certify inspectors and contractors who would be doing the work. The inspectors also had to undergo background checks.

### **TOO MANY, TOO SOON**

Although the goal for the pilot phase was to cap the number of eligible homeowners, the “reality is that when this made the newspapers and TV, more than 60,000 people applied in the first two weeks,” Torres says.

Once the hurricane season ended on November 30, 2006, the state stopped inspections to regroup.

“What I might say to my colleagues in other states is spend more time on the front end thinking about how you would implement a program like this rather than creating a pilot,” Torres says.

### **LEARNING TO FLY**

After post-election staff turnovers—including the agency director—in January 2007, Torres was put in charge of the My Safe Florida Home program. She was

tasked with heading the evaluation of the pilot phase and having the second phase up and running by March.

“It was a good experience,” Torres says, “but it was a lot like learning how to fly a jumbo jet plane in 30 days.”

Changes to the program included the legislature reducing the number of improvements for which homeowners could be reimbursed, which had allowed such things as roof replacement, and lifting an administrative cap on the program, permitting the agency to hire ten staff members to manage the program.

Before ending the process to receive new applications, the program had accepted more than 425,000 wind inspection applications and had reimbursed more than 15,000 homeowners statewide more than \$49 million.

As of October 2008, more than 38,000 homeowners were approved for a matching grant, and homeowners who had applied for an inspection or grant before the application process ended were still receiving free wind inspections and grants.

The legislative goal, Torres says, was to provide 400,000 inspections and 35,000 grants by June 30, 2009.

“I definitely don’t think this is Florida-specific,” Torres says. “Insurance companies are not just cutting back in Florida, but are cutting policies in other states, as well. A lot of what we’re doing we’re definitely eager to share with other states.” ❖

*For more information on My Safe Florida Home, point your browser to [www.mysafefloridahome.com](http://www.mysafefloridahome.com). For information on the Federal Alliance for Safe Homes, go to [www.flash.org](http://www.flash.org). You may also contact Tami Torres at [Tami.Torres@fldfs.com](mailto:Tami.Torres@fldfs.com).*

**Article was originally published in the January/February 2008 edition of *Coastal Services*.**

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## Public Use:

### Texas Works to Protect Rights and Beaches

**W**hen erosion eats away the sand in front of a house to the point that it is on state-owned land and is uninhabitable, making the public's use of the beach difficult and dangerous, whose rights are more important—those of the public to use the beach or those of the property owner whose land has been lost? Texas coastal resource managers have developed a compromise to try to protect both public use and private property rights.

"Texas beaches belong to Texans—all Texans," says Jerry Patterson, commissioner of the Texas General Land Office. "We are working to ensure a fair deal for the property owners and keep Texas beaches open to the public."

The compromise is the Texas Open Beaches Act relocation expense reimbursement program, which offers the owners of homes now on state-owned lands \$50,000 to help with the cost of moving the structures to a new location. Of the 116 structures on public beaches, the program has focused on 37 houses on Surfside Beach.

"These are the most egregious examples," says Thomas Durnin, a planner for the Texas Coastal Erosion Planning and Response Act, which implements the relocation program. "They all have water under them at least part of the time. Many are a threat to public health because of their condition, which is physically deteriorating. Decks and stairs are starting to come off, and they impede the public's access to move around on the beach."

Twenty-three of these houses and related debris were removed from the beach in 2007 by the state and the Village of Surfside Beach, which received Federal Emergency Management Agency (FEMA) mitigation funds to purchase and demolish nine structures whose owners opted to take the FEMA buyout. Village and state officials say removing the houses is a critical step

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*Sea level rise and increasing storm intensity caused by climate change may increase coastal inundation, erosion, and ecosystem losses. In the face of extensive coastal erosion, Texas is working to balance both the public's right to use the beach and private property rights.*

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in acquiring state and federal funding to do beach renourishment that will protect 450 homes in the community, as well as a road and other infrastructure.

#### ACCESS A RIGHT

In Texas, access to the beach is a right founded in state common law, Patterson says.

In 1959, the Texas Legislature formalized this with the creation of the Texas Open Beaches Act, which ensures the right of all Texans to access the beach. A portion of the beach can be privately owned, but owners must allow the public free and unrestricted access to, and use of, the beach.

This portion of the beach extends seaward from the line where plants naturally take root, or the natural line of vegetation. The mean high or higher water line marks the boundary where private ownership of the beach ends and public ownership begins. This creates a rolling easement, as the line of vegetation moves because of winds, waves, tides, storms, and hurricanes.

Under this rolling easement, property may become the state's if beaches erode, "but the reverse could be true, too," Durnin says. "The beaches can accrete, and people can gain property. That does happen in some places."

## LOSING GROUND

Since 1983, much of the Texas coastline has had one of the highest erosion rates in the nation, losing five to ten feet of beach each year.

“Our erosion rate has accelerated to 11 to 13 feet a year in the last four years, says Kelly Hamby, former city secretary for the Village of Surfside Beach. “Just in the last three days, we’ve lost another 6 to 8 inches of elevation.”

“With that kind of erosion rate, it’s not too difficult to see how structures that have been there for 30 years that were once way back from the beach landward of the dunes are now in front of the vegetation on the public beach,” explains Durnin. “The state is not taking that land; it’s the forces of Mother Nature at work.”

In Surfside, the line of vegetation has moved back to Beach Drive, which is the primary access road along the beach, says James Bedward, former mayor of the Village of Surfside Beach. Beach Drive is often damaged during extreme high tides or storms.

“There is not a place to locate another road to provide service to the next row of 85 houses,” Bedward says. “Our Beach Drive is the line in the sand.”

## CHANGING COURSE

For decades, the Texas General Land Office struggled with the problem of houses on state-owned beaches, Durnin says. In the past, officials tried litigation to force owners to remove their houses, but that was time-consuming, expensive, and not terribly effective, with only one house ever being removed.

With the number of appeals these cases go through, he says, it’s estimated to cost the state \$500,000 per case.

In 2004, after Hurricanes Katrina and Rita did severe damage to Texas’ beaches, Patterson imposed a two-year moratorium on enforcement of the

Open Beaches Act for the 116 houses determined to be located on public beaches. This allowed the natural vegetation line to grow back and gave Land Office staff members time to study the problem.

## ON HOLD

The damage to the beach at Surfside was so bad after Rita, Bedward says, that it was unsafe for the village to reconnect the 37 houses—mostly rental properties—to sewer or water utilities, and the properties were ordered evacuated.

A \$3 million beach renourishment project that had been approved for Surfside before Rita was lost because the houses were in the way and the beach had changed so dramatically.

## A NEW PLAN

When the moratorium was up, Patterson presented his “Plan for Texas Open Beaches,” which included eight proposals—some needing legislative approval—to strengthen and clarify the Texas Open Beaches Act. Four of the eight proposals were passed by the Texas Legislature in 2007.

While litigation was maintained as a tool for removing structures on state-owned beaches, Patterson offered to help property owners remove their structures from the public beach, making \$1.3 million in state money immediately available. The initial offer from the state was \$40,000 per house, which was raised to \$50,000 after the first offer received a small number of applicants, Durnin says.

The money can be used by property owners to help defray the cost of tearing down or moving the structure to another location, including removing underground utilities and completing final site grading. It, however, cannot be used to cover the cost of a new piece of land.

*Continued*

"It's not completely a free ride, but it does help defray a lot of the expenses," Durnin says.

Because two lawsuits were pending, Patterson says the offer allows property owners to retain their right to sue the state.

### **MOVING FORWARD**

Patterson held a public hearing in Surfside to explain the program and its requirements to residents.

So far, the state has approved and funded 14 relocations off Surfside Beach, as well as one relocation project in Galveston and a demolition at Treasure Island near Surfside.

Simultaneous to the state's offer of assistance, the village received a FEMA Hazard Mitigation Grant to pay volunteer homeowners full market value for some of the homes that were in the worst condition.

Before closing out their FEMA grant in October 2007, the village paid \$103 a square foot for nine homes and paid for their destruction and removal. Owners of four houses that were eligible for the buyout did not take the offer.

The property that was bought with the grant will become a village park, notes Bedward.

Rulings in both of the lawsuits against the state came in 2007 on the side of the Texas Open Beaches Act. The remaining houses were ordered to be removed, but an appeal in at least one of the cases could still be filed.

### **WORKING TOGETHER**

Patterson is reluctant to call the relocation program a success until all the houses are removed from Surfside Beach.

"Our objective is to get these houses off the beach so we can renourish the beach and save the next row of houses and infrastructure," Patterson says.

Durnin and Hamby both say that Patterson has provided an innovative solution to a problem that has stymied his predecessors for decades, and that the first phase has been a success.

"I don't think we are there yet," Patterson says, "We're moving in the right direction, and we're doing it in a fair manner, but there's still a lot of work to do." ❖

*For more information on the Texas Open Beaches Act relocation expense reimbursement program, contact Jerry Patterson, c/o Jim Suydam, at (512) 463-2716, or Jim.Suydam@GLO.STATE.TX.US. You may also contact Thomas Durnin at (512) 463-1192, or Thomas.Durnin@GLO.STATE.TX.US. For more information on the FEMA Hazard Mitigation Grant Program, go to [www.fema.gov/government/grant/hmgp/](http://www.fema.gov/government/grant/hmgp/).*

**Article was originally published in the November/December 2007 edition of *Coastal Services*.**

# Developing Guidelines for Green Growth in Georgia

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*Sprawling development is a contributor to climate change, and green or smart growth is an important factor in combating it, providing both mitigation and adaptation. Georgia is providing land-use guidance with the changing coastal landscape in mind.*

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**D**evelopment and conservation don't have to be mutually exclusive. Georgia coastal resource managers have created a manual to help illustrate this point and provide guidance to developers and others on designing with the coastal landscape in mind.

The Green Growth Guidelines help local governments, developers, engineers and land planners, landscape architects, and natural resource managers compare the environmental, social, and economic benefits of using sustainable development strategies with conventional development approaches.

"It's intended as a one-stop shop that provides a hypothetical case study, best management practices, and innovative approaches," says Jill Andrews, program manager for the Georgia Coastal Program. Techniques such as site fingerprinting, low impact development practices, and alternative stormwater and bank stabilization techniques are detailed. The economic benefits of conservation development also are analyzed.

"The results show an increase in sales and prices for the lots and houses in a conservation community, and lower costs for the developer and the local government," says Jeannie Butler, coastal management nonpoint source coordinator for the Environmental Protection Division of the Georgia Department of Natural Resources. "Benefits include the creation of great spaces for us to live and work, with clean water and abundant and diverse wildlife, plants, and habitats."

The Georgia Coastal Program used funding from the coastal nonpoint program to contract with the Coastal Georgia Regional Development

Center and the environmental services firm EMC Engineering Services Inc. to draft the manual.

"It was written and designed by professionals in the field," notes Andrews. "They compiled a tremendous amount of information," including basic information about geographic information systems and the Global Positioning System, that "we wouldn't have thought to include."

"A lot of the information seems basic to resource managers, but that information is really important to provide so that anybody can pick it up and follow the activities step-by-step," Andrews says.

The 179-page manual is published in a three-ring binder so that chapters can be added. Upcoming chapters will address recreational impacts, economics of conservation developments, climate change, and sea level rise.

The guide focuses on the unique environmental needs of coastal Georgia, but Andrews points out that developers and landscape architects from the rest of the state also have been interested in the publication.

"We've had a problem keeping copies in house," she says. "They've been flying out the door."

The companion "GreenCoast" subdivision certification program was recently completed by the University of Georgia Marine Extension Service's Coastal Sustainable Communities Program. GreenCoast will recognize new residential developments at the bronze, silver, or gold designations for integrated conservation land-use design and practices that reduce nonpoint pollution and protect coastal wildlife and habitats.

"I personally am surprised by how well the Green Growth Guidelines have been received," Andrews says. "'It's a great first step. We might tweak a few things, but ultimately, it's a terrific product.'"

She adds, "It would be a wonderful model for other states." ❖

*The Green Growth Guidelines are available on-line at <http://crd.dnr.state.ga.us/content/displaycontent.asp?txtDocument=969>. For additional information, you may contact Jeannie Butler at (912) 554-3494, or [Jeannie.Butler@dnr.state.ga.us](mailto:Jeannie.Butler@dnr.state.ga.us).*

**Article was originally published in the September/October 2006 edition of *Coastal Services*.**

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# The Rising Tide:

## How Rhode Island Is Addressing Sea Level Rise

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**W**hile a United Nations panel of scientists and government officials is predicting that oceans will rise up to 2 feet by 2100, coastal resource managers in Rhode Island are preparing for the sea to rise 3 to 5 feet. And that estimate is considered conservative.

"It's a big issue—a major issue—for us," says Grover Fugate, executive director of the Rhode Island Coastal Resources Management Council. "We're already starting to see issues in terms of our waterfront and water level impacts."

Sea level rise along Rhode Island's coast is contributing to increased coastal flooding and erosion, and has the potential to damage infrastructure and property.

When it became clear that sea level rise resulting from climate change would accentuate the impacts of future storms on coastal resources, the coastal council and Rhode Island Sea Grant worked with the legislature to amend the state building code to explicitly address sea level rise and climate change. They then began developing related coastal regulations, which were adopted in January 2008.

These regulations not only explain the science of Rhode Island's sea level rise and provide historical data, but they also will help the coastal council and others in the state better manage development and related concerns.

"Considering sea level rise when assessing appropriately placed development will be a vital tool for the coastal council, as well as municipalities, their planners, and developers," says Fugate. "Having these regulations in place will allow us to determine which areas would be most susceptible to flooding, and to plan accordingly for the future."

Another result of the regulatory creation process is a summary of sea level rise initiatives of coastal programs across the nation.

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*Sea level rise is a direct consequence of global climate change. Rhode Island is proactively responding to predictions by updating building codes and developing related coastal regulations.*

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### RISING TIDES

Sea level rise refers to the change in mean sea level over time in response to global climate and local changes. The Intergovernmental Panel on Climate Change (IPCC) projected in 2007 that the world's oceans would rise from 7 to 23 inches in the coming century. Since 1990, sea level has been rising faster than the rate predicted by models used to generate earlier IPCC estimates.

Future sea level rise is not expected to be globally uniform or linear, notes Pam Rubinoff, coastal management extension specialist for Rhode Island Sea Grant. As a result of ice flow dynamics or local subsidence, some regions will experience higher water levels than the global average, and others will be less impacted.

In addition to rising global sea levels, the land surface in Rhode Island is subsiding at a rate of approximately 6 inches per century, according to a coastal council science report. "The combination of these two effects is evident from the long-term trend recorded by the Newport tide gauge, which indicates a rate of 10.1 inches (plus or minus 1.2 inches) of relative sea level rise over the last century."

Fugate notes, "The acceleration data is lining up on our worst case scenario line, which has us very concerned."

### LOOKING FOR PROOF

Rhode Island began to suspect impacts from sea level rise after reports of regular flooding of a waterfront park in the City of Providence. "The city is using its hurricane gates 19 days of the year when there are high

tides and wind,” Rubinoff explains. “When you start having that happen, you begin to ask the question.”

The flooding was particularly troublesome to the state’s coastal managers because there is \$4 billion in development on the waterfronts in Providence, East Providence, and Pawtucket.

“There was a heightened sense that we need to look at this and see what the implications were for us,” Fugate says. “We knew that all this development would be susceptible to storm damage, and we wanted to get ahead of the curve on that before we were dealing with an after-the-fact issue.”

As part of the development of a Special Area Management Plan (SAMP) in 2006, the coastal council, Sea Grant, and others began to look into the causes of the flooding.

The tide charts showing an increase of almost a foot since 1929 seemed to be the proof that sea level rise was the culprit. Other incriminating evidence included erosion rates that doubled from 1990 to 2006 in certain areas, wetlands that were transitioning to salt marsh, and a three-degree rise in water temperature since 1970.

### **FEELING VULNERABLE**

This evidence was not welcome news. In addition to the potential of making recreation areas, public spaces, and coastal wetlands more vulnerable to flooding, storm damage, and erosion, sea level rise is projected globally to make residential and commercial structures, roads, and bridges more vulnerable, and to reduce the effectiveness and integrity of existing seawalls and revetments that were designed for historically lower water levels.

Drinking water may be compromised from salt intruding into aquifers. Higher water levels could compromise wastewater treatment facilities, and future increases in relative sea level could displace coastal populations.

There are also concerns about species changes. In Rhode Island, there are projections that the lobster fishery could disappear over the next two decades, and there are already declines in winter flounder populations, which may not be due to overfishing, Fugate says.

### **POLICY WINDOW**

Coastal hazards—including sea level rise—were being addressed by the SAMP planning group, which was working to update the Metro Bay SAMP that was originally created in 1983, says Rubinoff.

At the same time, a state legislative committee was looking at insurance issues related to hurricanes.

“We don’t get hurricanes that often, but this was post-Katrina and post-tsunami,” Rubinoff says. “The whole state of Rhode Island is in the coastal zone, so we looked at this as a potential policy window.”

The sea level rise data were presented to senate policy staff members, who were looking at the concerns of the insurance companies regarding building codes.

In June 2007, the Rhode Island legislature passed a law authorizing the state building codes commission to “adopt, maintain, amend, and repeal” code provisions for storm and flood resistance, taking into account climatic changes and sea level rise. The coastal council was also authorized to collaborate with the state building commissioner to adopt freeboard calculations, or the elevation of structures above the flood zone.

### **EXAMINING THE ISSUES**

In order to incorporate sea level rise and other climate change considerations into siting, building standards criteria, and enforceable policies, the coastal council and Sea Grant first focused on the science.

Scientists from the University of Rhode Island “looked into the science of what sea level rise is and what the existing science says,” explains Rubinoff. In addition, the coastal council and Sea Grant “looked at existing

*Continued*



development issues, identified key priorities, and looked at the impacts on buildings, the shoreline, and habitat.”

A series of public meetings were held. Fugate says visualizations created by Sea Grant showing popular coastal locations with three feet of sea level rise “really got people’s attention and helped people understand the issues.”

### THE BIG PICTURE

Sea Grant also looked at what other states were doing, working with the National Oceanic and Atmospheric Administration (NOAA) Office of Ocean and Coastal Resource Management to create a summary of sea level rise initiatives of coastal programs across the nation. (This can be viewed at [http://seagrants.gso.uri.edu/ccd/slr/SLR\\_policies\\_summary\\_Mar6\\_final.pdf](http://seagrants.gso.uri.edu/ccd/slr/SLR_policies_summary_Mar6_final.pdf).)

“We found out that several states aren’t doing anything,” Rubinoff says. “Others are coming at it very differently, through outreach, research, established commissions, or general policy. There’s not a lot of consistency.”

### NEW POLICY

The resulting policy information was presented during a workshop with the science panel and policy makers in the coastal council, state building commission, and senate policy office.

The group’s consensus was that the rate of sea level rise that should be planned for is 3 to 5 feet, but that the coastal council should review these figures frequently and adjust them as necessary.

This is the rate that will be used for future permitting, giving the state building commission the guidance needed to incorporate additional building elevations, or freeboard, into the state building code.

Fugate says this is just a start in the council’s efforts to address issues resulting from climate change. “Right now we have more questions than answers. This is a skeleton that still needs to be fleshed out.”

### FLESHING OUT

The Metro Bay SAMP planning group is helping to put some meat on the regulatory bones by creating

specific policies for sea level rise in the Providence area that will also be recommended for state implementation.

“Looking at a specific area through the SAMP process really helped us identify real issues,” Rubinoff says.

“We’re a small state, so it’s easy for us to take some of these issues from one place and adapt it statewide.”

Among the SAMP’s recommendations are more stringent building standards, flood ordinances, permitting processes, and best practices in coastal flood zones to reduce vulnerabilities to existing and future infrastructure. Also included are building setbacks and elevations, monitoring, and requirements for stricter flood-zone standards.

The SAMP also recommends incorporating climate change considerations into low impact design standards for stormwater management.

### NO EASY ANSWERS

While Rhode Island coastal managers are proud of the progress they have made in addressing sea level rise and climate change, the challenge before them is daunting.

“The hardest thing that we have had to come to grips with is that there aren’t a lot of hard and fast answers out there,” Fugate says. “We’re going to have to learn to live with that for the time being.”

He adds, “We’ve made the choice to go forward now and try to adapt rather than wait for more information. If you wait for all the answers, you’re really placing your coastal population at risk.” ❖

*To view the draft chapter on natural hazards in the Metro Bay Special Area Management Plan (SAMP), the science report prepared for the Rhode Island Coastal Resources Management Council, the summary of other state coastal program initiatives to address sea level rise, and the coastal council’s new sea level rise policy, point your browser to <http://seagrants.gso.uri.edu/ccd/haz.html>. For additional information, contact Grover Fugate at (401) 783-7112, or [gufugate@crmc.ri.gov](mailto:gufugate@crmc.ri.gov), or Pam Rubinoff at (401) 874-6135, or [rubi@crc.uri.edu](mailto:rubi@crc.uri.edu).*

**Article was originally published in the May/June 2008 edition of *Coastal Services*.**

# Bringing Hazards Information Together in Maryland

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*Maryland is using a Web portal to bring together all the state's hazards information, such as on storms and flooding from sea level rise, which may become more intense with climate change.*

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Many agencies typically work on state coastal hazards issues, which can make it hard for property owners, teachers and students, and even coastal resource managers to know where to turn for information and assistance. To solve this dilemma, Maryland coastal managers helped lead an effort to bring together all the state's coastal hazards information and tools onto a single website.

"Our vision was having a one-stop shop for coastal hazards in Maryland," says Audra Luscher, the former coastal hazards specialist for the Maryland Department of Natural Resources Coastal Zone Management Program. "We've been working on hazards for five years, and we wanted a centralized place where everyone could access all the great stuff we've been working on."

The result is Maryland Shorelines Online, a coastal hazards Web portal that enhances state agency coordination and provides information to a variety of users on assistance and tools needed to understand, assess, and manage hazards issues.

The Web portal provides everything from policies and regulations to information on technical and financial assistance. It gives users access to geographic information system (GIS) maps and shoreline inventory tools, as well as teacher lesson plans and fact sheets.

"We were at one of those points where technology became available that could meet our needs," Luscher says. "Internet mapping systems became more accessible and widely used and will soon allow us to include very memory-intensive data sets, such as lidar elevation data."

The Maryland Coastal Program worked with Towson University Center for Geographic Information Sciences and Maryland Geological Survey to develop and design the website.

Luscher notes that there was "a lot of discussion up front" between state agencies working on hazards issues to determine the scope and content of the website. Needs assessments of various groups, including local and county governments and citizens' groups, also were used.

"We wanted to tailor it to all of our needs," she says.

One of those needs included developing a training manual and users' guide for the site. In addition to sending out press releases and working with the media to attract users, coastal program staff members went on the road to festivals and meetings and provided training sessions to targeted user groups.

Survey feedback shows that the site is being used by a "wide network of users," Luscher says, with homeowners using the site the most. Government staff members also are using the site to work with homeowners to help them understand their hazards risks.

"The Web was the perfect tool for this," Luscher says. "When you have aerial imagery and you can see water overlying the majority of a county, it's easier for homeowners to understand. It's also easy for resource managers to print one page off and have a dialogue about it." ❖

*To view Maryland Shorelines Online, point your browser to <http://shorelines.dnr.state.md.us>.*

*For more information, contact Gwen Shaughnessy at (410) 260-8743, or [gshaughnessy@dnr.state.md.us](mailto:gshaughnessy@dnr.state.md.us).*

**Article was originally published in the July/August 2007 edition of *Coastal Services*.**

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# Coral Bleaching:

## The Impact of Rising Sea Temperatures on Florida Keys' Reefs

**A**t the end of July 2007, coastal resource managers in the Florida Keys were reporting that isolated coral colonies were beginning to show signs of paling or partial bleaching. If conditions continued, the threat of mass coral bleaching would be high.

Widespread coral bleaching means that these normally colorful ecosystems are being subjected to starvation and could face disease, and even death. The primary culprit, scientists say, is rising sea temperatures fueled by climate change.

The consequences of major bleaching events could include millions of dollars in lost tourism revenue, communities left more vulnerable to coastal storms, and less seafood for people around the country to eat.

"Based on observations in the Florida Keys, it is clear that coral bleaching events have been intensifying over the past two-and-a-half decades on a local scale. This is consistent with other observations reported on regional and global scales," says Billy Causey, regional director of the Southeast Atlantic, Gulf of Mexico, and Caribbean Region of the National Oceanic and Atmospheric Administration's (NOAA) National Marine Sanctuary Program.

While coastal resource managers cannot address the global rise in sea temperatures, Causey and others say there are things resource managers can do to help improve corals' chances of survival, such as reducing nonpoint source pollution and other coral stressors, conducting baseline monitoring of corals and other ecosystems, identifying and protecting resilient reefs, and communicating with managers, scientists, and the public.

This advice is suggested not only for managers of states or territories with coral reefs off their shores, but also for all environmental managers

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*Rising sea temperatures fueled by climate change is the primary culprit behind widespread coral bleaching. Florida resource managers, researchers, nonprofits, and others are working together to develop strategies to support reef resilience.*

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who may not realize the impact their state or local storm runoff may be having on coral reefs.

Florida managers also warn that corals are one of the first indicators of ecosystem change related to climate change and that the lessons they are learning are a warning to other managers who should be preparing now for the potential of environmental impacts.

### **BENEFITS OF CORAL REEFS**

The Florida Keys receive about four million visitors a year, who spend more than \$1 billion. Many of these visitors come to scuba dive, snorkel, and sport fish—activities that are all dependent on healthy reefs.

The reefs provide habitat for finfish and shellfish, helping commercial fishermen in the Keys land \$50 to \$70 million worth of seafood every year. Coral reefs absorb constant wave energy from the ocean, protecting coastlines from increased storm damage, erosion, and flooding.

The U.S. and world economies also benefit from coral reefs, says Mark Eakin, coordinator of NOAA's Coral Reef Watch.

About 45 million tourists visit U.S. coral reefs every year, generating \$17 billion in income, and U.S. reefs generate \$247 million from commercial fishing. Globally, coral reefs have a value of \$375 billion and provide food to about one billion people in Asia alone.

## GETTING WARMER

"The biggest issue we're seeing in global climate is that ocean temperatures are rising, and we expect them to continue to rise in the future," says Eakin. "Corals are sensitive to extremes in water temperatures and are already living at their uppermost thermal limits."

Less than a two-degree Fahrenheit temperature increase can trigger a major bleaching event.

"Coral bleaching can be caused by many adverse environmental conditions, but unusually high sea temperatures have been found to be the primary driving factor in mass coral bleaching events where entire reef systems and regions bleach," says Derek Manzello, marine biologist with the Cooperative Institute for Marine and Atmospheric Studies at the University of Miami.

"Without a doubt, in the late 1970s and early 1980s we started seeing signals of elevated sea surface temperatures affecting coral reefs in the Keys," says Causey. "We're already in a situation where the water temperature has risen high enough that we're seeing bleaching events occurring with greater frequency and intensity."

## BLEACHING

Corals often respond to stress by expelling the colorful algae that live within their otherwise clear tissues. Because these algae give corals their color, bleached colonies often appear stark white.

"If it's a mild event, coral will regain algae, and they will recover," Eakin explains. "If it is severe, or if the event is long-lasting, corals will die."

Secondary impacts to corals from bleaching events include disease, loss of living tissue, and low recruitment.

Manzello points out that "nearly every reef in the world has undergone temperature-

related bleaching, and the increase in the frequency and severity of coral bleaching events over the past 25 years is unprecedented."

## RAMPING UP

In 1997 and 1998, coral reefs worldwide bleached for the first time, killing about 16 percent of the world's living coral reefs.

Since 1996, more than 35 percent of the Florida Keys' shallow coral reefs have died. The number of coral species within particular reef areas is declining as well, says Brian Keller, science coordinator at the Florida Keys National Marine Sanctuary.

The risk of mass bleaching is higher when weather forecasts call for high air temperatures and extended periods of low winds and low cloud cover. In 2005, the Florida Keys escaped the impacts of a Caribbean-wide bleaching event when four hurricanes churned past the area, lowering water temperatures.

In the summer of 2007, when temperatures were higher than they had been in mid-July the previous year, managers were "ramping up for a bleaching year," notes Dave Score, superintendent of the Florida Keys sanctuary.

## VULNERABILITY

Coral reefs in Florida typically cannot withstand continued exposure to sea temperatures colder than 68 degrees Fahrenheit or warmer than 86 degrees, or great changes in water quality or salinity.

"Here in the Keys, the reefs that are the most vulnerable to bleaching are the ones that are the most popular—the shallow reefs that are the most beautiful dive destinations," says Causey.

Nearshore patch reefs have shown the least amount of decline. "One might not expect that to happen," notes Causey, because these reefs are generally found

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in the most turbid waters in the Keys adjacent to the shoreline where sanctuary monitoring has found high levels of nutrients. They are also exposed to a wider temperature range than the other reefs.

“They have acclimated over a long geological time to a broader range of temperature shifts,” Causey explains. “The algae in patch reefs also are a different type, which helps the coral communities survive.”

Corals are able to adapt, says Eakin, “if the rates of environmental change are slow enough. We don’t know how slow that is. The problem that we’re running into now is that the changes we’re seeing are at a rate that far exceeds what corals are capable of responding to.”

### **STRESSED OUT**

One of the problems is that the corals may be facing too many other stressors at once, such as land-based sources of pollution, habitat loss and degradation, and overfishing.

“Under normal conditions, corals can tolerate a certain level of environmental stress,” says Causey. “If you add the temperature stress to the corals and you add any of the other stressors—whether it is nutrients or physical impacts—all of these are part of the multiple stressors that are pushing corals to the very brink.”

The good news is that coastal resource managers can play a critical role in responding to bleaching events and in helping to control the issues that put additional stress on reefs.

### **BUILDING RELATIONSHIPS**

Some of the successful management efforts undertaken by the sanctuary include creating no-impact zones that protect reefs and species, and providing in situ and remote sensing observations to researchers who have developed prediction methods and who are working to better understand the bleaching phenomenon.

Sanctuary staff members have reached out to other reef managers and scientists around the country and world to share and compare bleaching-

related information and insights, and contributed to *A Reef Manager’s Guide to Coral Bleaching*, produced by NOAA, the Great Barrier Reef Marine Park Authority, and others, that provides information on actions local reef managers can take.

When a bleaching event is predicted, sanctuary managers alert the local dive and fishing communities, who provide information on bleaching conditions to an early-warning network of volunteers called BleachWatch.

They are also collaborating with resource managers, researchers, nonprofits, and other stakeholders to help develop strategies to support the natural resilience of reefs.

### **STRESS MANAGEMENT**

Other management actions that could improve reef health include working to improve water quality, or timing impacts to avoid exacerbating bleaching events. Mitigating the impacts of coastal development, commercial and recreational fishing, agriculture, and tourism could also reduce sources of coral stress.

“These are things coastal managers are looking to do anyway, and in many cases aren’t doing as well as they would like because of factors beyond their control,” Eakin says. “What’s going on with coral reefs could serve as a catalyst to help managers take the actions they would already like to be taking.”

He adds, “This truly is their issue, whether they have a reef in their backyard or not. Two-thirds of the U.S. has an influence on the reefs in the Gulf of Mexico and Florida Keys.”

### **HARBINGERS**

Coastal managers may also want to take the coral bleaching events in the Florida Keys as forewarning to prepare for their own environmental impacts from climate change.

“It’s a matter of time before others are experiencing the impacts of climate change like we’re experiencing in the Keys and other areas,” says Causey. “Coral reefs are really good indicators of climate change

and truly are also an indicator of ecosystem change. . . They are the canaries in the coal mine.”

He adds, “One of the lessons that we’ve learned is the need to focus scientific efforts on understanding this change as it takes place, and being prepared to adapt management for the future.”

### STAYING POSITIVE

While the impacts of coral bleaching are grave, there is still hope.

“It’s very serious in the short term, but over a much longer term coral reefs have adapted in various ways,” says Eakin. “Coral reefs have been around for 400 million years, and corals will continue to be around in some form.”

“We’re not giving up,” says Score, “and the colleges in South Florida are not giving up, and I don’t want to send the message that the problem is too big to fix.”

He adds, “Don’t be afraid to do your part when it feels like you can’t fix it all. It takes all of us working together to buy the time we need until we have a global solution.” ❖

*For more information on coral bleaching, contact Billy Causey at (305) 809-4670, ext. 234, or [Billy.Causey@noaa.gov](mailto:Billy.Causey@noaa.gov). Contact Dave Score at (305) 809-4700, or [David.A.Score@noaa.gov](mailto:David.A.Score@noaa.gov), or Brian Keller at (727) 553-1100, or [Brian.Keller@noaa.gov](mailto:Brian.Keller@noaa.gov). Mark Eakin can be reached at (301) 713-2857, ext. 109, or [Mark.Eakin@noaa.gov](mailto:Mark.Eakin@noaa.gov).*

**Article was originally published in the September/October 2007 edition of *Coastal Services*.**

## ADDITIONAL INFORMATION

A Reef Manager’s Guide to Coral Bleaching,  
[www.coris.noaa.gov/activities/reef\\_managers\\_guide/](http://www.coris.noaa.gov/activities/reef_managers_guide/)

The National Oceanic and Atmospheric Administration (NOAA) Coral Reef Conservation Program, [www.coralreef.noaa.gov](http://www.coralreef.noaa.gov)

NOAA’s Coral Reef Watch,  
<http://coralreefwatch.noaa.gov>

NOAA’s Coral Reef Information System (CoRIS),  
[www.coris.noaa.gov](http://www.coris.noaa.gov)

The Florida Keys BleachWatch program,  
<http://isurus.mote.org/Keys/bleachwatch.phtml>

The Florida Reef Resilience Program, [www.nature.org/wherewework/northamerica/states/florida/preserves/art17499.html](http://www.nature.org/wherewework/northamerica/states/florida/preserves/art17499.html)

# Website Uses Data to Paint Picture of Lake Superior's Watershed

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*Climate change is likely to increase certain water pollution problems, including polluted stormwater runoff. Minnesota is monitoring streams in real time and using the data to educate everyone from students to decision makers.*

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Getting homeowners to understand that what comes off their lawns impacts coastal waters, and inspiring them to do simple things that will reduce runoff and improve water quality, are goals of many coastal resource managers. An award-winning website that uses real-time stream monitoring data to paint a picture of what's happening in the Lake Superior watershed is helping Minnesota managers address these goals.

"Everybody is nuts about fishing and the outdoors up here," says Richard Axler, senior research limnologist for the Natural Resources Research Institute (NRRI) at the University of Minnesota at Duluth. While people enjoy the resources, "many don't know what a watershed is or that they live in a watershed, and many don't understand that if they blow their leaves and winter sand into the street, it goes right into the creeks" and ultimately Lake Superior.

Axler adds, "Our message is, protecting our waters requires individual responsibility and understanding."

The interactive website, [www.lakesuperiorstreams.org](http://www.lakesuperiorstreams.org), provides real-time water quality data from regional streams and incorporates the data into community information, classroom curricula, and case studies. A site design toolkit for reducing stormwater impacts is geared toward a broad audience that includes contractors, developers, and local government decision makers.

The website doesn't just present the data, notes Jesse Schomberg, coastal communities extension educator with the Minnesota Sea Grant College Program. "We're explaining the data and why it matters."

The data come from sensors that monitor streams for water flow, temperature, conductivity, and turbidity and transmit the information to the website. A data viewer allows users to "play" with the real-time data, creating interactive graphs and animations.

Animated data examples show users what happens to streams under different scenarios, such as the changes to water temperatures after it rains and stormwater runs over hot asphalt.

Planning for the website was begun in 2002 when NRRI, the City of Duluth, Minnesota Sea Grant, and others partnered to help the community address U.S. Environmental Protection Agency Phase II stormwater pollution issues. The site came on-line in 2003 as [www.duluthstreams.org](http://www.duluthstreams.org).

A Regional Stormwater Protection Team of 26 agencies and organizations was formed at the same time to develop and disseminate common educational and technical materials for the region and collaborate to help develop website content. The project expanded to cover North Shore and South Shore western Lake Superior watersheds in Minnesota and Wisconsin in 2005, and the name changed to [www.lakesuperiorstreams.org](http://www.lakesuperiorstreams.org).

Website use continues to grow, averaging more than 400,000 requests a month, with more than 20 percent of its use in spring and fall appearing to be due to student use, says Axler.

The site, which has received six awards since 2004 from state, regional, and national organizations, would be "very transferable," says Pat Collins, program manager of Minnesota's Lake Superior Coastal Program, which provided funding for the project.

Collins adds, "It's something that's been useful to a wide variety of audiences here." ❖

*To view the website, point your browser to [www.lakesuperiorstreams.org](http://www.lakesuperiorstreams.org). For more information, contact Richard Axler at (218) 720-4316, or [raxler@nrri.umn.edu](mailto:raxler@nrri.umn.edu). You may also contact Jesse Schomberg at (218) 726-6182, or [jschombe@d.umn.edu](mailto:jschombe@d.umn.edu).*

**Article was originally published in the November/December 2007 edition of *Coastal Services*.**

# Helping Oyster Harvesters While Collecting Data in Mississippi

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*Working with oyster harvesters to assess resources after Hurricane Katrina helped both Mississippi coastal resource managers and a devastated industry recover from the storm. Climate change is expected to increase the severity of tropical storms and hurricanes.*

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Oyster harvesting season in Mississippi was to begin a week after Hurricane Katrina devastated the Gulf Coast region. In addition to the destruction of boats, marinas, harbor facilities, and processing plants, the storm severely damaged and changed the resources. In response, the state's coastal resource managers developed a program that provided financial assistance to oyster harvesters and collected valuable data.

After Hurricane Katrina struck on August 29, 2005, "there were oysters out on Highway 90," recalls Eddie Rhodes, a Mississippi commercial fisherman. "We got 25 feet of water through here. It was like a set of rapids."

"Ninety to ninety-five percent of the market-size oysters were gone," says Bradley Randall, biological program coordinator for the Mississippi Department of Marine Resources (DMR) Shellfish Bureau. "There was no way to have a season," which was to run September to April.

It was two weeks after the storm before Randall and other Shellfish Bureau staff members could borrow a boat and find the gasoline to even do a preliminary assessment of the resources. "Everything had changed. There were reefs that had been very productive that were just no longer there," he says.

With 10,000 acres of resources to assess and fishermen whose livelihoods—and often homes

and belongings—had been lost, DMR created a program to pay Mississippi oyster harvesters to assist with mapping and assessing the oyster reefs.

For 25 days beginning in October 2005, 75 boats with 150 captains and deckhands who heard about the program by word of mouth used cane poles to assess the bottom type of each reef as a live oyster bottom (thick), scattered live oysters, shells/shell hash, firm mud, buried shells/oysters, sand, or too deep/unknown.

"Each day, they were assigned six one-nautical-mile transects that they had to complete," Randall explains. "Each data point was 120 feet. They would go out with a GPS [Global Positioning System] and go in a straight line to predetermined latitude and longitude marks and take the cane pole and feel the bottom."

The information gathered helped determine sites for a follow-up project in November and December 2006, where commercial oyster harvesters helped relay oysters to replace reef material lost during the hurricane from Biloxi Bay and Graveline Bayou to oyster reefs in the western Mississippi Sound.

In addition to the Shellfish Bureau collecting valuable data and oyster harvesters getting put to work, Randall says the program also improved communication between the regulators and fishermen.

"I would stress that this also gave the fishermen an idea of how much damage was done," he says. "Otherwise, it just would have been our word. This way they got to get out and see what damage was done to the reefs with their own eyes."

He adds, "This has brought fishermen and the state together on the same page. We're working together to solve the problems we have." ❖

*For more information on Mississippi's oyster mapping and assessment project, contact Bradley Randall at (228) 523-4085, or [Bradley.Randall@dmr.ms.gov](mailto:Bradley.Randall@dmr.ms.gov).*

**Article was originally published in the January/February 2007 edition of *Coastal Services*.**



# Preparing for Climate Change: Assistance from the NOAA Coastal Services Center

When it comes to preparing for climate change, every effort that helps coastal communities become more resilient is a step in the right direction.

The National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center assists coastal programs by providing a wide variety of products and services. The following summarizes some of the more frequently requested items that could assist the nation's coastal resource managers in addressing various impacts of climate change.

## **DATA: TOPOGRAPHIC AND BATHYMETRIC DATA**

Land and seafloor elevation data are essential for understanding where water will move when modeling sea level rise, hurricane flooding, tsunami inundation, and river flooding.

The Center's website provides access to some coastal high-resolution topographic and bathymetric data, including shoreline topobathy lidar data from the U.S. Army Corps of Engineers. These data sets can be accessed through the Digital Coast at [www.csc.noaa.gov/digitalcoast/data/lidar.html](http://www.csc.noaa.gov/digitalcoast/data/lidar.html).

In addition, the Center provides information to help users create a topobathy digital elevation model for their location. Find regional data inventories and the supporting information at [www.csc.noaa.gov/topobathy/](http://www.csc.noaa.gov/topobathy/).

## **DATA: DATA ACQUISITION ASSISTANCE**

When purchasing data, consider using the contracting vehicle the Center established with geospatial industry leaders. State and local agencies use the existing contracts to collect coastal data and obtain other geographic information system services. Fund transfers are coordinated through an established memorandum of understanding process. The Center does not charge overhead; therefore, 100 percent of state and local dollars applied to the contracts goes to the service requested. For more information, e-mail the Center at [csc@csc.noaa.gov](mailto:csc@csc.noaa.gov).

## **TRAINING: COASTAL INUNDATION MAPPING**

This course teaches students about coastal inundation issues and spatial techniques for creating inundation maps that can be used to support state and local planning efforts. This training can be brought to your location. See [www.csc.noaa.gov/training/](http://www.csc.noaa.gov/training/) for information.

### **TRAINING: COASTAL COMMUNITY PLANNING AND DEVELOPMENT**

Instruction in alternative development principles and their implementation is the focus of this course, which was designed to help community leaders prepare for the future by mitigating the negative impacts of growth. This training can be brought to your location. See [www.csc.noaa.gov/training/ccpd.html](http://www.csc.noaa.gov/training/ccpd.html) for information.

### **TECHNICAL ASSISTANCE: STAKEHOLDER ENGAGEMENT**

Even though climate adaptation planning is important and should engage many people, getting the right parties involved can be challenging. A Center publication provides information on increasing stakeholder engagement. The Center is also often called upon to help organizations design a process to increase public participation. Visit [www.csc.noaa.gov/techassist.html](http://www.csc.noaa.gov/techassist.html) to learn more.

### **TECHNICAL ASSISTANCE: VISUALIZING INUNDATION POSSIBILITIES**

Increasing threats of sea level rise, storm surge, and shallow coastal flooding have coastal communities wanting to “see” potential flooding scenarios. Most visualizations use lidar as the base data set, but there are many ways to generate the visualizations. The NOAA Coastal Services Center works with organizations to help them find the tools and methods that will create the visualization product best tailored to their community’s needs. Contact the Center at [csc@csc.noaa.gov](mailto:csc@csc.noaa.gov) to learn more.

### **FELLOWSHIP PROGRAM: COASTAL MANAGEMENT FELLOWSHIP**

Finding the extra set of hands needed to develop and implement a climate change strategy is not always easy. This program matches postgraduate students with state coastal zone programs for two years to work on projects proposed by the state. Visit [www.csc.noaa.gov/fellowships/](http://www.csc.noaa.gov/fellowships/) to learn more.

### **TOOLS: EASY VISUALIZATION WITH CANVIS**

While CanVis is most often used to add docks, buildings, and other structures to the background picture of the user’s choosing, this software can also be used to help communities “see” what sea level rise might look like in their neighborhoods. Order a free copy of CanVis from [www.csc.noaa.gov/canvis/](http://www.csc.noaa.gov/canvis/).

### **TOOLS: RISK AND VULNERABILITY ASSESSMENT TOOL**

This website is used by communities who want to assess their vulnerability to hazards and prioritize the precautionary measures that can make these communities more resilient. Visit [www.csc.noaa.gov/rvat/](http://www.csc.noaa.gov/rvat/) to access the tool.

To see a complete list of products and services, visit [www.csc.noaa.gov](http://www.csc.noaa.gov).

