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LOCAL STRATEGIES FOR ADDRESSING CLIMATE CHANGE

VOLUME TWO



NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY



About Coastal Services and Local Strategies for Addressing Climate Change, Volume Two

This is the second publication of the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center that is focused on what coastal resource managers around the country are already doing to address the impacts of climate change.

All articles first appeared in *Coastal Services*, a national trade journal for coastal resource managers published by the NOAA Coastal Services Center. The award-winning journal focuses on important coastal issues and successful programs and projects in coastal areas around the country.

To subscribe to *Coastal Services* or review back issues, go to www.csc.noaa.gov/magazine/.

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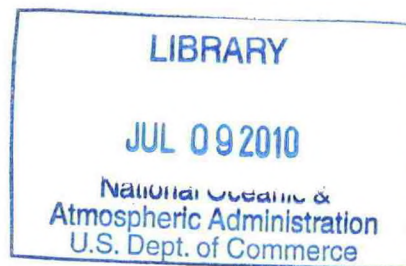


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From the Director

Coastal resource managers are on the front lines of climate change. Flooding and erosion from rising sea levels, more intense wind and waves from coastal storms, worsening water quality—many impacts of climate change will be felt in coastal areas first. In fact, many coastal areas are *already* seeing impacts.

As the articles in this publication show, there are many things that coastal managers around the country are already doing that are specifically or indirectly addressing the effects of climate change. Successful efforts range from helping communities communicate and plan for impacts to developing adaptation strategies.

Local Strategies for Addressing Climate Change, Volume Two features 12 articles that previously ran in the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center's publication *Coastal Services*. These articles showcase examples of the tools, programs, and projects that coastal managers currently have in place.

From harnessing cutting-edge technology to changing development practices, and thinking about existing programs and projects in new ways—these articles are presented to share what is already working and to help generate new ideas.

Articles look at how communities have recovered from devastating natural hazards—such as Hurricane Floyd—and are now more resilient than ever. Other topics explore how smart or green growth efforts can target mitigation and adaptation to climate change, how green infrastructure can improve stormwater and wastewater management, and how science can help create policies to better protect communities from future storms and sea level rise.

Tools and information that managers can use to help communities convey the impacts of climate change are presented, as are successful examples of how communities can adapt. There is even information on how managers can successfully use education to empower children facing the impacts of climate change.

Readers will also find examples of how to generate new ideas to address sea level rise and lessons learned in using lidar technology. 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 as this publication shows, coastal managers are actively addressing these impacts. We hope the tools, information, and examples in this publication inspire even more action in coastal communities around the country.



Margaret A. Davidson

Communicating Climate Change and Its Impacts





Guide Helping Coastal Managers Communicate about Climate Change

Want to create behavior change when talking to the public about climate? This guide can show you how.

Coastal resource managers often joke that it is the same 20 to 30 people who are engaged in environmental issues in their communities. As more and more coastal areas feel the effects of climate change, reaching a broader audience with information and inspiring action is becoming even more important.

"Many communities are struggling with how to effectively get the message out about climate change," says Missy Stults, adaptation manager for ICLEI–Local Governments for Sustainability. "They are unsure of how to convey the facts or inspire the action that needs to be taken. The reality is a lot of people don't know what's going on in the climate world."

To help communities engage the public in their climate protection efforts, ICLEI has created an "Outreach and Communications Guide." The guide, Stults says, can support coastal management efforts to "create successful community outreach campaigns, reach out to local media, host climate action events, and develop materials that reflect local circumstances and inspire local climate action."

Published on-line in January 2009, the 39-page guide contains an array of steps and methodologies for communication and outreach efforts. The guide provides information on general communications strategies, communications myths and facts, ways to identify audiences, and climate-specific communication.

The guidebook also features examples of communications strategies that have been successfully implemented in communities around the country. "That's really the heart of the guidebook," Stults says. "We looked to our members to find examples of what has worked."

In addition, ten communities worked with ICLEI to help develop the guide by selecting the content focus and providing guidance and feedback. Futerra, a London-based communications company focused on sustainability and corporate responsibility, also vetted the guide.

Learning about general communications strategies, myths and facts, ways to identify audiences, and climate-specific communication can help coastal managers who are struggling with how to effectively communicate about climate change.

Stults cautions that because the topic of communications is so broad, the guide focuses on ways to distribute a message but does not include information on gathering feedback from constituents.

She also notes that examples provided in the guide thus far focus on climate change mitigation efforts, where communities are working to reduce sources of greenhouse gases, but that the communications methodologies presented would also apply to actions that managers are taking to help communities and ecosystems adapt to changing climate conditions.

"What's nice about the guide," Stults says, "is that it's a living document, and we will continue putting examples on-line as our members use the guide and e-mail us stories. The guide will evolve over time."

She adds, "The challenge is that we could spend years developing a guide on such an important topic. We had to stop and say 'this is good enough for now,' and I think the result is a pretty solid launching pad for engaging your community in climate protection." ❖

To download ICLEI's "Outreach and Communications Guide," point your browser to www.icleiusa.org/action-center/engaging-your-community/outreach-and-communications-guide. For more information, you may contact Missy Stults at (617) 960-3420, ext. 203, or melissa.stults@iclei.org.

Article was originally published in the March/April 2009 edition of Coastal Services.



Helping Managers Communicate Climate Change

Social science information is helping communities around the country with climate change communication.

It is a common belief that if coastal resource managers and other communicators could just provide the public with information, people would take appropriate actions. But social scientists conducting research for the past 50 years have found this assumption riddled with misconceptions and are shedding light on how communications and outreach can more effectively influence behavior.

A new audio podcast and publications produced by Oregon Sea Grant are geared toward helping coastal managers navigate the challenges of communicating complex scientific concepts—such as climate change and variability—to the public.

“These are intended to help provide insights from social science to those who are on the front lines communicating with the public about climate,” says Joe Cone, assistant director and communications leader of Oregon Sea Grant. “Understanding more about how social science relates to climate science will help us all do our work better and help communities prepare.”

The Communicating Climate Change podcast is a series of recorded interviews with prominent social scientists on the question of how to communicate about climate change to a broad audience.

Two publications written by Cone, “Expand Your View: Insights for Public Communicators from Behavioral Research” and “Hold That Thought! Questioning Five Common Assumptions about Communicating with the Public,” help distill communications and related social science research and concepts.

BROADER DEFINITION

While the podcasts and publications are geared toward meteorologists, science journalists, government agency personnel, university outreach specialists, and members of nongovernmental organizations, Cone says they focus on a broad definition of communicator.

“Regardless of your business title, if you communicate with a nonspecialist audience about science, you

Social science can provide guidance to coastal resource managers who are struggling to communicate the facts about climate change and help communities prepare.

are a science communicator,” Cone says. “An agency administrator, for example, is as much a communicator as a public information officer, and the leader is likely to know less about communications.”

“There is value,” he says, “for all communicators to become more familiar with contemporary research in the social sciences.”

MAKING THE CONNECTION

The social sciences are probing the practices, processes, and effects that influence attitude, decision-making, and behavior change. This body of research, Cone says, is related to communicating climate change.

Cone made this connection in 2006 after receiving a grant from the National Oceanic and Atmospheric Administration (NOAA) Climate Program Office to help coastal communities in Oregon and Maine become more resilient to climate change.

“I realized very clearly after talking to various specialists that we have the opportunity to connect climate science and climate engagement with communities much more closely,” Cone says.

TUNING IN TO THE EXPERTS

To help coastal managers and others assimilate this social science information, Cone began producing the podcasts in January 2008. The occasional series has included interviews—often broken up into two parts—with eight social science leaders. Each podcast typically lasts about 20 minutes, and transcripts of the broadcasts are provided.

The interviews—all accessible by computer—are oriented toward preparing for or adapting to climate change, rather than mitigating actions to reduce greenhouse gas emissions.

Interviewees include Anthony Leiserowitz, director of the Yale Project on Climate Change and a research scientist who specializes in risk perception and decision-making, Susanne Moser, a natural scientist, social scientist, and communicator formerly with the National Center for Atmospheric Research, and Caron Chess, a human ecologist at Rutgers University who studies public participation in government decision-making.

Additional interviews include Baruch Fischhoff, a prominent national expert on risk analysis and communication at Carnegie Mellon University, Ed Maibach, director of the George Mason University Center for Climate Change Communication, and Gary Braasch, a climate communication practitioner, author, and photojournalist.

Interviews conducted in 2009 include Jesse Ribot, leader of an initiative in the Social Dimensions of Environmental Policy at the University of Illinois, and Elinor Ostrom, the Arthur F. Bentley Professor of Political Science at Indiana University and 2009 Nobel Prize Winner in Economic Sciences.

"The podcasts have been very occasional partly because I have been very selective and focused about the individuals that are there," Cone says. "There's a lot of substance there."

Other interviews will be added in the future, he says, and listeners can subscribe to receive notice when the next interview is posted.

EMPIRICAL EVIDENCE

Coastal managers may need to incorporate more social science-based communications strategies because communications and outreach efforts are often based on commonly held assumptions that limit their effectiveness.

For instance, one of the most common of these beliefs is that others would do something different if only they had the information.

"This is something described as 'spraying the fire hose of science' onto unsuspecting people and expecting that it will turn them in the right direction," Cone says.

This "information-deficit assumption" has been critiqued in social science literature, calling into

question common assumptions about audience—for example, researchers have found that there is no such group as the general public—and people's information needs and decision-making processes.

"There's no question that the right information can affect behavior," Cone says, "but it needs to be appropriate to address the specific concerns and decisions that the target population wants to make ... You have to empirically find out what they know and what they don't know and how to lower their barriers to being able to use the information."

He adds, "We tend to focus most of our attention and resources on understanding the natural environment and much less attention and resources on understanding and being effective with society. In modest ways, our podcast and publications are ... trying to improve that effectiveness." ♦

For more information on the Communicating Climate Change podcasts or Oregon Sea Grant's social science publications, contact Joe Cone at (541) 737-0756, or joe.cone@oregonstate.edu.

Article was originally published in the September/October 2009 edition of *Coastal Services*.

FOR ADDITIONAL INFORMATION

- Communicating Climate Change podcasts, <http://blogs.oregonstate.edu/communicatingclimatechange/>
- "Expand Your View: Insights for Public Communicators from Behavioral Research," <http://seagrants.oregonstate.edu/sgpubs/onlinepubs/h08006.pdf>
- "Hold That Thought! Questioning Five Common Assumptions about Communicating with the Public," <http://seagrants.oregonstate.edu/sgpubs/onlinepubs/h08005.pdf>



Competing with Ideas for How to Address Sea Level Rise in California

Learn how an international design competition can generate innovative ideas for adapting to sea level rise.

New and innovative ideas are needed to help communities adapt and respond to sea level rise resulting from climate change. To help generate these ideas, coastal resource managers in California held an international design competition for projects that address sea level rise in San Francisco Bay.

"The goal was to move the discussion forward with regard to what the bay might look like in the future," says Brad McCrea, design analyst for the San Francisco Bay Conservation and Development Commission (BCDC), which sponsored the competition. "BCDC Executive Director Will Travis thought a design competition would be a great way to generate new ideas for building along the shoreline."

The Rising Tides competition resulted in six first-place awards for ideas ranging from generating public awareness by using laser beams to create a temporary wall of light in San Francisco Bay where levees would be needed, to mechanically managing tides with a "ventilated" levee.

"There are ideas embedded in each of these that have potential for future planning," notes McCrea. "This really energized the design community and provided a way for them to join the discussion about sea level rise."

EIGHT INCHES HIGH AND RISING

At the Golden Gate Bridge sits one of the oldest tide gauges in the U.S., which has shown that over the last 150 years San Francisco Bay has risen eight inches. The state is anticipating an additional rise of 16 inches by 2050.

"Forty years from now, the bay will be about a foot and a half higher," McCrea says. "Over 90 years from now, we expect San Francisco Bay to be about four and a half feet higher."

He adds, "We know the bay is going to rise, and we want to plan for a future when the bay is higher. . .

Sea level rise caused by climate change may result in chronic flooding for developed coastal areas. New and innovative ideas are needed to help communities adapt and respond.

Lots of people are working on policy and planning and education around this issue, but one of the voices that didn't have a forum was the design community."

ON A SHOESTRING

With a \$125,000 section 309 grant from National Oceanic and Atmospheric Administration (NOAA), BCDC hired a competition advisor, who helped the agency create signature graphics, devise the competition website, and spread the news around the world through the Internet.

Several companies and organizations stepped in to provide services at cost or for free.

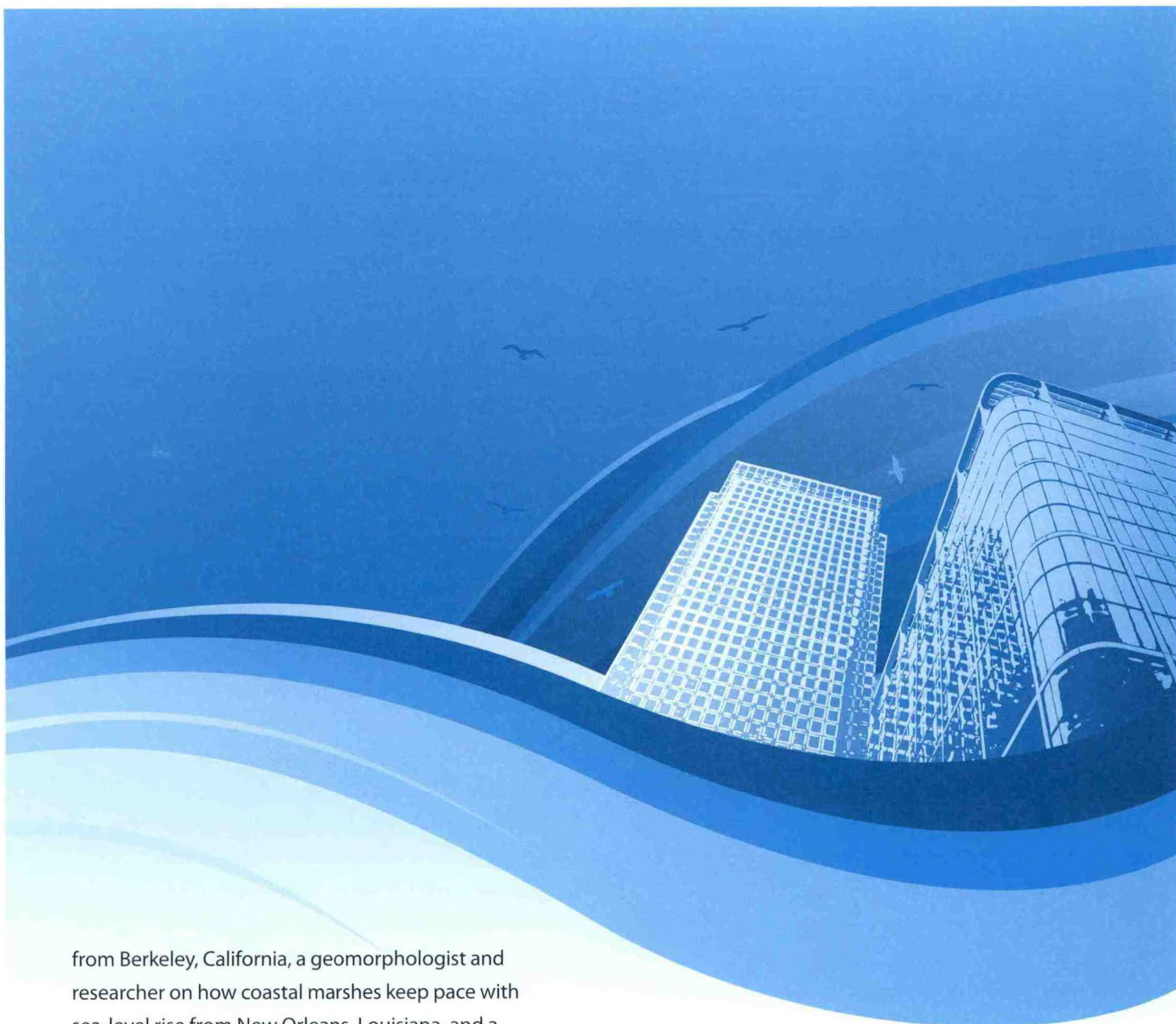
"We did this on a shoestring," McCrea says. "It easily could have cost double what we spent. People came out of the woodwork and provided support services for next to nothing."

RESPONSES FROM ALL OVER

After the June 29, 2009, deadline, BCDC received 130 entries from 18 countries. Of the entries from the U.S., nearly half were from the East Coast and half were from the West Coast.

"We said you could design at any scale for any type of project, as long as it was relative to the San Francisco Bay estuarine environment," McCrea says.

A five-member jury for the competition included a professor of architecture and urban design from New York, a professor of landscape architecture



from Berkeley, California, a geomorphologist and researcher on how coastal marshes keep pace with sea-level rise from New Orleans, Louisiana, and a coastal engineer and a journalist from Holland.

THE WINNERS

While the rules called for a \$15,000 grand prize, with another \$10,000 awarded as the jury saw fit, after a day of deliberations the jury instead divided the money equally among six winners.

"The six winning entries really begin to tell the story of adaptation to sea level rise," says McCrea.

Even though the entries were anonymous, it turned out that five of the six winners were from the San Francisco Bay area.

An exhibition of all 130 of the Rising Tides competition entries was put on public display in San Francisco. The winners can be viewed on-line at www.risingtidescompetition.com.

"We are thrilled," McCrea says, "not only at the way the competition turned out, but at the enthusiasm and excitement it's generated within the planning world, the coastal management world, and the design world."

He adds, "We have found that there are a great deal of ideas behind the ideas. We look forward to exploring deeper into the design concepts and sharing what we find." ❖

For more information on the Rising Tides competition, or to see the winning entries, go to www.risingtidescompetition.com. You may also contact Brad McCrea at (415) 352-3615, or bradm@bccdc.ca.gov.

Article was originally published in the November/December 2009 edition of *Coastal Services*.



Using Climate Change Education to Empower Kids in the Gulf of Mexico

A climate camp teaches storm-traumatized teens about climate change and what can be done to prepare for future weather and climate events.

Climate change is expected to increase the severity of tropical storms and hurricanes. While no individual storm can be attributed to climate change, Hurricane Katrina illustrated the vulnerability of the Gulf Coast to extreme storm events, leaving many coastal residents—particularly children—feeling defenseless in the face of the changing climate.

Climate change is expected to increase the intensity of coastal storms. Education can empower coastal residents who may feel defenseless after experiencing a damaging event.

In the summer of 2008, a group of 24 teenagers who experienced the devastation of Katrina firsthand went from powerless to empowered during a two-week Climate Change Camp in coastal Alabama, where they learned about the science, environmental impacts and responses, and policy questions resulting from climate change.

“We wanted to give them a proactive attitude about what they can do about climate and weather events in their future,” says Kate Graves, former Southeast Climate Program officer for the World Wildlife Fund–U.S. (WWF) and organizer of the camp, which was part of the organization’s Southeast Climate Witness Program.

While the Climate Camp was a one-time WWF event, Graves hopes that coastal resource management and other organizations will be able to take the program and reproduce it on a local level.

With funding for the camp from the Allianz Foundation for North America, Graves first developed an interdisciplinary climate change curriculum for high

school classes. She worked with educators in Alabama, Louisiana, and Mississippi to promote the program and developed criteria for selecting the students. All the participants were between the ages of 15 and 18, and had been displaced by Hurricane Katrina.

During the program, the teens met with researchers from the University of South Alabama at Mobile and regional and national scientists to learn about climate change issues and the coastal ecosystem. They also participated in restoration projects organized by the Mobile Bay National Estuary Program.

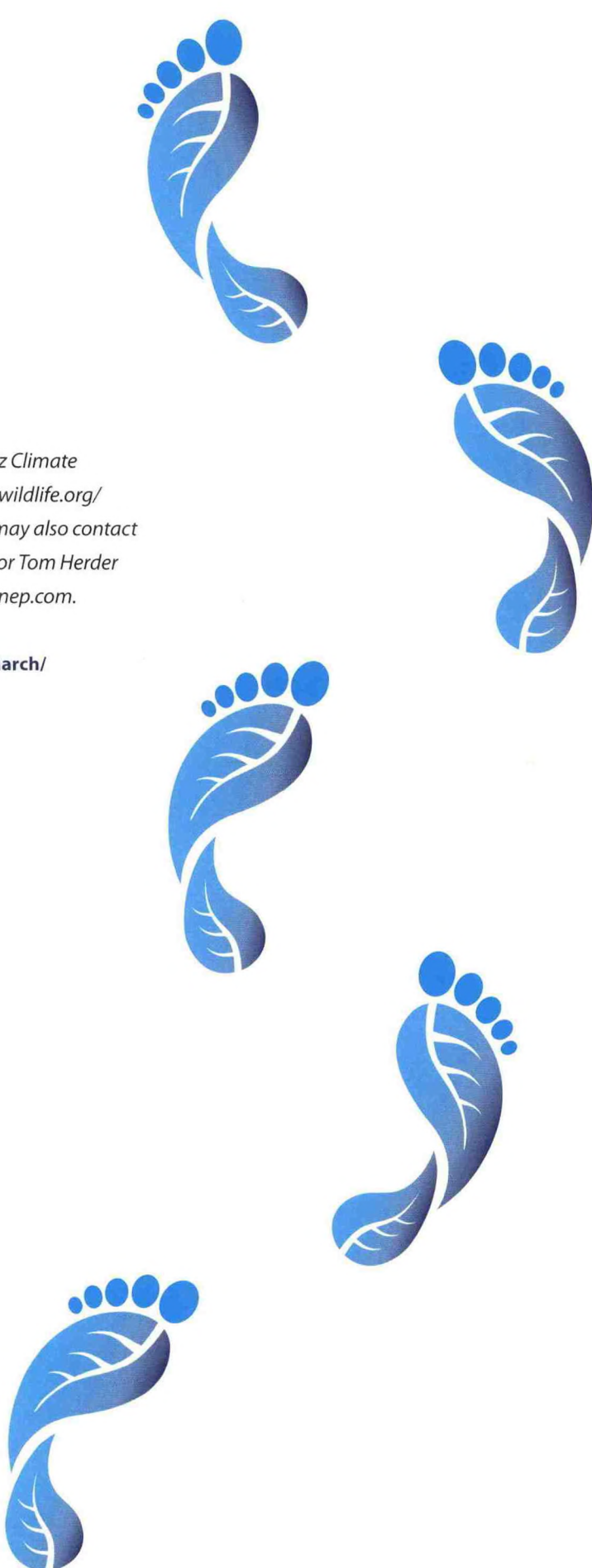
“My role,” notes Tom Herder, science communicator for the Mobile Bay Estuary Program, “was to put them to work and involve them in some activity to remediate the effects of the storm.”

Herder partnered with U.S. Fish and Wildlife staff members at Bon Secour National Wildlife Refuge in southern Alabama, where half the students completed a dune-plant restoration. Two days later, the rest of the students completed a marsh-grass restoration in Mobile Bay.

Getting hands-on with the restoration projects “really gave the kids power over the circumstances of Katrina,” Herder says. “They got to give back some of what the storm had taken away. After the camp, the kids were empowered, connected, and educated, which is what you want from a project involving public outreach.”

“Definitely other organizations could do this program in the future,” Graves says. “We did this on a large scale because we had the opportunity, but it could be done on a much smaller scale.”

She adds, “There is value in keeping it local and helping kids understand what’s happening with climate change in their own ecosystems.” ❖



For more information on the WWF Allianz Climate Camp, point your browser to www.worldwildlife.org/climate/curriculum/item5943.html. You may also contact Kate Graves at kgraves@islandpress.org, or Tom Herder at (251) 431-6409, or therder@mobilebaynep.com.

**Article was originally published in the March/
April 2009 edition of *Coastal Services*.**

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Preparing for Climate Change



Adapting to Climate Change Is the Focus of Washington Workshop

Managers around the country can present the tools and information communities need to plan for climate change impacts.

Climate change looms large for many local and state coastal resource managers, but the real challenge may be trying to figure out how to help communities plan for and adapt to coming impacts. A workshop developed in Washington State may help coastal managers around the country better understand climate change and the planning processes and tools necessary to prepare for the future.

To help communities prepare for the impacts of climate change, coastal managers need to understand current research findings and anticipated impacts, conduct vulnerability and risk assessments, engage stakeholders, and identify, select, and implement adaptation options.

"This workshop was developed to address the 'Now what do we do?' question," says Cathy Angell, Coastal Training Program coordinator at Padilla Bay National Estuarine Research Reserve in Mount Vernon, Washington.

The Planning for Climate Change Workshop, which was created and piloted by the Padilla Bay Reserve, Washington Sea Grant, King County, and the University of Washington's Climate Impacts Group, lays out current climate change research findings and anticipated impacts, and then addresses the fundamentals of how to plan for climate change.

"The point of the workshop is to help demystify to some degree what planning for climate change involves," says Lara Whitely Binder, outreach specialist for the Climate Impacts Group. "The fundamental skeleton of the training class is very transferable."

Geared toward planners at the city and county levels, and those at the state level who support them, the workshop gives "some how-to's on conducting things like vulnerability and risk assessments, engaging stakeholders who may be skeptical of the need for climate adaptation, and what tools and resources stakeholders need to be engaged," says Katrina Hoffman, coastal resources specialist for Washington Sea Grant. "I tell folks that this is a practical workshop."

ADAPTATION VS. MITIGATION

One of the key components of the workshop, says Angell, is that it focuses on adaptation—what people can do to prepare for or respond to climate change impacts. It does not address mitigation, or the actions required to reduce greenhouse gas emissions that contribute to climate change.

"We are acutely aware that fortune favors the prepared," says Elizabeth Willmott, former Climate Change Program coordinator for King County. "It's very important to reduce greenhouse emissions—that's number one—but the impacts are going to happen inevitably, even if we stopped emitting greenhouse gases today."

Willmott adds, "In general, folks on the front lines aren't grappling yet with this issue in a full and rich way, and they need a fundamental amount of education about climate change."

DETERMINING NEEDS

After receiving a grant from the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center to create a climate change adaptation workshop that could be customized by reserves in the National Estuarine Research Reserve System and other coastal managers, Angell first conducted a needs assessment

with national reserve managers and coastal training program coordinators about their target audiences' needs.

She followed that up with a needs assessment of the target audience in Washington. The national results mirrored the state survey.

"Our goals were really supported by the needs assessments," Angell says. "People were interested in adaptation and planning, and what steps they should start doing to prepare."

FOLLOWING THE GUIDEBOOK

The workshop also relied heavily on the publication, *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*, which the Climate Impacts Group and King County wrote in 2007. ICLEI—Local Governments for Sustainability published the guidebook and was a contributing partner in its national distribution.

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.

TRIAL RUN

In March 2009, the partners held two pilot workshops at different locations in Washington. Survey feedback from the first workshop was overwhelmingly positive but did result in some minor adjustments being made to the second workshop, Angell says.

The training covered current climate change research findings and anticipated impacts, including flooding, storm surge, drought, and sea level rise. Participants were introduced to the fundamentals of conducting a vulnerability assessment, looked at how current regulations address climate change, and were shown how other governments are preparing for climate change.

The instructors helped participants become familiar with key data sources and covered specific

strategies for engaging stakeholders in climate change preparedness. Each participant received a copy of the *Preparing for Climate Change* guidebook.

"It seems simple, but sometimes this information can be overwhelming to people," says Willmott. "What the training really does is break it down and simplify it so coastal managers can understand that this is really like planning for any other uncertainty."

The training was offered again in March 2010 with updated content.

SHARING WITH OTHERS

All the workshop materials—including the agenda, PowerPoint presentations, and streaming video of each of the workshop sessions—are posted on the reserve system's national website, www.nerrs.noaa.gov.

While some of the pieces are "plug and play," Angell encourages others interested in using the materials to do their own needs assessment, use local case studies, and bring in local scientists to discuss climate change research and anticipated impacts.

"It's really critical that people relate to how it's going to apply to them," she says. "I think it's important to lay a foundation of local science."

Whitely Binder encourages other coastal managers to experiment with the various components and come back to the website to provide feedback.

She adds, "It would be interesting to hear what is successful and what isn't in other regions. We want this to continue to evolve." ❖

*To view components of the Planning for Climate Change Workshop, go to www.nerrs.noaa.gov. To download *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*, go to www.cses.washington.edu/cig/fpt/guidebook.shtml. For more information on the workshop, contact Cathy Angell at (360) 428-1075, or cangell@padillabay.gov, Katrina Hoffman at (360) 416-7048, or kathhoff@u.washington.edu, or Lara Whitely Binder at (206) 616-5349, or lwb123@u.washington.edu.*

Article was originally published in the July/August 2009 edition of *Coastal Services*.



Sharing Delaware's Lidar Lessons

Learn how lidar data are helping Delaware address flooding and other issues related to climate change.

More and more, emergency and coastal resource managers are using lidar technology to acquire elevation data for incorporation into state and local maps being used for flood and other natural hazards planning. Coastal managers in Delaware were trailblazers in collecting and using lidar data and have learned hard-won lessons they can pass on to other states.

"We muddled through the hard way and are still one of the few states to have statewide lidar," says David Carter, environmental program manager for the Delaware Coastal Programs in the state Department of Natural Resources and Environmental Control's Division of Soil and Water Conservation. "Our staff members are now intimately familiar with lidar, its uses, and what you need to do" to collect it.

Carter adds, "Lidar is very expensive to do . . . and in the fiscal climate now, states need to be able to hit the ground running as soon as the data is delivered."

MEASURING PULSES

Lidar is an active sensor—similar to radar—that transmits laser pulses to a target and records the time it takes for each pulse to return to the sensor's receiver.

The lidar sensor is mounted to the bottom of an aircraft and integrated with Global Positioning System (GPS) and inertial measurement unit (IMU) technology. Measuring the pulse return rate determines the surface elevation and is used to create high-resolution topographic maps.

Delaware's statewide lidar coverage came from two separate collection projects, undertaken two years apart. At the time these data collection projects were proposed, very few of the state's employees had experience with lidar data, or had the ability to work with extremely large data sets.

Using lidar data to develop tools, such as inundation maps and flood and storm-surge modeling, can help managers address impacts of climate change.

BIG PICTURE POTENTIAL

Efforts began in 2002 to get the funding to collect lidar in Delaware in order to develop digital flood insurance rate maps. In addition, coastal managers hoped that the high detail elevation data could be used for habitat studies or vegetation identification.

In 2005, a coalition of the Department of Natural Resources and Environmental Control, U.S. Department of Agriculture, and the Delaware Geological Survey contracted with the U.S. Geological Survey and NASA to collect lidar for Sussex County using NASA's Experimental Advanced Airborne Research Lidar (EAARL), which is specifically designed to measure submerged topography and adjacent coastal land elevations.

Because Delaware did not have capacity to run the EAARL processing software, lidar-based habitat and vegetation studies were not realized.

"We did not have the capabilities in-house to know the big picture potential, so we deferred to the federal agencies," Carter says. "We were getting different guidelines and documents, which made it very difficult to sort out what we needed."

STORM DEVASTATION

On September 15, 2003, the Glenville community in Delaware was flooded by Tropical Storm Henri. After the storm, 172 homes were bought out using federal, state, and local government resources, and the community was abandoned in 2004.

"Legislators and others were asking how this could possibly happen," Carter says. "The answer was that we didn't have elevation data or a monitoring system that would warn us. The reaction was to spend the money to get this data statewide."

In 2007, the lidar for the remaining two counties in the state was collected by a commercial contractor as part of a statewide orthoimagery collection project.

PROCESSING PROBLEMS

Because of processing problems, by the time the 2007 lidar was flown, Delaware managers still did not have usable data from the 2005 flight. As a result, lessons learned were not incorporated into the second contract.

Problems encountered included the incompatibility of the EAARL data and the 2007 lidar, and that a third-party quality assurance and quality control was not conducted, both of which delayed the availability of usable statewide lidar.

VOICE OF EXPERIENCE

Having worked through all the problems, Delaware emergency managers and researchers have been able to use lidar to develop statewide inundation maps, are incorporating the data into flood and storm surge modeling, and are using it to create an early flood-warning system.

While they learned the hard way, it should be much easier for coastal managers to collect and use lidar today, Carter says. "There are tools and training available now to work with this data that didn't exist in 2002."

In addition, Carter is hoping that the lessons they have learned will be useful to other managers.

"I would recommend," he says, "spending a whole lot of time on the phone with states who have gone through this." ♦

For more information, you may contact David Carter at (302) 739-9283, or David.Carter@state.de.us, or Bob Scarborough at (302) 739-3436, ext.14, or Bob.Scarborough@state.de.us.

NOAA Coastal Services Center staff members Dave Easter and Keil Schmid contributed to this article.

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LESSONS LEARNED

Here are Delaware's top five lessons learned about obtaining lidar data. For a more detailed list, go to www.csc.noaa.gov/digitalcoast/inundation/map/obtain.html.

- 1. Agree on data standards.** Before committing to project-specific deliverables, it is important to consider the various end uses. The choices made in data processing or delivered products may limit other uses of the data.
- 2. Know the end users' technical capacity.** The hardware and software capabilities of the end users should be assessed to determine appropriate tiling and file sizes.
- 3. A common format should be used for an entire state.** In Delaware, counties were mapped using different and incompatible systems, causing problems in merging data sets for statewide coverage and in other statewide analyses.
- 4. Ensure all data and products are contract deliverables.** When developing a contract, ask all the end users to review the contracts to ensure that all the desired data and products are listed as deliverables. This should include the specification of each data product in the chosen format and, if applicable, resolution.
- 5. Metadata and Quality Assurance and Quality Control.** Complete and accurate metadata must also be specified with all the deliverables. An important but sometimes overlooked aspect is the quality assurance and quality control of all data sets by a separate contractor or by the end users before final acceptance.



Learning from Disaster: North Carolina Is More Resilient Ten Years after Hurricane Floyd

**Hurricane Floyd was North Carolina's worst disaster.
Ten years later, the state is better prepared than ever.**

Ten years ago, Hurricane Floyd left a track of devastation across North Carolina, becoming one of the worst disasters in the state's history. Today, coastal resource managers can point to the storm's many silver linings—successful programs and projects that have left a positive legacy.

"We have come up with solutions," says Chris Crew, state hazard mitigation officer for the North Carolina Division of Emergency Management. "North Carolina is now more disaster resistant."

These solutions include improved disaster preparedness and response coordination by the state's coastal managers, the implementation of emergency permits for rebuilding coastal property, buyout programs that are reducing flood impacts, relief grants for fishermen, and improved floodplain mapping that is serving as a national model.

While rebuilding has taken place and managers are better prepared than ever for future storms, Jack Thigpen, extension director for North Carolina Sea Grant, notes that it is the emotional and personal scars left by the storm that have been harder to heal.

THE STORM

Mid-September 1999, Floyd made landfall at Cape Fear, North Carolina, as a category 2 hurricane with sustained winds of 110 mph and a storm surge of about 10 feet. It also produced torrential rainfall in eastern North Carolina, adding more rain to an area hit by Hurricane Dennis just two weeks earlier.

The rains caused widespread flooding. Over a period of several weeks, nearly every river basin in

Flooding caused by sea level rise and more intense tropical storms may be a result of climate change. Coastal managers need to be as prepared as possible before disaster strikes.

the eastern part of the state exceeded 500-year flood levels. In total, Floyd was responsible for 57 fatalities and \$6 billion in damage, mostly in North Carolina.

WIND, WAVES, AND RAIN

As a result of Floyd's wind, waves, and torrential rain, thousands of families lost their homes, water quality suffered from chemical and sewage spills, and millions of farm animals perished. Muddy waters from rivers flowing to the coast resulted in dark sediment plumes in estuarine waters.

The fishing industry suffered extensive damage from the hurricane and floods. Fishing gear, vessels, and shoreside structures supporting both commercial and recreational fishing were damaged and lost. Many of the 7,900 licensed commercial fishermen could not fish for periods ranging from weeks to months.

The storm also caused shoreline erosion and wave damage along the entire North Carolina coast, affecting about 300 miles of shoreline.

SETTING THE STAGE

North Carolina was better prepared than it might have been because Floyd was the last of a series of five storms that hit the state in the 1990s.

"Basically, in order to talk about what we learned in Floyd, we have to go back and set the stage by talking about our response to previous hurricanes," says David Moye, interim district manager for the Washington regional office in the North Carolina Department of Environment and Natural Resources' Division of Coastal Management.

Before the 1990s, North Carolina had not been hit by a major hurricane since Hurricane Hazel in 1954.

When Hurricanes Bertha and Fran arrived a month apart in 1996, "we didn't have a framework in place to allow for damage to be repaired on a wholesale level," Moye explains.

HURRICANE MANUAL

The experiences with the storms before Floyd served as the basis for the creation of the state's hurricane manual, which came out in July 1999—just over a month before Floyd's arrival.

"What that did," Moye says, "was set policy for us for everything from preparedness prior to a storm, to long-range planning pre- and post-hurricane."

For instance, the manual includes cooperative agreements between the state and the Federal Emergency Management Agency (FEMA) to secure and access funding after a storm.

EMERGENCY PERMITS

The manual also sets out state procedures for creating "storm permits" that allow property owners to repair or replace shorefront homes and structures, such as docks and revetments. These procedures were codified after Floyd, says Doug Huggett, major permits coordinator for the Division of Coastal Management.

"We did similar emergency permits for the other hurricanes, but we realized after Floyd that what we needed to do was formalize a general permit, which is easier to implement, instead of issuing an emergency proclamation after each storm," Huggett says.

RESPONSE COORDINATION

Another outcome of Floyd was the establishment of the North Carolina Department of Environment and Natural Resources' Disaster Response

Center, which coordinates agency activities and communications, says Kenneth Taylor, chief of the North Carolina Geological Survey.

"We pass our information and analysis of potential and observed disaster impacts to the state Emergency Operations Center," Taylor says. There, emergency incident management technology is used to sort through reports coming in from many state agencies. That information is shared electronically with federal, state, and local governments.

Department resources, such as boats, planes, and personnel, are made available to respond to a disaster anywhere in the state.

The agency's Disaster Response Center also utilizes the department-wide geographic information system (GIS) capability to "assist in mapping the potential and observed disaster impacts," Taylor says. "We can generate a map and share it with everyone."

MAPPING PROGRAM

One of the impacts of Floyd was that about 10,000 buildings and homes were destroyed, and about another 7,000 were severely damaged by massive flooding, says Chris Crew. Close to half of these structures were not in areas previously mapped as being in a 100-year—or even a 500-year—flood-hazard area.

"Even in 1999 we were still relying on maps that had been created in 1977 and '78," Crew recalls. "Between '77 and '99, a tremendous amount of growth went on all over North Carolina that resulted in a variety of impacts in Floyd. . . That was the impetus for the state to come up with funds to update a whole new mapping system."

Since 2000, North Carolina's Floodplain Mapping Program has acquired ground elevation data using lidar and conducted engineering studies to update the flood maps for all 100 counties in the state, says John Dorman, the program's director. To accomplish this goal, \$145 million—half from the state and half from FEMA—has been invested in the program.

Dorman notes that they have done a cost-benefit analysis of the mapping program showing that it has helped the state avoid \$97 million a year in flooding costs. "For every dollar we have spent, we have \$2.4 in benefit."

Continued

BUYOUT PROGRAM

After Floyd, the state used FEMA mitigation funding to purchase flood-prone properties and provide assistance for elevating other structures to both avoid future losses and help the thousands of families in immediate need.

"The hazard mitigation program was relatively new at that point," Crew says. "When Floyd came along, we were really just getting underway with mitigation activities associated with Hurricane Fran in 1996. After Floyd, we streamlined the acquisition process. . . By mid-November of '99 we were writing checks to local governments for the acquisition of property."

FISHERMEN RELIEF

Because of Floyd's severe impacts to the state's commercial fishermen, assistance was provided to help replace lost vessels and gear, says Don Hesselman, chief of the License and Statistics Section of the North Carolina Department of Environment and Natural Resources' Division of Marine Fisheries.

"We distributed \$7 million in two phases of the relief program," Hesselman says. "This was the first time we had done this, so we had to come up with the rules and develop the methodology to distribute the aid."

BE PREPARED

These are just a few of the many successful programs and projects that resulted from Hurricane Floyd. The biggest lesson learned from the storm, managers say, is to be as prepared as possible before disaster strikes.

"Global climate change is happening," says Kenneth Taylor. "That means storms are getting more unstable, and we need to be more prepared."

"You can never be 100 percent prepared up front to anticipate all circumstances," advises Doug Huggett, "but the more preparation you do up front, the better you are at adapting on the fly."

He adds, "Don't be lulled into a false sense of security. It may not be this year, or even this decade, but a storm will come to all of us at some point." ❖

For more information on the Division of Coastal Management's role, contact Doug Huggett at (252) 808-2808, or Doug.Huggett@ncdenr.gov, or David Moye at (252) 948-3852, or David.Moye@ncdenr.gov. For information on the state's Floodplain Mapping Program, contact John Dorman at (919) 715-5711, ext. 102, or John.Dorman@ncmail.net. For information on the buyout programs, contact Chris Crew, at (919) 715-8000, ext. 277, or jcrew@ncem.org. For information on assistance to fishermen, contact Don Hesselman at (252) 808-8099, or Don.Hesselman@ncdenr.gov. For information on Sea Grant's role, contact Jack Thigpen at (919) 515-3012, or jack_thigpen@ncsu.edu. For information on coordination and communication, contact Kenneth Taylor at (919) 733-2423, ext. 401, or Kenneth.B.Taylor@ncdenr.gov.

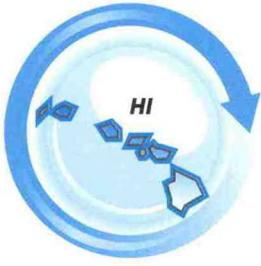
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FOR MORE INFORMATION

- Autumn 2009 edition of North Carolina Sea Grant's *CoastWatch* focusing on Hurricane Floyd, www.ncseagrant.org/home/coastwatch/
- North Carolina Floodplain Mapping Information System, <http://floodmaps.nc.gov>
- Information on managing risk, www.ncihrm.com



Adaptation Strategies



Creating Resilience to Hurricane-Force Winds in Hawaii

Hawaii is preparing for the next big hurricane by adopting building design standards for wind.

Hawaii's famously lush green mountains, coastal cliffs, and valley gorges make it one of the most visually dramatic places in the world. It is this very terrain that led state coastal resource managers to help launch a community resilience initiative that resulted in statewide adoption of hurricane-force-wind building-design standards that are specific to each of Hawaii's four counties.

Climate change may increase the intensity of winds associated with coastal storms. Hawaii is increasing its resilience to hurricane-force winds by adopting building design standards that are specific to Hawaii's wind hazard.

"There was a great need for this project because of the landforms in Hawaii," says Ann Ogata-Deal, planning and policy analyst for the Hawaii Coastal Zone Management Program. "We have huge volcanoes that cause wind speeds to differ significantly in various parts of the islands."

Research specific to Hawaii's wind hazards was needed to ensure that the design standards in the International Building Code being adopted by the state would be correct for Hawaii's wind conditions.

"What we created are different design criteria that depend on where a building is proposed to be built," says Russ Saito, Hawaii state comptroller and chair of the State Building Code Council. "From now on, all new construction [in the state] will be subject to more rigorous standards."

"This effort was scientifically driven," adds Gary Chock, president of the engineering firm Martin and Chock, Inc. "This is a good example of science informing policy."

CONSISTENTLY INCONSISTENT

Until recently, Hawaii's four counties were following either the 1991 or 1997 Uniform Building Codes.

"Basically, we had four counties establishing their own codes," explains Saito. "There wasn't any consistency among the counties—or the state—which has overriding responsibility for the construction of state facilities."

The result was a system of fragmented building requirements that was causing problems for contractors, building designers, and the insurance industry.

FOLLOWING RECOMMENDATIONS

Since 1992, the Structural Engineers Association of Hawaii has recommended that specific wind studies be done for Hawaii's unique topography and that the study results be considered in new building codes, says Chock. In 2000, work began in the state to develop a statistically valid method for predicting wind speeds based on various topographic parameters.

In 2005, conducting island-specific wind speed studies became a priority for the Hawaii coastal program and its network of partners working on coastal hazard mitigation, says Ogata-Deal.

"We realized early on that we could step in and make a difference," she says. "This was going to be a long-term project that was really huge in terms of the impact, as well as in the funding it would take to get the job done."

The coastal program used federal 309 coastal zone enhancement grant monies to fund wind speed

research for the counties of Maui and Hawaii using techniques that would account for wind flow over the terrain. The Federal Emergency Management Agency funded the work for Oahu and Kauai.

The studies included “what the formula should be in determining proper design in very specific areas of each island,” Ogata-Deal says.

“All new structures will have exactly the same level of risk,” notes Chock. “That is the essential elegance of this methodology.”

ADOPTING STANDARDS

In 2007, while the wind research was underway, the Hawaii legislature stepped in and directed the creation of a State Building Code Council, which would lead the adoption of the international and other codes for statewide application.

“Their job,” says Ogata-Deal, “was to establish a comprehensive state building code. The law specifies that standards be included for natural hazards such as hurricanes, flood, and tsunami.”

By mid-2008, the completed wind speed studies were provided to the State Building Code Council.

After a detailed review process, the council unanimously adopted the wind standards for all four counties, including them as a technical amendment to the 2006 International Building Code being adopted by the state. At the time this article was written, the new state building code incorporating the wind standards was waiting to be signed into law by the governor.

The new state code “requires the counties to amend and adopt the state building code for their own use,” explains Saito. “If they don’t do so in two years, then the state building code becomes the county code.” All new construction of state facilities must adhere to the new building codes within a year.

Two counties—Honolulu and Kauai—are already using the new codes.

LEARNING CURVE

The new codes are “quite a change from what we had before,” says Ogata-Deal. “The codes themselves

incorporate more state-of-the-art engineering and hazard mitigation standards. There’s a significant learning curve for all of those involved in code implementation.”

To help with this learning curve, the coastal program is providing funding for training on implementing various aspects of the code. So far, diverse training courses have been administered to about 1,800 county, state, and federal building officials, design professionals, and development, building, and insurance industry representatives.

NATIONAL RECOGNITION

The work Hawaii has done developing and incorporating the island-specific-wind building-design standards isn’t going unnoticed.

The American Society of Civil Engineers Standard for Minimum Design Loads designated the State of Hawaii as a special wind region, which codified national acceptance of the technical applicability of the state’s topographic wind speed adjustments.

The coastal program was also recently honored by the Hawaii Chapter of the Construction Specifications Institute, a professional industry organization, for providing the training on the new state code.

“The approach we used is applicable anywhere,” Saito says. “It really makes a lot of sense to do [area-specific] seismic zoning and wind speed maps.”

“This is the project with the most lasting effect of any that I’ve worked on,” says Ogata-Deal. “We focus on reducing the risk to life and property in our coastal hazards work. This will actually do that statewide, and will benefit everyone in Hawaii in one way or another.” ❖

For more information on Hawaii’s new wind-specific building codes, contact Ann Ogata-Deal at (808) 587-2804, or Aogata-Deal@dbedt.hawaii.gov, or Russ Saito at (808) 586-0400, or russ.k.saito@hawaii.gov. For more information on the science and engineering work, contact Gary Chock at (808) 521-4513, or gchock@martinchock.com.

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Using Science to Create Dune and Beach Protection Policy in Virginia

A ten-year odyssey to protect dunes and beaches results in better protection from future storms and sea level rise.

Over the past 10 years, a series of studies have been conducted to inventory and analyze Virginia dune and beach resources.

This extensive examination ultimately resulted in legislation passing unanimously in 2008 that expanded dune and beach protection from nine communities to all the communities in the state's coastal zone.

"This is what we all dream about when we talk about wanting science-based policy," says Laura McKay, program manager for the Virginia Coastal Zone Management Program.

The expanded Coastal Primary Sand Dunes and Beaches Act protects an additional 1,300 estuarine beaches and dunes along about 75 miles of shoreline that includes 24 counties and 14 cities.

The result is that communities and the state are now better able to protect dune and beach resources from shoreline hardening structures designed to control shoreline erosion, as well as other coastal development.

FIRST LINE OF DEFENSE

Dunes and beaches are critical resources for any coastal state, says Shep Moon, coastal planner for the Virginia Coastal Program.

The first line of defense during a hurricane or nor'easter, dunes and beaches act as buffers and absorb wave energy so that properties are protected from shoreline erosion.

"Dunes really work better than anything man-made as far as protecting land from storms," says Moon. "It's been shown time and time again that if you build on top of dunes, you lose protection and those houses are put in danger."

Dunes and beaches also provide critical habitat for a number of important plant and animal species, and protect water quality by filtering freshwater before it reaches saltwater or brackish water.

Healthy dunes and beaches are important in keeping communities resilient to climate change because they help buffer upland areas from future storms and sea level rise.

ORIGINAL LEGISLATION

The state's original legislation protecting primary dunes was passed in 1980. At the time, there was no comprehensive inventory of dune or beach resources, and only nine localities were covered, explains Moon.

In 1984, the legislation was expanded to include protection of beaches above the mean high water line in those same nine communities.

Other legislation, including the Tidal Wetlands Act, protected the state's shoreline below the mean high water line.

But there was a "hole in the Virginia shoreline protection system," says Lyle Varnell, assistant director of Advisory Services at the Virginia Institute of Marine Science (VIMS).

In many communities, sandy beaches above the mean high water line and primary dunes were given little or no protection, especially from the construction of shoreline hardening structures.

It was, however, concern about the protection of secondary dunes—older dunes found landward of primary dunes—which are not covered in any Virginia legislation, that led to the evaluation of the state's dune and beach resources.

SECONDARY QUESTIONS

"That was really the impetus to start this," acknowledges McKay. "Some people took me out and were showing me some really spectacular secondary dunes that were completely unprotected."

Scott Hardaway, a VIMS geologist, recalls that “when the coastal program posed the question about the secondary dunes, we responded that we couldn’t question the status of the secondary dunes because we didn’t know the status of the primary dunes.”

ENHANCING THE COASTLINE

The coastal program used federal 309 coastal zone enhancement grants to fund the series of studies conducted by VIMS that resulted in a comprehensive inventory and analysis of the state’s dune and beach resources.

Section 309 of the Coastal Zone Management Act is a voluntary grant program for federally approved coastal management programs to identify the highest state priorities related to public access, coastal hazards, ocean resources, wetlands, marine debris, cumulative and secondary impacts of growth and development, special area management planning, energy and government facility siting, and aquaculture.

RESEARCH SAYS

VIMS research showed that extensive dune and beach resources beyond the nine localities in the original legislation were unprotected, especially from the impacts of shoreline hardening structures such as rock revetments and wooden bulkheads.

Designed to control shoreline erosion, these structures can also affect dune and beach habitats and decrease the amount of sand necessary to maintain beaches.

The analysis also showed that most of Virginia’s secondary dunes were either already protected through conservation, were significantly altered by development, or faced little threat of development because of limited access.

FORMING POLICY

Using the VIMS research, the network of coastal agencies and communities that make up the coastal program’s Coastal Policy Team supported the idea of expanding the act to cover the unprotected beaches and primary sand dunes.

To protect the small number of ecologically valuable secondary dunes, efforts will include acquisition or conservation easements.

UNANIMOUS SUPPORT

With the research and program support in hand, Moon says the “next step was to package it to make it easier for the public, local elected officials, and general assembly members to understand the issues. VIMS did a publication with our grant support.”

The bill moved quickly through the state legislature, passing unanimously. It went into effect July 1, 2008.

LOCAL IN APPROACH

The expanded legislation enables communities to adopt a model ordinance that gives them the power to administer dune and beach permits through existing local wetlands boards, says Tony Watkinson, deputy chief of the Habitat Management Division of the Virginia Marine Resources Commission.

If a community chooses not to adopt the ordinance, then the Marine Resources Commission regulates development affecting dunes and beaches in that area.

“What the expansion really got us,” explains Moon, “is protection of dunes and beaches where they were unprotected. We now have the authority to ensure that more of these important coastal resources remain intact to buffer upland areas from future storms and potential climate change impacts,” such as sea level rise.

McKay adds, “We had the wonderful opportunity of using federal grant funds to analyze an issue and determine what the situation is, and how to make improvements. This is a fine example of how section 309 coastal zone enhancement grants did exactly what Congress—and we in coastal zone management—wanted it to do.” ❖

For more information on Virginia’s dune and beach research, go to www.vims.edu/physical/research/shoreline/cbdunes/. You may also contact Shep Moon at (804) 698-4527, or shep.moon@deq.virginia.gov, or Laura McKay at (804) 698-4323, or laura.mckay@deq.virginia.gov. For more information on VIMS research, contact Lyle Varnell at (804) 684-7764, or lyle@vims.edu, or Scott Hardaway at (804) 684-7277, or hardaway@vims.edu. For more information on regulatory implementation of the act, contact Tony Watkinson at (757) 247-2255, or Tony.Watkinson@mrc.virginia.gov.

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Creating Climate Ready Estuaries

Managers discover how estuaries can become more resilient to climate change impacts.

Because of their vulnerability to climate change, our nation's estuaries may be harbingers for the rest of the country regarding potential impacts from sea level rise, increasing storm intensities, and other effects. But with limited data on what the actual impacts of climate change will be, how are estuary managers supposed to assess their ecosystems' vulnerabilities, develop adaptation plans, and implement adaptation measures?

Estuaries may be particularly vulnerable to climate change effects. To prepare, coastal managers should incorporate climate change into existing comprehensive planning efforts, join forces with others, and create a process that responds to changing information and events.

"We think the vulnerability is so high for estuaries that they have to begin to plan now," says Jeremy Martinich, climate policy analyst for the U.S. Environmental Protection Agency's (EPA) Climate Change Division. "When you don't have perfect information, it creates a number of challenges."

To help coastal communities in their efforts, the EPA and the National Estuary Programs (NEPs) kicked off the Climate Ready Estuaries program in 2007. Since then, 11 estuaries have partnered with EPA to develop adaptation plans to help to protect sensitive coastal ecosystems, infrastructure, and economies from the effects of climate change.

After just several years, the programs are beginning to demonstrate results and provide lessons learned for other coastal resource managers. A Web-based toolkit has been developed where coastal managers can get information and links to websites, reports, and other resources.

"Ready, fire, aim—that's the thought we are really trying to encourage," says Martinich. "Push to go forward with developing preliminary adaptation plans using a process that's flexible and interactive. The plan can be revisited and updated over time when new or better information comes out."

FEELING THE IMPACTS

Not just places where rivers meet the sea, estuaries encompass whole ecosystems where millions of people live, work, and play.

Estuaries are projected to be particularly vulnerable to climate change effects, such as sea level rise, altered frequencies and intensities of precipitation, increased water temperatures, and more intense storm events.

The resulting impacts may include damage to and loss of wetlands, coastal property, and infrastructure, changes to water availability and quality, including impacts to groundwater and drinking water, and changes in habitat, fisheries, and other plant and animal distributions.

GETTING COMPETITIVE

Recognizing the seriousness of the estuaries' vulnerabilities, the EPA's Air and Water offices came together with the NEPs to develop a program to help local decision makers and resource managers take proactive steps to adapt to climate change.

"Effective adaptation will help reduce future costs because we're taking action while we still have time, and while the cost is less," notes John Wilson, program analyst in the EPA Office of Water's Oceans and Coastal Protection Division.

The 11 estuaries partnering with EPA are Albemarle-Pamlico NEP in North Carolina; Barnegat Bay NEP in New Jersey; Casco Bay Estuary Partnership in Maine; Charlotte Harbor NEP, Indian River Lagoon NEP, and Tampa Bay Estuary Program, all in Florida; Long Island Sound Study in New York; Piscataqua Region

Estuaries Partnership in New Hampshire and Maine; Partnership for the Delaware Estuary; Massachusetts Bays Program; and the San Francisco Estuary Project.

A UNIQUE PROCESS

While the estuaries received some EPA technical assistance and guidance, they were very much tasked with coming up with their own plans.

"There's a lot of wanting to be told what the process is, but we actually think that every program is so unique that they have to develop their own process," explains Martinich.

The guidance they were given included engaging old and new stakeholders, assessing vulnerability to the level of detail necessary, being explicit about the choices made based on acceptable risks and costs, clearly detailing specific implementation actions, and making sure the plan and process are flexible.

"We were also quite intent that this not just be a planning exercise and are encouraging movement toward implementation," adds Wilson.

RIISING TO THE SURFACE

While it is still early in the pilot estuaries' processes, there are already lessons rising to the surface. One of these is narrowing the initial planning scope.

For instance, the Piscataqua Region Estuaries Partnership has had success conducting a vulnerability assessment on the impacts to transportation infrastructure, such as culverts, and what measures should be taken if precipitation increases in the future.

"The narrow focus initially is helping them build support for additional vulnerability and adaptation work," Wilson notes.

Searching for and adapting existing data is another take-away message.

"We got a lot of requests in the beginning for high-resolution data," says Martinich. "There was a strong feeling in many places that they just didn't have the information to do inundation mapping. In some places that was true, but what we began to find is if people dig around, there's a fair amount of data out there."

Other lessons are to look at climate change in the context of existing comprehensive planning efforts, join forces with other related efforts, and

create an "adaptive" process that easily responds to changing information and events.

THE RIGHT TOOL

To help pass on information to other estuaries and coastal programs about climate change impacts and adaptation, the Web-based Climate Ready Estuaries Coastal Toolkit was developed.

The site offers information on monitoring climate change, coastal vulnerability and adaptation tools, smart growth in the context of climate change, communications and outreach materials, adaptation planning, sustainable finance options, and where to find data.

"It's an evolving site," Wilson says. "We would very much like folks to suggest things we should add."

"One take-away lesson from all this," says Martinich, "is that climate change adaptation has become a high priority for coastal managers, and there's a lot of opportunities to coordinate and collaborate, and bring other folks into the process."

He adds, "While uncertainties exist, it's better to get moving and be flexible and adapt as our climate continues to change." ❖

For additional information, you may contact Jeremy Martinich at (202) 343-9871, or martinich.jeremy@epa.gov, or John Wilson at (202) 566-1158, or wilson.john@epa.gov.

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ADDITIONAL RESOURCES

- More information on Climate Ready Estuaries, www.epa.gov/cre/
- Climate Ready Estuaries Coastal Toolkit, www.epa.gov/cre/toolkit.html
- Adaptation options relevant to estuarine management goals, www.epa.gov/cre/adaptationoptions.html
- "Climate Ready Estuaries 2009 Progress Report," www.epa.gov/climate-ready-estuaries/downloads/2009-CRE-Progress-Report.pdf



Coming to Terms with Green Infrastructure

Find out what green infrastructure means for communities across the country and how it can help with climate change.

When using the term “green infrastructure,” coastal resource managers may be referring to anything from a street-side rain garden to a statewide land conservation network. And while these examples may technically both be correct, some believe that the phrase has undergone “definition creep” and often means different things to different people.

A green infrastructure program can help communities adapt to climate change by reducing impacts from natural hazards, including flooding caused by sea level rise, and providing ecological services, such as sequestering large amounts of carbon.

“A lot of places wouldn’t consider rain barrels as green infrastructure,” notes Kevin Shafer, executive director of the Milwaukee Metropolitan Sewerage District, which sells rain barrels as part of its green infrastructure efforts. “By defining it and using common terminology throughout the country, we can learn more about it and help get those [green infrastructure] measures in place in a more efficient fashion.”

While the term is broadly used, what is commonly agreed upon is that implementing a holistically conceived green infrastructure program has many benefits. These include improving stormwater and wastewater management, helping to mitigate impacts from natural hazards and adapt to climate change, and providing other ecological and recreational services.

“There’s a great deal of benefit in restoring a natural landscape,” says Mike Friis, manager of the Wisconsin Coastal Management Program. “In addition to water quality benefits and resolving water quantity

issues, we’re providing environmental corridors for wildlife and habitat for endangered species. This is a multifaceted approach to dealing with problems.”

What is also agreed upon is that implementing green infrastructure—or the blue infrastructure some coastal managers are creating—will not eliminate the need for more traditional “gray” infrastructure.

DEFINING MOMENT

While green infrastructure is a fairly new term, the concept dates back over a hundred years to Frederick Law Olmstead, the 19th century founder of American landscape architecture, who believed connected systems of parks and greenways were more beneficial than isolated green spaces.

Coined by Edward T. McMahon, former vice-president of The Conservation Fund and now a senior fellow at the Urban Land Institute, the phrase was trumpeted in a May 1999 report of the President’s Council on Sustainable Development, *Towards a Sustainable America: Advancing Prosperity, Opportunity, and a Healthy Environment for the 21st Century*.

In the report, the council defined green infrastructure as “. . . an interconnected network of protected land and water that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for America’s communities and people.”

In 2006, McMahon and The Conservation Fund’s Mark Benedict co-authored, *Green Infrastructure: Linking Landscapes and Communities*, which outlines green infrastructure principles and practices. In it, green infrastructure is defined as “an interconnected network of green space that conserves natural ecosystems values and functions and provides assorted benefits to human populations.”

A NATURAL APPROACH

For Shafer, green infrastructure means “using a natural approach to try to manage stormwater,” which for his Milwaukee agency includes selling rain barrels, creating rain and roof gardens, and implementing the Greenseams Program, where flood-prone properties with hydric soils are purchased and left undeveloped to maximize their water-absorbing capacities.

Robert Christianson, director of the St. Johns River Water Management District’s Department of Operations and Land Resources, conducts a similar land-acquisition program in Florida to prevent flooding. “The heart of the matter,” he says, “is recognizing that non-structural flood protection has to be one of the keys to our success as water managers.”

Maryland coastal managers are expanding an existing statewide green infrastructure program to better incorporate what they are calling “blue infrastructure,” or aquatic priorities in the nearshore coastal zone, such as finfish habitat and submerged aquatic vegetation.

“We are creating a framework to identify coastal habitats and areas where conservation and restoration activities can be targeted to maintain and improve coastal resources,” says Catherine McCall, natural resource planner for the Maryland Chesapeake and Coastal Program.

BIG PICTURE

“First and foremost, green infrastructure is an approach to strategic conservation,” explains Will Allen, director of strategic conservation at The Conservation Fund. While it is the preferred strategy of The Conservation Fund, he notes that “there are other approaches to strategic conservation.”

For instance, open space planning and ecosystem-based management use different terminology but often have similar holistic goals.

Green infrastructure planning, Allen says, is proactive, systematic, coordinated with other policies, and most importantly, large- or broadscale.

HIGH-PRIORITY SYSTEMS

Fundamentally, green infrastructure means working with a broad group of stakeholders—what

The Conservation Fund calls establishing a “leadership forum”—to look at existing plans and barriers, and identify high-priority natural resources, such as woodlands, wetlands, rivers, and grasslands.

“Collaboration is the key that helps green infrastructure move forward,” notes Shafer. “It’s the building block of all this. You need a lot of people to collaborate on how you’re going to implement programs, how you’re going to pay for these programs, and what the priorities and benefits will be.”

The second step is developing a “network design,” where the resources are mapped using a geographic information system (GIS) and important habitat and ecosystem functions are identified and connected. Decisions can then be made on where it makes the most sense to conserve lands.

“Developing an interconnected network is the most critical part from our standpoint,” Allen says.

Only after that process is complete should the group decide where development and gray infrastructure, such as storm drains and tunnels, should go.

“We don’t want haphazard conservation any more than we want haphazard development,” says Kris Hoellen, director of The Conservation Fund’s Conservation Leadership Network. “What tends to happen in a lot of areas is the focus is on built development, and then they look at where they have natural resources. It should be done together, with the emphasis on proactively looking at natural resources—not managing what’s left.”

A MATTER OF SCALE

The last step in the green infrastructure planning process, Allen says, is also the one that contributes most to “definition creep.”

This step is developing an “implementation quilt,” where an array of tools can be implemented, such as installing a rain garden and green roof at the “site scale,” developing greenways or hazard mitigation at the “community scale,” and maintaining intact forests by doing land acquisition at the regional or “landscape scale.”

“This regional scale is the one we most frequently work at,” Allen says. “That, in essence, is our broad recommendation to coastal managers. Start at the watershed scale and then drill down.”

Continued

GREEN IS GOOD

The green and blue infrastructure programs in Florida, Wisconsin, and Maryland have helped reduce flooding, improved water quality, and are supporting diverse plant and animal populations. Other green infrastructure benefits include enabling valuable natural processes to take place, such as sequestering large amounts of carbon and generating economic benefits through farming, forestry, fishing, and passive recreation.

Adding nearshore resources and habitat—such as submerged aquatic vegetation, oyster bars, tidal wetlands, fish spawning and nursery areas, and shoreline buffers—to green infrastructure efforts will expand the interconnected resource network and help protect coastal communities from storm surge and erosion, says McCall.

Maryland is working to incorporate sea level rise and climate change into strategic land and habitat planning using the state's green and blue infrastructure networks. McCall says, "This will help identify coastal habitats threatened by sea level rise and will direct management and restoration activities to protect their long-term viability, and will shape policies regarding when and where lands are purchased in areas vulnerable to sea level rise."

MARRYING GREEN AND GRAY

With more than 1,881 flood-prone acres conserved in Milwaukee, green infrastructure has been an undeniable success. Friis notes, however, that what has worked best is marrying the green with the gray infrastructure.

"Green infrastructure is a valuable device, but it can be overplayed pretty quickly," says Christianson, whose St. Johns River Water Management District has conserved 700,000 acres. "It's important for the citizens of our area to understand the contributions from green infrastructure—and they are many—but we have to maintain [the gray infrastructure] we have, while we continue to increase our green tools."

"Just lead with the green," advises Allen.

"That's the best recommendation." ❖

For more information on The Conservation Fund's green infrastructure definition and support services, you may

contact Kris Hoellen at (304) 876-7462, or khoellen@conservationfund.org, or Will Allen at (919) 967-2223, ext. 124, or wallen@conservationfund.org. For information on Greenseams, contact Kevin Shafer at (414) 225-2088, or kshafer@mmsd.com, Mike Friis at (608) 267-7982, or michael.friis@wisconsin.gov, or Peg Kohring at (269) 426-8825, or pkohring@conservationfund.org. For more information on Maryland's blue infrastructure program, contact Catherine McCall at (410) 260-8737, or cmccall@dnr.state.md.us. For more information on the St. Johns River Water Management District's green infrastructure efforts, contact Robert Christianson at (386) 329-4470, or rchristianson@sjrwmd.com.

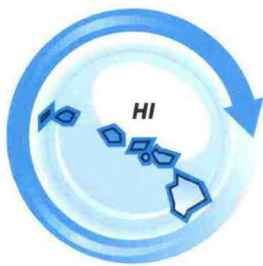
Article was originally published in the May/June 2009 edition of *Coastal Services*.

HELPFUL LINKS

For more information on green infrastructure, point your browser to

- *Green Infrastructure: Linking Landscapes and Communities* by Mark A. Benedict and Edward T. McMahon, www.conservationfund.org/pubs_product_list/131
- The Conservation Fund's strategic conservation services, www.conservationfund.org/Strategic_Conservation
- The Conservation Fund's upcoming green infrastructure courses, www.conservationfund.org/training_education/upcoming_training_courses
- The National Oceanic and Atmospheric Administration Coastal Services Center and The Conservation Fund's course, "GIS Tools for Strategic Conservation Planning," www.conservationfund.org/course/gis_tools_strategic_conservation_planning
- Maryland Shorelines Online, <http://shorelines.dnr.state.md.us>
- Green Infrastructure Community of Practice, www.greeninfrastructure.net/content/community-practice





Smart Growth: Changing the Course of Development in Hawaii

Smart Growth improves quality of life. In Hawaii, it is also making the islands more resilient to climate change.

Decisions about what, where, and how communities are built have profound impacts, not only on the land and sea environments, but on people's daily lives. Everything from the schools children attend to the length of daily commutes and the amount of exercise engaged in are impacted by decisions made long before ground is ever broken on a development.

Traffic from sprawling urban areas is considered a significant source of carbon emissions contributing to climate change. In addition to providing mitigation, smart growth can help lessen the impacts of coastal hazards that may result from climate change, such as flooding.

Coastal resource managers in Hawaii are working to help developers and local government officials take a more holistic approach to land-use decision-making using smart growth principles.

"Not only are we more effectively addressing our mission, goals, and objectives, but we're also making them relevant to people's everyday lives," notes Gordon Grau, director of the University of Hawaii Sea Grant College Program. "When we're talking about somebody sitting in traffic for three hours to get to work or to get their kids to school, it resonates with people. We're translating the environmental issues that we've always dealt with in terms of how it's affecting people every day."

Through the University of Hawaii Sea Grant Center for Smart Building and Community Design, Sea Grant and many partners brought a national team

of smart growth experts to Hawaii to work with local landowners, developers, and city planners—and are providing ongoing support—to help create a more comprehensive approach to regional planning.

As a result, a development of about 12,000 new housing units and commercial space on Oahu has been designed to minimize its coastal environmental impacts, and smart growth principles are being incorporated in development and redevelopment projects across the islands.

PAST PLANNING

Like many communities across the country, development in Hawaii has spread out from urban centers, taking over lands traditionally used for agriculture, putting longer distances between homes, stores, and jobs, and making people dependent on their cars.

"We have made over the past 40 years every mistake in land-use planning that a community can make," says Jeremy Harris, the former mayor of Honolulu. "We've adopted laws that encouraged sprawl... We've ended up with horrendous traffic and pollution."

Sprawling development is blamed for everything from wasting tax money by increasing the need for new roads, new water and sewer lines, new schools, and augmented police and fire protection, to adding to rates of obesity, since the options of walking and bicycling are less practical.

More roads mean more stormwater runoff, which degrades water quality. Traffic resulting from sprawling urban areas impacts air and water and is considered a significant source of carbon emissions contributing to climate change.

"The major contributors to the problems in coastal waters and watersheds have to do with what we're doing on land," Grau says. "That recognition should change the way we approach environmental problems," including water quality, ecosystem and habitat management, coastal hazard mitigation, and other Sea Grant priority issues.

CREATING SUSTAINABILITY

In general, smart or green growth is simply creative development strategies that can preserve natural lands and critical environmental areas, protect water and air quality, and reuse already developed land.

Smart growth neighborhoods typically are designed to have shops, offices, schools, churches, parks, and other amenities near homes so that residents and visitors have the options of walking, bicycling, taking public transportation, or driving.

A greater mix of housing can make it possible for people to live their lives in one community, from the young couple buying their first home to senior citizens looking to downsize.

"What smart growth promises, and I believe that it can and does deliver, is that balance between responsible development, which allows us to preserve open space through proper use of higher densities, while at the same time providing an increase in quality of life," says Eric Crispin, the former director of Planning and Permitting for the City of Honolulu.

The high quality of life in these communities typically makes them economically competitive, creates business opportunities, and improves the local tax base, notes Stephen Meder, director of the Center for Smart Building and Community Design and a faculty member of the University of Hawaii School of Architecture.

Meder says that smart growth's focus on reducing stormwater impacts and protecting natural environmental buffers can also help prevent flooding and lessen the impacts of coastal hazards, such as tsunamis, hurricanes, and storm surge, thereby increasing community resilience.

The features that distinguish smart growth in a community vary from place to place and even project to project, depending on the local natural and cultural resources, existing social situations, and the economic and political forces behind land development, management, and zoning.

INTRODUCING CONCEPTS

Soon after the Center for Smart Building and Community Design was created in 2004, Sea Grant began working with the City and County of Honolulu, the U.S. Environmental Protection Agency's Development, Community, and Environment Division, and local developers to bring smart growth experts from across the country to the island of Oahu to introduce the concepts during a multi-day workshop.

The workshop focused on the benefits and challenges of implementing smart growth principles in two existing projects—the new development of Kapolei, where large-scale planning activities were underway, and the redevelopment of Kailua.

"We had a packed house," Meder says. "We were really fortunate that every developer building homes in the area came," as did landowners, city planners, and other stakeholders.

FOSTERING CHANGE

The city continued the momentum created by the workshop by bringing the experts back for subsequent meetings, and developers in both Kapolei and Kailua revised their plans to incorporate some of the ideas presented by the team.

The workshop "definitely fostered some of the thought behind the planning of Ho'opili," says Mike Jones, president of D.R. Horton-Hawaii Division, which is planning the 11,750-home and commercial development in Kapolei.

Jones notes that D.R. Horton hired several of the experts who presented at the workshop to help design the project. As a result, Ho'opili has had extensive community involvement and plans center on mass

Continued

transit and various modes of transportation options, including pedestrian and bike paths. The project also will feature a mix of housing and commercial uses.

RIPPLE EFFECT

“The workshop was a phenomenal success,” says Meder. “The success is showing a number of years later, not only in the development of Kapolei, but in other parts of the state, as well. We’re seeing the ripple effects.”

The Center for Smart Building and Community Design has gone on to provide smart growth assistance to other community groups, local governments, and developers that has resulted in planning changes and the development of new codes and ordinances addressing shoreline setbacks. Several books and manuals have been contributed to, including a coastal hazard mitigation guidebook that was used in the aftermath of Hurricane Katrina.

“Sea Grant really turned the light on in the room,” says Crispin. “They showed us that doing the same thing will only yield the same results of sprawl.”

He adds, “They showed us that there is a different and better way that can be profitable, while allowing greater quality of life and sustaining the environment at the same time.” ❖

For more information on smart growth, point your browser to www.epa.gov/smartgrowth/. For information on the Hawaii Sea Grant Center for Smart Building and Community Design, go to www.soest.hawaii.edu/seagrant/. For more information on smart growth efforts in Hawaii, contact Gordon Grau at (808) 956-7031, or sgdir@hawaii.edu, or Stephen Meder at (808) 956-7031, or smeder@hawaii.edu. For more information on the Ho’opi development, go to www.hoopilioahu.com.

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COMMUNITIES PREPARING FOR CLIMATE CHANGE

NOAA tools and information can help.

The no-regrets approach to climate change seems to be gaining momentum. Citizens can be on the fence about climate change yet fully support the need to fight pollution, make communities more resilient, and prepare for natural hazards.

Products and services provided by the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center, including the ones listed below, are used by communities working to become more resilient. Visit the Center's climate webpages at www.csc.noaa.gov/climate/ and the NOAA Digital Coast website at www.csc.noaa.gov/digitalcoast/ to learn more.

“Every effort that helps coastal communities become more resilient is a step in the right direction.”

– Margaret Davidson, Director of the NOAA Coastal Services Center.

Understand It

NOAA'S NEW CLIMATE PORTAL | www.climate.gov

NOAA has begun building this climate powerhouse, a place where all of NOAA's climate-related resources can be found. The NOAA Climate Services portal provides access to a wide range of constantly updated data sets, and the online magazine, *ClimateWatch*, highlights new climate research through videos and articles. The educational section contains information and climate-change facts of interests to kids and adults.

COASTAL INUNDATION TOOLKIT | www.csc.noaa.gov/inundation/

Coastal flooding is a fact of life for many coastal communities. This how-to website features basic educational material about inundation, extensive guidance for communities that want to identify and map inundation possibilities, strategies for risk communications, and profiles of communities addressing this challenge head-on.

Bring the Message Home

COASTAL COUNTY SNAPSHOTS | www.csc.noaa.gov/snapshots/

Being aware of the problem is the first step. For each coastal county, this website provides a printable page of easy-to-understand charts and graphics that explain a county's hazard-related data, a perfect conversation starter for community boards, county councils, or any groups trying to make their community more resilient.

TRAINING BROUGHT TO YOUR LOCATION | www.csc.noaa.gov/training/

Coastal Inundation Mapping. This course covers coastal inundation issues and provides instruction regarding the use of spatial technology to create inundation maps.

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 lessening the negative impacts of growth.

Roadmap for Adapting to Coastal Risk. Participants in this webinar use hands-on exercises to characterize their community's exposure to current and future risk and learn strategies for addressing vulnerabilities.

Planning for Climate Change. The Center can help communities customize a one-day workshop with topics that include climate science principles, risk assessments, existing regulations, and adaptation planning.

Visualize “What-if” Scenarios

CANVIS – VISUALIZATION SOFTWARE FOR THE COAST | www.csc.noaa.gov/canvis/

Don't let the easy-to-use aspect of this product take away from its powerful impact. With CanVis, users can insert the local scenery picture of their choosing and add docks, piers, buildings, or whatever objects are appropriate to help people “see” what potential development might look like. Many communities are using CanVis to visualize sea level rise impacts.

Get an Extra Set of Hands

COASTAL MANAGEMENT FELLOWSHIP PROGRAM | www.csc.noaa.gov/fellowships/

Finding the “people power” 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 states.

COASTAL CLIMATE ADAPTATION | <http://collaborate.csc.noaa.gov/climateadaptation/>

This website provides information from other communities that makes it seem like an extra brain has been assigned to the problem! State and local officials use this website to see what others are doing in terms of adaptation planning. The site also includes basic climate change information useful for outreach efforts.

Get the Data

DIGITAL COAST | www.csc.noaa.gov/digitalcoast/

This website provides the baseline data needed by coastal managers, including shoreline change, land cover, and elevation data. Not only are the data available, but also the tools, training, and information needed to turn these data into useful information.

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About the NOAA Coastal Services Center

The National Oceanic and Atmospheric Administration (NOAA) is a world leader in coastal science and management. NOAA's Coastal Services Center provides the up-to-date technology, information, and management strategies needed to address complex coastal issues.

The Center is housed within NOAA's National Ocean Service and has offices and staff members throughout the coastal zone. Constituents include local and state governments, coastal regulatory programs, land trusts, Sea Grant, floodplain managers, research reserves, and emergency managers.

To access the Center's products and services, visit the website or e-mail the organization at csc@csc.noaa.gov to learn more.



NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

www.csc.noaa.gov