COASTAL SERVICES

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Linking People, Information, and Technology

PHARMACEUTICALS IN THE ENVIRONMENT:
Coastal Managers Are Discovering How to Respond

Creating Resilience to Hurricane-Force Winds in Hawaii

Having the Right Tool to Evaluate Impacts of Offshore Wind Energy in Michigan

From the Director

On January 1, 2010, hundreds of thousands of people probably reached for an ibuprofen as a solution to the headache caused by the previous evening's revelry. What scientists are finding, however, is that the medicine we take for granted may end up harming the environment.

Scientists have found the residue of over 100 different kinds of drugs and other products in many of the nation's rivers and coastal waters, raising concerns about potential impacts to humans and aquatic species.

In this edition of *Coastal Services*, we look at pharmaceuticals in the environment and how coastal resource managers are already beginning to address this emerging issue, by conducting research in Ohio and sponsoring events like those in New York where the public can return unused medicines for safe disposal.

Until science can prove that the low levels of pharmaceuticals being found in the environment are safe, it is prudent for coastal managers to take action to keep medications out of the environment in the first place.

Also in this edition, we look at how Hawaii is increasing its resilience to hurricane-force winds by adopting building design standards that are specific to Hawaii's wind hazard. This is particularly important in the face of climate change, which has the potential for increasing the severity of coastal storms.

Other articles focus on a new Web atlas showcasing examples of innovative low impact development projects from across the country that was developed by the National Nonpoint Education for Municipal Officials (NEMO) Network, and the way managers in Michigan proactively developed a geographic information system-based decision-support tool for offshore resources, which was perfectly timed to help inform the governor's council looking at siting offshore wind energy.

As 2010 gets underway, the issues facing the nation's coastal managers are daunting. But the articles in this—and every edition—of *Coastal Services* clearly demonstrate the creativity, determination, and talent of those who are on the front lines of these coastal issues.

I wish you all a very happy and productive New Year. ❖

Margaret A. Davidson

The mission of the NOAA Coastal Services Center is to support the environmental, social, and economic well being of the coast by linking people, information, and technology.

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News and Notes

We Heard You Loud and Clear.

When it comes to natural resource management, coastal communities want to be proactive, but they need help getting the data and information most relevant to their needs.

The Digital Coast is a good place to start. First developed by the NOAA Coastal Services Center, the Digital Coast began as a way to provide coastal management organizations with not only data, but also the surrounding tools, training, and examples needed to turn those data into information that can be used.

The Digital Coast website is accomplishing that plus more. The partnership group that oversees the effort includes the National Association of Counties, Coastal States Organization, National States Geographic Information Council, Association of State Floodplain Managers, and The Nature Conservancy. These organizations first came together through the Digital Coast to ensure the relevance of the website, but then realized the opportunity this partnership offered to advance coastal management issues. Through the partnership group, the Digital Coast now represents a powerful consortium.

Visit the website to learn more. Some of the tools from the website are profiled below.

The Coastal Inundation Toolkit. The partnership group requested a holistic resource on inundation-related issues, including how to begin addressing adaptation planning. With the toolkit, professionals can educate themselves about inundation, learn to identify and map potential impacts, assess a community's risk and vulnerability, and get tips on communicating the concept of risk to residents. *www.csc.noaa.gov/inundation/*

County Snapshots. While this resource is located within the Inundation Toolkit, the popularity of the snapshots warrants a separate mention. Users can select the coastal county of their choosing and get a quickly populated page of easy-to-understand graphs and charts that tell a story about a county's coastal risk factors. Local and county officials in particular seem to appreciate the visual way these important data are presented. *www.csc.noaa.gov/digitalcoast/tools/snapshots/index.html*

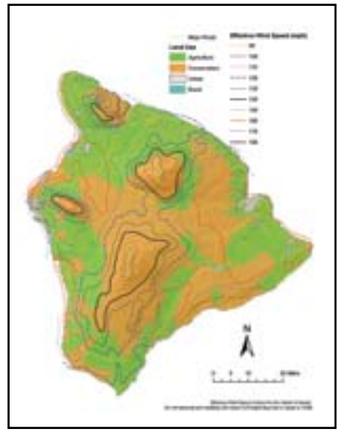
Habitat Priority Planner. This geographic information system (GIS)-based software is useful in a group setting where various land use scenarios are being discussed. Users determine what elements of the region are of particular interest to them (proximity to a highway? presence of endangered species?) and then use this tool to see how various scenario boundaries might impact the chosen elements. This tool is also used when incorporating participatory GIS into project plans. *www.csc.noaa.gov/hpp/*

Data. Training. Case Studies. Information. Many tools are available from the website, along with the data, training, and information users need to turn this content from something interesting into something that can be used in the decision-making process. Visit the website to access the contents or suggest additional resources to be featured on the site. ❖

The Digital Coast was funded in part by the Mississippi Coordinating Council for Remote Sensing and Geographic Information Systems.

The Digital Coast *www.csc.noaa.gov/digitalcoast/*

Creating Resilience to Hurricane-Force Winds in Hawaii



*H*awaii'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.

"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.

> *"This was going to be a long-term project that was really huge in terms of the impact."*
>
> *Ann Ogata-Deal, Hawaii Coastal Zone Management Program*

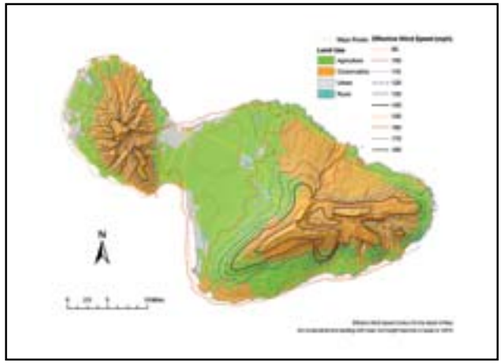
In 2005, conducting island-specific wind speed studies became a priority for the Hawaii coastal program and its network of partners working on coastal hazard mitigation, says Ogata-Deal.

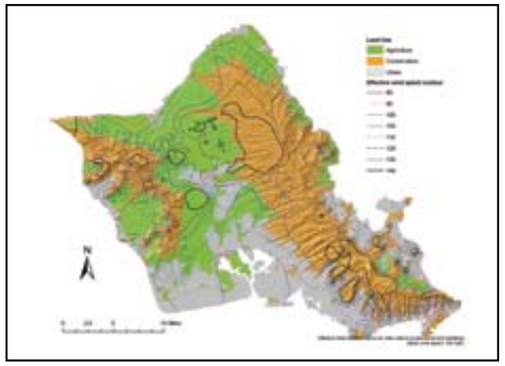
"We realized early on that we could step in and make a difference," she says. "This was going to be a long-term project that was really huge in terms of the impact, as well as in the funding it would take to get the job done."

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 quite a large 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.

Wind maps courtesy of Hawaii Coastal Zone Management Program

PHARMACEUTICALS IN THE ENVIRONMENT:

Coastal Managers Are Discovering How to Respond

When someone gets a headache, the typical response is to take an over-the-counter pain reliever—just one of tens of thousands of over-the-counter and prescription medicines on the market, with more being developed each year. The residue of these drugs and other products is being detected in rivers and coastal waters across the country, raising concerns about potential impacts to humans and aquatic species.

While there have been no indications of harm to human health, according to NOAA there is growing evidence that some of these chemicals may have negative effects on the reproduction of aquatic species,

> *"The fish are our canary in the coal mine."*
>
> *Yo Chin, Ohio State University*

or may stimulate the development of antibiotic-resistant bacteria.

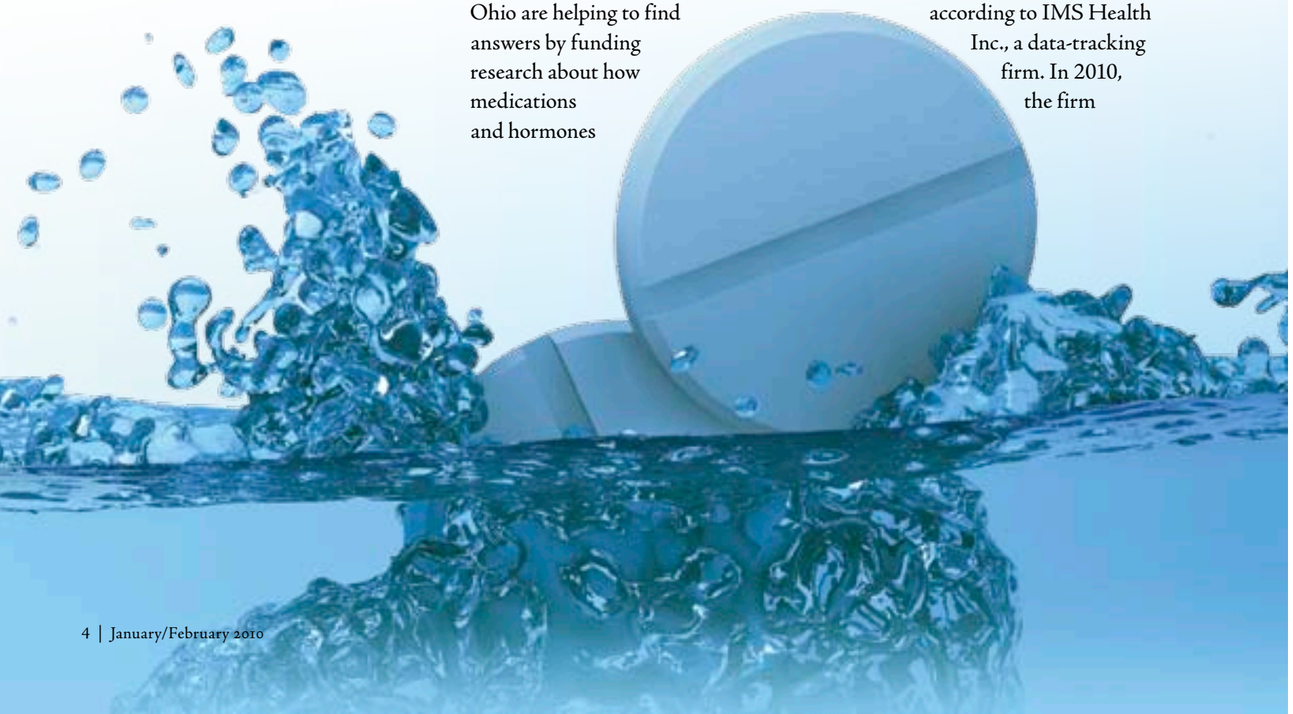
"The correct answer is that we don't know yet how much to be concerned," says Laura Jacobs, a former Old Woman Creek National Estuarine Research Reserve (NERR) graduate research fellow investigating the issue. "What we are seeing are very low concentrations—we're talking subparts-per-billion—but little is known about the effects of long-term, chronic exposure."

Coastal resource managers in Ohio are helping to find answers by funding research about how medications and hormones break down in the estuarine environment and potential treatment processes. Managers in New York and elsewhere are addressing the issue by sponsoring events where the public can return unused medicines for safe disposal and by providing education and outreach.

"What most coastal managers are trying to do right now," says Jeff Reutter, director of the Ohio Sea Grant College Program, "is basically encourage people to not follow the old routine from years ago of flushing used drugs down the toilet, which turns out to be pretty bad advice."

Growing Problem?

Annual U.S. prescription drug sales hit $291 billion in 2008, according to IMS Health Inc., a data-tracking firm. In 2010, the firm predicts that about $320 billion in pharmaceuticals will be sold in the U.S. and the value of the global pharmaceutical market will grow 4 to 6 percent, exceeding $825 billion.



As detection techniques have become more sensitive, scientists are finding pharmaceuticals and over-the-counter medications, as well as veterinary medicines, in estuaries, rivers, streams, groundwater, and sediments.

One of the most extensive studies of medications in streams, lakes, and rivers was conducted in 2001 by the U.S. Geological Survey. A network of 25 groundwater and 49 surface-water sources of public drinking water in 25 states and Puerto Rico was sampled and analyzed for 124 emerging contaminants. At least one emerging contaminant—including acetaminophen, steroids, hormones, codeine, antibiotics, antimicrobials, and ibuprofen—was detected in 96 percent of the samples (*http://toxics.usgs.gov/regional/emc/source_water.html*).

System Flush

The primary way medications make their way from the bottle into the environment seems to come from people taking drugs and flushing them—unmetabolized or unused—into wastewater treatment and septic systems, where treatment may not be adequate to remove all drug residues.

Medications can also leach into the environment from leaking landfills and runoff from lands where sewage wastewater and sludge have been applied. Veterinary pharmaceuticals can come from aquaculture and animal feeding operations. Even the drugs given to pets find their way into the environment.

"A huge part of the problem comes from agriculture," explains Yo Chin, a professor at Ohio State University's School of Earth Sciences and an Ohio Sea Grant researcher. "Cattle are injected with growth hormones and other compounds that are not hormones, but are hormone-like. It is those hormone-like compounds that scare me more than anything else because we don't know exactly what they are doing."

Uncertain Risks

Once these compounds are in the environment, their risks to aquatic organisms and to humans are uncertain. To date, scientists have found no evidence of adverse human health effects; however, research suggests that certain drugs—especially hormones—may cause ecological harm, including interference of growth and reproduction in species such as fish and frogs.

According to the U.S. Environmental Protection Agency, effects can include the production of more females than males within a given population, the presence of both male and female reproductive organs in individual organisms, poor egg-hatching success, decreased fertility and growth, and altered behavior.

"Reductions in the sperm counts of many fish have been well documented," notes Linda Weavers, a Sea Grant researcher and the John C. Geupel Professor of Civil Engineering at Ohio State University's Department of Civil and Environmental Engineering and Geodetic Science. "There appears to be a linkage [to pharmaceuticals], but there are many, many factors that could be causing it. . . The critical issue is being able to pinpoint it down to one thing."

"The fish are our canary in the coal mine," says Chin. "They are an early warning sign that we need to be paying attention" to this issue.

Funding Research

Coastal managers in Ohio are paying attention. Ohio Sea Grant and Old Woman Creek NERR, for instance, have provided research funding to explore the issue.

For more than a decade, Chin has been conducting a series of investigations into how pharmaceutical compounds break down in the estuarine environment of Old Woman Creek. "What I'm interested in," he says, "is when these compounds are in the environment, what happens? Does it break down or hang out? What role does sunlight play?"

In her work as a graduate research fellow at Old Woman Creek, Laura Jacobs looked specifically at how quickly the sun breaks down ibuprofen and caffeine within the estuary. "The sun does degrade it naturally, which is good news if you are thinking about long-term assessment," she says. The bad news is that by-products are generated.

"An important question that remains unanswered is what *are* the compounds breaking down *into*," says Frank Lopez, manager of Old Woman Creek NERR.

Continued

Naturally Breaking Down

Another important element of Chin's and Jacobs' work has been illustrating the "role wetlands have in breaking down organic pollutants and pharmaceuticals," Lopez says. "Their research further validates the filtering function of wetland systems."

"Most estuaries and coastal areas capture nutrients and break these compounds down," Chin says. "What we are demonstrating with our research is that maintaining and preserving estuaries and wetlands is doing a lot of good."

The underlying message for coastal managers, he says, is the importance of preserving and restoring natural wetlands. "Re-creating a wetland somewhere else is not the same."

Potential Treatments

Weavers is taking another approach and is researching the potential use of sonication—or applying sound waves—to remove pharmaceuticals and other products from wastewater or drinking water.

"It's important that we find solutions to remove these compounds, and that we find a solution that is reasonably cost effective," she says.

Weavers notes that many wastewater treatment plants are already using the technology to break up sludge in wastewater and that her research is just using the technology in different ways.

Medicine Take-Back Program

One way to reduce the level of medications in coastal waters is to reduce the amount of medications entering the environment in the first place. This is the route New York Sea Grant has taken, sponsoring a Return Unwanted Medicines event last spring, and educating residents and health care professionals about the issue.

The event, modeled after an Illinois-Indiana Sea Grant program, was the largest one-day collection of its kind on Long Island, says Larissa Graham, outreach coordinator for the Long Island Sound Study. Over 140 participants returned 496 pounds of unwanted medicines.

After the event, New York Sea Grant created a how-to-guide for other coastal managers.

Encouraging Action

While all those interviewed for this article urged a non-alarmist approach to the topic, most also cautioned that coastal managers should not wait to take action until science determines the answers to the myriad of questions.

"This should not be treated like a criminal court where it is innocent until proven guilty," says Weavers. "A huge body of research needs to be done to understand these things better."

Jacobs notes, "This issue could have a staggering amount of complications."

"The bottom line," says Reutter, "is what kind of strategies can we develop to keep unused drugs from getting into the system—period—and what strategies can we develop to remove them from the system."

He adds, "This is an issue that people are only beginning to think about." ❖

For more information on coastal managers' role in addressing pharmaceuticals in the environment, contact Jeff Reutter at (614) 292-8949, or reutter.1@osu.edu, or Frank Lopez at (419) 433-4601, or Frank.Lopez@dnr.state.oh.us. For research information, contact Yo Chin at (614) 292-6953, or yo@geology.ohio-state.edu, Laura Jacobs at (202) 334-2146, or LHelsabeck@nas.edu, or Linda Weavers at (614) 292-4061, or weavers.1@osu.edu. For information on New York Sea Grant's Return Unwanted Medicines event, contact Larissa Graham at (631) 632-9216, or larissa.graham@cornell.edu.

ADDITIONAL INFORMATION

NOAA's efforts to address pharmaceutical compounds in the coastal environment, *www.noaa.gov/features/protecting_1208/pharmaceuticals.html*

U.S. Environmental Protection Agency (EPA) website on pharmaceuticals and personal care products as pollutants, *www.epa.gov/ppcp/*

New York Sea Grant how-to guide on holding a successful pharmaceutical take-back event without outside funding, *www.seagrant.sunysb.edu/article.asp?ArticleID=362*

Taking a National Approach to Finding Local Low Impact Development Projects

Local officials may be intrigued by the idea of using low impact development (LID) to help curb stormwater and water quality issues, but they can be reluctant to implement LID without concrete examples of how other projects have been designed and implemented—and their long-term success. A new Web atlas is filling this need by showcasing examples of innovative LID projects from across the country.

"When we would go out and talk to communities about LID, a lot of them can be really nervous about being the first ones to do it," says John Rozum, former director of Connecticut's Nonpoint Education for Municipal Officials (NEMO) project. "This [Web atlas] really came up as a way to help our target audience visualize what LID is, and see that the technology is being used successfully around their state and the nation."

"The other piece," says David Dickson, the National NEMO Network coordinator, "is to give them a contact they can talk to in other towns in their state and region. It's serving as a portal to help local officials learn more about LID practices and about specific examples."

The LID Atlas was recently launched by the National NEMO Network, a confederation of educational programs in 30 states dedicated to protecting natural resources through better land use and land-use planning. LID refers to a number of stormwater management practices—such as vegetated swales, rain gardens, green roofs, rain barrels and cisterns, permeable pavement, and water conservation—that reduce runoff and help to protect water resources from the impacts of nonpoint source pollution.

The LID Atlas provides project summaries, photographs, and links to additional information.

The user-friendly atlas can be searched for examples of a particular practice, projects from a particular state, or projects on a land-use type (commercial, industrial, residential, mixed use). There is also a keyword search for users looking for a specific project.

"This is a grassroots tool that anyone can take and use," Dickson says.

> ***"This is a grassroots tool that anyone can take and use."***
>
> ***David Dickson, National NEMO Network***

Local in Approach

The atlas began as a Connecticut NEMO project to capture the LID projects in the state, says Rozum. It was quickly apparent that information from other NEMO programs could be added to the site to create a national resource.

When information about the Connecticut site was provided to the NEMO Network, the California NEMO program quickly signed on to add its inventory, Dickson says.

Connecticut's and California's data were combined using a "mashup" of each state's local LID practices on Google Maps imagery. A mashup is a combination of tools, programs, or data from two or more sources to make a separate, integrated product. The only drawback to the Google technology, says Rozum, is that the atlas does not work when viewed in the current version of Internet Explorer, although they are working on a way around that problem.

Continued on Page 9

Graphic courtesy of National NEMO Network

Having the Right Tool to Evaluate Impacts of Offshore Wind Energy in Michigan

When Michigan's governor created a task force to look at the potential opportunities and impacts of offshore wind energy, the state's coastal resource managers were ready with a geographic information system (GIS)-based decision-support tool for offshore resources. The maps that the tool generated were key to the task force's deliberations and decision-making.

> *"We were proactive, and we had something useful when the need came."*
>
> *Catherine Ballard, Michigan Coastal Management Program*

"We were proactive, and we had something useful when the need came," says Catherine Ballard, soon-to-be-retiring chief of Michigan's Coastal Management Program. "It was nice to be out in front on this issue."

Michigan's coastal program sponsored the development of the Lakebed Alteration Assessment Tool to aid in the permitting of activities that could result in lakebed impacts, such as offshore wind farms and dredging projects, Ballard says.

"Our goal was to produce a user-friendly mapping tool that assembles relevant political, cultural, environmental, biological, and physical data," says Matt Warner, environmental quality analyst with Michigan's Coastal Management Program.

The decision-support tool grew out of a study supported by the Great Lakes Fishery Commission looking at "what the future of the lakebed might be," Ballard says. "At the time we didn't have any good way to assess alterations to the lakebed."

In 2008, the coastal program gave funding to the University of Michigan and the Michigan Department of Natural Resources Institute for Fisheries Research to create a tool to identify bottomland areas that support fish production.

"That built the foundation for the Lakebed Alteration Assessment Tool," Warner explains. "It's an ArcGIS-system with added functionality that simplifies the process for the user."

"To me," Ballard says, "that's the beauty of it. You don't need to be a GIS expert to use it."

"One of the nice benefits," Warner adds, "is that this is going to feed into our marine spatial planning efforts. It's a very robust Great Lakes information system."

While the tool was developed to support coastal management permitting decisions, its beta testing coincided with the governor's creation of the Great Lakes Offshore Wind (GLOW) Council.

"It was a great symbiotic relationship," Ballard says. "GLOW used our tool to identify potential wind energy sites, and they gave us feedback that helped us improve the tool even more."

Even when Lake Michigan is frozen, coastal managers can use the Lakebed Alteration Assessment Tool to aid in the permitting of activities.

Warner notes that the tool could easily transfer to other coastal states. "We're using out-of-the-box software, and this is a pretty basic type of spatial analysis."

The tool is currently only available by CD-ROM, but there are plans to move it to the Internet. Work is also underway to incorporate a weighting mechanism for each attribute that would enable the ranking of various sites for development.

"I'm very proud of it," Ballard says. "I think we haven't even tapped all its different applications. It creates a great basis for us to move forward." ❖

For more information on the Lakebed Alteration Assessment Tool, contact Matt Warner at (517) 241-1442, or WARNERM1@michigan.gov.

Continued from Page 7

Adding Examples

Other NEMO programs began adding their states' LID projects, and the National NEMO Network held a contest to help populate the site with examples. The site currently has 233 examples, and each listing contains a project summary and specifics, photographs (when available), and links to more information.

Projects can be added in real time using an online form on the atlas website. Currently, only NEMO members are authorized to add projects, but coastal managers interested in including a project should contact their local NEMO coordinators, or e-mail Dickson.

Atlas information for a specific state can also be embedded on other websites. Because these localized versions pull from the same database as the national version, when a site is added to the atlas or edited, it is automatically updated on any embedded versions. NEMO programs in California, Colorado, Connecticut, and Rhode Island have already embedded localized versions of the LID Atlas on their websites.

"Coastal managers could use this site in much the same way as our target audience of land-use decision makers," Rozum says. "It's a great way to demonstrate how LID is working."

Dickson adds, "This is an excellent example of the power of the NEMO Network to create unique educational products. Not many organizations could pull off something like this, and we did it with a minimal budget, just using the collective abilities of our network members." ❖

To view the National LID Atlas, point your browser to http://clear.uconn.edu/tools/lidmap/. For more information, you may contact David Dickson at (860) 345-5228 or david.dickson@uconn.edu.

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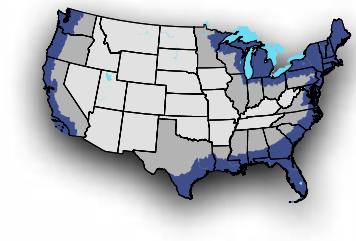

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