MANAGEMENT, PLANNING, AND POLICY CONFERENCE SESSIONS

Z.P. Johnson and A. Luscher

Maryland Department of Natural Resources, Coastal Zone Management Division, Annapolis, MD 21401

ABSTRACT

Hurricane Isabel's impact on the Chesapeake and its local citizens was devastating, but could have been worse but for the highly developed and effective management, planning, and policy programs in Maryland. Four panel presentations—Hazard Mitigation: Tools, Technologies, and Opportunities; Regulatory and Permitting Issues; Advances in Hazard Mapping; and Promoting Soft Approaches to Shoreline Management—provided an excellent opportunity for open discussion of successes and options for better preparedness in the future. As hurricanes and other natural disasters are certainly likely over the coming decades in Maryland waters, training opportunities identified by the group provide substantial capacities for educating and informing our local managers and responders, assuring potential within-state disaster preparedness for the coming years.

INTRODUCTION

Hurricane Isabel, a Category 2 hurricane, made landfall between Cape Lookout and Cape Hatteras on North Carolina's Outer Banks on Thursday, 18 September 2003. As the hurricane approached the Chesapeake Bay, it weakened to a tropical storm and tracked west of the Bay's main stem, causing the event to evolve into a watershed, rather than a coastal, event. Although the measured wind speed suggested low to moderate infrastructure damage, the wave setup from Hurricane Isabel's path concluded in one of the largest surge events recorded in the Chesapeake Bay.

Throughout the next several days, Isabel's destructive effects were felt throughout the Chesapeake Bay and the entire Mid-Atlantic region. A tally by the Maryland Department of Planning showed: 2,000 Maryland residents were evacuated; the agricultural industry sustained extensive damage; 2,550 businesses applied for aid; 18,000 Maryland residents applied for individual FEMA assistance; 3,250 homes received tax abatements; approximately 70 miles of shoreline experienced erosion damage; and approximately 50,000 gallons of fuel was recovered [1]. Hurricane Isabel was one of the most devastating natural events to affect the Chesapeake region in more than a century. This damage occurred in response to coastal flooding from the storm surge (the water height from the combined normal high tide and storm tide) as opposed to wind damage, which is most often associated with hurricanes.

The "Hurricane Isabel In Perspective" conference was organized to discuss the many factors that exacerbated Isabel's impact on the Chesapeake Bay ecosystem and its coastal communities. The conference agenda was developed through a solicitation of papers, as well as invited speakers and panelists. A primary goal of the conference was to create an open dialog between the scientific and management communities. To achieve this goal, conference organizers balanced the sessions with presentations and panel discussions of interest to both the academic and the scientific communities, as well as representatives of federal, state, and local agencies involved in management, planning, and emergency response. Additionally, sponsor funding was used to reduce or eliminate conference fees

K.G. Sellner (ed.). 2005. Hurricane Isabel in Perspective. Chesapeake Research Consortium, CRC Publication 05-160, Edgewater, MD.

for the local planners and emergency managers to encourage participation. The plenary sessions focused on broad-scale issues crossing all disciplines and were followed with paper presentations and panel discussions of planning, impact, and modeling issues.

This section of the proceedings document presents an overview of the Management, Planning, and Policy conference track. This conference track encompassed four panel presentations: Hazard Mitigation: Tools, Technologies, and Opportunities; Regulatory and Permitting Issues: Lessons Learned; Advances in Hazard Mapping; and Promoting Soft Approaches to Shoreline Management. Panelists within each session provided unique perspectives related to the hurricane and its impacts, as did audience participants encouraged to engage in panel discussions. Overviews of the four sessions are provided below, along with a list of panel participants and generalized findings.

HAZARD MITIGATION: TOOLS, TECHNOLOGIES, AND OPPORTUNITIES

Hazard mitigation is defined as sustained action taken to reduce or eliminate long-term risk to people and property from hazards and their effects. Numerous federal, state, and local hazard mitigation plans and programs exist in the Chesapeake Bay region. Panelists in this session discussed the development, adoption, and implementation of some of these programs, including Local Hazard Mitigation Planning, the Hazard Mitigation Grant Program (HMGP), the National Flood Insurance Program (NFIP), the Community Rating System (CRS), and hazard preparedness planning for federal facilities and the agricultural industry.

Session Chair: Zoe Johnson - Maryland Department of Natural Resources

Panelists:

David Thomas - Baltimore County Public Works

John Govoni - NOAA's National Centers for Coastal Ocean Science

Kimberly Golden Brandt - Maryland Emergency Management Agency

John Joyce - Maryland Department of the Environment

Pamela King - University of Maryland Cooperative Extension

Richard Sobota - Federal Emergency Management Agency

In the year after the storm, many of the agencies involved in hazard mitigation and response evaluated the effectiveness of the mitigation tools and technologies they use on a day-to-day basis in light of damage incurred by the storm. Drawing on lessons learned during and after the storm, panelists presented an overview of their independent evaluations; in doing so, they identified opportunities for improved preparedness, response, and recovery.

Planning Does Pay Off

One of the most important lessons learned from Hurricane Isabel is that elevating structures above the 100-year base flood elevation (BFE) helps prevent flood damage. Most structures elevated at the time of construction experienced less structural damage than similar structures in the same geographic area built lower to the ground. The current minimum standard under the NFIP for elevating structures is the BFE. To participate in the NFIP, communities must adopt and enforce a floodplain management ordinance containing minimum NFIP requirements. As the state coordinating office for the NFIP and the Community Assistance Program in Maryland, however, the Maryland Department of the Environment (MDE) recommends that all tidal communities adopt additional elevation requirements into their floodplain ordinances for new buildings. In light of sea level rise and storms such as Hurricane Isabel, the MDE is advocating that structures be elevated at least 0.61 m (2 ft) above the BFE. This measure will not only protect property and life from future flooding, but will pay

for itself in a few years in reduced flood insurance premiums under the CRS.

Non-structural mitigation measures include land use regulations and policies, building codes, open space preservation, dune and beach maintenance, and public education/outreach. Structural mitigation techniques include activities such as relocating homes or structures, constructing flood control devices, elevating ductwork, and anchoring residential oil and propane tanks. The Maryland Emergency Management Agency (MEMA) is the state agency charged with protecting the lives and property of Maryland citizens. It accomplishes this charge through an integrated and coordinated effort to mitigate, prepare for, respond to, and recover from emergencies and disasters. The MEMA oversees and/or administers several of the state's mitigation programs, including the HMGP, which received 5.5 million dollars in federal funds after Hurricane Isabel. These funds are being matched with monies from Maryland's Comprehensive Flood Management Grant Program (CFMGP) to finance structural elevation projects in eight jurisdictions and acquisition/demolition projects in three jurisdictions. In the event of another major storm, planning and mitigation efforts such as these will undoubtedly pay off.

Use of Forecasts and Models in Planning

Panelists provided multiple examples of how first responders and planners used forecasts and models to prepare and respond to the event. The National Centers for Coastal Ocean Science of NOAA have established detailed emergency response plans for their Beaufort, North Carolina and Oxford, Maryland laboratories in the event of either a hurricane watch or hurricane warning [2]. In addition to the National Weather Service (NWS) hurricane warnings, NOAA used the NWS National Digital Forecast Database and the SLOSH model to determine the level of necessary preparedness for Hurricane Isabel. Damage to NOAA's federal facilities was lessened because of adequate preparation in response to their surveillance of the NWS's forecasts and storm surge predictions. Several panelists, however, noted concern over the interpretation of models and forecasts and voiced the need to understand and recognize limitations of forecasts and projections, particularly at the local level and by popular media. Several panelists testified that the classified category of the storm did not represent the actual storm surge as it equated to a Category 4 hurricane. Many planners, as well and public citizens, were caught off-guard.

Local and Resource-based Planning

Local and resource-based planning form a critical component of hazard planning. Local governments are often the first and last responders to natural disasters: they must deal with the immediate impacts as well as the logistical red tape associated with cleanup and recovery for months to years after. Resource-based planning agencies, such as the Maryland Department of Agriculture (MDA), are also critically and closely involved in all phases of hazard planning and response [3]. Press releases, such as those issued by the MDA prior to the storm, urged farmers to prepare farms and livestock for Hurricane Isabel and provided invaluable and case-specific information to affected communities in a way unlike any other popular media source. The intimate knowledge that local and resource planners hold of the landscape, history, and resources at the local and regional levels proved invaluable in the response to Hurricane Isabel.

Need for Increased Education and Outreach

Despite accurate tracking of Isabel's landfall by the NWS, impacts still occurred that could have been avoided. Significant numbers of vehicles and private property were destroyed from floodwaters created by the surge of 1.2 to 2.4 m (4 to 8 ft) predicted in the Bay. The announcement of the surge forecasts was provided in sufficient time to evacuate automobiles and move personal items to higher ground. On the whole, the communication of this risk to the public proved ineffective. Many citizens were left stunned as they had little understanding of how to apply the forecasts to their own property. The public was more concerned about rainfall than storm surge, as the area had fairly

recent experience with high-rainfall hurricanes (e.g., Floyd, Agnes). For instance, Baltimore City emergency response personnel were posted along the Jones Falls in anticipation of high rains and flooding, but those impacts never materialized.

What did materialize was extensive coastal flooding throughout the Inner Harbor of Baltimore, but no staff was posted in this area to report the surge as it came ashore. The last memorable and comparable storm surge event in the Bay region occurred in 1933, when an unnamed hurricane also tracked onto the Bay's western shore. Session panelists commented that Hurricane Isabel has given the region a benchmark from which to measure and gauge the impact of future storms. This gauge will hopefully help alert the public and improve communication.

REGULATORY AND PERMITTING ISSUES: LESSONS LEARNED

Drawing from lessons learned from Isabel, panelists in this session presented an overview of the permitting and regulatory issues they faced during and after the hurricane, covering regulatory and permit compliance, emergency permitting, tree and vegetation removal, post-storm reconstruction, and public health. The panel's goal was to provide a forum to discuss these topics, while exploring methods and exchanging ideas for enhanced planning and preparedness for future natural events.

Session Chair: Julie LaBranche - Maryland Critical Area Commission

Panelists:

Tracy Keefer - U.S. Army Corps of Engineers
Doldon Moore - Maryland Board of Public Works
Patricia Farr - Baltimore County
Michael Galvin - Maryland Department of Natural Resources
Alan Williams - Maryland Department of the Environment

Panelists in this session conducted an informed dialogue on permitting and regulatory issues before, during, and after Hurricane Isabel. The exchange of information on what worked and what failed will both guide and further streamline future response efforts.

Streamlined Permitting and Review Made Recovery Effort Faster and Smoother

A major theme running throughout the session's presentations was the overwhelming effort federal, state, and local governments made to expedite permit processes. The U.S. Army Corps of Engineers (USACE) implemented expedited permit guidance through Special Public Notice #03-20, which established emergency permitting regulations for a two-year period. Immediately after the storm hit, the Maryland Board of Public Works (BPW) and the Critical Area Commission for the Chesapeake and Atlantic Coastal Bays (CAC) also realized the need to implement streamlined permit processes.

The BPW moved quickly to provide guidance on repairing damage while recognizing the significant volume of requests that would be forthcoming and the limited staff resources to assist with application reviews. It issued an Expedited Tidal Wetlands License to repair/replace structures damaged by Hurricane Isabel. The BPW also set out the authority; defined a timeline; established authorized activities, license conditions, and penalties for violations; and issued a consumer advisory.

The CAC's guidance on emergency permit procedures provided authority to local jurisdictions to implement a streamlined permit application process to allow property owners to: remove damaged structures and rebuild them on the original footprint or foundation; and remove damaged trees and other damaged vegetation, restore previously vegetated areas, and restore areas disturbed through compliance with emergency procedures.

Baltimore County also provided expeditious service to its communities by staffing the county's Disaster Recovery Center with personnel from Environmental Impact Review and Permitting departments. Building permit applications and approvals could be made at the center. The county

used 2002 geographic information system (GIS) information to verify the existence and size of structures and sent staff into the field only when structures could not be verified on aerial photos. Personnel also tracked the number of permits reviewed per hour to determine day-to-day staffing needs and developed categories of permits that could be finalized without delay. In the two months following the storm, Baltimore County processed over 300 permits per month, far exceeding the average 35 permits per month processed during the same time in the year after the storm.

Needed Improvements

Despite the large-scale efforts outlined above, panelists noted that some improvements could be made based on the lessons learned from their response to Hurricane Isabel. Most of the panelists agreed that federal, state, and local permitting processes should be amended to allow for minor enhancements or improvements to the design of rebuilt structures instead of replacing "like" structures in the same footprint. The BPW noted that it would have preferred to issue an Expedited Tidal Wetlands License to replace structures damaged by Hurricane Isabel with structures that would provide "greater environmental benefit," such as substituting damaged hard-shoreline structures with environmentally friendly methods of protection. Revetments to marsh creations, beach nourishment, and/or beach platform grading and bulkheads to revetments or marsh creations are all examples of projects that would provide "greater environmental benefit." Unfortunately, the state and federal permit processes could not be aligned to accomplish this process in expedited fashion.

"I Have No Idea How This Happened"

Another theme running through the panel presentations and audience discussions was the lack of understanding the general public has concerning the impact of natural hazards in local communities. Slides and visuals that showed extensive structural, physical, and natural resource damage that could have been avoided with proper planning appeared time and time again in the conference presentations.

Conversely, on a more positive note, panelists provided some sound guidance on how to improve the situation. Proper vegetation management—particularly within utility corridors—would prevent some undue electrical power outages. Elevating electrical meters and placing utility lines underground would lessen impact, as would educating public agencies and citizens not to store valuables or irreplaceable items in basements. Another recommendation, perhaps key to the "lessons learned" concept of the conference, was to use damage and permit application statistics along with demographic information to target planning and mitigation enhancements in preparation for the next major storm. As suggested, this step can be accomplished by mapping out structures within local communities that require repair/replacement permits to visually determine where to pursue flood mitigation efforts, including participation in the NFIP.

ADVANCES IN HAZARD MAPPING

Maryland is limited in its experience with storm disaster events compared to hot spots such as south Florida, North Carolina, and the Gulf Coast. Hurricane Isabel tested Maryland's response capabilities and planning activities. In particular, the events surrounding the preparation and response provided many success stories for which advancing technical capabilities proved invaluable. Since Hurricane Agnes in 1972, the evolution of GIS and information technology has greatly improved the ability to identify vulnerable areas. In turn, this advancement in technology has increased the sophistication of pre-disaster hazard planning and mitigation activities.

Within hours of the storm's passage over the Bay area, metropolitan regions rapidly generated incident reports and tracked these occurrences spatially through GIS databases. These products greatly assisted local staff in informing the commissioning bodies and allowing political appointees to illustrate the magnitude of the impacts to federal and state disaster relief and recovery organizations. Ultimately, these products rapidly

facilitated the declaration of Maryland as a State of Emergency and allowing it to become immediately eligible for federal disaster relief assistance.

The session highlighted advances in data and mapping technologies and demonstrated enhancements in identifying and mapping hazard areas more accurately. In particular, GIS provides an unprecedented opportunity to integrate multiple datasets to derive and visualize solutions to complex emergency management issues and identify hazard mitigation opportunities. Panel members included representatives of federal and state government and private and academic institutions working on various aspects of hazard mapping. Specific mapping applications discussed in these sessions included: LIDAR based-surge inundation modeling; modernization of floodplain studies; the HAZUS loss estimation tool; and statewide all-hazard mapping.

Session Chair: Ken Miller - Maryland Department of Natural Resources

Panelists:

Audra Luscher - Maryland Department of Natural Resources
Joseph Gavin - U.S. Army Corps of Engineers
Carrie Capuco - Capuco Consulting
David Sides - Towson University
Peter Conrad - City of Baltimore
Dave Guignet - Maryland Department of the Environment

Efforts and Opportunities in Hazard Mapping

Hazard mitigation mapping in Maryland is conducted mainly by two lead agencies: MDE and MEMA. Both agencies comply with federal mandates and programs established through the Federal Emergency Management Agency (FEMA). The MDE has responsibility for floodplain studies and mapping, repetitive loss GIS, and the CFMGP while MEMA is the first responder to any disaster in the state and prepares the State Hazard Mitigation Plan (SHMP) and vulnerability mapping, administers the HMGP, the Flood Mitigation Assistance Program (FMAP), and the Pre-Disaster Mitigation Program (PDM). MEMA is the primary contact agency for FEMA funding.

The MDE recently completed "A Business Plan for Map Modernization" for floodplain mapping and management. This report outlines the state's vision for floodplain management over the next five years (2004–2008) [4]. Maryland's vision for floodplain management is closely coupled with its vision for map modernization. The MDE seeks to reduce costs associated with traditional detailed studies by developing a new set of "live" studies (digital verses paper product), which can be modified as watershed conditions change. Any proposed changes can be modeled to keep the maps current as permits are issued. Another key to the modernization process is the acquisition of additional partnerships and funding to accomplish value-added improvements to support the study process.

With the advent of better elevation data and motivation from the storm to improve flood hazard mitigation, great momentum exists to update and increase the accuracy of floodplain maps in Maryland. These improvements incorporate updated elevation information generated from new data from LIDAR (LIght Detection And Ranging), using automated hydrology and hydraulic techniques to improve riverine floodplain analysis, and adding bridge and culvert data.

The MDE is currently working with FEMA and local governments to update all of the paper Flood Insurance Rate Maps (FIRMs) in Maryland and to develop Digital FIRMs for every county to allow different layers to be overlain in GIS. Each county will have continuous coverage (towns will be part of the county coverage), eliminating problems associated with annexations. The agency has received $2 million to complete flood studies and develop D-FIRMs for Anne Arundel and Howard counties and the lower half of the Eastern Shore, where LIDAR data are available. Once procedures are developed, the remaining counties will be completed as LIDAR becomes more accessible.

An important aspect of map modernization for state citizens will be better estimation of the risk of flooding and more accurate determination of who needs flood insurance from the NFIP. In Maryland, 116 communities participate in the NFIP—virtually all communities with land use authority with the exception of a few small towns. Whenever maps are revised based on better floodplain determinations, some properties will move into the floodplain, while other properties will be moved out. The ultimate objective, however, is to estimate the risk to all property more accurately.

In November 2004, MEMA completed the SHMP and associated mapping pursuant to regulations established by the Disaster Mitigation Act (DMA) of 2000. The goal of the SHMP is to reduce the loss of life and property damage associated with hazard events in Maryland. The agency complied with this priority as considerable effort has been expended to map state-owned and critical facilities, as well as impact areas for eleven other hazards.

The most important aspect of this mapping effort was the identification of facilities, total populations at risk, and vulnerable populations at risk within hazard areas. The data sets and mapping effort will continue to evolve and improve as new data and technologies become available. The FEMA has emphasized the importance of using the best available data when delineating hazardous areas, identifying facilities and populations at risk, and developing mitigation strategies.

Local governments are also required to develop multi-hazard mitigation plans and generate map products on vulnerable populations. These plans must be revised on a five-year schedule; however, annual reviews—particularly map updates—are encouraged. With the passing of the DMA, the PDM was created and is intended to fund mitigation measures before a disaster occurs to counties with hazard mitigation plans in place. Prior to the creation of this program, the only significant source of funding for hazard mitigation to county governments and citizens was the HMGP—grants only available after a presidential disaster declaration.

Another ongoing mapping effort involves HAZUS-Multi Hazard (MH), a risk assessment software program for analyzing potential losses from floods, hurricane winds, and earthquakes. This software estimates damage before or after a disaster and accounts for various impacts of a hazard event such as: physical damage to residential and commercial buildings, critical facilities, etc.; economic loss from lost jobs, business interruptions, and repair and reconstruction costs; and social impacts to people including requirements for shelters and medical aid.

The FEMA is sponsoring Anne Arundel County, Maryland as a national pilot for a coastal community. However, MDE is furthering these efforts and has partnered with Salisbury University to complete a statewide analysis of flood vulnerability estimated through the HAZUS-MH flood module. A Level One analysis estimating projected flood damage from a 100-year flood for each county, using national datasets, was released in spring 2005. The local jurisdictions can then decide to refine the analysis further by incorporating more precise local data.

New Data Advance Hazard Mapping

In Maryland, federal, state, and local partners have worked cooperatively using considerable resources to improve digital ortho-based mapping capabilities by acquiring high-resolution digital LIDAR imagery. This imagery provides elevation information at a scale never before offered and is improving the study and identification of flood and surge hazards. The use of LIDAR has multiple research and management benefits, with application to a range of tools and analyses including floodplain and hydrologic modeling, sea level rise studies, nonpoint source identification and resolution, and siting storm water restoration and "best management practices."

Acquisition of LIDAR was initiated in the low-lying counties of Maryland's Eastern Shore due to their vulnerability to coastal flooding and sea level rise. To date, over 1.5 million dollars have been provided through the Maryland's Coastal Zone Management Program (CZMP) and county

funds to acquire the bare earth or gridded digital elevation model (DEM) data. Ten coastal counties have been mapped, with partial coverage in two additional counties. Further funding from the CZMP has been allocated to delineate 2-ft (0.61-m) contours for portions of Dorchester, St. Mary's, and Anne Arundel counties and throughout Worcester County.

Panel discussions identified LIDAR as the most important data/tool available. Second to LIDAR was availability of good demographic and social data—essential for determining a region's vulnerability and potential impacts. With the exception of the HAZUS loss estimation model, all of the mapping products discussed used the newly acquired high-resolution elevation information.

Accessibility and Availability of Various Data Formats is Key Issue for Local Governments

The use of GIS and technical assessments to identify and develop strategies to mitigate storm impacts provided significant advantages in planning for and recovering from a disaster. The capacity to utilize these technical products, however, was not equal across all levels of government. In the days after the storm, differences in the capacity to use GIS-based information were highlighted, particularly at the county level. Metropolitan counties with numerous staff and advanced GIS facilities were more capable of using advanced technologies in the recovery process by spatially tracking damages, using GIS-based products to identify damage trends, and supporting decision-making. Such GIS tools and technologies are not as useful during the event, as emergency response decisions and activities are facilitated through more traditional means, such as radio announcements, word of mouth, and experience of residents and long-time emergency management staff to guide citizens out of harm's way. To merge technical capabilities into emergency management and planning activities of rural counties, however, an executive commitment to build facilities is needed from all levels of governments. Addressing the development of consistent data formats and mechanisms to transfer information to users of variable skill levels is also needed to increase the utility of many of these technical tools [5]. A concerted effort to make information available online through Internet mapping applications and data servers is a feasible option. Academia should also investigate its role in these efforts and seek opportunities to augment training and partnerships with state and local governments.

SOFT APPROACHES TO SHORELINE MANAGEMENT: ARE THEY EFFECTIVE?

Maryland's coastal zone comprises 66 percent of the total land area of the state. Bordering this coastal area is over 7,700 miles of shoreline, a disproportionate amount given the overall size of the state. A study by Maryland Geological Survey before Isabel determined approximately 69 percent of the shoreline has a measurable rate of shoreline change. A majority of this change, however, is less than 0.6 $m \cdot yr^{-1}$ (2 $ft \cdot yr^{-1}$) [6].

Immediately after Hurricane Isabel, Governor Robert L. Ehrlich tasked the Maryland Department of Planning (MDP) to oversee identification of the economic and environmental impacts and gather insights from the event to improve emergency response and recovery efforts. In June 2004, MDP issued "Lessons Learned from Tropical Storm Isabel" [1]. One of the single largest impacts of the event identified in the report was the economic impact of shore erosion on the citizens of the Chesapeake Bay. Much of the erosion occurred on properties along the open Bay, many with structural erosion control measures in place. Anecdotal information related to the success and performance of softer approaches in tidal creeks and embayments began to circulate in the months following the event.

The panel's objective was to discuss example projects that represent alternative approaches to traditional structural control in the Maryland Bay. These approaches are "softer," more natural shoreline treatments that incorporate living landscapes and minimize the structural components of erosion control. Although acceptance of these

practices is growing, homeowners often hesitate to rely on "softer" methods, as they are unsure of their effectiveness. The panel discussed the alternative approaches and identified approaches that performed well during the storm surge.

Session Chair: Audra Luscher, Maryland Department of Natural Resources

Panelists:

David Burke - David Burke & Associates
Kevin Smith - Maryland Department of Natural Resources
Bruce Young - St. Mary's County Soil Conservation District
David Wilson - Eastern Shore Resource, Conservation & Development Council
Marguerite Whilden - Terrapin Institute

Structural Control not Fail-safe

The surge generated from Hurricane Isabel piled up on the western shore of Maryland's Chesapeake Bay. The western side of the Bay has shorelines that are higher in elevation than those on the Eastern Shore. Along banks and bluffs, the surge elevated the line of wave attack higher on the banks. Any protection—manmade or natural (e.g., a narrow beach or marsh strand at the base of bluff)—was topped with the waves reaching farther inland. Upland areas not usually subject to wave attack were eroded during Isabel, while the shoreline itself did not appear to change position significantly. The main effect of the storm surge was the translation of the zone of wave influence vertically, removing the energy of wave attack from the toe of the bank or bluff [7].

After the surge peaked, floodwaters began to drain to the Bay. Most damage to erosion control structures occurred from hydraulic loading of the floodwaters on the backside of structures. Receding floodwaters scoured fastland sediment behind the structures and appeared to cause selective failure in the lowest or weakest point in a line of structural control. Once a structure was breached, water funneled to the Bay through that position, consolidating the energy and significantly scouring individual land parcels.

The need for maintenance of non-structural/hybrid approaches was minimal compared to the cost of reconstructing erosion control structures. In many cases, the greatest cost for reconstruction was replacing the tremendous volume of fill to re-establish the pre-storm profile above the height of the existing erosion control structure. To avoid any storm impact on these shorelines from a 100-year surge event, the structures would need to be considerably higher in profile or the bank would require a grade that accommodates wave run-up from the surge. To create a structure of that magnitude is economically prohibitive for most property owners and would lead to considerable impact on public bottom, access, and shoreline habitat. For many homeowners and coastal managers, the trade-off of greater protection is not worth sacrificing the connection to the Bay. Therefore, the concept of designing with nature instead of total defense against storm and wave processes was a major theme in the session.

Design with Nature

The panelists discussed a wide array of non-structural/hybrid approaches that were in place before the storm. These approaches included shore-perpendicular groins (rock and biologs) with marsh plantings, low-profile sills, marsh toe revetments, and offshore breakwaters (unattached and shore-parallel). For the structures highlighted in the session, post-construction photos and "as built" drawings were used to determine if changes in profile, sediment distribution, and plant abundance and health occurred. A structure's success depended greatly on site-specific characteristics, including energy environment, sun exposure, and boat traffic. In low-energy environments, low-profile sills with backside vegetative plantings appeared to have greater stability and success than groin systems. The low-profile sills appeared to diminish day-to-day wave attack and allowed the surge to roll up and over the structure with the vegetation baffling surge energy. Changes in profile of the shoreline due to sediment redistribution and loss of vegetation

occurred more often with the groin projects. Groin projects had the most success in areas with sediment sources and longshore transport that built the shoreline outward. Adjustments in profile and plant density can often be dealt with through routine maintenance, including re-grading the profile and vegetation plantings. Routine maintenance is not usually associated with structural approaches.

Monitoring Can Guide Site-selection Criteria

As soft approaches are not appropriate in all locations, better targeting of suitable shoreline settings can help assure project success. In particular, long-term monitoring of projects is needed throughout the Bay, as most are not evaluated after installation. Several recent efforts and studies are addressing how these projects perform over time. The Eastern Shore Resource Conservation and Development Council is in the process of assessing and photographing many of the more than 500 non-structural projects implemented over the last 15 years. Furthermore, the University of Maryland Center for Environmental Studies was supported to conduct science-based monitoring and assessment of five non-structural approaches in summer 2004 [8].

On-site and pre-construction analysis of site-specific conditions are the best approaches to ensure the success of an individual project. However, regional and eco-based assessments to assist in targeting areas for alternative approaches do not exist for most shorelines along the Bay. The CZMP, in cooperation with Towson University, is developing a data-intensive and spatial approach for regional targeting and shoreline management. An Internet-based resource portal, Shorelines Online, will provide data distribution capabilities, Internet mapping tools, and information about shore erosion and innovative methods for shoreline protection and restoration. The portal will provide a framework for centralizing access to technical and financial resources and data as a mechanism to improve shoreline planning and assist in decision-making/visualization of potential options. As shoreline management must balance infrastructure/property risk with the need to maintain shoreline habitat, a mapping tool hosted on this site will display spatial data and targeting tools to help stakeholders identify where alternative approaches are appropriate. The project seeks involvement of a wider array of stakeholder participation, particularly the public, in decision-making and data utilization by having the product available through the Internet.

TRAINING OPPORTUNITIES

Drawing from lessons learned, conference participants engaged in a dynamic forum to understand large storm events more fully and to enhance planning and preparedness for future natural events. The conference offered an excellent opportunity for information gathering and exchange for local planners and resource managers. One of the conference's major lessons learned was the need to increase our knowledge of hurricane dynamics and resultant impacts, and to translate this information from scientists to planners and emergency responders, and ultimately, to the general public. Opportunities to continue the education process are provided below.

Severe Storms Conference. This annual conference is hosted by the MEMA in the spring of each year. The conference provides valuable information on hurricane preparedness for Maryland's local governments and state agencies. The agenda for the conference includes a variety of breakout groups and presentations by the NWS and the National Hurricane Center (NHC). For more information, contact Robert Ward at (410) 517-3600 or by e-mail at *rward@mema.state.md.us*.

Maryland Association of Floodplain and Stormwater Managers. Formed in 2004, the association is comprised of local, state, and corporate floodplain managers. Anyone interested in floodplain or stormwater management can become a member and/or attend its annual meetings and training opportunities. For more information, contact Mike Sheffer at (301) 210-6800 or by e-mail at *msheffer@pbsj.com.*

Certified Floodplain Manager Program. This program was established by the Association of State Floodplain Managers to enhance the training and professional status of floodplain managers. Training courses are offered throughout the year. More information about the program and training opportunities can be found on the website at *www.floods.org.*

Introduction To Hurricane Preparedness. This course is held annually at the NHC. For more information, contact Robert Ward at (410) 517-3600 or by e-mail *rward@mema.state.md.us.*

Emergency Management Institute (EMI). This institute offers several useful floodplain management and hurricane planning courses online and at its training facility in Emmitsburg, Maryland. For more information on courses or to download an admission application, go to *http://training.fema.gov/EMIWeb/*. All applications must first be forwarded to the state training officer at MEMA.

Hurricane Planning. This two-day course is held annually by EMI. The course covers proven methods and techniques for planning response operations before and after a hurricane. Topics include hurricane hazards forecasting and decision aids, evacuation, shelter, refuges of last resort, and initial post-storm response. Planners responsible for developing or revising hurricane operations plans and procedures should attend. For more information, visit EMI's website at *http://training.fema.gov/EMIWeb/* or contact Sam Isenberger, EMI Training Division, at (301) 447-1071.

HURREVAC/SLOSH Training. This one-day training is held annually by EMI. It is a new FEMA developed standardized course of the FEMA-US Army Corps of Engineers hurricane decision-making software program known as HURREVAC. The training provides instruction with hands-on (interactive) experience and includes an exercise. The course briefly covers all aspects of HURREVAC and is for beginners as well as users seeking a refresher. For more information, visit EMI's website at *http://training.fema.gov/EMIWeb/* or contact Sam Isenberger, EMI Training Division, at (301) 447-1071.

Community Hurricane Preparedness. This EMI computer-based course provides those involved in the decision-making process for hurricanes with basic information about how hurricanes form and their hazards, how the NWS forecasts future hurricane behavior, and what tools and guiding principles can help emergency managers prepare their communities. For more information, visit EMI's website at *http://training.fema.gov/EMIWeb/* or contact Sam Isenberger, EMI Training Division, at (301) 447-1071.

Hurricane: Preparedness and Response. This EMI exercise-based course addresses preparedness and response in emergency situations due to a hurricane. The course places public officials and other key community leaders in a disaster simulation. Methodologies of classroom instruction, planning sessions, and exercises allow structured decision-making in an educational, yet realistic, environment. A key outcome is that additional planning needs are identified, providing the opportunity to enhance overall preparedness. The exercise scenario focuses on evacuation issues prior to the simulated hurricane making landfall and response activities after. For more information, visit EMI's website at *http://training.fema.gov/EMIWeb/* or contact Sam Isenberger, EMI Training Division, at (301) 447-1071.

Hurricane: Recovery and Mitigation. This EMI exercise-based course emphasizes recovery and mitigation issues. The course places public officials and other key community leaders in a simulation that begins after a disaster has affected a community. The course methodologies of classroom instruction, planning sessions, and exercises allow structured decision-making in a realistic learning environment. A key outcome is to provide participants with the ability to carry out their respective functions related to disaster recovery, both in the short and long term. The

exercise scenario focuses on community recovery from a hurricane disaster. Mitigation activities to prevent or reduce the future impact of a hurricane are also identified through course exercises. For more information, visit EMI's website at *http://training.fema.gov/EMIWeb/* or contact Sam Isenberger, EMI Training Division, at (301) 447-1071.

FEMA/NFIP website. This website is a great resource for multiple audiences, including consumers, insurance professionals, and state and local officials. The site provides links to computer-based training, classroom training, and "Ask the Expert" training. Visit *www.fema.gov/nfip* or for more information, contact Richard J. Sobota at (856) 489-4003 or by e-mail at *rsobota@csc.com.*

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