



SECURING PROSPERITY IN THE COASTAL ZONE

VIRGINIA ACADEMY OF
SCIENCE, ENGINEERING, AND MEDICINE

2018 Summit Report

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FROM SENATOR MARK WARNER

Dear Friends,

In 2013, I convened a small group comprised of the Virginia-based members of the three national academies—National Academy of Sciences, National Academy of Engineering, and the National Academy of Medicine—along with the presidents of Virginia's premier research universities to develop an independent body of science and technology experts to advise state policymakers on related issues of the day. From this meeting, the Virginia Academy of Science, Engineering, and Medicine (VASEM), modeled after the National Academies, formed and began hosting summits to forecast emerging issues critical to all Virginians.

The 2018 Annual Summit on Securing Prosperity in the Coastal Zone covered a broad range of interconnected issues that impact the prosperity of all Virginians. Hampton Roads and the surrounding coastal region in Virginia is host to the world's largest Navy base, a bustling port, top-tier research assets in our universities, national labs, and NASA facilities, and a fast-growing population and private sector economy. By providing opportunities for our policymakers and industry and research professionals to collaborate, we can develop a plan to maximize the potential of the coastal zone's assets and work to address emerging issues.

The organizing committee for this year's summit brought together a cross-section of universities working on issues related to the challenges facing Virginia's coastal zone. From this summit, important conversations are continuing with policymakers about further work that can be done as Virginia wrestles with this issue. Bringing our research capabilities together to inform policymakers with actionable guidance is why I helped create VASEM. I look forward to following its progress.

Sincerely,

Mark R. Warner
United States Senator



KEYNOTE

Lieutenant General (Ret.) Thomas Bostick, Former Chief of Engineers and Commanding General of the U.S. Army Corps of Engineers

REDUCING THE RISK OF COASTAL STORMS

Lt. General (Ret.) Thomas Bostick kicked off the 2018 VASEM Summit by praising Virginians for their pioneering efforts to plan for sea-level rise and more frequent and intense storms. “People in coastal areas across the country are focusing on this region,” he said. “It is leading the nation in exploring how we will live with water in the future.”

One reason, he suggested, is the special urgency of the challenge facing Virginia. Virginia is being impacted by subsiding land and a slowing Gulf Stream as well as rising seas. The result is the highest relative sea-level rise on the entire East Coast.

Bostick is in a position to know. He retired as Chief of Engineers of the United States Army and Commanding General of the U.S. Army Corps of Engineers (USACE). In that post, he helped lead the response and recovery efforts in the aftermath of Hurricane Sandy, which included over \$5 billion in USACE projects.

“I come here knowing that you have a great team of educators, scientists, and engineers, as well as business, academic, and community leaders who are coming together to tackle these very complex issues,” he said. Throughout his keynote address, Bostick stressed the importance of developing a collaborative approach to addressing sea-level rise. “The only way to solve tough challenges is to work together,” he said.

A MORE REALISTIC APPROACH TO RISK

Bostick noted that the key to any successful solution is to leave behind old ways of thinking about risk. In the past, engineers evaluated threats, determined vulnerabilities, and assessed consequences with the idea of building infrastructure to resist extreme forces. The problem with this approach, he noted, is that it is impossible to fully predict the future. “Inevitably, something

is going to come along that will defeat the measures we put in place,” he said. “A better approach is to create infrastructure systems that are resilient to disasters. You want to plan, absorb, recover, and adapt.”

These risk management solutions are inherently multidimensional. That was one of the major lessons highlighted in the North Atlantic Coast Comprehensive Study (NACCS), which USACE published in response to Hurricane Sandy. NACCS brought together experts from federal, state, and local government agencies, as well as non-governmental organizations and academia, to assess the flood risks facing coastal communities and ecosystems and collaboratively develop a coastal storm risk management framework to address increasing risks.

NACCS advocates a systems approach to resilience. “There are many options that can be applied in various combinations depending on circumstances,” Bostick said. “They can include reefs and submerged aquatic vegetation, drainage improvements, beach restoration and groins, seawalls and floodwalls, and acquisition and relocation of structures.”

THE HUMAN ELEMENT IN COASTAL STORM RISK MANAGEMENT

Bostick reminded the audience that infrastructure is not the only component to successful coastal storm risk management. It is vital, he said, to involve stakeholders from the start when developing a plan and to make sure they understand its implications. Typically, coastal risk assessments have not involved stakeholders, thereby producing very frustrated stakeholders after disasters occur. For instance, after Hurricane Sandy, many people felt angered and betrayed.

Bostick also noted that it is critical to be responsive to the political dimensions of disaster recovery, a lesson underscored by his interactions with Mayor Michael Bloomberg in New York City after Hurricane Sandy. “Our job is to make sure elected decision-makers know we are here to support them and work as part of their team,” he said.

THE FUNDING CONSTRAINT

Adding a note of realism, Bostick pointed out that the ability to effectively implement the framework laid out in NACCS and similar documents is often constrained by funding issues. The Army Corps of Engineers has a \$60 billion backlog of projects but receives only about \$1.5 billion a year for construction. “We have to spread these funds thinly like peanut butter among thousands of projects,” he said. Aging infrastructure and delayed maintenance problems are not restricted, however, to areas of USACE responsibility; they are general across the country. Bostick pointed out that the most recent

grade that the American Society of Civil Engineers gave to U.S. infrastructure as a whole was a D+.

The consequence of insufficient funding was abundantly clear in New Jersey in the aftermath of Hurricane Sandy. Of the USACE projects along its 137 miles of coastline, 15 were simply authorized, nine had funding appropriated, and just nine were either under construction or completed. These last nine locations received minimal damage from the superstorm.

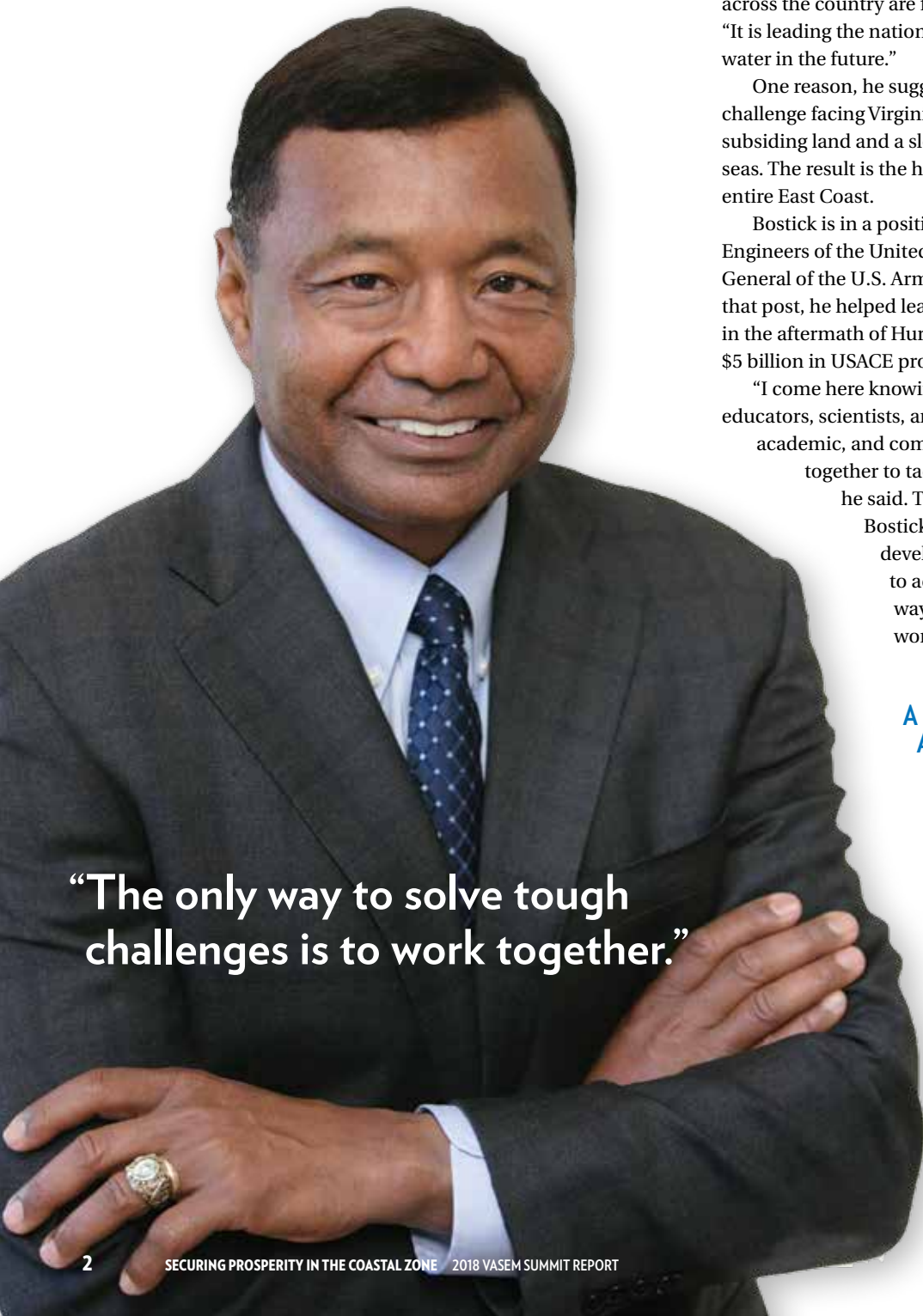
VIRGINIA IS OUT IN FRONT

In concluding his presentation, Bostick returned to his theme of Virginia’s leadership in managing the risk of rising seas. Bostick cited early efforts of the Virginia Silver Jackets team, which brings together staff from Virginia’s Departments of Emergency Management, Conservation and Recreation, and Environmental Quality with representatives of the Natural Resources Conservation Service, Federal Emergency Management Agency, National Weather Service, and U.S. Geological Survey. Since its founding in 2010, the Silver Jackets initiative has been effective in facilitating communication, sharing information, and providing a single source for local and state governments to obtain information and identify solutions to reduce flood hazards.

Bostick also highlighted efforts undertaken by the City of Norfolk. He noted that Norfolk’s position as a global security hub and international trading nexus made it imperative that it adopt a resiliency plan. He emphasized his point by offering several facts and statistics. Among other facilities, Norfolk is home to the world’s largest naval station and NATO’s North American Headquarters. Naval Station Norfolk has 12.4 miles of waterfront and employs 21,000 civilian government employees and contractors in addition to the 46,000 members of the military on ship and ashore. It is also home to Norfolk International Terminals, part of the Port of Virginia.

Bostick praised Norfolk for being one of the first Rockefeller Foundation Resilient Cities and the third city in the United States to launch a citywide resilience strategy. He also expressed his confidence that its Coastal Storm Risk Management Plan, which calls for more than \$1.7 billion in projects to protect the city from inundation during large coastal storm events, would be authorized by Congress. The plan assumes a 1.25-foot rise in sea level between 2026 and 2075 and, following the systems approach advocated by NACCS, calls for a combination of structural measures such as floodwalls, levees, and storm surge barriers, as well as nonstructural and natural and nature-based features.

“Here again, the question is the speed at which funds will be disbursed to create the infrastructure called for in the plan,” he said. “This project has tremendous potential but will require an across-the-board effort to make sure it gets done.” ◀



“The only way to solve tough challenges is to work together.”

KEYNOTE

Rear Admiral (Ret.) Ann Phillips, Special Assistant to the Governor for Coastal Adaptation and Protection

A VISION FOR COASTAL ADAPTATION AND PROTECTION

When Rear Admiral (Ret.) Ann Phillips was transferred to Hampton Roads more than a decade ago, she began to wonder about two things: Why, whenever it rains, does the whole place submerge? And why do I live in a city that's not in a county? "In many ways, these two questions encapsulate the challenges we face in addressing sea-level rise," she said. "And in the 12 years I have lived in Coastal Virginia, our problems have grown worse."

Phillips pointed to Old Dominion University professor Larry Atkinson's work that demonstrated that the region had reached a tipping point in the 1990s. Since then, flooding now occurs with greater and greater frequency, duration, depth, and results from a greater variety of causes. Within a decade or two, the nuisance flood—0.53 meters above mean higher high water—will occur at nearly every high tide cycle. Addressing this problem, Phillips said, will require collaboration across jurisdictions, be they city or county, state or federal.

CREATING A TEMPLATE FOR CHANGE

Phillips recalled that her first exposure trying to address these issues was when she was asked to chair the Infrastructure Working Group for the Hampton Roads Sea Level Rise Preparedness and Resilience Intergovernmental Pilot Planning Project, which was convened by Old Dominion University. The project worked to develop a collaborative, whole-of-government and community approach to address the impact of sea-level rise across the Hampton Roads region. The pilot project identified five key needs:

1. The need to develop and implement common regional planning standards, including common base-floor elevation, building and zoning codes, GIS attributes, and sea-rise level planning scenarios.
2. The need for support from universities to ensure the best possible science, data, and engineering expertise is available from a nonpartisan trusted agent.
3. The need to establish a regional data center to ensure an independent, centralized capacity to collect, analyze, distribute, and respond to regional data needs.
4. The need to identify critical infrastructure that is vulnerable to sea-level rise and to ensure collaborative,

prioritized planning and execution to create formalized relationships between federal and state governments, cities, municipalities, businesses, non-profits, and citizens.

5. The need to identify and prioritize projects in order to develop regional funding strategies and to create funding instruments for regional program needs.

Phillips noted that subsequently there has been progress in many of these areas. For instance, all 17 cities and municipalities in the Hampton Roads Planning District Commission (HRPDC) agreed unanimously in fall 2018 to adopt a set of uniform sea-level rise planning and policy guidelines. In addition, the Virginia General Assembly in 2016 established the Commonwealth Center for Recurrent Flooding Resilience that taps the expertise residing at our area's universities.

Phillips also pointed out that the five key tenets identified in the pilot project are consistent with what other regions are doing. "This framework positions us to connect to other regions around the country and around the world," she said. "It enables us to become a part of a global organization of coastal communities learning to live with the challenges of climate impact and sea-level rise."

"We need all hands on deck."



PHOTOGRAPH: TOM SAUNDERS, VDOT

THE TRUTHS ABOUT THE CHALLENGES WE FACE

Phillips set the stage for talking about Gov. Northam's efforts to increase the resiliency of Virginia's coastal zone by listing a series of truths about the challenges we face. They included the following:

- On the 50- to 100-year time scale, there is an existential threat to the commercial and government infrastructure of Coastal Virginia. This is a threat to our national security.
- The accelerating growth of its huge federal and port presence make Hampton Roads and therefore Coastal Virginia a crucible for the complex challenges that lie ahead.
- We do not, yet, have a water-management economy. Water management does not mean the elimination of all water.
- Coastal Virginia understands and accepts the fact of increased flooding. The need for long-term "revisioning" is less broadly understood.
- Realistic but sometimes stove-piped planning is proceeding.
- The key to success is in regional collaboration—and in federal, state, and local alignment.
- In reality, we need a national response to this challenge.
- Finally, waiting for the next big flooding event to stimulate funding is not an acceptable planning or adaptation methodology.

EXECUTIVE ORDER 24 (EO24)

As special assistant to the Governor for coastal adaptation and protection, Phillips said she found herself in the position of having an opportunity to do more than talk about the challenges that lie ahead for coastal Virginia and to actually be a part of planning and preparing for our future. She noted that Executive Order 24: Increasing Virginia's Resilience to Sea-Level Rise and Natural Hazards was signed just days before the summit convened. It contains three specific sections, each with slightly different intent, all focused on preparing Virginia for what is to come.

Section 1 focuses on making Commonwealth holdings more resilient and directs the Commonwealth's chief resilience officer, Secretary of Natural Resources Matt Strickler, to prepare, assess, and set standards for a unified sea-level rise projection and freeboard standard to protect state governmental building structures

Section 2 calls for the creation of a Virginia Coastal Resilience Master Plan. The intent of this is to use the best possible science and engineering from the many excellent universities across the state. It will include green,

grey, and blue infrastructure projects, marsh and wetland restoration, natural and nature-based infrastructure, along with innovative engineered solutions and smart development to protect our communities, homes, and businesses.

Section 3 focuses on coordinating statewide resilience. Phillips quoted Gov. Northam's explanation of this approach: "To truly make Virginia resilient, we must have a comprehensive and collaborative approach through engaging the federal government, localities, businesses, nonprofits, and, most of all, citizens." "We need," said Phillips using a Navy term, "all hands on deck."

FIVE OPPORTUNITIES FOR STUDY

Phillips then set out five opportunities for additional study. She listed the following topics:

Opportunity One—We must give our citizens a series of choices and paths that would give them options over time, so that we can create an orderly process to retain value but consider regional relocation. Likewise, we must give cities economic incentives to re-envision infrastructure at the water's edge that is vulnerable and will be too costly to protect, while still retaining economic vitality and the ability to service and meet the needs of their citizens.

Opportunity Two—We must quantify economic value to fully understand the positive impact to our economy created by green infrastructure and by natural and nature-based features in the context of developing our future cities. Right now, green infrastructure in any form scores very poorly.

Opportunity Three—We must gain an understanding of how such traditional water-based economy industries as aquaculture, fisheries, and coastal tourism as well as our coastal communities are affected by rising waters so that we can plan for their future.

Opportunity Four—We must develop a clear understanding of how sea water and rising groundwater interact to impact our infrastructure, and our property values.

Opportunity Five—We need a detailed risk assessment of flooding from extreme rainfall across the state.

In closing, Phillips returned to EO 24 and its importance in setting Virginia on a long-needed path to a collective future of resilience. EO 24, she said, lays out a framework for collaborative regional planning, including creative, innovative, and unique approaches that are tailored for our needs. It also generates opportunities for a vibrant innovation economy and for managing and using water in ways that can ensure the health and well-being of our citizens and our coastal heritage for generations to come. «

KEYNOTE

Thomas Farrell, Jr., Chairman, President and CEO of Dominion Energy

SUSTAINABLE ENERGY SUPPORTED BY SUSTAINABLE BUSINESS PRACTICES

Thomas Farrell, Chairman, President, and Chief Executive Officer of Dominion Energy, began his keynote address by reminding the audience how much society has advanced since the Middle Ages. In the 13th century, he noted, the average life expectancy was 31. People spent their lives in backbreaking manual labor, never traveling more than a few miles from their birthplace. Today, we live in a world of vaccines and beta-blockers, of cross-country flights, and of pocket-sized, plastic devices that enable us to access the entire sum of human knowledge.

“It is hard to overstate how fortunate we are to live in today’s astonishingly complex world,” Farrell said. “These advances were brought to you—and to me—by science, engineering, and medicine. We should never let anyone forget it.”

But rather than dwell on the past, Farrell took the opportunity to focus on the future—and in particular how the stressors on Virginia’s coastal zone are creating opportunities for innovation and further progress. As the leader of the region’s major power company, Farrell discussed these stressors and opportunities from the perspective of the energy sector.

He organized his presentation around three themes: renewable energy; the anticipated increase in power consumption, especially driven by electric vehicles; and resilience, the degree to which we are prepared for stressors and are able to bounce back from them.

RENEWABLE ENERGY

Farrell noted that there is a groundswell of interest in renewable energy sources, particularly solar and wind. “Dozens of cities have committed themselves to 100 percent renewable energy. So have scores of corporations. A majority of the public,” he observed, “wants as much renewable energy as possible.”

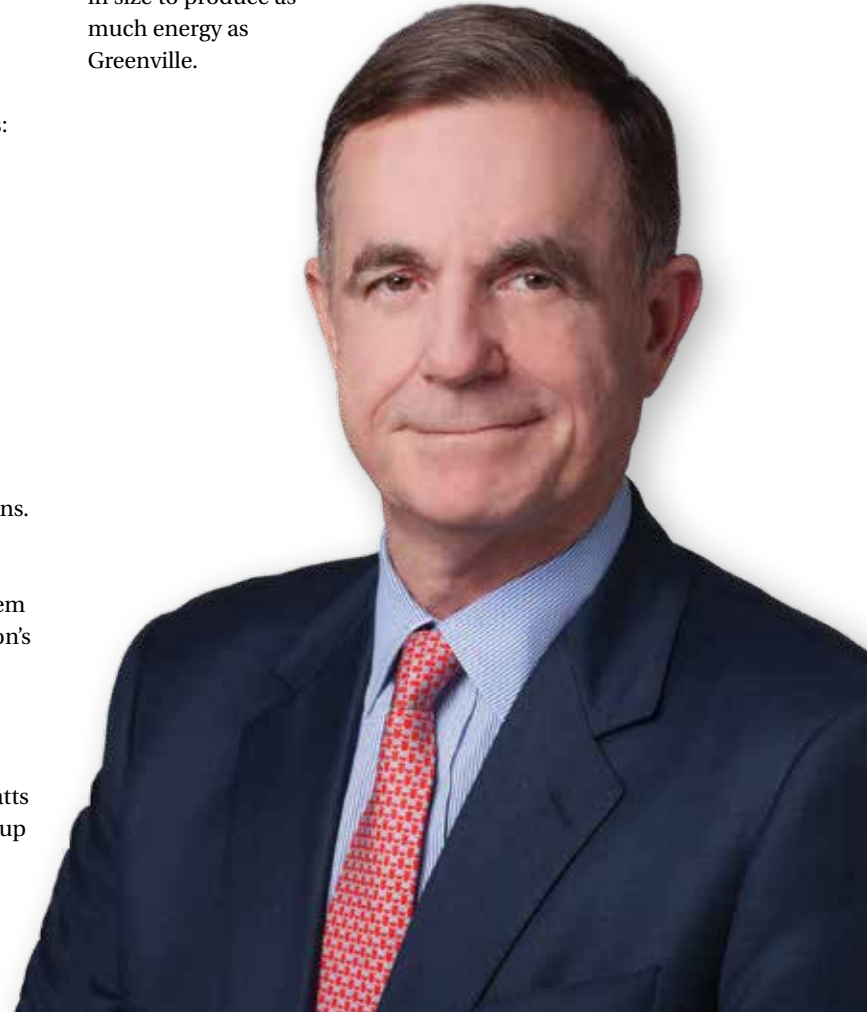
Dominion Energy, Farrell declared, is giving it to them in ever-increasing amounts. At the same time, Dominion’s stakeholders expect sustainable business practices. Dominion is also delivering on that commitment.

Farrell noted that in the last five years, Dominion Energy grew its solar fleet from zero to roughly 1,700 megawatts. It has plans for an additional 3,000 megawatts of solar and wind by 2022. Currently, its customers use up

to 22,000 megawatts at peak demand. “Renewable energy is a real opportunity,” Farrell said. “We intend to take full advantage of it.”

Farrell stressed, however, that every investment has an opportunity cost. When funds are allocated for a specific use, they are spoken for. They cannot be used for something else. He noted that there are a number of opportunity costs associated with solar energy. The most significant is funds invested in land.

Farrell noted that its new natural-gas-fired station being brought online in Greensville County will generate 1,600 megawatts with a footprint of only about 55 acres. Dominion’s 100-megawatt solar facility in Southampton County covers 1,200 acres. Furthermore, even with periodic maintenance, the Greenville station can produce at 85 percent of its capacity. Darkness and cloudy weather limit solar energy’s capacity to only about 25 percent. Taking capacity into consideration, a solar farm would need to be 65 square miles in size to produce as much energy as Greenville.



Farrell’s point was that the money Dominion Energy invested in land would be money it could not invest elsewhere—and that the land would have to be assembled so that it doesn’t disrupt the environment. This could mean rooftop solar or placing solar farms in highway medians. Solving this problem will require innovation.

Wind is the other form of renewable energy that Farrell highlighted. “Wind farms represent a terrific, clean-energy opportunity,” Farrell said. “But they also qualify as stressors to people and wildlife in certain circumstances. This might lead to a policy consensus that offshore wind farms make better sense all around.”

Farrell told the group that the State Corporation Commission had just approved Dominion Energy’s proposal for a Coastal Virginia Offshore Wind pilot project. It would be one of the first offshore wind projects in the country, the first to be owned and operated by a utility, and the first to be located in a federal lease area. If the pilot project goes well, it could pave the way for an additional 3,000 to 4,000 megawatts of offshore generation.

CHANGES IN POWER CONSUMPTION

Farrell then shifted from the supply to the demand side of the power equation. There are several forces at work. The first is population growth. Farrell noted that Virginia’s population is expected to rise to 10 million by 2050, an 18 percent increase from today. Energy conservation and efficiency measures may reduce some of the potential additional demand caused by rising populations. A more important stressor is the rise of electric cars.

Currently, there are about 750,000 electric cars on the streets of America, consuming just under 2 million megawatt hours annually. They represent just 2 percent of

“It is hard to overstate how fortunate we are to live in today’s astonishingly complex world.”

the overall market. As they grow in popularity, the demand on the system will grow dramatically.

Farrell then made a series of calculations that demonstrated this increase. If the typical licensed driver in Virginia, driving 15,000 miles a year, bought a Tesla 3, he or she would require 3,900 kilowatt hours each year to drive the vehicle. The average home in Virginia consumes 13,440 kilowatt hours per year. Adding one hundred Teslas is the equivalent of adding 30 houses to the grid. If half the 8.2 million vehicles in Virginia were replaced by all-electric vehicles, electricity demand in Virginia would increase by

the equivalent of more than 1 million households.

The key to addressing this need, according to Farrell, is better batteries that can store surplus power and release it into the system when it is needed. One approach that Dominion Energy has pioneered is a pumped-storage hydropower system. The concept is simple. There are two water reservoirs, one low and one high. When energy demand is low, water is pumped from the lower reservoir into the upper one. When energy demand rises, the water is released and generates electricity. Devices like this, Farrell suggested, could turn the stress of high demand into an opportunity for energy suppliers like Dominion.

RESILIENCE

Given our increased reliance on electric power in the future, it is clear, Farrell argues, that we must have resilient power systems. He noted that the devastation caused by Hurricane Maria in Puerto Rico was magnified many times over by the catastrophic damage to the power grid. What can utilities do, Farrell asked, if climate change leads to more frequent extreme weather?

One answer, he said, is for Dominion and other utilities to continue doing what they are doing now. For instance, they have emergency-response teams that follow FEMA’s National Incident Management System protocol. They have integrated Power Delivery Crisis Response Plans and hired chief risk officers. They conduct emergency drills and long-range scenario planning.

Another approach is to continue diversifying their fuel mix. A diverse fuel mix contributes to the reliability of the grid and lowers exposure to sudden energy price swings. In Virginia, Farrell maintained, this requires natural gas, both as a backup reserve for intermittent renewable generation and as a fuel in its own right. In his view, this necessitates additional pipelines, particularly the Atlantic Coast Pipeline.

Another component of resilience is grid resilience, promoted by the Grid Transformation and Security Act. This will include strategic undergrounding. Dominion Energy will spend \$2 billion over the next 10 years to place the

worst-performing neighborhood power lines below ground, cutting the duration of power outages by half. It will take other actions as well, for instance using concrete poles along the oceanfront, hardening substations serving critical facilities, and pursuing smart-meter technology that can pinpoint outages.

There is no single answer, Farrell concluded, but a combination of innovations and changes that will increase the resilience of the systems that are responsible for maintaining the quality of life we enjoy in the 21st century. «



U.S. NAVY PHOTO/CALEDON RABBIPAL

Assets

VIRGINIA'S COASTAL ZONE POSSESSES A COMBINATION OF ASSETS THAT ARE unmatched anywhere in the nation. They include:

- A series of military installations that includes the world's largest naval station
- The Port of Virginia, which offers direct service to more than 45 countries worldwide
- A flourishing industrial base that includes an extensive shipbuilding industry
- Headquarters of several federal agencies as well as critical facilities that support national security
- A series of highly ranked universities and research institutions
- A flight and rocket-launch range that services a variety of government and commercial customers
- Beaches and other attractions that attract millions of tourists each year
- A one-of-a-kind estuarine system that supports a thriving fishing industry.

All this is underpinned by an extremely highly educated, well-trained workforce and a collaborative culture in which federal, state, and local governments have successfully joined forces with industry and citizens group to address issues across the coastal zone. ■

James Balocki

THE NAVAL PRESENCE IN HAMPTON ROADS

A THREE-PART RESPONSE

Colonel (Ret.) James Balocki has a visceral understanding of the effects of sea-level rise on coastal communities. In the aftermath of Hurricane Sandy, he led a task force charged with restoring power in New York and New Jersey.

But in addition to understanding the scale of coastal assets and the stressors facing them, Balocki appreciates the opportunities that arise when communities come together to mitigate them. In his presentation, Balocki, now deputy assistant secretary of the Navy for installations and facilities, covered all three issues.

In response, the Department of the Navy has created the position of chief resiliency officer, a first for the Department of Defense. "This will enable us to develop multidimensional, multisystem resiliency that involves not only weather and manmade threats, but all kinds of threats that impact our physical and virtual operating environments," he said.

Balocki also cited the importance of military and civilian communities working together as a way to address environmental issues like sea-level rise. There is a precedent for this. He cited the collaboration of the cities of Virginia Beach and Chesapeake with Naval Air Station Oceana that resulted in a Joint Land Use Study to better anticipate potential conflicts between growth and operations. This led to the cities adopting zoning ordinances that the Navy incorporated into its land use planning and compatibility criteria. "Adopting these

A CLUSTER OF CRITICAL NAVAL FACILITIES

Balocki focused on the many critical federal assets in the Tidewater-Hampton Roads area that are vulnerable to risks associated with environmental threats. He began with Naval Station Norfolk, the world's largest naval station. It is home port to four carrier strike groups, the Military Sealift Command, and the submarines of the Atlantic Fleet.

Although Naval Station Norfolk is the area's dominant facility, it is far from the only major facility in the region. Balocki also listed Portsmouth Naval Shipyard, one of just four public shipyards in the nation capable of repairing and refueling the Navy's nuclear vessels; Naval Weapons Station Yorktown, which provides weapons and ammunition storage and loading for ships of the U.S. Atlantic Fleet; and Naval Air Station Oceana, which is responsible for training and deploying the Navy's Atlantic Fleet strike fighter squadrons. Balocki noted that the Department of Navy has over 150,000 civilians, sailors, and marines in the Tidewater-Hampton Road area. "This is a significant presence, one that represents a substantial investment by taxpayers," he said.

There are a number of stressors facing these installations, Balocki continued. Some are natural. They are facing the storm surges associated with more intense hurricanes as well as more frequent tidal flooding associated with sea-level rise. The Navy also recognizes that the growing population of Virginia's coastal communities represents a challenge to its training capacity.



U.S. NAVY PHOTO/JUSTIN WOLPERT

ordinances along with collaborative staff review for development applications has enabled the Navy and the cities to make more compatible choices," he said.

In addition, the Navy entered into multiyear partnership agreements with both cities to purchase properties

in areas affected by operations. On their part, the cities, with assistance from the Commonwealth, created an airfield acquisition and conformity program to purchase properties and relocate families and businesses when necessary. "For more than a decade, these programs have really been effective in reconfiguring the landscape near our airfields in ways that satisfy all parties," he said. "This creates a template for joint action to address environmental concerns."

Balocki concluded by stressing to the audience that the Navy recognizes challenges that it shares with local communities. "We are committed to working jointly to identify the risks and vulnerabilities facing our assets," he said. "We are committed to working together to understand their impacts and partner to achieve solutions." «

VIRGINIA'S CRITICAL AEROSPACE ASSET

An asset that sets Virginia apart from many coastal states is NASA Wallops Flight Facility on Virginia's Eastern Shore. Wallops provides low-cost flight and launch range services for a variety of government and commercial customers. Bill Wrobel, Wallops' director at the time of the summit, provided an overview of its programs.

Established in 1945, Wallops is NASA's premier location for conducting research using suborbital vehicles—aircraft, scientific balloons, and sounding rockets. Thanks to its partnership with the Mid-Atlantic Regional Spaceport, Wallops' capabilities also extend to the launch of orbital vehicles. Northrop Grumman uses MARS for its Antares rockets, which supply the International Space Station several times a year. To support these activities, Wallops provides range safety, surveillance, vehicle tracking and communications, command, meteorological services, and optical systems and maintains a range control center, payload processing facility, and launch vehicle integration center.



NASA/BILL INGALLS

In addition, Wallops manages NASA's only research airport, which includes three aircraft runways. The airport supports testing and operations of a wide variety of NASA, Department of Defense, and commercial aircraft. Wallops also has an unmanned aerial systems runway for testing small UAS vehicles.

"I can't think of another place that services such vastly diverse flight vehicles—and accesses flight regimes from the surface to deep space," Wrobel said. "Wallops is really a one-of-a-kind national asset."

BUILDING FOR THE FUTURE WITH ENVIRONMENTAL CHANGE IN MIND

Wrobel pointed out that Wallops is ideally situated for all these purposes. The 6,000-acre facility is 40 miles south of Ocean City, Maryland, and 100 miles north of Hampton Roads. Accordingly, its launch trajectory is primarily over ocean, avoiding populated areas. During its 70-year history, Wallops has launched more than 16,000 rockets carrying aircraft models, space and earth science experiments, technology development payloads, and satellites.

At the time of the summit, Wallops had an annual budget of \$350 million and provided direct employment to over 1,600 people. It has an estimated nationwide economic impact of \$801.2 million annually and generates almost 5,700 jobs.

NASA has \$1.2 billion in assets at Wallops and is in the midst of renewing and upgrading its systems. In doing so, it is adjusting for rising sea levels, Wrobel noted. It located its new Missions Operations Control Center on the mainland, replacing a facility on Wallops Island that it built in 1959. On Wallops Island itself, it is positioning new construction 11 feet above mean low tide. This includes the new MARS Payload Processing Facility, where propellants are loaded into spacecraft. The new facility was funded with \$20 million from the Commonwealth of Virginia.

A DIVERSE PORTFOLIO OF CLIENTS

These improvements, combined with its broad range of existing capabilities, are enabling Wallops to attract a variety of new projects. In 2019, the National Reconnaissance Office will begin launching satellites from Wallops, and in 2020, the Air Force will start using Wallops to collect flight data on new rocket motors.

Wallops has also been building its commercial business. Wrobel noted that his team is in active discussions with several small, emerging rocket developers. In October 2018, Rocket Lab named Wallops as its U.S. launch site, with its first launch scheduled for the third quarter of 2019. Wallops has also seen a great deal of interest from companies in a variety of industries that are interested in placing small cube sat payloads in orbit and is building out its unmanned aerial systems business for government and private clients.

"We invite you to come visit us," Wrobel said to the audience. "Wallops is quite an exciting place as a result of all the work we are doing." «

BUILDING VIRGINIA'S PORT OF THE FUTURE

As Captain (Ret.) Kit Chope, the vice president of sustainability for the Virginia Port Authority, noted at the beginning of his presentation, sustainability is a critical challenge for The Port of Virginia as well as a core value. The port operates six terminals across the Commonwealth of Virginia, four of which are in the Hampton Roads area. These have 50-foot-deep channels and 50-foot berths that can accommodate some of the largest ships in the world. From these terminals, the port sends containers by barge to the Richmond Marine Terminal and by double-stacked train to the Virginia Inland Port in Front Royal. "Thanks to The Port of Virginia, there are far fewer containers traveling on Virginia's interstates, reducing congestion and pollution," Chope said.

PREPARING FOR A REVOLUTION IN SHIPPING

Chope stressed that The Port of Virginia is vital to the Commonwealth's economy. It is the fifth-largest container facility in the United States. In calendar year 2018 through October, its activities fueled the construction of more than 1.8 million square feet of commercial space, helped create 2,434 jobs, and led business to make more than \$819 million in investments.

To ensure it remains a catalyst for commerce, The Port of Virginia is implementing an ambitious plan to expand its facilities. Much of this work, Chope pointed out, has been inspired by the Panama Canal Authority's decision to construct a third set of locks to accommodate the larger New Panamax class of vessels, capable of carrying over twice the cargo as previous ships. "When they opened in June 2016, these locks totally changed the dynamics of the global shipping industry," Chope said.

Virginia, however, is not the only East Coast port vying for this business. New York and New Jersey, Charleston, and Savannah have also been expanding their facilities "If you don't maintain infrastructure, both on-terminal and off-terminal, to accommodate these ships, the shipping industry is going to go somewhere else," Chope said.

In response, The Port of Virginia has invested more than \$750 million to automate systems and create additional capacity at the Virginia International Gateway (VIG), Norfolk International Terminals (NIT), and at the NIT's North Gate Complex. "By June 2020, we will have increased our capacity by 40 percent," Chope said. "That means we will be able to accommodate 1 million more containers each year."

PROTECTING A SUBSTANTIAL INVESTMENT

The size of these investments, Chope stressed, made it imperative that the port consider the consequences of sea-level rise. For instance, before it embarked on the NIT project, it commissioned Old Dominion University's Virginia Modeling, Analysis and Simulation Center to conduct a study of potential flooding of the south side of the terminal.



PORT OF VIRGINIA

"As we build new projects and safeguard existing ones, we are following the mantra that 'Good design equals resilient design,'" Chope said. "We are going beyond simply adopting industry standards. We are developing specific solutions that meet our needs in Hampton Roads."

Chope also noted that the region has received substantial assistance from the Commonwealth. The General Assembly created the post of special assistant to the governor for coastal adaptation and protection and the governor signed an executive order instructing the special assistant to develop a coastal resiliency master plan and government offices to adopt a uniform set of sea-level-rise curves.

In the meantime, the port is continuing to improve its facilities. It is the only East Coast port with Congressional authorization to deepen its channels to 55 feet, a project that it expects to complete by 2025. "This will allow Virginia to maintain its competitive advantage as a global gateway for years to come," Chope concluded. «



VIRGINIA INSTITUTE OF MARINE SCIENCE/ID. LOFTIS

Stressors

VIRGINIA'S COASTAL ZONE IS SUBJECT TO A NUMBER OF POWERFUL AND OFTEN interrelated stressors that are affecting the environment as well as its underlying economic and social networks. The changing climate is fueling sea-level rise, which is exacerbated by land subsidence in the Chesapeake Bay area. It is also increasing the variability and intensity of weather. Taken together, this means the coastal zone is subject to more routine flooding as well as more violent and damaging storms.

The projected increase in coastal population will only further intensify the stress on the region's water, power, and transportation infrastructure, much of which is aging, while putting pressure on its public health, healthcare, and education services. ■

Jonathan Woodruff

PROVIDING CONTEXT FOR RESILIENCY

The past can inform the future. That was the underlying message of Jonathan Woodruff's presentation of investigations that he and his colleagues have undertaken to better understand the role of natural systems and anthropogenic change in coastal system resilience. "Learning how coastal systems have evolved in response to human activity over past centuries can improve our response to future floods," said Woodruff, who is an associate professor of coastal processes at the University of Massachusetts Amherst. In his presentation, Woodruff focused on the area around New York Harbor, research that was inspired by Hurricane Sandy.

Woodruff noted that in addition to instrumental and historical records, his team relied primarily on what he calls "natural archives," or cores extracted from coastal lagoons like Seguine Pond on the southern shore of Staten Island. Fine-grained mud accumulates on the bottom of these lagoons unless the barrier island protecting them is breached by a storm, depositing a layer of coarse-grained sand. "We can compare the signature of modern events with those in the past to see how the system responded," Woodruff says.

THE IMPACT OF SEVERE STORMS

Woodruff learned a number of things. Hurricane Sandy, which was classified prior to the event using common generalized extreme value statistics as having a return period of 10,000 years, turns not to be so rare after all. Woodruff and his colleagues looked in great detail at the distribution of grains associated with an 1821 storm and conducted numerical modeling to determine its type and extent. Their study revealed that the storm, which predates the instrumental record, was roughly the same magnitude as Hurricane Sandy—and that the return period of storms of this size is between 100 and 200 years. "This research highlights the weakness of the instrumental record in trying to predict these rare and extreme events," Woodruff said. "We were off by two orders of magnitude." He cautioned that this analysis doesn't reflect sea-level rise or changes in storm frequency caused by climate change.

Woodruff also looked at changes in erosion and flooding caused by these severe storms. Prior to 1600, there is no evidence of coastal erosion and high-energy flooding in Seguine Pond. The answer, Woodruff believes, is that the coast was protected by offshore reefs that blanketed New York Harbor. Since then, the reefs have been systematically decimated. Woodruff and colleagues from Stevens Institute modeled the area and found that

the oyster reefs produced a 54 to 86 percent decrease in wave energy during severe storms.

"These conclusions support such nature-based approaches as the \$60 million effort underway to build an artificial oyster reef off Staten Island," Woodruff says.

THE CONSEQUENCES OF DREDGING

The destruction of oyster reefs, Woodruff noted, is not the only change that human beings have made to New York Harbor and the Hudson River. As a consequence of dredging, there are a number of deep channels in the harbor and the Hudson River that have affected the way water flows in and out of the system. "Understanding the response of the system is important in informing how we manage this human-natural system," Woodruff said.

Woodruff's colleagues have run models that show the changing amplitude of tides going all the way up to Albany between 1860 and now. "At the mouth of the estuary there hasn't been much change," Woodruff said, "but in the freshwater tidal regions near Albany there has been an increase in tidal range by almost a meter." This has not, however, led to an increase in flooding during high-discharge events. The added hydraulic conductivity produced by dredging has allowed water to drain from the system much more quickly. The overall conclusion is that the risk of flooding in Albany has dropped by just under 3 meters due to dredging.

"This is just another instance that illustrates my point," Woodruff said. "By understanding how the changes we have made to natural systems have affected them, we set the stage for using these findings deliberately to improve the systems." «



U.S. ARMY CORPS OF ENGINEERS

THE PSYCHOLOGICAL IMPACT OF DISASTER

“We are looking at disasters like Hurricane Michael or the Deepwater Horizon explosion from a different perspective,” said J. Glenn Morris, MD, at the beginning of his presentation. “I’ll let the engineers talk about the destroyed buildings. What I want to talk about is the people in the buildings.”

Morris, director of the Emerging Pathogens Institute at the University of Florida, explained that his goal is to find how people react to stresses like devastating hurricanes. He noted that one of the points he wanted the audience to bear in mind during his presentation was the greatest human health impact of these environmental stressors is not so much the acute event itself but rather the psychological impact of living in the changing and, in many instances, highly uncertain world that results. “It is this degree of uncertainty which has a major impact on people who survive these catastrophic events,” he said.

CRITICAL CRITERIA THAT DETERMINE RESPONSE

Before launching into his talk, Morris made several distinctions that are important in understanding how people respond. He distinguished between natural events like hurricanes and tornadoes, which are often acute and fast-moving, and technological or anthropogenic disasters like oil spills, which may be prolonged. “Natural disasters tend to have a cultural script that guides their actions and provides support,” he said. “Everybody knows what to do. The same is not true of technological or anthropogenic disasters.”

Another meaningful distinction is the immediacy of the exposure to the disastrous event. Morris noted that indirect exposure, which includes such phenomena as

job loss and weakening of social networks, tends to have a much broader effect on populations. He presented statistics of emergency department visits in St. Thomas in the U.S. Virgin Islands three months before and after Hurricanes Irma and Maria. He noted that looking just at diagnoses such as injuries, the effect of the hurricane appears to be short-lived, missing more challenging, longer-term problems such as increases in post-traumatic stress and depressive episodes.

THE DEEPWATER HORIZON EXPLOSION

Morris used the Deepwater Horizon explosion, a classic anthropogenic disaster, to illustrate his points about psychological responses to different categories of disasters. The explosion killed 11 people, spilled 206 million gallons of oil into the Gulf of Mexico, and affected 950 miles of shoreline. Initial studies that Morris and his colleagues conducted in Baldwin County, Alabama, and Franklin County, Florida, while the oil spill was still in progress, showed high levels of clinically significant anxiety and depression in persons living in coastal communities.

They continued their work under the auspices of the National Institute of Environmental Health Sciences (NIEHS) Deepwater Horizon Research Consortium. A year after the spill, levels of anxiety and depression remained elevated. “In manmade disasters, the consequences are particularly long-lasting and widespread,” Morris said. “These psychological impacts can have a profound impact on physical disease and may be a major driver for overall health levels within the population.”

THE IMPORTANCE OF COMMUNITY

Another insight that came out of the consortium’s research, Morris said, was that communities matter. Communities that scored poorly on indices such as the Social Vulnerability Index—which tracks things like poverty, lack of vehicle access, and crowded housing—and the Community Resilience Index—an index based on critical infrastructure resources and disaster planning measures—tended to exhibit longer-lasting psychological trauma

Morris concluded by stressing the need to prepare for the psychological as well as the physical consequences of disaster. States should identify high-risk communities and provide support before disaster strikes. «

ECOSYSTEM SERVICES DELIVERED BY VIRGINIA’S COASTAL REGION

Jonathan Hare began his presentation by asking the audience about the benefits they gain from coastal ecosystems. How many enjoy seafood? Going to the beach? Boating or fishing on the Chesapeake Bay? Hare noted that these are just some of the many ecosystem services that coastal regions deliver. “Ecosystem services are one way of describing our coastal assets,” said Hare, who is science and research director at NOAA’s Northeast Fisheries Science Center.

THE FOUR CATEGORIES OF ECOSYSTEM SERVICES

Hare broke those services into four groups—provisioning services, regulating services, cultural services, and supporting services—and then illustrated each category by drawing on examples from Virginia’s coastal areas.

PROVISIONING SERVICES

Provisioning services, Hare said, are often the first services that come to mind when people think of the coast. They include such valuable benefits as fish and energy. Virginia’s commercial fishery, for instance, generates \$200 million a year.

Another important provisioning service is aquaculture, which contributes \$50 million a year to Virginia’s economy. Virginia is the leading producer of hard clams in the country, and the number one producer of oysters on the East Coast.

Energy production, Hare noted, is another valuable provisioning service delivered by coastal ecosystems. In Virginia, there are 112,000 offshore acres reserved for wind development, which ultimately could yield an estimated 2,000 megawatts of power. The offshore environment is also a source of minerals. Sand with the particular grain structure required for beach replenishment, for instance, is mined offshore at Virginia Beach and Wallops Island.

REGULATING SERVICES

Regulating services provide benefits by modulating the environment in ways that benefit society. One vital source of regulating services are the marshes that hug shorelines and the seagrasses that line coastal lagoons. Both help reduce flooding and erosion. Hare cited a study in which investigators calculated the value that an acre of coastal wetlands provides by mitigating hurricane damage. This amounted to \$8,000 annually.



U.S. ARMY CORPS OF ENGINEERS/KERRY SOLAN

CULTURAL SERVICES

Because the environment is such a dominant presence in coastal areas, it shapes the inhabitants’ overall world view as well as their daily routine. Hare noted that the significance of the Chesapeake blue crab goes beyond its importance to the economy. Eating it has become a local tradition. The attraction of these cultural services is so strong that they draw others—tourists—who want to share them. Tourism is about a \$25 billion-a-year business across the Commonwealth, including a \$2.5 billion-a-year boost to Virginia Beach’s economy.

SUPPORTING SERVICES

Supporting services cover the basic natural processes that ecosystems perform, such as purifying groundwater and cycling nutrients. These also include providing habitat for wildlife.

CREATING A FRAMEWORK TO SUSTAIN ECOSYSTEM SERVICES

Altogether, Hare said, ecosystems services account for 32 percent of Virginia’s \$8 billion blue economy. “It only makes sense for society to be a conscientious steward of coastal ecosystems,” Hare said. “One of the challenges we face as a society is creating laws and institutions that allow us to take advantage of these services while sustaining them.” Nonprofit organizations, local, state, and federal government, and research universities all have a part to play. These too are assets, Hare maintained—and they are crucial in ensuring that we continue to enjoy the essential services that the environment provides. «



PAT CANOVA / ALAMY STOCK PHOTO



U.S. ARMY CORPS OF ENGINEERS/NORFOLK DISTRICT

Opportunities

GIVEN THE MAGNITUDE OF VIRGINIA'S COASTAL ZONE ASSETS, SEA-LEVEL RISE brings with it myriad opportunities for innovation in engineering and planning as well as for legal and policy foresight. The net result could be enhanced economic growth across multiple sectors and movement towards an adaptive and thus more resilient coastal community.

Examples of opportunities include engaging cross-sector teams in resilience design projects; developing a water management economy; designing more equitable and adaptive communities; pursuing regional-scale planning that encompasses a diverse portfolio of flood damage reduction measures; and incorporating resilient critical infrastructure—including energy, water, food, housing, health, transportation and education systems—that works with nature and promotes a high quality of life in the coastal zone, attracting industries and talent to the region. ■

Andrew Keeler

MANAGING THE INEVITABLE TRANSITION FROM THE COAST

Andrew Keeler began by remarking that challenges become opportunities when seen from different perspectives. But rather than focus on either one, he chose to enunciate overarching truths about the future of Hampton Roads and coastal communities in general.

Due to climate change and sea-level rise, citizens and localities on the coast are facing a serious change in the risks they encounter every day, he said. He noted that there has been laudable progress in applying engineering, financial instruments, and social networks to address these changing risks. At the same time, he stressed, it is imperative to consider long-term trends when making short-term choices.

“Based on my last eight years working with political scientists, geomorphologists, ecologists, and others, let me offer four unfortunate truths about the future of coast communities,” he said. Keeler is professor of economics at Eastern Carolina University and head of the Public Policy and Coastal Sustainability Program at the North Carolina Coastal Studies Institute.

FOUR UNFORTUNATE TRUTHS

The first unfortunate truth: we are buying time. “I want to be clear that I think this is a valid thing to do and economically rational,” he said. “At the same time, it is misguided to assume that we are going to be able to engineer our way to a permanent solution. We need to make our short-term investments with the understanding that at some point we will have to leave the coast.” The uncertainty about timing and the value of the built environment makes out-migration difficult to contemplate. He warned, however, that if we ignore this issue and stay in coastal communities until we have to abandon them, there would be serious environmental, economic, and social consequences.

The second truth Keeler emphasized is that, given our political system, our property rights system and our psychology, it will be individuals and businesses who will make the final choices about leaving, not government. At the same time, while these choices will depend on individual and social factors, they can be influenced by economic incentives and public policies.

Third, he warned that risk reduction investments can establish counterproductive expectations. Many things we are doing now to protect coasts—nourishing beaches and hardening infrastructure, for instance—are

economically valid responses, Keeler noted, but create a positive feedback loop, encouraging citizens to advocate for additional interventions. “This will lead to an abrupt transition when we must leave the coasts,” Wheeler said.

Keeler’s fourth truth was that the nature of the transition is critical. “Are we looking at a future where people slowly disinvest from their real estate so that it is not worth much when they leave?” he asked. “Or do we continue to invest so that the longer we stay the larger the crash?”



HILARY STOCKDON, USGS

THREE PUBLIC POLICY PRINCIPLES

Keeler offered three public policy principles that could help make the transition as easy and as coherent as possible. First: Make the market tell the truth. He argues that it is disastrous for the government to subsidize individual risk reduction and that investments made in the coast should be financed by coastal communities.

Second: Transfers and aid should be neutral. Resources should be transferred to people who are most affected by sea-level rise, but they should not be restricted to helping people maintain the status quo.

Third: Use adaptive engineering and peg actions to observable natural variables, for instance centimeters of sea-level rise. This transparency will encourage the formation of a functioning futures market, giving people a way to manage their investments over time and mediate their risk.

“I am confident we can live in the coastal zone for a long time, but I also think we can manage the inevitable transition to retain the valuable elements of coastal communities and minimize human suffering and dislocation,” he said. ◀

QUANTITATIVE RESILIENCE

John Headland began his remarks by noting that most definitions of resilience are qualitative, but when it comes to implementing measures to increase resilience, quantitative methods are essential. “Only a quantitative score can facilitate the ranking and selection of alternative plans,” he said. Headland is a vice president and principal project leader at Mott MacDonald, a global engineering, management, and development consultancy.

In his presentation, Headland discussed the use of quantitative methods by engineers to assess the resilience of existing infrastructure and to improve it. Two important dimensions of resilience that can be measured quantitatively are its robustness—in essence the ability to absorb a shock—and rapidity—the time it takes to return to the original level of performance.

THE AVAILABILITY OF DATA

Data is critical for quantitative assessment. Headland praised the North Atlantic Coast Comprehensive Study (NACCS), commissioned by the U.S. Army Corps of Engineers (USACE), for providing indispensable, highly detailed data on flooding associated with storms of different return periods. He gave examples of water-level and wave-height data from NACCS for the Navy Pier at Naval Station Norfolk, the Inner Container Terminal at The Port of Virginia, and at Virginia Beach. “This information is invaluable in developing a design for resilience,” he said.

SAMPLE QUANTITATIVE ASSESSMENTS

In his presentation, Headland focused on The Port of Virginia and the City of Virginia Beach. He showed that one meter of sea-level rise would not pose an

insuperable problem to everyday crane operations at Norfolk International Terminals (NIT), part of The Port of Virginia. Further analysis that Headland presented shows that currently NIT’s north and south piers could easily withstand a 100-year storm. However, if sea levels rise 1.6 feet between now and 2060, the south pier would be submerged during a storm.

He then turned to Virginia Beach with the observation that because it is on the ocean, water levels and waves are much higher here. Nevertheless, the same NACCS data can be used to plan and design future beach nourishments.

TOOLS AND TECHNIQUES

In fact, Headland suggested, some of this information has been deployed. He pointed to an assessment tool that the USACE, FEMA, and other groups employ called depth/damage curves. These curves have been developed and refined over time. They are used to estimate the amount of damage that occurs from inundation. The Dutch have developed a range of depth/damage curves for specific facilities. In addition to the Dutch curves, the USACE developed new depth/damage curves after Hurricane Sandy.

He also noted that there were various ways of making calculations about resilience that might lead to very different answers. When determining the magnitude of the retreat of a shoreline in response to changes in sea level during storms, engineers have historically used the Bruun Rule. In a given situation, the Bruun Rule might suggest a retreat of 60 meters. An alternative technique that involves generating a 100-year storm time series and using Monte-Carlo simulations forecasts a retreat of just 19 meters.

ADJUSTING TO SEA-LEVEL RISE

As sea levels rise, Headland said, engineers and planners should have the information needed to apply adaptive management measures over time. Headland showed a map of Portsmouth and Norfolk that the Virginia Institute of Marine Science (VIMS) developed that indicated expanding flooding range as sea-level rose a meter. Understanding the extent of that flooding, he noted, only highlights the magnitude of the challenge. He noted that the USACE has developed a comprehensive plan for the region that includes such measures as floodwalls, surge barriers, tide gates, and oyster reefs. “The amount of construction necessary to protect the area is daunting,” he said. «



U.S. ARMY CORPS OF ENGINEERS/PAMELA SPALUGY

THE EXAMPLE OF CHARLESTON

The last speaker at the Summit, David Johnston, used the opportunity to tie together themes raised by other presenters and to suggest ways that the various stakeholders in the Hampton Roads area could work together. Johnston is CEO of Hamilton Advisors, LLC, but spoke to the group as a member of the executive committee of the Charleston Resilience Network (CRN).

Johnston recalled that his first involvement with disaster was after the 2004 Aceh earthquake in Indonesia. “It was a tremendous experience for me,” he said. “Among the things I learned was that nothing can be accomplished without collaboration.”

THE CHARLESTON RESILIENCE NETWORK

“In many cases,” Johnston observed, “the issues that Charleston is dealing with are the same as those you are talking about here, but there are challenges that are particular to Charleston.” One is that historically significant areas most susceptible to flooding are built on landfill, which is subsiding. He noted that the frequency and duration of tidal flooding events is increasing and that Charleston has sustained four consecutive years of major flooding events.

The impetus for the creation of the CRN, Johnston recalled, was the Climate Vulnerability Assessment that the Department of Homeland Security convened in Charleston in 2014. The exercise brought together over 80 public, private, and NGO leaders, established a baseline understanding of climate vulnerability of the Charleston region, and highlighted the interdependence of public and private sectors. The exercise also identified barriers that organizations faced in planning for chronic disruptions. The recognition that these groups should come together on a regular basis, share information, and engage in dialog led to the CRN’s formation.

The CRN’s objectives are to:

- Enhance information sharing and identify information gaps
- Reduce barriers to consistent, high-quality data
- Build relationships and trust across sectors and governments
- Align strategies and avoid duplication of effort
- Identify opportunities for collaborative action

Subsequent engagement with the National Academy of Sciences, Johnston said, helped reframe the discussion of resilience to include structural, social, and economic dimensions.

Since its formation, the network has logged a number of key successes. These include a NOAA resilience grant to analyze parcel-level vulnerability and a grant from the National Institute for Hometown Security to test more than 90 hazard-vulnerability assessment tools.

As it looks to the future, the CRN will be enhancing its capacity and is in the process of revising its organizational outlook and strategy. “Although our early years have been successful, we are aware that an informal affiliation of like-minded organizations may not be enough, given the complexity of the challenges we face,” Johnston said.



RICHARD ELLIS / ALAMY STOCK PHOTO

PARALLELS BETWEEN SOUTH CAROLINA AND VIRGINIA

Johnston noted that in addressing the resilience issues Charleston faces, the CRN has developed a close relationships with leaders in Hampton Roads. “We see Virginia as one of the leaders on these issues, and we in South Carolina have learned a lot from all that you have done,” Johnston said. He listed several public forums and focused discussions that brought together stakeholders from both communities to exchange information and insight. In particular, he cited a recent forum hosted by the Center for Climate and Security in Charleston that encouraged conversation between civilian and military stakeholders about ways that they could cooperate.

In closing, Johnston reiterated that addressing these issues successfully requires collaboration. “You just can’t do it by yourself,” he said. “You have to listen, work together, and act.” «



SECURING PROSPERITY IN THE COASTAL ZONE

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