

A Sustainable Chesapeake

BETTER MODELS FOR CONSERVATION

Edited by David G. Burke and Joel E. Dunn

THE CONSERVATION FUND



The case study you have downloaded is highlighted below. Other case studies from this Chapter of *A Sustainable Chesapeake: Better Models for Conservation* can be individually downloaded. The editors encourage readers to explore the entire Chapter to understand the context and sustainability principles involved with this and other featured case studies. The full publication contains 6 Chapters in total: Climate Change Solutions, Stream Restoration, Green Infrastructure, Incentive Driven Conservation, Watershed Protection and Stewardship.

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Sea Level Rise

Maryland's Model for Adapting to Change

Maryland's Department of Natural Resources' sea level rise adaptation program provides other states in the Chesapeake Bay watershed with a process for assessing and addressing the impacts of climate change in coastal areas.

CASE STUDY SUMMARY

The State of Maryland has over 4,000 miles of coastline and is vulnerable to the impacts of climate change, particularly those associated with sea level rise and episodic storm events, such as shore erosion, coastal flooding, storm surge, and inunda-

tion. The Maryland Department of Natural Resources (DNR) recognized the significant risks this problem poses to the built and natural environment. Working with Governor Martin O'Malley, the Maryland State Legislature and the Maryland Climate Change Commission, DNR has been

instrumental in the development of adaptation policy, local government capacity building and public engagement. In an effort to accurately assess vulnerabilities, DNR acquired high-resolution topographic data, which was then used to develop a series of tools, perform strategic planning, and produce guidance documents.

Given the enormity of the problem, DNR

is committed to finding innovative solutions to the challenges of climate change and continues to pursue new approaches, mechanisms and partnerships to further develop effective adaptation policy and implementation on-the-ground projects. Their immediate future efforts are focused on high-risk coastal communities and unsustainable policies affecting public infrastructure and damaged infrastructure. They currently have a series of innovative policy tools under development including: sea level rise adaptation easements; community infrastructure service designations, sound investment policy criteria, and strategic partnership development. DNR's pioneering work in adaptation policy has resulted in a better model for conservation in the face of climate change and is valuable information for other states in the watershed with similar coastal vulnerability.

RESOURCE MANAGEMENT CHALLENGE

Tide gauge records show that sea levels in the Mid-Atlantic have risen over one foot in the last century and it is anticipated that the combined forces of climate change and regional land subsidence may result in as much as 3

Relative Sea Level Rise Rates (feet/century)



1/2 feet of sea level rise in Chesapeake Bay waters by the year 2100.¹

A rise of such magnitude will cause increased coastal flooding, inundation of low-lying lands, submergence of tidal marshes, more shore erosion, salt-water intrusion, and higher water tables. Over time, Maryland's entire coast will be affected but coastal areas at low elevation or with large amounts of exposed shoreline generally are most at risk. In fact, impacts to some of these areas are already visible to the naked eye. Thirteen Chesapeake Bay islands once mapped on nautical charts have disappeared beneath the surface; an estimated 400,000 acres of land on the State's Eastern Shore is gradually becoming submerged;² and the State is currently losing approximately 580 acres of shoreline per year to erosion.³

The threat of sea level rise poses many resource management challenges. One of the most pressing is how to address the potential loss of barrier islands, sandy beaches, and large expanses of tidal wetland and marsh systems which serve as the primary nursery and feeding grounds for



A structure threatened by sea level rise at Holland Island, Maryland.

many of the Chesapeake and Coastal Bay's aquatic species. If the rate of sea level rise outpaces the rate of sediment accretion in tidal marsh systems or if upland development prevents inland migration, vast amounts of wetlands in the region will ultimately be lost. Another serious challenge is how to protect thousands of miles of developed waterfront property from increased coastal flooding and

accelerated shore erosion. Hard policy decisions will soon need to be made regarding the protection, relocation and/or ultimate abandonment of many of Maryland's inhabited coastal communities.

Vulnerability to sea level rise will ultimately depend upon actual rise, as well as how state and local governments plan for and respond to the problem. As a society, we are continuing to invest, live, and actively manage lands in areas that we know with near certainty will be severely impacted by sea level rise. And, as a result, more and more of Maryland's people, property, public investments and natural resources, including vital fish and wildlife habitat, will be at risk. State and local governments must move beyond traditional land use planning and resource management practices and begin to aggressively plan for future change. Building in hazardous coastal areas must be avoided and laws and policies that enable the rebuilding of structures damaged time and time again by coastal storms must be re-evaluated. In the face of climate change — now more than ever — there is also a

MARYLAND CLIMATE COMMISSION

On April 20, 2007, Governor Martin O'Malley signed an Executive Order establishing the Maryland Climate Change Commission (MCCC) charged with collectively developing an action plan to address the causes of climate change, prepare for the likely consequences and impacts of climate change to Maryland, and establish firm benchmarks and timetables for implementing the Commission's recommendations.

Three work groups carried out the work of the Commission: Adaptation & Response Working Group; Greenhouse Gas & Carbon Mitigation Working Group; Scientific and Technical Working Group.

The Adaptation and Response Working Group was comprised of 34 local government, non-governmental environmental organizations, trade associations, and academic, business, and citizen representatives. This broad mix of participants were engaged for over a year to develop and ultimately recommend the conservation vision and underlying suite of 19 priority policy options for sea level rise adaptation and response.



Coastal shore erosion and tree mortality due to sea level rise at Taylors Island, Maryland.

critical need to protect and restore Maryland's natural resources that are already under human-induced stress.

CONSERVATION VISION

Maryland has set forth the following four pronged vision for protecting its future economic well-being, environmental heritage and public safety.⁴

- ▶ Promote programs and policies aimed at the avoidance and/or reduction of impact to the existing-built environment, as well as to future growth and development in vulnerable coastal areas;
- ▶ Shift to sustainable economies and investments; and, avoid assumption of the financial risk of development and redevelopment in highly hazardous coastal areas;
- ▶ Enhance preparedness and planning efforts to protect human health, safety and welfare; and

- ▶ Protect and restore Maryland's natural shoreline and its resources, including its tidal wetlands and marshes, vegetated buffers, and Bay Islands, that inherently shield coastal lands.

Underlying this vision are 19 priority policy recommendations of the *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*, a key component of Maryland's Climate Action Plan.⁵

IMPLEMENTATION RESOURCES

Maryland sea level rise adaptation planning efforts have been supported by a mix of financial and technical resources, as well as through many cooperative partnerships. DNR has maintained a staff of up to three coastal hazard planners since 1998 to oversee its many data acquisition, strategic planning, public outreach, and local government capacity build-

ing activities. Planning efforts have also been generously supported by the National Oceanic and Atmospheric Administration (NOAA) through Section 309 of the Coastal Zone Management Act. Approximately 5 million federal, state and local dollars have been spent in Maryland over the last decade on public engagement, planning and technical assistance, and LIDAR and shoreline erosion data acquisition efforts. Various local governments, non-governmental organizations, academic institutions, and stakeholder based entities have also worked in partnership with the State to advance sea level rise data, research and planning efforts.

CONSERVATION STRATEGY

Maryland's strategy to prepare for sea level rise has evolved over the past decade. The State developed its first state-level sea level rise

response strategy in 2000,⁶ and over the following years successfully implemented a number of its priority recommendations, including data acquisition and technical tool creation; adaptation policy development; local government capacity building; and public engagement. In August, 2008 the State released a *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*, a key component of Maryland's Climate Action Plan.⁷ The State is now in the midst of undertaking specific actions to advance three of its underlying planning priorities: (1) Improve the capacity of local governments to plan for and respond to sea level rise; (2) Develop adaptation policies (i.e., protect, retreat, abandon) for vulnerable public and private sector infrastructure; and (3) Pursue both conservation and restoration opportunities to protect natural resources and coastal habitat. Key elements of the State's past and present planning strategies are presented below.

Data Acquisition and Technical Tools: Perhaps the most essential piece of Maryland's sea level rise planning strategy has been the

steadfast focus on the acquisition of data and development of technical tools. Maryland is one of a few coastal states to acquire the high-resolution topographic data, known as light detection and ranging (LIDAR), necessary for modeling sea level rise inundation and assess vulnerability at state and local levels.

Adaptation policy development is now moving forward thanks to the availability of the state-wide sea level rise vulnerability mapping, historic shoreline position and erosion rate calculations, a comprehensive coastal inventory, a sea level rise economic impact assessment and such technical tools as the Erosion Vulnerability Assessment Tool, the Living Shoreline Suitability Model, and the Worcester County Sea Level Rise Inundation Model.

Adaptation Policy Development: Both the 2000 sea level rise response strategy and the recent strategy released by the Maryland Commission on Climate Change identified a number of policy, regulatory, and programmatic changes to assist with sea level rise adaptation. In 2008, two key pieces of sea level rise adaptation

policy were adopted. One of these is the Living Shorelines Protection Act of 2008 which requires the use of nonstructural, "living shoreline" stabilization measures that preserve the natural environment, except in areas mapped by the state as being appropriate for structural stabilization measures. As sea level rises the need for shore protection along the coast will increase. The benefit behind "living shorelines" is that while they control erosion they also allow for preservation of the natural shoreline, maintain coastal processes, and provide aquatic habitat.

A second key piece of adaptation policy was included in the strengthened provisions of the Chesapeake and Atlantic Coastal Bays Critical Area Protection Program Act, passed in 2008. Among other things the Act now requires an update of the jurisdictional boundaries of the program to reflect changes in tidal wetlands caused by sea level rise; an increase in the vegetated buffer requirement from 100 to 200 feet for new development; and the inclusion of coastal flood hazards as a factor to consider during "growth allocation" decisions.

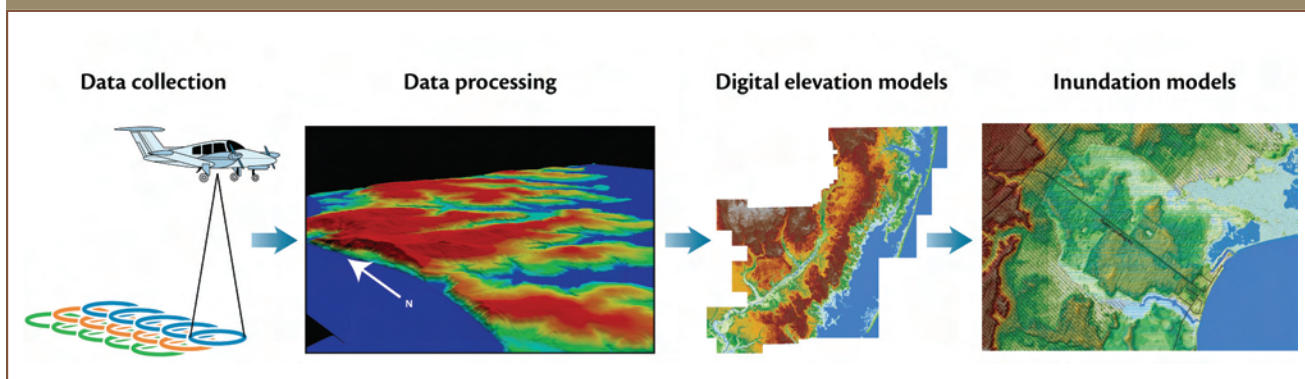
Local Government Capacity

Building: Building the capacity of local governments to address sea level rise challenges has been a chief focus of state planning efforts. To date, technical and financial assistance has or is currently being provided to Worcester, Somerset, Dorchester, Kent, Prince George's, Baltimore and Anne Arundel counties, the Town of Crisfield and the City of Annapolis. These projects have all been tailored to specific sea level rise or coastal hazard data and/or planning needs of the locale, with several providing specific written sea level rise planning guidance. The Worcester, Somerset and Dorchester sea level rise guidance documents contain valuable recommendations



A living shoreline constructed with a low profile stone sill that allows tidal waters to freely exchange with the planted marsh area.

► Sea Level Rise Mapping and Modeling Process



and are now serving as “best practice” manuals for many other coastal counties and communities facing similar management challenges.

Some of the most valuable components of the three reports include sea level rise vulnerability assessments; “critical action” identification; planning and regulatory development; and recommended public investment policies. In general, sea level rise vulnerability was assessed using mapping products derived from the LIDAR high resolution topographic data. The range of storm surge and “relative” sea level rise projections, such as low (steady state 1 ft./century), medium (2.7 ft./century), and high (3.4 ft./century) were assessed for two of the jurisdictions over 25, 50, 100-year timeframes. The documents evaluate the impact of rising waters on each jurisdiction’s infrastructure, including: transportation networks,

emergency evacuation routes, and critical facilities, such as hospitals, and fire stations; private infrastructure; and natural features, including beaches, wetlands and vegetated buffers. All three reports highlight the importance of integrating the sea level rise mapping and impact analysis information into comprehensive and emergency response planning within each jurisdiction.

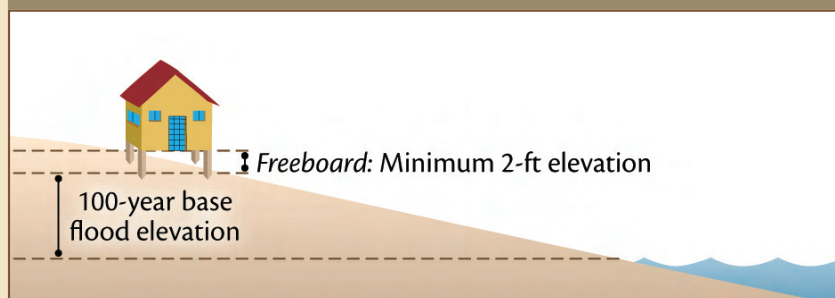
The identification of current threats and immediate impacts expected to occur within the next 25 years along with remedial “critical actions” is another vital element of the guidance documents. The primary focus of critical actions is to identify current needs for the protection of existing infrastructure and development. The reports advocate for the creation of “sea level rise overlay zoning districts” within which to implement measures to protect against and/or to promote

“avoidance” of impact within next 50 years. Recommended measures could include restricting future development in areas subject to sea level rise within the next 50 years and the adoption of increased elevation or “freeboard” standards for new development as depicted in the graphic below.

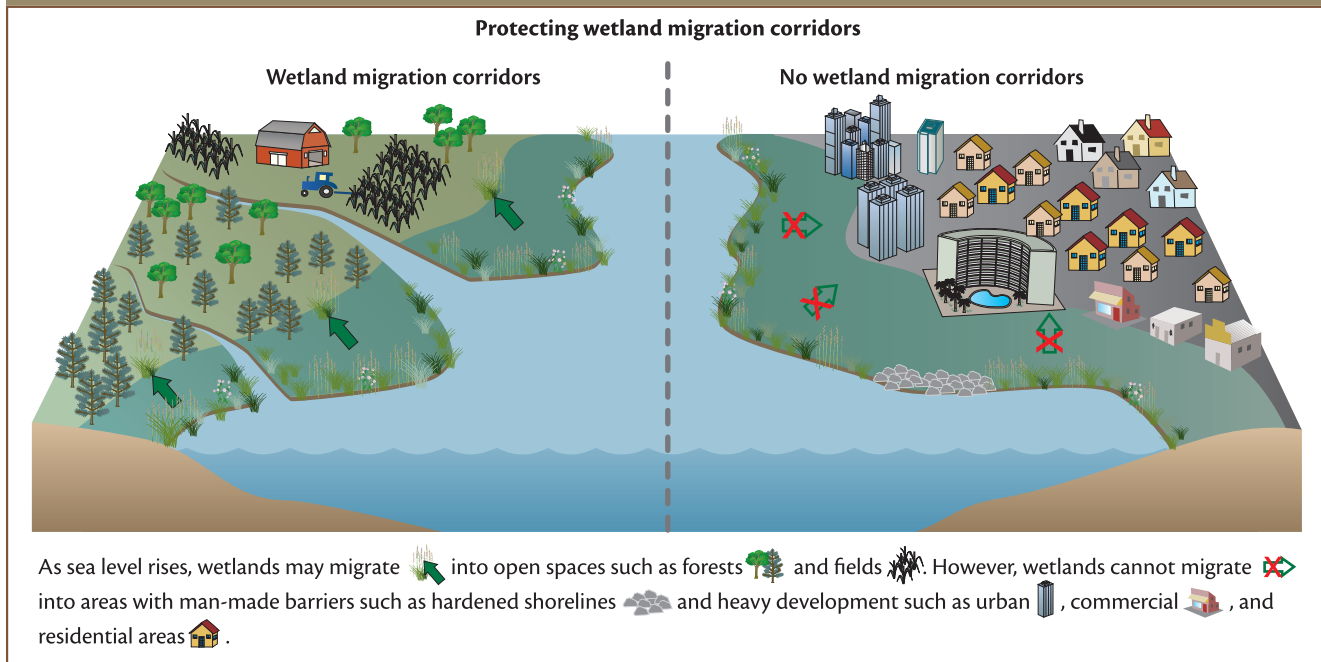
In terms of public investment, the reports recommend that local governments designate frequently flooded and publicly maintained roads as “low-water crossings” and require affected property owners to acknowledge access limitations. Another suggestion for local governments is to consider lowering the design elevation of maintained roads to avoid drainage problems. Somerset County maintains a list of 80 “frequently flooded roads” which are typically affected by above average tides. The gradual upgrade of these roads in response to sea level rise will simply overwhelm the budget of one of Maryland’s poorest counties.

Public Engagement: Public outreach and engagement has also been a mainstay of Maryland’s sea level rise adaptation program. DNR staff has conducted numerous workshops, participated in hundreds of public events, and developed handfolds of print and web-based outreach materials to improve public awareness of climate change and sea level rise planning

► Freeboard Standard



► Protecting Wetland Migration Corridors



needs. Public access to Maryland specific sea level rise and coastal hazard data and technical planning resources through *Shorelines Online*,⁸ an interactive web portal, has remained a major programmatic priority.

Stakeholder engagement is another critical element of strategic planning for sea level rise as it helps to ensure buy-in and future support for project development and policy adoption. Maryland employed a stakeholder-based planning process to develop its Climate Action Plan.⁹ The Adaptation and Response Working Group of the Maryland Commission on Climate Change was comprised of 34 local government, non-governmental environmental organizations, trade associations, and academic, business, and citizen representatives. This broad mix of participants were engaged for over a year to develop and ultimately recommend the conservation vision and underlying suite of 19 priority policy options for sea level rise adaptation and response.

Building off the recommendations contained in the Climate Action Plan,

DNR further engaged the public by hosting the *Building Coast-Smart Communities* interactive summit in April 2009.¹⁰ The centerpiece of the summit was an innovative role-play where participants negotiated policy options on a scorecard aimed at reducing coastal communities' vulnerability. Areas of discussion were centered on how to protect Maryland's built environment, including its critical infrastructure and public and private structures; and, on how to ensure the protection of the State's vital natural resources, such as wetlands, wildlife, farms and forests. Materials from the Coast-Smart forum are available and can be used to replicate the summit in other communities facing similar sea level rise planning challenges.

Future Directions: The sea level rise research and planning initiatives above provide the State with a vision, framework and the impetus for moving forward. And thanks to these efforts, Maryland has been recognized as a national leader in sea level rise adaptation and response. However,

much work including further policy development and on-the-ground implementation of "best practices" still remains. The State is now shifting its adaptation strategy to explore and pursue new approaches, mechanisms, and partnerships.

Fresh ideas are needed to help coastal communities move beyond the current model of "build-insure-rebuild" in vulnerable coastal areas. New solutions also will be required to avoid the assumption of the financial risk of development and redevelopment in vulnerable areas. Innovative mechanisms will be necessary to achieve such adaptation objectives as protecting wetland migration corridors, storm surge buffer, and flood storage areas. Community infrastructure service designations, sea level rise adaptation easements, strategic partnerships, and sound public investment policies are four of the emerging mechanisms.

Community Infrastructure Service Designations: Building new public infrastructure and/or rebuilding damaged infrastructure in high-risk

coastal communities is not a sustainable policy particularly in light of climate change and sea level rise in which entire areas may be inundated and/or cutoff from inland resources. One mechanism to address this risk is the creation of “community infrastructure service level designations” for roads, water, wastewater, and public facilities. These designations could be established to signal local government intentions for construction/reconstruction based on future sea level rise scenarios and to direct future infrastructure monies as part of broader local-based adaptation plans. Such designations (see Potential Community Infrastructure Service Level Designations table) could be reviewed every 5 years as more accurate data is collected and mapped.

Sea Level Rise Adaptation Easements:

Land right purchase and easement programs, e.g., Rural Legacy, Maryland Agricultural Land Preservation Foundation, Maryland Environmental Trust, have been in existence for many years. These programs are voluntary and involve public or charitable finance measures to fund the acquisition and retirement of development rights in order to preserve and increase stewardship of culturally and environmentally significant rural resources in perpetuity. A “Sea level Rise Adaptation Easement” is an emerging concept that could either work in concert with existing land purchase or easement programs or independently. Through such an easement a landowner could receive payment for adaptation stewardship activities, e.g., living shoreline,

increased storm buffer or a wetland migration corridor.

Other ideas to explore include using these easements to limit development in highly vulnerable areas or to assist with retreat by phasing out remaining development rights subject to certain specified catastrophic events associated with predicted sea level rise or massive storm surge damage. One additional thought is that the easement agreement could specify reclamation requirements, such as the removal of septic system and roadways from abandoned properties.

Strategic Partnerships: Strategic partnerships between private landowners and governmental and non-profit sectors can enhance on-the-ground implementation. Partnerships can help build resiliency of the natural and built infrastructure by testing and implementing adaptation strategies and communicating lessons learned to other communities in Maryland and beyond. Innovative cutting-edge partnerships should be encouraged and considered essential enhancements to state initiated efforts.

Sound Investment Policy: One of the next steps for federal, state and local governments is to account for sea level rise in decision-making regarding: land acquisition;¹¹ land and facility management; and the siting and design of facilities and infrastructure. Calls for these three “Lead by Example” policies were set forth in the Maryland Climate Action Plan and movement is afoot to establish each component. In the fall of 2009, DNR began a two-year project to

develop coastal land conservation targeting tools to facilitate sea level rise adaptation. Assessment criteria for adaptation objectives, including wetland migration corridors, storm surge buffers, and flood storage areas, will be one of the primary project outcomes. Policies for land management and the siting and design of state-owned facilities and infrastructure are also under development.

RESULTS

Technical Tools: The acquisition of LIDAR data and the other key coastal hazard data sets have allowed DNR to develop a suite of tools necessary for modeling sea level rise inundation and assess vulnerability at state and local levels.

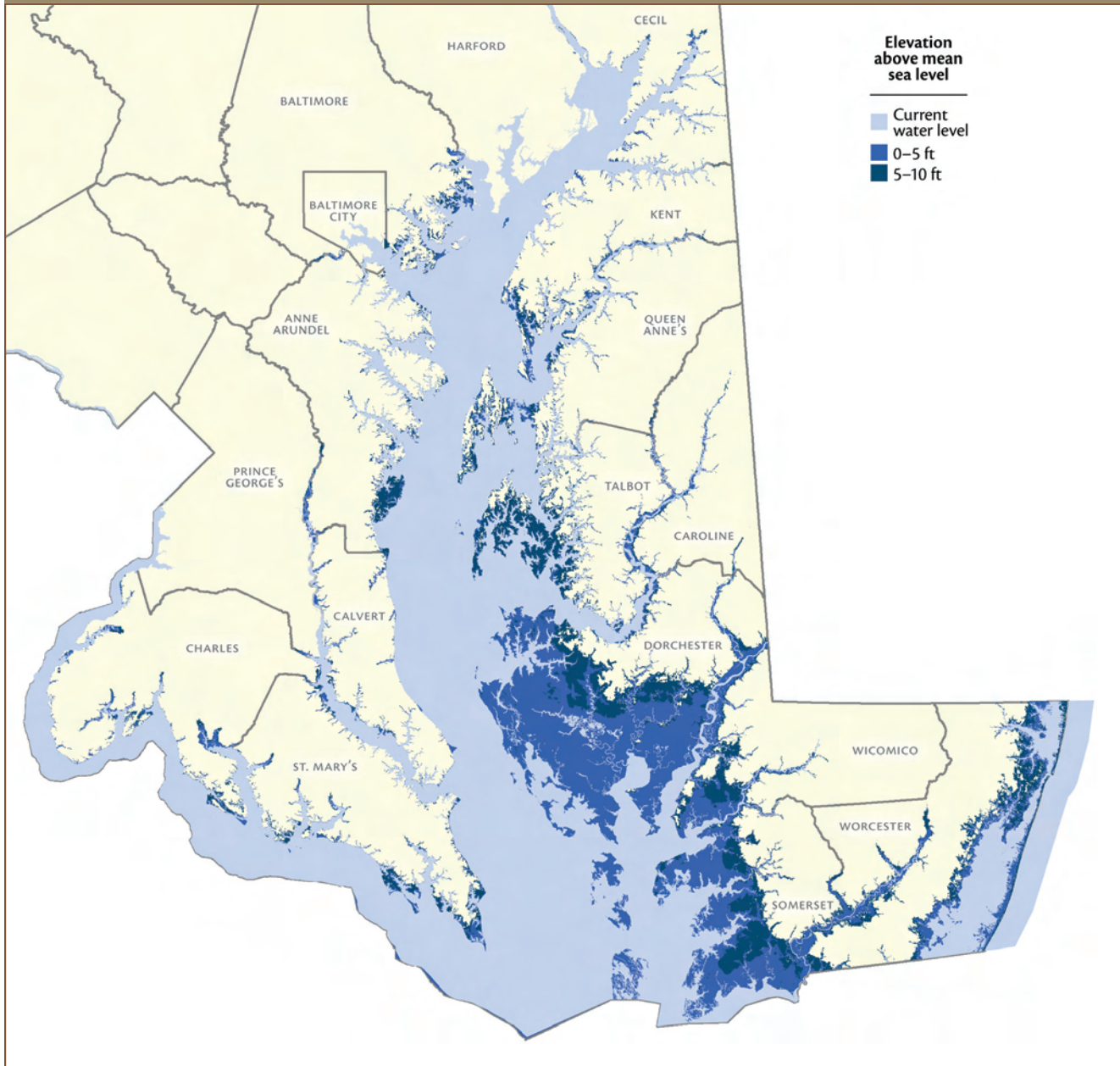
Sea Level Rise Vulnerability Mapping: Over a five-year time span, DNR worked with State and local partners to acquire LIDAR data for 15 of the State’s 16 coastal counties. Detailed sea level rise modeling has been completed for Worcester and Dorchester County, and pilot areas within Anne Arundel and St. Mary’s Counties. State-wide Sea Level Rise Vulnerability Maps have been created for 14 coastal counties, depicting lands at potential risk.

Shoreline Change Maps: In 2003, the Maryland Geological Survey (MGS) completed an update of digital shoreline positions and calculations of linear rates of shoreline erosion across the State. The multi-phase study was undertaken to support research and management of sources of non-point source pollutants, buffer areas of

Potential Community Infrastructure Service Level Designations

Designation	Action
Improve/Augment	Proactive adjustments to improve safety
Maintain/Replace	Holding steady as no adjustments are anticipated
Reduce Footprint	Situations where maintenance is problematic
Remove/Relocate	Situations after significantly damaging events

► Sea Level Rise Vulnerability Map



critical concern, and to reduce vulnerability to coastal hazards. In 2005, the Shoreline Changes Study and historical shorelines were made available through an interactive mapping application, *Shorelines Online*.¹²

Comprehensive Shoreline Inventory (CSI): CSI captures baseline shoreline conditions throughout the tidal portions of Maryland's coastal counties. Shoreline features and conditions were identified through a three-tiered

shoreline assessment approach. Data from the survey was processed to create three GIS coverages, displayed through reports, summary tables, and maps, which are viewable online.¹³

Erosion Vulnerability Assessment Tool (EVA): The Baltimore District Army Corps of Engineers and DNR developed EVA under a joint partnership to identify areas along the shore that have demonstrated historic patterns of instability, and currently

support valued natural, social, or economic resources. As a planning tool, EVA uses a 50-year planning window to project shoreline position in 50 years to inform local planners where community infrastructure, cultural resources, and habitat are potentially at risk in the future. The map outputs identify where resources will be vulnerable, and can enhance or redirect future development options for individual communities, and define areas where opportunities for

sea level rise adaptation easements could be directed.

Living Shoreline Suitability Model:

The Virginia Institute of Marine Sciences developed a model for DNR to geographically target shoreline areas suitable for the placement of living shorelines to counteract erosion problems. The suitability model classifies the shoreline into three major categories: suitable for soft stabilization, suitable for hybrid options, and not suitable for living shoreline. To date, models have been completed for Worcester, Calvert and Somerset Counties.

Strategic Planning: Over the course of the last 10 years, DNR has released three seminal documents regarding responses to sea level rise and storm surge.

- ▶ *A Sea Level Rise Response Strategy for the State of Maryland*¹⁴
- ▶ *Maryland Coastal Zone Management, Section 309 Coastal Hazard Enhancement Strategy*¹⁵
- ▶ *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*¹⁶

These documents are a good source of information for other coastal and natural resource managers that are undertaking sea level rise adaptation planning efforts. In 2009, the Sea Level Rise Response Strategy for the State of Maryland was accessed via the Internet more than 1,350 times.

Guidance Documents: In Fall 2008, DNR released sea level rise planning guidance for Worcester, Somerset and Dorchester Counties:

- ▶ *Sea Level Rise: Technical Guidance for Dorchester County*¹⁷
- ▶ *Sea Level Rise Response Strategy: Worcester County, Maryland*¹⁸
- ▶ *Rising Sea Level Guidance: Somerset County, Maryland*¹⁹

Regulatory Reform: Maryland's State Legislature and Governor have taken significant steps to update state law to address some of the most pressing and immediate impacts of sea level rise and storm surge.

- ▶ The Chesapeake and Atlantic Coastal Bays Critical Area Protection Program has been updated to account for sea level rise in its jurisdictional boundaries; increase the required vegetated buffer requirement from 100 to 200 feet for new development; and include coastal flood hazards as a factor to consider during "growth allocation" decisions.
- ▶ The Living Shoreline Protection Act was passed in 2008 and requires the use of nonstructural, "living shoreline" stabilization measures that preserve the natural environment, except in areas mapped by the state as being appropriate for structural stabilization measures.
- ▶ The Greenhouse Gas Emissions Reduction Act, passed by the Maryland State Legislature in 2009, seeks to address the long-term causes of sea level rise by reducing greenhouse gas emissions 25% by 2020.

KEYS TO SUCCESS

Problem Recognition: DNR staff raised concerns about climate change in a series of ground breaking reports. Subsequently, Governor Martin O'Malley's Executive Order (01.01.2007.07) recognized that Maryland is particularly vulnerable to the climate change impacts of sea level rise, increased storm intensity, extreme droughts and heat waves, and increased wind and rainfall events. Maryland's Commission on Climate Change then developed a Climate Action Plan that the Legislature acted upon.

Financial Support: Planning efforts have also been supported by the National Oceanic and Atmospheric

Administration (NOAA) through Section 309 of the Coastal Zone Management Act. Approximately 5 million federal, state and local dollars have been spent in Maryland over the last decade on public engagement, planning and technical assistance, as well as LIDAR and shoreline erosion data acquisition efforts. The acquisition of key data sets early in state planning efforts was of utmost importance.

Dedicated staffing: DNR has maintained a staff of up to three coastal hazard planners since 1998 to oversee its many data acquisition, strategic planning, public outreach, and local government capacity building activities. The success Maryland has achieved thus far would not have been possible without staff dedicated to sea level rise and coastal hazard planning.

Hurricane Isabel: The State used the increased public awareness of coastal flooding and storm surge created by the arrival of Hurricane Isabel in September 2003 to further sea level rise planning efforts. DNR was a major cosponsor of the *Hurricane Isabel in Perspective Conference* held in November 2004. The conference was organized to discuss the many factors that exacerbated Isabel's impact on the Chesapeake Bay ecosystems and its coastal communities.

Partnerships: Numerous local governments, non-governmental organizations, academic institutions, and stakeholder based entities have also worked in partnership with the State to advance sea level rise data, research and planning efforts. They will also play a vital role in the testing and implementation of adaptation strategies in years to come.

PHOTOS AND FIGURES

Page 3: Photo, Chelsie Papiez; figure, Maryland Climate Action Plan 2008
Page 4: Photo, Olivia Campbell



This wetland has been subjected to excessive saturation from elevated water levels, causing the marsh to die back and the substrate to erode - leaving barren clumps of marsh peat.

Page 5, 6: Photos, David Burke
Page 7: Figure (top), Maryland Department of Natural Resources; figure (bottom), Maryland Climate Action Plan, 2008
Page 8, 10: Figures, Maryland Climate Action Plan 2008
Page 12: Photo, Chelsie Papiez

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