

Appendix E

Maryland Climate Action Plan

Adaptation & Response Working Group

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EBEI-2. Observation Systems for Changes in Coastal Areas

Option Description

The Chesapeake Bay is the largest inner-coastal estuary in the nation. It covers more than 166,000 square kilometers, has more than 150 rivers and streams draining into the watershed, and is home to about 15 million people. Most of Maryland's communities and economic activities in this low-lying coastal region are particularly vulnerable to storm surges and flooding, events that will be likely be intensified by the rising sea level associated with climate change. Maryland relies on its coastal areas along the Chesapeake Bay and its Atlantic coast for healthy fisheries and reliable transport and navigation. Its dependence on infrastructure networks (e.g., roads and power grids) intensifies the potential vulnerability of these areas to impacts from climate change-induced natural disasters.

Enhanced ability to observe changes along Maryland's coastal areas induced by sea level rise (SLR) will provide key benefits to the state. Under climate change, managing resources in these areas is more important than ever and will require accurate information from integrated observation systems to allow for detection and prediction of the causes and consequences of changes in coastal systems, watersheds, and infrastructure resources. This option will support, enhance, and integrate observation systems already in place in Maryland. Specifically, the option will strengthen those systems to enable comprehensive surveillance, monitoring, documentation, and dissemination of rates and locations of SLR in Maryland. Surveillance equipment will be installed in coastal sites where current public-private infrastructure is potentially vulnerable to small increases in sea level, long-term coastal monitoring aspects will be incorporated into existing protocols, and observation activities will be incorporated into regional efforts.

Option Design

This policy option aims to enhance statewide monitoring programs in natural and urban settings to detect biological, physical, and chemical changes and responses due to direct and indirect effects of climate change. This option will be facilitated through the observation, analysis, and interpretation of trends in coastal water levels, elevation (subsidence rates, if any), shoreline change, wetland loss, and tidal influence on estuaries and water supplies. The observation systems will enable the state to assess the responses of coastal landforms to SLR and to the effects of increases in storm activity. Implementation of the policy option will be coordinated with Policy Option FBEI-6, Integrated Geographic Information Systems: Mapping, Modeling, and Monitoring (Appendix F) and with the policy options related to detecting specific impacts of climate change and SLR on resources and resource-based industries.

The specific objective of this option is to assess how existing observation systems for the Chesapeake Bay region can be enhanced to better understand and address long-term SLR and its impacts on the built environment. The overall option design is summarized in the bullets below.

Targets: Observation networks are an essential component of adaptive management in low-lying coastal areas. They are also essential in planning and evaluating the effectiveness of restoration programs in Maryland's coastal zone. The target for this option is in the form of a detailed assessment regarding the adequacy of Maryland's current observation systems, system protocols, technologies, and surveillance strategies to address long-term changes in SLR and the associated impacts. The output of the study should be a series of recommendations regarding how current observation networks could be reinforced and how new components could be added to better address changing conditions regarding SLR. The following components should be part of the study:

- Enhance local-, state-, regional-, and federal-level interagency integration and coordination of observation systems that detect trends in coastal water levels, elevation (subsidence rates, if any), shoreline change, wetland loss, and tidal influence on estuaries and water supplies.
- Assess the suitability of vertically controlled tide gauges.
- Investigate funding the installation of additional tide gauges in particular locations, including Jug Bay.
- Assess the adequacy of surface elevation tables (SETs) to measure whether marsh accretion is keeping pace with erosion or inundation and examine opportunities to add more SETs for select marsh locations.
- Integrate findings and study objectives for the Statewide Wetlands Monitory Strategy, currently under development by the Maryland Department of the Environment (MDE).
- Observe and record changes for a set of "leading indicators" of specific climate change impacts. Include indicators that are representative of specific geographic ranges or behaviors or population characteristics of certain species of plants, birds, mammals, and insects that are known to be hypersensitive to SLR and other climatic changes.
- Encourage the use of the Maryland Geological Survey Groundwater Quality Network to assess well water quality in areas where saline intrusion adjacent to tidal waters is known to occur.
- Evaluate whether the Maryland Geological Survey Subsidence Studies Program needs to be expanded to assess the risk of elevation declines due to ground water withdrawals, which would exacerbate any impacts of SLR. Locations to be assessed could include those with significant current ground water withdrawals and/or those where population and associated groundwater withdrawals are projected to increase significantly in the near future.

Timing: The timing of the study is immediate. It is anticipated that a 3-year period will be needed to complete the study. By the end of this period, there should be a detailed recommended program regarding additional integrated observations that are required, supplemental data management and distribution systems (if any), and a set of analytical products that respond to the specific needs of the commercial, management, recreational, educational, scientific, regulatory, safety, hazard protection, and restoration communities.

Parties Involved: Several parties would be involved in the design and oversight of the study. At the state level would be the Maryland Department of Natural Resources (DNR), MDE, and local and national weather services offices. At the regional and national levels would be the National

Oceanic and Atmospheric Administration (NOAA), National Geodetic Survey (NGS), Chesapeake Bay Observing System (CBOS), the United States Geological Survey, and the National Office for Integrated and Sustained Ocean Observations.

Implementation Mechanisms

This option would be implemented by first preparing a feasibility study on the scope, issues, challenges, and likely costs associated with upgrading existing observation systems. On the basis of this study, terms of reference for the assessment would be prepared and implemented by a qualified organization or consortium. The recommendations of the study would become the input for changes to existing rules and regulations or new legislation to implement the activities necessary to adequately monitor SLR and the effectiveness of Maryland's adaptation responses to climate change.

Related Policies/Programs in Place

Chesapeake Bay Observing System (CBOS): There are important observation systems already in place in Maryland to monitor the Chesapeake Bay. The CBOS is an organization that provides integrated data observation, management, and distribution systems and information for use by those concerned about the Chesapeake Bay and by residents of coastal communities. It is part of an evolving subregional observing system embedded in the Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA) and the congressionally mandated Integrated Ocean Observing System (IOOS).

Center for Operational Oceanographic Products and Services (CO-OPS), Tides and Currents: Tides and Currents, managed by CO-OPS, is the portal to NOAA's collection of oceanographic and meteorological data (historical and real-time), predictions, and nowcasts and forecasts. Historic tide gauge data for the Chesapeake Bay can be found at <http://tidesandcurrents.noaa.gov/index.shtml>

National Water Level Observation Network (NWLON): NWLON is a network of 200 long-term, continuously operating water-level stations throughout the United States that provide tidal data and water level observations as well as long-term sea level trends. They also serve as the foundation reference stations for NOAA's tide prediction products, and they serve as controls in determining tidal data for all short-term water-level stations.

VDatum: VDatum is a software tool administered by NOAA that is designed to coordinate data transfer between 28 different vertical datums consisting of tidal, orthometric, and ellipsoidal datums (<http://www.nauticalcharts.noaa.gov/csdl/vdatum.htm>).

Climate Change Science Program (CCSP): The CCSP Draft for Synthesis and Assessment Product 4.1 is titled "Coastal Elevations and Sensitivity to Sea Level Rise" and is available for public comment at <http://www.climatechange.gov/Library/sap/sap4-1/public-review-draft/>

National Geodetic Survey (NGS): NOAA's NGS defines and manages a national coordinate system. This network, the National Spatial Reference System (NSRS), provides the foundation for transportation and communication, mapping and charting, and a multitude of scientific and engineering applications. The following are related programs:

- *Continuously Operating Reference Stations (CORS)*—The CORS network includes more than 1,200 global positioning system (GPS) stations that run 24 hours a day, 7 days a week and are adjusted daily. The CORS system enables positioning accuracies that approach a few centimeters relative to the NSRS, both horizontally and vertically. The NGS is working with CO-OPS to co-locate CORS with NWLON stations. This has already been done at several coastal sites, including Charleston, South Carolina, and Key West, Florida. Co-locating CORS with NWLON stations enables local land elevation changes to be accounted for within local sea level measurements.
- *Height Modernization Program (HMP)*—The HMP provides accurate height information by integrating GPS technology with existing survey techniques.
- *Remote Sensing Division (RSD)*—The RSD is responsible for collecting national shoreline information to be fed into nautical charts.
- *State Geodetic Advisors*—Geodesists are placed within states to help with surveying and geospatial data issues.
- *Surface Elevation Tables (SETs)*—NGS is currently working on guidance documents on how to use GPS to tie SETs to local tidal and geodetic datums to enable measurement of vertical movement of coastal habitats.

Maryland Department of Natural Resources (DNR)

TEA/MANTA [Tidewater Ecosystem Assessment/Monitoring and Non-Tidal Assessment] Tidal Monitoring—Maryland’s Chesapeake Bay Water Quality Monitoring Program includes an integrated set of components that together provide a comprehensive assessment of water quality conditions. This set of water quality and habitat indicators includes physical and chemical properties, nutrient limitation of algal growth, ecosystem processes, river inputs of nutrients and sediments, phytoplankton, zooplankton, and benthic organisms. The design, analysis, and interpretation of each component of the program address four objectives: (1) characterizing existing conditions; (2) detecting changes and trends in key water quality variables in response to management actions; (3) determining attainment or non-attainment of water quality criteria; and (4) understanding how the Bay ecosystem functions as it relates to anthropogenic and natural stresses, management actions, and relationships between water quality and living resources. Data are physically collected by scientists 16 times a year at 22 stations located in Maryland’s Chesapeake Bay mainstem, 12 to 20 times a year at 55 stations sampled in the Chesapeake Bay tidal tributaries, and 12 times a year at 45 stations in the Coastal Bays.

TEA/MANTA/ Non-Tidal Monitoring—Long-term water quality monitoring has occurred at 54 locations on major (4th order and larger) non-tidal portions of Maryland’s rivers since 1976. Sampling at these stations provides the data for determining trends in water quality constituents commonly associated with urban and agricultural land use. Some of the TEA/MANTA monitoring data mentioned above can be accessed via Eyes on the Bay (EOTB).

Eyes on the Bay (EOTB)—EOTB (a Web site of DNR’s TEA Division) provides easy access to near real-time, mapped, and historical Chesapeake and Coastal Bays water quality information and data on water temperature, salinity, dissolved oxygen (the amount of oxygen available for aquatic life), water clarity, chlorophyll (the amount of algae in the water), and pH levels (the

acidity or alkalinity of the water). Continuous Monitoring and Water Quality Mapping data can be retrieved at EOTB.

MANTA–Maryland Biological Stream Survey (MBSS)—Since 1994, the Maryland DNR MANTA has sampled and assessed more than 2,000 freshwater wadable streams for biological, habitat, and chemical quality through the MBSS. Stream quality indicators have been developed for fish, benthic macro-invertebrates, and salamanders and for their physical habitat. MBSS results have been used for (1) watershed characterizations (i.e., targeting areas in need of both restoration and protection) via the Clean Water Action Plan and the resultant Watershed Restoration Action Strategies, (2) listing impaired streams for MDE’s 303(d) list, (3) evaluating stressors to aquatic fauna, and (4) determining geographic ranges of rare, threatened, or endangered aquatic species.

MANTA’s Sentinel Site Network—To track natural variability in stream chemical, physical, and biological conditions, the MBSS established a long-term monitoring component, the Sentinel Site Network, in 2000. The Network consists of 26 of the highest quality, minimally disturbed streams in Maryland that were selected on the basis of physical, chemical, and biological data collected by the MBSS from 1995 to 1997. Long-term monitoring of sentinel sites offers the best hope for detecting the effects of climate change on Maryland’s non-tidal streams and rivers and will provide important information for the management of stream resources in the face of this threat. In addition, MANTA has developed a proposed monitoring program for tidal freshwater ecosystems because there is a paucity of information on these unique transitional habitats.

Comprehensive Shoreline Inventory (CSI)—Maryland’s Coastal Program contracted with the Virginia Institute of Marine Sciences (VIMS) to prepare a CSI that captures baseline shoreline conditions throughout the tidal portions of Maryland’s coastal counties. Shoreline features and conditions were identified by using a three-tiered shoreline assessment approach. The Inventory divided the shore zone into three regions: (1) immediate riparian zone (land use), (2) bank (bank characteristics such as height, bank type, and shoreline buffers), and (3) shoreline features (shoreline attributes such as bulkheads, riprap, marinas, boat ramps, and docks). Data from the inventory were processed to create three geographic information system (GIS) coverages displayed in reports, summary tables, and maps that are viewable online at <http://ccrm.vims.edu/index.html>. CSI is often used to determine changes in shoreline conditions due to climate change and SLR impacts. The CSI has already been used by St. Mary’s County to conduct a shoreline structure damage assessment following Tropical Storm Isabel. The CSI was incorporated into Hazards U.S. Multi-Hazard (HAZUS-MH) to provide shoreline conditions for conducting the Level One analysis of flood vulnerability in Maryland. In addition, the CSI was merged with the Stream Corridor Assessment used in the development of the Watershed Restoration Action Strategy (WRAS) program to provide a watershed view of the tidal and non-tidal shoreline conditions. The CSI information was used in conjunction with historical shoreline position data by the Maryland Geological Survey to assess loading of sediments to the Chesapeake Bay from shore erosion. Changes in shore erosion rates and sediment loading that accompany accelerating SLR can be assessed from this database.

Maryland Geological Survey Groundwater Quality Network—DNR’s Maryland Geological Survey routinely conducts well water quality assessments in areas where saline intrusion adjacent to tidal waters is known to occur. Currently, wells on Kent Island and in Ocean City are

sampled annually, Annapolis Neck less frequently, and Indian Head on the Potomac River only occasionally. Groundwater is the major source of potable water in the rapidly developing tidewater region of the state, and the combination of increased extraction for human consumption and SLR are likely to increase the areas where saline water intrudes into aquifers and increase the salinity of the water where intrusion is currently known to occur. The database for areas already under study and the methodologies currently in use can be extended to other areas at risk of saline intrusion.

Maryland Geological Survey Subsidence Studies—The Maryland Geological Survey, in cooperation with Anne Arundel County and the State Highway Administration, has been conducting elevation surveys at three county water supply well-fields since 1994. These surveys have indicated only minor declines in elevation at the locations of the withdrawals, but groundwater levels at these sites have not declined significantly to date. This methodology can be extended to other locations that might be at risk of elevation declines due to groundwater withdrawals, which would exacerbate any impacts of SLR. Locations to be assessed could include those with significant current groundwater withdrawals and/or those where population and associated groundwater withdrawals are projected to increase significantly in the near future.

Additional Benefits and Costs

Implementing a program for enhancing statewide monitoring programs to detect the direct and indirect effects of climate change will be subject to a variety of costs and produce distinct benefits. As noted above, there are already several related programs/policies in place into which a climate change observational system can be integrated. The types of costs considered here are incremental to those that have already been incurred to develop and maintain the existing framework of observation systems currently in place in Maryland to monitor the Chesapeake Bay.

Incremental costs to address climate change through enhanced monitoring programs fall into four major categories: assessment, equipment, staffing, and maintenance. Assessment involves the costs for designing and carrying out the feasibility study on the upgrading of existing observation systems. Equipment costs involve the costs associated with any new equipment (e.g., gauges), software (e.g., database management), and any departmental/office arrangements that are implemented on the basis of results of the feasibility study. There may also be new staffing costs associated with recruiting additional technical expertise to manage the observational networks and produce information specifically tailored to climate change. Finally, there will likely be a set of annual costs associated with the maintenance of physical equipment and database systems.

The benefits associated with enhanced monitoring programs in Maryland center on the degree to which they can enhance both the state's adaptive capacity and its flexibility to respond to future climate change threats. Regarding adaptive capacity, the enhanced observational networks—and the additional time series data they will provide—should strengthen the ability of institutions and systems in Maryland to better foresee looming risks and plan for future climate change damages. These benefits, while difficult to quantify, are nevertheless substantial. Regarding flexibility, the accumulation and processing of information associated with the operation of the observation networks will increase the state's flexibility for adapting to future possible responses to an uncertain and changing climatic regime. The option will thus enhance the ability of the state to consider and adopt future corrective measures as needed, including statutory changes. Taken

together, the value of the adaptive capacity and flexibility benefits is likely to be much higher than the incremental costs associated with the implementation of the option.

Feasibility Issues

None.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

EBEI-3. Adaptation of Vulnerable Public and Private Sector Infrastructure

Option Description

Maryland has thousands of miles of developed waterfront property along the Chesapeake Bay and its tributaries. Much of this area contains public and private sector infrastructure that will be adversely impacted by SLR and increased climatic severity (storms and wind-driven tides) caused by climate change and subsidence. Public sector infrastructure (i.e., roads, bridges, airports, wastewater treatment facilities, and municipal water systems) is essential for community framework. Private sector infrastructure (i.e., residential properties, boating facilities, retail and office buildings, and farms) has historically enjoyed higher market value compared with inland properties because of its proximity to the water, especially in more recent times.

As the sea level continues to rise, both state and local governments in Maryland, as well as many other public and private property owners are facing the very real and hard decisions about how to adapt and at what expense. Decisions about how to adapt to the impacts of SLR will be different for different types of land use, and must take into consideration the value of the land (monetary, resource-value, and perceived value), public opinion, public safety and risk assessments, ecosystem survival and replacement, and environmental and development opportunities.

There are potential adaptation options—protection, relocation, and retrofitting—that can be used to respond to SLR. Vulnerable coastal infrastructure can be protected by using structural bulkheads, seawalls, or revetments (the least desirable means). Some forms of protection can improve ecosystems and create new opportunities. However, it will not be practical (socially, economically, or environmentally) to use protection for all areas at risk. A framework for making abandon/modify/move/protect decisions must be developed in combination with other comprehensive planning and emergency management decision-making frameworks.

The objectives of this option are to identify and assess Maryland’s SLR-impacted public and private sector infrastructure (based on various SLR scenarios agreed upon by the Scientific and Technical Work Group [STWG] that identified vulnerable inundation areas), categorize and assess impacted infrastructure on the basis of research that determines feasible option strategies, and formulate strategies to integrate action plans at the local, state, and federal levels.

In order to plan and to ascertain priorities, properties that can adapt to SLR need to be differentiated from those that may need to be abandoned and/or relocated. For public infrastructure, this determination can be made by comparing the impact of projected SLR and the projected useful life of the facility. Coordinated plans need to be developed between the private sector and local, state, and federal authorities for how adaptation can best be accomplished. Existing laws and regulations, processes, and practices need to be revisited and possibly changed, eliminated, and/or supplemented so that they facilitate positive potential results from adaptation in recognition of the changing climate and environment.

Maryland county topographic storm and tidal surge mapping should also include all active freight and passenger railroad lines and their potential susceptibility to storm surges and rising sea levels. This would include all Class I (CSX and Norfolk Southern) and short-line freight

railroads and all transit rail operators such as AMTRAK and MARC. MARC passenger trains operate on either CSX or AMTRAK's infrastructure; therefore, all SLR planning efforts must include coordination of each of their planning and investment efforts to address adaptive response issues. As the sea level rises, railroads across lowlands near tidal water will experience more frequent flooding during high tides and storms. This effect may be especially severe in certain estuaries where the rise in sea level will be amplified, the more so because these same estuaries are more vulnerable to storm surges as water funnels into a gradually narrowing arm of the sea.

It is most important that every effort be made to encourage and facilitate opportunities to offset the impact of inevitable losses.

Option Design

Targets: The following are the key targets for this option:

- Raise awareness of the impact of SLR in potentially impacted areas. Since SLR is so gradual, one of the obstacles to implementing successful adaptation strategies will be to overcome denial and achieve “buy-in” and participation from stakeholders.
- Identify vulnerable SLR inundation areas along Maryland's shoreline by using newly acquired topographic data.
- Assess public and private sector infrastructure within these vulnerable areas to gain a statewide sense of the breadth of infrastructure impacted.
- Categorize and assess impacted infrastructure on the basis of research to determine feasible adaptation strategies. Research should be conducted by a team of experts who consider the successes and failures of other actions attempted or contemplated worldwide, potential engineering solutions, and technological applications to determine potential applicability to the projected impacted areas. The scope of this study should be to prepare descriptions of generic adaptation methods and assess the feasibility (costs and impacts) of implementing various adaptation scenarios (abandon/modify/move/protect).
- Formulate and prioritize strategies to adapt to climate changes and SLR and create a method for integrating action plans at the state and local levels This should begin as soon as categorization and assessment are completed during 2010 or 2011.
- Formulate and prioritize strategies for adapting railroads to climate change and include the following components:
 - *Track*—The levels of such railroads may have to be raised by reballasting from time to time. Some railroads already experience flooding during heavy rains and high tides, and these events would increase. Especially in the case of short-line railroads, tracks may be so low that they are often flooded, and the beds may be vulnerable to sinking from compaction of marsh peat. A number of East Coast railroads have been in their current locations for 150 years, and many tracks, signals, and stations are low enough to be flooded during severe storms.
 - *Bridges*—All Maryland-owned railroad bridges come under the same safety guidelines as SHA highway bridges. Bridge clearance above high water will gradually diminish for bridges across water in the tidal zone. The amount of the reduction will be greater in the

case of bridges upstream in estuaries where the rise of water level is amplified by funnel effects. Although the rise may be slow and gradual, the consequences of damage to a bridge may be so catastrophic as to warrant regular monitoring.

- **Tunnels**—Tunnels may also become more vulnerable, because the risk of their entrances and vents flooding will be greater and because the hydraulic pressure on the tunnel walls increases as water tables rise. There are no state-owned railroad tunnels. The Howard Street Tunnel in Baltimore City is owned and maintained by CSX Transportation, and the B&P and Union Tunnels in Baltimore City are owned and maintained by AMTRAK. Planning and investment for SLR issues by these carriers must be coordinated to address adaptive response issues.

Timing: The following are some of the key schedule milestones for this option:

- Raising the awareness level has already begun and is an important part of all options in this effort.
- Existing tools, programs, and resources could be used to compile data on projected SLR inundation areas and existing infrastructure within those areas and therefore could begin immediately and be targeted for completion by the end of 2009.
- Impacted infrastructure should be categorized and assessed after the initial data compilation. This phase of the option should begin in late 2009 and be completed by 2011.
- Formulate strategies, priorities, and implementation action plans.

Parties Involved: Coordinated involvement will be needed from property owners, local town and city governments, county governments, and Maryland agencies, including DNR, Maryland Department of Transportation (MDOT), MDE, Maryland Department of Planning (MDP), and the Maryland Utilities Commission. Federal agencies that need to be involved include the U.S. Department of Agriculture (USDA) and the U.S. Army Corps of Engineers (USACE).

Implementation Mechanisms

Identifying and assessing impacted properties, performing research, determining strategies, creating incentives, and enabling legislation and/or changes in processes and practices are needed before widespread adaptive measures can be successfully implemented.

Related Policies/Programs in Place

The following are related policies/programs in place in Maryland:

- **Comprehensive Shoreline Inventory (CSI):** [Described in detail under EBEI-2, Policies/Related Programs in Place.] The CSI can be used as a state and local planning tool to inventory and assess coastal infrastructure vulnerable to SLR inundation or coastal flooding.
- **Strategic Shore Erosion Assessment (SSEA):** From 2000 to 2002, a NOAA Coastal Services Center Coastal Management Fellow worked with the Coastal Program to develop a comprehensive approach to shore erosion planning for Maryland and to develop a protocol for creating regional strategies to deal with shoreline erosion issues. The Fellow worked closely with Dorchester and St. Mary's counties to identify an approach that would balance

the need to address risk from erosion while also maintaining natural shoreline habitat. The resulting protocol became the foundation for the SSEA, currently under development.

In 2002, Coastal Program staff worked with DNR's Shore Erosion Control Program to integrate the protocol developed for the SSEA into the Program's Project Selection Criteria and Financial Assistance Priority Rating System. Environmental and habitat enhancement considerations are now incorporated into the rating system, which creates a score for homeowner projects based on criteria such as infrastructure threat from erosion and an applicant's financial need.

- **Maryland's 2006–2010 Coastal Zone Management Act (CZMA) §309 Coastal Hazard Strategy:** The Strategy, approved by NOAA in 2006, defines the current work plan for developing the SSEA. The project is being implemented in four phases: (1) generation of the fetch exposure tool, community risk assessment, and environmental risk assessment; (2) application and validation of GIS tools through development of the Corps Feasibility Study Master Plan; (3) incorporation into the interactive mapping application; and (4) workshop development and training of state and local coastal managers and planners.
- **Chesapeake Bay Shore Erosion Control Master Plan:** Maryland's Coastal Program is currently participating in the development of the Chesapeake Bay Shore Erosion Control Master Plan along with the USACE and MDE. The Plan, which is being developed as a component of Chesapeake Bay Coastal Management Feasibility Study, will result in outreach material for contractors and homeowners as well as a Master Plan that uses modeling tools to evaluate stretches of shoreline and prioritizes these areas for erosion control activities. The Master Plan will serve as a guide for potential shore erosion management strategies and will help the agencies maintain consistency when promoting strategies along tidal shorelines. These strategies will likely include structural and non-structural erosion control devices, designation of natural erosion areas, land acquisition, and establishment of local erosion-based setback requirements.
- **Draft Report 4.1 of the U.S. Climate Change Science Program (CCSP) Synthesis and Assessment Product:** "Coastal Elevations and Sensitivity to Sea Level Rise" is one of 21 synthesis and assessment products being prepared by CCSP (www.climatechange.gov/Library/sap/sap4-1/public-review-draft/). The report went out for public review and comments were due by COB April 10, 2008. The draft report includes the results of a research project titled "The Likelihood of Shore Protection in Maryland." This project, conducted by the U.S. Environmental Protection Agency (EPA), was based on interviews with state regulators and county planners and was intended to investigate existing and anticipated coastal policies and land uses. The study developed maps that distinguish coastal areas in Maryland that are likely to be protected as the sea level rises and areas that will likely retreat because of protection cost or current land use policy.
- **HAZUS-Multi Hazard (HAZUS-MH):** HAZUS is a risk assessment software program for analyzing potential losses from floods, hurricane winds, and earthquakes. HAZUS-MH can be used to estimate damage before or after a disaster occurs and takes into account social and economic impacts of a hazard event. MDE began working with Salisbury University in 2004 to complete a statewide analysis of flood vulnerability estimated with the HAZUS-MH flood module. The Level One analysis, completed in June 2005, estimates flood damage to commercial and residential properties from a 100-year coastal or riverine flood event. This

study takes the next step from identifying flood vulnerability to understanding the risk to the built environment. The final report, “An Assessment of Maryland’s Vulnerability to Flood Damage,” is now available at:

<http://www.esrgc.org/pdf/hazus/An%20Assessment%20of%20Maryland's%20Vulnerability%20to%20Flooding.pdf>. Moreover, the coordination and reinforcement for this option should be coordinated with the other options in this report:

- Assessment of Coastal Zone Adaptation Options and Evaluation of Shoreline Protection Structures (RRI-7, RRI-9, and EBEI-6)
- Integrated Planning for Coastal Erosion, Coastal Storms, and Sea Level Rise (FBEI-1)
- State Agency Reporting on Response to CCC Findings (FBEI-2)
- Preserve Undeveloped, Vulnerable Lands (RRI-7, RRI-9, EBEI-6)
- Integrated Geographic Information Systems: Mapping, Modeling, and Monitoring (FBEI-6)
- New Criteria for Identifying Priority Protection Areas (RRI-1)
- Forest and Wetland Protection (RRI-4, RRI-11)
- Modify Environmental Protection Regulations to Promote Sustainable Shoreline and Buffer Area Management Practices (RRI-7, RRI-9, EBEI-6)

Estimation of Adaptation Benefits and Costs

Implementing a program for the adaptation of vulnerable public and private sector infrastructure will undoubtedly have tremendous costs to local, state, and federal government and the private sector. Much of this cost can be offset by implementing laws, regulations, and policies that encourage innovative, environmentally sound, practical solutions even though some of these will require a new paradigm regarding adaptation. Cost considerations include the following:

- Estimated detailed cost of adapting, relocating, and replacing public infrastructure can be determined only after impacted properties have been identified and assessed. Some properties, particularly major infrastructure, will be able to serve out their useful life before they need to be replaced. In the meantime, care should be taken to not site new public sector infrastructure in impacted areas. However, there will be a considerable financial cost to local, state, and federal governments from replacing or relocating impacted public infrastructure that becomes inundated prior to fulfilling its projected useful life. This contrasts with the current perception that the life spans of certain properties can often be extended by renovation or modernization, which may be more cost-effective than relocation and replacement.
- Abandonment of properties will result in loss of asset value and thus loss of tax revenues for local and state governments.
- Environmental and ecological costs will result from the fact that currently existing, productive, useful farmland and marshes will be eliminated as SLR progresses.
- Benefits and opportunities will accrue from several sources including protecting existing properties where practical and feasible by facilitating an environment that encourages innovation to maintain or improve value while maintaining or improving environmental and ecological sensitivity.

- Innovative incentives should be made available to the private sector to stimulate opportunities to help offset asset losses when appropriate.
- The following are data sources that are relevant to the assessment of costs and potential benefits of this option:
 - Town of Oxford, Maryland Flood Insurance Rate Map, Community panel number 240068-001 A, effective September 28, 1984.
 - Earth From Space, available at: http://earthfromspace.photoglobe.info/spc_netherlands_dikes.html
 - The Tyee, available at: <http://thetyee.ca/News/2007/05/28/FloodControl/>
 - MSN Encarta, available at: http://encarta.msn.com/encyclopedia_761572410/netherlands_the.html
 - Maryland Shorelines Online, available at: <http://shorelines.dnr.state.md.us/living.asp>
 - Chesapeake Bay Funders Network, available at: http://www.campbellfoundation.com/html/related_projects.html
 - Coastal defense solutions (approach of ComCoast) <http://www.comcoast.org/>
 - Intergovernmental Panel on Climate Change, available at: <http://www.ipcc-wg2.org/index.html>

Feasibility Issues

The feasibility of the strategies and priorities identified from research efforts depends on accurate projections of SLR, as well as the availability of adequate funding for strategies that can be justified on the basis of short-term and long-term ecological, environmental, and financial benefit.

Uncertainties that affect the feasibility of this option are (1) the rate and extent of SLR and the relative impact of subsidence, (2) property protection across multiple owners if one or more do not wish to participate, and (3) the nature of the future federal response to the threat of SLR.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

EBEI-8. Building Code Revisions and Infrastructure Design Standards

Option Description

This option involves strengthening existing building codes and construction techniques for new infrastructure and structures in vulnerable coastal areas. Since building codes were originally intended to ensure the safety of new residential and commercial construction, pursuing this option will involve evaluating existing codes and design standards (including the Maryland Building Performance Standards (MBPS) and all local building code ordinances currently in place in Maryland jurisdictions) with respect to their proven effectiveness in past storm events, identifying causes of failure, and recommending and implementing changes to improve performance in the future. In addition to past performance, codes and standards should be reviewed and strengthened by taking into account future increased hazards caused by sea level rise and the associated possible increase in storm frequency and intensity caused by climate change. All types of building development (residential, commercial, and institutional) and public infrastructure (roads, bridges, water, and sewer) should be analyzed. Standards for marine-related structures (piers and wharves) should be included in this review as well.

In addition to the overall evaluation and strengthening of codes, the entire development process must change to allow for an integrative process that recognizes and takes into account potential impacts of SLR and climate change at all stages, including early design and decision making. Design professionals must look for ways to reduce future impacts, and local governments must increase plan review, inspection, and enforcement efforts.

This effort is ongoing at several levels. FEMA regularly publishes a “Summary Report on Building Performance” after major natural disasters (such as Hurricane Andrew and Hurricane Katrina). These reports study the damage resulting from the event, identify areas of strength and weakness in building design and construction, and recommend improvements. The International Code Council (ICC) also studies code effectiveness and regularly makes improvements to its codes. The MBPS and Maryland local building code ordinances make improvements by adoption of various ICC codes such as the 2006 International Existing Building Code (IEBC) and the 2006 International Energy Conservation Code (IECC). It is imperative that these future code reviews begin to consider the effects of climate change and SLR on the long-term sustainability of structures and infrastructure.

Option Design

Targets: All construction-related codes and design standards should be evaluated for their effectiveness in protecting against the future effects of climate change and SLR. The State of Maryland has adopted with modifications for Maryland law, the International Building Code (IBC) 2006 and the International Residential Code (IRC) 2006 as the Maryland Building Performance Standards (MBPS or Standards). As of July 2007, the Standards apply to all building structures within Maryland for which building permit applications are received by a local jurisdiction. Each local jurisdiction may, by local amendment, modify the provisions of the Standards to address issues relevant to that jurisdiction. Many jurisdictions have, in fact, made amendments in addition to the MBPS. Therefore, any review must include an evaluation of the

MBPS as well as local building code ordinances. (Building codes are largely enforced by local officials; attention to training and enforcement will be important to the successful implementation of future code improvements.) Reviews will include the following issues:

- *Elevation of buildings*—Maryland could enhance current FEMA requirements and mandate a statewide freeboard for all new construction in coastal flood hazard zones. Currently some local jurisdictions have adopted a freeboard requirement of 1.0 ft into their local floodplain ordinance. Freeboard is an elevation above a design high water level (base flood elevation). For example, the bottom of the lowest horizontal structural member should be elevated a minimum of 2 feet (or more) above the base flood elevation. This is especially pertinent with regard to SLR, since base flood elevations will be higher in the future. The required freeboard should relate to the amount of SLR expected, potential wave height, and the expected life of the structure. Experience from Hurricane Katrina shows that building elevation is the most effective deterrent to flood damage.
- *Foundation design*—Certain types of foundations are more effective in flood situations than others. Deep pile or column foundations are desired if significant erosion is possible in oceanfront locations as well as bay locations where the following conditions exist: erodibility of the soil, exposure to “damaging” waves (greater than 1.5 feet high), potential for velocity flow, potential for flood-borne debris, and required resistance to wind forces. These locations include FEMA identified V-zones (i.e., high hazard areas) as well as A-zones (i.e., areas within the 100-year flood zone and outside the V-zone).
- *Long-duration flood impacts*—Long-duration flooding, which may be a result of SLR in the future, can cause extensive damage to interior contents of buildings and building materials. Moisture entrapment within walls and floors can impact structural integrity and can cause biological and chemical contamination. Elevation will avoid this problem as will the use of flood-resistant building materials installed above the minimum elevation.
- *Debris impact*—Substantial damage can be caused by floating or wind-driven debris in a flood or storm event. Current codes and construction standards should be evaluated with regard to debris resistance.
- *Building envelope*—Building envelope is the entire exterior surface of a building, including walls, windows, doors, and roofs. All parts of the building envelope must provide protection from wind, wind pressure, and wind-borne debris. Building codes are very specific regarding these issues, but they should continually be reviewed and improved as needed.
- *Public infrastructure*—Design of future public projects, including roads, bridges, tunnels, landfills, water, and wastewater treatment plants, should consider the effects of climate change and SLR. In addition, standards should be developed for the modification of existing facilities in response to SLR.
- *Abandoned facilities*—Provisions should be made to minimize the negative impacts of structures and facilities that may be abandoned due to SLR. Such impacts may include navigational and environmental hazards.

Timing: This is primarily an ongoing effort. As noted above, codes are currently in place and should be implemented and enforced by everyone involved in the design and construction process. FEMA and the various code agencies continually evaluate the effectiveness of the code

requirements, especially after a major event such as a hurricane or flood. These events provide essential information regarding the performance of code compliant structures and reveal areas in need of improvement. Training of enforcement personnel should also be an ongoing effort. Codes and design standards should be reviewed periodically in light of new science and evidence of climate change and SLR.

Parties Involved: All parties who are part of the design and construction process should be involved in this effort, including the ICC, design professionals such as architects and engineers, building materials manufacturers, building trade associations, the federal government (FEMA, National Weather Service, NOAA and USACE), state government (Maryland Emergency Management Agency [MEMA], Department of Housing and Community Development [DHCD], MDP, Maryland Drug Enforcement Agency [DEA], MD State Energy Office, DNR, and Maryland Department of Transportation [MDOT]), and local governments. Coordination with the Americans with Disabilities Act (ADA) is essential. Property owners also need to be aware of potential hazards and be presented with opportunities to become informed about the performance of their properties.

Implementation Mechanisms

Implementation of this option will initially involve an evaluation of all existing codes and regulations applicable in the State of Maryland (see above) with specific regard to the threats associated with climate change and SLR. To account for the expected lifespan of newly constructed buildings, this will involve looking many decades into the future and trying to predict how buildings will be impacted. If deficiencies are found, changes to codes, regulations, and laws will be necessary. Adequate enforcement of these codes, which is largely the responsibility of local governments, will be critical to the success of code improvements.

Related Policies/Programs in Place

As noted above, the State of Maryland has adopted with modifications for Maryland law, the IBC 2006 and the IRC 2006 as the Maryland Building Performance Standards (MBPS or Standards). As of July 2007, the Standards apply to all building structures within Maryland for which building permit applications are received by a local jurisdiction. Each local jurisdiction may, by local amendment, modify the provisions of the Standards to address issues relevant to that jurisdiction. Many jurisdictions have, in fact, made amendments in addition to the MBPS. Therefore, any review must include an evaluation of the MBPS as well as local building code ordinances. Building codes are largely enforced by local officials; attention to training and enforcement will be important to the successful implementation of future code improvements.

Codes are currently in place to regulate construction. The IBC is the primary building code. FEMA's flood insurance program is the primary source of flood protection regulations. State and local governments often complement these general programs with more site-specific regulations.

Estimation of Adaptation Benefits and Costs

Implementing a program for strengthening existing building codes and construction techniques for new infrastructure and structures in vulnerable areas will be subject to a variety of costs and will produce distinct benefits. As noted above, this option is focused on evaluating existing codes and standards for their effectiveness in protecting against the future effects of climate change and

SLR. The types of costs considered here are incremental to those that have already been incurred for developing and maintaining the existing framework of codes and standards in place in Maryland.

Incremental costs to address climate change through the implementation of strengthened codes fall into four major categories: assessment, new design requirements, training, and inspection. Assessment involves the costs for the comprehensive evaluation of existing statewide and local building codes and standards. New design requirements involve the future costs associated with meeting more stringent code requirements (e.g., freeboard requirements and higher safety factors for foundation design in coastal areas). Training involves the incremental costs associated with meeting the technical capacity needs of inspectors who will be charged with ensuring compliance with new codes. Finally, inspection involves new funding to ensure that an adequate number of trained code officials and inspectors are available.

The benefits associated with strengthened building and infrastructure codes in Maryland center on the degree to which they integrate climate change risks into the state's codes and standards framework. Future state building stock and infrastructure will be designed and installed subject to standards established in response to emerging knowledge about climate change. Insofar as uncertainties remain, an implicit precautionary approach will be applied. The gradual transition of building and infrastructure stock should better position Maryland to plan for and mitigate against future climate change risks. These benefits, while difficult to quantify, are nevertheless substantial and likely to be higher than the incremental costs associated with the implementation of the option.

Feasibility Issues

None identified for the evaluation of existing codes and regulations with specific regard to the threats associated with climate change and SLR.

Regarding long-range issues, the recommendation for adopting a statewide additional freeboard for new construction in coastal areas is dependent on current FEMA 100-year floodplain maps. If a 2.0-foot minimum freeboard requirement is put in place, additional protection measures also need to be implemented to provide the same level of protection in areas adjacent to the coastal 100-year floodplain. As the floodplain increases or rises 2 to 3 feet, the area adjacent to or behind the current coastal floodplain will also become inundated by the higher coastal floodplain. In order to provide the same level of protection to new construction within these "adjacent flood zones," the freeboard requirement also needs to address construction that falls within the anticipated sea level rise areas.

Status of Group Approval

Unanimous

Barriers to Consensus

None

EBEI-10. Disclosure

Option Description

With the ongoing and anticipated changes to the Maryland coastline associated with climate change, future property owners must be aware of the potential impacts that SLR, storm surge, and other effects of climate change may have on the property they are considering purchasing in order to make informed decisions. It is in the interest of prospective property owners to be fully informed of risks they are undertaking and potential insurance implications—as well as potential options for addressing these risks—at the time they are making the decision to purchase property. Such awareness will enable potential purchasers to better evaluate the appropriate uses of the property and will decrease the possibility of subsequent lawsuits and other disputes.

Option Design

This option is applicable to all counties bordering the Atlantic Ocean and the Chesapeake Bay.

Targets: Information on the following three items, among others, should be required at as many stages of property transaction and ownership as possible:

1. Notification of potential buyers in the property listings.
2. Disclosure notice at settlement.
3. Recording on the plat maps, zoning maps, and with the title and deed, with notice to the property owner, of relevant information collected by local, state, or federal agencies showing changes in the coastal boundaries and natural and topographical features (e.g., wetlands and dunes).

Timing: The timing for making disclosure information available for real estate transactions is immediate.

Parties Involved: Those parties directly involved in the transaction (i.e., the buyer and seller and their agents) and authorities with relevant information about physical changes to the coastal zone are involved.

Other: At various stages of property transactions and ownership, the information required to be disclosed should cover as many of the following types as possible:

1. General information about SLR, coastal storms, and coastal erosion and their impacts on the area (i.e., coastal counties). This could be in the form of a generic brochure, which could be developed by the state in concert with realtors and other stakeholders.
2. Whether the property is in an area that has been determined to be at risk from SLR and associated hazards by relevant authorities, such as the National Flood Insurance Program, Maryland Critical Areas Commission, NOAA, and Maryland DNR.

3. Any knowledge that the property owner has of any flooding, avulsion, erosion, or other significant damage to the natural or topographical features or any built structure that has occurred on the property.

Implementation Mechanisms

Implementation of this option will require changes to existing law in Maryland in two major areas. First, the state may require property owners or managers to provide general information on climate-related risks, similar to the general notice (pamphlet) regarding lead. This notice requirement could be triggered particularly for vulnerable properties: for lead, that includes residential buildings built before 1978; for SLR, that could include houses in coastal counties or those located in areas specifically identified as vulnerable to SLR, erosion, storm surges, and other related risks. Second, to the extent that a property owner or manager has knowledge regarding the risk to that particular property (presence of lead-based paint, or past flooding or erosion), the law would also require the property owner or manager to disclose that information.

Details on all aspects of this policy option will need to be worked out carefully at a future date.

Related Policies/Programs in Place

See Feasibility Issues section below.

Estimation of Adaptation Benefits and Costs

Implementing disclosure requirements for coastal hazards related to the transfer of residential and commercial properties is a fairly low-cost option. Because residential and commercial real estate in certain locations may be at greater risk due to climate change effects (e.g., rising sea levels, increased hurricane severity), the disclosure requirements are intended to serve as a public awareness function regarding the potential risks incurred by the buyer. Given the regional nature of coastal threats, this function is not limited to Maryland's coastal areas but serves to inform buyers that all coastal properties are subject to similar conditions.

The incremental costs are associated with developing the statutory framework to ensure that general and specific disclosure documents are included in the set of documents for purchasers of real property in the coastal counties of Maryland and that such information is also made available in real estate listings and recorded with local real estate records. These costs are likely to be de minimus. While one cost of this option may be a change in the profitability of real estate transactions in the coastal zone, the corollary benefits in awareness and preparedness of property owners and decreased needs for disaster relief will outweigh any costs of this option.

The incremental benefits associated with these disclosure requirements are difficult to quantify. It seems likely that the disclosure requirements will have a much smaller effect than the evolving perspectives of property insurers who may increase insurance premiums for properties located in coastal zones deemed vulnerable to climate change, or the perspective of lending institutions that may consider the property's value as having reduced collateral for a commercial or residential mortgage loan. It is not clear that disclosure itself would result in changes in the profitability of real estate transactions in the coastal zone, but the corollary benefits in awareness and preparedness of property owners and decreased needs for disaster relief will outweigh any costs of this option.

Feasibility Issues

These advice and notice requirements would build upon the implementation precedent of requiring residential property sellers to provide information regarding lead and lead-based paint (notification requirements regarding radon provide another precedent). Federal¹ and state² law require both general and specific disclosure regarding lead in residential housing transactions. In particular, persons selling or leasing most residential housing built before 1978 are required to provide purchasers and renters with a federally approved lead hazard information pamphlet (Protecting Your Family from Lead;³ Maryland Real Property Disclosure and Disclaimer Statement⁴) and to disclose known lead-based paint and/or lead-based paint hazards in the sales contract.⁵

Status of Group Approval

Unanimous

Barriers to Consensus

None.

¹ 24 CFR Part 35; 40 CFR Part 745; 9061 Fed. Reg. 61 (Mar. 6, 1996), available at: <http://www.epa.gov/fedrgstr/EPA-TOX/1996/March/Day-06/pr-24120.pdf>; see also, http://www.epa.gov/lead/pubs/selr_eng.pdf

² COMAR, Real Property Article § 10-702, available at: http://mlis.state.md.us/asp/web_statutes.asp?grp&10-702

³ <http://www.epa.gov/lead/pubs/leadpdf.pdf>

⁴ <http://www.dllr.state.md.us/forms/danddform.doc>

⁵ EPA, *Interpretative Guidance for the Real Estate Community on the Requirements for Disclosure of Information Concerning Lead-Based Paint in Housing*, August 20, 1996, available at: <http://www.epa.gov/lead/pubs/1018fin.pdf>

Acronyms and Abbreviations

ADA	Americans with Disabilities Act
CBOS	Chesapeake Bay Observing System
CCSP	Climate Change Science Program
CO-OPS	Center for Operational Oceanographic Products and Services
CORS	Continuously Operating Reference Stations
CSI	Comprehensive Shoreline Inventory
CZMA	Coastal Zone Management Act
DEA	[Maryland] Drug Enforcement Agency
DNR	[Maryland] Department of Natural Resources
EOTB	Eyes on the Bay
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GIS	geographic information system
GPS	global positioning system
HAZUS-MH	Hazards U.S. Multi-Hazard
HMP	Height Modernization Program
IBC	International Building Code
ICC	International Code Council
IEBC	International Existing Building Code
IECC	International Energy Conservation Code
IOOS	Integrated Ocean Observing System
IRC	International Residential Code
MACOORA	Mid-Atlantic Coastal Ocean Observing Regional Association
MANTA	Monitoring and Non-Tidal Assessment
MBPS	Maryland Building Performance Standards
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MDOT	Maryland Department of Transportation
MDP	Maryland Department of Planning
MEMA	Maryland Emergency Management Agency
NGS	National Geodetic Survey
NOAA	The National Oceanic and Atmospheric Administration
NSRS	National Spatial Reference System
NWLON	National Water Level Observation Network
RSD	Remote Sensing Division
SET	Surface Elevation Table
SLR	sea level rise
SSEA	Strategic Shore Erosion Assessment
STWG	Scientific and Technical Work Group
TEA	Tidewater Ecosystem Assessment
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture

VIMS	Virginia Institute of Marine Sciences
WRAS	Watershed Restoration Action Strategy
DHCD	Department of Housing and Community Development

Future Built Environment Infrastructure

FBEI-1. Integrated Planning for Coastal Erosion, Coastal Storms, and Sea Level Rise

Option Description

Current coastal hazards, such as storm surge, coastal flooding, and erosion, are becoming more severe due to ongoing sea level rise (SLR). This policy option aims to increase the capacity of Maryland's state and local governments to adapt and respond effectively to threats associated with SLR and related hazards by increasing the integration of land-use, hazard management, and health care planning efforts by local, state, and regional entities. This option focuses on state and local comprehensive policy plans. It does not address operational plans or building codes.

This option includes two major components: (1) local coordination of comprehensive and other plans to reduce risks from SLR and associated coastal hazards, and (2) coordination of Maryland's state plans to reduce risks from SLR and associated coastal hazards.

Key to planning will be the establishment of a statewide standard estimate of expected SLR and the time frame for the future projected rise. Projections of the amount and rate of SLR will vary due to local conditions and are expected to change with increasing scientific understanding. Therefore, planning must reflect that uncertainty. Planning for SLR and related hazards must be flexible in that it must account for a diversity of places, time horizons, and a variety of hazards. These plans should appropriately implement strategies along the continuum from protection to retreat. They should also address mitigation activities, such as avoidance. Plans should include policies and suitable adaptation responses for the diversity of defined geographic areas.

The goals of this policy option are to increase coordination and consistency in planning approaches and to create a framework for the integration of other climate adaptation proposals, such as new building and zoning codes, adaptation of infrastructure, and protection of natural resources. Land-use-related plans need to be integrated with transportation and infrastructure plans, emergency plans, and natural resource plans.

There are three continuums that must be addressed in these plans: land use, risk, and response. Maryland's coastal lands run the gamut and include Assateague Island beaches, Ocean City condominiums, Middle River residential neighborhoods, and the 350-year-old historic downtown area of Annapolis. This diversity of land uses represents a tremendous challenge; thus, flexibility will be important in responding to SLR-related concerns.

Maryland's coastal community floodplains are mapped through the Federal Emergency Management Agency (FEMA) and the National Flood Insurance Program (NFIP). The Maryland Department of the Environment (MDE), Maryland Department of Natural Resources (DNR), and federal partners are completing additional hazard mapping of hurricane inundation and potential SLR flooding and inundation. These maps, taken together, will show a continuum of risk with some regions exposed to high velocity waves, while other areas may have only periodic shallow

flooding. Government and private responses to these increased risks include protection in place, mitigation design, avoidance and retreat.

At a minimum, state and local plans would address potential threats in affected areas and strategies for a phased implementation response under the following categories:

- Land use, zoning, and development density regulations to reduce population and investment at risk;
- Public and market-based incentives or disincentives to reduce property damage and threats to human health;
- Anticipation and planning for adverse health consequences of flooding, storms, and storm surges (this planning should consider the physical and mental health consequences);
- Provision of community infrastructure (i.e., roads, schools, public safety and medical facilities, water and wastewater systems, gas, electrical and communications utilities);
- Maintenance of existing and future natural resource lands and wildlife habitat, as well as working lands (i.e. agricultural and forest lands);
- Adaptive shoreline erosion control (non-structural and “living shorelines” approaches) and buffer management strategies, including the accommodation of future wetland migration corridors, where limited or no development is allowed; and,
- Public communication and outreach.

Greater integration and coordination of plans supporting public and private actions are recommended, as these processes provide an overarching mechanism necessary to facilitate more consistent and integrated statewide risk management. Specifically, the Maryland Department of Planning (MDP), DNR, and MDE, in consultation with local governments, should investigate the appropriate planning mechanisms to implement this policy option. Considerations should include current timing of plan updates, capacity of local governments, and availability of suitable data. The primary mechanism may be local comprehensive-plan elements, as required in Article 66b of the Annotated Code of Maryland.

This recommendation requires consideration of the plans that shape the comprehensive plan. The plans include, but are not limited to, appropriate infrastructure and community facilities (e.g., water and wastewater) land-use, municipal growth elements, sensitive areas and areas of special concern (e.g., floodplain management, Chesapeake Bay Critical Area, forest preservation), and special plans (e.g., marina and boating, Land Preservation Parks and Recreation Plans [LPPRP], shoreline and emergency management, and all hazard). Particular attention should be given to the integration of All Hazards Planning and the Comprehensive Planning processes, because there is currently no mechanism in place to coordinate these activities.

In addition, insight from Health Impact Assessments (HIAs) recommended in policy option HHSW-1 [Human Health, Safety and Welfare] should be incorporated into planning efforts. This recommendation is expected to form the policy basis at the state and local level for the implementation of EBEL-3 [Existing Built Environment and Infrastructure], Adaptation of Vulnerable Public and Private Sector Infrastructure. RRI-1 [Resources and Resource-Based

Industries], New Criteria for Identifying Natural Resource Priority Protection and Restoration Areas, will also be an important cross-linked adaptation option.

Option Design

Targets:

- Identify all public and private land at risk from SLR and storm surge. Regularly updated floodplain mapping, combined with predictive mapping of storm surge associated with specific weather events, should be undertaken. Local land-use regulations should be adapted to better anticipate these risks. State and local health departments should assess the potential health impacts.
- Local, state, and federal transportation planners will include SLR and storm surge vulnerability into short- and long-range transportation planning to avoid infrastructure expansion into vulnerable areas. Where existing infrastructure is already vulnerable, options should be evaluated to minimize risks, move infrastructure from vulnerable areas, or otherwise reduce vulnerabilities. A process similar to that under the Smart Growth Priority Funding Areas Act should be considered as a possible screening mechanism.
- Storm-water management calculations must also take into account the best available science on anticipated changes in precipitation associated with climate change in the Mid-Atlantic region and seek to accommodate potentially greater volumes of storm water within the watershed without creating or exacerbating downstream and coastal water quality, as well as habitat problems. All new development and transportation projects must include advanced “environmental site design” techniques to the maximum extent practicable for storm-water, such as infiltration, use of natural features, and bio-retention, over traditional storm-water management techniques.
- Infrastructure and development should be adaptable and resilient in areas where development cannot be avoided. Provide disincentives for development within high-vulnerability areas by ensuring that public funds are not spent on infrastructure that supports new development within vulnerable areas. Where feasible, the plan should identify where gradual realignment of existing structures, population density, land uses, and management approaches will be required to protect the long-term health, safety and welfare of Maryland residents.

Parties Involved: DNR, MDP, MDE, Maryland Department of Health and Mental Hygiene (DHMH), Maryland Department of Transportation (MDOT), Maryland Emergency Management Agency (MEMA), and local and county governments.

Timing: 2008, assess capacity of local governments; 2009, select appropriate planning implementation mechanisms at state and local levels; 2009, prepare proposed administration legislation; 2009, seek passage of legislation; 2010, prepare administrative guidelines and technical assistance materials; 2011, state and local plans begin to incorporate SLR response elements.

Other: Maryland Association of Counties (MACo), Maryland Municipal League (MML), affected local governments in Maryland’s coastal zone, National Oceanic and Atmospheric Administration (NOAA), U.S. Geological Survey (USGS), and the U.S. Army Corps of Engineers (USACE).

Implementation Mechanisms

Assessment of Local Government Capacity

The current capacity of local governments to undertake necessary steps to implement these actions is unknown, but it is expected to be insufficient to successfully complete these actions in a timely manner. Therefore, it is recommended that the DNR, MDE, MDP, MDOT, and MEMA work with MML and MACo to estimate that capacity by performing or providing

- A survey of local governments throughout the state to assess the planning measures already in place for SLR, assess the perceived barriers, and determine how best to share information between local, county, and state governments;
- A technical review and assessment of planning guidelines used by local communities and municipalities within the coastal zone; and
- Guidance to assist local governments with identifying specific measures (e.g., local land-use regulations and ordinances) to adapt to SLR and increasing coastal hazards.

Based on findings of the capacity assessment, state offerings of technical assistance, academic assistance, grants to local governments, and support for local geographic information system (GIS) mapping may be appropriate.

Selection of Plan Mechanisms and Development of Guidelines

Planning guidelines would be developed jointly by MDP, DNR, and MDE in consultation with local governments to ensure consistency and clarity and to facilitate integration of the new plan element with existing comprehensive planning and zoning requirements. Of particular importance is the need for the SLR element to clearly identify, under various scenarios, how the provision of public infrastructure may change (i.e., whether local governments plan to fortify or rebuild damaged infrastructure, reduce the footprint of vulnerable or damaged infrastructure, or abandon or relocate critical public infrastructure). Local governments should also evaluate the estimated costs and benefits of proposed solutions and associated funding mechanisms. These analyses and decisions are of monumental importance to existing and future property owners, insurers, emergency personnel, local, state, and federal government agencies, elected officials, the business community, and others.

Maryland Planning Article 66B

Implementation of these recommendations could include amendments to §3.06(b) of Article 66B of the Annotated Code of Maryland to expand sensitive areas, or a section on SLR could be added under county comprehensive and local hazard mitigation plans. These efforts should draw on statewide mapping and monitoring efforts. Additional modifications to the Chesapeake Bay Critical Area Act (DNR Article, §8-1807) and implementing criteria (Code of Maryland Regulations [COMAR], Title 27) to enhance SLR adaptation and response might be required.

State Finance and Procurement Article §5-611

The State Finance and Procurement Article, Title 5, Subtitle 6, establishes the authority for the MDP to define “areas of critical state concern.” MDP, DNR, MDE, and local governments should work together to define the geographic limits of areas potentially impacted by SLR, coastal erosion, and storm inundation. Once defined, MDP and local governments should act to

more formally designate these areas as “areas of critical state concern.” This will allow the state to apply “federal consistency,” which refers to the review process mandated by Section 307 of the Federal Coastal Zone Management Act of 1972, as amended (CZMA), and NOAA regulations (15 CFR part 930). The CZMA requires federal actions likely to affect any land or water use or natural resource of a state’s coastal zone to be conducted in a manner consistent with a state’s federally approved Coastal Zone Management Program (CZMP). The CZMA federal consistency requirement applies to direct federal activities, such as development projects, licenses or permits, and assistance to state and local governments. Federal consistency determination must be based on enforceable policies officially incorporated into the state’s CZMP.

Capital Planning Component

Capital project planning efforts should include estimations of vulnerability to SLR and storm surge for new or modified infrastructure. This process will consider broad floodplain management criteria to ensure that development occurs in areas that best reduce and minimize storm and flood hazards; facilitate natural infiltration; protect and restore riparian buffers, wetlands, and forests; and allow wetland migration corridors.

Emergency Management and Mitigation Plans

The adverse health consequences of flooding, storms, and storm surges are complex and far-reaching, and they include the physical health effects experienced during the event or clean-up process or from effects brought about by damage to infrastructure, including population displacement. The physical effects largely manifest themselves within weeks or months following the event and may be direct (e.g., injuries) or indirect (e.g., increased rates of vector-borne and other diseases). Extreme weather events are also associated with mental health effects, such as post-traumatic stress disorder, resulting from experiencing the event or from the recovery process. These psychological effects tend to be much longer lasting and may be worse than the direct physical effects.

To address these risks, effective approaches will be developed in collaboration with appropriate public health agencies and stakeholders to communicate appropriate responses that protect human health during large-scale floods, storms, and storm surges. Of particular concern are communication systems and plans that address health issues associated with low-income and underserved populations and other vulnerable groups. Plans will be developed for moving critical acute and long-term care facilities if they need to be closed because SLR, storm surges, or flooding may put them at risk. The plans will ensure that climate change concerns are integrated into activities of the Maryland Institute for Emergency Medical Services Systems (MIEMSS) and other organizations engaged in disaster response. Stakeholders will include managers of hospitals, public buildings, and infrastructure that provide emergency security, communications, and health services to reduce the vulnerability of critical activities and equipment during an extreme event or climate-related event.

Efforts to link locally developed and adopted comprehensive plans and emergency management plans, as well as the planning processes used to develop these plans, must be accomplished as described above.

Integration Across State and Local Plans

Planning policies adopted at the state level will be integrated with local efforts at three levels of planning. At the broadest level of planning, state and federally mandated efforts (i.e., the Maryland Comprehensive Master Plan, the Maryland Critical Area Master Plan, Maryland and the U.S. All Hazard Plans, the Maryland Transportation Plan, and the Maryland and U.S. Master Water and Sewerage Plans) would guide adoption of comprehensive classifications of impacts and policy response.

Local planning requirements would address in detail the design requirements for public and private development in areas at risk from SLR and associated hazards. Examples include Marina, Boating and Water Facility; Emergency Response; Erosion Control; Floodplain Management; and Shoreline Master Plans. Planning for all publicly funded projects through Capital Plans would require screening for possible SLR impacts and establish design standards for mitigating impacts.

Related Policies/Programs in Place

The Maryland Coastal Program Coastal Communities Initiative provides technical and financial assistance to local governments to promote the incorporation of natural resource and coastal management (e.g., coastal hazards, public access, water-use activities) issues into local planning and permitting activities. Additionally, a number of state-sponsored activities related to this option are currently underway: hazard mitigation planning, incentives and technical assistance for soft shoreline erosion control, SLR and storm surge mapping, green and blue infrastructure assessments, and an evaluation of growth management tools in coastal areas.

The Maryland Coastal Program is currently providing funding to Dorchester, Somerset, and Worcester counties to develop SLR planning guidance for each respective county. The purpose of the written guidance documents is to further the use of SLR and coastal hazard data and mapping products (made available through application of the light detection and ranging [LIDAR] data) in planning for and responding to SLR and coastal hazards at the local level. The three projects will map out the process, methodology (i.e., draft language), and a proposed timeline for incorporating SLR and coastal hazard response preparation into local planning processes and frameworks. The guidance will address the following four phases of SLR and coastal hazards planning: (1) Vulnerability and Impact Assessment; (2) Long-Range and Comprehensive Planning; (3) Code, Regulation, and Development Standards; and (4) Public Education and Outreach. The guidance will also provide recommendations for sequencing and integrating the four planning phases and will identify financial and technical assistance needs at the local level. Final products are expected in September 2008.

Mapping efforts are already underway, such as Maryland Shorelines Online (MSO) and Maryland Statewide Basemap (*iMap*)—an Internet-based interactive map suitable for use by state agencies, local governments, and the public. In addition, the policy option proposal for Integrated Geographic Information Systems (IGIS): Mapping Modeling and Monitoring, will provide local and regional governments with access to required spatial information for these planning efforts.

The DHMH Office of Preparedness and Response (OP&R) coordinates with local health departments and MEMA on the health response portion of this option.

Estimation of Adaptation Benefits and Costs

This policy option aims to increase the capacity of the Maryland government to respond effectively to threats associated with SLR and associated hazards by increasing the integration of local, state, and regional land-use, hazard management, and health care planning efforts. It emphasizes the need for careful preparation before disasters to minimize loss and to guide post-disaster response toward greater community resilience. The benefits of the effort are its many contributions to risk reduction. Such benefits, which relate to identification and implementation of risk management strategies, are difficult to quantify.

The improved coordination across planning efforts will increase flexibility in the design and selection of future response options by reducing implementation obstacles (e.g., response time and inconsistent implementation) and by increasing the pool of strategies likely to be more effective and timely. Training efforts suggested in this policy option and others will disseminate information to people on the risks of SLR and associated hazards through implementation and by establishing a broad foundation of knowledgeable parties who are better able to identify future adaptation options. This policy option addresses the need to improve coordination of diverse planning efforts in Maryland and will provide benefits for other planning goals.

This option involves two main sets of costs: (1) legislative development, research, and training elements require investments of staff time and communications resources; and (2) increasing capacity to conduct planning, according to new criteria and implementation of planning processes. These costs are more broadly distributed among local, state, and regional planning staff. The training costs will be similar to those associated with other changes to state planning. The implementation costs are most likely to be incremental additions to the cost of ongoing planning processes.

In 2008, staff time will be required to research and draft proposed administration legislation. Two specific projects have been identified:

- A survey of local governments throughout the state to assess the planning measures already in place for SLR, the perceived barriers, and how best to share information between local, county, and state governments; and
- A technical review and assessment of planning guidelines used by local communities and municipalities within the coastal zone.

During 2009, staff will support passage of the legislation. Assuming successful passage, preparation of technical assistance materials that identify specific measures (e.g., local land use regulations and ordinances) will take place in 2010. Beginning in 2011, localities revising their comprehensive plans will be required to incorporate the new integrative elements.

Feasibility Issues

Full benefit of this effort will depend on access to local information on SLR and associated hazards for planning purposes. A policy option designed to address monitoring, data

management and quality, GIS, and integration of required modeling efforts is recommended elsewhere in this report. In addition, public awareness of the risks will be important to the successful implementation of strategies to increase resilience. An option that addresses approaches to increasing public awareness is included in this report.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

FBEI-2. Adaptation and Response Performance Measurement

Option Description

A two-part strategy is proposed to advance action on key recommendations and promote integration of existing programs with recommendations. Under this option, each agency with a mission affected by SLR, associated hazards, and recommended policy options will review the recommendations of the Maryland Commission on Climate Change (MCCC) and the adaptation policy options developed by the Adaptation and Response Working Group (ARWG), report on how these issues and recommendations relate to their missions, and outline an agency action plan for integrating SLR and associated hazards into their planning and evaluation procedures. These revised procedures will be the basis for establishing performance measures.

The report should address opportunities for integration with existing programs, actions initiated, new programmatic efforts, and barriers to response; it should also provide a timeline for response. Particular attention should be given to state and local program implementation to ensure that future decisions and actions adequately consider and respond to anticipated impacts due to SLR and increases in storm frequency and intensity. Greater detail on report content is discussed under implementation mechanisms below. These reports are to be submitted to the Governor, the Executive Committee, Cabinet members, and Committee Chairs with copies to the MCCC. Information from these reports would support ongoing evaluation of Maryland's efforts, capacities, needs, and progress in addressing climate change mitigation and adaptation.

Performance measures will be reported annually. These measures should document processes and progress in adapting to SLR and associated hazards. Revised procedures and performance measures would remain in place, unless new information on risks or policy changes emerges.

Option Design

Targets: The relevant subset of potential impacts and policy options will vary among agencies. However, the agencies should evaluate and identify needed changes to their programs, policies, standards, and activities in the areas of engineering, design, and construction; siting and planning; funding; coastal zone management activities such as permitting of shoreline activities and monitoring; staff training programs; and education and outreach programs. These efforts should model best practices; ensure that funding is consistent with the broad goal of reducing exposure to coastal risks; and utilize the most recent scientific information, spatial mapping resources, and monitoring systems on climate change impacts in Maryland.

Timing: Reports and first indicator data will be submitted within a year of publication of MCCC Mitigation, Adaptation, and Science Working Group reports. Draft language for necessary changes to rules, forms, evaluation criteria, and policies and procedures should be prepared concurrently with the report to facilitate implementation. If changes require legislation or adoption of new regulations, then proposals for the recommended changes should be brought forward in the second year. Agencies will be asked to participate in the development of a reporting framework to accommodate agency-designed measures and ensure clarity, consistency,

and measurability of indicators among agencies. Performance indicators will be submitted annually.

Parties Involved: A large number of state agencies will be affected by the changing risks and adaptation policy options: Maryland Department of Aging (MDOA); Department of Budget and Management (DBM); Department of Business and Economic Development (DBED); Community Initiatives; Maryland State Department of Education (MSDE); MEMA; MDE; Maryland Environmental Services (MES); Department of General Services (DGS); Governor's Grants Office of Maryland (GGO); Maryland Health Care Commission (MHCC); DHMH; Maryland Higher Education Commission (MHEC); Governor's Office of Homeland Security (GOHS); Department of Housing and Community Development (DHCD); DNR; Maryland Insurance Administration (MIA); Department of Labor, Licensing and Regulation (DLLR); MIEMSS; MDP; Maryland Public Broadcasting Commission (MPBC); Public Service Commission (PSC); Maryland Board of Public Works (BPW); State Retirement and Pension System (SRPS); Rural Maryland Council (RMC); Maryland Secretary of State; Governor's Office on Service and Volunteerism (GOSV); Maryland Office of Tourism; MDOT; State Treasurer's Office (STO); University System of Maryland (USM); and Volunteer Maryland (VM).

Implementation Mechanisms

Orientation and training will familiarize principal agency staff involved in the review process with Maryland-specific information on SLR, associated hazards, and adaptation policies. The initial agency reports on adaptation should

- Identify programs affected by SLR, storm frequency, and storm intensity;
- Evaluate programmatic and procedural modifications needed to address these issues, including issues that may involve legislative or regulatory changes;
- Provide a timeline for modifications that will
 - Provide draft language for early implementation of changes that can be implemented without legislation or adoption of new regulations;
 - Identify changes that require legislation or adoption of regulations for introduction in the following year; and
 - Identify changes that require additional study or information over a longer period, prior to development of necessary changes to programs, policies, standards, and activities.
- Specify mechanisms to ensure that policies are updated regularly and in accordance with science and observed changes;
- Develop a reporting framework that will accommodate measures identified by agencies and will ensure clarity, consistency, and measurability of indicators among them; and
- Provide an annual report on performance indicators.

Related Policies/Programs in Place

All agencies identified have ongoing review processes and reporting requirements for programs that might be influenced by SLR and associated hazards directly or by proposed policy options.

BayStat: Governor Martin O'Malley created BayStat by Executive Order in February 2007. BayStat is a powerful new statewide tool designed to assess, coordinate, and target Maryland's Chesapeake Bay restoration programs and to inform its citizens on progress. Each month, Governor O'Malley meets with his BayStat team—the Secretaries of Maryland Department of Agriculture (MDA), MDE, DNR, and MDP, scientists from the University of Maryland (UM) and other key staff—to make sure Bay restoration work is on track. These sessions provide a regular opportunity for the team to assess progress, evaluate what is working and what is not, and adapt the efforts accordingly. BayStat allows Maryland state agencies to work smarter by coordinating efforts and programs, base decisions on the best available science, target resources to get the best value, and be more open and accountable to Maryland citizens.

National Coastal Zone Management Performance Measures System (NCMPMS): NOAA has established the NCMPMS to serve as a mechanism for quantifying the national impact of the CZMA. The system consists of performance indicators to track how well the CZMP and the National Estuarine Research Reserve System (NERRS) are achieving CZMA objectives. The NCMPMS includes performance indicators for Public Access, Government Coordination, Coastal Habitat, Coastal Water Quality, Coastal Hazards, Community Development, and Coastal Dependent Uses. The Maryland Coastal Program has submitted its performance measurement data in accordance with the program in 2006, 2007, and 2008.

Estimation of Adaptation Benefits and Costs

Mainstreaming consideration of SLR and associated impacts into policy and procedures promotes a comprehensive approach to adaptation that reaches across the diverse programs potentially affected by efforts to adapt to SLR and associated hazards. Absent a full review of programs that may be affected, the benefits cannot be quantified, but they will include reduction of economic, social, health, and ecological risks to SLR and associated hazards. The process of refining policy and procedures will result in increased staff awareness and understanding of the climate change, SLR, and associated potential impacts for Maryland. The deeper engagement offers greater capacity for sophisticated, innovative responses to new information.

This policy option has relatively low capital needs, because it is designed to mainstream adaptation issues into current programs and review processes. In the first year, it will require each affected agency to conduct an analysis of existing programs and procedures and report on proposed refinements to those processes. This initial effort in the first year report and direct follow-up actions in subsequent years will require dedicated staff time for coordinating staff in each program area. In addition, agency staff most closely involved with this review and refinement process are likely to require additional training on climate change, SLR, and associated impacts to ensure that they bring to the process a firm knowledge base, informed by the most recent science conducted for Maryland.

Feasibility Issues

Internal constraints to agencies' abilities to address these changes are likely to be affected by budget limitations and availability of staff time. In some cases, external factors, such as legislative issues and potential agency need for enabling legislation, might limit potential to make certain changes. Agency staff may require additional training on SLR and associated hazards in order to conduct thorough evaluations of their programs.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

FBEI-5. Climate Change and Insurance Blue Ribbon Advisory Committee

Option Description

Insurance is a central, cross-cutting element to an overall adaptation strategy. The insurance industry faces certain SLR, coastal erosion, and increased likelihood of severe storms, including hurricanes. Climate change is likely to have widespread impacts on the insurance industry and is also likely to have significant impacts on the financial condition of insurers and reinsurers, the ability to pay future claims and, thus, on the availability and affordability of insurance to Maryland's citizens and businesses. The structure of insurance will shape social investments and the distribution of risks through society, as well as the willingness of financial institutions to make capital available for mortgages and other capital investments in at-risk areas. Other policy options recommended here, such as those focusing on building code revisions, integrated planning, and modeling potential impacts, take a proactive approach to reducing risk, avoiding future costs, and helping the state to maintain insurability of investments. This option focuses on assessing changing risks and opportunities throughout the insurance arena.

There are a number of approaches being discussed and tested in other states and many changes taking place in the industry. In some cases, the vulnerability of state insurance systems to climate change is becoming clearer. In Florida, where 79% of insured property sits along the coast, homeowner insurance premiums have risen more than in any other state, with the average policy increasing by 88% between 2001 and 2006. Florida has a liability of over \$27 billion dollars for a hurricane with an estimated return time of 100 years.¹ Some insurance companies are no longer writing new coverage in the state.² In states that are insurers of last resort, the possibility of increasingly expensive or unavailable insurance coverage could pose significant problems for the state's financial and fiscal health. States not currently the last recourse for insurance may be pressured to assume that role if adverse results force insurers to withdraw.

Two measures in particular can help Maryland to assess its options for state regulation of insurance in the face of climate change. First, there is a need for information on the risks posed by climate change and how insurers and reinsurers are managing those risks. Second, it is important to have a focused assessment of this issue and a strategy for managing the ramifications of climate change risks and uncertainties.

Blue Ribbon Advisory Committee. It is recommended that the Governor establish a blue ribbon advisory committee to study and report on potential impacts of climate change on insurance in the state, determine the potential role for insurance in promoting environmental management goals, and address the relationship between changing building and design standards and insurance. Further, the advisory committee should be independently chaired, and the MIA should take an active role in the advisory committee without chairing it to ensure that the breadth of

¹ Financial Services Commission, Florida Office of Insurance Regulation, "Annual Report of Aggregate Net Probable Maximum Losses, Financing Options, And Potential Assessments." February 2008.

² Environmental Defense, "Blown Away: How Global Warming is Eroding the Availability of Insurance Coverage in America's Coastal States," 2007.

stakeholder concerns is heard. This committee would consider policy options identified by the National Association of Insurance Commissioners (NAIC) on climate change, incentives (or disincentives) in the current insurance market, innovative means for insurers to support best practices in risk reduction, and forms of public–private partnerships to support industry advance in these areas. As part of this effort, the committee should consider whether it is possible to develop a program similar to the Community Rating System (CRS) within the NFIP, which would encourage local governments to implement protective or adaptive measures by offering reduced insurance rates for risk-reducing actions.

Enhanced Disclosure of Climate Risks. It is also recommended that the MIA consider requiring insurers operating in the State of Maryland to disclose to their investors the risks posed by climate change, and what steps the companies are taking to manage those risks. At a minimum, the MIA could consider requiring disclosure of the steps taken to assess the impact of climate change in the state, the results of the assessment over various time periods (short term to long term), and the degree to which climate risks could affect the company’s access to reinsurance, solvency, risks in its own investment portfolio, and possible effects on availability and affordability of coverage.

Option Design

There are two actions in this option:

1. Create a Blue Ribbon Advisory Committee to advise the MIA and the Governor of the risks climate change poses to the availability and affordability of insurance for Maryland citizens and businesses, and
2. Require the MIA to study and report on the costs and benefits of requiring greater disclosure of the risks posed by climate change to investors on the part of all insurance companies operating in the State of Maryland.

Targets:

The Blue Ribbon Advisory Committee should consider the following key issues:

- Assess whether data available to insurers are adequate to assess risks posed by climate change (including SLR) and recommend steps to improve data deficiencies;
- Assess the degree to which adaptive options (e.g., zoning that recognizes risks of building in high-risk areas and improved building codes to protect against more severe weather and flooding) may mitigate insured losses due to climate change and whether insurance rate structures could be constructed that provide incentives for early adaptive actions;
- Assess the accuracy and quality of climate initiatives on the part of insurers; and
- Assess options to promote partnerships with policyholders for loss mitigation.

Timing: The advisory committee should be established and provide an initial report back within one year.

Parties Involved: MIA, DNR, DHMH, MDP, representatives of insurance and reinsurance companies (representing the spectrum of insurance [e.g., property and casualty, life and health,

directors and officers insurance]), homeowners and property developers, representatives of public or private institutions providing essential infrastructure services (e.g., electricity, water and sewerage, and telecommunications), and businesses whose access to insurance is essential for continued operation.

Other: Inevitably, there will be tension between the insurance companies and those insured, particularly when disasters occur. In some cases, most recently in Florida, many insurance companies curtailed their property and casualty businesses along the coastline, in anticipation of more damaging storms, increased incidence of severe weather, and SLR. The loss of insurability, or increasingly expensive coverage, may well be an effective mechanism to discourage further development in areas most at risk from the effects of climate change, and may well be something Maryland policymakers should consider. However, changed coverage and loss of affordability can also be extraordinarily damaging to the reputations of insurers, even if the actions they take are in the long-term beneficial to public interest. It would be useful for the commission to not only consider the needs of Maryland's homeowners and businesses in the work of the commission, but also to take into account the needs of the insurance companies.

Implementation Mechanisms

An advisory committee composed of staff from the MIA, MEMA, MDP, homeowners and municipalities vulnerable to damage from SLR, and representatives from associated industries such as insurance and reinsurance companies would meet to consider major issues. They would be expected to bring in additional outside experts to inform their discussions. It is recommended that the chair of the advisory committee be an independent outside expert.

Related Policies/Programs in Place

The MIA has joined the NAIC Climate Change and Global Warming (EX) Task Force.

Maryland Task Force on the Availability and Affordability of Property Insurance in Coastal Areas. In recognition of concerns over changes in the availability and affordability of property insurance in coastal areas all along the East Coast and into the Gulf, and in response to questions concerning the availability and affordability of property insurance in Maryland's coastal areas, the Maryland General Assembly, through signature of the Governor, enacted House Bill 1442 (Chapter 486 (2007)) "Task Force on the Availability and Affordability of Property Insurance in Coastal Areas." The statutory purpose of the Task Force was to "examine methods to ensure the continued availability and affordability of property insurance in coastal areas of Maryland." The Task Force issued its final report in March 2008; the following are its recommendations:

- Require any insurer seeking to refuse to underwrite or renew a risk based solely on the fact the risk is located in a certain geographic area to obtain the prior approval of the Insurance Commissioner. This recommendation would require legislation to amend the existing statute, Section 19-107 of the Insurance Article.
- Require any insurer seeking to use catastrophe modeling as a basis for its rating and underwriting to have its catastrophe model reviewed and approved for use by the Insurance Commissioner. This recommendation would require legislation to be supplemented by regulation.

- Require any insurer seeking to apply a mandatory and separate deductible for losses arising out of a hurricane or named storm in an amount greater than 5% to obtain the prior approval of the Insurance Commissioner. This recommendation would require new legislation, because the Insurance Article currently has no such restriction.
- Require any insurer seeking to apply a separate deductible for losses arising out of a hurricane or named storm to advise the insured of this separate deductible and its amount in the Annual Summary of Coverages and Exclusions, as required by Section 19-205 of the Insurance Article. This recommendation will require an amendment to the existing statute.
- Require any insurer seeking to apply a separate deductible for losses arising out of a hurricane or named storm to have common language that operates as a trigger for the application of the deductible. It is recommended that a deductible be triggered when the National Weather Service (NWS) has issued a Hurricane or Named Storm Warning for the State of Maryland; it will be removed 24 hours after the NSW has cancelled the Hurricane or Named Storm Warning or Watch. This recommendation will require new legislation, because the Insurance Article does not address this matter.
- Require the development of a statewide building code to apply to all new construction and major renovations (equating to more than 50% of the property), with the requirement that residential dwellings meet the International Residential Code (IRC) and that commercial construction meet the International Building Code (IBC). This recommendation will require new legislation.
- Encourage mitigation efforts taken by the insured to protect their properties in the event of a loss by requiring insurers to provide a discount on the policy premium to those insured. The Insurance Commissioner will identify the mitigation efforts and establish the appropriate amount of the discount. This recommendation will require legislation supplemented by regulation.
- Provide the Commissioner with the authority to take the necessary actions, with respect to submission of claims, grace period for payment of premiums, postponements of cancellations and nonrenewals, and other powers as needed to protect the citizens of the state when the Governor has declared a state of emergency. This recommendation will require new legislation, because the Insurance Article does not currently provide the Commissioner with this type of authority.
- Request that the MIA study the desirability and feasibility of a State Catastrophe Fund.

The Task Force concluded that neither availability or affordability of property insurance in the coastal areas of Maryland are issues but that it must work to make sure the situation remains that way and the marketplace continues to be stable. Thus, the Task Force encouraged the Maryland General Assembly to implement legislation to codify its recommendations.

House Bill 1353, Omnibus Coastal Property Insurance Reform Act. This Act, which passed in the 2008 Legislative session, states that insurers of homes cannot adopt an underwriting standard requiring a set deductible unless they've received approval from the Insurance Commissioner to do so. The Bill goes on to say that the deductible is subject to timing and percentage of policy limitations. Discounts are required where homeowners have made improvements that reduce risks inherent in coastal zones provided the homeowners have used

licensed contractors and the improvements are inspected for compliance. Catastrophic risk assessments should be used to set rates. The actual text of the law is footnoted below.³

The Act also requires the DHCD to conduct reviews and provide reports by specific dates to allow for the implementation of this Act and for other initiatives related to coastal property insurance.

Estimation of Adaptation Benefits and Costs

This option calls for investigating insurance issues specific to Maryland and identifying policies and practices that best meet the state's needs. The option does not commit the state to a course of action but seeks to inform a long-term policy process for establishing legal and financial obligations that may be difficult to adjust in the future. By drawing a diverse set of stakeholders into a dialogue on insurance issues, this process will create a knowledge resource specifically attuned to Maryland's concerns. The potential benefits depend on emerging knowledge of vulnerability and risks as well as investment responses to climate change risks; thus, they are difficult to fully anticipate. However, the effort will benefit the state by informing decisions about the government liability associated with various insurance strategies; identifying insurance options to meet the needs of the residents and businesses in the state; creating a forum for insurers, government, and consumers to discuss the role of insurance in managing climate risks; and providing access to information on the risks faced by insurance agencies and possible impacts on the accessibility and affordability of coverage.

Option costs are associated with staffing and convening an advisory committee and overseeing the disclosure process. There will be costs for staff time for organizing the committee, research to support committee efforts, reports by the staff and communication and outreach on findings. The committee is expected to meet over the course of one year. The disclosure process would pose an incremental cost to the MIA. The full benefit of this effort will depend on a strong understanding of risks for Maryland. The proposed inventory of public and private investment along the coast, integrated geographic information system (IGIS), SLR monitoring, and science studies are associated costs.

³ "[This law] prohibits an insurer *that issues a policy of homeowner's insurance* from adopting an underwriting standard that requires a certain deductible unless the insurer has made a certain filing and obtained approval from the Commissioner; providing that if an insurer has adopted a certain underwriting standard that requires a deductible equal to a percentage of the policy limits of a policy, the deductible may only be applicable during a certain time; requiring an insurer that has adopted a certain underwriting standard to send a certain annual statement; requiring certain insurers to offer a certain premium discount to certain policyholders who submit certain proof of certain improvements made to a certain insured premises; requiring certain improvements to be completed by certain licensed contractors; authorizing an insurer to inspect certain improvements; requiring certain premium discounts to be in compliance with certain provisions of law; requiring certain insurers to provide a certain annual statement; requiring certain insurers that use catastrophic risk planning or other models in setting *homeowner's insurance* rates to file certain information with the Commissioner and explain certain information and make certain arrangements; providing that certain information is proprietary and confidential commercial information under a certain provision of law; authorizing the Commissioner to adopt certain regulations; requiring a certain insurer to file a certain plan at a certain time; providing for the contents of the plan; prohibiting the plan from taking effect until a certain time after a certain filing; authorizing the Commissioner to extend a certain waiting period for a certain time upon a certain notice; providing that a certain filing is deemed approved unless disapproved by a certain time; authorizing the Commissioner to allow a certain insurer to implement a certain plan within a certain time; requiring the Commissioner to approve the plan under certain circumstances; requiring the Commissioner to assess a certain impact; requiring the Commissioner to state certain points of objection and certain amendments under certain circumstances; requiring a certain insurer to file a certain amended plan within a certain time; prohibiting any intended withdrawal in accordance with a certain plan until a certain plan is approved; and, defining certain terms."

Feasibility Issues

This effort will require a limited amount of funding and committed staff time, but no exceptional feasibility issues have been identified.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

FBEI-6. Integrated Geographic Information Systems: Mapping, Modeling, and Monitoring

Option Description

Maryland's coast is particularly vulnerable to episodic (i.e., hurricanes and Nor'easters) and chronic hazards associated with shore erosion, coastal flooding, storm surge, and inundation. These hazards are driven by and exacerbated by climate change and SLR, which occurs in the mid-Atlantic region at a rate nearly double the global average. SLR poses a significant threat to resources and infrastructure in Maryland's coastal zone. These impacts are likely to escalate as growth and development continues, especially within low-lying Eastern Shore communities.

In recognition of the state's vulnerability to SLR and its ensuing coastal hazards, Maryland's state agencies have been aggressively acquiring and analyzing various data and technological resources (see Related Policies and Programs) to gain a better understanding of SLR vulnerability and to increase the state and local government capacity to adapt and respond. To date, the State of Maryland has amassed a significant amount of data and undertaken state-of-the-art research, making Maryland a national leader in SLR modeling, research, and response planning. However, more work in the following areas is needed to complete statewide SLR modeling and develop mapping and monitoring products to support state and local SLR adaptation and response planning efforts:

- Complete statewide SLR inundation and storm surge modeling on a scale appropriate for state and local planning;
- Adopt a production and maintenance schedule for mapping and modeling activities; include the anticipated costs, financing options, and data sources; and increase the accuracy of predicted results;
- Ensure that state and local governments have easy access to the comprehensive body of information necessary for planning and response activities;
- Review institutional and organizational data management practices and make recommendations to enhance efficiency and cost-effectiveness of data gathering, sharing, maintenance and processing efforts and to minimize duplication of effort, data, and modeling redundancies;
- Create a digital spatial inventory of infrastructure potentially impacted by SLR that identifies public and private systems and facilities and threatened historical structures. This database should be maintained relative to SLR projections and scenarios;
- Utilize GIS systems to model and monitor specific "leading indicators" of climate change impacts—indicators that are representative of specific geographic ranges, behaviors, or population characteristics of certain species (e.g., plants, birds, mammals, and insects) known to be hypersensitive to SLR and other climatic changes. See Policy Option EBEI-2, Observation Systems for Changes in Coastal Areas, for more information; and
- Enhance the integration of SLR and other climate change data, research, and technology into state and local SLR adaptation and response planning efforts.

In addition, participating agencies should coordinate requests from Maryland to federal agencies asking them to provide regular updates of flood risk maps and to account for climate change risk in these mapping efforts.

Option Design

Targets: The effort will provide comprehensive coverage for the state and ensure regular updates of data, models, and maps. It will also strongly encourage and support requests to federal agencies for regular updating of flood risk maps and accounting for potential climate change impacts on risk in these maps. These maps will be made broadly accessible to professionals and the public to support adaptation planning and understanding of risks and processes of change.

Timing: This effort will support the ongoing efforts of MDP, Maryland DNR, MDE, and DHMH to integrate GIS data and improve data quality standards.

Parties Involved: Maryland DNR, MDE, MDOT, MEMA, MDP, and DHMH, *iMap*, Maryland State Geographic Information Committee (MSGIC), and USM.

Other: Identify other factors or parties that would need to be engaged for successful implementation of the option in the state.

Implementation Mechanisms

This effort will build on ongoing efforts of the Maryland DNR, MDE, MDP, MEMA, and DHMH to improve the integration and data quality standards of their ongoing data acquisition, mapping, and modeling efforts.

Implementation of this policy option should be intrinsically linked with *iMap* and will provide access to standardized information (e.g., imagery, roads, streams, place names, and property information) to serve as a base on which to overlay other data, such as the locations of features or resources at risk from SLR or predicted water levels from storm surge modeling. Anticipated deployment of Phase I of *iMap* is Spring 2008. The coordination of maps and model output will be supported by broadly accessible information on the nature of the risks and guidance on appropriate use of the models.

Implementation of this option should also be closely coordinated with MSGIC, which promotes coordinated development and efficient use of resources among all entities involved in the collection and use of spatial data and GIS technologies in Maryland.

Related Policies/Programs in Place

Over the past several years, the State of Maryland has directed substantial efforts toward advancing the state's understanding of SLR and coastal hazard vulnerability. The foundation of this understanding has been the implementation of an aggressive strategy dedicated to advanced technology and data and research acquisition and support.

SLR Vulnerability: Recent data and research efforts of the DNR include the completion of historic shoreline position maps; the statewide calculation of historic erosion rates; a comprehensive inventory of shoreline features and conditions for Maryland's coast; and an SLR

economic cost study. Another achievement for the state is the acquisition of LIDAR high-resolution topography. Over a 5-year time span, DNR worked with state and local partners to acquire high-resolution topographic data for the majority of the state's coastal counties including all of the Eastern Shore. This data is now being used to develop SLR inundation models that demonstrate the impact of gradual SLR inundation over time, as well as impacts associated with increased storm surge from episodic flood events. SLR modeling has been completed for Worcester County (<http://www.dnr.state.md.us/Bay/czm/wcslrreport.html>), Dorchester County, and pilot areas within Anne Arundel and St. Mary's counties. Recently, SLR Vulnerability Maps have been created for all coastal counties, depicting lands (i.e., 0 to 2 feet, 2 to 5 feet, and 5 to 10 feet) above mean sea level.

Maryland Shorelines Online (MSO): To provide ready access to the data and information discussed above, the Maryland Coastal Program, in cooperation with Towson University (TU), developed the MSO Internet portal (<http://shorelines.dnr.state.md.us/>). The portal provides information and tools to coastal managers and decision makers, educators, and the public on SLR, coastal hazards, and shoreline management. This Web site houses information regarding Maryland's legal framework, permitting and regulatory guidance, educational materials, assessments, and spatial decision support tools for shore erosion and SLR. The tools provided on the Web site allow for the identification of potential shoreline protection and restoration options throughout the state to mitigate hazards and enhance natural shoreline habitat. MSO is currently undergoing a comprehensive update to incorporate new information and data.

Coastal Bays Hazards Initiative: In February 2004, the Coastal Bays Policy Committee charged the DNR Coastal Program with the task of assembling a work group to investigate the need for and opportunities for better coordination of coastal hazards issues. In particular, recommendations were to be developed on how to promote the use of new tools and developing technologies at the local level to assist in visualizing hazards and local vulnerability.

Recent developments in data gathering, information management, and planning tools have crossed technological thresholds, which greatly enhances the ability to use desktop planning for hazard response and mitigation. To achieve the efficiencies offered by these new technologies and tools, a better understanding is needed of local government technology requirements, of mechanisms for increasing coordination, and of how to leverage available resources. This Final Report identifies some of the hurdles to implementation and lays the groundwork for expanding application of the products and tools statewide. Specific recommendations in the Report focus on the means for incorporating, developing, processing, and formatting data for decision makers; identifying capacity-building opportunities and needs; recognizing responsibilities and coordination; and providing technical support and financial assistance.

Floodplain Map Modernization: The MDE Business Plan for Map Modernization (2004–2008) outlines the state's vision for updating flood studies throughout Maryland by using FEMA's Digital Flood Insurance Rate Maps (DFIRMS) as a base line. Maryland's objectives for floodplain management have been realigned to coincide with the newer digital floodplain maps being prepared in most of the state. MDE plans to reduce costs and review times associated with traditional detailed studies by maintaining or integrating the FEMA flood studies as a continuously updated model that can be modified as watershed conditions change. Proposed

changes (i.e., new roads, bridges, and development) can be added to the flood model to keep the FEMA flood maps current as permits are issued by MDE.

MDE, along with FEMA and local government partners for select counties, initiated the floodplain map modernization project in 2005. Products for Montgomery, Harford, Frederick, and St. Mary's counties have been completed; Baltimore County and Baltimore City are currently pending completion; and Wicomico, Dorchester, and Somerset counties will be completed by the end of 2008. Howard, Anne Arundel, and Cecil counties are scheduled for completion in 2009. Allegany, Washington, Carroll counties and a new Chesapeake Bay Storm Surge Model are planned for 2010. Garrett, Washington, and Talbot counties are expected to be complete in 2011. Completion of products for the remaining counties will depend on the availability of FEMA funding.

Surge Inundation Mapping: LIDAR data were also used by the USACE to develop surge inundation models for Maryland's Eastern Shore counties. These counties are the lowest areas in the state, and some areas are experiencing significant growth pressures. The maps are essential in expanding our knowledge of potential impacts and identifying vulnerable communities and infrastructure. These maps have been provided to local comprehensive planning and emergency management offices. Extension of these mapping efforts into all coastal counties is needed and under consideration.

Local Hazard Mitigation Plans: In November 2004, the MEMA completed the Maryland State Hazard Mitigation Plan (SHMP) and associated mapping pursuant to regulations established by the Disaster Mitigation Act (DMA) of 2000. The goal of SHMP is to reduce the loss of life and property damage associated with hazard events in Maryland. MEMA complied with this priority, because considerable effort has been put forth to map state-owned and critical facilities, as well as the areas for 11 other hazards. The most important aspect of this mapping effort was the identification of facilities, total populations at risk, and vulnerable populations at risk within hazard areas. The data sets and mapping effort will continue to evolve and improve, as new data and technologies become available. MEMA considered historic shoreline changes data during the development of SHMP, which was then used by local governments as the baseline or starting point of information for local hazard mitigation planning activities.

Hazards U.S. –Multi-Hazard (HAZUS-MH): Hazards U.S. (HAZUS) is a risk assessment software program for analyzing potential losses from floods, hurricane winds, and earthquakes. Hazards U.S.-Multi-Hazard (HAZUS-MH) estimates damage before or after a disaster occurs and takes into account various social and economic impacts of a hazard event. MDE partnered with Salisbury University (SU) to complete a statewide analysis of flood vulnerability estimated through the HAZUS-MH flood module. The Level One analysis, completed in June 2005, estimates flood damage from a 100-year coastal or riverine flood event to commercial and residential properties. This study takes the next step after identifying flood vulnerability to understanding the risk to the built environment. The final report, "An Assessment of Maryland's Vulnerability to Flood Damage," is now available.

Emergency Management Mapping Application (EMMA): EMMA was developed by TU University Center for Geographic Information Science (CGIS) in cooperation with MEMA. EMMA is an incident response tool the emergency management community can use to display

relevant information before, during, and after an incident occurs. As a Web-based mapping application, EMMA enables the emergency responders to identify incident locations from the field, generate location-specific reports, visualize incident locations via a map, perform site-specific analysis, and coordinate response efforts. Using a simple Web browser, such as Internet Explorer, EMMA provides basic and advanced tools for map visualization, location analysis, and report generation.

Sea, Lake and Overland Surges from Hurricanes (SLOSH): SLOSH is a computer program available to the emergency management and planning communities and is used in the state and local emergency operations centers to identify storm-surge impacted areas and determine evacuation routes. SLOSH, a computerized model developed by the National Hurricane Center (NHC), helps Maryland's emergency management and response communities estimate storm surge heights and winds resulting from historical, hypothetical, or predicted hurricanes by taking into account a storm's pressure, size, forward speed, track, and wind velocity. During tropical Storm Isabel, communication of the surge predictions from SLOSH for the Chesapeake Bay were not accurately translated and transferred to the public.

Hurricane Evacuation Tool (HURREVAC): HURREVAC is a computer program that is available to the emergency management and planning communities through the NHC. HURREVAC automatically tracks hurricane-related information and displays the results graphically. The program is used in the state's Emergency Operations Center (EOC) at MEMA to help determine evacuation options and routes. HURREVAC uses current and forecast storm data and displays the track of the storm in various formats. The program derives the potential for storm surge and calculates evacuation times based on storm speed and intensity. It can also be used as a "what-if" tool to help decision makers determine courses of action for different storm characteristics.

Coastal Inundation Prediction System (CIPS): CIPS is being developed by a team of government, academic, and industry partners through the Chesapeake Bay Observing System (CBOS) of the Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA) within the Integrated Ocean Observing System (IOOS) to improve the accuracy, reliability, and capability of flooding forecasts for tropical cyclones and nontropical wind systems (e.g., nor'easters) by modeling and visualizing expected on-land storm-surge inundation along the Chesapeake Bay and its tributaries. CIPS will provide an end-to-end prototype of inundation forecasting system to facilitate decision making for emergency management in the challenging case of complex coastlines—semi-enclosed, coastal bays, and estuaries. An initial prototype was developed for the tidal Potomac River in the Washington, DC, metropolitan area. The Chesapeake Bay component was initiated in October 2007, with an expected completion date of 2010.

Maryland State Geographic Information Committee (MSGIC): MSGIC promotes coordinated development and efficient use of resources among all entities involved in the collection or use of spatial data and GIS technologies in Maryland. Most recently, MSGIC focused on interoperable practices and standards, which relate to the "capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units" (MSGIC Web site). The Maryland Mapping Resource Guide (MMRG) lists projects addressing parcel

mapping, tax maps, emergency management support, floodplain mapping, and other projects, including several at the county level.

Maryland Statewide Basemap: Maryland Statewide Basemap (*iMap*) will provide access to standardized information (e.g., imagery, roads, streams, place names, and property information) that will serve as a base on which to overlay other data, such as the locations of features or resources at risk from SLR or predicted water levels from storm surge modeling. Anticipated deployment of Phase I is Spring 2008.

Maryland Department of the Environment Wetlands and Waterways Program: The program provides guidance materials, sample drawings, regulations, permit applications, and supporting information on wetlands and waterways. Databases are maintained on wetland gains and losses for regulatory programs, including all types of shoreline stabilization practices, and voluntary restoration and preservation practices, with a focus on marsh creation. Consolidated wetland map layers are also available.

Estimation of Adaptation Benefits and Costs

This option builds on ongoing efforts to integrate and disseminate GIS information collected by local, state, and regional entities and proposes expansion of the available modeling and mapping information relevant to SLR and associated coastal hazards. Integration of the diverse, relevant spatial data, increased monitoring information, refined risk-modeling capabilities, and improved accessibility of information is required to ensure the full benefits of many adaptation options and other planning goals. Greater accessibility of spatial information combined with regularly updated modeling and risk mapping will facilitate the integration of climate change-related information into existing decision-making and planning processes. These tools offer benefits that help inform a wide array of planning initiatives for individuals, public, and private entities and help with assessment of risks and policy options. While information is crucial to some analyses and benefits are likely to be substantial, the benefits of the inputs to a decision are difficult to empirically assess separately from future decisions and uncertainties.

The option requires more detailed assessments in several areas to inform a cost estimate. Research needs include determination of an appropriate maintenance schedule for updating mapping and modeling; assessment of the status and capabilities of mapping and modeling efforts; review of institutional data management practices to enhance efficiency and coordination; and development of pertinent data sets and modeling tools. Development of a financial strategy will depend on findings of these studies and a determination of the adequacy of cyber-infrastructure to ensure easy access to information.

Feasibility Issues

This option involves a capacity assessment of agencies and cyber-infrastructure. Full implementation and benefits will depend on funding to address any needs identified in the assessment. Flood hazard maps need to be updated regularly to ensure that planning and regulatory actions using these data sets are based on the best available information.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

FBEI-8. Green Economic Development Initiative

Option Description

“We must transition from a carbon-based economy to a green, sustainable economy...” — Governor Martin O’Malley testimony before the U.S. Senate Environment and Public Works Committee (EPW), September 2007.

A bold, simple vision that unites diverse interests, when supported by a plan, resources, and tangible results, can inspire Marylanders to meet the challenges of today and tomorrow. The observed and projected impacts of climate change provide ample reason for Maryland and the United States to shift toward a green, sustainable economy. A green economy will involve the greenhouse gas (GHG) mitigation efforts necessary to avoid the increasingly severe impacts associated with greater change and the adaptations required in responding to the current climate-change commitment created by past and ongoing emissions.

While some fear climate change as inhibiting economic prosperity and development, more businesses recognize solutions to climate change may actually create significant economic opportunities while solving other societal problems. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007), Working Group II Report "Impacts, Adaptation and Vulnerability, Section 20 states “Sustainable development can reduce vulnerability to climate change by enhancing adaptive capacity and increasing resilience. At present, however, few plans for promoting sustainability have explicitly included either adapting to climate change impacts, or promoting adaptive capacity.” Although green-collar jobs in the energy sectors are more widely recognized, adaptation responses to reduce climate change threats and promote sustainability also offer economic development opportunities.

Solutions to climate change can be smart, win-win strategies that simultaneously address multiple issues for diverse stakeholders. There are many adaptation strategies to reduce vulnerability to SLR and associated hazards. If they are carefully crafted, some adaptation opportunities can also contribute to climate change mitigation efforts and broader goals of environmental sustainability. To realize the promise of such strategies, a green economic development plan for Maryland is needed.

Fortunately, the benefits of creating a green, sustainable economy are substantial and widespread. They include a better quality of life, independence from imported fossil energy, thousands of green-collar jobs, lower operating and maintenance costs for homes and businesses, cleaner and more reliable and resilient power systems, a more dependable and healthy food system, better access and mobility, and significant environmental and health improvements, such as cleaner air and water, open space, pedestrian-friendly communities, and restored habitats.

The goal of this option is to initiate the development and execution of a green economic development plan. The intent is to catalyze a self-reinforcing green growth cycle across all sectors of Maryland’s economy. In such a growth cycle, an increasing demand for green products and services sustains a thriving community of green businesses and industries which, in turn, create more jobs, healthy communities, and a cleaner environment. Central to this growth cycle

are natural principles, such as turning waste into wealth, resource efficiency, optimizing stakeholder value, and life cycle thinking. Thus, Maryland will meet the challenges of climate change while helping the state shift toward a greener, leaner, more sustainable economy.

Option Design

Targets: Establish Maryland as a leader in the new “green” economy by 2015 by increasing the market value of businesses within the state that provide products or services related to a green, sustainable economy and increasing the amount of investment within the state in products and services related to the green economy.

This option includes new green businesses, as well as the greening of more traditional businesses, to improve their economic, social, and ecological performance. Currently, there is no standard for defining what constitutes a green business or commonly accepted measures of what it means to be “green.” However, the growth potential for a green, sustainable economy is likely to be quite large, given the existing opportunities for reducing resource waste, pollution, and ecological impacts. Using the state government as a “pump primer” will save taxpayers money by reducing waste, while encouraging the growth of green service and product providers. Finally, while the exact percentage of Maryland’s economy considered green is difficult to discern, it is generally understood that the green portion is relatively small, but the demand for green growth is substantial.

There are many barriers to any new technology, and many of those barriers are created by those who profit from the status quo. Using public-sector procurement and publicly supported resources, like academic institutions, to help overcome those barriers is a strategy that has been successfully used by governments at every level. The dominance of American microelectronics throughout the latter half of the twentieth century is attributable in some significant measure to early support by the U.S. Department of Defense (US DOD), just as Europe’s current dominance in renewable energy technology is attributable to government incentive programs.

Parties Involved:

Climate change response and economic development efforts will influence a wide array of people and organizations and relate closely to the broader agenda of sustainability. This partial list of parties identifies agencies, businesses, and environmental organizations associated with climate change responses, coastal areas, and green business initiatives.

Green Business Groups—Maryland Green Community (e.g., Green Drinks, Green Building Institute [GBI], Chesapeake Sustainable Business Alliance [CSBA], Maryland League of Conservation Voters [LCV] and Businesses for the Bay), Maryland Green Building Council (standing commission created by legislature), and Clean Energy Partnership (CEP), a Maryland-based nonprofit that organizes businesses in support of practical solutions to global warming.

Business and Labor Organizations—Local Chambers of Commerce, the Maryland chapter of the National Federation of Independent Business (NFIB), a small business advocacy organization, labor unions, organizations, and the financial community (e.g., banks, investment firms, and pension funds).

State Agencies and Offices—DBED, Maryland Economic Development Corporation (MEDCO), MDE, Maryland Coastal Program (a networked program administered at DNR that includes local, state, and federal partners), MDOT, MDA, DHCD, Maryland Office for a Sustainable Future (OSF) within DNR, Maryland Sustainability Subcabinet, and USM.

County and Local Government Agencies—Baltimore Development Corporation (BDC) and MACo.

Implementation Mechanisms

Building on Governor O'Malley's vision and the momentum of initiatives already in place, the State of Maryland should take immediate steps to capitalize on green economic development potential. The Governor should establish a Task Force or other appropriate group capable of acting quickly to refine implementation and initiate strategies to give Maryland strong capacity to recognize and promote market opportunities arising from climate change adaptation and mitigation requirements. DBED and other agencies with programs in business development and trade promotion should play a critical role in this effort. The first effort of the group will be to determine the capacity of existing efforts to identify emerging opportunities in the area of climate change adaptation and mitigation, support the development of products and ideas, and promote these businesses nationally and internationally. The appropriate group should include strategies to enhance statewide capabilities to the level necessary to act on this group's recommendations. Steps for a task force, or other appropriate body, include advancing strategies to accomplish the following:

- **Build public and business awareness of why a green, sustainable economy is good for Maryland.** This step will stimulate demand for green products and services and the “greening” of businesses across sectors. Use benefits listed under Option Description to track and communicate progress. While developing a green sustainable economy is critical to mitigating the impacts of climate change, the challenges created by SLR, increases in storm frequency and intensity, and the many other impacts of climate change will create needs for innovative processes and the development of new goods and services, as well as open competitive market opportunities.
- **Promote the greening of existing Maryland businesses.** Society is being forced to adapt to the impacts of changing climate, while minimizing long-term threats through mitigation efforts. For businesses, adaptation means improving risk management and innovating for new opportunities by demonstrating and supporting practices and solutions that integrate economic, social, and environmental performance. For instance, a company can reduce its risks, build market share and profits, and cut costs through better environmental management (by reducing waste, pollution, and ecological impact) and the introduction of green products and services. Key actions include recognizing leadership in green business practices; providing education, networking, and outreach; and supporting technology and standards development.
- **Use Maryland government as a “pump primer” for stimulating the growth of a sustainable, green economy.** This includes greening state procurement and work policies to save money, improve worker productivity and morale, reduce waste, improve resource efficiency, and lower or eliminate pollution. Develop a scorecard to measure progress in these and other goal areas.

- **Develop adaptation-decision support services and tools for business.** Develop applications and training programs to help businesses identify the climate change issues most relevant to them and the available adaptation options. Climate change will affect business insurance and financing, product and service development, distribution networks, supply chains, relationships with regulators and local communities, competitors, and customers, and markets. Each of these areas is an opportunity for some businesses to adapt to reduce impacts and for others to expand into a new important sector.
- **Market Maryland as a leader in the green revolution.** Undertake a communications campaign to market Maryland as a “green-collar state” receptive to new green businesses. Take inventory of green initiatives and green enterprises already started within the state. Help these entities collaborate, succeed, and market themselves more effectively. Build on the innovations of other states and governments and promote eco-innovation within the state.
- **Build a green-collar, entrepreneurial workforce through education, training, and outreach.**
 - Education from grade school to university or community colleges can help our society transition to a greener, more sustainable future. People will become more aware of problems and opportunities.
 - For some economic sectors, job retraining will be an important element in helping people adjust to changes in the necessary skill sets.
 - Professional and trade personnel across diverse industries need to be trained on installation and maintenance of technologies and the opportunities and risks associated with climate change.
 - Networking and public outreach will help foster collaboration and help build public support.
- **Consider allocating portions of public pension funds within the state to green or clean technology strategies, within the state’s definition of fiduciary duty.** Like public procurement, state and local government pension funds can help foster the development of clean technologies and enterprises. Several state pension funds have made allocations of small portions of overall assets to publicly traded or private equity green technology portfolios. The size of the allocation must be consistent with public, private, and nonprofit funding sources and can play a pivotal role in, for example, retirement funds and mortgages. Consider targeting state pension plans to in-state investments. Investment portfolios should consider risk management related to climate change when investing in insurance providers. State retirement funds should offer opportunities to invest in green industries, technologies, and companies
- **Create an environment to foster green business and markets.** With the proper environment, Maryland could
 - Develop new sustainability curricula and research and development (R&D) programs within the USM;
 - Create a business incubator within the USM to provide technological and business services support and outreach to green businesses;

- Provide tax credits or other tax incentives for green consumers, businesses, and technologies;
 - Foster businesses that pursue innovations for more resilient coastal area development—from planning to new technology and design;
 - Promote a sustainable trade program that includes capacity for marketing, outreach development, and Web site design and management; arrange sustainable trade delegation itineraries and sponsor conventions;
 - Promote and invest in water quality and water conservation technologies that will be adaptive to the stresses of saltwater intrusion, drought, and the potential for an increased number and intensity of severe storms;
 - Promote and invest in distributed power systems, such as combined heat and power (CHP), micro-turbines, wind power, and solar power;
 - Subsidize the production of cellulosic biomass in the agricultural and forestry industries and partner with Pennsylvania and other states that promote this development path;
 - Increase the Renewable Portfolio Standard (RPS) requirements for utilities and broaden the requirement to include energy efficiency along with renewable energy;
 - Foster businesses that specialize in emissions brokering, offset credits and allowances, and other economic opportunities generated by Maryland’s participation in the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade system (C&T) and provide tradable credits for green buildings, agricultural sequestration, and other GHG mitigation mechanisms under the C&T system;
 - Incorporate monitoring and improvement of sustainability performance metrics for state agencies under the new Department of Information Technology (see Governor’s 2008 Legislative Agenda), and tie economic incentives to performance;
 - Create sustainability “revitalization and incentive zones,” similar to, or incorporated within, new Base Realignment and Closure Act Revitalization and Incentive Zones (BRAC R&I; see Governor’s 2008 Legislative Agenda) or green business park models; and
 - Foster green, eco-industrial parks where collocated businesses benefit from sharing and exchanging resources and by-products (http://en.wikipedia.org/wiki/Industrial_ecology).
- **Create sustainable resource-based industries.** Resource-based industries, such as forestry, agriculture, commercial and recreational fishing, and sportsmen’s activities, represent the economic backbone of rural Maryland. These industries are heavily dependent on the health and vitality of the Chesapeake Bay and its tributary ecosystems, which is threatened by SLR and associated hazards (e.g., storm surge, coastal flooding, and erosion). Research should to be conducted within each respective field to identify potential ecological and subsequent economic impacts. The end result should lead to formulating and implementing appropriate adaptation strategies to buffer such effects, as well as identifying potential opportunities for expansion and development within respective fields.

Related Policies/Programs in Place

There is a wide variety of efforts aimed at promoting environmental and business interests. In addition to the federal, state, and local programs mentioned below, further programs are likely to be identified if action is taken on policy option FBEI-2, State Agency Reporting on Response to

MCCC Findings. This policy option complements the GHG mitigation policy option developed by the MCCC's Mitigation Working Group (MWG) titled "Promote Economic Development Opportunities Associated With Reducing GHG Emissions in Maryland" (CC-9) and RRI policy option "Resource-Based Industries—Economic Initiative." (RRI-4)

The federal government is currently supporting an array of green business and green-collar job programs, the majority of which are focused on renewable energy and the broader agenda of sustainability, but they indicate federal support for environmental businesses and jobs. As the adaptation agenda gains greater traction, it is likely to emerge as a new dimension to these efforts, particularly where adaptation and mitigation efforts can be integrated, as in living shorelines management strategies or green buildings. The federal agenda is distributed across several agencies, including the U.S. Department of Commerce (U.S. DOC), U.S. Environmental Protection Agency (U.S. EPA), U.S. Department of Energy (U.S. DOE), the U.S. Department of Agriculture (USDA), and the International Trade Administration (ITA) (http://www.ita.doc.gov/competitiveness/sustainablemanufacturing/USG_PRS_Sustainable_Business.asp). The Energy Independence and Security Act of 2007 included a provision for the U.S. Department of Labor (U.S. DOL) to establish a worker training program in energy efficiency and renewable energy that includes grants to states, to support national research for developing labor market data, and to track workforce trends for energy-related initiatives.

Statewide efforts related to this option fall into these main categories: sustainable energy policy, sustainable environmental policy, economic development supported by university educational initiatives, education and state lead-by-example. Efforts to increase government efficiency provide further support for implementation.

Sustainable Energy Policy

Initiatives focused on sustainable energy policy are establishing programs that offer economic development opportunities. The Maryland Energy Agency (MEA) created the Maryland Strategic Electricity Plan to help the Governor and General Assembly craft a sustainable energy policy for Maryland's future. The 2008 legislative session passed several pieces of enabling legislation that will have a significant impact on energy-related opportunities.

EmPOWER Maryland

EmPOWER Maryland, originally established by the Governor, is now codified and strengthens the state's commitment to reducing electricity consumption 15% by 2015. Utilities will rely heavily on increasing implementation of existing technologies to meet this goal.

Maryland Strategic Energy Investment Fund

The Maryland Strategic Energy Investment Fund will make approximately \$40 million a year available to support clean energy programs. It will create economic opportunities by supporting investment in energy efficiency technology, stimulating Maryland's emerging clean energy industry, promoting programs to reduce electricity consumption by low- and moderate-income customers, and sponsoring research on technologies to reduce Maryland's vulnerability to climate change. The fund allows MEA to support traditionally underserved markets by providing below-market financing to encourage energy efficiency investments by homeowners and small

businesses. The fund will be financed through the upcoming sale of carbon allowances to power plants as part of the RGGI.

Green Building Standards for Building Financed with State Funds

The General Assembly passed legislation promoting green building technologies in new construction that receives state funding. Maryland will lead by example by requiring that all new schools and significantly renovated state buildings over 7,500 square feet meet the Leadership in Energy and Environmental Design Green Building Rating System™ (LEED) Silver standard.

Renewable Portfolio Standard

To meet growing electricity needs, new legislation commits Maryland to investing in new forms of electricity generation by raising the RPS from 9.5% to 20%. This requirement will create opportunities to increase renewable and clean energy generation.

Solar and Geothermal Tax and Grant Incentives

New tax relief and grant opportunities for solar and geothermal systems are designed to stimulate investment in clean energy and increase supply. These incentives create new economic and employment opportunities by encouraging more investors and households to enter clean energy sectors.

Sustainable Environmental Policy

The Chesapeake Bay is Maryland's most precious natural resource. Approximately \$381 million from the fiscal year 2009 budget is designated to provide programs directly related to the restoration of the Bay and its tributaries. Maryland has supported developing expertise in agricultural management programs, which protect the Bay while supporting sustainable agriculture practices and preserving open space. State legislation also supports improved storm-water management and oyster restoration. SLR and associated threats of climate change will exacerbate the threats to the Bay. Thus, skills, knowledge, and technologies developed for environmental management will become increasingly valuable elements of adaptation. The following are other state programs that may support more effective environmental management.

Chesapeake Bay 2010 Trust Fund

The Chesapeake Bay 2010 Trust Fund will ultimately make \$50 million available for innovative pollution reduction and cleanup strategies to improve the health of the Bay.

Revisions to the Critical Area Act

Revisions to the Critical Area Act improve administration and enforcement capabilities to protect critical buffers around the Bay.

Transit-Oriented Development

Transit-oriented development (TOD) legislation provides another tool to support smart growth, revitalize communities, and curb sprawl, while offering opportunities to reduce transportation contributions to GHG emissions. International, national, and state trends in efforts to reduce GHG emissions suggest that knowledge and experience in this sector will be increasingly sought after.

Promoting Jobs And Economic Growth

Several new efforts to support education, workforce development, and economic and community growth offer opportunities to promote environmentally friendly technologies and practices. In addition to the programs and policies listed above, there are other initiatives related to renewable energy development (especially ethanol and biodiesel) and business incubators that could support green economic development.

Base Realignment and Closure Community Enhancement Act and Revitalization and Incentive Zones

The BRAC Subcabinet, which coordinates the planning and financial resources of the state government to support the missions of military installations expanding under BRAC, anticipates as many as 60,000 new jobs and 28,000 new households will come to Maryland by 2011. The BRAC Community Enhancement Act includes initiatives to leverage state and private sector investments critical to supporting the community and transportation infrastructure necessary to accommodate BRAC-related growth. BRAC R&I Zones will provide local jurisdictions with incentives to enhance public infrastructure, such as streets, utilities, and recreation venues, in designated revitalization and redevelopment areas in keeping with Smart Growth principles. BRAC Zones will offer incentives to draw businesses into targeted areas of the state in need of revitalization and redevelopment. These incentives may also provide an opportunity to encourage high-quality green businesses to locate in the state. In addition to the BRAC Community Enhancement Act, the Administration will propose to expand the uses of the new Higher Education Investment Fund to allow for BRAC-related initiatives administered by the MHEC. Governor O'Malley has included \$3 million in the fiscal year 2009 budget for workforce training initiatives related to BRAC.

Education

The USM has established an Environmental Sustainability and Climate Change Initiative aimed at improving environmental management practices on campuses, supporting state efforts, and providing training in environmental programs. While education programs currently listed are not focused on climate change, they include relevant efforts such as the University of Maryland Center for Environmental Science (UMCES) and the multi-campus graduate program in Marine-Estuarine-Environmental Science (MEES).

State Government Lead-by-Example

The state government can lead by example, as well as foster innovative climate change responses. Programs that were established to increase government efficiency may be used to track these efforts. StateSTAT— a performance measurement and management tool—collects data on important state initiatives to improve accountability and efficiency.

Many policy options proposed here rely on coordination across agencies. The newly created Department of Information Technology will be responsible for information technology policy enabling agency, community, and public access to vast amounts of data and other useful information. This new department will also assume the responsibility for coordinating, purchasing, and managing all telecommunications devices and systems utilized by state agencies. The Secretary of Information Technology will lead chief information officers of all agencies to streamline business processes across state government, achieve cost savings through economies

of scale, and coordinate initiatives related to security, disaster recovery, and continuity of operations.

Estimation of Adaptation Benefits and Costs

This policy option focuses on taking advantage of new market opportunities arising from climate adaptation and mitigation needs. The level of benefits will depend on the implementation strategies pursued and their success in the broader competitive market. At a minimum, this option encourages private sector involvement in innovation and development of green economic sectors and jobs. It also broadens the range of entities involved in collecting, evaluating, and responding to climate change and increases the potential for innovation and better adaptation solutions. The mix of these programs can be adjusted relatively quickly and easily to accommodate new information and opportunities, particularly if there is a diverse set of sectors and strategies in the portfolio. Costs associated with this policy option will vary, based on the portfolio of strategies pursued.

Feasibility Issues

This option builds on Maryland's strong base of leadership and expertise in environmental management. There are ideas and technologies ready for further development or adoption, as well as a growing market. Success of this effort depends on funding availability and public and organizational acceptance and support for climate change adaptation and mitigation.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

Acronyms and Abbreviations

ARWG	Adaptation and Response Working Group
BDC	Baltimore Development Corporation
BPW	Board of Public Works
BRAC R&I	Base Realignment and Closure [Act] Revitalization and Incentive [Zones]
C&T	cap-and-trade
CBOS	Chesapeake Bay Observing System
CEP	Clean Energy Partnership
CGIS	[Towson University] Center for Geographic Information Science
CHP	combined heat and power
CIPS	Coastal Inundation Prediction System
COMAR	Code of Maryland Regulations
CRS	Community Rating System
CSBA	Chesapeake Sustainable Business Alliance
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
DBED	Department of Business and Economic Development
DBM	Department of Budget and Management
DFIRMS	[FEMA's] Digital Flood Insurance Rate Maps
DGS	Department of General Services
DHCD	Department of Housing and Community Development
DHMH	Department of Health and Mental Hygiene
DLLR	Department of Labor, Licensing and Regulation
DMA	Disaster Management Act
DNR	Department of Natural Resources
DOE	U.S. Department of Energy
EBEI	Existing Built Environment and Infrastructure
EMMA	Emergency Management Mapping Application
EOC	Emergency Operations Center
EPW	[U.S. Senate] Environment and Public Works [Committee]
EX	Climate Change and Global Warming
FEMA	Federal Emergency Management Agency
GBI	Green Building Institute
GGO	Governor's Grants Office [of Maryland]
GHG	greenhouse gas
GIS	geographic information system
GOHS	Governor's Office of Homeland Security
GOSV	Governor's Office on Service and Volunteerism
HAZUS MH	Hazards U.S. Multi-Hazard
HHSW	Human Health, Safety and Welfare
HIA	Health Impact Assessment
HURREVAC	Hurricane Evacuation Tool
IBC	International Building Code

IGIS	integrated geographic information system
iMAP	Maryland Statewide Basemap
IOOS	Integrated Ocean Observing System
IPCC	Intergovernmental Panel on Climate Change
IRC	International Residential Code
ITA	International Trade Administration
LCV	League of Conservation Voters
LEED	Leadership in Energy and Environmental Design™
LIDAR	light detection and ranging
LPPRP	Land Preservation Parks and Recreation Plans
MACo	Maryland Association of Counties
MACOORA	Mid-Atlantic Coastal Ocean Observing Regional Association
MCCC	Maryland Climate Change Commission
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDOA	Maryland Department of Aging
MDOT	Maryland Department of Transportation
MDP	Maryland Department of Planning
MEA	Maryland Energy Agency
MEDCO	Maryland Economic Development Corporation
MEES	Marine-Estuarine-Environmental Science
MEMA	Maryland Emergency Management Agency
MES	Maryland Environmental Services
MHCC	Maryland Health Care Commission
MHEC	Maryland Higher Education Commission
MIA	Maryland Insurance Administration
MIEMSS	Maryland Institute for Emergency Medical Services Systems
MML	Maryland Municipal League
MMRG	Maryland Mapping Resource Guide
MPBC	Maryland Public Broadcasting Commission
MSDE	Maryland State Department of Education
MSGIC	Maryland State Geographic Information Committee
MSO	Maryland Shorelines Online
MWG	Mitigation Working Group
NAIC	National Association of Insurance Commissioners
NCMPMS	National Coastal Zone Management Performance Measures System
NERRS	National Estuarine Research Reserve System
NFIB	National Federation of Independent Business
NFIP	National Flood Insurance Program
NHC	National Hurricane Center
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OP&R	Office of Preparedness and Response
OSF	Maryland Office for a Sustainable Future

PSC	Public Service Commission
R&D	research and development
RGGI	Regional Greenhouse Gas Initiative
RMC	Rural Maryland Council
RPS	Renewable Portfolio Standard
RRI	Resources and Resource-Based Industries
SHMP	State Hazard Management Plan
SLOSH	Sea, Lake and Overland Surges from Hurricanes
SLR	sea level rise
SRPS	State Retirement and Pension System
STO	State Treasurer's Office
SU	Salisbury University
TOD	transit-oriented development
TU	Towson University
UM	University of Maryland
UMCES	University of Maryland Center for Environmental Science
US DOC	U.S. Department of Commerce
US DOD	U.S. Department of Defense
US DOE	U.S. Department of Energy
US DOL	U.S. Department of Labor
US EPA	U.S. Environmental Protection Agency
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	United States Geological Survey
USM	University System of Maryland
VM	Volunteer Maryland

Human Health, Safety, and Welfare

HHSW-1. Health Impact Assessments of the Climate Change Action Plan

Option Description

Policy options that relate to preparing for and responding to climate change may have considerable health consequences for Maryland residents. Therefore, a mechanism is needed to assess the public health consequences of proposed mitigation or adaptation policies and measures before they are adopted. Health Impact Assessments (HIAs) are a proven approach to ensuring that public health concerns are identified and addressed before they become a problem. The World Health Organization describes the value of HIAs in this way: “HIA provides decision makers with information about how any policy, programme or project may affect the health of people. HIA seeks to influence decision makers to improve the proposal.” (see <http://www.who.int/hia/en>).

An HIA should be conducted, at a minimum, whenever an Environmental Impact Statement is required or if a proposed policy is expected to have health-related impacts. HIAs can also be used to identify the co-benefits of smart growth and development policies.

Option Design

HIAs would be required as part of mitigation and adaptation strategy evaluations. This option could be implemented by a legislative mandate that would require a letter sign-off by the Department of Health and Mental Hygiene (DHMH) on proposed mitigation and adaptation policies and measures that need an Environmental Impact Assessment.

The formal process of an HIA involves the following steps:

- 1. Screening:** This involves a rapid assessment of whether the policy would require a formal, detailed HIA or a relatively limited assessment. The DHMH would screen proposed policies, and the results would be reported as a recommendation for either a more formal HIA or a limited staff assessment.
- 2. Scoping:** If a formal HIA is recommended, DHMH would work with the group that proposed the option and other interested parties to define the objectives of the HIA, key participants, and potential data needs.
- 3. Appraisal:** This is the actual analysis. For a given policy option, there might be an analysis of the affected populations, distributional and equity considerations, an examination of health resource requirements, and an assessment of health infrastructure implications. In addition, alternatives would be introduced for reducing or mitigating potential health consequences of the proposed policy.

- 4. Monitoring and Evaluation:** During this phase, the adopted policy’s implementation would be monitored and evaluated, and corrections would be made as needed to ensure that the policy is effective and that it protects human health.

Targets and Timing: Adoption of HIAs as a formal requirement for policy alternatives for mitigating or adapting to climate change would be implemented immediately, and there would be immediate benefits for the residents of Maryland.

Parties Involved: The DHMH, together with the Maryland Department of Environment (MDE), Maryland Emergency Management Agency (MEMA), and local health agencies, would review proposed policy options according to the HIA framework. Review would be coordinated through the Environmental Health Liaison Committee.

Implementation Mechanisms

No statutory change is required to implement this option, but it would require adoption of an executive policy that provides for conducting HIAs of proposed adaptation or mitigation policies.

Related Policies/Programs in Place

Environmental Public Health Tracking—a project funded by the Centers for Disease Control and Prevention (CDC)—would make environmental and public health data from a number of surveillance programs available on a single Web site. This program could benefit the process of developing HIAs, because it would provide a ready source of historical data and geographic information system (GIS) capability.

Implementing this option would facilitate achievement of the goals of the Healthy Places Act. For example, an HIA was conducted in Georgia for their “BeltLine” policy for transportation and land use (<http://www.cqgrd.gatech.edu/HIA>).

Adaptation Benefits and Costs

Capital Intensity: Capital is not required for adoption of this policy; however, additional staff time will be required.

Flexibility: HIAs have been shown to increase the flexibility of proposed policy options because they require that policy alternatives be considered.

Adaptive Capacity: This proposal would increase the adaptive capacity of state institutions by incorporating consideration of possible public health considerations at the beginning of the policy process, rather than waiting for adverse consequences to be recognized and mitigated at the end of the process. Further, recognizing possible adverse health consequences early on results in preventing injuries and illnesses before they occur and also results in less costly solutions. In addition, the cross-department and agency collaborations developed as a result of HIAs increase the capacity of the state to prepare for and respond to climate change risks.

Documentation of Adaptation Benefits and Costs

Data Sources: Information on HIAs is available at <http://www.cdc.gov/healthyplaces/hia.htm>. Data needed for HIAs within the state will be obtained from DHMH, MDE, Maryland Department of Natural Resources (DNR), MEMA, and other agencies.

Quantification Methods: HIAs would require some staff time and some data on environment and health, which should be available through environmental public health tracking and other sources.

Key Assumptions: There is an assumption that HIAs would be mandatory for climate change policy evaluation, as well as (in the future) for other major development policies.

Key Uncertainties: There are no uncertainties associated with implementing this policy option.

Additional Benefits and Costs

An additional benefit of HIAs is the potential beneficial impact on the planning process in general. As health benefits (and costs) are taken into account in evaluating development and planning projects, the state stands to make better decisions regarding growth that benefits current and future residents.

Feasibility Issues

The major feasibility issues are the sufficiency of the data and the level of involvement of interested parties. The major successes for HIAs have been in communities with considerable input into the process and a range of potential options from which to select.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

HHSW-2. Coordination Across Agencies Responsible for Human Health and Safety

Option Description

A gap analysis will be conducted to determine whether management, procedures, and coordination of county- and city-level options are adequate for ensuring consistency in and capacity for adaptation and response to health-related impacts of climate change across boundaries. For example, coordinated responses may be required for large-scale floods and storms to ensure the safety and protection of drinking water sources and septic systems/waste treatment and in the event of infectious disease outbreaks. One response might be ensuring adequate planning and implementation for extreme or wet-weather events that could affect surface- and groundwater water quality, wastewater, and human health. The Code of Maryland Regulations (COMAR) and/or county codes may need to be modified for drinking water supplies that require a well to protect the health of populations and the Chesapeake Bay from increasing saltwater intrusion due to climate change. Septic system requirements in COMAR and/or county codes may need to be modified because of the increased risk of groundwater elevation from sea level rise.

The gap analysis would be coordinated with the 2008 Federal Gap Analysis, as applicable. Recommendations resulting from the analysis will recognize and account for differences in response capacity between counties, and mitigation and augmentation options will be recommended to minimize disruption in services due to lack of capacity.

Option Design

Targets and Timing: The principal target organizations include DHMH, local health departments, MEMA, MDA, MDE, and the Maryland Institute for Emergency Medical Services Systems. The gap analysis would require approximately 2 months to plan, 8 months to conduct, and 2 months to evaluate and finalize.

For example, one conclusion of the analysis might be that counties and municipalities should be encouraged to adopt well and septic provisions, update Water and Sewer Plans, and re-map zoning for areas that are at-risk for inundation due to flooding or tidal and storm surges. Requiring denitrification of septic systems in critical at-risk areas, and modification of septic systems in areas that are prone to low groundwater tables, should be a consideration for maintenance of water quality and public health and safety. Several counties have recently passed laws for denitrifying septic systems in at-risk areas.

Counties will need to use watershed-level planning—land use planning, building codes, and land easements and acquisitions—for an integrated approach to sea level rise.

Parties Involved: See Targets and Timing.

Implementation Mechanisms

The DHMH Office of Preparedness and Response (OP&R) would lead the gap analysis in cooperation with MEMA and other target agencies. Components of the gap analysis are (1) organization of the response, (2) benchmarking (from external best practices), (3) capacity inventory, (4) information technology and communications, (5) needs analysis, and (6) state law and policy amendments.

Related Policies/Programs in Place

OP&R already has continuity of operations (COOP) plans in place for many aspects of DHMH operations and has worked with local health departments on their COOP plans. Critical issues, such as personnel capacity to respond to large-scale events, have been discussed in a number of forums, including the Environmental Health Liaison Committee.

Other programs that may require review and/or amendment are

- Source Water Assessment Program (SWAP). The Safe Drinking Water Act, as amended in 1996, requires all states (MDE manages this for Maryland) to develop and submit plans to the U.S. Environmental Protection Agency (EPA). Source Water Protection is voluntary under federal law, but the state could require that the Program be adopted in specific areas www.mde.state.md.us/Programs/WaterPrograms/Water_Supply/sourcewaterassessment/index.asp
- Fish Consumption Advisory (from MDE) for mercury and other contaminants (www.mde.state.md.us/CitizensInfoCenter/FishandShellfish/hom/index.asp)
- Reporting and Public Notification of Sewage Overflows (from MDE) (www.mde.state.md.us/ResearchCenter/Publications/General/eMDE/vol1no4/overflows.asp)
- Emergency Planning and Community Right-to-Know Act (EPCRA) for Hazardous Substances (www.epa.gov/oem/content/epcra/index.htm)

Adaptation Benefits and Costs

Capital Intensity: Capital is not required for adoption of this policy.

Flexibility: The gap analysis will identify barriers and constraints to response. Overcoming the barriers will increase the state's flexibility in responding to large-scale events.

Adaptive Capacity: This policy option would increase the adaptive capacity of state institutions by increasing coordination and collaboration among the various entities and by raising awareness of how to appropriately address the health risks of climate change.

Documentation of Adaptation Benefits and Costs

Data Sources: The gap analysis will require consultation with all participating agencies. Best practices for interagency coordination will be consulted, including those enumerated in the CDC's TIIDE project (Terrorism Injuries: Information, Dissemination and Exchange), available at: <http://www.bt.cdc.gov/masscasualties/modelcommunities.asp>

Quantification Methods: Standard gap analysis techniques will be employed.

Key Assumptions: The gap analysis will involve a considerable amount of dedicated staff time from several agencies. The potential for contributions of technical expertise, funding and other resources from the private sector is unknown.

Key Uncertainties: None.

Additional Benefits and Costs

The gap analysis will benefit all aspects of agency operations and coordination, as well as specific responses to climate change.

Feasibility Issues

Feasibility is critically dependent on interagency coordination.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

HHSW-9. Vector-Borne Surveillance and Control Programs

Option Description

One of the consequences of climate change that has received considerable attention is the likelihood of changes in patterns of vector-borne diseases. As the climate warms, the geographic range of several insect- and arthropod-borne diseases is likely to expand northward.

The DHMH, in close cooperation with the Maryland DNR and the Maryland Department of Agriculture (MDA), has responsibility for conducting vector-borne disease surveillance and control programs such as the West Nile virus surveillance program that tracks mosquitoes and cases of human infection. This option would entail development of a coordinated plan to ensure adequacy of the surveillance program, given increased demand resulting from climate change.

Option Design

Targets and Timing: A working group will be created that includes members from each department responsible for vector-borne surveillance and control to develop a coordinated plan to ensure adequacy of programs.

Significant increases in personnel and resources may be required if surveillance of vectors and cases is to be expanded. Vector surveillance requires collection of specimens, laboratory analysis, and GIS or other spatial analysis in order to follow the physical distribution of the vector. These tasks require specialists capable of specimen collection, laboratory resources, and data management capacity. The long lead-time required to recruit and/or train the personnel to fill these specialized positions necessitates advance planning and dedication of resources. For example, some positions may take more than a year to fill. The lack of trained entomologists could be addressed by providing university scholarships.

Parties Involved: MDA, Maryland DNR, and the DHMH would be involved in developing a coordinated plan. In addition, those agencies would collaborate with other agencies responsible for water storage and storm water management to ensure that these programs achieve their goals without increasing the number of breeding sites for disease-carrying vectors.

Implementation Mechanisms

The policy option would create a working group involving all of the departments that would prioritize and identify the resources required to meet the increased demands associated with climate change.

Related Policies/Programs in Place

There are currently vector and disease surveillance programs within the state that could meet some (but not all) of the demands associated with increased monitoring of vector-borne diseases. The MDA provides mosquito control services in cooperation with participating county governments (www.mda.state.md.us/plants-pests/mosquito_control/mosquito_control_policy.php). The preferred mosquito control strategy

is the reduction of mosquito larvae numbers by source reduction, use of biological control agents, or use of biological insecticides. Adult mosquito control, by ultra-low-volume application of insecticides is conducted by using aircraft or truck-mounted application equipment in residential areas for nuisance abatement and to protect the public from mosquito-borne disease.

The aim of the U.S. Department of Agriculture (USDA) Veterinary, Medical and Urban Entomology National Program is to reduce the risk to humans from arthropod-borne and zoonotic diseases (http://www.ars.usda.gov/research/programs/programs.htm?NP_CODE=104).

The U.S. Fish and Wildlife Service has a mosquito management policy (<http://www.fws.gov/policy/library/E7-20201.html>). The National Wildlife Refuge System has a draft mosquito and mosquito-borne disease management policy (<http://cc.msns-cache.com/cache.aspx?q=73540470571274&lang=en-US&w=c499b04c.87053e86>).

The use of integrated vector management and the use of the least toxic pesticides necessary to achieve the desired results should be included in this option. There are also techniques such as organic landscaping for storm water management that should be evaluated in light of the need to control breeding grounds for certain disease vectors.

The working group would provide outreach to programs, such as those promoting a green economy, to ensure that the risks of vector-borne diseases do not increase with changes in infrastructure and landscape management.

Estimation of Adaptation Benefits and Costs

Capital Intensity: The capital requirements relate to funding for the additional personnel needed to meet the demands identified by the working group. There may be some additional capital requirements for specialized trapping equipment related to vector surveillance or to increase laboratory capacity.

Flexibility: This policy option allows flexibility because it entails the option of using personnel involved in surveillance activities to perform multiple functions or to switch to different surveillance activities if the impacts of climate change differ from projections.

Adaptive Capacity: This option provides the state with considerable capacity to adapt to the effects of climate change. Both the personnel and laboratory capacity anticipated will be able to perform multiple functions which will allow the state to shift resources in a relatively narrow window.

Documentation of Adaptation Benefits and Costs

Data Sources: For best practices, recommendations were from the Council of State and Territorial Epidemiologists (CSTE), as well as the CDC Emerging Infectious Disease program (<http://www.cdc.gov/ieip/>); recommendations from the World Health Organization are available at: <http://www.who.int/heli/risks/vectors/vectordirectory/en/index6.html>.

Key Uncertainties: None

Feasibility Issues

The primary feasibility issue relates to the state’s ability to recruit and retain the personnel required to carry out surveillance activities.

Improving surveillance and control activities should include educational programs so that individuals do not over-spray when vector-borne diseases are identified. Using excessive amounts of insecticides has adverse health and environmental consequences.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

Acronyms and Abbreviations

CDC	Centers for Disease Control and Prevention
COMAR	Code of Maryland Regulations
COOP	continuity of operations [plans]
CSTE	Council of State and Territorial Epidemiologists
DHMH	[Maryland] Department of Health and Mental Hygiene
DNR	[Maryland] Department of Natural Resources
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
GIS	geographic information system
HIA	Health Impact Assessment
MDA	Maryland Department of Agriculture
MDE	Maryland Department of Environment
MEMA	Maryland Emergency Management Agency
OP&R	Office of Preparedness and Response
SWAP	Source Water Assessment Program
USDA	U.S. Department of Agriculture

Public Awareness

Public Awareness, Outreach, Training, and Capacity Building

Option Description

Sea level rise and increases in the frequency and intensity of flooding, storms, and storm surges are expected to have complex and far-reaching consequences for residents, businesses and trades, and local governments. Better preparation, through modification of existing strategies and policies and implementation of new ones, will reduce the impacts experienced by Maryland’s citizens. A key component is increasing awareness of the risks and appropriate responses among those responsible for preparation and response—the media, non-governmental organizations, and others—as well as those likely to be affected. It is important that all stakeholders be identified, along with their specific educational, outreach, training, and capacity-building needs.¹

Communicating the potential risks of and responses to climate change will be an essential part of implementing the recommendations from all policy options identified by the Adaptation and Response Working Group (ARWG). Two basic activities are needed: development of coordinated and cohesive communication messages, and effective distribution of the messages to a wide variety of people and professionals across all levels of government, sectors, and organizations. For example, plans for addressing the needs of property owners in coastal counties will differ from plans to ensure that mental health needs are addressed during and after a disaster. Of particular concern is the development of communication plans to reach low-income and underserved populations.

Education, training, and outreach programs are needed for those in the public health sector so they can better decide what actions to take during and after an event to reduce the potential for outbreaks of vector-, food- and waterborne diseases from contaminated recreational water. Efforts to educate health care providers and the public on the signs and symptoms of these diseases will improve detection and treatment.

Vulnerable infrastructure needs to be protected from storm surges and serious or frequent flooding events. The building and development community needs to be made aware of and to

¹ Outreach—is an effort by an organization to connect its ideas or practices to the efforts of other organizations, groups, specific audiences, or the general public.

Training—refers to the acquisition of knowledge, skills, and competencies as a result of the teaching of practical skills and knowledge.

Technical assistance—professional and direct assistance intended to provide guidance to organizations or individuals to conduct or strengthen specific management objectives.

Capacity building—a comprehensive suite of tools to strengthen the abilities, behaviors, and skills of individuals and improve institutional structures and processes such that the organization can effectively meet its mission and goals.

understand how to implement new building codes that have been adopted for reducing losses. Local governments need to understand how to implement and enforce new polices. Shoreline changes resulting from sea level rise and coastal hazards could impact a broad group of constituents, and it is important that landscapers, mortgage brokers, and property owners, for example, understand those impacts. Incorporation of climate change risks into formal training programs for individuals entering businesses likely to be impacted by climate change would ensure a strong capacity to address these issues in the future.

Option Design

This policy focuses on integrating information on climate change risks and risk management strategies into existing and ongoing educational, outreach, training, and capacity-building programs and supports the creation of new programs as needed. Coordination will be needed to ensure efficiency and coherence across these programs.

Targets:

- Establish a framework for consistent communication within 1 year of implementing this option.
- Develop climate change risk communication training with Public Information Officers of germane agencies to ensure clear and consistent messaging and prevent contradictions in messages and warnings. The Network for Education of Municipal Officials (NEMO) could be used as the template.
- Develop educational programs on appropriate behavior before, during, and after extreme events. Identify and engage all current licensing, training, and capacity-building programs in areas at serious risk from sea level rise and extreme weather events. Work with industry professionals, people who live or work in these areas, and others to identify gaps in public awareness, training, and capacity building.
 - Recommend specific policy and program changes that will enable these groups and programs to respond to future training and capacity needs in a manner best suited to their respective involvement in activities related to risks from sea level rise and extreme weather events.
 - Continue to provide training and public awareness opportunities and capacity-building assistance, but begin to offer more targeted support to populations and areas that will be most seriously affected.
- Ensure that education, outreach, training, and capacity-building programs specifically address the needs of low-income and underserved populations.
- Increase the ability of at-risk residents, businesses and trades, and local governments to understand the risks, gather the information they need to make informed decisions, and work with partners to identify solutions.
- Develop educational programs to increase awareness of the risks of vector- and waterborne diseases in a warmer climate that may result from climate change.
- Contact landowners to make them aware of wetland and forest protection programs (e.g., land easement and/or purchase programs).

- Conduct outreach to marine contractors to train them in the design and implementation of innovative shore erosion control strategies.
- Conduct outreach to communities to inform them of the most current design and construction standards for erosion control structures and tidal shoreline habitat enhancement projects.
- Disseminate information from the assessment of potential climate change impacts on resources-based industries.
- Ensure access to outputs from Option RRI-1, New Criteria for Identifying Natural Resources Priority Protection Areas [RRI = Resources and Resource-Based Industries]. This option would include using geographic information system (GIS) tools to assess target areas for strategic action. Outputs would include maps that identify areas most vulnerable to sea level rise. Access to these maps could be made available on a public Web site to increase awareness of the risks of sea level rise.

Timing:

- Recommend that all counties have Citizens Emergency Response Teams within 2 years.
- Increase the number of training programs and capacity-building efforts in areas most at risk over the next 5 years.
- In areas most at risk, convene a multidisciplinary group to identify risks and possible responses for public health, disaster management, building trades, and others. For building trades, review building codes and other regulations to identify and adopt necessary changes over the next 10 years and incorporate these activities into licensing training procedures.

Parties Involved: Parties involved include Maryland Department of Natural Resources (DNR), Maryland Department of the Environment (MDE), Maryland Department of Health and Mental Hygiene (DHMH), Maryland Department of Labor, Licensing and Regulation (DLLR), Maryland Emergency Management Agency (MEMA), NEMO, the Governor’s Office of Community Initiatives, the Governor’s Office on Service and Volunteerism, local governments, Citizens Emergency Response Teams, property owners, business and trade members in industries affected by sea level rise and climate change, church-based groups, and non-governmental organizations.

Implementation Mechanisms

Implementation of this recommendation would require a coordinated effort by a number of existing agencies or departments, groups, organizations, and programs. One approach would be to assign a staff member from MEMA to participate on the Governor’s Sustainability Sub-Cabinet. The Maryland Municipal Leaders and the Maryland Association of County Officials also could play a significant role in implementation, possibly including sponsoring a yearly event focused on education.

Successful implementation would require an investment in staff time and funding to complete a review of current training and capacity-building programs or delivery options; identify mechanisms through which new or revised programs would be most likely to succeed; and create or update policies and regulations.

Publish a real estate disclosure brochure on the risks associated with climate change.

Related Policies/Programs in Place

This option supports all the policy options identified by the ARWG; without effective education, training, outreach, and capacity building, the general public will have insufficient understanding and motivation to support implementation of the policies needed to protect the state and its residents and businesses.

Examples of existing policies and programs include

- The Maryland DLLR’s Division of Occupational and Professional Licensing, Maryland Home Improvement Commission (MHIC) provides a variety of licensing services required by the state to industry professionals.
- The Maryland Coastal Program and other coastal and shoreline groups that serve the Chesapeake Bay deliver technical and financial assistance, data tools, and training opportunities to groups such as property owners, local and state governments, marine contracting professionals, and other networked partners.
- The MDE Wetlands and Waterways Program provides technical assistance, guidance and educational materials, and training on wetland/waterway regulatory issues, wetland conservation and management, shoreline management, floodplain management, and local floodplain ordinance development and implementation.
- The Chesapeake Bay National Estuarine Research Reserve’s Coastal Training Program leads training events for professional coastal decision makers on a variety of coastal- and climate change-related issues in cooperation with a network of partners.
- The Maryland DHMH provides outreach to health professionals on vector-borne diseases. In addition, the Office of Preparedness and Response works with local health departments and the MEMA on public preparedness efforts.
- Other organizations and programs also coordinate with industries and groups concerned with the health and safety of citizens to provide training, public awareness programs, and capacity building.

Estimation of Adaptation Benefits and Costs

Incorporation of the risks of climate change and sea level rise into educational, outreach, training, and capacity-building programs for individuals, businesses, organizations, and agencies will increase Maryland’s effectiveness in addressing these issues in the future and in incorporating new information into its mitigation and adaptation approaches.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

Acronyms and Abbreviations

ARWG	Adaptation and Response Working Group
DHMH	[Maryland] Department of Health and Mental Hygiene
DLLR	[Maryland] Department of Labor, Licensing and Regulation
DNR	[Maryland] Department of Natural Resources
GIS	geographic information system
MDE	Maryland Department of the Environment
MEMA	Maryland Emergency Management Agency
MHIC	Maryland Home Improvement Commission
NEMO	Network for Education of Municipal Officials
RRI	Resources and Resource-Based Industries

Resources and Resources-Based Industries

RRI-1. New Criteria for Identifying Natural Resources Priority Protection Areas

Option Description

This option provides the technical and scientific foundation for developing and testing new and existing criteria for identifying priority protection and restoration areas, in the context of sea level rise (SLR). The assessment will focus on identifying undeveloped lands and ecologically and economically important land and aquatic areas (including important habitats and marsh migration corridors) critical for targeted conservation and coordinated restoration, in response to SLR and its associated effects. The assessment will also address the future distribution and condition of underwater habitats and resources, such as Submerged Aquatic Vegetation (SAV) and oyster beds. This information will be fed into other policy options to strategically and cost-effectively direct and implement specific conservation, restoration and growth management actions.

Rising sea level will impact coastal ecosystems and natural resource lands. These resources provide important ecosystem services and benefits. Coastal resources support wildlife habitats, have regional significance for migratory birds, sequester large amounts of carbon, provide sediment and nutrient water quality and flood control benefits, and generate economic benefits through farming, forestry, fishing and passive recreation. Preserving undeveloped, vulnerable lands offers a significant opportunity to avoid placing people and property at risk to SLR and associated hazards, including storm surge, coastal flooding, and erosion.

As sea levels rise, various future conditions are possible. As an example, tidal marshes, beaches and dune habitats have the potential to: migrate landward if there are no barriers to migration, such as roads and buildings or other unsuitable physical factors; or become eliminated if the opportunity to migrate landward is blocked, or the rate of migration is exceeded by the rate of SLR. Identifying where these resources are, how important they are for various ecosystem values and economic services, and what the likely impact of SLR will be provides the basic information needed to plan for the protection and management of coastal natural resources. Existing assessments should be used to develop geographic information systems-based (GIS) and modeled criteria. These criteria should be ground-truthed and enhanced by additional field-based criteria.

The objective of this option is to identify target areas where strategic management actions, identified in other policy options, can be focused to buffer against the impacts of SLR and other climate changes. These actions may include expanding the priorities for existing land conservation to promote horizontal marsh migration, risk reduction and other land use goals. Other actions may focus on appropriate areas for restoration or rehabilitation projects, such as sand and sediment replenishment to fuel the vertical growth of wetlands, barrier removal or other coastal ecosystem and land management practices.

Option Design

Targets:

- Identify high priority ecological and economic natural resource lands and aquatic habitats in the coastal zone (a condition assessment) using existing assessments and any additional enhancements or additions necessary to address data gaps for considering the effects of SLR.
- Identify coastal land areas important for wetland migration corridors, for maintaining ecosystem integrity and connectivity, to support farming, forestry and fisheries industries and to confer risk reduction to coastal communities, in response to projected SLR inundation and coastal flooding scenarios (a functional assessment).
- Determine through conserved lands and protective zoning overlays where high priority coastal lands are currently protected and where strategic conservation and forest and wetland restoration targets should be identified.
- Develop a peer-review method for modeling wetland migration resulting from SLR.
- Develop a set of field-based criteria that considers effects of SLR and climate change to further identify the suitability of lands for protection or restoration, in order to ensure eligibility for implementation programs.

Timing: Within the first year, develop a scoping plan for conducting the study which will determine how to use and tie together existing information to identify protection and restoration priorities in relationship to SLR, and to determine what data gaps and modeling efforts need to be addressed for a comprehensive analysis. Other components of the scoping plan includes developing a timeline to include initial assessment using best available information (Phase I), additional assessments as new data, models and criteria are developed (Phase II), and determining the level of staffing and funding resources needed to complete each phase of assessment.

Implement the assessment plan over the following 2 years, provided technical resources can be secured. Phase I implementation can include an initial and coarse level assessment of resource priorities, current level of protection, and resource vulnerability to SLR using results from existing resource assessments and SLR projections.

Field studies may need to be conducted to develop and test criteria for determining the site-scale suitability of various restoration practices in response to SLR. The suite of restoration practices includes wetland restoration and marsh migration projects, reforestation using salt-tolerant species, SAV and oyster bed restoration. The criteria would inform the likelihood of success and the necessary design specifications of the project. The timing of this would be dependent on the programs being concerned with adaptation responses, as detailed in other policy options.

Parties Involved: The Maryland Department of Natural Resources (DNR), Maryland Department of the Environment (MDE), Maryland Department of Planning (MDP), University of Maryland (UM), and other technical and scientific organizations should complete the resource assessment, threat analysis, and model development.

MDP should specifically evaluate the degree of current protection of vulnerable lands targeted as conservation and restoration priorities, through local and state growth-management controls.

MDE and DNR should specifically evaluate the degree of protection, through regulatory mechanisms (Tidal and Non-tidal wetland regulations and Critical Area regulations).

Implementation Mechanisms

Implementing this recommendation would require the investment of staff and funding to complete the analysis, conduct any needed specialized studies and document and publish the results. Potential funding mechanisms that could be explored include of the Clean Water Act's Section 309, the Coastal Zone Management Act (CZMA), and Coastal Enhancement Strategies dealing with coastal hazards. A National Oceanic and Atmospheric Administration (NOAA) Coastal Zone Management fellowship could also be pursued to recruit the staffing expertise needed for developing the first year plan and focusing on Phase I implementation.

Related Policies/Programs in Place

Existing natural resource assessments can be used, in concert with other modeling and mapping efforts. In addition, existing conservation priorities, such as DNR's Priority Conservation Areas, those identified in Maryland's Coastal and Estuarine Land Conservation Plan (CELCP), and other agency conservation targets.

Existing resource assessments and conservation priorities include the following:

- The Green Infrastructure Assessment identifies an ecological hub and corridor network across the state, prioritizes for ecological value, and is a DNR foundation for focusing conservation and restoration work;
- The Blue Infrastructure Assessment specifically focuses on aquatic values and the aquatic and terrestrial interface, surveys aquatic, wetland, and shoreline natural resources, identifies areas of highest ecological and economic value, and currently under development by DNR;
- Strategic Forest Lands Assessment is a DNR project that identifies forested areas of highest ecological and economic value;
- Prioritizing Sites for Wetland Restoration, Mitigation, and Preservation in Maryland by the MDE uses GIS to map, target, and rank opportunities for wetland restoration, mitigation, and preservation for habitat and water quality benefits;
- Maryland Shorelines Online (MSO) is a DNR Web site that provides a digital GIS survey of shoreline condition (e.g., built, soft or hard stabilization, naturalized), erosion rates, and habitat benefits, and GIS-based SLR inundation areas are also available on the site; and
- SLR projections, elevation assessments, and inundation maps provided by DNR.

Maryland Department of Natural Resources Priority Conservation Areas: DNR's Program Open Space (POS) has identified landscapes with high ecological value (based on Green Infrastructure and other resource assessments) and designated these areas as Priority Conservation Areas. POS then focuses in on a subset of these areas to target its ecologically based land conservation objectives.

Maryland Department of Planning Priority Preservation Areas: These areas have been identified, as required through the 2006 Agricultural Stewardship Act (House Bill 2; 2006), as

high priority, agricultural resource lands, and will be the targets for agricultural land-preservation programs.

Other Studies and Programs

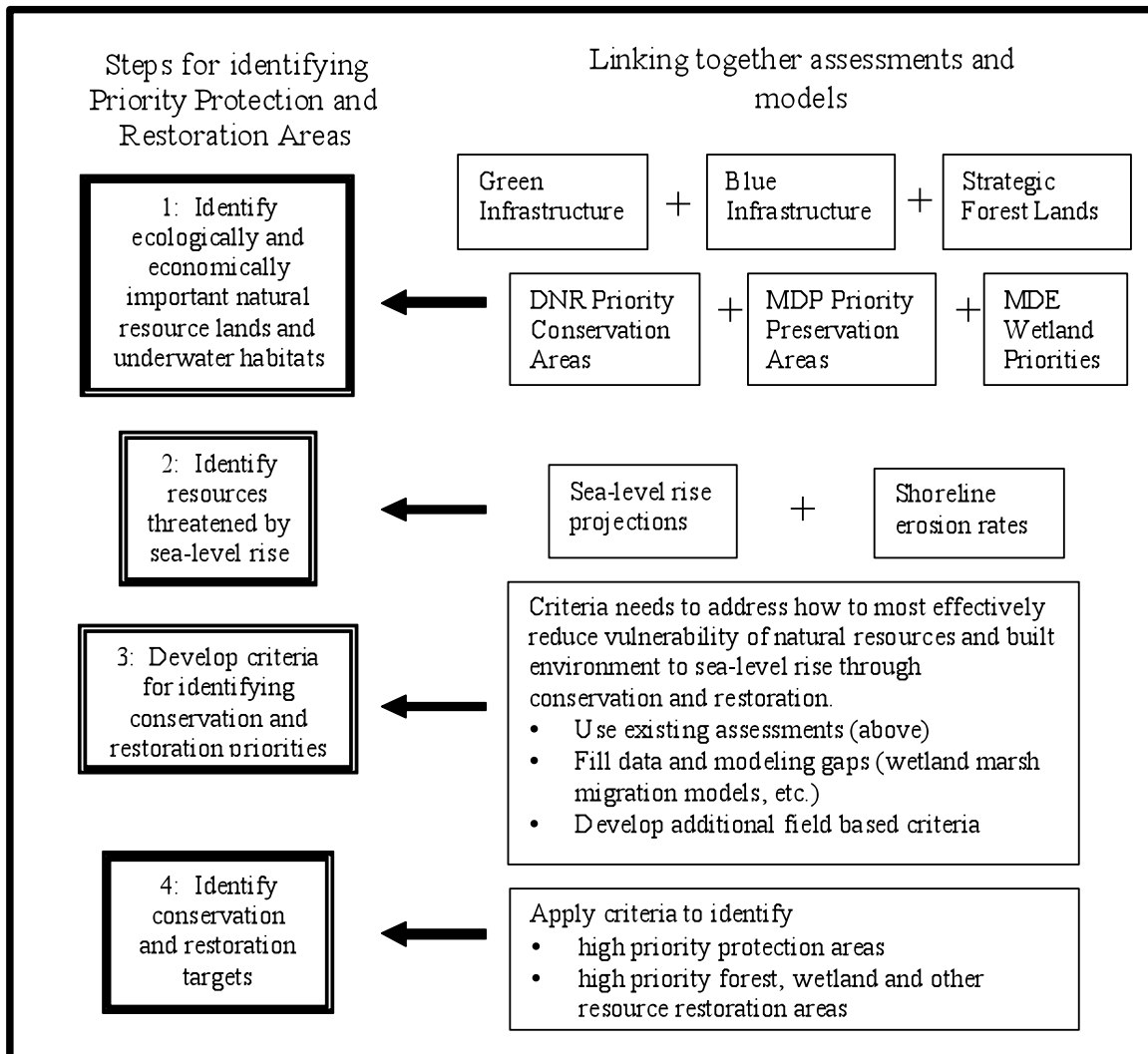
Restoration of Blackwater National Wildlife Refuge marshes—This is an ongoing study that is building up degraded marshes through sediment replenishment and marsh grass plantings. Marsh accretion and carbon sequestration is being intensely monitored at this site, and will provide the basis for field and modeled criteria and factors for determining suitable marsh migration corridors and restoration sites (UM, U.S. Fish and Wildlife Service [US FWS], DNR, MDE, and Constellation Energy).

Sea Level Affecting Marshes Model—Sea Level Affecting Marshes Model (SLAMM) is a modeling effort funded by the U.S. Environmental Protection Agency (EPA) first developed in the mid-1980s and currently being refined as Version 5. Results for the Chesapeake Bay will be available by mid-2008 and were funded by The National Wildlife Federation (NWF).

Integration Strategy

A framework diagram will illustrate how these various assessment and models could be linked together to determine the location of high priority natural resource conservation and restoration areas.

Figure I-1. Outline of proposed approach



Estimation of Adaptation Benefits and Costs

The costs associated with implementing a program of identifying priority areas for strategic management actions will be incremental to those already incurred to develop and maintain existing natural resources assessments. These incremental costs fall into four major categories: staffing, assessment, equipment, and maintenance. The primary cost associated with this option involves recruiting dedicated staff to develop the scoping plan and conduct the resources assessment. Assessment costs involve the costs associated with developing and testing new methodologies and criteria for prioritizing protection areas. Equipment costs involve the costs associated with any new equipment (e.g., gauges) and software (e.g., database management) required to complete field studies. Finally, there will likely be a set of annual costs associated with the maintenance of physical equipment and database systems.

The benefits associated with identifying priority protection areas center on the flexibility this information offers to other programs that seek to implement strategic actions to protect against the anticipated impacts from SLR.

Feasibility Issues

Inadequate staffing and funding resources largely hinder implementation feasibility. For the first year, one full-time staff member at DNR would need to be dedicated to the development of the resource assessment plan, to coordinate the necessary peer review required to approve and move forward with the plan, and to direct early action analysis. The analytical steps outlined in the flow diagram could be separated into two work phases.

Early Action Phase: The technical assessments needed to complete Steps 1 and 2, are complete, except for the Blue Infrastructure Assessment (completion date targeted for December 2008). Preliminary analyses to coarsely identify resources at risk could begin immediately if dedicated staff time and expertise could be identified for technical analysis and technical direction.

Project Coordination And Final Product Phase: Significant review and coordination with relevant scientific and technical expertise needs to be initiated within the next year to begin the development of criteria and the identification of model and data gaps (Step 3). Technical direction and documentation of the final product, listed as Step 4, is also needed. This will require the funding and dedication of one full-time staff person, in addition to other staffing and resource investments needed to complete the comprehensive identification of high priority protection and restoration areas.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

RRI-2. Forest and Wetland Protection

Option Description

Use enforcements, financial incentives, and educational outreach to retain and expand forests and wetlands in the coastal zone, and other areas subject to storm surge and SLR, to enhance adaptive response to climate change. The aim of this option is to develop actions to prioritize expansion and retention of working forests and wetlands in areas suitable for long-term survival and ambient land-use. The expected benefits of this option include protection from shoreline erosion, reducing peak runoff during storm events, and avoiding stranded infrastructure. The forest and wetland protection option for adaptation and response builds upon the Mitigation proposal and analysis done by the Agriculture, Forestry, and Waste Management (AFW) Technical Work Group (TWG), especially AFW-3 and AFW-4.

Critical Areas, buffers, and other non-urban, future impact areas will be targeted for forest establishment and expansion, based on elevation and landscape planning. Future forest and wetlands areas will provide replacement zones for wildlife migration and movement corridors. Research efforts are needed to develop more water and salt tolerant plant species as SLR impacts move inland. Forest conservation incentive policies will be increased in targeted areas emphasizing not only preservation and expansion, but also forest management issues that optimize forest health.

There will be multiple climate-change benefits, as these forests and wetlands will continue to sequester carbon until called on to provide a critical storm barrier. Water and air quality, wildlife habitat, and many other natural resource improvements will be immeasurable side benefits of implementing this option. Increased forests will provide local needs for renewable resources, such as wood products for construction, pulp, and fuels, and the demand for which will also increase.

Option Design

Targets:

- From RRI-1, use the new criteria for identifying priority protection areas to identify priority forest and wetlands for protection. Potential areas to target for forest and wetland expansion and protection include undeveloped areas within 1000 feet of mean high tide (current Critical Area definition), floodplain areas in the coastal zone, and areas prone to saltwater intrusion. Already developed areas will consider appropriate opportunities for setting and realizing tree canopy goals, establishing rain gardens, and promoting other means of green infrastructure to simulate the benefits of intact forest and wetlands.
- Develop, package, and market new and existing incentive programs to landowners for ease of targeting protection and restoration.
- Future impact areas, based on elevation mapping, become priority forest retention and establishment areas. Lower areas are more suitable for salt-tolerant woody species or for wetland establishment, especially where connected to existing wetlands.

- Create and augment dedicated sources of local funding, such as through ballot initiatives, for the conservation of forests and support these through state matching grants (see New Jersey model below).
- Identify and develop programs to enhance and protect migration corridors, from shorelines to inland habitats, and maintain connectivity of forest core areas across the landscape.
- Provide officials and staff to better enforce existing laws such as Critical Areas.

Timing: The program will be implemented in 2009, due to the need to establish and conserve forested areas as soon as possible. This will maximize the benefits of the new forest or wetland prior to their need as replacement habitat. An intensive public relations effort will begin prior to full implementation (2008–2009) to the citizens of Maryland, but particularly to the citizens of future impacted areas of the SLR issue, and the values of promoting and enhancing forest areas. This program should run indefinitely (continuous), and be evaluated regularly for effectiveness and when new information becomes available.

Parties Involved: DNR, Maryland Department of Agriculture (MDA), and MDE will be lead agencies involved in the implementation of various tasks under the program. Technical assistance infrastructure is already in place, especially for restoration, through cooperative programs, such as the Maryland Forest Service, Soil Conservation Districts, and Agriculture and Forestry Extension Agents, as the on-the-ground contact for landowners. DNR and MDA can provide some promotional staff and resources to identify and target contact areas. There is also considerable overlap with existing federal programs, including those of the Natural Resources Conservation Service (NRCS). Numerous national, regional, and local private-nonprofit organizations also conduct and support land protection (e.g., land trusts) and wildlife enhancement activities (e.g., wildlife and waterfowl habitat restoration groups). Maryland legislature would have to approve new incentives for land protection.

Other: County and local governments must become involved in this endeavor, in promotional and implementation efforts, including land-use planning and zoning efforts.

Implementation Mechanisms

Identification of priority working forests and wetlands to protect will be implemented, as identified in the mapping and analysis exercise described in RRI-1. In order to protect these priority lands, it is expected that Maryland will use a mix of increased tax benefits, easements from willing landowners, creative local financing and acquisition, and other incentive programs. The reason to invest in these lands is to avoid the costs of inundation in the built environment, and to avoid the economic and environmental costs incurred by losing these resource lands.

For restoration of riparian forest buffers and wetland restoration, this option can be implemented through existing and ramped-up Farm Bill programs, such as the Conservation Reserve Enhancement Program (CREP) and the Wetlands Restoration Program (WRP), as well as the Chesapeake Bay Restoration Act Funds. There may be untapped opportunities to use Farm Bill programs and funds to promote forest restoration. But forest conservation and restoration incentives are currently limited, and overshadowed by those provided for protection of farmlands. Additional staffing and funding will be needed as current on-the-ground and support

resources for forests and wetlands are minimal at this time compared to the past (reductions in funding and staff), and compared to what would be needed to fully implement this Option.

One researched mechanism to greatly increase available funds for land conservation without additional expenditures by state government is known as the New Jersey Model. In this Model, local governments in Maryland are enabled to post ballot initiatives to create a dedicated source of funds to protect forests and wetlands. Recent polling shows that a wide majority of Maryland voters would support such an initiative. Concurrently, state legislation would be passed to provide matching funds to those funds raised by local governments. This mechanism would conservatively generate four times the current available funding for land conservation without spending additional state funds.

Related Policies/Programs in Place

- Maryland's Forest Conservation Act
- Critical Areas Law
- Maryland's POS, including Rural Legacy, uses funds garnered through realty transaction taxes to acquire priority land. Land has not been prioritized according to SLR, but includes other criteria, such as scenic value and lands beneficial to water quality.
- National-level policies such as the Coastal and Estuarine Land Protection Act and Forest Legacy, and conservation acquisition programs supported by The Nature Conservancy, The Conservation Fund, and other non-governmental environmental groups
- State-level programs such as Chesapeake Bay Trust and Maryland Environmental Trust (MET), and programs supported by organizations like the Chesapeake Bay Foundation (CBF), 1000 Friends of Maryland.
- Various programs supported by local and regional land trusts, watershed organizations (planning, networking, and education function), and other non-governmental groups.
- Chesapeake Bay Program (CBP) water quality cap maintenance goals, under the Sound Land Use goal area of *Chesapeake 2000*, are goals for identifying and protecting valuable resource lands. Since 2000, these goals have been better defined and geographically targeted (e.g., 2007 Forest Conservation Directive [conserve forests for water quality and riparian forests, expand use of tree canopy goals] and the Chesapeake Action Plan [due out in 2008]). There currently is no CBP goal for wetland protection.
- Farm Bill programs offer conservation practices, such as riparian and shoreline afforestation (CREP) and wetland enhancement (WRP), that provide short-term easements of 10 to 30 years, and permanent easements in the case of the Farm and Ranchlands Protection Act. At this point, the latter program excludes forestlands and wetlands, except where they are incidental to farms.
- MDE Wetlands and Waterways Program protects wetlands primarily through a regulatory program and by direct compensatory wetland mitigation to targeted areas, as identified in MDE's *Priority Areas for Wetland Restoration, Preservation, and Mitigation* and *Priority Areas for Wetland Restoration, Preservation, and Mitigation in Maryland's Coastal Bays*, and their amendments. Funding for restoration and enhancement of wetlands is available for

state wetland programmatic mitigation projects, and through MDE's Water Quality Infrastructure Program (WQIP).

Estimation of Adaptation Benefits and Costs

The costs of conserving and restoring forests and wetlands are associated primarily with capital costs of acquiring easements on the land identified as critical to buffering against the impacts of SLR. These costs vary according to the implementation mechanism, or range of mechanisms used. As noted above, some federal and local funding may be able to assist the state in this regard. However, in order to serve as an incentive to landowners, funding must be increased to be comparable with land values for development. In addition to acquiring easements, there are incremental costs associated with dedicating agency staff to managing conservation and restoration programs.

Maintaining healthy coastal forests and wetlands will provide many important ecosystem services to the state, including protection from shoreline erosion, reduction of peak runoff during storm events, protection of water quality, and carbon sequestration. These functions of forests and wetlands directly benefit aquatic and terrestrial ecosystems by preserving habitat for native and migratory species, which in turn support the resources that sustain recreational and commercial endeavors.

Feasibility Issues

- Proposed changes to the Critical Areas definition increases the initial bandwidth in select areas on which one cannot develop from 100 feet to 200 feet. This may cause confusion and a rush-to-develop in the short term, but in the long term will be helpful for adapting to climate change.
- Legislative issues are to identify and maximize targeted landowner incentives, and get them approved, and to pass enabling legislation that allows for local ballot measures to create dedicated funding for local land protection.
- The mapping product from RRI-1 may not be available at the initial stages of implementing this option. However, this option may use MDE's wetland targeting maps as a starting point, which reflect current assessments, but do not consider vulnerability to SLR.
- Technical and economic feasibility issues need to be addressed on a case-by-case basis. Proposed projects need to be ranked according to their technical merit and economic impact, which would assess the expected value and risk of a range of strategies. Considering specific actions and locations will be a necessary step in evaluating which projects receive the highest priority for support.
- Implementation of certain mechanisms is subject to increased funding available to landowners for restoration and protection projects.
- There may also be social feasibility issues caused by pressure to develop in areas vulnerable to SLR.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

RRI-3. Sustainable Shorelines and Buffer Area Management Practices

Option Description

Shoreline erosion is a significant issue facing Maryland's diverse coastal environment. Approximately 70% of Maryland's 7,700-mile shoreline is experiencing some degree of erosion, which will worsen as a result of increased rates of SLR, and increased frequency and intensity of coastal storms from climate change. Comprehensive shoreline management must be an integral part of any future erosion control planning effort, and should aim at striking a balance between protection against erosion and preserving natural shoreline processes and habitats. Natural shorelines are essential for maintaining and promoting important aquatic and terrestrial habitats, trapping sediment, and filtering pollution. An increased understanding of non-structural and structural erosion control alternatives at the practitioner level, new mapping resources, regulatory guidance, shoreline inventories, and Web-enabled analytical tools are now sufficiently in place to facilitate such plans. Adopting a collaborative state-local approach to developing such plans will maximize the odds of success in designing and implementing a specific shoreline erosion control practice that achieves a balance between protecting land and minimizing disruption to the coastal environment.

The recommendation for a unified approach to shoreline management was presented in the "Interim Report to the Governor and the Maryland General Assembly: Climate Action Plan." As a direct result, two bills were introduced and passed in the 2008 Maryland General Assembly. The first, the Living Shorelines Protection Act of 2008 (HB 973), directs erosion control projects to consist of nonstructural shoreline stabilization measures that preserve the natural environment, such as marsh creation, except in areas mapped by the state (MDE and DNR) as being appropriate for structural stabilization measures. There is also a provision that it is the responsibility of the property owner to demonstrate to MDE's satisfaction that such nonstructural measures are infeasible. The second strengthens the Chesapeake and Atlantic Coastal Bays Critical Area Protection Program (HB1253/SB844). In general, the changes: provide a greater authority to the Critical Area Commission; update the basic components of the program, including the Critical Area boundary; enhance buffer and water quality protection; coordinate new development more closely with Smart Growth principles and other environmental protection and planning processes; and strengthen enforcement and variance provisions. Implementation of these legislative actions will require coordination across multiple levels of government (e.g., state, local or county, municipality), recognizing that each level of government will need to address these from different aspects.

In addition to moving the new legislation forward, this option focuses efforts on filling in any remaining gaps and should incorporate the following elements:

- A reorientation of DNR's Shoreline Conservation and Management Program (formerly the Shore Erosion Control Program) to promote the installation of innovative shore protection techniques that maximize habitat restoration and enhancement, and accommodate for projected SLR.

- Develop a general permit that streamlines the rebuilding process of storm-damaged tidal marshes, including the placement of additional clean, sandy fill, plants, and temporary biodegradable structures to protect rebuilt areas. Currently, introducing clean, sandy fill material requires a state permit, while simple planting of wetland species on existing substrate in the correct hydrologic and salinity regime does not. Repairs would be authorized under guidelines issued by the MDE.
- A requirement directing a joint effort of state agencies to standardize design and construction methods and protocols employed for shore-erosion control structures—new and retrofit—that consider climate adaptive strategies for coastal environments subject to SLR, erosion and storm hazards. Guidelines should be developed and tailored for specific target audiences, including marine contracting professionals, government officials, and public citizens.
- Expand current outreach and education programs directed at the public and marine contracting professionals to help ensure a smoother transition toward broader implementation of nonstructural and hybrid techniques. Using up-to-date protocols mentioned previously, contractors may receive training about the design and installation of proven control practices that may also maintain or enhance coastal processes and habitats. Contractor training will increase the likelihood of successful installations and boost property owner confidence in the benefits of increased state oversight. A certification program, in cooperation with the Maryland Home Improvement Commission (MHIC), should be considered as part of the implementation of this element.
- Integration of mapping and modeling products into state and local planning and implementation efforts. This should include a mechanism to update the Maryland Comprehensive Shoreline Inventory (CSI) to include type and quantity, location, and conditions of shore erosion control structures, on the order of every 5 to 10 years. This could be linked to the permitting process, in order to create a system for automatic entry and updates to the database for projects being proposed and implemented.

Option Design

Targets:

There are four key targets associated with this option, as outlined below:

1. Implement statutory changes passed during the 2008 General Assembly.
2. Work with an interdisciplinary team with expertise in wetlands, coastal processes, biology, restoration, and coastal erosion control design and engineering to standardize design and construction protocols for erosion control structures and tidal-shoreline habitat enhancement projects.
3. Distribute modified and new design and construction standards to engineering, contractor, local governments, non-governmental organizations (NGOs), and property owner communities. Appropriate training will be developed for engineering and contracting outfits, in order to transfer critical information about the design and installation of these innovative techniques.
4. Development of a strategy for updating the CSI every 5 or 10 years.

Timing: Adopt required regulatory changes in October 2008; promulgate guidance manuals and attendant training programs by 2009; have a strategy for updating CSI in place, with the first subsequent update by 2010; following CSI update, initiate shoreline management plans in 2011, with target completion date for plans by 2013.

Parties Involved: Critical Areas Commission, MDE, and DNR.

Other: Resource Conservation and Development agencies; local governments in the coastal zone; Board of Public Works (BPW), Wetlands Administrator; engineering, contracting, and property owner communities; U.S. Army Corps of Engineers (USACE) and other federal resource management agencies; the Center for Coastal Resources Management (CCRM) of the Virginia Institute of Marine Science (VIMS); and others.

Implementation Mechanisms

Implementation of this option will include a combination of executive, legislative, and programmatic actions. The first step is the promulgation of regulation to implement statutory changes passed during the 2008 Maryland General Assembly. Second, updated design and construction standards and protocols for Shore Erosion Control (SEC) structures—new and retrofit—should consider climate adaptive strategies for coastal environments subject to SLR, erosion, and storm hazards. These guidelines should be distributed to the engineering, construction, and property owner communities, via state agencies, county planning offices, and Resource Conservation and Development agencies.

Additional programs that would support the implementation of this option could include professional development programs for contractors and permit reviewers to establish a quality control mechanism, revitalizing and expanding the financial assistance program through DNR's Shoreline Conservation and Management Program, and expanding outreach and education programs for local governments and waterfront landowners.

Related Policies/Programs in Place

A number of state and federal sponsored activities and programs that are related to this option are currently underway, including:

- The DNR's *Shoreline Conservation and Management Program* (formerly the SEC Program), provides subsidies and technical assistance for non-structural projects to Maryland property owners in resolving shoreline erosion problems along the Chesapeake Bay and its tributaries
- The *Comprehensive Coastal Inventory Program* (CCI), through the CCRM at the VIMS, has developed shoreline situation reports for CSI, which include land use, bank conditions, and shoreline features (including erosion control structures). The inventory captures baseline shoreline conditions throughout the tidal portions of Maryland's coastal counties. The CSI can be used as a state and local planning tool to inventory and assess coastal infrastructure vulnerable to SLR inundation or coastal flooding.
- The DNR, through various programs, is conducting SLR and storm surge mapping.
- The DNR's *Green and Blue Infrastructure Assessments* (Blue Infrastructure is still under development).

- *Strategic Shore Erosion Assessment (SSEA)*—from 2000 to 2002, a NOAA Coastal Services Center Coastal Management Fellow worked with the Maryland Coastal Program to initiate the development of a comprehensive approach to shore erosion planning for Maryland. The Fellow was tasked with developing a protocol to create regional strategies to deal with shoreline erosion issues. The Fellow worked closely with two counties, Dorchester and St. Mary's, to identify an approach to balance the need to address risk from erosion, while maintaining natural shoreline habitat
- The Maryland Coastal Program in conjunction with VIMS, the USACE and MDE, is participating in the development of *Erosion Vulnerability Assessment (EVA)* as a component to the Chesapeake Bay Shore Erosion Control Feasibility Study and Master Plan. This assessment is designed to evaluate stretches of shoreline and prioritize these areas for erosion control activities. The outcomes of the project will include outreach material for marine contractors and homeowners, and a guide for potential shore erosion management activities for various government agencies
- The Maryland Coastal Program and VIMS are creating the *Living Shorelines Suitability Tool* for Worcester County that identifies areas not suitable for living shoreline treatments, those that are suitable and those that may be suitable with design restrictions. This tool is slated for completion in September 2008
- The *Living Shorelines Stewardship Initiative (LSSI)* is a collaborative effort by various public and private entities to promote the use of “living shorelines” (i.e., vegetated buffers) to waterfront property owners
- *DNR's Coastal Program* has collaborated with MDE and contractors that currently install “living shorelines” to offer outreach and education workshops for marine contractors and homeowners. Among other aspects, these courses focus on the designs, installations, permitting, and benefits of “living shorelines.”
- MDE prepared guidance, the *Shore Erosion Control Guidelines: Marsh Creation*, as shore erosion control practice and habitat benefit. These guidelines were developed based on completion of an MDE-funded study to UM. Fact sheets are also available on contractor selection, practice selection, maintenance, and marsh creation
- *Maryland Department of the Environment Sample Drawings*, developed for marsh creation projects, based on results and recommendation of a UM study. Drawings include marsh as a stand-alone project, as a hybrid project with a supporting sill, and marsh creation in conjunction with existing bulkheads.
- *Shore Erosion Control Guidelines for Waterfront Property Owners 2nd edition*, MDE's update of its 1992 publication, addresses latest guidance for structural and nonstructural practices. The document will be completed in 2008 and will include latest regulatory requirements to address 2008 legislative additions for shoreline management and preference for marsh creation. To be completed in 2008.

Estimation of Adaptation Benefits and Costs

Costs for this option could include additional financial support to upgrade MDE's permit database for improved tracking of shore erosion control projects, as well as incremental costs associated with managing a program to update the CSI. An increased demand for “living

shoreline” training and outreach programs, such as those conducted by the Chesapeake and Coastal Program at DNR and the Wetlands and Waterways Program at MDE, is expected. Additionally, DNR’s Ecosystem Restoration Services will likely see an increase in shoreline property owner requests for technical and financial assistance for implementation of nonstructural shore protection practices.

Shore erosion will be exacerbated as a result of rising sea levels, and as such shore erosion control projects will continue to be in demand as a means of protecting coastal property and infrastructure. The increases in demand for these projects will likely result in positive economic impacts to the marine contracting industry, given that adequate professional training is provided to shift those outfits that have historically installed hardened structures.

Developing clear guidelines for the design and implementation of shoreline erosion control practices has distinct benefits. As noted above, implementing this option increases the odds of success in achieving a balance between protecting the land and minimizing disruption to the coastal environment. Thus, the benefits can generally be viewed as the avoided costs of property damage from storm events and the maintenance of ecosystem services provided by natural shorelines, which include sediment trapping and pollution filtering.

Feasibility Issues

The need to address professional development opportunities for the marine contracting industry is a key issue of the feasibility of this recommendation. At present, there are limited marine contracting companies capable of designing and installing these innovative and nonstructural approaches to shoreline erosion control. Many companies have focused on structural erosion control techniques, such as riprap and bulkheads. To help ensure a smoother transition toward broader implementation of nonstructural and hybrid techniques, additional offerings of contractor training are a logical approach. The DNR’s Maryland Coastal Program has collaborated with MDE and contractors that currently install “living shorelines” to conduct a limited number of training sessions to address this emerging need. However, more training is needed to transfer critical information about the design and installation of proven control practices that may also maintain or enhance coastal processes and habitats. Additional training will increase the likelihood of successful installations and boost property owner confidence in the benefits of increased state oversight.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

RRI-4. Resource-Based Industry—Economic Initiative

Option Description

Resource-based industries such as forestry, agriculture, commercial and recreational fishing, and sportsmen’s activities represent the economic backbone of rural Maryland. These industries are heavily dependent on the health and vitality of the Chesapeake Bay and its tributary ecosystems. While potential climate change impacts to these industries are widespread (e.g., changes in salinity, temperature, rainfall, disease, invasive species), SLR and associated hazards, such as storm surge, coastal flooding and erosion, threaten areas where the current primary land use supports these industries. Comprehensive adaptation response strategies that investigate all possible impacts should be addressed, recognizing that many will fall outside the focus of this phase of adaptation planning.

Baseline information regarding the impacts of climate change, including SLR and associated coastal hazards, on the economics of varying sectors of resource-based trades and industries is lacking. Research within each respective field should aim to identify these potential impacts, and lead to developing an appropriate strategy to buffer such effects as well as identifying potential opportunities for expansion and development. State agencies, in cooperation with the private sector, should focus efforts on the development of long-range plans (i.e., fishery management plans, forestry management plans, marine sensitive areas initiatives, and agriculture land use plans) flexible enough to adjust to ongoing and future change. Such plans should be developed in ways consistent with local land use master plans, and foster small local mills and farms. This option addresses protection mechanisms to minimize the economic impacts of climate change on natural resource industries, or adaptation by the use of new non-conventional methods.

Fisheries-Based Industries

The total estimated value of the Maryland seafood industry is \$700 million, with \$207 million generated by commercial fishing and crabbing activities. There are 73 processing plants employing 1,360 people and over 6,000 watermen who work the Chesapeake Bay, which account for \$1.76 billion in wages. Impacts to this industry due to climate change are largely unknown, mainly due to the uncertainty attendant to climate change effects on aquatic habitats and populations. Resource populations (i.e., crabs, oysters, and finfish) and the associated industries are already under stress due to present land-use practices, overfishing, degradation and loss of nursery habitat, and extensive inshore and coastal pollution. Conserving habitat and diversity is a present challenge, and SLR may further aggravate habitat fragmentation. Additionally, not knowing what population and species changes will follow makes it difficult to predict what could replace the current economic engine for which Maryland is famous. Concern over species and habitat shifts is real and likely not amenable to mitigation through traditional planning. Long-range plans for these resources will have to be innovative, and should consider all aspects of the seafood industry. This includes, but is not limited to, areas such as: the methods in which the resource populations and associated habitats are managed; processing, packaging and distribution practices; and aquaculture practices, in order to streamline costs and maximize profits while ensuring sustainability.

Management efforts should focus on conserving a diversity of habitats to maintain functionality and persistence of populations, so they can be resilient during times of stochastic climate conditions and associated coastal hazards. Significant opportunities for industry development might exist within the aquaculture field. Maryland currently produces a wide variety of aquatic fish, shellfish and plants, the value of which was nearly \$3.4 million in 2003. Research is needed to determine whether there are additional populations that could be supplemented, restored in the wild, or generated simply for supply.

Forestry-Based Industries

Maryland's forest products industry is a \$2.48 billion industry, considered to be the largest industry in Western Maryland and the second largest industry after agriculture on the Eastern Shore. The long-term profitability of the forest products industry is directly linked to a sustainable-forest resource base and stewardship of forests and forestlands in a way that maintains their potential to fulfill relevant ecological, economic, and social functions to ensure the future health and usefulness of the forest. Forests, like other open space areas, are under intense development-related pressures for residential, commercial, and industrial conversion attendant to the demands of a growing population. Just a 1% decrease in harvestable trees between now and 2018 would result in an indirect economic loss of over \$236 million on Maryland's GDP and a loss of over 1,600 Maryland jobs.

Identifying areas where the forest products industry is likely to be viable in the long term provides focus for effective management activities, but should also be adaptive so that if future conditions change and the forest shows signs of stress or decline, silvicultural management techniques can be adjusted. Programs and policies should be developed—through financial incentives and cost share programs—that encourage private forest and waterfront or riparian landowners to favor the retention of forests and other native habitats over development and conversion. Additional attention should address streamlining and modernizing the processing, manufacturing, reduction or beneficial use of waste and by-products (to create heat and power), and distribution aspects of this important resource-based industry.

The intent of potential industry directives should be to enhance a broad-based understanding of the measurable environmental and economic benefits attendant to a healthy forest system and the stewardship practices of private landowner and industry alike, which would serve to help Maryland meet its commitment under the Chesapeake 2000 Agreement and the 2007 Forest Conservation Initiative. Any initiatives should take into account impacts from climate change, and may include:

- Integration and streamlining of land conservation (acquisition and easement) programs within DNR and across state agencies and local governments to better prioritize the conservation and restoration of forest and stream or coastal buffer habitats, and meet the goals established by the Maryland Wildlife Diversity Conservation Plan;
- Adopting management plans that incorporate supplemental planting on poorly stocked lands, age extension of managed stands, thinning and density management, fertilization and wood waste recycling, expanded use of short-rotation woody crops for fiber and energy, with expansion in accompanying industries (e.g., Fuels for Schools program), expanded use of

genetically preferred species, and salt tolerant species within projected SLR impacted areas, modified biomass removal practices;

- An initiative that directs the use of local wood for construction, furniture or other value-added wood products to enhance local economies, while reducing carbon emissions by lowering transportation distances and sequestering carbon in those products; and
- Forest stewardship plans—on both public and private forestlands—that will, among other things, foster forest landowners to better manage their land for wildlife habitat enhancement, sustainable timber production, and the protection of soil and water quality, wetlands and streams by re-developing forested riparian buffers with salt tolerant species.

Agriculture Industries

The total market value of agricultural goods produced in Maryland was estimated at \$1.3 billion in 2006. Within the state there are approximately 12,000 farms, totaling over 2 million acres of farmland. A number of these operations, both agriculture and livestock combined, lie in low elevation areas, and are subject to flooding and inundation as a result of SLR. Long-range management plans should discourage further establishment of operations within these areas and, where feasible, be relocated or protected to minimize impacts. Additional considerations should be made to protect or move groundwater wells and waste storage structures associated with existing operations in vulnerable areas.

Potential industry directives could include: identifying and utilizing new non-conventional agriculture crops which are salt tolerant; expansion of nurseries specializing in native wetland plants for use in nonstructural erosion-control projects, or “living shorelines”; processing the by-products of farm practices (chicken litter, methane, slash, switchgrass, cornstalks, and other agricultural by-products and feedstocks) for renewable energy and transportation fuels; and state and local level programs that promote the sustainable production and consumption of locally produced agricultural goods, or so-called “Buy-Local” initiatives.

Tourism Industry

More than 28 million people visited (traveled more than 50 miles) Maryland in 2006 and generated more than \$11.72 billion in spending, according to the Maryland Tourism Development Board. Roughly 62% of the state’s tourist activity occurs in the coastal counties, beaches and waterfront destinations. Of particular interest, resource-based recreational activities contribute significantly to Maryland’s economy. Recreational saltwater fishing generated nearly \$308 million, and wildlife watching activities generated over \$30 million that same year, according to the US FWS. One of Maryland’s (and Virginia’s) most popular national parks, Assateague Island National Seashore, attracted 1.9 million visitors in 2006, which spent nearly \$140 million and supported over 2,600 jobs (in Maryland and Virginia). This island is particularly vulnerable to SLR, as it is a long, narrow, low barrier island. This economic base is contingent on the continued availability and accessibility to the natural resources that define Maryland and the Chesapeake Bay region.

Marine Trade and Port Activities

The recreational marine trades industry in Maryland contributes \$2.3 billion per year to the economy, employs more than 28,000, and serves some 220,000 boats registered in Maryland,

plus boats visiting from other states. This industry is comprised of boatyards, marinas, and commercial marine service facilities, including docking, service, and market facilities for the catch. Many of the recreational and commercial facilities are located on the waterfront within a few feet of the current sea level. These water dependent businesses are especially vulnerable to the impact of SLR. Depending on the elevation of adjacent upland land, some will ultimately need to relocate; others will be able to defend against SLR by raising the elevation of their properties.

Port activities account for a significant portion of Maryland's economy and employment. The Port of Baltimore produces \$1.98 billion in annual economic benefits and provides for 127,000 maritime related jobs. According to the report "*Economic Impacts Generated by the Port of Baltimore in 2005* (August 22, 2006)," the Port of Baltimore was responsible for \$1.1 billion in local purchases by businesses directly dependent on port activity; activities of the Port generated state, county and municipal taxes of \$278 million; and the U.S. Customs and Border Protection (US CBP) collected \$507 million in 2005. These facilities require appropriate water depth for port maintenance, and SLR impacts will need to be addressed through strategic planning efforts.

Coastal Management and Restoration Industries

Managing shoreline erosion, either through living shorelines, or other stabilization methods, will continue to grow as an emerging industry in Maryland's coastal counties. In addition, other industries related to coastal ecosystem and infrastructure management, whether it is wetland or forest restoration, retrofitting of coastal infrastructure or water management, will continue to grow and prosper. Many new economic opportunities will develop. Efforts should be focused to support these emerging industries and developing guidance on standardized practices and fostering innovations represents opportunities in restoration and coastal management economies that should be harnessed (Cross-cutting with Sustainable Shorelines and Buffer Area Management Practices, Economic Development Initiative).

Option Design

Targets:

The resource-based industries discussed above are vulnerable to a broad spectrum of climate change impacts beyond SLR and coastal hazards. Due to limitations of state staffing and financial resources, a concurrent evaluation of all resource based industries does not appear to be feasible. The Adaptation and Response Workgroup staff will consult with the Scientific and Technical Working Group of the MCCC to determine a protocol and priorities for evaluating specific resource-based industries and their relationship to SLR.

Phase 1: Research and Data Collection

Teams with expertise within the resource-based industry should convene to evaluate key vulnerabilities and potential economic impacts from climate change. The team will conduct an assessment intended to provide guidance to decision and policy makers. Research should address, but not be limited to, these key areas:

- Identification of geographic areas vulnerable to SLR and coastal hazards that currently support resource industries;

- Assessing the importance of the system(s) at risk, in terms of ecosystem goods and services, and the direct economic impacts on the state as a result of no action (e.g., loss of jobs, loss of revenue from residents and visitors of the state, loss of ecosystem services), and should consider the magnitude, timing, persistence, and likelihood of potential economic impacts; and
- Identification of prospective adaptation mechanisms with associated cost and benefit analyses.

Phase 2: Systematic and Strategic Planning

Subsequent to the economic studies, overarching management and planning guides for the industry should be developed using a crosscutting, systematic and strategic approach. Areas of consideration include:

- Developing a framework for making abandon, modify, move, or protect decisions to address long-term strategic planning and potential solutions for at risk facilities and operations;
- Identifying potential areas for streamlining costs via processing and manufacturing, transportation and distribution, and waste reduction and utilization;
- Identifying potential supplement or replacement industries to promote alternative businesses or practices, which can supplement or replace traditional means;
- Inclusion of a mechanism to monitor or track leading economic indicators of change within each sector (i.e., geographic ranges, migratory patterns, disease outbreaks, invasive species) of certain species (e.g., plants, birds, mammals, insects) known to be hypersensitive to early climate change impacts and have significance to the economics of a particular industry; and
- Identifying specific targets and timelines for each sector or industry.

Phase 3: Implementation

The implementation of the management and planning programs could occur via programmatic modifications, executive order, or legislative action. Strategies could include:

- Mitigation of regulatory and programmatic burdens to facilitate sustainable management of natural resources in the face of climate change;
- Development of guidance and training programs for professional and public development; and
- Identification of opportunities within existing programs, or development of new financial assistance programs, that focus on proactive or prevention management rather than reactive treatment (e.g., non-conventional crop use and tree species, protection of groundwater wells and waste storage structures of poultry and livestock operations).

Timing: Phase 1 would begin following the release of the final report from the MCCC to the Governor, and no later than 2009. Appropriate and key partners will be identified to participate in the research and assessment team for the established priority industry. Phase 2 would initiate immediately following the completion of the assessment. Implementing proposed strategies and programs, Phase 3, would occur in different stages. Other industries should comply as seen fit.

An intensive public-relations effort should accompany the implementation phase. This should be directed at the citizens of Maryland particularly located in future SLR impacted areas, but span across the various resource-based sectors. This program should run indefinitely (continuous), and be evaluated every 5 years for effectiveness.

Parties Involved: DNR, MDA, MDE, numerous fisheries, forestry, and agricultural organizations, and business interests.

Other: Various levels of local government, CPB, NRCS, USFS, the Partnership of Sustainable Forestry, private landowners, public landowners, private sawmills, landscaping industry, nursery industry, Maryland Cooperative Extension (MCE) and Master Gardeners, agricultural and wood product primary producers (such as Maryland farmers, lumber mills, farmer’s market associations and promoters), value-added producers (such as Maryland caterers, producers of packaged food for retail, furniture makers, construction businesses, wholesalers and retailers of construction and do-it-yourself products, architects and designers), applicable trade associations, Leadership in Energy and Environmental Design Green Building Rating System™ (LEED™) certification entities, and others.

Implementation Mechanisms

There are many existing programs (e.g., agricultural assistance, economic development grants) and policies in place that will support the implementation of this option. Overall implementation would include such elements as land acquisition, conservation easements, purchase and transfer of development rights, tax credits and structures, and zoning. The toolbox would also include refining land use planning policies and funding programs to allow users of these tools—governments, non-governmental organizations and private citizens. Additional opportunities include the utilization of new Farm Bill program funding to promote alternative crops. State and local regulations may be needed through existing zoning programs to regulate new poultry and livestock operations in at risk areas. The MDE may need to investigate if existing regulations are in effect for the installation of well protection devices to prevent saltwater contamination of groundwater sources.

Specific incentives include the following:

- Provide credit through LEED for sustainable wood products grown and harvested locally;
- Increase incentives through programs (such as Fuels for Schools, tax-forgiveness);
- Establish incentives for utilizing renewable heating fuels (such as tax credits similar to those afforded electric producers in the Maryland Clean Energy Act); and
- Support all activities through an extensive outreach and education effort.

It should be noted this recommendation has multiple areas of crosscutting implementation mechanisms for a recommendation being proposed by the Future Built Environment and Infrastructure Technical Working Group (FBEI)—“Economic Development Initiative.”

Related Policies/Programs in Place

Fisheries Programs

The Task Force on Fisheries Management, created by Chapter 217 of the Acts of 2007, is charged with overseeing a full review of current fishery management processes and developing recommendations for methods to improve, modernize, and streamline fishery management. The Task Force will look in depth at a range of fisheries conservation challenges, management issues, and a variety of science concerns, including stock assessment capabilities and limitations, ecosystem based interactions, and socioeconomic considerations associated with Maryland's fisheries.

Farming and Forestry Assistance Programs

DNR and MDA, the U.S. Department of Agriculture (USDA), academic resources, such as those made available through the UM system, and local forestry and farming boards offer a wide range of technical, financial and research assistance and training programs to members of the state's rural resource-based industries. Adaptation guidance and assistance can be developed and delivered through these existing programs, so long as financial resources are made available to them to effect responsive outreach efforts.

Feasibility Issues

Due to limitations of state staffing and financial resources, it does not seem feasible to conduct concurrent evaluations for all resource-based industries. A protocol should be established to prioritize the timing of such evaluations, and be based on MCCC findings and state agency priorities. Implementing any policies, initiatives, or programs that result from said evaluations would require further appropriation of staff and funding.

Status of Group Approval

Unanimous

Barriers to Consensus

None.

Acronyms and Abbreviations

CBP	Chesapeake Bay Program
CCI	Comprehensive Coastal Inventory
CREP	Conservation Reserve Enhancement Program
CSI	Comprehensive Shoreline Inventory
DNR	[Maryland] Department of Natural Resources
EVA	Erosion Vulnerability Assessment
GIS	geographical information systems
LEED	Leadership in Energy and Environmental Design
LSSI	Living Shorelines Stewardship Initiative
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
NGO	non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
SAV	submerged aquatic vegetation
SEC	shore erosion control
SLAMM	Sea Level Affecting Marshes Model
SLR	sea level rise
SSEA	Strategic Shore Erosion Assessment
UMD	University of Maryland
US EPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
VIMS	Virginia Institute of Marine Science
WRP	Wetlands Restoration Program