

## **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 sea level rise (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, municipal water systems, etc.) is essential for community framework. Private sector infrastructure (i.e., residential properties, boating facilities, retail and office buildings, farms, etc.) has historically enjoyed higher market value compared to inland properties because of its proximity to the water especially in more recent times.

As 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 decision about how to adapt and at what expense. Decisions about how to adapt to the impacts of sea level rise will be different for varying land uses, taking into consideration the value of the land (monetary, resource-value, and perceived value), public opinion, public safety and risk assessments, ecosystem survival and replacement, environmental and development opportunities, and others.

There is a range of potential adaptation options such as protection, relocation and retrofitting that can be utilized to respond to sea level rise. Protection of vulnerable coastal infrastructure can be accomplished by use of structural bulkheads, seawalls, or revetments which are the least desirable means. Protection can also be accomplished that will be improve ecosystems and create new opportunities. However, it will not be practical (socially, economically or environmentally) to do so for all areas at risk. Developing a framework for making abandon/modify/move/protect decisions must be done 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 STWG which identify vulnerable inundation areas), categorized and assess impacted infrastructure based on research to determine feasible option strategies, and formulate strategies to integrate action plans at the federal, state, and local levels.

In order to plan and ascertain priorities, there needs to be differentiation between properties that can adapt to SLR and those which may need to be abandoned and/or relocated. In the case of public infrastructure, one important factor in 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, local, state, and federal authorities for how adaptation can best be accomplished. Existing laws and regulations, processes, and practices need to be re-

visited and possibly changed, eliminated, and/or supplemented so that they facilitate positive potential results from adaptation in recognition of the changing climate and environment.

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

## Option Design

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

1. Raise the awareness of the impact of SLR in impacted areas. Since SLR is so gradual, one of the obstacles to implementing successful option strategies will be to overcome denial and achieve “buy-in” and participation from stakeholders.
2. Identify vulnerable SLR inundation areas along Maryland’s shoreline using newly acquired topographic data.
3. Assess public and private sector infrastructure within these vulnerable areas to gain a statewide sense of the breadth of infrastructure impacted.
4. Categorized and assess impacted infrastructure based on research to determine feasible option strategies. This should be conducted by team of experts considering successes and failures of other actions attempted or contemplated worldwide, potential engineering solutions and technological applications to determine potential applicability to the impacted projected areas. The scope of this study should be to prepare generic adaptation methods descriptions, and the feasibility (costs, impacts, etc.) of implementing various adaptation scenarios (abandon/modify/move/protect).
5. Formulate and prioritize strategies to adapt to climate changes and SLR, along with a plan to integrate plans of action at the state and local levels.

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

1. Raising the awareness level has already begun and is an important part or all options in this effort.
2. Compiling existing data on projected SLR inundation areas and existing infrastructure within those areas could utilize existing tools, programs and resources, and could therefore begin immediately and be targeted for completion by the end of 2009.
3. Categorizing and assessing impacted infrastructure of adaptation options should follow the initial data compilation. This phase of the option should begin in late 2009 and be completed by 2011.
4. Formulate strategies, priorities and implementation action plans (*timing??*)

## Parties Involved:

Coordinated involvement will be needed from property owners, local town/city governments, county governments, Maryland agencies including DNR, MDOT, MDE, MDP (Maryland Department of Planning, Maryland Utilities Commission, federal agencies including USDA, US Army Corps of Engineers.

**Other:** NA

### Implementation Mechanisms

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

### Related Policies/Programs in Place

There are several related policies/programs in place in Maryland, as outlined below:

- ❑ *Comprehensive Shoreline Inventory (CSI)*. Maryland's Coastal Program contracted with the Virginia Institute of Marine Sciences (VIMS) to prepare a Comprehensive Shoreline Inventory that captures baseline shoreline conditions throughout the tidal portions of Maryland's coastal counties. Shoreline features and conditions were identified through a three-tiered shoreline assessment approach. The Inventory divided the shorezone into three regions: 1) immediate riparian zone (land use), 2) bank (bank characteristics such as height, bank type, etc., and shoreline buffers), and 3) shoreline features (shoreline attributes including bulkheads, riprap, marinas, boat ramps, docks, etc.). Data from the survey was processed to create three GIS coverages, displayed through reports, summary tables, and maps, which are viewable online at <http://ccrm.vims.edu/gisdatabases.html>. The CSI can be used as a state and local planning tool to inventory and assess coastal infrastructure vulnerable to sea level rise inundation or coastal flooding.
- ❑ *Strategic Shore Erosion Assessment (SSEA)*. From 2000 – 2002, a NOAA Coastal Services Center, Coastal Management Fellow, worked with the 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 also maintaining natural shoreline habitat. The developed protocol became the foundation for the Strategic Shore Erosion Assessment (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 each homeowner's project based on criteria such as infrastructure threat from erosion, and an applicant's financial need.

- ❑ *Maryland's 2006 – 2010, CZMA §309 Coastal Hazard Strategy*: The Strategy, approved by NOAA in 2006, sets for the current workplan for development of the SSEA. The project is being implemented in three phases: (1) generation of 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 U.S. Army Corps of Engineers (USACE) and MDE. The Plan, 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 assist the agencies in being consistent with 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 of CCSP Synthesis and Assessment Product 4.1, "Coastal elevations and sensitivity to sea level rise:"* This report is one of 21 synthesis and assessment products being prepared by the U.S. Climate Change Science Program (CCSP). The Draft Report is posted on the CCSP web site at: [www.climatechange.gov/Library/sap/sap4-1/public-review-draft/](http://www.climatechange.gov/Library/sap/sap4-1/public-review-draft/). The report is currently out for public review. Comments must be received by COB **10 April 2008**. The draft report includes the results of a research project entitled the Likelihood of Shore Protection in Maryland. This project, conducted by the EPA, was based upon interviews with state regulators and county planners 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 sea level rises and areas that will likely retreat because of protection cost or currently land use policy.
- ❑ HAZUS-Multi Hazard (MH): HAZUS is a risk assessment software program for analyzing potential losses from floods, hurricane winds and earthquakes. 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 in {insert year} with Salisbury University 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 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.
- ❑ Moreover, the coordination and reinforcement for this option should be with the following other options in this report:
  - Assessment of Coastal Zone Adaptation Options and Evaluation of Shoreline Protection Structures
  - Integrated Planning for SLR and Associated Coastal Hazards
  - State Agency Reporting on Response to CCC Findings
  - Preserve Undeveloped, Vulnerable Lands
  - Integrated geographic information systems, monitoring, and modeling
  - New Criteria for Identifying Priority Protection Areas

- Forest and Wetland Protection
- Modify Environmental Protection Regulations to Promote
- Sustainable Shoreline and Buffer Area Management Practices

### 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 off-set 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. Considerations of costs are:

- ❑ estimated detailed cost of adapting, relocating & replacing public infrastructure can only be determined after the assessment and identification of impacted properties is performed. Some properties, particularly major infrastructure, will be able to serve out their useful life before the need to replace them. 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 their projected useful life. This contrasts with the current perception that often the life spans of certain properties can be extended by renovation/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/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 off-set asset losses when appropriate.

Some data sources that are relevant to the assessment of costs and potential benefits of this option are outlined below:

- ❑ Town of Oxford, Maryland Flood Insurance Rate Map, Community panel number 240068-001 A, effective September 28 1984
- ❑ Earth From Space. [http://earthfromspace.photoglobe.info/spc\\_netherlands\\_dikes.html](http://earthfromspace.photoglobe.info/spc_netherlands_dikes.html)
- ❑ The Tye. <http://thetye.ca/News/2007/05/28/FloodControl/>
- ❑ MSN Encarta. [http://encarta.msn.com/encyclopedia\\_761572410/netherlands\\_the.html](http://encarta.msn.com/encyclopedia_761572410/netherlands_the.html)
- ❑ Maryland Shorelines Online: <http://shorelines.dnr.state.md.us/living.asp>

- ❑ Chesapeake Bay Funders Network:  
[http://www.campbellfoundation.com/html/related\\_projects.html](http://www.campbellfoundation.com/html/related_projects.html)
- ❑ Coastal defense solutions (approach of ComCoast)
- **Henk Jan Verhagen** and **Paul J. Visser:**  
<http://www.citg.tudelft.nl/live/pagina.jsp?id=dcc8f165-73c7-475f-a9a5-5d8eca330d5f&lang=en>
- ❑ Intergovernmental Panel on Climate Change: <http://www.ipcc-wg2.org/index.html>

### **Feasibility Issues**

Feasibility of the strategies and priorities from research depends on accurate projections of SLR, as well as the availability of adequate funding for strategies developed can be justified and become available because both short term and long term ecological, environmental, and financial benefit.

Moreover, several uncertainties can affect the feasibility of this option. These include the uncertainty regarding a) the rate and extent of SLR. the relative impact of subsidence, b) property protection across multiple owners should one or more not wish to participate, and c) the nature of the future federal response to the threat of sea level rise.

### **Status of Group Approval**

TBD.

### **Barriers to Consensus**

TBD.