2015 GGRA Report - DRAFT

Adaptation

I. Introduction

Climate change will affect Maryland in a variety of ways. More obvious impacts could include an increased risk for extreme events such as drought, storms, flooding, and forest fires; more heat-related stress; the spread of existing or new vector-born disease; and increased erosion and inundation of low-lying areas along the State's shoreline and coast. In many cases, Maryland is already experiencing these problems to some degree, today. Climate change raises the stakes in managing these problems by changing the frequency, intensity, extent, and magnitude of these problems.

As the State moves forward with actions that will reduce greenhouse gases and ultimately result in increased energy efficiency, a more sustainable economy, and cleaner air; climate impacts will still be felt into the future. Therefore, adaptation, together with mitigation, is necessary to address climate change. It is noted, however, that these actions are by no means independent of each other and any program or policy to mitigate the effects of climate change will complement steps to reduce the state's risk to climate impacts.

Climate change adaptation is an extremely complex process and there is no single means of response. As stressed in a recent report by the National Academies[1], climate change adaptation must be a highly integrated process that occurs on a continuum, across all levels of government, involving many internal and external partners and individual actions, and often evolves at different spatial and temporal scales. That said, the State is already taking steps to enhance the resilience of a broad spectrum of natural and human-based systems to the consequences of climate change.

II. Background

Maryland's Climate Action Plan includes two climate change adaptation strategies that are currently being used to guide state-level adaptation planning efforts. The first strategy (Phase I), released in 2008, addresses the impacts associated with sea level rise and coastal storms. The second strategy (Phase II), released in 2011 as a compendium to the Climate Action Plan, addresses changes in precipitation patterns and increased temperature and the likely impacts to human health, agriculture, forest and terrestrial ecosystems, bay and aquatic environments, water resources, and population growth and infrastructure. Together, the strategies are the product of the work of more than 100

[1] National Research Council. 2010. Adapting to the Impacts of Climate Change. National Academies Press, Washington, DC

experts from the governmental, nonprofit, and private sectors that held a series of meetings for the purpose of interpreting the most recent climate change literature, evaluating adaptation options, and recommending strategies to reduce Maryland's overall climate change vulnerability.

The strategies provide the basis for guiding and prioritizing state-level activities with respect to both climate science and adaptation policy over the near and longer terms.

Between 2008 – 2014, the State as a whole made substantial progress to implement high-priority elements of Maryland's Phase I and II Adaptation Strategies. Chapter 8 of Maryland's Greenhouse Gas Reduction Plan (2012), the Adaptation Update, provided detailed information on state agency implementation efforts to date, along with short, medium and long-term priorities for future action. Summaries of a selection of high priority Phase I and II adaptation strategies, including current and planned near-term implementation efforts are outlined below.

III. Adaptation Strategy Implementation Update (2008-2015)

Leading by Example

Maryland Department of Natural Resources (DNR)

Initiative: "Lead by Example" Policy: Building Resilience to Climate Change

Description: The DNR has the lead role among state agencies in advancing the scientific understanding of Maryland's vulnerability to climate change, and advocating for sound planning to avoid or minimize the anticipated impacts. In October 2010, the DNR issued a new policy to direct its investments in and management of land, resources, and assets so as to better understand, mitigate and adapt to climate change. The policy establishes practices and procedures related to new land investments, facility siting and design, habitat restoration, government operations, research and monitoring, and resource planning. The goal of the policy is to lead by example; and along the way, encourage and educate others in the methods for managing natural resources and designing facilities with an understanding of the effects of climate change.

Sea Level Rise and Coastal Storms

Background

The Chesapeake Bay region's geography and geology make the state one of the three most vulnerable areas of the country to changes resulting from sea level rise – only Louisiana and Southern Florida are more susceptible. Historic tide records show sea level has increased approximately one foot in the Chesapeake Bay over the last 100

years. Estimates provided by the Scientific and Technical Workgroup of the Maryland Commission on Climate Change indicate that Maryland is projected to experience between 2.7 to 3.4 feet of sea level rise over the next century.

The Phase I Strategy, produced by the Maryland Commission on Climate Change's Adaptation and Response Working Group, detailed the actions necessary to protect Maryland's future economic well-being, environmental heritage, and public safety in the face of climate change and sea level rise.

Implementation Status

In 2008, Maryland passed two pieces of key legislation called for in the Strategy: The Living Shoreline Protection Act and amendments to the Chesapeake and Coastal Bays Critical Area Act. Both will reduce Maryland's vulnerability over time and protect natural resources from the impacts of sea level rise by restoring natural shoreline buffers, such as grasses and wetlands, helping to limit new growth in vulnerable areas. In addition to these two pieces of legislation, a variety of other projects designed to implement the Strategy have been completed or are currently underway.

State of Maryland

Initiative/Action: Climate Change and Coast Smart Construction Executive Order
Description: On December 27, 2012, Governor O'Malley signed the Climate Change and Coast Smart Construction Executive Order, enacting a number of policy directives, including directing all State agencies to consider the risk of coastal flooding and sea level rise when they design capital budget projects and charging the Department of General Services with updating its architecture and engineering guidelines to require new and rebuilt State structures be elevated two or more feet above the 100-year base flood level.

The EO also charges the Maryland Department of Natural Resources to work with the Maryland Commission on Climate Change, local governments and other parties as appropriate, to develop additional Coast Smart guidelines within nine months, for the siting and construction of new and rebuilt State structures, as well as other infrastructure improvements such as roads, bridges, sewer and water systems, and other essential public utilities. Recommendations for applying the new construction guidelines to non-state infrastructure projects that are partially or fully funded in the State's capital budget were also developed.

Additionally, the EO requested that the Critical Area Commission for the Chesapeake and Atlantic Coastal Bays evaluate existing regulations and policies for State Agency Actions Resulting in Development on State-Owned Lands and consider the adoption of new or revised provisions that address climate change and the risk of sea level rise and other extreme weather-related impacts.

Lastly, the EO tasks the Scientific and Technical Working Group of the Maryland Commission on Climate Change with providing updated sea level rise projections for Maryland. In 2008, the Scientific and Technical Working Group published sea level rise projections for Maryland, with a high end range of 3.4 feet by the year 2100. However, considerable new research on sea level rise has since been published requiring the updating of these projections. New sea level rise projections were issued in June, 2013.

Department of Natural Resources (DNR)

Initiative/Action: Local Government Technical and Financial Assistance: *Coast Smart Communities*

Description: DNR's Coast-Smart Communities Program supports local level implementation of the adaptation strategy. Under CoastSmart, the DNR administers a competitive grant program to provide financial and technical assistance to local governments looking to reduce their vulnerability to the effects of coastal hazards and sea level rise through planning and permitting activities. Grants of up to $75,000, drawn from the state's federal Coastal Zone Management Act funds, are awarded on an annual basis and may be renewed for up to three additional years. In coordination with the Coastal Training Program, a training curriculum for local planners and official is available to complement and inform available technical assistance. Further, CoastSmart developed a self-assessment tool to guide local communities in their understanding of current and future risk and opportunities for increasing resiliency. Attendance of trainings and completion of a Scorecard Self-Assessment exercise will allow for improved targeting of grants. All activities within the CoastSmart Program aim to foster knowledge exchange on coastal hazards among local communities to help integrate hazards planning into a wide range of existing planning processes.

Initiative/Action: Adaptation Toolbox: The Coastal Atlas

Description: Maryland is using the latest technology, and detailed information to undertake state-of-the-art sea level rise mapping and research. Results acquired by both the DNR and individual Maryland counties is housed on the *Coastal Atlas* (http://dnr2.maryland.gov/ccs/Pages/coastalatlas.aspx#), an online toolbox of resources available to assist local governments with becoming ready, adaptive, and resilient to the impacts of sea level rise and coastal storms. Data products and technical tools currently available on the *Coastal Atlas* include: statewide sea level rise vulnerability mapping, historic shoreline position and erosion rate calculations, and the Erosion Vulnerability Assessment Tool. The Coastal Atlas mapping application will be continuously updated as new data becomes available or as updates to existing data are made.

Initiative/Action: Sustainable Shoreline and Buffer Area Management

Description: Through the Shoreline Conservation Services and its Natural Filters Program, DNR is working to implement buffer reforestation, wetland restoration, and shoreline practices to enhance ecosystem resilience to the impacts of climate change. Practices include on-the-ground habitat restoration projects such as stream and shoreline buffer plantings, stream-floodplain reconnection, marsh hydrology restoration, and living shorelines. DNR Staff provide various technical assistances (site visits and evaluations, problem assessments and recommended solutions) for different stakeholders (private citizens, local government, non-profit organizations, state and federal agencies). All of these practices increase ecosystem resiliency by improving water quality, reducing erosion, and enhancing habitat condition and connectivity. Due to the fact that most living shoreline projects involve a channelward encroachment with sand fill, these shoreline restoration techniques provide space for potential marsh migration.

Initiative/Action: Maryland Coastal Resiliency Assessment
Description: The DNR partnered with The Nature Conservancy in 2015 to conduct a "Statewide Coastal Resiliency Assessment." The Assessment will evaluate the risk reduction value of natural infrastructure, assess coastal community vulnerability to coastal hazards, and identify priority conservation areas that currently provide risk-reduction benefits to vulnerable human communities. The Assessment will also identify priority restoration areas or opportunities where natural features could provide future risk reduction benefits. The Assessment considers a wide range of natural features such as tidal wetlands and marshes, vegetated buffers, oyster reefs, submerged aquatic vegetation, Bay islands, beaches, and dunes. These features buffer coastal communities from the impacts of coastal hazards through wave attenuation, infiltration, sediment stabilization, and other risk-reduction benefits. The purpose of this project is to establish state priorities for natural infrastructure solutions within tidal regions of the coastal zone. The priorities established through this project will be integrated into Maryland's "Blue Infrastructure" framework and a parcel-level scorecard used to review land acquisition projects. Following completion in 2016, trainings will be held with state land managers, conservation planners, restoration specialists, and local partners to share the Assessment datasets and integrate results into current land conservation and restoration targeting efforts.

Maryland Department of Transportation (MDOT)

The MDOT is working to assess Maryland's critical transportation facilities and systems' vulnerability to projected sea level rise and extreme weather damage. This assessment provides the information necessary to evaluate options for dealing with potential impacts to infrastructure and connectivity, as well as aid in the development of adaptation policies for existing and planned transportation facilities. The assessment will ultimately influence long-term strategic planning for system adaptation that can account for the uncertainty of future climactic conditions.

Initiative/Action: Maryland State Highway Administration (SHA) Transportation Vulnerability Assessment
Description: Among Maryland agencies, SHA has the largest and most geographically dispersed network of facilities requiring the most complex long-term action plan. SHA is studying the effects of severe weather and climate change to the infrastructure on the highway system. SHA with Maryland Transportation Administration (MDTA) developed a climate change adaptation strategy and implementation plan to address severe weather and climate change impacts to the state maintained highway network. This plan provides a foundation for strategies and priorities actions by near-, mid-, and long-term actions. In order to implement the strategies, SHA needs more specific information on vulnerable assets. SHA completed the FHWA funded 18-month pilot project for the Climate Adaptation and Vulnerability Framework. The study was completed in October 2014 and includes a detailed Vulnerability Assessment for two pilot counties (Anne Arundel & Somerset). SHA continues to develop vulnerability assessments which utilize tools from the pilot study to further analyze additional counties vulnerable to intense storms or sea-level rise. The vulnerability assessments are very detailed and require time to develop. Completion of a vulnerability assessment for all tidal counties is anticipated in 2017.

Initiative/Action: Maryland Port Administration (MPA) Climate Change Vulnerability Assessment and Recommendations
Description:. As a component of the overall Maryland Transportation Initiative described above, the Maryland Port Administration prepared the report, "Climate Change Vulnerability Assessment and Recommendations" in 2010. The report provides recommendations for future capital investments based on the findings of the vulnerability assessment, and identifies the need for the MPA to make infrastructure and facility improvement decisions that consider climate change and sea level rise. In response, the MPA implemented a policy of migrating facilities out of the flood plain if possible, or elevating in place if relocation is not possible, or mitigating for saltwater inundation if the facility cannot be relocated or elevated for operational reasons (i.e. build stronger to withstand wave action, and with corrosion resistant material, etc.). As the MPA reviews its Dredged Material Management Plan and Marine Terminal Development Plans, it plans to factor sea level rise and potential storm surge inundation into its evaluation of proposed projects. Additionally, the MPA works with its partners in the Maryland and Federal Dredge Material Management Programs to incorporate climate change vulnerability analysis into decision-making processes.

Initiative/Action: Maryland Transit Administration (MTA) Climate Change Vulnerability Assessment
Description: The MTA Climate Change Vulnerability Assessment is being developed in response to Maryland's Climate Action Plan, produced by the Maryland Climate Change Commission, and to the Climate Change and Coast Smart Construction Executive Order (2012) as well as MTA's climate change policy. The purpose of the study is to identify MTA assets that are vulnerable to three expected results of global climate change: sea level rise; storm surge; and flooding due to major rain events.

MTA has completed the vulnerability mapping and are currently underway with the risk assessment. The risk assessment, scheduled to be completed in December 2015, will evaluate the likelihood and consequences of climate-related impacts on MTA assets and identify adaptation strategies for priority assets. A stakeholder meeting is scheduled for July 2015 with a follow-up workshop in Fall 2015.

Initiative/Action: Maryland Aviation Administration (MAA) Airport Layout Plan Vulnerability Assessments
Description: The MAA conducted a review of the Airport Layout Plans (ALPs) for five airports that were identified to be potentially affected by projected sea level rise/inundation. The ALP is a Plan that shows all existing and planned airport improvements, including runways, taxiways, terminals, and other structures. The airports in the State of Maryland that are potentially affected by projected sea level rise/inundation are Martin State Airport, Bay Bridge Airport, Essex Skypark, Ocean City Municipal Airport, and Crisfield Airport. The projected 2-foot, 5-foot, and 10-foot sea level rise contours, as developed by Maryland Department of Natural Resources (DNR) were overlaid onto the ALPs of each of the five airports. At Martin State Airport (MTN), planned future improvements were eliminated from the projected sea level rise contour areas, resulting in a reduction in potential adverse effects of inundation, and a lessening of potential conflicts with emerging Maryland "Coast Smart" construction policies. The MAA Office of Regional Aviation Assistance is working with the other four airports in an advisory role to support continued airport layout planning to reduce or eliminate potential conflicts to aviation facilities from projected sea level rise/inundation effects.

Maryland Department of Planning, Maryland Historical Trust (MHT)

Initiative/Action: Historical, Archaeological, and Cultural Resources Vulnerability Study
Description: Rising sea levels, erosion, and major storms all pose a significant threat to historic and archeological sites, districts, and landscapes. In 2010, the MHT completed a preliminary vulnerability assessment of historical and cultural resources in Maryland. The study was completed using inundation level data from the DNR. Sea-level rise was raised by local governments and advocates through the *PreserveMaryland* planning process and included as a regional issue of concern in the statewide preservation plan for 2014-2018. As a first step, MDP produced an interactive online map, based on data used in the preliminary vulnerability assessment, to help local preservation planners and raise public awareness.

In 2011-2012, MHT was awarded a Coastal Zone Management Grant, through DNR, to complete a pilot project focusing on the Choptank River watershed in Dorchester County to develop a methodology for an in-depth analysis of vulnerable sites that

provides details for management prioritization. In the first phase, sea level rise layers and additional shoreline data from DNR and their partners were incorporated, including erosion rates and other shoreline risk data. These layers were used to construct a general model of areas within the pilot project zone which are subject to various levels of impact from coastal hazards and sea level rise. MHT then analyzed the recorded historic buildings and districts located in the pilot area impact zone. A methodology was developed to characterize each resource according to its level of recordation, extent of survey, extent and nature of potential impact, and the property's significance. This analysis allowed MHT to identify and prioritize high-value historic resources that are most threatened in the pilot area for documentation and/or mitigation. During the second phase of the project, MHT undertook documentation of 35 endangered sites within the watershed, including fieldwork, documentary research and Maryland Inventory of Historic Properties forms.

Initiative/Action: Cultural Resources Hazard Mitigation Planning Program
Description: With funding from the National Park Service, MHT has launched a two-year Cultural Resources Hazard Mitigation Planning Program aimed at protecting historic places, archeological sites, and cultural landscapes from the effects of natural hazards, such as flooding, wind and coastal erosion. Partnering with MEMA, DNR, MDE and others, MHT is currently developing trainings, model guidance and educational materials to help local governments create hazard mitigation plans for their cultural resources. MHT promotes a planning framework based on *FEMA's Integrating Historic Property and Cultural Resources Considerations into Hazard Mitigation Planning*, which is currently being tested in Annapolis. MHT also offers one-on-one technical assistance to aid local governments in plan development and mitigation projects involving cultural resources.

Initiative/Action: Local Government Technical and Financial Assistance: *Greater Crisfield Long-Term Recovery Project*
Description: The Greater Crisfield Long-Term Recovery Project primarily focuses on rehabilitation of homes and infrastructure damaged by Hurricane Sandy, along with economic development and some limited new home construction. In addition to serving as a State climate change and technical/financial assistance liaison to the local Somerset County Long Term Recovery Committee (LTRC), which provides new housing and housing rehabilitation services, MDP leads the interagency State Recovery Committee, which has worked to determine how best to assist the Greater Crisfield area while also implementing State climate change adaptation strategies. This has included the use of federal community development block grant (CDBG) disaster recovery funds available for Sandy recovery, as well as planning and community visioning assistance. One such visioning project, The Smith Island Vision Plan, jointly funded by DHCD and DNR, committed grant funds to Somerset County to work with a local citizens group, Smith Island United, to develop a Vision Plan for Smith Island. Members of the State Recovery Committee have served on the Steering Committee for this year-long process, which was just recently endorsed by Smith

Island in the summer of 2015. The Smith Island Vision Plan will be adopted as an addendum to the Somerset County Comprehensive Plan and will serve as a key document for future infrastructure projects, as well as climate change adaptation strategies. The Greater Crisfield Project can serve as a model to improve Maryland's short-term and long-term hazard response approach.

Initiative/Action: Pre-Planning Assistance to Local Governments
Description: MDP offers assistance to local governments prior to the beginning of the local comprehensive planning process. This includes facilitating access to DNR maps of areas vulnerable to coastal hazards to inform local government decision-making related to land use and infrastructure.

Maryland Insurance Administration (MIA)

Initiative/Action: Climate Change Insurance Advisory Committee
Description: In the fall of 2008, the Maryland Insurance Commissioner convened a Climate Change Insurance Advisory Committee. The committee was charged with:

- Reviewing the adequacy of the data available to insurers to assess the risk imposed by climate change;
- Examining whether adaptive options are available to help mitigate losses and whether rating can be structured to provide an incentive for these options; and
- Reviewing ways to promote partnerships with policyholders for loss mitigation.

The committee released its final report in December 2010.

Maryland Department of the Environment (MDE)

Initiative/Action: Living Shoreline Regulation Development
Description: In 2008, the Maryland legislature enacted the Living Shoreline Protection Act. The Act requires riparian property owners to rely upon "living shorelines" defined as nonstructural shoreline stabilization measures such as marsh creation, whenever feasible, to protect shorelines from erosion while also providing critical wildlife habitat. A variety of state agencies are involved in implementing the program and related efforts. MDE issued draft implementing regulations on November 7, 2012. Final regulations went into effect in February, 2013.

Initiative/Action: Higher Regulatory Standards for Floodplain Management
Description: Flood Insurance Rate Maps (FIRMs) are being updated throughout Maryland by the Federal Emergency Management Agency (FEMA). Part of this process requires communities that currently participate in the National Flood Insurance Program (NFIP) to update their local floodplain management regulations by the map effective date. At a minimum, these regulations must be consistent with federal regulatory requirements, but communities can choose to adopt higher regulatory standards. As the State Coordinating Office for the NFIP, MDE is

assisting communities with this by providing a Maryland Model Floodplain Management Ordinance as a template containing higher regulatory standards such as a 2' freeboard requirement. Freeboard can be a community tool to respond to sea level rise, and to achieve lower flood insurance premiums for property owners. Many communities are implementing these higher regulatory standards in order to gain additional points for the Community Rating System (CRS), a flood insurance discount program for communities that go beyond the minimum NFIP requirements.

Department of Housing and Community Development (DHCD)

Initiative/Action: Review of Current Statewide Building Codes and Recommendations for Enhancement in Coastal Regions of Maryland
Description: As required under Section 2 of the Omnibus Coastal Property Insurance Reform Act of 2009 (Act), Chapter 540 (House Bill 1353), DHCD conducted reviews and prepared a report to members of the Senate Finance Committee and House Economic Matters Committee (Members) on "…enhanced building codes for coastal regions of the State that promote disaster-resistant construction in the coastal regions of the State...". The report was delivered to Members in October, 2010. The report was also provided to planning boards of the counties in the coastal areas of the State.

Maryland Emergency Management Agency (MEMA)

Initiative/Action: State Hazard Mitigation Plan
Description: Maryland's 2011 State Hazard Mitigation Plan was approved by Governor Martin O'Malley in September 2011. Vulnerability to climate change, coastal hazards and sea level rise issues was evaluated as part of the State risk assessment and specific adaptation strategies were included in the overall mitigation plan. The 2016 update of the State Hazard Mitigation Plan are expected to include risks associated with non-coastal impacts of climate change as prioritized in the mitigation plan, the 2015 DNR Coast Smart Construction guidelines and the results Maryland Coastal Resilience Assessment.

Initiative/Action: State Disaster Recovery Operations Plan (SDROP)
Description: The Maryland SDROP has been developed by the Recovery Support Function Leadership Group in order to ensure the ability of the State of Maryland to recover from a catastrophic incident that overwhelms the State or any local jurisdictions by coordinating support and engaging all necessary State, local, federal, private sector, voluntary, faith-based, and nongovernmental agencies to address the needs of Maryland residents, visitors, and communities following a disaster. The SDROP is an all-hazards, capabilities based, state-level plan that outlines how agencies will coordinate support to and interact with local and community constructs during the recovery process. The first final draft was completed in June 2015. A statewide tabletop exercise to test the plan was held in July 2014. (updated by Chas)

Human Health

Background

Climate change poses serious health risks to people in Maryland, including increases in heat-related injuries, cardiovascular mortality and morbidity, respiratory illness, changes in infectious disease patterns (vector-borne, food-borne, and water-borne diseases), impacts to water supply and quality, and both direct and stress-related injuries from extreme storm events and flooding. The role of the public health system is to anticipate and manage these risks, in partnership with other agencies and institutions.

The health impacts of climate change will be influenced by other societal changes, including changes in health care and health care delivery, public health capacity, and many other factors. One challenge will be to focus the attention of institutions and agencies used to planning cycles of months to a year, on climate forecasts of fifteen to thirty years. However, the public health strategy for climate change in Maryland has been developing tools and case studies to assist local health departments and other agencies in considering health impacts in their planning processes.

Implementation Status

Maryland Department of Health and Mental Hygiene (DHMH)

Initiative/Action: State Climate Change Environmental Health Capacity Building
Description: To ensure that risks, costs, and benefits are evaluated in a systematic manner, Maryland successfully competed for and was awarded a 2012 capacity building cooperative agreement from the U.S. Centers for Disease Control and Prevention (CDC) Climate Ready Cities and States Initiative. The cooperative agreement, "Building Resilience Against Climate Effects (BRACE)," was implemented in Maryland as the Maryland Public Health Strategy for Climate Change. The four-year award is enabling DHMH to identify and address needs in the areas of: (1) epidemiologic capacity in injuries/disasters and vector-borne disease; (2) short, intermediate, and long-term climate change modeling and integration capacity; (3) training in health impact assessment (HIA); and (4) integration of information management tools related to disasters with routine DHMH functions. The strategy is outlined in Figure 1, below.

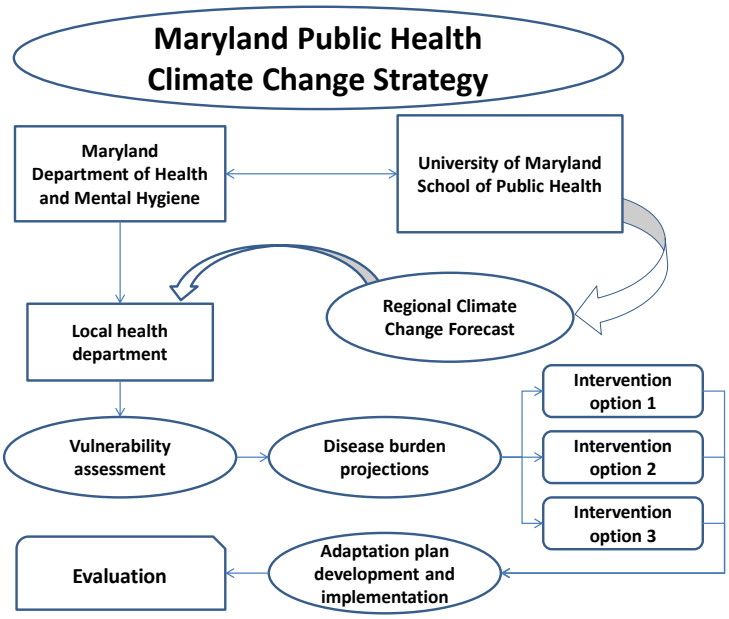

Figure 1. Overall framework of proposed Maryland project on public health and climate change.

Initiative/Action: Enhanced Environmental Public Health Tracking infrastructure
Description: A combined effort is needed in order to minimize the public health risks of climate change. Through continued coordination between the DHMH and other state agencies, preemptive measures can be taken to both prevent and minimize the impact of climate change on public health. In 2002, the DHMH received Center for Disease Control funding to plan for a statewide Environmental Public Health Tracking Network that will be part of the national tracking network. Maryland used the funding to build capacity and enhance infrastructure. The results range from starting or improving surveillance to enabling faster responses to environmental public health questions and faster action to prevent disease. These enhancements will be achieved through the CDC project on capacity building, integrating them with the environmental public health tracking project.

Initiative/Action: Development of Climate Health Indicators
Description: The DHMH is working with the Commission on Environmental Justice and Sustainable Communities, the MDE, and the MDP on the selection of health indicators that could be used by the MDP and other agencies to evaluate the potential impacts of climate change adaptation or mitigation strategies, as well as the potential health consequences of projects related to adaptation to sea level rise. The DHMH has strengthened its coordination with the DNR and the MDE related to monitoring and reporting of Chesapeake Bay-related health concerns, specifically with respect to harmful algal blooms.

Initiative/Action: State Heat Plan

Description: In May, 2012, DHMH released the Maryland State Heat Emergency Plan which guides state actions during an Extreme Heat Event: a weather condition with excessive heat and/or humidity that has the potential to cause heat-related illnesses. An Extreme Heat Event is defined as a day or series of days when:

- The heat index is forecasted to be approximately 105 degrees or higher, or;
- The National Weather Service has issued a Heat Advisory, or;
- Weather or environmental conditions are such that a high incidence of heat-related illnesses can reasonably be expected.

DHMH has also activated the State Heat Emergency web site (http://dhmh.maryland.gov/extremeheat) which includes links to the State Heat Plan, Facts about Heat Related Illness, and weekly Heat Reports that provide guidance and information about deaths and illness caused by extreme heat in the region.

Agriculture

Background

Agriculture is the largest commercial industry in Maryland, employing about 350,000 people, primarily in the north-central and Eastern Shore regions. Farms occupy about two million acres, or about one-third of the State's land, though individually the farms are, on average, much smaller than those in other states. Maryland's agriculture is diverse, including nursery plants, dairy products, beef cattle, vegetables, wheat, horses, and fruit. Poultry, fed by largely locally produced corn and soybeans, maintains the largest market value. Projected increases in temperature, precipitation variability, and frequency of extreme events associated with climate change are likely to affect the conditions upon which farming has been established. Many of the stressors farms already face are likely to intensify or become less predictable: drought frequency, winter flooding, pests and disease, and ozone levels. These changes occur in the current context of the high economic uncertainty and small profit margins, and are likely to result in increased costs to both farmers and consumers.

To adapt to a changing climate, farmers will require guidance on climate smart crop species and strategies to reduce poultry and livestock loss and stress associated with heat. More intense water management will be needed to offset the impacts of growth and uncertainty in water supplies on agricultural production and water resources.

It is the broad goal of these strategies to help reduce stress on agricultural operations and to build the resilience of Maryland farms, despite changes they may face in the future, and to improve the quality of the Chesapeake Bay and its watershed. As climate change may affect the intensity of how farmers manage, alter effectiveness of agricultural BMPs, and affect the implementation of relevant regulations, farmers need to be prepared and supported for adjustments that may be required.

Implementation Status

Maryland Department of Agriculture

Initiative/Action: Invasive Plants Advisory Committee
Description: Maryland's Invasive Plant Advisory Committee (IPAC) was established by legislative mandate in October 2011. The IPAC's primary responsibility is to advise the Secretary of Agriculture on regulating the sale of invasive plants, and preventing them from entering Maryland or from spreading further in the state. Using a scientific weed risk assessment protocol, IPAC will classify invasive plants as Tier 1 or Tier 2 and recommend regulations to reduce the risk of invasive plants in Maryland. Initial regulations were promulgated in January of 2013. The remaining regulations, including proposed Tier 1 and Tier 2 plant lists were written in May of 2015 and are in the process of being finalized. There are currently six weed assessments available online.

Maryland Department of Health and Mental Hygiene/DNR/MDA

Initiative/Action: Vector-borne disease surveillance and control
Description: Maryland State officials continue to track the spread of WNV and other arboviral activity in the State in vector species, host animals, and humans. This allows for ongoing enhancement and deployment of effective tools to support surveillance, prevention, and control of West Nile virus and other arthropodborne viruses, including novel or emerging pathogens that threaten the health of Maryland residents. In addition, the Mid-Atlantic Zoonotic and Vector Borne Disease Inter-Agency Workgroup (MAZV), a collaboration between DHMH, DNR, MDA, and researchers, practitioners, and federal agency partners meets regularly to monitor and discuss vector borne disease activities in Maryland and the surrounding regions.

Forests and Terrestrial Ecosystems

Background

The diversity of Maryland's forests and terrestrial ecosystems reflects the wide variety of environmental conditions found across the State's five major physiographic provinces. Not only do forested systems regulate climate and sequester carbon, but they play a major role in any adaptation plan to reduce the impacts of urban heat, enhance migration corridors, mitigate flooding, protect drinking water supplies, and reduce nutrient and sediment runoff. From the mountains to the sea, one can hike through western Maryland's thick groves of hemlock lining deep gorges, across grassy serpentine barrens supporting the unique purple-flowered fringed gentian, by vernal pools inhabited by salamanders, and through the pine forests and hardwood swamps of the Eastern Shore. The State's forests are mostly privately owned and only 27% are permanently protected from development. These habitats and their plant and animal communities are shaped

mainly by geology, climate, and interactions with other species. They also are subject to many existing stressors such as development, pests, and pollution, limiting their capacity to adapt.

Forests and terrestrial ecosystems contribute an estimated $2.2 billion to Maryland's economy and $24 billion in ecological services. The condition of these ecosystems and the services they provide is likely to be altered by climate change. Climate change will alter distributions of species and habitats and exacerbate existing stressors at an uncertain rate and degree. Native species populations may decline, increase, or migrate from the State while new species may migrate in due to habitat shifts. Services provided by forests such as temperature regulation, water filtration, aesthetic value, and habitat may be altered. Existing stressors on species and habitats may be exacerbated by climate change.

Implementation Status

Maryland Department of Natural Resources

Initiative/Action: GreenPrint Update
Description: Maryland's GreenPrint initiative identifies the most ecologically valuable areas in the State and designates these lands and waters as "Targeted Ecological Areas (TEAs)". TEAs are the "best of the best" natural resources across the State. TEAs were first defined in 2008 and included the most ecologically important large blocks of forests and wetlands; wildlife and rare species habitats; aquatic biodiversity areas; and forests for protecting water quality. In 2011, DNR updated the TEA designations to include coastal ecosystems; habitats for climate change adaptation and marsh migration, and areas for supporting commercial and recreational fisheries. Together, these areas are identified as conservation priorities for natural resources protection. DNR is now using these updated conservation priorities to target Stateside Program Open Space land conservation projects.

Initiative/Action: Wildlife Vulnerability Assessment
Description: The DNR has conducted a vulnerability assessment of GCN species using Nature Serve's Climate Change Vulnerability Index. The DNR is also participating in an expert panel effort in the northeast headed by the Manomet Center for Conservation Science to assess the likely impacts of climate change on northeastern fish and wildlife habitats and species of greatest conservation need. All of this information is planned for incorporation into the next version of the Maryland's State Wildlife Action Plan. The DNR's Natural Heritage Program is currently updating the State Wildlife Action Plan, which includes Maryland's analysis of selected Species of Greatest Conservation Need and their vulnerability to climate change. This report will be published in October 2015.

Initiative/Action: Forest Management Plans

Description: In 2011 DNR's Forest Service included climate change and adaptation information as a required element in forest management plans. These plans are required by any forest landowner who participates in State property tax abatement programs or USDA forestry programs and thus will reach a wide audience.

Initiative/Action: Maryland Forest Resource Assessment and Strategy
Description: The DNR Forest Service has incorporated climate change into their 2010 Forest Resource Assessments as an additional stressor. Climate change was also identified as one of the top five areas for action in their five year strategy. As part of this, the Forest Service is working with other local, state, and federal agencies to incorporate adaptation into existing forestry programs.

Initiative/Action: Urban Tree Canopy Assessment
Description: DNR is currently working to maintain and improve the health and longevity of trees in urban areas and increase the urban tree canopy cover throughout Maryland. Urban trees shield buildings from cold winds, lower ambient summertime temperatures, reduce heating and cooling costs, decrease the demand for energy production and reduce vulnerability to the effects of heat waves on at risk populations. Reduced heat slows the formation of ground level ozone as well as the evaporation of fuel from motor vehicles. Thirty-seven communities in Maryland have committed to participation in the UTC Goal effort to date. Baltimore City, Annapolis, and the Frederick County Board of Education have already adopted goals; the other communities are in the process of assessing their existing and potential UTC. Communities like Baltimore City have also begun to prioritize plantings for urban heat reduction and water quality improvement.

Bay and Aquatic Ecosystems

Background

The Chesapeake Bay is the largest estuary in the United States, fed by a watershed that stretches from mountains to sea, across 64,000 square miles (166,000 square kilometers), spanning six states - Maryland, Delaware, Virginia, West Virginia, Pennsylvania, New York, and the District of Columbia. Within its watersheds and oceanfront, Maryland's extensive aquatic ecosystems range from freshwater swamps and bogs, tidal and non-tidal freshwater rivers and marshes, tidal brackish and saline rivers and marshes, and coastal bays. These ecosystems are influenced by precipitation, temperature, tropical storms, and human activity. Currently, the services provided by the Bay are estimated to be approximately $1 trillion, annually. However, human development and pollution have degraded their natural resilience, leaving them more vulnerable to extreme events. Climate change will likely exacerbate this problem, creating a greater threat to these ecosystems. The Bay has already warmed by 3 degrees Fahrenheit and additional temperature increases could change the composition of commercial fisheries and increase anoxia in the Bay (Prasad et al 2011). To

protect its marine, estuarine and aquatic ecosystems against future damage, the action is needed to alleviate existing stressors and to strategically conserve and restore critical bay and aquatic habitats.

Implementation Status

Maryland Department of Natural Resources

Initiative/Action: Climate Change Criteria for Conservation
Description: The DNR completed a project, "Coastal Land Conservation in Maryland: Targeting Tools and Techniques for Sea Level Rise Adaptation and Response." The purpose of the project was to develop new conservation criteria to identify coastal habitats that may help Maryland proactively adapt to sea level rise and increased storm events associated with climate change. Climate change targeting criteria resulting from this project was used to develop new conservation areas for "GreenPrint" and a parcel-level scorecard used to review land acquisition projects. Trainings have been held with state land managers and conservation planners to share the new tools and datasets, and to implement them into current land conservation targeting and review processes.

Initiative/Action: Coastal Resilience Conservation Easements

Description: The DNR has developed a new conservation easement focused on increasing the resilience of coastal ecosystems and reducing the vulnerability of landowners to climate change. This tool has been shared with county conservation planners, local land trusts, the Maryland Department of Agriculture, and other conservation partners.

Initiative/Action: Temperature Sensitive Stream Regulations
Description: In 2011, the DNR and the MDE collaborated to create an update to Use Class III (naturally-reproducing trout) streams. Future coldwater protections are being assessed for contributing watersheds to these streams and for the protection of streams that harbor coldwater dependent invertebrate species. Future models may address those streams that will be most sensitive to climate change and those that will remain coldwater systems.

Initiative/Action: Guidelines and mapping for vulnerable ephemeral and headwater systems
Description: The DNR has identified ephemeral and intermittent freshwater habitats that are highly sensitive to changes in precipitation regimes and ultimately climate change. These habitats include ephemeral, intermittent, and headwater stream systems and vernal pools. Headwater streams support rare and endangered species, serve as migratory corridors, and process and store proportionally larger amounts of nutrients and sediment than larger streams. Mechanisms are now being explored to increase mapping of these systems, to develop model ordinances, and develop model field protocol for their identification and protection by local governments and organizations.

Initiative/Action: Bay Acidification Task Force
Description: Maryland General Assembly passed House Bill 118 creating a Task Force to Study the Impact of Ocean Acidification on State Waters during the 2014 legislative session.

The Task Force issued a report in January 2015 calling for monitoring, industry partnerships and collaboration with federal agencies. Maryland is one of the first East Coast states to take action on ocean acidification, and these proactive efforts will help the state reduce potential impacts and its coastal businesses prepare for a changing ocean. The report is a much-needed first step to protect Maryland's $1.65 billion blue crab, oyster and striped bass seafood industry.

Key findings from Maryland's Task Force focus on seven areas that should be addressed in order to enhance acidification understanding, recognize its impacts on Maryland aquatic industries and leverage resources to capitalize on federal and other state acidification research and monitoring programs. Key areas include:

- Enhancing monitoring of State waters to quantify scale
- Patterns and trends of ocean acidification
- Establishing additional research priorities in estuarine and coastal waters
- Improving coordination with other state and federal resource managers
- Focusing on impacts to key species and associated activities
- Providing direct support to affected industries
- Pursuing legislative action
- Improving communications and outreach

Addressing the above seven issue areas identified by the Task Force will position Maryland in both the short- and long-term to leverage existing monitoring, research and programmatic assets; collect the information necessary to assess the impacts of acidification on our aquatic resources; communicate the results to various stakeholders to meet the demands of our expanding aquatic industries; and mitigate the impacts of rising CO2 emissions.

Initiative/Action: DNR Stream Restoration Policy

Initiative/Action: Chesapeake Bay Agreement – Climate Resiliency Management Strategy
Description: In June 2014, representatives from across the region signed the *Chesapeake Bay Watershed Agreement*, with the vision of fostering an environmentally and economically sustainable watershed with clean water, abundant life, conserved lands and access to the water, a vibrant cultural heritage, and a diversity of engaged citizens and stakeholders. Signatories include the governors of Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia; the mayor of the District of Columbia; the chair of the Chesapeake Bay Commission; and the administrator of the U.S.

Environmental Protection Agency (EPA). This agreement marked the first time a "climate resiliency" goal and associated outcomes were included in the Partnership's guiding principles. To guide implementation of the Agreement, the Chesapeake Bay Program Partnership formally released a Climate Resiliency Management Strategy in July 2015. The Strategy lays out the management approach for assessing climate impacts and vulnerabilities, increasing the capacity of the Bay Program to prepare for and respond to climate change, implementing adaptation projects, and tracking the effectiveness of and ecological response to adaptation efforts. A biennial work pan for the Management Strategy will be developed by the Bay Program's Climate Resiliency Work Group on or before April 2016.

Water Resources

Background

Maryland is fortunate to have an abundance of water sources that have historically been adequate for meeting the drinking water needs, as well as the needs for commercial, industrial, and agricultural use. However, during recent droughts, many of the previously believed reliable sources have experienced difficulties impacting a number of users who are dependent on them. The vulnerability of our resources due to variability in weather patterns combined with population growth, development, and pollution from manmade contaminants, pose a risk to sustainability of our water resources as well as Maryland's future economy and public health.

In the past 30 years, Maryland's climate has become wetter and hotter, resulting in more runoff and longer heat waves. Variability in weather patterns can cause either drought or flooding, threatening the reliability of our State's water resources. As a continued consequence of climate change, every area of Maryland could be impacted by increased flooding, more frequent and longer droughts, more intense storms and greater water demand. The Chesapeake Bay region is ranked the third most vulnerable area to sea level rise in the nation behind Louisiana and southern Florida. Current projections indicate that flooding will increase: 100-year floods will increase by 10-20 % and 10-year storms will increase by 16-30%. There is a greater likelihood that more powerful rain and windstorms will strike Maryland as ocean waters warm, accompanied by higher storm surges and rainfall. These variations in weather patterns and sea level rise have the potential to cause water infrastructure damage, flooding of water supply wells and salt water intrusion, bacteriological and chemical contamination of water sources, algal blooms, increased demand for irrigation and ultimately decrease in availability of water for Marylanders. Our water resources are finite, and we should be aware of the fragility of our State's water resources, and challenges that threatens their sustainability. We must develop and implement plans to meet the upcoming challenges.

Implementation Status

Maryland Department of the Environment (MDE)

Initiative/Action: Coastal Plain and Fractured Rock Studies
Description: The MDE has two long-term water supply studies that have been initiated in partnership with the Maryland Geological Survey, the U.S. Geological Survey, and the Department of Natural Resources Monitoring and Non-Tidal Assessment Division. The Coastal Plain and Fractured Rock studies were initiated in 2006 and 2009, respectively. These studies will develop information and tools to help the MDE make sound science-based decisions about water allocations, ensure ongoing sustainability of the resource, and evaluate the potential impacts of withdrawals on aquatic habitat. In addition, the studies will provide valuable information to assist local governments as they plan for future growth and water use needs.

The Coastal Plain study involves a complex aquifer model, which will be capable of modeling various management scenarios as well as potential impacts of climate change. The MDE is already using two important tools developed as part of these studies known as the Coastal Plain and Fractured Rock Aquifer Information Systems. These geographically-referenced tools provide MDE's permit project managers with up-to-date and easily accessible data, including geophysical logs, aquifer test information, water levels, well locations, and selected water quality data. Funding to continue the studies beyond SFY 2012 has not been identified to date.

Initiative/Action: Developing source water protection implementation measures for vulnerable communities
Description: The MDE has delineated areas around each public water supply well or intake where measures should be taken to protect the water supplies from water quality impacts. More than three hundred communities around the State have adopted land use ordinances or other measures to protect their water sources. In 2011, MDE contracted with two private consultants to assist twenty vulnerable groundwater communities to assist them in developing and implementing protection measures. This project was completed in 2013.

Initiative/Action: Tools for water utilities
Description: The MDE has produced a publication for public drinking water systems that provides the systems with information about the possible impacts of climate change on utilities and recommends a variety of adaptation measures to help water systems prepare for and/or avoid these impacts. The publication has been distributed by mail to all community water systems in the State.

Initiative/Action: Environmental Site Design
Description: Current Maryland law and regulations require that Environmental Site Design (ESD) be used to the maximum extent practicable (MEP) to control

stormwater from new and redevelopment. The goal is that ESD planning techniques and practices are to be implemented to replicate runoff characteristics similar to "woods in good condition." These practices reduce runoff and improve water quality and ultimately help buffer communities from the impacts of rain events.

Population Growth and Infrastructure

Background

Maryland's growing population lives and works primarily in a built environment and is reliant on transportation, water, and communication and energy networks, spanning a wide range of landscapes, from cooler Appalachian Mountains in the west, to low-lying areas of the Eastern Shore. These systems, regulated in part at the state level, but more directly influenced by local decision-making – are subject to pressures of shifting population and often - unreliable sources of funding support to address needed maintenance, planning and upgrade. The projected effects of climate change, including increases in precipitation variability and extremes, winter precipitation and temperature, are likely to affect the frequency, severity and timing of many existing problems, such as stormwater, or buckling of roads and malfunctioning train systems due to heat waves. Historical and current climate conditions will no longer be adequate to guide planning, design, operation and maintenance decisions.

For sustainable development, planning efforts must reflect and address projections for both population growth and the effects of climate change. Many areas in Maryland are expected to experience increased growth and development. Decisions about growth need to factor in climate impact projections. Temperature and precipitation extremes will likely harm infrastructure and affect human health. Increases in precipitation and the intensity of storm events will likely exacerbate existing problems, particularly in urban areas. Problems associated with stormwater, flooding, heat stress and air quality will likely worsen. Building codes, infrastructure design, emergency management and planned development should be oriented to reduce impacts caused by increased climate variability and extremes. Maryland's built environment needs to be reinforced to prepare for new temperature and precipitation regimes. Over time, changes to the system including the operation, maintenance, design and management of much of the State's built infrastructure may become necessary.

Implementation Status

Maryland Department of Planning

Initiative/Action: Local & State Targeted Growth and Conservation Areas

Description: Climate Change Impact Areas were identified as one of the Local and State Targeted Growth and Conservation Areas that warrant special attention.. Climate Change Impact Areas include: projected 50 and 100-year Sea Level Rise Inundation Zones, 50-Year Erosion Vulnerable Zones, Category 2 Storm Surge Inundation Zones, Marsh Transition Zones, Temperature Sensitive Streams, Drought Hazard, and Wildfire Risk Areas. The intent of identifying these areas is to ensure that the State and local governments make wise decisions about how we protect our natural resources, and where and how we develop and redevelop in light of climate change induced hazards and risks. State capital investments consider Climate Impact Areas during the identification of potential sites and the scope of the work associated with the capital investment. Local governments also are educated on how to use the maps and encouraged to utilize them in capital improvement planning. Guidelines for reducing climate change impacts within these areas include:

- Promoting the safety and well-being of Maryland's citizens by avoiding infrastructure capacity improvements that increase human exposure to natural disasters; avoid assumption of the financial risk of development and redevelopment in vulnerable or hazardous coastal areas;
- Ensuring the wise and sound public investments in Maryland's sea level rise inundation zone. However, appropriate conservation efforts along Maryland's shorelines should not preclude important investment in the State's water-dependent infrastructure, such as our seaports;
- Analyzing climate change impacts on historical and cultural resources and prioritize necessary recovery, documentation, and protection efforts; and
- Protecting critical natural environments from impacts of climate change (i.e., sea level rise, temperature increase, precipitation change) and climate-induced natural hazards.

Department of Natural Resources

Initiative/Action: Community Connections Protocol Development
Description: DNR has developed an additional protocol for assessing land conservation projects based on their value and ability to connect people to the land. The assessment includes a Climate Change Resilience component, which considers on-site adaptation benefits including community storm surge protection, shoreline stabilization and restoration, urban tree canopy protection, and future planned abandonment and relocation facilitation. The community connections protocol and scorecard will be used for appropriate proposed projects to be funded by Program Open Space.

Initiative/Action: State-wide Land Preservation and Recreation Plan
Description: DNR developed the 2014 State-wide Land Preservation and Recreation Plan (LPRP) in coordination with the Maryland Department of Planning, local governments, a wide range of stakeholders, and public input. This was the first iteration of the LPRP to provide an analysis of how climate change may impact

Maryland's natural and cultural resources, open space, recreation and tourism, as well as provide strategies for ensuring sustainability and increasing resilience. The LPRP is a working resource and tool for state-wide outdoor recreation and open space planning.

Tools, Research and Education to Inform Sound Decisions

Background

Maryland managers and decision-makers need the right tools to anticipate and plan for climate change. Long-term monitoring and research efforts are critical. As Maryland experiences a new suite of hydrologic and temperature conditions, the State will need to gain a better understanding of these conditions. Financial, educational, scientific and political support will also be necessary in order to assess conditions and to research new ways to build up the resilience of natural and built infrastructure to the impending impacts of climate change.

Investment in education is also essential to teach public officials, planners, and other decision makers how to use the tools to formulate and implement specific actions. Coordination with the public is necessary, particularly those most vulnerable and without the necessary resources to respond. In the short-term, there is a critical need to establish and disseminate state-specific climate data and information in order to develop a common understanding of future planning needs at both state and local scales. This is an important first step to ensuring climate issues are during infrastructure planning, design, construction and budget processes.

Implementation Status

Maryland Department of Natural Resources/University of Maryland, Center for Environmental Science

Initiative/Action: Information Dissemination
Description: Information on both the Phase I and II adaptation strategies have been widely disseminated and presented at a variety of conferences, workshop and stakeholder events. Topic and sector-based fact sheets have been developed and are available online (http://www.dnr.maryland.gov/climatechange/). DNR and UMCES are both working to widely disseminate climate change-related data and information to agencies, stakeholders, and the public via existing networks and social media outlets.

University of Maryland, Maryland State Department of Education

Initiative/Action: MADE-CLEAR

Description: The recently funded Maryland and Delaware Climate Change Education, Assessment and Research (MADE CLEAR) program will bring together university faculty, middle school and high school teachers and informal educators to develop training opportunities in climate education across Maryland and Delaware. The goal will be to ensure that students graduating from Maryland schools understand the science behind climate change, the choices available to mitigate and adapt to a changing climate, and professional opportunities related to the green job market. For more information on MADE-CLEAR, visit: http://www.madeclear.org/

Department of Natural Resources

Initiative/Action: Incorporation of climate change into education initiatives
Description: In 2011, the DNR assembled a series of talking points on climate impacts in Maryland to be utilized by its education staff. As a next step, DNR is including K12 teacher and informal science educator professional development that incorporates climate change into existing education and outreach programs. DNR is also supporting climate change interpretation and communication at Maryland State Parks through park ranger and seasonal staff professional development in climate change communication techniques. Messages of most relevance to citizens will be used as appropriate in outreach programs aiming to encourage stewardship actions; while more direct coastal education programs and materials are being developed for use in classroom settings.

Initiative/Action: Climate Change Adaptation Needs Assessment, Training and Technical Assistance
Description: The Maryland Chesapeake and Coastal Service (CoastSmart Communities Program & the Coastal Training Program) and its Partners continue to use the outcomes of the formal needs assessment conducted in 2012 to guide programming and routinely conduct informal need assessments of local government staff to continue to understand the evolving needs. Since 2012 there has been a series of targeted trainings and courses offered through the Chesapeake and Coastal Service and Partners. An example of courses offered include: Introduction to the Community Rating System Part I & II; Climate Adaptation for Coastal Communities; CoastSmart Communities Scorecard Facilitation; Be Flood Ready; Conducting Local Governments to Share Ideas to Reduce Flooding; FEMA's Managing Floodplain Development through the National Flood Insurance Program in addition to others. An updated needs assessment is being considered in 2016 to further understand the information/technical assistance needs so that CCS and its partners can meet those in the most efficient way possible.

IV. Strengthening Climate Action in Maryland

On November 19, 2014, Governor Martin O'Malley issued Executive Order (01.01.2014.14), to expand the membership, mission and work of the Maryland Commission on Climate Change

(MCCC). As one of four working groups organized under the MCCC, the EO establishes the following charge for the Adaptation and Response Working Group (ARWG):

- Strengthen and maintain existing State action plans to further address, prepare for and adapt to the consequences of climate change;
- Reestablish the Adaptation and Response Working Group, as needed;
- Convene regular Working Group meetings to ensure that sufficient progress is being made across all sectors and communities in Maryland; and
- Establish a comprehensive and accountable annual work plan that set annual goals and performance benchmarks, and prioritizes new and existing climate change adaptation actions and initiatives.

Under the umbrella of the MCCC, the efforts of the ARWG will be undertaken in conjunction with the efforts of the MCCC's Mitigation (MWG), Scientific and Technical (STWG), and Education, Communication and Outreach (ECO) Working Groups.

A. **Prioritizing new and existing climate change adaptation actions and initiatives**

Sea Level Rise and Coastal Storms

Priority Recommendations	Action Strategies	Lead Agency	Key Partners	Implementation Priority (L, M, H, TBD)	Implementation Timeframe (C, O, S, M, L, TBD)	Status
Reduce Impact to Existing and Future Growth and Development						
Take action now to protect human habitat and infrastructure from future risks	Require the integration of coastal erosion, coastal storm, and sea level rise adaptation and response strategies into existing state and local policies and programs.	DNR/MDP	MDE, MDOT, DHCD, local governments	High	Ongoing	
	Develop and implement State and local adaptation policies (i.e., protect, retreat, abandon) for vulnerable public and private sector infrastructure.	DNR	MDP, MDE, MDOT, local governments	High	Ongoing	
	Strengthen building codes and construction techniques for new infrastructure and buildings in vulnerable coastal areas.	DHCD/DNR	MDP, MDOT, MDE, local governments	High	Ongoing	
Financial and Economic Well-Being						
Minimize risks and shift to sustainable	Develop and implement long-range plans to minimize	DBED				

economies and investments	the economic impacts of sea level rise to natural resource-based industries.		DNR	Medium	Long	
	Establish an independent Blue Ribbon Advisory Committee to advise the State of the risks that climate change poses to the availability and affordability of insurance.	MIA	DNR	High	Complete	
	Recruit, foster, and promote market opportunities related to climate change adaptation and response.	DBED	DNR	Low	Long	
Protection of Human Health, Safety and Welfare						
Guarantee the safety and well-being of Maryland's citizens in times of foreseen and unforeseen risk	Strengthen coordination and management across Agencies responsible for human health and safety.	DHMH	MDA/DNR	High	Ongoing	
	Conduct Health Impact Assessments to evaluate the public health consequences of climate change and sea level rise-related projects and/or policies.	DHMH	MDA/MDE / DNR/MDP	High	Medium	
	Develop a coordinated plan to assure adequacy of Vector-borne Surveillance and Control Programs.	DHMH/MDA	DNR/MDE	High	Medium	
Natural Resource Protection						
Retain and expand	Identify high priority	DNR	MDE	High	Ongoing	

forests, wetlands and beaches to protect us from coastal flooding	protection areas and strategically and cost-effectively direct protection and restoration actions.					
	Develop and implement a package of appropriate regulations, financial incentives, educational, outreach, and enforcement approaches to retain and expand forests and wetlands in areas suitable for long-term survival.	DNR	MDE	High	Ongoing	
	Promote and support sustainable shoreline and buffer area management practices.	DNR	MDE	High	Ongoing	
Adaptation and Response Toolbox						
Give State and local governments the right tools to anticipate and plan for sea level rise and climate change	Strengthen federal, state, local, and regional observation systems to improve the detection of biological, physical, and chemical responses to climate change and sea level rise.	DNR/UMD	NOAA/EPA	High	Ongoing	
	Update and maintain state-wide sea level rise mapping, modeling, and monitoring products.	DNR	NOAA	High	Ongoing	
	Utilize new and existing educational, outreach,	DNR/UMD	MDE/MDP		Ongoing	

	training and capacity building programs to disseminate information and resources related to climate change and sea level rise.			High		
Future Steps and Directions						
State and local governments must commit resources and time to assure progress	Develop state-wide sea level rise planning guidance to advise adaptation and response planning at the local level.	DNR	MDP, local governments	High	Ongoing	
	Develop and implement a system of performance measures to track Maryland's success at reducing its vulnerability to climate change and sea level rise.	DNR	Other State agencies	Medium	Ongoing	
	Pursue the development of adaptation strategies to reduce climate change vulnerability among affected sectors, including agriculture, forestry, water resources, aquatic and terrestrial ecosystems, and human health.	DNR/UMD	Other State agencies	High	Complete	

MARYLAND COMMISSION ON CLIMATE CHANGE
PHASE II: Building Societal, Economic and Ecological Resilience
Implementation Guidance Table

Table Key:

Implementation Priority: L (Low); M (Medium); H (High – Needs Immediate Action); TBD (To Be Determined)
Implementation Timeframe: Ongoing (a component of an existing program); Short (1 -3 years); Medium (3 – 5 years); Long-Term (5 + years); TBD (To Be Determined)
Implementation Cost: Low ($0 - $100,000); Medium ($100,000 - $200,000); High ($200,000 +); TBD (To Be Determined)

Priority Recommendations	Action Strategies	Lead Agency	Key Partners	Implementation Priority (L, M, H, TBD)	Implementation Timeframe (O, S, M, L, TBD)	Potential Implement -ation Cost (L, M, H, TBD)	Status
HUMAN HEALTH							
Conduct vulnerability assessments to gain a better understanding of risk and inform preventative measures.	Assess potential health threats and the sufficiency of Maryland's response capacity.	DHMH	MEMA	TBD	TBD	TBD	
	Evaluate impacts to food safety and availability.	DHMH	MDA	Medium	Medium-Term	TBD	
	Assess the vulnerability of Maryland's populations and communities to changing health threats.	DHMH	MDP, MDE	Medium	Long-Term	TBD	
	Identify potential barriers to effective emergency response.	DHMH	MEMA	High	Medium-Term	TBD	

Integrate impact reduction strategies into State and local planning practices.	Improve response capacity through the development of new or expanded programs.	DHMH	MEMA	Medium	Long-Term	High
	Address climate-related health risks in hazard mitigation and emergency response plans.	DHMH	MEMA	Medium	TBD	TBD
	Support community engagement in planning and emergency response decisions.	DHMH	MEMA	Medium	Long-Term	TBD
	Pursue opportunities to enhance protection of Maryland's "green infrastructure."	DNR	DHMH, MDP	TBD	TBD	TBD
Streamline and revise data collection and information dissemination channels.	Improve the resolution and availability of health and population data.	DHMH	UMD, MDP, CDC, EPA	High	Ongoing	High
	Analyze health and population data along with other spatially explicit information (e.g., land use, air quality, water quality).	DHMH	DNR, MDP, MDE, EPA, CDC	High	Ongoing	High
AGRICULTURE						
Increase crop diversity, protect against pests and disease, and intensify water management.	Promote diversification of crop species and varieties.	MDA	UMD-Extension (UME), Local Agricultural Producers	Low	Ongoing	TBD
	Intensify water management and conservation through research, funding and incentives.	MDA	UME, MDE, DNR, USDA, EPA, Bay Trust	High	Ongoing	High

	Protect against incoming pests, weeds and disease.	MDA	UME	Low	Ongoing	TBD
	Support innovative solutions that foster adaptation and also reduce energy costs and carbon footprints.	MDA	UME, MEA	Medium	Ongoing	TBD
	Enhance dissemination channels to improve the relay of climate information.	MDA	UME, SCDs, NRCS, NGOs, commodity orgs.	Low	Ongoing	TBD
Strengthen applied research, risk communication and technical support.	Identify opportunities to support the transition of farm and agricultural practices.	MDA	UME, NRCS, Farm Credit, Insurance Industry	Low	Long-Term	TBD
	Enhance emergency response and risk management.	MDA	UME, Farm Credit, Insurance Industry	Low	Ongoing	TBD
Enhance existing Best Management Practices and land conservation targets.	Evaluate the effectiveness of BMPs under future climate change scenarios	MDA	UMD, DNR, MDE	Low	Ongoing	TBD
	Assess and revise targets for agricultural land preservation.	MDA	Local and Regional Land Trusts	Low	Ongoing	TBD
FORESTS & TERRESTRIAL ECOSYSTEMS						
Expand land protection and restoration and revise targeting priorities.	Integrate climate data and models into existing resource assessments and spatial planning frameworks.	DNR	EPA, CBP, USDOI, USFWS, NGOs NASA	High	Medium-Term	Medium

	Incorporate climate change adaptation strategies into state resource management plans.	DNR	NOAA MDP, EPA, CBP, USDOI, USFWS, NOAA USFS NGOs	High	Medium-Term	Low
	Collaborate with federal partners to support regional and national adaptation planning.	DNR	EPA, CBP, USDOI, USFWS, NOAA USFS NGOs	Medium	Medium-Term	Low
	Update existing land protection targeting programs and project evaluation protocols.	DNR	EPA, CBP, USDOI, USFWS, NOAA USFS NGOs	High	Ongoing	Low
	Develop climate change adaptation guidance and technical tools suitable for local government planning.	DNR	MDP, UMD Cooperative Extension	High	Ongoing	Medium
Adjust management practices and reduce existing stressors.	Strengthen State and local programs to slow the loss and fragmentation of forest and terrestrial ecosystems to new development.	DNR	MDP, MDE MDOT USFWS, USFS, EPA, CBP, NGOs	High	Ongoing	Medium
	Review and revise best forestry management practices**.**	DNR	UMD-Cooperative	Medium	Medium-Term	Medium

	Continue to support incorporation of the policies and strategies of *Maryland's Sustainable Forestry Act of 2009* into state and local planning decisions.	DNR	Extension State Forest Conservancy District Boards	High	Ongoing	Low
	Evaluate sustainable forestry certification programs for opportunities to enhance climate resiliency.	DNR	Sustainable Forestry Initiative, Forestry Boards, Forest Stewardship Councils	Medium	Medium-Term	Medium
	Improve capacity to manage and respond to stressors exacerbated by climate change.	DNR	MDA, Maryland Invasive Species Council, Forest Health Emergency Contingency Program	Medium	Short-Term	High
Foster stewardship on private lands.	Develop new tools to guide adaptation stewardship activities on private lands.	DNR	Forest Stewardship Councils, UMD-Cooperative Extension	High	Short-Term	Medium
	Integrate adaptation strategies into existing programs.	DNR	USFS, Forest Stewardship	High	Short-Term	Medium

	Develop new conservation easement mechanisms to promote adaptation stewardship activities on private lands.	DNR	Councils, UMD-Cooperative Extension USFS, Forest Stewardship Councils, UMD-Cooperative Extension MDA	High	Short-Term	Medium
BAY AND AQUATIC ECOSYSTEMS						
Advance protection of at-risk species and habitats.	Revise state-level protection targeting programs to reflect climate change adaptation priorities.	DNR	UMD, USACE, USGS, USFWS, NOAA, NGO's	High	Ongoing	Low
	Develop new protection and conservation mechanisms to promote adaptation stewardship activities on private lands.	DNR	UMD, USACE, USGS, USDOI USFWS, NOAA, NGOs	Medium	Medium-Term	Medium
	Amend legal mechanisms to designate and protect temperature-sensitive streams.	DNR	MDE,EPA	High	Ongoing	Medium
	Implement an adaptive management approach.	DNR	MDE, MDOT, MDA, MDP, Federal	High	Medium-Term	Low

			Partners, NGOs			
Restore critical bay & aquatic habitats to enhance resilience.	Proactively pursue, design and construct habitat restoration projects to enhance the resilience of bay, aquatic and terrestrial ecosystems.	DNR	USACE, USGS, USFWS, NOAA, EPA, CBP, NGOs	High	Long-Term	High
	Conduct an audit of state-owned lands to identify habitat restoration potential for enhancing ecosystem resilience and increasing on-site carbon sequestration.	DNR		Medium	Short-Term	Low
	Increase on-the-ground implementation of existing stream restoration practices.	DNR	USGS, EPA, CBP, USFWS	High	Short-Term	High
	Remove barriers to habitat connectivity.	DNR	MDE, USFWS, NOAA	High	Ongoing	High
Reduce existing stressors.	Reduce impervious surface cover.	DNR, MDE	MDP	High	Ongoing	High
	Prepare for new or expanding ranges of invasive species.	DNR	MDA, Maryland Invasive Species Council, USFWS	High	Ongoing	Medium
Foster a collective response to climate change.	Adjust bay and watershed restoration priorities in light of a changing climate.	DNR	MDE, UMD, NOAA, USGS, EPA, Penn State,	Medium	Ongoing in Coastal Plain	Medium

			USFWS			
	Integrate both adaptation and mitigation reduction strategies into natural resource management plans and programs.	DNR	USFWS, NOAA, NGOs	High	Short-Term	Low
	Revise fishery and wildlife management to build climate resilient safeguards.	DNR	USFWS, NOAA, NGOs	High	Long-Term	Medium
	Increase collaboration between federal, state, local and regional climate change adaptation partners.	DNR	UMD, NOAA, USGS, EPA, NGOs	High	Short-Term	Low
WATER RESOURCES						
Ensure long-term safe and adequate water supply for humans and ecosystems.	Adopt and fund the recommendations of the 2008 "Wolman Committee" report.	MDE	DNR, MDP, local govts., federal partners	High	Ongoing	High
	Manage water through the lens of future climate and population.	MDE	MDP, DNR, local govts.	High	Ongoing	TBD
	Enhance planning and coordination within the water resource community.	MDE	MDP, local govts.	High	Long-Term	TBD
	Encourage water suppliers to evaluate and improve their resilience.	MDE	Water utilities, Local govts., MEMA, EPA	High	Long-Term	TBD
	Promote demand management and water conservation practices.	MDE	Local govts., MDA, Business community	Medium	Ongoing	TBD
	Assess, target and protect high-quality water recharge	MDE	DNR, MDP	Medium	Long-Term	TBD

	areas.					
Reduce the impacts of flooding and stormwater.	Encourage the removal of vulnerable or high-hazard water supply and treatment infrastructure.	MDE	Water utilities, local govts.	Low	Long-Term	TBD
	Prevent inundation and overflow of on-site disposal systems.	MDE	Local govts.	Medium	Long-Term	TBD
	Revise Clean Water Revolving Fund criteria.	MDE		Low	Short-Term	Low
	Invest in an improved understanding and communication of flood probabilities and hazards.	MDE	DNR	Medium	Long-Term	TBD
POPULATION GROWTH & INFRASTRUCTURE						
Ensure safety, clean water, clean air and sufficient infrastructure.	Address funding and revenue constraints to ensure adequate support for current and future infrastructure needs.	MDOT, MDE	MEMA, DGS, Utilities, Local govts.	Medium	Ongoing	TBD
	Conduct a comprehensive analysis of the vulnerability of Maryland's infrastructure.	MDOT, MDE	MEMA, DGS, Utilities, Local govts.	Medium	Ongoing	High
	Develop a "lead by example" investment policy to guide state investments.	DNR	All State Agencies	High	Short-Term	Low
	Reduce regional air quality impacts in Maryland.	MDE	MDOT, EPA, MPOs, Other states	High	Medium-Term	High
Plan for precipitation-related weather extremes and	Assess the economic costs resulting from severe weather events.	MDOT	MEMA, Utility Providers, Local Govts.	Low	TBD	TBD

increase resilience to rising temperatures.	Identify state investment needs to prepare for future weather emergencies.	MDOT, MEMA	Utility Providers, Local Govts.	Low	TBD	TBD
	Accelerate use of improved stormwater management strategies and environmental site design (ESD).	MDE	DGS, DNR, MDOT, UMD, Local Govts.	High	Ongoing	High
	Enhance the preparedness of transportation system and utility providers.	MDOT, MEMA	PSC, MEA, Utility Providers, MPOs,	Low	TBD	TBD
	Develop operation contingency plans for critical infrastructure.	MDOT, MEMA	Utility Providers	Medium	Ongoing	TBD
	Increase urban tree canopy.	DNR	Local Govts.	High	Ongoing	High
	Strengthen building and infrastructure design standards.	DHCD	Local Govts., MDOT, MEA, MDE, MEMA	High	Ongoing	TBD
Institutionalize consideration of climate change.	Promote integration of climate change adaptation strategies into state and local policies and programs.	MDP	DNR, MEMA	High	Long-term	Medium
	Integrate climate vulnerability data into state and local spatial planning frameworks.	MDP	DNR	High	Long-term	Medium
	Consider climate change issues in combination with ongoing growth and development planning efforts.	MDP	Sustainable Growth Commission, Local Govts.	High	Short-term	Low
	Explore incentives to promote sound planning practices	MDP	MEA, UMD	High	Medium-term	TBD
	Investigate the impacts of climate	DNR	MDE, MEA,	High	Ongoing	Medium

change on future energy needs.		MDA, DBED, MDP, MDOT			
Create a framework and standards for the placement and use of alternative energy.	DNR, MEA	MDE, MDA, DBED, MDP, MDOT, Critical Area Commission, UMD	High	Ongoing	Medium

B. Recommending short and longer-term strategies and initiatives to better address the consequences of climate change

1. *Developing broader public and private and federal, state and local partnerships*
   - From 2007-2014, the ARWG has primarily been comprised of representatives of the following state agencies: DNR, MDE, MDP, MHT, DHCD, DoIT, MES, MEMA, DBM, DHMH, MDOT, MPA, SHA, MDA, MIA, MEA, DGS and the University System of Maryland. The ARWG has also formed a number of sector-based working groups to assist with implementation of specific action items, including the development of the Phase I and II Adaptation Strategies. Both state agency and stakeholder representatives have participated on each of the ARWG's underlying working groups. ARWG members will engage in broadening stakeholder representation to include business and industry representatives with specific expertise in the areas of the ARWG.

2. *Addressing the challenge that low income and otherwise vulnerable communities will likely be disproportionally impacted by climate change (EO Task E(3)c)*
   - Climate change poses unique and often more devastating impacts to vulnerable and low-income communities. These communities already face challenges such as outdated infrastructure, poor healthcare, and lack of resources, which are then exacerbated by the effects of climate change. The ARWG will work with vulnerable and low-income communities in Maryland, the Environmental Justice Commission, and the Education and Outreach Working Group to help these communities better adapt to the impacts of climate change.

3. *Assessing the impacts that climate change will likely have on the State's economy, revenues and investment decisions (EO Task E(3) d)*
   - The ARWG will work to explore what impacts that climate change will likely have on the State's economy, revenues, and investment decisions (EO Task E(3)d) by utilizing Maryland's Greenhouse Gas Reduction Act Plan Report (2013), which addresses the cost of inaction. The report focuses on five major areas of economic loss if no climate measures are implemented: 1) coastal lands, infrastructures and ecosystems, 2) tourism, 3) agriculture, 4) public health and 5) energy. Additionally, the ARWG will look to integrate, where appropriate, topics or concepts from other states' reports (i.e., New York, Florida, and Washington) into Maryland's prevue.

4. *Delivering Tools and Assistance for Local Governments (EO Task E(3)(f))*
   - ARWG members will assess the delivery of tools and assistance to local governments to support community-scale climate vulnerability assessments and the development and integration of specific strategies for enhancing resilience to the impacts of climate change into local plans and ordinances. The ARWG will explore introducing programs, similar to CoastSmart, to non-coastal communities

to address issues such as the intersection of climate and stormwater, as well as riverine and nuisance flooding.

C. State Enhancement Actions

1. Maryland Environmental Policy Act Guidelines

- In November, 2014, Executive Order 01.01.2014.14 tasked the Department of Natural Resources to issue Maryland Environmental Policy Act (MEPA) guidelines that require the consideration of climate change factors, including both mitigation and adaptation. DNR is working to incorporate these changes into the MEPA guidelines by integrating climate change mitigation and adaptation into the consideration of environmental effects and alternatives of proposed state actions. In addition to revising the guidelines, DNR will consider adding adaptation and mitigation questions to the Environmental Assessment Form for proposed state actions.

2. State Planning, Regulatory and Fiscal Program Analysis

- Executive Order 01.01.2014.14 tasked all state agencies to "review State planning, regulatory and fiscal programs to identify and recommend actions to more fully integrate the consideration of Maryland's GHG reduction goal and the impacts of climate change." State agencies will analyze state funded programs to determine whether additional executive, legislative or administrative requirements will be necessary to incorporate consideration of climate change adaptation measures. Programs to be analyzed should include but not be limited to the following:

V. Conclusions

The information presented in this Chapter is not intended to be a final work product or strategy on climate change adaptation for the State of Maryland. It should be viewed as "living document" that provides a snapshot of where the state currently stands in terms of implementing its broad scale climate change adaptation planning efforts. The chapter is intended to provide the basis for guiding and prioritizing future state-level activities with respect to both climate science and adaptation policy within short to medium-term timeframes (i.e., 1 – 5 years). It is also envisioned that it will also serve as a framework not only to direct state-action, but also to engage policy-makers and stakeholders, and facilitate collaboration among federal, regional and local partners.

Adaptation planning efforts at the state-level will be routinely reviewed and updated new climate science and information becomes available and we gain a better understanding of how to adapt to climate change. State agencies leads, as well as internal and external partners will remain key to advancing climate change adaptation planning here in Maryland. In closing, it goes without

saying that further detailed planning, stakeholder engagement, and funding will be required to build Maryland's ecological, societal and economic resilience to the impacts of climate change.