

CLIMATE CHANGE RESILIENCY FOR COASTAL LANDOWNERS

Climate change is causing storm surges, higher sea levels, and more intense storms, in addition to increased air and water temperatures and droughts. These changes may make your property and its shoreline vulnerable to flooding and erosion.

A **storm surge** is the rise in water level above the regular high tide caused by a severe storm such as a hurricane or northeaster. These storms bring rain and heavy wind, which drives larger waves and can blow water up the Chesapeake Bay, thus causing the rivers to rise. Storm surges can create extensive storm damage, erosion, and inundation of low-lying coastal areas.

Shoreline erosion is caused by many variables, such as storm surges of higher than normal tides, and wind driven waves; sea level rise, which causes higher tides than in decades past; boat wake; as well as upland runoff from rain storms. Shoreline erosion can threaten the integrity of existing structures, roads and utilities and has adverse impacts to water quality and wildlife habitat.

Maryland's tidal waters have increased by one foot over the last 100 years and are expected to increase from 1.4 to 2.1 feet by 2050 and from 2.1 to 5.7 feet by the end of this century¹. Maryland's **sea level rise** is higher than other parts of the world due to land subsidence (gradual sinking of the earth's surface) from postglacial rebound (the rise of land masses which were once depressed by a glacier), and groundwater extraction. Inundation of tidal waters over low-lying coastal areas is already occurring. Sea level rise may also cause salt water intrusion into fresh water aquifers.

To learn more about what Maryland is doing about Climate Change click here:

http://dnr.maryland.gov/climatechange/Pages/about_climatechange.aspx

To view the latest report on sea level rise projections for Maryland click here:

<http://dnr.maryland.gov/climatechange/Documents/MDSeaLevelRiseProjections.pdf>

Here are some ways to help you prepare your property to be more resilient to climate change:

Know your vulnerabilities

Know where mapped floodplains are located on your property. The Federal Emergency Management Agency (FEMA) produces Flood Insurance Rate Maps (FIRMs) to show areas that are predicted to flood in the event of a 100-year storm (a storm that has a 1% chance of occurring in a given year). FIRMs are typically available for

¹ Boesch, D.F., L.P. Atkinson, W.C. Boicourt, J.D. Boon, D.R. Cahoon, R. A. Dalrymple, T. Ezer, B.P. Horton, Z.P. Johnson, R.E. Kopp, M. Li, R.H. Moss, A. Parris, C.K., Sommerfield. 2013. Updating Maryland's Sea Level Rise Projections. Special Report of the Scientific and Technical Working Group to the Maryland Climate Change Commission, 22 pp. University of Maryland Center for Environmental Sciences, Cambridge, MD

viewing at your County Planning Department and online through FEMA's How to Find Your Flood Map web page: <https://msc.fema.gov/portal>

Land areas less than five feet above mean sea level (the sea level halfway between the average high and low water levels) are particularly susceptible to rising seas. Check Maryland's Coastal Atlas online, to see whether your property is vulnerable to sea level rise. Click on Content and Sea Level Rise, choose the inundation depth of interest to you (0-2 feet, 2-5 feet, or 5-10 feet), and zoom into your property: <http://dnr.maryland.gov/ccs/Pages/coastalatlus.aspx>

During a storm, note any ponds that form and watch where water flows on your property. This will help you to predict what areas are likely to erode or flood during a storm, and whether any infrastructure on your property is in danger. This information can also help you locate an area to install a **rain garden**. During a storm surge or king tide (an especially high tide), note how high the water, waves and debris reach. King tides are the highest predicted high tide of the year at a coastal location. As time goes by and sea levels rise the water level currently reached during a king tide will one day be the water level reached at average high tide. For additional information on King Tides click here: <https://www.epa.gov/cre/king-tides-and-climate-change>

Control stormwater runoff to prevent erosion

Stormwater runoff is the rainwater or snow melt that flows over ground surfaces, such as paved surfaces and roofs that do not allow the water to soak into the ground. It often is polluted with sediment, chemicals, nutrients and debris. High volume and high velocity flows of stormwater runoff cause erosion. Intensity of runoff and associated pollution increases with greater development. More frequent and intense storms are part of the changing climate, which means you can expect to deal with eroding and polluting runoff. The following stormwater control methods will help to prevent erosion, decrease pollution and manage flooding.

A **rain garden** is a garden that is close to and downhill from a source of runoff, which prevents erosion by slowing water as it travels downhill, giving it less time to gain momentum and erosive power. It also improves water quality by trapping sediment and nutrients, and can provide food and habitat for wildlife. Rain gardens are designed to withstand moisture and concentrations of nutrients that are found in stormwater runoff. There are two types of rain gardens; under-drained and self-contained. For more information, click here:

http://www.lowimpactdevelopment.org/raingarden_design/whatisaraingarden.htm

A **rain barrel** is a container that collects rainwater runoff from your roof, which would otherwise be diverted to storm drains and streams. Rainwater can be used to water your gardens. Rain barrels are an easy solution to help reduce runoff pollution, erosion, and your water bill. For more information, click here:

<http://www.rainbarrelguide.com/benefits-rainwater/>

Pervious pavers provide a self-draining system, which allows water to seep around and through their paved surface, naturally soaking into the ground. In doing so, they increase groundwater recharge (method in which water enters an aquifer), which increases the quantity and improves the quality of water. Pervious pavers are longer lasting than conventional concrete. They increase the natural irrigation of your yard, and reduce water use. They reduce flooding and erosion, and promote tree survival by providing air and water to their roots. For

more information, click here: <http://doee.dc.gov/service/riversmart-homes-pervious-pavers> or check out the Interlocking Concrete Pavement Institute: <http://www.icpi.org/paving-systems>

Pervious asphalt allows water to drain through the pavement surface onto a stone bed, slowly infiltrating the soils below. This stormwater management system promotes infiltration, improves water quality and eliminates the need for a detention basin. It replenishes water tables and aquifers, rather than forcing stormwater into storm sewers. Pervious asphalt lasts for a long time, and often times it is hard to notice a difference in appearance from regular asphalt. The surface of pervious asphalt pavement is smooth enough to meet requirements of the Americans with Disabilities Act (ADA). For more information, click here: http://www.asphalt pavement.org/index.php?option=com_content&view=article&id=359&Itemid=863

Each of these practices requires some degree of routine maintenance. For example, debris that blocks the mesh screen on a rain barrel lid should be removed regularly, while some pervious pavers need to be mowed and vacuumed.

Plant vegetation to reduce erosion

A climate-change resilient shoreline can reduce erosion and resist storm damage, while also minimizing impacts on the shoreline ecosystem. A resilient shoreline includes natural vegetation that acts as a **buffer**, which lessens or absorbs the shock of an impact. Shoreline vegetation helps bind soil, attenuates waves, slows runoff over land, can be planted in a way that frames the view and even provides protection from raindrops. Vegetated shorelines allow for wetland migration up slopes as the sea level rises. If there is infrastructure behind a wetland (such as a bulkhead or patio), the wetlands will have no place to migrate and will instead be washed out and disappear. Wetlands are a valued part of our environment because they not only provide habitat for a variety of animals such as fish and crabs, but also help reduce the force and impact of storm surges. Vegetated shorelines also provide habitat and nursery grounds for wildlife, and opportunities for recreation and enjoyment for people. They also help to mitigate climate change by absorbing carbon dioxide from the air and storing carbon in the plants, and creating shade that may cool the adjacent water or your home.

When choosing vegetation to plant along the shoreline of a waterfront property, it is important to select plants that are able to handle dynamic and harsh conditions including salt water and sandy and nutrient-deficient soil. Your landscape will be better protected over time with a diverse planting pallet that includes plants with deep and broad-reaching fibrous root structures and extensive foliage (trees, shrubs, flowering and herbaceous plants, and grasses). Our Storm Resilience graphics provide a visualization of how such plantings work to protect your property.

Native plants are indigenous to an area and are adapted to thrive in the climate and soils of a certain region. Therefore, native plants require minimal maintenance and are drought-tolerant. They need less watering, fertilizers and pesticides than non-native plants. The result is less pollutants that might be carried by runoff into our wetlands and rivers. Native plants also provide wildlife with familiar sources of food, shelter and places to raise their young.

When planting, focus on stratification of vegetation layers in response to storm resilience. Start by planting water-tolerant grasses and shrubs along the shoreline and work upland with a more diverse planting pallet that does not require frequent water tolerance, but can accommodate periodic flooding events and can further support a greater soil composition. In the uplands, plant drought-tolerant plants. See our sample planting plans for ideas!

For more information about choosing plants appropriate for Maryland's coast, check out these resources:

- US Fish and Wildlife Service BayScapes Conservation Landscaping Program: <http://www.nps.gov/plants/pubs/nativesMD/lists.htm>
 - For a list of native Maryland landscaping plants, their photos, and their characteristics such as shade-tolerance, water-tolerance and bloom time: <http://www.nps.gov/plants/pubs/chesapeake/toc.htm>
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Install living shorelines

While also providing all the environmental benefits of a vegetated shoreline, a living shoreline absorbs and dissipates wave energy unlike hardened shorelines, which reflect and redirect waves. Maryland requires that new shoreline erosion control projects include tidal wetland vegetation. Living shoreline erosion control techniques include planting native wetland plants on the tidal boundary and may include bioengineering such as coconut-fiber rolls, or stone structures called off-shore sills. Off-shore sills break up waves and allow for tidal flushing of the natural shoreline, and enhance sand buildup on the shoreline. Living shorelines can even include oyster reefs, if your property has brackish water. On existing beaches, living shorelines can include sand replenishment and creating dunes with sand fencing and beach grasses. To learn more about living shorelines, check out these links:

- Maryland's Shore Erosion Control Guidelines for Waterfront Property Owners: <http://dnr.maryland.gov/ccs/Publication/Shoreerostext.pdf>
 - VIMS Center for Coastal Resources Management: <http://ccrm.vims.edu/livingshorelines/>
 - Chesapeake Bay Foundation's booklet on living shorelines: <http://www.cbf.org/Document.Doc?id=60>
 - Maryland regulations and permits for shoreline erosion control projects: <http://www.mde.state.md.us/programs/Water/WetlandsandWaterways/Pages/LivingShorelines.aspx>
 - Critical Area Commission's information about shoreline erosion control projects: <http://dnr.maryland.gov/criticalarea/Pages/sec.aspx>
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Get involved in county or municipal planning for climate change resiliency

Many effective techniques to address the impacts of climate change must be implemented on a local or regional level, such as land use zoning controls, increasing stormwater runoff storage capacity through expanding stormwater ponds, separating sewage and stormwater flows, adjusting building codes to address future flood elevations, installing backflow preventers in stormwater systems, or revising parking lot requirements. Contact

your local planning department to find out whether they have conducted a risk assessment and how you might get involved in planning for climate change. For more information about community planning for climate change, see the links below:

- Planning for Climate Change: <http://dnr.maryland.gov/climatechange/Documents/ClimateChangeImpactAreas2.pdf>
- Maryland Chesapeake and Coastal Service: <http://dnr.maryland.gov/ccs/Pages/default.aspx>
- Climate change planning at the state level: <http://climatechange.maryland.gov/>
- U.S. Climate Resilience Toolkit: <https://toolkit.climate.gov/>
- U.S. Environmental Protection Agency's Climate Ready Estuaries Program: <http://www.epa.gov/cre>
- National Wildlife Federation's nature-based approach to climate change resilience for communities: <https://www.nwf.org/What-We-Do/Energy-and-Climate/Climate-Smart-Conservation/Climate-Smart-Communities.aspx>

Contacts

Critical Area Commission for the Chesapeake & Atlantic Coastal Bays: <http://dnr.maryland.gov/criticalarea>

Maryland Department of Natural Resources, CoastSmart Communities: <http://dnr.maryland.gov/ccs/coastsmart>

University of Maryland Extension, Sea Grant: <http://www.mdsg.umd.edu/topics/extension/our-services>

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