

**AN ORDINANCE PERTAINING TO THE ADOPTION OF THE BROOMES
ISLAND FLOOD MITIGATION PLAN**

WHEREAS, pursuant to the authority in Title 3 of the *Land Use Article* of the Maryland Annotated Code, as amended, the Board of County Commissioners of Calvert County, Maryland (hereinafter the "Board") has general powers to promulgate and amend planning documents;

WHEREAS, by Ordinance 28-11, the Board of County Commissioners of Calvert County, Maryland adopted the Calvert County Flood Mitigation Plan, which called for the creation of the Broomes Island Flood Mitigation Plan; and

WHEREAS, after study and evaluation, the Calvert County Department of Community Planning & Building recommended to the Planning Commission and the Board of County Commissioners a Draft Broomes Island Flood Mitigation Plan;

WHEREAS, after due notice was published, the Planning Commission of Calvert County, Maryland (hereinafter, the "Planning Commission") and the Board of County Commissioner of Calvert County, Maryland conducted a joint public hearing on January 10, 2017, at which time the proposed plan was discussed, staff's recommendations were considered, and public comment was solicited;

WHEREAS, at the conclusion of said public hearing the Planning Commission voted to recommend adoption of the Broomes Island Flood Mitigation Plan and conveyed its recommendation to the Board of County Commissioners by resolution; and

WHEREAS, after considering the staff report, testimony presented at the public hearing regarding the Broomes Island Flood Mitigation Plan, and the recommendation of the Planning Commission, and in furtherance of the public health, safety and welfare, the Board of County Commissioners of Calvert County, Maryland determined it is in the best interest of the citizens of the County to adopt the Broomes Island Flood Mitigation Plan as set forth in Exhibit A, attached hereto and made a part hereof.

NOW, THEREFORE, BE IT ORDAINED by the Board of County Commissioners of Calvert County, Maryland, the Broomes Island Flood Mitigation Plan **BE**, and hereby **IS**, adopted as shown in attached Exhibit A hereto and made a part hereof.

BE IT FURTHER ORDAINED by the Board of County Commissioners of Calvert County, Maryland that, in the event any portion of this Plan is found to be unconstitutional, illegal, null or void, it is the intent of the Board of County Commissioners to sever only the invalid portion or provision, and that the remainder of the Plan shall be valid.

BE IT FURTHER ORDAINED by the Board of County Commissioners of Calvert County, Maryland that the foregoing recitals are adopted as if fully rewritten herein.

BE IT FURTHER ORDAINED by the Board of County Commissioners of Calvert County, Maryland that this plan shall be effective upon recordation.

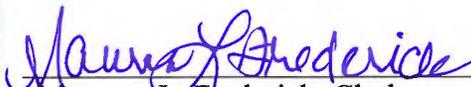
BE IT FURTHER ORDAINED by the Board of County Commissioners of Calvert County, Maryland that this Ordinance shall be effective upon recordation and without publication of a fair summary, but not before January 20, 2017.

DONE, this 10th day of January 2017 by the Board of County Commissioners of Calvert County, Maryland.

Aye: 5
Nay: 0
Absent/Abstain: 0

ATTEST:

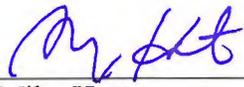
**BOARD OF COUNTY
COMMISSIONERS OF CALVERT
COUNTY, MARYLAND**


Maureen L. Frederick, Clerk

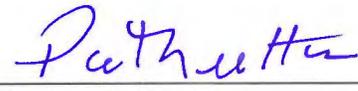

Tom Hejl, President

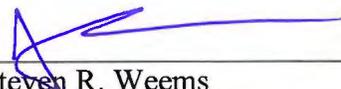
Approved for form and legal
sufficiency by:


Evan K. Slaughenhoupt Jr., Vice-President

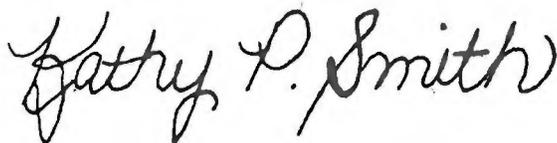

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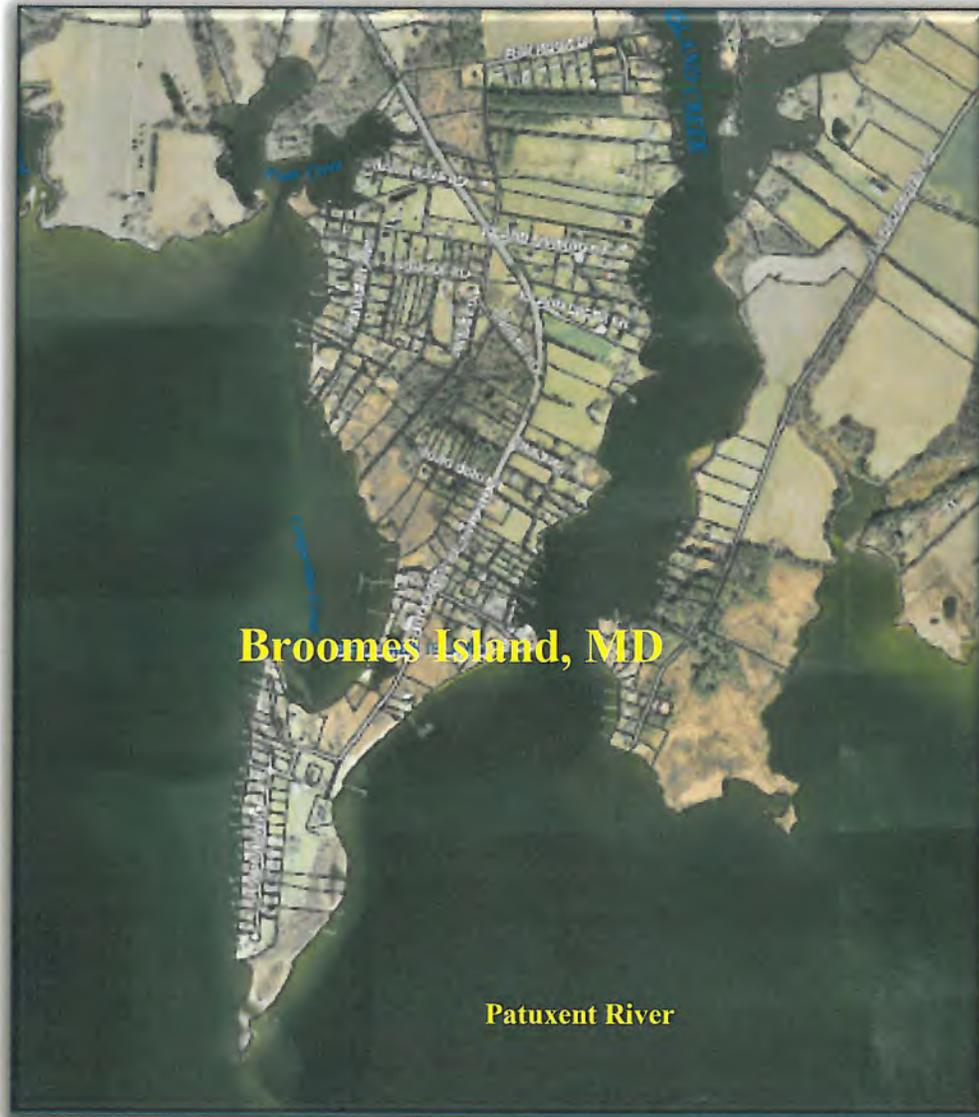

Steven R. Weems

Received for Record... January 25, 2017..
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Folio 28..... COUNTY COMMISSIONERS
ORDINANCES AND RESOLUTION.



Broomes Island Flood Mitigation Plan

September 8, 2016



Prepared by **Tay Harris and David Brownlee, PhD, AICP**
Calvert County Department of Community Planning and Building

This product was prepared by Calvert County Government using Federal funds under award number NA12NOS4190136, NA14NOS4190125, NA15NOS4190165 from the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. The statements, findings, conclusions and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.



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Acronyms

BFE – Base Flood Elevation
BIFMP – Broomes Island Flood Mitigation Plan
BRF – Bay Restoration Fund
CPB ES – Calvert County Department of Community Planning & Building, Environmental Section
CRS – Community Rating System
DNR – Maryland Department of Natural Resources
DPS EMD – Calvert County Department of Public Safety, Emergency Management Division
DPW EHD – Calvert County Department of Public Works, Engineering and Highway Division
EOP – Emergency Operations Plan
FEMA – Federal Emergency Management Agency
FFD – Farm and Forest Zoning District
FIRM – Flood Insurance Rate Map
FMA – Flood Mitigation Assistance Grant Program
FMP – Flood Mitigation Plan
FPE – Flood Protection Elevation
GIS – Geographic Information System
HMGP – Hazard Mitigation Grant Program
IBC – International Building Code
IDA – Intense Development Area Critical Area Overlay Zone
IRC – International Residential Code
LDA – Limited Development Area Critical Area Overlay Zone
LiMWA – Limit of Moderate Wave Action
MC – Marine Commercial Zoning District
MDE – Maryland Department of the Environment
MEMA – Maryland Emergency Management Agency
MNS – Mass Notification System
NFIP – National Floodplain Insurance Program
NOAA – National Oceanic and Atmospheric Administration
OCRM – Office of Ocean and Coastal Resource Management
PDM – Pre-Disaster Mitigation Grant Program
RCA – Resource Conservation Area Critical Area Overlay Zone
RCD – Rural Community Zoning District
RD – Residential Zoning District
RFC – Repetitive Flood Claims
RTEs – Rare, Threatened and Endangered Species
SAV – Submerged Aquatic Vegetation
SBMA – Special Buffer Management Area Overlay Zone
SHA – Maryland State Highway Administration
SRL – Severe Repetitive Loss Grant Program
USFWS – U.S. Fish and Wildlife Service
USACE – U.S. Army Corps of Engineers
WL – Wetland Zoning District

Executive Summary

Broomes Island is a peninsula located along the Patuxent River in Calvert County. It is the County's second most flood-prone community with an estimated 71 structures and segments of roadway south of Church Road vulnerable to flooding. To address flood vulnerability in Broomes Island, Calvert County's Community Planning and Building Environmental Section (CPB ES) compiled and ranked citizens' concerns and consulted with Calvert County's Department of Public Works, Engineering and Highway Division (DPW EHD) and Department of Public Safety, Emergency Management Division (DPS EMD) to prepare the Broomes Island Flood Mitigation Plan (BIFMP). The BIFMP identifies flood issues, describes conditions contributing to flooding and makes recommendations to mitigate flooding.

What is the 100-Year Floodplain?

The 100-year floodplain is an area that has a one percent annual chance of flooding to the base flood elevation during a 100-year flood.

In addition, the BIFMP includes an inundation analysis, which takes into account land subsidence and possible sea level rise increases and the impacts on Broomes Island. Mitigation recommendations are made under the following two scenarios: (1) a 2.1-foot rise in sea level resulting in a 2.1-foot increase in elevation of the 100-year floodplain by 2050 and (2) a 3.4-foot sea level rise resulting in 3.4-foot increase in sea level by 2100, inundating land elevations up to 10 feet. Under the scenario of 2.1 feet of sea level rise by 2050, vulnerable primary structures could increase from 71 to 133 and segments of roadways southwest of Island Creek Lane could become more flood-vulnerable. Under the sea level rise scenario of 3.4 feet by 2100, vulnerable primary structures could increase from 71 to 196 and large segments of roadways south of Island Creek Court could become more flood-vulnerable.

Flooding issues were identified and ranked by residents during a nominal group meeting facilitated by a third party consultant. These issues include: the flooding of several segments of roadway and areas of vacant and developed lands; wetland inundation and flooding of surrounding areas; inadequate stormwater management; flooding of businesses; hurricane preparedness; and emergency vehicle access/evacuation below Broomes Island Road Causeway during floods. Factors that contribute to flooding on Broomes Island are low land elevations, a high water table, inadequate stormwater management for site conditions and the construction of structures in the floodplain prior to floodplain regulations and/or the construction of structures when floodplain regulations were not as protective as they are today.

Recommendations to address flooding in the near term include:

- Increase the freeboard requirement from two feet to three feet above sea level to mitigate for the 2050 sea level rise scenario, to four feet above sea level to mitigate for the minimum 2100 sea level rise scenario or six feet above sea level to mitigate for the maximum 2100 sea level rise scenario for new homes and substantial improvements to existing homes currently located in the 100-year floodplain;
- Address current flood threats by elevating structures or retreating (removing structures);

What is Freeboard?

Freeboard is the required elevation of the first floor above the base flood elevation.

- Consider elevating the Broomes Island Road Causeway by 4.5 feet for 5,926 feet of its length and research funding sources (i.e., road tax district);
- Consider conducting a study to address stormwater management issues that contribute to flooding where Ballard Rogers Road, Penkert Lane and River View Road converge;
- Utilize Bay Restoration Funds (BRF) to address stormwater's adverse impacts on a septic system lying adjacent to a stormwater conveyance area and wetlands where Ballard Rogers Road, Penkert Road and River View Road converge, and in general, where septic systems are failing within the 100-year floodplain, apply for BRF to upgrade to nitrogen removing septic systems;
- For the property owner on Patuxent Avenue, elevate structures on the property and conduct an elevation/drainage study;
- Ensure culverts along Broomes Island Road remain unclogged and debris-free through regular Maryland State Highway Administration (SHA) and Calvert County DPW maintenance efforts;
- Encourage residents to be hurricane and flood ready by utilizing County online resources and becoming familiar with County emergency preparedness procedures and protocols (i.e., emergency notification service, emergency shelter locations, radio stations offering emergency information, etc.); and
- Seek and plant free trees through the County's Critical Area Free Tree Planting Program for the purpose of flood control.

Recommendations to address flooding into 2050 and 2100 include:

- Consider retreat to address flood threats into 2050 and beyond;
- If retreat is not the preferred option into 2050 and beyond, consider utilizing amphibious homes, floating neighborhoods, coastal armoring and/or enhancing the natural resources along the shoreline as flood mitigation measures;
- If retreat is not the preferred option into 2050 and beyond, serve Broomes Island with public water and sewer;
- Establish a threshold for which traditional flood mitigation measures (i.e., elevation of structures or retreat) are no longer considered adequate to address flooding issues; and
- Conduct outreach to elected officials and residents about the impacts of increasing depth and extent of sea level rise over time.



Figure 1: Study Area: Broomes Island

Source: Calvert County Government

In conclusion, Broomes Island has been vulnerable to flooding from the onset of its development more than a century ago. Historically, residents have been accustomed to flooding. Elevating structures and the Broomes Island Road Causeway at the present time can mitigate flooding of structures and the roadway;

however, if sea level rise scenarios for 2050 and 2100 become a reality, a shift from utilizing traditional to nontraditional flood mitigation measures will likely be needed. Elevation standards for structures should eventually be higher than what is currently required under the County's floodplain regulations and instead of elevating roadways or segments of roadways, relocation and/or boardwalk systems may be considered if Broomes Island is to remain a viable community as projected fifty plus years out. Such considerations will impact public safety, infrastructure investments and sustainability. Funding and staff resources for mitigation measures will need to be identified.

Background

Countywide Flood Mitigation Planning

The County adopted its first countywide Flood Mitigation Plan (FMP) in 2011 to comply with the Disaster Mitigation Act of 2000 (Public Law 106-390). The act requires local jurisdictions to prepare and adopt hazard mitigation plans, which include flood mitigation as a condition for receiving pre-disaster mitigation grant assistance and hazard mitigation grant program assistance from the Federal Emergency Management Agency (FEMA). The purpose of the countywide FMP is:

To develop a flood mitigation plan to improve Calvert County's and its municipalities' resistance to floods by identifying actions to reduce the impact of floods to County residents and structures¹.

The Calvert County FMP identifies the County's most flood-prone communities: Cove Point, Broomes Island, Chesapeake Beach, North Beach, Plum Point (including Breezy Point and Neeld Estate) and Long Beach. In 2014, a flood mitigation plan for the Cove Point Community, the County's most flood-prone community (166 structures at risk), was adopted. This BIFMP identifies flooding issues and recommends mitigation actions for the County's second most flood-prone community, Broomes Island. Broomes Island has 71 flood-prone structures. In 2016 to 2017, CPB ES is preparing a flood mitigation plan for the Plum Point Area which includes Breezy Point and Neeld Estate.

Broomes Island is a peninsula on the western shore of the County southwest of St. Leonard and north of Jefferson Patterson Park and Museum (Figure 1). The Patuxent River flows along the peninsula's shorelines and two coves, Grapevine Cove and Nan's Cove, which are located along the peninsula's western shoreline. Island Creek borders the peninsula's northeastern shoreline (Figure 1). Broomes Island experiences extensive flooding during hurricanes and heavy storms, and mild to moderate flooding during heavy/prolonged rains and high tides.

¹ Calvert County Flood Mitigation Plan, 2011, p. 5.

Purpose and Objectives

The purpose of the BIFMP is:

To develop a flood mitigation plan to improve the Broomes Island community's resistance to flooding by identifying actions that reduce flood impacts to residents, structures and infrastructure; reviewing and modifying, if necessary, the emergency response plan for Broomes Island; and by identifying projected impacts of sea level rise scenarios at 2050 and 2100.

The objectives of the BIFMP are to:

- Identify flood issues specific to Broomes Island;
- Identify options to mitigate flooding and address safety concerns due to flooding;
- Make recommendations to mitigate flooding on Broomes Island;
- Identify the implications of sea level rise on Broomes Island;
- Make recommendations on mitigation measures, both short and long-term, to address potential sea level rise impacts to Broomes Island; and
- Serve as a planning tool to address flood issues and emergency preparedness on Broomes Island.

Planning Process

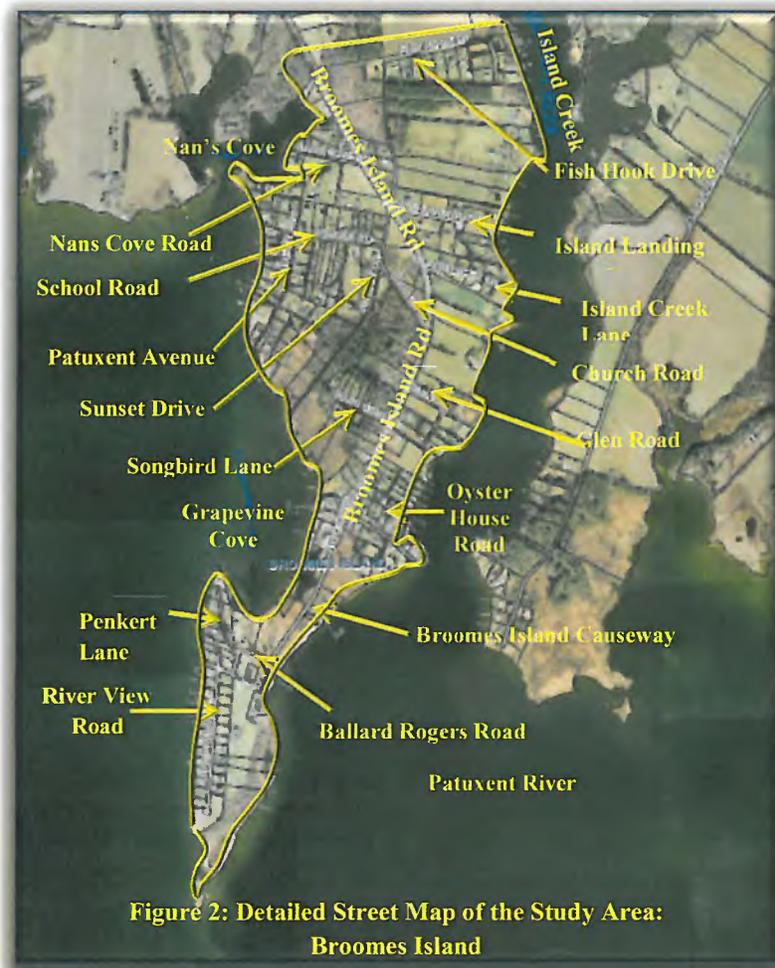
In 2013, CPB ES coordinated with the U.S. Army Corps of Engineers (USACE) to conduct elevation assessments of 15 Broomes Island homes. After obtaining permission from homeowners, the elevation assessments were conducted in February and June 2013. On May 17, 2014, CPB ES held a public meeting in Broomes Island to discuss flood issues at a facilitated public meeting. Twelve residents attended. The Department of Community Planning and Building Environmental Section prepared the BIFMP between July 2014 and January 2016 utilizing information gathered at the public meeting, information contained in the 2011 Calvert County Flood Mitigation Plan (Countywide FMP), data from the elevation assessments and consultations with Calvert County DPW EHD, Calvert County DPS EMD and SHA. The Board of County Commissioners, Calvert County, Maryland reviewed the draft BIFMP on March 1, 2016. CPB ES solicited comments from the county agencies, boards and commissions, residents and adjoining jurisdictions and Maryland governmental departments through the Maryland Clearinghouse Review process. Comments were incorporated into the BIFMP between December 2015 and September 2016. A public hearing was held before the Planning Commission, Calvert County, Maryland and the Board of County Commissioners, Calvert County, Maryland on January 10, 2017. The Board of County Commissioners Calvert County, Maryland, having received the recommendation to approve the BIFMP from the Planning Commission, approved the BIFMP on January 10, 2017. Funding for the BIFMP was provided by the Board of County Commissioners Calvert County, Maryland and through the Office of Ocean and Coastal Resource Management (OCRM), National Oceanic and Atmospheric Administration (NOAA, Grant # NA12NOS4190136; NOAA, Grant # NA14NOS4190125; NOAA, Grant # NA15NOS4190165) and administered through the Maryland Department of Natural Resources, (DNR) Chesapeake and Coastal Service's Coastal Communities Initiative Grant Program.

Participants

The BIFMP was a collaborative effort involving Broomes Island residents, Calvert County CPB ES, Calvert County DPW EHD, Calvert County DPS EMD, the Maryland Department of the Environment (MDE), DNR, USACE, SHA and SynergyForces LLC a professional facilitator.

Study Area

For the purposes of the BIFMP, the study area (Figure 2) is delineated by the Broomes Island ZIP code of 20615, which extends slightly north of Fish Hook Drive to the southern tip of the Broomes Island peninsula. Broomes Island is a patchwork of single family residential development, farmlands, forestlands, wetlands and commercial properties including The Point at Broomes Island, Stoney's Restaurant, Broomes Island Marina, Len's Marina, Billy's Marina/Island Creek Marina, Patuxent Seafood Company and Joe's Garage. The institutional uses on Broomes Island include the Broomes Island Wesleyan Church, the Broomes Island Community Center and Broomes Island Post Office. The peninsula is located in the State of Maryland's 12-digit watershed named Island Creek, which drains into the 8-digit watershed of the lower Patuxent River and the 6-digit watershed of the Patuxent River.



**Figure 2: Detailed Street Map of the Study Area:
Broomes Island**

Source: Calvert County Government

Broomes Island's historical significance is anchored in the seafood industry of days past when there was an abundance of oysters, crabs, eels, turtles, shad, rockfish and hardhead. Oystering was the most lucrative harvest from the early 1900s until 1983 when the oyster stock was in steep decline due to deteriorating water quality, natural disasters, over-fishing and disease. Supporting the booming oyster business for many decades was the Warren Denton & Co. seafood packing house which got its start in 1926 and closed its doors in 2001. This site is currently occupied by The Point at Broomes Island, which is a wedding/banquet facility. Today, the Broomes Island community is a quiet residential community with minor commercial and marine commercial uses. Many of the homes have been owned by the same families and passed down for generations.

Zoning

Conventional Zones

Conventional zoning regulates the type and extent of land uses allowed in a particular zoning district. Conventional zoning for Broomes Island consists of the following districts: Farm and Forest District (FFD), Marine Commercial District (MC), Residential District (RD), and Wetland District (WL, Figure 3). Below is a description of allowed uses in the zoning districts.

- **Farm and Forest District**—Allows for farms and forestlands with limited scattered residential development, with an emphasis on preserving farms with highly productive soils, environmentally sensitive lands, drinking water supplies, historic and scenic landscapes and lands in proximity to County Agricultural Preservation Districts.
- **Marine Commercial District**—Allows for uses that cater to and serve marine activities.
- **Residential District**—Allows for residential development mixed with public buildings, schools, churches, public recreational facilities and accessory uses.
- **Wetland District**—Tidal wetlands.

Chesapeake Bay Critical Area Overlay Zones

Many properties on the peninsula are located in the Chesapeake Bay Critical Area and must comply with the Critical Area's overlay zones (Figure 4). A description of the Critical Area overlay zones governing Broomes Island is provided below.

- **Resource Conservation Areas (RCA)**—Areas within the Critical Area characterized by natural resources (e.g., wetlands, forests, abandoned fields, etc.) and resource utilization activities (e.g., agriculture, forestry, fisheries activities or aquaculture).
- **Limited Development Areas (LDA)**—Areas within the Critical Area where low or moderately intense development exists and animal and plant habitat areas coexist with development.
- **Intense Development Areas (IDA)**—Areas within the Critical Area where residential, commercial, institutional and/or industrial developed land uses predominate, and where relatively little natural habitat occurs. In Broomes Island, these areas include the marinas, Stoney's Restaurant and The Point at Broomes Island.
- **Special Buffer Management Areas (SBMA)**—Areas designated by the local jurisdiction and approved by the Critical Area Commission where an exemption from certain portions of the 100-foot critical area buffer regulations may be granted. In order to designate these areas, the local jurisdiction (e.g., Calvert County government) must sufficiently demonstrate that the existing pattern of residential, industrial, commercial or recreational development in the Critical Area prevents the 100-foot critical area buffer from fulfilling its functions. If an exemption is granted, local jurisdictions shall propose other measures for achieving water quality and habitat protection objectives. These measures may include but are not limited to public education and urban forestry programs. In Broomes Island, these SBMA areas include The Point at Broomes Island Banquet and Wedding facility, Stoney's Restaurant, Len's Marina, the Patuxent Seafood Company and Billy's Marina/Island Creek Marina. At these sites, disturbance can occur in the area from 50 to 100 feet

from the water without a variance, but mitigation is required. Buck's Seafood, Stoney's Restaurant and The Point at Broomes Island sites are also zoned IDA.

Conventional zoning and Critical Area overlay zoning are based on existing land uses. These zoning districts allow for uses compatible with the current land use. While the nature of the marine-related uses on Broomes Island has changed throughout the years—from seafood processing operations to marinas and a seafood restaurant, wedding and banquet hall—the mix of single family homes, farms, and wetlands hasn't changed much with the exception of residential growth. The serene setting of this quiet bedroom community alongside large wetlands and the Patuxent River provides residents with unique opportunities to observe plant and animal wildlife while in their backyards or walking down Broomes Island Road.

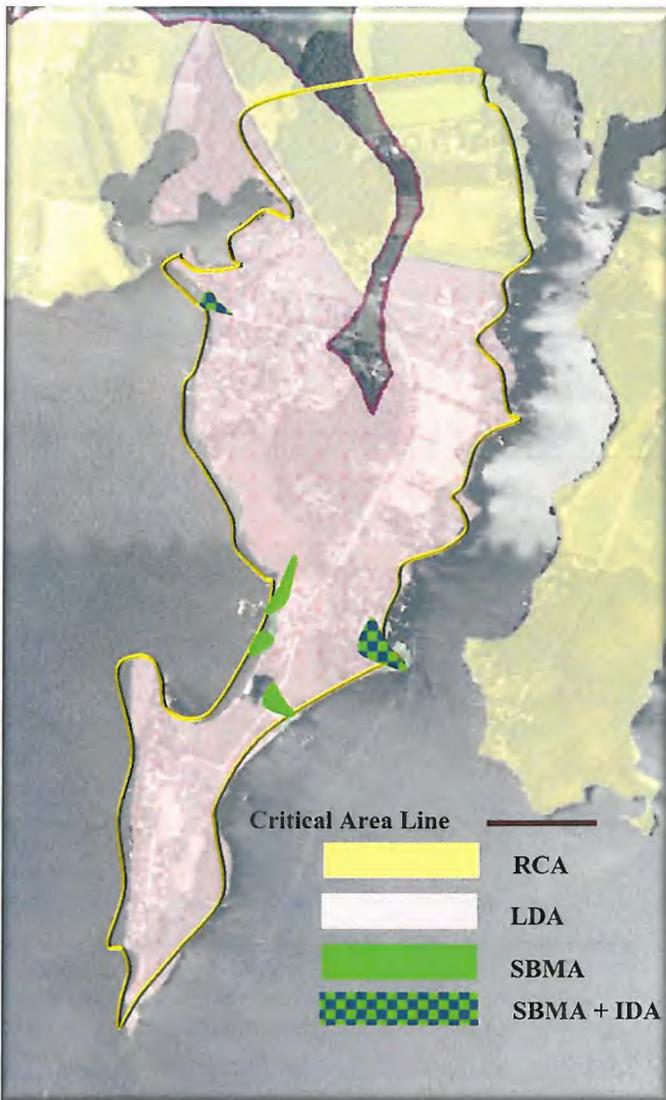


Figure 4: Broomes Island Critical Area Overlay Zones & Critical Area Boundary
 (Approximate rendering of SBMA and SBMA + IDA)
 Source: Calvert County Government

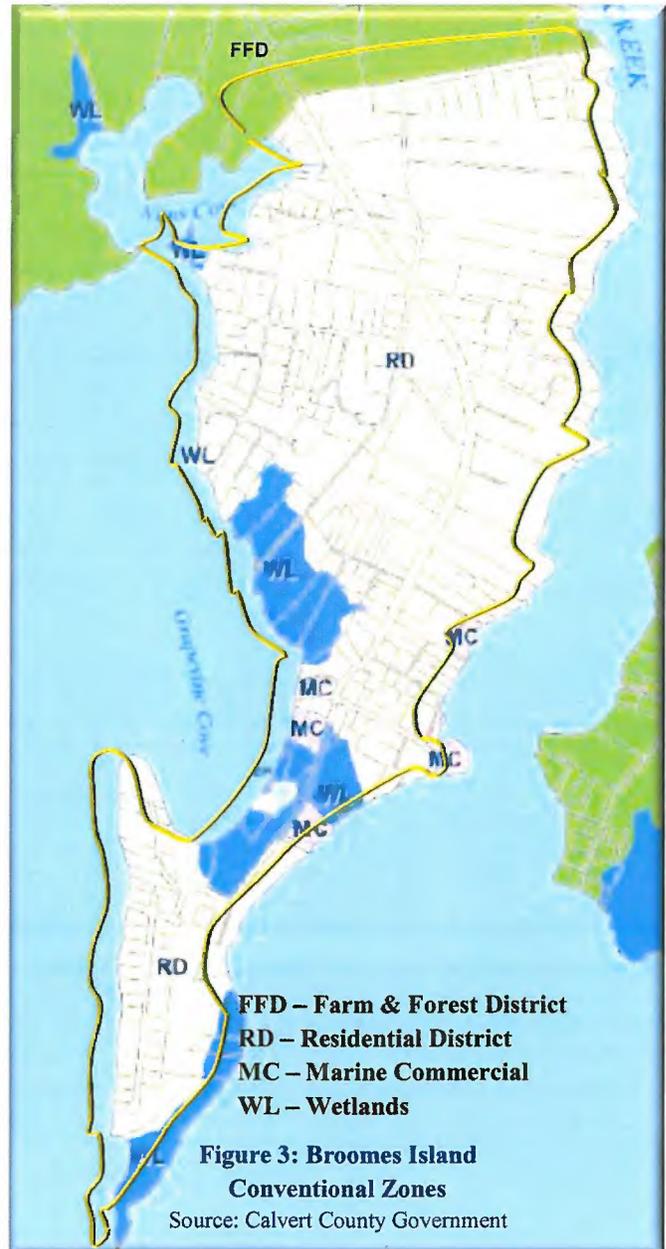


Figure 3: Broomes Island Conventional Zones
 Source: Calvert County Government

100-Year-Floodplain

100-Year Floodplain

The topography of Broomes Island is relatively flat with most of the lower two-thirds of the peninsula lying in the 100-year floodplain (Figure 5). The 100-year floodplain is an area that has a one percent annual chance of flooding to the base flood level (BFE) and is broken into different “flood zones” based on established versus unestablished BFEs and wave action. Base flood elevations are anticipated floodwater depths during a base flood (100-year flood). Broomes Island BFEs are five and six in the AE Zone and seven and eight in the VE Zone. The five, six, seven and eight “flood depths” usually mean “above sea level”² and is expressed by NAVD88, which is a system used by engineers and surveyors for relating ground and flood elevations³. BFEs governing a particular property may be found on Flood Insurance Maps (FIRMs) and on the Calvert County website. The FIRMs delineate the 100-year floodplain, flood zones and BFEs.

The AE Zone overlays the majority of the western and southern portion of the peninsula, and in many areas includes the Limit of Moderate Wave Action (LiMWA). The LiMWA is an area where wave action is anticipated and represents the approximate landward limit of a 1.5-foot breaking wave of the VE Zone (depicted with a

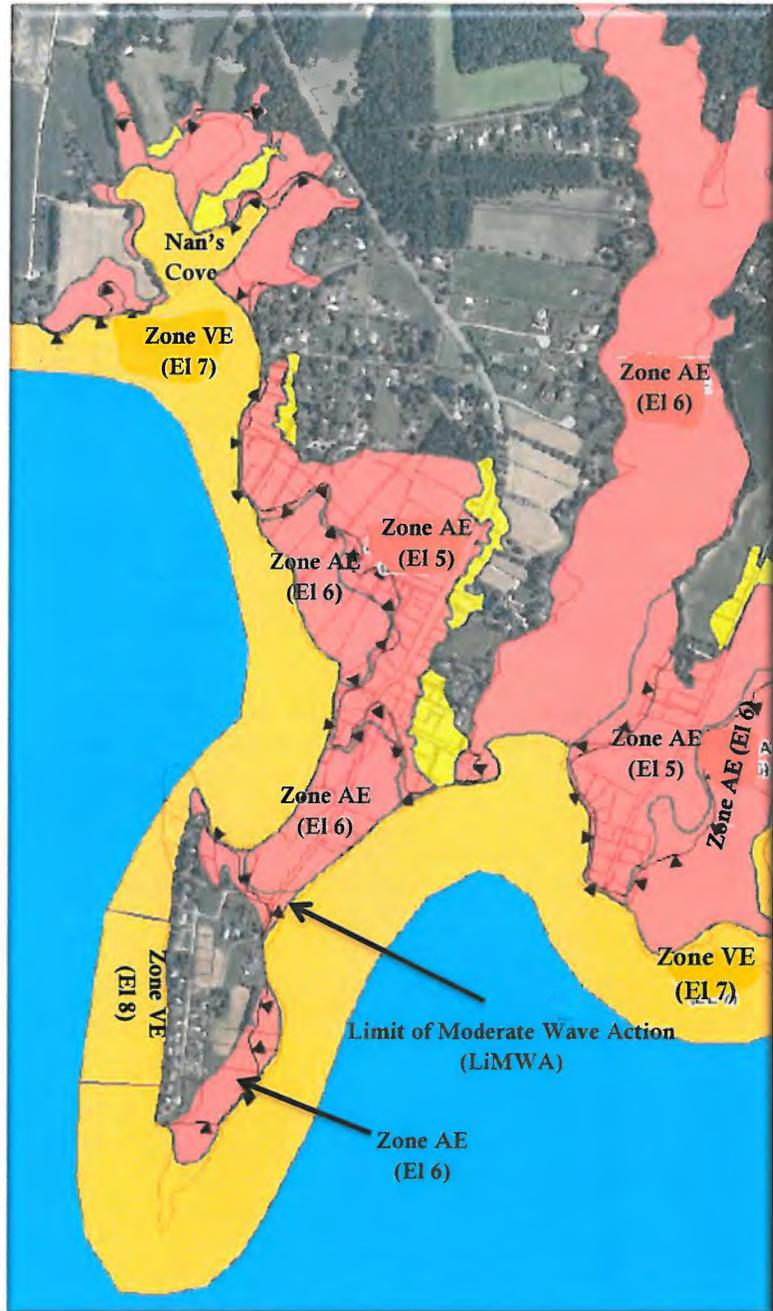


Figure 5: Broomes Island 100-Year Floodplain & LiMWA (approximate rendering)

Source: Calvert County Government

² Some inland communities' elevation records were developed using some other starting point. For example, Chicago NAVD88 started from the level of Lake Michigan.

³ Source: <http://www.fema.gov/media-library-data/e0431351fd0536694a66cef26268a694/440+NGVD-NAVD+5-09+508OK.pdf>.

line and triangles in Figure 5). The lower two-thirds and west side of Broomes Island is delineated with LiMWA, indicating the potential for waves to break from Nan’s Cove to the Broomes Island Road Causeway and on the eastern side of the peninsula’s southern tip. The VE Zone is adjacent to the entire shoreline of Broomes Island, depicting velocity and wave action of up to 3 feet landward. The remaining area in the floodplain is in the “0.2 percent annual chance flood” or the 500-year floodplain, which is not regulated (depicted in yellow in Figure 5). According to the Countywide FMP, the 71 flood-prone structures in Broomes Island have potential to:

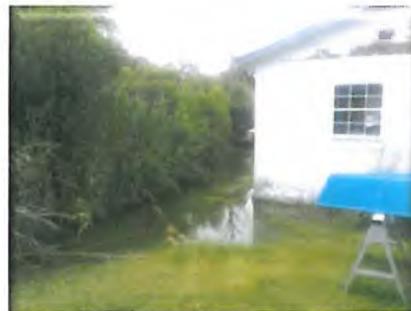
“.....sustain some damage, some severe, from a 100-year event, which will most likely come in the form of the storm surge of a tropical storm. Areas that are particularly at risk in Broomes Island include Patuxent Avenue, Songbird Lane and Broomes Island Road near Oyster House Road⁴.”

Flooding History

Over the years, Broomes Island has been impacted by storms, hurricanes and nor’easters. In October of 1954, Hurricane Hazel increased tides six to eight feet higher than normal. In 1955, Hurricane Connie dumped 9.5 inches of rain on the County and caused above normal tides. In 1996, Hurricane Fran brought high winds and surging tides to Broomes Island. In 2003, Hurricane Isabel caused a storm surge of five to nine feet above normal tide, washing away portions of Broomes Island’s southern tip⁴. Tropical Storm Ernesto in 2006 and heavy rain storms in 2008, 2012 and 2014 caused flooding on the peninsula, which flooded out portions of the Broomes Island Road adjacent to the wetlands/marshes, referred to as the “Broomes Island Road Causeway.” Residents south of the Broomes Island Causeway were stranded and several properties were flooded.



Photograph 1: 2011–Flooding at The Point at Broomes Island



Photograph 3: 2014-Ballard Rogers Road DPW Culvert Stormwater Conveyance Area Flooded



Photograph 2: 2012 – Flooding Oyster House Road



Photograph 4: 2014 – Wetlands by the Causeway/Broomes Island Road After Heavy Rains

⁴ Calvert County , MD Flood Mitigation Plan, 2011, p. 25.

Flooding Sources and Vulnerability Assessment

Contributing Factors

Significant contributing factors to Broomes Island's flooding vulnerability include:

- Low land elevations, primarily under ten feet;
- A high water table;
- Inadequate stormwater management to manage flooding; and
- The building of homes prior to the County's 1984 initial implementation of flood regulations and the more recently adopted 2011 and 2014 more stringent regulations.

Discussion of Contributing Factors

Land Elevations and High Water Tables

Due to low land elevations and high water tables, during heavy/prolonged rain events, Broomes Island generally floods along and south of the Broomes Island Causeway and along Songbird Lane. Many primary structures have been elevated somewhat; therefore, most of these structures only flood during the most intense flood events such as nor'easters, hurricanes and tropical storms. Some accessory structures are more apt to flood as fewer of these structures have been elevated. The majority of Broomes Island's land is less than ten feet in elevation and in most cases less than six feet in elevation. The AE Zone with an established BFE of five and six feet above sea level governs most of the peninsula, and many areas of Broomes Island have land elevations less than the established BFEs. Additionally, the water table is high, sitting just below the surface of storm drain openings under normal circumstances⁵.

Floodplain Regulations

Many structures on Broomes Island were built prior to the adoption of floodplain regulations and thus are more vulnerable. Over time floodplain regulations have become stricter. For example the law requires increased elevation of structures (higher freeboard, the required elevation of the first floor above the BFE), elevation of outside A/C units, anchoring of fuel tanks, increased venting requirements, etc. In 2011 and 2014, Calvert County adopted new floodplain regulations which complied with FEMA's concurrent National Floodplain Insurance Program (NFIP) and with MDE's and FEMA's model floodplain ordinance. These floodplain regulations are more stringent than those previously adopted, resulting in less flood vulnerability of new development and redevelopment over time. Examples of more stringent requirements include:

- Prohibition of structures in floodplain zones unless there is mitigation such as elevating the structure. Under previous regulations structures were allowed in the floodplain if the applicant could demonstrate no alternative, the structure could withstand 100-year floodplain wind and waves and no sand dune system would be impacted.
- Two feet of freeboard above the BFE. Under previous regulations, one-foot of freeboard was required.

⁵ As identified by Broomes Island residents at the May 17, 2014 public meeting and verified on field visits by Calvert County CPB ES and Calvert County DPW EHD.

Stormwater Management and Wetland/Flood Water Management

The County's DPW EHD and/or the SHA have installed culverts to convey stormwater into the Patuxent River with the exception of the storm drain on Patuxent Avenue (Figure 6)⁶. The culverts work properly unless there are heavy/prolonged periods of rain. Heavy/prolonged periods of rain, combined with high tides overwhelm the culverts. Water stagnates and floods localized areas, overwhelming stormwater conveyance systems in some instances. This is especially evident during the wet season, October through May. According to Broomes Island residents, this occurs along: (1) the Broomes Island Road Causeway where there is a culvert under the road connecting the adjacent wetlands to the Patuxent River; (2) the location where Ballard Rogers Road, Penkert Lane and River View Road converge; (3) Nan's Cove; and (4) Patuxent Avenue (site of the storm drain is on private property).



Source: Calvert County Government

The wetlands/marshes adjacent to Songbird Lane and the Broomes Island Road Causeway (Figure 7) provide some flood control, but they are overwhelmed during heavy/prolonged rain events or higher than normal high tides. In these instances the culverts and stormwater management measures do not function since they are inundated with water. Additionally, when flooding overcomes the Broomes Island Road Causeway, the southwestern most portion of Broomes Island is cut off from the remainder of the peninsula, making the southern point of Broomes Island truly an island until flood water recedes. Residents may be stranded for several days. On Songbird Lane, water floods the wetlands and the adjacent land on which homes are located.

⁶ The county asserts the stormwater drain and pipe located on the Patuxent Avenue site is legally the responsibility of the property owner since the county has no record of an easement granting the county access onto the property for maintenance purposes.

In an effort to assess the flood-vulnerable areas identified by residents, Calvert County CPB ES and SHA conducted site visits to State managed culverts/storm drains; and Calvert County CPB ES and Calvert County's DPW EHD conducted site visits to County maintained culverts/storm drains. CPB ES and DPW EHD also made a site visit to the privately maintained storm drain on Patuxent Avenue.

SHA manages Broomes Island Road from MD Route 4 southbound to Oyster House Road, which includes two culverts—one located at Nan's Cove (Photograph 5) and one located north of Oyster House Road (Photographs 6 and 7). Upon inspection, both culverts appeared to be working properly. At Nan's Cove, the culvert was clear of debris and the stormwater pond appeared to be working properly. Land elevation is approximately ten feet at this location and the BFE is six. Given the current conditions, there is no recommended flood mitigation measure for these locations other than periodic inspections and maintenance of the culverts.



Location of culvert



Photograph 5: SHA Nan's Cove Storm Drain, July 31, 2014

Source: Calvert County Government

In addition, SHA and the Calvert County CPB ES inspected the culvert located north of Oyster House Road (Photographs 6 and 7), and by its appearance, it appeared to be working properly. Portions of Oyster House Road will flood during periods of heavy/prolonged rain, and more so when coupled with high tide—oftentimes coming perilously close to homes (Photograph 8).

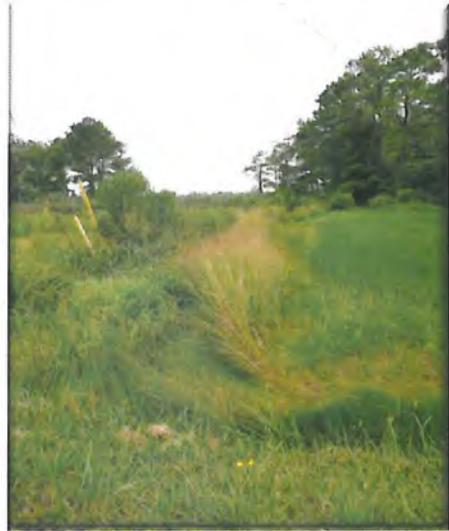
Land elevations along Oyster House Road range from 1.5 feet to 6.4 feet. Most of Oyster House Road is below five feet in elevation. Base flood elevations are five. Given the low land elevation and high water table, the recommended flood mitigation measure along Oyster House Road is to elevate structures. In October 2014, SHA flushed out the Broomes Island Road culvert (just north of Oyster House Road) to ensure water is able to flow freely. The culvert at Nan's Cove was checked by SHA, but did not need flushing.

Calvert County's DPW EHD maintains Broomes Island Road south of Oyster House Road. Calvert County CPB ES and Calvert County DPW EHD conducted a site visit on July 31, 2014, to the Broomes Island Road Causeway, Songbird Lane, Patuxent Avenue and the interconnected stormwater management for Ballard Rogers Road, Penkert Lane and River View Road in an effort to assess flood-prone areas identified by residents.

On Patuxent Avenue, a storm drain backs up onto a property, causing standing water during heavy/ prolonged rains and/or high tide. The land elevation is four feet and the BFE is five. The water table is high at the location of the storm drain, with the water level normally lying just below the surface of the drain opening. At high tide there is nothing to keep tidal water from backing up through the drain to flood a portion of the property. There is no record of an easement for County access to the property; therefore, the County assumes it is the responsibility of the property owner to maintain the drain. The recommended flood mitigation measure is to elevate structures on this property and for the property owner to have an elevation study of the drainage system performed. If indicated by the study, it is also recommended that a one-way valve be installed on the bulkhead to prevent water from backing up through the drain and flooding the surrounding area.



**Photograph 6: SHA Culvert –
North of Oyster House Road**



**Photograph 7: SHA Culvert –
Water Drainage to Patuxent River –
Oyster House Road
(across the street from culvert pictured in
Photograph 6)**



**Photograph 8: High Tide,
Oyster House Road
August 12, 2014**

On Songbird Lane which is adjacent to wetlands/marshes, low land elevations of 1.5 feet to 2.8 feet contribute to the flooding. There is no drainage system from the wetlands/marshes to the river. The whole area is in the 100-year floodplain and the BFE is five or six depending upon the location. The recommended flood mitigation measure is to elevate or demolish structures along Songbird Lane.

Along the Broomes Island Road Causeway land elevations are under three feet and the BFE is six. Upon inspection of the culvert within the wetlands/marshes adjacent to the Broomes Island Road Causeway, the culvert appears to be working properly. The culvert drains stormwater from the wetlands/marshes on the southeast side of the Broomes Island Road Causeway back into the Patuxent River through the marshes on the northwest side of the Broomes Island Road Causeway. However, during times of heavy/prolonged rains and/or high tides, the culvert becomes submerged and thus ineffective. Calvert County's DPW EHD developed two options to consider for flood mitigation of the Broomes Island Road Causeway, which are presented below.

Option 1- Raise Broomes Island Road Causeway by two feet for a length of 1,558 linear feet: Raise 4,368 linear feet of Broomes Island Road, including 1,558 linear feet of the Broomes Island Causeway for a total of linear 5,926 feet by 4.5 feet. This project will likely trigger a review by the: U.S. National Fish and Wildlife Service (USFWS) for otter/muskrat crossings; USACE and MDE for a Joint Federal/State Wetlands and Waterways Permit and a wetland delineation; DNR and USFWS for rare, threatened and endangered species (RTEs); U.S. Department of the Interior depending upon the extent of the impact to RTEs, if any, for a Takings Permit and the preparation of a protection plan; and the Maryland Chesapeake Bay Critical Area Commission for impacts to the critical area 100-foot buffer, wetlands, otter crossing and for the preparation of a protection plan. Other reviews may be required. The estimated cost of elevating the Broomes Island Road Causeway by two feet for 1,558 feet was \$775,000⁷. The costs for the otter/muskrat crossings study, protections plans, etc. and the associated permits need to be determined and factored into the overall cost.

Important to note is the land elevations adjacent to the Broomes Island Causeway are zero to two feet and the BFE is six. Due to low land elevations relative to the Patuxent River's water level and a BFE of six, elevating the Broomes Island Road Causeway by two feet will not alleviate flooding that occurs presently.

⁷ The cost estimate includes the costs to physically elevate the road, engineering and the preparation of wetland delineation. Additional costs will need to be factored in for permit reviews and requirements. The road improvement cost estimate was developed by Calvert County's DPW EHD.

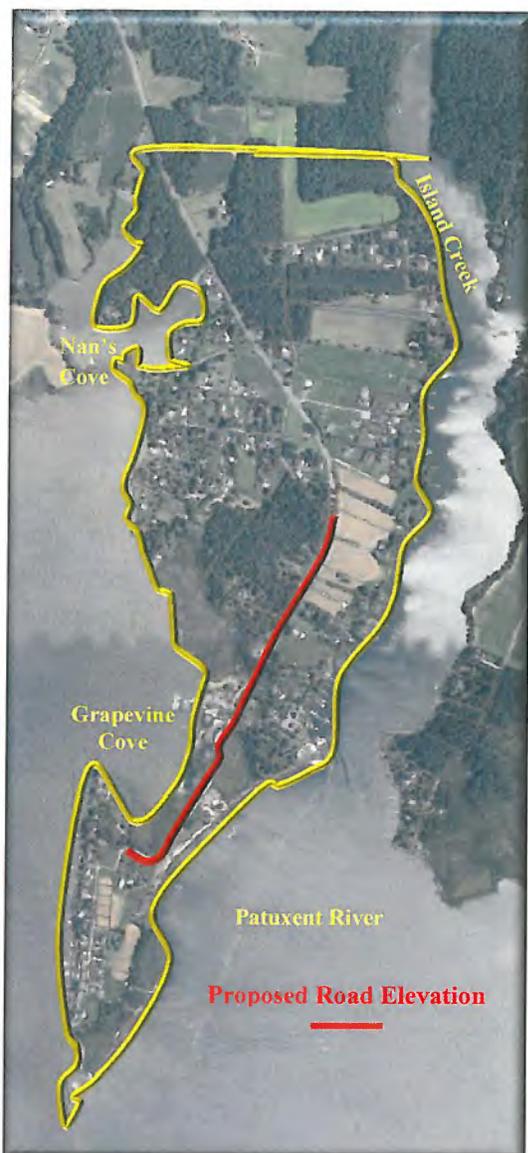


Figure 8: Proposed 4.5-Foot Elevation of Broomes Island Road Causeway

Option 2 - Raise Broomes Island Road Causeway by 4.5 feet for a length of linear 5,926 feet: Raise 4,368 linear feet of Broomes Island Road, including 1,558 linear feet of the Broomes Island Causeway for a total of linear 5,926 feet by 4.5 feet (Figure 8.) The same conditions apply to raising the road 4.5 feet as if raising the road two feet (see above under Option #1) including but possibly not limited to permitting, engineering, preparing a wetland delineation, etc. The estimated cost of elevating this section of the roadway by 4.5 feet is \$1.5 million⁸. Elevating the Broomes Island Road Causeway by 4.5 feet will alleviate flooding during heavy/prolonged rain events; however, it may not remain dry for more severe events such as a hurricane or nor'easter. It is recommended that the Broomes Island Road and Broomes Island Road Causeway be raised by 4.5 feet and for a total length of 5,926 linear feet. Funding options will need to be explored (i.e. road tax district).

In the area where Ballard Rogers Road, Penkert Lane and River View Road converge, stormwater management is an issue (Figure 9). During times of heavy/prolonged rain and high tide, water levels rise above the pipe located in the revetment at the western end of Ballard Rogers Road. This pipe (labeled as "pipe" in Figure 9) normally conveys stormwater into the Patuxent River, but backs up during heavy/prolonged rain events and high tides, flooding the area depicted as "Area B" in Figure 9. When the backup is severe, stormwater is conveyed (green arrow in Figure 9) through a grassed swale and storm drain to the uplands and wetlands depicted in "Area A." When stormwater conveys from "Area B" to "Area A" the

water velocity is fast enough that the water flow slowly erodes land located within the "Area A" stormwater conveyance area. In addition, during high tide, and especially when combined with heavy/prolonged rain events, water will back up in "Area A" through an opening in the bulkhead. The opening in the bulkhead is required by MDE to maintain the existing wetland behind the bulkhead. The water flowing through the opening in this bulkhead flows into "Area A." In these instances and when there is flow from "Area B," the back flow floods the septic drainage field of the house east of "Area A." Owners of this property report issues with disposal of water during high water level events including high tides.



The County is working with the property owners of the parcel where Area A conveys stormwater to the Patuxent River. The County has determined that the septic system is failing because it is not water tight, which deems the property owners eligible for a septic system replacement funded through the BRF grant program. The County manages the BRF program, which funds the retrofit of existing conventional septic systems with nitrogen-removing septic systems. Failing septic systems located in the Chesapeake Bay Critical Area have top priority (other eligibility criteria apply). The recommended mitigation measure is to alleviate septic system issues exacerbated by flooding and excessive stormwater by replacing the existing septic system with a new water-tight, nitrogen-removing septic system funded by the BRF grant program. The County anticipates that once the septic system is replaced, water disposal will no longer be an issue except at times of extreme flooding. It is recommended that a study be conducted to identify stormwater management measures that may be implemented to help alleviate flooding in this area.

Vulnerability Assessment

As indicated previously and according to the Calvert County FMP, 71 structures are vulnerable to flooding on Broomes Island. Table 1 provides a breakdown of the potential damage for the 71 structures based on a 100-year flood event.

**Table 1: Calvert County Flood Mitigation Plan
Vulnerability Assessment of Broomes Island**

<i>Number of Structures</i>	<i>Predicted Structure Damage</i>	<i>% of Total Structures</i>
5	0%-10%	6
34	11%-25%	49
27	26% to 50%	39
5	51% to 76%	6

Source: Calvert County Flood Mitigation Plan (2011), p. 27.

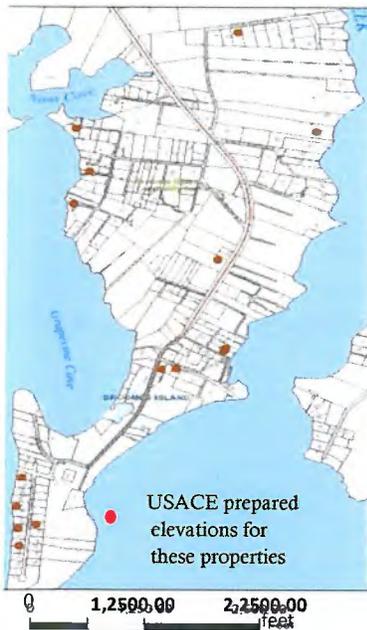


Figure 10: Broomes Island Elevation Assessment Inventory

As a supplemental effort to assess flood vulnerability, USACE worked with the County conducting elevation assessments for property owners in the most flood-prone areas of the County. After contacting property owners in Broomes Island, Cove Point, Solomons and Hallowing Point, USACE was permitted to conduct more than 90 elevation assessments. In Broomes Island, USACE was given permission to conduct 15 elevation assessments (Figure 10). The assessments were conducted in February and June of 2013.

As discussed previously, the BFE for the majority of Broomes Island is five or six. Of the 15 houses assessed, all structures have lowest openings (door or vent) and/or lowest adjacent land above but close to the BFE. Historical flood trends and personal accounts indicate that some homes have been elevated slightly but not enough to remain safe from severe storm events that cause flooding. Additionally, as stated previously, in areas like Oyster House Road, flood water comes dangerously close to structures after prolonged/heavy rain, and especially so when combined with high tides.

Repetitive Loss Properties

Repetitive loss properties are strong indicators of areas/properties prone to flooding and in need of flood mitigation measures. Repetitive loss properties are insurable properties for which owners have submitted two or more claims to FEMA and for which the NFIP has paid at least \$1,000 to the homeowner within a 10-year period. According to FEMA's most recent data, one repetitive loss property, which has not been elevated, exists in Broomes Island. The presence of one repetitive loss property supports the accounts by residents that primary structures do not typically flood on Broomes Island. More severe storm events such as a nor'easter, hurricane or tropical storm were likely the cause for the one repetitive loss property. It is also reasonable to conceive that other structures have flooded during more severe storm events, but claims were not filed.

Repetitive Loss Areas

Repetitive loss areas contain repetitive loss properties and the 100-year floodplain adjacent to a repetitive loss property. Under the County's Community Rating System (CRS, see below) participation, the portion of Broomes Island that is located in the 100-year floodplain has been designated as a repetitive loss area.

Community Rating System

The CRS program is FEMA's voluntary program aimed at lowering floodplain insurance premiums for property owners who own property within the 100-year floodplain. Premiums are lowered through a point system based upon the participating jurisdiction's flood management actions under the CRS program. FEMA approved the County's participation in the CRS Program at a level eight, resulting in a 10 percent reduction in residents' flood insurance premiums for structures located in a flood hazard area. The 10 percent premium reduction began for new or renewed policies on May 1, 2015. First floor of structures not elevated above the current BFE are considered noncompliant and ineligible for the CRS insurance premium reduction.

Calvert County participates in the CRS program through the following activities:

- **Map Information Services:** Interactive geographical information system (GIS) mapping indicating in which flood zone a property lies, if the property is designated with LiMWA, flooding depths, etc.
- **Open Space and Preservation:** An inventory of designated open space or preserved lands within the 100-year floodplain that is governed by the Calvert County Zoning Ordinance.
- **Flood Management Planning:** Verification that the County has a countywide flood mitigation plan complying with the Federal Hazard Act of 2000.
- **Repetitive Loss Area Outreach:** Outreach to property owners with properties located within repetitive loss areas.
- **Elevation Certification:** Certification that the floodplain manager reviews permits triggering the need to elevate structures, and ensures that elevation certificates are completed and kept on file.

Sea Level Rise Scenarios

Sea Level Rise Scenarios for 2050 and 2100

While there is disagreement amongst scientists about what causes sea level rise, contributing factors have been attributed to human-induced global warming, natural geological and climate changes and land subsidence. Regardless of the cause, the primary impacts are evident—increased coastal and nuisance flooding, higher tides, increased storm surges, intensified coastal erosion, wetland inundation, salt water intrusion of wells and septic system failures. For property owners, coastal flooding and nuisance flooding are safety issues and a property devaluation issue.

According to the Scientific and Technical Working Group of the Maryland Climate Change Commission in its 2013 report, “Updating Maryland’s Sea Level Rise Projections,” determining sea level rise in Maryland involves consideration of the following factors that are capable of producing a range of outcomes:

- The regional differences in sea level rise with regard to ocean dynamics associated with the decline in the strength of the Gulf Stream. It is uncertain as to whether the trends in the decline of the Gulf Stream will continue into the future and if other ocean dynamics play a role in sea level rise⁸.
- Vertical land movement (land subsidence), which is determined by several complicated and variable factors. In addition, in Maryland, vertical land movement can be greatly influenced by sedimentation compaction and groundwater withdrawal effects⁹.
- Changes in tidal range and storm surges due to inundation, which is influenced by water depth and the effect that water depth has on frictional resistance. Frictional resistance is lessened in deeper water, increasing the tidal range when the tide or a storm surge hits the shorelines¹⁰.
- The increase in the global mean sea level rise, which is influenced by the expansion of ocean volume caused by the melting of the Greenland and Antarctic ice sheets. The rate at which these ice sheets melt and the distribution of this water influences global mean sea level rise¹¹.

The report recommends planning for a relative sea level rise of 2.1 feet by 2050; 3.7 feet by 2100 (minimum 2100 scenario); and 5.7 feet by 2100 (maximum 210 scenario) if the built environment is to function beyond 2050 and/or 2100. Planning and mitigating for sea level rise is a locality’s decision which should be based on the service goals and objectives for its infrastructure and public facilities, and the occurrence and flooding frequency of such infrastructure and public facilities. For example, SHA currently performs feasibility studies using a 2.1-foot increase in sea level rise by 2050 and a 5.7-foot sea level rise by 2100¹².

⁸ Source: Updating Maryland’s Sea Rise Projections (2013) p. 12 (website source: <http://www.umces.edu/sites/default/files/pdfs/SeaLevelRiseProjections.pdf>).

⁹ Source: Updating Maryland’s Sea Rise Projections (2013) p. 13 (website source: <http://www.umces.edu/sites/default/files/pdfs/SeaLevelRiseProjections.pdf>).

¹⁰ Source: Updating Maryland’s Sea Rise Projections (2013) p. 14 (website source: <http://www.umces.edu/sites/default/files/pdfs/SeaLevelRiseProjections.pdf>).

¹¹ Source: Updating Maryland’s Sea Rise Projections (2013) p. 15 (website source: <http://www.umces.edu/sites/default/files/pdfs/SeaLevelRiseProjections.pdf>).

¹² Source: A Maryland State Highway Administration letter dated February 22, 2016, concerning the elevation of a segment of MD 261 in North Beach.

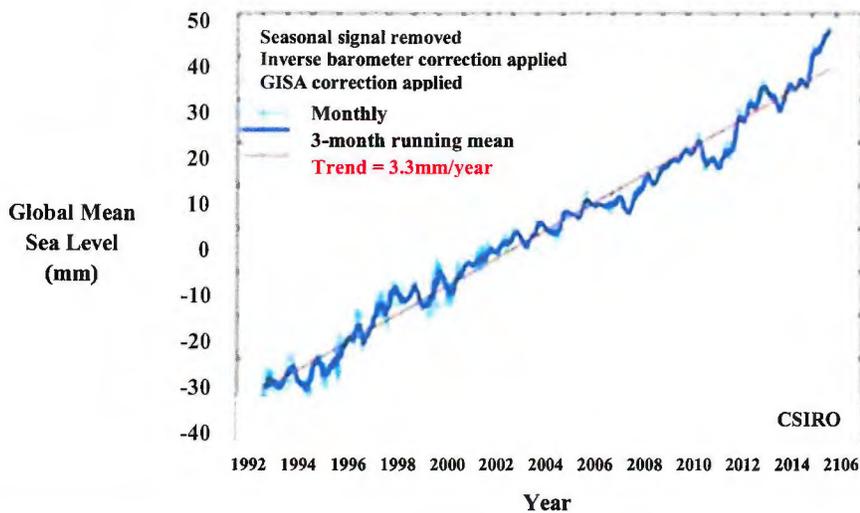
Sea Level Rise Scenarios and Shoreline Vulnerabilities

On the following pages is information about: global and East Coast sea level rise trends (Figures 11A and 11B); Calvert County’s 2050 100-year floodplain scenario (Figure 12); wetland migration scenarios (Figures 13A-13C); high tide vulnerability (Figure 14); storm surge vulnerability (Figure 15); shoreline erosion rates (Figure 16); and shoreline rates of change (Figure 17).

Figure 11A: Global Sea Level Rise Trends

**Global Mean Sea Level Rise
National Oceanic Atmospheric Administration**

GMSL from TOPOX/Poseidon, Jason-1 and Jason-2 satellite altimeter data

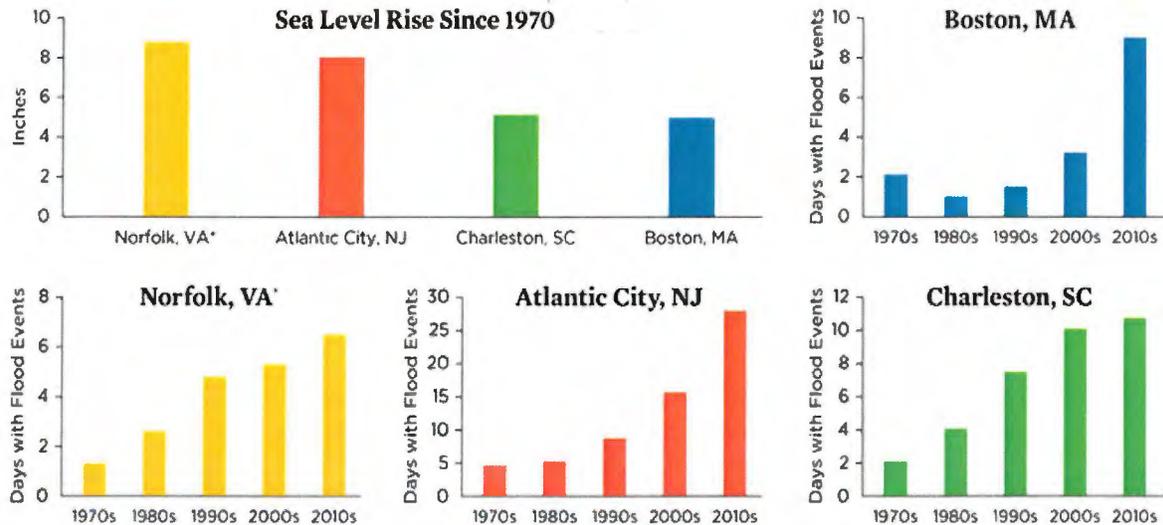


Source: Oceans and Atmosphere Flagship and the Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC) (website source: http://www.cmar.csiro.au/sealevel/sl_hist_last_decades.html).

Global trends indicate that between 1993 and 2015, sea level rose 3.3 millimeters (mm) per year, which equates to 2.8 feet (Figure 11A).

Figure 11B: East Coast and Solomons Island Sea Level Rise Trends
National Oceanic Atmospheric Administration

Local Sea Level Rise and Tidal Flooding, 1970–2012

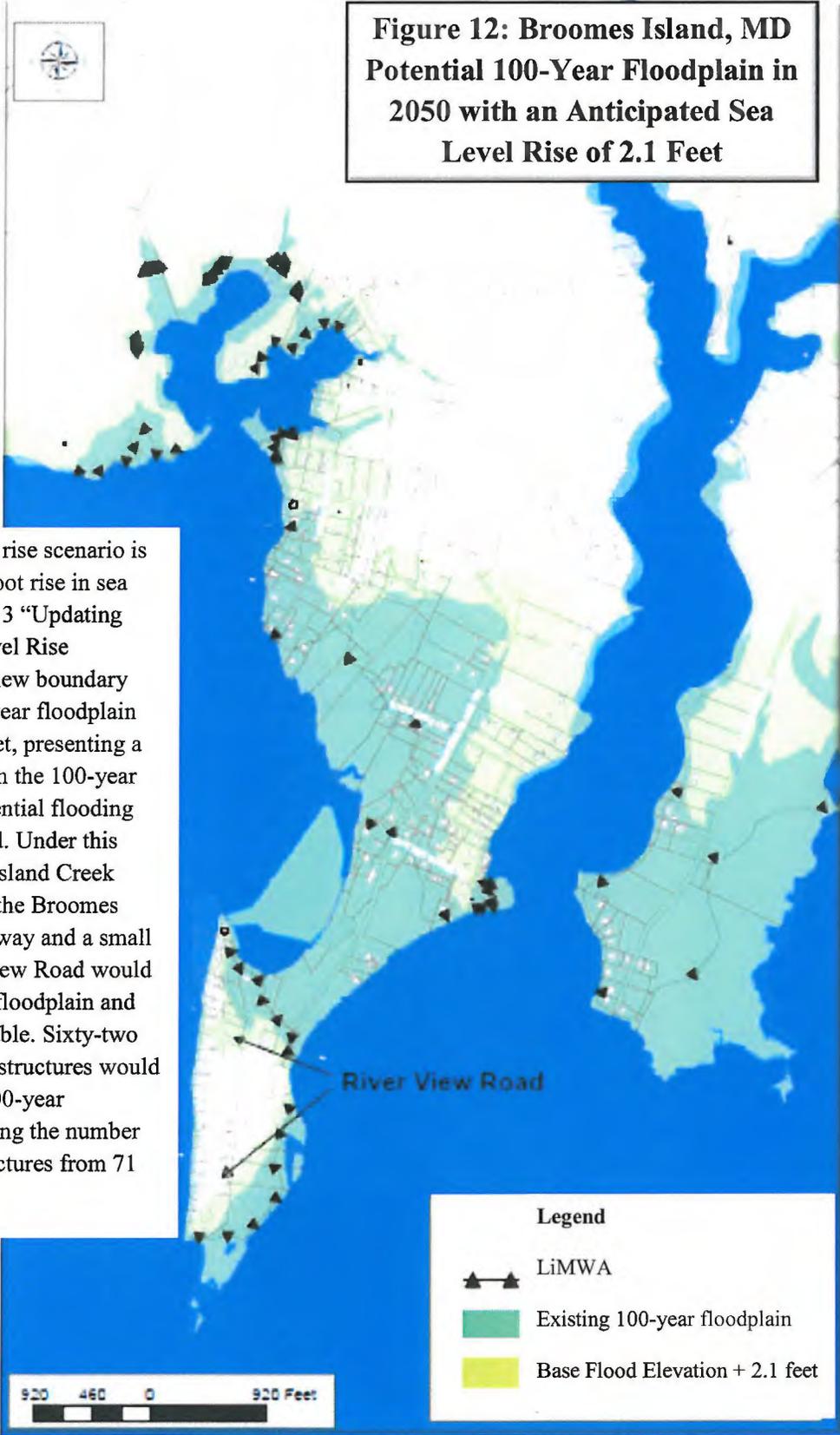


*Norfolk statistics recorded at Sewells Point tide gauge © Union of Concerned Scientists 2014.

Source: Norfolk statistics recorded at Sewells Point tide gauge © Union of Concerned Scientists 2014 (website source: www.ucsusa.org/encroachingtides). Data sources: UCS ANALYSIS: MORALES AND ASHEIMER 2014; NOAA AND CURRENT 2014; NOAA TIDES AND CURRENTS 2013B.

According to NOAA, sea level has risen by about 3.5 inches globally—but more along the East Coast since 1970. At Sewells Point, VA, for example, sea level has raised more than eight inches, and in Boston, approximately five inches. Rising seas mean that communities up and down the East and Gulf Coasts are seeing more days with tidal flooding. Charleston, South Carolina, for example, faced two to three days with tidal flooding a year in the 1970s. The city now averages 10 or more such days annually. East Coast trends (Figure 10B) show an increase in local sea level rise, ranging from four plus inches to eight plus inches; and an increase in flood event days annually, ranging from a two-day increase in number to 10-day increase in Boston, Norfolk, Atlantic City and Charleston. According to NOAA's data on sea level, Solomons Island has seen a 3.72 mm/year increase in sea level between 1937 and 2014, which equates to nearly one-foot in 78 years. Trends indicate sea level rise will progressively increase over time.

**Figure 12: Broomes Island, MD
Potential 100-Year Floodplain in
2050 with an Anticipated Sea
Level Rise of 2.1 Feet**



The 2050 sea level rise scenario is based upon a 2.1-foot rise in sea level as per the 2013 “Updating Maryland’s Sea level Rise Projections.” The new boundary increases the 100-year floodplain elevation by 2.1 feet, presenting a potential increase in the 100-year floodplain and potential flooding by a 100-year flood. Under this scenario, south of Island Creek Lane to the end of the Broomes Island Road Causeway and a small portion of River View Road would be in the 100-year floodplain and more flood-vulnerable. Sixty-two additional primary structures would be located in the 100-year floodplain, increasing the number of flood-prone structures from 71 to 133 (Figure 12).

Source: Calvert County Government

The 2100 sea level rise scenario is based upon a 3.4-foot rise in sea level as per DNR's Coastal Atlas. At the time This Plan was written, DNR's Coastal Atlas reflects sea level rise scenarios presented in Maryland's 2008 Climate Action Plan¹³. Under the 2100 sea level rise scenario, vulnerable primary structures could increase by 125 or from 71 to 196 vulnerable primary structures. Impacted roadways and lands are generally located south of Island Creek Road.



Photograph 9: Broomes Island 2016



Photograph 10: Broomes Island 2016



Photograph 11: Broomes Island 2014

¹³ Source: Maryland's 2008 Climate Action Plan (2008) (website source: <http://www.mde.state.md.us/programs/Air/ClimateChange/Pages/Air/climatechange/legislation/index.aspx>).

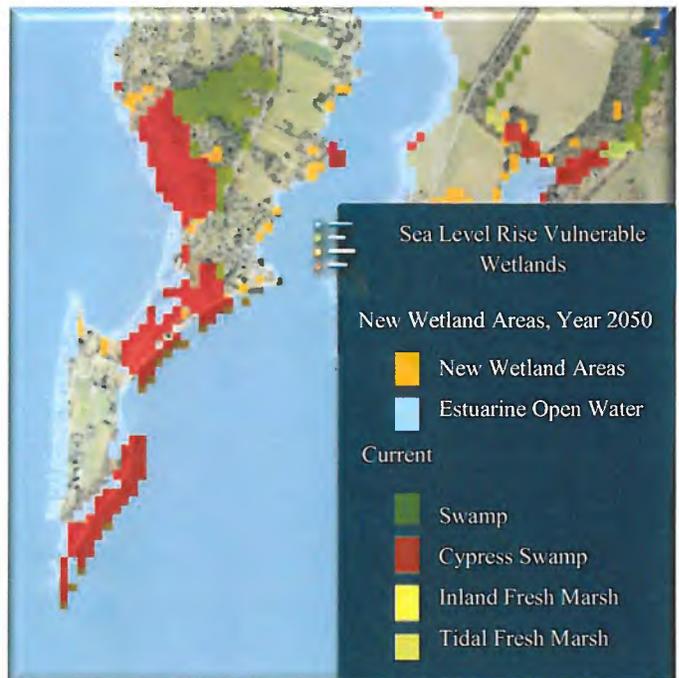


**Figure 13A: Broomes Island
Current Wetlands**

Figure 13A to the left shows wetlands in their current state (red and green). Cypress swamp and swamp wetlands exist on Broomes Island.

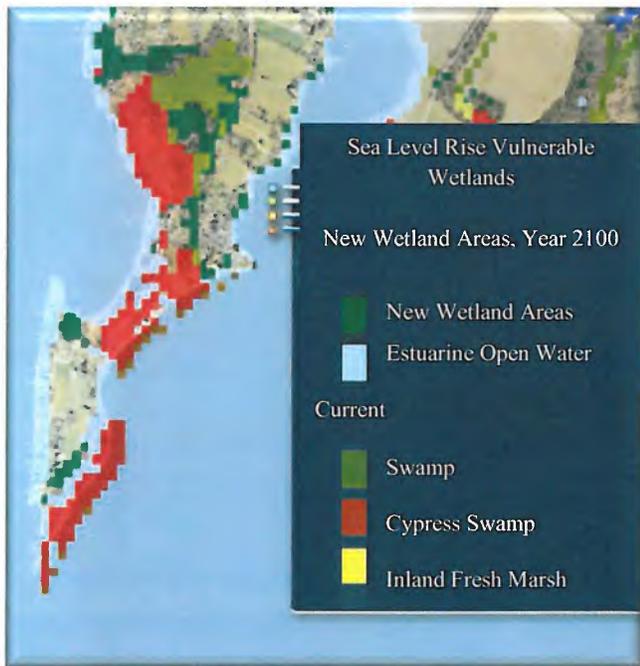
Figure 13B below shows current and new wetlands by 2050 based upon a 1.3-foot rise in sea level (orange).

Figure 13C to the bottom left shows current and new wetlands by 2100 based upon a 3.4-foot increase in sea level (dark green).



**Figure 13B: Broomes Island
New Wetlands by 2050
(assuming a 1.3-foot increase in sea level)**

Wetland migration could consume portions of Patuxent Avenue, Church Road and School Road and land areas west of Broomes Island Road including the Broomes Island Causeway. If the scenario of a sea level rise of 3.4 feet by 2100 is realized, all current wetlands could be under water.



**Figure 13C: Broomes Island
New Wetlands by 2100
(assuming a 3.4-foot rise in sea level)**

Source: DNR Coastal Atlas (website source: <http://gisapps.dnr.state.md.us/coastalatlus/WAB/index.html>).
DNR Coastal Atlas reflects sea level rise scenarios presented in Maryland's 2008 Climate Action Plan.

The Broomes Island High Tide Inundation Vulnerability Map (Figure 14) shows areas vulnerable to flooding during high tide. According to residents' descriptions of high tide, this map represents current circumstances with the exception of high tide on Oyster House Road. High tide tends to flood the properties along Oyster House Road, and even more so after heavy/prolonged rains coupled with high tide.



Figure 14: Broomes Island High Tide Vulnerability

Source: DNR Coastal Atlas (website source: <http://gisapps.dnr.state.md.us/coastalatlus/WAB/index.html>).



Figure 15: Broomes Island Storm Surge Vulnerability

Source: DNR Coastal Atlas (website source: <http://gisapps.dnr.state.md.us/coastalatlus/WAB/index.ht>)

The Broomes Island Storm Surge Vulnerability Map (Figure 15) shows storm surges ranging from a Category 1 to a Category 4 hurricane. According to the Coastal Atlas, Category 1 hurricane events may flood the Broomes Island Road Causeway and the wetlands/marshes along Songbird Lane. In addition to the Broomes Island Road Causeway and wetlands/marshes adjacent to Songbird Lane, Category 2 hurricane surges may flood Patuxent Avenue and Oyster House Road in their entirety. Category 3 and Category 4 hurricanes may flood the bottom two-thirds of the peninsula, generally south of Fish Hook Road to the southern tip.



Figure 16: Broomes Island Erosion Rate Map

Source: DNR Coastal Atlas (website source: <http://gisapps.dnr.state.md.us/coastalatlus/WAB/index.html>).

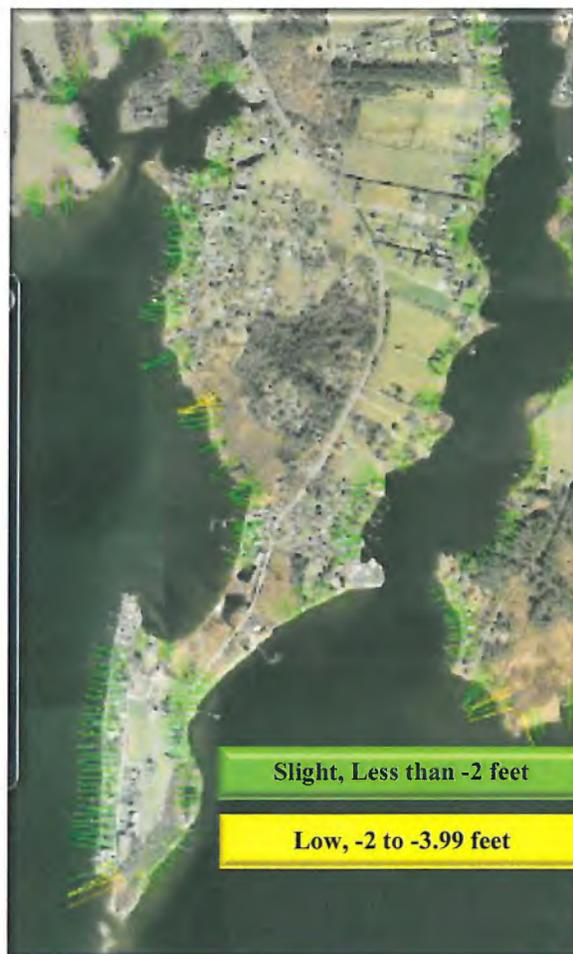


Figure 17: Broomes Island Shoreline Rates of Change Map

Source: DNR Coastal Atlas (website source: <http://gisapps.dnr.state.md.us/coastalatlus/WAB/index.html>)

The Broomes Island Erosion Rate Map (Figure 16) shows areas vulnerable to erosion and areas that are likely to experience accretion. Broomes Island experiences erosion primarily with a few areas of accretion. While erosion does occur along Broomes Island's shorelines, it is at a slight to low rate, as indicated by Shoreline Rates of Change Map (Figure 17).

What does the above mean to Broomes Island's flood vulnerability during a 100-year storm event by 2050? By 2100?

Comparing the 2050 2.1-foot sea level rise scenario (Figure 12) with the current 100-year floodplain boundaries (Figure 5), the number of flood-prone structures could increase from 71 to 133 and roadways/segments of roadways south of Island Creek Lane to the end of the Broomes Island Road Causeway and a small portion of River View Road would be in the 100-year floodplain and more flood-vulnerable. Comparing the 2100 3.4-foot sea level rise scenario with the current 100-year floodplain boundaries (Figure 5), the number of flood-prone structures could increase from 71 to 196 and impacted roadways and lands would generally be located south of Island Creek Road.

Do Visuals Affect Residents' Perception of Increasing Sea Level Rise Impacts?

A study was conducted by Beth Olsen in 2012, a doctoral candidate at the University of Maryland using Broomes Island residents and Cove Point Community residents. This study used GIS and the most up-to-date flood data available to explore three flood risk scenarios: (1) historic flooding; (2) future risk; and (3) worst case scenario 50 years out. The study was designed to determine if people are more willing to purchase flood insurance if visual aids show impacts of flood water and sea level rise increases 50 years into the future versus people who have no visual aids. Olsen and her team held a meeting with Broomes Island residents using GIS/visual aids. Olsen and her team also held a separate meeting with Cove Point Community residents using no visual aids. While the results of the study have not yet been published, observations of residents' reactions about flood and sea level rise scenarios indicate that residents are well aware of the possibility of higher flood water in the future. While the residents could not quantify their expectations exactly, both Cove Point Community and Broomes Island residents expressed interest in flood mitigation measures such as elevating their homes. Residents in both communities have experienced numerous flood events.

Sea Level Rise: Maryland's Climate Action Plan

The County may want to increase freeboard, this increasing the Flood Protection Elevations (FPE) to mitigate for the Maryland Commission on Climate Change's 2013 sea level rise scenarios: 2.1 feet (2050), 3.7 feet (2100 minimum) and/or 5.7 feet (2100 maximum). The FPE is the BFE plus the freeboard requirement. Below is Tables 2A-2C indicating the recommended increase in freeboard and FPE.

Table 2A: Broomes Island
Current Flood Protection Elevations & Potential Flood Protection Elevations
Factoring in the 2.1-Foot Rise Sea Level Rise by 2050

<i>Current Base Flood Elevation (NAVD88)</i>	<i>Current Flood Protection Elevation with Current Freeboard Requirement: 2 Feet (NAVD88)</i>	<i>Potential Base Flood Elevation with 2050 Increase in Sea Level: 2.1 Feet (NAVD88)</i>	<i>Recommended Freeboard Requirement for BFE of 4: 2050 Scenario (NAVD88)</i>	<i>Potential Flood Protection Elevation for BFE of 5: 2050 Scenario (NAVD88)</i>
AE 5	7	7.1	3	8
AE 6	8	8.1	3	9
VE 7	9	9.1	3	10
VE 8	10	10.1	3	11

Table 2B: Broomes Island
Current Flood Protection Elevations & Potential Flood Protection Elevations
Factoring in the 3.7-Foot Rise Sea Level Rise by 2100

<i>Current Base Flood Elevation (NAVD88)</i>	<i>Current Flood Protection Elevation with Current Freeboard Requirement: 2 Feet (NAVD88)</i>	<i>Potential Base Flood Elevation with 2100 Increase in Sea Level: 3.7 Feet (NAVD88)</i>	<i>Recommended Freeboard Requirement for BFE of 4: 2100 Scenario (NAVD88)</i>	<i>Potential Flood Protection Elevation for BFE of 5: 2100 Scenario (NAVD88)</i>
AE 5	7	8.7	4	9
AE 6	8	9.7	4	10
VE 7	9	10.7	4	11
VE 8	10	11.7	4	12

Table 2C: Broomes Island
Current Flood Protection Elevations & Potential Flood Protection Elevations
Factoring in the 5.7-Foot Rise Sea Level Rise by 2100

<i>Current Base Flood Elevation (NAVD88)</i>	<i>Current Flood Protection Elevation with Current Freeboard Requirement: 2 Feet (NAVD88)</i>	<i>Potential Base Flood Elevation with 2100 Increase in Sea Level: 5.7 Feet (NAVD88)</i>	<i>Recommended Freeboard Requirement for BFE of 4: 2100 Scenario (NAVD88)</i>	<i>Potential Flood Protection Elevation for BFE of 5: 2100 Scenario (NAVD88)</i>
AE 5	7	10.7	6	11
AE 6	8	11.7	6	12
VE 7	9	12.7	6	13
VE 8	10	13.7	6	14

Potential Mitigation Measures

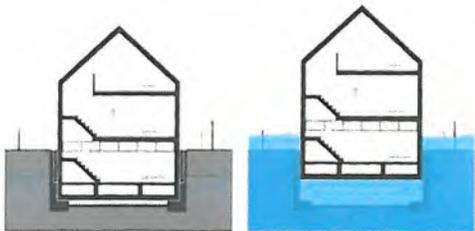
Options to mitigate flooding can range in depth and scope, and may include but are not limited to floodable development including amphibious structures and floating neighborhoods; barriers; coastal armoring; elevating the height of land in combination with coastal armoring; living shorelines; elevating structures; and/or demolishing structures and retreating and allowing the land to transition to its natural state.

Floodable Development including Amphibious Homes and Floating Neighborhoods

Floodable development can utilize techniques such as amphibious homes, floating neighborhoods, low impact development techniques and underground water storage tanks. For Broomes Island, the high water table is a challenge for anchoring and stabilizing underground storage tanks. Low impact development techniques can refer to site design and to stormwater management. In this context, low impact development refers to incorporating the natural landscape and resource lands into site design.

Floodable development techniques such as amphibious homes and floating neighborhoods may present feasible and preferable mitigation measures for some of Calvert's flood-prone communities into the future. The Netherlands, with two-thirds of its land below sea level, is a leader in utilizing such techniques. Amphibious homes have concrete foundations anchored below the ground's surface and are designed to become buoyant when water rise, allowing the home to elevate with flood water. Once flood water recedes, the home lowers back into its resting place (Graphics A and B).

**Graphic A: Amphibious Home
Example #1**

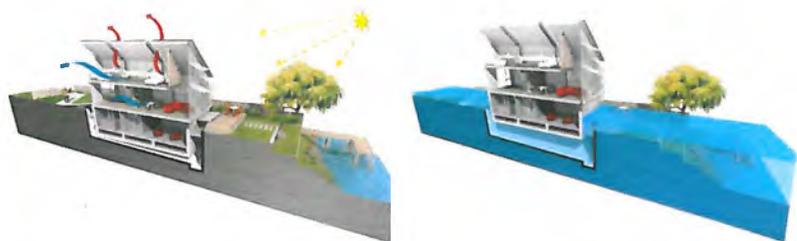


Resting Position

Flood event

In an extreme flood the house can rise over 2.5 meters.

**Graphic B: Amphibious Home
Example #2**



During a flood situation the entire building is designed to rise up in its dock and float there, remaining buoyed by the flood water.

Source: <http://thetechjournal.com/development/uks-first-amphibious-house-a-floating-pontoon.xhtml/attachment/uks-first-amphibious-house>

**Graphic C: Amphibious Home
Example #3**



Source: <http://www.inspirationgreen.com/floating-homes.html>

The amphibious home concept is used for a home on the Mississippi River with foam blocks under the home and guideposts on each corner of the house to keep it anchored (Graphic C).

Floating neighborhoods is another flood mitigation measure. Floating neighborhoods utilize boardwalks for sidewalks (Graphic D). The floating neighborhood below consists of 75 homes. If these mitigation measures are utilized, policies and regulations for amphibious homes and floating neighborhoods need to be developed.

**Graphic D: Floating Neighborhood
Example #1**



Source: <http://www.care2.com/causes/5-amphibious-houses-built-to-survive-the-coming-floods.html>

Barriers

Storm surge barriers are typically used at the mouth of a tidal waterway and attempt to decrease the linear feet of shoreline needing flood protection. These barriers are typically large in scale and are not suitable for small flood-prone communities such as Broomes Island. The Netherlands uses a storm surge barrier, the Maeslantkering, which is the largest in the world (Graphic E).



Figure 18: Groin Field & Bulkheads in the Breezy Point and Neeld Estate

Source: Calvert County Government

Graphic E: The Netherlands: Maeslantkering Storm Surge Barrier
 Source: <https://en.wikipedia.org/wiki/Maeslantkering>

Coastal Armoring

Examples of coastal armoring include but are not limited to sea walls, levees, dikes and double dikes (the area between the dikes holds flood water), groins, bulkheads, revetments and jetties. Calvert County’s shorelines contain coastal armoring. While Broomes Island does not contain coastal armoring along its shorelines, there are examples of coastal armoring along other communities in Calvert County. For example, in the Breezy Point and Neeld Estate communities, a groin field protects Breezy Point from erosion, jetties located at either end of the Breezy Point Marina canal minimize sedimentation of the canal and a bulkhead protects Neel Estate’s shoreline and the homes behind the bulkhead (Figure 18), and Town of Chesapeake Beach has a flood gate, which is designed to protect the Town from coastal flood water.

Elevating Land in Combination with Coastal Armoring

Elevating the land in combination with coastal armoring is another option along the shoreline. Beach nourishment (i.e., creating dunes and beach replenishment) in combination with fill and elevating structures inland is an example of utilizing both techniques simultaneously. Fill is permitted under very limited circumstances per the County's floodplain regulations. Beach nourishment, if used as a means to mitigate flooding, needs to balance the need to replenish eroded beach areas with the need to preserve sensitive habitats and ecosystems. For example, in Cove Point, the County's most flood-prone community, there are natural resource lands such as tidal wetland, coastal barrier resources and sensitive species project review areas. In the Town of Chesapeake Beach, the County's third most flood-prone community, there is tidal wetland, a natural heritage area, a fish blockage location and sensitive species project review areas. In Breezy Point and Neeld Estate, the County's fifth and seventh (respectively) most flood-prone communities there are tidal wetland and sensitive species project review areas.

Living Shorelines

Living shorelines are shoreline measures typically constructed out of plants, stone, sand fill and other structural and organic materials. Living shorelines are designed to reduce wave energy, trap sediment and filter runoff while maintaining or increasing beach or habitat. The use of living shorelines as opposed to structural shoreline measures is preferred in Maryland. Living shoreline measures have been used at the Jefferson Patterson Park and Museum in St. Leonard, MD (Figure 19). The living shoreline, as shown on Figure 19, is a segmented breakwater with marsh plantings shoreward of the breakwater and is built near and parallel to the shoreline

to reduce wave energy on the land side of the structure. Living shorelines function more to stabilize shorelines, but in flood-prone areas with the right physical conditions, living shorelines can help control flood water by storing them and allowing a slow release back into the Chesapeake Bay, Patuxent River and/or groundwater.



Figure 19: Living Shoreline Measures at Jefferson Patterson Park and Museum

Source:

<http://www.jefpat.org/Documents/JPPM%20Living%20Shorelines%20Site%203.pdf>

Residents' Ranked Flooding Concerns

On May 17, 2014, CPB ES hosted a public meeting led by a professional facilitator where Broomes Island residents identified and prioritized flooding concerns. See Table 3 below for the Broomes Island resident's ranked concerns. Following Table 3 are responses to the residents' concerns. Note: Issues #1 - #4 appear to be close in importance to residents since the point spread between these four issues is less than 10 points.

Table 3: Broomes Island Residents' Ranked Flooding Concerns

<i>Table 3: Broomes Island Residents' Flooding Concerns – Ranked</i>	<i>Points Given by Residents</i>
#1 Wetland/marsh management is needed during times of heavy rain, tropical storms and high tide	77.5
#2 Financial assistance is needed to elevate homes or grade yards to drain water away from homes	71.0
#3 Emergency response needs to be addressed at Broomes Island Road Causeway when flooding occurs	71.0
#4 Flood water on the roads needs to be addressed	68.5
#5 Water quality is impacted by flooding and needs to be addressed	61.0
#6 Hurricanes and emergency preparedness need to be addressed	58.0
#7 Flooding of businesses needs to be addressed	38.0

Responses to Ranked Flooding Concerns of the Broomes Island Community

#1 Wetland/marsh management is needed during times of heavy rain, tropical storms and high tide:

During the meeting, residents expressed the need to manage the wetlands/marshes along the Broomes Island Road Causeway, Oyster House Road and Songbird Lane in order to mitigate flood water during heavy/prolonged rain events, tropical storms and high tides. On Songbird Lane and Oyster House Road, low land elevation contributes to flooding. Land elevation is zero to two feet on Songbird Lane. On Oyster House Road, land elevations range from 1.6 feet to 6.4 feet, with most of the land under five feet. High tides can also be higher than the lower land elevations on Oyster House Road. When there are heavy/prolonged rains, the wetlands/marshes adjacent to the Broomes Island Road Causeway flood the portion of Oyster House Road closest to Broomes Island Road. Wetlands/marsh management cannot adequately alleviate flooding on Songbird Lane and Oyster Houser Road due to the low land elevations and a BFE of five. Elevation of structures or retreat (demolition of homes with land returning to its natural state) on Songbird Lane and Oyster House Road are the recommended flood mitigation measures.

Along the Broomes Island Road Causeway, DNR and MDE have maintained an outlet for water to drain from the wetlands/marshes into the Patuxent River. As indicated by the yellow arrow in Figure 20, water is able to flow into the river because the outlet opens and closes with the tide. In addition, Calvert County's DPW maintains a culvert, discussed previously, which allows water to flow from the wetlands/marshes on the east side of the causeway into the marshes on the west side of the causeway, and then into the Patuxent River. However, when heavy/prolonged rains occur, the culvert becomes inundated with water and cannot convey water from the wetlands/marshes into the



**Figure 20: Wetlands/Marshes Opening to the Patuxent River
– Broomes Island Road Causeway**
Source: Calvert County Government

river effectively enough to prevent flooding. This occurrence is due to low land elevations; therefore, additional wetlands/marshes management measures cannot adequately alleviate the flooding that occurs along the Broomes Island Road Causeway. It is recommended that the Broomes Island Road and Broomes Island Road Causeway be elevated by 4.5 feet and for 5,926 feet in total length. See pages 15 and 16 of this plan for a more in-depth discussion of this recommendation and Figure 8 for a graphic of the proposed road segment to be raised. Funding options for elevating the road bed should be researched. A road tax district is one option for funding the project.

#2 Financial assistance is needed to elevate homes or grade yards to drain water away from homes: As discussed previously, MEMA offers financial assistance under its pre-disaster grant programs: HMGP, PDM, FMA, RFC and SRL Programs. The grant assistance is a matching grant, requiring a non-federal/local 25 percent match to FEMA's 75 percent grant. Assistance to demolish or elevate homes requires the property owner to incur costs of an appraisal or elevation certificate, respectively. The cost of the appraisal or elevation certificate qualifies as part of the 25 percent matching local funds. In addition, the property owner must obtain cost estimates for elevation or demolition. See Table 2 on page 33 for a summary of FEMA's grant assistance¹⁴.

¹⁴ For more information regarding these programs, go to FEMA's Hazard Mitigation webpage: <http://www.fema.gov/hazard-mitigation-assistance>.

During the first half of 2014, FEMA and CPB ES worked with seven property owners to elevate homes located in Broomes Island, Cove Point and North Beach; and one property owner in Broomes Island to demolish a structure. Four property owners in Broomes Island received a grant award, of which three are to elevate structures and one is to demolish a structure with County acquisition of the land. The County will purchase the property with FEMA grant funds and allow the land to regenerate back to its natural state. Several trees, some underbrush and two structures are located on the property. The property is also adjacent to a wetland.

The County submitted the applications to FEMA in April 2014 and awarded the grant in January 2015. The County anticipates construction/demolition to commence in 2017. After the County submitted the applications to FEMA, additional homeowners in Broomes Island expressed interest in securing grant funds to elevate their homes. In the spring/summer of 2015, CPB ES submitted another round of grant applications to elevate homes, but the applications were not funded. FEMA prioritizes structures located in repetitive loss areas and severe repetitive loss areas. None of the 2015 applications involved structures in the repetitive loss or severe repetitive loss areas. It is recommended that the County continue to work with residents and FEMA to secure additional FEMA pre-disaster funds to elevate or demolish additional homes in the future.

In addition to securing mitigation grant monies, the Broomes Island residents expressed a desire to secure funds to grade their yards so water drains away from their homes. Calvert County floodplain regulations allow for minor grading and the placement of minor quantities of fill for landscaping and drainage purposes under and around buildings and for the support of parking slabs, pool decks, patios and walkways. However, securing funds for this particular activity may not be possible since FEMA does not offer grant funds for this purpose. If a property owner desires to conduct minor grading on their property, then the property owner would likely need to fund the grading on their own and secure approval of a grading permit from the County.

#3 Emergency response needs to be addressed at Broomes Island Road Causeway when flooding occurs:

If the weather forecast predicts a heavy/prolonged rain event, a tropical storm or a hurricane, Calvert County EMD sends County road maintenance staff to Broomes Island to post signs along Broomes Island Road Causeway warning residents that flood water will rise and potentially flood the Broomes Island Road Causeway. Fire, rescue and emergency responders also inform residents residing south of the Broomes Island Road Causeway that forecasted weather will leave residents along River View Road, Penkert Lane, and Ballard Rogers Road stranded until flood water recedes. While leaving one's residence is voluntary, County policy advocates that residents leave their homes if there is a public safety threat. To address the flooding of the Broomes Island Causeway, it is recommended that the Broomes Island Road and Broomes Island Road Causeway be elevated by 4.5 feet and for 5,926 feet in total length. Funding would need to be researched. The most likely funding would be a road tax district. See pages 15 and 16 of this plan for a more in-depth discussion of this recommendation and Figure 8 for a graphic of the proposed elevation of the road segment.

#4 Flood water on the roads needs to be addressed: Depending upon the severity of a storm event, sections of Broomes Island Road, the Broomes Island Road Causeway, Penkert Lane, River View Road and Ballard Rogers Road tend to flood. Due to the low land elevations of these roads and BFEs that are

generally higher than land elevations along these roads/segments of roads, these areas will continue to flood during severe weather conditions and/or heavy/prolonged rain events, especially combined with high tide. It is recommended that the Broomes Island Road and Broomes Island Road Causeway be elevated by 4.5 feet and for 5,926 feet in total length. Funding would need to be researched. The most likely funding would be a road tax district. See pages 15 and 16 of this plan for a more in-depth discussion of this recommendation and Figure 8 for a graphic of the proposed elevation of the road segment. To address flooding at the juncture where Penkert Lane, Ballard Rogers Road and River View Road meet, it is recommended that DPW EHD conduct a study and develop a plan to reduce stormwater impacts in this area.

#5 Water quality is impacted by flooding and needs to be addressed: Calvert County has a nontidal water quality monitoring program, which involves collecting water samples on a quarterly basis. The program includes water quality monitoring in Island Creek at the intersection with Ross Road (located north of the study area). Total suspended solids, nitrogen and phosphorus levels at the Island Creek sampling site showed that nitrogen, phosphorus and total suspended solids levels were almost always below the targeted levels as suggested by scientific literature. Nitrogen loading per year per acre of watershed above the sample site was low, only about 30 percent of the average for the 25 stations sampled in the County. Nitrogen loads at this site come from residential development including septic systems and agriculture. Phosphorus loads at this site come from residential and agricultural lands. Total suspended solids were not a problem at this site in Island Creek.

In addition, the Chesapeake Bay Laboratory monitors water quality in Island Creek at three stations. Three samples have been taken during June, July and August from 2009 to 2014¹⁵. Water clarity at the Island Creek stations was not sufficient enough for submerged aquatic vegetation (SAV) growth, dissolved oxygen levels were often low, and algae blooms were present at these stations. Upstream stations showed the highest levels of algal pigments and lowest oxygen levels indicating reduced water quality upstream. Water quality results show that there is an abundance of nutrients coming off the land and going into Island Creek, creating high levels of algae growth, low dissolved oxygen levels and insufficient water clarity for Island Creek to meet water quality target goals. Since the nontidal water quality measurements at the Ross Road site indicated good water quality, it is expected that the pollution source supporting the poorer water quality results come from further downstream where there is more residential and agricultural land use. Pollution from residential development including septic systems, lawn fertilization and agricultural activities is expected to increase during times of flooding though no measurements have been made during storm events. Residents attending the May 17, 2014, meeting indicated that septic system failures were not a major issue during flooding events in general.

Given the current water quality sampling activities in Island Creek, it is recommended that residents apply for BRF funding to upgrade their septic systems to nitrogen-removing septic systems, avoid lawn fertilization unless a soil test indicates a need for fertilizer and convert more of their lawns to native vegetation. Calvert County has a free tree program in the Critical Area for which residents could seek funds to plant native vegetation. Agricultural land owners should continue to ensure that their Soil and

¹⁵ Water Quality Monitoring Program for Tidal Creeks in Calvert County, Maryland (2014), p. 60.

Water Conservation Plans are up to date and implemented. Monitoring water quality through the non-tidal water quality program and tidal water by the Chesapeake Bay Laboratory should be continued, to monitor future trends.

#6 Hurricane and emergency preparedness needs to be addressed: Residents expressed a concern regarding hurricane preparedness for Broomes Island. Over the years, Broomes Island has been impacted by numerous storms, hurricanes and nor'easters that generated storm surges, higher than normal tides, wave action and flooding.

Knowing the flood vulnerability of the peninsula is the first step in being prepared for a hurricane. Many long-time residents are familiar with the flooding that occurs on the peninsula during typical storms, hurricanes and prolonged/heavy rains. Some residents plan accordingly. In addition to life experiences of residents, Calvert County offers several resources for being "hurricane prepared."

Preparedness

The County's website provides resources for preparedness including but not limited to:

- An emergency supply checklist found at <http://www.co.cal.md.us/DocumentCenter/Home/View/316>.
- An online family emergency preparedness planning tool through FEMA and found at <http://www.ready.gov/make-a-plan>.
- Commonly known emergency disaster resources may also be found at <http://www.co.cal.md.us/index.aspx?NID=351> and include:
 - American Red Cross
 - FEMA's Preparedness Site
 - National Hurricane Center
 - National Weather Service
 - MEMA
 - Utility Companies
 - BGE
 - SMECO
 - Exelon
 - Dominion Cove Point

The County recommends that residents become prepared through becoming familiar with and utilizing online emergency preparedness resources offered through the County's website.

Emergency Operations Plan

In addition to the County's online resources, Calvert County's Emergency Operations Plan (EOP) outlines emergency notification, evacuation and accessibility procedures for events such as hurricanes and floods. The EOP is required by the 2008 National Response Framework and the requirements of FEMA's Comprehensive Preparedness Guide 101. The EOP may be found at <http://www.co.cal.md.us/documentcenter/view/4255>.

The County's DPS EMD is the lead agency for implementing the EOP. If a tropical storm is developing, DPS EMD will monitor its status. If the storm event develops beyond a tropical depression, DPS EMD coordinates monitoring efforts with NOAA and MEMA five days prior to the predicted impact. The County's DPS EMD sends out a notification through Calvert County Alert to Calvert County agencies and departments and other partnering organizations providing emergency function operations. An emergency operations center is established and, if necessary, designated staff report to the emergency operations center. The County recommends that residents become familiar with the County's EOP.

Notification

The County's DPS EMD operates a 24/7 monitoring and notification system through the Calvert Control 911 Communications system to dispatch fire, emergency and medical services where needed. Together, DPS EMD and the Calvert County Public Information Officer warn and provide emergency information to the public through the following outlets (also found at Calvert County's website):

<http://www.co.cal.md.us/index.aspx?NID=346>):

- **The Emergency Alert System:** This is a national system jointly administered by the Federal Communications Commission, FEMA and the National Weather Service. This system is designed to allow the President of the United States to speak directly to the nation in times of a national disaster.
- **Emergency Information Line:** Maintained by DPS EMD, this is a prerecorded line providing emergency preparedness information to County residents during an emergency. During an emergency, the operations of the emergency information line are expanded to 24-hours a day and staffed by several call-takers.
- **Comcast Channel 6:** This cable television station provides residents with critical emergency information, using "crawl messaging" for people with hearing and audio impairments.
- **Channel 95:** St. Mary's County Government.
- **Emergency Notification Network:** EMnet is a privately managed communications network for the emergency management community that allows communications via satellite or the internet if primary satellite capabilities are unavailable. This network is used for urgent messages and supports information such as documents, pictures, etc.
- **Mass Notification System (MNS):** A database maintained through a list-serve that allows the County to administer emergency notifications via cell phones, pagers or email. This list-serve is intended to serve residents in communities such as Broomes Island where there is high vulnerability to flooding. To receive notifications, go to the County's website to register at <http://www.co.cal.md.us/index.aspx?NID=330>.
- **Local radio stations including:**
 - WSMD 98.3 FM Mechanicsville
 - WKIK 102.9 FM / 1560 AM California and La Plata
 - WPRS 104.1 FM La Plata
 - WYRX 97.7 FM Lexington Park
 - WPTX 1690 AM Lexington Park
 - WGOP AM 540 kHz Pocomoke
 - WRAR FM 105.5 MHz Tappahannock
 - WNNT FM 100.9 MHz Warsaw
 - WTOP FM 103.5 Frederick and DC
 - WCEI FM 96.7 MHz Easton

- WEMD AM 1460 KHz Easton
- WCEM FM 106.3 MHz Cambridge
- WCEN AM 1240 KHz Cambridge
- Electronic roadway messaging boards along major roadways
- Facebook

It is recommended that residents become familiar with the County's notification resources and use them during times of emergency.

Evacuation

In addition to the notification resources, the County has evacuation procedures. These evacuation procedures are in the EOP and are classified into three different categories: (1) focused evacuations, involving a specific area and limited number of residents; (2) area evacuations, involving multiple neighborhoods and potentially involving relocating people to shelters within the County; and (3) full-scale evacuations, involving all persons in the County evacuating outside of the County¹⁶. If an evacuation is recommended, residents have the choice to stay in their homes or go to a shelter. To see a map of the County's shelters, go to Shelter Map:

<http://www.co.cal.md.us/DocumentCenter/Home/View/315>. On the following two pages is a sample evacuation order and sample instructions.

Emergency Response/Recovery

During times of emergency response and initial recovery, immediate health and safety needs are addressed. Emergency response could include rescuing persons from a flooded house or area. There are three types of recovery: (1) short-term, (2) intermediate and (3) long-term. Short-term recovery goes beyond immediate rescue needs and could involve restoring infrastructure and essential services. Intermediate recovery occurs after more severe emergencies that require an area or full-scale evacuation. Recovery efforts could include returning persons and families to their homes and restoring critical infrastructure and government operations. Long-term recovery involves activities like rebuilding destroyed structures and/or infrastructure. It is recommended that residents familiarize themselves with the types of emergency response/recovery so that in a severe weather event they can better plan for degrees of response/recovery and the associated timelines (i.e., short-term versus long-term).

Special Needs Registry

For people with functional and/or medical special needs that prohibit them from managing independently in a shelter or evacuation center, or before, during and/or after an emergency, the County has a registry for individuals and organizations serving these individuals. Through the registry, the County is able to stay in constant contact with this segment of the County's population and is able to poll them for need of emergency services before, during and after an emergency. The Special Needs Registry may be found at <http://www.co.cal.md.us/DocumentCenter/View/5616>. It is recommended that providers with special needs persons register with the County's Special Needs Registry. It is recommended that residents become familiar with evacuation procedures and shelter locations.

¹⁶ Calvert County Emergency Operations Plan, 2013, p.65.

SAMPLE INSTRUCTIONS

Instructions

All persons residing within the name of the area are advised to evacuate immediately. The area covered runs give boundaries of evacuation area.

Persons residing in this area are asked to leave via: Evacuation Route.

If you cannot stay with relatives or friends outside of the evacuation area, go to temporary shelter:

_____.

If you do not go to temporary shelter or friends call # _____ to inform of your whereabouts for the next few days and contact information.

Take only essential items—medicine, special foods, valuable papers, baby supplies, pet supplies—but do not overload your car. Secure your home before you leave. Lock windows and doors, turn off water and gas, and disconnect all electrical appliances except for the refrigerators and freezers.

Tie a white cloth or towel on your front door knob to indicate the premises is vacant.

Be sure to check on any neighbors that may need assistance.

Domestic pets will not be allowed in shelters. If you cannot make arrangements for someone outside of the evacuation area to take care of your pets, Calvert County Animal Control will provide temporary shelter for your domestic pet(s) at the temporary Emergency Shelter located at: _____.

Owners need to provide kennels for pets and copy of pet(s) shot records.

Residents with service animals will be provided temporary shelter along with their service animal at the temporary shelter.

Functional Needs:

If you have no means of transportation, ask for help from a neighbor or a friend, or walk to one of the following pick-up points: _____.

If you are physically unable to go to one of the pick-up points, call # _____.

SAMPLE EVACUATION ORDER**Tropical storm Christina
1600 hrs. August 31, 2015****Summary**

The Calvert County Office of Emergency Management has increased its situational awareness and staffed the EOC in preparation for the possible impact of Tropical Storm *Christina*.

Executive Action

EOC Activation: The Calvert County Emergency Operations Center will activate to level 2 starting at 0800 hrs. on September 1, 2013 with limited ESF partners activated. The EOC staff is monitoring National Hurricane Center advisories, National Weather Service, coordinating conference calls with MEMA, the National Weather Services, and producing updated situation reports as necessary.

EMD Priorities: Expand monitoring of the storm, prepare for the activation of the EOC, increase communications with state, local, volunteer partners; coordinate logistics and resources management; confirm all communications systems are operational; develop public/external affairs strategy.

Weather Forecasts

Hazardous Weather Outlook, September 1, 2013: Christina continues to track up the eastern seaboard coast with landfall projected in the Hampton Roads area of Virginia sometime on September 2, 2013 between 1400 and 1600 hrs.

Forecast September 1, 2013: Showers and thunderstorms throughout the regions of Calvert, Charles and St. Mary's counties with heavy rainfall possible. High temperatures will range from ___ to ___ and overnight low temperatures will range from ___ to ___. Winds will be variable ___ to ___ MPH.

Hazardous Weather Outlook, September 2, 2013: Very Heavy Rain will continue as Tropical Storm *Christina* Impacts the Southern Maryland Region of Calvert, Charles and St. Mary's. Local flash flooding in low lying areas can occur. Coastal flooding both on the bay and the Patuxent River is expected with High Tides at 4 feet above normal. High Temperatures will range from ___ to low ___ overnight temperatures will range from highs ___ to low ___. Winds will be North Northeast ___ to ___ MPH with gusts up to ___ MPH.

EOC Activation: Calvert County EOC will activate to Level 1 at 0800 September 2, 2013.

Sample Evacuation order

#7 Flooding of businesses needs to be addressed: Flooding impacts most businesses on Broomes Island due to the nature of the businesses—marinas, a seafood restaurant, a wedding/banquet hall and a seafood company. All are located on or near the shoreline and within the 100-year floodplain. Businesses located on Broomes Island include Stoney’s Restaurant, The Point at Broomes Island (a banquet/wedding hall built under recent floodplain regulations), Broomes Island Marina, Len’s Marina, Billy’s Marina/Island Creek Marina, Patuxent Seafood Company and Joe’s Garage. According to DNR’s Coastal Atlas, all of these commercial properties could be severely flooded by 2100. Currently all properties are vulnerable to storm surges, and some to high tides, especially after a heavy/prolonged rain event. Oyster House Road is also vulnerable to flooding, which further impacts Stoney Restaurant and the wedding/banquet hall, Broomes Island Marina, and Joe’s Garage. The flooding of the Broomes Island Road Causeway impacts Billy’s Marina/Island Creek Marina (main building has been elevated).

The short-term solution is to elevate or flood-proof Broomes Island commercial properties. FEMA provides grant assistance to flood-proof commercial properties under its Flood Mitigation Assistance Program, Dry-Proofing of Nonresidential Structures. This grant is highly competitive since nonresidential structures across the nation are vying for this flood mitigation assistance. (Note: In Maryland, flood proofing may only be used as a flood mitigation measure on commercial and institutional properties; residential structures must be elevated.) The long-term solution would be to relocate the commercial or institutional operations, if feasible. FEMA provides acquisition/relocation flood mitigation assistance. This grant, like FEMA’s other grants, is also highly competitive. As discussed in the sea level rise section, mitigation measures to elevate or retrofit the structures to rise and fall with flood water may also be an option in the long-term.

Additional Concerns Raised Through the Public Review Process

During the public review process, the watermen community expressed the desire for the Plan’s



Figure 20: Wetlands/Marshes Opening to the Patuxent River – Broomes Island Road Causeway
Source: Calvert County Government

recommended flood mitigation measures to support the watermen’s objectives in Broomes Island. In particular, the watermen identified the sedimentation of Nan’s Cove and the water adjacent to the Broomes Island Causeway (as seen in Figure 18). Currently flood water drains through the opening in the wetlands along the Broomes Island Causeway. The watermen contend that water may better drain on the south side of the wetlands. In addition, there is a public oyster bar in Broomes Island. The watermen would like to add oysters to this oyster bar through partnerships amongst land trusts, watermen and the State.

Recommendations

The recommendations presented below are categorized into: (1) immediate and short-term actions that may be used to address flooding into the foreseeable future; and (2) actions to consider approaching 2050 and 2100. Approaching 2050 and beyond, the County and the residents should establish a threshold by which traditional flood mitigation measures, i.e. elevation of structures and infrastructure, are no longer desired due to flooding and/or inundation posing public safety and welfare issues.

Recommendation #1: Increase the Freeboard Requirement for New Houses and Substantial Improvements of Existing Houses Currently Located in the 100-Year Floodplain from Two Feet to Three Feet Above Sea Level to Mitigate for the 2050 Sea Level Rise Scenario, Four Feet Above Sea Level to Mitigate for the Minimum 2100 Sea Rise Level Scenario, or Six Feet Above Sea Level to Mitigate for the Maximum 2100 Sea Level Rise Scenario.

Residents and the County should consider the life of a 20-year bond or 30-year bond when making decisions about infrastructure investments such as roads that lie within the 100-year floodplain and are susceptible to flooding. This infrastructure should be designed to function to 2050, which would include factoring in the 2050 2.1-foot rise in sea level. For example, the Town of North Beach is working SHA to redesign MD 261 from the Calvert County/Anne Arundel County border to the Town of North Beach's border. MD 261 is an emergency evacuation route. Designing this portion of MD 261 to mitigate for the 2050 2.1-foot increase in sea level will increase the functionality of this emergency evacuation route for approximately the next 30 years (assuming the 2050 scenario becomes a reality). Additionally, residents should consider the life of their mortgage when deciding on flood mitigation measures. Typically, mortgages are 30 years. The 2050 sea level rise scenario has a timeline that closely mirrors the life of a 30-year mortgage at this point in time. Homeowners, if they are elevating their homes, should factor in a 2.1-foot sea level increase into their FPE.

Under current conditions, it is recommended to elevate residential structures and/or retreat (demolishing a structure and allowing the land to transition back to its natural state) in areas that lie within the 100-year floodplain. The current FPE in Broomes Island is five or six plus the two feet freeboard requirement, resulting in FPEs of seven or eight feet above sea level. Property owners have the option and are encouraged to elevate a structure more than the FPE for longevity of the structure. Utilizing findings in the Maryland Climate Change Commission's 2013 report, "Updating Maryland's Sea Level Rise Projections," the County should consider modifying freeboard requirements to:

- Three feet to mitigate for the 2.1-foot sea level rise by 2050;
- Four feet to mitigate for the 3.7-foot sea level rise by 2100; or
- Six feet to mitigate for the 5.7-foot sea level rise by 2100.

Additionally, if stricter freeboard requirements are in place and if the County were to seek FEMA pre-disaster flood mitigation grant monies/disaster funds to elevate structures, FEMA would fund the elevations to the higher elevation standard. Currently, FEMA will fund elevations to the two-foot freeboard requirement only.

Recommendation #2: Address Current Flood Threats by Elevating Structures or Retreating.

Elevating residential structures and/or retreat (demolishing a structure and allowing the land to transition back to its natural state) are commonly used methods to mitigate for flooding and are appropriate in Breezy Point and Neeld Estate; funding may be private or through FEMA's pre-disaster or disaster grant fund assistance. FEMA awards flood mitigation grants that fund 75 percent of elevation and/or acquisition/demolition costs, while the remaining 25 percent is funded by the property owner. As of 2016, the County is administering a FEMA grant to elevate three homes and acquire one property/demolish the structure and allow the land to transition back to its natural state. Three residential structures are being elevated, of which one is located in Broomes Island, and the other two are located in Cove Point. The residential structure being demolished and transiting back to its natural state is located in Broomes Island. It is recommended that the County continue working with MEMA and FEMA to secure pre-disaster and disaster recovery flood mitigation grant funds to elevate residential structures and/or retreat.

FEMA's current policy is to award pre-disaster grant funds to severe repetitive loss properties, of which there are presently none in the County. Pre-disaster flood mitigation funding is highly competitive nationwide. Refer to Table 3 for an overview of grant programs offered by FEMA. Less competitive funds have become available through FEMA's declaration of Maryland as a disaster area due the 2016 nor'easter that dumped more than three feet of snow on the metropolitan area. In this instance, only Maryland property owners within the 100-year floodplain are competing for these grant funds; therefore, they are less competitive than pre-disaster nationwide competitive funds. The County is working with FEMA and MEMA to secure funds to elevate additional homes under the 2016 disaster declaration.

Recommendation #3: Consider Elevating the Broomes Island Road Causeway by 4.5 Feet for 5,926 Feet of its Length and Research Funding Sources.

Elevate 4,368 feet of Broomes Island Road and 1,558 feet of the Broomes Island Road Causeway by 4.5 feet, for a total of 5,926 feet raised roadway. Funding options will need to be explored. The most likely funding would be a road tax district. This project will likely trigger a review by USFWS for otter/muskrat crossings; USACE and MDE for a Joint Federal/State Wetlands and Waterways Permit and a wetland delineation; DNR and USFWS for RTEs; Department of the Interior depending upon the extent of the impact to RTEs, if any, for a Takings Permit and the preparation of a protection plan; and the Maryland Chesapeake Bay Critical Area Commission for impacts to the critical area 100-foot buffer, wetlands, waterfowl concentration and staging areas and the preparation of a protection plan. Other reviews may be required. The estimated cost of elevating the Broomes Island Road Causeway by 4.5 feet and 5,926 feet in length is \$1.5 million¹⁷. The costs for the otter/muskrat crossings study, protection plans, etc. and the associated permits need to be determined and added to the total cost. Elevating the Broomes Island Road Causeway by 4.5 feet will alleviate flooding during heavy/prolonged rain events; however, it will not remain dry for more severe events such as a hurricane or nor'easter. See Figure 8 on page 15 for a graphic showing the approximate length of roadway that would be elevated.

¹⁶ The cost estimate includes the costs to physically elevate the road, engineering and the preparation of wetland delineation. Additional costs will need to be factored in for permit reviews and requirements. Road improvement cost estimate was developed by Calvert County's DPW EHD.

Recommendation #4: Consider Conducting a Study to Address Stormwater Management Issues That Contribute to Flooding Where Ballard Rogers Road, Penkert Lane and River View Road Converge.

It is recommended that a stormwater management study of the area where Ballard Rogers Road, Penkert Lane and River View Road converge be completed. The proposed measures should be designed to decrease the frequency and volume of backflow of stormwater. The impacts of this stormwater flow contributed to the failure of the adjacent property owner's septic system failure. Funding options need to be explored to fund the study.

Recommendation #5: Utilize Bay Restoration Funds to Address Stormwater's Adverse Impacts on a Septic System Lying Adjacent to a Stormwater Conveyance Area and Wetlands Where Ballard Rogers Road, Penkert Lane and River View Road Converge, and Where Septic Systems are Failing Within the 100-Year Floodplain, Apply for Bay Restoration Funds to Upgrade to Nitrogen Removing Septic Systems.

Septic systems can fail during flood events and fecal matter can leak into nearby rivers, streams and groundwater sources. Water quality sampling can help determine if failing septic systems are a possible contributor to localized health and public safety. Water quality sampling upstream in Island Creek indicates generally good water quality. However, sampling downstream indicates water clarity is too low to support SAV growth, and low dissolved oxygen levels and algae blooms that occur during summer months. One expected source for higher nutrient levels downstream is failing or conventional septic systems. Although residents in Broomes Island indicated that septic system failures are not a problem, on-site sewage disposal in areas such as Broomes Island with a high water table and frequent flooding oftentimes fail and the resident may be unaware. Additionally, in these areas characterized by a high water table, holding tanks are a means to address failing septic systems. The holding tank is designed to eliminate untreated or partially untreated effluent from releasing into the surrounding environment. The effluent is held in the tank, pumped out as needed (when the tank is approaching full), and disposed of off-site at a State approved site (waste water treatment plant). It should be noted that in some areas with high water tables, holding tanks are difficult to anchor. It is recommended that residents apply for BRF support to upgrade their septic systems to nitrogen removing septic systems. If the existing septic system is failing and the site will not accommodate a nitrogen removing or conventional septic system, the Health Department may require a holding tank. The BRF can also fund the installation of a holding tank under certain circumstances. Contact Steven Kullen, Bay Restoration Fund Manager, at kullenst@co.cal.md.us or 410.535.1600 x2336, for more information on upgrading to a nitrogen removing septic system or installing a holding tank. While a holding tank or nitrogen removing septic system may work in the short-term, the provision of public water and sewer service is a potential long-term mitigation measure.

As for the property owner adjacent to the stormwater conveyance area and wetlands area where Ballard Rogers Road, Penkert Lane and Riverview Road converge, the County worked with the property owner to secure BRF grant monies to replace the failing septic system on site with a watertight nitrogen-removing septic system. The conveyance of stormwater through the property exacerbates water disposal issues associated with the septic system, especially during heavy /prolonged rain events that contribute to flooding. The conveyance of stormwater through the property owner's yard will need to be addressed in

order to protect the integrity of the septic system replacement. See Recommendation #4 above for addressing stormwater conveyance issues on this property.

Recommendation #6: For the Property Owner on Patuxent Avenue, Elevate Structures on the Property and Conduct an Elevation/Drainage Study.

Since the County has no record of an easement permitting the County access to the storm drain on the Patuxent Avenue property, the property owner is responsible for addressing the stormwater management/flooding issues on the property associated with the private storm drain. After the County inspected the drain on site, staff recommended the property owner conduct an elevation/drainage study and install a one-way valve on the bulkhead if indicated by the study. In addition, the County recommends the property owner elevate the structure(s) on site. In 2014 and 2015, CPB ES worked with the property owner on Patuxent Avenue, as well as several other property owners, to apply for FEMA Hazard Mitigation Grant funds to elevate their homes. FEMA awarded grant funds for purposes of elevating homes on seven properties including this home on Patuxent Avenue.

Recommendation #7: Ensure Culverts along Broomes Island Road Remain Unclogged and Debris Free Through SHA and Calvert County DPW Maintenance Efforts.

Standard protocol for identifying clogged stormwater management culverts is for residents to notify SHA and the County's DPW EHD and/or through inspections made by SHA/County inspectors. In October of 2014, SHA flushed the SHA-maintained culvert located north of Oyster House Road. The culvert at Nan's Cove did not need flushing. The state-maintained culverts are working properly.

The County-maintained culverts at the Broomes Island Road Causeway function as they had originally been designed; however, due to the water elevation during times of heavy/prolonged rain events and low land elevations, the culverts become inundated and are unable to drain rain water from the wetlands in a manner that addresses flooding issues. Stormwater management cannot address this particular occurrence. Raising the Broomes Island Road Causeway and portions of Broomes Island Road can alleviate flooding along these roadways. See Recommendation #3.

Recommendation #8: Encourage Residents to be Hurricane Ready by Utilizing County Online Resources and Becoming Familiar with County Emergency Preparedness Procedures and Protocols.

Residents on Broomes Island should be prepared for flooding, intense storm events and hurricanes by:

- Signing up for the County's Mass Notification System;
- Knowing the television channels and radio stations by which the County provides updates and emergency information;
- Knowing where the nearest County shelter is in case of evacuation;
- Utilizing the County's online resources found on its webpage;
- Familiarizing oneself with the County's EOP (Emergency Operations Plan);
- Creating a "preparedness kit" for severe flooding events, which may be found at the County's website: <http://www.co.cal.md.us/DocumentCenter/Home/View/316>;
- Registering with the Special Needs Registry, if necessary; and

- Purchasing flood insurance to protect homes against flooding.

Residents are encouraged to engage in additional activities as outlined in the EOP.

Recommendation #9: Seek and Plant Free Trees Through the County's Critical Area Free Tree Planting Program for the Purpose of Flood Control.

It is recommended that residents utilize Calvert County's free tree program, available to property owners in the Chesapeake Bay Critical Area, to plant trees for the purposes of flood control. The program helps to support the County's policy to maintain 100 percent existing forest cover within the Chesapeake Bay Critical Area. Applications are due November 1st for spring plantings and May 1st for fall plantings. For more information go to <http://md-calvertcounty.civicplus.com/index.aspx?nid=1254> and/or contact Robin Munnikhuysen at munnikrp@co.cal.md.us or 410.535.1600 x2502.

Recommendation #10: Consider Retreat to Address Flood Threats into 2050 and Beyond.

If the impacts of sea level rise and more severe weather events occur as predicted, the County officials and the residents of impacted communities may want to consider retreat, especially if public water and sewer and utilities and roads cannot feasibly serve the area—financially and/or physically.

Recommendation #11: If Retreat is not the Preferred Option into 2050 and Beyond, Consider Utilizing Amphibious Homes, Floating Neighborhoods, Coastal Armoring and/or Enhancement of Natural Resources Along the Shoreline as Flood Mitigation Measures.

Approaching 2050 and beyond, in areas where retreat is not the preferred flood mitigation solution, it is recommended that homeowners and the County consider amphibious homes and floating neighborhoods in flood-prone areas. Instead of elevating structures or acquiring properties/demolishing structures in Broomes Island, determine if amphibious homes and floating neighborhoods will adequately mitigate flooding of structures. As discussed previously in this Plan, amphibious homes rise and fall with flood water. Since the County's most flood-prone communities will likely flood more frequently and severely into the future, boardwalks, serving as sidewalks and providing access to homes may be appropriate and needed to keep these communities viable. The concept of homes served by boardwalks is referred to as a floating neighborhood (Graphic F). According to the County's initial research on the costs of a boardwalk, it is estimated that 1,500 feet of boardwalk costs \$1.5 million.¹⁸

If amphibious homes and boardwalks are the chosen flood mitigation measures, the neighborhood should function as a safe and quality place to live.

Therefore, infrastructure and public services should

**Graphic F: Floating Neighborhood
Example #2**



Source: <http://www.inspirationgreen.com/floating-homes.html>

¹⁷Cost per foot is based upon costs associated with constructing the North Beach Boardwalk.

be provided in a manner that flooding can't adversely impact. Public water and sewer, or a shared community system, utilities and centralized parking would need to be accommodated. Options would need to be explored and a shift in flood mitigation policies and regulations would need to occur. In addition, this option will require a significant investment of funds. Funding sources would also need to be identified.

Recommendation #12: If Retreat is Not the Preferred Option, Serve Broomes Island with Public Water and Sewer.

Over the long-term, public water and sewer service will mitigate septic system failures, well contamination and water quality degradation associated with flooding events in the County's most flood-prone communities such as Broomes Island. Funding for water and sewer service will need to be identified. At present, financing options include a water and sewer tax district offered through the County; and/or MDE's Revolving Loan Fund. The BRF grant can cover up to \$20,000 per home for hook-up costs. Water infrastructure costs may be paid for by Broomes Island property owners or through a Maryland Department of Public Works grant.

Recommendation #13: Establish a Threshold for Which Traditional Flood Mitigation Measures (i.e., Elevation of Structures, Demolition/Acquisition, etc.) are No Longer Considered Adequate to Address Flooding Issues.

It is recommended that the County and Broomes Island residents establish a threshold for which traditional flood mitigation measures to maintain the functionality of structures and infrastructure are no longer considered worthy investments and in the interest of public safety and health. At this point, flood mitigation measures may transition from elevation to retreat, floodable development (amphibious homes or floating neighborhoods) and/or coastal armoring.

Recommendation #14: Conduct Outreach to Elected Officials and Residents.

It is recommended that Calvert County CPB ES conduct outreach to elected officials and citizens about changing flood levels due to projected sea level rise. Recommended actions include but are not limited to:

- Conduct an analysis which identifies all neighborhoods/communities that may be impacted by the 2050 and 2100 sea level rise increase scenarios using DNR's Coastal Atlas or comparable GIS interactive tool as recommended by DNR;
- Incorporate sea level rise into the County's next comprehensive plan update;
- Create a "sea level rise" page on the County's website; and
- Integrate sea level rise into annual FEMA CRS outreach efforts.

Conclusion

As mentioned at the beginning of this Plan, CPB ES has, is and/or is planning to write several small area flood mitigation plans for the County's most flood-prone communities. Utilizing DNR's Chesapeake and Coastal Communities Initiative Grant Program, CPB ES is taking a focused look at flood issues impacting these communities and is also working with the County's DPW EHD and DPS EMD to identify

mitigation measures to address flood issues. Writing three small area flood mitigation plans (Cove Point, Broomes Island and Breezy Point/Neeld Estate) has brought to light common themes in flood-prone communities such as inadequate stormwater management and inadequate road access during flood events. Also brought to light are challenges to addressing these common themes. For example, in some instances addressing inadequate stormwater management or road access is not feasible due to a high water table and sandy soils. In another instance, the presence of a sea wall may hold flood water back during less severe storm events, but during more severe storms events the sea wall may not work as intended and flood water may breach the wall and flood a community.

Calvert County's CPB ES, DPW EHD and DPS EMD are working together to address flood issues raised by residents of these communities either by identifying mitigation measures that will reduce flood hazards into the immediate future and by identifying mitigation measures that will not work. In addition, CPB ES is taking this opportunity to explore potential sea level rise impacts on the County's most flood-vulnerable communities. These impacts range from the migration/expansion of wetlands and the 100-year floodplain to the inundation of land currently above sea level and home to County residents and some of the County's infrastructure. Residents, policy makers and elected officials will be protecting property values, citizens from weather-related hazards, and community investments by identifying mitigation measures that will reduce flood hazards associated with the 100-year floodplain, sea level rise and land subsidence.

A special thanks to the following county and state staff persons who have contributed to the Broomes Island Flood Mitigation Plan (listed in alphabetical order):

- Shelly Gooding, Emergency Management Specialist, Calvert County Department of Public Safety, Emergency Services Division for participating in the community meeting and providing emergency response information to residents and for this small area flood plan.
- Robert Helms from Calvert County's Department of Public Works, Road Maintenance Division for conducting a site visit with CPB ES and property owners in Broomes Island.
- Alfred Jeffery, Division Chief, Calvert County Department of Public Safety, Emergency Services Division for participating in the community meeting and providing emergency response information to residents and for this small area flood plan.
- Ian Liong, Project Engineer, Calvert County Department of Public Works, Engineering and Highways Division for working with the residents on stormwater management issues including site visits, developing road improvement and boardwalk cost estimates for Broomes Island.
- Russell Swann, State Highway Administration, for conducting a site visit with CPB ES regarding state managed stormwater management culverts.



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