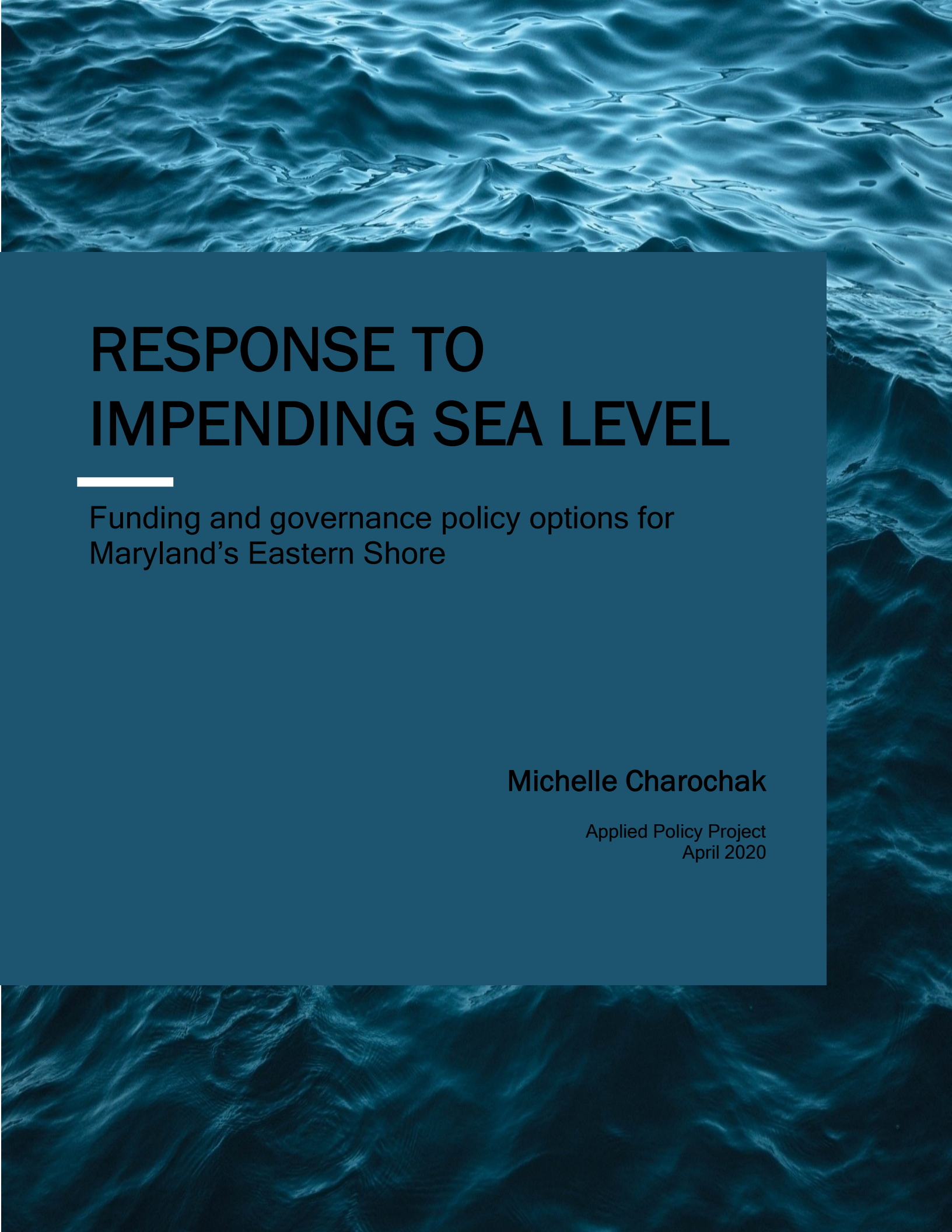

RESPONSE TO IMPENDING SEA LEVEL

Funding and governance policy options for Maryland's Eastern Shore

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Applied Policy Project
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I could not have completed this project without the guidance and support of so many. I would like to thank Jim Bass for allowing me the pleasure of working on a project I care deeply about with an organization that will continue to make incredible impacts on the Eastern Shore. His guidance and thoughts on this project were invaluable.

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Finally, shout out to COVID-19. Forcing us all to move home with our families to finish out this applied policy project was the ultimate test of perseverance and dedication to our Master's program. Could have definitely done this without you, but thanks for throwing us the curve ball.

Cheers!

On my honor as a student, I have neither given, nor received aid on this assignment.

DISCLAIMER

The author conducted this study as a part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgements and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, the University of Virginia, or by any other entity.

CLIENT PROFILE

This project was completed for the Eastern Shore Land Conservancy (ESLC). ESLC is a non-profit, 501(c)(3) charitable organization which works alongside local governments and nonprofits in the Mid and Upper Shore of Maryland. ESLC is committed to preserving and sustaining the vibrant communities on the Eastern Shore and the lands and waters that connect them. The organization has been a leading regional land trust on Maryland's rural Eastern Shore and is responsible for preserving nearly 65,000 acres.

ESLC is a founding member of the Eastern Shore Climate Adaptation Partnership (ESCAP). ESCAP is a network of local and state government staff, academic institutions, and nonprofit partners planning for impacts of climate change in the region. The partnership was established to assist communities in their response to climate vulnerabilities. ESCAP promotes learning and collaboration among Eastern Shore communities to prepare for changes in climate patterns, flooding, and other environmental conditions.

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ACRONYMS

CRS	Community Rating System, administered by FEMA as a part of the NFIP
CCCL	Coastal Construction Control Line, created by Florida in 1980
CEA	Cost Effectiveness Analysis
ESLC	Eastern Shore Land Conservancy
FEMA	US Federal Emergency Management Agency
HMGP	FEMA's Hazard Mitigation Grant Program
NFIP	National Flood Insurance Program
SLR	Sea Level Rise
SFHA	Special Flood Hazard Areas, designated by FEMA to indicate the 1% annual chance flood plain, as part of the NFIP

GLOSSARY

Eastern Shore	The 6 counties and 45 municipalities on the Eastern Shore of Maryland that fall under ESLC's domain
Inundation	The complete and permanent flooding of a given area
Subsidence	The sinking of land, which accelerates the effects of SLR, especially on the Eastern Shore
1% Chance Flood	More inaccurately known as 100-year flood; Flood with a 1% chance of happening in any year
0.2% Chance Flood	More inaccurately known as 500-year flood; Flood with a 0.2% chance of happening in any year

EXECUTIVE SUMMARY

Sea level rise (SLR) threatens to inundate Maryland's Eastern Shore, displacing multiple communities if present trends continue. This natural hazard threatens properties and residents along the shore as increasing water levels steadily inundate the coastline, leading to flooding and land disappearance. Approximately 9,500 buildings will be vulnerable on the Eastern Shore by the year 2040 (Scott, n.d.).

The Eastern Shore remains one of the most vulnerable areas to the impacts of SLR in the United States. In this region, land is sinking, allowing SLR to occur at an unprecedented pace. Man-made infrastructure creates a short-term source of protection from these issues, however this paper will explore a twenty-year plan for funding future managed retreat and buyout programs.

There are two major issues in addressing the problem, governance and finance. Fragmented local governments in the region cannot develop a comprehensive strategy on their own. As such, a new governance model needs to be developed before addressing the financial issues. The report proposes four policy options to address these problems:

1. Develop self-funding buyouts with local governments
2. Create a compact
3. Lobby the State for a trust fund
4. Continue the status quo

These options and their respective outcomes are evaluated using five criteria: cost effectiveness, political feasibility, equity, environmental impact, and administrative feasibility.

PROBLEM DEFINITION

The Eastern Shore of Maryland has an abundance of occupied houses, farms and other commercial establishments that will become flooded due to climate change by the year 2040. Local communities on the Eastern Shore do not have the resources or strategy to prepare for this imminent displacement.

Communities on the Eastern Shore are exposed to the impacts of land loss and rising sea levels at an increasing rate. SLR is exacerbating the pre-existing challenges created by coastal erosion. Compounding these issues further, the Eastern Shore is naturally susceptible to elevated water levels and heavy storm systems. Sitting on the Chesapeake Bay and housing numerous tributaries, the region is made up of low-lying areas that are exposed to coastal and riverine flooding. Climate change is intensifying these environmental conditions, increasing the risk of natural hazards. As increasing water levels steadily inundate the land and exacerbate coastal erosion, SLR poses an even greater threat to the ecosystems and developed areas of the Eastern Shore.

The Eastern Shore is experiencing SLR at a rate of three to four times greater than the global average. This will have an immense impact on housing, agriculture, and commercial infrastructure in the region by 2040. As the shoreline sinks and the sea level rises, the economic and physical health of its residents are at risk.

Eastern Shore communities have begun to use recovery and adaptation tactics to protect themselves from impeding waters. Some of their methods include rebuilding resiliently, reinforcing hard infrastructure with seawalls and riprap, adapting soft infrastructure including coastal vegetation, and restoring or enhancing natural ecosystems. These measures address the reduction of flood and storm surge but are unable to eliminate risk entirely. With more frequent extreme weather events and continuously shrinking shoreline set to occur, countless individuals and entire communities will be forced to retreat from flood-prone zones.

COST TO SOCIETY

Global SLR is driven by climate change. As SLR increases, the probability of intense flooding and storm surge events increases. Residents of the Eastern Shore will experience property damage and eventual displacement, resulting in severe costs to society.

Many low-lying communities on the Eastern Shore are beginning to experience the effects of climate change-induced SLR. Faced with sunny-day flooding events, increased storm surges, and permanent inundation, infrastructure has become increasingly at risk. SLR can conceivably inundate large swaths of land, destroying property at an unprecedented rate. Such losses impose a high cost on families, insurers, and the environment. These flooding events could cost as much as $2.76 billion in exposure and $178 million in damages by the year 2050 (Scott, n.d.).

As land disappears and infrastructure is destroyed, real estate will be lost at a costly rate. Entire communities will have to relocate and society will bear the burden of rebuilding lost property. In addition to costs, most local governments across the nation receive their largest source of general revenue from property tax revenues (Harris & Moore, 2013). For example, in fiscal year 2019, property tax revenue accounted for about 44.7% of Talbot County's revenue. The loss of this revenue would compound the financial calamity the Eastern Shore is already set to face.

BACKGROUND

The Eastern Shore of Maryland that falls under ESLC domain includes six counties and 45 municipalities. This region experiences varying rates of sea level rise and coastal erosion depending on location and vulnerability. This section of the report will focus on information necessary for understanding SLR impacts on the Eastern Shore as well as the background knowledge necessary for considering the policy alternatives.

SEA LEVEL RISE AND COASTAL EROSION

The Science

As the Earth warms, land ice melts and ocean water particles expand due to higher temperatures. On a regional scale, land subsidence, or sinking, contributes to even greater rates of relative SLR. The global sea level has risen by 0.66 feet in the past century. By contrast, the sea level along the shoreline of the Chesapeake Bay has risen by 1.2 feet in the past century (Leatherman & Leatherman, 2017). This disparity is attributable to a number of natural and human-caused mechanisms that lead to land subsidence.

Subsidence occurs naturally as tectonic plates shift or when an underground resource (i.e., groundwater, oil, or natural gas) is exploited. When groundwater is pumped from the ground faster than it can be replenished by natural hydrologic cycles, the land surface begins to sink by 2.0 to 4.8 millimeters per year. Researchers have discovered that groundwater extraction and shifting tectonic plates are contributing to the subsidence on Maryland's Eastern Shore (Ezer & Atkinson, 2015; Eggleston & Pope, 2013). As a result, the relative rate of SLR is greater on the Eastern Shore, where land is sinking as the sea level is rising.

SLR threatens coastal areas in three main ways: flooding, inundation, and coastal erosion. Floods occur due to predicted variations in weather patterns and extreme weather events like hurricanes. When hurricanes make landfall on the eastern seaboard of the US, their strong winds bring a flood of water onto the land, called storm surge. As the sea level rises, storm surges are projected to become more severe and reach higher elevation areas, causing more damage (Freedman, n.d.; Bryant, 2008). SLR also threatens coastlines with inundation, which occurs when land becomes completely and permanently submerged beneath ocean water. Complete inundation occurs over time, ultimately displacing all non-aquatic life from the area (Leatherman & Leatherman, 2017). Lastly, coastal erosion is the movement of coastal land and sediment by wind and waves. A leading theory proposes that SLR exacerbates coastal erosion because the higher water level allows intense waves to erode and impact higher elevated land. SLR is not the only factor contributing to coastal erosion, but studies have revealed a strong correlation between SLR and coastal erosion (Leatherman et al, 2000). The combination of coastal erosion and inundation from SLR contributes to coastal retreat, or the landward movement of the coastline (Leatherman & Leatherman, 2017).

The Eastern Shore

The rate of SLR on the Eastern Shore varies due to the topography of the land and the Chesapeake Bay. The U.S. Army Corps of Engineers and the Maryland Climate Commission have estimated that SLR will approximately reach 2 feet by the year 2050 and 6 feet by the year 2100 in the Chesapeake region (Bass et al, 2019). Coastal erosion is further exposing communities on the Eastern Shore to land loss and rising sea levels. Off the coast of the mainland, barrier islands bordering the Atlantic Ocean and islands in the Chesapeake Bay are shrinking at an alarming rate due to coastal erosion. As a result, SLR will both inundate the peninsula's land and aggravate the existing challenges of coastal erosion, leaving communities along the Eastern Shore increasingly vulnerable to flooding.

Many low-lying communities on the Eastern Shore are already beginning to experience the effects of climate change-induced SLR. The window of opportunity to make policy adjustments that adapt communities to SLR is still open in many parts of the region, but closing quickly. Most communities on the Eastern Shore utilize FEMA Flood Zone maps to plan for potential extreme weather and flooding events. Currently, floodplain management provides protection for today's 1% and 0.2% chance floods. These floods are measured by the amount of precipitation that occurs within a given time period. A statistical measurement referred to as a recurrence interval is used to determine what level of flood event has occurred. A 1% flood is also known as a 100-year flood, but the latter is dangerously inaccurate. A 100-year flood does not necessarily mean that the flood event is only likely to happen once every 100 years, but instead that it has a 1% chance of happening any year. Similarly, the term 500-year flood is being replaced with 0.2% chance flood, as it more accurately describes the likelihood of the flood event occurring. As of today, a 1% chance storm impacts $1.2 billion in property value and causes $30 million in damages. Without further action to combat SLR, these impacts are estimated to increase that same storm's effects to $2.8 billion in property value and $178 million in damages (2016 dollars) (Bass et al, 2019).

DIFFERENTIAL IMPACTS

Counties along the Eastern Shore experience SLR differently depending on their geographic location, economic status, and proximity to the Chesapeake Bay. **Figure 1** illustrates the location of these counties.

Figure 1: Map of Eastern Shore Counties
Source: Data pulled from ArcGIS website and projected by the author Nov. 2019

Dorchester County. Dorchester County is the most vulnerable to flooding. The future impact of SLR is higher here due to the extreme significance of current potential harm from flooding. As of this moment, almost 17% of the buildings in the county area are threatened by a 1% chance flood event. In 2050 that number will rise to 22.6%. This relatively small increase raises damage costs significantly from $11 million to $66 million (Bass et al, 2019).

Talbot County. Topography and past flood management practices have created a margin of safety for Talbot County. Based on estimations completed by ESLC's SLR report, only 39 buildings will be impacted by SLR in 2050. However, once the margin of safety is breached, Talbot County will experience some of the worst results in the region. Nearly 30% of all buildings in Talbot could be impacted by 1% chance events in 2100 (Bass et al, 2019).

Caroline County. Caroline County has been and will continue to be the least impacted by SLR in the region. As land values in Caroline have been historically less than in neighboring counties due to its distance from the Bay, there will likely be increased development pressure in the coming decades. There is the potential for threat but also an opportunity to build right the first time (Bass et al, 2019).

Queen Anne's County. Research has found that Queen Anne's County infrastructure would be impacted by a 0.2% chance event at a rate five times higher than a 1% chance storm (Bass et al, 2019). These impacts will increase as sea level continues to rise. The consequences of future flood events to the commercial sector in Queen Anne's will be even more grave than in other counties due to development patterns. As a result of its location, there has been increased pressure to develop in areas where exposure to damage will be drastically increased as severity in storms continue to grow.

Kent County. A report projected that under a SLR-storm-surge scenario, a Category 1 hurricane in the year 2050 would create flooding that impacts 2,368 structures, approximately 10% of infrastructure in the County. In this scenario 11,000 acres of land would experience flooding. Without the experience of a severe weather system, Kent County is still estimated to be impacted by two feet of SLR by the year 2050, inundating over 200 structures and almost 3,000 acres (ESLC, 2016).

Cecil County. Situated at the northernmost point of the Chesapeake Bay, Cecil County experiences a unique type of coastal flooding. The narrowing and shallowing effects occurring in this portion of the Bay create a high vulnerability to coastal flooding. Their geographic location affords Cecil County a considerably wider window of opportunity to prepare for SLR (Bass et al, 2019).

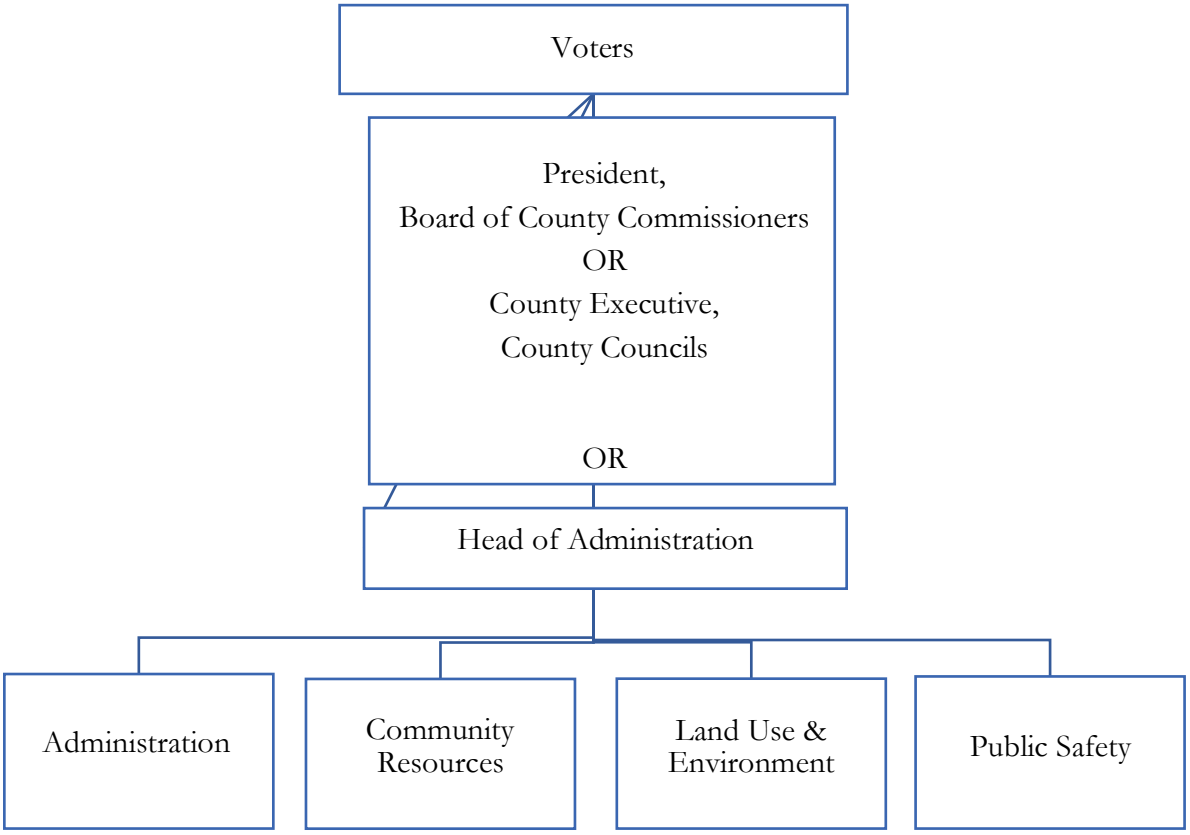
LOCAL GOVERNMENT STRUCTURE

The local government of Maryland's Eastern Shore is separated between six counties and 45 municipalities.

County

Individual counties have their own executive, judicial, and legislative branches. Each Executive Branch within the county systems is set up in a fairly similar way, regardless of their governing system, as seen in **Figure 2**.

Figure 2: General County Executive Branch Structure



The judicial branches of the counties are broken up between circuit court, district court, and orphan's court.

The General Assembly authorizes legislative power to the county commissioners under Code Local Government Article, secs. 9-101 through 9-113. Three of the counties – Cecil, Dorchester, and Talbot – are governed legislatively by county councils. County councils are made up of, on average, 5 members elected by voters for 4-year terms (Maryland State Archives, 2018). The remaining three – Caroline, Kent, and Queen Anne's – are governed legislatively by boards of county commissioners. County commissioners are authorized under the General Assembly to legislate for a county. A board of county commissioners exercises executive and legislative functions, defined by the state law and giving them power to enact ordinances. Counties elect their county commissioners through voters for 4-year terms. Currently, boards in Caroline, Kent, and Queen Anne's counties are made up of 3 to 5 county commissioners (Maryland State Archives, 2018).

Municipalities

In order to become a municipality in the state of Maryland, towns must acquire a municipal charter. These charters determine the basic structure of the municipality and outline the basic powers that a municipal corporation may exercise in coordination with Maryland State law (Maryland Municipal League, n.d.). These charters lay out the government structure including the Office of the Mayor and its power and duties, as well as the Council and the powers of the Council. Most municipalities have a Clerk to the Council, a Town Attorney, and a Town Manager. Depending on the size of the towns, these duties may be combined into one role (Maryland Municipal League, n.d.).

Home Rule in Maryland

Maryland is a Home Rule state. This means all municipalities have their own basic laws describing their structure, powers, and procedures. Based on these powers provided by the Maryland State Constitution and Code of Maryland, municipalities may exercise all authorized powers and make alterations to their local charter on a strictly local basis (Maryland Municipal League, n.d.). Municipalities do not need to seek additional permission from the General Assembly to do anything that is granted to them within the Constitution or Code, but the authority of municipalities is still conditioned.

Home Rule in Maryland grants incorporated government systems taxing authority. This means that they are able to change tax rates. By incorporating, towns have direct local control over finances. This control allows elected officials to determine local revenue and expenditure needs and set the local tax rate and service charge levels (Maryland Municipal League, n.d.).

FINANCING

This section provides a broad overview of potential revenue sources to finance the policy alternatives in this report. Federal programs, state transfer taxes, and pre-existing taxes and revenues for local governments on the Eastern Shore will also be discussed.

Federal Programs

The Community Development Block Grant (CDBG) program provides local governments with resources to tackle their unique needs (HUD, n.d.). The US Department of Housing and Urban Development (HUD) runs the program and distributes annual grants on a formula basis.

Two programs within the CDBG have the potential to grant government funding opportunities for housing related issues caused by climate induced SLR (HUD, n.d.):

1. CDBG State Program
2. Section 108 Loan Guarantee Program

The CDBG State Program allows states to award grants to local governments in order to provide services in vulnerable communities. Any local government unit that does not receive CDBG funds directly from HUD are eligible for the state's allocation of the grant. These areas are known as non-entitlement areas and are cities with populations lower than 50,000 and counties with populations lower than 200,000 (HUD, n.d.) States are given the power to allocate the funding to individual local governments as they see fit.

According to the State of Maryland CDBG Program Policies and Procedures Manual FY2019, eligible activities that align with the buyout program initiatives are as follows (Hogan, et al., 2018):

- Acquisition of real property
- Acquisition, construction, reconstruction, or installation of public works facilities
- Clearance, demolition, removal, reconstruction, and rehabilitation of buildings and improvements
- Relocation payments for displaced individuals, families, businesses, organizations, and farm operations
- Planning
- Payment of reasonable administrative costs
- Assistance to neighborhood-based nonprofit organizations, local development corporations, and nonprofit organizations serving the development needs of communities

In FY2019, the State allocated 67% of funds, approximately $4.7 million, to community development and approximately 14%, or $996,030, to special projects (Hogan, et al., 2018). All 45 municipalities on the Eastern Shore are classified as CDBG eligible non-entitlement jurisdictions by the Maryland Department of Housing and Community Development.

The Section 108 Loan Guarantee Program provides communities with funding for housing rehabilitation, public facilities, economic development, and large-scale physical development projects. In order for non-entitlement communities to receive funds from this program, communities must be assisted in the application process by their state. Activities eligible for this CDBG program as they relate to this report include (HUD, n.d.):

- Acquisition of real property
- Housing rehabilitation
- Construction of public facilities

Funding from this program could provide local governments the opportunity to rebuild communities outside of hazardous flood zones. Providing housing and other community resources will be crucial during the buyout program process.

FEMA Hazard Mitigation Grant Program

The purpose of the FEMA Hazard Mitigation Grant Program (HMGP) is to connect individuals – state and local government representatives – with the resources they need to implement hazard mitigation measures in their community.

Maryland State Transfer Tax

A Real Estate Transfer Tax is a levy imposed on the transfer of title of real estate between owners. In Maryland, the party receiving ownership of the deed or title, the grantee, is liable for payment of the tax. Maryland has set the Real Estate Transfer Tax Rate at 0.5% of the valuation assuming the maximum development potential for the land. Valuation by maximum development potential assumes that the new owner will seek to derive the highest possible profitability given land area and existing zoning regulation from the real estate. Maryland state revenues from the Real Estate Transfer Tax for FY2014 through FY2019 are as follows (Maryland Department of Assessments and Taxation, 2019):

- FY2014: $166 million
- FY2015: $202 million
- FY2016: $162 million
- FY2017: $185 million
- FY2018: $261 million
- FY2019: $222 million

The Real Estate Transfer Tax serves as the most significant resource of revenue. This revenue funds "Program Open Space" (POS) under the Maryland State Department of Natural Resources. POS receives its funding through the transfer tax, providing a direct correlation between encroaching development and public land conservation efforts. The increases in total revenue received from the tax are a result of increasing land valuation in Maryland, rather than an increasing number of applicable transfers. Much of this increase is likely seen in the Washington, DC metro area.

Current Taxes and Revenues for Eastern Shore governments

The Eastern Shore comprises the State's most and least affluent counties with Talbot and Queen Anne's among the highest and Caroline and Dorchester the lowest. Eastern Shore governments have a low tax base but a great need to fund their public service program, leading to the imposition of relatively high property and income tax rates.

Table 1 below provides the current property tax rates and per capita revenues by Eastern Shore county (Maryland DLS, 2019).

Table 1: Tax Capacity Measures & County Revenues

	Property Taxes		*Income Taxes*	
County	**Tax Rate**	**Per Capita Revenues**	**Tax Rate**	**Per Capita Revenues**
Caroline	$0.980	$770	2.73%	$408
Cecil	0.991	1,031	2.80%	561
Dorchester	0.976	909	2.62%	375
Kent	1.022	1,526	2.85%	661
Queen Anne's	0.847	1,352	3.20%	267
Talbot	0.547	982	2.40%	753

CURRENT INSURANCE SYSTEMS

Due to the high-risk levels of flooding, few private insurance companies offer insurance in potential high-risk areas. If they were to offer it, the premiums would be too high for homeowners to purchase. Therefore, in 1968, the federal government created a program that subsidies insurance (National Flood Insurance Act, 1968). As of 2017, FEMA owed the federal government $24.6 billion that it borrowed to subsidize these premiums (Cottle, 2017). Many believe that the program is counterproductive. Positing that it creates incentives for individuals to overbuild in flood-planes.

Private Flood Insurance

Currently, the flood insurance business lacks a robust private marketplace. Residents living within a FEMA SFHA are able to purchase private flood insurance policies that satisfy mandates set by the federal government and mortgage requirements. In general, private flood insurance protects the structure of a residence and its contents from flood damage. The policies are not backed by the federal government and are paid for by the for-profit insurance companies that are either reliant on a reinsurer or money collected from other claimants' premiums (Resendiz, 2019). Private flood insurance tends to cover a higher dollar amount and a greater variety of events and can oftentimes be less expensive than government provided options. However, private insurance is fairly new and research on their success is limited (Resendiz, 2019). Additionally, there is usually a longer claims process and claims are often denied during times of disaster.

Presently, there are no public-private insurance partnerships covering floods or natural disasters. There have been many calls to action for collaboration between the private and public sectors. As storms continue to intensify, more Americans will need to be covered by insurance programs. Experts believe the only way to ensure coverage is through the formation of strong partnerships with the private sector. Until

these partnerships are formed, it is important to understand FEMA's National Flood Insurance Program as well as the private sector's flood insurance structure.

National Flood Insurance Program

With SLR threatening property on the Eastern shore, many communities rely on the National Flood Insurance Program (NFIP) administered by FEMA to mitigate the risk of flood damage. NFIP was established through FEMA in 1968 as a means of providing affordable flood insurance to homeowners, businesses, and renters (National Flood Insurance Act, 1968). The program was created to combat high private flood insurance rates and the lack of motivation for providers to offer flood insurance in the first place (Molk, 2016). The program offers insurance premiums to properties located within participating communities that enforce minimum floodplain management programs within the FEMA designated Special Flood Hazard Areas (SFHA). In 2018, NFIP premiums were increased by 8% and fees were added on as payments made by the policyholders, increasing insurance bills by approximately $194 (FEMA, 2018). Presumably, this increase has been even greater in areas with increasing flood risks.

The NFIP's efforts are flawed and limited. The Government Accountability Office found that NFIP policyholders currently have no incentive to reduce insurance losses, and that increasing mitigation efforts could address this problem. Such mitigation efforts could include vouchers, grants, or loans rather than delivery of subsidies through discounted rates (United States Government Accountability Office, 2016). FEMA sometimes uses outdated maps to indicate flood risk and determine rates. This oversight can subject uninsured homeowners to billions of dollars in property damage. In fact, only 42% of FEMA's maps accurately identified flood risk in 2017, and newer maps may be insufficient because they do not account for rapid rainfall or climate change impacts (Keller et al, 2017). So far, NFIP owes taxpayers almost $25 billion in borrowed money for covering damage claims (Katz, 2017).

Community Rating System

The Community Rating System (CRS) stems from FEMA's National Flood Insurance Program and the points-earning capacity of activities related to open-space preservation. CRS is a "voluntary incentive-based program that rewards localities that take extra steps to reduce flooding with lower flood insurance premiums for property owners" (Wetlands Watch, 2019). CRS recognizes communities that generate and contribute data, creating a more accurate flood insurance rating. CRS encourages communities to implement mapping and information programs and to create comprehensive floodplain management programs. The following efforts are considered when rating comprehensive floodplain management:

- Protect lives
- Further public health, safety, and welfare
- Minimize damage and disruption to infrastructure and critical facilities
- Preserve and restore the natural functions and resources of floodplains and coastal areas
- Ensure that new development does not cause adverse impacts elsewhere

Communities receive their CRS classification based upon the total credit for their completed activities. There are ten CRS classes, with Class 1 requiring the most credit points and providing the greatest discount in terms of flood insurance. These class ratings are based upon a credit point system. These credit points are awarded for approved CRS activities, each having a varying amount of possible points earned. These points could provide a community with a savings of 25% on all federally-backed flood insurance policies. However, communities are not required to participate and only about 1,444 are active participants, mostly on the West Coast (FEMA, 2017).

OTHER HIGH-RISK AREAS IN THE UNITED STATES

In addition to the Eastern Shore, there are many other high-risk regions within the US that face the impacts of climate induced SLR. Most notably, Florida has one million properties at risk, New Jersey with 250,000, and New York with 143,000 (Ross et al., 2019).

Florida

In Florida, sea level has risen about 8 inches in the last decade and currently the rate is about one inch every three years (Sea Level Rise, n.d.). Currently, 100 Florida towns have more than half of their population living four feet below the future projected high tide line (Strauss, n.d.). Storm surge level is anticipated to double in Florida by 2030, leaving hundreds of thousands of Floridians at risk.

Florida established the Coastal Construction Control Line (CCCL) in the 1980s, bringing firm setback lines and enforcement for major infrastructure in hazardous areas which are stricter than NFIP (Siders, 2013). The CCCL has been successful in its use of coastal nourishment practices but because of the state's porous limestone bedrock, implementation of hard-infrastructure measures have failed (Sea Level Rise, n.d.).

Overall, Florida is currently mitigating the effects of climate change through the use of hard and soft infrastructure tactics. While these preventative measures are less costly than reactive measures, government officials are aware that they will not permanently alleviate future impacts. Many local communities have begun planning for increased demands on Florida's infrastructure, property damage, and total displacement (Bloetscher et al. 2017).

New Jersey

New Jersey has experienced river and coastal flooding for decades. In 2007, the New Jersey DEP established the Green Acres, Farmland, Blue Acres, and Historic Preservation Bond Act. This Act authorized $12 million for the acquisition of lands in floodways and hazardous flood zones. An additional $24 million was approved by voters in 2009. Property that has been damaged by, or made susceptible to recurrent damage from storms or storm-related flooding is eligible for acquisition (NJ DEP, 2020). These buyout programs are voluntary, but provide sellers the opportunity to leave hazardous areas, creating a natural buffer against future storms and floods.

Additionally, reports recently conducted by the Center for Climate Integrity have found that New Jersey would require almost 2,700 miles of sea walls, costing almost $25 billion to protect coastal communities from projected SLR by the year 2040 (Hurdle, 2019). Similar to Florida, New Jersey's economy receives a lot of revenue from their beaches and tourism industry. Blocking these beaches with sea walls would be costly for the State.

New York Metropolitan Area

Many communities in New York, specifically those within the New York Metropolitan area, are experiencing the impacts of SLR at an increasing rate. Similar to the Eastern Shore, land in this region is sinking while sea levels continue to rise. Given the complexities of the city's unique location, networks of underground public transportation, and being home to nearly half the state's population, New York's residents and resources are at great risk (Sea Level Rise, n.d.).

As SLR continues to accelerate, with current projections estimating one inch per every six years, the city and state officials are working towards building a resilient community. In 2014, the Governor signed the Community Risk and Resiliency Act (CRRA), ensuring funding for potential SLR risks and establishing guidelines for projecting future sea levels. Since the implementation of the CRRA, the State of New York has drafted guidance for Smart Growth Public Infrastructure and Flood Risk Management (NYDEC,

2020). Following Hurricane Sandy in 2012, many communities that were impacted used managed retreat as a solution. Others rebuilt and put hard-infrastructure in place for future protection. Since then, New York City has allocated $3.7 billion in coastal protection plans for the next 10 years (Sea Level Rise, n.d.). This funding is going to interim flood protection measures, ensuring that neighborhoods are best protected from coastal flooding until more permanent measures are completed.

STRATEGIES TO MITIGATE RISING SEAS

SLR is often referred to as the "ultimate planning challenge" as it is nearly impossible to address proactively (Johnson, 2000). Three dominant strategies have been used to mitigate the impacts of SLR on coastal communities: fortification, adaptation, and managed retreat:

Fortification

This strategy involves solidifying the shoreline with "hard" infrastructure, including seawalls, bulkheads, and jetties. These structures protect coastal land from erosion and floods and have been used in many coastal areas, including the Eastern Shore of Maryland. However, fortification has a number of drawbacks. It is costly to build these structures, so the construction of "hard" infrastructure is "necessarily selective" and is often only implemented in areas facing severe risk (Ryan et al., 2015). Fortifying coastlines also disrupts coastal habitats by segmenting the area between the land and the shore.

To ensure that all aspects of the environment and infrastructure within the impacted zone are able to withstand future inundation impacts, structural and non-structural solutions are considered. Structural examples include hard infrastructure practices that have been used for hundreds of years in order to protect communities against impeding waters. These structures include seawalls, groins, geotextiles (permeable fabric tubes), offshore breakwaters (manmade reefs), and riprap (stones or concrete installed as breakwater).

On average, these hard infrastructure installations are estimated to cost up to $1,022 per lineal foot with approximately $100-400 in project repairs over their 30-year lifespan. An external benefit cost analysis estimates that seawall installation generates higher losses than gains overall (Coastal Hazards, 2017). However, the waters are relatively calm on the Bay-side of the Eastern Shore, so the installation and maintenance of hard infrastructure is less expensive than on the rougher ocean side.

Adaptation

Adapting to SLR involves changing building codes to increase surface permeability and prohibit development in at-risk areas, as well as protecting the coast through coastal nourishment and living shoreline techniques (Ryan et al., 2015) Living shoreline techniques are synonymous with "soft" infrastructure; they are currently being implemented to stabilize shorelines. Techniques include oyster reef construction, dune replenishment, wetland and vegetation reconstruction, etc. These techniques work to prevent coastal erosion and flooding by reducing wave energy and the strength of storm surges. Adaptation strategies often have positive environmental impacts, although they may not be effective in some locations (Dr. Cora Johnston, personal communication).

Non-structural solutions, or soft infrastructure, are often more environmentally adaptable options, including coastal nourishment practices and vegetation reconstruction. Soft infrastructure practices, in terms of preparing for inundation impacts, are structured in a way that allows the area to flood without impacting the livelihoods of surrounding residents. This deliberate process of altering flood defense mechanisms helps to avoid uncertain outcomes and negative impacts. Down-planning actions must occur in order to limit residential density within these areas. This also aids with coastal ecosystem migration through the maintenance and restoration of adequate open space within the zone of accommodation.

Managed Retreat

Very soon shoreline protection efforts and their maintenance will no longer be feasible or effective. In many cases, erosion control through structural and nonstructural solutions will become a losing battle and relocation measures will be necessary.

Managed retreat is defined as the practice of moving communities, buildings, and other infrastructure landward, out of areas likely to flood. This process mitigates potential damage to valuable infrastructure and gives coastal inhabitants the opportunity to migrate inland.

The process of managed retreat typically begins with the designation of a threshold. This threshold is utilized to determine at what point demolition and relocation of structures under threat must begin (NOAA, 2015). Different planning and regulatory techniques must be utilized in order to identify high-risk areas that require this type of long-term policy solution. After determining the threshold and identifying the most vulnerable areas in the region, different forms of protection, accommodation, and retreat strategies are considered.
By ensuring that areas are 'SLR-ready', proper consideration is given to public and private infrastructure and development within these vulnerable areas. The adaptation of adequate protection of the built environment in hopes of maintaining a static shoreline is also required.

By beginning managed retreat strategies early on, local governments have the ability to restore the shoreline to its natural state. As coastal areas are eroded and overtaken by seawater, buildings and infrastructure will be forced to retreat. Human and concrete infrastructure are most commonly referred to as hard or gray infrastructure. When this gray infrastructure is removed, coastal ecosystems and vegetative regions will naturally begin to restructure themselves. This increases the environment's ability to adapt, protecting wildlife and the ecosystem itself, while also creating a natural barrier to hold up against encroaching sea levels. The natural areas will mitigate the impact of SLR by creating a buffer between high energy wave action and the Eastern Shore's mainland (Akson, 2012). This also reduces the loss of habitat and ecosystem services due to SLR. Accommodating the impeding waters allows development to proceed in transition areas and where SLR is uncertain and minimizes potential damage.

Forced Retreat in California

In California, coastal erosion is the driving force behind managed retreat tactics. The California Coastal Commission created a requirement two years ago for all coastal-local governments to consider managed retreat as an adaptation strategy in their coastal management plans (Siders, A.R., personal communication, 2019). This has become hugely controversial within these local communities and some are pushing back.

Mayor Druker of Del Mar stated that houses along the beach are actually acting as a protective barrier between the impeding seas and the homes to the east of them. He stated that forcing these homes to retreat would become "problematic" and would allow "the ocean to take over the whole flood plain" (John, 2019). Other arguments from residents of Del Mar and neighboring communities are centralized around cost and space. With nowhere to relocate residents and cost of buyouts being incredibly high, the implementation of managed retreat plans into all coastal management programs has little to no support in the area.

Many local government officials are asking the Coastal Commissioners to revoke the managed retreat mandate (John, 2019). Despite their pleas, the Coastal Commission continues to stand strong on creating managed retreat plans in addition to more protective policy options. So far, no local governments have added a managed retreat strategy to their coastal management plans.

BUYOUT BEST PRACTICES

A majority of the alternatives in this memo consider the option of home buyout programs. Home buyouts are normally used after natural disasters or repeated flood events. Buyouts are voluntary and no one is required to sell their property. After a presidentially declared disaster, local officials may request money from the state to purchase properties that have flooded or deemed substantially damaged. The decision to offer buyouts is made by the state using money that FEMA allocates through its Hazard Mitigation Grant Program. 75% of buyout costs are paid by FEMA and the rest is paid by the state or local government. Buyout programs have been used in multiple scenarios across the United States in dealing with the repercussions of disasters. Research has been conducted looking to improve these programs that lead to a substantial burden on local governments (FEMA, 2019).

Buyout programs have been an unpopular adaptation initiative because of the social and political challenges they pose (Freudenberg, 2016). These programs notoriously create hurdles for individuals, communities, and administrators. With rising sea levels and increasingly frequent storms of higher intensity, the implementation of buyout programs can create more successful outcomes for residents and local governments.

Grand Forks, North Dakota

In the spring of 1997, the Red River reached a peak of 54 feet during a severe flood event in Grand Forks, North Dakota. This was five feet above projections for the storm provided by the National Weather Service and forced 90% of the city to be evacuated, the largest evacuation of citizens since Atlanta during the Civil War (Siders, 2013). 4.5 million acres of land were flooded, only relatively smaller than the state of New Jersey (5.5 million acres) (Freudenberg et al, 2016). The impacted acres led to 83% of homes being damaged, more than $3.5 billion in destruction, and 4.5 million acres of land being flooded (Freudenberg et al, 2016). In response, President Clinton provided 100% federal government funding through FEMA (normally on 75%) and requested an additional $5.5 billion from Congress (Siders, 2013).

Grand Forks organized a buyout of over 800 properties using $171 million in CDBG funding from HUD. These property lots were located near the Red River in the central part of the city that was most impacted by the flood. The purchased lots were turned into the 2,200-acre Greater Grand Forks Greenway, more than double the size of Central Park in New York City (Siders, 2013). The Greenway contains 20 miles of trails, golf courses, boat ramps, campgrounds, and other recreational facilities with the goal of mitigating future flood impacts.

The remainder of the CDBG funding was utilized in partnership with a private development company to fund relocation efforts for those who were bought-out from flood zones. The construction of 180 new homes were financed in an underdeveloped area of Grand Forks. The prices of these new homes ranged from $105,000 to $147,000 which was substantially higher than the original $50,000 to $80,000 value of the homes demolished by the flood (Siders, 2013). These new homes were also built in an area that was isolated from the main city and many local amenities such as public-school districts, grocery stores, etc. This led to only 0.06% of homes being bought within the first two years of their construction. Eventually, the city reduced the prices of the homes and they sold, partly due to population growth (Siders, 2013).

Charlotte, North Carolina

Beginning in 2000, Charlotte's Storm Water Service administered a series of buyout programs. Storm Water Services identified areas that were at the greatest risk of repeat flood damage and determined which structures and homes qualified for the buyout because of potential risk (Siders, 2013). FEMA and local funding were utilized for the purchasing and demolishing of vulnerable infrastructure. Since the

implementation of this buyout program, 460 structures have been removed and replaced with greenspace (Sellers, 2019).

The programs implemented in Charlotte are all voluntary, meaning the homeowner must agree to sell their property. However, there could be an opportunity for the government to utilize eminent domain and purchase property without homeowner approval. This will likely occur in the future when voluntary buyouts are completed and those who still remain in high-risk areas become threats to public safety. If the government can provide evidence of a history of repetitive loss or elevated risk, they have the right to acquire the property without homeowner consent (Siders, 2013). While this tool is both legal and well-established in other realms, it will be expensive and controversial.

CRITERIA

State and local governments can evaluate policy options and their respective outcomes by utilizing the following criteria. These criteria have been chosen based on concerns surrounding managed retreat and the impacts it will have on communities, they have been weighted to best address those concerns.

Cost Effectiveness (25%)

Cost effectiveness is defined as the discounted cost of moving buildings over the next 20 years over the number of units moved. The calculation of this cost was determined using a 7% discount rate. This criterion assesses the costs associated with building and moving residents to new housing as well as commercial entities and costs of potential infrastructure. Cost effectiveness measures each alternative's usefulness in relation to its cost. In order to complete the cost effectiveness analysis (CEA) I will calculate the costs and divide them by the measured outcome for each alternative. The outcome in this CEA will be the number of residences, commercial, and government buildings that are relocated because of the implementation of the alternative. Cost effectiveness will be measured at a discounted rate in a variety of ways including property values through 2040, losses in property tax revenue, cost of initial implementation, and other potential expenditures.

In order to provide a standardized set of assumptions, one must create an index for applying the different aspects of effectiveness. A policy is determined "effective" if it is able to reduce the number of buildings destroyed.

Meanwhile, cost will be considered the expected direct and indirect costs of enacting each policy. This includes the material costs, managerial costs, and labor costs required to enact the policy and ensure its effectiveness and continuation. Additionally, the incorporated projected spillover costs, externalities, and opportunity costs on society. These will attempt to be measured in dollars and use comparable projects and projections whenever available to justify the expected financial cost. Whichever policy can result in the lowest cost over the greatest value of effectiveness will receive a higher rating (cost-effectiveness ratio = total cost/units of effectiveness).

Political Feasibility (25%)

This criterion assesses whether an option is practical given the current political climate at the local and state level, and is concerned with the likelihood of policy implementation by legislators and other governing officials. Any proposed policy should be able to be passed by the relevant authority in order to be seriously considered. For this reason, when interpreting political feasibility, it is important to consider which level of government will be enacting the policy. Different policy options will require different bodies of support in order to be achieved. The adoption of the option would mean enactment of both the governance and finance in the alternative by the appropriate government entities.

The political feasibility of the option is deeply related to cost effectiveness. This criterion also accounts for the public's perception of the option. Political feasibility is assessed with input from key non-government stakeholders, mostly local residents and industry. Thus, this criterion will be scored on a spectrum from low political feasibility to high political feasibility.

Equity (25%)

Any alternative chosen across counties will have enormous equity issues given the differences in the problem in terms of geographic location, as well as the views regarding the solutions and wealth of citizens. This criterion will focus on balancing the benefits of the alternative for general citizens at the expense of property owners. There is a disproportionate income gap between property owners living in high risk flood zones throughout the region. This equity problem will be evaluated based on the alternative's ability to impact varying levels of affected property owners. This criterion will be scored on a spectrum from low equity to high equity.

Environmental Impact (5%)

This criterion assesses the projected effects of the policy option on the Eastern Shore's environment, including the health of local ecosystems. As a rich, natural area, the Eastern Shore serves as a valuable habitat for many species. Additionally, as sea level continues to rise, infrastructure will be flooded and water will be polluted.

As seen throughout history, natural disasters leave a trail of pollution and hazards in their wake. Predicted measures for water quality will be used to evaluate this criterion. Researches use a variety of metrics to assess water quality in the Chesapeake Bay and its tributaries, mostly focused on the abundance of nutrients and minerals in a body of water (Boesch, Brinsfield, & Magnien, 2001). Potential shifts in levels of water quality due to the pollution of the Bay due to SLR will be utilized for the evaluation. This criterion will be scored on a spectrum of low environmental impact to high environmental impact.

Administrative feasibility (20%)

This criterion will measure the ability to effectively implement an alternative. The process through which the government establishes and funds managed retreat programs does not have direct control over the actors in the situation and all stakeholders that must be considered. This criterion will quantitatively analyze the ability of local government and non-government organizations to aid in the implementation of each alternative in order to achieve the desired outcome. It will be scored on the spectrum of low to high administrative feasibility.

ALTERNATIVES

POLICY ALTERNATIVE 1: SELF-FUNDING BUYOUTS WITH LOCAL GOVERNMENT PROGRAMS

In order to implement buyout programs, cities and counties must raise funds. Currently, there is no revenue stream for funding buyouts on the Eastern Shore. Local governments with high-certainty of destructive SLR by the year 2040 should seek funding options and solutions now to prepare for the imminent damage.

Many local governments across the nation receive their largest source of general funding through property taxes and intergovernmental transfers (Harris & Moore, 2013). Intergovernmental transfers are funds provided directly by the state or federal government, such as the CDBG program. To aid in the funding process of buyout programs and additional costs due to managed retreat, local governments within the region should look to apply for these additional funding streams.

In FY2020, Allegheny County, partnered with the Maryland Emergency Management Agency (MEMA), was able to solidify $700,000 in CDBG funding, matching the $750,000 Federal Hazard Mitigation Grant secured from FEMA (Luell, 2020). The funds from these grants will be utilized to purchase property and relocate residents from a section of the Garden City Mobile Home Park that sits in a frequently impacted floodplain. Due to similar or more severe community impact on the Eastern Shore, it could be assumed that these communities could receive funding of equal or greater value to the $1.5 million received by Allegheny county.

Property taxes are popular across the nation because of their flexibility in the presence of changing market conditions. Other forms of local government revenue, such as sales and income taxes, respond immediately to economic downturns. Property taxes, however, can continue to provide stable revenues due to manipulated property tax rates (Lutz et al., 2011; Harris & Moore, 2013). Ideally, to self-fund a buyout program, property taxes in each county would need to be increased to 2%, this would be a 150% growth from the current tax rate. However, given differences in socio-economic makeup of Eastern Shore counties, we can assume that individual counties on their own will not be able to move very much in terms of taxes and will have differential tax rates implemented. We can also assume that not all counties will be open to participate. For these reasons, this option is going to assume that the three most highly impacted counties -- Dorchester, Talbot, and Queen Anne's -- would be willing to participate in such a program. These three counties could come together to create a broad funding base so all money could be used for financing projects.

In Maryland, the state caps tax increases to 10% a year (Baltimore Sun). This means that a 150% increase in property tax would be phased in over a 12-year period. Assuming that these counties were able to successfully implement a 150% tax rate increase from their current rate by the year 2033, approximately 12 years from 2021, the per capita revenues listed in **Table 2** could be expected.

Table 2: Tax Capacity Measures County Revenues by Year 16

		Property Taxes
County	**Tax Rate**	**Per Capita Revenues**
Dorchester	$2.44	$2,273
Queen Anne's	2.11	3,380
Talbot	1.37	2,455

Additionally, this alternative would require a coordinating committee. Each participating local government would appoint a member to be a part of the working-group. The goals of the committee would be to develop a recommended tax increase, whether it is based on threat of flooding, socio-economic status, etc. The committee would also be responsible for determining how funding will be distributed. For example, the government entity could dedicate 10% of funds to the coordinating committee for high priority projects across the region and the other 90% would be spent by the entity that enacted the tax. This tax would have to be phased in over an eleven-year period.

POLICY ALTERNATIVE 2: CREATING A COMPACT

A compact is an interstate agreement between two or more signatory governments that is approved by an overseeing entity, in this case the Maryland General Assembly. Once created, this entity has the authority to tax and raise funds accordingly. Compacts are different from laws in that they are not subject to unilateral amendments nor administrative agreements. When adopting a compact, local governments act as sovereigns within a constituent union and create their own binding treaties between the representing governments.

This alternative requires the creation of a new government entity that has the ability to both tax and set priorities for spending. Creating a compact would grant local counties and municipalities the ability to plan for the imminent impacts of climate change and SLR. The compact may aid in the coordination and delivery of services that could not be funded or implemented effectively by any one municipality or county.

Through the creation of a tax-based sharing system, the compact has the ability to collect taxes or implement a new tax in order to raise funds for buy-out programs. Once created, the compact should pass a statute increasing property taxes. Since the compact would be collectively passing the legislation, it would be implemented by all partaking counties and municipalities. This would allow for total participation in funding the buyout programs. Property taxes would be best implemented on a tiered tax system – low valued properties with a lower increase than higher valued properties.

In order to self-fund a buyout program, property taxes in each county and incorporated town would need to be increased to 2%. Currently, the average property tax on the Eastern Shore is 0.8%. Increasing property taxes from 0.8% to 2% is approximately a 150% growth. This growth would be phased in over a sixteen-year period.

For the first fifteen years of implementation, counties can expect to see a gradual increase in per capita revenues. These funds may be used for additional resilience projects such as hard-infrastructure maintenance or construction to buy communities a bit more time in high-hazard areas. However, local governments should consider creating an individual fund that is dedicated to financing buyouts and their associated costs. After the full property tax increase is implemented, counties should expect to see a 150% increase in per capita revenue from the increased property tax. The projected tax rate and revenue was calculated in **Table 3** below using data from **Table 1** (Maryland DLS, n.d.).

Table 3: Tax Capacity Measures County Revenues by Year 16

		Property Taxes
County	**Tax Rate**	**Per Capita Revenues**
Caroline	$1.47	$1,155
Cecil	1.49	1,547
Dorchester	1.46	1,364
Kent	1.43	2,289
Queen Anne's	1.27	2,028
Talbot	0.82	1,473

Similar to the increase in the first alternative, we could expect the tax rates would increase by 9% each year until it reaches 2% in 2032. This would then generate $465 million in revenue for the purchase of property.

POLICY ALTERNATIVE 3: LOBBY THE STATE FOR TRUST FUND

Buyout program funding stems from a mixture of federal, state, and local level funding. Some major cities such as Charlotte, Houston, and New Orleans have self-established their own funding streams (Freudenberg, 2016). However, not every community has that ability. Creating a new funding model for buyouts that can be administered incrementally over time instead of directly following disaster would allow communities and their residents to avoid severe loss and damages.

In order to create a buyout fund, Maryland could expand the use of open-space taxes. Currently, Maryland utilizes a Real Estate Transfer Tax on the transfer of title of real estate between owners. Maryland has set the Real Estate Transfer Tax Rate at 0.5% of the valuation. The tax serves as the most significant and expansive source of revenue for "Program Open Space" (POS) under the Maryland State Department of Natural Resources. This open space program is funded through the transfer tax which, with a slight increase to 1.25%, could also help to support the funding of buyout programs (MDAT, 2019).

Creating a buyout fund, with the same structure as a trust fund, would allow for multiple funding streams to aid in growing the program. The additional revenue from the increase in the open space transfer tax could be combined with an increase in sales tax to create further funding. Increasing the local sales tax, that is in addition to the current state sales tax, could allow for supplementary funding collection for the buyout fund.

Stakeholders on the Eastern Shore have the opportunity to lobby the state to enact legislation to create this trust fund and collect additional taxes. By creating an advisory group of local members and lobbyists, the Eastern Shore could take the issue to the state level. Here, there is an opportunity to create statewide legislation for the implementation of a buyout fund and establish its funding.

POLICY ALTERNATIVE 4: STATUS QUO

This option demonstrates the impacts of SLR and associated episodic flooding if the Eastern Shore makes no significant policy changes going forward. This option does not take additional measures to maintain the current state and sends the message that there is no immediate danger from SLR. Sticking to the status quo relies mostly on changes at the federal level and has little room for state or local improvements. Spending on protection measures, such as hard and soft infrastructure, as well as tax rates, are frozen.

The status quo continues to present the most realistic and most risk averse present course of action, with the least potential for unintended consequences and costly interruptions. Continuing the status quo allows for research to continue into best practices for reducing the impact of SLR at a lower cost.

OUTCOMES MATRIX

Table 4: Projected Outcomes Matrix

	Cost Effectiveness 25%	Political Feasibility 25%	Equity 25%	Environmental Impacts 5%	Administrative Feasibility 20%
Develop Self-Funding Buyouts	$693,032	Medium	Medium Low	Medium	Medium Low
Create a Compact	**$285,105**	**Medium**	**High**	**Medium Low**	**Medium**
State Trust Fund	$2,299,326	Medium Low	Medium High	Low	Medium High
Status quo	N/A	Medium High	Low	High	High

FINDINGS

EVALUATION OF COST EFFECTIVENESS (25%)

Based on the analysis of this paper and the more in-depth discussion of cost effectiveness in *Appendix A*, creating a compact would be the most cost-effective solution. We would expect the average cost effectiveness for the twenty-year period of this option to be $285,105 per building unit. This is slightly more favorable than the option to develop self-funding buyouts ($693,032) or allowing for the state to implement its own trust ($2,299,326).

Because the status quo served as a baseline measurement, it was not possible to establish a cost-effective measurement, given that there were no anticipated changes in projected effectiveness outcomes, based on previously established expectations. Overall, if the status quo continues, there will be no buildings moved. However, there will still be the cost of flooded buildings ($219,732,800) and the belongings within them.

EVALUATION OF POLITICAL FEASIBILITY (25%)

Political feasibility refers to two potential paths: either legislative action on the state government level or local government action. The status quo is ranked the medium high, as this is already the current state affairs. However, there are political representatives who believe more should be done to protect the Eastern Shore from future damages.

Developing self-funding buyouts and creating a compact were both ranked medium. These alternatives both allow local government on the Eastern Shore to have autonomy over the taxation, financing, and implementation of future programs. Residents and representatives of the Eastern Shore are prideful about their region and their ability to take care of themselves. For this reason, the state trust fund ranks low on political feasibility, as it would require the region to hand over power to the state.

Developing self-funding buyouts is ranked medium given that counties are being impacted by SLR on varying levels. Counties such as Talbot, Dorchester, and Queen Anne's where depth and displacement levels are projected to be much higher haver more of an incentive to implement tax rate increases and begin funding programs. This inconsistency across local governments leads to a medium political feasibility ranking.

Creating a compact would be a feasible option when considering the local government system. However, there is limited data available to inform how likely Maryland would be to creating a compact strictly for local governments on the Eastern Shore. This also alludes to why lobbying the state received a medium low ranking. The option would require local government to hand over all power and authority related to buyout programs to the state and their administrative body. Many residents on the Eastern Shore would be unlikely to give up their authority or their ability to oversee buyout programs occurring in their communities.

EVALUATION OF EQUITY (25%)

As defined in the evaluative criteria portion of this analysis, equity is seen as the balancing of benefits of the alternative for general citizens at the expense of the property owners. As such, only two policies meaningfully achieve this. The creation of a compact, rated high, would allow for local governments to collectively determine the most at-risk areas on the Eastern Shore and help channel funding to resiliency projects and buyout programs in those areas based on first-hand knowledge, thus increasing overall equity.

Meanwhile, lobbying the state for the creation of a trust fund receives a medium high rating as it would create a large pot of money to go towards financing buyout programs on the Eastern Shore. However, it is

also less equitable for local residents, as the State government has less direct knowledge of everyday concerns on the Eastern Shore and would be in complete control of who received funding for projects.

The other two options received low and medium low ratings as they would continue to be seen as an unfair burden placed on citizens. Affluent communities on the Eastern Shore are already in a financial position to begin funding buyouts. In contrast, some of the most vulnerable areas have residence of lower socio-economic status who are likely less able to help themselves and other community members.

EVALUATION OF ENVIRONMENTAL IMPACT (5%)

Ratings for environmental impact are based on the ability of the alternative to fund the removal of buildings and additional infrastructure from impeding sea level. The criterion is defined as the effects of the policy option based on the health of the environment and local ecosystems. A state trust fund would allow for multiple streams of funding to be channeled into a trust that could cover the costly removal process. The other two alternatives are ranked lower based on their potentially lower revenue streams and status quo has high environmental impact as nothing will be removed from the flooded areas.

EVALUATION OF ADMINISTRATIVE FEASIBILITY (20%)

The status quo was ranked as high given that current practices are implemented. Based on this analysis' definition of administrative feasibility as the idea that any policy must be able to be implemented to be reasonable and unified in order to be successful, the status quo is definitionally the easiest option to be implemented.

Lobbying the State was ranked medium high given the fact that this option would be administratively executed by the state government. The state government has many resources as well as the authority to implement policy change through legislation. While there would be some intended enactment period, the ultimate implementation of this option would be run on the state level meaning larger funding opportunities to recruit talent and a greater pool of resources.

Creating a compact received a medium evaluation. Despite the fact that this option means total power of raising funding and channeling finances would be solely given to the compact, , it would still have more limited resources than the state government. The local government representatives collaborating on the Eastern Shore compact team would still have limited resources for funding or soliciting experts in the field. Additionally, because these local governments are much smaller, they also have smaller staffs. This would involve either adding work to someone's already busy schedule, or asking governments to take on an additional employee to help split the work. These may not be feasible for some communities, especially those who are not expecting high risks as early on as others.

RECOMMENDATION

After reviewing the outcomes matrix, the relative scores of each policy, and the relative weight of each criteria, it is clear that **creating a compact** (Option 2) offers the greatest opportunity for implementation given its cost effectiveness and its ranking in political and administrative feasibility. Additionally, this option is the only one that scores high on equity, suggesting that it is an effective, long-term policy that manages to equitably determine winners and losers.

The creation of a compact is the only proposed policy option that is both cost-effective and allows local governments on the Eastern Shore autonomy over the funding and implementation of buyout programs. While self-funding programs (Option 1) allows similar autonomy, it would be much costlier for local governments to move homes individually. Perhaps more importantly, state funding buyout programs (Option 3) is the most expensive option and would take over twenty years to obtain the funding necessary to move and demolish impacted buildings. Option 2 is the only proposed policy option that moves all buildings prior to their projected permanent flooding.

IMPLEMENTATION CONSIDERATIONS

In order to achieve success, this report suggests first going to the state and requesting the creation of a regional compact. Given that this would be a new idea within the state, it is critical to secure support with state officials. While all state delegates and senators representing the Eastern Shore region are conservative, many of them hold seats on influential committees (Ways and Means, Budget and Taxation, Economic Matters, Environment and Transportation). These representatives will be crucial in ensuring the compact is passed, allowing taxing authority to the participating local governments.

Once the compact is negotiated and approved, local governments will need to appoint a representative to act on their behalf as a part of the compact. These representatives are responsible for devising a plan to increase the property tax across the Eastern Shore in order to finance the buyout program. Because of the income inequality across the shore, the compact may wish to introduce a tiered tax system, increasing the property tax rate in lower-income communities at a slower rate. This would allow for higher equity across the region while still collecting funds for the program.

Finally, because the compact would be able to start accruing profit by the year 2027, representatives may want to consider if they wish to use the first few years of funding on mitigation projects such as fixing or upgrading rip rap, sea walls, or coastal nourishment projects. While this report has repeatedly stated that these mechanisms are not feasible for long-term protection, they could buy a few additional years in protection for vulnerable buildings.

APPENDIX A: COST EFFECTIVENESS ANALYSIS

I. BASELINE/STATUS QUO

TABLE A1: GENERAL ASSUMPTIONS

Discount rate	7%
Analysis period	20
Projected buildings constantly flooded by 2040	853
Cost of purchasing building	$257,600
Total cost of purchasing buildings flooded by 2040	$219,732,800
Demolition cost per building	$22,455
Demolition of buildings and infrastructure (in 2020 USD)	$19,154,196
Total cost of purchase and demolition per structure	$280,055
Taxation losses	$4,542,650
Deadweight loss	25%

Under the status quo, the current trends of impeding SLR, damage, and cost would be anticipated to continue. Macro level factors such as global climate change lead many scientists to expect expedited SLR as well as increases in extreme precipitation and weather events (Charochak & Bass, 2019). There is a bit of uncertainty with predictions and variability based on unpredictable changes in weather patterns which can make it difficult to accurately project SLR. This paper opted to use the results of a vulnerability assessment conducted by Dr. Scott as Salisbury University. The assessment utilized the following data to project future SLR levels and the 853 buildings that would be constantly flooded by 2040 on the Eastern Shore (Scott, n.d.):

- High-resolution, most recent LiDAR data
- 2015 USACE estimates of SLC (SLR and subsidence) vs. main sea level
- Tidal flow network to remove unconnected inundated areas
- HAZUS-MH (multi-hazard) flood depth grids for 1% and 0.2%-chance floods
- Building footprints, combined with Maryland Department of Planning property information
- Summary statistics by damage percentage, land use, and property value

The cost of purchasing a building in a high-risk area was determined through finding the median property value for each county included in Dr. Scott's analysis. These counties include Talbot, Dorchester, Queen Anne's, Cecil, and Caroline. The median property value for each county was added together and averaged to be $257,600. This value was used as the cost of purchasing an individual building in a high-risk area.

Next, the cost of demolition of buildings and infrastructure was determined by utilizing research conducted and published in the Ocean & Coastal Management journal in 2016. Data from Table 10: Relative weights of costs and benefits for the standard relocation scenario. This data, originally in 2016 euros, was converted to US$7,094,147. This number accounted for approximately 100 homes, 200 apartments, and 60 shops and restaurants. This estimate accounted for about half of impacted buildings on the Eastern Shore and did not account for additional infrastructure such as roads. For this reason, the number was multiplied by 2.7 to account for these additional costs of demolition and removal, equaling $19,154,196. The cost per structure was determined by adding the total cost of purchasing buildings flooded by 2040 ($219,732,800) with the cost of demolition of buildings and structures ($19,154,196) and then divided by the total number of buildings constantly flooded by 2040 (853).

Finally, taxation losses are based on the revenue that will no longer be collected by the local government system after the building is deemed lost. We can only estimate costs as of 2040 when these buildings are anticipated to be permanently flooded, therefore the cost in the analysis is only occurring in year 2040. This number was determined by multiplying the average cost of purchasing a building ($257,600) by the current property tax (0.8%) and then multiplied by the number of buildings deemed lost by 2040 (853). These calculations provide a baseline for comparing any changes that are a result of a new policy initiative. Now, using the best data available and key assumptions, this paper aims to evaluate the relative cost-effectiveness of each option.

II. POLICY ALTERNATIVE CALCULATIONS

Each policy option assumes that there will be a cost of employing current local or state government staff in order to implement the funding mechanism. For the first two policy options, self-funding local government buyout programs and creating a compact, the average salary of county officials were averaged ($89,376). This average was then broken down into an hourly wage of $46.55 as seen in **Table A2** and **Table A3** below.

TABLE A2: SELF-FUNDING BUYOUTS ASSUMPTIONS

Hourly wage of each local government representative	$46.55
Estimated number of participating representatives	26
Estimated hours of participation per year	250

TABLE A3: COMPACT ASSUMPTIONS

Hourly wage of each local government representative	$46.55
Estimated number of participating representatives	51
Estimated hours of participation per year	400

The estimated number of participating representatives for these options is determined by the number of anticipated local government members. Since the first option assumes that only three total counties, those with the most high-risk buildings, would participate, it is estimated that a representative from both the county government (3) and municipality governments (23) would participate. For the creation of a compact, it is anticipated that all county (6) and municipal (45) governments on the Eastern Shore would participate.

Similarly, as seen in **Table A4**, option three, the creation of a state trust fund would require state employees. The average salary of employees working for the Maryland Department of Housing and Community Development were taken and an hourly wage was estimated ($49.92). There would be participating members from multiple legislative committees and state government agencies, leading to an estimation of 23 participating state employees.

TABLE A4: STATE TRUST FUND ASSUMPTIONS

Hourly wage of each local government representative	$49.92
Estimated number of participating representatives	23
Estimated hours of participation per year	600

The estimated hours of participation per year were determined for each policy option based upon anticipated hours of participation. As the administrative process often takes longer on the state level because of multiple levels of communication and approval, it is anticipated that state-level employees would have the most amount of time dedicated to the implementation of the state trust fund.

III. RESULTS

TABLE A5: REVENUE EARNED – SELF-FUNDING BUYOUTS

YEAR	2021	2022	2023	2024	2025	2026	2027
Increasing Property Tax	$0.00	$11,966,350	$25,009,671	$39,226,892	$54,723,662	$71,615,142	$90,026,854
	2028	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
	$110,095,621	$131,970,577	$155,814,279	$181,803,914	$210,132,616	$210,132,616	$210,132,616
	2035	**2036**	**2037**	**2038**	**2039**	**2040**	
	$210,132,616	$210,132,616	$210,132,616	$210,132,616	$210,132,616	$210,132,616	

TABLE A6: COST – SELF-FUNDING BUYOUTS (2021-2027)

YEAR	2021	2022	2023	2024	2025	2026	2027
Total cost of purchasing buildings flooded by 2040	$205,357,757	$179,367,418	$167,633,101	$156,666,450	$146,417,243	$136,838,544	$127,886,490
Demolition of infrastructure	$17,901,118	$15,635,530	$14,612,644	$13,656,677	$12,763,250	$11,928,271	$11,147,916
Total estimated cost of local representatives	$282,780	$246,991	$230,833	$215,732	$201,618	$188,429	$176,101
Cost of tax (DWL)	$0	$2,991,587	$6,252,418	$9,806,723	$13,680,916	$17,903,785	$22,506,714
Total	$223,541,655	$198,241,526	$188,728,996	$180,345,581	$173,063,026	$166,859,029	$161,717,222

TABLE A7: COST – SELF-FUNDING BUYOUTS (2028-2034)

YEAR	2028	2029	2030	2031	2032	2032	2034
Total cost of purchasing buildings flooded by 2040	$119,520,084	$111,701,013	$104,393,470	$97,563,991	$91,181,300	$85,216,168	$79,641,279
Demolition of infrastructure	$10,418,614	$9,737,022	$9,100,021	$8,504,692	$7,948,310	$7,428,327	$6,942,362
Total estimated cost of local representatives	$164,581	$153,814	$143,751	$134,347	$125,558	$117,344	$109,667
Cost of tax (DWL)	$27,523,905	$32,992,644	$38,953,570	$45,450,978	$52,533,154	$52,533,154	$52,533,154
Total	$157,627,184	$154,584,493	$152,590,812	$151,654,009	$151,788,322	$145,294,994	$139,226,462

TABLE A8: COST – SELF-FUNDING BUYOUTS (2035-2040)

YEAR	2035	2036	2037	2038	2039	2040	NPV
Total cost of purchasing buildings flooded by 2040	$74,431,102	$69,561,777	$65,011,007	$60,757,950	$56,783,131	$53,068,347	$1,335,149,838
Demolition of infrastructure	$6,488,189	$6,063,728	$5,667,035	$5,296,295	$4,949,808	$4,625,989	$116,385,545
Taxation losses						$4,542,650	$4,542,650
Total estimated cost of local representatives	$102,493	$95,787	$89,521	$83,665	$78,191	$73,076	$1,838,519
Cost of tax (DWL)	$52,533,154	$52,533,154	$52,533,154	$52,533,154	$52,533,154	$52,533,154	$288,867,104
Total	$133,554,937	$128,254,447	$123,300,717	$118,671,064	$114,344,284	$114,843,216	$1,746,783,656

TABLE A9: RESULTS – SELF-FUNDING BUYOUTS

Total NPV Cost	Moved	Cost Per Building Moved
$1,746,783.66	2520	$693,032

TABLE A10: REVENUE EARNED – CREATING A COMPACT

YEAR	2021	2022	2023	2024	2025	2026	2027
Increasing Property Tax	$0.00	$26,462,625	$55,306,886	$86,747,130	$121,016,997	$158,371,151	$199,087,180
	2028	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
	$243,467,650	$291,842,364	$344,570,801	$402,044,798	$464,691,455	$464,691,455	$464,691,455
	2035	**2036**	**2037**	**2038**	**2039**	**2040**	
	$464,691,455	$464,691,455	$464,691,455	$464,691,455	$464,691,455	$464,691,455	

TABLE A11: COST – CREATING A COMPACT (2021-2027)

YEAR	2021	2022	2023	2024	2025	2026	2027
Total cost of purchasing buildings flooded by 2040	$205,357,757	$179,367,418	$167,633,101	$156,666,450	$146,417,243	$136,838,544	$127,886,490
Demolition of infrastructure	$17,901,118	$15,635,530	$14,612,644	$13,656,677	$12,763,250	$11,928,271	$11,147,916
Total estimated cost of local representatives	$887,495	$775,173	$724,461	$677,066	$632,772	$591,376	$552,687
Cost of tax (DWL)	$0	$6,615,656	$13,826,721	$21,686,783	$30,254,249	$39,592,788	$49,771,795
Total	$224,146,370	$202,393,777	$196,796,927	$192,686,975	$190,067,513	$188,950,979	$189,358,889

TABLE A12: COST – CREATING A COMPACT (2028-2034)

YEAR	2028	2029	2030	2031	2032	2032	2034
Total cost of purchasing buildings flooded by 2040	$119,520,084	$111,701,013	$104,393,470	$97,563,991	$91,181,300	$85,216,168	$79,641,279
Demolition of infrastructure	$10,418,614	$9,737,022	$9,100,021	$8,504,692	$7,948,310	$7,428,327	$6,942,362
Total estimated cost of local representatives	$516,530	$482,739	$451,158	$421,643	$394,059	$368,279	$344,186
Cost of tax (DWL)	$60,866,913	$72,960,591	$86,142,700	$100,511,200	$116,172,864	$116,172,864	$116,172,864
Total	$191,322,141	$194,881,365	$200,087,349	$207,001,525	$215,696,533	$209,185,638	$203,100,691

TABLE A13: COST – CREATING A COMPACT (2035-2040)

YEAR	2035	2036	2037	2038	2039	2040	NPV
Total cost of purchasing buildings flooded by 2040	$74,431,102	$69,561,777	$65,011,007	$60,757,950	$56,783,131	$53,068,347	$1,335,149,838
Demolition of infrastructure	$6,488,189	$6,063,728	$5,667,035	$5,296,295	$4,949,808	$4,625,989	$116,385,545
Taxation losses						$4,542,650	$4,542,650
Total estimated cost of local representatives	$321,669	$300,625	$280,958	$262,578	$245,400	$229,346	$5,770,122
Cost of tax (DWL)	$116,172,864	$116,172,864	$116,172,864	$116,172,864	$116,172,864	$116,172,864	$1,527,785,169
Total	$321,669	$300,625	$280,958	$262,578	$245,400	$229,346	$5,770,122

TABLE A14: RESULTS – CREATING A COMPACT

Total NPV Cost	Moved	Cost Per Building Moved
$2,989,533,323	10486	$285,105

TABLE A15: REVENUE EARNED – STATE TRUST FUND

YEAR	2021	2022	2023	2024	2025	2026	2027
Increasing Real-Estate Transfer Tax	$0.00	$261,595,336	$244,481,622	$228,487,497	$213,539,717	$199,569,829	$186,513,859
	2028	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
	$174,312,018	$162,908,428	$152,250,867	$142,290,530	$132,981,804	$124,282,060	$116,151,458
	2035	**2036**	**2037**	**2038**	**2039**	**2040**	**NPV**
	$108,552,764	$101,451,181	$94,814,188	$88,611,391	$82,814,384	$77,396,621	$1,667,319,381

TABLE A16: COST – STATE TRUST FUND (2021-2027)

YEAR	2021	2022	2023	2024	2025	2026	2027
Total cost of purchasing buildings flooded by 2040	$205,357,757	$179,367,418	$167,633,101	$156,666,450	$146,417,243	$136,838,544	$127,886,490
Demolition of infrastructure	$17,901,118	$15,635,530	$14,612,644	$13,656,677	$12,763,250	$11,928,271	$11,147,916
Total estimated cost of local representatives	$643,828	$562,344	$525,555	$491,173	$459,040	$429,010	$400,944
Cost of tax (DWL)	$0	$65,398,834	$61,120,406	$57,121,874	$53,384,929	$49,892,457	$46,628,465
Total	$0	$245,346,926	$229,296,193	$214,295,507	$200,276,175	$187,173,995	$174,928,968

TABLE A17: COST – STATE TRUST FUND (2028-2034)

YEAR	2028	2029	2030	2031	2032	2032	2034
Total cost of purchasing buildings flooded by 2040	$119,520,084	$111,701,013	$104,393,470	$97,563,991	$91,181,300	$85,216,168	$79,641,279
Demolition of infrastructure	$10,418,614	$9,737,022	$9,100,021	$8,504,692	$7,948,310	$7,428,327	$6,942,362
Total estimated cost of local representatives	$374,714	$350,200	$327,290	$305,878	$285,867	$267,166	$249,688
Cost of tax (DWL)	$43,578,004	$40,727,107	$38,062,717	$35,572,633	$33,245,451	$31,070,515	$29,037,864
Total	$163,485,017	$152,789,735	$142,794,145	$133,452,472	$124,721,936	$116,562,557	$108,936,970

TABLE A18: COST – STATE TRUST FUND (2035-2040)

YEAR	2035	2036	2037	2038	2039	2040	NPV
Total cost of purchasing buildings flooded by 2040	$74,431,102	$69,561,777	$65,011,007	$60,757,950	$56,783,131	$53,068,347	$1,335,149,838
Demolition of infrastructure	$6,488,189	$6,063,728	$5,667,035	$5,296,295	$4,949,808	$4,625,989	$116,385,545
Taxation losses						$4,542,650	$4,542,650
Total estimated cost of local representatives	$233,353	$218,087	$203,819	$190,485	$178,024	$166,377	$4,185,899
Cost of tax (DWL)	$27,138,191	$25,362,795	$23,703,547	$22,152,848	$20,703,596	$19,349,155	
Total	$101,810,252	$95,149,768	$88,925,017	$83,107,492	$77,670,554	$77,131,953	$1,344,014,830

TABLE A19: RESULTS – STATE TRUST FUND

Total NPV Cost	Moved	Cost Per Building Moved
$1,344,014,830	584	$2,299,436

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