Understanding Shoreline Management Decision-Making

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Goal of the Project

- Better understand how shoreline property owners make choices about managing their property in light of sea level rise.
  - What management options do they choose?
- Part of larger project that will examine how those choices impact neighboring property and the ecosystem in which the property lies.
- Ultimate goal is investigate the linkages between human and natural components of shorescapes and create a model that integrates physical, biogeochemical, and human components in order to simulate and select climate change adaptation strategies that will support a sustainable system.

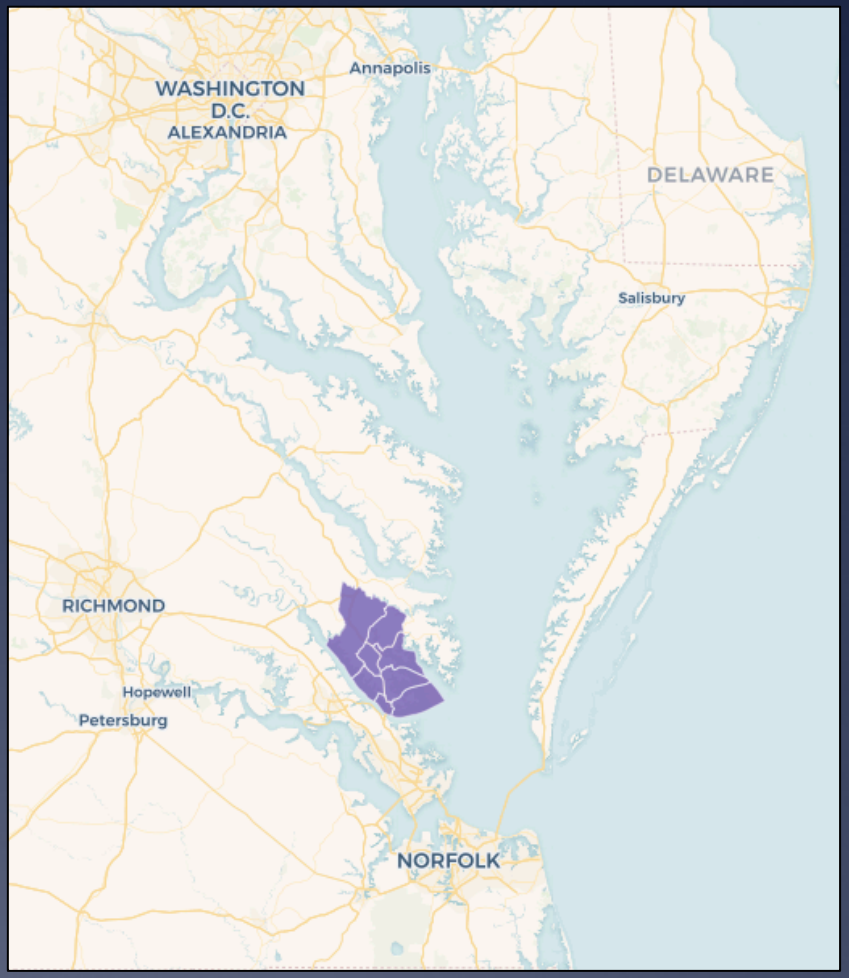
What are the possible management choices?

- Defensive structures harden the shoreline to prevent erosion from waves.
  - Bulkheads or seawalls
  - Revetments
  - Groins
- Offensive structures dissipate wave energy before it reaches the shoreline.
  - Breakwaters
- Living shorelines stabilize the shore through enhancement of natural habitats.
  - Sills
  - Marshes

Option	Property Owner Costs	Property Owner Benefits	External Costs	External Benefits
Bulkheads	Most expensive. Reduces access to water.	Durable. Stabilizes shoreline.	Interrupts shoreline ecosystems. Increases erosion at neighboring properties.	
Revetments	Relatively expensive. Reduces access to water.			
Groins	Relatively expensive.	Durable. Minimizes beach erosion. Maintains access to water.		
Breakwaters	Relatively expensive.	Maintains access to water.	Increases erosion at neighboring properties.	Maintains shoreline ecosystems. Maintains water quality and runoff.
Living Shorelines	Least expensive, but requires ongoing maintenance. May take time to establish.	Maintains some access to water. Maintains natural habitat.		Maintains/enhances shoreline ecosystems. Maintain water quality and runoff.

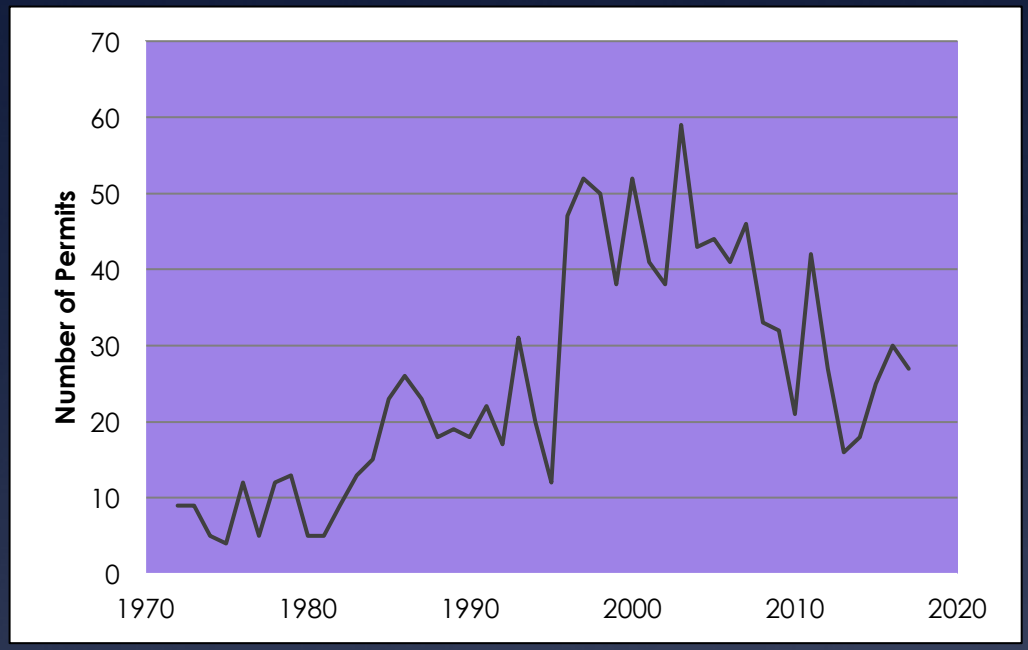
Case Study of Gloucester, Virginia

- Why a case study?
  - Integrating cadastral data across localities is a chore.
- Why Gloucester?
  - We have a good working relationship with the county and they have good cadastral data.
  - Good test case as the county has over 600 miles of shoreline and a significant number of shoreline modifications.
  - Additionally, it has already experienced significant shoreline erosion and is forecasted to experience even more in the coming decades.



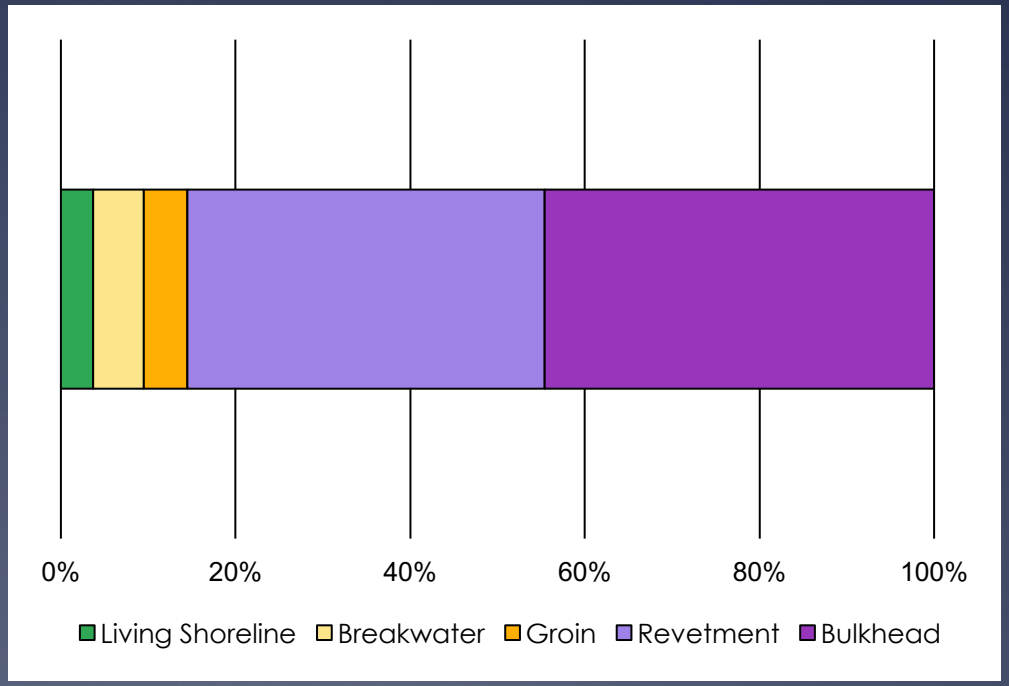
Shoreline Modification Data

- Since 1972, shoreline modifications have required permits from VMRC.
  - Property owners must identify where the modification is to take place as well as the type of modification.
    - Most recent permit submissions include street address of the property and can be matched to tax parcel numbers.
    - However, early submissions often provided "alternate" location info such as driving directions.
- Additional information on modifications is available from a shoreline inventory conducted from 2009-2011 using aerial images and visual inspections.



Of the 1,167 applications for shoreline modifications in Gloucester submitted between 1972 and the end of 2017, over 80 percent were filed in 1990 or later. Of these, 95% can be geolocated.

Applications for multiple modifications are categorized by the most defensive type requested. Only four percent request a stand-alone living shoreline and no requests for living shorelines were made before 1999.



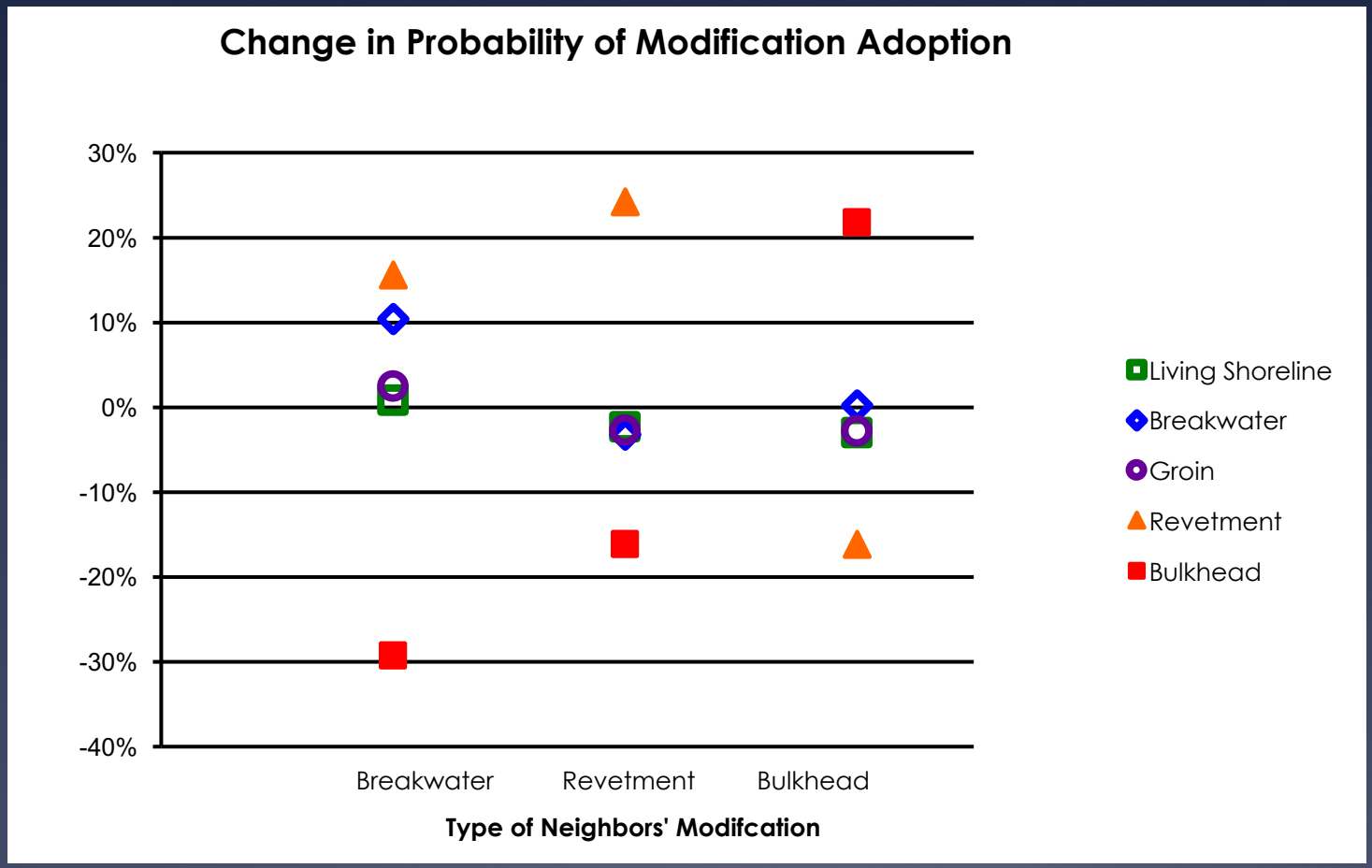
Property Data

- From tax records we have data on:
  - Size of parcel.
  - Current land and improvement value.
  - Current owner.
  - Zoning classification.
- Overlaying other GIS layers on the cadastral data we can determine:
  - Location in Hurricane Storm Surge and Special Flood Hazards Areas.
  - Land use data.
  - Primary structure's elevation and distance to shore.
  - Shoreline length, bank height, wave energy.

Findings

- With respect to the decision to undertake any type of shoreline modification:
  - More likely to modify if higher wave energy, higher Hurricane Storm Surge categories, higher land or improvements value.
  - Less likely to modify the farther the primary structure on a parcel is from the shoreline, property is in conservation zones, has a high percentage of natural cover.
- More likely to have defensive modifications if NOT in conservation area, in Storm Surge Category 1 or 2, or have a high bank.
- More likely to have offensive modifications if total shoreline is long, have a low bank, or experience more flooding.
- More likely to have living shorelines if not in Storm Surge Category 4 and have moderate wave energy

And Neighbors Matter A Lot!



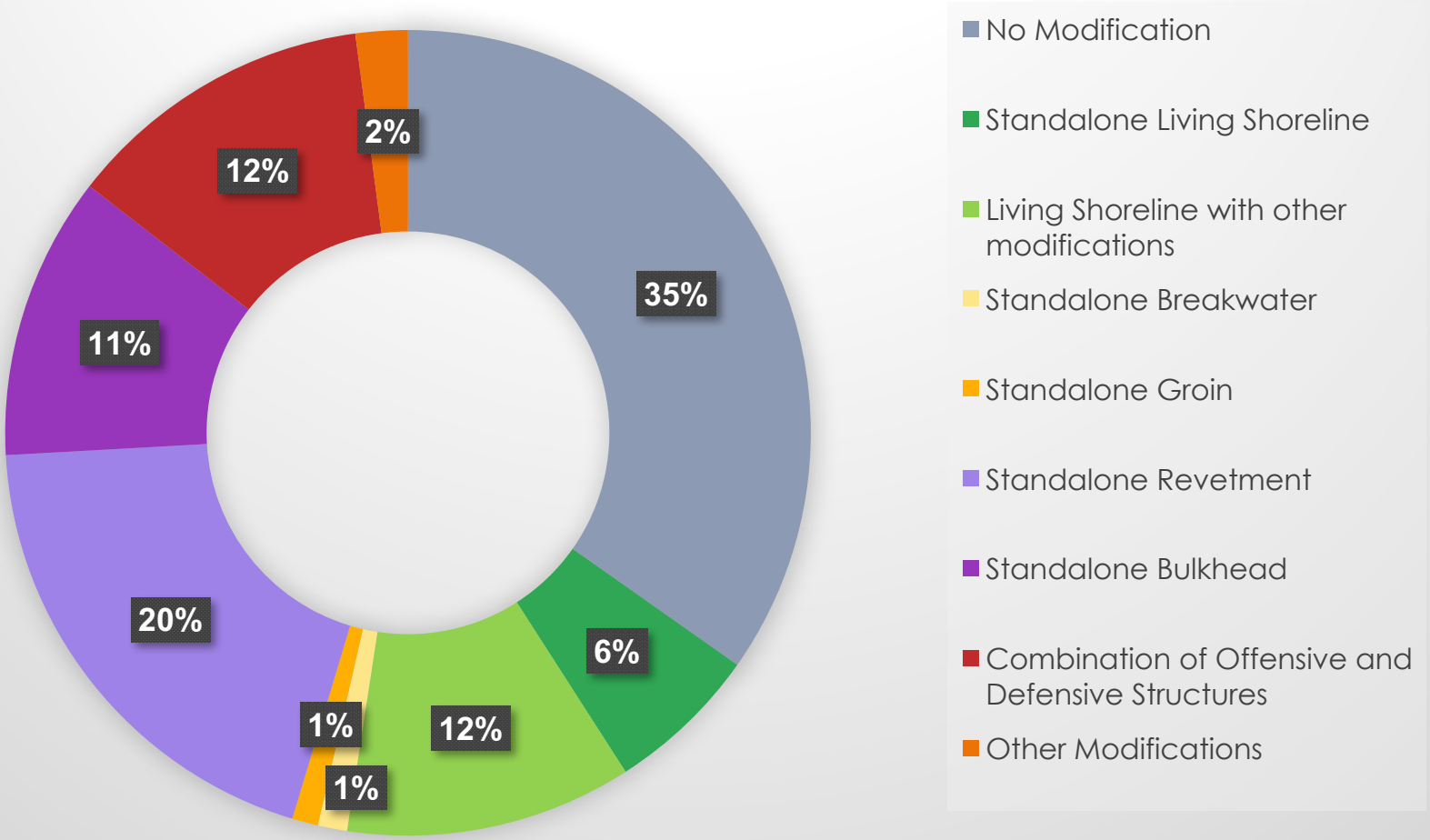
Conclusions from Gloucester Study

- While the models do identify factors that impact the choice of modification, they do not do a particularly good job of predicting the type of modification that will be implemented for most parcels.
  - This suggests that there are many other non-modeled factors that are important in determining which type of modification will be selected.
- Additionally, while we know that neighbors matter, we don't know why.
  - It could be that neighbors share similar physical environmental factors that are not included in the model that make one modification preferred over another. It could also be that owners prefer to have the same type of modifications for aesthetic reasons or because they get advice or referrals from their neighbors.
- These results suggest that there is a role for guidance, outreach, and public policies to play in influencing the modification choice.

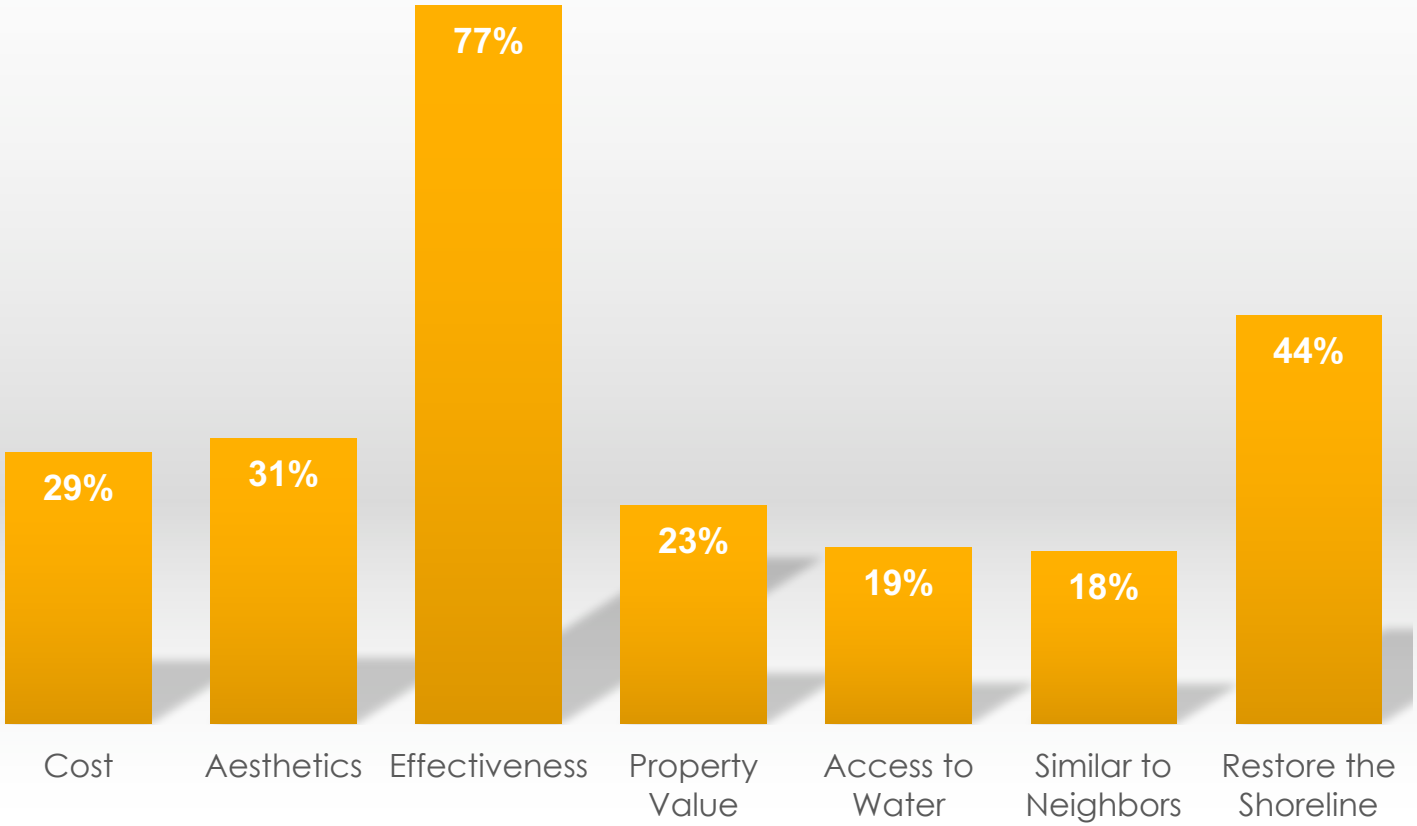
Property Owners Survey

- Sent 3,050 mail surveys to stratified random sample of property owners in Gloucester, Lancaster and Norfolk.
  - Received 765 back (25 percent response rate) with good coverage of the three areas.
- Survey collected data on:
  - Experience with erosion.
  - Types of modifications in place and when they were made.
  - Reasons for modifying/not modifying.
  - Sources of information about shoreline modifications.
  - Perceptions about changing levels of flooding/erosion.
  - Perceptions about impact of their choices on erosion and the health of the bay.

Modification Types Reported



Reasons for Shoreline Modification Choice



Reasons for Not Modifying the Shoreline