



Utilizing Brownsville Preserve as a Climate Adaptation and Resilience Classroom for Eastern Shore Communities

Sustainability Leadership
Case Study, Spring 2022

Introduction

TinaMarie Haskell



Virginia Eastern Shore

- 70-mile peninsula between the Chesapeake Bay and Atlantic Ocean
- Home to undeveloped barrier and marsh islands
- Old railroad towns, fishing villages, tourism, aquaculture, farming
- Formerly one of the wealthiest areas in the country (Reiter, 2021)
- Demographics (Census, 2021)
 - Population ~ 45,331
 - ~ 17% in poverty



The Nature Conservancy

- Nonprofit
- Mission statement:
 - “Our mission is to **conserve the lands and waters on which all life depends**. To achieve this, we must boldly address the biodiversity and climate crises over the next decade. By maximizing our ability to affect change between now and 2030, we can shape a brighter future for people and our planet.” (The Nature Conservancy, 2022).
- Volgenau Virginia Coast Reserve (VVCR)
 - 14 barrier islands, many with public access
 - Model for how human and natural communities can adapt and become more resilient in the face of climate change
- Brownsville Preserve (BP)
 - Headquarters for VVCR
 - Enhanced bird habitat
 - Public trails

Global Change

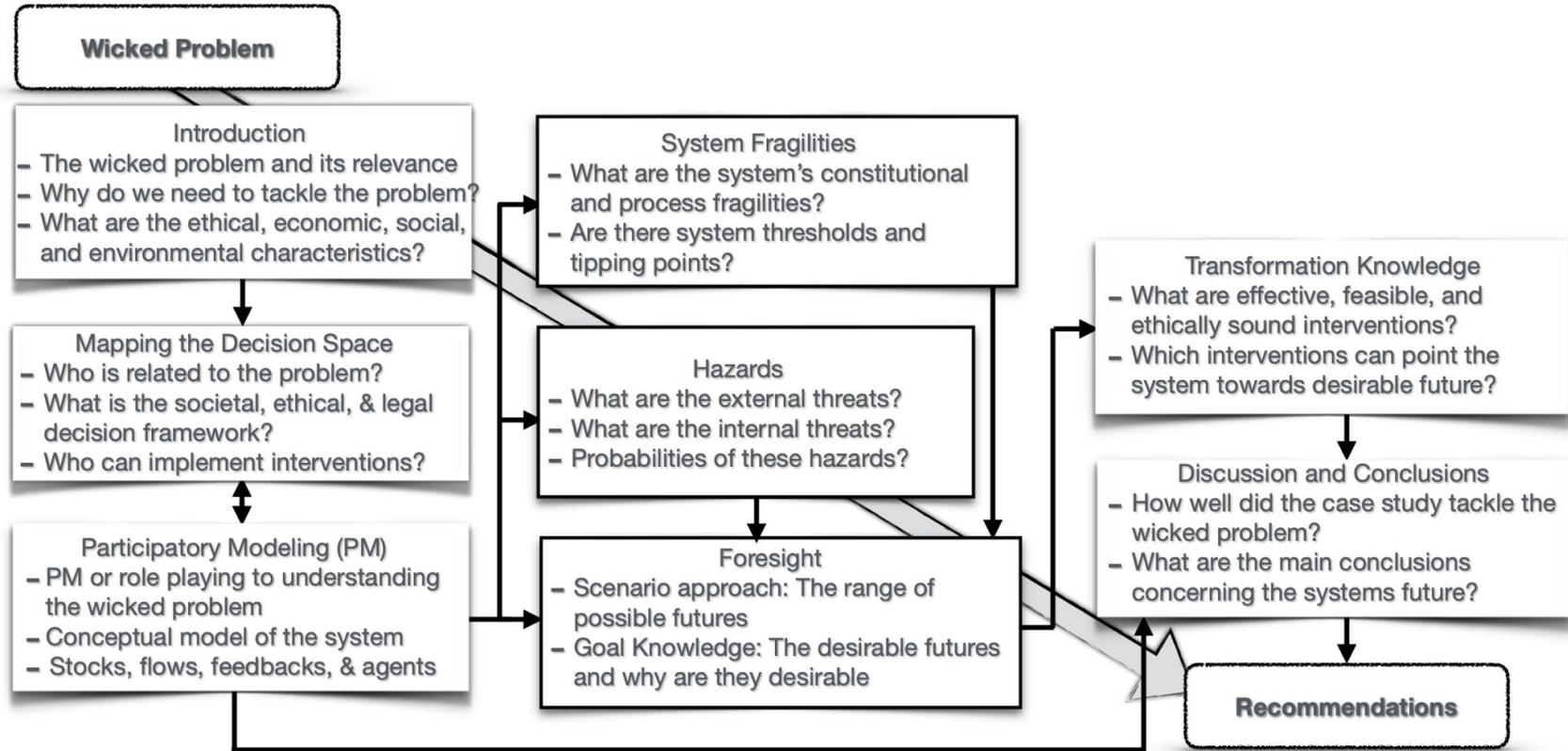
- CO₂ increase
- Temperature increase
- Sea level rise
- Pollution
- Inequality
- Environmental injustice



Initial Stakeholder Meeting

- Demonstrations of ways to mitigate and adapt in the face of climate change
- Lacking baseline ecological data for BP
 - Can't marry sea level rise with habitat loss and land use
- Increase volunteering
 - Younger members, diversity
 - Trail maintenance
- Increase communication with the local community and governments
- Social aspect
 - Role in community
- Solutions to eventual flooding of Brownsville House

Case Study Template



Decision Space

TinaMarie Haskell



Decision Space

Mapping of important stakeholders based on their interest and influence and understanding the social dynamics and roles of the stakeholders

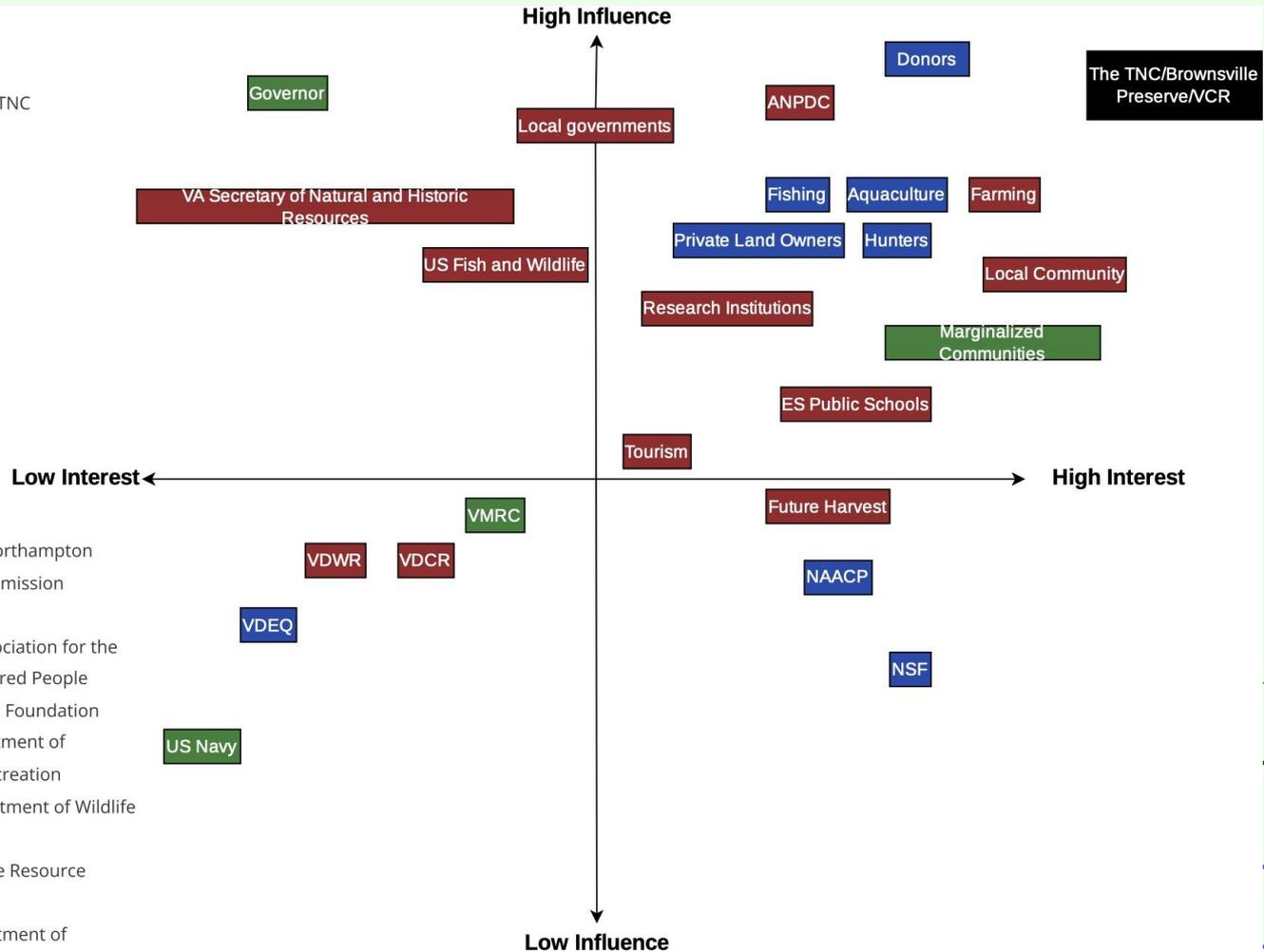
- Identify important stakeholders
- Understand the main rules and regulations
- Role playing

Legend

Green: Interest from TNC

Blue: Interest in TNC

Red: Mutual Interest



Abbreviations

ANPDC: Accomack-Northampton

Planning District Commission

ES: Eastern Shore

NAACP: National Association for the
Advancement of Colored People

NSF: National Science Foundation

VDCR: Virginia Department of
Conservation and Recreation

VDWR: Virginia Department of Wildlife
Resources

VMRC: Virginia Marine Resource
Commission

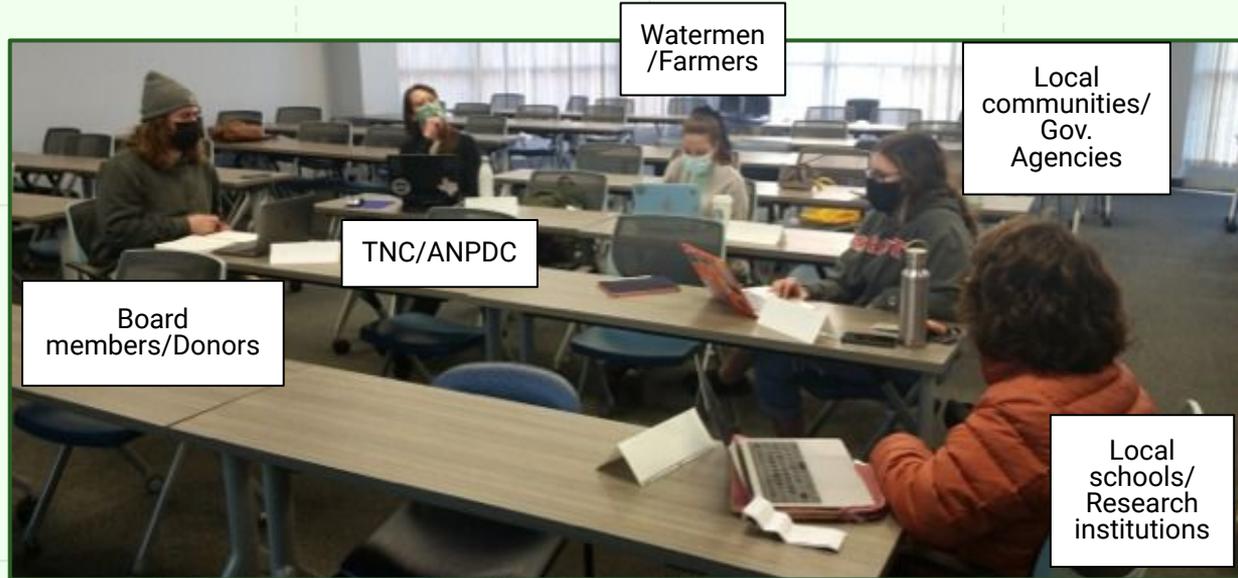
VDEQ: Virginia Department of
Environmental Quality

Stakeholders and Context

Stakeholder	Level of Interest	Interest	Level of Influence	Decision Making Authority
TNC	High	Fulfill mission, improve community relationships and public perception, more volunteers and engagement	High	Landowners, have final say in any decision
Advisory Board	High	Guide what goes on at BP	High	Strong influence on BP staff
Farmers, Watermen	Medium	Healthy land and waters to maintain their jobs and lifeways	Medium	Could make TNC staff's jobs easier or harder through social or political pressure
Local Schools	High	Educational opportunities for students, helps TNC "plant seeds"	Medium	Determines curriculum and educational focus
Eastern Shore residents generally	Low	Healthy land and waters, a place to relax and learn	Low	None, but could make TNC staff's jobs easier or harder
Local Government	High	Open space as green infrastructure, opportunities for resilience projects	Medium	Land use regulations, coordination with other groups
Research Institutions	High	Research opportunities	Low	None, essentially guests on property
Local Nonprofits	Medium	Land conservation and environmental education	Low	None
State and Federal Agencies	Low	Environmental protection and regulations	High	TNC has to comply with all regulations

Participatory Modelling

Role playing exercise
to develop perspective
of important and
valuable stakeholders



Goal Statement Iterations

ITERATION 1 Working around SLR/CC

- Communication - Govts, residents, researchers
- Engagement: "relevance" to ES.
(action 2 to drive)
- Empower: honor minority communities (EJ).
DIVERSITY?
- Conservation: restoration (oysters, eelgrass, etc) Birds!
- Adaptation (ag, recreation, fisheries)
- Risks
- Protect ELSS

ITERATION 2

more easily considering
resilience of systems
Increase Engagement w/ local comms and govts
to promote: facilitate through dialog adaptation actions on the
E.S. to protect the ELSS

SLR/CC

Justice? Who loses?

Teach people to adapt in place (or leave?)

Lessons learned on EJ, adaptation retreat

Make info available to Community.

- accessible
- actionable
- adapt

Working around
prioritizing
in the context of

System Dynamics

ITERATION 3

Increase engagement w/ local comms & govts,
"emphasis on EJ", through demonstration
projects to educate & empower people to
protect ELSS and adapt in the
face of SLR/CC: Em. Inv.

Goal Statement

The Nature Conservancy and local communities together meet the challenges and losses of sea-level rise and climate change in a manner that is equitable and environmentally just.

Wicked Problem and Conceptual Model

Benjamin Leonard



Wicked Problem

A wicked problem is a social planning problem

Social planning problems normally expressed in the goal statement for the future, are wicked problems

Every wicked problem is unique to itself and no two are the same, solutions to them will always be custom designed and fitted

Proposed solutions to these problems are not true-or-false, but better or worse

Different people have different views on what the problem is; there is no set of solutions to pick from

Wicked Problem

A future where the Nature Conservancy and local communities together meet the challenges and losses of sea-level rise and climate change in a manner that is equitable and environmentally just

The focus is on managing unavoidable losses in an environmentally and socially just manner

Conceptualizing the Wicked Problem

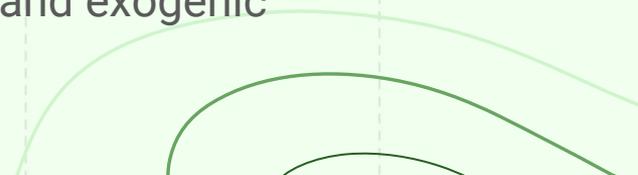
Conceptual models are needed to fully understand how the system works and what the main feedback loops are

The conceptual model shows the entire Brownsville Preserve system

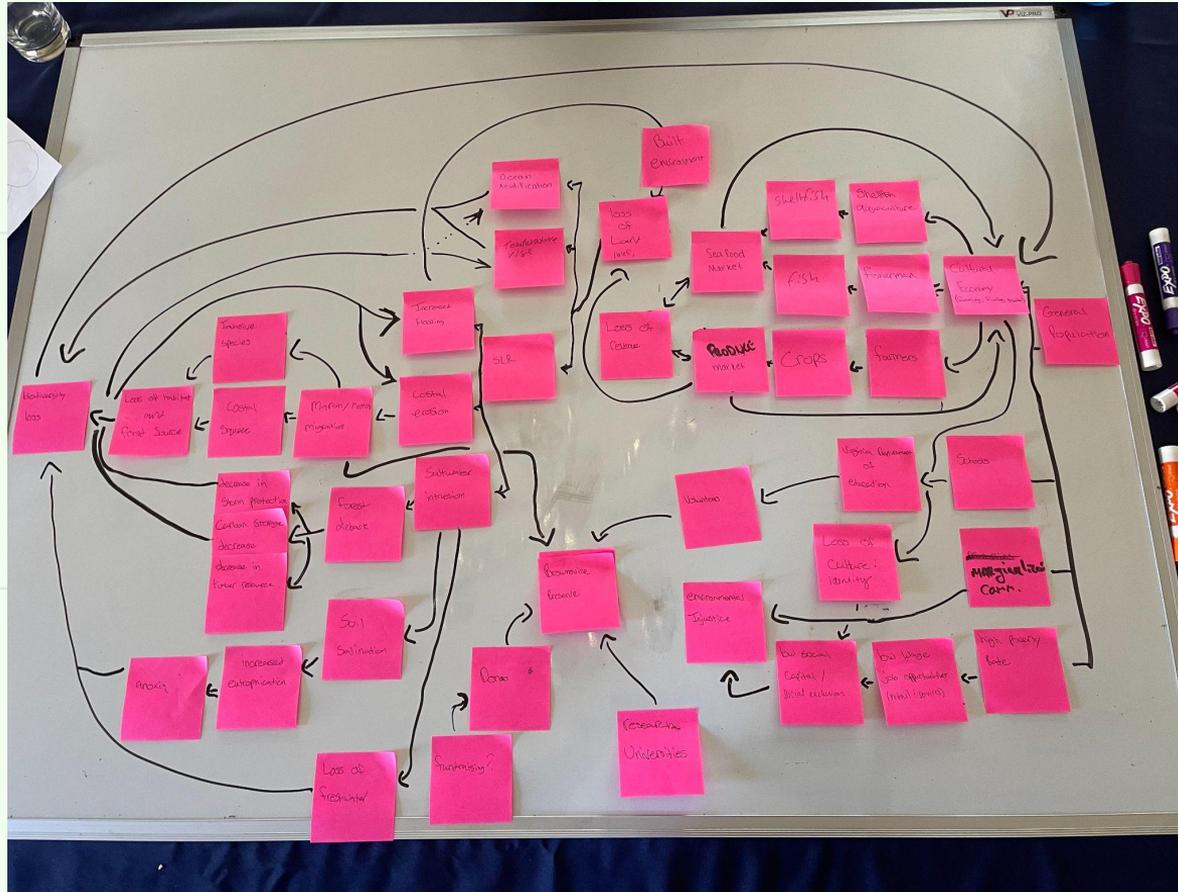
The three systems:

- Economic system
- Social system
- Brownsville Preserve system

The model shows the fragilities, endogenic hazards, and exogenic hazards coupled with each system

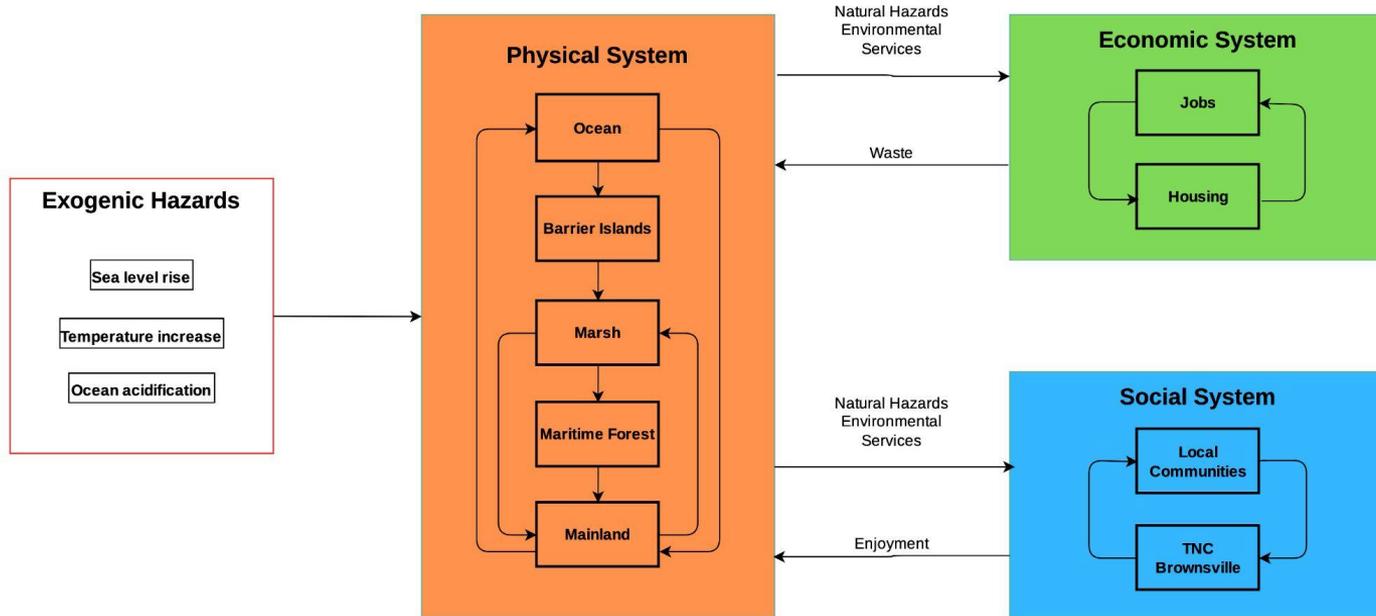


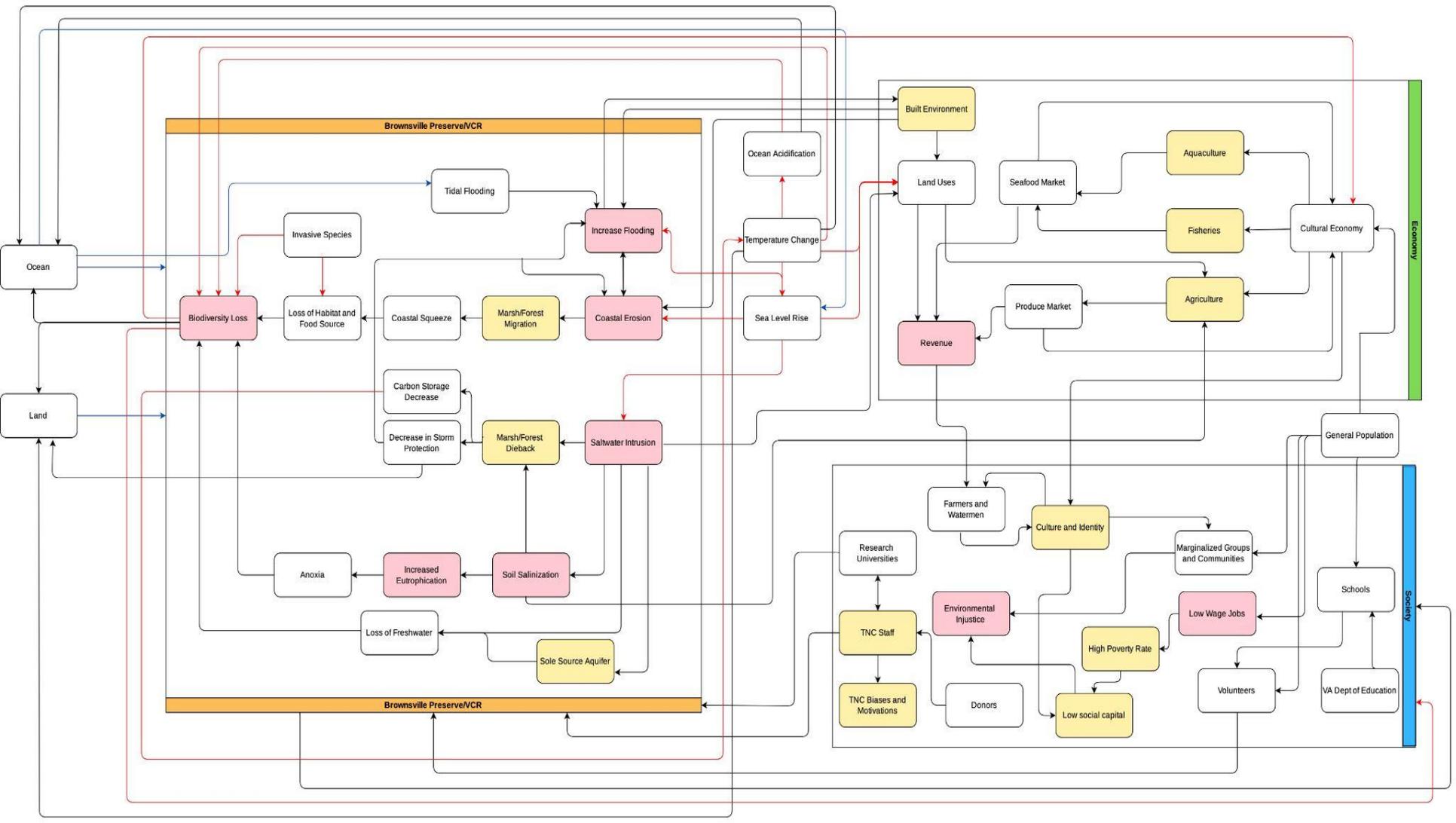
First Conceptual Model



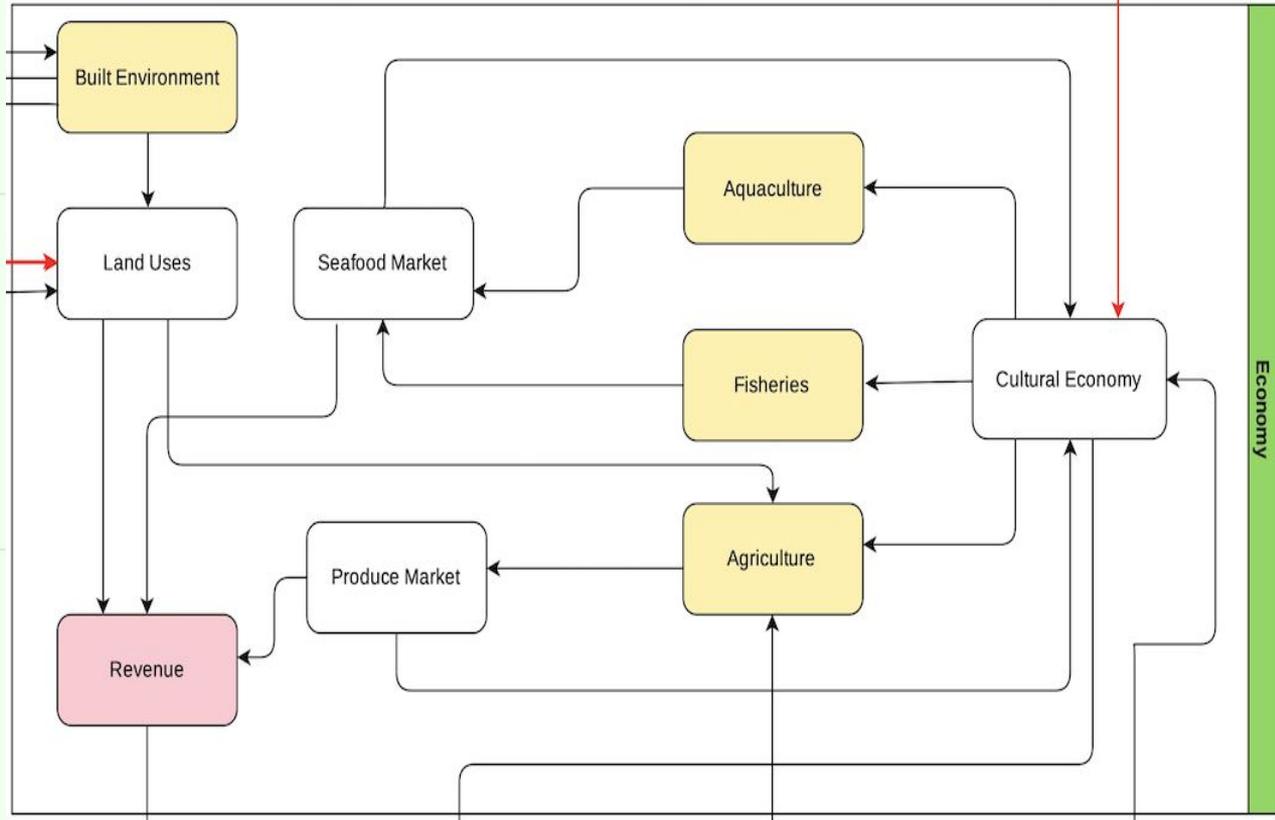
Conceptual Model

High Level Conceptual Model





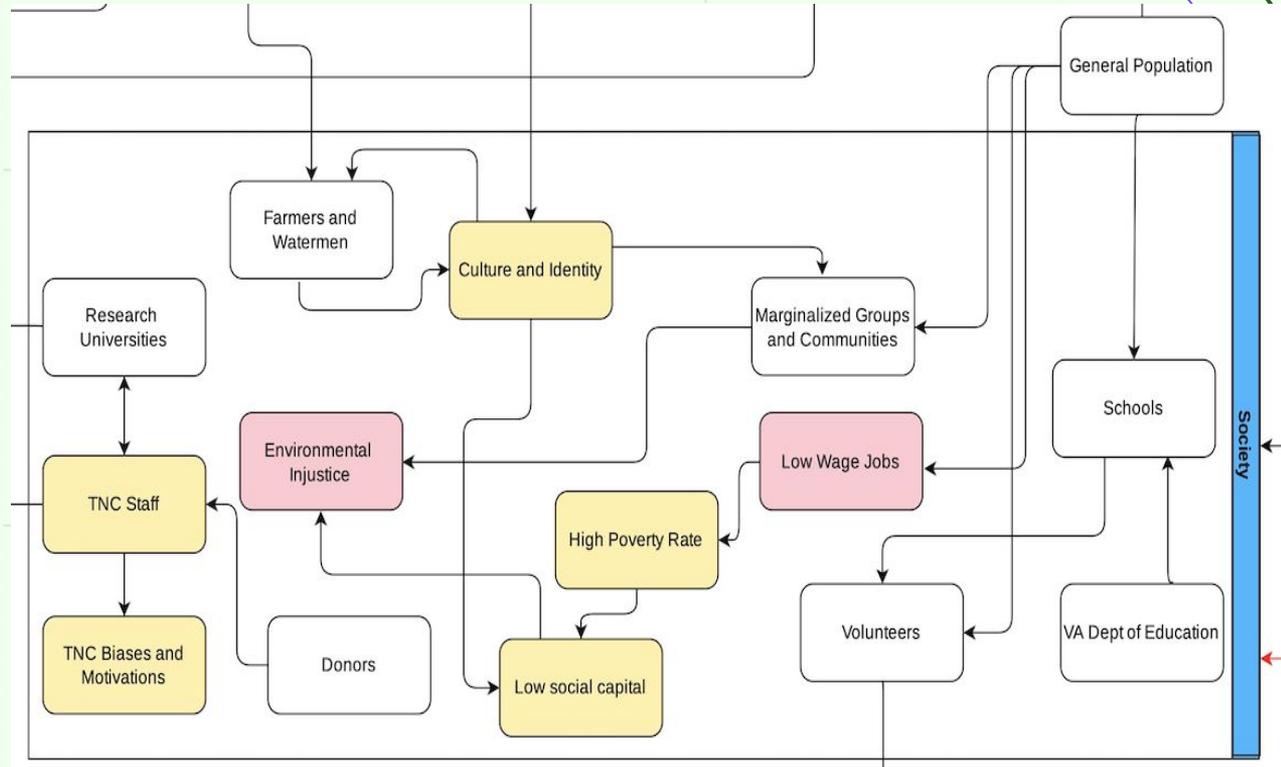
Economic System



- Not a very diverse system
- Produce being sold is the driving force in increasing revenue
- Agriculture relies on availability of land

Social System

- Economic disadvantage
- Environmental injustice
- Maintaining culture and identity
- Understanding The Nature conservancy biases and motivations



Fragilities

Elaine Walters



Fragilities, Hazards, & Consequences

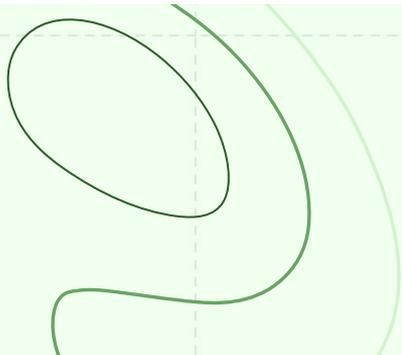
System	Fragility	Hazard	Consequence
PHYSICAL	Low-lying land	SLR	Inundation
		Storm surge	Inundation
		Saltwater intrusion	Soil salinization
	Loss of freshwater		
	Sole source aquifer		
	Built environment on low-lying land	Increased flooding	Inundation
	Dependency on specific habitat	Marsh/forest dieoff, invasive species	Biodiversity loss
	Dependency on specific food and its availability		
	Need for terrestrial carbon storage	Marsh/forest dieoff	More atmospheric carbon, temperature increase, ocean acidification
	Narrow range of temperatures tolerable to marine life	Temperature increase	Marine organisms die, biodiversity loss
	Shellfish depend on CaCO ₃	Ocean acidification	Shellfish die, biodiversity loss
	Tolerance to nutrient loads	Soil salinization	Eutrophication
	Plants and animals need oxygen	Eutrophication	Anoxia
	Development on barrier islands	Barrier islands are dynamic	Erosion, flooding of built environment
	Forest and marsh vegetation tolerate narrow ranges of salinity	Soil and water salinization	Marsh/forest dieback
	Forest and marsh vegetation tolerate narrow ranges of water depth	SLR	
Forest and marsh have set rates of migration			
Forest and marsh cannot migrate over barriers			

Fragilities, Hazards, & Consequences.

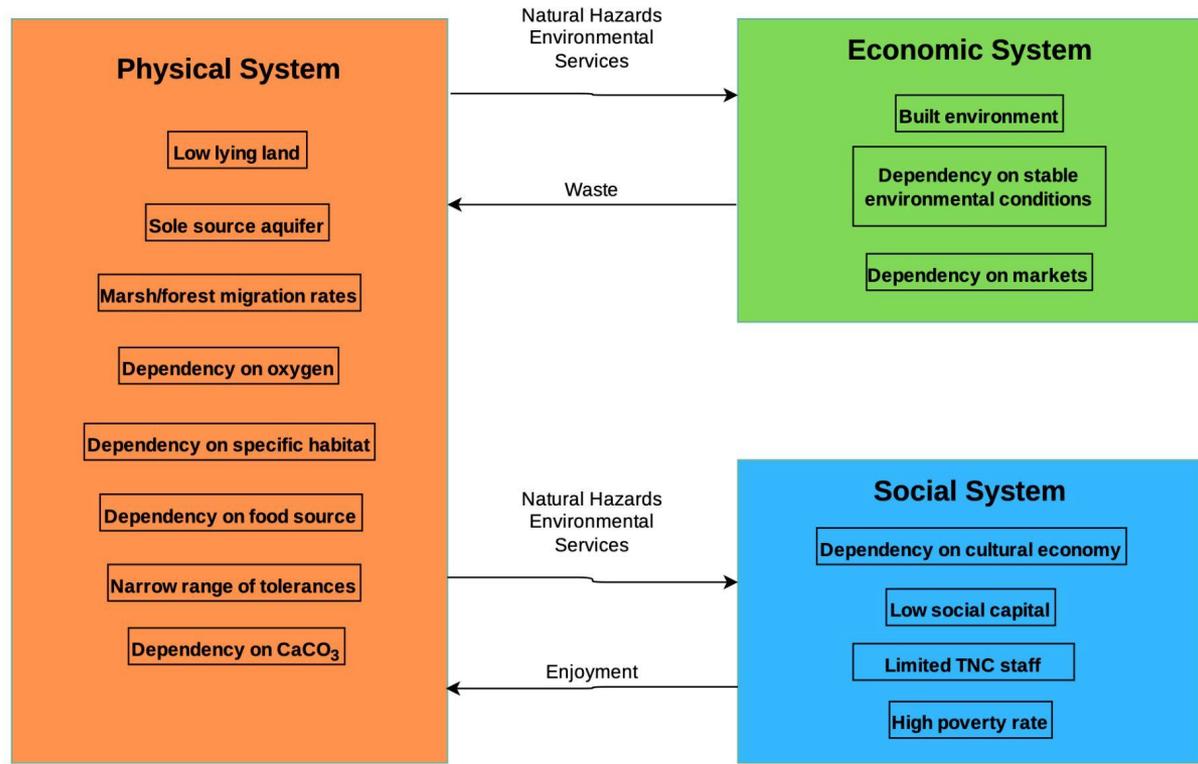
System	Fragility	Hazard	Consequence
SOCIAL	Culture and Identity dependent on natural resources and cultural economy	SLR, CC, Loss of cultural economy	Loss of culture and identity, unemployment, loss of morale, depression
	Car-dependent and low-density population	Limited economic opportunity and transportation options	Difficulty recruiting volunteers
	High poverty rate	Flood damage, job losses, low-wage jobs	Limited ability to deal with shocks, can't afford to move before or rebuild after natural disaster
	Low Social Capital	SLR, CC	Limited access to financial and political resources
		Environmental injustice	Being more exposed to and severely impacted by SLR/CC
	Limited capacity of TNC Staff	Inability to fully achieve their mission	Lack of credibility in community, wasted money and staff time
Disconnect between BP's "purpose" and "de facto purpose"	Conflicting goals, inconsistency	Decreased or more difficult engagement	

Fragilities, Hazards, & Consequences.

System	Fragility	Hazard	Consequence
ECONOMY	Built environment at low elevations	SLR, storm surge, nuisance flooding	Inundation
	Agriculture depends on stable environmental conditions	SLR, temperature change, soil salinization, saltwater intrusion	Loss of revenue and cultural economy
	Aquaculture depends on stable environmental conditions	SLR, temperature change, ocean acidification, eutrophication	
	Fisheries depend on stable environmental conditions	SLR, temperature change, ocean warming, ocean acidification, eutrophication	
	Cultural Economy dependent on markets	Market volatility	Revenue loss, Loss of cultural economy



System Fragilities

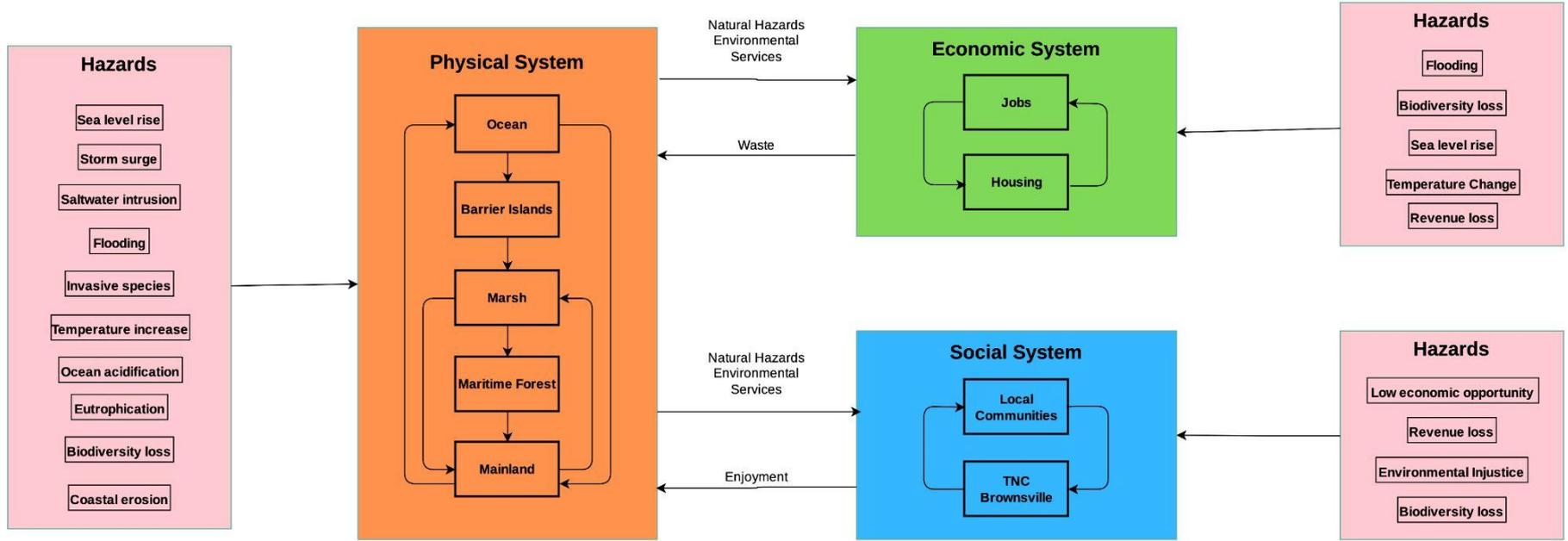


Hazards

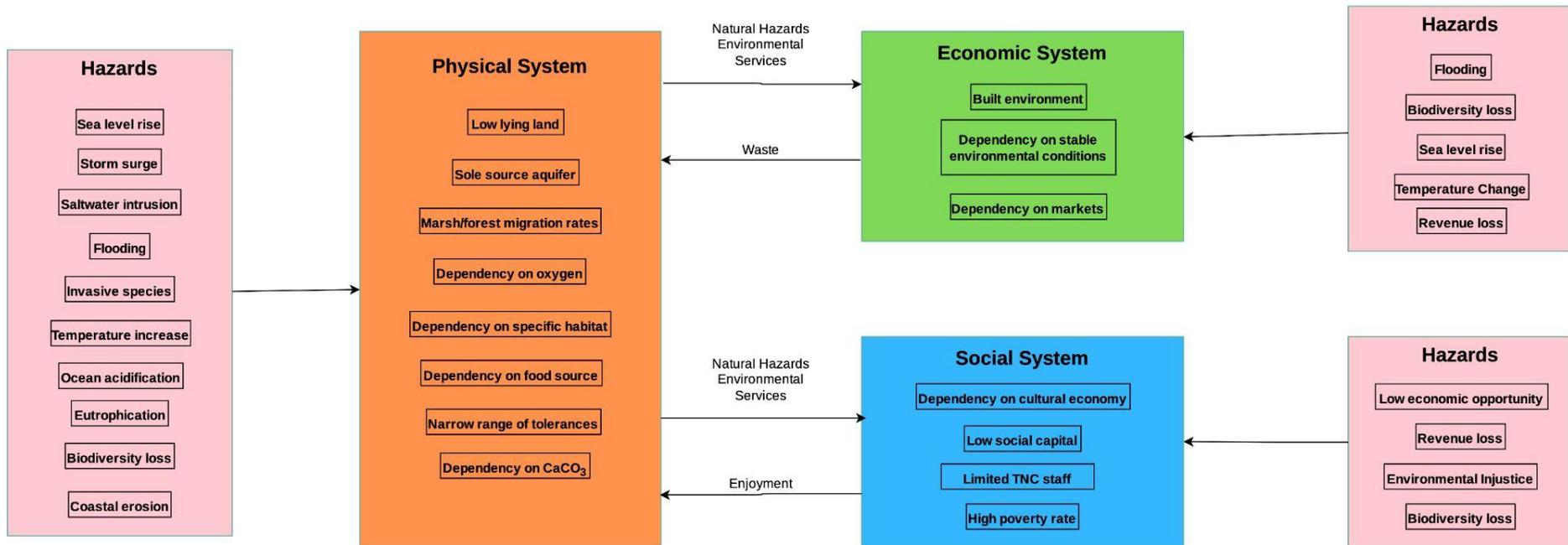
Elaine Walters



System Hazards



System Fragilities



Sea Level Rise

- Virginia experiences rates higher than the global mean
 - Warming ocean
 - Local land subsidence
 - Ocean dynamics
- Wachapreague tide gauge station
 - 4.11 +/- 1.5 mm/yr of relative SLR
- LOYW Station in Exmore
 - -1.84 +/- 0.62 mm/yr of land subsidence

Sea Level Rise Scenarios by 2100

Scenario 1

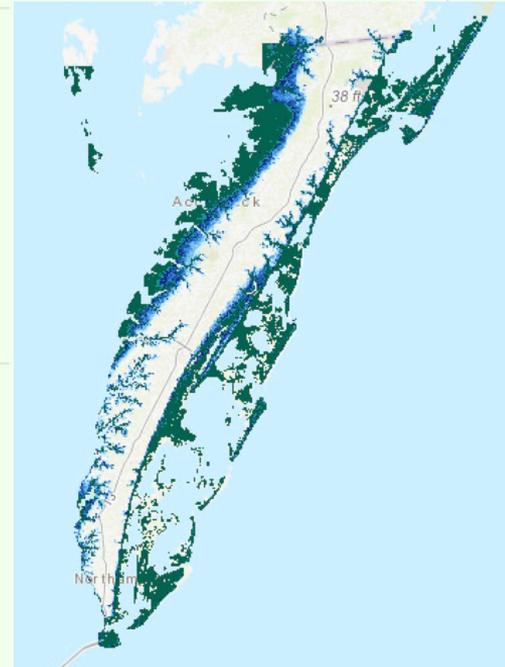
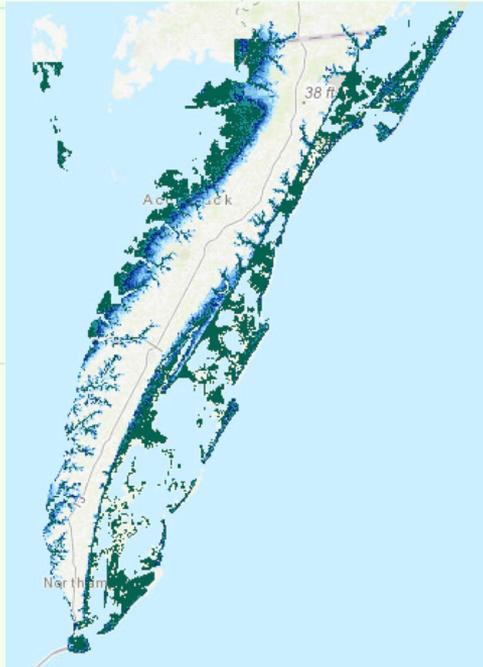
Scenario 2

Scenario 3

Intermediate

High

Extreme



Saltwater Intrusion

Soil Salinization

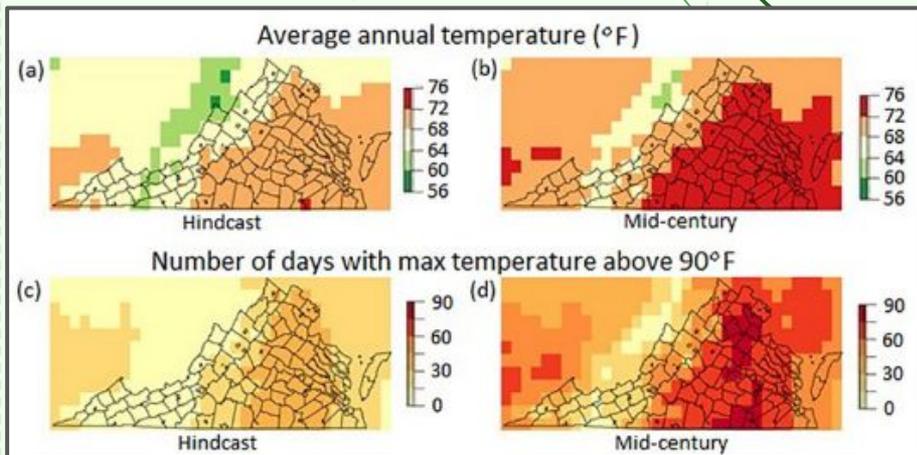
- Growing threat to Eastern Shore
- Multiple causes
 - Storms and storm surge
 - High tides
 - Infiltration through irrigation ditches
 - Saltwater intrusion through groundwater
- SLR/CC exacerbate through higher tides, more frequent and intense storms
- Droughts decrease amount of freshwater available to flush salts out of soil

Aquifer Contamination

- Eastern Shore wholly dependent on Columbia and Yorktown-Eastover Aquifer System
- Freshwater recharge of the aquifer limited to precipitation falling directly onto the Shore
- Only about 0.1% (9M GPD) of precipitation on the Shore reaches the Yorktown aquifers
- Drought > irrigation > aquifer discharge rate

Temperature Increase

- By mid-century, Eastern Shore projected to have
 - Average annual temps of 72-76F
 - 40-60 days above 90F
- Increased aeolian erosion
- Increased irrigation demand



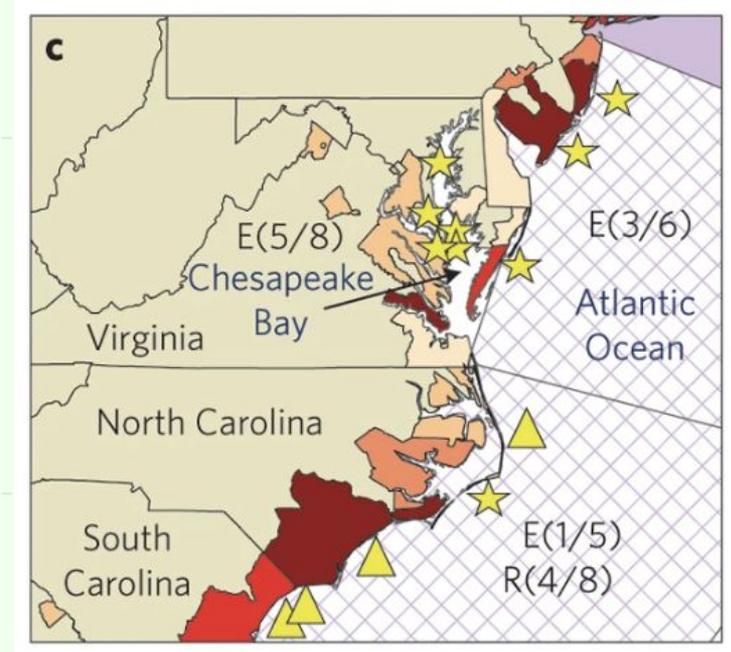
Eutrophication

- Excess nutrients from chemical fertilizers (N&P) get into water through nutrient leaching and aeolian erosion
- Pollutants decrease water quality by causing algal blooms, which block sunlight, deplete the water of oxygen, and suffocate wildlife
- SLR exacerbates > unbinding nutrients
- Agriculture responsible for 42% of nitrogen, 55% of phosphorus, and 60% of sediment entering Chesapeake Bay watershed



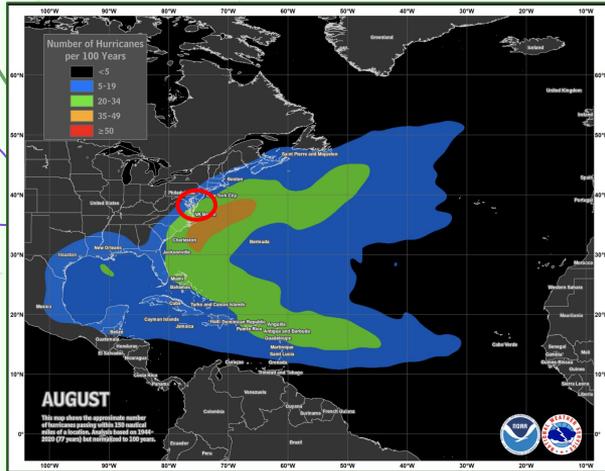
Ocean Acidification

- Ocean absorbs 25% of atmospheric CO_2
- Local factors
 - Eutrophication
- Oysters and clams are threatened by ocean acidification because of their need for CaCO_3
- Ocean acidification will jeopardize watermen of the Eastern Shore's revenue and jobs

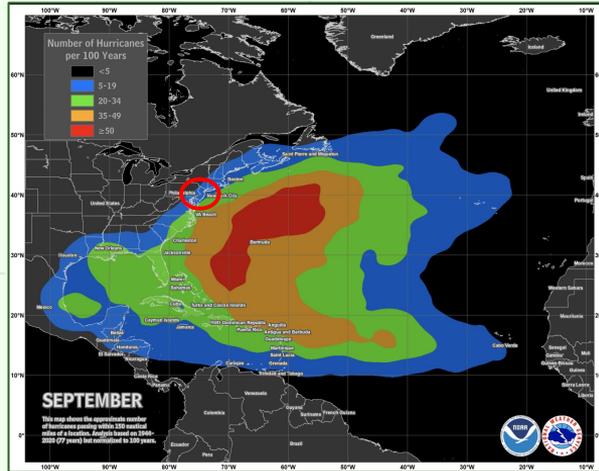


Hurricanes

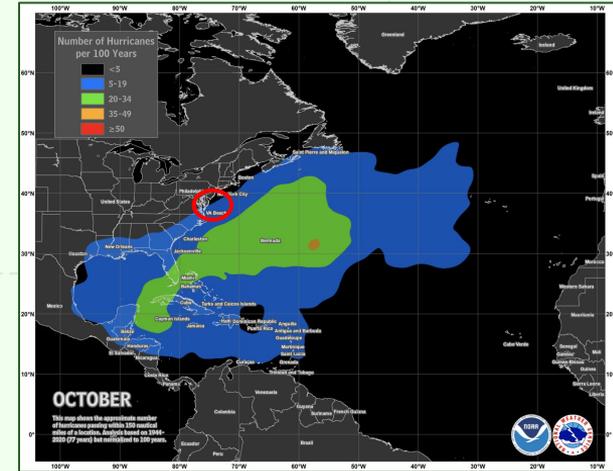
During the month of **August**, the Eastern Shore is expected to have **~20** hurricanes per 100 years.



During the month of **September**, the Eastern Shore is expected to have **~20** hurricanes per 100 years.



During the month of **October**, the Eastern Shore is expected to have **~5** hurricanes per 100 years.



Storm Surge

Using the Coastal Resilience Tool, hazard scenarios for storm surges can be formulated based on the 3 different storm surge intensities.

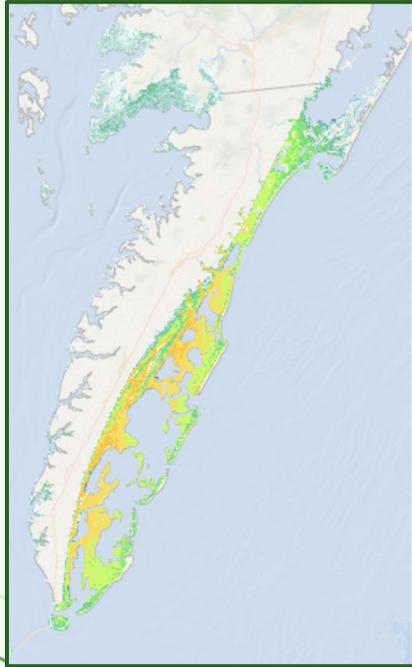
- Low Intensity
- Medium Intensity
- High Intensity



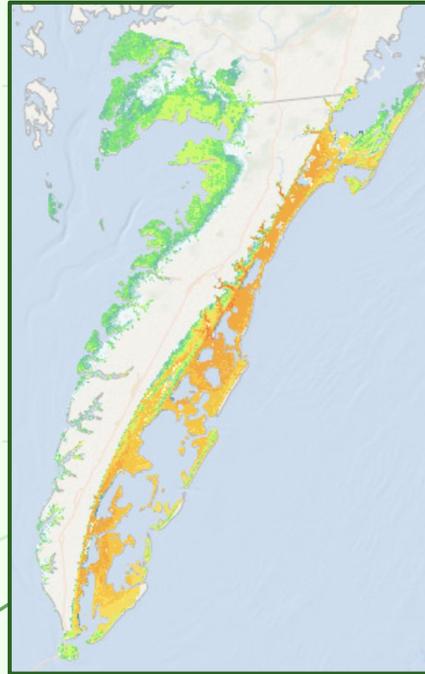
Storm Surge

Current

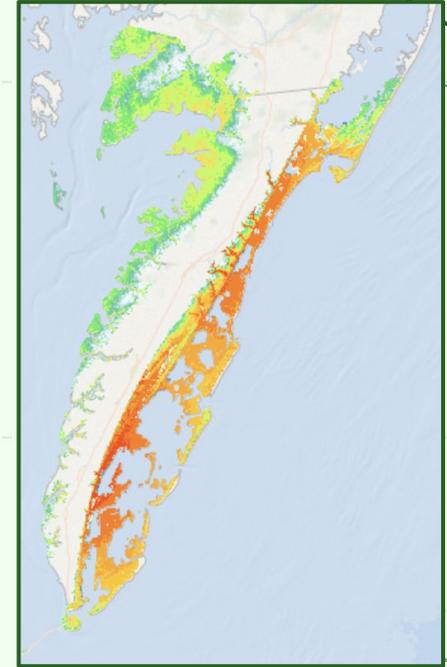
Low



Medium



High



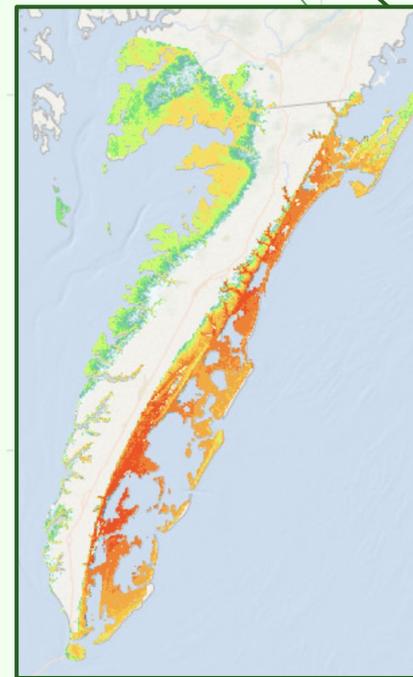
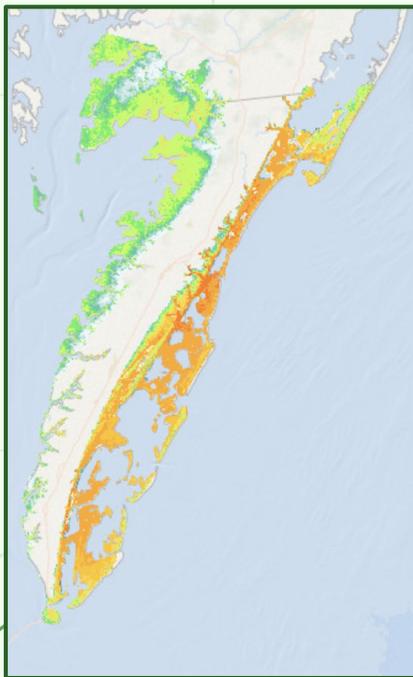
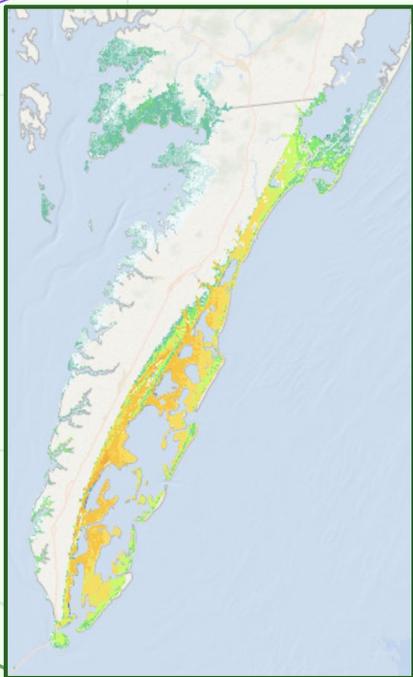
Storm Surge

Year 2040

Low

Medium

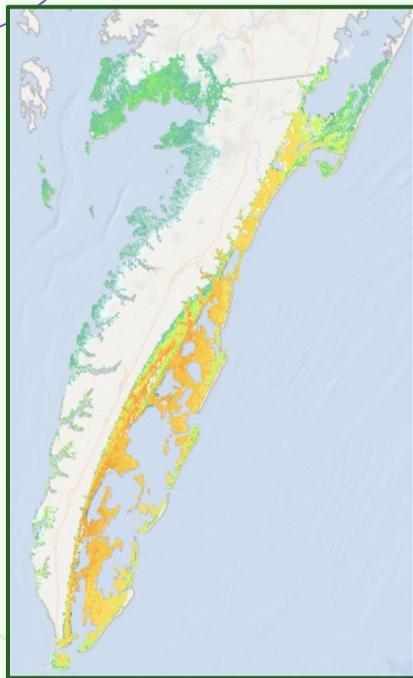
High



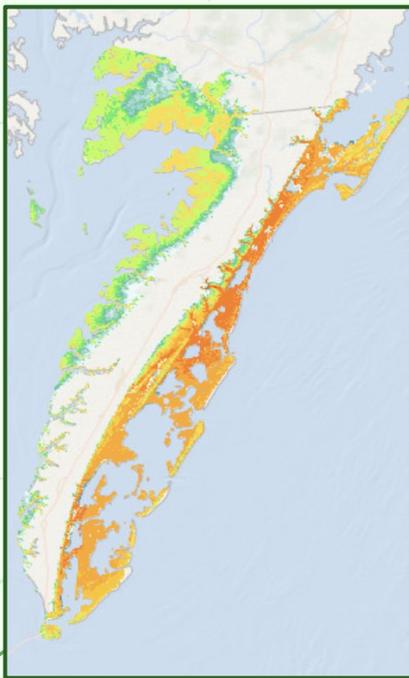
Storm Surge

Year 2065

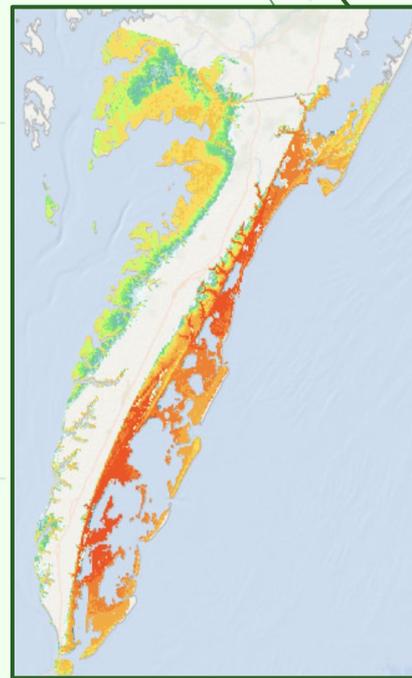
Low



Medium



High



Tidal Flooding

Mild Scenarios:

- Citizens unable to travel due to blocked roads.
- Damaged infrastructure
- Crops will be stressed

Extreme Scenarios:

- Citizens unable to leave their home. Depending on intensity of flooding, rescue teams like the fire department, police, and coast guard will have to rescue people from flooded homes/buildings.
- Stores will be flooded out. Less access to vital resources.
- Lives lost due to drowning or injury of intense flooding



Outmigration

- People with more resources/education may choose to leave before they are faced with the challenges of the impending hazards
- People with the fewest resources are left to fend for themselves as the Eastern Shore faces SLR/CC
- As people migrate they may leave their possessions and homes, which will lead to pollution.
- The socioeconomic system of the Eastern Shore may become destabilized as people with higher resources leave.

TNC's inconsistencies

- If TNC's actions do not match their stated purpose
 - The surrounding communities will be less willing to trust and engage with them
 - They are unable to achieve their goals
- Scenarios
 - TNC does not use the Brownville Preserve and VVCR to bridge the gap between the community and climate change
 - TNC uses their unique position to facilitate a climate adaptation and resilience classroom for the Eastern Shore communities

Foresight and Possible Futures

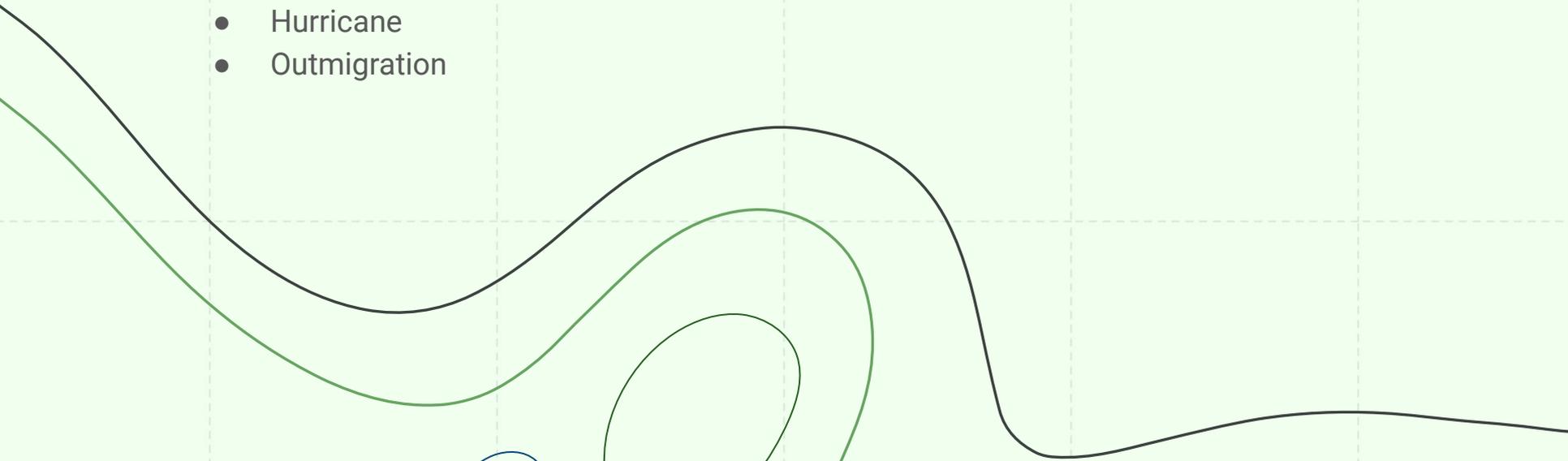
Becca Boyd



Possible Futures

Given the phenomenon of climate changes, there are multiple possible futures we must consider for the Eastern Shore.

The top 5 futures our group decided to focus on:

- Sea Level Rise
 - Temperature Change
 - Aquifer Contamination
 - Hurricane
 - Outmigration
- 

Possible Future

Sea Level Rise

Most Desirable Future: people of the eastern shore are **capable** of migrating more inland to avoid inundation of sea level rise

Less Desirable Future: **adaptation** efforts are sufficient enough to survive until the entire peninsula is covered.

Undesirable Future: low income families are unable to move inland which may lead to increased **sickness**, and **death**.



Possible Futures

Temperature Change

Most Desirable Future: there is still available **heat-tolerant species** of animals & plants to cultivate for cultural economy. Or southern species **migrate** up north which can be utilized for the economy as well.

Less Desirable Future: there is artificial shellfish and agriculture farming to act as a **band aid solution** for loss of biodiversity in watersheds and lack of farmable land

Undesirable Future: there is **not adaptation** for biodiversity which leads to the community heavily relying on import of products.



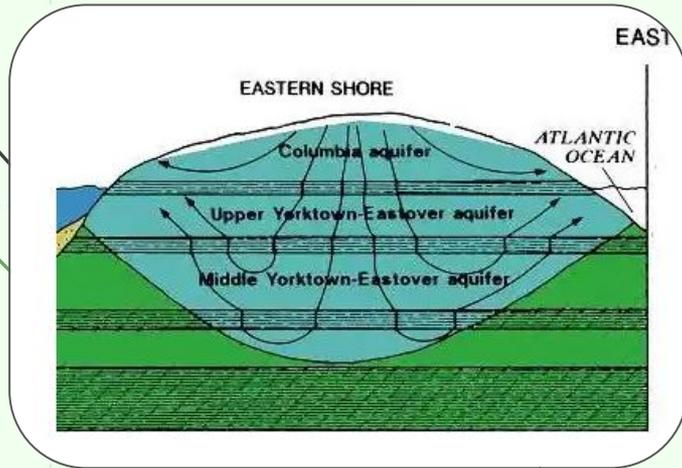
Possible Futures

Aquifer Contamination

Most Desirable: No contamination, Water-conservation measures

Less Desirable: Gradual contamination, Plan to invest or Decide when to leave

Undesirable: Rapid contamination, Collapse



Possible Future

Hurricanes

Most Desirable Future: a category 1 hurricane calls for effective hurricane protection plan which allows the **entirety** of the Eastern Shore to be more prepared for a more severe hurricane

Less Desirable Future: severe hurricane hits the Eastern Shore with no protection plan but there is enough **funding** to repair damages after a year or a few years.

Undesirable Future: a severe hurricane hits the eastern shore causing sudden evacuation which **low income** people are not able to afford.



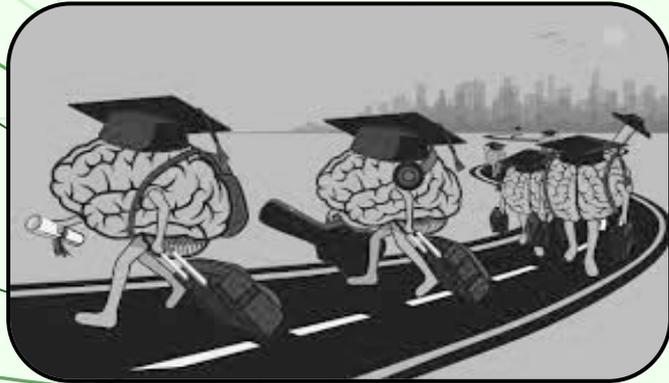
Possible Future

Outmigration

Most Desirable: Young adults remain in/return to Eastern Shore, use knowledge to build **resilient** communities, make a plan for **managed** migration

Less Desirable: “**Brain drain**”, piecemeal flooding and abandonment

Undesirable: **Event-triggered** mass migration, people left behind, receiving communities destabilized



Interventions

Catie Sauer



Interventions

Physical

- 2020 Case Study Recommendations
- State Observation Wells
- Remove Brownsville House
- Engineered Solutions
- More Trails

Social

- Increase Educational Resources
- Improved BP Webpage
- Public event at VCR
- Volunteer Recruitment
- Demonstration Projects

- Transportation meetⁿ-_{grat}
 - More \$ for Staff
- Better website
- Virtual Comm Center
- More Events (July 4th etc)
- Better advertising
- Literature (tracks/poop ID etc)
- (Farming) Demo Projects
- Engage w/ Saxia researchers
- "Apocalypse" Trail/Art
- Future Harvest/Theloniuss
- Scavenger Hunt
- Art Contest/Lessons
- Improve QR code website : audio tour
- Sponsor - a - tree for classes
- Tabling @ farmers markets/events
- Compost center for community - dupps + pickup
- Summer camps or weekends
- Scouts / 4H pg

Physical Interventions

Facilitating Ecosystem Regime Shifts

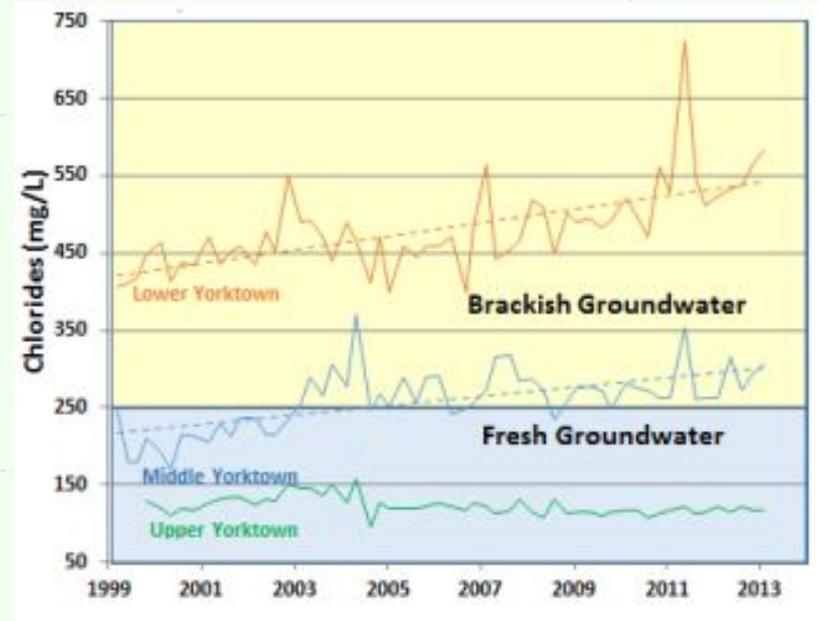
- As outlined in the 2020 case study
- Divide BP into three sections
 - Implement different management styles in each section
- Pros
 - Provide data on different management strategies
 - Monitor successes and failures
- Cons
 - Time consuming
 - Labor intensive



Physical Interventions

Install State Observation Wells

- Pros
 - Systematic approach
 - Collect more data at edge of freshwater lens
 - Improve forecasting ability for aquifer contamination
- Cons
 - Cost?
 - Expertise to monitor/interpret



Physical Interventions

Host Events in Brownsville House

- Pros
 - Welcoming and inviting
 - Ready-made space
 - Literal classroom within figurative classroom
 - Control access to building
 - Fundraising (private events)
- Cons
 - Staff time
 - Scheduling



Physical Interventions

Relocate Brownsville House

- Pros
 - Demonstration project
 - Preserve historic building
 - Avoid costly flood damage
 - Remove potential pollutants from environment
 - Fundraising (auction)
- Cons
 - Expensive and labor intensive
 - Preserving whose history?
 - Best use of TNC funds?



Brownsville House with 3 Feet of Sea Level Rise (NOAA 2022)

Physical Interventions

Document and Demolish Brownsville House

- Pros
 - Preserve history
 - Virtual Tour
 - HABS
 - Avoid costly flood damage
 - Remove potential pollutants from environment
 - Fundraising (sell artifacts)
- Cons
 - Cost



Physical Interventions

Engineered Solutions

- Seawall or dike, dredging, artificial barrier islands
- Pros
 - Provide some short term protection from sea level rise
- Cons
 - Band-aid solution
 - Detrimental to local ecosystem
 - Disrupts sediment supply to other parts of East coast
 - Expensive
 - Slow



Physical Interventions

More Trails

- “Once and Future” Trail
 - Show coastline from 100 years ago, and 100 years in the future
 - Visualize SLR and coastline change
- Ghost Forest Trail
 - Visualize saltwater intrusion impacts
- Pros: Minimal infrastructure needed; trees already dead
- Cons: Increased traffic on paths, garbage, people going off-trail



Social Interventions

Increase Educational Resources

- Themed Literature (animal tracks or scat, plants, ecosystem)
 - Pros: Tailored experience, appeal to different people
 - Cons: Time, money
- Virtual Community Center
 - Pros: Build community online, visitors/resident able to interact with each other, wider reach, no physical space to take up
 - Cons: Need someone to build and maintain it
- Art Contests/Lessons
 - Pros: Wider reach, personalized experience and meaning
 - Cons: Coordinating with schools and other groups



Social Interventions

Improve QR Code and Webpage

- Make downloadable media more obvious on webpage (Know Before You Go, Audio Tour tab)
- Advise visitors cell service is spotty
- More and varied materials for download
 - Animal tracks/scat, plants, birds
 - Themed audio tours
- Pros: Wider appeal, more variety and accessibility, customizable
- Cons: Staff time to create and publish content

Numbers on the trail map correspond with markers along the trail. Refer to the trail guide for information on these points of interest.

Social Interventions

Public Event to Visit the VCR

- TNC's main research focus is barrier islands
- Pros
 - Many residents don't have a way to access the barrier islands
 - Increase public's understanding of TNC's work
 - Build goodwill within community
- Cons
 - Logistics and liability
 - Will require many volunteers and boats



Social Interventions

Volunteer Recruitment

- Reach out to Scouts and 4H groups
 - Camporees, Service projects
- Include a sign-up/info sheet at 10th-grade field trip
- Carpool meet-and-greet
 - Transportation a limiting factor
 - Prospective volunteers (and their parents) can meet each other, coordinate rides
 - Pair senior and youth volunteers
- Pros
 - More diverse volunteer group
 - Increased sense of ownership
 - Mentorship opportunities, networking
- Cons
 - Younger volunteers may need extra supervision
 - Older volunteers might not want to be “chauffeurs”



Social Interventions

Demonstration Projects

- Partner with Future Harvest
- Pros
 - High concentration and visibility
 - Relevant to Eastern Shore economy
 - Networking opportunities (students)
 - Small business promotion
- Cons
 - Why here?
 - Maintenance?



Recommendations

Benjamin Leonard



Recommendations

- Recognizing that:
 - The Nature Conservancy at Brownsville Preserve is limited on:
 - Staffing
 - Funding
 - Resources
 - Sea levels are rising causing marshlands and coast to migrate, and lands to become inundated with saltwater
 - The changing global climate will cause biodiversity loss, forest dieback, and an increase in storm frequency and intensity
 - The Eastern Shore relies on a sole source aquifer

Recommendations

- Acknowledging that
 - The Nature Conservancy is the main stakeholder dealing with the wicked problem
 - Their interventions can contribute to the entire Eastern Shore
 - With the mission to conserve the lands and waters on which all life depends
 - The challenge of handling sea level rise and climate change will not be an easy task

Recommendations

Physical

- Ecosystem Regime Shifts
 - Implement different management styles in each section
- State Observation Wells
 - Increase foresight into aquifer contamination
- Host trainings and events in Brownsville House
 - Acts as classroom for visitors
- Document and begin planning to dismantle Brownsville House
 - This will remove potential pollutants from entering the waterway
- Ghost Forest Trail
 - Giving the public a visualization of the saltwater intrusion impacts

Recommendations

Social

- Increase Educational Resources
 - Provide literature on animal tracks or scat, plants, and the ecosystem
- Demonstration Projects in Partnership with Future Harvest
 - Ability to showcase the work of Future Harvest for public advancement
- Improve BP Web Page and QR Code
 - Developing an easier to use Web Page with downloadable literature
 - QR Code at trailhead with the downloadable literature
- Increase Volunteer Recruitment through events and transportation
 - Provide volunteer transportation to public for event held at Brownsville Preserve

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Thank You!

Questions?