

An aerial photograph of a coastal area, likely Oxford, Maryland, overlaid with a strategic planning map. The map features various colored zones: green for parks and open spaces, yellow for residential areas, and blue for water bodies and wetlands. A red dashed line outlines a specific project boundary. The map shows a mix of developed areas, including buildings and roads, and undeveloped land with natural features like trees and water. The text 'Oxford 2100 A Strategic Vision' is centered at the top in white. Below it, 'Volume III Student Projects' is centered, and at the bottom, 'By Students from Maryland School of Architecture, Planning, & Preservation' is centered.

Oxford 2100 A Strategic Vision

Volume III
Student Projects

By Students from Maryland School of Architecture, Planning, & Preservation



Credits

This report was prepared in conjunction with the Town of Oxford, Maryland using Federal funds under award number NOS204190206 from NOAA, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.

Preservation Green LLC & George, Miles & Buhr, LLC prepared the Volume I Oxford 2100 A Strategic Vision Report & Volume II Oxford 2100 A Strategic Vision in conjunction with the Town of Oxford, Maryland. Volume III contains the proposals by students from the Maryland School of Architecture, Planning, and Preservation as part of the initial Oxford 2100 A Strategic Vision project.

The Oxford 2100 Strategic Vision is preceded by various resiliency projects including the Stormwater and Flood Management, Financing Study issued in 2013 by the Maryland Environmental Finance Center in collaboration with the National Fish and Wildlife Foundation, the Eastern Shore Land Conservancy, and the Chesapeake Bay Foundation; the Stormwater Management and Shoreline Protection Inventory and Masterplan Study, prepared in GMB in 2014; the creation of the Causeway Park and The Wetlands Park; and finally with funding from the Maryland Department of Natural Resources (DNR) and the National Oceanic and Atmospheric Administration (NOAA), students from the Maryland School of Architecture, Planning, and Preservation developed the initial phase of the Oxford 2100 Strategic Vision as part of the University's Partnership for Action in Sustainability (PALS) in collaboration with the Town of Oxford.

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HARBOR TO HARBOR

RETHINKING AND RETELLING THE STORY OF OXFORD, MD

Oxford will undergo a rethinking and retelling of its time-honored story as one of Maryland's iconic port towns. After persisting through the centuries, the town will become a model of resilience and adaptation for a burgeoning issue promised to be part of the next century's zeitgeist - climate change.



The main issues at hand are sea level rise (SLR), pluvial/ nuisance flooding, and storm surge.

In addition, it is a priority to honor the community desire to maintain Oxford's historic character.

In response to projected 3.5 ft SLR by 2100, the work of this redesign will present adaptation strategies on the site scale to allow Oxford's cultural and functional longevity through and beyond the next 80 years.

ASSUMPTIONS

Need for vehicular infrastructure and use will steadily decline in the coming decades, making space for roads to be narrower

The Oxford community at large are interested in creating more publicly-accessible recreational spaces

Residents living adjacent to the proposed design are excited and willing to be a part of these spaces

Other adaptation interventions will be implemented in other vulnerable areas of the town in order to create a strong, fortified system in conjunction with the proposed design

There is an understanding that landscapes alone cannot fully resolve conditions of this scale, and should be supplemented at the policy- and individual- level

MAPPING OXFORD



COASTAL RESILIENCY ASSESSMENT

LOW RISK Maryland Department of Natural Resources data shows areas on the southern and western regions of Oxford to be less resilient to flooding and erosion. This is attributed to various reasons including

3.5 FT SLR

Topographic data indicates that these areas of Oxford will be inundated at the projected 3.5 ft SLR in 2100.

AREAS OF CONCERN

Layering of high risk areas, areas reported to be commonly affected by pluvial flooding and tidal intrusion, and areas vulnerable to 3.5 ft SLR illustrate Oxford's key spaces of concern.

GIS mapping data indicates that Bank St. and MD 333 entering Oxford are two areas projected to inundate within the first 2 ft of SLR.

The design team has decided to centralize efforts on protecting these sites, first and foremost, with adaptable interventions that will remain meaningfully effective as SLR continues.

Another significant factor that went into choosing these sites are their quality of public interest.

Ideally, redesign efforts would be for the benefit of the Oxford community as a whole.



PROPERTY LINES AND BUILDINGS

Being mindful of the existing properties and commercial buildings, interventions should be designed to be as non-invasive as possible to the existing land-use



FLOOD PRONE ROADS

Bank St. (top) MD 333 (bottom) Tides and storm surge coupled with grading and low-elevation create regular flooding issues for these roads. Severe events render these roads undrivable, a particular problem for MD 333 which is the only land access road to Oxford.



GREENSPACES

The projected inundation of Causeway Park, located centrally in town, provides an opportunity to use the earth within the park's boundaries in a newly imagined way.



WETLANDS // TYPES

Palustrine Estuarine Historic natural character of Oxford consisted of wetlands. These landscapes, which naturally act as buffers to storm surge, may prove beneficial as part of the land to these landscapes

3.5 FT SLR

Sea Level Rise is projected to immediately impact these areas by 2100. These will become the priority properties to protect in the design intervention.

OXFORD AT A GLANCE



POPULATION
651 RESIDENTS



AVERAGE AGE
63 YEARS OLD



TOP INDUSTRY
PRIVATE MARINAS AND
BOAT BUILDING



204 HISTORIC HOMES

SCOPE



AREA
45.4 Acres



PROPERTY
\$81, 504, 418



SHORELINE
4,880 FT

CURRENT

POST-SLR

23 Acres
INUNDATED

\$20, 915, 000
INUNDATED

15,840 FT
INCREASE

While SLR is a behemoth-sized issue, the goal is to avoid as much area loss and property damage as possible.

PROGRAM

FOCUS AREA A | DIMILLO'S MARINA ON BANK ST.

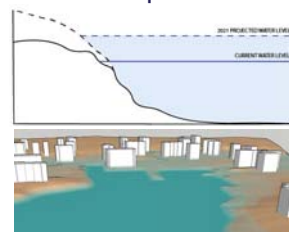
- Llevee park will fortify low-lying area against storm surge and tidal intrusion; and act as a sponge for pluvial flooding
- Increased vegetation, to include salt-tolerant and aquatic plantings, will maximize stormwater infiltration and capture while minimizing conveyance
- Elevated pedestrian infrastructure will allow for participation in the landscape in varying flood and inundation conditions

FOCUS AREA B | CAUSEWAY PARK ON MD 333

- Marina will allow community maritime-lifestyle will persist by embracing SLR
- Inundation will provide opportunity for oyster and marsh habitat restoration
- Access drawbridge will maintain a flexible intersection between Oxford and the mainland, as well as marina-goers and the outlet to Tred Avon

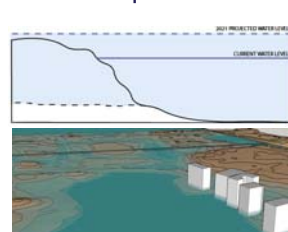
SEA LEVEL RISE RESPONSES

A. OVERCOME | FILL SCENARIO

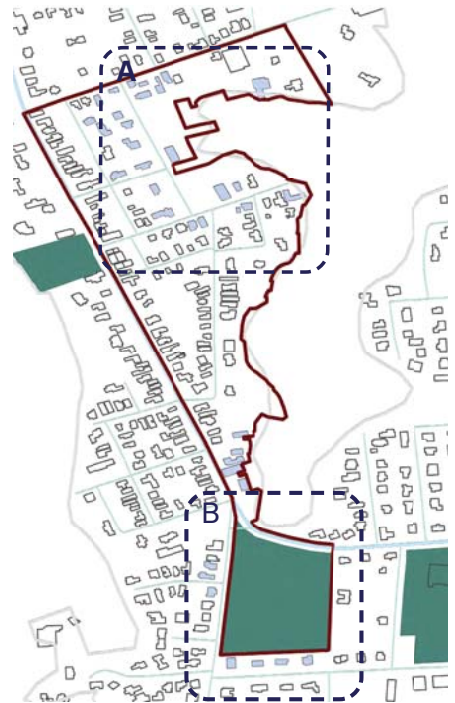


Another threshold between the Bay and the Historic Neighborhood, this critical length of shoreline will be reinforced so that the Bay remains in place for as long as possible.

B. EMBRACE | CUT SCENARIO



MD 333 is a threshold situated between the Bay and Oxford's Causeway Park and southern half. This potentially inundated sports field park, will SLR as an advantage.



BUILDINGS IMMEDIATELY IMPACTED BY SLR



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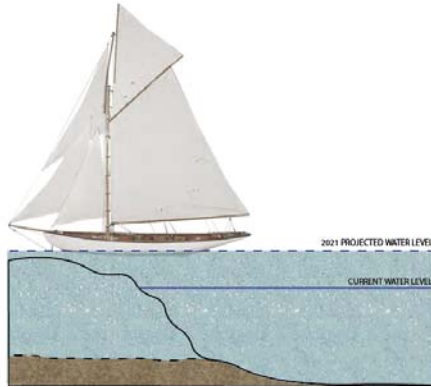


Micaela Ada | LARC 642 | Dr. David Myers

CAUSEWAY PARK & MARINA

PRESERVING OXFORD'S MARITIME LIFE

EMBRACE | CUT SCENARIO



Causeway Park & Marina will be a space of public recreation and celebration of Oxford's story as a bustling town on the water. This design speaks to the, at times necessary, design approach of migration. In response to SLR, some of Oxford's landmarks may need to relocate. This solution testifies to the idea that the town's culture can endure despite the possibility of these coming changes.

The former turf field park is the site chosen for the new location of Dimillos Marina. The site was strategically chosen to be excavated and converted due to it being a non-residential area that was problematically flood prone and vulnerable to inundation. In this, we allow the water to be where it wants to be because we want it to be there as well.

The Marina's new location farther inland will give more protection from Storm Surge events, with it being centralized in town, the park and marina will tie more of Oxford's community with maritime activities and amenities.

The entry road, once frequently subject to closure by flood events, will be hoisted into the air as a shared bridge along the perimeter of the marina. Visitors and residents will arrive into town eye-to-eye with a rhythm of oaks on one side and, on the opposite, a near 360 degree view of the waters below.

Two picnic area destinations provide an opportunity for people to rest and watch the bustling flow of boats traveling the Marina. Trailheads at each picnic area gently take park-goers up to the levee promenade which borders the Marina in unison with the entry road bridge. The half-mile promenade breaks in the middle to provide an opportunity for people to walk down to the community comfort station, pay the marina a visit, and interact with the water.

A meandering exit to the ground slowly paces people down the side of the earthen levee, one last tactile reminder of the form that protects residents below from the rising water.



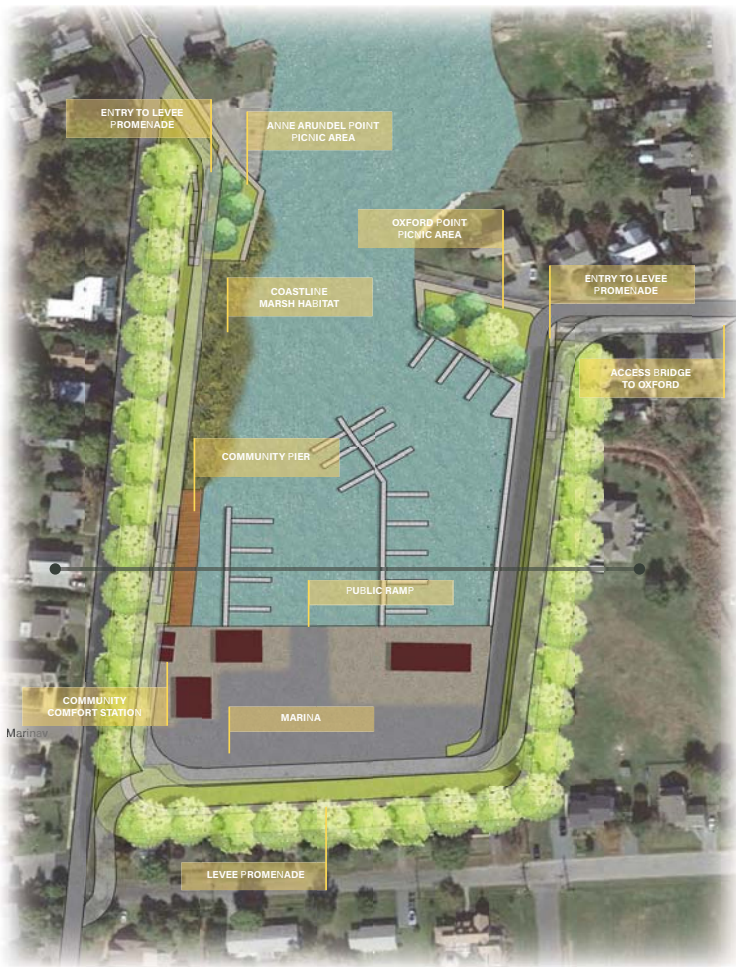
PICNIC AT OXFORD POINT



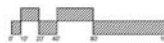
WALKING ON AIR



DOWN TO THE WATER



MASTER PLAN



SECTION A - A'

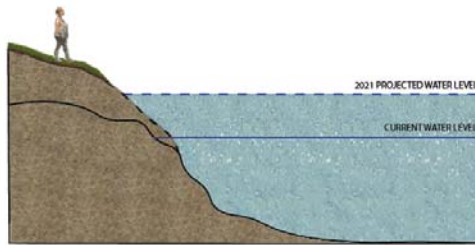


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HARBOR PARK

PROTECTING OXFORD'S HISTORY



OVERCOME | FILL SCENARIO

To honor the integrity of Oxford's Historic District, Harbor Park will help the neighborhood "adapt in place". DiMillo's Marina and the surrounding area will be filled into a large levee using excavated earth from the work done in Focus Area B, which will be discussed in detail later in the presentation.

The levee will serve as protection from Sea Level Rise, allowing the Historic homes to remain in place for years to come. The conversion of Bank St. to a softened landscape will mitigate storm water run off and flooding events that frequented this area. Overall, the site will serve as a public park space for people to recreate and experience the local wildlife.

With forms modeled after the Historic district's grid streets and architecture, Harbor Park is meant to fit like a puzzle piece into the iconic neighborhood. An elevated boardwalk continues the street pattern into the park while habitat structures built in the likeness of Oxford's historic architecture, maintain an unforgettable presence for picnickers to sit beneath and birds to perch above.

Entering the park, visitors transition through a curtain of trees before opening up to a view of the water. People could either continue on the ground or up a ramp to the elevated boardwalk where they are invited to fish, birdwatch, or simply take in the view. On the ground-level, people are given moments of access to nature, whether it be at the waters edge, overlooking the marsh, or under the canopy.

In this space, residents can spend time with their friends and family, and build a relationship with nature. It is an outdoor destination that calls to the past and is hopeful of the future.

Understanding that this solution requires a disruption to the long-standing and popular marina, this strategy extends on to Focus Area B.



MASTER PLAN



OUTING TO THE PARK



A VIEW OF IT ALL



A MOMENT WITH THE DUCKS



SECTION B - B'



A Step At A Time

A Plan to Raise Protect and Highlight Southern Oxford

Inventory & Analysis

1

Proposal

The Southern Oxford Pier and Causeway Boardwalk is a multi faceted design project meant to highlight a series of new shoreline protection areas on the western coastline of Oxford MD. These areas will highlight new living shorelines meant to protect the coast of Oxford from storm surge and rising sea levels. The oystertecture breakwater reefs will dissipate waves and minimize coastal erosion during strong storm events. A new pier will be installed to provide recreation while educating the public on sea level rise adaptation, positive benefits of living shorelines, and the wonders of oystertecture breakwater reefs. Added to the scope of my design will be an improved and raised Oxford Rd. to allow for better access and transport. A plan to reshape Causeway Park would provide adaptation from the rising seas and also allow the natural formation of a tidal marsh. A new boardwalk for recreation would help circulation within the park and a new pumping station will also be installed to the East of the S. Morris St. intersection to alleviate standing water and better protect homes in that low lying area.

Sea Level Rise

For this design we used an assumed sea level rise of 3.5 feet around the time period of 2100. Depending on timely action from State and Federal governments on emissions regulations, these levels could range above or below that predicted amount and can be seen with more clarity in the graphics below.

Goals

- 1 - Protect the fragile western coastline through a series of living shorelines and 3 oyster breakwater reefs
- 2 - Create a multilevel pier and public park to highlight the southern Oxford shoreline
- 3 - Raise Oxford Rd. to improve access during storm events and tidal flooding
- 4 - Construct a new boardwalk within Causeway Park to allow for continued use of the area as a tidal marsh
- 5 - Install a new pumping station on the east side of South Morris St. to help with pluvial flooding build up.
- 6 - Improve and update plantings within Causeway Park and on the new blue pier design

Data

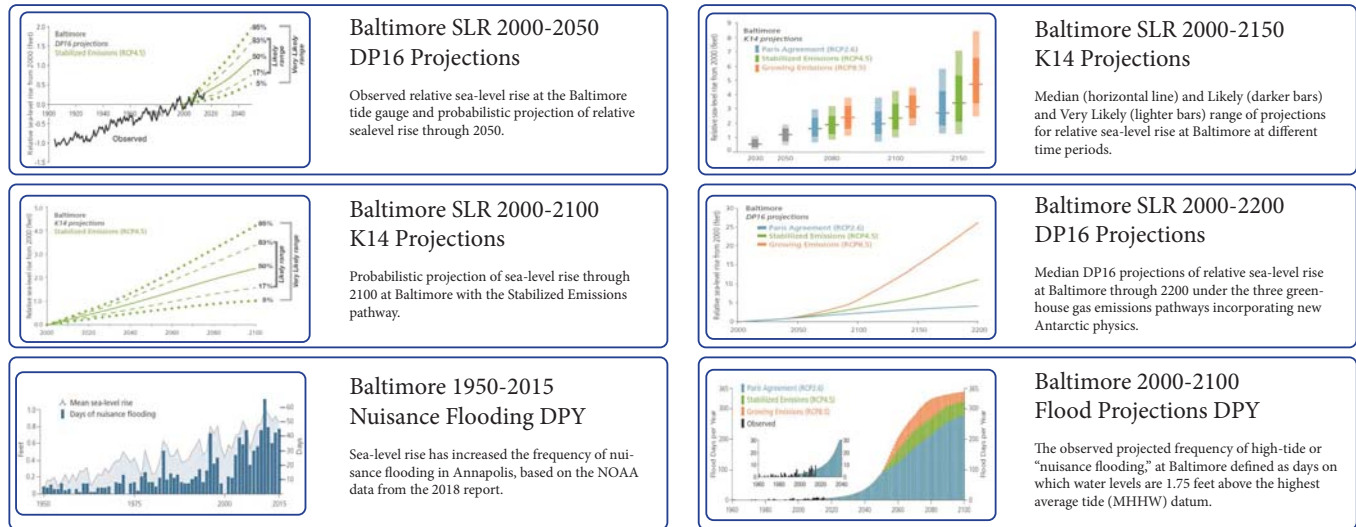
Data and predictions are directly tied to the Sea Level Rise Projections provided in the 2018 University of Maryland Center for Environmental Science study. The probability distribution of estimates of relative sea-level rise from the baseline year of 2000 are provided over time and, after 2050, for three different greenhouse gas emissions pathways: Growing Emissions (RCP8.5), Stabilized Emissions (RCP4.5), and meeting the Paris Agreement (RCP2.6)

Site Location

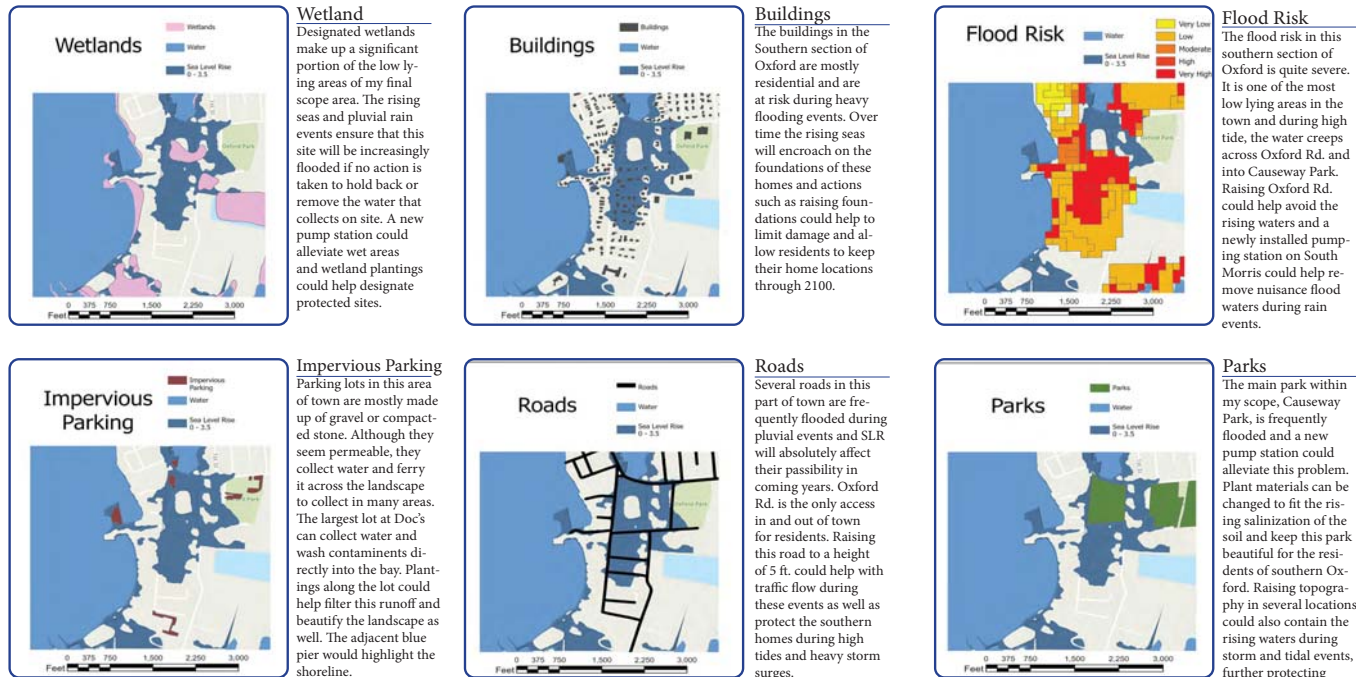


3 Project Areas : South Morris St. / Oxford Rd.

Sea Level Rise Data



Site Inventory



Source: Other History and Imagery: <https://ustronomy.org/ustronomy/>
 SLR Data and Graphs: <https://www.umces.edu/sea-level-rise-projections>
 Other: President and Evan Imagery: Google
 GIS Imagery: ESRI ArcGIS Pro (D. Bentley)
 All Bound Imagery: SketchUp Lenses (David Birch (D. Bentley))
 Additional Sources Provided Upon Request

Danny Bentley
LARC 642

Fall 2021
Dr. David Myers



A Step At A Time

A Plan to Raise Protect and Highlight Southern Oxford

Oxford's Oyster History

Past Oxford Maryland has a remarkably rich oyster heritage...



Supply and Demand

The history of Oxford's oyster economy dates back to 1870 when Victorian Europe developed a love for the Chesapeake Bay delicacy. In 1872 the Maryland Delaware Railroad was established which increased export productivity to New York, Pennsylvania, Great Britain and even the western territories.



Peak Harvest

With the fishing economy well established, boat building and seafood packing followed closely behind to round out the Oxford economy. In 1884 alone, 15 Million bushels were gathered from the bay. Only agriculture among Maryland occupations provided more employment that year. By 1890 at least 9 packing houses were in operation to satisfy the demand by the market.



Overfishing

In the early 1900's oyster populations steeply decline due to over harvesting and runoff pouring into the bay from industrial Washington D.C. Initial protections are implemented by natural resource organizations by 1916. Fast forward to 1960 and the bay's oysters are ravaged by two deadly diseases, Perkinsus marinus and Haplosporidium nelsoni.



Road to Recovery

Into the new century oyster populations are at record low levels. In 1993 the Oyster Recovery Partnership is established to address concerns about the native oyster populations in the Chesapeake Bay. Technology like sonar and GPS and placement of manmade reefs enhance recovery.



Future The tradition continues into the twentieth century...



By 2003 the annual oyster harvest had dropped to 26,000 bushels. This marked the lowest recorded harvest ever in the state of Maryland.



In 2008 the Maryland Grow Oysters Program was started to increase awareness about oyster recovery and make a difference in the bay.



Large scale oyster population rebuilding begins in the bay. Results of a state and federal environmental impact study outline future oyster population goals.



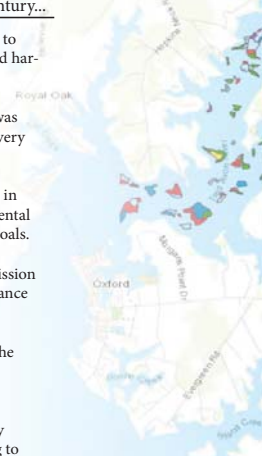
By 2010 the Maryland Oyster Advisory Commission is established along with the Shell recycling alliance changing the aquaculture economy in MD.



In 2012 the largest oyster sanctuary project in the world is established in the Tred Avon River just north of Oxford covering over 6,600 acres.

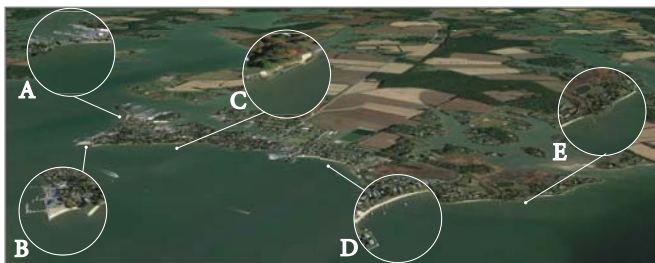


UMD's Horn Point Laboratory Oyster Hatchery produces 1 billion baby oysters in 2013, helping to meet the needs of the growing aquaculture industry.



Possible areas of application in Oxford MD...

Several other areas of Oxford's coastline warrant the same adaptation methods applied to the focus area in this project. (A) The beach on the Northern edge of the historic district provides ample opportunity for oyster breakwater structures to protect the popular beach park and northern neck of Oxford. (B) Eastern beaches at the northern tip experience harsh storm surges and would benefit from reef structures here as well. The ferry docks and homes in this area would also benefit from a more stable living shoreline. (C) Oxford's downtown park is a great place to highlight the work being done on the island to combat storm surge and sea level rise. Expansion of the living shoreline here could empower residents to make changes on their personal beach front properties. (D) The area just south of my area of focus also experiences considerable erosion from storm surge events. By installing oyster reefs here they could improve their home shorelines and contribute to oyster populations as well. (E) The southern beaches of Oxford are well fortified by private improvements but a living shoreline could add beauty to the beaches here.



Danny Bentley
LARC 642

History & Experiences

2

User Narratives



Retirees

My husband and I moved to Oxford years ago for the quiet eastern shore setting. We love the sunsets and the quiet tranquility of the bay in the summer evenings. The historic nature of the town also attracted us to retire here to our home on the bay.



Married Couple

We stumbled on Oxford some years ago on a drive to Ocean City MD for summer vacation. We absolutely love this secret gem of a town. The inn is very cute and perfect for a romantic getaway for the weekend. We come back as often as we can.



Oyster Waterman

My family has been harvesting oysters from the Tred Avon for over 80 years. With the new oyster recovery measures in place the industry is stronger than it has been in many years. It gives me hope for the future of the economy in MD.



Young Children

I love to visit my grandparents in Oxford on the weekends. We watch the boats in the bay and can see the men return to the docks with the days catch. The ice cream from the creamery is also the best I have ever had. My favorite flavor is chocolate chip.



DNR Lab Researcher

At the DNR Lab in Oxford we research oyster diseases, improve aquatic animal health, and monitor oyster reef populations throughout the Chesapeake Bay. This lab is critical to our understanding of overall bay health and to oyster recovery efforts.



Environmental Student

As an environmental student I am researching my thesis topic on Oyster Recovery in the Chesapeake bay. Oxford makes a perfect base of operations to get out on the water and count oysters and return for a cozy stay at the inn for a few night stay.

Precedent Design Photos



Oysterecture

Maryland serves as an example of the success that can be achieved over time through community and state government collaboration. The area just North of Oxford along the Tred Avon River serves as the largest man made oyster reef in the world. By using the oysters as a building material for these breakwater reefs we allow the oysters to clean the bay, we improve oyster reproduction, and protect the shores of the fragile Maryland coastline from rising waters and storm surge in the process. As a staple of the Oxford economy historically, oysters serve as a major draw for tourists and visitors as well. By expanding the oysterecture down the coast of Oxford we can capitalize on this unique point of interest.



Blue Pier

Recreational piers have many benefits to coastal areas. By using space over water, land use area is reduced and marine life areas can be highlighted and celebrated. Living shorelines and oyster reefs can be observed up close. Further highlighting Oxford's unique ecology. Direct access to the waters edge can be facilitated through changing levels on the pier and sloping docks to allow children and visitors to get up close to the infrastructure and see ecology at work. Opportunities to enjoy the beautiful coast of Oxford while learning about living shorelines and oyster breakwater reefs will develop southern Oxford into a new destination. It will also teach the public about how the town is embracing sea level rise and tidal flooding issues by considering future development strategies.



Marsh Boardwalk

Tidal marshes offer diverse habitats and support a range of biodiversity. They provide sanctuaries to migratory birds and certain species of small fish. Over time these landscapes have been changed by man and the number of tidal marshes has decreased rapidly. The tidal marsh boardwalk would allow visitors to Oxford to experience these changing landscapes with minimum impacts to the site. Unique ecology can be developed for southern Oxford to educate the public about the changing coastline of the town. Salt tolerant plants can be established and residents can learn to adapt their maintenance techniques for future encroachment of tidal waters.



Living Shorelines

Living shorelines provide a long list of benefits to coastlines where storm surge is a considerable issue. Mixed with the inevitable rising sea levels, storm surge poses a particularly large threat to homes and coastline in this southern area of Oxford. Fortifying the coast with appropriate plantings and manmade structures we can reduce wave erosion from passing boats as well. Natural fiber barriers, rock formations, salt tolerant plants, and sand fortifications are able to be combined to form unique habitats for marine birds, fish and other marine animals that call the bay home. Furthermore, these living shorelines help make the bay beautiful for human residents as well. Living shorelines will help to guarantee healthy shorelines along Oxford's eastern shore for years to come.



Fall 2021
Dr. David Myers



Landscape Architecture
DEPARTMENT OF PLANT SCIENCE AND LANDSCAPE ARCHITECTURE

A Step At A Time

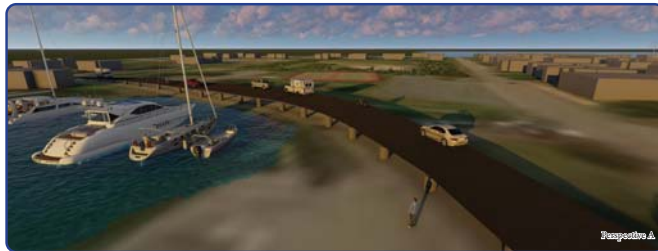
A Plan to Raise Protect and Highlight Southern Oxford

A New Destination In Southern Oxford

My design proposal includes multiple solutions that target southern Oxford to help solve the issues facing the town as sea level rises through 2100. The living shorelines and oystertecture breakwater reefs will protect the fragile shoreline in this area during storm surge events. Erosion will be minimized through salt water grass plantings and the reefs will provide increased wave attenuation during strong storms but also from daily boat traffic in and out of southern Oxford. By working with the Maryland Grow Oysters Program, UMD's Horn Point Laboratory Oyster Hatchery and the Maryland Oyster Advisory Commission, Oxford can add to the already impressive array of oyster recovery projects on the eastern shore of Talbot County. The centerpiece of my design will be the newly constructed blue pier. It will serve to draw tourists and locals alike to this area of Oxford. More importantly it will highlight the work being done to save the bay's oysters and educate the public on the possibilities of shoreline protection and oyster recovery. A new education center on a lower level of the pier can educate while the rest of the pier serves as a new recreation site for sunsets and ice cream. It is sure to be a frequent destination for visitors but also for locals on a daily basis.

The newly raised Oxford Rd. will provide better access during daily tide fluctuations but also during heavy rain events that may otherwise render the road impassible. Just to the south of this new entrance road will be the Causeway Park boardwalk. As the park succumbs slowly to tidal waters it will be developed into a salt marsh to show visitors that the changing bay is not something to fear but something to embrace. The raised wood platforms will allow visitors to walk the fields edge and take in the scenery of beautiful southern Oxford.

These small design steps towards a new and changing Oxford will embrace the changing sea levels, protect the fragile coastline and educate the public about the wonders of the bay and the beauty of Oxford MD as we move through the next century.



Raised Oxford Rd. / Causeway Boardwalk



Living Shorelines

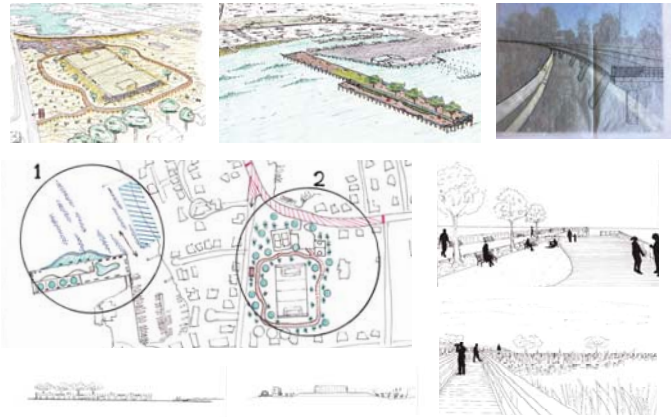


South Oxford Pier Section View

A New Oxford Destination

3

Concept Sketches



South Oxford Pier



Oystertecture Breakwater Reefs

Site Plan



WETLAND, WATER, WONDER

Oxford in 2100

OVERVIEW

[LOCATION] Oxford, MD

[FOUNDED] 1683

[SIZE] 531 Acres

[POPULATION] 580

[HIGHEST ELEVATION] 14'

OXFORD [2021]



OXFORD [2100]



FOCUS AREAS



INTRODUCTION

Wetlands are among the world's most productive ecosystems. They offer tremendous environmental benefits, like carbon sequestration and fortifying coasts against extreme weather events. Wetlands also sequester more carbon than forests, though they are disappearing 30% faster. However, there are few opportunities for the public to engage in this wondrous ecosystem, as much of Southern Oxford has been privatized. This design aims to restore Oxford's coastal ecosystems to help it adapt to a warmer climate while offering engagement and educational opportunities for residents and visitors alike.



SEA LEVEL RISE (SLR) is projected to increase in Oxford by at least 3.5 feet by 2100. Northern Oxford faces the most risk, with many homes being partially-submerged by 2100. About 40% of southern Oxford will also be inundated.



STORM SURGE, compounded with rising sea levels, is also expected to increase over the course of the century. Oxford already experiences significant, disruptive flooding several times a year. Oxford is vulnerable: there is neither coastal buffer to mediate surge, nor higher ground to elevate to.



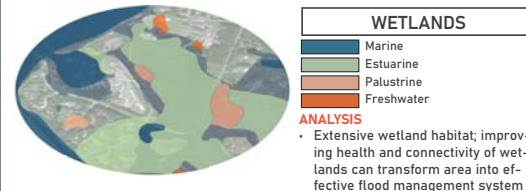
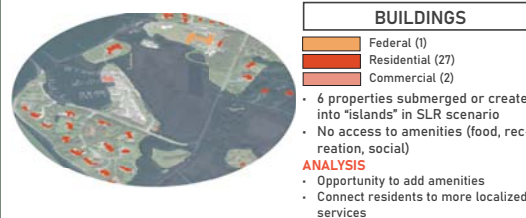
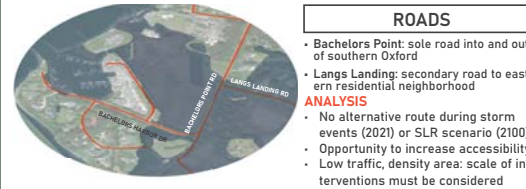
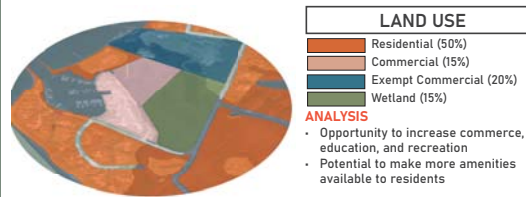
PLUVIAL FLOODING is a serious threat to Oxford, as the town's existing stormwater infrastructure is insufficient in handling excessive precipitation. Much of the overflow is channeled to central Oxford, the only access point in and out of the town.

ISSUES

- **RESTORE** ecological integrity of existing wetland and coastal edge
- **FOSTER** an interactive, educational dialogue with residents and visitors
- **PROVIDE** areas for engagement, recreation, and economic activities
- **ENHANCE** public realm, and accessibility in southern Oxford
- **FORTIFY** coast with climate-adaptive features for 2100 and beyond

GOALS

SITE CONTEXT



SITE INVENTORY AND ANALYSIS

ASSUMPTIONS

- Population remains at current levels
- Cars are smaller, electric, and no longer dominant form of transportation
- Increased private and public collaboration to fortify properties against SLR and storm events
- Zoning regulations shift from predominantly residential to mixed-use
- Small boats predominant form of transportation in coastal communities
- Dependence on local agriculture and aquaculture
- Dependence on localized solar energy
- Relaxed aesthetic standards to meet LEED and other sustainability requirements

CONSTRAINTS

- AREA PRIMARILY ZONED FOR RESIDENTIAL
- NEWLY DEVELOPED NEIGHBORHOOD; MANY HOMES NOT DIRECTLY IMPACTED BY SLR, RESIDENTS MAY NOT SEE NEED FOR INTERVENTION
- USE PATTERNS: MOST ACTIVITY AND TOURISM GENERATED IN SUMMER, LOW POPULATION IN OFF-SEASON
- PERMITTING FOR WETLAND DEVELOPMENT DIFFICULT

OPPORTUNITIES

- + INTRODUCE PUBLIC REALM TO PRIVATIZED AREA, ENHANCE COMMUNITY AND ENGAGEMENT OPPORTUNITIES
- + INTRODUCE ECONOMIC, RECREATIONAL, AND SOCIAL ENGAGEMENT
- + ATTRACT RESIDENTS AND VISITORS YEAR-ROUND WITH MULTI-USE SITE, INCREASE ECONOMIC PRODUCTIVITY
- + LEVERAGE SENSITIVITY OF WETLAND AS ENGAGEMENT AND LEARNING TOOL FOR LOCALS

INTERVENTION

- **Expand** public realm by transitioning private coastal edge to public use
- **Fortify** coast with living seawalls and anti-erosion, herbaceous vegetation
- **Transition** wetland and coastal edges in residential areas
- **Increase** accessibility to southern Oxford
- **Support** multimodal transportation
- **Elevate** and **Adapt** roadways for future SLR and flood events
- **Elevate** submerged and high-risk structures
- **Add** resilient structures for public/multi-use and recreational functions
- **Create** buffer for wetland migration
- **Increase** wetland connectivity
- **Facilitate** opportunities public recreation, education, and research
- **Introduce** or replant native plant species

WETLAND, WATER, WONDER

Campbell's Cove Waterfront

PROPOSAL

CREATE A MIXED-USE WATERFRONT SITE THAT INCREASES INTERACTION WITH BOTH THE WETLAND AND THE SEA WHILE ACCOMODATING NATURE'S RYTHMS. IN ADDITION TO RECREATION, THE WATERFRONT WILL ALSO BE A DESTINATION FOR ECONOMIC ACTIVITY. FROM A RESTAURANT, FARMER'S MARKET, TO COMMUNITY SPACE, THE SITE'S MULTI-USE CAPABILITIES WILL ENCOURAGE ENTREPRENEURSHIP AGAINST A BACKDROP OF WONDER AND BEAUTY. THE DESIGN WILL ALSO BE DESIGNED FOR PERIODIC FLOODING, SPARKING IMPORTANT DIALOGUE AND REFLECTION OF THE LANDSCAPE WITH VISITORS.

GOALS

- EXPAND PUBLIC REALM
- EXTEND WETLAND EDGE
- ENHANCE CIRCULATION
- ENCOURAGE INDUSTRY AND ECONOMIC DEVELOPMENT

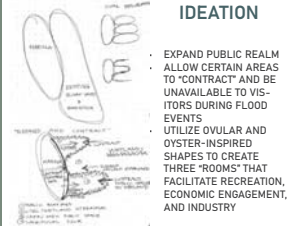
SITE

- SIZE: 13 acres
- CURRENT USE: Private Marina (100-140 slips)
- ISSUES: Impervious surfaces, lack of community amenities, no public access to water



SHAPE STUDIES

- Abstracted existing ovular form of Marina to investigate potential forms and shapes for the design
- Explored various shapes comprising an oyster, an evocative shape that represents Oxford's history as a predominant oyster harvesting community and its current efforts to aid in oyster restoration in the Chesapeake Bay



IDEATION

- EXPAND PUBLIC REALM ALLOW CERTAIN AREAS TO "CONTRACT" AND BE UNAVAILABLE TO VISITORS DURING FLOOD EVENTS
- UTILIZE OVULAR AND OYSTER-INSPIRED SHAPES TO CREATE THREE "ROOMS" THAT FACILITATE RECREATION, ECONOMIC ENGAGEMENT, AND INDUSTRY

PROCESS



TIDAL GARDENS (D) AND DOCK WALK (M)
SOURCE: SCAPE



INTERACTIVE ROCK BUFFER (G, K, N)
SOURCE: BARANGAROO RESERVE, BRUCE MACKENZIE

PRECEDENTS



WETLAND "SPONGE" IN PLAZA
SOURCE: E2DESIGN

SITEPLAN



- A: Breakwaters
- B: Stabilized shoreline with herbaceous marsh planting
- C: Elevated bridge system
- D: Restored wetland

MASTERPLAN

- AREA 1: NORTHERN BOATYARD (LOWLAND)
 - A: Campbell's Boat Yard and overflow parking
- AREA 2: CENTRAL PLAZA (MIDLAND)
 - B: "Amphi-theatre"
 - C: "Center Sponge", alternating wetland planters and grates
 - D: Floodable tidal gardens and "pool"
 - E: Wetland spine
 - F: Lawn
 - G: "Amphi-theatre" to rock and rain garden
 - H: Storage facility and public amenities (water, restroom)
 - I: Transitional gabion walkway over wetland plantings
- AREA 3: SOUTH COVE (UPLAND)
 - J: Multi-use facility with restaurant, cafe, pro-shop, and open programmable space; covered outdoor seating
 - K: Rock and rain garden with bench seating
 - L: Gabion retaining wall and sand bar
 - M: Dock walk
 - N: Coastline fortification and erosion control
 - O: Grand lawn
 - P: Golf cart, bicycle parking
 - Q: Wetland "sponge" and elevated walkway to entrance
 - R: Elevated road
 - T: Wetland buffer

SITE KEY



SECTION A-A: Central Plaza

- A: "Center Sponge", gabion grate over wetland planting cells
- B: Plaza
- C: Forested lawn area, transitional upland planting palette
- D: Floodable "Amphi-theatre" with permeable pavers
- E: Rock rain garden, transitional midland planting palette

SECTION KEY



PERSPECTIVE A: Restaurant and main lawn

NARRATIVE: LONG-TIME RESIDENT



"We've lived in Southern Oxford for over a decade, enjoying our retirement. Though we love the slow pace of our neighborhood, we enjoy the revived sense of energy and community at the new cove. Enjoying a glass of wine with friends watching the boats ride by is our favorite past-time! We also enjoy having more amenities close to home has made life even more convenient here."

PROGRAM: RESTAURANT AND CAFE, OPEN COMMUNITY SPACE (INDOORS, OUTDOORS), RECREATION (PRO-SHOP, SAND BAR, DECK WALK)



PERSPECTIVE B: Plaza and tidal gardens

NARRATIVE: VISITING FAMILY



"We love to spend a day or two in Oxford on the way to the Eastern Shore - it is the perfect day trip and a great reprieve from traffic! Also, it's easy to keep the whole family entertained. There are activities and small businesses that we can all enjoy!"

PROGRAM: TIDAL POOL AND GARDEN, RELAXTION (GENEROUS WATERFRONT SEATING), BOATING



PERSPECTIVE C: South Cove to Central Plaza transition

NARRATIVE: LOCAL FISHERMAN



"I love the new plaza space right off the shore - it's a bustling space that is filled with residents and visitors every day. I love to set up my stall during the weekend markets, where other small fisheries, farmers, and local vendors sell their goods!"

PROGRAM: PROGRAMMABLE PLAZA (WEEKEND MARKETS, EVENTS), OPEN LAWN, ACCESS TO WATERFRONT

ILLUSTRATIVES

WETLAND, WATER, WONDER

Wetland Walk

PROPOSAL

THIS DESIGN AIMS TO RESTORE OXFORD'S THREATENED WETLANDS AND CREATE A BUFFER FOR WETLAND AND HABITAT MIGRATION. IN ADDITION TO RESTORING THE ECOLOGICAL PRODUCTIVITY OF THE WETLANDS, THIS DESIGN ENCOURAGES INTERACTION AND DIALOGUE WITHIN THE WETLAND THROUGH RECREATIONAL AND EDUCATIONAL OPPORTUNITIES. IT ALSO SERVES AS AN ELEVATED MULTI-MODAL TRANSPORTATION MECHANISM FOR SOUTHERN OXFORD WITH SEPARATE PEDESTRIAN AND CYCLING PATHS.

GOALS

- IMPROVE WETLAND HEALTH**
- ELEVATE AND ENHANCE CIRCULATION, PROVIDE ALTERNATIVES**
- CONNECT AND ENGAGE VISITORS TO WETLAND THROUGH INFORMATIVE SIGNAGE AND CLOSE INTERACTION WITH ECOSYSTEM**

SITE

- SIZE:** 16 acres
- CURRENT USE:** Wetland
- ISSUES:** Inaccessible; only opportunity for recreation is one paved road; wetland degradation; Bachelor's Point Road will be submerged by 2100



ELEVATED WETLAND DRIVE (A)
SOURCE: GETTY IMAGES, CAPE COD, MA



DUAL-LEVEL, MULTI-MODAL PATHS (B)
SOURCE: JAMES CORNER FIELD OPERATIONS



PEDESTRIAN WALKWAY WITH INTERACTIVE GABION STEPS (C)
SOURCE: SCAPE



WETLAND EDGE TRANSITION (D)
SOURCE: JAMES CORNER FIELD OPERATIONS



BUSHY BROOMSEDGE



WOOD REED



MARSH FERN



SWAMP MILKWEED

PRECEDENTS

SAMPLE PLANT LIST

SITEPLAN



- A: Breakwaters
- B: Stabilized shoreline with herbaceous marsh planting
- C: Elevated bridge system
- D: Restored wetland

MASTERPLAN

- A: Elevated dock road
- B: Pedestrian, bike path
- C: Wetland engagement areas
- D: Transitional edge

SITE KEY



PERSPECTIVE D: Wetland engagement area

NARRATIVE: LOCAL EDUCATORS



We love to bring our students here from Easton to teach them more about their local environment! The students love engaging in the local ecology and are emerging as mini stewards - we believe these trips may instill a life-long appreciation of, and commitment to, nature!

PROGRAM: INTERACTIVE WETLAND BOARDWALK, EDUCATION AND ENGAGEMENT PATIOS



PERSPECTIVE E: Pedestrian path

NARRATIVE: FAMILY



Our family loves coming here every weekend to get some fresh air and exercise. Our children also love to see the wildlife in the wetland - especially the birds! We love Oxford's storied history and are happy our children can share in its future!

PROGRAM: BOARDWALK NETWORK, WETLAND VISTAS, WILDLIFE ENGAGEMENT



PERSPECTIVE F: Multi-modal bridge network

NARRATIVE: RESIDENTS



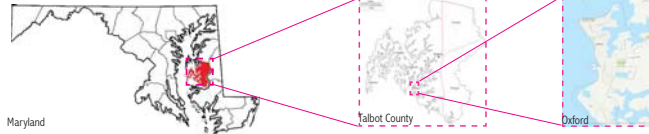
Since the flooding of our beloved Bachelor's Point Road, we are pleased that we now have a multi-modal, elevated bridge system to connect our neighborhood - even during a flooding event! We also enjoy the renewed health and vitality of the wetland - we spend time on the boardwalk nearly every day!

PROGRAM: MULTI-MODAL BRIDGE NETWORK, CONNECTIVITY TO WETLAND WALK

ILLUSTRATIVES

OXFORD'S ACCESSIBILITY FUTURE

SITE LOCATION



INTRODUCTION

Oxford, Maryland is one of the oldest towns in America. This project considers adaptation strategies to ensure this historic town remains accessible.

VISION

The vision is to redesign mobility circulation to withstand sea level rise, storm surge and pluvial flooding so residents can remain in Oxford. This will be achieved through the replacement of impervious paved surfaces with raised and floating boardwalks, a new solar ferry route, and community complex that hosts a marina, shops, and other facilities for the public, residents and maritime employees.

MOBILITY vs. ACCESSIBILITY

MOBILITY is how far you can go in a given amount of time.

ACCESSIBILITY is how much you can get to in that time.

OBJECTIVES

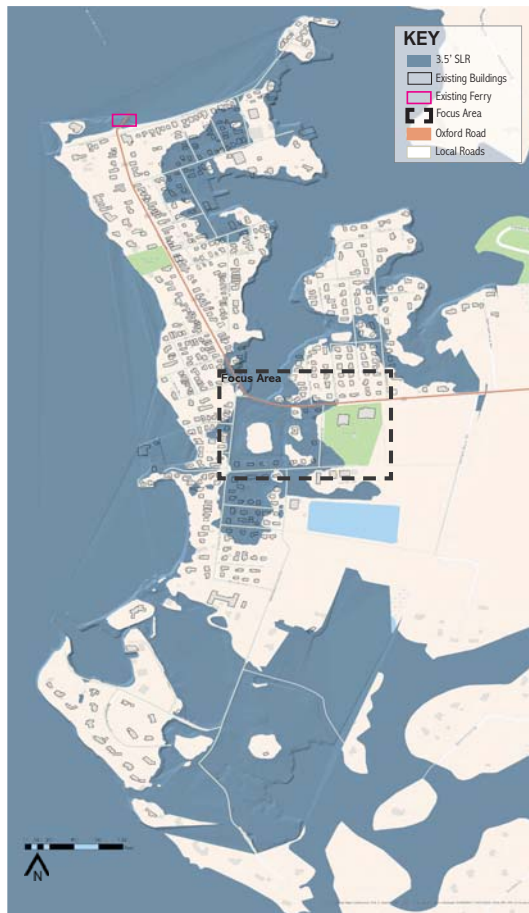
Identify new mobility methods in Oxford that accommodates SLR, reduces PF and can withstand SS while having minimal ecological impact and increases accessibility:

- Solar Ferry: Water transportation relates to historic experience.
- Boardwalks/docks: Residents have extensive experience building these structures, width to be no less than 10 feet.

ASSUMPTIONS

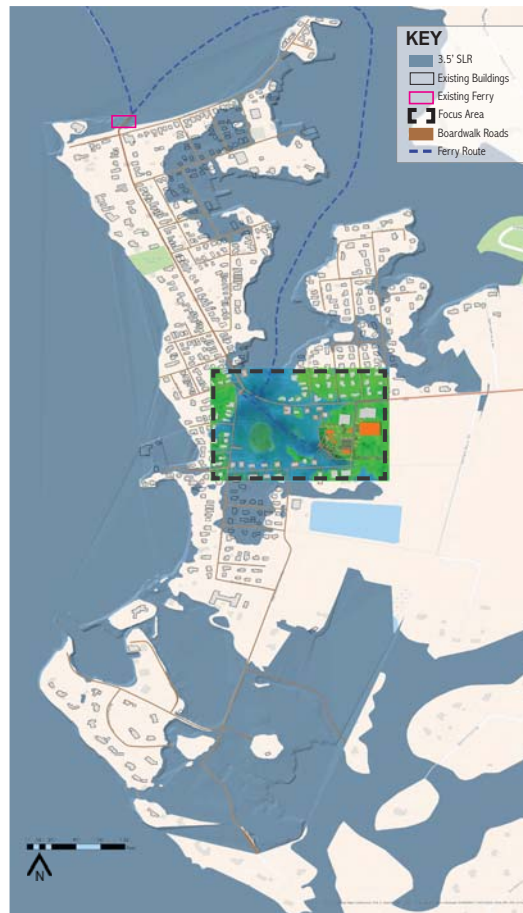
- 3.5' Sea level rise (SLR) from current (2021) SLR.
- Storm surge (SS) risk is measured as the percentage of land area in a block potentially inundated in the event of a category 1 hurricane with a surge of 3-5 feet above normal high tide.
- Pluvial flooding (PF) occurs when precipitation intensity exceeds the capacity of natural and engineered drainage systems.
- Voluntary cooperated agreement to fulfill this design proposal and received funding from the state and federal government.
- Future forms of mobility in 2100 will be light-weight, electric or human powered, and affordable.

OXFORD IN 2100 BEFORE INTERVENTIONS



Map showing Oxford's new coast line in the year 2100 due to 3.5' of SLR.

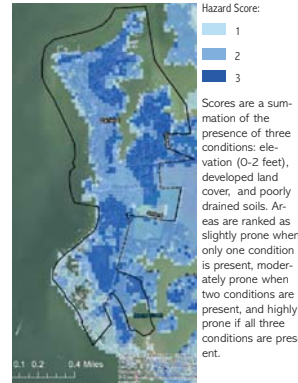
AFTER INTERVENTIONS



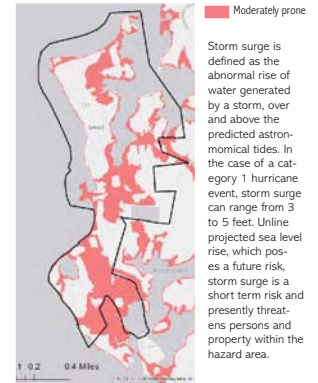
Map showing Oxford's new coast line in the year 2100 due to 3.5' of SLR with master plan proposal, boardwalks and ferry route in place.

SITE CONDITIONS

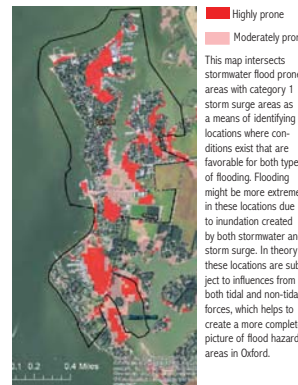
STORMWATER FLOOD PRONE AREAS



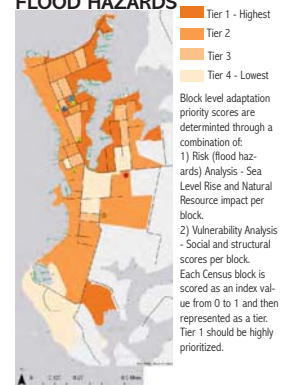
STORM SURGE (SS) AREAS



INTERSECTION OF SS + STORMWATER FLOOD PRONE AREAS



PRIORITIZING ADAPTATION ACTIVITIES FOR LONG TERM FLOOD HAZARDS



GENERAL IMPACTS: CONSTRAINTS + SOLUTIONS ROADS

Low lying roads will completely disconnect some neighborhoods. Existing roads increase pluvial flooding, reducing mobility during floods.



Connect isolated neighborhoods with raised boardwalks. Water is able to permeate through gaps and walkways are accessible during flood events.

EROSION

Storm surge will increase coastal erosion, primarily on the western coast. Erosion will destabilize foundations of homes.



Utilize oyster breakwaters to aid in water quality and reduce impact.

WETLANDS

SLR treats wetland health, as brackish waters become more saline. Wetlands were once the dominate landform in Oxford.



Replanting native wetland vegetation will provide critical habitat for a variety of species. Restabilizing coastal edges will aid in resiliency during storm surges.

BUILDINGS

SLR, PLF and SS will degrade building foundations over time, resulting in costly repairs and will eventually be inhabitable.



Floating buildings will allow them to rise with the tide and give people water-front property.

OXFORD'S ACCESSIBILITY FUTURE

WALKABILITY STUDY



Western coast of Bachelor Point.



Eastern coast of Bachelor Point.



From proposed ferry terminal.



From northeastern tip.

Distance of 20-Minute Walk Proposed Ferry Terminal

The purple region is the distance an average person can walk within 20 minutes. Nearly all of Oxford is a 20 minute walk to the proposed ferry terminal.

PROPOSED BUILD OUT PHASE (1) 2040



Replace Bachelors Point Road, S Morris Street, and Strand Roads with boardwalk. Create temporary surface parking in proposed garage location.

PHASE (2) 2060



Replace northeastern neighborhood's roads with boardwalks. Expand boardwalk to E Pier Street neighborhood and build drawbridge.

PHASE (3) 2080



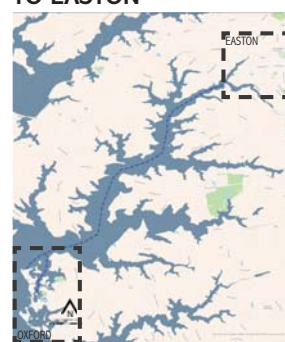
Build out solar ferry terminals, begin dredging causeway park. All homes to be converted to float if necessary or adapted with stilts.

PHASE (4) 2100



Complete community complex area, new marina and maritime facilities operational, all boardwalks connected.

FERRY CONNECTION TO EASTON



Adding a ferry line to Easton, Talbot County's county seat, will give residents direct access to additional resources, such as a hospital, larger stores, and jobs.

FOCUS AREA: OXFORD ROAD CAUSEWAY THREATS

Oxford Road is the **only connection** between Oxford and Talbot County on land.

3.5' SLR will **completely disconnect** land access to Oxford.

31 buildings will be flooded in this area of focus, over **500 buildings will lose land access** to Talbot County.

Causeway Park will be mostly flooded, recreation facilities such as tennis and basketball courts will be inaccessible.

Maritime workers will need to find a new port.

SOLUTIONS

REPLACE CARS with **alternative transportation**: Remove paved roads with boardwalks. Key areas will have floating boardwalks. Drawbridge maintains Oxford Road route. This aids permeability and reduces pluvial flooding.

FLOAT HOMES: Cluster to create communities. Connect with boardwalks. **Reacts and engages with sea level rise.**

DREDGE CAUSEWAY PARK: Enables solar ferry route to replace Oxford Road and creates new marina. Use dredged land to **rebuild coast lines and build foundation** for new community complex.

COMMUNITY COMPLEX: Open air market, welcome + education centers, shops, and maritime facilities.

OFF-SITE GARAGE: Removes cars from Oxford, prevents additional compaction; safely **stores vehicles and boats during storm events**; provides visitors with place to park as there is currently limited street parking; provide bicycle storage for commuters and visitors; have shower facilities for post-recreation use.

NEW MARINA: Provides alternative access (boat) to public and gives **maritimes employees** new port to process their catch.

MARITIME PROFESSIONALS' FACILITIES: Increase available boat slips for more economic opportunity; designated building for processing, storage and cleaning; closer proximity to Easton.

SITE PHOTOS



Oxford Road flooding, typical occurrence during and after storm events. (Source NOAA)

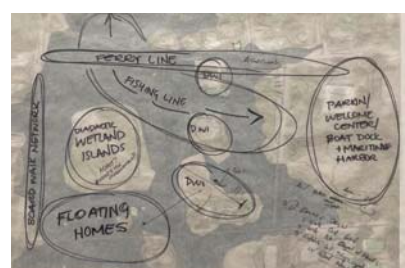


Pluvial flooding occurs throughout town, need for absorption and storage of stormwater.

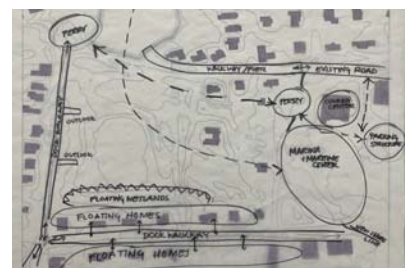


A bioswale, located in Causeway Park, filled with stormwater following a rain event. (Source NOAA)

CONCEPT DEVELOPMENT



General space layout of new landscape. Questions regarding dredging or keeping diadactic wetland islands (DWI) arose.



More specific layout regarding community complex developed.

PRECEDENT IMAGES



Offsite parking lot safely stores personal vehicles, raising above ground reduces soil compaction and green house gas emissions.



Board walk roads replace existing pavement; reducing flooding.



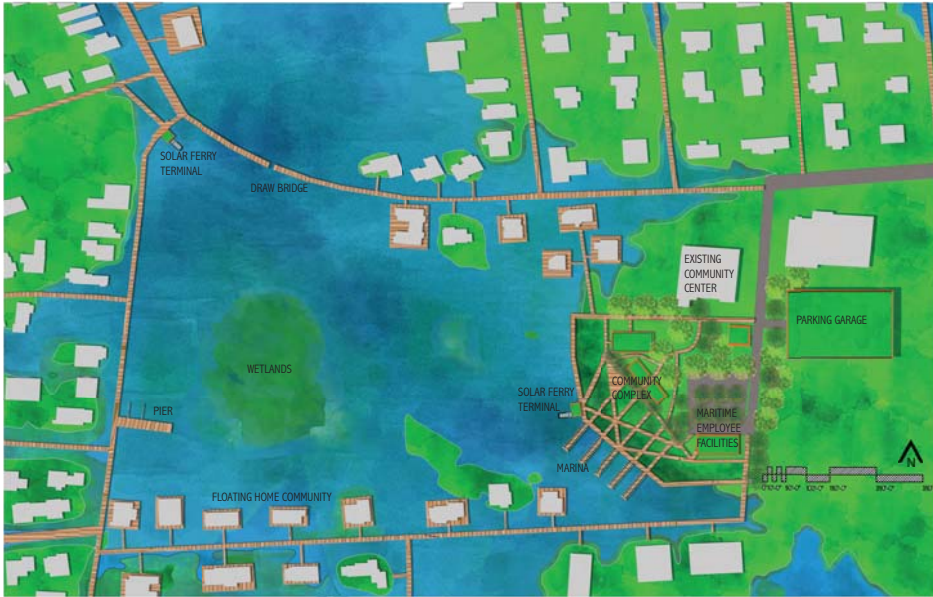
Solar ferry connects the east and west side of Oxford Road, as well as the existing ferry stop and remove fossil fuel dependency.



Future transportation will change the way we move, solar-powered assisted electric bicycles are one example.

OXFORD'S ACCESSIBILITY FUTURE

MASTER PLAN



FEATURES

COMMUNITY COMPLEX

- Visitor's welcome center provides historical and educational information.
- Restroom and shower facilities
- Solar ferry ticket booth and indoor terminal
- Public park and wetland walkway
- Water access for swimming and non-motorized boating
- Shops, restaurants & grocery store

GARAGE

- Car and boat parking/storage
- Bicycle storage
- Shower facilities
- Built on stilts for additional flood prevention

MARITIME EMPLOYEE FACILITIES

- 25 reserved spaces for maritime employees
- Dedicated building for processing, storage, and cleaning
- Permeable parking lot for employee vehicles and bus use
- Restrooms with shower facilities

MARINA

- 75 boat slips for public use
- Boat launch accessible to public
- Wetland boardwalk with educational boards

PERSONAL EXPERIENCES

RESIDENTS



We were a little unsure about losing direct access to our car but have adapted to our new commute quickly. **Walking and biking to the solar ferry** is a lovely way to start the day and the neighborhood is so **peaceful** without the car traffic. The parking garage is a **quick walk** from the ferry and we love getting drinks for **happy hour at the new community complex** after work.

MARITIME EMPLOYEE



I really appreciated the Oxford community providing watermen dock space at Safe Harbor, but having to drive my truck through town spent a lot of time. The **new marina gets me in the water quickly** and there's **plenty of space** to clean equipment, stock up on ice and take a shower after a hot day. The parking is a nice touch too!

RETIRES



Being retired, we love Oxford more than ever. The new **community complex has great events and wonderful shops** we enjoy visiting after taking the **quick solar ferry** from North Morris St. We love sitting on the wetland walkway and to **watch the birds and wildlife**.

CLASS TRIP



We loved learning about the **history** of Oxford, testing water quality of the **Chesapeake Bay** and learning about **oysters**. Oxford's new education center was so **welcoming** and the boat tour was really fun. Seeing **sails made by hand** was one of the coolest parts of the trip!

TOURISTS



Oxford is a fantastic **travel destination!** History, ecological restoration, fresh seafood, small town charm, what more can you ask for? The **ferry and bike routes** connect everything. We can hardly believe there were once cars in town, it seems so natural the way they **live with the water**. It'd be a dream to retire here one day... in a couple years.

COMMUNITY COMPLEX PLAN



NORTH WEST VIEW OF WETLAND BOARDWALK



VIEW OF FLOATING WETLAND BOARDWALK



Section A-A'

VIEW OF FLOATING HOME



Section B-B'

Vision: Remembering is not exclusively about beholding the past...
... it can be future-facing

The Past Inspires the Future

In 80 years, climate-induced sea level rise in the Chesapeake will move the coastline at least 3.5ft higher than where it currently stands. How can progressive, cutting-edge, resilient infrastructure be designed without losing out-of-place? Balancing traditional materials and familiar American forms with progressive ideas is the best way forward.

The Present Remembers the Past

Founded in the mid-1600s, Oxford stands as one of the oldest towns in the nation. Streets are lined with perfectly-maintained colonial homes, shaded by mature trees, and tickled by bay breezes. Historic charm is integral to this town's identity, but the coming decades present a revolutionary problem that urgently needs to be addressed.

The Future is Built in the Present

The cultural experience of Oxford is largely commemorative and focused on its history. Our time in town is a nostalgic opportunity to remember the way things used to be. However, remembering is not exclusively about beholding the past. The present, taking inspiration from the past, strives to build the future. Viewing Oxford as a town "locked in time" disregards its innate capability of progress and forward momentum. I strive to create a terrain where the past, present, and future are distilled seamlessly through culture, instead of constructing a landscape confined by antiquity.

Goals & Objectives

Climate Change Adaptations

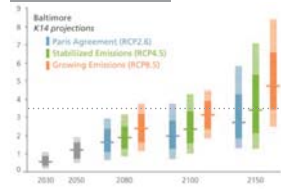
- Prevent Sea Level Rise in low-elevation areas
 - Employ embankments to protect existing infrastructure in floodplains
- Address Storm Surge on coast-lines most heavily affected (west and north)
 - Utilize living shorelines and constructed wetlands to dissipate wave energy before it reaches the shoreline
 - Construct hard edges to break momentum
- Prepare for Increase in amount and frequency of Pluvial Flooding
 - Build wetlands that absorb water in areas prone to inundation
 - Develop a system of renewable-powered water pumps

Human Design Goals

- Facilitate recreation, pleasure, and learning
 - Keep sight lines open
 - Harness the spectacle of water's natural beauty with points for viewing and points for interacting
 - Allow close access to wetland areas
 - Incorporate signage about wetland habitats, sea level rise, and coastline protection methods
- Continue the story of Oxford, in the appropriate style that represents the town
 - Keep building materials, structures, forms, and overall experience in traditional style
 - Embrace the water-centric lifestyle of residents
- Design for the people who live in Oxford
 - Meet with local stakeholders to grasp a feel of their goals and aspirations

Assumptions

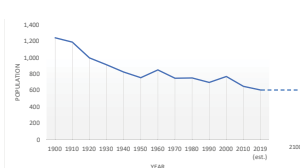
Sea Level Rise



3.5ft by 2100

This graph depicts a compilation of current (2018) sea level rise predictions for the Chesapeake region by the University of Maryland. The average value for each prediction is marked with a hatch. For this project, 3.5 feet sea level rise will be modeled for the year 2100.

Town Population



Stable Population

The population of Oxford has been on relatively steady decline since 1900. For planning purposes, town officials recommend keeping a stable population into 2100, with residents hovering in the low 600s.

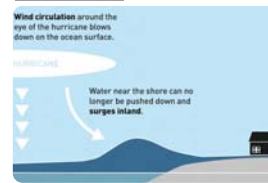
Tourism Focus



Continued Tourism

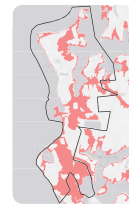
Oxford - and Talbot County as a whole - have invested heavily in building a robust tourism industry based around leisure, historic charm, and a coastal lifestyle. This is likely to continue.

Storm Surge

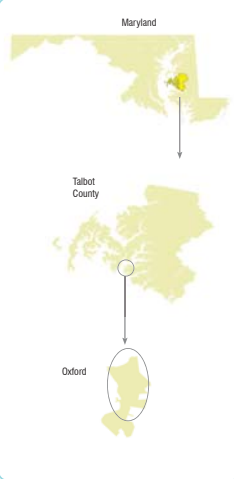


Increased Sea Level During Storm Events

Storm Surge is an increasing threat due to climate change and greater frequency of intense storms. Storm Surge is a phenomenon where water levels rise dramatically during windy storm events. The most recent extreme storm surge in regional memory was during Hurricane Isabel in 2003 when water levels on the Eastern Shore rose between 5 - 8 feet above normal. A NOAA-assembled risk map of Storm Surge in Oxford is represented to the right. It aligns closely with low elevation maps of Oxford, seen below.



Site Location



Oxford, Maryland

Site Inventory



Geographic Context



Property & Zoning



Transportation



Topography

Oxford Today - 2020



Present Oxford Sea Levels

Oxford Tomorrow - 2100



3.5 Foot Sea-Level Rise Predictions

Focus Area Concerns

The Northeast Isthmus

- Sea level rise due to low elevation
- Severe storm surge concerns
- 9 buildings permanently flooded
- 10 buildings marooned on an island

The Historic Harbor

- Widespread sea level rise due to low elevation
- Minor storm surge concerns
- Severe pluvial flooding concerns due to topography
- Salt water intrusion and high water table issues
- Coastline erosion due to high boat traffic
- 61 buildings in jeopardy from sea level rise of 3.5 feet
- Majority of town's historic buildings sit here, in a region of high flood risk

Jack's Point

- Sea level rise due to low elevation
- Salt water intrusion and high water table issues
- 12 buildings in jeopardy from sea level rise of 3.5 feet
- Many residences cut off from roadways on islands

The Causeway

- Sea level rise due to low elevation
- Salt water intrusion and high water table issues
- Storm surge concerns to the west
- Road transportation to Oxford completely severed
- 45 buildings in jeopardy from sea level rise of 3.5 feet

Site Photos



Bulkhead along north shore



Impervious parking lot



Historic Harbor at low tide



Groundwater seepage creates standing water



House with drainage pit in yard



Small house on stilts



Campbell's Boatyard



Large house on the water



Photos of "Lake Oxford", a low-lying region of Causeway Park that never drains

The Historic Harbor

Oxford's Historic Harbor was settled and established in the mid 1600s, making it one of Annapolis's oldest towns in the state of Maryland. The vast majority of Oxford's historic buildings are situated here. Many of them lie below 3.5 feet in elevation, and recent sea-level rise predictions put these homes and businesses in jeopardy.

The visuals on the left depict where the Historic Harbor is located in relation to the rest of Oxford. The satellite image depicts current conditions for the location - full of homes, businesses, boats and trees. My goal is to maintain as many of these aspects as possible, while selectively choosing areas for redevelopment that offer greatest protection to the town.



Oxford's Historic Harbor region

Constraints

- Pluvial Runoff** - Historic Harbor is a bowl, catching runoff from all directions
- Historic Buildings** - Residents discourage moving or elevating of buildings
- Salt Water Intrusion** - Threatens canopy trees near future shorelines
- Lifestyle** - Oxford's harbors are the lifeblood of their culture. Maintain its function

Opportunities

- Protection** - Prevent the permanent inundation of 61 historic buildings
- Naturalization** - Take advantage of ecological systems for shoreline resiliency
- Biodiversity** - Support ecosystem health, and provide habitat for animal-spotting
- Tourism** - Attract tourists with new design to augment town revenue

Inspiration Images



Raised Boardwalk & Rock Edge
- Shenzhen, China



Turf Embankment & Path
- Sheffield, UK



Shaded Learning Station
- Corpus Christi, Texas



Chesapeake Living Shoreline
- Piltalent River, Maryland

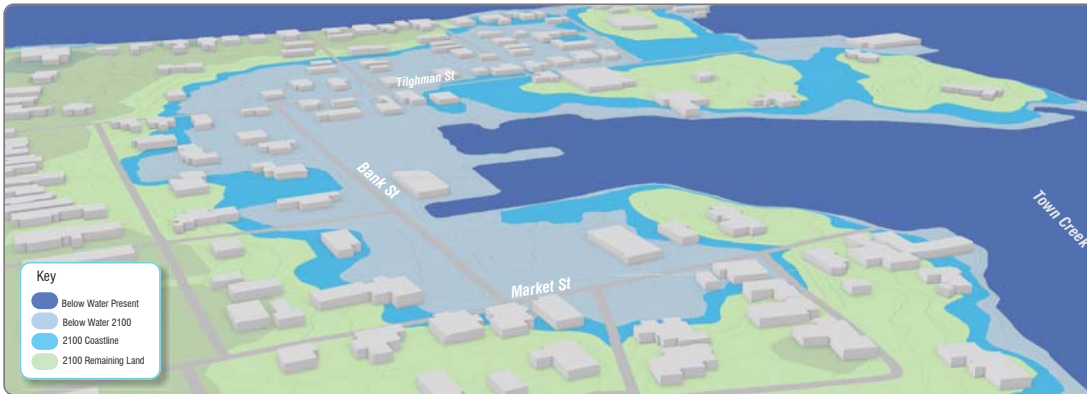


Trunk Erosion Protection & Ecology Extension
- Parsons Island, Maryland



Recreation Boardwalk
- Providence, Rhode Island

Harbor 2100: No Intervention



Embankment Ideation

To hold back water and prevent inundation of the historic harbor, an embankment can be used to connect existing high-grounds.

Oxford Topography



Integrated Design Solution

Interior Low-Ground

- Constructed marshland filled with salt-water tolerant plantings to absorb reverse percolation and pluvial runoff trapped on inner side of embankment
- Attract marsh animals for viewing from boardwalk
- Drainage pump takes overflow during storm events and pipes it into the adjacent harbor

Main Embankment

- Central feature of the design to protect against sea level rise and storm surge. 10ft high embankment connects high ground at north end with high ground in southeast. 50ft wide with sloping sides. Build on existing low ground
- Interior is lined with clay to prevent water intrusion.
- Edges where embankment borders water are lined with riprap to prevent erosion.
- Protects 50 buildings from permanent inundation.

Living Beach

- Beach protected by wetland on both sides
- Recreation opportunity

Ghost Island

- Island with "Ghost Forest" of dead trees from salt-water intrusion. Wave-break & habitat extension with artfully-scattered trunks, anchored into the ground.
- Plaques on nearby beach and on pier to explain what is happening on the inaccessible wetland island



Pier & Floating Boardwalk

- Pier extension from embankment boardwalk allows for fishing and close-up water views.
- Access to floating pier near water-level.
- Floating boardwalk contains seats, planters, and signs for learning.

Terraced Oyster Stairs

- Large stairs leading from the embankment boardwalk down to the living shoreline waterfront.
- Turfed top, edge wall plastered with oyster shell chunks.
- Creates visual interest and play opportunities for young children

Embankment Boardwalk

- Boardwalk along the top of embankment, allowing raised viewpoint into the harbor.
- Seating, pergolas, canopy trees, and opportunities for learning.
- Accessible by both ramps and stairs

Memory Lane

- Set of chronologically informative plaques laid out along the boardwalk, walking visitors through Oxford's history, through the present, and into the future.
- An opportunity for reflection, learning, and consolidation of local culture.

Living Shorelines

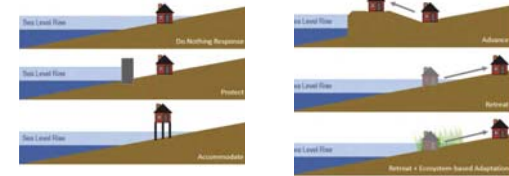
- Beach and marsh grasses in an artificial inlet, protected by riprap. Protects against erosion and storm surge.
- Opportunity for recreation and to behold traditional Chesapeake environments.

The Everyday Experience

Learning an aesthetic inspiration from the past and resiliency techniques from the present, this design weaves together a unique and dynamic toolkit for Oxford's future. At the human level, the new Historic Harbor design should feel familiar and comfortable - almost disguising its complexity and progressiveness by paring aspects down to their simplest possible form.

Through these tactics I hope to design a space where memories of the old, cherished Oxford can flourish, while also dislodging the town from its past. Great challenges are on the horizon, and these climate change adaptations thrust it into contemporary times. Memory Harbor seeks to challenge the notion that the past is exclusively behind us, and pushes the theory that history is just as alive in our current everyday experience as it will be in the future.

Sea Level Rise Approach Models

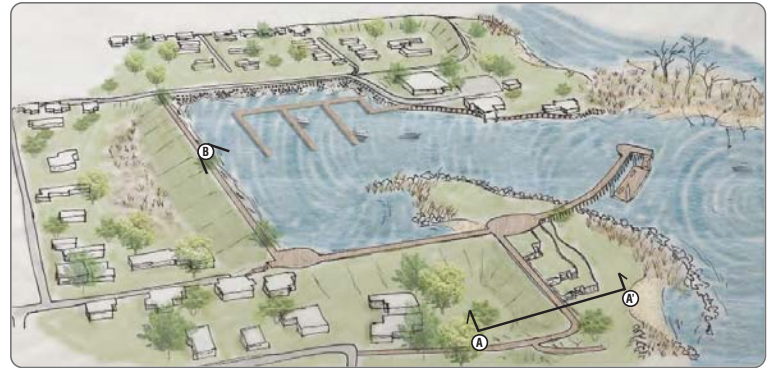


Evaluate and Act

There are many theories on ways to adapt to sea level rise. The three most common discussions revolve around *protect*, *retreat*, and *accommodate*. Each has their positive and negative aspects, and many different design applications. I choose to employ a mixture of *Protect* and *Retreat* + *Ecosystem Adaptation*. Important historic areas can be protected, while less important regions can retreat and be replaced with highly resilient green infrastructure.

Integrated Design Solutions

This map shows the location of the renderings below



Experiences



"...After we first arrived, we felt a little lost. The historic harbor is our favorite place to walk, and it helps us understand what makes Oxford so special..."

A New Home

Susan and Jim moved to Oxford just 6 months ago, at the beginning of 2022. Coming from Syracuse NY, they arrived feeling a little isolated without having roots in the Chesapeake region. The Memory Lane Boardwalk gave the couple initial insights into the town's history, and caught them up to speed on current overarching events the town is experiencing. Also acting as a great meeting place for new friends and family, the historic harbor helps them feel connected to Oxford.



"...We hadn't even moved all the construction equipment off site yet and birds had already begun exploring the new shoreline..."

A Surprising Discovery

Anthony worked on the Historic Harbor Redevelopment Project for two years. As workers were putting the final touches on the boardwalk, he noticed that many species of native waterfowl were already frequenting the shorelines he just constructed. He beamed, along with many residents, at all the shapes and varieties of birds prancing up and down the new beach. Seeing the direct, immediate ecological impact of this project was highly influential on him, and he wants to study more ecological restoration tactics.



"...She knows how to swim now, but she still insists that we visit the beach where 'fish tickle our toes'. It makes my heart smile knowing she will keep these memories..."

A Stronger Family

The Pascal family is from Denton MD, but frequents Oxford during warm summer weekends. Living on the watery Delmarva Peninsula but not having access to a swimming pool, it was very important to parents Alex and Sydney that their daughter Minnow learned how to swim. The public beaches and calm waters of Oxford were ideal for their little girl to become comfortable in the water. Even though Minnow turned nine last month and is now a strong swimmer, the family still visits this Chesapeake shoreline occasionally. These days she gets excited running along the living shorelines, peeking in the reeds, and picking up beach rocks to look for little crustaceans. The delightful memories built in Oxford will stick with the family forever.



"...When I sit on the benches and close my eyes, the salty breeze kisses my cheek and I can feel him with me once again..."

A Dignified Memorial

Stephanie, an Oxford resident since 2020, sadly lost her husband Bruce to cancer two years ago. Bruce was a Talbot County native and an avid sailor. Spending his time on the shores of the Chesapeake in Oxford was his paradise. On quiet mornings, Stephanie takes morning walks along the waterfront boardwalk, watching the sun rise over the harbor. The natural beauty and the soft smell of the water reminds her of what Bruce loved most about his favorite town. These powerful memories and emotional experiences are very special moments to Stephanie. Places like the historic harbor help her remember the past, while giving her strength to continue moving forward and embracing every day.

Healthy Marshlands

Overflowing with Benefits

Ecologically healthy marshlands and shorelines are significantly more resilient and resistant to dangerous problems posed by climate change like storm surge and pluvial flooding. These ecosystems are dynamic, and when designing man-made replicas, it is important to remember that they will change over time. These sorts of "living" shorelines are better at preventing detrimental erosion, filtering pollution, balancing nutrient levels, and supporting native wildlife. Additionally, they are beautiful spaces which can be enjoyed by visitors.

Healthy Components

- High Ecological Biodiversity
- High Concentration of Native Plants
- Natural Wave-Breaks - like rocks, oyster-reefs, sandbars, or vegetation
- Clean Sediment
- Biodegradable Organic Materials
- Flexibility of Structure
- Habitats for Native Animals

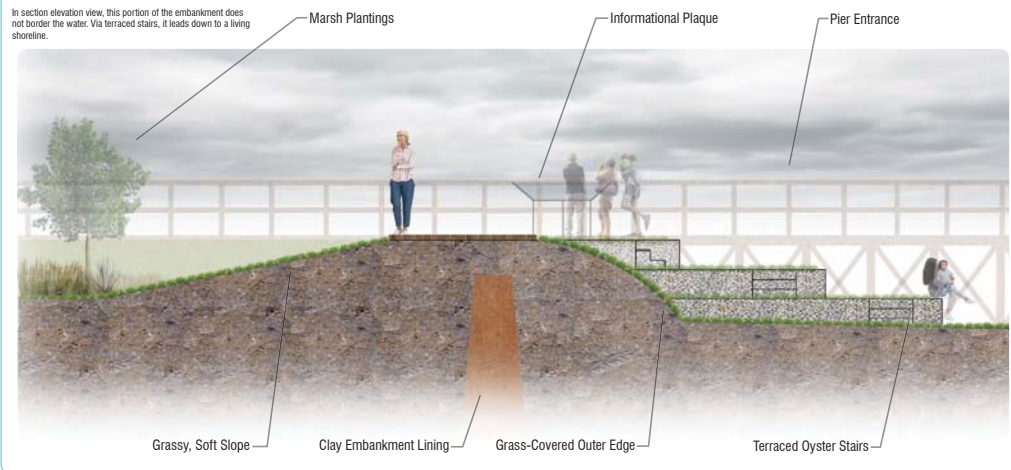
Chesapeake Marsh Plantings

- Sea Oats - *Uniola paniculata*
- Switch Grass - *Panicum virgatum*
- American Beachgrass - *Ammophila breviligulata*
- Groundsel Bush - *Baccharis halimifolia*
- Saltmarsh Cordgrass - *Spartina alterniflora*
- Black Nelderush - *Juncus roemerianus*
- Saltmarsh Bulrush - *Scirpus robustus*
- Southern Bayberry - *Myrica cerifera*



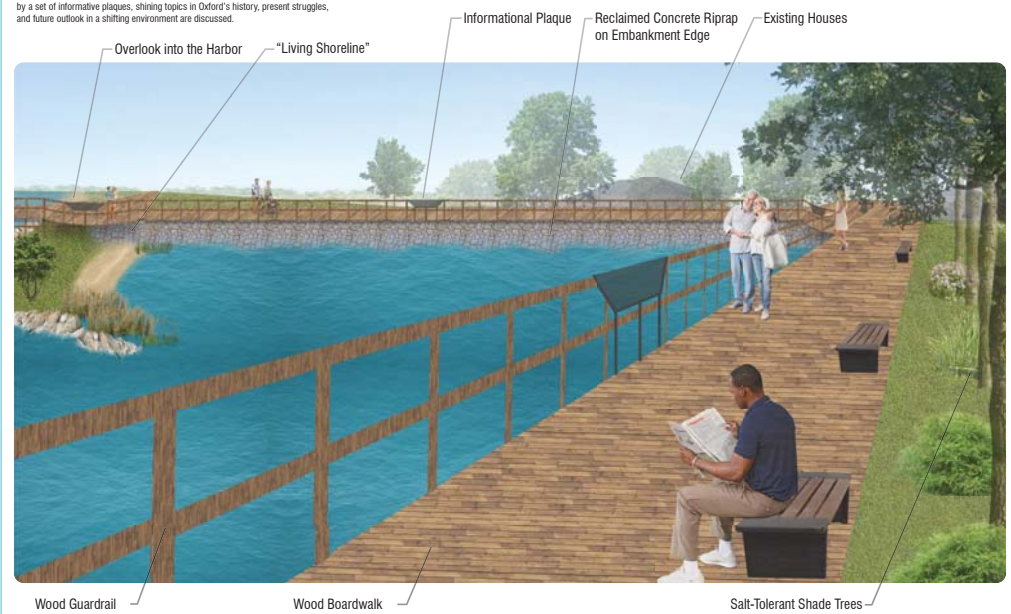
A-A' The Southern Embankment

In section elevation view, this portion of the embankment does not border the water. Via terraced stairs, it leads down to a living shoreline.



B A Walk To Remember

The key component tying this design to the Vision is a guided walk along the harbor embankment boardwalk through Oxford's memorable history and into its future. Led by a set of informative plaques, sharing topics in Oxford's history, present struggles, and future outlook in a shifting environment are discussed.



Connecting Communities: Northern Oxford in 2100

Introduction and Site Inventory & Analysis

Introduction

The Earth is already seeing the disastrous results of human-caused climate change, but it is only the beginning. Even if we were to change our behavior today—which we have shown no evidence of real plans to do so—we are past the breaking point. The temperature will continue to rise, and extreme weather events will be routine. The acidification of the ocean and its related rise will have a negative impact, especially on coastal communities.

Oxford, Maryland

Oxford is a charming coastal community in eastern Maryland. It has all things you would associate with a town on the shore: boats, docks, crabs, oysters, and tourists and more!

Living on the water, flooding is not unusual to people here. But even new residents can see that it is getting worse and more frequent. Some great mitigation efforts are already in place in Oxford, but the community knows they must do more to ensure they can continue living in this great town.

Location



Oxford is located in Talbot County, on the Eastern Shore of Maryland. It is conveniently located 15 minutes from the county seat and economic center, Easton and less than two hours from Washington, DC. It is one of the wealthier communities in the Eastern Shore. Many residents are retired and/or own a second home. Housing prices are high and properties taxes are the lowest in the state. Oxford is not a very diverse town.

Site Photos

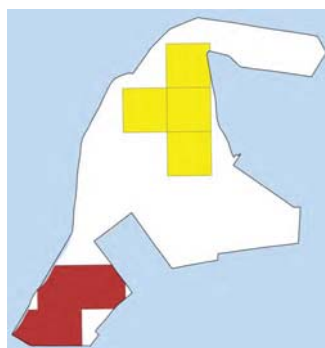


Project Focus Area



My project scope is the northern tip of Oxford, or the East Strand area, as it's known locally. This area is part of a larger historic district of the town. It is a small area, less than 0.25 miles long and about 0.10 miles across at its widest point.

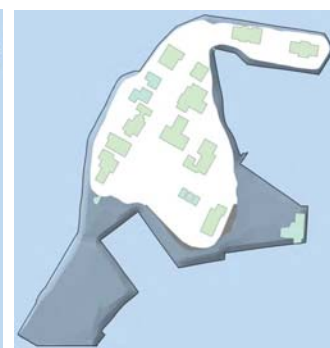
Issues



1. Pluvial Flooding (EPF)
This map shows areas at risk of pluvial flooding, when extreme rainfall event creates a flood independent of an overflowing water body. Risks are indicated by historic evidence and predicted estimates. The yellow boxes indicate a moderate flood risk, and red ones denote areas of very high risk.



2. Storm Surge (ESS)
The blue arrows represent storm surge as indicated by historic evidence and predicted estimates. The western side of the area receive the strongest surges, while itself blocking the eastern side. But if portions of this area are underwater, they would no longer stop surges from going into the harbor.



3. Sea-Level Rise (SLR)
Sea-level rise is the greatest threat to the East Strand area. A conservative estimate of 3.5' in sea level rise completely floods the causeway connecting this area to the rest of Oxford. Surrounded by water on all sides, this area is now an island. In addition to the landbridge, portions of this area will be underwater.

Goals and Objectives

My project goals are to address and reduce the severity of the effects of climate change on Oxford, specifically on the East Strand area. For each problem, I will propose at least one climate change mitigation strategy.

Although pluvial flooding is not a major issue in my focus area, I would like to address it and propose solutions to slow down stormwater runoff during increasingly-frequent major rain events.

Because my entire focus area is on the coast, I need to address storm surge. I want to stabilize the shores of most of the area to prevent erosion and add breakwaters where possible.

Most of my focus will be on addressing this issue of sea-level rise because it affects this area the most drastically. I want the East Strand residents to maintain their lifestyles and ensure that this area retains its functionality.

Site Inventory & Analysis



Buildings

There are **11 houses** and two additions located in the scope area. **None of these residences will be inundated**, but the water level will be near the homes. The other buildings in this area include a **commercial building** and four shed-like structures. **The commercial building will be completely flooded.**



Docks and Boat Slips

Seven private docks are located on the northern half of this area. The marina on the southern half of has **three large docks** and nearly **100 boat slips**. Most of the docks are located on the eastern side, protected from storm surges.



Roads

Only **two roads** traverse this area: **East Strand Road**, which runs the entire north shore of Oxford, and **Valliants Lane**, which is short and mostly used by the marina. When the water rises, Strand Road will be below sea level, and **this area will be cut off from the rest of Oxford by vehicle.**



Topography

This area is **relatively flat**. Its highest points, 8' above current sea level, are inland. The land slopes gradually toward the ocean on all sides and then slopes steeply on the shores. **For the most part, water drains into the ocean, but there are areas that pool after severe rain events.**



Property Lines & Ownership

Most of the properties in this area are **privately owned**, either by one owner or an LLC. The east lot of the southernmost portion of this area is owned by the **Commissioner of Oxford**. **The road and right-of-way are also publicly owned.**



Impervious Paving

There are **two impervious parking lots** in this area. One is for the marina, and the other is a public parking lot. **Both of these parking lots will be under water with a 3.5-foot rise in sea level.**

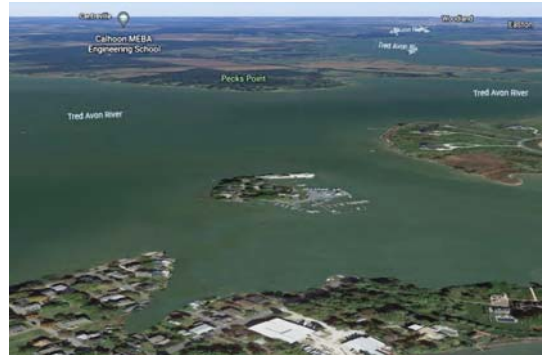
Connecting Communities: Northern Oxford in 2100

Program and Design Solutions

East Strand: Today



East Strand: 2100 with no Mitigation



2100 Assumptions

- Only 3.5' sea level rise.
- All vehicles are now electric and don't take up as much room, so roads are narrower.
- But there are no cars on the island, only personal electric vehicles.
- Boats and planes are mostly electric.
- Online shops have replaced most brick-and-mortar stores, including for purchasing groceries, clothing, electronics, furniture, and appliances.
- Drones are regularly used for delivering items.
- Telehealth is widely available, and doctors can prescribe prescriptions remotely.
- Telework is increasingly common.

Vision

When sea-level rise turns an area into an island, there are two options: build a bridge or adapt to island life. I would like to see the East Strand region embrace its future as an island community. I want to help the residents of this area retain connectivity to Oxford and the greater Talbot County area. I want East Strand Island to be functional so that living in this area is a viable option in the year 2100.

Program: Connectivity

What does connectivity mean? What makes an island functional? I think island must meet residents' needs--from basic to advanced--without too much of a challenge for them.

Basic Needs

- Food/Water
- Groceries
- Restaurants
- Shelter
- Home without flooding

Safety Needs

- Employment
- Jobs in Oxford, Easton, DC, or remote
- Education
- Public or private schools
- Health
- Hospital in Easton or remote doctor
- Medication

Love and Belonging Needs

- Friendship
- Family
- Sense of Connection
- Coffee shops
- Mail
- Internet
- Sports
- Clubs
- Community events
- Nature

Narratives



Resident #1: Retiree

Bill and his wife Betty are retired. They live in Oxford in the summers and winter in Florida. Bill has several health problems and makes monthly trips to Easton for medical appointments and regular trips to the pharmacy for his medications. Bill and Betty have nine grandchildren, who love spending their summers on the water in Oxford. Bill is not worried about sea-level rise, but he wants to make sure his beloved linden tree is still around for his great-grandchildren to climb.

Resident #2: Second home owner



Elizabeth and her husband Joe live and work in Easton. They are empty nesters whose youngest child just left for school in College Park. The couple owns a second home in Oxford, which was an investment; but they also enjoy spending time there on weekends in the summers. Their jobs and social lives are based in Easton, and they do not have a strong connection to downtown Oxford. Elizabeth and Joe used rock to stabilize the banks by their home. But, otherwise, Sea-level rise is not a major concern for them because they will just sell their home before it is inundated.



Resident #3: Child

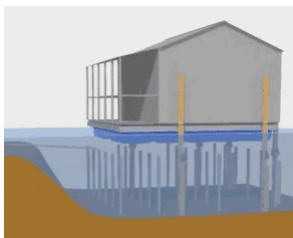
Ryan lives in Oxford, but he attends second grade at a private school in Easton. Most of his friends live in the surrounding Talbot County. He has a severe asthma so his parents always carry an inhaler and know all the routes to University of Maryland Shore Medical Center at Easton. He likes to go out with his parents on their boat and swim and fish in the summers. Ryan does not know what climate change is, but he thinks warmer weather means more time for fishing.

Resident #4: Remote Worker



Maddie lives in Washington, DC and works for a company based there. She is able to work remotely most days and make trips to DC once a month. Because she has the freedom to work anywhere, she wants to move to the Eastern Shore. She cannot afford a home in Oxford, so she is looking to rent a house. Maddie is very concerned about climate change caused by humans, and she recycles and composts religiously. But as long as the WiFi is working, she is happy.

Design Solutions



Sea-Level Rise: Amphibious Foundations



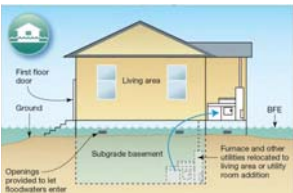
Sea-Level Rise: Elevate Buildings



Sea-Level Rise: Floating Pavilion



Sea-Level Rise: Floating Dock and Marshlands



Pluvial Flooding: Wet Floodproof Homes



Storm Surge: "Soft Infrastructure"



Storm Surge: Living Breakwater



Connectivity Hub: Delivery Lockers



Concept Diagram



Section A-A': Floating Pier Community Hub



Site Plan - East Strand 2100



Recommended Design Interventions

Pluvial Flooding (EPF)

1. Reconstruct more **narrow roads** and use remaining area as native-planted **bioretention areas** to collect and filter rainwater.
2. Where elevating homes is not possible, **wet floodproof all homes** in the area so they can handle occasional inundation.

Storm Surge (ESS)

3. Construct **breakwaters** on the northwest side of the area to protect the shorelines from erosion during storm surges.
4. Build up the former East Strand Land Bridge to protect the harbor from storm surge and rough waters. Construct **new wetlands** to grow there.

Sea-Level Rise (SLR)

5. Construct a **large floating pier** with a **community hub** building. This is where East Strand Island residents can go to pick up their grocery and medicine deliveries, mail, purchases, and more. Golf carts are available for bringing home large items. The hub also a social center with gathering spaces and a coffee shop. If the sea levels rise further, the pier can rise on its amphibious foundation.
6. Some business will have to **retreat** due to lost property in this area.

Reconnecting Communities

7. The pier will have an area where residents can catch a **ferry** to Oxford or to Easton.
8. In addition to the community hub, East Strand residents can gather at the **new beach** on the northern shore, protected by a seawall.

Bird's Eye View



Share the (Narrower) Roads



LIVING WITH THE WATER

A Solution for Oxford in 2100

Oxford



Existing Site Conditions

Land
Area- 513 acres (142 acres submerged)
Watershed- Lower Choptank
Land use- 88% residential

Demographics
Population- 580 residents
Median age- 63.3 years old
Median household income- \$81,000 with 3% poverty rate
Race and ethnicity- 92.4% white (non-Hispanic)

Transportation
Road network- one road into Oxford (Route 333)
Public transportation- no public transit
Average cars per household- 2

Assumptions

- 3.5' of sea level rise by 2100
- All homes must remain within the site area
- Storm surge defined as inundated in the event of a category 1 hurricane with a surge of 3 to 5 feet above normal high tide
- Oxford residents have access to autonomous, electric vehicles allowing for narrow streets
- Voluntary, cooperative property agreements that receive federal funding for housing reconfiguration
- Population of Oxford remains stable and persist as a tourist destination

Oxford Photographs



Photographs courtesy of LARC 642 students

Challenges

Sea Level Rise
 Warming water due to climate change is causing sea level rise through three major mechanisms.

- Ice sheets and glaciers are melting worldwide, adding water to the ocean.
- The volume of water expands as it warms.
- Groundwater is being removed from the land, largely due to pumping, causing the land to sink and elevate sea level

Storm Surge
 Increasing sea level rise can also leads to impacts from storm surge events. Small changes in vertical increase in sea level can lead to large changes in horizontal reach of a storm for low-lying coastal community.

In addition, warmer water temperatures can impact weather patterns and increase the intensity and size of storm events. The western coast of Oxford, adjoining the Chesapeake Bay, will be the most impacted by storm surge events.

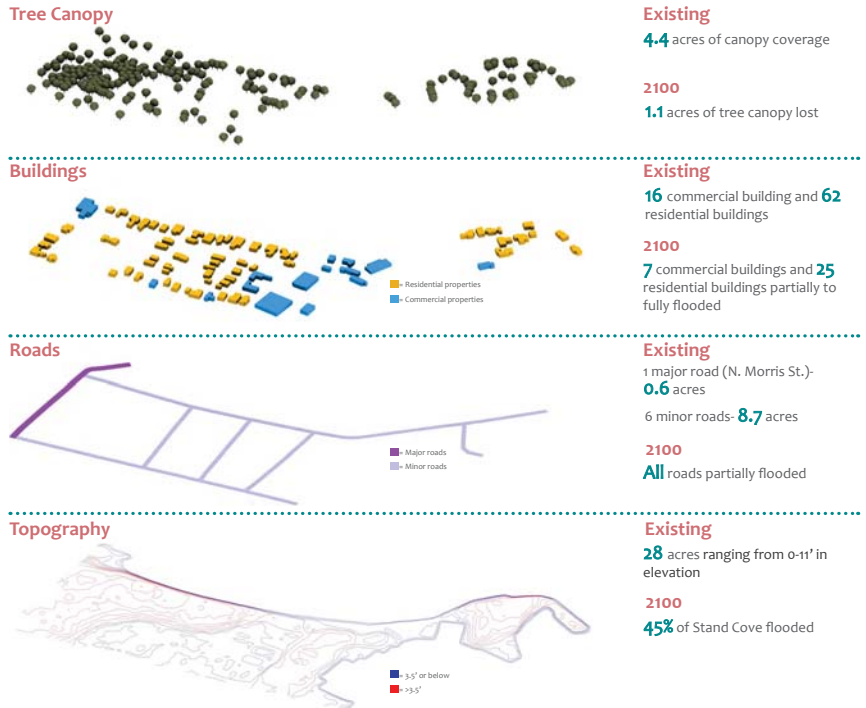
Pluvial Flooding
 Pluvial (rain) events are expected to increase in frequency and severity worldwide. This is a result of increased evaporation, causing greater atmospheric moisture, and therefore more rain events. Pluvial flooding in urban areas is most likely due to increased impervious surfaces, density of people, and density and buildings.

Historic Preservation
 Oxford, Maryland was founded in 1693 as a large port town. The northern portion of Oxford is considered part of the National Register of Historic Places with homes from the 19th and 20th century.

Design Process



Site Inventory & Measures



Design Vision

Exemplary Model for Small Towns in Maryland
 In the year 2100, the Town of Oxford will be a model for coastal adaptation to sea level rise, storm surge, and pluvial flooding. Oxford will remain a thriving coastal community by establishing constructed wetlands, minimizing the use of conventional cars, and utilizing aquatic modes of transportation to travel throughout the town.

Objectives
EMBRACE WATER
 Design adaptive measure to allow people and water to be exist in harmony
ADAPT THROUGH ECOLOGY
 Develop green design strategies to assist with sea level rise, flooding, and storm surge
MAINTAIN HISTORIC CHARACTER
 Identify and retain the historic character of Oxford and integrate that with new, resilient infrastructure

Site: Strand Cove



LIVING WITH THE WATER

A Solution for Oxford in 2100

Five Character Defining Features of Strand Cove



1. Water Transit



Historic image Oxford Bellevue ferry



Current image Oxford Bellevue ferry dock

Water transit has remained a priority in Oxford since the establishment of the Oxford-Bellevue ferry along the northern coast in 1843. It is a simple, effective way for residents and visitors to move from the peninsula to neighboring towns.

2. Historic Structures



Historic image Robert Morris Inn



Current image Robert Morris Inn

19th and 20th century homes reside in northern Oxford. These historic structures reflect an era of prosperity, growth, and industry for the town that must be preserved.

3. Tree-lined Streets



Historic image street without trees



Current image St. Albans Street

Tree-lined streets are present throughout Strand Cove providing shade, comfort, and beauty for all. This protection would be missed if no longer present.

4. Working Wooden Docks



Historic image northern aerial looking west



Current image Tighman Street dock

These quintessential structures found along Strand Cove's shoreline reflect Oxford's long history as a working watermen port. The weathered, wooden materiality represents a key feature of the docks.

5. Grid Layout



Historic image 18th century map of Oxford



Current image grid layout in Oxford

Since its founding, Oxford has maintained a grid city layout. A rectilinear form for circulation must be sustained in Strand Cove to promote connection between this site and the town neighborhoods.

Photographs courtesy of LARC 642 students and the Oxford Museum website

Design Strategies & Precedent

Embrace Water

Utilize the following design features to embrace water in 2100:

- Floating homes
- Buoyant foundations
- Public access boardwalks/piers
- Water taxi



Schoonship (floating community) Space&Matter



Amphibious House-Baca Architects



China Basin Park-SCAPE



Boston Water Taxi

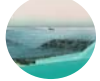
Adapt Through Ecology

Incorporate the following design features to adapt through ecology in 2100:

- Constructed/floating wetlands
- Green piers
- Living breakwaters
- Bioretention



Gowanus Canal Sponge Park diastudio



Living Breakwater-SCAPE



Wetland Park-Yifang Ecoscope



Race Street Pier-Field Operations

Maintain Historic Character

Abstract the five identified character defining features through materiality and form to maintain historic character in 2100 while enhancing infrastructure and sustainability:

- Access to homes via the water
- Durable, sustainable, weathered wooden docks
- Salt-tolerant plantings
- Pervious brick paving



Nysse sylvatica aerosol and soil salt tolerant tree



Electric boat-X Shore



Composite deck board-Tree



Heritage brown permeable paving-Eco Priors

Concept Diagrams

Housing

Concept 1- Elevating



Partially and fully inundated buildings are elevated using still or raised foundations



Concept 2- Floating



Fully inundated buildings are floated while partially inundated buildings are raised



Concept 3- Floating & Consolidating



Inundated buildings in the central and south portion of the cove are floated and consolidated to create a floating community



Circulation

Concept 1- Elevate Existing Roads



Inundated roads are elevated for vehicular access to the buildings



Concept 2- Dock Network



Inundated roads form a grid network of pedestrian docks for access to buildings



Concept 3- Dock Network & Boat Channel



Pedestrian docks consolidated in conjunction with buildings, and a boat channel created to provide access to the cove from the north shore



Strand Cove Master Plan



98 new trees planted

2 new ferry stops created

30 homes consolidated and floated

3 acres of wetland constructed

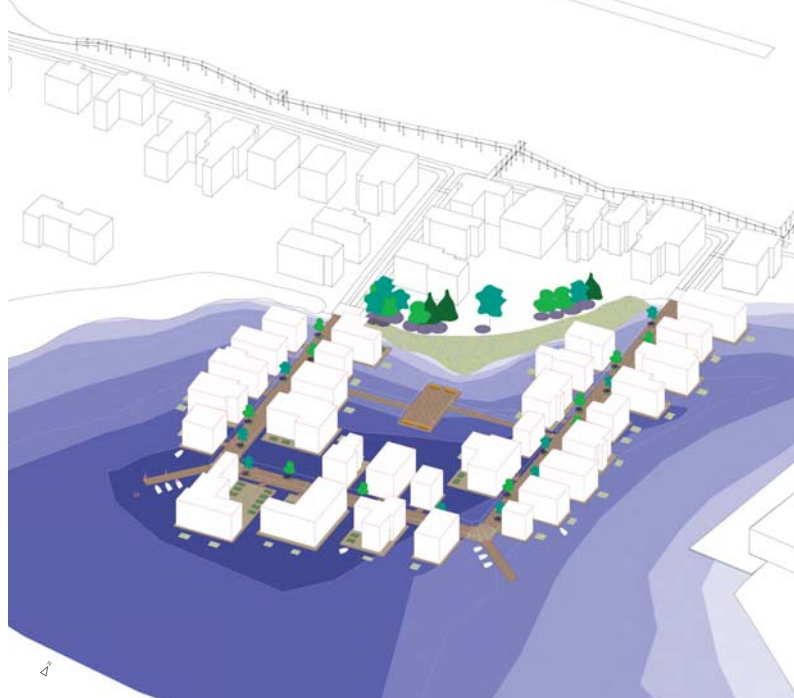
740 linear feet of wetland boardwalk designed

36 floating wetlands established

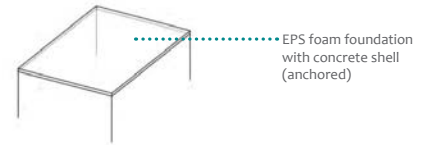
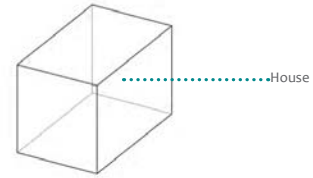
LIVING WITH THE WATER

A Solution for Oxford in 2100

Focus Area: Strand Cove Floating Community



Floating foundation



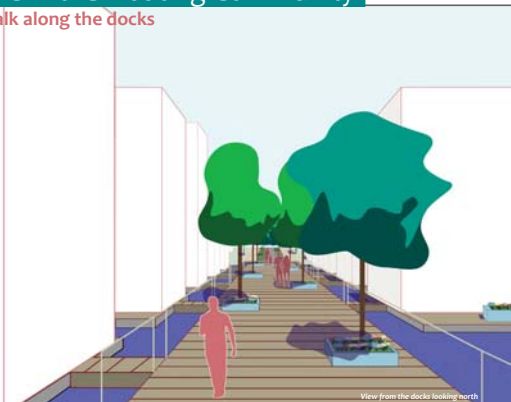
Floating Wetland



Oblique of the Strand Cove floating community

Life in the Floating Community

Walk along the docks



Town Thoughts



Fred (Retired)

"I have lived in this community for over 40 years. I am happy to say that although there have been some necessary changes in town, it still feels like home. I enjoy walking along the wetland boardwalk every morning with my wife, Millie, and waving at boats as they pass by the shore."



John (Waterman)

"It's good to know that Oxford still considers waterman a priority in town. There is plenty of space for me to dock my boat, and I actually have started a weekly delivery to the Strand Cove floating community."



Phoebe (Middle School Student)

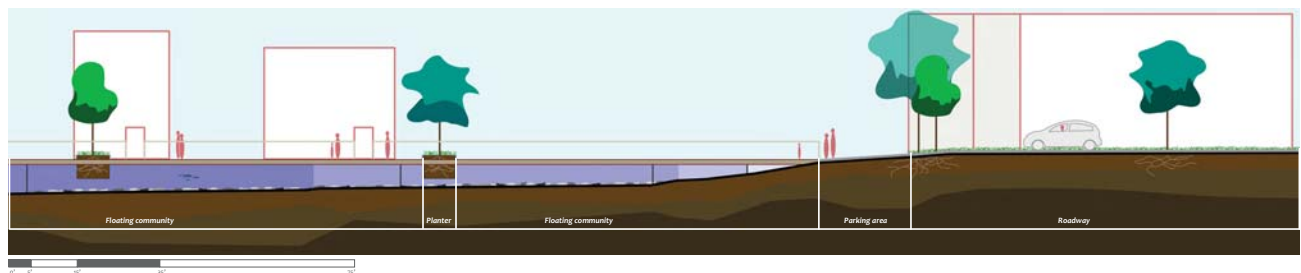
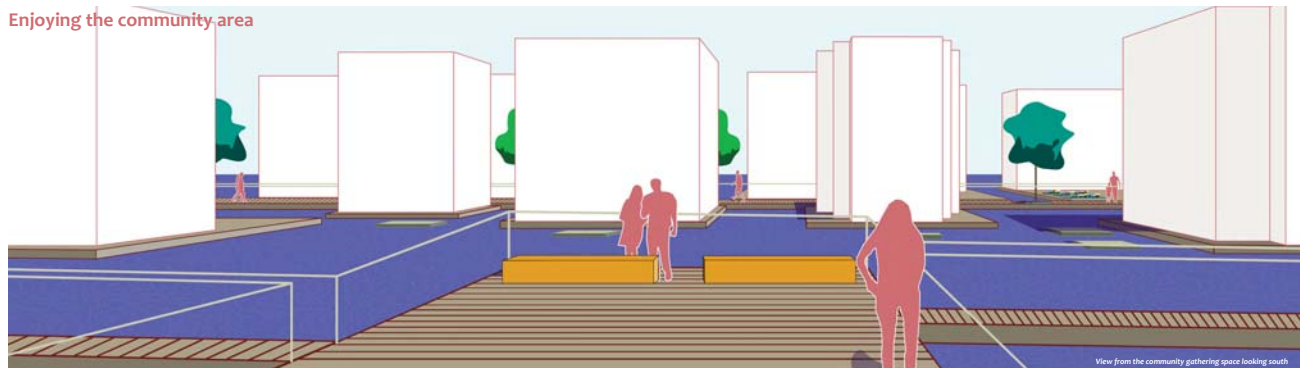
"There is nothing cooler than living in a floating house! We have a new boat, that no one in my family lets me drive yet, but everyone loves visiting my house. I can watch the birds that visit our floating garden right outside my window and everyone here is like family, always outside chatting. It's super neat!"



Catherine (Business Owner)

"As a resident and business owner in Strand Cove, I am thrilled with the redesign of the neighborhood. It certainly has remained a destination for residents and visitors because its historic charm still remains. Many of my store guests are from outside of the neighborhood, and they always mention how easy it is to explore by land or by sea."

Enjoying the community area



Oxford 2100

HISTORY



Oxford officially founded
Though it traces its origins to nearly 20 years early, Oxford marks 1683 as its official founding.

1683



1694

Oxford becomes one of the two ports in Maryland

Oxford and Anne Arundel (now Annapolis) selected as the only two ports of entry for providence of Maryland



1847

Revitalization of Oxford
General Tench Tilghman establishes the Maryland Military Academy in Oxford to bring interest, activity, and commerce back to the area.



1872

Railroad established
The Tilghman's established terminus for Maryland Delaware Railroad in Oxford. Fishing ascends while auxiliary industries (boatbuilding, seafood packing, etc) thrive. Tourism in Oxford booms, and residents can travel to NY.



1951

Bay Bridge construction
Just over four miles long, the Bay Bridge connects the Eastern Shore to the west, increasing accessibility and supporting population growth

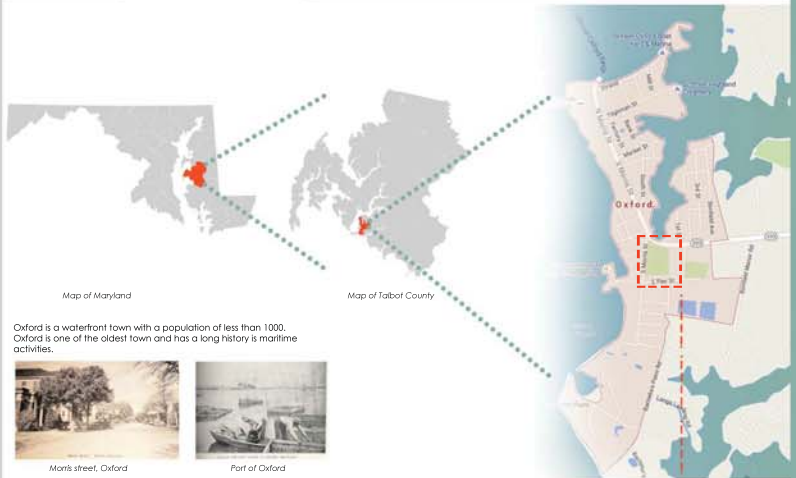


1972

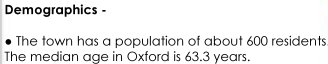
Chesapeake Bay Maritime Museum
The only museum dedicated to understanding maritime history of the Bay consists of 35 buildings, 10 of which house exhibitions open to the public.



LOCATION



Oxford is a waterfront town with a population of less than 1000. Oxford is one of the oldest towns and has a long history of maritime activities.



OXFORD 2021

Demographics -

- The town has a population of about 600 residents. The median age in Oxford is 63.3 years.
- There are about 224 employees in the town.

Economy -

- The main industries are -
 - Professional/Scientific/Technical
 - Arts
 - Tourism

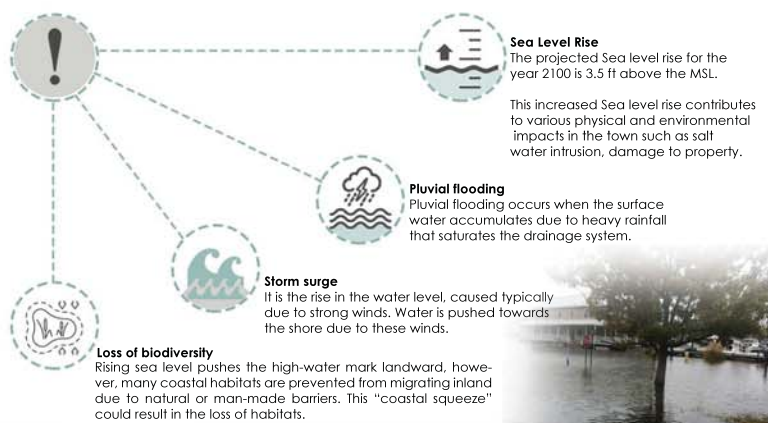


FOCUS AREA



- The causeway park and its surrounding area is selected as the area of focus.
- Based on the existing topography and projected SLR, the selected area is at a higher risk.
- This area provides an opportunity to use the existing Infrastructure in planning for the future.

ISSUES



A NEW WATERFRONT DEVELOPMENT

The **VISION** for Oxford 2100 is to use the projected sea level rise as an advantage, by creating a new waterfront development along the area at risk from the sea level rise.



- Environmental** - Increases resilience against risk of sea level rise. Promotes restoration of wetlands, thus helps in dealing with flooding and storm surge.
- Commercial** - Proposed market area on the waterfront promotes commercial growth and will also attract more tourists.
- Recreational** - Includes recreational areas for various age groups. The harbour helps people engage in various water-related activities. Maintains the town's connection with water.



GOALS



FOCUS AREA AND INVENTORY

The Causeway park is centrally located. The location of the park is an advantage considering the accessibility from different areas of the town. The buildings around the park could be raised in order to protect them from SLR.

The two main types of wetlands in the town are Estuarine and Palustrine. The existing wetlands have been greatly impacted by SLR and other issues. Restoring these wetlands is essential for the environment and to deal with the environmental issues.

The inventory marks the 3ft contour to identify the areas at risk and propose a suitable design intervention.

The projected sea level rise indicates that a major portion of the park is at risk. The central area is at lower risk as compared to the other areas.

Buildings and Park
Buildings
Causeway Park

Wetlands
Estuarine
Palustrine

Contours
Contour
3ft contour

Projected sea level rise
Elevation below 3.5ft

O X F O R D 2100

SITE ANALYSIS



Causeway Park



A

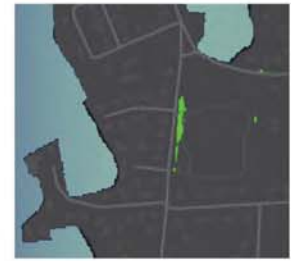


B

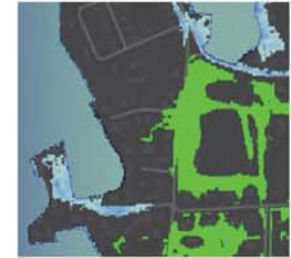


C

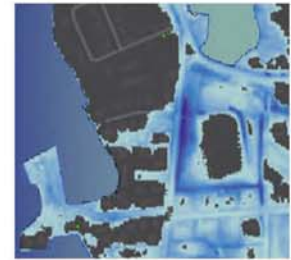
IMPACT OF SLR



(2021) Current conditions



(2060) 2ft Sea Level Rise
Low - lying areas



(2100) 3.5ft Sea Level Rise
Area affected by sea level rise

CONCEPT DEVELOPMENT



Identifying the main roads and raising the roads to protect against sea level rise.

Identifying the areas of highest elevation to create island for the waterfront

Establishing connection between the identified areas along the axis.



Wetland restoration



Potential waterfront

DESIGN GOALS -

- Raising existing buildings and roads to ensure protection against sea level rise.
- Design a potential waterfront using existing infrastructure.
- Create new recreational facilities for various age groups.
- Facilitate restoration of wetlands.

DESIGN PRECEDENT



Harbour



Harbour



Promenade along the road



Seating area



Berm



Raised road

USER EXPERIENCE

FAMILY



The new waterfront is a really nice place. It is a great recreational area where we often meet our friends and neighbors. We also organize small get-togethers with other town residents on the central plaza. The waterfront has become the children's favourite place. It has various outdoor activities that kids can take part in. It is easily accessible due to its connectivity to the main road.

TOURIST



I visit the town during holidays to meet my family. The waterfront provides multiple seating areas where I can work, relax and get some fresh air. I like going there because it has some silent zones where I can meditate in a peaceful environment. My friends and I occasionally meet up in the newly developed area when I am in town.

RETIRED COUPLE



We love our morning and evening walks. The waterfront is an excellent place to enjoy some fresh air and meet other residents. We have organized various town gatherings at the central plaza. It is also a great place for morning yoga and fitness sessions. The new harbour is a really nice place to move around in my boat.

PET LOVER



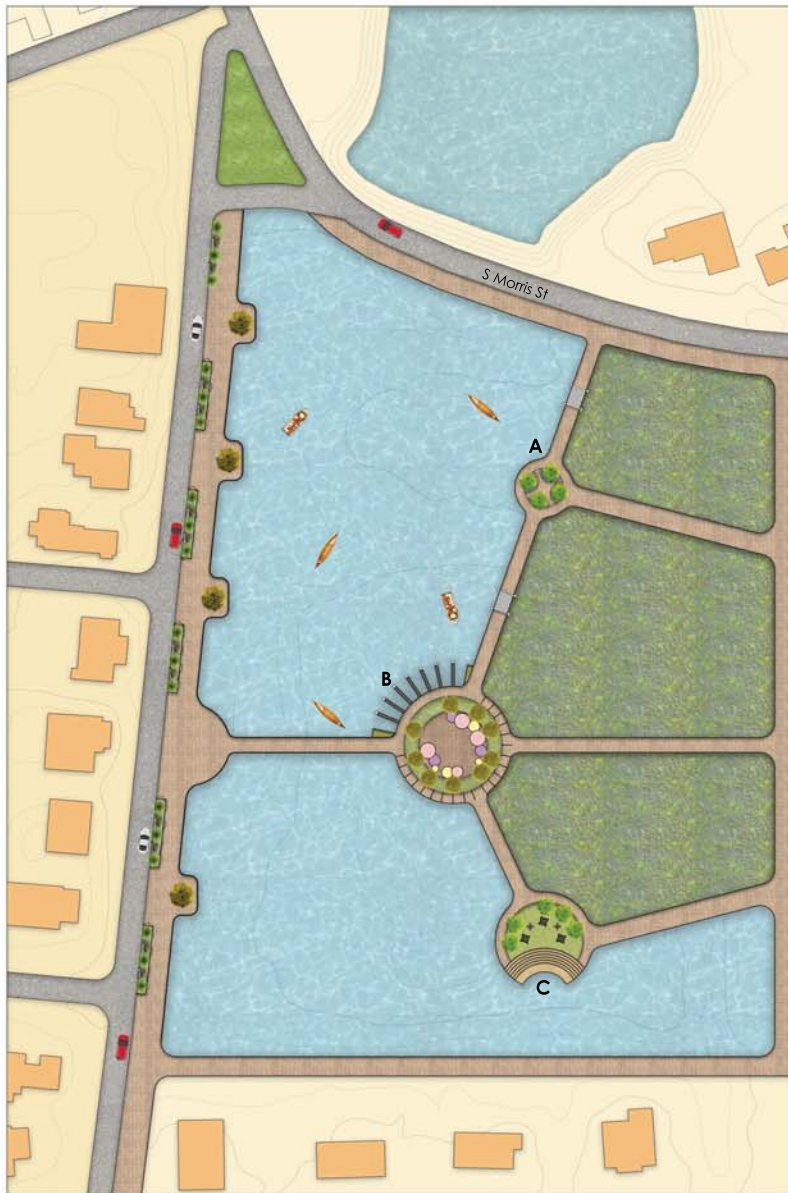
The promenade along S. Morris street is my dog's favourite place to be these days. He gets to meet his other dog friends and play around.

BUSINESS OWNER



The new market area at the waterfront provides business owners like me to participate in the farmers market held every week. This has helped increase demand for our produce.





PROPOSED SITE PLAN



SECTION



Ariel view



S.Morris street and promenade



(A) Seating area overlooking the waterfront
Recreational | Environmental



(B) Harbour created around the central plaza
Recreational | Commercial



(B) Central plaza and market space
Recreational | Commercial



(C) Amphitheater
Recreational



(C) Walkway around central plaza
Recreational



(C) Wetland Restoration
Recreational | Environmental

INNOVATE | RESTORE | FORTIFY

OXFORD OF THE NEW CENTURY

PROJECT INTRODUCTION

This project will provide the Oxford community with a visual glimpse into the future of the built environment of the bustling port town in the year 2100.

In addition to a change in mean sea level, mean high high water (MHHW) above sea level will be considered to explore and document planning and design scale intervention that will serve as a foundation for Oxford's possible futures. The design of this hypothetical intervention will focus on sea level rise but also explore other factors such as pluvial hydrology, saltwater intrusion and storm effects.

ASSUMPTIONS

Sea levels will rise 3.5 ft as projected by the Town of Oxford and the DNR Coastal Planner using Maryland's 2018 SLR Projections

Oxford will no longer permit fuel powered vehicles to be used within town limits. People must use smaller, eco-friendly modes of transportation such as autonomous vehicles, "pod" cars, bicycles, scooters, etc.

There will be assumed voluntary cooperation among residents to implement certain interventions that will receive funding from the state or federal government

CONTEXT

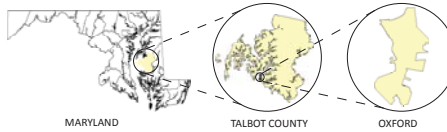
Oxford has approximately 650 full time residents, a number that more than doubles in size during the summer months. The average age is 63 years old

Oxford is small in size covering only 513 total acres

The highest elevation is 11 feet above mean high water with many parts of town falling between 4 - 10 feet above sea level

The majority of Oxford is located in a floodplain and is frequently exposed to flooding caused by tidal and and rain events resulting in many areas of town

LOCATION



PROCESS

- Introduction to project program
- Group site inventory & analysis
- Define site scopes and establish specific project goals
- Site visit & meeting with town manager
- Refine goals and begin conceptualizing design
- Produce design
- Communicate our ideas

PROJECT GOALS

Identify issues in Oxford regarding sea level rise, pluvial flooding, high tide, and storm surge. Determine in which neighborhoods these are the worst

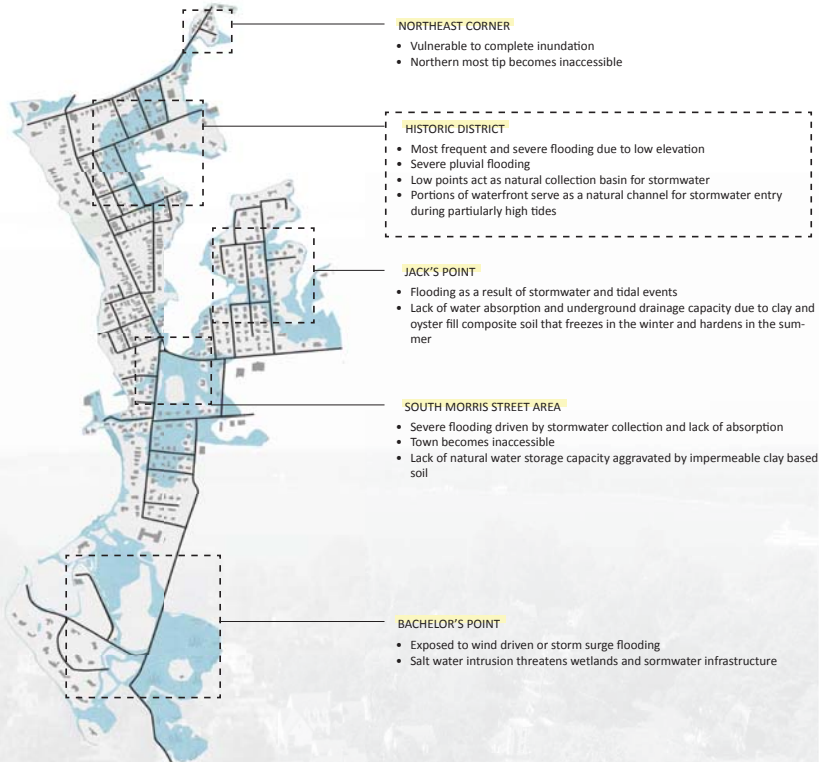
Conduct research on these issues. Learn more about the measures other cities have undertaken to mitigate these problems. Visit Oxford and get a sense for the site

Communicate through GIS mapping, illustratives, and precedents possible solutions to the issues aforementioned in a clear and concise way

SEA LEVEL PROJECTIONS



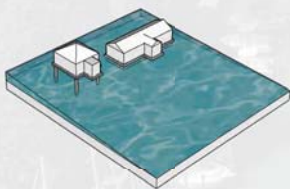
CONCERNS BY NEIGHBORHOOD



CONSTRAINTS

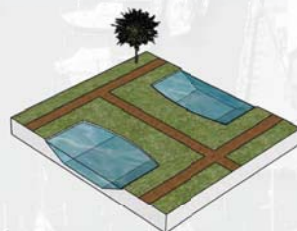
BUILDINGS

Sea level rise will have a significant impact on homes located in Oxford. In 2021, 22.7% of these homes are sitting at or below the 3.5 contour line. As sea level rises, all land below 3.5 ft will become inundated and homes will flood. Sustained water presence will surely cause structural damage, such as loose or buckling floors and roof or foundation cracks as well as electrical malfunctions. Flooding can also expose homeowners to contaminated water and dangerous mold.



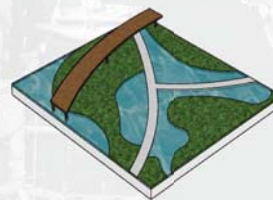
ROADS

Sea level rise will leave many of Oxford's roads inaccessible. Oxford Road, or the Causeway, is the main, and only road, leading in and out of Oxford. In 2021, at 3.5 ft sea level rise, this street will be completely inundated, cutting the town off from the rest of the county. This not only hinders traffic patterns, but can be dangerous and even life threatening for the residents of Oxford.



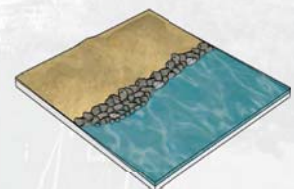
WETLANDS

Wetlands and tidal marshlands once occupied a significant portion of Oxford's lands. Now, they occupy only 2.5% of its total acreage. While the wetlands still exist, they are located mainly in the southern portion of town. In the north, where flooding is most severe, wetlands are virtually non-existent and instead replaced by impervious streets and a relatively dense housing scape. Unfortunately, wetlands are not without their own vulnerability. Salt water intrusion is threatening their wellbeing.



COASTLINE

Sea level rise will significantly change the shape of Oxford's coastline. Approximately xx% of land will be lost to rising waters. Currently, Oxford uses measures such as bulkheads, revetments, and some living shorelines to protect its coast, but this clearly is not enough to stop the severe flooding and impacts of storm surge the town experiences.



OPPORTUNITIES

Oxford residents have 2 main options when it comes to protecting their homes from sea level rise. They can either adapt, meaning live with the water, or they can retreat, meaning move to higher ground. Residents who do not wish to leave can take several measures to protect their homes. One such measure would be to raise the home to an elevation about 3.5 ft. Another would be to implement technology that would allow the home to float over water.

The threat to Oxford's roads gives the town an opportunity to reinvent their street pattern. A possible intervention for sea level rise is to create canal streets out of some of Oxford's vulnerable roads. The canals would mitigate sea-level rise by draining water into lower-lying levels. This would allow for the existing streets to continue to function and serve the neighborhood, while intertwined with the new canal system.

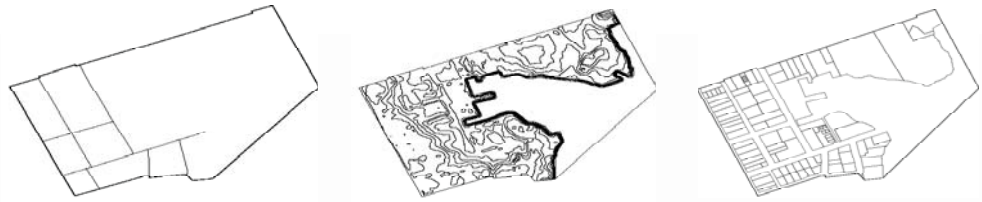
Wetlands are incredibly important fortifications against flooding and storm surge. Wetlands function as natural sponges that trap and slowly release surface water, rain, snowmelt, groundwater and flood waters. They act as buffers between the water and areas upslope. Preserving and restoring wetlands can often provide the level of flood control otherwise gained by expensive dredge operations and levees. Restoring wetlands, especially in Oxford's northern half will be key in mitigating flooding issues.

Next to the creation wetlands, the fortification of Oxford's coastline is a critical factor in preventing flooding and alleviating the impacts of storm surge. Aside from existing bulkheads, revetments, and some living shorelines, interventions can include riprap, living shorelines, breakwaters, and dune restoration. While these measures will not necessarily stop sea level rise, paired with wetlands, they will certainly help mitigate Oxford's flooding problems for years to come.

HISTORIC DISTRICT SITE PHOTOS



INVENTORY & ANALYSIS



USER NARRATIVES

RETIRED COUPLE
 We love the new marina in the historic district. We like to come here for walks in the mornings to see the sunrise or on warm evenings after a hot summer day. The new pier and outlook are wonderful for views of the water. We bump into all our friends at the pier and often end up chatting the night away. We love walking through the terraced garden that give us access to beach. We will often bring towels and beach chairs to sit on the sand and watch the boats come and go. We love to bring our family whenever they come to visit, our grandchildren just love running along the pier, jumping from the terraces and playing on the beach.

VISITING FAMILY
 Our family visits Oxford every summer and since the creation of the new marina, the town has become even more special. The site is a wonderful place to dock our boat for the day and spend time downtown. I love going for early morning runs on the pier. My wife is an ornithologist and has been so excited by all the birds the new design has brought to the town. She enjoys taking walks along the wetlands to see all the wildlife. My kids have loved the new beach addition. Its a great place for us to go to relax and to keep the kids entertained. We will definitely be telling all our friends about this new attraction.

DOG WALKERS
 Our dogs are a big part of our lives, so when we heard about the new marina, we knew that it would become our go to for daily walks. We love that our trip to the pier takes us through a walk through nature. We are so mesmerized by the new wildlife we've been seeing, and so have our dogs. The beach has become a wonderful place for them to run around and play while we relax. We've also noticed a huge decrease in flooding around our house. Water no longer stagnates on our street and high tide is no longer an issue from the side of the marina. What a great innovation!

CHILDREN
 We love visiting our grandparents in Oxford. Their new floating house is so cool! We tell all our friends that we get to live on the water for the whole summer. They live right next to the pier so we spend the whole day outside playing. The beach is definitely our favorite part. We also love waving to all the watermen who stop by the docks. Sometimes grandpa will take us to the overlook at the end of the pier and we feel like we can see the whole world from up there! Grandma and grandpa also say they're so happy that they don't have to worry about their home flooding like people used to before.

ROADS

47%
 INACCESSIBLE

47% of the roads in this scope will be under water with 3.5 ft sea level rise. Road lengths will decrease from 3513 ft to just 1653 ft, summed up. Bank St, Market St. and Wilson St. will be most heavily affected.

LANDMASS

50%
 CONSUMED

The coastline in this scope will increase by 50% with 3.5 ft sea level rise. The length will go from 3562' to 5351 ft. The area in this scope will also decrease by 50% from 20 acres to just 10 acres.

BUILDINGS

27%
 UNINHABITABLE

27% of buildings in this scope will be under water with 3.5 ft sea level rise. Currently there are 75 buildings standing in this area of study. 20 of these buildings are either fully or partially at or below a 3.5 ft elevation

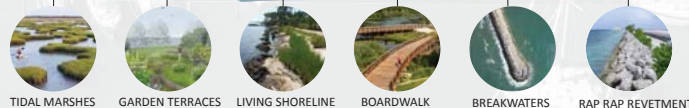
ISSUES

- Frequent and severe flooding due to **low elevation**
- Severe **pluvial flooding**
- Low points act as natural collection **basin** for stormwater
- Portions of waterfront serve as a natural channel for stormwater entry during **high tides**
- Destruction of vegetation due to **salt water intrusion**

GOALS

- Immortalize Oxford as a coastal town on the cutting edge of climate change intervention by conceiving a new and innovative harbor in Oxford's north district, while maintaining its vibrant historic legacy
- Bring back tidal marshlands that once occupied Oxford's land. Restore these wetlands to retain natural flood control that would otherwise require dredging and levees
- Address sea level rise by providing fortification for the vulnerable areas where elevation is low and severe flooding occurs, particularly Bank St, Market St. and Wilson St.

A NEW PERSPECTIVE



HISTORIC HARBOR MARINA IN 2100 SITE PLAN



PRECEDENT IMAGES



LIFE IN 2100



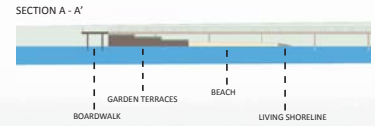
BREAKWATER OUTLOOK



FLOATING COMMUNITY



BEACH VIEW



GARDEN TERRACES

The terraces provide shoreline protection by slowing wave activity in open water to combat coastal erosion. They will also be planted with vegetation for both erosion mitigation and to promote biodiversity.

TIDAL MARSHES

Coastal wetlands are able to absorb wave energy during storms or tide cycles. They reduce the potential for erosion and mitigate the impacts of coastal flooding by reducing wave heights. Marshes trap sediments from tidal waters, allowing them to grow in elevation as sea level rises.

BOARDWALK

Boardwalks will allow for movement, transportation, and recreation. They will give people access to parts of town inaccessible due to sea level rise.

RAP RAP REVETMENT

Rock riprap protects soil from erosion due to concentrated runoff. It is used to stabilize slopes that are unstable due to seepage. It is also used to slow the velocity of concentrated runoff which in turn increases the potential for infiltration.

BREAKWATERS

A breakwater is an offshore shore-parallel structure that "breaks" waves, reducing the wave energy reaching the beach and fostering sediment accretion between the beach and the breakwater.

LIVING SHORELINE

Living shorelines use native vegetation alone or in combination with low sills to stabilize the shoreline. They provide a numerous benefits including nutrient pollution remediation, essential fish habitat structure, and buffering of shorelines from waves.

Introduction

Oxford is small town located on the Eastern Shore of the Chesapeake Bay in Maryland. It was founded in 1683. The town is a tourist attraction and historic fishing/boating town. The town has been experiencing sea level rise, storm surge and flooding but more often in the recent years due to Climate Change. The population is mostly retirees, wealthy and small working class. The economy of Oxford still depends on the access to water.

Location



Goal

"The goal is to propose a design that will help sustain the town of Oxford into the year 2100. Such design should tackle natural disturbances that the town faces: **3.5 feet sea-level rise, pluvial flooding and storm surge.**"

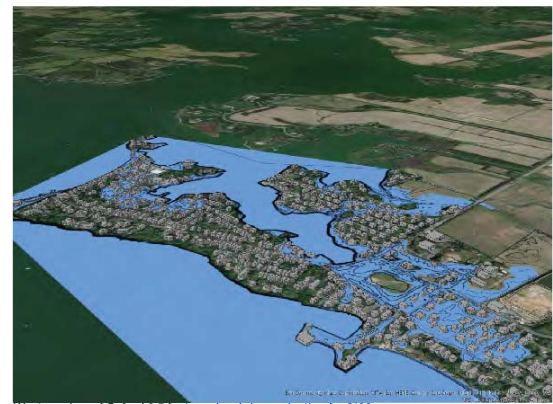
Issues

- **Sea Level Rise** An increase in the world's oceans level due to global warming effects. Caused by melting glaciers and expanding warm seawater.
- **Pluvial Flooding** Occurs when precipitation intensity exceeds the capacity of natural and engineered drainage systems.
- **Storm Surge** Storm surge is an abnormal rise of water generated by a storm, over and above the predicted astronomical tides

Solutions

- Elevate structures in parts of the town most prone to damage
- Elevate bulkheads/docks
- Line bulkheads with gabions or rocks
- Add wave breakers around perimeter of Oxford
- Use durable materials for bulkheads
- Incorporate marshes
- Pervious surfaces for parking lots and streets
- Underground water conveyance system
- Incorporate swales and berms

Site Inventory and Analysis



Flood Risk Areas

- Medium Risk
- High Risk
- ⌈ Focus Area
- Boundary

The majority of Oxford's land area experiences flooding. However, most flooding and damage occurs along Banks St and Causway Park.

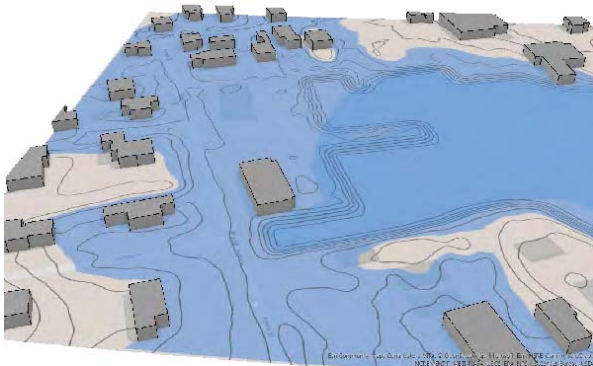
Local Roads and State Route

- Local Roads
- State Highway 333

Oxford has one major highway (State Highway 333) that leads to the entrance and the rest are local roads

Source: RoadsMaryland.gov

Focus Area: Banks Street



Aerial images of Banks Street and marina showing 3.5 ft sea-level rise. Majority of homes in and around area will be inundated. Produced from GIS data.

Current Images



- A: water damaged wooden dock
- B: low, worn, damaged bulkhead, water level close to surface and street, no barriers



- C: flat surface level, no passage for runoff/floodwater
- D: one major drainage system, old, needs updated
- E: flooded marina, high sea-level (compare to A)
- E: flooded Banks St, drainage system (D) flooded

Inventory

- Area will be under water by 2100 due to 3.5ft sea-level rise
- Marina and residential area
- Bordered by the Tred Avon River
- Low surface area
- Frequently flooded due to storm surge in blue

Analysis

- Opportunities to elevate land and infrastructures
- Area needs better storm drainage for pluvial flooding
- Convert marina into flood/sea-level rise proof area
- Implementation of barriers for storm surge i.e wave breakers, berms
- Potential to be recreational area constructed of durable materials

Precedents



Aquaview Glass Pool Fences & Railings
Miami, FL



Wave-breakers
Zona de Banyes del Fòrum, Barcelona



Seattle Public Utilities
Seattle, Washington



Aquaview Glass Pool Fences & Railings
Long Island, NY

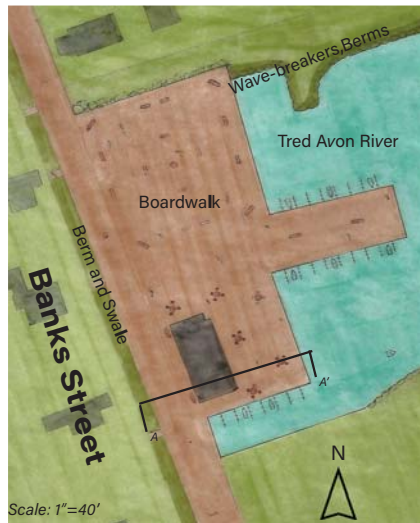


Berm
Total Landscape Care



Pier 60 Park
Florida

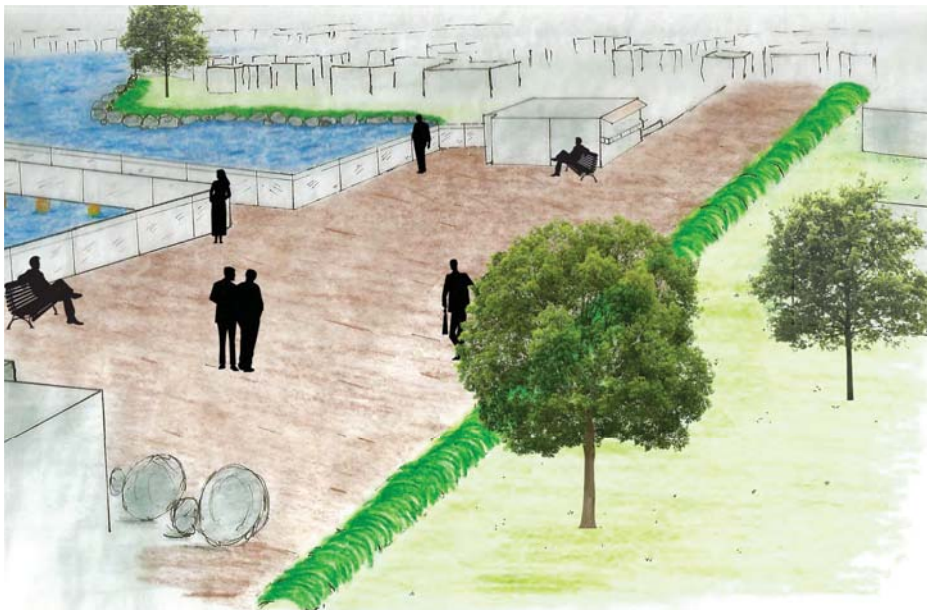
View To A Safe Harbor



Concept and sketched illustration of proposed design for Banks St.

Design proposes area to be converted to a boardwalk with existing docked boats.

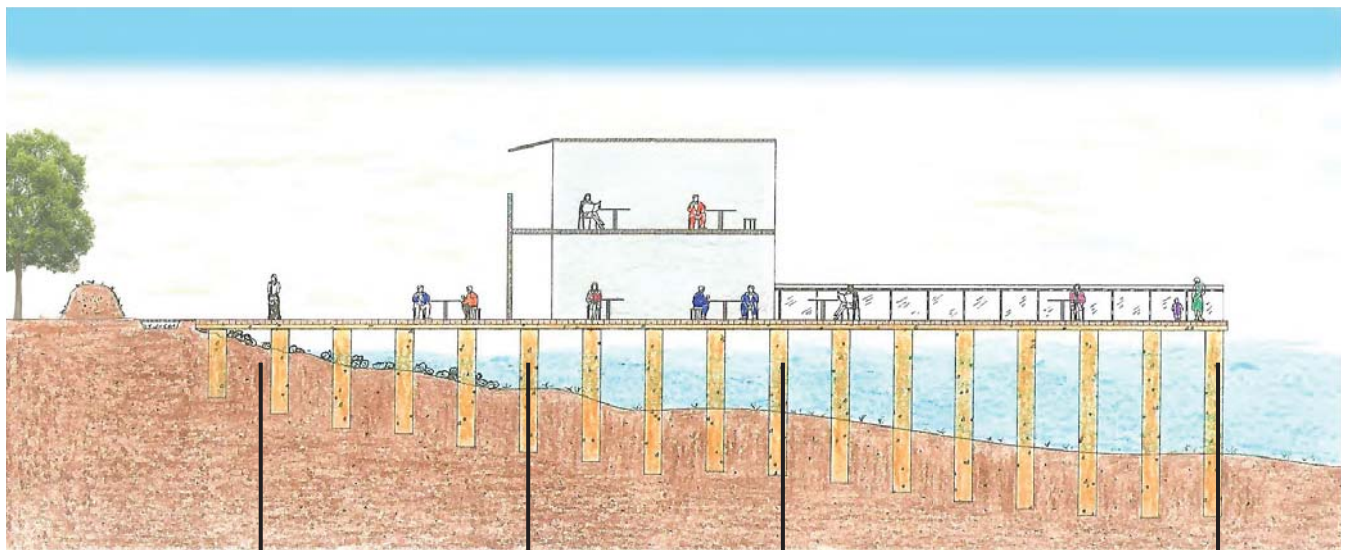
Area will have a restaurant, seating/gathering space, glass wall, shoreline bordered with wave breakers, and residential area bordered with berms and swales.



Sketched perspective of proposed design. Boardwalk contains tempered glass wall for sea-level rise but allows visibility for visitors.

Narrations

- Nadia: I come here with my grandchildren. I love looking at the boats and I do not worry about them falling into the water.
- Carl: My friends and I eat at the restaurant every weekend. I can walk here from my home.
- Steve: My backyard does not get flooded so often anymore.
- Beth: This is a quant town. I enjoy the boardwalk.



Berm and Swale

Restuarant

Tempered Glass

Section illustration of proposed boardwalk and glass wall.

