

An aerial photograph of a residential neighborhood with a river. The houses are outlined in white. A road runs horizontally across the middle. The river is at the bottom. There are several areas with black dots, indicating flood zones or water levels. The title 'RISING WITH THE WATER' is overlaid in large white letters, with the word 'WATER' having a green-to-yellow gradient.

# RISING WITH THE WATER

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MLA CANDIDATE 2015  
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A thesis submitted in partial fulfillment of the requirements for the Master of Landscape Architecture Degree in the Department of Landscape Architecture of the Rhode Island School of Design, Providence, Rhode Island.

By Xi Yang  
May 12, 2015

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# Overview

Under predictions of sea level rise in the next hundred years, this thesis looks at South Boston as an experiment for coastal community development in response to the rising water. South Boston shares issues facing many other coastal communities, including potential risk of flooding and adaptive beach occupations. This body of work primarily investigates innovative strategies to work with the rising water and form sand dunes that will protect the neighborhood from daily floods in 2100, continue providing secure access to the beach, and encourage new public engagements at the waterfront.

Phase 1 mainly looks at the scenario of South Boston becoming an isolated island in 2100. The research looks into what will threaten its survival and identifies the potential loss of key infrastructures and open spaces as the critical issues to investigate. It becomes clear that the current periphery will no longer function or even exist in 2100 and that a new paradigm is urgently needed to alter the conversation between urban fabrics and the water. Thus the initial proposal aims at understanding dynamics of the changes between now and then, and developing an adaptive strategy to create an evolving network of transportation, economics, and ecology. Phase 1 also explores the specific edge conditions of the north and south waterfront in preparation for further investigation.

Phase 2 mainly looks at the south site and how sea level rise impacts the immediate neighborhood. The study of South Boston’s history of land-filling and other precedents reveals great opportunities for new typologies of adaptive sand-building. Then the research turns to detailed analysis of tidal fluctuations in the Old Harbor and sandy beach formations. Based on the

findings, the investigation proposes that the community works with the rising sea level to form an adaptive and evolving periphery that continues to protect the neighborhood and creates new public engagements with the water. The intervention is mainly about triggering an evolution of self-building beaches, sand dunes, and wetlands as a buffer between the rising water and the South Boston community.

Phase 3 first zooms out to reexamine the regional network of streets, infrastructures, open spaces, and water edges. It proposes that the south periphery act as a buffer between the rising water and the neighborhood, with layered systems of natural habitat, sand dunes, bike paths, pedestrian boardwalks, a ferry port, and other public infrastructures. A more precise study of how sand accumulates over time reveals critical sections for sand-building at each stage. The hourly tidal change and study of muddy flat habitats greatly informs where people will have access to the ground/water and where they will need to stay on the protected structures in 2100. Finally, to trigger the self-building process of sand dunes, a new type of sand fence is designed to both accumulate sand and generate a framework within which new activities can happen on the beach. The new beach will not only protecting the neighborhood but also change residents’ behavior towards water. By engaging the community in ways other than mere protection, the fences become a cultural component of residents’ daily life, which represents stewardship of water, nature, and ongoing life.

# Site

South Boston is a unique neighborhood in the Boston area with a rich history of land-filling. The northern part of this area features a man-made channel and some of the key infrastructures supporting this thriving community. The southern part mainly consists of residential blocks with a band of sandy beach surrounding the Old Harbor. With projected sea level rise in the next hundred years, a large amount of lower land faces the risk of being flooded daily at high tide. This thesis mainly investigates the southern beach and its potential for forming sand dunes that protects the residential neighborhoods from daily inundation. The proposal also challenges the current use of the beach and anticipates more adaptive and protective occupation of future water edges.



South Boston: View from East

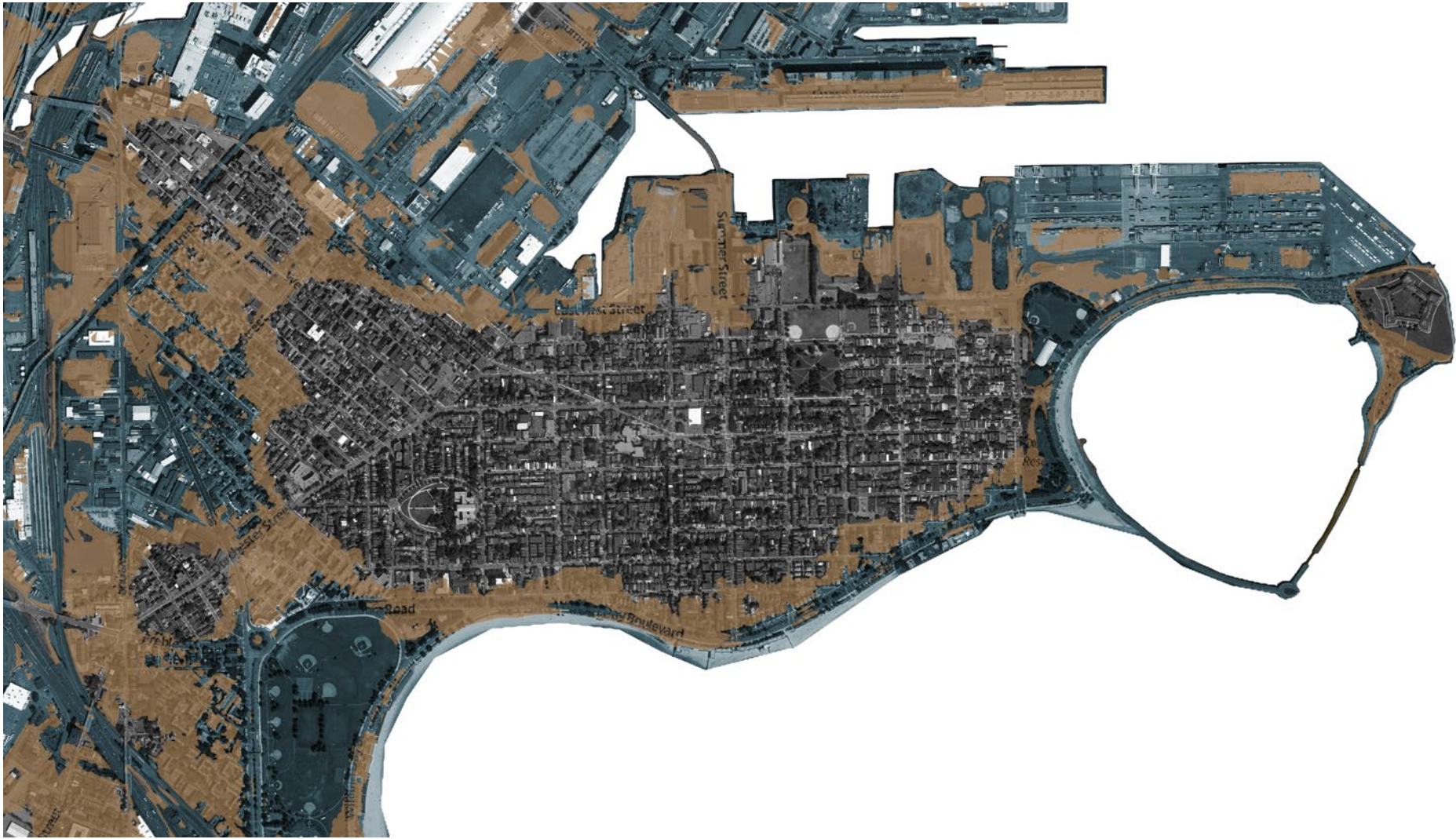


South Boston: 2100 High Tide



2100 Mean High Tide = 16'  
2100 Mean High Tide + Storm = 21'

South Boston: 2100 Mean High Tide + Major Storm







# Phase 1

South Boston — *the “Lucky” Neighborhood?*



# Abstract

This body of research explores the potential changes in street network and neighborhood due to climate change and rising sea levels in South Boston. In this phase, the investigation poses the question of what the South Boston neighborhood might become in 2100 and looks into what challenges could threaten its survival. The study has shown that the neighborhood will very likely become an island like it once was, isolated from the rest of Boston both physically and socially. Under this premise, comparisons in sectional drawings are then made to understand how north and south edges of the neighborhood will physically react to sea level rise. It is clear that the current periphery will no longer function or even exist in the 2100 scenario and that a new paradigm is urgently needed to alter the conversation between urban fabrics and the water. The objective is to understand dynamics of the changes between now and then, and to develop adaptive strategies to create an overlap of networks in transportation, economics, and ecology within the nuanced cultures of South Boston.



Composite of 2100 Flooding Scenario

# Introduction

Phase 1 aims at understanding what South Boston will be facing in the big picture of 2100. The research looks at a number of risk factors — including food, power, transportation, freshwater, and open space — and determines that the community will be deprived most of its support from the greater Boston area. Part of the proposed solution is to look at reorganizing the community’s social structure and building new connections.

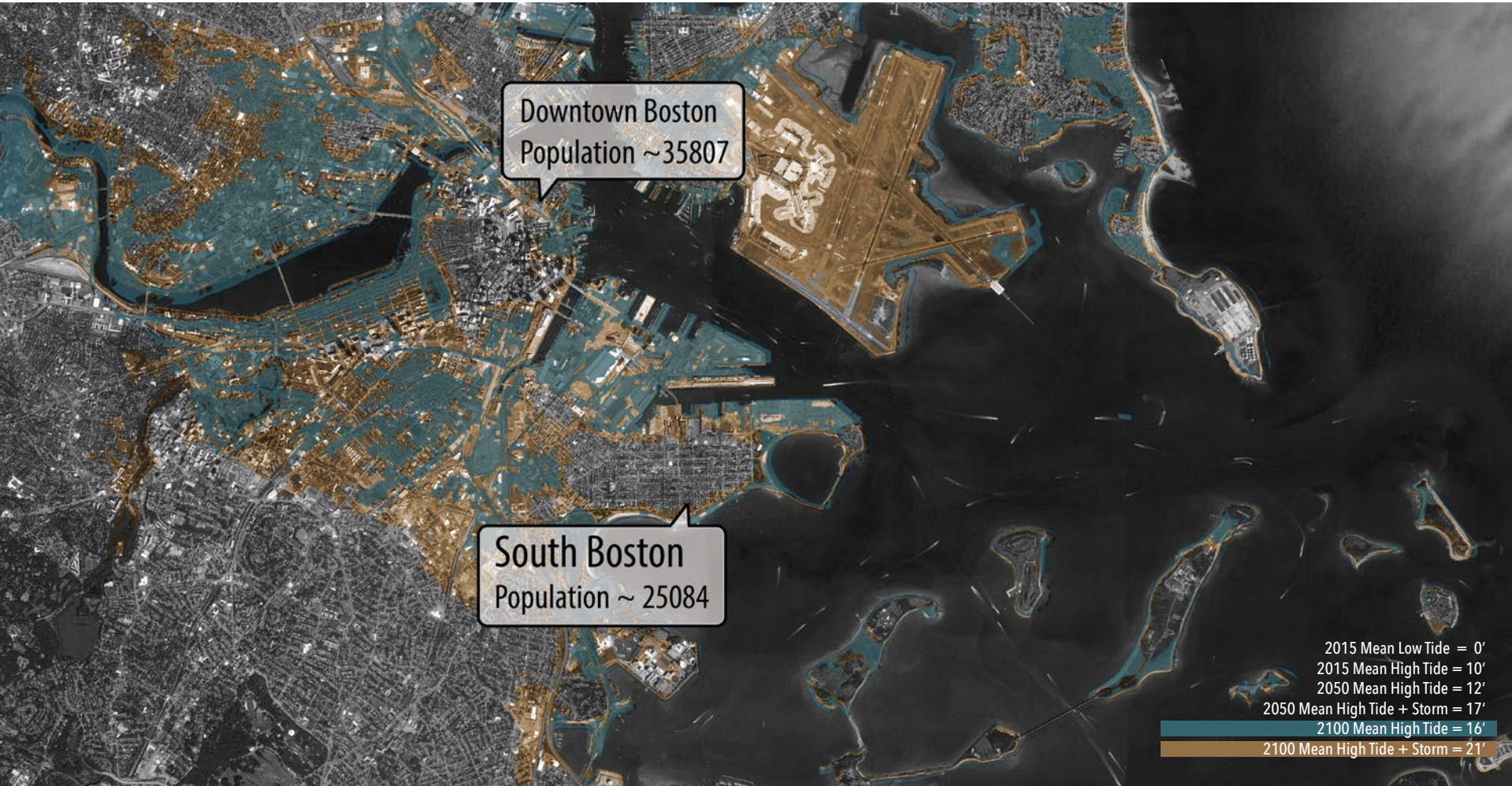
In this scenario, where street fabric meets water becomes the crucial component of the new periphery. The concurrence of tidal fluctuations, subsistence, economy, and transportation will bring these places to the center of daily life. Thus, the study seeks to develop new typologies to initiate incremental changes necessary for adapting between now and then.

# Methods

1. Analyze sea level rise implications on peripheries of South Boston in plans, sections and modeling.
2. Map endangered infrastructures of South Boston in 2100 (focusting on transportation and open space).
3. Diagram potential new water routes and critical water edges in the new periphery.
4. Diagram proposed overlay of systems and possible typologies.



2100: South Boston as an *Island*



With rising sea levels and increasing probabilities of storm hazards, the peripheries of Boston will keep changing drastically, eventually isolating downtown Boston and the South Boston community. Luckily, it seems that the majority of the South Boston neighborhood will survive the flooding. However, with connections to the larger city cut from almost all sides, is it really luck or misfortune?



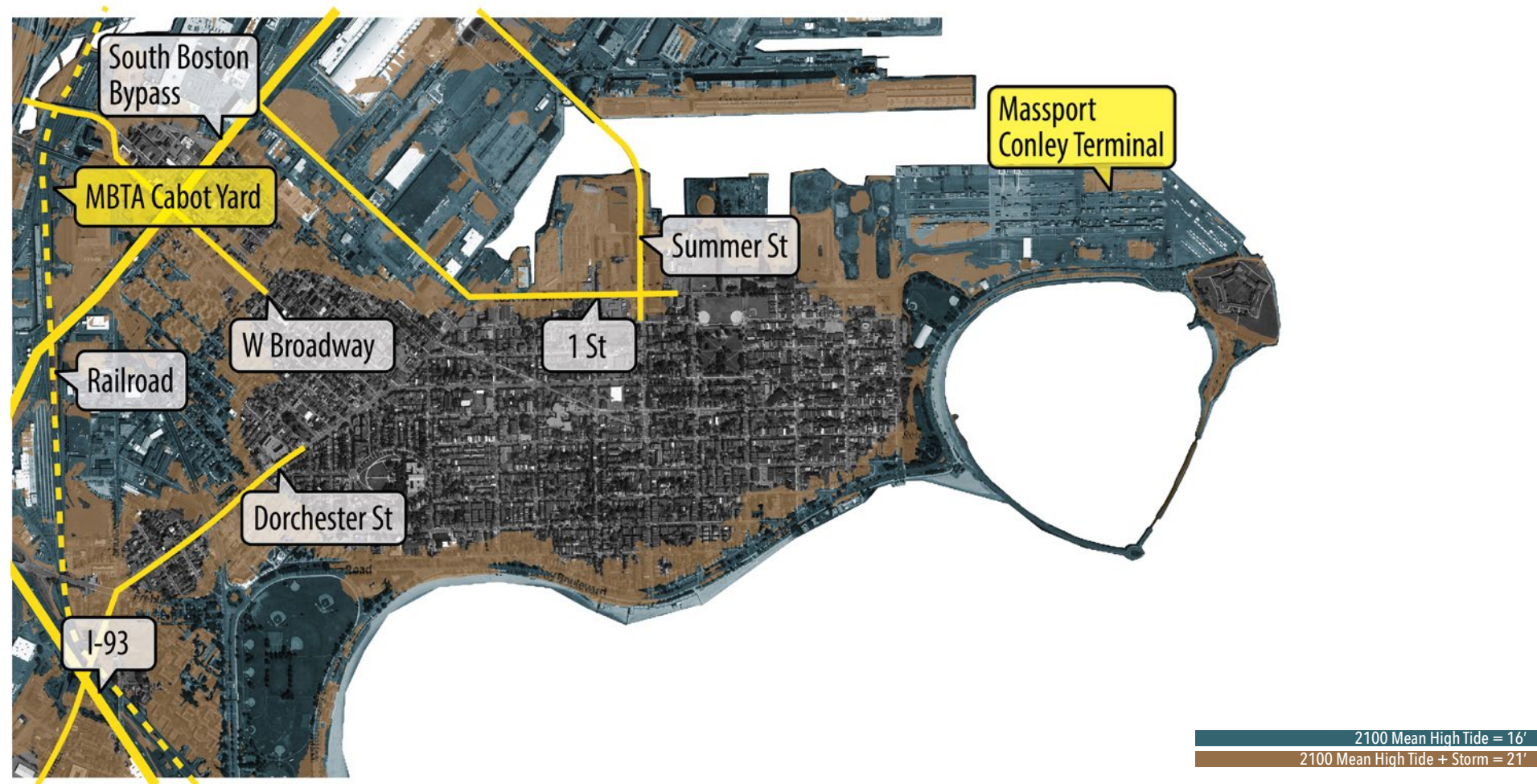
Boston Land Fill History Map  
Source: Krieger, Alex. Mapping Boston. Cambridge, Mass.: [MIT Press], 1999.

Until the last few hundred years of land-filling, Boston has been a series of islands with a periphery very similar to the one projected in 2100. What is history trying to reveal? Will South Boston go back to being an island that depends on maritime and farming? How is the community going to survive?



Model of the Submerged Boston

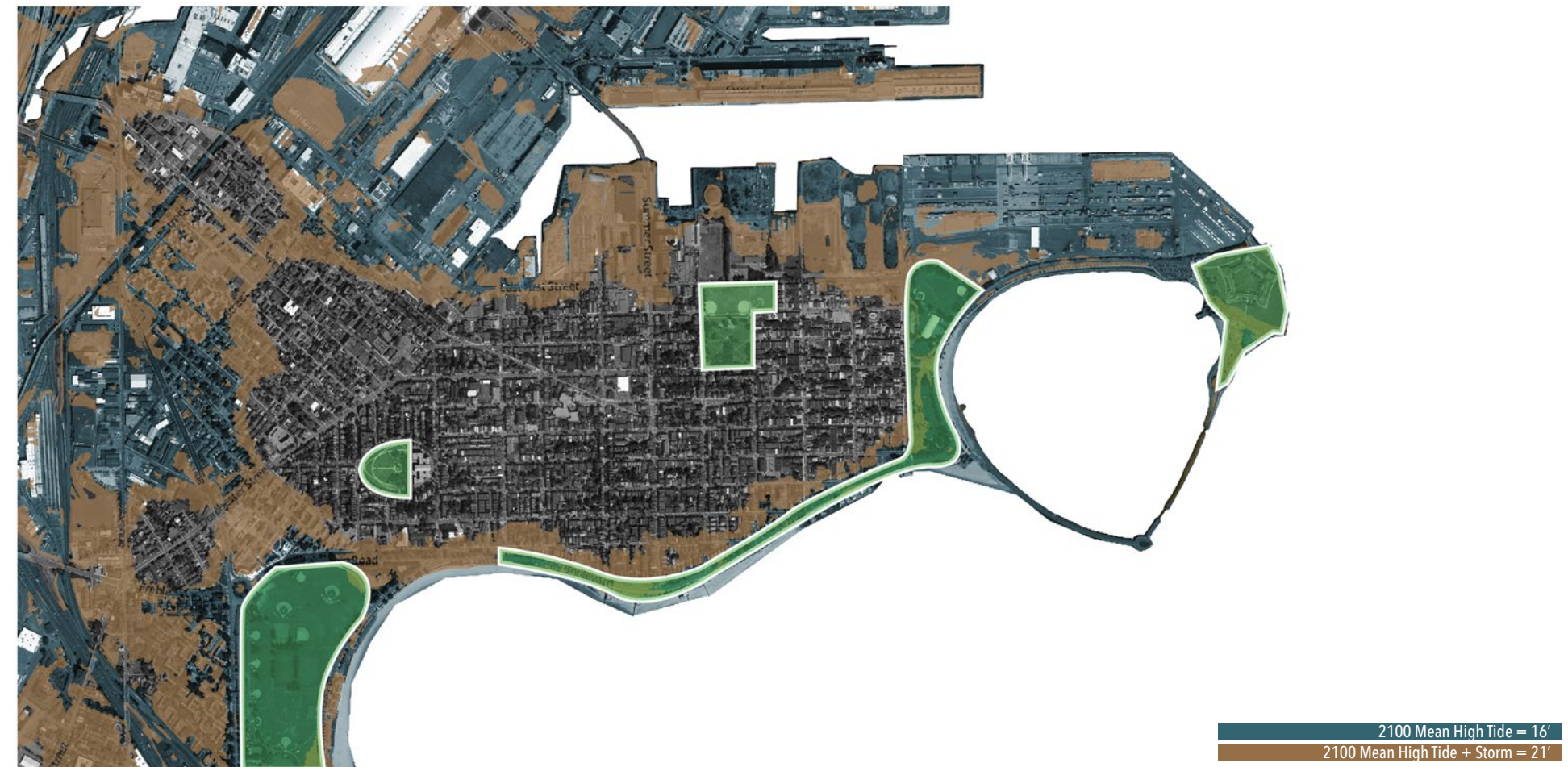




### Transportation Vulnerability in 2100 \_ *Commodities, Communication?*

In 2100, major roads such as Dorchester St. and Summer St. will be flooded daily.

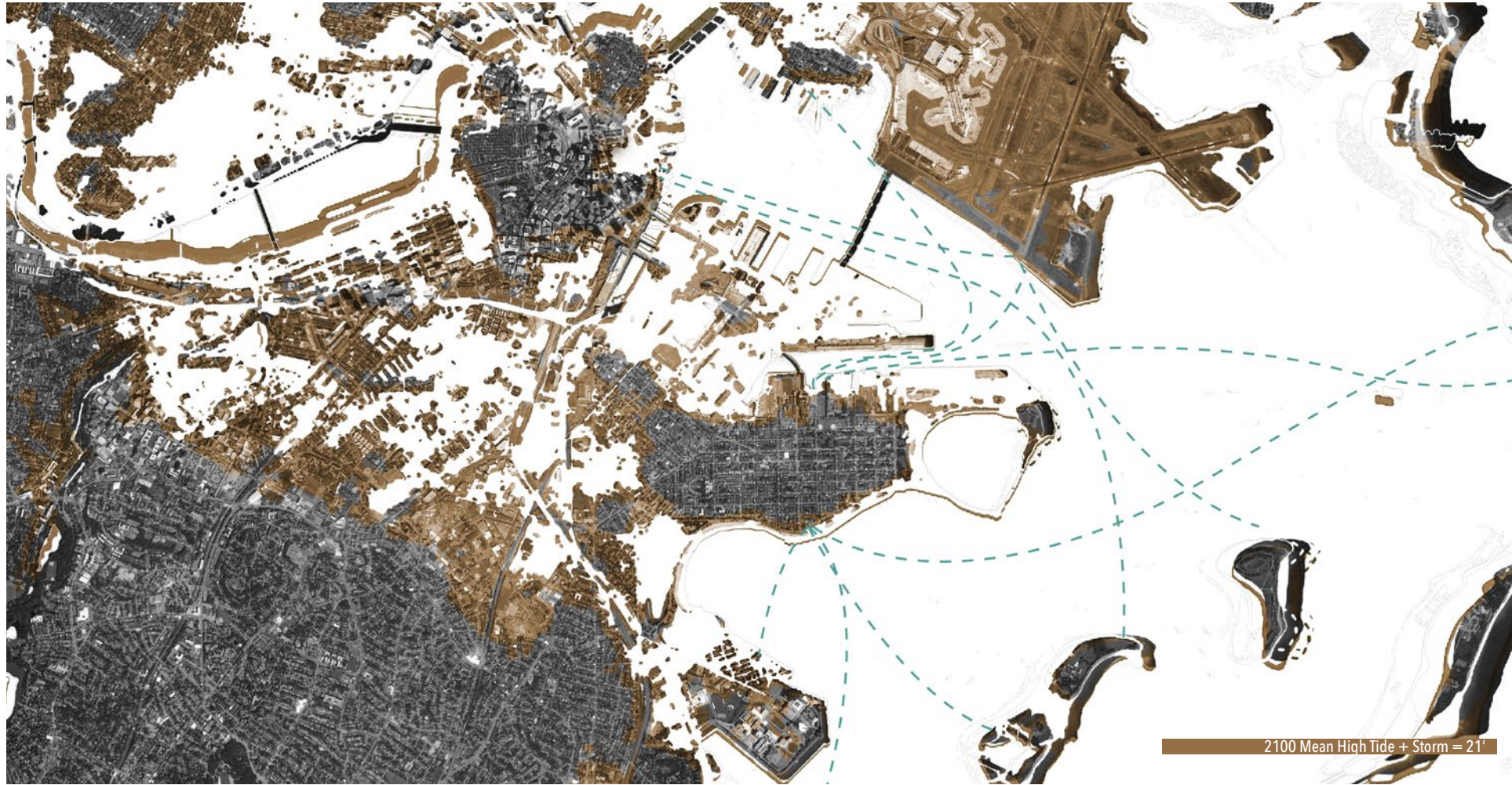
During a major storm surge in 2100, significant shipping infrastructures such as Conley Terminal and MBTA Cabot Yard will be flooded.



### Open Space Vulnerability in 2100 \_ *Gathering, Evacuation?*

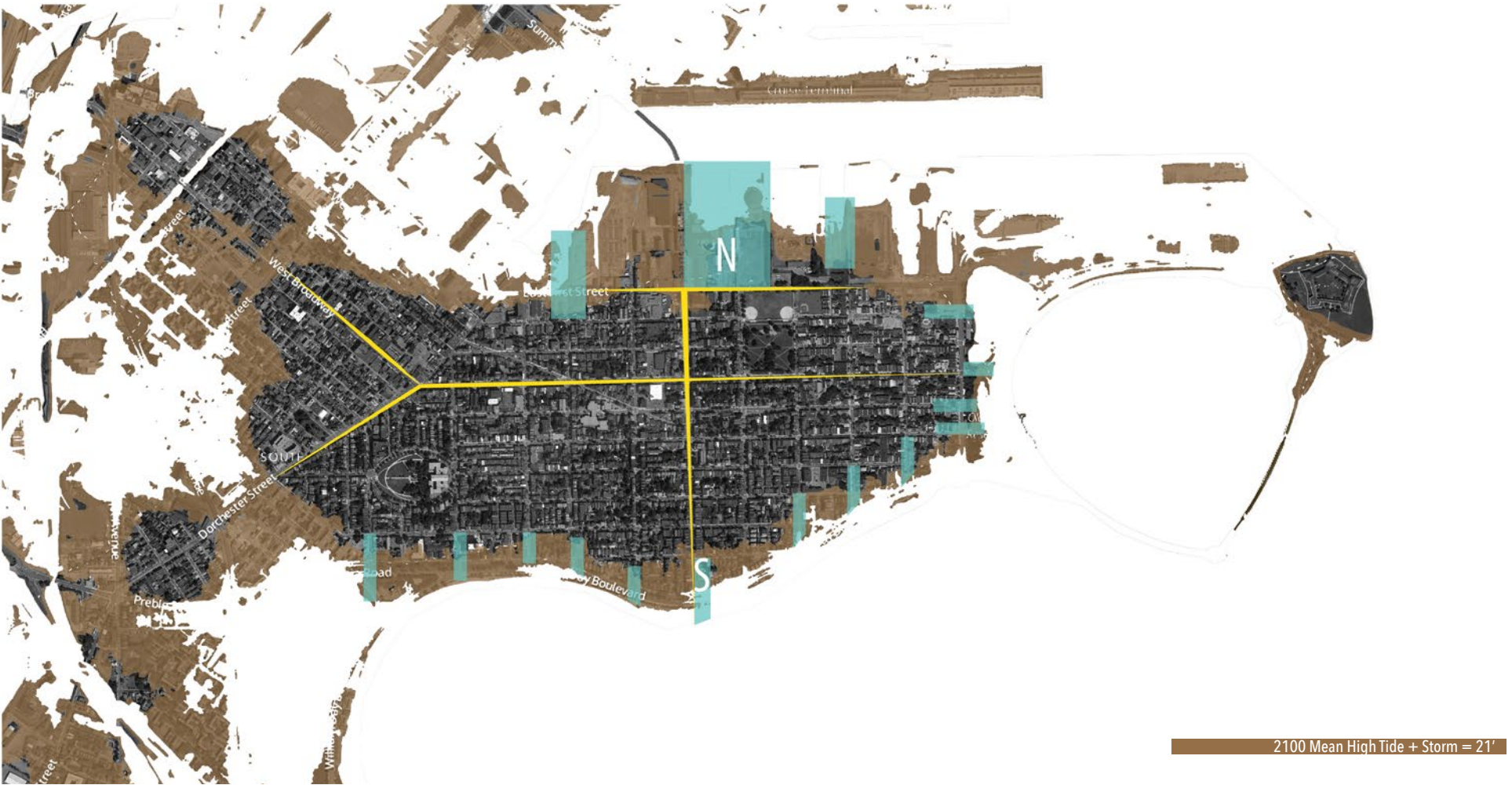
Because of their vicinity with the harbor, Pleasure Bay and the south beach will be flooded daily in 2100, meaning the neighborhood's interface with the water will be completely different. The remaining open spaces will be on higher grounds.





### 2100: Potential New Water Routes

In a case of history repeating itself, South Boston will likely return to dependance on water transportation to connect with the outer world.

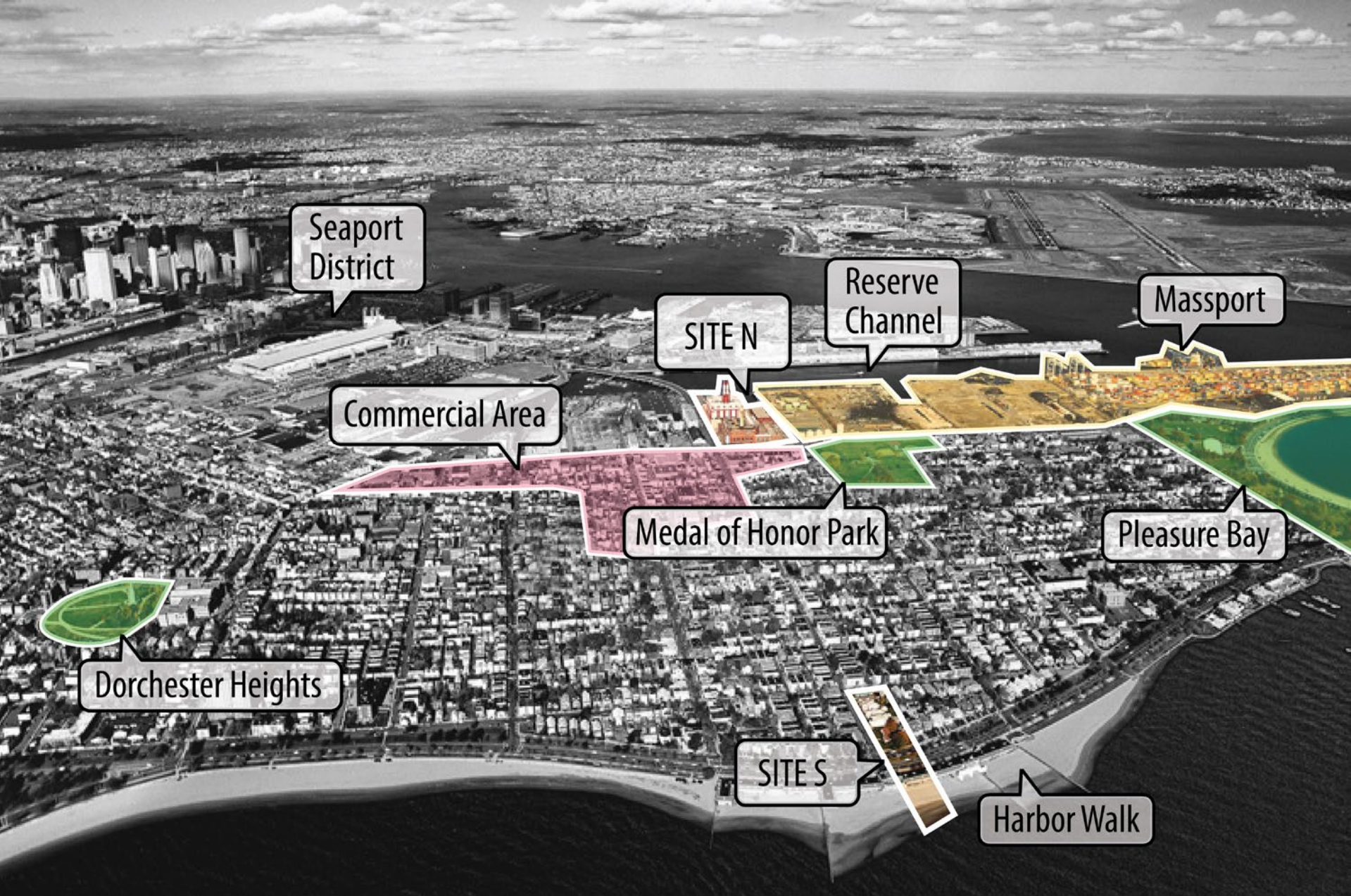


### 2100: South Boston Periphery and Potential Docks

When the new periphery forms, its intersections with the street network become critical for exploring potential extensions and combinations.

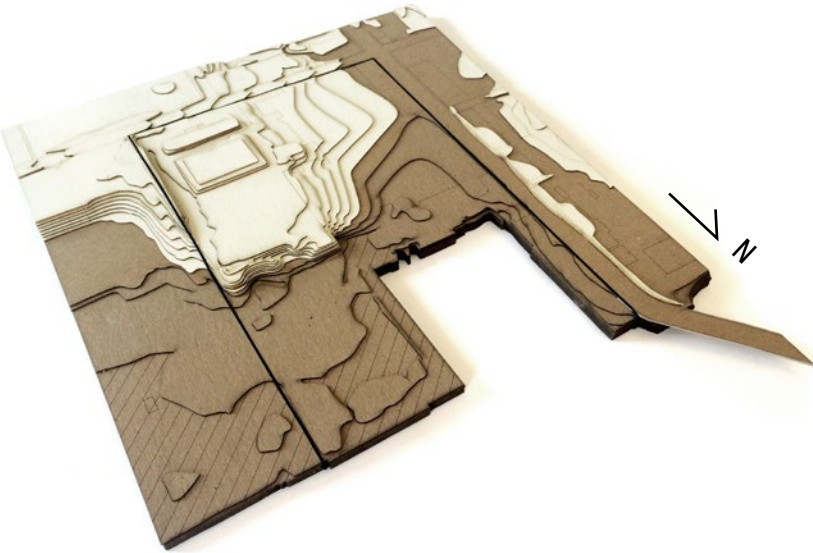


Site Selection, Analysis, and Proposals



Model of Site N

Site N sits on the edge of Curley Terminal and consists of the New Boston Generating Station (oil power plant). The northern part of South Boston is mostly industrial, commercial, and maritime.



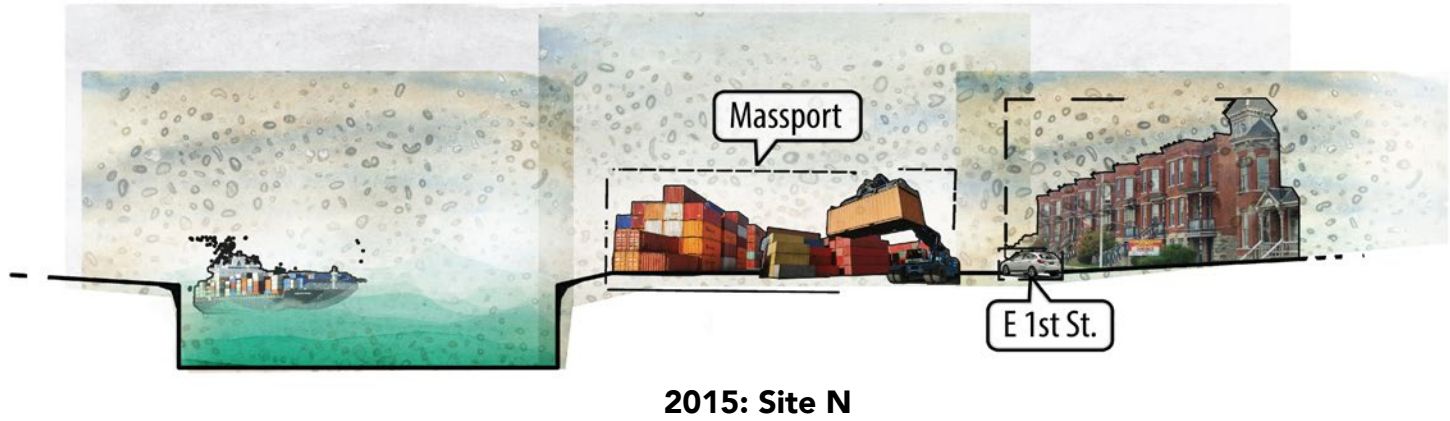
Model of Site S

Site S sits within the typical residential neighborhood of South Boston. It goes through the Curley Community Center, which includes a section of the south beach.

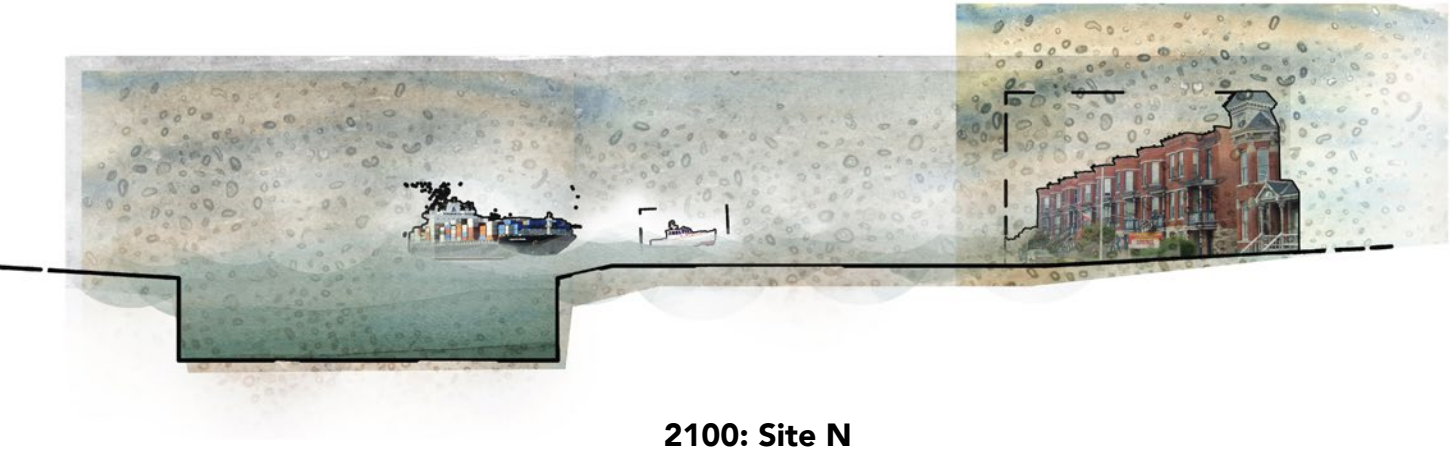




A Section through South Boston: *North vs. South*



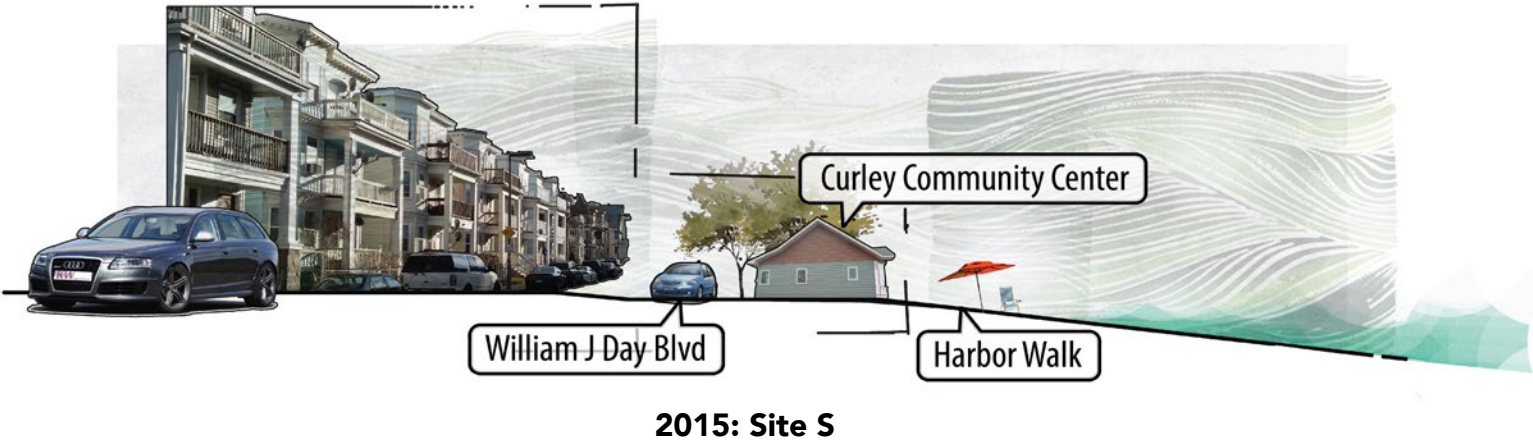
2015: Site N



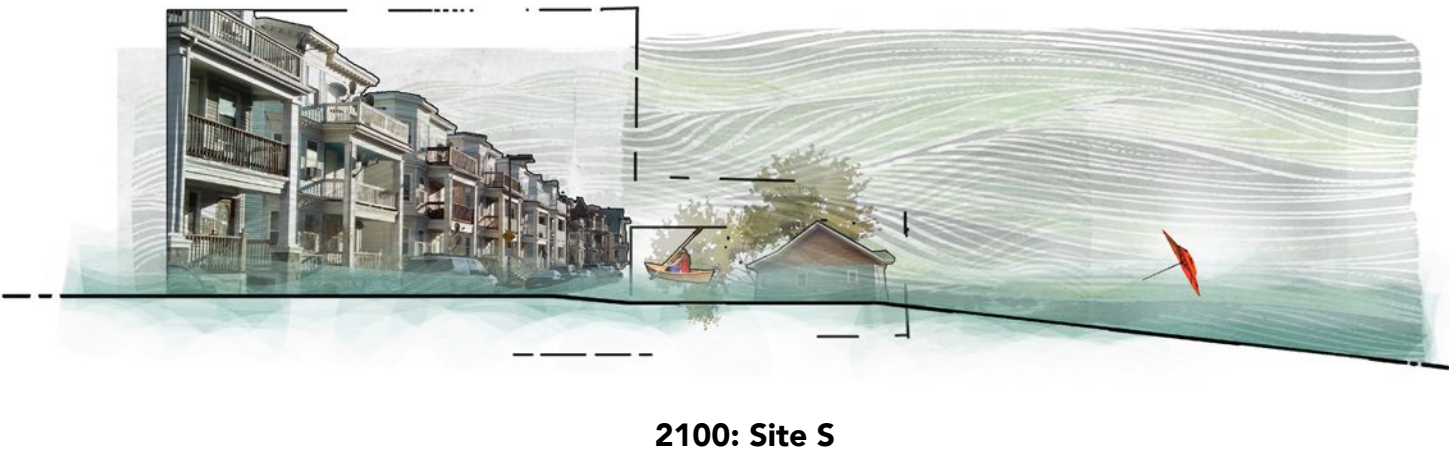
2100: Site N

2015: The northern part of South Boston is largely occupied by Massport and other industrial/commercial buildings. The man-made channel facilitates the \$4.6 billion per year business.

2100: Because of the nature of Reserve Channel's hard edges and Massport's impervious surfaces, when water comes in there will be very little flexibility for absorbance.



2015: Site S

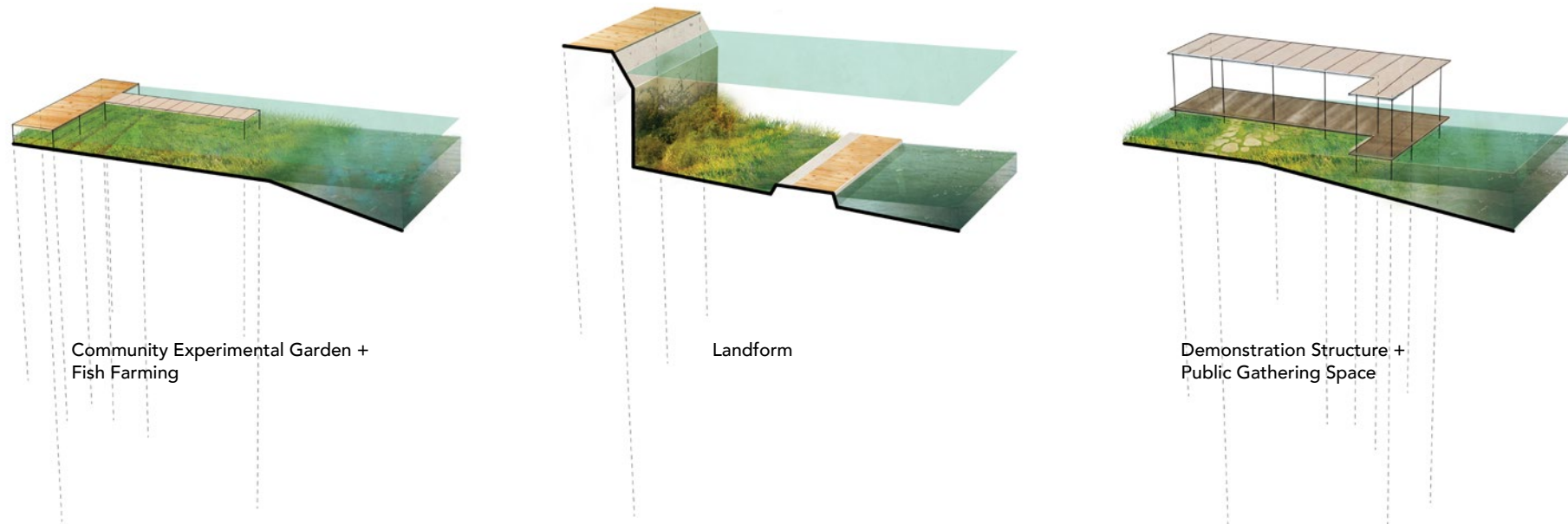


2100: Site S

2015: Currently, the south beach is a big attraction for young families to move in to the neighborhood. It's a pleasing place for interaction with water.

2100: When the sea level rises ,the water will destroy Curley Community Center and go straight into the closest neighborhood. A critical component of further studies will be to protect the community from such direct impact.

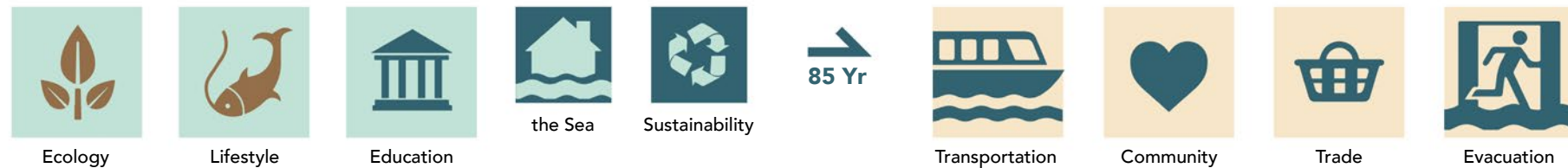




## Possible Programs: *Now vs. Then*

The investigation reveals an opportunity for the intersection of street network and the changing periphery. This is a quick proposal of possible strategies of providing sustainable living, public space for gathering and trades, transportation and evacuation, erosive and depositional landforms, and most importantly, how to tie all the elements together with the urban fabric.

Based on these findings and proposals, Phase 2 will seek to test the possibility of planting a seed of an evolving edge typology that allows functional uses now and incrementally changes to a new shoreline in 2100.



## Feedback from Nick DePace (secondary advisor)

The challenge here is to articulate your “stance” or position on the topic of sea level rise vis-a-vis the course of action that you have chosen. You are inherently taking on the responsibility of sea level rise, through taking “action” or “inaction”, right?

Is it Lucky to be isolated or a misfortune? I would say a mix of both — but you need to be able to articulate each.

The issues surrounding sea level rise are daunting and intimidating for everyone. I think another way for you to look at the challenges of thesis is not in providing “solutions” to a particular problem with so many facets but to try to understand the questions inherent your proposal. (What’s at stake?) Trust me when I say that no one has absolute solutions to sea level rise. How might you use a hypothetical model (the context and the situation you have discovered in South Boston) to test your initial assumptions and allow for discoveries and further questioning to strengthen your stance?

Permitting for “isolation” of the land form and erosion of the shoreline while extending, strengthening and evolving the street network from a terrestrial system (cars, roads, trucks, walking, etc.) into an aquatic/maritime one is a very strong position to take, but one with consequences. Given those consequences, can you name or articulate the net positive and net negatives for the strategies you have chosen? I think that might be a good goal for the conclusion of thesis. Based on the urban transect you have chosen of South Boston (North point connecting to South point) it is clear that the viability of an island community may rest between life (homes/services/societies, etc.)

and industry (production/trade/economy) through modes of transportation, specifically where water meets land and how the imposed street grid reconciles with the changing shoreline. I don’t think this is new for South Boston, (see historic maps), but you are proposing how to account for it from this point forward.

In current South Boston, the north most edges are heavy industry, shipping and energy manufacturing with deep-cut hard edges between land and water, sea walls, dry-docks, etc. While the southernmost edges are south facing, residential and the street grid currently terminates at a gradually sloped recreational edge, beach, tree-lined boulevard, etc. Why would this living dynamic change by 2100? Is there something already broken about this, and what is worth preserving? If so, how would these edges change on account of natural and anthropogenic factors?

The nature of the north and south edges currently signify and service very different ideas. How might they change? If you permit for isolation and erosion, how will this urban transect change? Can you draw an sectional transect across the island to show how erosion and sea level rise can positively transform the land-form under your design guidance to strengthen your position for the isolation of South Boston? That’s how you can take on the larger question of the responsibility of dealing with sea level rise.

You should remember to reference the large-scale issue of the island, even as you work into detail for the next phase.



For the next phase, as you have proposed, the South site is an extension and strengthening the street/wharf/jetty, etc. while permitting for erosive and depositional characteristics to inform the periphery. But remember to take into consideration the other factors, namely that it is a dense residential area that meets the water. The prevailing wind (for example, the current tree-lined boulevard and front-line of buildings reduce wind impact on the neighborhood) the sun's exposure, and how buildings, as well as biota-habitat, depend greatly on its nourishment.

I wonder how your research can look at restoring an ecology from the past as a way of anticipating the future. What sort of aquatic foraging and farming existed here before nineteenth- and twentieth-century development as a self-sustaining system? Is this the Luck you are referring to? How much of this place would need to depopulate to regain an equilibrium with nature that is mutually beneficial?

It is clear that some homes will be evacuated and destroyed, but you need to structure the reasoning for what happens incrementally in the next 75 – 100 years to preserve the “community.” Does the behavior and regulations (code) dictating residential buildings change? Which strategies in construction are retreating, and which are durable? Is this the same dynamic between land form and “street”?

If human living in this area becomes untenable, then it is no longer a community. Ultimately you are proposing a community that will need to act differently with its progressively transforming environment, and that can be a positive

transformation, one would hope.

The images/drawing/maps/photos you produce say a lot about your strategies and position. How might time-based drawings help us understand the transformed nature of South Boston as it becomes more and more isolated?

END 03/05/15

## Findings + Conclusions

Phase 1 investigation mainly shows that under the projected sea level rise, the edges of South Boston have a high risk of being submerged and turning the community into an isolated island. Because of the Massport Conley Terminal's and Curley Community Center's vicinity with water on both the north and south edge, and hence the potential to be flooded fairly easily, there will be a huge change on the water interface in 2100. That will lead to major loss of maritime facilities and most of the community's current open spaces. Great proportions of the current transportation, economy, and social network will be jeopardized under such scenarios.

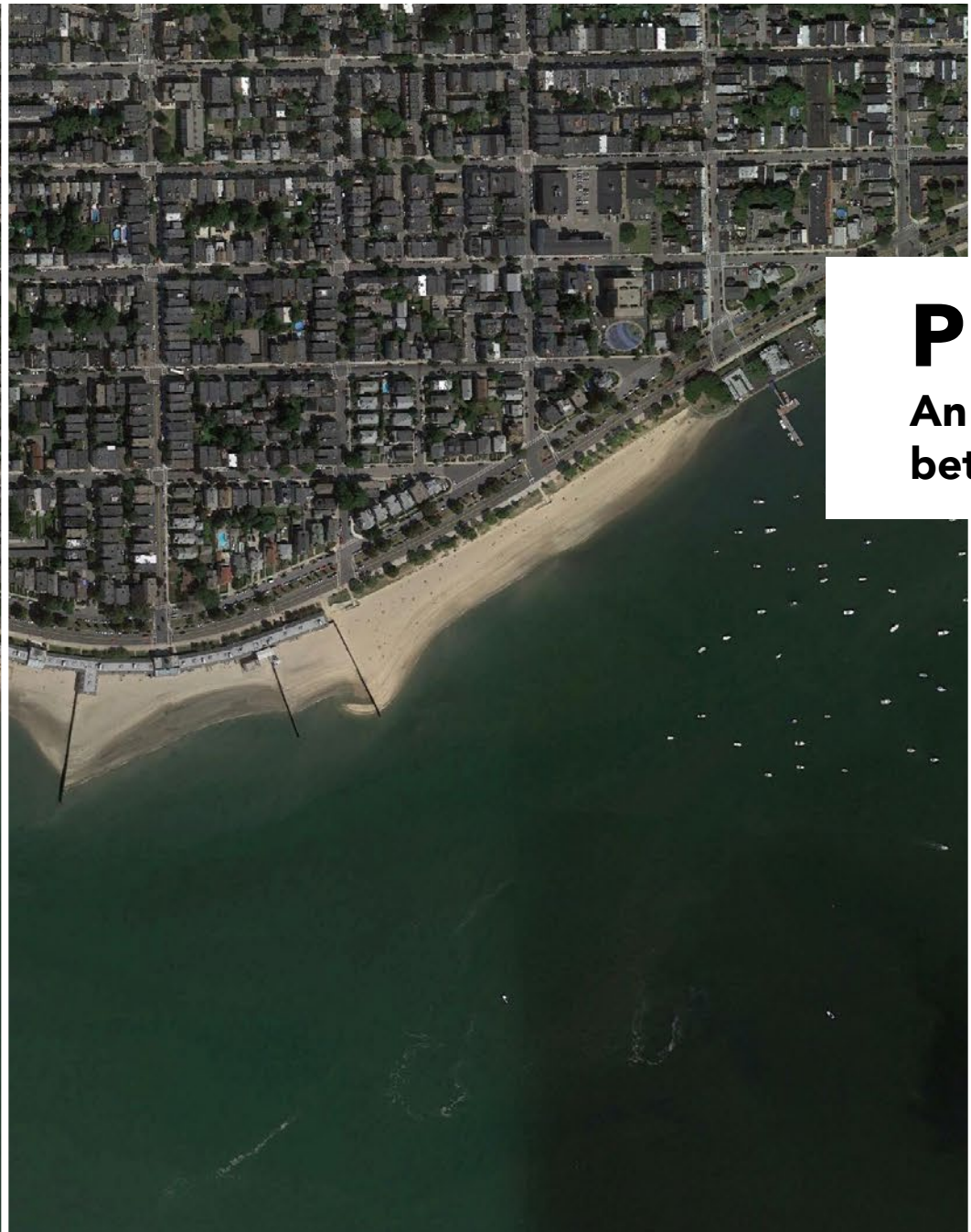
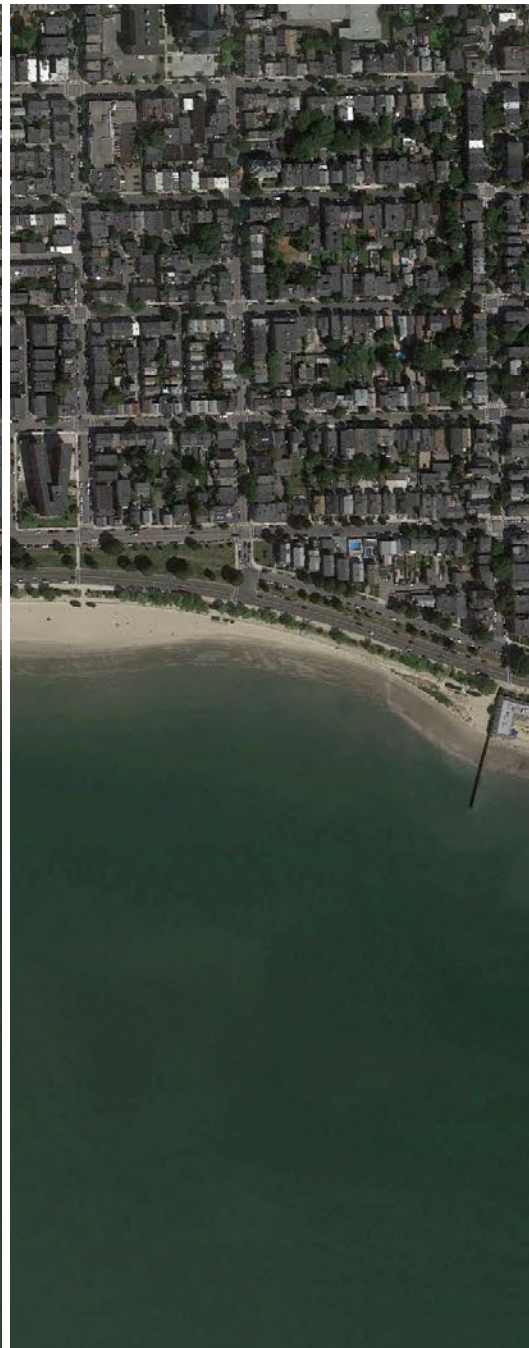
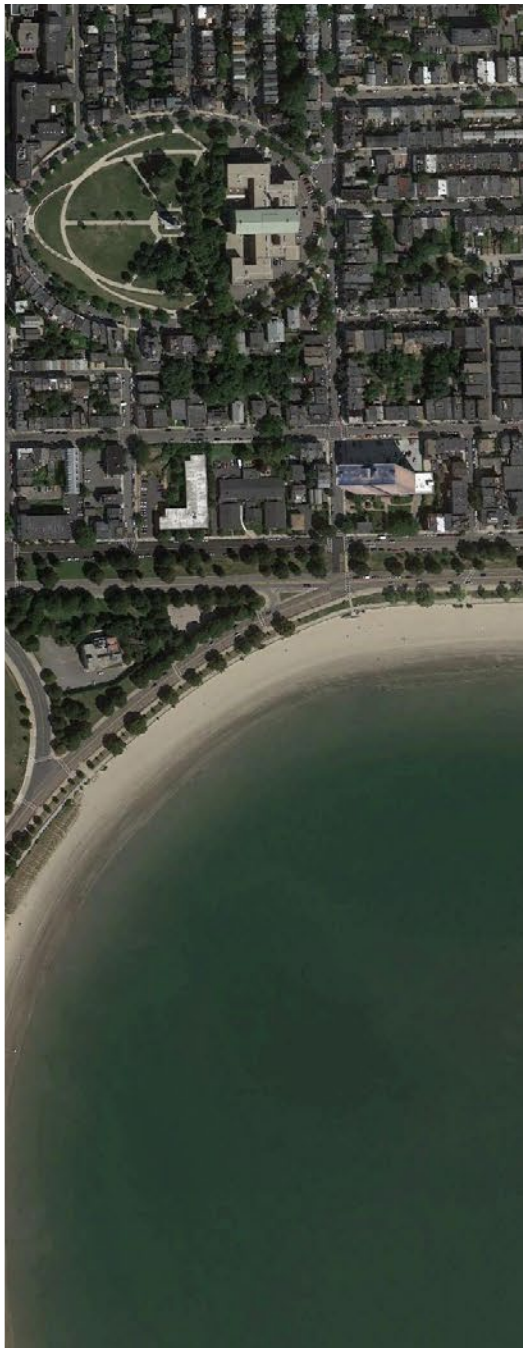
The study recognizes the overlay of potential flooded area and street fabrics as the critical area of intervention. New typologies will be further developed to incrementally change the neighborhood's interface with water. A strong water edge with transportation possibilities is to be formed before community gathering and social uses are greatly compromised. The dynamic evolution of a social, sustainable, and transportation shoreline will be further studied and tested. For the design development of Phase 2 investigation, lessons are yet to be learned from how the history of South Boston can inspire its future and how from north to south the change between industrial and residential informs the transformation of this community.

## Assessment

Phase 1 investigation has answered the contextual questions of what South Boston might become in 2100. The search to understand how rising water levels will affect the terrestrial peripheries has in most parts been worked out. Geological analysis of the physical water edge is lacking and will be accomplished in early Phase 2. Initial studies of social structures in the neighborhood brings forward the discovery of the transformation from maritime/industrial/commercial use to residential, spanning from north to south. However, further investigation needs to be carried out in studying how the community actually functions within that framework.

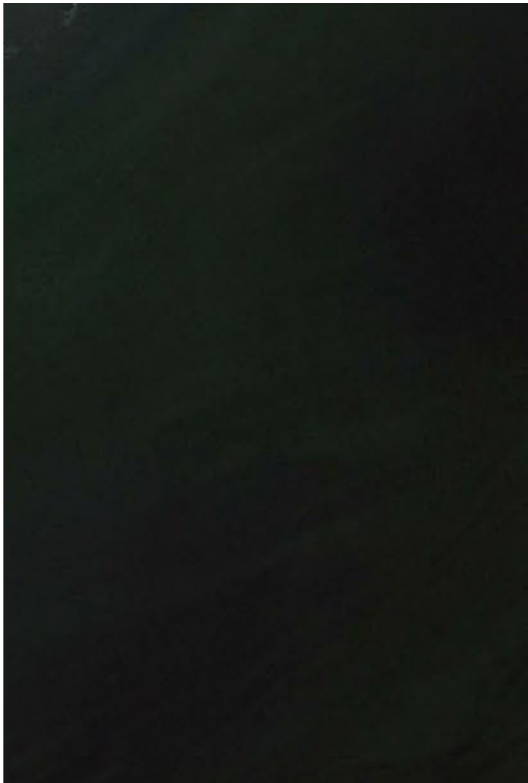
Timewise, the initial schedule worked well until the complexity of their ramifications started to overwhelm the scale of possible interventions. Then the original goal of designing for the future shifted to investigation of an evolving typology within the next 85 years. During the process, it became clear that topics of research needs to be prioritized first to allow time for summarizing, adjusting and pushing forward.





# Phase 2

An Evolving Equilibrium  
between Land and the Rising Sea





# Abstract

Under impacts of rising sea levels, South Boston faces the risk of gradually losing a great part of its filled land and becoming an island. This part of investigation proposes that the community work with the rising sea level to form an adaptive and evolving periphery that continues to protect the neighborhood and creates new public engagements with the water. The intervention is mainly about triggering an evolution of self-building beaches, sand dunes, and wetlands as a buffer between the rising water and the South Boston community. The ongoing process of beach building will keep providing protected access to the water and eventually become the foundation for a water transportation hub in 2100.

Phase 2 mainly focuses on incremental evolution of the periphery under proposed intervention. Investigation includes geological histories of South Boston, as well as research and modeling of intervention impacts on sand accumulation and current directions.



Modeling Process

# Introduction

Phase 2 mainly looks at the south site and how sea level rise impacts the immediate neighborhood. The current sandy beach has accumulated more than 4 feet in height during the past 100 years. This is promising because it indicates more sand will continue to be collected along the shoreline to form new land. However, as the sand gets higher, the beach is becoming narrower due to erosion caused by tidal currents. Within this intricate pull and push between the forces of water and land, Phase 2 proposes an intervention that works with these phenomena and allows nature to help build up the beach.

In order for the new land-building typology to accommodate sea level rise, the investigation first looks at historical periods of South Boston to understand how the periphery changed over time, as well as at projections of tidal floods in 2100. Then the research turns to a detailed analysis of tidal fluctuations in the Old Harbor and sandy beach formations. Since the regional peninsulas and islands form initial barriers to protect South Boston from wave actions, the question then becomes how a soft edge can be created that grows with the rising water and continues to provide an occupiable buffer periphery for the community. Hence physical modeling is utilized to test impacts of intervetion on tidal current movement and sand deposit. With the information gathered, a series of projected plans and sections at different incremental time frames toward 2100 is then drawn to visualize evolution of the new beach under intervention.

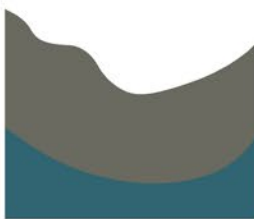
# Methods

1. Map historical peripheries of South Boston at different scales and diagram the edge conditions.
2. Overlay sea level rise impacts on the south site and compare with proposed outcomes of intervention.
3. Map regional terrestrial relations and analyze tidal current directions in the Old Harbor.
4. Model impacts of tidal currents on site topography.
5. Model sand depositions with intervention.
6. Project incremental changes of periphery with intervention in plan and section.



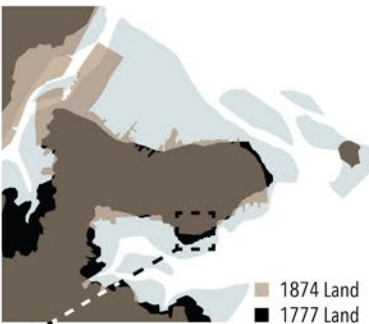
# History: What was South Boston?

1777



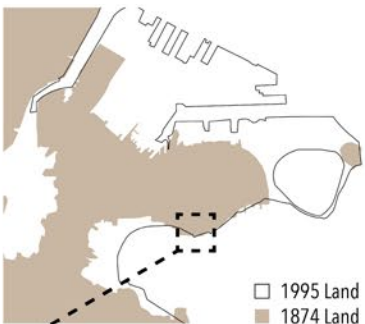
Prior to any European settlements, a large proportion of South Boston was salt marshes and muddy flats.

1874



As the century-long land filling began, South Boston became populated with families. Lots of residential neighborhoods were built on the peninsula.

1995



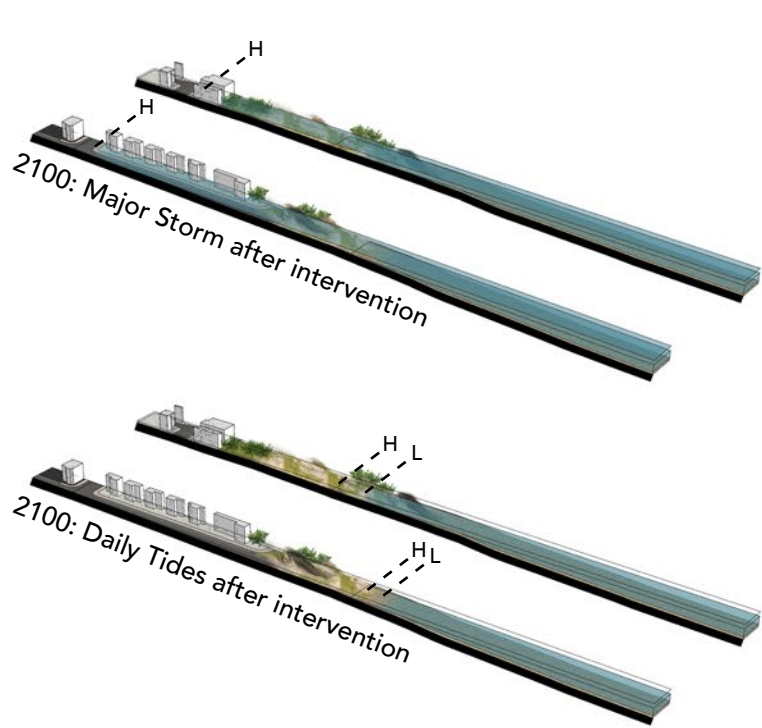
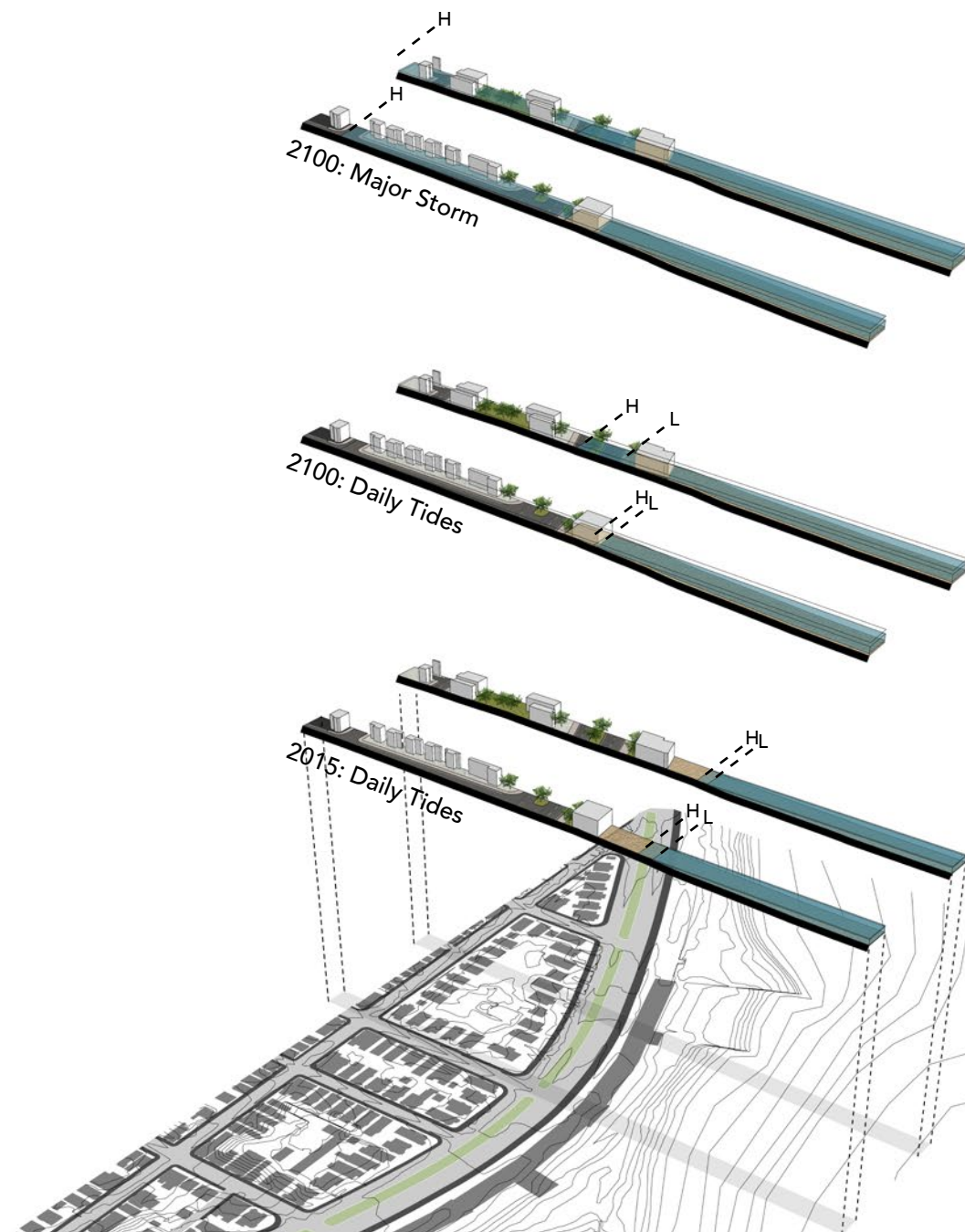
As part of the Emerald Necklace connection, a designated public beach was formed. At the same time, families that used to dominate the neighborhood were gradually replaced by young professionals who commute to work every day.

2100



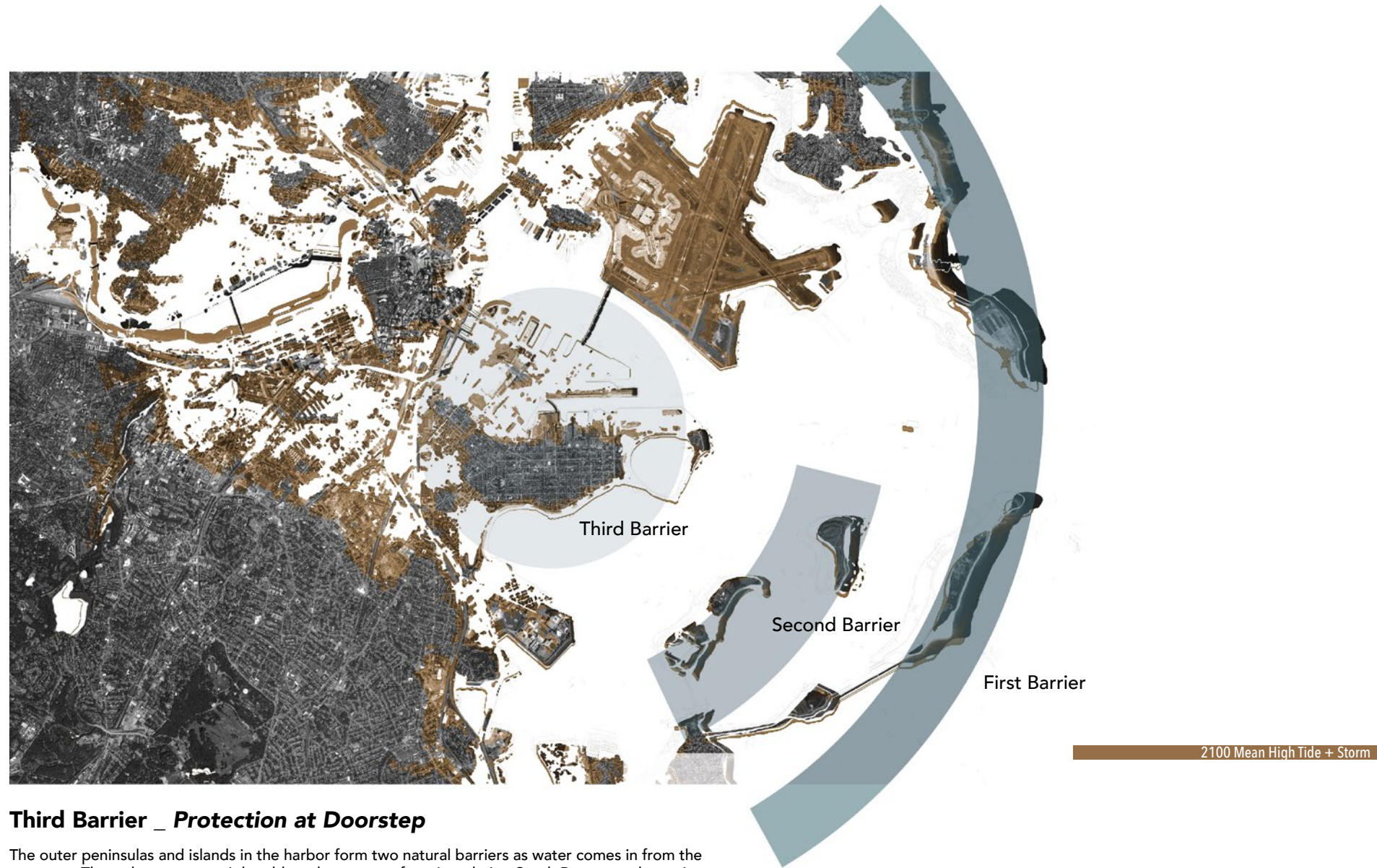
Due to flatness of the filled land, the configuration of South Boston is very likely going to return to its 1777 state according to projections of sea level rise.

# 2100: What will South Boston be?



The intervention mainly focuses on mitigating impacts of daily tidal floods in 2100. By proposing land-building and gradual relocating of major infrastructures, the intertidal zone will continue to provide safe and easy access to the waterfront. The intervention will not prevent the community from flooding during major storms. However, the evolved edge will act as a buffer that reduces direct wave impacts.





### Third Barrier \_ *Protection at Doorstep*

The outer peninsulas and islands in the harbor form two natural barriers as water comes in from the open sea. These, however, won't be able to keep water from inundating South Boston as the entire sea level rises. Therefore, a third barrier is called for at the community's water edge to provide immediate protection.



### Forces of the Water \_ *Depositional and Erosive*

In the study of tidal current directions of the Old Harbor, it is clear that water mainly hits the site from the southeast. The tide is depositing sand on the beach, making it higher. However, on the horizontal direction, water is eroding into the headland, and eating away the sandy beach.





### Transportation Possibilities in 2100 \_ *Walking and Ferries*

In 2100, the South Boston island will be 30 minutes walking distance from east to west and 15 minutes from north to south. People will be free from the need for vehicles to travel within the island. Docks on the south shore will connect residents with the greater Boston area, commuting to work or visiting friends.

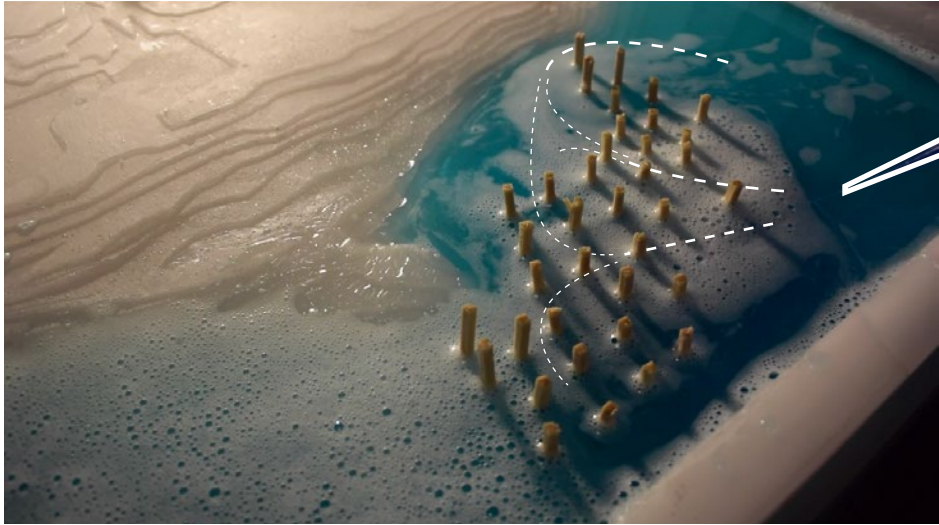
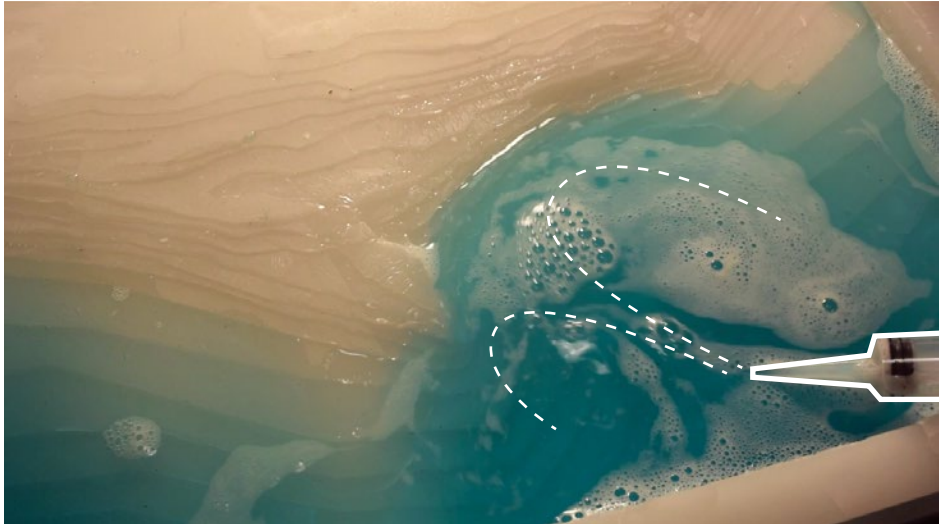


### Open Space Possibilities in 2100 \_ *Shifting Waterfronts*

To carry on as a functioning community, South Boston will continue to require open spaces that allow people to access nature and water; hence, a safe and ongoing process of beach building will satisfy these needs. The new waterfront will perform not only as a barrier but also as a social catalyst for new engagements with the sea. It will not be the same “private” beach for pure enjoyment of the sand and water, but a web of different systems that provokes appreciation for nature.



First Trial: Model Testing of Currents and Sand



The way bubbles move in different situations informs how water might push sand around the piles.



By starting to test water moving through different arrangements of densities and proportions of piles, a pattern of how sand remains began to emerge.



An Evolving Periphery: 2015 – 2100

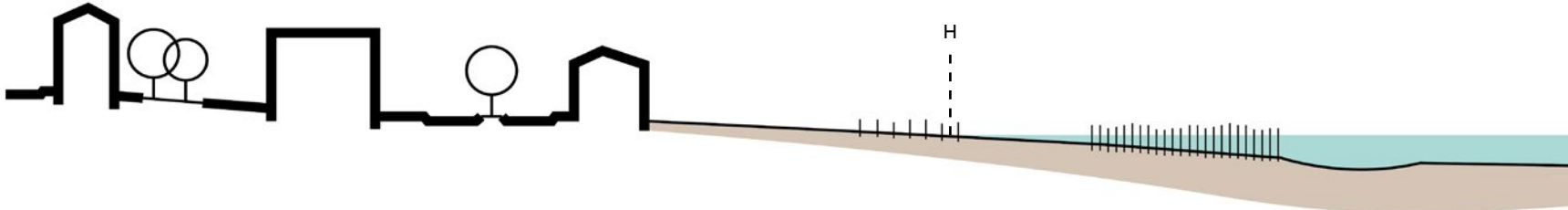
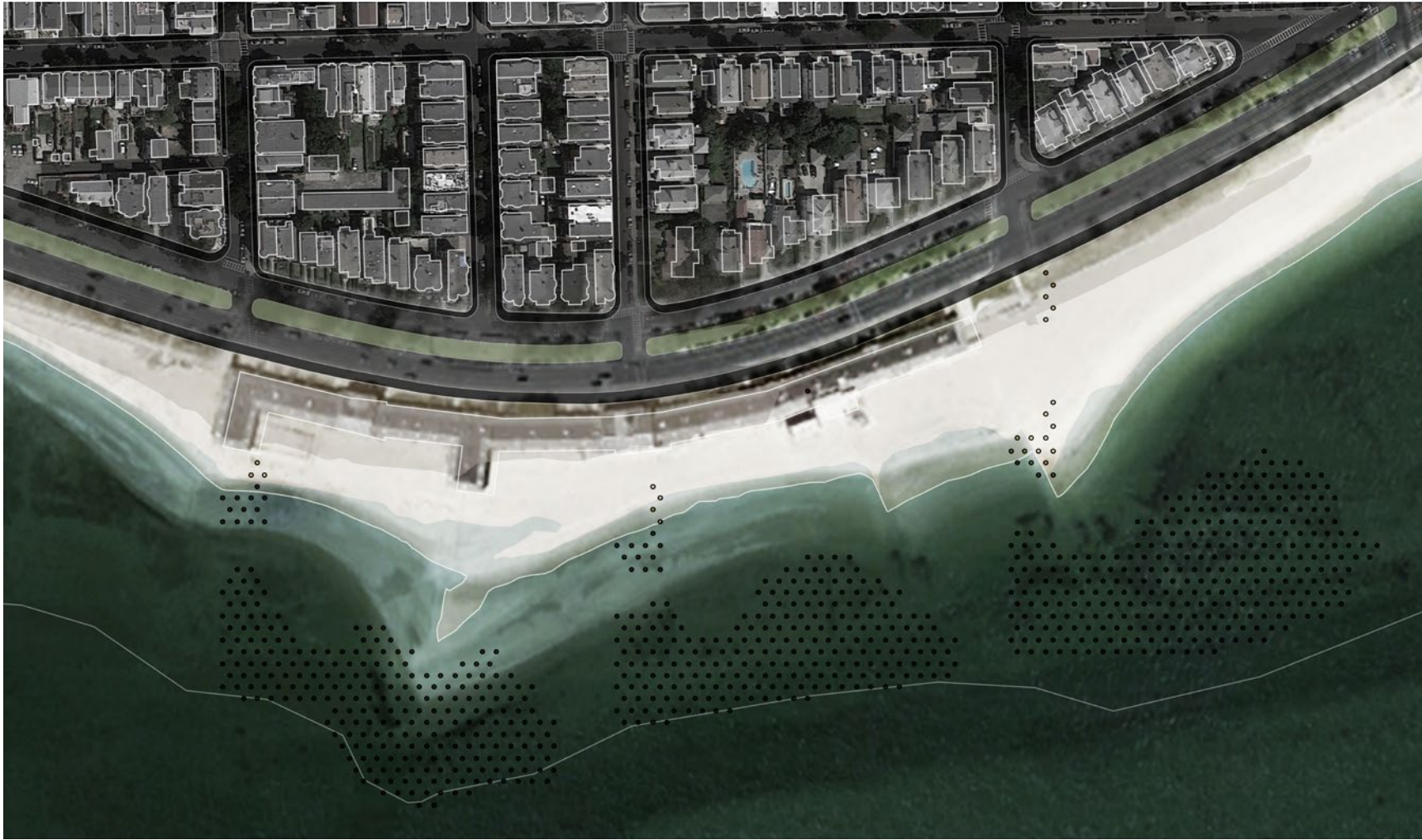


100 ft

NTS

2015

As a first-step implementation that can take place *now*, the fence will be removed and replaced with piles to initiate sand deposition.



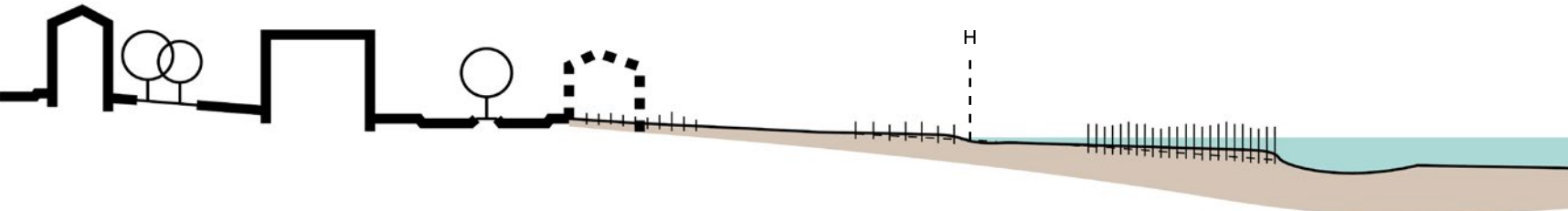
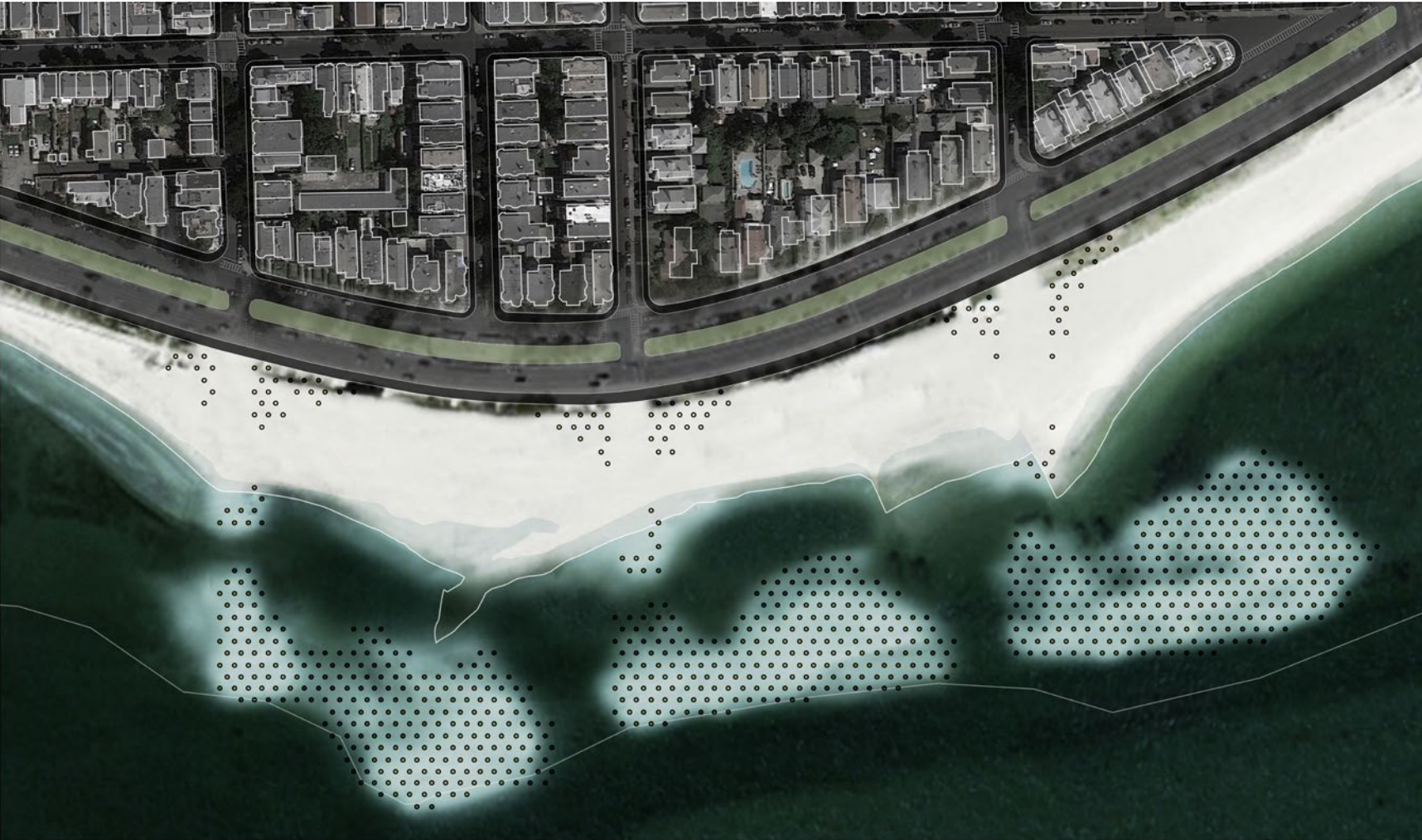
100 ft

NTS



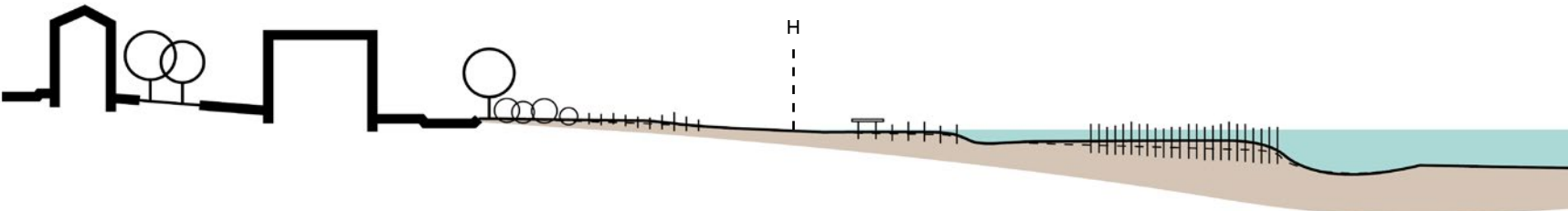
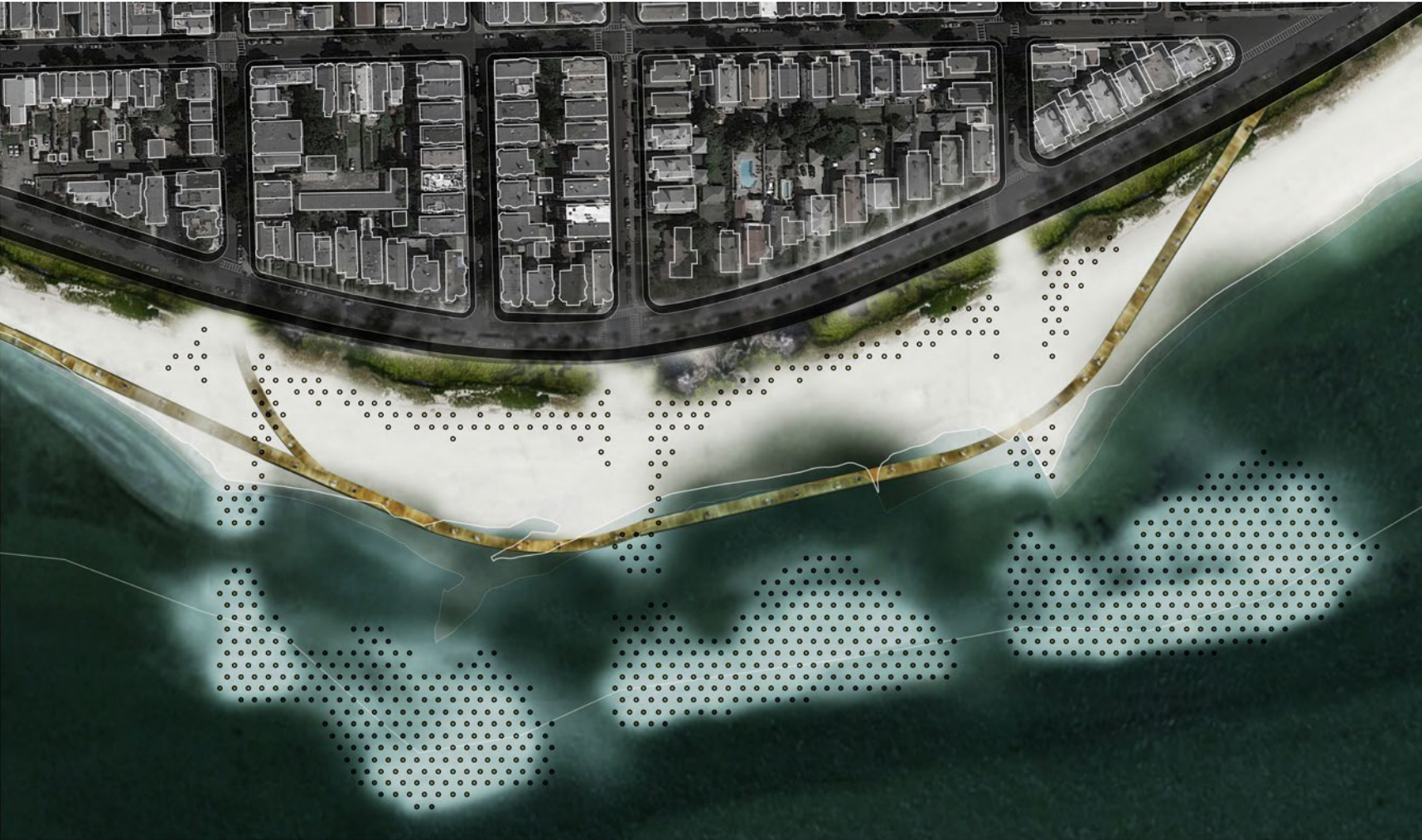
2030

As a precaution against more frequent major storm surges, the Curley Community Center is to relocate to higher grounds. Sand continues to accumulate around the piles, while a second implementation of piles are placed closer to the neighborhood.



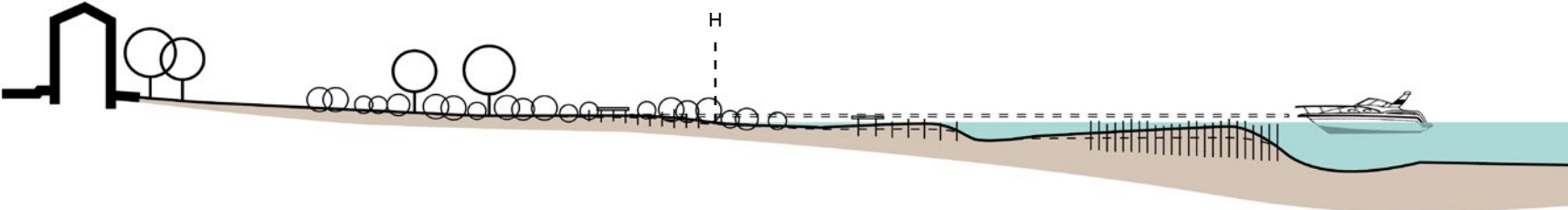
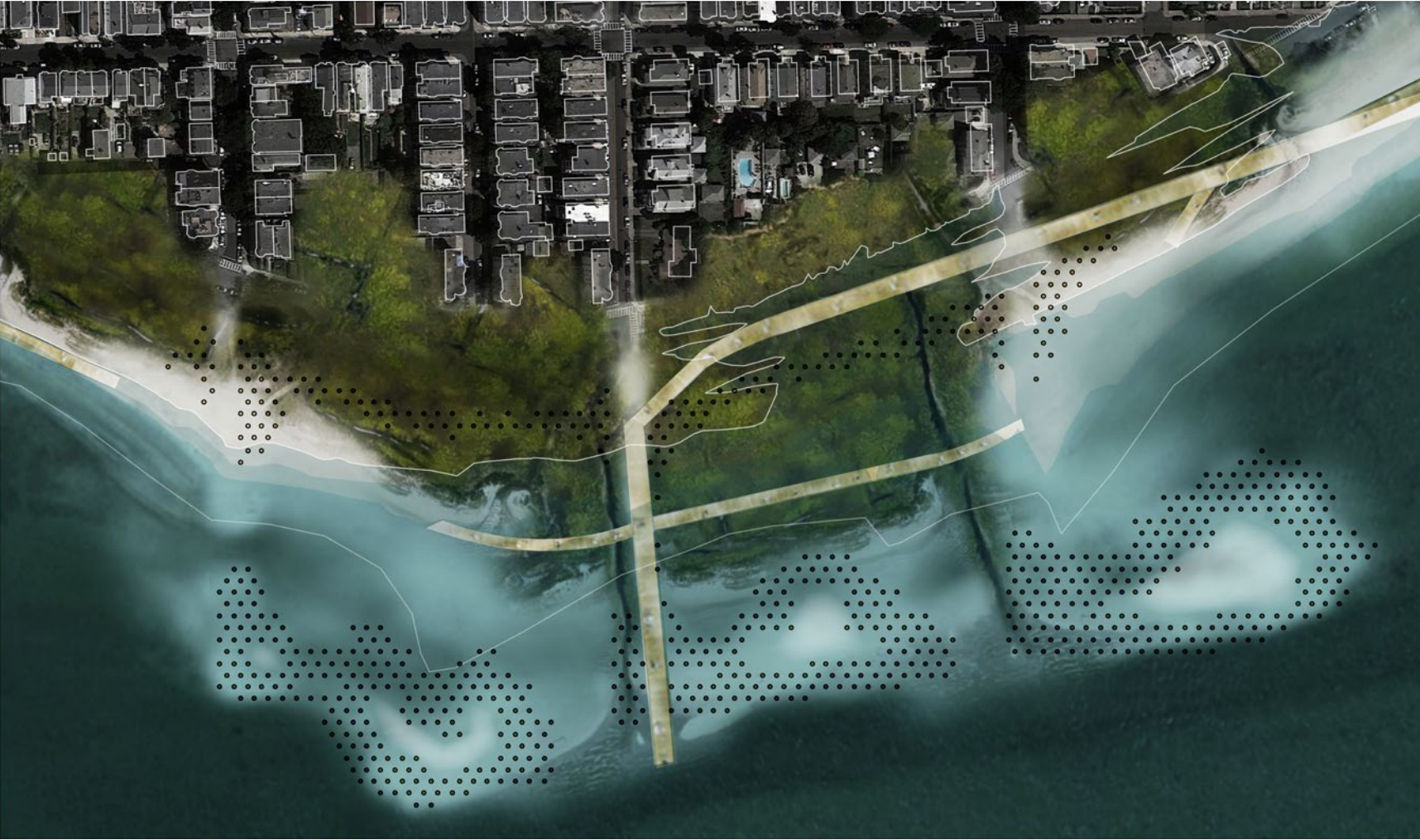
2050

In the gradual retreat of infrastructures, half of the William J. Day Boulevard is to be removed to allow further growth of beach. As sand keeps building up, some shallow water bodies begin to form on the beach, which prepares the ground for salt marshes to form. To better function as a socially active space, public amenities such as bike trails and bird watching platforms will be built upon some of the piles.





By further retreating the neighborhood, the salt marsh habitat will acquire more space and vitality. The new waterfront will become a network of tidal marshes, patches of sandy beach, public paths at different scales, and a web of piles that will begin to deteriorate and dissolve into the foundation for new infrastructures.



100 ft

NTS



Life will go on for Southie residents, neither in panic nor in ignorance, but in respect of the rising water and its consequences. The fear sea level rise presents to us will not affect children playing at the unique “growing” beach that continues to protect their homes. They will have a perception of water quite different from ours, one of collaboration and embrace.



**Feedback** from Nick DePace (secondary advisor)

Now that you have proposed a methodology for making ground with a staged implementation plan in consideration with natural processes, all playing out together in a very specific time frame, you have a base from which to really question the resultant form presented in this current submission. This is a great advancement from the last submission.

I think challenging some of your assumptions by further pursuing the empirical investigations in model will further help to clarify the forces/actions that will be at play into the following century. The model work is still diagrammatic and I would encourage you to be more rigorous with the dynamics involved in constructing the barrier beaches, causeways, groins through sand deposition, water currents, ecosystems, etc.

The more knowledgeable you are of these dynamics, the greater economy of means you bring to the project so that it will preserve an accessible, albeit transformed, coastal edge while creating an indispensable amenity to assure the longevity of the community until it is no longer viable.

So, what are the physical, infrastructural, economic, and cultural aspects that must remain durable for South Boston? What is the motivation for continuing human habitation in South Boston? These questions will help you contextualize this particular community with some “big picture” perspective of the greater Boston area. How would Southie be identified as unique and different from other neighborhoods?

To some degree the loss of the “community building” without some sense of

its replacement and the backyard “no-man’s land” without jurisdiction is still a sour note of pessimism in this phase of the work and is something you can work towards in your third investigation. In a South Boston that may become increasingly more isolated and marine-like in nature, consider the intrinsic worth of dwelling more emphatically at the water edge.

Regarding the beach/boathouse, all durable institutions outgrow and outlive their initial facilities and even rewrite their charters. Couldn’t this program be the connector you are looking for? Aren’t you already constructing stable land in the outreach of the water’s edge? Perhaps this is the program/place for public interface which resolves where private land ownership meets community or municipal responsibility? Just don’t think of it like a building but a system or a network.

END 04/11/15

**Findings + Conclusions**

Through the Phase 2 investigation, it’s clear that land-building in South Boston should not repeat its history in filling the muddy flats and making flat ground. Instead, the community needs to critically look at the rising sea level in both its destructive and constructive forces. Fortunately, South Boston is naturally protected by barriers in the harbor and won’t get directly hit in major storms. However, the erosive and subversive impacts of the water will continue to shrink the peninsula until it becomes an island. Therefore, an intervention is called for that allows the edge to grow with the rising water. By looking at precedent cases and physical model testing, a web of piles is proposed to accumulate sand and build the beach out into the water. To protect the neighborhood from daily tidal floods, gradual retreat of infrastructures along the shoreline will be inevitable. It will also leave more space for the beach to evolve into an ecologically sound and structurally stable state.

The study also begins to resolve the relation between the community and the water edge. In order to allow residents to access and occupy the beach, public amenities need to be provided as the beach evolves towards its own trajectory. Analysis of the existing transportation infrastructures of South Boston reveals the potential for the future island to become a walking/biking-oriented environment. As suggested since Phase 1, South Boston will remain connected with the larger Boston area through water transportations. To this goal, parts of the proposed intervention will transform into a foundation for critical infrastructures.

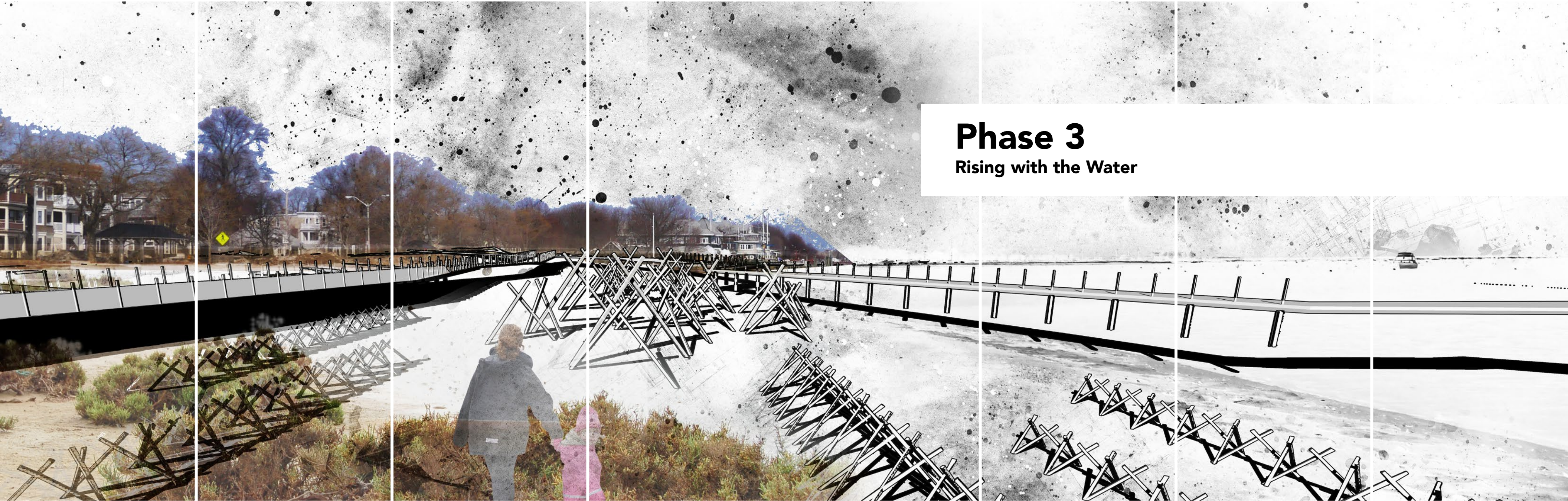
To further investigate in the future of South Boston, the first part of Phase 3 will continue to study the urban fabric and project its evolution in response to the critical changes at water edge.

**Assessment**

Phase 2 has been a good start of answering many questions about South Boston’s waterfront futures. It has to some degree understood the physical interaction between land and water and answered how sand will react to proposed interventions. The physical model testing of current and sand actions has been a helpful beginning, but a more dynamic and constructive method of testing needs to be developed, and the testing will carry on in Phase 3. The human/social side of this project has been somewhat neglected in Phase 2. It’s lacking a deeper understanding of how South Boston residents will be interacting with the edge. The in-between of neighborhood and tidal zone is also still ambiguous and needs further resolution. Overall, a clear vision of what South Boston will be in 2100 and what roles the beach will play in that big picture is urgently called for.

At the same time, an insufficiency of detailed spatial design failed to provide visualizations of the actual occupancy of the beach. The study needs to quickly move into smaller scales and answer functional and programmatic questions about the project.





# Phase 3

Rising with the Water



# Abstract

This part of thesis looks at South Boston as an example for adaptive beach building in response to sea level rise. It proposes that the community works with the rising water to form an evolving periphery, which will continue to protect the neighborhood and muddy flat habitats as well as create new public spaces at the waterfront. In 2100, the periphery will act as a buffer between the rising water and the neighborhood, with layered systems of natural habitat, sand dunes, bike paths, pedestrian boardwalks, ferry port, and other public infrastructures. To trigger the self-building process of sand dunes, a new type of sand fence is designed to both accumulate sand and generate a framework within which new activities can happen on the beach. This ongoing process of beach building will keep providing protected access to the waterfront and, eventually, foundation for recreation and transportation infrastructures in 2100.



Different Surfaces on Site

# Introduction

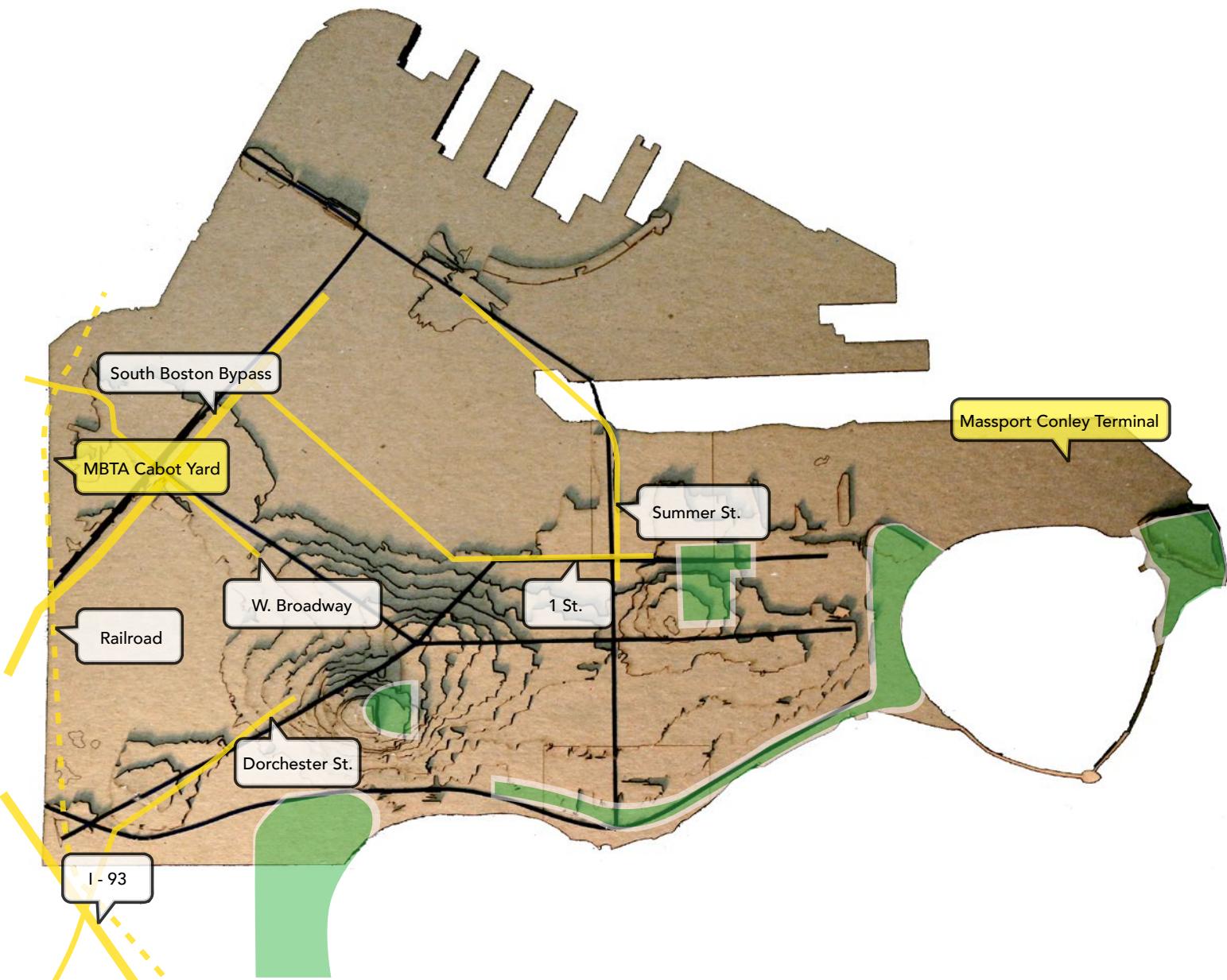
Phase 3 focuses on spatial designs of the evolving beach, as well as the proposed fences and infrastructures. The investigation first zoomed back to the regional scale to understand unique features of the site and its importance in the open-space connection of South Boston. The transition from neighborhood to water is one with layered infrastructures, activities, and habitats. A more precise study of how sand accumulates over time reveals critical sections for sand building at each stage. Sand-building will allow the beach to remain at its existing width at low tide in 2050 and protect the neighborhood from flooding in high tides in 2100. The hourly tidal change and study of muddy flat habitats greatly informs where people will have access to the ground/water and where they need to stay on the protected structures in 2100. The design proposes an interweaving system of sand dunes, fences, muddy flats, bike paths, boardwalks, and platforms that changes with the dynamic of tides and provides a new waterfront experience for South Boston.

The investigation includes a detailed study of proposed fences through potential form, scale, and program. The purpose of this investigation is to seek opportunities for the intervention to connect with the community in multiple ways. The new beach is one not only protecting the neighborhood but also changing its behavior towards water. By engaging the community in ways other than mere protection, the fences become a cultural component of their daily life, which represents stewardship of water, nature, and ongoing life.

# Methods

1. Map key infrastructures and open spaces in South Boston.
2. Diagram proposed north and south edges.
3. Model sand accumulation in transition zone between neighborhood and water in 2015, 2050, and 2100.
4. Project sand accumulation and infrastructure proposals in 2015, 2050, and 2100 through plan and section.
5. Render critical scenarios in 2100.
6. Model sand-accumulating fence typologies.
7. Diagram possible form, scale, and programs for sand fence.





### Key Infrastructures and Open Spaces

It is critical to recognize the distinctive features of the north and south edge in South Boston. On the one hand, key infrastructures such as the Conley Terminal and oil power plant are located on the north edge. On the other hand, major open spaces are mostly located along the south beach. Also, the north edge is a thin, steep, solid, man-made channel, while the south edge is a thick, shallow, sandy beach.

## Proposed Edges: North vs. South



Two different edge strategies are proposed in response to the mapping study on the left: a solid levee on the north to protect key infrastructures and a soft adaptive beach on the south to continue providing access to the waterfront. The thicker natural edge on the south offers better opportunity for gradual accumulation of sand and generous space for public infrastructures to build upon.



# Transition from Neighborhood to Water



Neighborhood



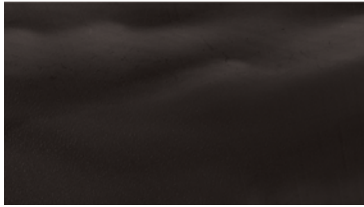
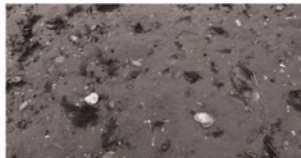
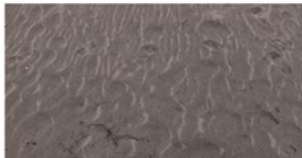
Street



Public Sandy Beach



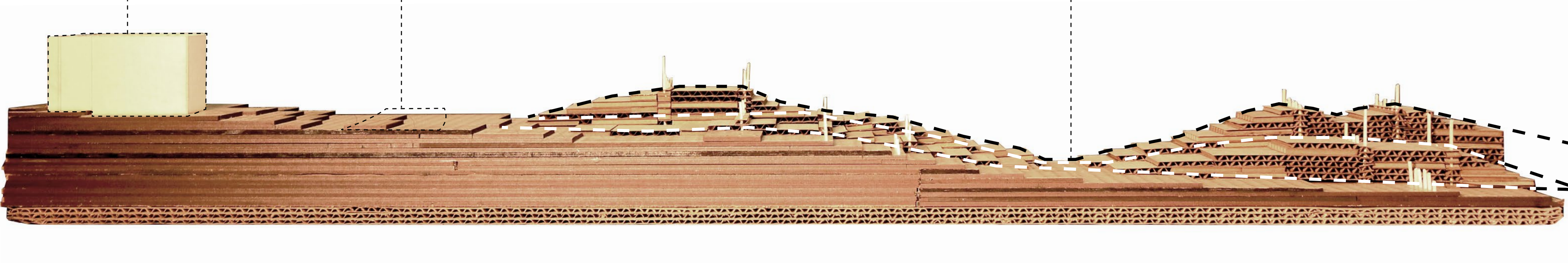
Muddy Flat



Bathymetry

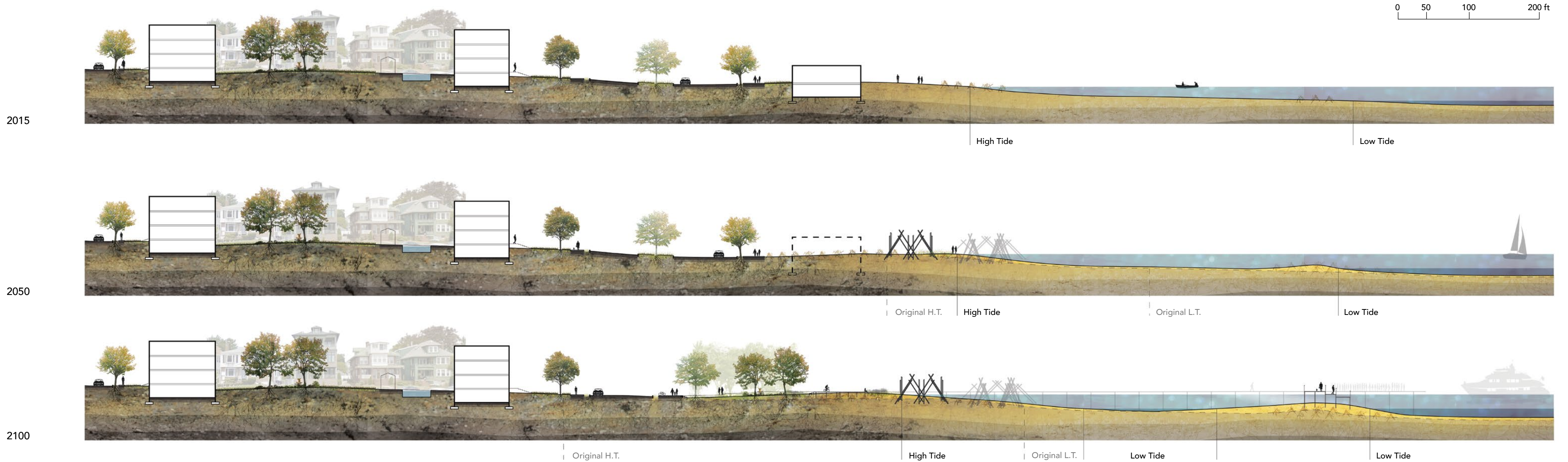


Water Transportation



The model looks at location, height, and scale of sand accumulation that needs to happen in order to preserve a certain width of beach and protect the neighborhood. It also acknowledges the material transition of the intertidal zone and retains certain spaces for muddy flat habitat preservation.





This series of sections shows the main interventions deployed in 2015, 2050, and 2100. The first layer of sand fences are applied at low tide mark in 2015 to allow sand accumulation to retain the width of beach at low tide in 2050. Then the Curley Community Center is removed and a second layer of fences implemented to start another round of sand-building that keeps high tide from flooding the neighborhood in 2100. On top of the growing beach is a system of walking and biking structures that allow protected access onto the beach.



2015

Implementation of initial sand-accumulating fences at low tide mark.



0 50 100 200 ft

2050

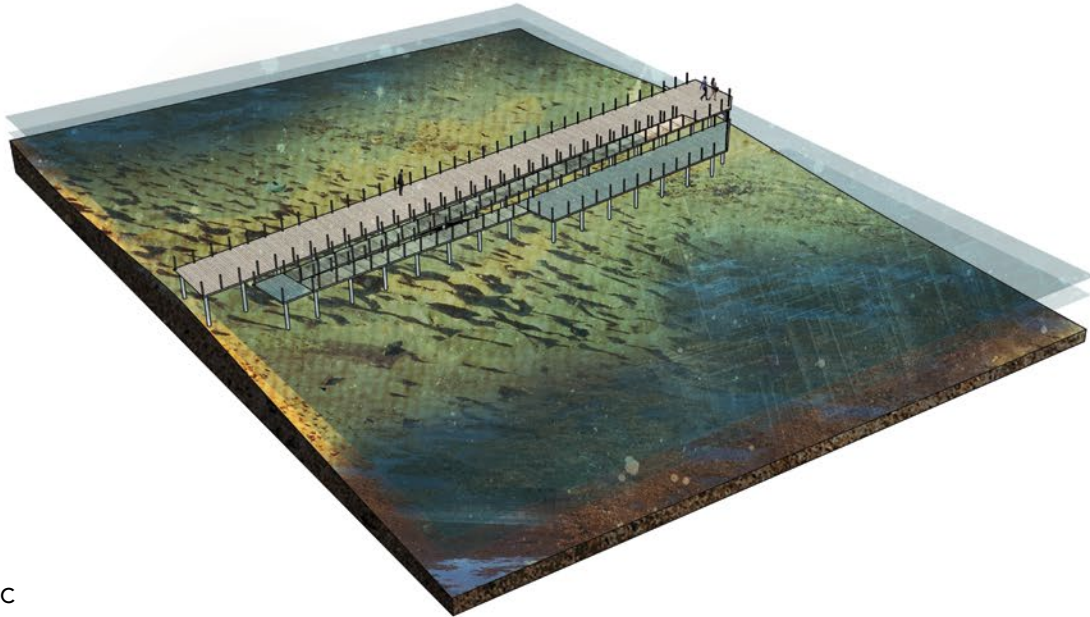
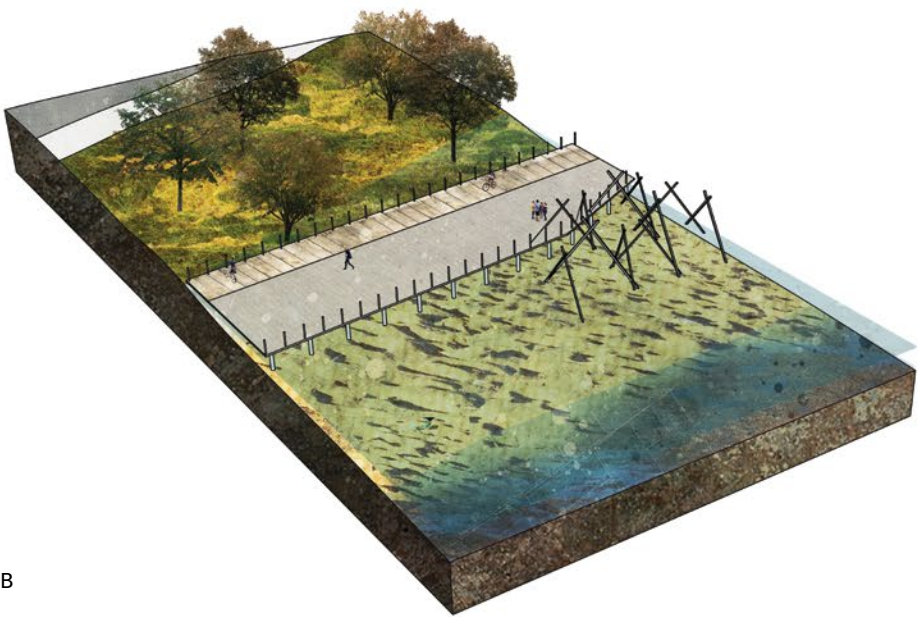
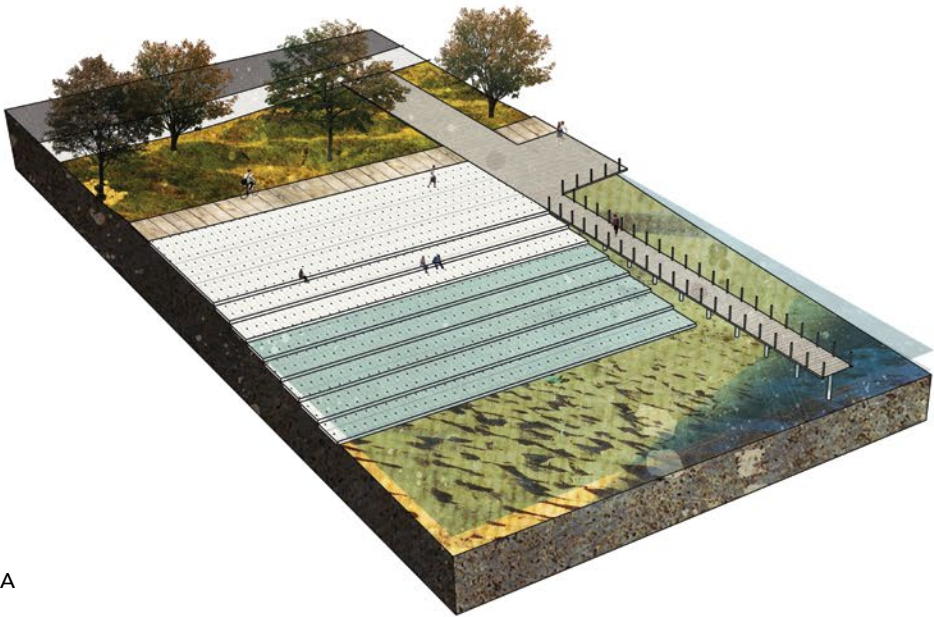
Removal of Curley Community Center and implementation of the second layer of fences. Beach grass begins to take root on the sand dunes.



0 50 100 200 ft



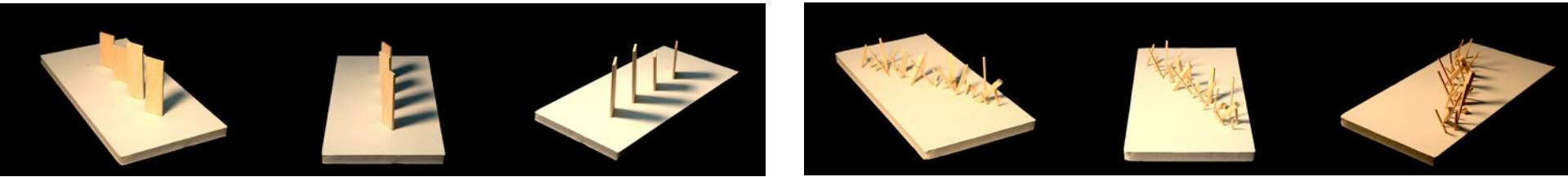
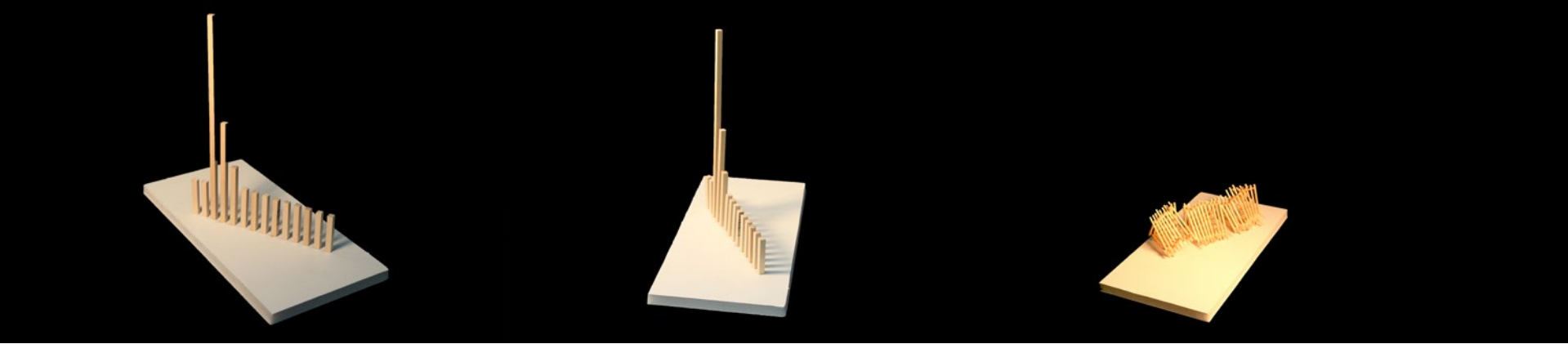
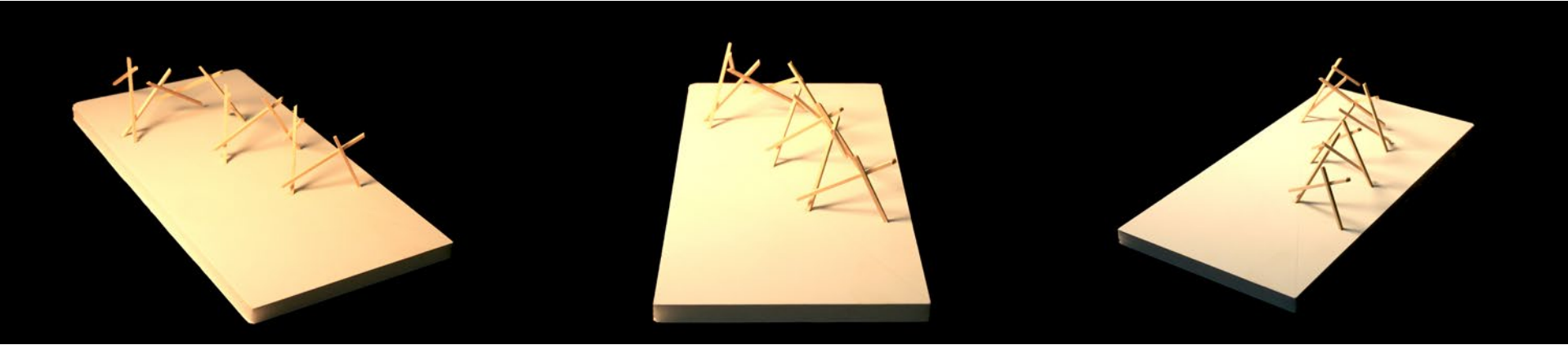
Sand-building creates a shallow muddy flat that continues to provide habitat for shellfish and seabirds. Human access is mostly elevated to a system of bike trails, pedestrian boardwalks, and certain sandy beaches. L Street extends into the headland and serves as a port for water transportation.



Certain flexible spaces are also provided to encourage different occupations of the beach. A shows an amphitheater that registers the tidal change and can connect to the sandy beach and host performances at low tides. B is a section of the elevated platform engaging the scaled-up sand fences. C shows a section of the boardwalk bringing people from the inner beach to the outer waterfront that also engages the tidal change and offers access to the harbor.



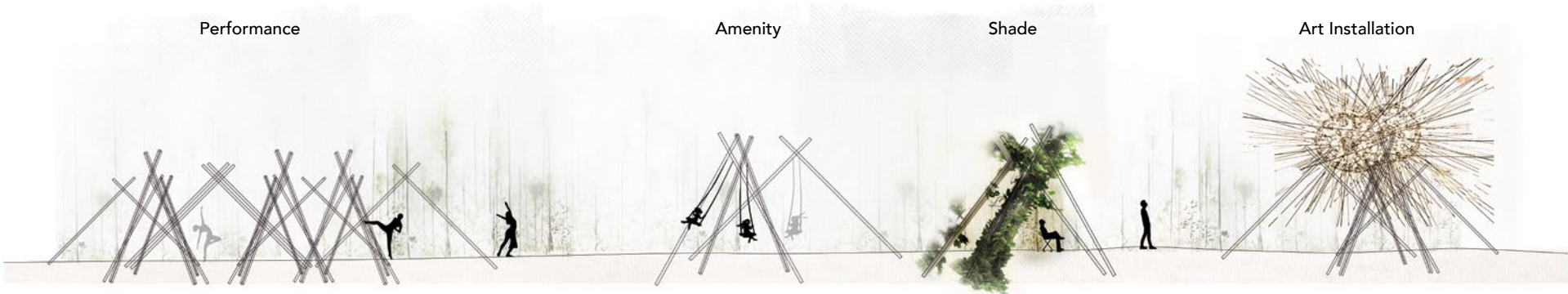
## Second Detail Study: Model Testing of Sand Fence



The study looks beyond conventional sand-fence building and proposes different forms that are more successful in creating interesting spaces and engaging physical activities.



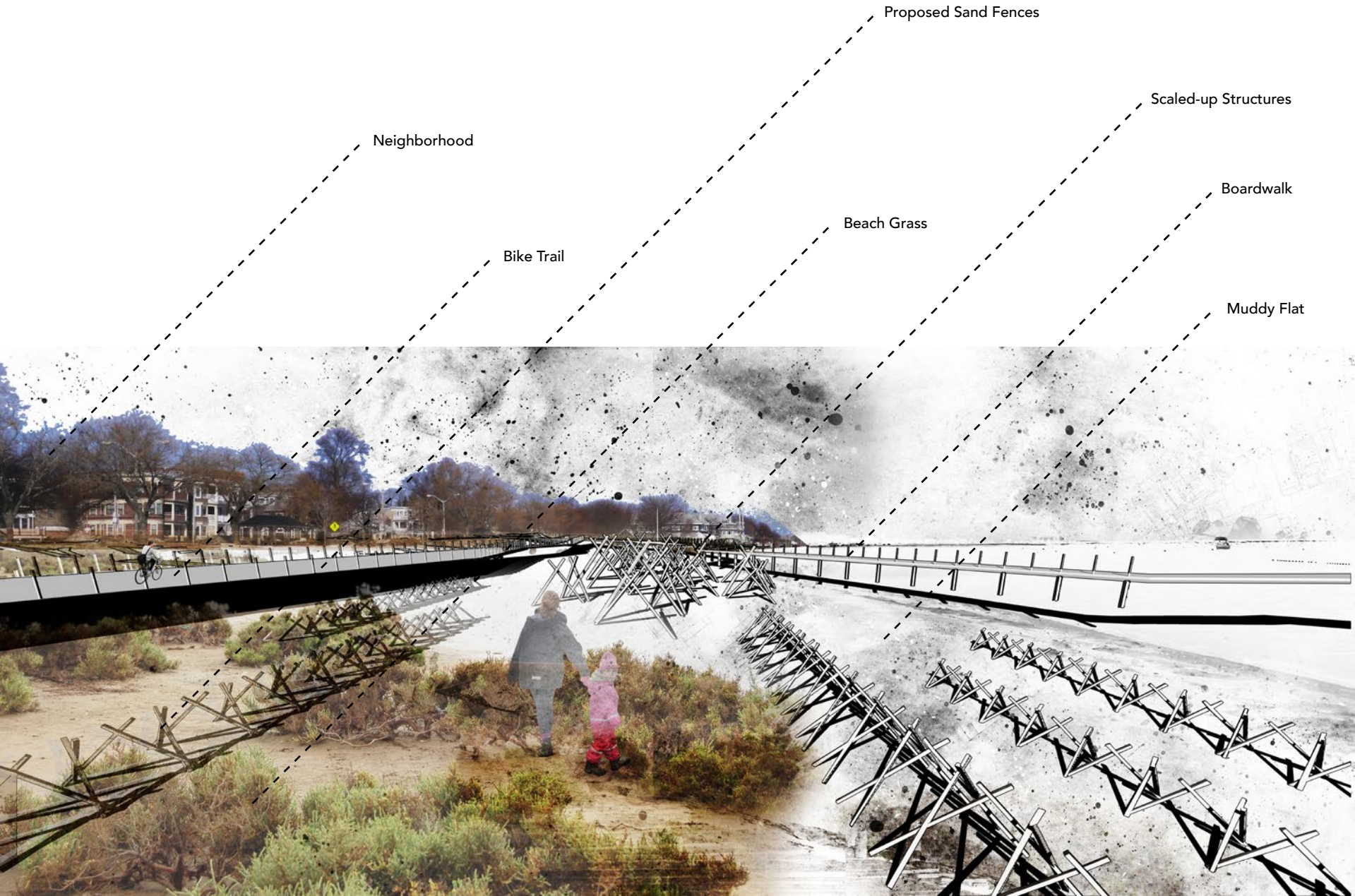
Sand accumulation requires that fences “grow” as sand gathers. The proposed structures are built with stable angles that allows the second layer to take hold. The scaling of the structures brings more visibility to the project and generates spaces of various sizes, density, and shapes to accommodate different uses.



The arrangement of these scaled-up structures aims at providing a flexible framework on which different programs can be attached.



Nature, Water, and Entropy





**Feedback** from Nick DePace (secondary advisor)

The tessellated cardboard and stick model, which I believe speaks to the way sand dunes and sand bars accumulate and strengthen over time, is a wonderful invention that hasn’t been studied thoroughly enough. How exactly does this model work? What are its rules? I imagine it could be used to study and evaluate sand deposition and erosion patterns against any existing or proposed wall or fence or building or groin.

It appears at some point in the process it was supplanted by another method of generation and representation. One that is less concerned about the systematic construction of ground or the context of the changing shoreline, but instead it reverted to an event-based collaged landscape of superimposed and juxtaposed elements. In your final rendition, South Boston seems neither lucky or unlucky but ordinary and bland, without trials or tribulations. What happened to sea level rise and the forceful command you attributed to it in the earlier investigations? How is it that when you began, the future of South Boston was waterlogged and isolated, and now it looks pretty much “status quo” but with a new boardwalk and art installations and without a community building? What did you learn in this process? What conclusions did you draw from this new perspective on the future?

I think one of the most exciting premises you relinquished yourself from in this phase of study is the catastrophic forecast you anticipated as a design challenge in the thesis from the start of your work. This initial vision, albeit severe and somewhat dystopian, was an appropriate place to ask questions about sea level rise and the impact they will have on coastal communities and their livelihoods, particularly one with such a unique identity and orientation

within a larger metropolitan center.

To this end, I ask you to look back at comments that have been made about what a community center may represent to the neighborhood and for the act of bathing/boating/gathering etc. You have depicted some recreational activities, like an inconspicuous bike path or an anemic boat pier (which go where exactly?), but I am interested in the way you might respond to a neighborhood’s continuing desire to be semi-naked and bathed in salt water, since there will be a lot more of it.

Nevertheless, I think you are in good position to summarize what you have learned, but I will ask you to make sure your thesis question is well considered and clearly articulated given your final and most detailed design strategy. Does it contradict your earliest assumptions?

END 05/05/15

**Findings + Conclusions**

Phase 3 has answered in depth the question of where and how the sand needs to be accumulated and how the muddy flat habitats can be preserved with the new bathymetry created by sand fences. The proposal strategically places sand fences in each time period to build up sand dunes that will hold off tidal floods in the next time frame. Essentially, as the water rises, sand will also grow higher to maintain a certain width of beach to be usable by the community. However, this evolution of sandy beach is not only about changing heights but also about introducing beach habitat and infrastructures that support human activities. In 2100, the sandy beach will not only protect the neighborhood from daily tidal floods but also provide foundation for a system of bike trails, pedestrian boardwalks, and different platforms to accommodate various programs. The intertidal muddy flat habitat will also be preserved through limited human access and careful design of water exchange during high tides.

This investigation also starts to resolve the formal and structural design of the sand fences. Moving away from conventional fences, which keeps people away from engaging with the sand-building process, the proposed structure creates geometries that allow building upon itself and opportunities for human engagements. The scaled-up structures call attention to the project as well as generate occupiable spaces in which different programs can begin to take place. The structure aims at becoming an open-ended framework upon which other amenities can be attached.

This proposal is an interplay of the ephemeral and the stable: the structures decaying and gradually buried, public infrastructures being built on the new ground. This reflects the adaptive lifestyle of South Boston in 2100.

**Assessment**

As the end of this thesis, Phase 3 has been successful in presenting spatial details of the process of adaptive beach-building in South Boston. A typology has began to emerge that possibly will inform coastal neighborhoods with similar issues. However, the proposal has not yet fully engaged with the rich cultural implications of the site, which has led to a resolution that still feels somewhat imposed on the area. Although aiming to be applicable to more places, the project still needs to be grounded in the context of this particular site and be respectful to its historic heritage. The dialogue needs to be carried on as to how the project can truly speak to the nature of the community in 2100.

Additionally, the lack of quantitative analysis of the proposed sand accumulation is also hindering deeper understanding of the intervention. More physical model testing should greatly inform further decision making.



# Overall Assessment



# Final Conclusions

After all three phases of investigation, it became clear that a coastal neighborhood like South Boston needs to carefully examine consequences of sea level rise and seek ways to live with the rising water. In this particular neighborhood, potential flood will not only put critical infrastructures and open spaces in danger but also cut off the community from the larger city. However, the site has the advantage of owning a width of natural sandy beach, which has the potential of becoming a buffer zone between the community and the water.

South Boston needs build itself up against the projected rising sea levels and protect its residents from major property loss. Conventional defense strategies such as seawalls will likely be easily successful in providing a quick strong solution to the problem. But it might also turn the existing natural water edge into an isolated, man-made, and solid edge. However, given that there is a generous width of sandy beach, it could possibly allow a much slower and gradual protection process. Such is the proposal of this thesis that a seed intervention can be put in place to trigger a process driven by the natural forces such as water and wind movements. With a much softer and process-driven solution than the seawall, the water edge will continue to be accessible and occupiable. This process acknowledges the culture of South Boston residents and their long-loved “private” beach but also develops their new identity associated with the rising water.

The main purpose of this investigation is to understand and utilize the dynamics among the neighborhood, the public sandy beach, and the rising water. The study draws from South Boston’s history of land-filling as well as

other land-building precedents and proposes a sand-accumulating system that will form land with the forces of the rising water. The evolving periphery will continue providing an accessible beach for the public as well as keep high tide from inundating the neighborhood. The investigation includes an in-depth investigation of how sand accumulates around fences and how to engage the community with this process. Essentially, as sand begins to accumulate and raise the ground as water gets higher, the sand fences will also need to continue building new layers to drive the ongoing process. In this case, both ground and the sand fences will continue rising with the water. On top of this growing landscape will be a system of muddy flat habitats, elevated boardwalks and platforms, bike trails, sand fences, and sand dunes that creates a transformed waterfront experience.

Another component of the investigation is to combine and extend terrestrial streets into potential water transportation ports. The proposal looks at South Boston as an island that needs to stay in connection with the greater Boston area in 2100, which implies a shift in transportation paradigm for the residents. As critical transportation infrastructures will be flooded on a daily basis, the community becomes a more pedestrian- and biking-oriented system, with public ferries introduced as the main transit method.

Finally, this thesis continues to question the neighborhood’s attitude towards water in 2100. The physical and programmatic proposals will have a great impact on how people perceive the harbor. Currently the beach is mainly used for sunbathing, swimming, and walking. These behaviors take advantage of the beach for its great view, the adjacent water, and the openness of space.

However, as sea level rise begins to threaten the survival of this community, residents’ mentality and behavior must change to embrace the new reality. The neighborhood needs to understand, respect, and work with the rising water and its consequences. Hence, this thesis advocates for collaboration and respect. New generations growing up around the beach will learn to protect it, nourish it, and still enjoy their intimate relationships with the water.



# Final Assessment

Within 3 weeks, Phase 1 was able to understand the system level of issues projected in 2100. It was unable to bring the problems identified into the site scale and generate practical strategies. The research in Phase 2 greatly narrowed down the targeted issues by zooming in to the site and focusing on one edge condition: sandy beach. This quickly pushed the project towards a specific strategy of incremental sand-building that protects the neighborhood from flooding in 2100. Physical model testing and drawing in different time frames has proved to be incredibly useful in understanding the physical implications of each intervention. Similar processes are also carried out in Phase 3 with detailed spatial designs of the intervention and infrastructures. This is the most grounded phase since a lot of assumptions made earlier need to be grounded and the concepts fully developed into physical forms. By continued investigation using physical models, a final decision about the process of sand accumulation was made. Since the thesis is aimed at picking one possible solution and pushing it to a more developed state, the study dropped a number of other proposals and didn't fully compare the options. A huge amount of time was devoted to testing different distances and density of dunes, which was not as helpful in explaining the project as expected. Should there be another phase, the investigation will retest the physical models with more possible formal configurations.

One major recurring problem is the lack of contextual associations. Since the thesis sets out to create a typology that should inform any number of similar projects, less attention was paid to the distinct features of South Boston. The focus has been more on commonalities than on site specificities. However, in reflection on the entire process, the project probably would have benefited by

being more grounded in the existing conditions and urban contexts. Since one of the goals of the proposal is to engage the community in multiple ways, it would have been much stronger if the design had spoken more to the historic and cultural aspects of the community.

Physical model testing has been a very effective tool to push the process forward. With this particular topic, the importance of understanding impacts of rising sea levels on the site has to do with both the physical topography of the land and the incremental change over certain time periods. Modeling at different scales has helped with understanding both the regional systems and the human scale implications of rising waters. Model testing has also been successful with the interventions proposed in this thesis in terms of ability to accumulate sand and relationship between the sand-building process and inner land.

The quantitative understanding of the rising sea level and proposed intervention has not been addressed well in this thesis. It hypothetically assumes the amount of sand accumulated over the next hundred of years will be sufficient to reach the projected mass. There's not enough evidence found that supports this projection. Also a study of how the proposed sand fences will accumulate sand in 1:1 scale would have benefited the project. With many educated guesses and assumptions, the thesis was able to get to a state where its effectiveness in flood prevention and human experience can be tested. However, much more hydrological and technical studies is needed to fully develop this proposal.

Another challenge has been to anticipate the future and to understand changes of the intangibles. To envision oneself a century from now is both extremely difficult and exciting. The ability to foresee how people's perception changes through time not only comes from grounded experiments with scientific backup, but also requires educated assumptions and bold visions. This thesis has aspired to begin drawing the big picture of South Boston in 2100 as a working and adaptive community. However, much more work is still needed to ground this vision in the daily dynamics of life in South Boston.



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