ABSTRACT

Title of Document:	INTERVENING IN PLACE; A RESPONSE TO EVOLVING URBAN COASTLINES
	Eric Guest Joerdens, Master's of Architecture, Spring 2013
Directed By:	Professor of the Practice, Peter Noonan, AIA, School of Architecture, Planning and Preservation.

The beginning of the Anthropocene signals awareness of human's ecological impact on the planet. With emerging technology, knowledge, and theory how can we re-design our built environment to align with ecological parameters? This thesis studies how architecture meets the needs of humans while honoring a place's environment. Through studying sea-level rise and urban areas, a hypothetical program emerges. A new institution is form around the Chesapeake Bay's rising seas and loss of heritage. A new museum of archaeology is sited in Annapolis, Maryland. Around Ego Alley ideas of place-making and regeneration are examined. The place formed around the institution is intended to adapt and utilize rising waters, while attempting to mitigate its' own greenhouse gas emissions.

INTERVENING IN PLACE; A RESPONSE TO EVOLVING URBAN COASTLINES

By

Eric Guest Joerdens

Thesis submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Master's of Architecture
2013

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Preface

In the age of the Anthropocene, the relationship between man and natural bodies of water is set to change. Global Warming, Sea-level rise and land sublimation have forged a "perfect storm" in the Chesapeake Bay region with land sinking and water rising up to four feet by the year 2100. This condition does not just affect the scientific and sustainability communities, with rising sea's the sites and places of Chesapeake culture and history will be inundated. Rising waters threaten multiple inhabited urban areas as well as thousands of archaeological sites in Maryland alone. This thesis asks two connected questions; how can built structures intervene at the juncture of land and sea, in order to adapt and prepare existing urban places to sea level rise, and how can we create a place that responds to the culture artifacts found in archaeological sites which would have been lost due to changing water levels?

For the purpose of investigating these questions of place, time and ecology, a hypothetical institution is born, The Chesapeake Cultural Heritage Museum. This institution houses the threatened artifacts discovered on these archaeological sites while the building itself exhibits new and best practices for water management between the urban and hydrological realms. Discussed throughout this document include understanding the intersection of ecology and urbanity, a brief and concise history of the ecological design movement, architectural precedents, site and program concerns, design approach and considerations, as well as a presentation of the most recent design for the Chesapeake Cultural Heritage Museum.

Dedication

To my family, for all their support along the journey.

Acknowledgements

I would like to acknowledge the many players who I have encountered in academia:

To my chair, Peter, you have guided me and taught me more than I could have imagined.

To my committee, Madlen and Powell, thank you for your time, wisdom, and encouragement throughout this process. I could not have formed this realm of thought and continued to ask questions without your help.

Many thanks to my many colleagues who put up with me and helped me along the way throughout this effort: Emma Crenshaw, Nick Tomaszewski, Mark Elliot, Jacob Bialek, Amber Wendland, Nicole Ng, Julian Goldman, Khara James, Ben Bates, Sarah Stien, Claire Dickey, Katrine McRainey, Sasha Petersen, Mike Taylor, Zhao Chen, and Tamir Ezzatt.

Thank you to the many teachers and professors who have helped me create this journey. Thank you to the students who asked questions, which sparked this adventure.

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Chapter 1: Intersecting Urban and Ecological Transects

Understanding the primal relation between man, water and the Chesapeake

Elements Interacting

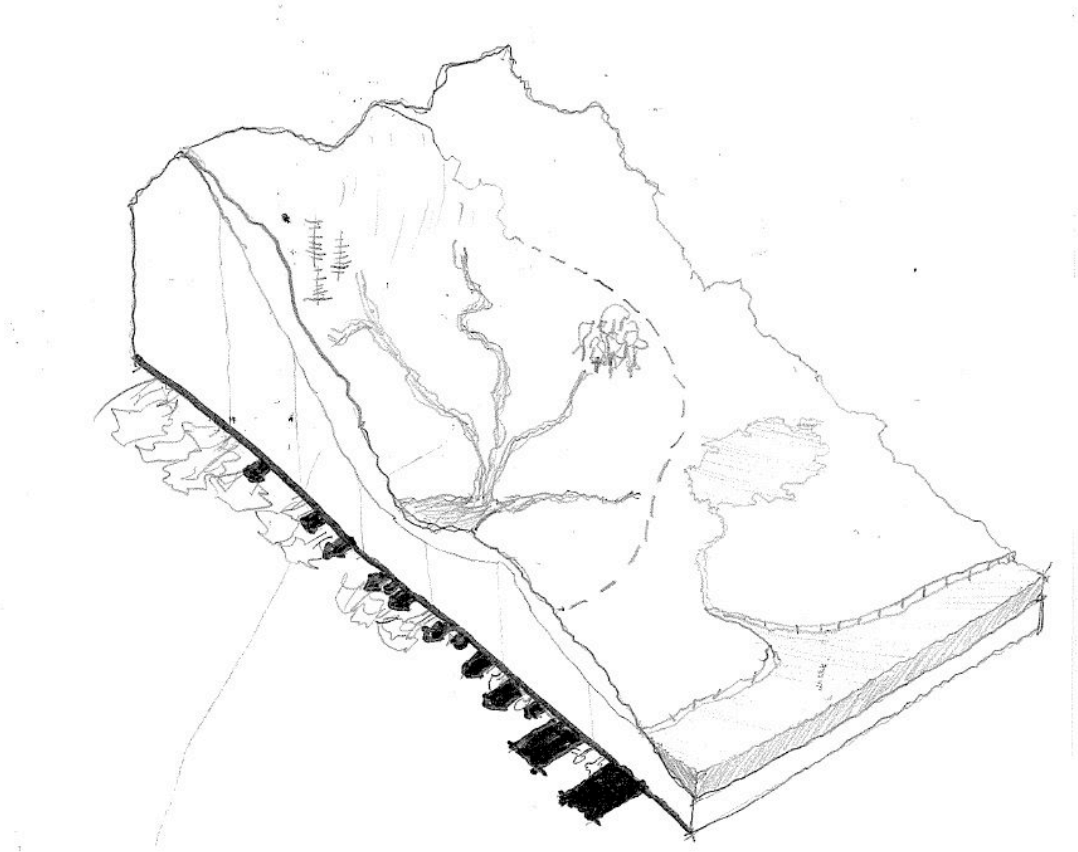


Figure 1 : Conceptual Superimposition of Urban and Hydrological transects. 2012. [Drawn by Eric Joerdens]

Architecture, an indelible mark on the landscape, manipulates the path and interaction of water through its form. In contrast to the static nature of architecture, water is in constant flux due to the incessant processes of precipitation, evaporation, and movement.

The movement of water acts as a vessel of collection and distribution for waste, trade, and cultivation by humans and animals alike. Paired with human intervention, the natural movement of water has led to desertification, pollution and the rise of the bodies of water throughout the world.

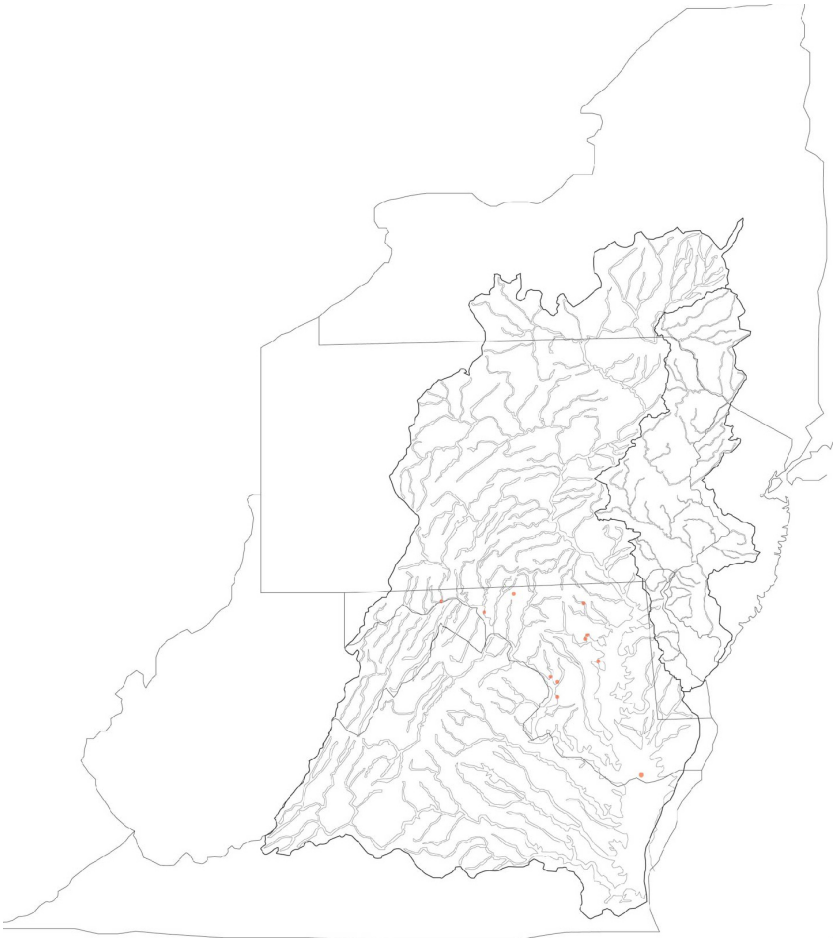


Figure 2 : A Geographic map of the Chesapeake bay watershed shown with state political boundaries. 2012. [Eric Joerdens]

Locally, it is clear that pollution from industrialized man has wreaked havoc within the Chesapeake watershed. Consequently, this pollution has decimated local

biodiversity, economy, and human recreation within the region. This loss of this cultural heritage will only be accelerated with sea-level rise in the 21st century.

Subsection 2

Before examining the relationship of the built environment and water, it is important to identify the expansive region of the Chesapeake. As a watershed, the Chesapeake is home to over 11,000 miles of shoreline and more than 3,600 species of plan, fish and animal species.[1] This diverse number of species is paired with a dense human population of 17.3 million people living in the watershed in 2010.[2]

Historically, the Chesapeake Bay watershed ahs seen continuous growth in human population. At the turn of the twentieth century, the population of the watershed was 5 million people.[3] In 1950 the population of the bay was 8.3 million people.[4] The Chesapeake bay region is continuing to grow, by 2030 the human population of the watershed is expected to reach 20 million residents. This continual growth, around 10 to 11% per decade, shows no sign of slowing down, as many of the country's large cities and economies are within the watershed. The density of urban areas correlates

[1] UMD WaterShed, December 21 2010. Transcript recited by Allison Wilson. "Watershed Digital Walkthrough." YouTube. https://www.youtube.com/watch?v=SZJe2CReFA8 [Accessed November 20th 2012].
[2] UMD WaterShed, December 21 2010. Transcript recited by Allison Wilson. "Watershed Digital Walkthrough." YouTube. https://www.youtube.com/watch?v=SZJe2CReFA8 [Accessed November 20th 2012].
[3] Ruark, Eric A. 2010. *Immigration, Population Growth and The Chesapeake Bay*. Federation for American Immigation Reform. pg7.
[4] Chesapeake Bay Program. Chesapeake Bay Watershed Population. http://www.chesapeakebay.net/indicators/indicator/chesapeake_bay_watershed_population [Accessed November 8th 2012].

with the Bay's main tributaries, as 80% of the bay's fresh water supply stems from three densely populated rivers, the Susquehanna, the Potomac and the James.[5]



Figure 3 : Human Population of Watershed, 1950-2030 (projected). [Image by Chesapeake Bay Program http://www.chesapeakebay.net/indicators/indicator/chesapeake_bay_Watershed_population]

This epidemic of building urban corridors along ecologic intersections extended beyond the Chesapeake. With the population of the United States expected to reach 438 million by 2050, there is a large imperative to rethink how the urban and hydrologic transecting overlap.[6]

[5] Ruark, Eric A. 2010. *Immigration, Population Growth and The Chesapeake Bay*. Federation for American Immigation Reform. pg5.
[6] Ruark, Eric A. 2010. *Immigration, Population Growth and The Chesapeake Bay*. Federation for American Immigation Reform. pg5.

Growth, Development findings.

The rapid growth and needs of the human population in the Watershed has taxes the environment beyond natural limits of equilibrium. The ecological strain of humans on the environment is summarized best by noted environmental scientist Tom Horton, "If the current economy and population growth never grew again, those of us already here are already overwhelming the bay."[7]



Figure 4 : Development creepts onto picturesque wetlands of the Chesapeake. [Image by Chesapeake Bay Program http://www.chesapeakebay.net/issues/issue/development]

[7] [8] Tom Horton, "Current recession a time to rethink growth," *The Maryland Gazette,* Juanuary 21, 2009. (http://www.hometownglenburnie.com/news/mdgazette/2009/01/21-14)/.

Environmental toll of Development



Figure 5 : Deadzones in the Chesapeake are destroying key habitat. [Image by Kevin Reming hhtp//jimbodouglass.blogspot.com/2008/12/crabs-dying-from-pollution-and.html]

Pollutants of the Chesapeake

Scientific assessment of the bays health has led to an understanding of human contributed pollutants within the watershed. The major culprits of current Chesapeake Bay pollution include nitrogen and phosphorus, as well as loose sediment on the sea floor. Higher than average levels of nitrogen and phosphorus create unnaturally high levels of algae growth in the water, thereby blocking the sunlight and stealing oxygen from the water and species (crab and oysters, etc) which depend on clear waters.[8] In turn, this effects fishing settlements across the Chesapeake region.

Contrary to popular understanding, a majority of these pollutants do not come from agriculture, rather they form from processes and flows of urban life. Excessive

[8] Chesapeake Bay Foundation. *What is Killing the Bay?*. Chesapeake Bay Foundation. http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/what-is-killing-the-bay [accessed October 15, 2012].

amounts of nitrogen and phosphorous are results from wastewater, septic tanks, air pollution, and urban and suburban storm water runoff. These pollutants and particulates are carried into our waterways from natural erosion and expedited erosion on construction sites.[9]

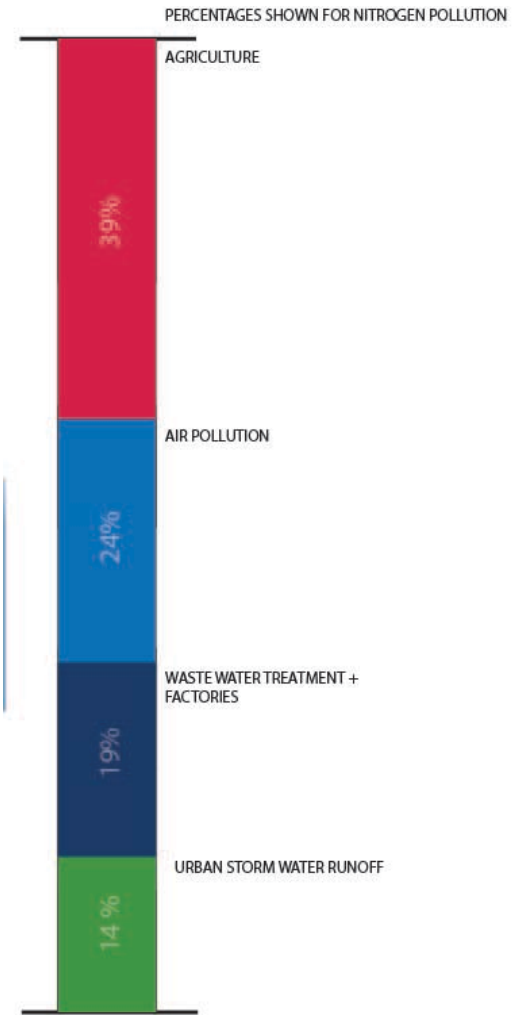


Figure 6 : Chesapeake Bay Nitrogen pollution by Source. Data courtesy Chesapeake Bay Foundation. [Images by Eric Joerdens]

Sixty percent of the urban water pollution is due to factors of urban and suburban storm water runoff, wastewater treatment & industrial factories, and air pollution caused in part by motor vehicles and electrical generation plants. This, surprisingly, leaves only forty percent due to agricultural runoff.[10]

This strain on the environment due in part to the built environment is taxing the forests and wetlands of the watershed of its ability

[9] Chesapeake Bay Foundation. *What is Killing the Bay?*. Chesapeake Bay Foundation. http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/what-is-killing-the-bay [accessed October 15, 2012].

[10] Chesapeake Bay Foundation. *What is Killing the Bay?*. Chesapeake Bay Foundation. http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/what-is-killing-the-bay [accessed October 15, 2012].

to filter these pollutants before they reach our waterways. [11] Consequently large *deadzones* in the Chesapkeae Bay appear where little to no aquatic life can live.



Figure 7 : 2005 Chesapeake Deadzone shown in void [Image by Eric Joerdens]

Deadzones are caused by diminishing the Bay's dissolved oxygen levels caused by previously mentioned factors. Without sufficient oxygen fish, crabs, and oysters are forced to suffocate in their typical habitat. These deadzones also fuel algae zones in estuararies typically full of underwater grasses. By this process, animal habitat and breeding grounds are compromised.[12] In 2005, severe lack of oxygen deadzone of the Chesapeake bay measured 87 miles long, from the mouth of the Patuxent River, near Baltimore, stretching past the Tappahannock river Virginia. [13] The extent of these deadzones are in migratory routes for fish and crab, decimating the population as pollution levels rise and unoxygenated regions grow.

[11] Chesapeake Bay Foundation. *What is Killing the Bay?*. Chesapeake Bay Foundation. http://www.cbf.org/how-we-save-the-bay/chesapeake-clean-water-blueprint/what-is-killing-the-bay [accessed October 15, 2012].
[12] Chesapeake Bay Foundation. *Dead Zones*. Chesapeake Bay Foundation. http://www.cbf.org/how-we-save-the-bay/issues/dead-zones [accessed October 15, 2012].
[13] http://www.eco-check.org/pdfs/do_letter.pdf

Loss of Bio-Diversity in the Chesapeake

The result of this pollution has been the loss of cultural and biological keystone species, namely the oyster, blue crab, sturgeon, and striped bass. This loss is contrary to the historical knowledge of biodiversity in the Chesapeake. Throughout time, the Chesapeake was defined by its bounty. Etymology of the word Chesapeake traces back to the Algonquin word meaning "great shellfish bay."[14]



Figure 8 : A diagram showing the wealth of 19th C. Oyster Reefs [Image by Eric Joerdens]

Throughout early colonial times, sailors and voyagers would remark about the clarity of the waters and how oysters blocked shipping lanes due to their large and abundant reef structures. The waters were cleaned and clarified by the oysters, whose reefs also provided dwellings and spawning grounds for crabs and fish.[15] Water quality benefited, the large population of oysters filtered the entire volume of water of the Chesapeake in three to five days. Currently, that task takes

[14] Tom Horton, "Current recession a time to rethink growth," *The Maryland Gazette,* January 21, 2009. (http://www.hometownglenburnie.com/news/mdgazette/2009/01/21-14)/.
[15] NOAA, Chesapeake Bay Office. "Oyster Reefs." Accessed October 8th 2012. http://chesapeakebay.noaa.gov/oysters/oyster-reefs

well over a year. Accordingly, the waters of the Chesapeake were pristine, and it was possible to see, with the naked eye, to depths of at least twenty feet.

As the Chesapeake region became more industrialized, the rich harvest its waters offered began to decline. Pollution began to contaminate the bay, affecting the life dependent upon its waters. This boom in human production levels is consequence of man's removal from natural limits, due in part to technological advances.

During the 19th and 20th centuries mans capability of harvesting exceed natural limits. Industrialized processes created new heavy metal and petrol based pollutants which nature is largely unequipped to handle. As agricultural became infused with chemistry, new pesticides found their way, through gravity and the hydrologic cycle into our large bodies of water. Simultaneously, industry blossomed and cities became more polluted and residents began to move out, developing the landscape into current suburbs. This further exploited and taxed our water resources; as a result, life dependent upon the waters has plummeted.

Vexingly, this lack of biodiversity has avoided public interest at large through the globalization of the food market, which is able to meet local demand for cultural seafood staples.

This shifting baseline of the bays biodiversity and our own recognition of the situation is caused in part from a perceptual separation of the built environment and

the larger environment. Housing developments with paved driveways, streets and roofs are causes of the bays degradation. Large Farms continue to grow further into the hinterland and stress the hydrological cycle. However, it is rarely noted that the casual citizen is actively harming the health of their water systems through daily processes which are dependent upon the built environment and infrastructure. This sense of removal from nature is a major cultural factor to the pollution of the Chesapeake bay. As architecture is the meeting place of man, society and the land, it is imperative that we form an architecture which re-aligns its values with larger natural flows.

Regeneration of the Chesapeake

Cleaning habits and waters

Over the past decade, the bay has gone through a mild resurgence. Pollution levels are beginning to be monitored and controlled, and some species numbers are growing. This is largely due to an effort to clean the waters of the Chesapeake Bay. Though improvement is underway, it is important to remember the role urban areas and infrastructure have in the Chesapeake Bay watershed. As such, it is important to strive for best practices of storm and waste water treatment on any site in the built environment. Likewise, reducing fossil fuel us and utilizing renewable energy will help the ecology of the bay.

Mitigating and adapting to reality

Within these best practices lies the harsh reality associated with sea-level rise. Our urban areas will need to adapt to higher waters, and any intervention should not contribute to further emissions, which cause sea level rise. This concept aligns with

department of natural resources guidelines and definitions. To the state, mitigation of sea level rise is the reduction of greenhouse gas emissions in order to stop or curtail climate change at a global scale. Adaptation is an adjustment in natural or human systems that respond to actual or expected climatic stimuli or their effects. These can moderate, harm or exploit beneficial opportunities.[16]

Rising Seas, Losing history

Archaeology and sea-level rise

Current urban areas are not the only settlements which lie in the inundation areas. Within the state of Maryland there are over 12,600 archeological sites which are known and inventoried. Of those sites, 2539 lie within vulnerable areas between 0-5 feet above sea-level. By 2113, all of these sites are projected t be inundated.[17] Largely situated around the coastline of the Chesapeake, these sites can be separated into three broad categories, Colonial America, Contact period, Paleoindian. Each category represents past settlements and interactions between humans and the bay. The Paleoindian period spans from 9,000 to 11,000 BC when many people depended upon the bay for their entire livelihood. The Contact period represents the time between European Contact but before colonization. Also in jeopardy are the colonial settlements which began in the 17th century and subsisted in places like Kent and Holland Island as well as around the shorelines of Maryland.

[16] Johnson, Zoe. "Climate Change Adaption Planning in the State of Maryland". Office for a Sustainable Future. Maryland Department of Natural Resources. Climate Resilience: Mitigation + Adaptation. 2013.
[17] Johnson, Zoe. "Climate Change Adaption Planning in the State of Maryland". Office for a Sustainable Future. Maryland Department of Natural Resources.

Colonial Sites along the Chesapeake



Figure 9: House on Holland Island, MD, A colonial development. This house is now partially submerged and destroyed. [Johnson, Zoe. "Climate Change Adaption Planning in the State of Maryland". Office for a Sustainable Future, Maryland Department of Natural Resources]

Along the Chesapeake global warming is accounting fro rising seas. However, the region is also unique as the land around the bay is subsiding. This dual threat places all low lying areas, urban and historic closer to the coastline each day. Already islands and settlements are being lost and the culture around the bay, the watermen is dissipating with the land.

A call for harvesting the collections

With over 3,000 miles of coastline the Chesapeake bay is much to broad to prevent all land from being inundated. Urban areas represent significant investments in infrastructure, buildings and commerce and also lie in inundation zones. This thesis

examines ways to adapt these urban areas to higher sea's while respecting and representing the loss of rural and less dense land. By surveying, digging and depositing the findings of 2,500 plus archaeological sites in a new institution we can adapt an urban shoreline for higher seas while allowing the story of coastal living in the Chesapeake throughout time to be on display.

This new museum, which would house the collections of Maryland's coastal archaeology can serve as a cultural reminder of how to perhaps live more sustainably and locally as well as servings as a call to change our current emissive society. The museum itself can serve as a method of adapting an urban shoreline while also finding innovative ways to mitigate and utilize the rising seas for human and ecological needs.

Conclusion and Generation of Principles

A Paradigm shift

As the science of ecology develops, new information about the interconnectedness and consequences of our actions and how they relate to the larger environment develop. In architecture, we can adapt knowledge into environmentally based best practices for the built environment. Through theory, conceptions of how to implement regenerative ideas develop and applications of thought are designed. These applications strive to balance urban needs with ecological parameters.

Chapter 2: Ecological Design, a synopsis

Introduction to the ecological design movement

An evolving knowledge base

Ecology is largely a new science, founded in the last part of the 20th century. Rooted in the interconnectivity of species, processes, and natural flows a basis of understanding is constantly evolving. This chapter focuses on the design professions developing contact with nature through theoretical approach and application. It argues that actions taken by designers throughout history is dependent upon the prevailing knowledge of the time, examines current theories. These theories are then examined pragmatically, through investigating current ideologies of developing with sea level rise, wastewater solutions and energy generation in order to design a structure which is infused with a localities natural processes.



Figure 10 : Aerial image showing an uninhabited section of the Chesapeake Bay. [Image by Outward Bound Baltimore http://outwardboundbaltimore.org/wp-content/uploads/2012/08/ChesapeakeBayProgram.jpg]

"Design with Nature"

Theoretical approach: The evolving landscape of man

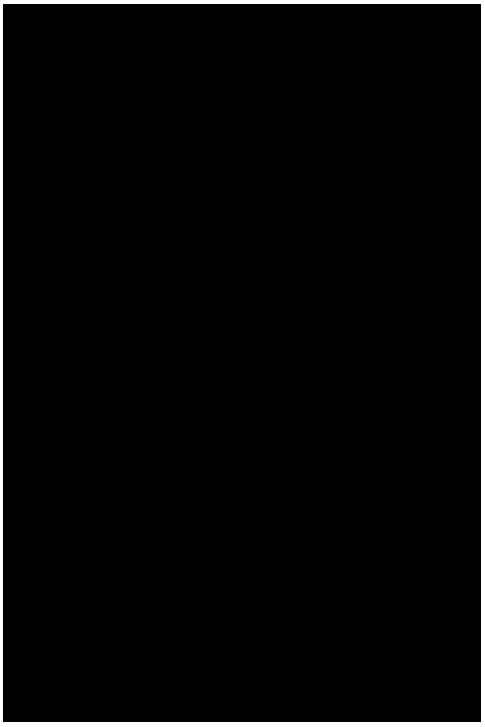


Figure 11 : Man imposing form into the landscape. Villa Farnese, Caprarola Italy. [http://www.gardenvisit.com/history_theory/library_online_ebooks_ml_gothein_history_garden_art_design_early_baroque_gardens_italy]

Concurrently with each successful revolution of man, a different outlook of her relationship to nature emerges. This section tracks the evolution of man's value between nature through time to suggest a coming alternative to the dominant, industrial view characterized today. This current view, which is all but a hangover from the industrial age seems outdated when placed in context of the knowledge and technology of the current beginnings of the Anthropocene. From its known beginning of the Native American, to the development of the western philosophy through the Italian Renaissance and humanism, the French Baroque, and English Romanticism, to the current outlook through the lense of industrialization the relationship of man and nature has constantly evolved.

Non-Western ideas of intervening with the landscape were formed through an understanding of living with it's bounty. From initial over exploitation of the land, the hunter gatherers of the America's adapted to the capacity of the land to provide fruit and

meat.[18] Through tradition and religion the Native American acquired and exploited empirical knowledge of the various fluxes of the landscape, climate, and creatures.[18] McHarg categorizes the dominant viewpoint of this era, "It was believed that the actions of man in nature can affect his own fate, that these actions are consequential, immediate and relevant to life." This *deference* to the landscape formed the basis of a sustainable society, "where members could promise their children's inheritance of a physical environment at least as good as it had been inherited." [19]

In America this view was dominant until the time of European Colonization. Concurrently, contrasting viewpoints in Europe were evolving. Contrary to the view of the Native American, the renaissance humanist expressed an anthropocentric view of nature. This era was in line with the western tradition, where man presumed power over nature. The authority of man was prominently dictated with a simple Euclidean geometry upon the landscape, with the geometric garden as proof of man's superiority.[20] This can be seen initially in the gardens of Florence ,and progressively implemented again in works of the great renaissance architects of Raphael, Palladio and Vignola.[21]

[18] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 67
[19] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 68
[20] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 71
[21] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 70



Figure 12: Man Extending his realm infinitely into the landscape. Versailles. [http://www.mtholyoke.edu/courses/rschwart/hist151/versailles_plan1.jpg]

The relationship between man and nature evolves during the French Baroque. According to McHarg "the same anthropomorphic simplicity was applied at larger scale to the flat and docile landscape. Through the work of Le Notre vectors of man were cast upon the landscape. These lines were the regulators of outdoor rooms and "testimony to the divinity of man and his supremacy over nature." [22]

[22] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 71



Figure 13 : Stourhead. An English landscape which is formed from and by the site. [Image courtesy http://arquitecturaxviiiyxix.blogspot.com/2008_09_01_archive.html]

Through a western lense, the largest single outlier is the 18th century English landscape tradition. This era begins a transition to the modern viewpoint, where designers such as Sir William Temple and Lancelot "Capability" Brown, "leapt a fence, and saw that nature was a garden."[23]

In this tradition gone were the classical image of imposing geometry onto the landscape and a new emergent principle came to fruition, in which process and form

[23] Walpole, Horace, *Anecdotes of Painting in England with some Account of the Principle Artists,* collected and digested by George Virtue, Henry G. Bohn, London, 1849, Vol. III, p.801.

became indivisibly linked through the changes of nature.[24]

The most recent phase is that of 19th and 20th century industry. In this era, the major viewpoint aligns with that of conquest and exploitation of nature, however now there is an added caveat of large, mechanized tools.[25] Begun with the American and French revolutions, there is increasing consciousness in this era for social justice, yet the landscape remains ever marginalized. Counter movements of ecological conservation have emerged which challenge the divine right of man to exploit the landscape.



Figure 14 : Crystal Palace. An early representation of Industrialized man consuming nature. [Image http://www.studenthandouts.com/01_Web_Pages/01-Picture-Pages/10.07-Industrial-Revolution/Crystal-Palace-Great-Exhibition-Hyde-Park-London-1851.htm]

[24] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 73
[25] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 75

Currently, we have evolved past the industrial economy, yet principles of its exploitative relationship to nature remain, as a result we are victim to pollution and marginalization of land and water. This thesis looks towards the future in how to create an architectural/infrastructural relationship which lies in harmony with natural flows. McHarg challenges us to align our environment with nature through a simple challenge, "If one accepts the simple proposition that nature is the arena of life and that a modicum of knowledge of her processes is indispensable for survival and rather more for existence, health and delight, it is amazing how many apparently difficult problems present ready resolution."[26]



Figure 15 : Naturalized Landscape evolving from an industrial past. The Highline, NYC [Image by Rachell Boyer. April 4th 2012. http://urbantimes.co/2012/04/brooklyn-the-high-line/2012_03nature-and-industry-on-the-high-line-w-border/]

[26] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 7

Using the preposition *with*, McHarg links biological processes and human cooperation. Though this implication of designing with nature creates restrictive bounds, this framework yields more creative and environmentally aligned solutions to problems of development, infrastructure and the built environment.[27] Through studies and examples of McHarg's applied theory a set of principles can begin to be developed towards creating environmentally aligned buildings, which act as a living infrastructure. Noted examples of McHarg's work include building on coastal grounds, response and processes of values, the river basin, and the evolution of a city.

Theoretical Applications: Designing for a ravaging tide: storms development and despair

In examining shoreline development, McHarg submits to the idea that nature is process, interacting, responding to laws, and represents values and opportunities for human use with certain limitations and prohibitions.

McHarg compares the New Jersey Shoreline to The Netherlands. Two barriers emerge which protect development from the sea, dune (natural) and dike (infrastructure).[28]

The dune, as claimed by McHarg, with its sand piles and grasses are able to accept storm's waves and absorb their forces. Typically, three zones of natural defense are formed for waves and storm surges against rising waters, the beach, the primary dune, and the secondary dune. Each zone plays its respective roles in defending inland areas from the ravaging seas. All three of these zones are dependent upon basic needs; groundwater, preservation, and land regeneration.

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[27] McHarg, Ian. *Design with Nature.* New York. Natural History Press. 1971. pg viii.
[28] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 7

The first of the natural defensive zones, the beach, is tolerant to human use and constantly changing and the tides clear out debris. The next zone, the primary dune, is intolerant to human intervention and is a great protector of development behind it. This zone also comprises the inland dune, a second line of defense, as venerable as the primary dine, but of higher elevation and therefore more protection. The third zone, begins at the back dune and continues to the bay shore. The bay shore itself is relatively fragile, as it represents one of the most reproductive ecosystems in the world.[29] The development of a set of principles towards life by the sea is imperative to ensure a lasting enjoyment of the delight of water.

"Landscape Urbanism"

A basis for implementation

Landscape Urbanism, a movement coined by Landscape Architect and theorist James Corner, suggests a new hybrid discipline, not unlike the merging of biology and technology (biotech), in order to open new possibilities for the built environment.[30] The intent is to evoke new urban forms based on process, flows and textures which emerge from work, function and procedure as opposed to form. Landscape Urbanism involves the understanding of mixing ingredients in order to produce a rich, vibrant urban ecology.[31]

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[29] McHarg, Ian. *Design with Nature*. New York. Natural History Press. 1971. pg 13
[30] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p58.
[31] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p58.

In viewing the city as a living ecology, the theory offers no best practices, rather the impetus to engage in the Through cross-discipline applications and indeterminacy of resolution, five main themes are paramount; horizontality, infrastructures, forms of process, techniques ,and ecology.

Processes

The shift towards processing society as horizontal is an emerging trend in our society today. The social revolution today has caused shift in emphasis from one to the many, from an object to fields, and the evolution from singularities to *open-ended network.*[32] This should have implications on our built environment as we shift away from centralized infrastructures to more agile, local based technologies. This assembling and moving can connect and route our neighborhoods while allowing differences to comingle and proliferate.[33]

Corner argues that the shift to *horizontality* establishes a vast organizing field which can serve as substrate to future development, in itself developing an infrastructure.[34] Landscape urbanism charges the designer to implement and orchestrate *infrastructures which perform and produce*.[35] In tradition site and urban design, this might include earthwork grading, drainage, soil cultivation, vegetation, land management, roads, utilities, and bridges. Through the generation of performative

[32] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p59.
[33] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p60.
[34] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p60.
[35] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p60.

effects, these infrastructures can imbue effects and production into their form.[36] With form, Landscape Urbanism stands apart from traditional aspects as it argues that traditional techniques rely on the presumption that spatial order can control history and process.[37] Urban Geographer David Harvey challenges designers to become less interested in form and more concerned with "the advancement of a more socially just, politically emancipating and ecologically sane mix of spatiotemporal production processes."[38] Here the emphasis shifts from, 'what things look like to how they work and what they do.'[39] Corner does not understate the importance of *form,* rather argues it be valued *'not only for aesthetic and qualitative aspects but also for their instrumental and productive effects.'*[40]

Dependent upon this *simultaneity*, is technique, or perhaps the process of craft. Dependent upon successful technique is the exploration of a diversity of perceptions and synthesis of the deferent design agents at play in the built environment. Through this process emerges a vision of a more wholesome and heterogeneous world which celebrates these processes and flows.[41]

The foundation of landscape urbanism is the evolving science of ecology. It is the science

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[36] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p60.
[37] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p61.
[38] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p61
[39] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p61.
[40] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p61.
[41] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p62.

which 'teaches us all life is bound into dynamic and interrelated processes of codependency'. [42] Landscape Urbanism *infuses the built environment into a larger ecology,* claiming that cities and infrastructures are just as 'ecological' as forests and rivers. In this mindset, the designer is then challenged to respond to soft systems, which have the capacity to absorb, transform and exchange information with its surroundings.[43]

Principles adapted

Landscape urbanism revises the traditional realm of form based design to that of a process which actively stirs ecologies in order to restore and reinvigorate new ecosystems and create new kinds of public space. Through *simultaneity* of designing the built environment within its larger ecology, landscape urbanism forges new paths and opportunities for the design profession based upon generating and evolving horizontality, infrastructure, technique, process and ecology.

"Cradle to Cradle: Rethinking the Way We Make things"

Towards a zero waste mentality

Architect William McDonough and Chemist Michael Braungart advocate that humans can contribute positively to the environment at large. In *Cradle to Cradle: Rethinking the way we make things,* the two argue that industrial infrastructure is outdated and detrimental, as it is powered by bestial and artificial sources of energy which are

[42] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p62.
[43] Mostafavi, Moshen " Landscape Urbanism: A Manual for the Mechanic Landscape." 2003. Architectural Association. Spain. p58.

environmentally depleting.[44] They theorize that instead of creating an infrastructure, which works by its own rules, humans should endeavor to create a built environment that is inextricably linked to the flows of nature.

Like McHarg, McDonough and Braungart see potential through a designed utilization of systems, that is the output of one creature are the imports to others.[45] This simple idea leads to what McDounough and Braungart have termed the *Waste equals Food* concept. This theory aligns human practice with nature, operating within a system in which there is no such thing as waste.[46] Earths main nutrients carbon, hydrogen, nitrogen, and oxygen, which constitute 99% of organic bodies, are continually cycled and recycled through life flows.[47]This cradle to cradle system has nourished the planet, creating a diverse and thriving ecosystem for millions of years. Until recently, it was the only system, and every living thing was a member.[48]

With the advent of industrial process, a new realm of processes has been created through recycling metals and plastics, that of technical flows.[49] McDonough and Braungart argue that if products designed by humans exclusively stay within one realm or the other, than the purity of the nutrients will not be disturbed and a re-use of recycling of the product can occur.

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[44] McDounough and Braungart. *Cradle to Cradle: Rethinking the way we make things.* North Point Press. New York. 2003. p17.
[45] McHarg, Ian. *Design with Nature*. pg45.
[46] McDonough and Braungart. *Cradle to Cradle: Remaking the way we make things.* North Point Press. New York. 2003. p92.
[47] McDonough and Braungart. "Cradle to Cradle" New York. 2002. p92
[48] Ibid.
[49] McDonough and Braungart. "Cradle to Cradle" New York. 2002. p109

Waste Equals Food

When addressing the issue of wastewater, it is important to remember that something considered vile in our realm are welcomed as nutrients to various plants and animals. Originally sewage treatments was conceived of as taking active biological waste (urine and excrement) and render it harmless through microbial and bacterial digestion. Currently, large centralized sewage treatment plants lie far our of the public realm and fall victim to unintended wastes of chemicals, pharmaceuticals, and household wastes and cleaners.[50]

"Rising tides and the Chesapeake Region"

In Preparation of Sea-level Rise

When constructing on the coast, new and specific necessities emerge in relation to sea level rise and storm surge. This thesis will examine they projected rise by year 2050 and 2100 as a measure for sea level rise. By year 2050, sea level rise is expected to reach one foot.[51]

By 2100, sea level rise is projected to between 3 and 4 feet. An annual storm will add 2 feet of storm surge and a 100year storm, another 4 feet of storm surge. Altogether, this projects to a potential 4 foot permanent rise in sea-level, and temporary rises to 8 feet above current levels.[52]

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[50] McDonough and Braungart. *Cradle to Cradle: rethinking the Way We make Things.* North Point Press. New York. 2003. p 101.
[51] Chanse, Victoria. "Civic Engagement on Climate Change in Dorchester Cunty, MD." Publication by Depatment of Plant Science and Landscape Architecture at University of Maryland. 2011-2012.
[52] Chanse, Victoria. *Dorchester Workshop*.

With eminent rising waters, how can new construction become durable and resistant to this flux and how might it offer protection to existing structures which lie in harms way of rising waters?

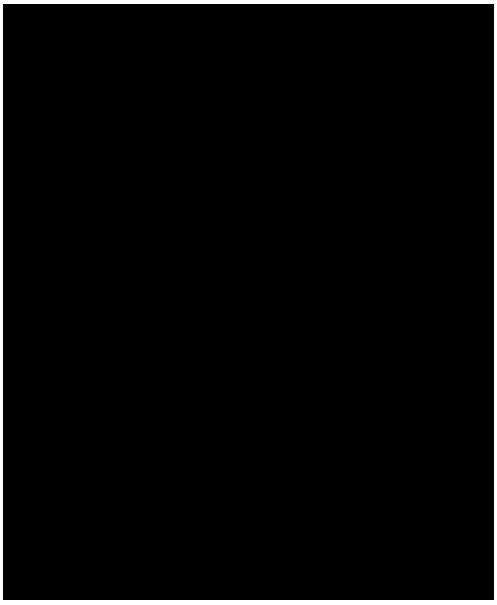
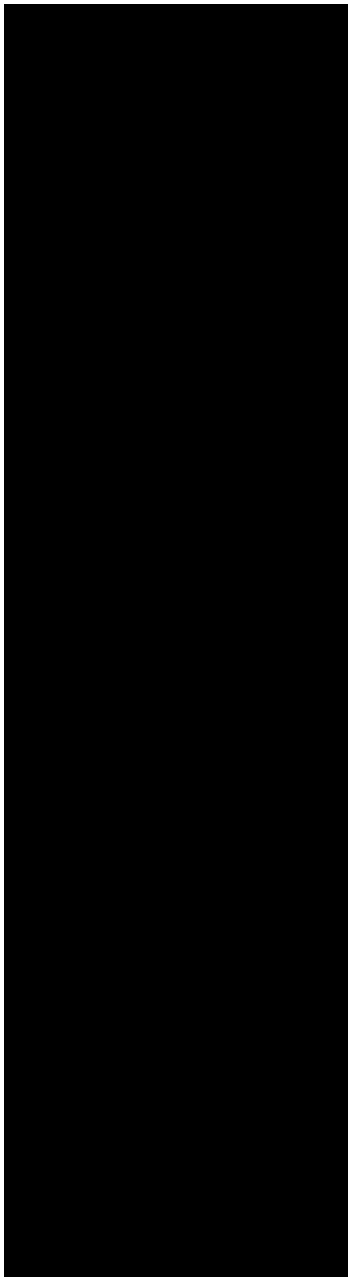


Figure 16 : Potential relative sea level rise in the Chesapeake. Land inundation shown in red. [Source: Chesapeake Adaptation http://www.chesapeakeadaptation.org]



Figure 17 : Land inundation due to Sea Level Rise, Anne Arundel County, MD. Note US Naval Acadamy Region. [Source Chesapeake Adaptation http://www.chesapeakeadaptadation.org/]

Options for the built environment



Dr. Chanse provides three projected possibilities of the built environment and its relation to sea-level rise; *business as usual, build for resilience and protect*.[53] In each case, a different type of construction methodology is used to protect habitat, architecture, and infrastructure.

In Business as usual also known as the current status of the Chesapeake shoreline, roads, shoreline and houses allow flooding. This method is advised for when investments in resilience and protection are not practical nor possible.[54]

The case of Build for Resilience, roads and dwellings are raised on pilotes, or their elevation raised with cut and fill to allow the water to pass, unrestricted beneath the new elevated ground plane. This case is recommended when facilities need to be designed to withstand flooding and storm surges.[55]

[53] Chanse, Victoria. *Dorchester Workshop*.
[54] Chanse, Victoria. *Dorchester Workshop*.
[55] Chanse, Victoria. *Dorchester Workshop*.

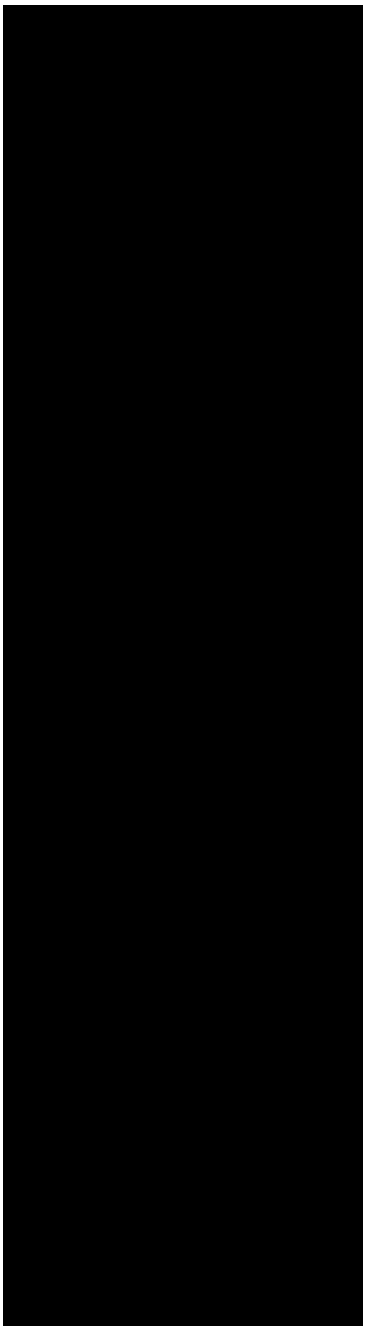


Figure 18 : Principles of resilience for sea-level rise. [Image source Victoria CHanse 2011-2012 Transiciplinary Project: Civic Engagement on Climate Change in Dorchester County, MD]

The final case, entitled Protect, involved the construction of a levee or wall to act as a protector of existing infrastructure. This idea, is similar to the role that dunes play in coastal development (See McHarg, design with Nature). This case, according to Chanse, is recommended for when buildings and facilities cannot be moved or rebuilt, as protection involves construction of protective walls and levees.[56]

> Principles generated for site and the Rising Tides Exhibtion.

In a similar manner, Lewis Tsurumaki Lewis Architects, proposed a "Water Proving Ground" for Jersey City and Lower Manhattan. In this scheme, This slope exploits rising sea level and dynamic fluxuations in water (create existing and proposed cut and fill for scheme). Hard edges and soft slopes coexist to create a diversity of landscapes within the new coastline. Floating docks rise and fall with the tide, creating a constant pathway to experience the ephemeral changes in water.

The theory of living with sea level rise and the conceptual design application yield multiple principles for moving forward. The construction application of mitigating, protecting, and circumventing sea-

[56] Chanse, Victoria. *Dorchester Workshop*.

level rise is imperative in any new, coastal construction. This is especially important where historic areas exist that are susceptible to the destruction of rising water. Moreover, the ability to inhabit, research and learn from these areas could produce a new experience on occupying the water's edge.

A Summary and generation of theoretical principles.

Subsection 1

Conceptual and applied theory create an ideological substrate to investigate the potential of design to merge with natural processes. superimposing these ideas onto already built projects can yield a more solidified framework for a design proposition.

Chapter 3: Architectural Precedent

Introduction

Developing designs with nature

This chapter investigates limited historic and recent examples of design professions engaging in infrastructures and place. Examples include cultural paradigm shifts about the treatment of public works and places, to conceptual and built applications of designing for sea-level rise, cleaning waste water and harnessing natural electrical generation potential.

The Design Professions and Wastewater

Olmsted: Amenity as Infrastructure

At the request of the city of Boston, Olmsted designed a sequence of parks which responded to *flooding* tides and the need for *sewage treatment*. The commission to clean the back bay with a park grew out of Citizen's concern when the tide left and residue would lay odiferously on the mudflats.[57]

[57] Zaitzevsky, Cynthia. *Frederick Law Olmsted and the Boston Park System.* Belknap Press. 1992.



Figure 19 : Olmsted's Fens, wetland area is highlighted around a meandering streat to the Charles. [Image Source Zaitzevsky p54]

The Fens was to be a park that serviced people with experiential delight and the city through a sanitary improvement plan centered around marsh grasses. The plan which centered around a meandering watercourse and marsh grasses, was not well perceived as it was not a traditional parkscape. Determined, Olmsted pushed the idea of the park through primarily by stating the need of sanitary improvement.[58] The majority of the sewage was exported to the Charles through a conduit, which was common practice at the time.[59] The wetlands served both as a restorative place for habitat that had left and also serving as a flood zone where in times of need additional acres could be flooded due to the parks wetland condition.[60]

This absorbed about half the acreage of the park, as a result, recreational activities could take place in only half the park. The Fens was complete in 1895, unfortunately the salt marsh design Olmsted campaigned so heavily for lasted only another 15 years. The tide system used to regulate the waters was overused and

[58] Zaitzevsky. p54
[59] Zaitzevsky p57.
[60] Zaitzevsky. p57

overloaded rendering the salt water marshes obsolete.[61] Nevertheless, the Fens design was executed with the vision of the built environment working with natural flows to help solve infrastructural problems of tide and waste water.

Lott Clean Water Alliance

Miller Hull designed a wastewater treatment headquarters inverts the experience the typical urban American has with water infrastructure in a building. The LOTT Alliance Regional Services Center, aims to make the invisible processes of water infrastructure visible, while harvesting energy from the water treatment process itself. By making these processes didactic details of the buildings architecture, LOTT aims to educate the public to become stewards of water conservation.[62]



Figure 20 : Exterior rendering of LOTT Clean Water Alliance. [Image source: Inhabitat http://assests.inhabitat.com/wp-content/blogs.dir/1/files/2010/08/lott-ed01.jpg

[61] Ziatzevsky p57
[62] Kolleeny, Jake. "Waste Not, Want Not". Green Source the Magazine of Sustainable Design. Volume Six Issue Two. March 2011. New York New York. p54

The 32,5000 square foot facility treats 85,000 residents of the Olympia, Washington Region. The facility is comprised of three components, laboratory, office, and educational center, which serves as a place of outreach and a coming children's museum. The landscape plans invoke the construction of an outdoor educational park, with water conservation as a theme, linking the building to the new museum.[63] The project uses Class A reclaimed water-which is approved for all uses except drinking – as both amenity and symbol. Through the overt use of water within the complex, a water plaza connected by bridges, the building rests surrounded by a pond, creating the illusion of the building floating on water.[64]

In the spirit of conservation, the buildings facades and glazing are all executed in different ways to react to varying solar orientations. Inside, daylighting strategies where determined based upon a "30-foot rule". This requires that all interior spaces be sited less than 30 feet from exterior glazing in order to have access to natural light.[65]

The byproducts of LOTTS waste water treatment are used on the campus. Resultant methane from process is reused within the building to heat, cool and power the facility.70[66] Paired with the buildings mechanical and domestic hot water systems, the building sees a 35% reduction in carbon emissions, and 42 percent in energy use compared with ASHREA 90.1-2004 energy code. The reclaimed water, treated to tertiary standards, us used for plumbing within the building, supplies water to the exterior pond, and irrigates the ground and green roof. This ultimately creates a

[63] Kolleeny, Jake. "Waste Not, Want Not". pg 55
[64] Kolleeny, Jake. "Waste Not, Want Not". pg 65.
[65] Kolleeny, Jake. "Waste Not, Want Not". 65.
[66] Kolleeny, Jake. "Waste Not, Want Not". pg 66

savings of .30 cents on the dollar when compared to potable water usage during these processes.[67]



Figure 21: Diagram of treated water and its location and purpose of reuse. [Image source Inhabitat: http;//inhabitat.com/elegant-lott-clean-water-alliance-building-shows-the-sexier-side-to-water-treatment/lott-clean-water-alliance-6/]

Through innovative processes within the architecture through didactic details, Miller Hulls linkage of architectural and infrastructure serves as a model for waste water reuse and cultural change. LOTT Executive Director Michael D. Strub sums up the goal of the project best, "The aim is to create a natural resource educational destination that will ensure that the next generation has a greater appreciation for the benefits of conservation and reclaimed water reuse."[68]

Oyster-tecture

Led by Kate Orff, Scape studies formed a conceptual project around cleaning the highly polluted Gowanus Canal between Governor's Island and Red Hook, Brooklyn in New York City.[69] In spirit to rejuvenate the local community and canal water quality, the concept was centered around a park-like development of oyster reefs which would also serve to protect against rising tides.

[67] Kolleeny, Jake. "Waste Not, Want Not". pg67.
[68] Kolleeny, Jake. "Waste Not, Want Not". pg 65
[69] Bergdoll, Barry. "Rising Currents: Projects for New York's Waterfront". The Museum of Modern Art, New York. 2011. p 90

Scape devised of a structure, comprised of piles and a web of rope, which serves as substrate for oyster colonies. These oysters would begin their natural process of cleaning and regenerating, creating reefs which would cleanse millions of gallons of harbor water per day.[70] These Oyster reefs, with the help of mussels and eelgrass, are wave-attenuating structures which protect the adjacent shoreline. Moreover, these reefs act as purifying devices, taking sewer overflow and removing detritus by using the oyster as a natural filter.[71]

The aggregation of oyster reefs over time not only helps purify the waters of the Gowanus Canal, but also helps direct public life around the water. Through a network of paths and edges, recreation outlets are created which recenter the Red Hook community on the cleansing of water.[72] Oystertecture reintroduces the historically prominent reefs which protects inland neighborhoods and creates a protective, cleansing, and generative agent in the harbor.[73]

Energy Generation

Chesapeake Bay foundation

Built in 2001, The Philip Merrill Environmental center is an example of the building working with its larger environment. Not only does the Foundation headquarters boast composting toilets and a rainwater catchment system to minimize water usage, but cisterns are also used as storage for collected water. A simple sand filter treats rainwater

[70] Bergdoll, Barry. "Rising Currents: Projects for New York's Waterfront". p 90
[71] Bergdoll, Barry. "Rising Currents: Projects for New York's Waterfront". p.90
[72] Bergdoll, Barry. "Rising Currents: Projects for New York's Waterfront". p92.
[73] Bergdoll, Barry. "Rising Currents: Projects for New York's Waterfront". 94

to levels well enough to be used for hand washing.

A bio retention, storm water treatment system, man-made wetlands, filters water and removes oils before the water enters the Bay or its neighboring estuaries.

Renewable energy sources provide approximately 30% of the building's energy load and solar hot water provides all the domestic hot water for the building. Onsite, a 4Kw photovoltaic system subsidizes a portion of the building's electrical load.

For heating and cooling, the Merrill Center uses a ground source heat pump. Comprised of 48 wells, 300 feet deep this geothermal energy helps offset cooling needs in the summer and heating needs in the winter.

Oberline College: Adam Joseph Lewis Center

Designed by Charlottesville based firm McDonough + Partners, The Adam Joseph Lewis Center at Oberlin College stands as a leading example of ecological design principles. The intention of the project was to provide 'institutional learning' which developed operational and educational capabilities having to do with college buildings, landscape management, energy use, resource flows, and environmental impacts.[74] This is achieved through stitching landscape, materials, energy and water together within the context of a small building.[75] The wastewater treatment system known as the living machine by the manufacturer, combines conventional wastewater treatment technology with the purification process of a natural wetland ecosystem to remove organic wastes and nutrients from waste water.[76]

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[74] Orr,David. *Design on the Edge: The Making of a High-Performance Building*. p160
[75] Orr, David, *Design on the Edge: The Making of a High-Performance Building*. p162
[76] Energy Data on the Lewis Center pg22.

It is designs to handle 2,300 gallons of waste per day, and by spring 2002 the system was producing water which exceeded federal tertiary standards through only the use of plants and animals.[77]

Housing the school of environmental studies, the building is composed of atrium, offices, auditorium, and indoor and outdoor classrooms and laboratories and on-site waste water treatment facilities. The roof has an integrated 60kw PV system, which is connected to the larger grid, and meets all energy needs of the building.85 Energy efficient design includes passive solar heating and ventilation, daylighting, efficient lighting design, ground source heat pump loops, energy recovery, and up-to-date energy management auditing systems. These innovations make the Adam Joseph Lewis Center one of the US Department of Energy's thirty milestone buildings of the twentieth century, and create an intellectual infrastructure of inquiry, where students are better equipped to research and solve twenty first century ecological problems. [78]



Figure 22 : Perspective of the Adam Joseph Lewis Center showcasing the constructed waste water wetlands [Image source Inhabitat http;//inhabitat.com/oberlin-college-setting-a-sustainable-example-in-ohio/]

[77] Orr,David. *Design on the Edge: The Making of a High-Performance Building* p 167
[78] Orr,David. *Design on the Edge: The Making of a High-Performance Building* p168

Water Run off

WaterShed

The University of Maryland's recent Solar Decathlon entry provides an example of the local capability of an integrated architectural and infrastructural water management. WatersShed uses traditional water principles, uncommon to the United States, that all water is not created equal, and then subsequently uses and treats potable water, rainwater, greywater, and blackwater differently, as called upon by circumstances determined by their use.



Figure 23 : Form works with the natural flow of water, creating integrated water management. [Image by Leah Davies http://2011.solarteam.org/design/living-systems/water-management**]**

Grey Water and Rainwater are cleansed by the house through constructed wetland and green roofs. Constructed wetlands are at the center of this house and provide a substrate for purifying microorganisms to clean water.[79] Here, a film around the root structures of wetland plants facilitates aerobic and WateShed's wetlands cleanse grey water, as well as storm water runoff from the structures roofs and decks before continuing on to other

[79]WaterShed. "Constructed Wetlands." University of Maryland Solar Decathalon. 2011. http://2011.solarteam.org/design/living-systems/constructed-wetlands

processes of the water cycle.

Omega Center, Reinbeck NY



Figure 24 : Facade showing integrated water management and energy technology. [Image Source Flow, In pursuit of living Buildings. p4]

The Omega Center is a recent construction and example of synthesis of architecture within a larger ecology. From the outset, the Omega center was conceived through the lens of stewardship of water. Three main principles were at the center of the design; treat all water as a precious resource, never squander it as a waste product, restore health and stability to the site and surrounding landscape through the redevelopment process, utilize integrated design to achieve multiple objectives with a singular element.[80] Therefore, every element of the Omega Center is designed to function within a "water sensitive" relationship between the built and natural environments. Each decision was weighed to meet the purpose of the building while contributing to the landscape and larger region.

[80] Berkebile, Bob; Todd John; Steve McDowell, Lesniewski Laura. *Flow in Pursuit of a Living Building.* ORO Editions. 2011.pg 15

Each layer and component of the building was designed and integrated as part of the whole, including – the eco-machine™ room, landscape terrace, water treatment lagoons, façades, parking lots, (scalar relationship sort), and windows. The idea was to produce a micro-climate, of clean air and clean water which beautifully adds to the landscape and the occupant's spirit. Parking lots were converted into parking gardens, and the building remained compact, in order to maximize surface are to replenish the aquifer. A series of lagoons were designed to clean the water through natural processes and these occupy nearly half of the building and a proportionate amount of the landscape.

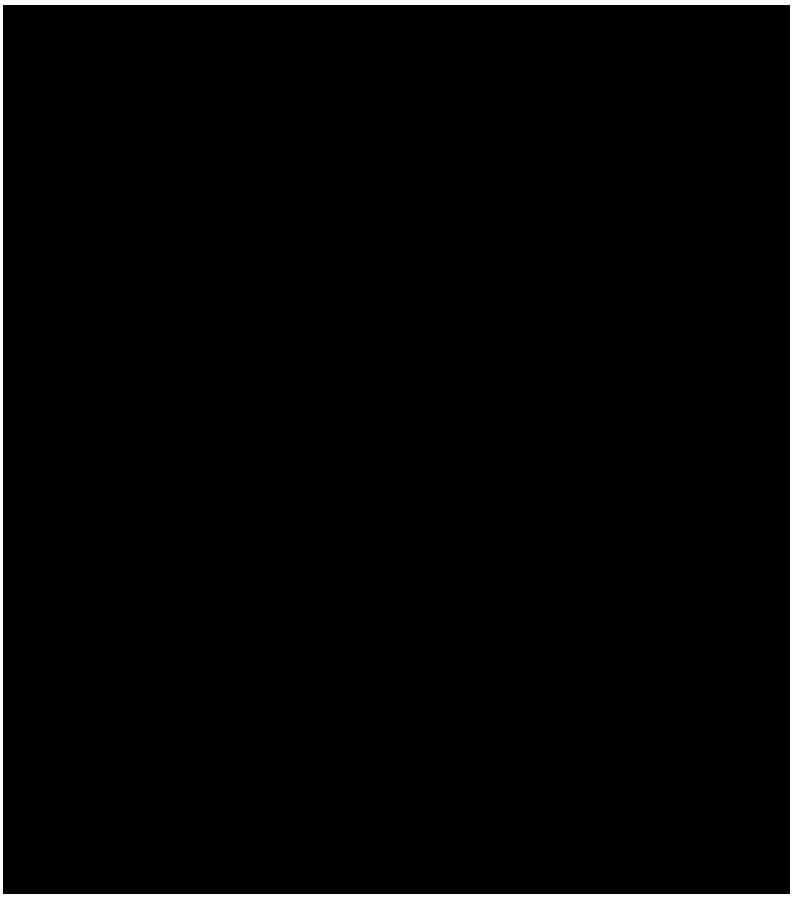


Figure 25 : The ecomachine room purifies the waste water of the center. [Image Source Flow, In Pursuit of Living Buildings. p30]

These Eco-Machines™ and constructed wetlands aid in water purification processes and work with the same principles of estuaries .To serve the interior lagoons overhead

skylights aim lumens of energy upon the leaves of the plants throughout the year. The roof acts as a fifth façade, which harvests daylight, filters water and converts solar energy to electricity. Outside, addition wetlands are planted in aerated lagoons, forming a living relationship between plant roots and microbes which further cleanse the water, pg 41. These wetlands terrace down the southern slope adjacent to the building and water passes between them and gravel beds before gradually being released into subsurface areas north of the building.

The form of the building evolved largely from a practical need to service the plants of the living wastewater machine. The landscape design is viewed holistically, regenerating native site ecology, didactic in form, serves a broader function while simultaneously creating beauty.

The eco-machine has a dedicated south facing room, which harnesses sunlight in order to foster growth of the watery-plants which are critical to cleaning and reclaiming the water in the cellular lagoons.[81]

The center, aside from being a place which restores local water quality, contains space for yoga studios where visitors come to restore their spirit. Natural ventilation and views are achieved through a system of operable, fixed and solar tracking louvers and windows.[82] These channel the hot air out and through convection push breezes over the lagoons, creating a cooling sensation inside the center.

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[81] Berkebile, Bob; Todd John; Steve McDowell, Lesniewski Laura. *Flow in Pursuit of a Living Building.* ORO Editions. 2011.
pg 34

[82] Berkebile, Bob; Todd John; Steve McDowell, Lesniewski Laura. *Flow in Pursuit of a Living Building.* ORO Editions. 2011.
pg 16

Function of the building is to house an ecological waste water treatment system, and serves to integrate the landscape of man with nature.[83] The entire building and water processes use site-harvested renewable energy, which when integrated creates a net zero energy system. The project stands as an example of how science, measurement, and art and anticipation have furthered design, furthering the notion that form follows function[84]

The Omega center and other precedents serve as examples of a shifting paradigm One from singularity and exploitation towards a paradigm of sustainability and creativity. "We are in the midst of a renaissance – a time when the understanding of the interdependence of all life became a blue-print for living, a time when individuals, organizations and cultures around the world woke up and took stock of what really matters.

[83] Berkebile, Bob; Todd John; Steve McDowell, Lesniewski Laura. *Flow in Pursuit of a Living Building.* ORO Editions. 2011.
pg 32
[84] Berkebile, Bob; Todd John; Steve McDowell, Lesniewski Laura. *Flow in Pursuit of a Living Building.* ORO Editions. 2011. pf 7



Figure 26 : Plan of the Omega Center Showing scale of eco-machine room. [Image source Flow. p35]

Designing a civic paradigm shift through institutions and infrastructure

Fairmount water works



Figure 27 : Fairmount Water works shown against the Schukilly River. [Image Source Historic Landmarks of Philadelphia]

Built from 1812 to 1872, the water works stands as a memory of an era when civic pride

and public infrastructure coexisted. Though now abandoned for procuring water, in its time, the Waterworks represented a blending of nature and technology.[85] Developed from a need for Philadelphia to have a cleaner water supply, the waterworks would take clean water from the Schuylkill River and deposit it underneath a reservoir (atop which is now the Philadelphia Art Museum), which was to be distributed to center city.

Previous to construction, the city received its water from a collection of wells, and it was common knowledge that pollution was tainting the then current water supply, which was an aquifer underneath the city. This prompted the city to hire architect/ engineer Benjamin Latrobe to develop a plan for a city wide water system. Latrobe investigated the city and deemed a pumping station necessary to siphon fresh, clean water from the less industrialized Schuylkill River.

Latrobe and his assistants developed plans for the waterworks, which was constructed in the neoclassical style. This decision to build the waterworks as a temple of water to the city led to civic engagement with the works. Gardens, promenades, and romantic woodland adjacent to the pumping station added to the civic scale and grandeur of the waterworks. This parkland, owned by the city, simultaneously protected land upstream from industrial development along the swift moving Schuylkill, protecting the integrity of the city's water. [86]

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[85] Gibson Jane Mork, Wolerstorff Robert. *The Fairmount Water Works: Philadelphia Museum of Art Bulletin*. Philadelphia Museum of Art. pg 5

[86] Gibson Jane Mork, Wolerstorff Robert. *The Fairmount Water Works: Philadelphia Museum of Art Bulletin*. Philadelphia Museum of Art.

The waterworks today is a centerpiece in Philadelphia's Fairmont Park, and a museum which receives many visitors per year. The investment into public works, and the designs' accessibility to the city created a lasting icon of Philadelphia's infrastructure.



Figure 28 : 19th C Perspective of the Waterworks and accompanying park. [Image source Historic Landmarks of Philadelphia]

Wusong Riverfront, SWA Group



Figure 29 : Aerial of Future Habitat. [Image by Hui-Li Lee Et. Al. http;//www.asla.org/2012awards/196.html]

SWA Group's new "landscape infrastructure" park aims to restore a riverfront and simultaneously support wild-life habitat, public education, and economic growth

along the Wusong River in China.[87] Due to industrialization, the quite fishing villages have been replaced with industrial uses and development and the river has degraded into lifelessness. SWA infused water treatment landscape infrastructure and public space making in an effort to renew the city's water based heritage.[88] According to the ASLA, "The design established a treatment flow rate capable of treating Class V water (the lowest water quality classification in China) to Class III water (suitable for recreation)." This is done in part through the use of purifying wetlands, and active aeration ponds which help rid the water of particulates

[87] "Wusong Riverfront: Landscape Infrastructure Pilot Project. Kunshan City, Jiangsu Province, China." American Society of Landscape Architects. Accessed November 15th 2012. http://www.asla.org/2012awards/196.html

[88] "Wusong Riverfront: Landscape Infrastructure Pilot Project. Kunshan City, Jiangsu Province, China." American Society of Landscape Architects. Accessed November 15th 2012. http://www.asla.org/2012awards/196.html

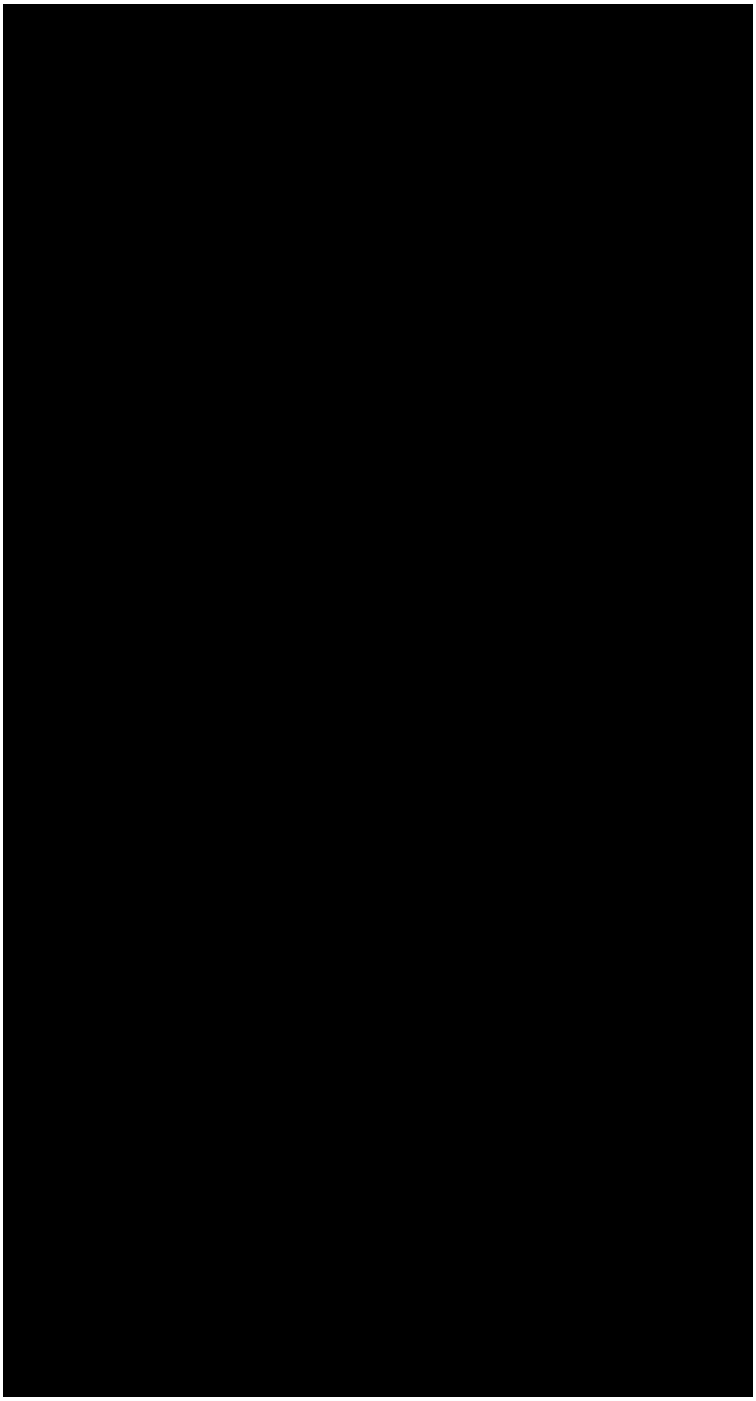


Figure 30 : Different sections along the restorative promenade. [Image by hui-li Lee et. Al. http;//www.asla.org/2012 awards/196.html

The first stage in the project mimics natural cleansing processes, acting as a "kidney" for the river, cleaning sludge and industrial effluents, which were discharged upstream, and thereby extend the benefits of the park downstream to the larger region. The multiple ponds and channels of the cleansing process are conceived as a series of gardens and open spaces with functional recreation uses.[89] Processes of water cleansing are not only functioning engineering tools, but expressed artistically; for instance, the sediment pond is also a reflection pool, a treatment channel becomes a Linking these together is a promenade, which runs the length of the treatment

[89] "Wusong Riverfront: Landscape Infrastructure Pilot Project. Kunshan City, Jiangsu Province, China." American Society of Landscape Architects. Accessed November 15th 2012. http://www.asla.org/2012awards/196.html

park and connects the variety of spaces together. In this way, the process becomes didactic, as the community can witness the process of water cleansing, in a way which would not normally be available through conventional infrastructure.[90]

The particular success of the Wusong Riverfront development project comes from linking public use with creatively expressed innovations of infrastructural processes. This creates a shift in landscape from passive and ornamental to active and regenerative processes while serving the larger ecosystem and promoting change in the public's interaction with water and nature.

Summary and generation of principles based on precedent

Subsection 1

Through historic and recent examples of designing with nature it is clear that a places form can simultaneously create promenades and places for human while providing place of ecological work. Through bringing these issues to the forefront of the design, each stand as a unique example of how natural processes can be embodied into design

[90] "Wusong Riverfront: Landscape Infrastructure Pilot Project. Kunshan City, Jiangsu Province, China." American Society of Landscape Architects. Accessed November 15th 2012. http://www.asla.org/2012awards/196.html



Figure 31 : Wetland stages work with the stages of conventional water treatment processes. [Image by Hui0Li Lee Et. Al http://www.asla.org/2012awards.196.html

Chapter 4: Site and Program Concerns

Site Approach

Surveying the Chesapeake Watershed

In order to focus on problems between the built environment and water, siting was limited to within the Chesapeake Watershed, as this bonded any site to similar problems and opportunities. An array of sites was chosen, each was uniquely situated in the hydrologic and urban transects. Selected parameters governing the applicability of sites included size and proximity to an adjacent water body and were broken down into three, coarse categories; the creek, river and basin. Potential sites to study were then overlaid with their location within categories of the urban transect, creating a matrix of potential sites with unique opportunities in relation to the built environment and the Chesapeake Bay. Rural sites, sparsely populated with humans represent a large percentage of the area of the Watershed, yet suburban and urban sites account for more of the Bay's pollution than rural sites. Therefore an urban site was selected.



Figure 32 : Site Selection, Annapolis City Dock. [Eric Joerdens]

Identifying a location to implement ideas.

One site has been selected in order to study the relationship of urban form and water at the scale of a building. The City Dock of Annapolis has been selected as a conceptual test site. This site represents a common site typology found across the Chesapeake, as it is an urban coastline site, currently in a derelict form and adjacent to a large body of water. Surrounded by parking lots, this site has a tenuous relation to its waters in both ecologic and civic functions, as the purpose of the dock has evolved from a commercial port to a post-industrial recreational and civic area.

History of the Site

1888 Expansion

The bulkhead of the city of Annapolis was reformed in the late 19th century due to commercial and hygienic needs. Serving watermen, the city dock was surrounded by warehouses and shipping factories, as well as being downhill of town. As consequence, the existing dock was a collecting vessel of fish waste and human waste, creating a great stink of decomposition. The city dock adapted simultaneously to resolve the hygienic problems while creating infrastructure for a functioning port.



Figure 33 : Historic Shoreline against todays shoreline. Data Courtesy MD DNR Coastal Atlas. [Image Eric Joerdens]

Previous Professional Explorations

National Sailing Hall of Fame

Designed by Boggs and Partners Architects, the national Sailing hall of Fame is to be built at the edge of Prince George Street.

The building and center is to be an interactive tool for educating the public on sailing, a sport for which Annapolis has international acclaim.

The Museum re-uses the Burtis House and is composed of a three-story exhibition hall. Transparency aides in forging a connection between the museum and the water, with a large, south-facing glass aperture providing views towards two docks with sailboats.

The massing of the building keeps with the current informal build to line 220 feet away from City dock edge.

Olin Landscape City Dock Study

With help from Olin Landscape Architecture and various other designers and consultants, the master plan for the Annapolis City Dock is based around a redevelopment strategy centering on the issue of parking availability. The plan consists of six major principles; emphasize the historic layout and scale, programming of public space and create a pedestrian oriented flexible environment, support a greater mix of transportation nodes, contribute to the City's greening, and to promote public art opportunities.[91]

Emphasis of the master plan includes a higher quality pedestrian experience with more

[91] City of Annapolis. "Public Workshop." Presentation, September 27th 2012. http://www.annapolis.gov/Government/Departments/PlZon/CompletedPlans/CityDockReport.pdf

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space for walking.[92] This includes less conflict with cars and shaded paths connecting to open spaces. The master plan is ambivalent on the current abundance of parking around the dock and has kept the large majority of parking spaces- and therefore the existing connection between building, landscape and water.

Programmatically, the plan attempts to create and link green spaces of parks and plazas with Ego Alley and Main Street through a network of trees while promoting outdoor dining space. The promenade also is intended to serve as a place for boat shows and art exhibitions. The Master plan attempts to create a continuous pedestrian landscape that connects the public to the water through viewing along a promenade and places of stasis. However, the plan does not aggressively challenge the current abundance of parking lots adjacent to the cities best amenity.



Figure 34 : Aerial of a possibility for Annapolis City Dock [Olin Landcape Studio]

Urban Land Institure: 2010

In 2010 a study of the Annapolis City Dock was spearheaded by the Washington Chapter

[92] Ibid

of the Urban Land Institute, giving recommendations for development of the City Dock. In an effort to renew the city dock, the study analyzed the use of the dock and created suggestions to renew the city dock to a vibrant place for tourists and residents alike.[93]

Currently, programming of the city dock includes a weekend farmers market, space for jugglers and musicians, as well as a boat show in October. The Urban Land Institute was asked how to develop the dock further while preserving the current economic functions of the dock.

Visions include creating a pedestrian-friendly source of pride with meaningful connections to the water, rooted in colonial American History, fostering attractions which draw economically and culturally, and creating a festive dynamic and exciting destination.[94]

Within the report are ideas sponsoring the repurpose of the surface lot adjacent to the dock and water as well as creating a multi-modal drop off destination for buses, pedestrians and boaters. Recommendations including access to the water, more of the water's edge (to allow more function and capacity), and heightened interaction with

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[93]Urban Land Institute. "A technical Panel Assistance Report: Annapolis City Dock." City of Annapolis, Department of Planning and Zoning. November 2010. Accessed October 2012. http://www.annapolis.gov/Government/Departments/PlZon/CompletedPlans/CityDockReport.pdf

[94]Urban Land Institute. "A technical Panel Assistance Report: Annapolis City Dock." City of Annapolis, Department of Planning and Zoning. November 2010. Accessed October 2012. http://www.annapolis.gov/Government/Departments/PlZon/CompletedPlans/CityDockReport.pdf

the water.

In sum, this study suggests "the evolving heritage, industry, and personalities relevant to the City Docks' past should be evident in the materials, forms, architecture and activities that define the new city dock." It argues that historical authenticity, is a strength of the Annapolis waterfront and it "can be strengthened with state of the art infrastructure and amenities"[95]

Site Precedents

Nyhavn

Nyhavn, the famous waterfront street of Copenhagen is lined with quaint 4 story converted warehouses fronted with café's. Extending from a main city square, the wharf is a major public space, and tourist hot spot of the city.

Overlaid graphically, it can be seen that Nyhavn's canal is similar in width to the city dock of Annapolis. The length of Nyhavn is slightly larger than what could be feasible in Annapolis, however, this length suggests a possibility of land fill to extend the promenade of the city dock. Similar to City dock, Nyhavn serves as a docking point for the world's sail boats as well as a public gathering place, active with street perfomrers, café's, food stands and ferries. Anchoring the end of the dock is one of Copenhagen's major theatres.

[95] Urban Land Institute. "A technical Panel Assistance Report: Annapolis City Dock." City of Annapolis, Department of Planning and Zoning. November 2010. Accessed October 2012. http://www.annapolis.gov/Government/Departments/PlZon/CompletedPlans/CityDockReport.pdf pg 24

The success of Nyhavn as a place and cultural anchor of the city is due to four large factors; built edge proximity to water, celebrating connections of man and water, blurring the edge between land, city and water, and a continous wall of similar density and height which creates a large outdoor room.

Compared with Annapolis, the built edge to the water is more compact, heightening the interaction between water and man in Nyhavn's many cafés and promenades. Nyhavn averages 50' in width from water to building edge, one-third of the distance of Annapolis City Dock.

Nyhavn has discrete public space celebrating the connection between man and water. A civic square at the edge is accompanied with a smaller green space at the end of the dock, creating a different spatial experience compared to the lateral movement along the water. This moment of stasis is juxtaposed to a pedestrian bridge in the center of the dock , connecting the two sides of the dock and the buildings on either side.

Nyhavn then meets the edge of the water and transitions into an extended pier and promenade connecting to the Royal Danish National theatre. This creates discontinuous space, fragmenting and challenging our typical relation to water as adjacent to the city, here the city continues out into the water.

Nyhavn can be read as a great outdoor room, with similar density and height creating a continuous wall around public space and water. The continuity of built and landscaped vertical surface creates enclosure on three ends, as the dock then opens itself to Copenhagen's larger canal.

Nyhavn serves as a possible template of converted industrial dock to public amenity, evolving and challenging the relation between man, water and city.

Monterey Bay Aquarium

Monterey Bay Aquarium provides a successful interaction of man, architecture and water. By blurring the edge between water and man the exhibitions become a cohesive part of the larger environment as a whole.

The buildings construction changes with the landscape, moving from spread footing to piers, allowing the building to continue out into the water. The extension of man's realm into and over water allows the public to interact with the foreign aquatic environments. By leaving the realm of land, this simple but effective tool helps fulfill the mission of education and advocacy of aquariums.



Figure 35 : Composite drawings of site, satellite image with dock, figure ground without water, figure ground with coasts and docks. [Figure grounds by Eric Joerdens]|Satellite image courtesy Google Maps|

Site Diagrams

Annapolis City Dock

Annapolis formed as a colonial port city and the state of Maryland's Capital city. Founded on a peninsula between the Severn and South rivers.

The peninsula is capped with hills, which later became the site of large civic buildings. The city dock, formed around a natural port in the coast line. Throughout the 19th and 20th centuries as Annapolis expanded, the coastline was

manipulated from a soft landscaped edge to an abrupt landscaped wharf and dock.



Figure 36 : Diagrams Topography: Topography Contoures, Middle One Hundred year flood plain. Bottom: site drainage [images by Eric Joerdens]

The 19th century city fabric began to grow between the two major pressures of the town with dense streets linking the State House, Dock and later the rail station (on the Western Edge of town). The United States Naval Academy and St. John's College occupy the northern half of the peninsula, creating an edge to the city at King George Street and Boundary Road, located just behind City Dock. The site for the Museum of the Chesapeake has been selected as it represents a common morphology of coastal the landscape and urban edge. Warehouses and wharfs have been replaced with parking lots that have no relation to its geographic location. Annapolis also stands as a vibrant mini-urban district with an active water culture and heritage. The city dock stands as a large void within the center of the city whose history is formed by its relation to water. Annapolis also has a vibrant tourist industry, which creates an ideal opportunity to reshape a culture towards stewardship of water in hopes of altering the current paradigm.

Uses of the Area

Annapolis city dock represents the commercial and maritime heritage of Annapolis. The pensulisla's edge has been manipulated into a hard, geometric edge serviceable for ships. Parking lots exist around the dock. A market stands at the west end of the dock. To the south is a mixture of restaurants, parking lots, and small historic commercial buildings. To the north of the dock is a line of historic buildings containing restaurants and gallery's. To the north of this strip lies the US Naval Academy.

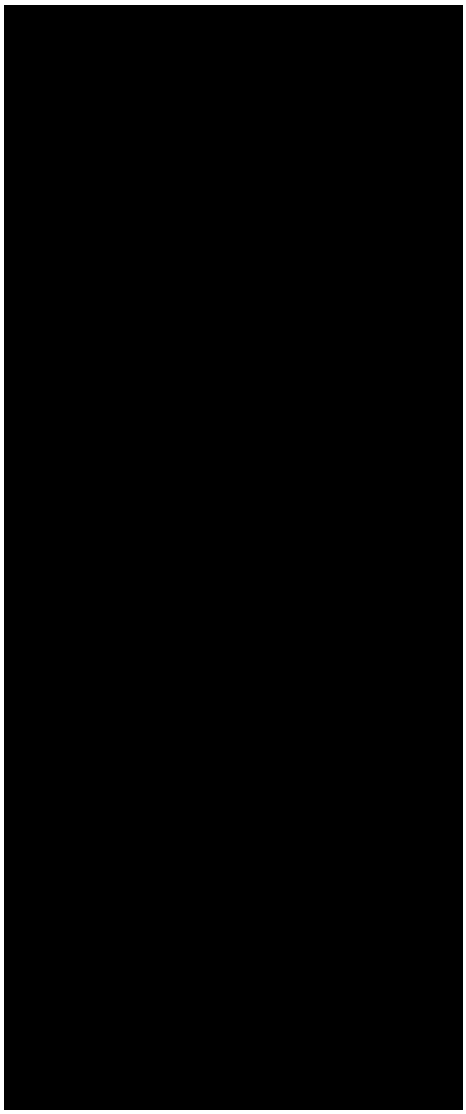


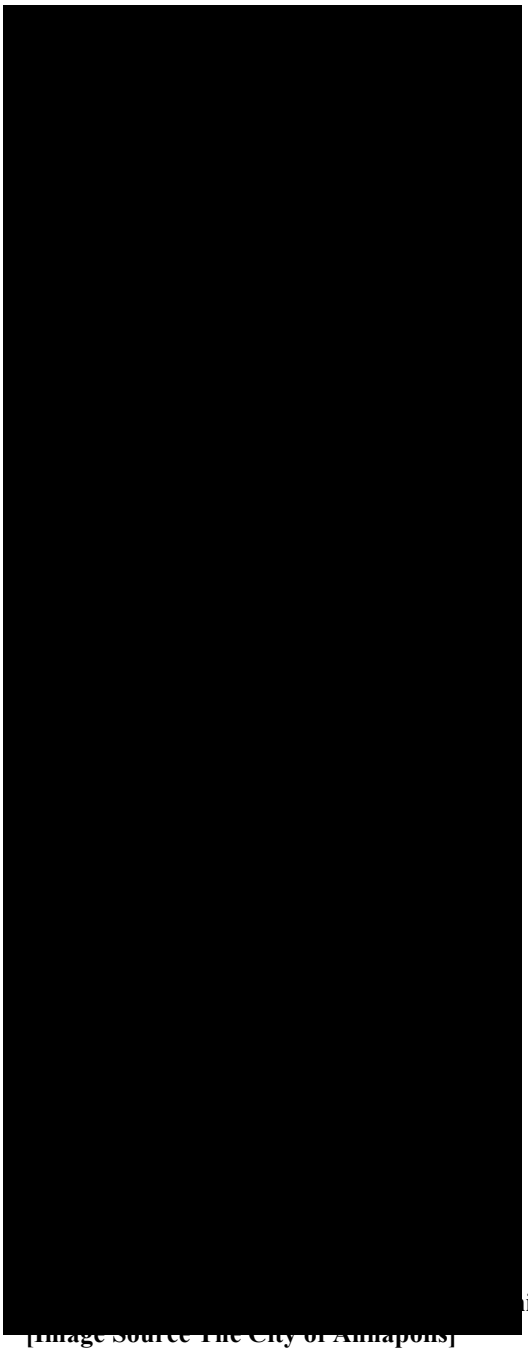
Figure 37 : Diagram - Historic Growth of Annapolis. [Images by Eric Joerdens]

The city is comprised of major avenues radiating from the state house super-imposed on a rectilinear grid. Comparing a figure ground and a figure ground with docks included shows how built form has been adapted to constraints of water. The walk able edge of the city extends across the water's edge providing places of harbor, commerce, and recreation.

The density of buildings along main street Is terminated by the void between the market and City Dock. The site for the Museum of the Chesapeake begins at the west side of the dock and continues out past the current edge. The eastern edge of the site is co-planar with the Naval Academy storm wall.

The City dock is formed from two culverts joining at the coast line. In between the culvert is Annapolis' largest hill,

which the state house prominently stands. To the east lies the flat end of the Naval Academy. Hills also shape the western edge of the dock. The hills of Annapolis create a relatively small flood plan area for the city. The 100 year flood Plane extends to the crest of main street borders the southern edge of the naval academy. As a result, the entire building lies within the 100 year flood plain. The 2003 Hurricane Isabel is representative of the 100 year storm and its flooding potential of the historic district and City Dock of Annapolis.



[Image Source The City of Annapolis]

As the site for the Museum of the Chesapeake borders the coast, stewardship of rain water transitioning into the bay is a critical component of the Museum's site. To study this, a map of the coastline of the site paired with its associated drainage area exists. The ridgeline and crests of hills to the west and east form the valley and channel for storm water. This allows the museum to ameliorate storm water pollution of the bay through acting as a regenerative device.

The city dock remains the historical center of commerce in the city. A linear strip of retail and offices extends beyond the dock on Main Street towards the state house. The city dock and its surrounding retail acts as a meeting place between the Naval Academy and city's oldest residential districts.

These areas are characterized by tight, one way streets and

small compact building shells spread over a walkable area.

Movement and Urban Morphology

Site changes character through experience and mode of transit. Urban blocks seem continuous looking through a dashboard of a car but the grain of the urban fabric becomes much more fractal through the pedestrian experiences. Alleyways, setbacks, and subtle façade and street wall alterations engage the pedestrian and create hidden avenues of exploration and delight. Pathways begin to shape urban space similarly to roads dedicated for automobiles, dimension becomes based on a step rather than the movement of four wheels.



Figure 39 : Morhology of the city and transportation routes based on mode. [Images by Eric Joerdens]

Approach similarly changes from the water. Buildings become wall, serving as a barrier between sea and city. Once docked, the sailor becomes a pedestrian encountering the city from a coastline departure site. Through analyzing the street network, it is apparent that Prince George's street becomes a back street between City Dock and the basketball arena, which fronts King George St. This change in streets provides an opportunity to discretely service the site of the Museum of the Chesapeake

Climate

Annapolis is located at 38 degrees latitude. Close to the Chesapeake, Annapolis rests between sub-tropical and temperate climate zones. It is characterized by hot summers and cool winters. The sites orientation is predominately southern. The Summer Solstice appears to set over the city centered on city dock.

A large water basin, the Chesapeake creates a milder micro climate to its coastal environments compared with the larger region which suffers hotter and more humid summers and the colder winters.

A comprehensive assessment of the temperature and humidity in the Annapolis area shows that the average monthly temperatures lie, for the large part within a malleable range of comfort for application of passive solar technology.

The bay also provides cooling breezes day and night for the city as the temperature changes and air current adjusts to the pressure differential. Here, there is potential for water to serve as a direct and indirect cooling device for the building and larger environment.

Program Tabulation

Subsection 1

This section covers the foundation of a program which can utilize the site of the city dock, scheme proposals as well as implementations of principle which were previously examined.

An approach to program

The site and program of the Museum of the Chesapeake work to create a place of regeneration and cleansing at the level of three scales; the environment, the community

and the self. The museum will provide a level of public works, through cleansing the waters which pass through it and generating clean electricity, which conserves water as well as protects the water around a traditional coal power plant. Didactically the museum will act as connective interface between man and nature. The Museum serves as an educational device, with exhibitions and promenades that serve to create interaction with past and present relations of man and water.

The exhibition space will serve as an interactive device between the Chesapeake's past present and future and the visitor. Exhibition spaces extend outside the walls of the museum, into wetland aquaculture beds where oysters are raised to regenerate the bay. The public will have the opportunity to interact with the dock through a promenade of café, shop, exhibition and regeneration. Engagement with water occurs at a public open air swimming facility, merging man and water.

Catered events and exhibitions can occur along the promenade, which serves to unite the fractured public realm of the docklands. The museum will serve as a place for the public to engage in learning of the role of the Chesapeake in the regions culture and our role in affecting its health. Classrooms and exhibitions provide opportunity for formalized learning while informal spontaneous learning occurs through the interaction of built form on site.

Constructed wetlands and aquaculture provide a place for cleansing the environment. Café' and swim center engage the community in regeneration and cleansing. The individual is engaged in regeneration through education and contemplation and emersion

in nature and water. A sauna exists to extend the public's corporeal interaction with water into the contrasting winter months.

Quantifying the Program

Building Program

Exhibition and Gallery

Large Exhibition Space 10,000 SF

A large exhibition space for the public to engage in installations of Chesapeake culture. Includes space for flexible and transient exhibitions of small fishing vessels, interactive exhibits of science, ecology and culture.

Exhibition Rooms 10 at 400 SF EA. 4000 SF

Small display rooms for fixed collections based on themes of an evolving relationship between man and water in the Chesapeake region. Includes exhibitions on pre-colonial interaction with the Great Shellfish bay to current interactions with the Bay.

Public Engagement

*Museum Lobby*400 SF

Serving as a space of transition and orientation from the City Dock transition to exhibitions and classrooms. This space shall be adjacent to the information desk and in close proximity to the coat check and public rest rooms.

Information Desk 100 SF

This space receives and orients guests into the museum. A place to purchase tickets and distribute information is to be accommodated.

Café 2000 SF

A place for sixty to sit and enjoy a meal. Included are flexible options for informal dining and small private banquets. This is a flexible space which can stage events, fundraisers and lectures. The café is located adjacent to the kitchen spaces and includes storage for dining furniture and tableware.

Museum Shop 1500 SF

Following recent revenue trends of museums, a shop will accompany exhibitions for the public to purchase books, information and goods on the Chesapeake. A small back of house storage will accompany the main shop.

Classrooms 2000 SF

A place for formal classes, meetings and information sessions. This space should be able to be accessed separately from the main exhibitions.

*Swimming Pool*3000 SF

An open air facility for public use. Limited access controlled by gates. Accompanied by bathrooms, changing rooms, and sauna.

Museum Spaces

Public Restroom 1000 SF
Two separate male and female public bathrooms intended for use of the general public. Located close to the museum entrance and pool entrance. Each bathroom will include accessible toilet and washbowl.

*Service Kitchen*1000 SF
This space accommodates the cooking needs of the museum café'. Space for preparation, cooking and storage of food is to be accommodated.

Coat Check 400 SF
A place to remove winter garments and store them securely is required.

Collections Workshop 1000 SF
This space should serve as a place to prepare and repair exhibitions away from public interaction. Storage for tools is required. This space should be in close proximity to the receiving and collections storage.

Crating and Uncrating Room 1000 SF
This space serves as a transition for exhibitions between storage, workshop and receiving.

*Freight Elevator*200 SF
This space is intended to serve the needs of safely moving large exhibition pieces vertically.

Collections Loading Dock 1000 SF
The loading dock is intended for the shipment of exhibition related items. Due to the possible fragility of these items it is imperative to keep this space discrete from other day to day receiving.

Receiving 500 SF
This receiving space is intended for the day to day flow of goods including food, mail, and packages.

Exhibition Storage 2000 SF This space is intended to securely store the collections of the museum. The actual storage fixtures are to be acquired
through museum staff. Nevertheless an array of storage spaces for oversize to hand sized pieces should be considered.

Museum Store Office 150 SF
Intended as a discrete space for the management of the store. A place for books, desk and computer should be accommodated

Museum Offices 750 SF
Office space shall be provided for the museum curator, director, and management personnel.

Conference Room 500 SF

A private shall be provided for meetings between staff, specialists and the Board of Directors.

Security Office150 SF
An Office to oversee for security and supervision of artifacts.

Collections Storage 2000 SF
2000 Square feet of dedicated storage for permanent and rotating collections of the museum.

Computer Room 400 SF
A dedicated room for computer and server equipment. This shall be separately mechanically ventilated.

Security equipment Room 100 SF
A secure room for the maintaining of security equipment and recording devices.

Support Space

Mechanical and Electrical 3000 SF
Includes spaces for necessary mechanical, electrical, and telecommunication equipment
Circulation 25% NSF less Exhibition Spaces
Includes all internal hallways, stairways, elevators. The large exhibition space includes circulation, as a result, circulation has been calculated at 25% of remaining net square foot spaces.

Storage
Aggregate tabulation of individual storage. Does not include Museum collections warehousing.
Outdoor Museum Space TBD SF

Restorative Wetlands
The site will have wetlands which mitigate pollution from storm water as well as the buildings wastewater functions. Circulation should be allotted for the visitor to experience the constructed wetlands.

Oyster Beds TBD SF
Oysters, the keystone of the bay, are to be cultured for their cleansing and nutritional properties on site. Circulation should be allotted to allow the museum vaster to experience the constructed reefs.

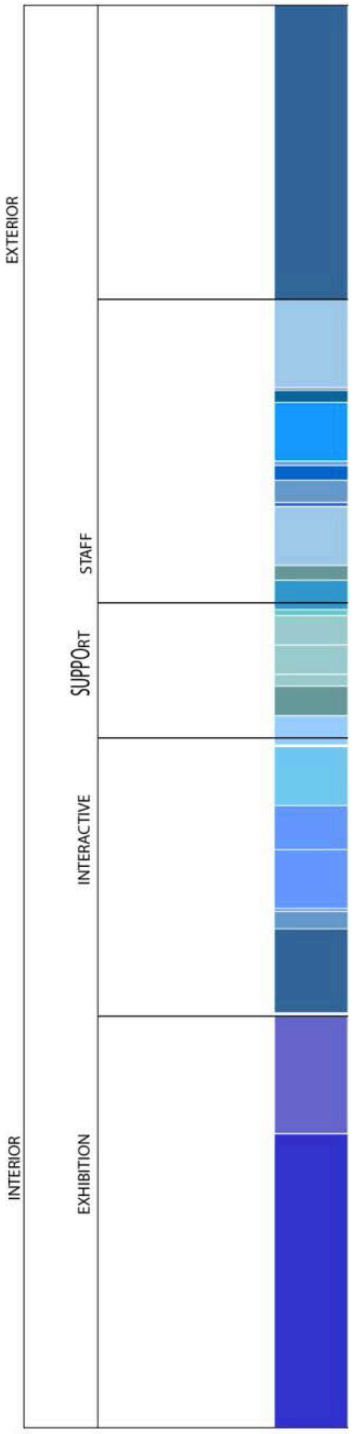


Figure 40 : Diagram depicting scalar relationships of programmatic elements. [Image by Eric Joerdens]

Chapter 5: Design Approach and Considerations

Overview of principles

This thesis will examine they projected rise by year 2050 and 2100 as a measure for sea level rise. These sections will emerge out of the design phase of the year as options for handling such issues materialize. Those sections deal with various roles the museum will have within the site and program. Broken down into three broad categories, the design focuses at three scales, the urban scale, the building and programmatic scale, and energy and sustainable applications of the building. The following chapter explores possibilities examined within the design phase.

The Urban Scale

Identifying the Promenade

As a public building located at the end of a waterfront, a quick dilemma emerged between the role of housing a collection and keeping the waterfront public so that pedestrians can stroll about the harbor. Taking cues from the Neustattsgallerie, a principle quickly emerged that no matter the form of the building, the waterfront must be accessible for the public at large.

This formed the creation of a peripheral path around the Museum, which connected the Naval Academy to Ego Alley creating a unified waterfront for the city.

Ego Alley

Ego Alley, known for housing large yachts and sailboats during the summer months is currently surrounded by parking lot. This parking lot acts as a divider between the many shops and restaurants, which would benefit from being closer to the water and the boats which dock in Annapolis. Various options were considered to create a more walkable pedestrian experience around the alley and also provided for more boats. Early in the process, a scheme where Ego Alley would be expanded to have a continuous 60' wide pedestrian café/walk/dock dimension around an amorphously shaped harbor was considered. A counter argument quickly developed where ego alley became a regular shape with a constant dimension for dock. In this scheme the space in-between would adapt overtime to become wetlands and water-based decks would create outdoor urban seating for restaurants and shops around the harbor.

A Counterpoint to the tradition Urban water experience

As the Museum is intended to adapt to sea-level rise, the form between the interior of the museum and the water took on an atypical characteristic. All along Annapolis, land and sea are joined via a bulkhead, either of concrete or wood, and only on the outskirts do natural, earthen, inclined shorelines exist. Ecologically, these shorelines are heavily planted with trees or grasses so as to keep back erosion. Perceptually, the sloped shoreline offers a chance to walk with, across or in the water. This is not possible with a traditional urban bulkhead, where pedestrians are forced to walk next to and above the water. In the mind, This difference creates a profound gap between the pedestrian and the water whereas with a sloped shoreline there is a choice to engage the water, thereby breaking the mental threshold.

The degree of slope of the shoreline, also referred to as the angle of repose, was continuously worked and reworked during the process. Parameters which included boat right of way, walk ability, shoreline resistance and potential to harvest energy continually altered the angle of repose as well as the dimension between building and sea.

The Building Scale

Program and Massing

In a similar manner to the landscape, the mass of the building continuously changed based on further explorations of site and program. Originally starting as two wings of exhibitions concentrated around a central exhibition room, the massing of the Museum shifted to respond to site concerns. A main exhibition hall and accompanying classroom and gallery are on axis with the market hall at the other end of ego alley. This main hall is connected to a thinner, more bar like mass, which is more in keeping with the shops and restaurants on the northeast side of Ego Alley. The space between these two exhibition wings serves as the entrance and connecting atrium.

Tectonic Relationships

As the massing of the Museum shifted from a symmetrical to the main room to a more asymmetrical approach, the tectonic relationship between elements shifted accordingly. The main exhibition bar began to become the focus, as it created an axial alignment with the market. Exploring the theme of Chesapeake materials, this mass continually examined how wood could be used to showcase a modern

institution. Masonry and glass were to be used as the other bar and connecting element.

In contrast to the local buildings, which were of column and beam or bearing wall construction, a rain screen would be utilized to show modernity in the museum, despite similar materials. This would keep the collection dry and create opportunity for full or screened openings and views from within the museum.

Procession and Experience

As the landscape and siting of the building became rooted in adapting to the slow and hard to perceive rising waters, the metaphor of rising grew as a way to experience the site. As the sea will rise 4 – 6 feet in the next 100 years, this act of rising also be comprehensible within a single visit to the trip. The slope of the landscape and entrance to the exhibitions became an exercise in experiencing the space between low and high ground, the area of potential inundation. The lower floor of the museum thereby rests under an artificial landscape and the promenade connects the visitor from outside next to the water, to inside and above the water.

This procession was examined and inverted and altered throughout the process, however it was deemed best continue to explore the idea of rising with the landscape. Details of the final procession are included in chapter six.

Energy: Mitigation and Utilization

Unprogrammed Space as a place of electrical generation

As the area between the edge of the landscape and the building is man-made there was the possibility of exploring the undercroft of the museum as a place to utilize rising waters. Likewise the roof of the building could be used as a location for solar energy collection. Trials and research throughout the process gave insight to the possibilities of on site energy generation.

The idea of site energy generation would be important to the Museum of the Chesapeake's mission. As an institution that exhibits the cost of sea-level rise, it is logical to assume that the museum itself should not contribute to the loss of more archeological sites and treasures of Maryland. As a result, the museum should strive for carbon neutrality and to become a Net-Zero building. This would thereby mitigate the buildings effects to sea-level rise by effectively removing its green-house gas contribution to the environment. In order to mitigate against sea-level rise, various forms of renewable energy could be utilized on site.

Solar Studies

Throughout the design process, the roof are was continuously audited to examine how many kilowatt hours of electricity could be produced to help offset the Museums energy needs. Day lighting opportunities were uncompromised through the use of clerestories, allowing the roof to still have the possibility of housing solar panels. On the northeaster mass of the building, a thick roof plate was designed to allow for green roofs to work in conjunction with solar panels. This can allow the

solar panels to operate at cooler, more efficient temperatures producing a higher yield as opposed to on top of a more conventional roof.

Generate		
1 Solar Panel	10-14w sq/ft	
roof area	11614	bar
	23228	2 bars
	10000	center area
	44842	total roof area
x watt	448420	watts
	448.4 KW	estimate max
	224.2	low estimate
Tidal Power, Delta		
chang ein tide son avg 3 feet		

Figure 41 : Audit of possible elctrical generation through rooftop solar panels [Eric Joerdens]

Tidal Studies

Also studied was the idea of utilizing the rising waters and changing tides to generate electricity. Here the change in daily and special event water heights could be captured and translated into electricity. Known as a tidal energy barrage, this technology effectively creates a basin or tub, collecting water between periods or low and high water points /tides. Then the basin stores the water past high tide, releasing it and converts the potential energy into electricity via a generator as the height of the water returns to that of outside the basin. Though the museum and landscape footprint measures over 9,000 square feet, the tides in Annapolis do not change significantly enough to justify constructing such a system. This technology hold more potential on coastal sites with large tide changes, such as Newfoundland, or the coasts of France

and Scotland, where tides change the height of water upwards of 15-20 feet. n Annapolis the difference between low and high tide is generally between two and three feet, creating an insufficient order of magnitude.

Conclusion and culmination towards a "final" design

Throughout the design process, larger moves of landscape and massing worked along and in tandem to ultimately create a singular place where the rising interaction between sea and land could be experienced within one trip and throughout a lifetime of a visitor. The building which houses the archaeological collections of the Chesapeake was continuously refined to be of its specific site, between land and sea. The Museum took on form and technology, which would help mitigate sea level rise and be utilized to help with the buildings energy needs or a persons procession and experience of the site and building. While this chapter explores some issues uncovered and developed within the design process, the following chapter explains the final development of those issues.

Chapter 6: Design Review and Analysis

Landscape Experience

Merging the built environment with the larger environment



Figure 42: View from Secondary Walk [Eric Joerdens]

The Museum houses a collection of archaeological remains, which would otherwise have been inundated by sea level rise and the elements. Celebrating the richness of the built environment and society though, should not come at the price of the larger environment, ecosystem and the Chesapeake. From the above view we see how the museum stands on an artificial ecosystem which creates living habitat near the water.

Terraces of wetlands originate from a large scupper in of the main exhibition room, celebrating roof drainage, rain, and daily water events.

A New Urban Room

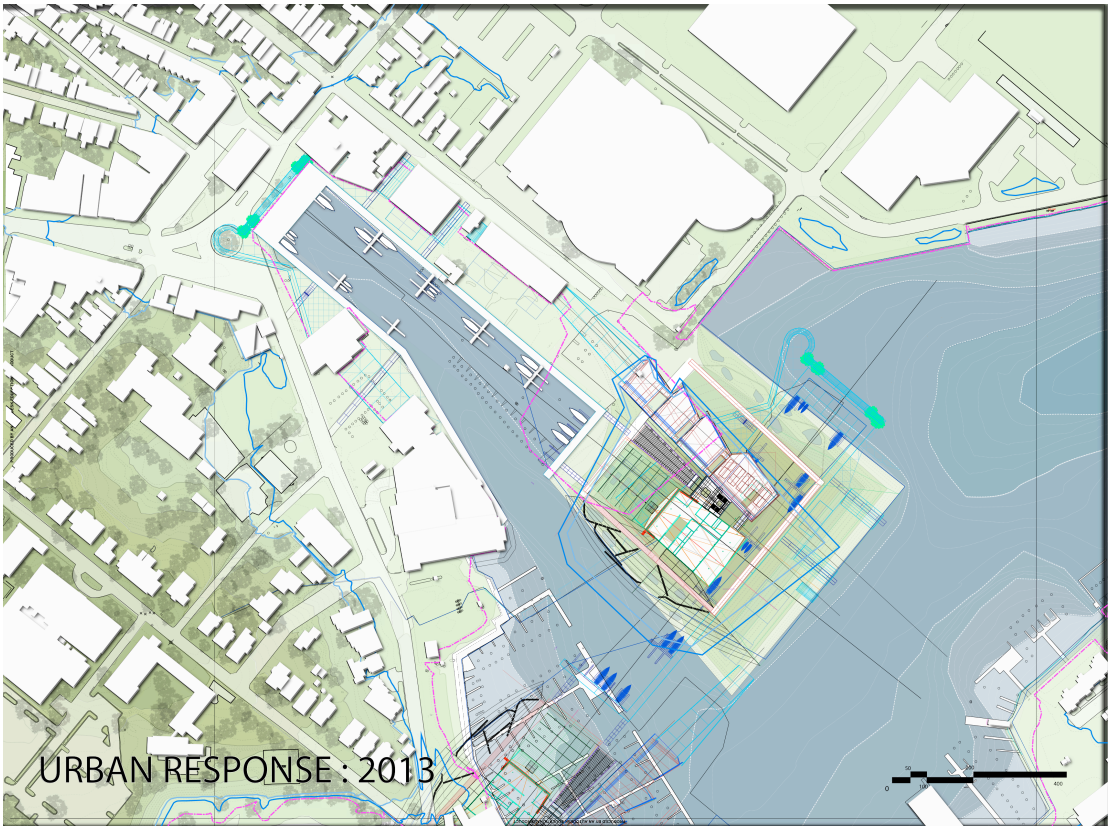


Figure 43 : A New Ego Alley [Image by Eric Joerdens]

The final proposal calls for the parking lot in ego alley to be removed, creating more harbor space. A continuous promenade between the harbor and the museum is created, creating two different outdoor rooms in downtown Annapolis. The current parking lots land could be excavated with the cut offsetting the new land fill of the museum site. The inlet remains in a low lying area where existing buildings and new intervention between the buildings can help keep areas behind dry. The museum itself rests upon man made topography. This new type of fill (up and out, not just

out) creates a new hill in Annapolis and relates the public institution to the state house and cities main church.

Celebrating the place of Annapolis



Figure 44 : A view from the market looking south to the expanded Ego Alley [Eric Joerdens]

Above, is a rendition of the enlarged Ego Alley. Extended boat parking allows Annapolis to celebrate its sailing heritage. The capital's waterfront is capped with the museum of the Chesapeake at the end. In the foreground is an inclined sea-wall. This would allow changing sea levels to happen within Ego Alley and still not affect urban areas behind the wall. Combined, the planted wall, new promenade and enlarged dock enhance a currently fractured sense of place with the existing ego alley and derelict parking lot.

Museum Plan

Museum Ground Floor

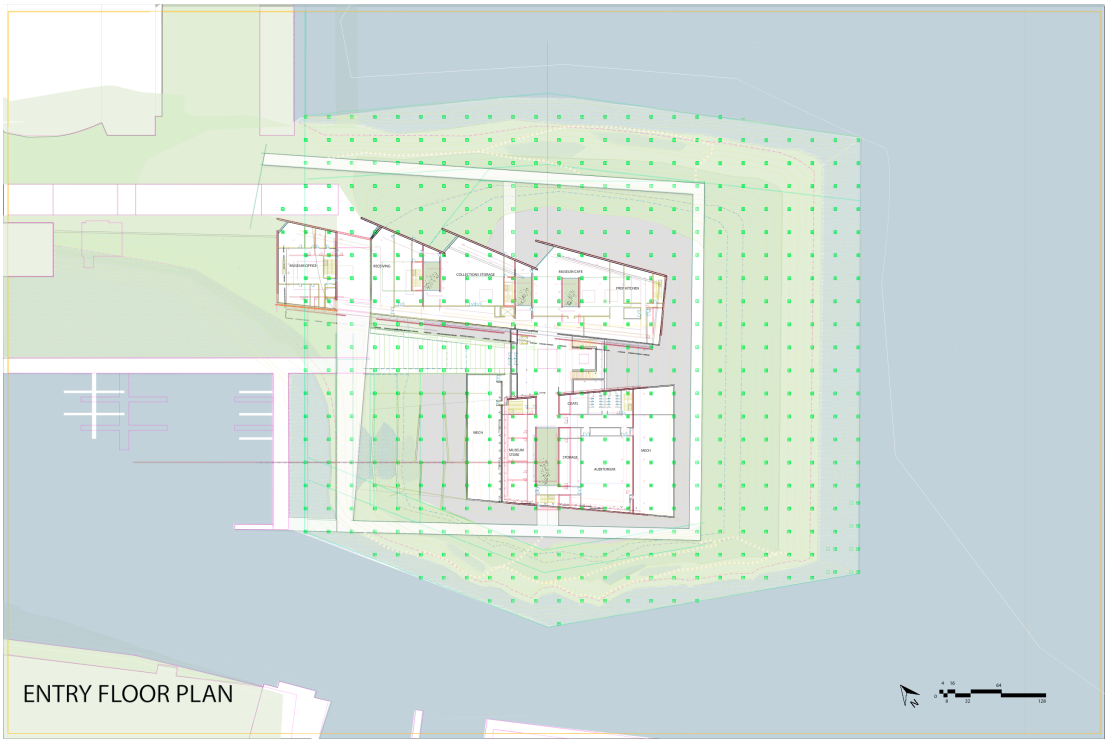


Figure 45 : Ground Floor Plan [Image Eric Joerdens]

Outside the museum ground floor are two pedestrian paths along the waterfront. The primary path allows a pedestrian to continue along the Annapolis waterfront. Towards the east, a pedestrian can walk onto the inclined berm which becomes a city beach. On the northern and southern sides the path is surrounded by wetlands and planters. Here a secondary path exists where one can meander closer to the water or experience a more naturalized coastline.

To enter the museum, one goes up a large outdoor stair, which runs through the center void of the building. Upon entering, one can continue upstairs to the exhibtions. The

lower floor contains the café, theatre and museum shop for patrons. The northern wing also houses the museums collection storage, loading and office entry.

Main Floor

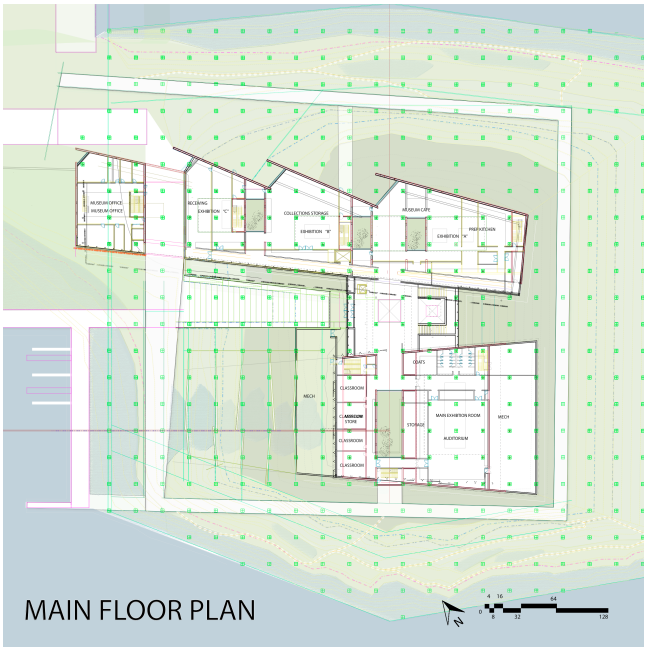


Figure 46 : Main floor plan [Eric Joerdens]

After arriving on the main floor, guests can examine artifacts in the sequential exhibitions rooms located in the northern bar of the museum. Here, views of the Chesapeake appear throughout the walls as framed openings periodically throughout the exhibition. To the south is the large exhibition room and classrooms. From here, a visitor can walk onto the terrace near the beach side or look back towards views of the State House and downtown Annapolis. Circulation between the two bars occurs at a center joint where stairs and elevator are located. In this way not only are the artifacts on exhibition but also the people viewing the findings.

The third floor also contains exhibtion spaces as well as a gallery. Where offices were locate don't he ground floor is now an extended exhibition wing

allowing visitors to learn about projects of sea level rise and the ecological changes which will occur in the Chesapeake as seas rise.

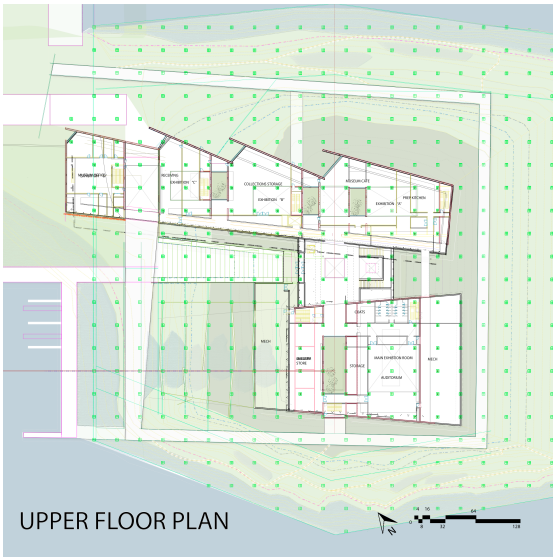


Figure 47 : Third Floor plan [Eric Joerdens]

In Section



Figure 48: Transverse Section through atrium [Eric Joerdens]

Here we can see the connection between exterior, interior, exhibition wing and central exhibition room. The artificial landscape rises up and creates a "basement –like" atmosphere for the entry level. In this way, one can experience the difference between venerable area and safe area (the second floor height) based on quality of

light and different tectonic treatment of the spaces. Moreover, this effectively masks the service spaces of the museum. Courtyards are used as way finding devices where visitor's can relate their interior location to the outside, and also offer needed mental breaks from being inundated by artifacts within the exhibition rooms.

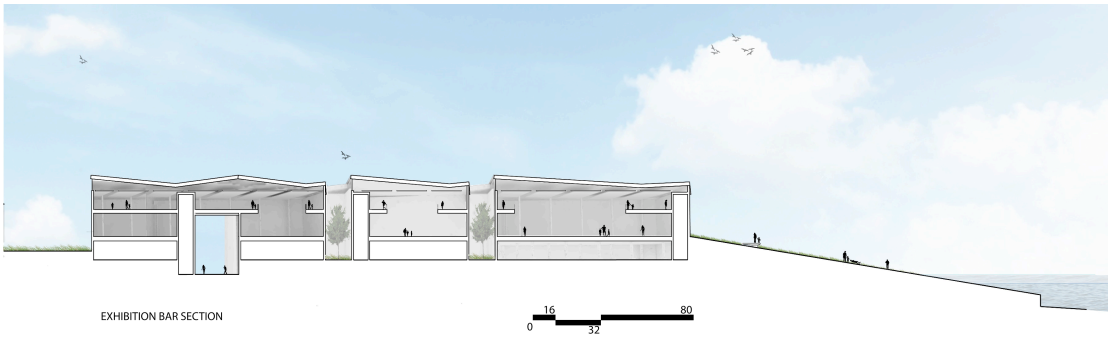


Figure 49 : Longitudinal section through exhibition bar [Eric Joerdens]

The exhibition wing is stratified by a rhythm of room and courtyard. One can circulate between the rooms or along the rooms creating multiple paths to experience the museum's collection. Within each exhibition room, the space is treated as a volume where curators can utilize the flexibility offered by two story exhibition spaces. Along the exterior of the rooms, casework lines the walls creating a perimeter display. The central area remains flexible for changing exhibitions and circulation. Along the southern edge (shown right in section above) of each exhibition room, the wall is punctured with many small windows. This allows a small amount of direct light into the space. The northern wall and roof angle to allow in diffused light via clerestory or large opening.

Experiencing Rise and fall of Water

Landscape Promenade



Figure 50: Perspective of museum from main walk showing water course [Eric Joerdens]

As part of the experience of the landscape and interior of the Museum of Chesapeake Cultural Heritage, the experience of water is intertwined with the promenade and experience of the individual. The form of the roof, landscape, façade, and individual elements of the building all contribute to the expression of water. Both formal and ecological aspects are considered throughout the museums grounds to illustrate the path of water. Across from the market hall, a water course is formed which terminates or begins the ceremonial axis of downtown Annapolis. Here, the roof of the main exhibition bar is angled so that the water received is drained through a large, protruding scupper along the Northern façade. From here, the water falls to a series

of terraced wetland pools where visitors can see the storm water cleansing ponds and associated wildlife. This not only creates a spectacle from a possibly mundane experience but also allows the water, which falls to be purified before continuing into large regions of the Chesapeake Bay.



Figure 51: Perspective of entry stairwell [Eric Joerdens]

Entering the museum form the landscape, allows the visitor to experience the difference in height and water levels. By designing the entry as a gash in the landscape, the height difference between venerable and safe water levels can be seen in one view. Markers of high water marks can be displayed on risers of stairwells as the waters rise from storms and through time. What drainage is also celebrated by a tripartite stair. A ramp exists to the left of the generously proportioned star (asix

inch rise for every 5 feet of tread), and to the right are larger cascading stairs. When dry, this allows visitors a place to sit for friends. When it is raining, water on the stairway will wick to these enlarged stairs, creating a cascaded down the entry sequence towards the bay.



Figure 52: Entry Court at lower level of atrium space [Eric Joerdens]

Inside the Museum

After entering through the outdoor stairs, a visitor finds themselves under the museum. With a stairwell across from them, they must pass under the atrium, which offers views to the artifacts above,in order to see the exhibition spaces. This space, like the rest of the lower floor, appears heavy and subtractive in nature, with light only being permitted to enter from above.



Figure 53: View of main stair, from second level [Eric Joerdens]

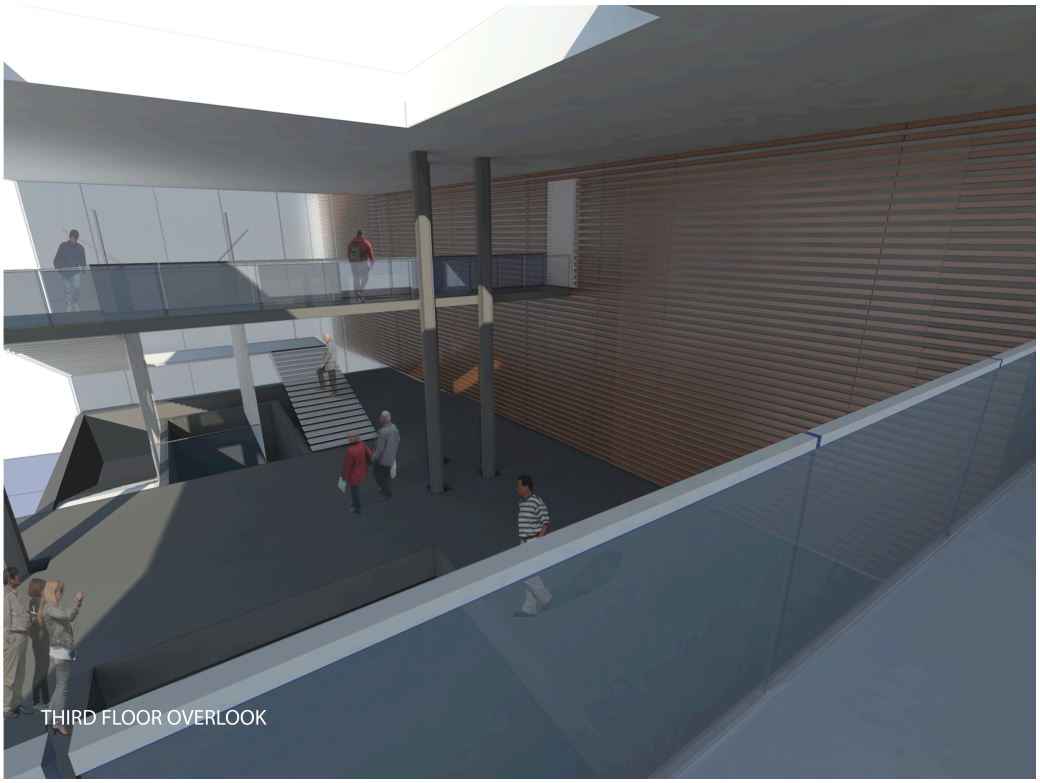


Figure 54: View from third story catwalk across atrium [Eric Joerdens]

A stereotomic and tectonic expression

After ascending the main stair, located with the earth, the visitor finds themselves on the main exhibition level. Here, within the atrium, expansive views of downtown Annapolis and the waters of Annapolis can be seen. This large open area, directly contrasts with the connected space below, created a dichotomy of expression within the unifying space between the exhibition bars. Slender columns extend upwards and support delicately placed catwalks. The stair between the second and third levels has a drastically different tectonic expression than that of the lower level. Together, the two expressions work together to heighten the awareness of ascending and descending for the visitor of the museum.

Assessing Venerability

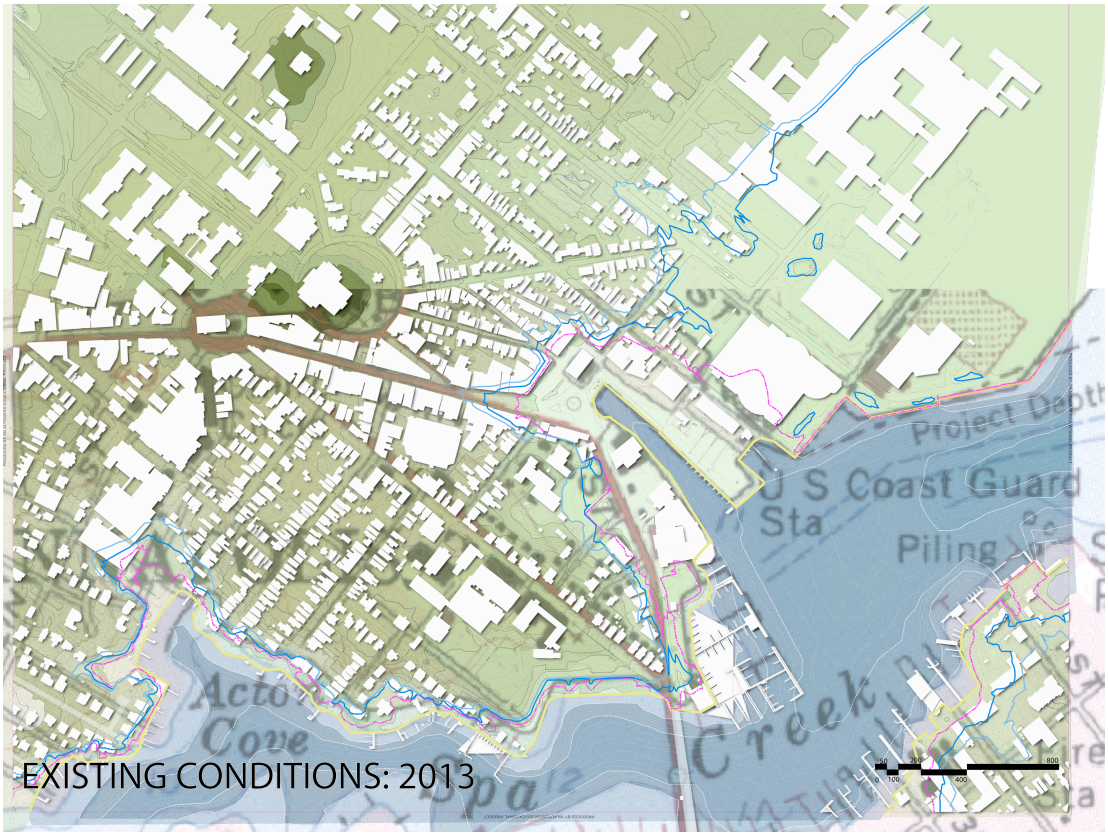


Figure 55 : Current Sea-level rise venerability and topography overlaid on Annapolis Figure Ground [Eric Joerdens]

The Museum of Annapolis not only spreads awareness of rising waters, it also helps adapt the city to the rising waters at a large scale. Above, the pink line represents where water level will be in 2113 as opposed to the current 2013 water line. The blue lines represent the current 100 and 500 year flood planes respectively. As it can be seen, the area around Ego Alley and the market like in the most venerable parts of the city. This area also represents a large part of Annapolis image ability, creating the need for intervention within this zone.



Figure 56: Proposed Sea-level rise venerability and topography overlaid on proposed Annapolis figure ground [Eric Joerdens]

With the placement of the museum at the end of the dock, and utilizing topography as an adaptive and experiential device, the above image shows an adapted ego alley, prepared for 2113 normal water levels. The landscape of the museum connects the city of Annapolis to the Naval Academy's sea wall, which is already engineered for higher seas. Urban interventions create safety measures within Ego Alley, altogether creating a distinct place which celebrates and utilizes rising waters for a better public, ecologically principled public realm.

Conclusions and takeaways

Rising Waters, salvaging history

Scientific modeling suggests that seas will rise throughout the coming century. This creates two devastating challenges and opportunities as we look toward the future; how can we protect present urban area which lie in jeopardy, and how can we save relics from the past which solidify our reason for being and placement within a specific geography? These two challenges can be approached as separate issues, or as demonstrated here as a combined issue which a culture can use as a rallying departure for change. Our built environment needs to adapt to rising waters, and the interventions, which come directly shape, inform and open opportunities of distinct place-making. Integrating ecological needs, the joys of a specific place, and thresholds of safety will be an important key in creating rich, diverse, urban coastal experiences in the 21st century

Utilizing change

Though the potential loss of coastline and low lying urban areas seems, and most likely will be, devastating, we must also look to utilize the opportunities of rising waters to better the environment around us. Interventions need to examine whether there is energy generation potential on the site as well as how the area of intervention can adapt while providing opportunities for habitat growth, cleansing, and places of destination for humans and animals alike. In this way, interventions can ensure that a place is left in an improved state compared to its previous existence.

A scalar opportunity

Seas will rise and coast will be lost throughout the world. Consequently, each city and coastal area must adapt to their changing needs. Though this thesis thoroughly examined how sea level rise will affect a singular coastal urban area ideas and designs examined throughout the exploration can be adapted and scaled to fit other coastal urban areas.

Maryland will not be the only area which loses cultural artifacts to the rising tides, within the next century we will be faced with the reality of our industrialized actions. As we face the loss of many historic and archaeologically significant areas due to global warming and sea-level rise, the actions we take to protect and adapt such areas will have to examine how best to mitigate green house gas emissions while preparing for the warming, rising waters caused by global warming.

Change is an eminent factor in life, however our collective history can provide clues and insight into how to best live between society and the environment. As coastlines change, how we respond to that change in urban and rural areas will ultimately shape the places we experience and reveal protected pasts, which can no longer exist due to change. Throughout this exploration, a variety of ways of capturing and adapting a shrinking sense of place have been examined in the hope of salvaging a part of our collective past which would otherwise be muted through the rise of our waters.

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