INDUSTRIAL ORGANICISM:
EVOLVING THE CULTURAL LANDSCAPE OF THE MINAS BASIN, NOVA SCOTIA THROUGH COMMUNITY OWNED RENEWABLE ENERGY

by

Megan N. Lloyd

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ABSTRACT

My thesis explores the evolution and ongoing cultural relevance of the unique Minas Basin landscape located along the Bay of Fundy coast in the province of Nova Scotia. The extreme tides of the Bay of Fundy, the highest in the world with a twice daily range of up to 16 meters, have been shaping this landscape for thousands of years, both physically and socially. Consequently, all settlers have been required to adapt to these conditions in new and innovative ways, including altering landforms and modifying traditional vernacular building materials and methods. These necessary adaptations over time have created a significant sense of place throughout the Minas Basin. Taking lessons from the past and looking ahead to the future, my thesis is proposing the implementation of a community owned renewable energy collective as the next step in the evolution of this working landscape.

Using the theory of organicism as the methodological framework of the study and keeping true to the notion of holistic sustainability, all interventions are to be designed with a "landscape-first" attitude, actively drawing in existing landforms and waterways into an architecture where the whole is larger than the parts. The building site itself, located on the tidal Cornwallis River will act as a technological and social hub for the entire region, by including spaces for both permanent and temporary residents to interact with one another and promote renewable energy practices.

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CHAPTER 1: INTRODUCTION

1.1 Theoretical Framework: Organicism

Organicism is the philosophical perspective which sees the world and its parts as organic wholes, each serving a specialized function, all feeding back into the greater whole. Organicist theory states that parts can not exist independently, and knowledge of the whole is necessary in order to understand the parts, and vice versa.[1] Throughout this thesis, I use organicism to connect the parts of architecture to natural systems and bring it into a whole expressed in the cultural landscape of the Minas Basin. Organicism, as it was defined in the 19th century, was not meant to be a direct aesthetic imitation of nature but rather a deep understanding of the laws of nature expressed as functional adaptations. This thesis is studying the role of the organic as more than a style; it investigates organicism from its roots in classical and Renaissance ideas, through its development in nineteenth century architectural theory.[2] It is also using organicism as a strategy of invention, by which design decisions are informed, and interpretation of meaningful architectural form can be manifested.[3]

Gottfried Semper's position on the role of the organic in architecture is important to the formulation of this thesis. Semper saw the art of building with nature as a whole, following the laws of nature and not purely visual imitation. Even though he saw nature as an incredibly complex structure capable of creating an infinite variety of forms, he was able to identify the repeated simple elements that exist throughout all creations, and the way they were constantly adapting and renewing to suit new developments in their environments. He identified that architecture, in the same way as nature, has basic elements that morph with varying natural circumstances such as climate and cultural practices.[4] Sir Isaac Newton said that "nature delights in transformation."[5] This speaks to the phenomenon that nature's fundamental laws are continually adapting over time resulting in no truly static

1. David R. Keller and Frank B. Golley, *Philosophy of Ecology* (Athens, Georgia: University of Georgia Press, 2000), 171.
2. Caroline van Eck, *Organicism in Nineteenth Century Architecture: An Inquiry into its Theoretical and Philosophical Background* (Amsterdam: Architectura & Natura Press, 1994), 12.
3. Ibid., 19.
4. Ibid., 230.
5. D'Arcy W. Thompson, *Growth & Form* (London: Cambridge University Press, 1942), 1030.

form. Architecture does, as nature, produce living, breathing organisms that are shaped by their surrounding environments, and therefore should be expected to adapt as needed.

This thesis will take Semper's position on organicism as the backbone theory and apply it to the evolving cultural landscape of the Minas Basin in Nova Scotia. Each component that makes up this study will be treated as a moving piece where all components contribute energy to the whole. These key elements will be explored throughout the remainder of this chapter as well as an introduction to the primary goals of the study. In the following chapter, I will begin to tie the components together by tracing the cultural and technological histories of the place and studying the notion of social collectives as the next step in the evolution of the landscape. The final chapters will clearly define the design goals and architectural strategies working with Semper's theory of organicism, on stereotomic and tectonic elements.[6] Theories formulated after Semper, under the study of ecological philosophy will also be considered in further generating the idea of macrocosm/microcosm; how to translate the organic whole that is the Minas Basin landscape into a modern architectural expression. Finally, the physical translation of the whole in relation to all components in the organic system will result in the concluding holistic architectural design of this thesis project. Organicism will also be used as a way of investigating all aspects of the whole in an interdisciplinary way by maintaining an understanding of the effect the landscape has on the sciences as well as the arts. This will be done by incorporating not only scientific theory but works of artists who have been inspired by the Minas Basin such as the poetry of J.F. Herbin and the work of local artists such as John Neville. The inclusion of this broad spectrum gives a clearer vision to what this uniquely beautiful landscape is.

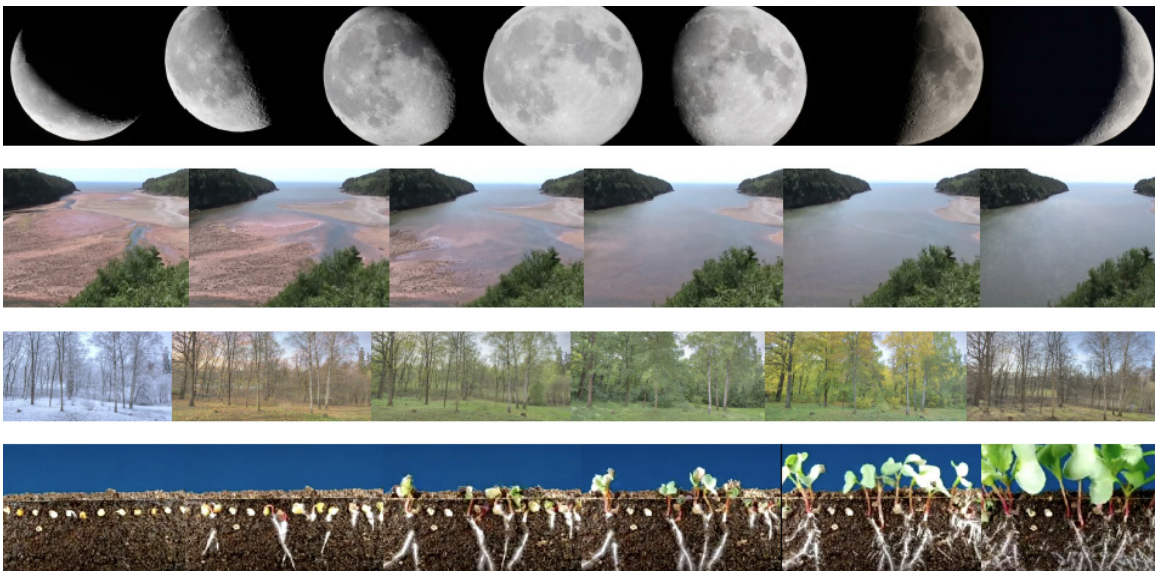
1.2 The Whole: The Evolution of the Minas Basin Cultural Landscape

Just as D'Arcy Thompson speaks of the organic morphology of living forms in his 1917 book *Growth & Form,* the landscape of the Minas Basin can too be described in those terms. Thompson says that the reason why no chain forms a perfect catenary and no raindrop a perfect sphere is due to the innumerable natural forces acting upon all matter. However, it is through knowledge of these natural forces that the form of the chain or the raindrop can begin to make sense.[7] The same can be said for the Minas Basin landscape

6. van Eck, *Organicism in Nineteenth Century Architecture*, 144-174.
7. Thompson, *Growth & Form*, 1029.

in that defining and studying the parts which have contributed to its form will provide a deeper understanding of the landscape as an organic whole. When defining the acting forces on the landscape, the physical as well as cultural and historical forces must be considered separately but knowing that they all act on one another. The tides have played, and continue to play, the most significant role in the physical shaping of the land. Culturally, the landscape has been shaped through adaptations by the Mi'kmaq and Acadian people.

It is through the understanding of these "forces" acting over time that one can begin to realize the organic whole that is the dynamic landscape of the Minas Basin. Just as scientists can now predict the next evolutionary stage in an organism's form, we can begin to make an informed projection about the form of the next stage in the landscape evolution and its reconnection to place.



Study of some of the concurrent cycles which make up the Minas Basin: From top to bottom: Lunar, Tidal, Seasonal and Agricultural.

1.2.1 Part 1: Bay of Fundy Tides

Ebb and Flow

John Frederic Herbin, 1909

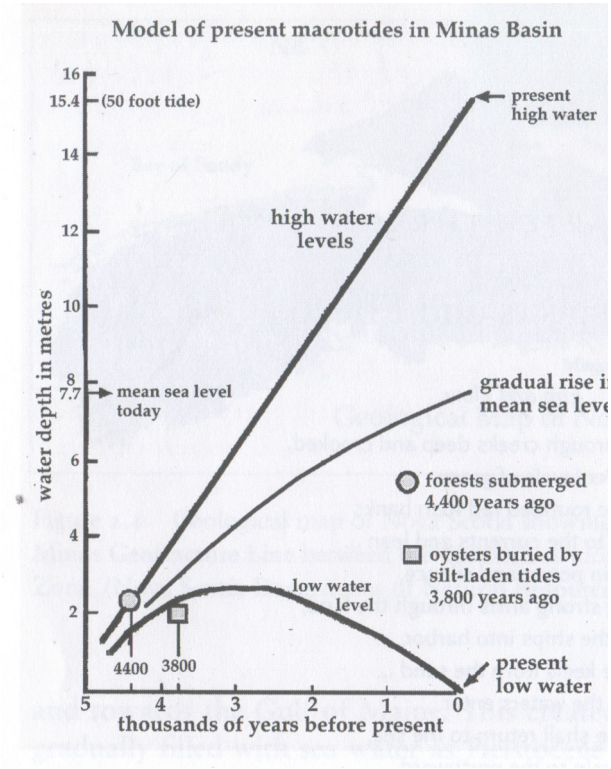
Curling through creeks, deep and crooked,
Gliding o'er levels of green,
Hiding the rounded red rush banks
That sing to the currents and lean ...
Flooding in power and silence,
Thrusting strong arms through the land,
Whirling the ships into harbor,
Lifting the keels from the sand ...
As swiftly the waters enter
So the tide shall return to the sea,
Ebbing again to the northward,
Southward again to the sea.[8]

A fishing boat stranded on the bay's floor at low tide. Photo taken near Digby, NS on the southern Fundy coast.

The Minas Basin within the Bay of Fundy is home to the highest tides in the world. This extreme tidal range, up to 16 meters, is caused by the basin's natural resonance period and

8. Sherman J. Bleakney, *Sods, Soils and Spades* (Montreal: McGill-Queen's University Press, 2004), 11.

the lunar cycle syncing up perfectly. A 5 kilometer channel adjacent to Cape Split, Nova Scotia forms the mouth of the shallow Minas Basin. Over the course of each semi-diurnal tidal cycle, approximately 14 billion tonnes of water rushes through at speeds between 7-8 knots (13-15 km/h). In the middle of the cycle, the flow going through this narrow channel is equivalent to the combined flow of all the rivers and streams on the planet. The immense weight of the water forces the land underneath the Minas Basin to rhythmically sink and rise with each cycle. The tides rush through here, rising by approximately 2.5 meters every hour, stretching their wet fingers into thousands of acres of tidal meadows, salt marshes and beaches.[9]



A graph mapping the macrotides of the Minas Basin indicating major points in the tide's history. Note that increasing amplitudes in the Minas Basin have lowered low tide levels, thereby exposing ancient forests and oyster shell beds that had previously been completely submerged; from Bleakney, *Sods, Soils and Spades*.

The extreme conditions caused by these tides requires settlers, both modern and historical, to adapt. These evolving adaptations have breathed life into the environment of this very special region, allowing its history to be read clearly through its continually evolving cultural landscape and waterways.

The tides have shaped all aspects of the Minas Basin's cultural landscape. Since the wa-

9. Ibid., 13.

ter moves so fast, it is read as one with the deep reddish mud, giving off the appearance of a brown, and sometimes purple hue. This changes the look of the entire landscape. The juxtaposition of the purple/brown water against the trees and agricultural fields makes them appear even greener. The sky looks bluer. The air feels fresher. The light becomes curiously brighter. When you are travelling to the Minas Basin, you will know when you arrive because everything starts to feel, and appear, differently. It is immediately evident that you are entering a truly unique and special place.

The mud of the cliff is seen being pulled out and into the Bay. The mixing of the blue water and red earth give the impression of the unique purple hue. Photo taken near Digby, NS on the southern Fundy coast (unedited).

Unique colors are seen throughout the landscape near low tide on the Avon River, a tidal river directly off of the Minas Basin (unedited).

The tides have played a role in the human experience as well. Everyday human tasks and rituals have to be altered to work cooperatively with the constantly flowing water. Traditional fishing methods have been adapted, recreational activities such as beach walking or swimming must be planned to coincide with low or high tide and the industry of agriculture has been completely reshaped through diking and field draining.

The fishing industry is an excellent example of an activity that has required serious adaptation on the Fundy coast. This image shows an example of horse and wagon fishing from the early 1900s; from Bleakney, *Sods, Soils and Spades*.

1.2.2 Part 2: Agriculture

The Dikes of Acadie

John Frederic Herbin, 1909

O marshes green, the dikes of Acadie,

I have been nursed upon your ancient breast,

And taught your patience and your heart's calm rest,

Your large content and fine serenity![10]

10. Ibid., 3.

The salt marshes of the Minas Basin have been continuously building to keep up with the erosion forces of the tides for thousands of years. The development of the marsh results from the trapping of sediments, together with absorbed nutrients, by salt marsh plants each time the tide rises. Thus, a Fundy salt marsh represents thousands of years of biological production: the plant roots, sediments and nutrients have been stored in the marsh over a vast geological timespan, producing an accumulation of fertile soil. The soil needs no additional fertilizer, has neither stones nor trees to clear, is almost perfectly level, and has a uniform distribution of nutrients. When the Acadians settled the land in the late 17th century, they recognized the significant promise this land had and they worked hard to see the fruits of this soil. They built extensive dike networks all along the tidal coast to protect the fields from being continually flooded.

In the future, as we face rising sea levels, adaptations will need to be constantly explored so as to protect such an invaluable resource.

1.2.3 Part 3: Renewable Energy as the Next Step in the Working Landscape

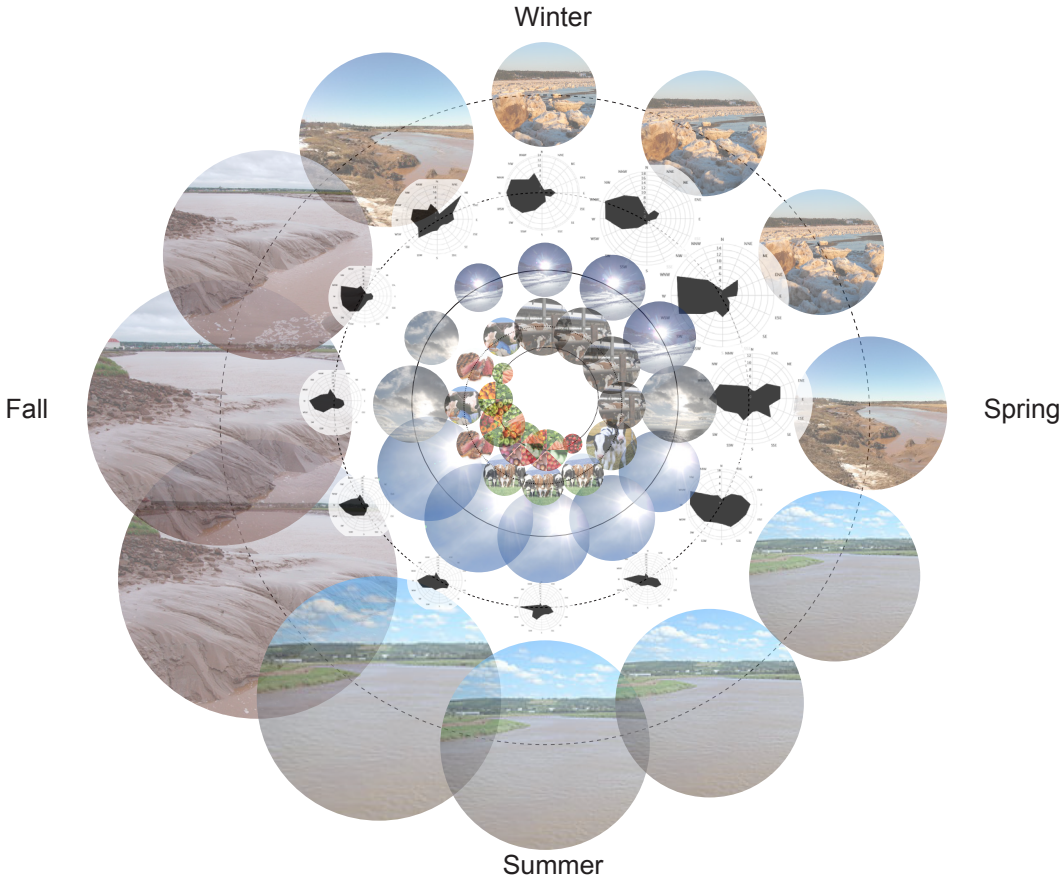
In the middle of the 20th century, the study of ecology began to emerge as a new integrative discipline. Scientists and philosophers alike began to realize that in order to adequately study and understand complex ecological systems, they had to first understand the hierarchical organization of the system. A simple way to think about this is through the old saying “the whole is greater than the sum of its parts.” In 1953, as an answer to this changing definition of ecology, brothers Eugene and Howard Odum wrote Fundamentals of Ecology, a revolutionary book for two reasons: First, the principles of ecology were presented from a whole to part progression (introducing the ecosystem level first, instead of last) and second, energy is used as the common denominator for integrating biotic and physical parts into functional, organic wholes.[11] I will adopt this attitude in the way I will be speaking about energy throughout this thesis by using the term not only as a simple definition for “electricity,” but to describe integral, qualitative aspects of the parts which make up the larger whole.

11. Keller and Golley, *Philosophy of Ecology*, 195.

A single glowing windmill can be seen catching the sun beyond the hills of Annapolis Royal.

Industrial landscapes are prevalent in many areas across the world, and often viewed as negative additions to otherwise perfect places. This is especially true for a place like the Minas Basin. The fact is, however, a “working” landscape can be a beautiful thing--a sign of progress and forward thinking. The dikes which trace the Fundy coast are a historic example of altering the landscape for industrial purposes. The next step in the evolution of this is adapting the landscape for renewable energy.

Currently, power generation in Canada is causing major damage to the environment and local economies. The current trend of using fuel based resources is instilling bad habits into the public, combined with a lack of progressive public education. Now is the time to swap out our dirty coal and gas in favor of clean, renewable energy sources. Although the obvious choice for a renewable resource in the Minas Basin is tidal energy, a balanced scheme of all available, concentrated, predictable resources is the best way to ensure the most reliable source of electricity in that area. In addition to the tidal potential, the site also has a strong potential for solar power, wind energy, and biomass. The power sources will be used in sync with the seasonal cycles when each of the resources is most plentiful. For example, when the sun is strongest in the summer, solar power may become the primary source of energy while wind power may take a back seat.



Calendar representation of the annual cycle of available renewable resources: tidal, wind, solar and biomass.

Working within the framework of the community-owned energy collective, I am proposing that a continuing education platform would be established to inform the public about available renewable resources near them. A good example of this type of tool can be found in Project Sunroof, a solar power initiative started by Google. Their goal is to use Google's expansive data in mapping and computing resources to help everyday people get a better idea about a possible solar power plan for their home. It takes into account aerial imagery, 3D modelling of rooftops, cast shadows and sun position throughout the year to recommend installation sizes, potential energy savings, average costs and even points you in the direction of local suppliers and installers.[12] This type of intuitive tool could be adapted to suit the other available resources in the region and could make the process of investing in small scale renewables much more accessible to all.

12. Google, *About Project Sunroof,* accessed January 2, 2016, www.google.com/get/sunroof/about

1.2.3.1 Tidal

Using tidal power is the most readily available renewable resource choice in this region, the home to the highest tides in the world. It is important to remember, however, that appropriate scaling as well as utilizing a highly visible installation location are both crucial considerations. Since it is the extreme tides of the region that have made the most significant impact on the historical cultural landscape, it is important to explicitly showcase the ways these tides can be used today to inform the next step in the cultural evolution as a means of public education. Incorporating small scale tidal energy generators into existing infrastructure such as bridges is a great way to feature this promising way to produce renewable energy while maintaining low impact on the natural environment.

Small scale tidal turbines installed under the Avon River rail bridge at low tide.

1.2.3.2 Solar

The towns within the Minas Basin could lend themselves quite well to the implementation of a solar powered energy network in that there are no tall buildings and few tall trees that would cast shade. Additionally, compared with other regions in Nova Scotia, the micro-climate of the Annapolis Valley allows more sunny days annually. It also helps as well that the most widely recognized expression of renewable energy is the solar panel. Most people are generally familiar with what a solar panel looks like and the general mechanics of how it works: sun + panel = electricity. More elusive to the general public is how this form of energy can actually be realized, and the impact it can have on an individual scale. A way to encourage these conversations and further explorations into solar power is by installing panels in highly visible places in the busiest areas of town. For example, installing an array of solar panels on the rooftops of Acadia University in Wolfville, the largest population center in the Minas Basin, would be an excellent way for students and community members to take notice and begin a dialogue in an academic setting.

Solar panels installed on Acadia University rooftops.

1.2.3.3 Wind

Nestled between North Mountain, a long narrow ridge stretching between Brier Island and Cape Split, and South Mountain, the range between the Annapolis Basin and Mount Uniacke, lies the Annapolis Valley. Coupled with the tides, this valley condition lends itself to many unique characteristics relating to climate, fertile soil and more; all of which have contributed to its success as a sustained working landscape. Another unique characteristic of a valley, however, is the creation of a wind tunnel. Normally, this condition is seen as not much more than a nuisance. In the case of harvesting clean energy however, it is good news. Several wind farms, owned by Nova Scotia Power, have already started to emerge in the region. This is a testament to the success of wind energy in the Annapolis Valley; it is proof that an investment in this variety of renewable is smart.

The presence of another mountain, Wolfville Ridge, closer to the towns of Wolfville, New Minas and Kentville, gives an opportunity for placement which would maintain a strong visual connection to the higher density population centers. Like the historic dikes, the visual presence of these windmills will clearly articulate the evolving story of the land.

Highly visible windmills throughout the Annapolis Valley landscape.

1.2.3.4 Biomass

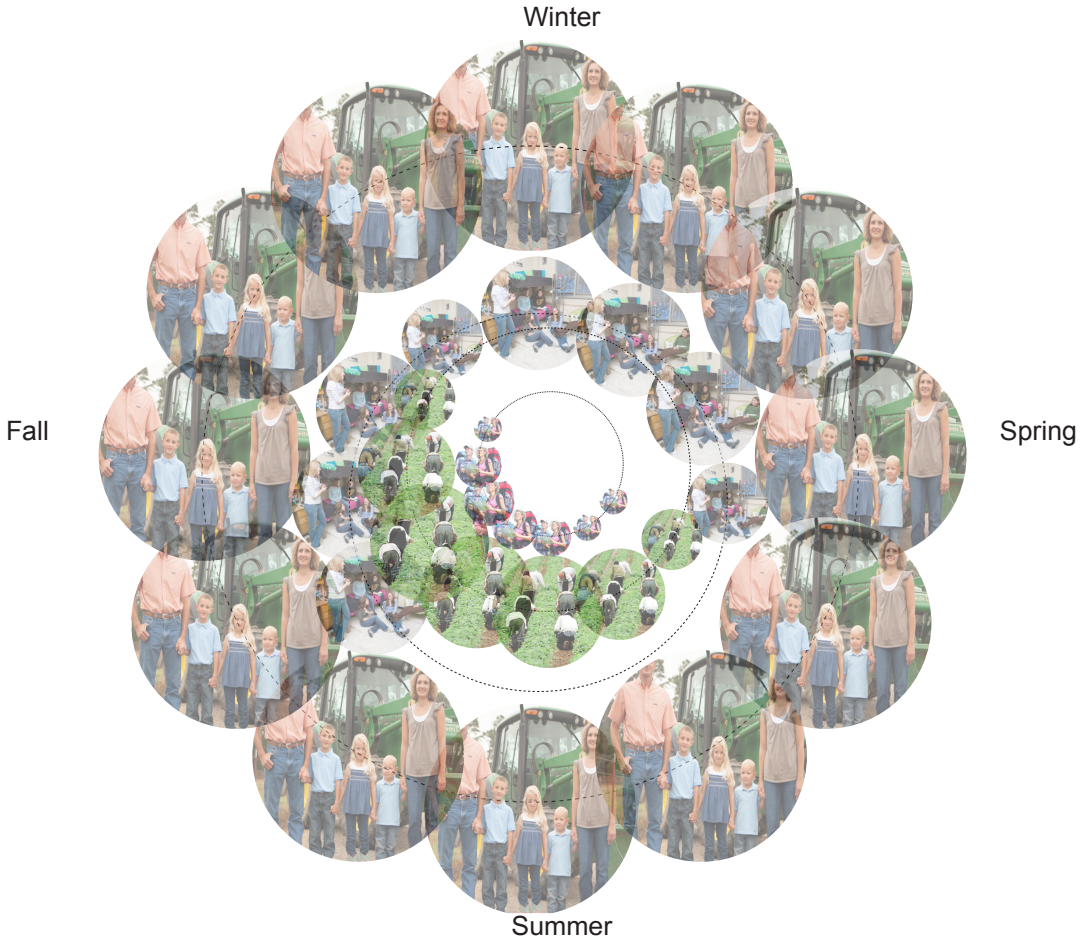
Biomass can come in many shapes and forms including trees and brush, agricultural residues, crop waste, and livestock manure.[13] With so many farming operations in the Annapolis Valley, it is easy to envision a small biomass generator incorporated into existing out-buildings or barns on each farm using what would have been waste products to create energy. Much of the waste material is currently reused by the farmers as fertilizer, but there is still a sizable amount that remains unused and wasted. In addition to the by-products already existing on the farm, planting “energy crops,”such as high yielding grasses and low maintenance perennial crops, could also add to the production, if there is additional unused field space on the farmer’s property. It is feasible to think that farms could actually start to “grow” energy.[14] In terms of Semper’s organic approach, biomass (waste and by-products) could be seen as the “hateful,” or undesirable cog in the system, being used for good to complete the harmonious whole.[15]

13. Natural Resources Canada. *Bioenergy from Biomass*, Government of Canada, June 18 2015, accessed January 5 2016, http://www.nrcan.gc.ca/forests/industry/bioproducts/13323
14. Biomass Energy Centre, *Energy Crops,* Biomass Energy Centre: Government of UK, 2011, accessed January 5, 2016, http://www.biomassenergycentre.org.uk/portal/page?_pageid=75,17301&_dad=portal&_schema=PORTAL
15. van Eck, *Organicism in Nineteenth Century Architecture*, 230.

Biomass operations integrated into existing outbuildings on farms.

1.2.4 Part 4: Permanent & Transient Population Groups

This region has many unique factors including the large number of farms, wineries and breweries, its adjacency to the highest tides in the Bay of Fundy, being home to a UNESCO World Heritage Site at Grand Pré as well as the nationally recognized Acadia University all within an hour drive from Halifax. With the addition of a green energy collective, these unique conditions make way for a diverse ebb and flow of population made up of permanent residents, migrant farm workers, students and renewable energy specialists working for the collective. This thesis will work to address the needs of all the population groups which flow through the region. In order to address the various needs of the four groups, the project will include three primary program types: housing for the temporary residents (mainly farm workers and students), the collaborative hub office for the energy collective, and an activated, integrated outdoor space to encourage social interaction between all population groups.



Calendar of permanent (farmers and families) and temporary (students/interns, migrant workers and tourists) population groups.

1.3 The Four Pillars of Sustainability

The sustainable evolution of the Minas Basin landscape is the overarching goal of this thesis. The four pillars of sustainability will be carefully considered and addressed throughout the study.[16]

1. Environmental - The promotion of renewable energy throughout the landscape is an obvious way this thesis addresses environmental sustainability. The amount of renewables we can take advantage of directly relates to the amount of pollution we are keeping out of the air, land and water, keeping the Minas Basin beautiful.

2. Economic - The significant community-owned facet of this project helps to maintain the success of the local rural economy, in a time where urbanization is taking over.

3. Social - All architectural interventions proposed as components of this thesis will encourage strong, meaningful social connections between a diverse cross section of cultures and population groups.

4. Cultural - By studying the history of the place and framing the proposed intervention as an evolution to an already successful story of adaptation, this thesis encourages residents of the Minas Basin to learn more about the past and encourages innovation. The Acadians shaped the land in a way that continues to benefit residents some 350 years later. This cultural connection is perhaps the most important pillar to consider in that it is the spine which holds the other pillars in place. The cultural sustainability of the Minas Basin is of utmost importance, and will be considered highly throughout this thesis study.

The four pillars of a sustainable community.

16. Sustainable Antigonish. *Four Pillars of Sustainability*, accessed March 2, 2016, http://sustainableantigonish.ca/4-pillars/

1.4 Thesis Goals

After the initial introductory study to the site, I realized that there were two ways this project could be taken. The first option would be to investigate infrastructure as architecture and study the ways in which these proposed renewable “pieces” could be thought of in a new and accessible way. The other option was to think of the project in a more holistic and sustainable way, by considering all aspects of the site, both technological and social, and to formulate goals in this way. Organicism says that for the whole to be understood, all pieces must be represented and understood. It became clear at this point, that the thesis goals must address all of the concerns that the site puts forth, not just those relating directly to renewable energy. The idea behind this is that with the proper pieces in place, social and technological, the interest in the renewable shift will naturally grow, just as any other organism would. With this in mind, three main thesis goals can be established:

1. Encourage a Better Connection between Permanent and Temporary Residents.

2. Increase Awareness and Investment in Renewable Energy Resources.

3. Address The Need for Quality Housing for Temporary Residents.

These three primary goals will be considered while researching site history, renewable technology and social conditions in Nova Scotia and through case studies in other parts of the world in order to ensure a thoughtful architectural response.

CHAPTER 2: RESEARCH

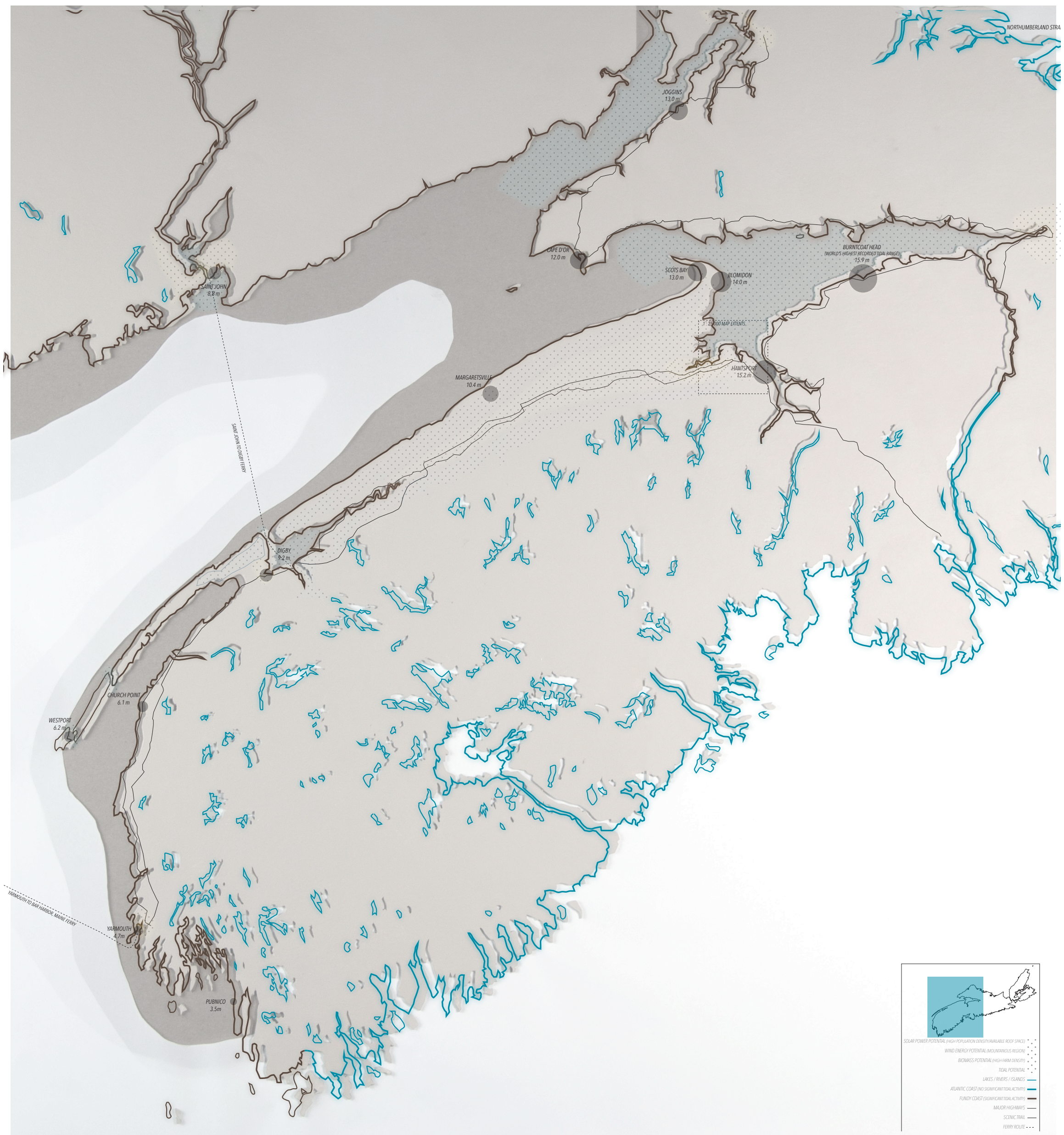
In this chapter, I will address the three main components that will outline the thesis: site analysis - landscape, renewable energy - technology, and community-owned collectives - social. Each sub chapter includes a brief history, a snapshot of modern conditions and a case study outlining an example of best practice.

2.1 Understanding the Landscape

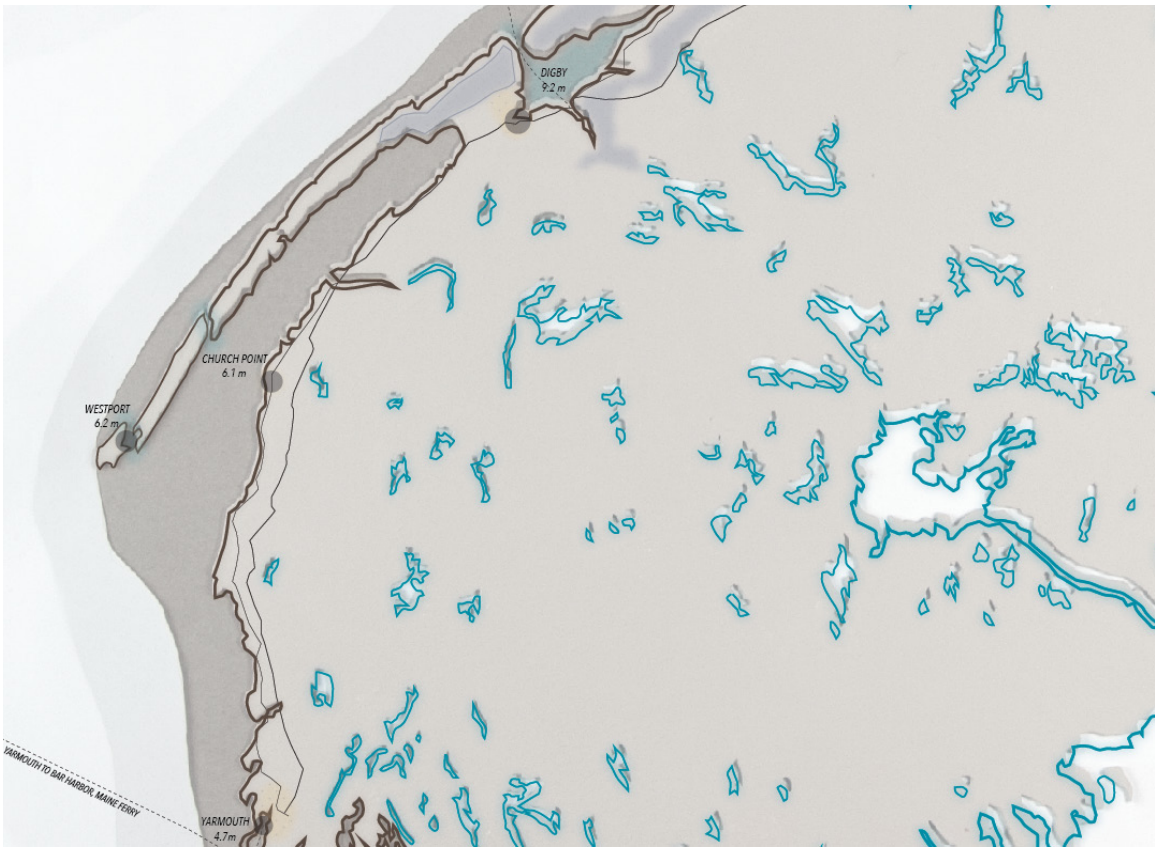
This section will address the history of the entire Minas Basin area, followed by a more in depth analysis of the town of Port Williams, the thesis project site. Following the study of these local conditions, I will examine the unceasingly adapting Dutch cultural landscape as a best practice example.

2.1.1 History of the Minas Basin

The intense spectrum of colors is seen clearly here in this unedited photograph of the harvest season landscape at the county line between Kings and Annapolis County.

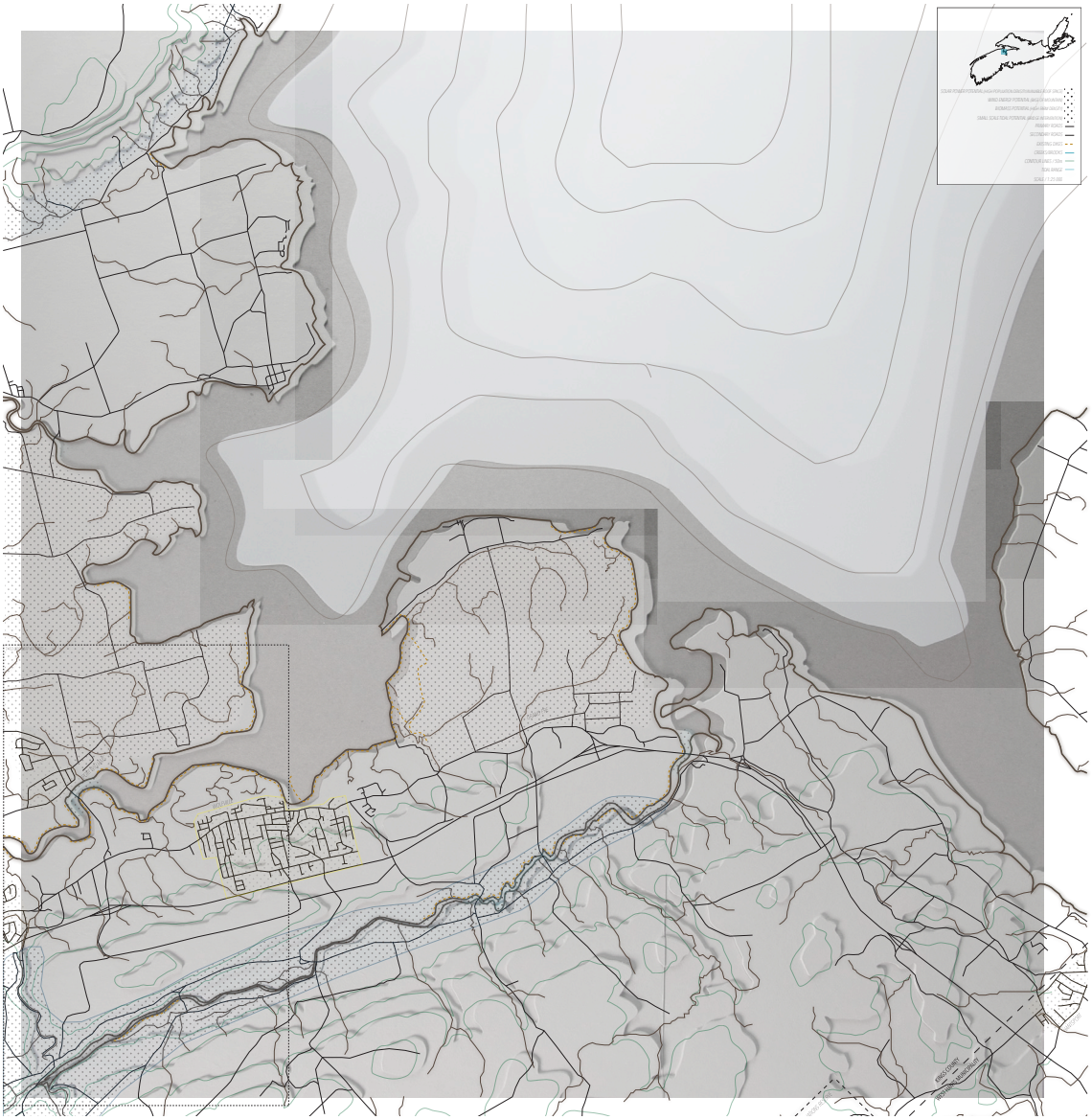


Interpretive hybrid site model/map of the Fundy coast of Nova Scotia, indicating tidal range, and renewable potential in the context of neighboring land areas and the Atlantic coast, with a much less extreme tidal range.

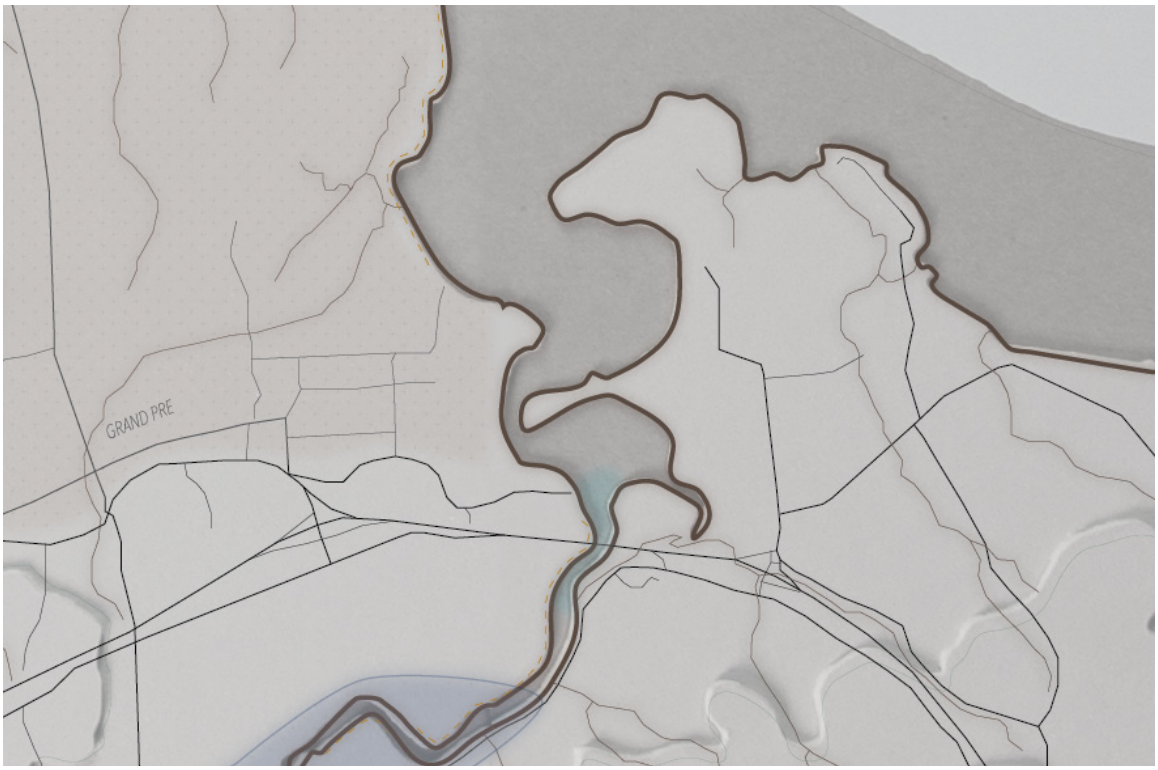


Detail of Fundy map showing where the extreme tidal activity begins at the south western tip of the province.

Detail of Fundy map showing the location of the Minas Basin, the area with the most extreme tidal range in the Bay of Fundy, in relation to the rest of the province, and the neighboring province of New Brunswick.



Interpretive hybrid site model/map encompassing the entire Minas Basin region, indicating population centers, tidal range and areas with high renewable potential for tidal, wind, solar and biomass energy generation.



Detail of Minas Basin map showing one of the potential building sites near the Gaspereau River where three out of four potential renewable resources are possible.

Detail of Minas Basin map showing the chosen building site of Port Williams which is the only area in the Minas Basin where all four of the potential renewable resources are possible.

The unique conditions of the Minas Basin have always been a source of inspiration for artists. Seen here are three intaglio prints by Hall Harbor artist John Neville. From left to right: *Rowing Against the Tide*, 1994; *Andrew & Albert Rowing Against a Tidal Surge*, 1994; and *Turn of the Century*, 1998. The colors used throughout the works are certainly inspired by the landscape, especially the color of the sky in *Turn of the Century;* from Secord Gallery.

This area of Nova Scotia has rich historical significance, both socially and technologically. Much of this history dates back to the settlement of the French in the region. The transition from French to the current term, Acadian, was a result of environmental, social and political influences on the settlers.[17] Although some of the settlers had experience with intense tidal conditions in their home country of France, the tides of the Bay of Fundy were even more extreme than what they had ever seen before. Together with the harsh weather conditions of the winter months required serious adaptation. A significant portion of this adaptation was guided by the strong relationship the Acadians formed with the original settlers of the land, the Mi'kmaq First Nation. History has shown us that they often worked together, sharing their respective insight and expertise.[18] This can be seen in the documentation of many mixed marriages between cultures as well as variances in their language. Often, Acadian words are hybrids of French and Mi'kmaq terms such as the word "matues," a word both cultures shared that means porcupine. These influences helped to assure the settler's sense of independence and initiative and their distancing from French allegiance as they began to form their own culture. This was all crucial in the sense of the strong Acadian community values. Over a period of less than a century, from 1680-1755, they formed an idyllic civilization by adopting a democratic, industrious, peaceful and prosperous way of life.[19]

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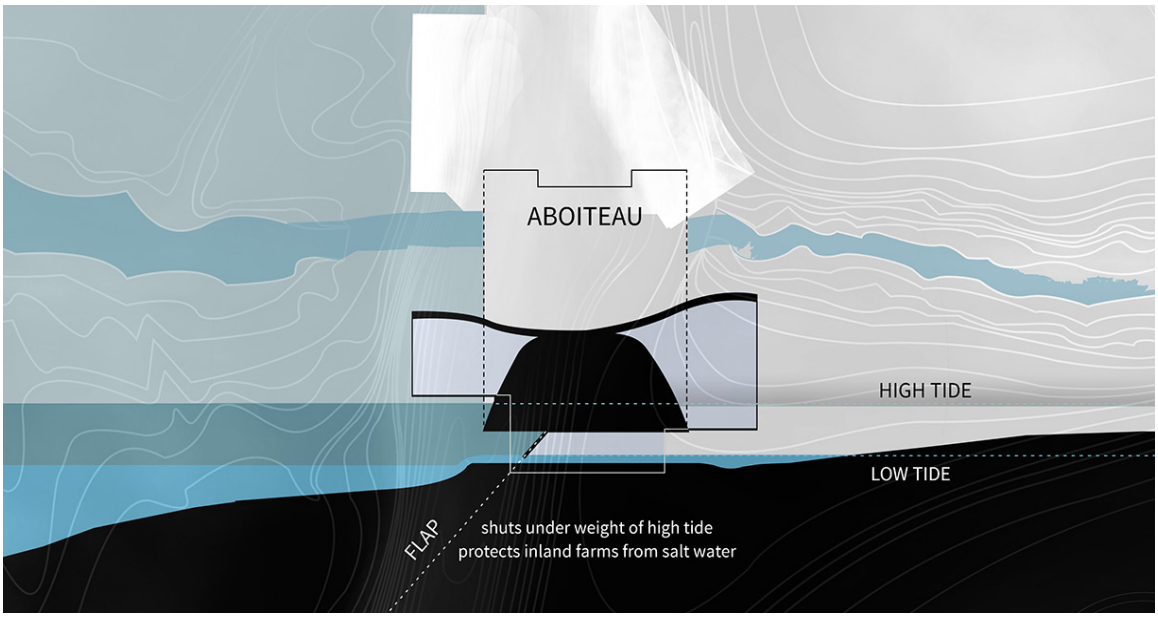
17. Landscape of Grand Pré, *Landscape of Grand Pré: A UNESCO World Heritage Site*, accessed November 26, 2015, landscapeofgrandpré.ca
18. Landscape of Grand Pre. *The Acadians and the Creation of the Dykeland 1680-1755,* accessed March 1, 2016, http://www.landscapeofgrandpré.ca/the-acadians-and-the-creation-of-the-dykeland-1680ndash1755.html
19. Bleakney, *Sods, Soils & Spades*, 3.

The large scale diking projects built by the Acadians demonstrate how their community spirit was manifested into an incredibly simple yet complex technological system. As the Acadians continued to perfect their craft, they came to be known as défricheurs d'eau (water pioneers). This was used in order to distinguish them from other colonists in North America who created farmland by clearing the forest. They became the only North American pioneers to successfully farm below sea level, through explicitly altering the landforms into their own industrial landscape.[20] The dominant element in their agricultural method was to claim the tidal marshes via diking and their very own adapted technology called the aboiteau. A very important aspect of this effort, which has a metaphorical significance to this thesis, is that this undertaking was a community project for the collective benefit of all. The main rule which governed the collective management was that each landowner was required to contribute to the building and maintenance of the dikes and aboiteaux.



Sectional diagram of an aboiteau through an Acadian dike; from Rhode Island School of Design. *Aboiteau - UNESCO Site Visitor Center, Grand Pré, NS.*

The Acadian settlers were not born with this technical knowledge. It was a collective effort that was created by adopting the Mi'kmaq's intrinsic and deeply spiritual relationship with the land as well as training from the Dutch about water management engineering. The unique aboiteau solution is a great example of how drawing from various cultural know-

20. Ibid., 6.

ledge bases can solve complex problems; in this case, how to continually drain marshes from sea water.

The collaborative Acadian way of life continued even after their untimely deportation in 1755. Many of the Acadians were sent south to modern Louisiana where they made strong connections with the existing Creole community, as they did with the Mi'kmaq in Nova Scotia. Through this connection, and their adjustment to another kind of extreme coastal environment, the Acadians (or Cajuns as they eventually began to be called) were required to adapt once again, by constructing larger levees, building on wooden stilts and learning to adapt to a new material culture which embraces living in the southern climate.

An image showing the collaborative nature of dike building and maintenance. This image was taken by A.L. Hardy in 1913 and shows men repairing the Davidson Aboiteau and dike wall on Long Island, Grand Pré; from Bleakney, *Sods, Soils & Spades*, 39.

Building the Aboiteau
John Frederic Herbin, 1909
Now is the tide returned with angry face ...
Lo! In its road an earthy gate is turned,
It gathers force and lifts its vengeful height,
Leans full against the portal with vain might,
Vain pressure on the salty forces now ,
The dyke o'ertops it with its lofty brow,
So for the hours like giants in embrace,
Breast beats on breast and face is unto face ...
While far within the sheltering of its wall
The cattle graze and endless harvests fall.[21]

21. Ibid., 71.

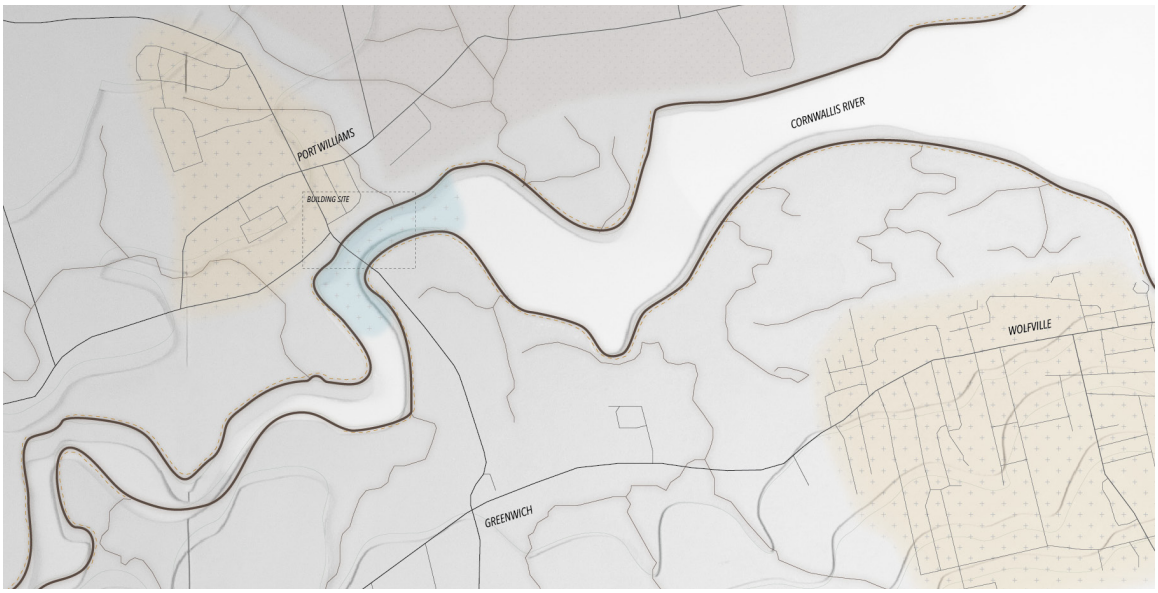
2.1.2 Site Selection

I chose a site in Port Williams along the northern bank of the Cornwallis River because this location lends itself well to the different variables required of this thesis project. Socially, its location between the largest urban centers, Wolfville and Kentville/New Minas, makes it easy for residents of either town to travel to. The community is also cradled in farmland, and is very close to many markets, wineries and breweries. The social success of the Port Williams' water front on the Cornwallis River is furthered by its direct adjacency to an existing popular pub and micro-brewery, the Port Pub and Sea Level Brewery, which was started as a community owned business by local stakeholders. From an energy perspective, Port Williams is located in the knot of four possible renewable regions; the only location in the entire Minas Basin which has this much potential. The south facing orientation could facilitate solar power, and its proximity to a narrow part of the Cornwallis River and a heavily used bridge would work well with small scale tidal. Its location near Wolfville Ridge is great for harnessing wind energy, and finally, its proximity to some of the largest farms in the area could facilitate biomass energy production. This Port Williams site begins to emerge as a microcosm within the macrocosm of the Fundy landscape.

This thesis project aims to connect the dynamic social activities and natural phenomenon of the Minas Basin region. Encompassing all aspects of the region including available energy resources, academia and seasonal agricultural activities, the Cornwallis River at Port Williams represents an active node where all of these components can coexist and work together. The strategy for the design of the site and the buildings will be similar. Based on the organicism theory connecting permanent and transient population groups while drawing from the past and looking forward to a sustainable future.

View from the site to its neighbor, the Port Pub and Sea Level Brewery at high tide.

Interpretive hybrid site model/map of Port Williams within its social and technological context indicating the major population centers of Wolfville and Kentville/New Minas and its position between four potential renewable resources..



Detail of Port Williams map indicating its location near both “urban” Wolfville and “rural” farm lands, areas with high temporary and permanent population groups.

Detail of Port Williams map indicating its location in the knot of four renewable resources, small scale tidal under the Port Williams bridge, wind from Wolfville Ridge, solar from the agricultural warehouses in Port Williams as well as the big box stores of New Minas and finally biomass from the vast neighboring farmland.

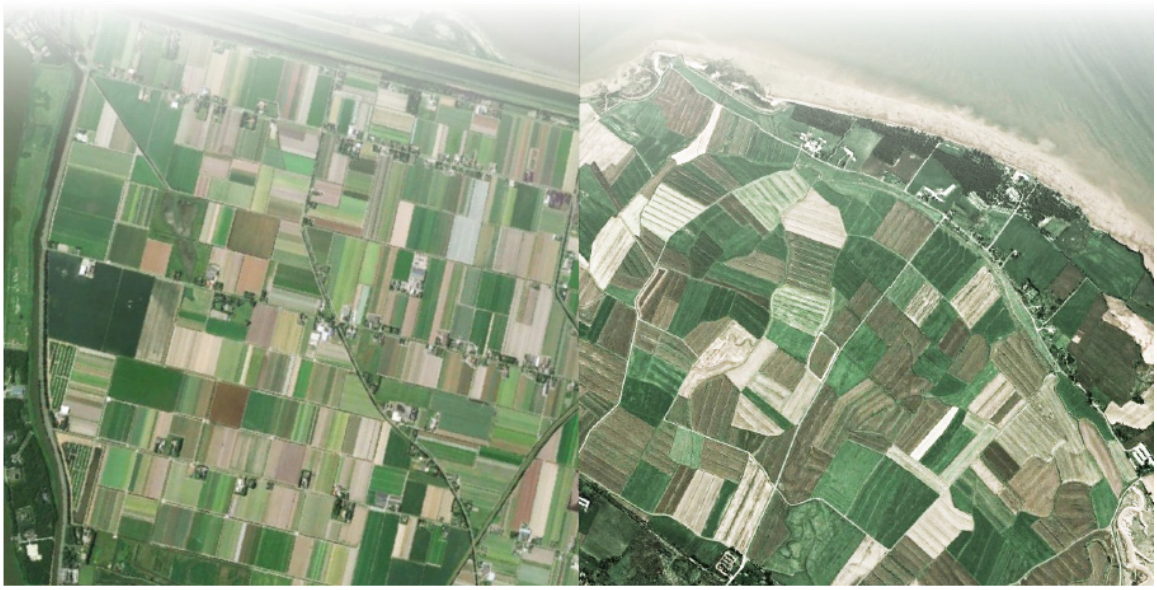
View looking south from the site at high tide in mid fall (October 2015). Across the river, Wolfville Ridge is seen as well as a vast industrial farming landscape.

View looking south from the site at low tide in early spring (April 2016). Across the river, Wolfville Ridge is seen as well as a vast industrial farming landscape.

View looking east from the site at high tide in mid fall (October 2015). Wolfville is visible in the distance.

View looking east from the site near low tide in early spring (April 2016). Wolfville is visible in the distance.

2.1.3 Case Study: Evolution of a Cultural Landscape: The Dutch



Many similarities exist between the rural landscape of Holland and the Annapolis Valley. Left: Northern Holland farmscape on the Ems River, Right: Grand Pré on the Minas Basin.

Water and the Dutch cultural lifestyle go hand in hand. Adapting to unique aqueous conditions throughout history has made water an intrinsic part of their life; so much so that you could imagine that water runs through their veins. Understanding the significance of and working with a liquid landscape is fundamental to Dutch cultural identity, and thus has remained largely unchanged over time. The intrinsic connection can be seen in all aspects of typical Dutch life including building culture, industry and art. The historic Mi'kmaq and Acadian cultures were also intrinsically tied to their own unique water conditions, and have adapted in similar ways. The Dutch and Acadians have in common a rich history of cooperation and their implementation of dikes and other static landforms to control water. These landforms and agricultural practices have created a unique landscape of cooperation.

For centuries, the Netherlands has been adapting their urban planning strategies to suit the constant, very real threat of flooding. The North Sea Flood of 1953 was the result of the combined forces of a spring tide and a terrible storm. The storm killed almost 2,000 people, 30,000 animals, destroyed nearly 10% of the country's farm land and made about

100,000 people homeless.[22] This was a major catalyst for the country to jumpstart the next step in their own explicit landscape adaptation. The country immediately embarked on an ambitious flood defence system, the Delta Works, in an attempt to avoid another such catastrophe.[23] Construction began with the Oosterschelde Storm Barrier, a feat of civil engineering which closes off the mouth of the Oosterschelde and regulates the tide by using a unique open system that very carefully considers nature, recreation and habitation as well as human safety.[24] Many other multi-faceted landscape adaptations would be implemented through Delta Works over the years. Climate change poses many new issues for the modern Dutch engineers to deal with. The average sea level in the Netherlands is predicted to rise up to a meter in the next century. This, coupled with higher amounts of precipitation and overall sinking due to long term geological processes, puts the country in a very interesting position where their creativity and ingenuity will be tested once again. What is special about the Dutch example is that they do not wait for the water to rise out of control. Work has already begun in anticipation of the problems that climate change is bringing in the future.

Another classical Dutch image of sustainability and forward thinking is the windmill's presence in the landscape. A staple of the Dutch landscape, windmills have been producing power in the Netherlands for hundreds of years. There are more than a thousand windmills spread throughout the country. Some of the stand-outs include Zaanse Schans, a 250 year old wind park comprised of over 600 windmills, and the 19 polder draining windmills of the Kinderdijk,[25] designated as a UNESCO World Heritage Site in 1997.

> The Kinderdijk-Elshout mill network is an outstanding man-made landscape that bears powerful testimony to human ingenuity and fortitude over nearly a millennium in draining and protecting an area by the development and application of hydraulic technology.[26]

22. Tracey Metz and Maartje van den Heuvel, *Sweet & Salt* (Rotterdam: NAi Publishers, 2012).
23. Deltawerken, *After the Deltaworks*, Stichting Deltawerken Online, published 2004, accessed November 24, 2015. http://www.deltawerken.com/after-the-deltaworks/333.html
24. Holland: Pioneers in International Business, *Water & The Dutch,* Royal Netherlands Embassy, accessed November 24, 2015. www.waterandthedutch.com
25. Holland. *Windmills,* accessed March 1, 2016. http://www.holland.com/global/tourism/interests/traditional/windmills.htm
26. United Nations Educational, Scientific, and Cultural Organization. *Mill Network at Kinderdijk-Elshout* accessed March 1, 2016. http://whc.unesco.org/en/list/818/

Zaans Schans windmill park, the oldest industrial landscape in the world.

Kinderdijk-Elshout is a popular destination year round for tourists and permanent residents alike. This image shows skaters enjoying the historic scene on the frozen polders.

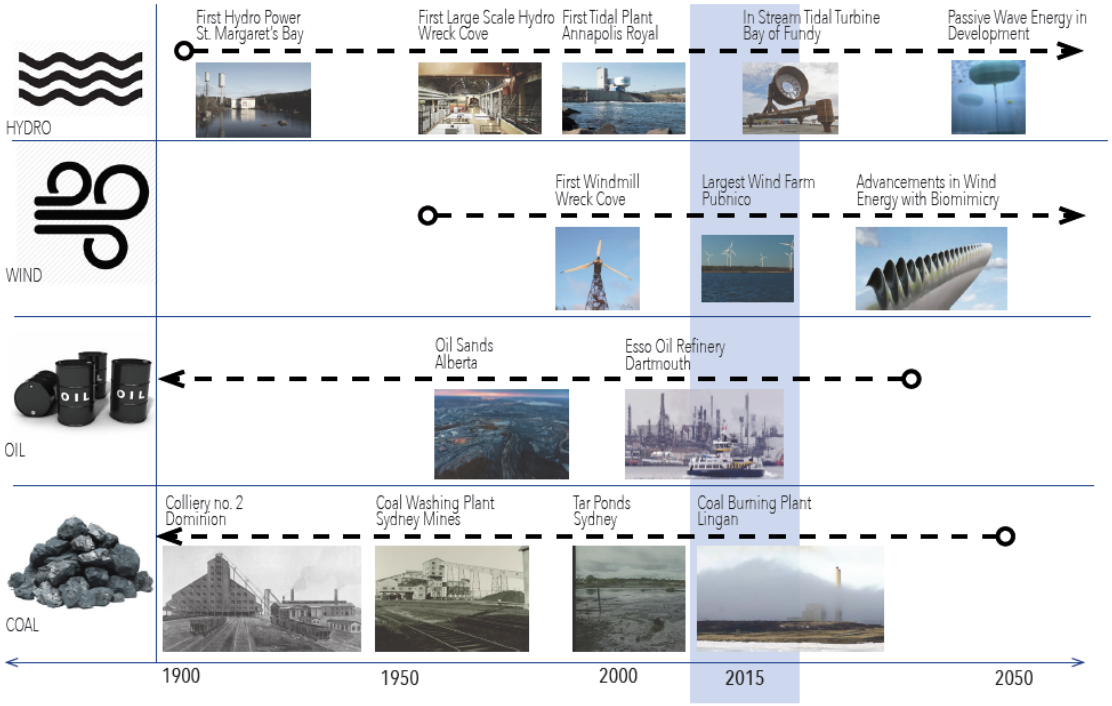
I was fortunate to be the recipient of the Bruce & Dorothy Rosetti Travel Scholarship in Architecture for 2015 (See Appendix 2). This allowed me to travel to the Netherlands and interpret the landscape in situ. My visit was directly after participating in the intensive Green Building Solutions summer university course held at the Technical University of Vienna and the University of Natural Resources and Life Sciences in Austria. This prequel to my travel experience through Holland put me in the perfect mindset to critically study the adaptation strategies of the Dutch, and to think about how these successes can be translated to a Canadian landscape. My time abroad gave me first hand experience with successful amphibious living, and allowed me to see the cooperative interactions between people and the water. I believe that what makes the Netherlands different is that the residents are engaged in the discussion of their evolving liquid landscape, and are active participants of change.

“Super Dike” proposal for Rotterdam by De Urbanisten is a good example of how the Dutch use dikes as multi-use infrastructure, mixing flood protection, transportation, recreation and more.

In this creative spirit of innovation through landscape adaptation, we are reminded again of the Acadians. Another surge of innovation is required as we move forward with new building methods and strategies in our increasingly wet east coast Canadian landscape, and it is important to look back on these cultures who were constantly morphing in order to stay resilient. The site strategy of this thesis will address the changing landscape and propose to adapt as the Dutch have: with a creative, cooperative multi-faceted holistic approach.

2.2 Understanding the Technology

In this thesis, I intend to synthesize social integration and renewable energy systems. This would be quite a significant shift from the current model of energy production in the province. The next section will lay out a brief history of power generation in Nova Scotia, and outline what needs to change, followed by my proposal for the type of change in particular that is needed. Last is an investigation of Université Sainte-Anne in Church Point, NS, where the shift to community-owned renewable energy has begun. This case study is not only important as an example of best practices to shift to renewable energy sources, but I specifically chose it because of its location along the Fundy coast, clearly showing that this type of project is possible in the region. The case study will also look into the local funding model used to help get this project realized.



Timeline of power generation in Nova Scotia indicating the shift from coal and gas to the more sustainable wind and hydro options.

2.2.1 The History of Power Generation in Nova Scotia: Why Things Need to Evolve

Energy production in Nova Scotia: 1. Coal 49.0%, 2. Fuel Oil 25.3%, 3. Hydro 16.6%, 4. Wind 5.5% & 5. Biomass 3.6%

In the early days of the Nova Scotia Power Commission, established in 1919, the majority of electricity was produced by burning oil. The main source soon changed to burning coal after dozens of mines began to open, mostly in Cape Breton, resulting in an economic boom. All of this would change when the Commission started to buy coal from the US and South America for a less expensive price until eventually all mines in Cape Breton were closed, with the last closing in 2001.[27] Labor and resources continued to be outsourced even more when the Commission, originally a Crown corporation, was privatized. The current owner of Nova Scotia Power (NSP) is Emera Inc., a company which also owns other utility companies throughout the Atlantic provinces and internationally.

Canada is behind on the development of global sustainable energy. Countries with similar climates and natural resources such as Iceland and Norway generate 100% and 98% of

27. Nova Scotia Power, *Story of Power*, Nova Scotia Power: An Emera Company, accessed October 25, 2015. www.tomorrowspower.ca/story

their electricity from renewable resources, respectively.[28] The major difference is in their political priorities. These countries see the funding for renewables as an investment for generations to come. Historically Canada, on the other hand, has a short sighted view which takes advantage of cheap, seemingly endless resources with little consideration for the future. The energy production potential through renewable resources in Canada, with its large landmass and diverse geography, is enormous, yet we are still burning dirty oil and coal.[29] The electricity produced in Nova Scotia, for example, is still approximately 50% sourced by coal purchased from abroad.

Currently, the province of Nova Scotia generates about 20% of its electricity from renewable resources with about half of that coming from hydroelectric dams.[30] Modern advancements in less invasive hydropower, such as in stream tidal turbines,[31] shows us the possibility of a renewable resource that could also generate power sustainably, without the potential issues that can come out of traditional hydroelectric dams. The Fundy coast has huge potential for small and large scale tidal power operations, and work has been ongoing for some time to harness the power.[32] This could lead to a strategy for power generation where scale is considered more carefully, seeing a number of smaller projects set up throughout the landscape instead of relying on major plants to do all the work.

Only 400 of a potential 8500 MW of hydroenergy is being harnessed in Nova Scotia.[33] Compared to buying coal or relying on large hydro dams in other provinces,[34] a much more economically, environmentally and educationally sustainable option would be to locally source the electricity by investing locally in tidal infrastructure. We saw how a short

28. Norden. *Nordic Energy Research,* accessed March 1, 2015. http://www.nordicenergy.org/thenordicway/country/iceland/
29. Natural Resources Canada, *About Renewable Energy,* Government of Canada, accessed October 25, 2015. http://www.nrcan.gc.ca/energy/renewable-electricity/7295
30. Nova Scotia Power, *Renewable Electricity,* Nova Scotia Power: An Emera Company, accessed October 25, 2015. http://www.nspower.ca/en/home/about-us/how-we-make-electricity/renewable-electricity/default.aspx
31. Natural Resources Canada. *Tidal Energy Project in the Bay of Fundy,* accessed March 1, 2016. http://www.nrcan.gc.ca/energy/funding/current-funding-programs/cef/4955
32. Fundy Tidal Inc, accessed March 1, 2016. http://fundytidal.com
33. Canadian Hydropower Association, *Five Things You Need to Know about Hydropower: Canada's Number One Electricity Source,* Canadian Hydropower Association, accessed October 26, 2015. https://canadahydro.ca/facts/
34. Emera Newfoundland and Labrador. *Maritime Link,* accessed March 1, 2016. http://www.emeranl.com/en/home/themaritimelink/overview.aspx

sighted plan affected the Cape Breton coal mining industry and subsequent local economy about a half a century ago. Outsourcing this energy will again have the same negative effect on the already fragile Nova Scotian economy.

Damage to the surrounding natural environment is seen in images of these three examples of Nova Scotia dams. From left to right: Malay Falls, Annapolis Royal Tidal Dam and Sissiboo Falls

Nova Scotia Power's Open Hydro In-Stream turbine before installation in 2012. A person is highlighted under the turbine for scale.

A way to take this local sourcing idea even further is seen through the community-owned green energy collective model. This way, the energy and the expertise are sourced locally, and the financial investment stays in the community.

2.2.2 Community-Owned Renewable Resource Based Power Generation: The Change That is Needed

A completely community-owned renewable energy collective has yet to be seen in Nova Scotia. There is, however, a project currently underway that is moving in this direction. This project, funded by the municipalities of Antigonish, Mahone Bay and Berwick, is set to source electricity from a wind farm to be located in Ellershouse, NS. This is a municipality-funded project meaning that the provincial utility provider, NSP, is not involved. The profit gained from the investment in the project will be fed directly back into the municipalities, instead of NSP. In addition to this investment, the average power bill for community

members in these municipalities is expected to be approximately 5% less than other Nova Scotians who are provided electricity solely through NSP.[35]

The Annapolis Valley area, including the Minas Basin on the Fundy coast, has potential for many different types of renewable resources including tidal, solar, wind and biomass as outlined in 1.3.2. As discussed above, the history of the region shows a strong sense of community based efforts. A resident-owned renewable electricity program is the twenty-first century version of this cooperative ethic. The implementation of such a project could be the next step in the evolution of the landscape as well as a new way to celebrate the sense of community pride of the residents of the Annapolis Valley.

2.2.3 Case Study: A Successful Community-Led Energy Project in Nova Scotia: Université Sainte-Anne

The Université Sainte-Anne is the only French language post secondary institution in Nova Scotia.[36] The main campus, in Point de l'Église on the southern Fundy coast, acts as a hub for four smaller campuses throughout the province in Tusket, Halifax, Petit-de-Grat and Saint-Joseph-du-Moine. In 2010, the university made a bold move through its "Green Commitment" to transform the face of energy production at its main campus. In just a few years, the school has implemented three sources of renewable energy to its local grid: a solar thermal system for domestic hot water comprised of 118 solar panels, a biomass furnace fuelled by local wood chip waste and two 50 kW wind turbines. These efforts have cut the school's energy cost in half, saving them approximately $200,000 per year which feeds directly back into the core services of the university. Additionally, the school is able to provide local jobs and set an important example for its students.

This initiative was made possible in part by Nova Scotia's Community Feed-In Tariff (COMFIT) program. A successful funding model implemented through Nova Scotia's NDP government in 2010, the program was specifically targeted at the development of local renewable energy projects by municipalities, First Nations groups, co-operatives, universities, non-profits, and Community Economic Development Investment Funds (CEDIF)

35. Alternative Resource Energy Authority, *Wind Energy Project,* Alternative Resource Energy Authority, accessed December 1, 2015, http://areans.ca/project.html

36. Université Sainte Anne. *Our Green Commitment*, accessed January 2, 2016. www.usainteanne.ca

groups.[37] The goal of the program was to include communities in the province's energy portfolio and guaranteed a rate per kW/h for the energy the project would feed into the province's electrical grid.[38] As a result, approximately one third of all renewable energy generated in Nova Scotia is community funded.[39] This is a sure sign that renewable energy is what Nova Scotians want. Despite the overwhelming success of the program, the newly elected Liberal government has decided to shut it down, accepting no new applications as of August 2015.[40]

The real problem with the politics that surround programs like this one, is that they come and go. There have been dozens of similar programs set up since the oil crisis in the 1970s, but none have stuck. The COMFIT program is just one example of a non-sustainable government initiative on green energy.

The COMFIT program would be the perfect funding vehicle to bring the Minas Basin renewables plan to life. If we look at the case of Université Sainte-Anne as an example, it is simple to imagine the massive effect this sort of initiative could have on an entire region. It is crucial for the Nova Scotia government to reconsider this move, and to keep Nova Scotians' best interest in mind.

Left: Solar thermal panels installed on the lawn when the Université ran out of roof space on the student residences. Right: Two 50 kW windmills are placed directly on a popular walking path behind the campus to encourage interaction with the renewable infrastructure.

37. Province of Nova Scotia Department of Energy. *Community Feed-In Tariff Program Facts.* Accessed February 15, 2016. http://energy.novascotia.ca/sites/default/files/comfit_facts.pdf
38. Province of Nova Scotia Department of Energy. *COMFIT.* Accessed February 15, 2016. http://energy.novascotia.ca/renewables/programs-and-projects/comfit
39. Dodge, David. *Nova Scotia' Community Power* - Notes from Green Energy Futures Podcast no. 20, podcast audio. Accessed February 14, 2016. http://www.greenenergyfutures.ca/episode/nova-scotias-community-power
40. Province of Nova Scotia. *Minister Announces COMFIT Review Results, End to Program.* Accessed February 15, 2016. http://novascotia.ca/news/release/?id=20150806001

2.3 Understanding the Collective

The notion of a community-initiated collective is the glue that holds this thesis project together. The following section will tell the story of cooperatives and collectives throughout Nova Scotia's history, compared then to what is now needed to run a successful modern collective. The case study which will conclude this chapter will look at the state of Schleswig-Holstein in northern Germany and their incredibly successful community-owned wind energy program. This is an excellent example of a program that started out as a small initiative and has turned into something that not even its residents could have imagined.

2.3.1 History of Cooperatives and Collectives in Nova Scotia

There is a long history of cooperative social models in Nova Scotia dating back to the Mi'kmaq and Acadian cultures including shared ownership of land and sustainable modifications to the landscape such as dike building and maintenance. Over time, the notion of a cooperative or collective grew in Nova Scotia and became more formalized.

Founded in 1861 by British immigrant coal miners was the very first cooperative consumer store in North America located in Stellarton, NS. By the 1890s, creameries and fruit growing cooperatives began to be established in the Annapolis Valley. As the cooperative model began to catch on, community leaders assisted local fishermen, farmers, miners and foresters to begin cooperative ventures during the 1920's. The movement continued to gain popularity after that, including the establishment of the province's first credit union in 1932. In the earliest days of the Nova Scotia Cooperative Council the guiding principles, adopted by the International Cooperative Alliance, were the following: voluntary and open membership; democratic member control; member economic participation; autonomy and independence; education, training and information; cooperation among cooperatives; and concern for community.[41]

We are still seeing modern expressions of cooperatives throughout Nova Scotia such as the continued use of credit unions in place of banks, collective housing groups and locally produced food co-ops. The Nova Scotia Cooperative Council is still active today supplying Nova Scotians with tools and support to encourage engagement with cooperatives.

41. Nova Scotia Cooperative Council. *A Historical Perspective 1949-2014.* 2014.

> Co-operation will give the people a measure of economic independence but it will do something infinitely greater than this. It will condition them to the point where they are able to manipulate effectively the other forces that should operate in a democratic society.[42]

Early cooperative ventures in Nova Scotia. Top Left: Thorburn Cooperative Society Ltd., Bottom Left: Shelburne Cooperative Ltd., Right: Cheticamp Credit Union Ltd.; from Nova Scotia Cooperative Council. *A Historical Perspective 1949-2014.* 2014.

2.3.2 The Modern Collective

We have now seen the significant history of the cooperative tradition throughout the province. The next step is to discuss the contemporary expression. The future of collectives in the Minas Basin will be seen through the lens of renewable energy; a community-owned green energy collective. So, what exactly does this look like? The following is a summary of the important points relating to the concept of “community energy:”

42. Moses Coady. *Masters of Their Own Destiny: The Story of the Antigonish Movement of Adult Education Through Economic Cooperation*. (New York: Harper& Row Publishers Inc., 1939), accessed March 1, 2016. http://coady.stfx.ca/coady-library/MOD.pdf

1. An approach from the ground up is critically important for sustainable energy transitions on a much larger global scale - The community energy model is a diverse and rapidly growing grassroots movement that is already thriving throughout many parts of the world, such us Germany and the United Kingdom. This bottom-up approach gets the wheels turning on larger scale infrastructural projects. Nova Scotians have shown throughout their long history of cooperatives and unions, that success can be found by this approach. The method is to first plant a seed; the seed's growth is nourished as the community continues its support and attention.

2. The community energy model is about much more than sustainable electricity - Community energy deals with sustainability as it relates to local economy and rural development, changing attitudes through continuing education as well as the most obvious environmental aspects associated with using renewable resources. In this age of urban densification, rural areas in Nova Scotia, and many other places in the world for that matter, are often forgotten about and not given proper resources or supports in order to thrive. The towns within the Minas Basin are no different. This responsibility is often passed over to the residents, requiring sustained local support to grow from within the rural system. This often results in a stronger network of community spirit and pride of place.

3. This model thrives on local enthusiasm - A place such as the Minas Basin, where there is already inherent knowledge and insight in the landscape is the perfect place to spur interest into this type of collective. Additionally, the transient nature of the student and migrant worker populations will continually breathe new life into the project.

4. The expertise required to run a successful green energy collective is just as much about soft skills as it is about hard technology - A multi-disciplinary approach allows the collective to grow in an organic way, encompassing all population groups in the community. People with skills in all sectors such as public outreach, business, politics, etc. should all be involved in this collective model. This multi-faceted system is perfect for the Minas Basin, a place which is home to many different shifting groups of permanent and transient residents with a wide array of skills and backgrounds.

5. This type of energy production model is not yet being taken seriously enough by the government - The community-owned green energy collective model demands flexible and

tailored policy supports at all levels of government, especially during the start-up period. Since this idea remains relatively untested in Canada, governments are hesitant to invest. Policy makers must evolve with this new type of community energy model for these projects to sustain success.

6. It is crucial to stay connected to, learn from, and share resources with other community and sustainability networks - During the initial start-up of a collective of this kind, strong support networks from other well-established groups and organizations are an invaluable asset. The internetworking between groups further spurs the success of both and encourages more social connection through shared values.[43] This could further build on the tradition of cross cultural collaboration in Nova Scotia.

2.3.3 Case Study: Community Energy: Schleswig-Holstein, Germany

Bordering the Elbe River, and both the Baltic and North Sea is Germany's most northern state, Schleswig-Holstein.[44] Green energy started in this region at the household or small community scale, and now the state is powered wholly by renewable sources (almost entirely through wind energy). Due to this small scale start, approximately 90% of the wind turbines in the region are owned by the local farming families and other permanent community members. The residents are investing their savings into these turbines and are getting major returns, with hopes of becoming a major power exporter for the country on the strength of this booming business. Public support for the Energiewende (Germany's green energy transition plan) is greater than 90%. This is due to the public buy-in and ownership. This type of success would not have been possible without the small scale start up.[45] A way this successful public buy-in can be measured is by looking at their changing landscape. Fields are lined with windmills as far as the eye can see, on public and private land, adding an aesthetic of evolution to the state's landscape.

Schleswig-Holstein is a largely agricultural region, similar in many ways to Nova Scotia's

43. Gill Seyfang, Jung Jin Park & Adrian Smith, "A Thousand Flowers Blooming? An Examination of Energy in the UK," Energy Policy 61 (2013): 977-989.

44. Schleswig-Holstein. *Ministry of Energy, Agriculture, the Environment and Rural Areas*, accessed March 1, 2016. http://www.schleswig-holstein.de/EN/StateGovernment/V/v_node.html

45. Chris Turner, *Tilting at Windmills: Canada's Most Ambitious Green Energy Plan Failed--But Not For The Reason Everybody Thinks*, The Walrus, published November 2015, accessed November 20, 2015. https://thewalrus.ca/tilting-at-windmills/

Annapolis Valley. The climate, economy,and population groups of this area mimic that of the communities within the Minas Basin. The only major difference between regions is the politics. With changes and much needed updates to Canadian policies, including increased support in funding and progressive education, Nova Scotia could be the next success story for community owned green energy. The province came close to this with the COMFIT program, but the same short sighted views that have been discussed previously in this chapter, were seen again when it was shut down.

The vast agricultural landscape of Schleswig-Holstein is lined with windmills as far as the eye can see.

CHAPTER 3: DESIGN STRATEGY

This chapter provides an introduction to the overall design strategy including the underlying theory of macrocosm/microcosm as it relates to organicism, an analysis of the proposed material palette and the architectural strategy which will go further in depth about the specific architectural considerations for the building components making up the proposal.

3.1 Macrocosm / Microcosm

The word ecology comes from the Greek word oikos, meaning house. This means that "ecology" translates to "study of the house." Each element of a house can be broken down into smaller and smaller pieces, each relying on one another to properly function as a whole. In the realm of architecture, we are testing out "ecosystems" every day. An integral part of architectural study is seen by looking at these macro ideas in micro form. For architects, this often means making models and drawings at smaller scales to understand the relationship of all the pieces to its whole.

In this case, if we think about the landscape as a macrocosm, a way we may be able to understand it more clearly, is by studying its components as a microcosm. The Fundy landscape is especially complex, built up with remnants of thousands of years of deposited history. I am investigating the Cornwallis River at Port Williams, with design decisions and material choices as a way to test macro-landscape ideas at a micro-architecture scale.

"Micro-ecosystems" gathered from materials found along the Fundy coast. Materials were grouped together and placed in airtight jars, and have been exposed to sun on a west facing window since October 2015.

I collected “specimens” from a trip to the Fundy coast in October 2015, to inhabit my west facing windowsill. Since then, I have been documenting their decay. This has been an experiment in studying the components as they exist in a controlled vacuum, without the accompanying components of the Minas Basin landscape. It is clear that the elements thrive when they work in cooperation with the other pieces of the ecosystem.

3.2 Understanding the Material Culture of the Bay of Fundy

The unique nature of the variable liquid landscape has required all settlers of the region to adapt to their surroundings in new and innovative ways. The most prominent available building materials are earth and wood. This next section is a study of each one of these materials in terms of its history in the region, the evolution the material has made thus far and the potential future application as the next evolutionary step in the landscape-first building approach.

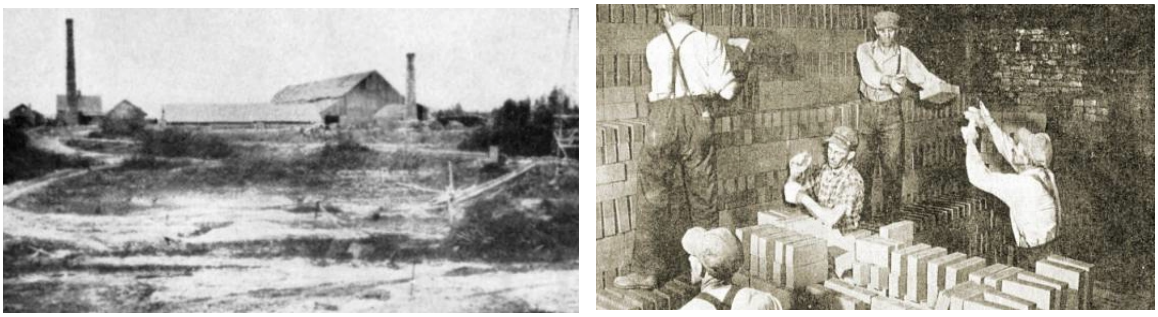
3.2.1 Earth as a Stereotomic Material

The earth acts a vessel for story telling in both its natural and processed state. Left: The tides allow for accelerated erosion along the cliffs of the Minas Basin. This makes way for a large number of significant fossil discoveries. Right: A diked landscape at mid-tide shows the fields on the left and salt marshes on the right. A person can even be seen walking along the trail on top of the dike.

3.2.1.1 History and Evolution of Fundy Earth

Mud is a significant material in shaping the working landscape of the Minas Basin. It has been the main vessel for telling the stories of centuries of adaptation in the region. Stories of prehistory can be told through the fossil cliffs at Joggins, and the story of 18th century Acadians can be interpreted through the dikelands as a unique cooperation between land, water and people. The stories are told both through the earth in its natural state (fossil cliffs for example), as well as through man made, interventions with the earth, such as the dikes. Canada is home to only thirteen UNESCO recognized sites; the earth of the Fundy coast holds host to two of these sites. The natural state of the fossil cliffs at Joggins is a UNESCO World Heritage Site (inscribed in 2008) containing the best and most complete known fossil record of terrestrial life in the iconic carboniferous period in Earth's history dating back 318 to 303 million years. Grand Pré is the other UNESCO recognized site (inscribed in 2012), significant in its portrayal of the traditional Acadian cultural landscape, featuring processed earth seen in the extensive dike networks and poldered farmlands.

The agricultural land that the dikes protect from the salty tides, is rich and fertile and have been a main source of the region's economy for centuries. Another way the earth has contributed to the local economy is through brick manufacturing. In this case, an outside process (firing) is applied to the material to form something new. In 1861, the first brick plant in the province was established in Hantsport on the Avon River. After the success of this plant, several more were opened in other small communities in the region; Avonport, Brickton and Bridgetown,[46] all using Fundy clay, with its familiar red hue, as the main source of material.



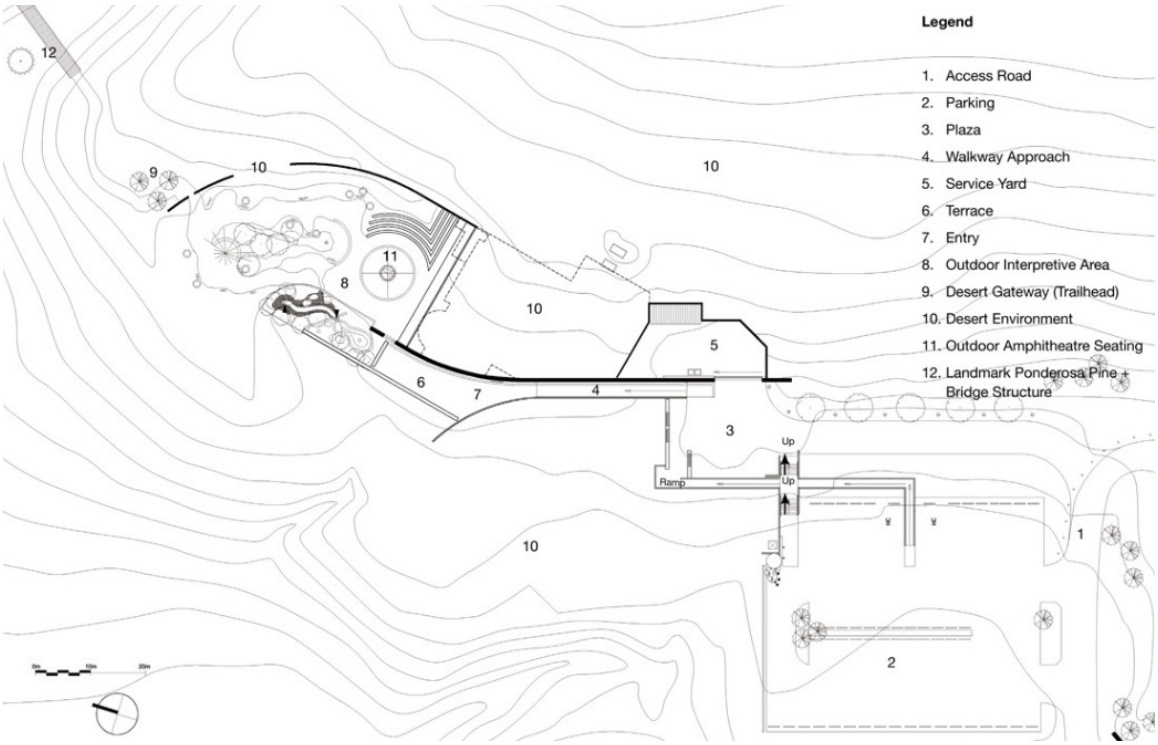
Historic images of the first brick plant in Hantsport, NS.

46. Shaw Brick. *Company Timeline*, accessed February 14, 2016. http://shawbrick.ca/timeline/?page.id=40

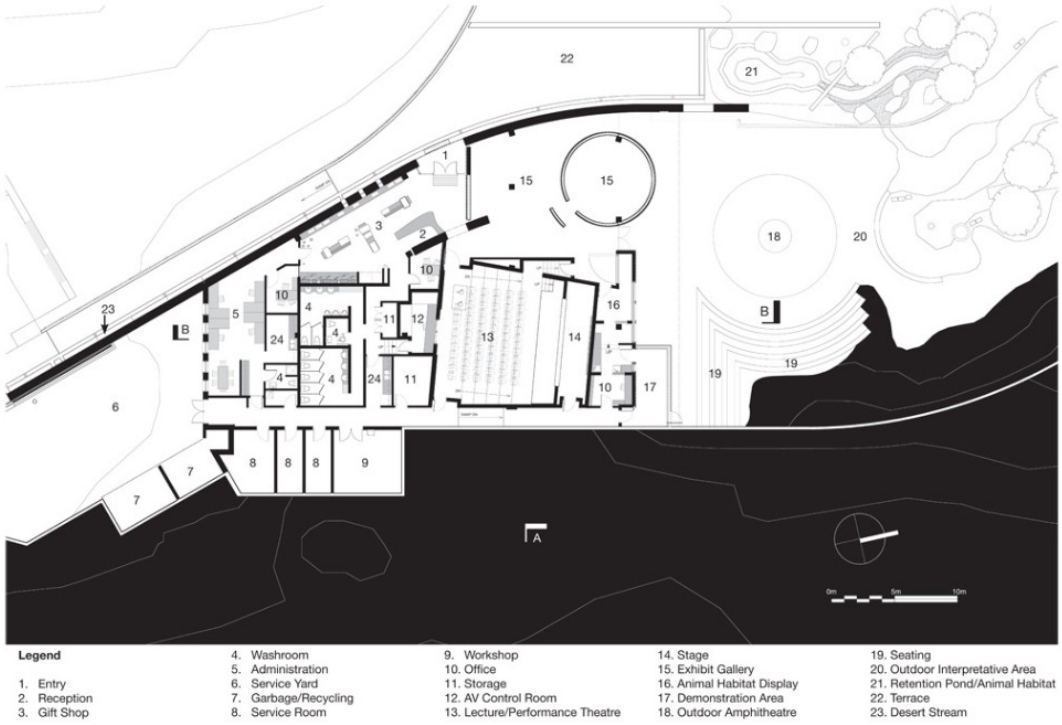
The next step in the material adaptation of Fundy mud will be seen in rammed earth. Opposed to brick, rammed earth is a much more sustainable choice. Earth is the oldest building material in human history. For some time, earth's role as an unprocessed building material has not been as popular as it has in the past, particularly in the western world. This may be due to its high degree of variability and strenuous labor requirements. Modern technology can, however, transform the perception of modern rammed earth construction into a viable, environmentally responsible building method. Rammed earth is attractive for many reasons: its long lifespan, its typically low maintenance schedule, its physical formation from local soils, the fact that it can be used as a thermal mass, structural or retaining wall, and of course that it is a leading environmental choice. Using rammed earth can contribute to certification for LEED, Passivehouse, and Living Building Challenge projects. Using the rammed earth construction technique results in a strong, durable structure that does not off-gas toxic or greenhouse gas emissions that has excellent thermal qualities, acting as a heat sink being warmed by the sun during the day and releasing heat through the cold nights.

Typically, rammed earth has been used in warm, dry regions such as northern Africa, however, there has recently been an increased interest in adapting the technology to suit northern climates. Two great Canadian examples can be found in the Edmonton Valley Zoo by Dialog and the Nk'Mip Desert Cultural Center in British Columbia designed by HBBH Architects. The Edmonton Valley Zoo Entry and Wander project features a 72 meter long rammed earth exterior wall, the northern most of its kind. The soils which make up the wall are meant to express the sedimentary layers of the nearby North Saskatchewan

Edmonton Valley Zoo Entry and Wander, Edmonton, AL, Canada. Dialog. This project features an exterior rammed earth wall in the harsh northern climate of Edmonton.



Overall site plan for the Nk'Mip Desert Cultural Center showing long, curved rammed earth walls. Image source: Dialog Design.



Floor plan of the Nk'Mip Desert Cultural Center shows the longest rammed earth wall facing the west with minimal openings. This is done so maximum heating potential can be gained by the strong western sun without the low, blinding daylight; from HBBH Architects.

Nk'Mip Desert Cultural Center, Osoyoos, BC, Canada. HBBH Architects. Left: Night time image of the rammed earth exterior wall, Top right: The architecture completely blends in to the landscape, Bottom right: Window detail in rammed earth wall.

Representation of the steps required to build a rammed earth wall.

River. The Nk'Mip Desert Cultural Center, although in a much drier climate than Nova Scotia, still lends important lessons to the way rammed earth can be used in a modern way.

I draw from these case studies design principles, methods of construction and assembly as well as application suitability. Most exterior rammed earth projects incorporate curved walls into the design. This provides extra structural support for the wall, allowing it to be able to stand on its own without extra buttresses or supports. Soft curves instead of hard corners are often used as a method of simplifying the labor involved with the ramming

process to build the wall. The process of physically building the wall is reminiscent of the Acadians building the dikes. Standard rammed earth construction involves erecting wood forms and compacting the prepared soil into these molds, which are removed after the walls are completed.[47] Since the wooden form work does not require destruction after the earth has set, the wood can then be reused elsewhere in the project.

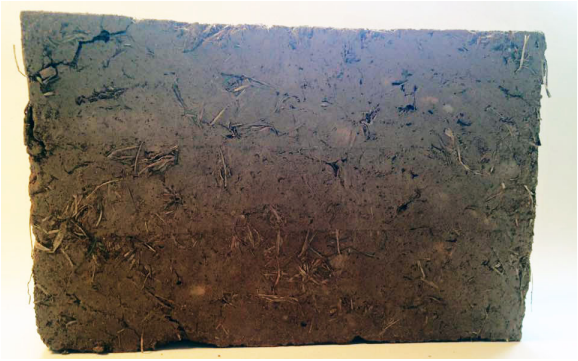
The area which seems to be the most difficult to maintain in colder, wet climates is the bottom of the wall, where it meets the earth or foundation. This is the area which sees most of the rain or snow pool, and is likely to show its wear before other areas of the wall. Because of this, foundations of rammed earth buildings are typically constructed from stones or concrete with considerable attention paid to a proper flashing and waterproofing system. When taking the cold, damp Nova Scotian climate into consideration, these examples of the material and its uses have indicated that the best utilization for this method is either in a covered outdoor space or an indoor application.

Due to the cultural significance of earth in the Minas Basin, along with its physical properties, all earth is to be used as a stereotomic element throughout the design. Earth as a building material will be used to ground the architecture and to connect with the overlapping stories that are being told through the natural landscape.

47. How Products are Made. *Rammed Earth Construction*, accessed March 1, 2016. http://www.madehow.com/Volume-3/Rammed-Earth-Construction.html

3.2.1.2 Experiments with Earth

Rammed earth is an excellent construction material for many reasons, but it is crucial to do it correctly on order for it to work properly. It is an easy technique to get wrong due to the high variability in earth material and expertise levels of the involved tradespeople. Several experiments were conducted with the material to predict what the best mix would be for the earth, the optimal amount of tamping as well as dry time.



Experiment 1: Earth + Grass - Grass was mixed with the earth as an experiment to test the grass as a natural tensile material. This test went over quite well with no immediately apparent major problems. Other natural tensile materials that could be used instead of or in conjunction with grass could be wool, hay or straw.

Experiment 2: Earth + Portland Cement - A very small amount of Portland cement was mixed with the earth to test its structural strength and rigidity. My goal was to use as little cement as possible due to its high embodied energy. The result of this experiment led to a very strong, heavy block that actually had a pleasing shiny finish suitable for interior or exterior application.

Experiment 3: Earth + Clay - Since Fundy earth has a high clay content naturally, this experiment was very important in order to simulate the existing natural environment. The experiment resulted with a product I was not expecting, a crumbly and structurally weak block. After a week of drying, the block still showed signs of crumbling in the form work and continued to degrade when taken out and dried further without the form. This was a clear sign that in order for this clay-laden earth to be structurally sound, it would need to either be fired (such as a brick), or mixed with other additives.

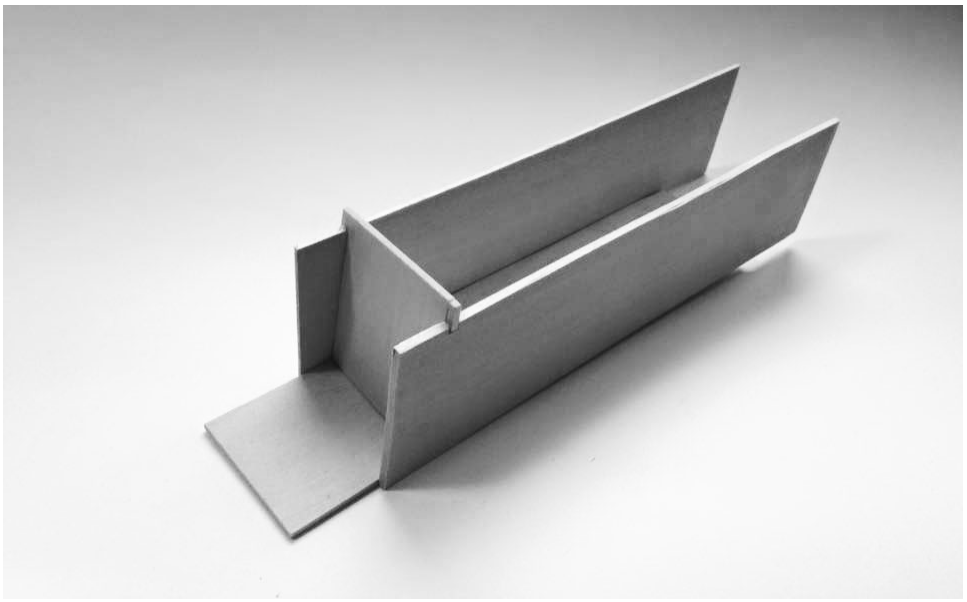
Experiment 4: Earth + Plaster - Plaster was used in this experiment to test the finish quality for interior application of rammed earth. I wanted the layering effect to be clearly seen in this test so each layer was given a different ratio of plaster and earth. Seen on top is the mix that had more earth than plaster, and the bottom more plaster than earth. Although a little crumbly, the overall result of this experiment was favorable as an interior finish. More additives would need to be mixed in to ensure rigidity in the material for exterior application.

Experiment 5: Earth + Sand - Sand is a popular additive in concrete manufacturing. This mixing experiment was to test the effects of sand acting alone without more additives. The construction process of this block was not as straightforward as the others as the mixture's grainy texture led to difficulty in tamping. Perhaps adding more water to the mix would have prevented this, but would have increased the drying time. The dried block was good overall, resulting in a strong and robust construction.

Experiment 6: Earth + Clay + Cement + Grass - After going through the previous five experiments and recording the process and results, I decided to test a mixture that I thought may be suitable for the primary application in the project. Although the clay mixture yielded unfavorable results, I decided to add it in regardless to stay true to the earth that exists along the Fundy coast. I was happy with the tensile strength that the grass lent to the block, so that was added as well as a very small amount of cement for added structural strength. After a week of drying in the form work and a week of drying fully exposed, the block ended up performing quite well in strength and aesthetics.

3.2.2 Wood as a Tectonic Material

Left: Existing aboiteau in an Annapolis Valley diked farm land, Right: A recovered aboiteau, circa 1700s, discovered at Grand Pré.



Interpretive model of an aboiteau water draining system exhibiting the one way clapper valve.

3.2.2.1 History and Evolution of Fundy Wood

Wood is the next most significant material in the Fundy landscape. As with all communities in the Maritime provinces, wood plays an important role in shaping the built environment. Throughout the province, you will often see wood used in fairly typical ways; stick frame houses, wooden shingle cladding, etc., however, the communities along the Bay of Fundy have adapted the use of wood to suit their own specific purposes. One of the most historically documented instances of this adaptation can be seen in the construction of the aboiteau, the wooden sluice developed by the Acadians to drain their fields.

Other unique ways that the people of Fundy communities have adapted traditional uses of wood are seen in fishing weirs and boat stands, used at low tide to keep a fishing boat elevated from the bay floor which could scratch up the belly of the boat. The tides are higher than the local trees grow, so this means that creative ways of attaching timbers is seen in most wharf structures. Often, because the material is exposed to water so often, barnacles and other sea life start to make their homes on the wood creating their own micro-ecosystems. This phenomenon is especially true for the wharves and weirs.

Examples of unique wood applications along the Fundy coast. From top (clockwise): Barnacles and other sea life living on the posts of a wharf structure on Digby Neck at mid-tide, Wooden boat rest under the belly of a typical Fundy fishing boat at low tide, Wooden slats forming a makeshift path over a salt marsh, Typical fishing weir at low tide comprised of birch timbers and net.

Wood also has a strong architectural connection to the Acadians. When they inhabited the Fundy coast, it was their primary building material for homes and other structures. When they were expelled and sent to Louisiana in 1755, the Acadians were required to adapt the knowledge they had about wood to suit the wet, humid bayou environment where the threat of flooding was ever present. Even today, the use of Acadian building traditions can be seen in the modern vernacular of Louisiana architecture.

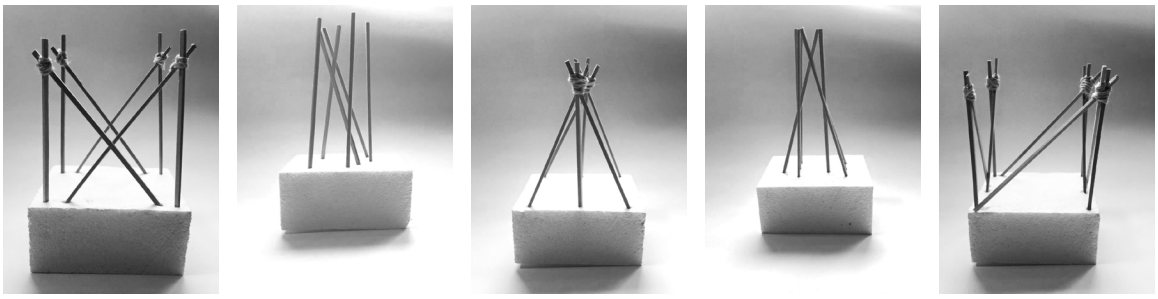
Left: An Acadian woman is seen accessing her home by boat in the Louisiana bayou; from State Library of Louisiana, Right: Modern Louisiana architecture still adopts the same historic Acadian style.

The strategy for application of wood in the design proposal is to gain insight and inspiration from traditional adaptations and apply those to modern architectural interventions. The tectonic character of wood is obvious, in that it is an “additive” material that is temporary in nature. For that reason, the application of wood will be programmtically linked to “temporary” activities.

Wood here is seen as a wharf and boardwalk. Seen in the image as well is the flying Acadian colors and birds feeding on fish that have been trapped on the bay floor at low tide.

3.2.2.2 Experiments with Wood

What is most interesting about wood along the Fundy coast is the way it has adapted over time to suit the needs dictated by the tides. In my own design proposal, I want to tap into this creative construction method by mimicking the way wharf structures are built in the region. A number of experiments were completed to get a better idea on how the wood can work structurally and aesthetically while telling the story of the history of the region.



A variety of stilting and lashing methods are shown in this experimental series.

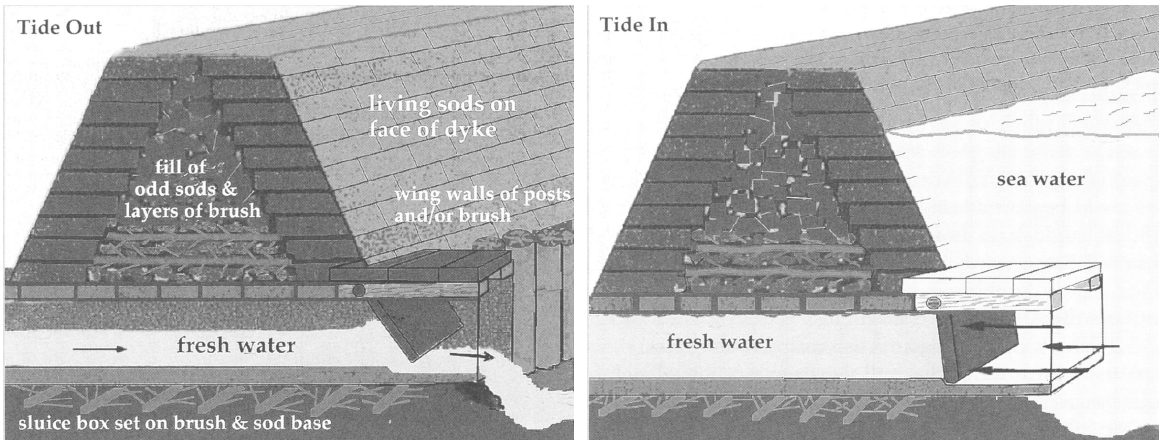
3.2.3 Stereotomic and Tectonic

Gottfried Semper distinguishes the critical elements of architecture in terms of stereotomic and tectonic. The stereotomic elements of architecture are classified based on their relationship to massive earthwork construction, “formed out of repetitious stacking of heavy weight units,” and tectonic to its association with lightweight, linear components. Semper sees the stereotomic mass as an extension of the earth, closely associated to creating volume, providing the tectonic elements a base to ascend from to form open structural frames.

The point at which the permanent nature of the stereotomic and the temporary nature of the tectonic meets is where the architectural intention becomes clear. In this project, that point will be where earth and wood come together.

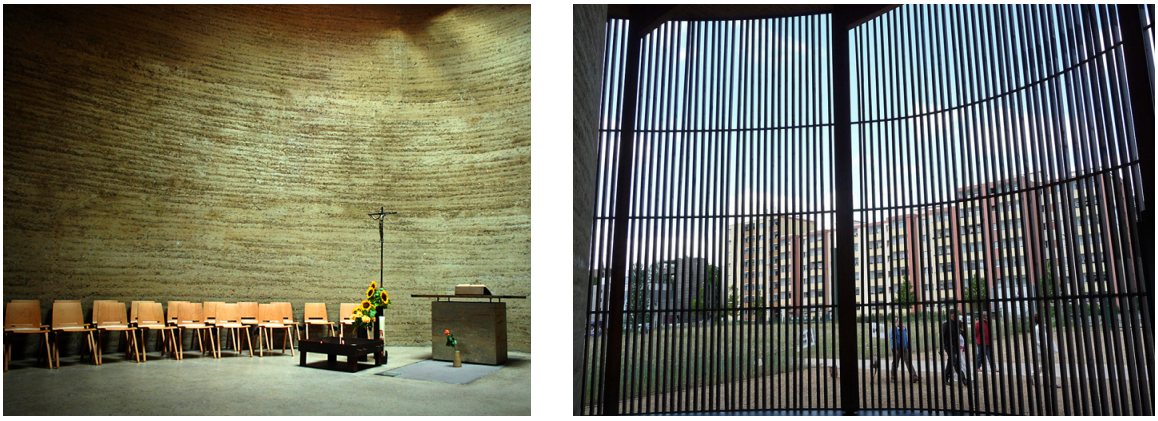
The best local example which signifies the importance of these two materials coming together is seen in the formal relationship between dike (earth) and aboiteau (wood) and the way it responds to the water.[48]

48. Bleakney, *Sods, Soils and Spades*, 52.



The aboiteau seen here allowing water to drain from the fields at low tide, while disallowing salty tidal water in during high tide. The aboiteau is a great example of a successful combination of stereotomic and tectonic materials; from Bleakney, *Sods, Soils and Spades*, 52.

A great example of a project which incorporates both stereotomic and tectonic elements to tell a story, in a climate similar to Canada, is Peter Sassenroth's Chapel of Reconciliation in Berlin. Completed in 2000, he uses the earth to tell the story of a once divided Berlin signifying the strength and permanence of the unified city as it exists today. He uses wood to play with light and space in the ambulatory while also signifying the modern permeability of what once was the impermeable wall that separated East and West Berlin.[49]

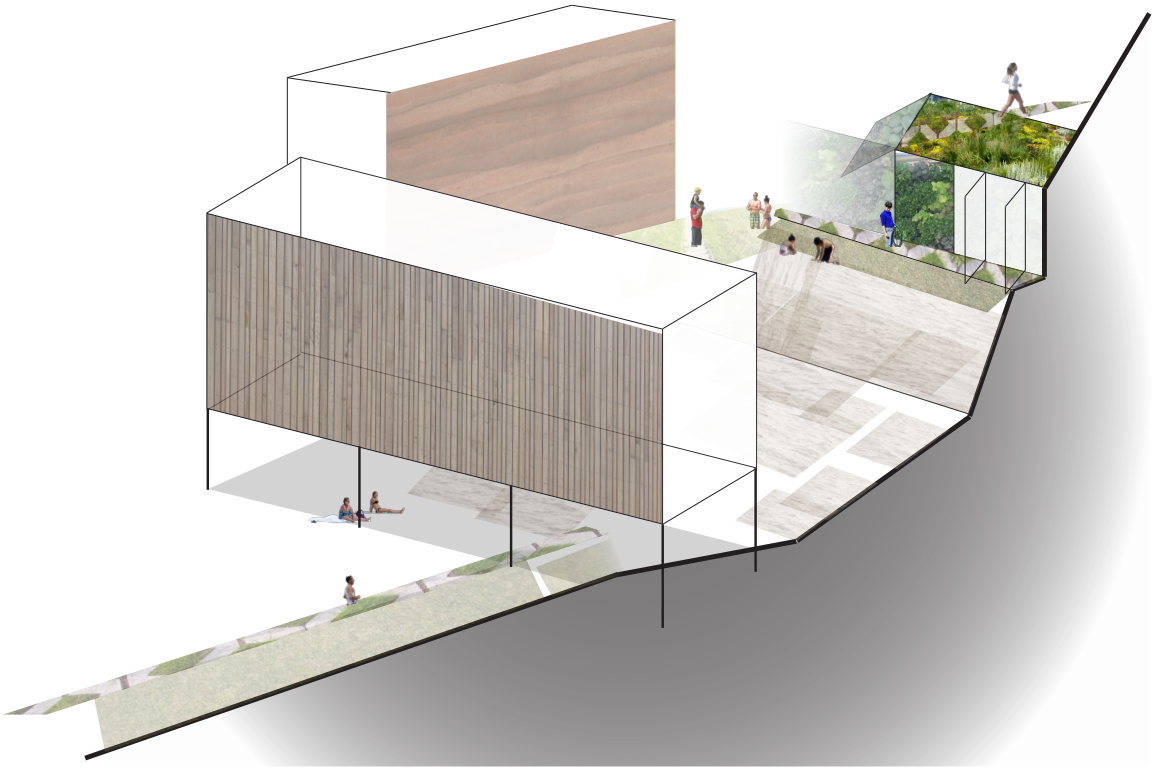


Peter Sassenroth's Chapel of Reconciliation. Left: Stereotomic rammed earth inside the chapel, Right: Wooden exterior facade.

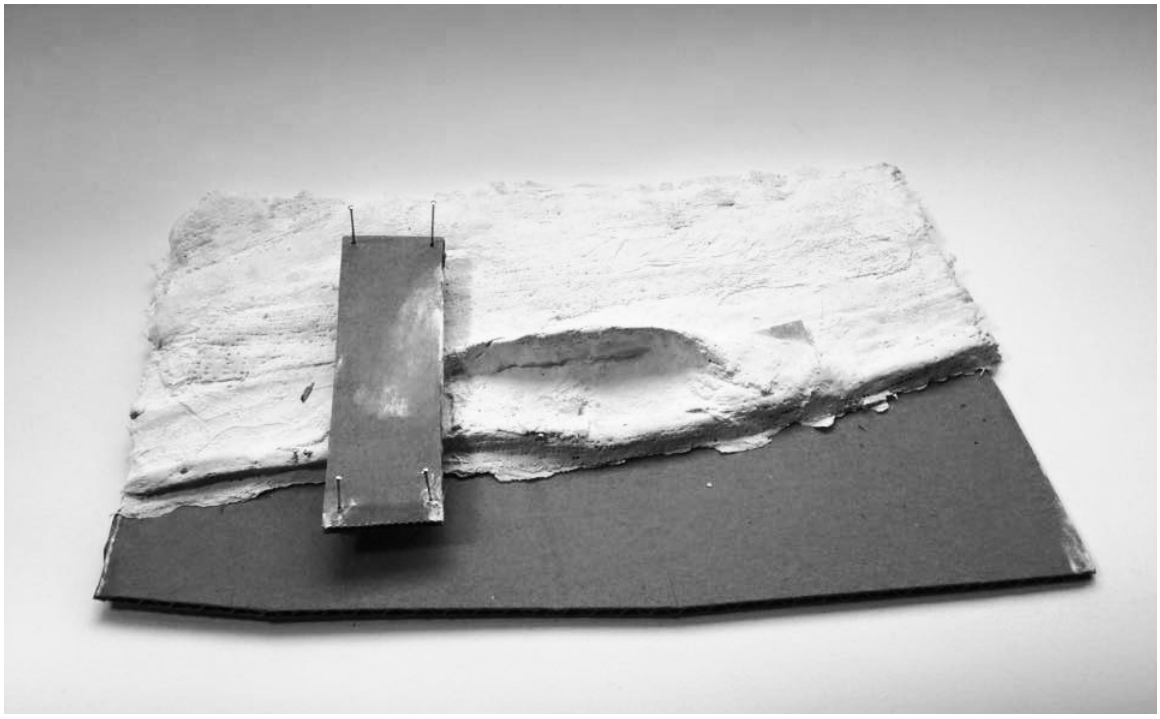
49. Berlin Wall Memorial. *Chapel of Reconciliation*, accessed March 1, 2016. http://www.berliner-mauer-gedenkstaette.de/en/chapel-of-reconciliation-216.html

The view from the ambulatory in the Chapel of Reconciliation looking out through the wooden slats resemble bars telling the story of segregation before the Berlin Wall was taken down. The special moment where the stereotomic and tectonic materials meet is seen in this important, yet tense, space in the design.

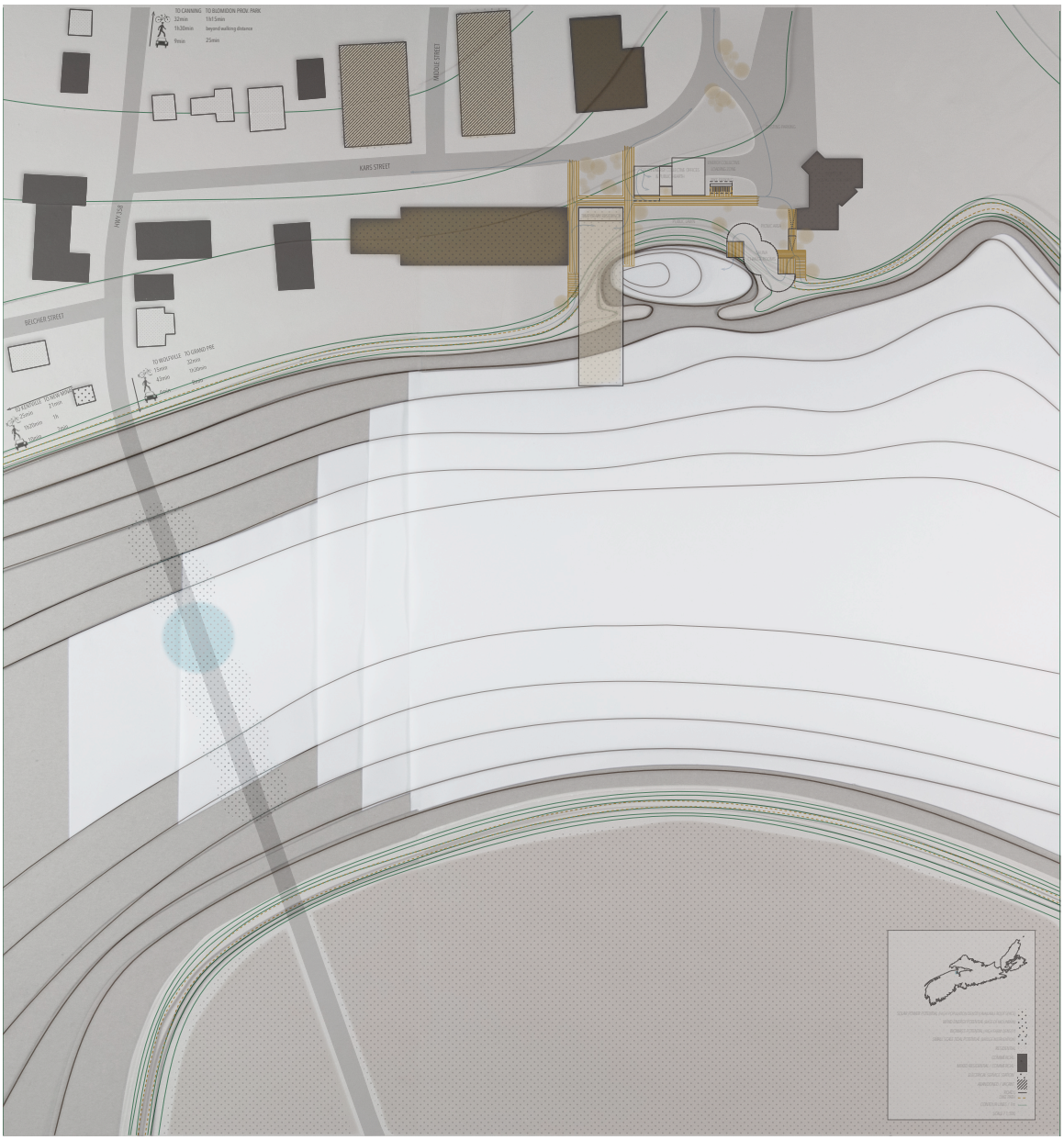
CHAPTER 4: ARCHITECTURAL PROPOSAL



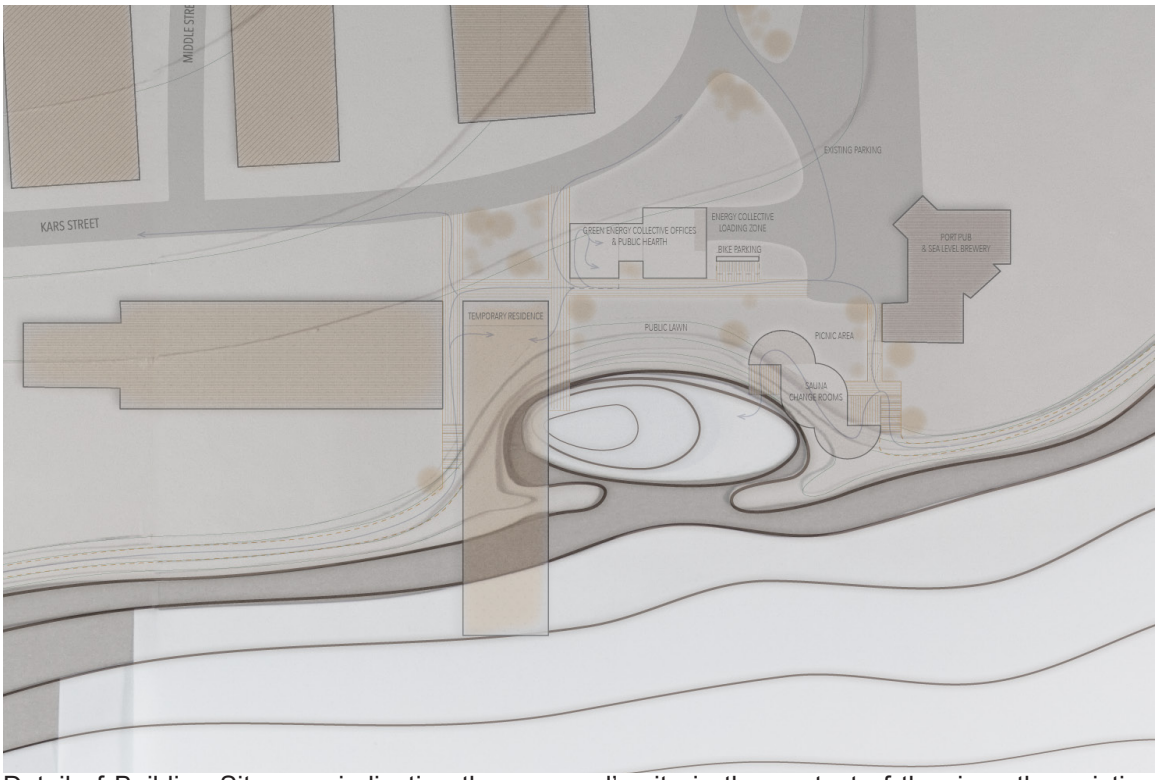
An early conceptual collage of the proposed buildings in relation to the tidal pool.



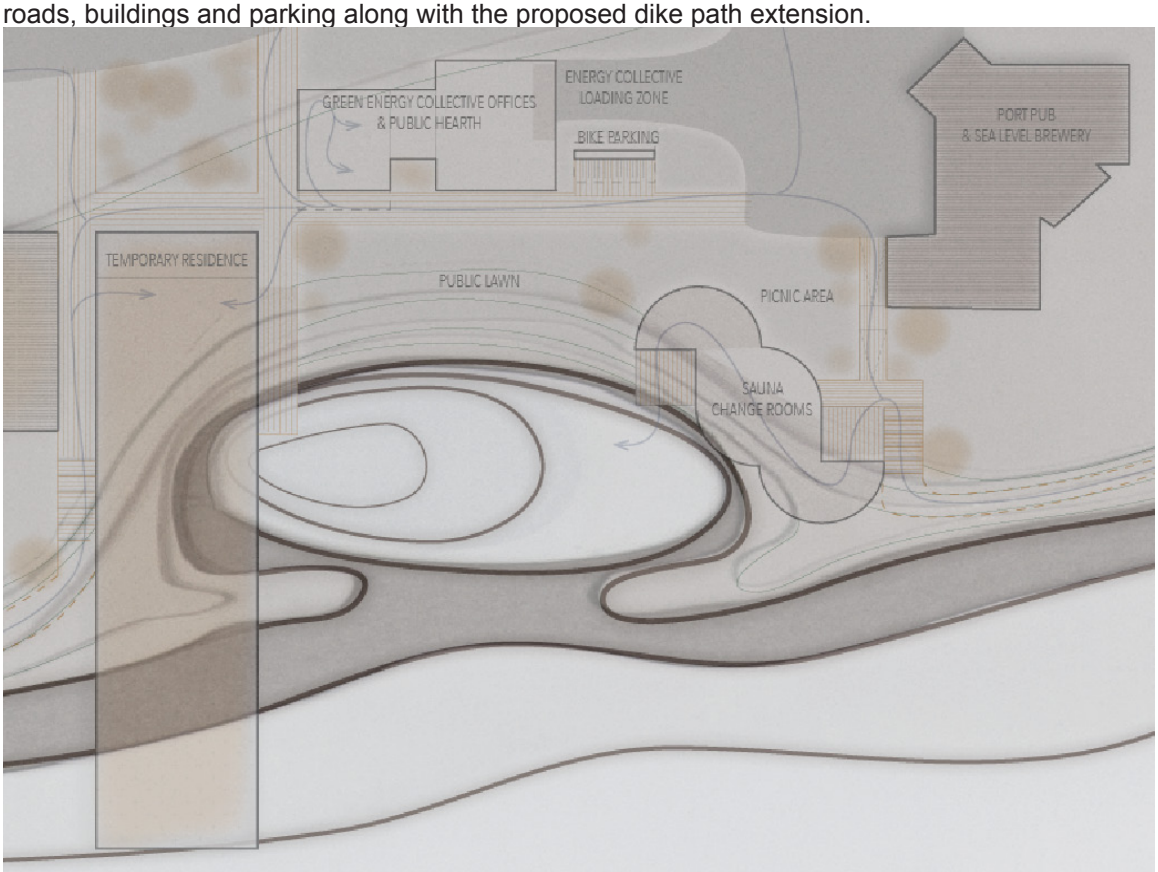
An early conceptual plaster and cardboard model of the proposed buildings in relation to the tidal pool.



Interpretive hybrid site model/map locating the building site of the landscape and architectural proposal on the north bank of the tidal Cornwallis River at Port Williams and its proximity to renewable resources and nearby communities.

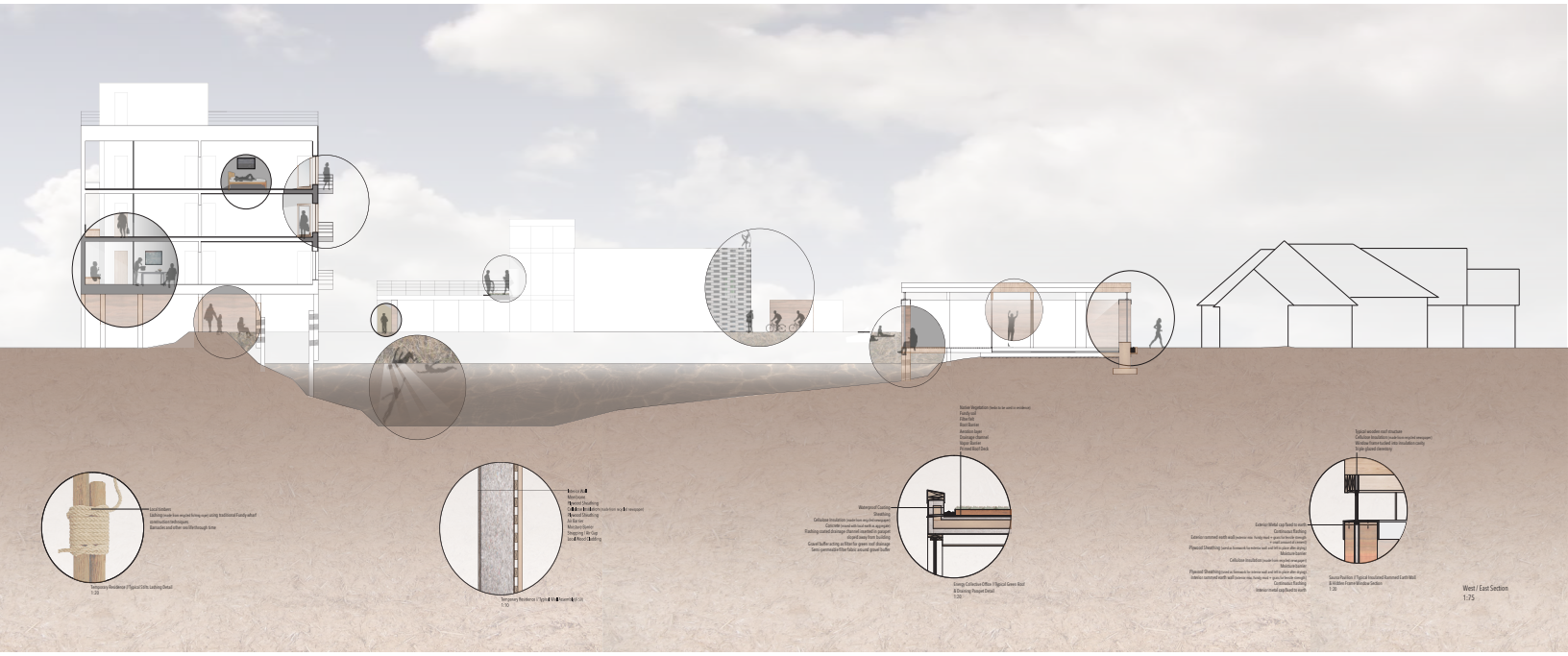


Detail of Building Site map indicating the proposal's site in the context of the river, the existing roads, buildings and parking along with the proposed dike path extension.

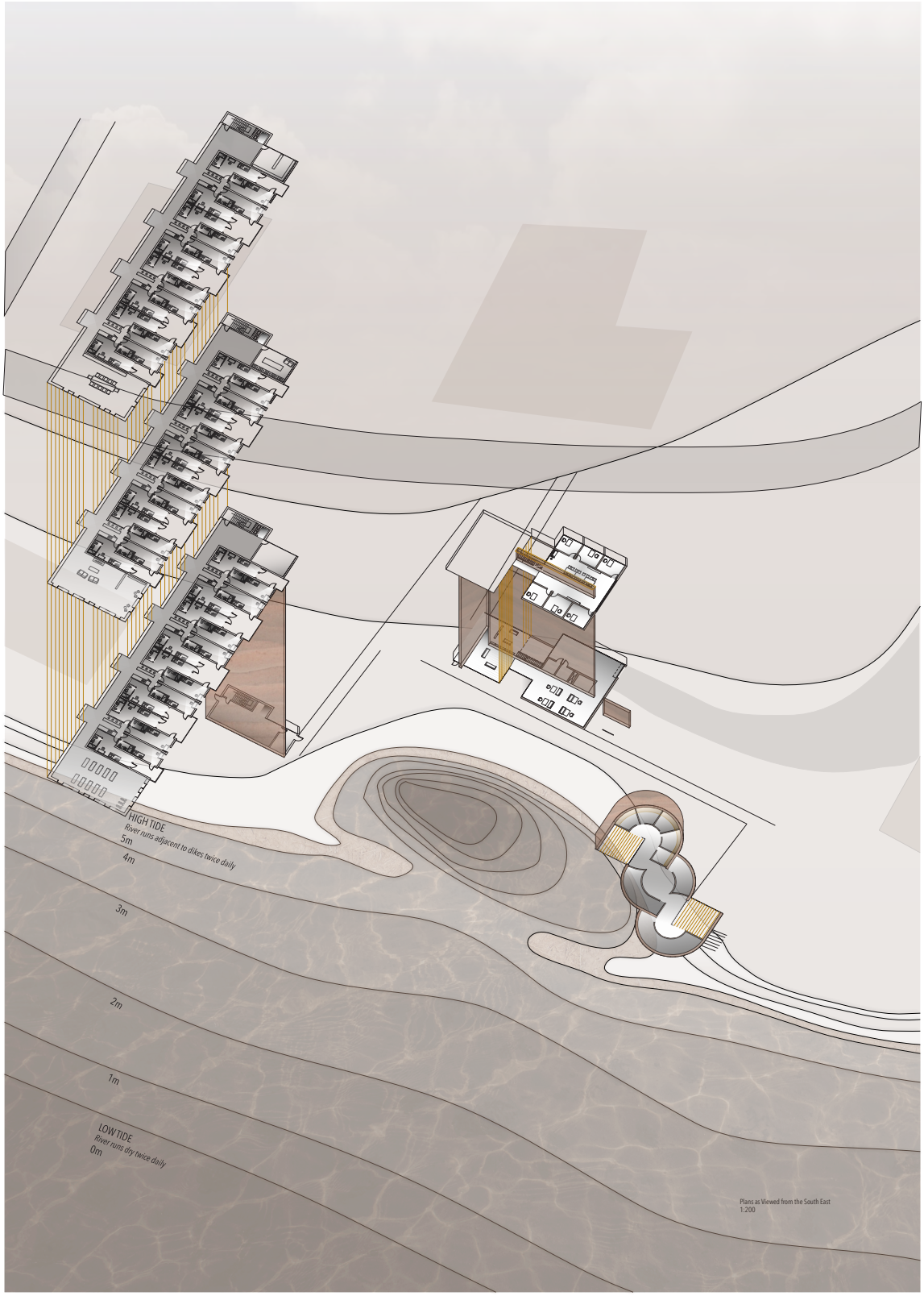


Detail of the Building Site map indicating the immediate site map of the architectural proposal in the context of the major site feature, the proposed tidal pool.

Detail of the Building Site map indicating the town's position within the context of the other neighboring communities and points of interest and travel time by bike, walking and car.



West to east section of the architectural proposal, through the temporary residence, tidal pool and facilities pavilion. Seen in elevation behind the tidal pool is the renewable energy collective offices.



Axonometric plan representation of the architectural proposal indicating tidal variances: The temporary residence is perched over the river, the collective office space is set back on the site allowing for a public lawn space and the tidal pool facilities pavilion organically follows the path of the dike.

This view shows all pieces of the architectural proposal. The figure is looking over the temporary residence balcony to the tidal pool and facilities pavilion at high tide. Seen behind the tidal pool is the collective office space which creates a public lawn.

The three primary thesis goals set out in Chapter 1 will be referenced again in this chapter:

1. Encourage a Better Connection between Permanent and Temporary Residents.

2. Increase Awareness and Investment in Renewable Energy Resources.

3. Address The Need for Quality Housing for Temporary Residents.

The proposal as a whole is meant to act as a sustainable kit of architectural parts for the evolution of this cultural landscape to grow with renewable energy. It is meant to bring people together in a natural way, through living, working and recreation. The rest of this chapter will address the individual pieces of the proposal and identify why each one is important to the functioning of the whole.

4.1 Architectural Response to Thesis Goal 1: Communal Spaces

Although the communities around Port Williams have permanent year-round residents, there are also highly transient population groups that ebb and flow through the towns seasonally, including students, tourists and migrant farm workers. Given that some of these groups are only in the region for a short time, it can be difficult to instill a sense of community connection. I am proposing two ways that these relationships between permanent and temporary residents can be fostered. The first is a large scale proposal to connect all of the fragmented pieces of existing trails to form one integrated active greenway. The second is a smaller, building site scale proposal to design a recreational water feature, which will exist along the greenway path, in which all buildings on the site will interact with.

4.1.1 Integrated Dike Pathway

There are currently existing trails between nearby Cambridge and Coldbrook, areas with a high amount of permanent populations.[50] This trail links to another, the Kings County Rail Trail, in Kentville, an area whose population is primarily permanent but experiences some variance with the presence of the Nova Scotia Community College campus. The Kentville trail abruptly ends and then another starts up along the dikes of the Cornwallis River near Port Williams, but end short of the main waterfront at my proposed building site. Fragmen-

50. Cornwallis River Pathways Society. *Cornwallis River Greenway*, accessed February 5, 2016. http://www.cornwallisgreenway.ca

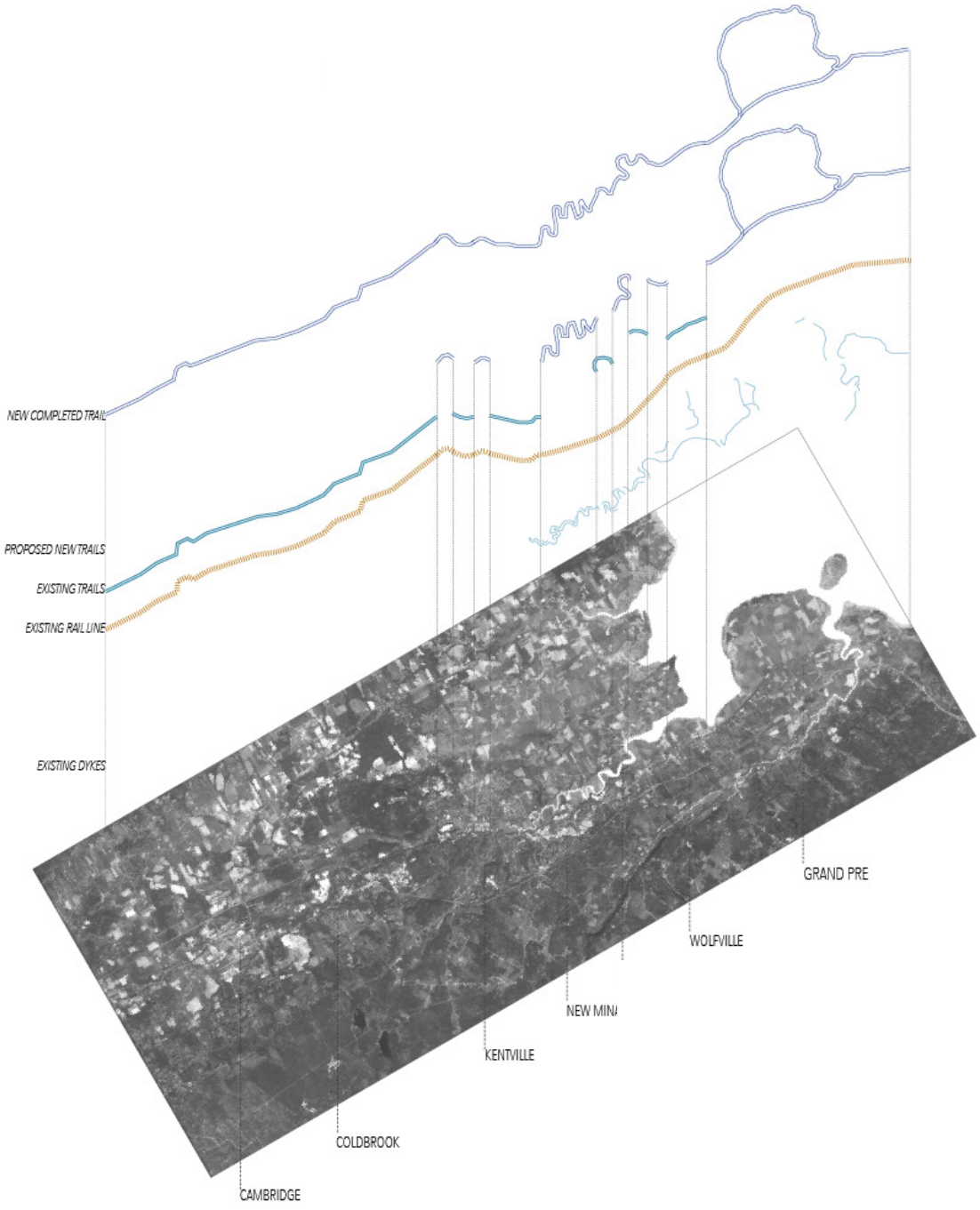
ted trails pick up again along the dikes just north of Wolfville.

I am proposing that the existing wooden wharf on the Port Williams waterfront be taken down, to recycle the wood for use in the construction of the pathways linking the new architectural proposals on the site, and a dike be put up along the bank in its place. This new dike would link up with the existing dikes and trails and be further extended to Grand Pré and include interpretive points of interest along the way to tell the evolving story of the region. This physical link to the various communities throughout the region will make the transient populations feel more connected with the permanent residents through recreation, shared experiences and casual friendly encounters along the path.

The current fenced off wooden wharf structure along the riverbank at the building site is uninviting and underused. The proposal for a linked dike pathway along the bank would provide a much more useful and inclusive space for people to experience.

The proposed greenway will share stories of the past, but also look forward to the future. It is important that this pathway include visual connections to the new proposed renewable infrastructure. For example, the route through Wolfville could include a path through Acadia where a large solar array would be present. Placing windmills along the pathway will also help to increase the visual connection with what renewable energy can look like and

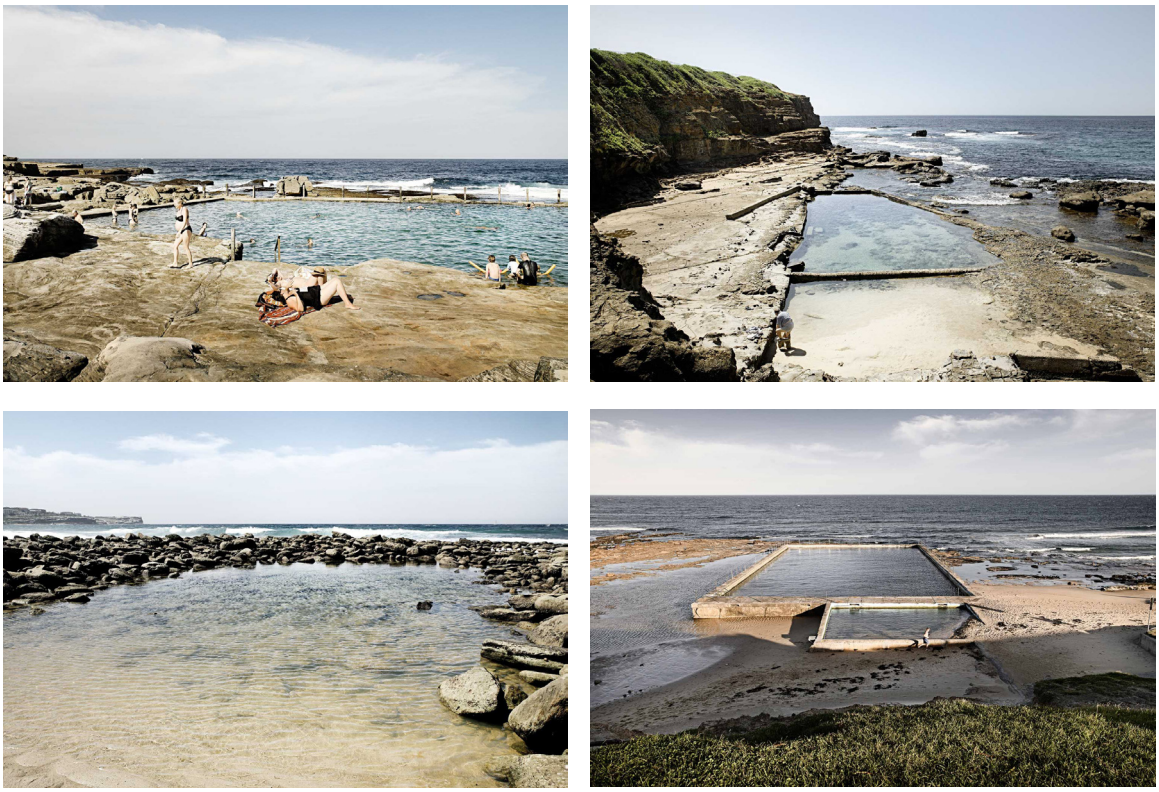
act as wayfinders along the route. Placing the infrastructure directly along busy pathways will show people that windmills do not have to ugly or noisy additions to the landscape but that in fact they are the vision of a clean, green future. The same highly visible application will be done for small scale tidal turbines attached to existing bridge infrastructure across the river.



Proposed Dike Greenway Route.

Pathways exist on top of and adjacent to existing dike seen here in eastern Wolfville. The Minas Basin can be seen on the left at mid/high tide, and farm land can be seen on the right with a drainage channel (polder) running in between pathway and field.

Eastern Wolfville dike pathways can be seen again in this image with the town in the background. Typically, both the paths on top of and adjacent to the dike are used. The upper path is used by people looking to take in the view, the lower path is used by people trying to get out of the wind.



Selection of images from Pim Vuik's Tidal Pool photo series showing the different forms a tidal pool can take in order to take advantage of tidal water for swimming; from *Tidal Pools* by Pim Vuik.

4.1.2 Tidal Pool

Water is the element that has most significantly shaped, and continues to shape, the landscape. It is the reason why the earth is so fertile, and why the Bay of Fundy is so unique. It is a clear design intention that a communal water feature must be prominent. I am proposing that this feature be a tidal pool in the warm months and skating rink in the colder months. Feeding into the macro/microcosm theory, it is crucial that this feature be a prominent element in the landscape and inform the land and structures that surround it, just as the tides have done for thousands of years.

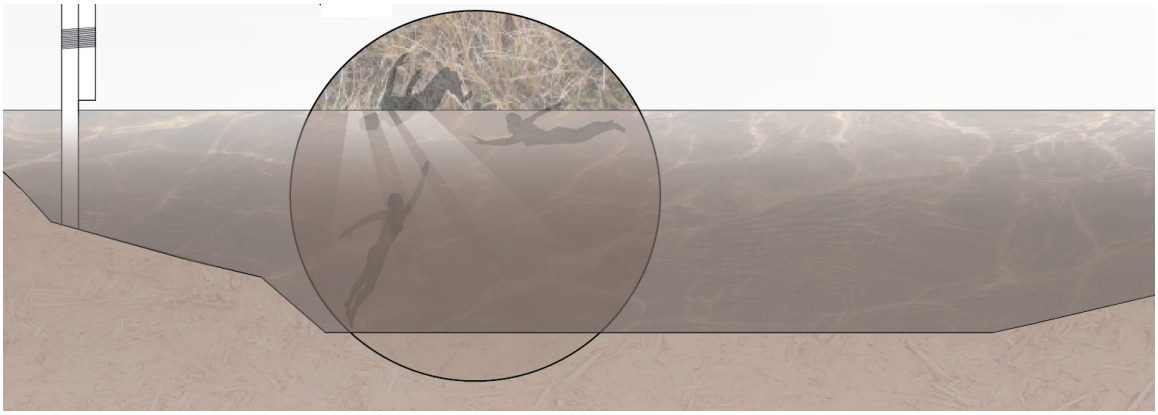
It is important to design this feature to be a place for communal physical activity and re-creation. The best way to unite different groups of people is by offering them an enjoyable activity to do together. Additionally, there is a long history of the tides and mud flats being used for recreational purposes, including tidal bore rafting in the Shubenacadie River and the annual Mud Creek Days festival in Wolfville.[51]

51. Wolfville, Nova Scotia. *The Muddiest Festival in the Valley!* http://www.wolfville.ca/mud-creek-days.html

Left: Tidal bore rafting in the Shubenacadie River, Right: Acadia students enjoying Mud Creek Days in Wolfville.

Although there is this link to using the water and mud for recreation throughout the region, swimming is left out for two reasons: The first is that the water is always quite cold, even in the summer months. Since the water is moving so quickly it never has the chance to fully benefit from the warming effects of the sun. The second reason is because, at any given time, there is only a 50% chance that there will be water at any of the local beaches. The tides of the Minas Basin have a 5 kilometer horizontal range, meaning that the beaches are very often dry. These are both important reasons why a recreational tidal pool would be a well-received communal space by all residents, permanent and temporary, in the region.

The dike running along the site would be peeled back, and the pool would be dug into the earth. At high tide, the tidal pool and the water from the river would be at the same level. As the tide lowers, however, the river would run dry but the pool would stay almost completely full. Concentrating the water in this relatively small, south facing area with the dark mud ground would allow for the water to become adequately warmed up to perfect swimming temperature. Additionally, the constant flow of the tides would allow for natural filtration of the water, meaning that there would be no need for additional heavy maintenance or the use of chemicals.



The muddy waters of the tidal pool, lit by the south sun, can be seen here being utilized by the residents for swimming.

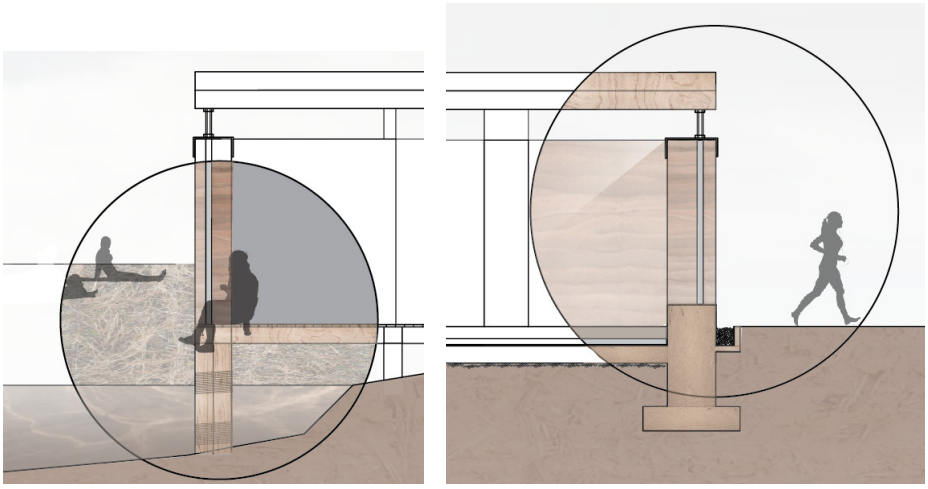
An important part of the thesis is the role of cycles. The seasonal cycle can not be ignored here. As a result, the central water feature will be designed to accommodate activity all year round. In the summer it will act as a tidal pool for swimming and in the winter the space will double as a skating rink when all the water has frozen over. An example of a project that has been designed in a similar way is the Water Plaza in Rotterdam designed by Florian Boer and Marco Vermeulen. The plaza is meant to control the spread of water during storm surges while also providing an activity hub for all seasons.

Top left: Typical condition on a dry and sunny day, Top right: after a heavy rainfall, Bottom left: During a rainstorm, Bottom right: Plaza doubles as an outdoor skating rink when the water freezes over.

4.1.3 Tidal Pool Facilities Pavilion

In order to facilitate the tidal pool, a public space will be incorporated into the architectural scheme. This space will house changing rooms, washrooms, skate/swimming supply rental and a sauna, which will be heated via waste heat from the adjacent buildings including Sea Level Brewery, located next door.

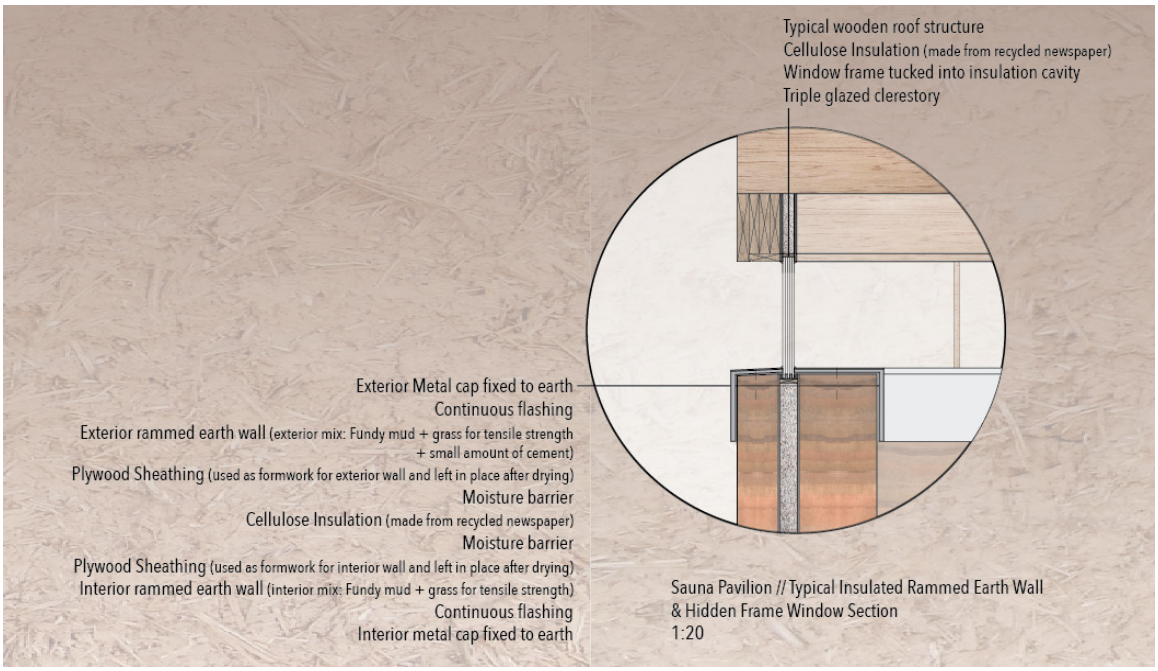
This is the most steretomic elements of all in the scheme. Due to this nature, the building's structure will be made of rammed earth, it's form will follow the curve of the dike path and mimic the familiar round plan grain silo shape frequently seen in the region and it will be inset into the ground; reading as one with the earth. The only places where this material language breaks is at the entrances/exits, off the dike path and into the water, where the material is speaking in tectonics through wooden construction. The wooden decks indicating the entry points are positioned in such a way to frame the view of the river.



Two experiential sections show the intention of this building: On the left is the west facing section, showing the moment where the stereotomic meets the tectonic at the water's edge. On the right shows the way the building is sunk into the earth and how it interacts with the activities of the dike path.

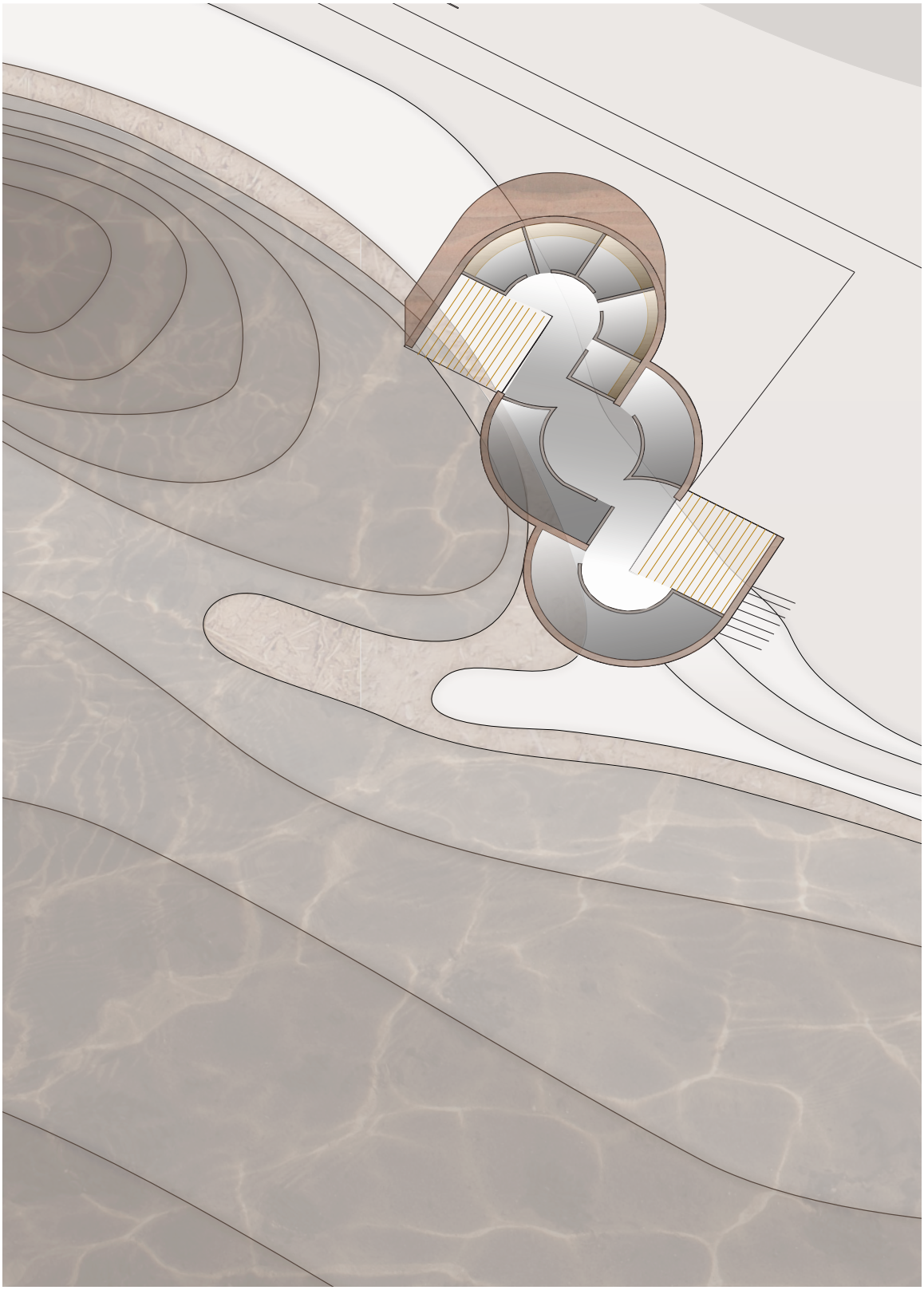
The design itself can be read quite clearly through one key detail: the cross section of the rammed earth wall, showing the relationship between exterior and interior spaces, where the wall meets the roof at a clerestory window. Through this detail, the construction strategy can be seen to keep the interior quality of the space intact even if the exterior wall degrades over time. The wall could almost be conceived as two separate pieces: one facing the exterior and one facing the interior, with cellulose insulation made from recycled newspapers between, adding to the thermal quality of the wall. In this gap where the in-

sulation is applied, sits the window frame, allowing for a seamless transition from earth to sky. A flashing system bridges over from the exterior to interior and a cap is placed on top to eliminate any thermal breaks. This is also to ensure minimal degradation from Atlantic coast weather conditions.



Rammed earth to clerestory window detail of tidal pool facilities pavilion.


The tectonic wooden deck framing the view of Wolfville Ridge and the vast agricultural fields across the river.



A detail of the tidal pool facilities pavilion plan showing its context in relation to the public lawn, tidal pool, river and dike path.

4.2 Architectural Response to Thesis Goal 2: Community-Owned Green Energy Collective Collaborative Office Space

The architectural response to this thesis goal will be to provide a physical manifestation to the proposed community-owned green energy collective. This office building will give a face to the collective, with public program spaces designated for community consultation and information, a demonstration area and a resource library as well as private spaces for the collective's staff including collaborative work areas, meeting rooms and offices.

The architectural language of the space is both stereotomic and tectonic in nature. It is permanent in that it is deeply rooted in using the landscape of the place as its "fuel," but is temporary in the way that it will encourage workers from a diverse cross section of population groups, from long-time residents to internship positions for temporary students.

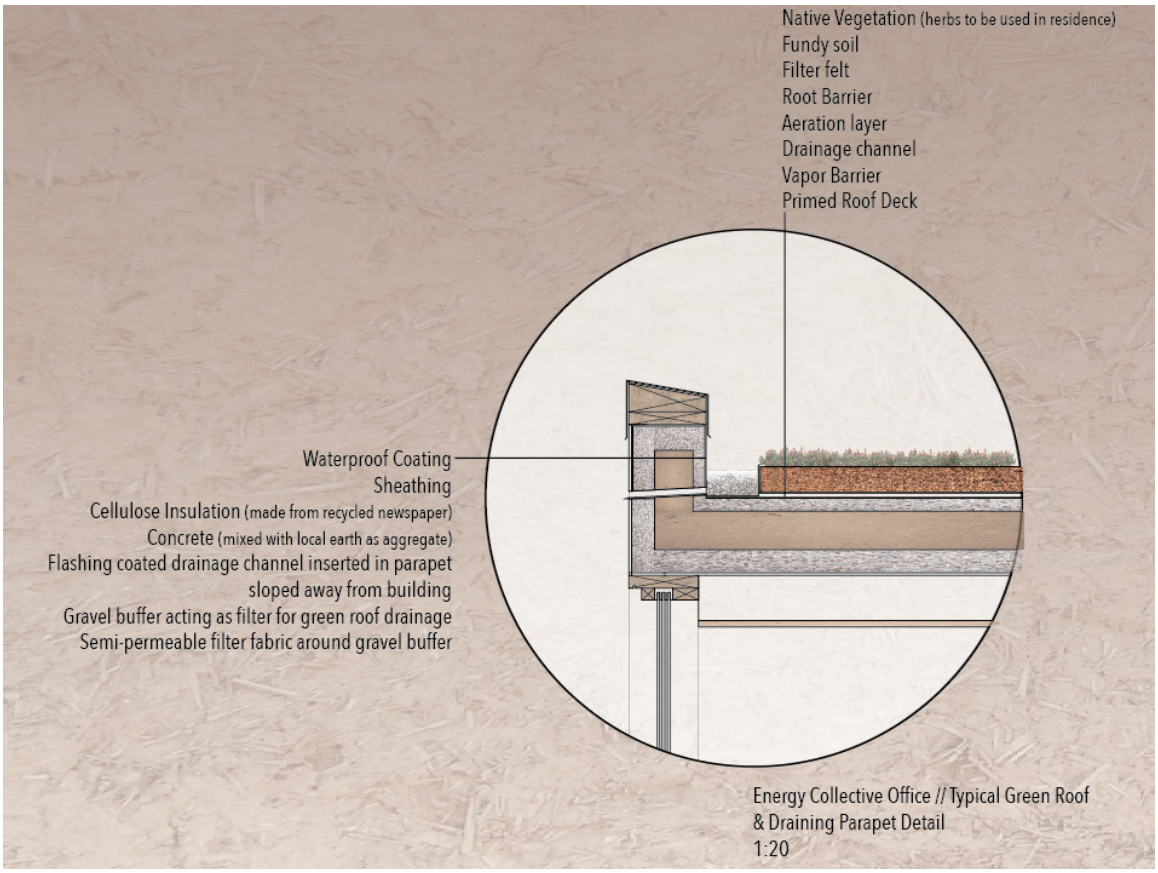
The north facing public reference library on the first floor gives residents the best reading light. To the right, along the west facing wall, a figure can be seen walking through the extruded trombe wall used as a primary circulation space.

The main structure of the building is seen through two interior rammed earth walls. One wall runs along the glazed west face of the building acting as an extruded circulatory trombe wall. This wall acts primarily as a thermal mass to heat the public hearth and reference library. The second rammed earth wall runs perpendicular to the trombe wall. It runs through the public space on the western half of the design, up and through to the collaborative work space of the collective's employees on the second floor. This wall has three primary design functions: The first relates to structure; this large wall acts as the

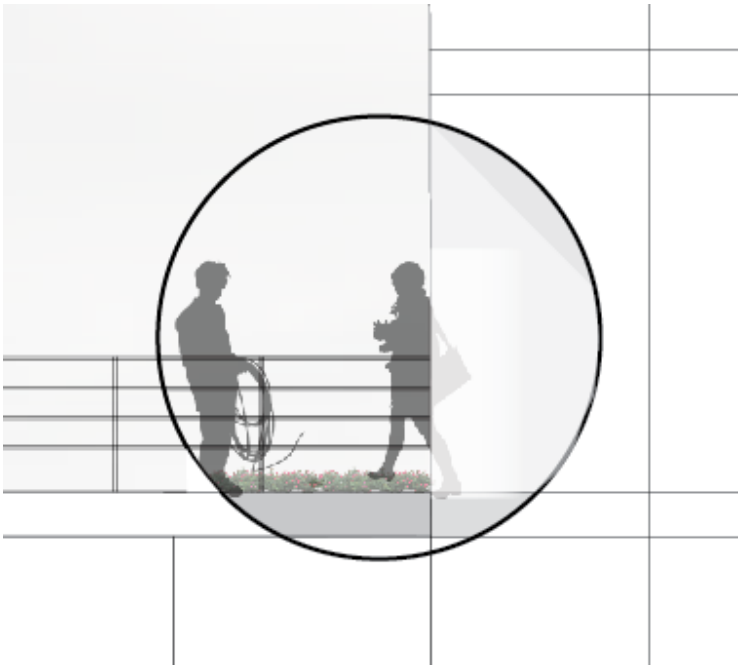
main structural spine in which the wooden floors and glass walls hang from. The second function is to act as a thermal mass. Since this wall has a large southern face it collects the heat of the sun during the day and lets it out at night, allowing the space to be sufficiently warmed up by the time the workers arrive in the morning. The third design function of this wall has a greater social importance. The wall pierces through the second floor but does not reach all the way to the ceiling. It comes up through the floor plate to a height suitable to act as an additional work surface. A wooden cap could be put on top of the wall and it could easily act as a long collaborative work table.

The second floor is home to the collective's collaborative work space. Seen here is an east facing window with a view to the river and nearby Wolfville as well as the additional work space provided by the table-height rammed earth wall.

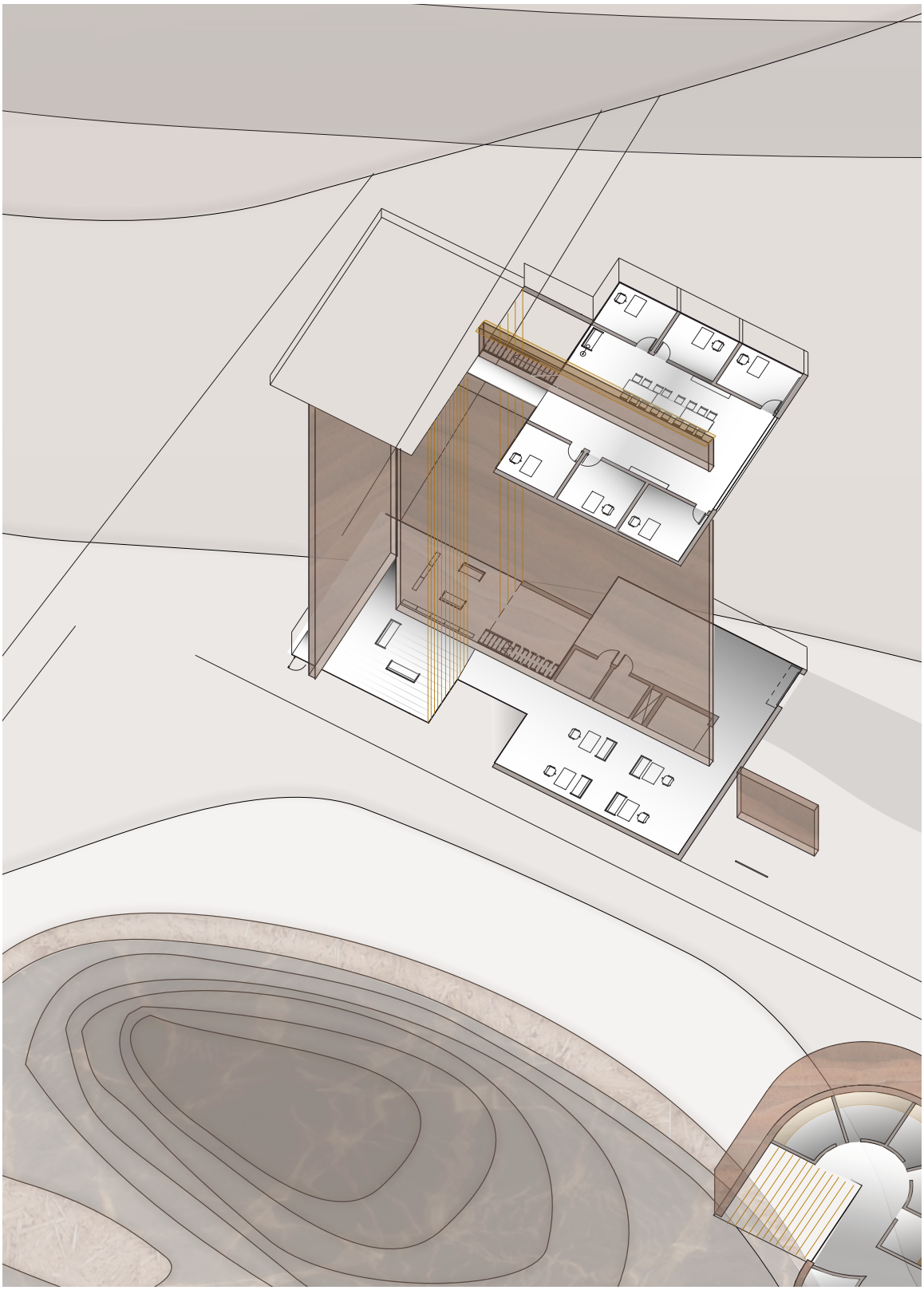
Another way this building connects itself to its surrounding site is through the application of a green roof. From the second floor work space area, the green roof can be accessed for the workers to enjoy a break surrounded by locals plants and the south west sun. The composition of the green roof is such to be as sustainable and true to the place as possible featuring a draining parapet detail, insulation made from recycled materials and to only use Fundy soil and vegetation.



The local and sustainable detailing strategy can be seen here with a draining parapet, and native soil and vegetation application.



Collective staff are seen here in this experiential section taking a break together on the office's green roof.



A detail of the collective office space plan clearly indicating public and private spaces and its relationship to the public lawn, circulatory pathways, the tidal pool and the street.

4.3 Architectural Response to Thesis Goal 3: Temporary Residence

Responding to this goal will be a temporary housing program capable of holding approximately 50 residents including students, green energy collective interns, and migrant farm workers. The design intention is to provide these different groups of residents a variety of communal areas encouraging cross-cultural interaction. It is in these shared, indoor and outdoor spaces throughout the design, that this encouragement of interaction can be seen best.

The quiet study space is shown here with private spaces for reading and working alone or in pairs acoustically separated through the use of wooden shelving units. Collaborative work spaces for group projects, book club discussion, etc. line the south sun lit wall.

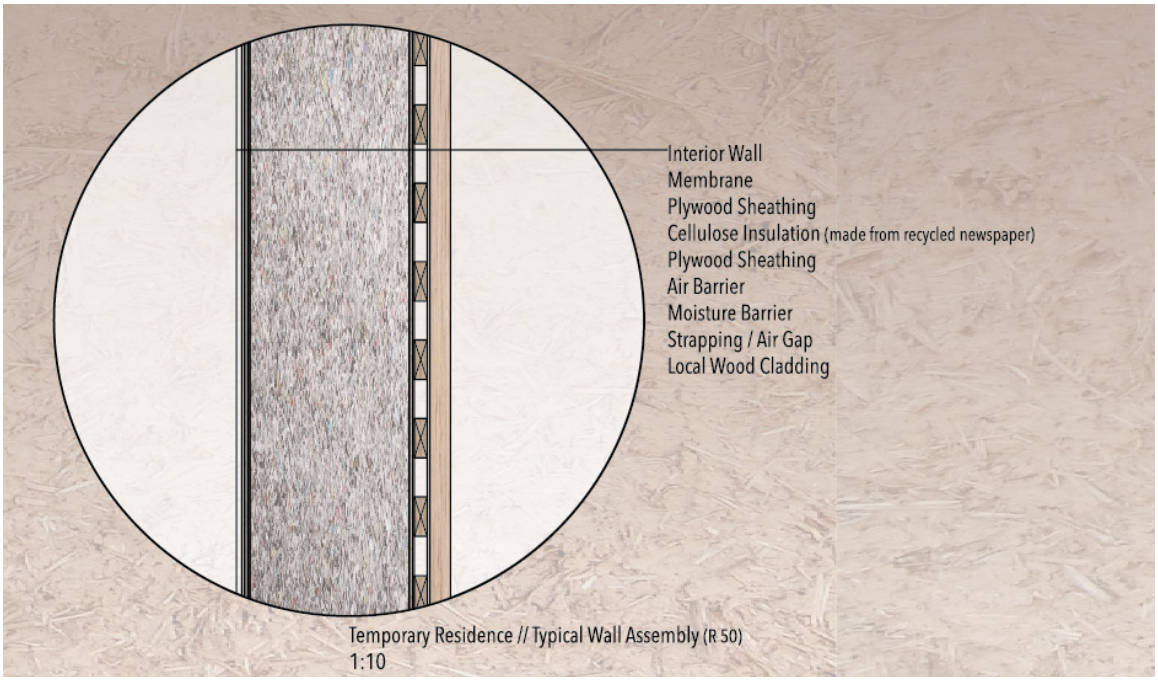
The louder, “party” space is much more open than the quiet study space, allowing for visual connections between everyone in the room. This room can host movie nights, board games or just friends hanging out.

Communal kitchen centrally arranged to allow for frequent social connections between all residents who share the space as well as any resident who may be walking past in the adjacent hallway.

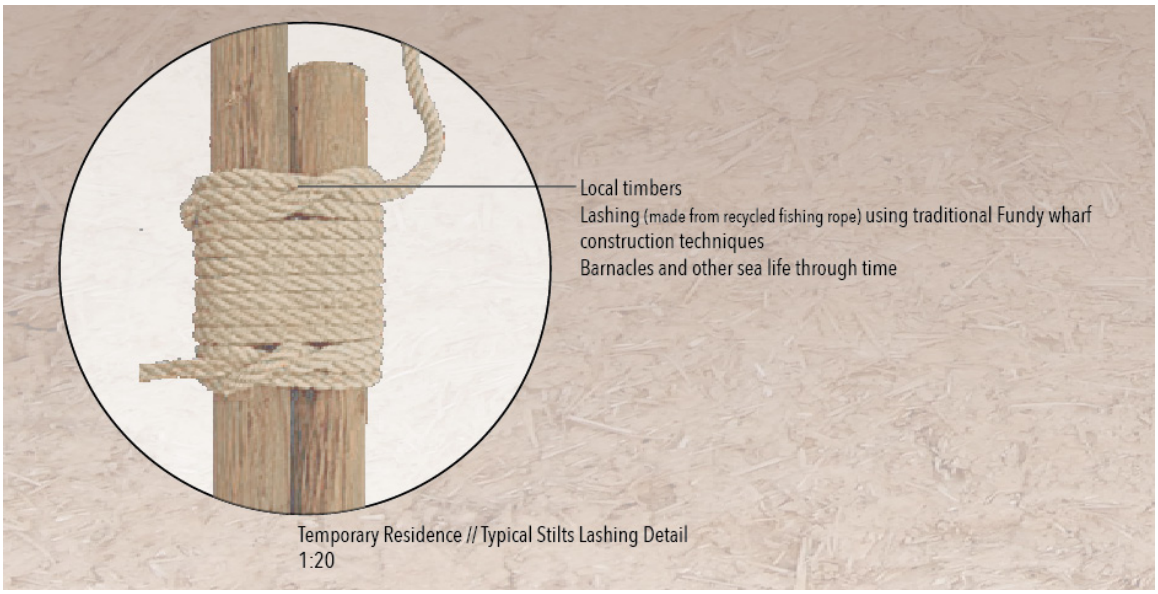
The two types of resident rooms are shown here. On the left is a room set up by a typical student. You can see she can set up her desk under the window next to the balcony door for maximum natural working light. On the right is a room set up by a Mexican migrant worker who chooses to use his window space to grow plants.

Each floor is home to two collective spaces for all residents. The north facing space is a service area, different on all floors, such as a public laundry space or bike storage. The program of the larger south facing space is also different on each of the floors, including areas for both loud activities such as movie nights and board games and quiet activities like studying or reading. Making sure that each of the floors host different activities was done to ensure that residents would feel free to move around the entire building and not feel tied to their own floor.

Each individual resident room has its own full washroom and closet. Every four rooms share one communal kitchen area including space for collaborative cooking and dining, lit by the western dinner time sun. A different quartet of rooms share an east facing balcony which overlooks the Cornwallis River and tidal pool. This balcony is meant to catch the morning sun and encourage residents to join each other for their morning coffee. The kitchen and balcony composition was designed in such a way to ensure that the interaction with different residents would be wide cast, and that the kitchen sharing residents would not all be the same residents who share the balcony. This means that instead of just getting to know the three people with whom you share your kitchen, any given resident would also get to know up to two additional residents on their shared balcony.



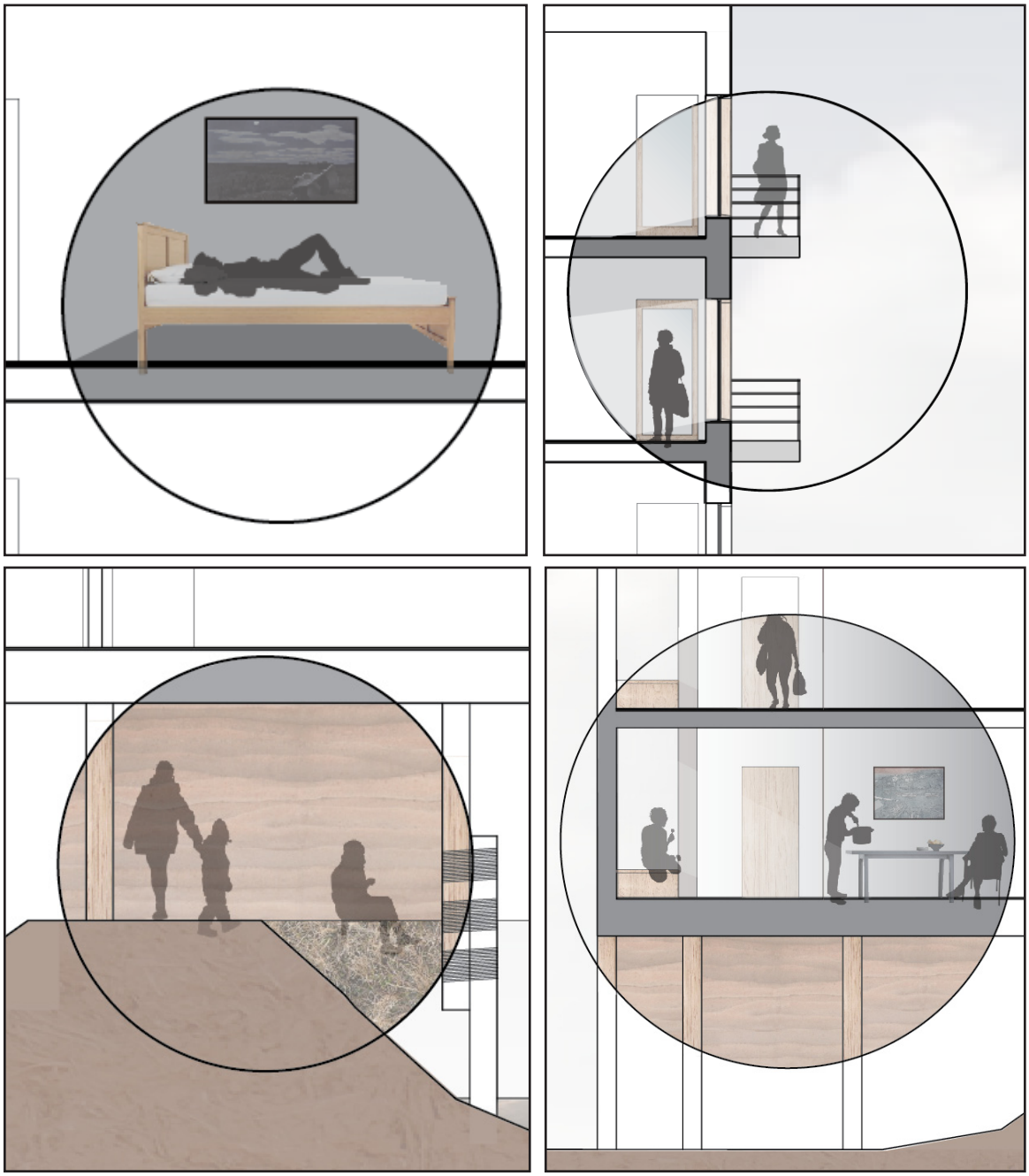
Typical wall detail for the temporary residence shows wooden construction detailing featuring a thick layer of recycled insulation, increasing the building's thermal mass and acoustic qualities while decreasing its energy costs.



Typical lashing detail seen on wooden stilts.

As with the other designs, the temporary residence is made to be as sustainable and as responsive to its surrounding environment as possible. A wall section shows how the wooden structure houses a thick layer of recycled cellulose insulation, acting as a passive insulator and thermal mass. This wall is meant to trap the heat from the morning sun to warm the room in the evening, when most residents will be occupying the space the most. All resident groups (student, interns and farm workers) will typically be out of their room in the day time, returning in the evening.

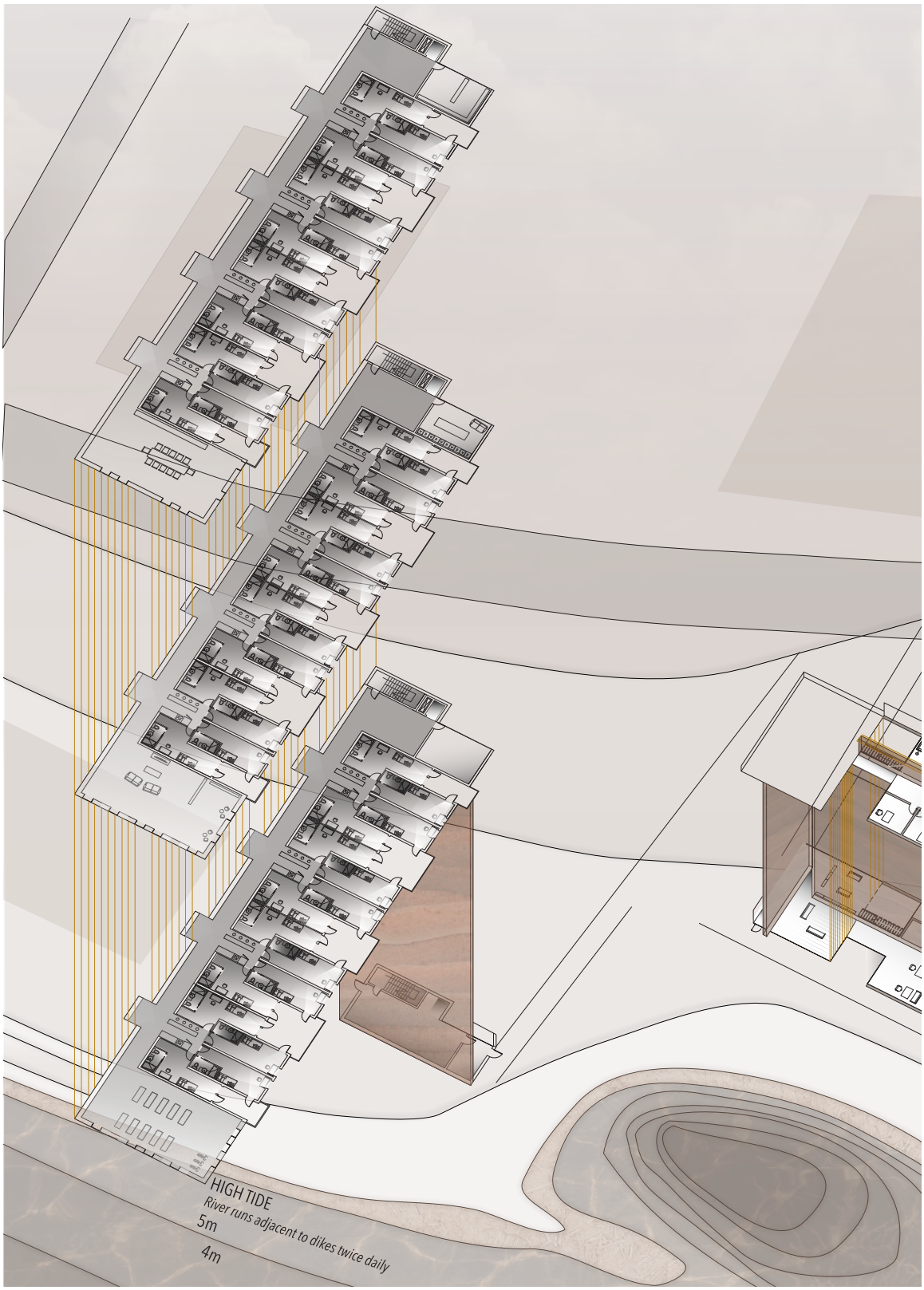
The form of the temporary residence comes from the massing of the agricultural warehouse next door, which shares the formal language of many of the familiar barn and warehouses throughout the rural landscape. This form is lifted off the ground, turned perpendicular and inserted into the water on lashed wooden stilts. This architectural composition acts as a metaphor for the people inhabiting the space. A tectonic, wooden structure will make up the skeleton, tied into an earth wall connecting to the dike path. Except for this one connection point to the earth, the structure will otherwise be very lightly touching the ground, built on top of wooden stilts, once again expressing the temporary, somewhat disconnected nature of the residents. In the same way the pieces which make up a wooden structure are replaced from time to time, the residents too will come and go. Their temporary nature is only true as a singular piece. Together, as a whole, they form a permanent and significant fixture in the cultural landscape of the region.



Some typical social experiences of the temporary residence can be seen in this quartet of sections. Clockwise from top left: A single resident taking a nap, A resident looking off of her east facing balcony to the tidal pool, A family taking a walk under the residence among the stilts on the dike path, and new friends and neighbors prepare a meal together in the sunny communal kitchen.

Cyclists can be seen going for a ride along the dike trail under the stilts of the residence at high tide.

A family goes for a walk at low tide.



A detail of the temporary residence plan in relation to the river, tidal pool, dike path, collective office space and street. Through these plans you can clearly see the organization of private and shared spaces throughout the three inhabited floors.

CHAPTER 5: CONCLUSION

In conclusion, the implementation of a community owned energy collective in the Minas Basin along with the temporary residence and communal tidal pool at the central hub of Port Williams successfully addresses my thesis goals: renewable energy can seen as a viable, and necessary step in adapting the landscape and the diverse cross section of population groups are all brought together with this common goal. Just as the Acadians, the Dutch and the Mi'kmaq people came together and build the dikes, we can too all come together to sustainably evolve with this unique working landscape.

The next step that this project allows is for the renewable ethos to spread itself even wider than the Minas Basin to other Canadian landscapes and beyond. With so many people from other parts of the world visiting, or temporarily residing in the region, the success story of this industrial landscape could begin to exist in other towns and cities throughout the country, as well as the world. The lessons learned through the Minas Basin project could be used as a case study in other regions who want to try the same thing.

Industrial Organicism Thesis defense, Dalhousie University. March 21, 2016.

APPENDIX 1: PHOTO ESSAY OF THE FUNDY COAST - A STORY OF ADAPTATION

Taking a walk along the trail behind Universite Sainte Anne where both their windmills as well as the largest wooden church in North America, the Eglise Sainte-Marie church, can be seen prominently as part of the landscape, indicating the equal importance of a traditional material culture as well as renewable energy.

Creative use of wood making its way into architectural and industrial forms near on Digby Neck.

Wood acts a vessel for telling the story of the tides in Annapolis Royal.

At low tide near Gosses Coques, birds are seen feasting on stranded sea creatures, as the wooden wharf structures around them tell the story of the continually changing tide through the existence of micro-ecosystems of barnacles and other plants and creatures who have made their home on the wooden structure.

The Sissiboo Falls dam near Bear River is a very stark and uninviting industrial intervention on an otherwise beautiful landscape. The above image shows the river not even five minutes away from the dam, existing in its untouched and idyllic setting.

The Annapolis Royal Tidal Station, which has been running since 1984, is the only tidal generating station in North America.

APPENDIX 2: THE AMPHIBIOUS CITY - FIELD STUDIES RESULTING FROM THE BRUCE & DOROTHY ROSETTI TRAVEL SCHOLARSHIP FOR ARCHITECTURE 2015

THE AMPHIBIOUS CITY //

SEA LEVEL ADAPTATION STRATEGIES AND THEIR EFFECTS ON SOCIAL AND TECHNOLOGICAL ASPECTS OF URBAN LIFE

PRIMARY STUDY AREA //
THE NETHERLANDS
DENMARK

FACULTY ADVISOR // GRANT WANZEL

MEGAN LLOYD // JULY 21 - SEPTEMBER 08 , 2015


Vienna, Austria

My travel destinations as recipient of the Bruce & Dorothy Rosetti Scholarship were the Netherlands and Denmark. These countries have long been seen as world leaders in progressive climate adaptation planning that plays hand in hand with their "water-friendly" attitude. I went into each place to study the interaction between the city dwellers and the water in the coastal cities at all scales from a technological and sociological angle:

Sociological
Large Scale // Plans and policies in place that allow for social sustainability (inclusive high quality affordable housing for example)
Small Scale // Connection between overall quality of life in the city and interaction with urban waterways

Technological
Large Scale // Major infrastructural interventions, such as flood walls, as well as plans in place for climate change such as green energy alternatives
Small Scale // Building foundations and cladding systems that are designed to tolerate and work with water, instead of against it

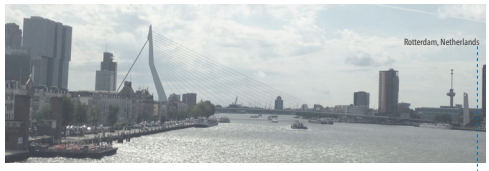
Before visiting the primary destinations, I had the opportunity to take a course called Green Building Solutions in Vienna, Austria. This course included valuable knowledge on sustainability in planning, architecture and engineering. Vienna is known world wide as being a leader in sustainable living, both socially and environmentally. The experience of taking part in this course put me in an ideal mind space to truly take in all I was about to see in The Netherlands and Denmark. It helped me discover different aspects of green building and urban planning that I had not even thought about before and very much helped me know what to look for and what to ask when continuing my travels.

By visiting The Netherlands and Denmark and allowing myself to become fully immersed in their culture, I could begin to realize the effect of the connection to the water. Both countries associate their cultural identity as being one with the adjacent water and this connection becomes a strong source of national pride. Water based living is embraced in all ways, and integrated into the everyday life of a typical amphibious city dweller. The reason these places are so successful in water integration has a lot to do with the policies and priorities of the national governing bodies, but another important reason for the success is that each and every resident is engaged in the discussion. It is inherent in the citizens of these nations to be active participants of change.

The act of physically traveling through (instead of flying over) these countries was an extremely important aspect of my process as well. This allowed me several stopovers along the way between my primary destinations to gather further insight into the European way of living sustainably and harmoniously with water. If there was ever an opportunity to travel via water or train, I took it over flying. This was another way for me to get the most out of this study trip.

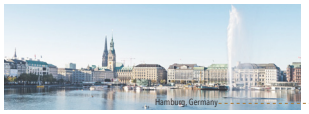
My current research work for my Masters' Thesis is studying sustainable hydro power systems and their effect on adjacent communities in Nova Scotia. This travel opportunity was an invaluable piece of research on this topic. The experience gave me insight on how attitudes for positive change can be instilled into a community and become a source of pride. The chance to visit some of the most leading edge amphibious projects in the world will no doubt help me with my design as I move forward through the remainder of my time at Dalhousie as well as after graduation.


Amsterdam, Netherlands


Rotterdam, Netherlands


Copenhagen, Denmark


Hybrid Ferry from Germany to Denmark

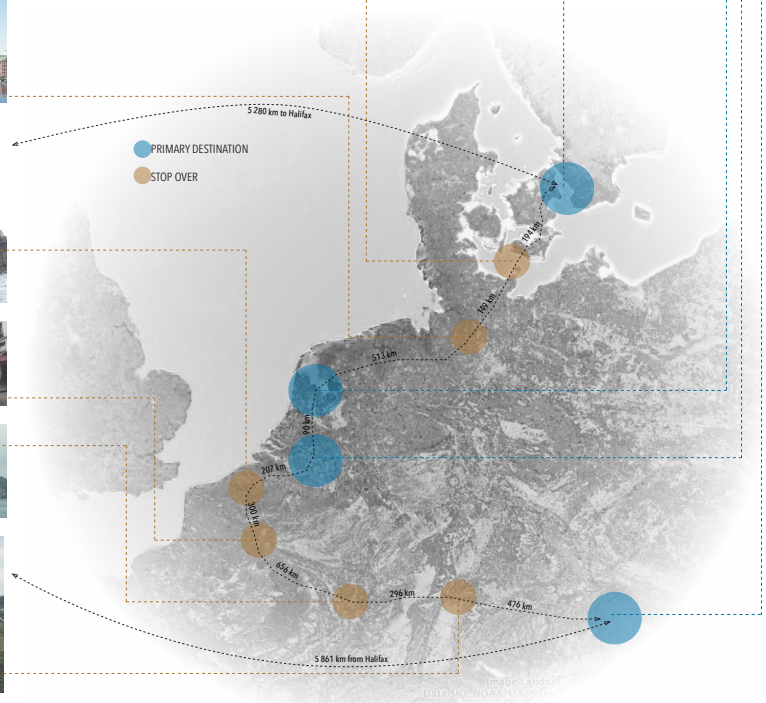

Hamburg, Germany


Bruges, Belgium


Paris, France


Zurich, Switzerland

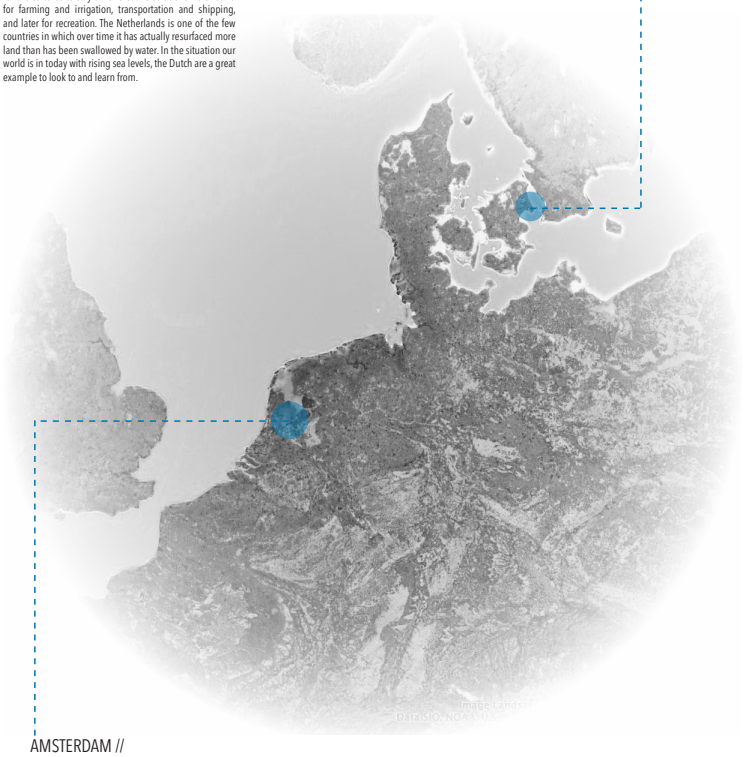

Alps, Western Austria

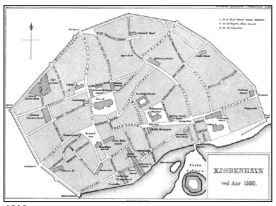


Map of my travels beginning in Austria and ending in Denmark. It was important to my study to travel solely by train so I could physically watch the landscape change from country to country.

REGIONAL // HISTORY + FUTURE

The Dutch and Danish cultures have always been tied to the water. Their creative engineering started early out of pure necessity of land requirement. This was needed in order for the cultures to stay alive. Creative solutions were found for farming and irrigation, transportation and shipping, and later for recreation. The Netherlands is one of the few countries in which over time it has actually resurfaced more land than has been swallowed by water. In the situation our world is in today with rising sea levels, the Dutch are a great example to look to and learn from.

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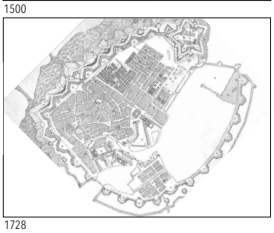
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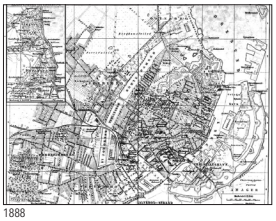
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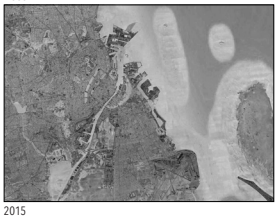
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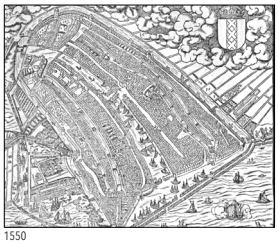
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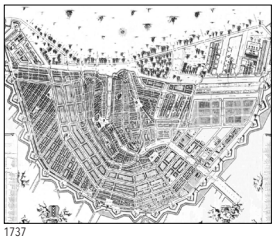
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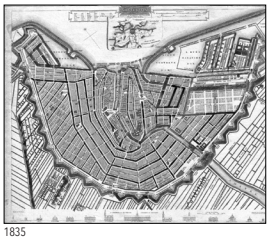
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2015

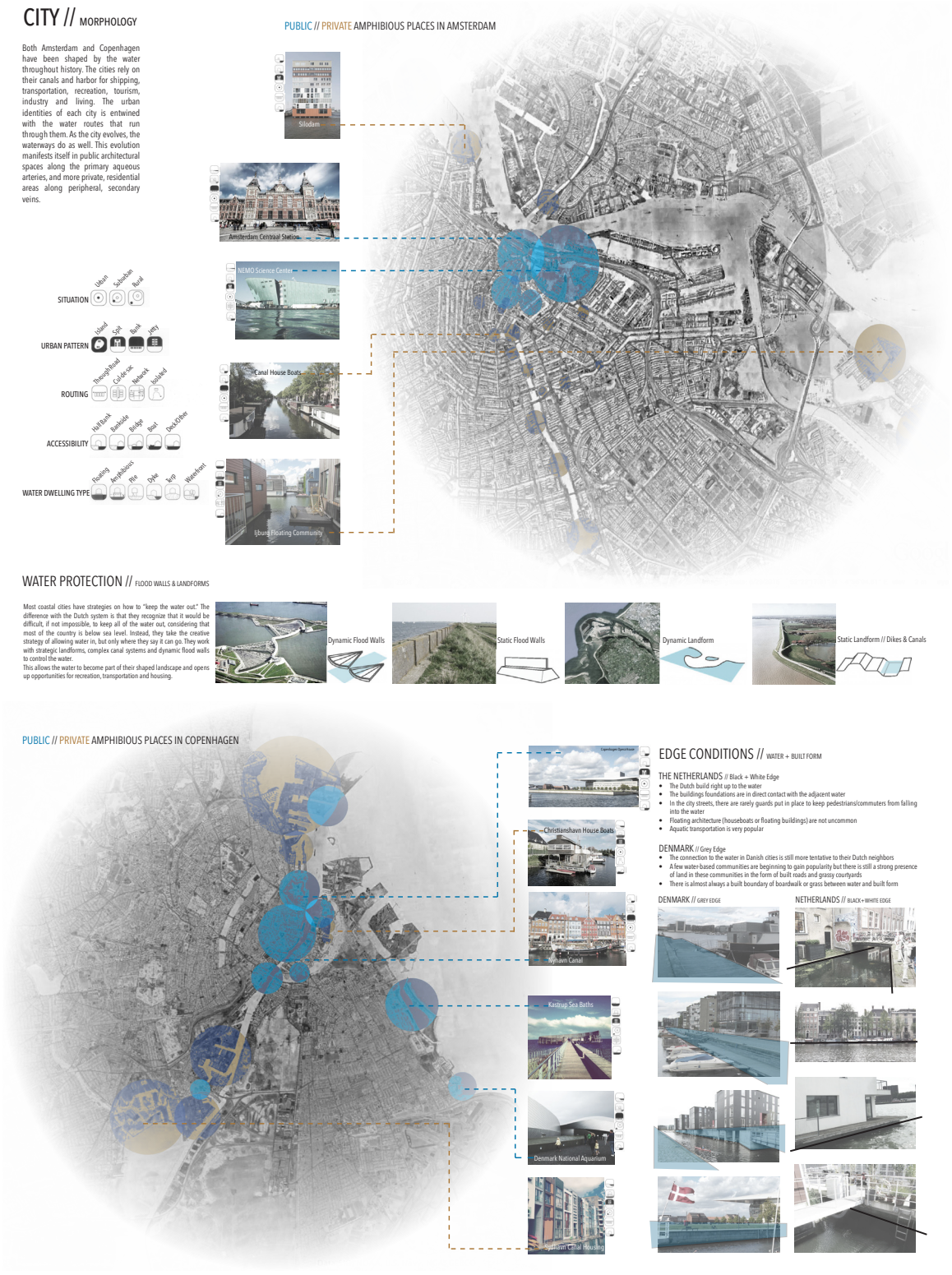
ADAPTATION LEADERS //
WHAT MAKES THESE COUNTRIES WORLD LEADERS IN CLIMATE ADAPTATION?

The Netherlands and Denmark are global leaders with their creative solutions to engineering and infrastructural issues involving water. We are currently in the middle of a climate change crisis, and the work of the Dutch and Danish is, not surprisingly, still the cutting-edge. Each country has developed progressive Climate Adaptation Plans that other nations are looking at and adopting. Some of the key initiatives, goals and projects underway are the following:

- Major infrastructural changes to increase the size of sewers and catch basins in anticipation for more severe weather systems
- Creative water routing through cities and towns
- Using excessive water as recreation opportunities
- Amphibious/water based housing
- Soft surfaces mandatory when possible over hard surfaces (grass over asphalt)
- Water based transportation
- Investment in renewable resource generated energy options
- Commitment to be carbon neutral by 2025
- Separating infrastructure renewal funds and agencies from politics
- Changing the attitude of water from a problem to an opportunity
- Water integrated into park spaces
- Mandatory green roof for flat roofs
- Community gardens
- Investment in floating architecture
- Strong educational aspect into all climate adaptation initiatives
- Changing the attitude of their country's residents to make it "cool" to be green

CLIMATE ADAPTATION STRATEGIES // SELECTED INITIATIVES FROM THE NETHERLANDS AND DENMARK

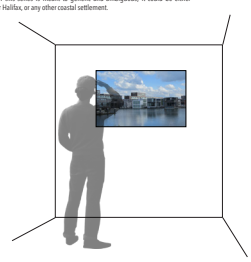
Regional analysis of Amsterdam and Copenhagen, the two major cities I visited during the field study, and their relationship to climate adaptation strategies and initiatives.



City/Building scale analysis of Amsterdam and Copenhagen, studying each city's relationship to the water in terms of their edge conditions, flood protection measures and use of public and private space next to the water.

HUMAN // DAY IN THE LIFE OF AN AMPHIBIOUS DWELLER

Here, the daily life of an "amphibious dweller" is examined by the hour, showing interaction with the water as being an integral part of every activity. The amphibious city depicted in this series is meant to generic and ambiguous; it could be either Copenhagen or Halifax, or any other coastal settlement.



06:30 //

WAKE UP TO THE SOUND OF THE GULLS

07:00 //

HAVE MORNING COFFEE WITH A SEA BIRD

07:30 //

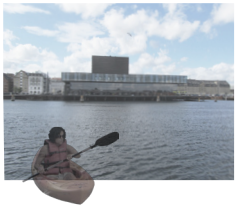
DEPART FLOATING COMMUNITY

08:00 //

CYCLE ACROSS THE BRIDGE

09:30 //

GO TO WORK AT YOUR DOCK-SIDE OFFICE



16:00 //

FIT IN SOME AFTER-WORK EXERCISE AT THE PADDLING CLUB

18:00 //

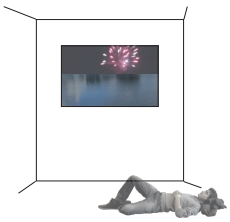
GRAB A FRESH CATCH ON THE WAY HOME

19:30 //

HAVE DINNER WITH FRIENDS ON THE FLOATING DECK

21:00 //

NIGHT CAP BY THE SHORE



23:00 //

FALL ASLEEP TO THE SOUND OF CRASHING WAVES

Studying the human scale through mapping the daily rituals of a typical amphibious city dweller.

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