Obverse Ecologies

Coexisting with Nature in the Anthropocene

By Nicholas Leblanc

A thesis submitted to the Faculty of Graduate and Postdoctoral Affairs in partial fulfillment of the requirements for the degree of

Master of Architecture In M. Architecture

Carleton University

Ottawa, Ontario

©2016 Nicholas Leblanc

OBVERSE ECOLOGIES

Coexisting
with
Nature
in
the
Anthropocene

By Nicholas Leblanc

ABSTRACT //

Architecture and nature cannot exist as two of the same. While architecture is the product of our need to create or to control space for our own benefit, nature simply 'is' for its own benefit. The title Obverse Ecologies is a direct reaction of the separation between the constructed environment and nature: obverse - corresponding to something else as its opposite or counterpart; ecologies - connections and interactions between organisms and their environment. This thesis is an exploration of architecture and nature as opposite counterparts in a mutually beneficial relationship. It attempts to rectify a possible future where nature exists within the constructed environment of the Toronto port lands. This project explores architecture as an ecotone. It attempts to reintroduce a gradient boundary where the constructed environment and Nature can exist at the same time and rectify the connections and interactions between these obverse ecologies.

ACKNOWLEDGMENTS //

To my family and friends who have continuously supported me throughout the architecture program.

Thank you to my thesis advisor, Johan Voordouw, for his encouragement and guidance.

TABLE OF CONTENTS //

INTRODUCTION	01	PART THREE : COEXISTENCE.....62
		Organism //
PART ONE : NATURE	06	Organ //
What is Nature? //	07	Cell //
Scales of Nature //	08	Habitat //
Functional Scale		Ecosystem //
Physical Scale		
Temporal Scale		CONCLUSION.....104
Connectivity //	14	
System: Parts to the Whole		
Landscape Connectivity		
Ecotones //	16	
Nature of the Site //	18	
The Natural History of the Site		
Human Occupation		
Culture and technology	23	
PART TWO : ANTHROPOCENE.....	27	
The Anthropocene //	28	
Anthropogenic Site //	29	
Early Port Settlement		
Arrival of the Railway		
Landfilling Ashbridge's Marsh		
Erasing Ecotones and Sharpening Boundaries		
Keating Channel		
Victory Soya Mills		
The Port Lands Today //	44	
Constructed Elements of the Site		
Port Lands Redevelopment //	48	
Architecture as Ecotone //	52	
Separation of Structure and Services		
Structure		
Services		
Structure and Services as Functional Scales		
Technology vs Nature //	60	
When to Leave Nature 'Be'		
Anthropocene Future //	62	

LIST OF ILLUSTRATIONS //

- Figure 001 // **Transitioning Into Nature**. Nicholas Leblanc.
- Figure 002 // **Diagram of Symbiosis**. Nicholas Leblanc.
- Figure 003 // **Canadian Boreal forest and Central Park in New York City**. Images gathered from Wikipedia.
- Figure 004 // **Ashbridge's Bay Water Lilies, 1909**. Toronto Archives.
- Figure 005 // **Functional and Physical Scales** Images gathered from Wikipedia.
- Figure 006 // **The Geological Clock**. Nicholas Leblanc.
- Figure 007 // **Volvox, Green algae**. Nicholas Leblanc.
- Figure 008 // **Marsh Ecotone Diagram**. Nicholas Leblanc.
- Figure 009 // **Topographic Map of Toronto**. Toronto Archives. Nicholas Leblanc
- Figure 010 // **Toronto shoreline and Ashbridge's Marsh before human occupation**. Toronto Archives.
- Figure 011 // **Palisaded Huron-Iroquois Village with Longhouses**. Jefferys, C.W. *Part of a Palisaded Huron-Iroquois' Village* In *The Picture Gallery of Canadian History*. Toronto, Canada: The Ryerson Press, 1942.
- Figure 012 // **Toronto Skyline and Smog, 1912**. *Toronto Skyline + Smog 1912*. City of Toronto Archives, Fonds 1244, Item 1122a.
- Figure 013 // **Ashbridge's Marsh: 1909**. *Ashbridge's Bay Looking Northeast From North Bank of Cut*. City of Toronto Archives, Fonds 200, Series 376, File 4, Item 63
- Figure 014 // **Dredging boat depositing material on Ashbridge's Marsh sandbar, 1890**. *Ashbridge's Marsh sandbar, 1890*. City of Toronto Archives, Fonds 200, Series 376, File 1, Item 47
- Figure 015 // **Dock wall in construction, 1912**. No Name. City of Toronto Archives, Fonds 1244, Item 1517.
- Figure 016 // **Aerial View Looking Northwest From The Inner Harbour, 1921**. "Aerial view looking northwest from the Inner Harbour in 1921" Digital Image. The Star. August 06, 2013. Accessed February 02, 2016. http://www.thestar.com/news/gta/2013/08/06/torontos_waterfront_dredging_up_the_past_to_build_the_future.html.
- Landfilling maps: 1818 - 2016**. City of Toronto Archives. Drawn by Nicholas Leblanc
- Figure 017 // **Ashbridge's Bay Looking West, 1920**. *Toronto Ashbridge's Bay 1920 Looking West*. October 06, 1920. Baldwin collection, Toronto Reference Library, 942-1-34. Accessed February 01, 2016. <http://www.torontopubliclibrary.ca/detail.jsp?Entt=RDMD-PICTURES-R-1411&R=DC-PICTURES-R-1411>.
- Figure 018 // **Dredging of Keating Channel, 1914**. City of Toronto Archives
- Figure 019 // **Victory Soya Mill Silos**.
- Figure 020 // **View of silos from Queen's Quay East**.
- Figure 021 // **Victory Soya Mill during production, 1947**.
- Figure 022 // **Former Site of Victory Soya Mills, North Shore, 2011**. Cooper, David. "Toronto Port-lands" Digital Image. The Star. November 25, 2011. Accessed February 01, 2016. http://www.thestar.com/news/city_hall/2011/11/25/port_land_makeover_to_speed_up.html.
- Figure 023 // **Constructed Infrastructure of the Site**. Nicholas Leblanc.
- Figure 024 // **Master Plan proposed by Michael Van Valkenburgh Associates, 2010**.
- Figure 025 // **Proposed Don River Mouth, Looking North-west , 2010**.
- Figure 026 // **Aerial of lower port lands looking west, 1959**.
- Figure 027 // **Aerial view of Lower port lands after proposed naturalization, 2010**.
- Figure 028 // **The Plug-In City** By Peter Cook of Archigram. 1964 . Cook, Peter. *Plug-In City: Sustenance Components*. In *Beyond*

Archigram: The Structure of Circulation. London, UK: Routledge, 2009.

Figure 029 // The Plug-In City By Peter Cook of Archigram. 1964 . Cook, Peter. *Plug-In City: Sustenance Components*. In *Beyond Archigram: The Structure of Circulation*. London, UK: Routledge, 2009.

Figure 030 // Scheme for a modern city by 'Metabolist' Group. 1963 Isozaki, Arata. *Metabolist Group, Scheme for A Modern City, 1963*. In *Modern Architecture since 1900*. Englewood Cliffs, New Jersey: Prentice-Hall Inc, 1987.

Figure 031 // Typical plan of the Centre George Pompidou, 1971. Rogers, Richard. *Plan: Top Plan With Terraces*. In *Richard Rogers: Complete Works*. London, UK: Phaidon, 1999.

Figure 032 // Section of the Centre George Pompidou, 1971. Rogers, Richard. *Cross Section From the North*. In *Richard Rogers: Complete Works*. London, UK: Phaidon, 1999.

Figure 033 // Section of the Centre George Pompidou, 1971. Rogers, Richard. *Cross Section From the North*. In *Richard Rogers: Complete Works*. London, UK: Phaidon, 1999.

Figure 034 // Habitat 67, Safdie. Image Taken By Nicholas Leblanc.

Figure 035 // Diagram comparing scales in Nature with scale of the constructed environment Nicholas Leblanc

Figure 036 // La Tourette Monastery, Le Corbusier ,1960. *La Tourette Monastery*, In *Green Roof - A Case Study*. New York: Princeton Architectural, 2007.

Figure 037 // Siedlung Halen Housing, Atelier 5, 1961. *Siedlung Halen Housing*, In *Green Roof - A Case Study*. New York: Princeton Architectural, 2007.

Figure 038 // National Library of France, 1996. Taken by Nicholas Leblanc

Figure 039 // Possible configurations of substructure within the ecotone structure. Nicholas Leblanc.

Figure 040 // Phytoremediation. Nicholas Leblanc.

INTRODUCTION //

Humans are part of a complex living network sustained by earth, water and air and powered by the sun. We share this planet with a bounty of extraordinary organisms, plants and animals; supported by healthy habitats and held together by rich ecosystems.¹ Even though our existence as a species is relatively short, we have managed to separate ourselves from the rest of the natural world as the sole culturally-driven species.

Definition // Culture

Behaviours, beliefs, values, and symbols that are accepted by a group of people, and that are passed along by communication and imitation from one generation to the next. Culture is accumulated over time as each generation may refine a rudimentary cultural item into a more sophisticated cultural item. [Brown and Toadvine, 2007, 33].

Definition // Technology

Technology encompasses all the machinery and methods used by humans to provide their wants. It includes simple and sophisticated tools (sharpened wood spear or airplane) and the harnessing of natural processes like fire or flowing water. [Angermeier, 2000: 3]

According to Irene Klaver nature and **culture** exist as separate realms that have been forced into a dualism where nature is considered inferior to culture.² Among the many components of culture, **technology** is singled out as the most boundary-defining component as it has the ability to impact and transform nature.³ It is through technology that we have accelerated changes to natural landscapes and environments. Our continued dominance and exploitation of Earth's resources and natural processes interrupt nature's ability to maintain a balanced ecological environment. In addition, the constructed environment of cities today plays a large role in the disconnect between people and the natural world by establishing static boundaries that prevent nature from existing in harmony with the city.

Although this thesis began as an attempt to blur the lines between the constructed environment and nature, what became apparent through its development is that architecture and nature are far too separated. Is it possible to reverse the separation between the two by rethinking the boundary, not

Definition // System

Relationship among a set of interacting processes, parts or entities to form a whole. Within an environment a system exchanges inputs/outputs. Systems can have different degrees of complexity and influence on other systems such as a single-cell organism or a hurricane system. [Brown and Toadvine, 2007: 97]

Figure 001 // Transitioning Into Nature

Three stages are required for transitioning from technology to Nature: The first stage is to improve a purely mechanical technology based on the function of a biological system in order to produce a more efficient technology - biomimicry. The second is to embed a biological system into the technology as a living part. The third stage is the most compelling and responds to the thesis question. Once biological systems have been embedded into technology and operate symbiotically within the constructed environment, when can biological systems be left alone to operate independently and to become Nature.

as a static entity, but one that is continuously at work, strengthening connections between them and itself? While both are dissimilar, their differentiation has been artificially exaggerated with the help of technology.

This thesis rehabilitates the ecological equilibrium of the site by rethinking the role of architecture as a constructed ecotone. An ecotone is a contour or boundary ecosystem where two landscapes and their associated **systems** intersect.⁴ Architecture will be explored as a bridging gradient between the constructed environment and nature as obverse ecologies: obverse - corresponding to something else as its opposite or counterpart; ecologies - connections and interactions between organisms and their environment. Architecture is divided into two parts: structure and services - a concept introduced by Reyner Banham in 1969.⁵ For the purpose of connecting the constructed environment with nature, the structure becomes the ecotone while services embody a wide range of constructed, hybrid and biological systems that inhabit and connect within the ecotone. These services can evolve to include biological processes in its system of operation and attempt to define when these biological processes become nature through time [Figure 001]. As a dynamic and evolving system, the architecture will provide an environment that responds to the needs of nature as part of the city, allowing it to become integrated into the constructed environment. It will allow for a symbiotic relationship between the constructed environment, people and biological processes by enabling them to connect at the various scales within the design [Figure 002]. The project is examined at a series of scales, from the scale of the city, the master plan, the services and their

Figure 002 // Diagram of Symbiosis

The project attempts to create a mutual collaboration or symbiosis between people, architecture and biological processes in order to rehabilitate the natural equilibrium of the site. The project is explored as an ecotone that facilitates the connection between the three.

individual technological components. Scale is what makes the project obversely complex and compelling, rectifying the implication that to build a constructed ecotone, architecture has to balance aspects from its larger environment.

The final design project is situated in Ashbridge's Marsh in Toronto's post-industrial port lands. Once a rich and dynamic ecosystem located at the threshold between Lake Ontario and the lower plains, Ashbridge's Marsh was sequentially landfilled to provide valuable land for Toronto's growing port. This thesis is a response to the extensive management initiative led by Waterfront Toronto and the City of Toronto to reverse a century of industrial activity that has resulted in a hard water-land boundary by re-shaping Toronto's waterfront and capture elements of its condition prior to human alteration.⁶ Moving forward this thesis will distinguish between:

[n]ature - typical urban green space, controlled as an external human-influenced environment.

Common perception of something that is biological and appears not to have any human influence.

[N]ature - exists for its own benefit and development, free from human intervention as described by Hegel.⁷

The relationship with Georg W. F. Hegel's philosophy of Nature is what makes this thesis a unique exploration in the realm of architecture. The fallacy in most existing and proposed urban plans is that

Figure 003 // Canadian Boreal forest and Central Park in New York City.

This thesis defines regions of the Canadian Boreal forest that have been left untouched as [N]ature while New York City's Central park is considered as [n]ature because of the level of design and planning in its creation.

the use of biological systems such as a tree suggests that the development is more "in tuned" with [N]ature. Unfortunately, the level of planning, prescription, constraint and artifice that are linked to the tree's existence within the development enable the tree to truly exist for its own benefit and therefore is described as only [n]ature. Such a comparison can be made between the Canadian Boreal forest and New York City's Central Park [Figure 003]. The final design project, considers Hegel's definition of Nature, in an attempt to bring the gradient back to Ashbridge's Marsh by allowing natural processes, rather than a man made response, to shape the landscape. When and what aspects of the projects can be left to Nature's devices; eroded by waves, shaped by winds, colonized by insects or overgrown with plants. The constructed ecotone becomes a mediator between the constructed environment of the city and the Nature of the site.

This paper will be presented in the form of a timeline that spans the existence of the Don River and Ashbridge's Marsh. It is defined in three parts:

Part One: Nature

Part Two: Anthropocene

Part Three: Co-Existence

Part One begins with defining Nature, its processes and manifestations as it relates to the natural history of Ashbridge's Marsh. It examines human culture as a biological adaption and technology as

a boundary-defining component of culture that separates humans from the natural world.

Part Two explores how technology enabled humans to become a major force on Earth in the Anthropocene and its implications in transforming Ashbridge's Marsh into a post-industrial port land.

Part Three attempts to rectify a symbiotic relationship between the constructed environment and Nature by rehabilitating the ecological equilibrium of the site and reintroducing the gradient back into Ashbridge's Marsh. This thesis does not seek to produce an absolute outcome. It does not set out to define what should happen on the site but rather the possibilities that could manifest in Toronto's port land as a result of rethinking architecture as an ecotone.

NOTES //

1. Peter Head, *Entering the Ecological Age: The Role of the Engineer* (London, UK: ARUP, 2008,) 5.
2. Irene J. Klaver, "Boundaries on the Edge" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 122.
3. Paul L. Angermeier, "The Natural Imperative for Biological Conservation" in *Conservation Biology Vol. 14 No. 2* (2000), 374. Doi:10.1046/j.1523-1739.2000.98362.x.
4. Irene J. Klaver, "Boundaries on the Edge" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 120.
5. Reyner Banham, *Architecture of the Well-tempered Environment* (Cambridge, MA : MIT, 1986), 242.
6. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 154.
7. A. V. Miller, *Hegel's Philosophy of Nature* (Oxford: Clarendon Press, 1970), 4.

001 //

PART ONE - NATURE

// NATURE // noun //

1. the fundamental qualities of a person or thing; identity or essential character
2. [often capital, esp when personified] the whole system of the existence, arrangement, forces, and events of all physical life that are not controlled by man
3. all natural phenomena and plant and animal life, as distinct from man and his creations (New Oxford English Dictionary)

Figure 004 // Ashbridge's Bay Water Lilies, 1909

Native water lilies in Ashbridge's Marsh.

WHAT IS NATURE? //

Nature simply 'is'

Georg Wilhelm Friedrich Hegel (1770-1831) was a German philosopher during the European Industrial Revolution. This thesis is grounded in his theories of Nature, written in *The Philosophy of Nature*, part II of the *Encyclopedia of the Philosophical Sciences*, 1830. In Hegel's book he discusses how Nature simply is. It itself has no absolute, final end, but is in constant change and transformation of its own existence.¹ He stated that, "Nature is to be regarded as a system of stages, one arising necessarily from the other and being the proximate truth of the stage from which it results."² Nature exists for its own existence without the influence of humans.

Considering this definition, the stages of growing in a tree are Nature. There are conditions that impact the growth of the tree, influencing the tree to grow more or less in response to the conditions. These conditions include changes in temperature, forest fires or flooding but some other conditions are inflicted by humans such as pollution, changes in land-use and deforestation. In situations such as deforestation the tree is not returned back to the forest as it would if it had fallen, died and decomposed. It is extracted and used for something else such as building material where it might be chemically treated to slow or eliminate the process of decomposition. Decay is part of Nature - removal is not. It is important to stress that humans have continuously overcome the systems found in Nature, using its resources for their own purposes. However Hegel describes that Nature itself, "in her universal aspect, humans cannot overcome in this way, nor can they turn her to their own

purposes.”³ Nature is so called “out of reach” from humans. We cannot control Nature because the act of control will rob it of the essence of being.

SCALES OF NATURE //

This thesis highlights three types of scales:

Functional scale // defined by a process within a hierarchy of processes

Physical scale // defined by and relating to body and matter

Temporal scale // defined by and relating to time

Functional and Physical Scales

The functional scale of a technological system can connect to a biological system when both are performing the same process. On the other hand, it is harder to connect the physical scale of a technological system with that of a biological one because the constructed environment is rarely explored at the physical scale of a cell or ecosystem. While the former is explored in more detail because it is easier to find similar processes in Nature and in technological systems, the latter remains important because connections happen spatially. While the next paragraphs explore the functional and physical scales as they manifest in Nature, **Part Two** of this paper will continue the exploration of these scales in relationship to the constructed environment.

Figure 005 // Functional and Physical Scales
 From top to bottom - Plant cells, human heart,
 bees, coral reef, amazon rainforest

The smallest of these interactions occurs between simple and complex **cells** [Figure 005]. The first sign of life on Earth appeared in the form of a simple, single cell that could perform a singular function – these became the smallest building blocks.⁴ With different functions, simple cells cooperate as intercellular bodies to make up a complex cell that is either distinctively plant or animal. It is these complex cells that began to adopt sexes with the capability of exchanging genetic traits, which propelled adaptation in the form of natural variation also known as evolution.⁵ Complex cells join to produce a higher level of complexity in the form of multi-cellular organisms.

An organism is composed of interaction parts: cells and organs. At the second scale, an **organ** is comprised of a collection of common cell tissues that cooperate to perform a function specific to the organ. It is the symbiosis between a series of organs through a variety of processes that creates a living individual such as a bee, bird, tree or mushroom. Unlike a single organ, an organism can perform more than one task on account of the collaboration and arrangement of its organs.⁶

At the third scale, an **organism** is dependent on the exchange of material and energy with its environment and other organisms through mutual collaboration to survive.⁷ The waste product from one organism becomes an essential resource for another organism, or eventually, an organism will evolve to take advantage of the unexploited resource.⁸ This

simple yet effective arrangement highlights Nature's efficiency by taking advantage of every opportunity. For example, bees collect pollen to bring back to their hive. In the process of flying from one flower to the next, the bee transfers pollen made from one flower and deposits it to the next flower. Flowers depend on this process of pollination from bees to reproduce and generate seeds.

Organisms interact within the physical environment of their **habitat**. The fourth scale is the habitat which is defined by its biotic and abiotic features and its physical scale is defined by the scale of the organism. The landscape of a habitat influences the success of material exchange between organisms. This is relevant to the project as it attempts to create a physical environment that is conducive to natural organisms while still maintaining an environment where humans continue to operate.

At the largest scale, the **ecosystem**, all interactions between organisms and their surrounding habitats create a complex network of interacting processes over a larger geographic region. The ecosystem is defined by the composition of organisms, abiotic elements and processes. Their arrangements or patterns of organization manifest in different structures to produce a grassland ecosystem, forest ecosystem, or marsh ecosystem, etc.⁹ An ecosystem is a holistic conception of natural landscapes by considering all connections between organisms and their environments as well as considering that there are no distinct boundaries. Nature exists

seamlessly across all scales. By distinguish these scales, this project can identify common scales in the constructed environment that may be able to connect to Nature. In relation to the design project at the end of this thesis, the ecosystem of Ashbridge's Marsh will include elements of the constructed environment as part of its holistic network.

Temporal Scales

Nature requires time. A temporal scale denotes a measured length of time. Some aspects of the natural world take longer to manifest than others. The temporal scale does not follow any physical or functional scale. A cell has the smallest physical scale but its temporal scale is one of the largest as it requires many years for the cell's DNA to evolve. Temporal scales are structured as: organism, environmental-ecological and evolutionary-geomorphological.¹⁰

Organism processes have the smallest temporal scale. Plant species, depend on photosynthesis, which operates in a day/night cycle and can live from just a season (annuals) to a couple hundred years (large trees). Animal species rarely live to exceed a century and the life span of the average human now spans a period of eight to nine decades.¹¹

Environmental and ecological processes take longer and can vary from less than a decade to several thousand years. Floods, forest fires and draughts happen periodically, while erosion happens continually but its effects is only seen over much longer periods of time. On the scale of the everyday, environmental and ecological processes may appear unchanging but

seen at a larger temporal scale the processes become fluid and dynamic.¹² Evolutionary and geomorphological processes are the largest and slowest, ranging from 100,000 to several million years.¹³ It is through evolution, “a research and development period”,¹⁴ that organisms are continuously adapting to their environment and strengthening their connection with other biological processes to create an equilibrium in which they can survive.

The geological clock presented on the next page depicts the evolution of Nature on Earth [Figure 006]. Increasingly we consider how we can conserve as much of this environment as possible and are attaching greater value to its retention. Before our influence on the world Nature was free to systematically evolve through a number of ecosystems influenced by geological forces and will continue to do so in the future with or without our presence. Therefore, our desire for stasis is counter to the long running evolutionary development of Nature and our exploitation of its resources slow down or speed up its temporal scales. The project understands that to successfully coexist with Nature it must be dynamic and constantly in flux by responding to the various temporal scales associated with Ashbridge's Marsh and Toronto's port lands. Furthermore, it does not seek a future nor an absolute final outcome as the project and Nature together will systematically evolve indefinitely.

Figure 006 // The Geological Clock

The geological clock visualizes the temporal scales of past and current species, systems and geological events. The over-arching lineage of 3.7 billions of years of evolution is only important in respect that our own human history represents a small fragment of this lineage. Through a human lens, if we consider Nature's systems that have been slowly adapting and evolving in their states before human inhabitation then it becomes apparent that there is a poetic beauty and sublime quality to Nature.

Figure 007 // Volvox, Green algae

Volvox is a genus of green algae that form spherical motile colonies of up to 50,000 individual cells. A system of structural cytoplasm connects each cell together to form a colony. As a larger whole, the Volvox has the ability to swim in a coordinated fashion towards light that has been detected by eye-spots on each cell. While each cell in its individuality is considered to be simple in function, as a larger system, the Volvox demonstrates high levels of complexity in morphology and sexual reproduction, acting like one multi-cellular organism. Daughter colonies are formed symbiotically within the larger colony creating interconnections between colonies. In this system, there are three levels of interconnectivity produced by one single unit (cell): cell to cell, cell to colony and colony to colony. (Allaby 2012)

CONNECTIVITY //

The complexity in Nature is not the individual organisms or processes and how they operate independently but how they begin to connect to one another. These connections are in the form of dynamic relationships that are continuously in flux and in negotiation.

System: Parts To The Whole

Nature does not exist in isolation at any one scale or with any individual organism but is continuously intertwined at all scales and with all organisms into a complex living network - it is, in itself, a living whole.¹⁵ Connections between different scales produce a seamless network of interconnected parts. The key to developing complexity is not simply achieved with a greater number of unique units but with the combinations and interactions between fewer units and these interactions must be explained at the scale at which they occur.¹⁶ Connectivity operates in a 'bottom-up' approach where the interactions between cells are rectified at a specific physical and temporal scale which influence the organism followed by the habitat and ecosystem.

The concept of 'system' is to draw relationships or connections between entities that somehow belong together. It consists of a set of parts that work together to form a whole.¹⁷ The Volvox, a colonization of green algae cells, operate in symbiosis to produce a complexity much like a multi-cellular organism [Figure 007]. By working together, the cells operate like

a system to achieve processes that no one cell could achieve independently. This project is conceived as a system much like the volvox. Within a larger network, the project manifests simultaneously in isolated systems while considering the overarching network that connects and supports them. It is important to address the constructed environment as a series of scales and explore the connections between these scales as they operate in natural systems. If the constructed environment were designed with consideration to the connections that Nature already operates with, then symbiosis could be achieved more effectively and on a more successful level.

Landscape Connectivity

Connectivity in Nature relies heavily on the physical world to facilitate the flow of material (species, nutrients, energy, etc.) across the landscape.¹⁸ Landscape connectivity can manifest as structural connectivity and functional connectivity. Structural connectivity refers to the form and configuration of habitats and abiotic components in the landscape while functional connectivity considers the ability of a single organism to move across the landscape. Accordingly, the functional connectivity of a landscape for an organism is directly related to the structural connectivity of the landscape that defines its habitat at a distinct physical scale.¹⁹ This project attempts to create functional connectivity between all services, programs, mechanical systems, biological systems and natural processes at various scales by exploring the structural connectivity that can be achieved through architecture. Connectivity

along the landscape is achieved by gradients among the abiotic elements of intersecting ecosystems. They are areas of transition and transformation. The prefix “trans” suggests the notion of “crossing or going beyond” which implies that there is a boundary.²⁰

ECOTONES //

Divisions, boundaries, thresholds and limits structure the physical world. Nature’s ability to blur the presence of such constraint in the biophysical environment can be highlighted in the ecotones that are generated from the interface of two separate and distinct landscapes. An ecotone is a contour or boundary ecosystem where two landscapes and their associated habitat systems intersect. They are characterized as highly dynamic ecosystems supporting a greater variety of organisms (than either of the bordering landscapes) some that are unique to the ecotone itself.²¹ Examples of such rich interactions occur where a forest ends and grassland begins, where a valley ends and a mountain range begins or where a lake ends and land begins.²²

An ecotone is characterized by its physical chemistry and how easily organisms and their associated processes (species, nutrients, energy, etc.) are able to flow across the landscape. While most ecotones are in the form of ‘soft’ boundaries that allow for a dynamic and complex gradient, some are characterized as ‘hard’ boundaries, which generate abrupt transitions and stasis among systems.²³ Land-water boundaries can range from the very

Figure 008 // Marsh Ecotone Diagram

'soft' ecotones such as marsh-lands, gradually sloping shorelines and beaches, to the very 'hard' boundaries typified by eroding bluffs or constructed barriers as a result of human intervention which will be examined in further detail in **Part Two**.²⁴

A marsh, like this project's site in Ashbridge's Marsh, is a rich ecosystem at the threshold of a body of water and a landmass. It contains a gradient of land and water [Figure 008] that is favourable for supporting high levels of biological diversity: organisms from land and aquatic ecosystems simultaneously, allowing the organisms and their processes to interact. Ecotones are essential in maintaining landscape connectivity between separate ecosystems allowing Nature at all scales to interact. Ecotones are active.

Ecotones change and induce change. They are constantly evolving as new boundaries are drawn from changing water levels, erosion, forest fires and other natural forces. Season changes and weather patterns present another set of variables that can effect the boundary.²⁵ As the ecotone evolves over time, it influences the organism it supports to adapt or evolve themselves. The more an environment is characterized by rapid change, that can happen at fast or slow temporal scales, the more it can sustain a diverse population of organisms, species and biological systems.

The architecture intends to become an ecotone to mediate and strengthen the connection

between the constructed environments of the city and Nature by containing elements that are conducive to both ecologies. As an adaptable scaffolding structure, the architecture is in constant negotiation, drawing new boundaries and enabling dynamic relationships between the city and Nature.

NATURE OF THE SITE //

The Natural History of the Site

The Don Valley and River with the surrounding Ashbridge's Marsh have been shaped over thousands of years by natural forces acting on the landscape. Continental drift, changes in climate, flooding and erosion have had lasting impacts on the major features that define the Toronto region. Although the geomorphology of the site does not strongly inform the project, it is important to understand the natural forces that have had and continue to have an impact on the transformation of the Don Valley, Ashbridge's Marsh and Toronto harbour.

The geology of Toronto begins at a depth of four hundred meters with a solid foundation of bedrock – the unexposed Canadian Shield. Above this is 300 to 350 meters of layers of ancient rocky sea-bottom, topped with a thin layer of glacial till consisting mainly of clay-silt and sandy-silt soils tens of meters thick deposited by retreating ice-shields during interglacial periods stretching over 120,000 years.²⁶ The Don Valley formed at the end of the Wisconsinan glaciation as the Laurentide ice shield retreated northward approximately

Figure 009 // Topographic map of Toronto

This topographic map depicts major landscape features of prehistoric Greater Toronto Area with the Don River network at its centre.

12,000 years ago [Figure 009]. As the ice shield melted, large amounts of fresh water emptied into Lake Iroquois (prehistoric Lake Ontario) eroding the deposited glacial till to form the beginnings of the Don Valley.²⁷ Water rose 40 meters above the current water level, as a result, the shoreline stood further inland leaving much of what would be Toronto underwater.²⁸ A thousand years later, the St Lawrence River formed, connecting Lake Iroquois to the Atlantic Ocean dropping water levels 100 meters and relocating the shoreline 20 km south from the current location.²⁹ Exposed land quickly became vegetated as a boreal forest populated the landscape. Rising temperatures allowed for a mixed forest as southern species like Eastern White Pine, Sassafras, Speckled Alder, Red Maple, Eastern Hemlock and Willows were able to extend their range north.³⁰ Established communities of oak trees, prairie grasses and multitudes of wildflowers could be found at the mouth of the Don River – all maintained by naturally occurring wild fires.³¹

As the lake approached its current water level, about 3,000 years ago, the Don River was continuously modified as fluctuating water levels deposit sand and gravel on its banks straightened its course and rising water levels flooded lower parts of the river valley.³² Simultaneously, sediment discharged from the river and sediment drifting westwards from the erosion of the nearby Scarborough Bluffs formed sand banks at the mouth of the river.³³ The force of waves sculpted these banks into the Toronto Islands and Ashbridge's Marsh, the largest trapped wetland on the shores of Lake Ontario.³⁴ The river flowed through

Figure 010 // Toronto shoreline and Ashbridge's Marsh before human occupation

Ashbridge's Marsh before entering Lake Ontario. [Figure 010] The marsh presented a highly dynamic boundary between land, river, marsh and lake. It facilitated structural and functional landscape connectivity as a land-water ecotone.³⁵

Human Occupation

The earliest signs of human habitation in the Toronto region date back approximately 10,500 - 11,000 years ago when nomadic hunters travelled to the sub-arctic landscape of Ontario in search of big game animals such as caribou, mammoths and mastodons.³⁶

The earth provided them with ample resources to survive and they adapted to their natural environment without any need of modifying it.³⁷ This mutual relationship with Nature

changed with the introduction of agriculture. By 1,400 years ago corn, beans, squash, sunflowers, and tobacco were introduced into Ontario from the south.³⁸ At this time,

indigenous groups began to modify the natural features of the landscape to yield healthy crops and constructed permanent structures as they abandoned their nomadic lifestyle.³⁹

Their shelters were constructed with raw local materials such as earth, mud, stone, wood and vegetable fibres: so when these structures were abandoned they return back to the earth.⁴⁰

Figure 011 // Palisaded Huron-Iroquois Village with Longhouses.

Around 700 years ago Iroquois groups from southern Ontario systematically relocated their villages [Figure 011] every 10 to 20 years as their longhouses began to deteriorate, fields turned sterile and local, natural resources depleted. After being abandoned, parts of the

Definition // Entropy

The degree of disorder or uncertainty in a system.
A process of degradation or running down or a trend to disorder. [Merriam-Webster Dictionary]

longhouse were salvaged while the rest of the village was left to return to Nature.⁴¹ As time and **entropy** reclaimed the constructed, an ecological balance was restored at the site of the former village. The fields that had once been cleared and tended quickly regained its fertility and regenerated into the rich primitive forest.⁴² Through building, the Iroquois changed the local environment but Nature maintained control over the landscape. Left to its devices, Nature finds a way to heal. Slowly people became more effective at subtly modifying their environment in the construction of shelters or in the creation of cropland but never did they have the ability to fully transform the ecosystems around them.⁴³

CULTURE + TECHNOLOGY //

This research is interested in the 'essential boundary' that differentiates the natural and human worlds. Although Homo sapiens is a natural species, it is the emergence of culture as a biological adaption (already present in the earliest homo sapiens) that has created this essential distinction and making humans peripheral to Nature.⁴⁴ Cultural evolution is more rapid than genetic evolution hence humans influence the landscape quicker than other organisms can adapt.⁴⁵ It accelerates our temporal scale, hence it is seen as unnatural because it defies Nature's speed.⁴⁶ Technology is the most boundary-defining manifestation of culture as it has the most impact on Nature as we use it to transform its features. It is arguable that "human activity becomes unnatural when it involves technology" as it allows the user to achieve tasks that their physical body cannot achieve alone or as efficiently.⁴⁷ This

paper does not fully agree with this statement because there must be line drawn between basic technological advancements that helped humans survive - basic shelter and hunting/gathering tools and technology invented for ease and efficiency - plowing machines and transportation infrastructure.

In respect to the history of the Ashbridge's Marsh, prior to colonization the Iroquois used tools that caused only limited impact on the landscape. The materials they used eventually deteriorated and returned to the earth. Alterations to the landscape became more destructive with more recent innovations in technology. Once the inhabitants understood how to change their environment with agriculture, farming or architecture, the natural landscape of the Don Valley and Ashbridge's Marsh would begin to fade away under constructed environments. It is the Anthropocene that marks the turn from a world of regional human intervention to a world of global human intervention.⁴⁸ To what degree is Nature left to exist in the Anthropocene if humans have evolved as a major force on Earth? Does Nature only exist as a combatant against our relentless need for control? Our separation with Nature is physical, spatial and temporal with culture and more specifically, technology, at the root of this division.

NOTES //

1. A. V. Miller, *Hegel's Philosophy of Nature* (Oxford: Clarendon Press, 1970), 4.
2. Ibid, 20.
3. Ibid, 5.
4. Richard A. Fortey, *Life: A Natural History of the First Four Billion Years of Life on Earth* (New York: Alfred A. Knopf, 1998), 51.

5. Ibid, 62.
6. Beth Dempster, "Boundarylessness: Introducing a Systems Heuristic for Conceptualizing Complexity" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 102.
7. Ibid, 102.
8. Micheal Pawlyn, *Biomimicry In Architecture* (London, UK: RIBA, 2011), 58.
9. Beth Dempster, "Boundarylessness: Introducing a Systems Heuristic for Conceptualizing Complexity" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 104.
10. C. S. Holling, "Cross-scale Morphology, Geometry, and Dynamics of Ecosystems." *Ecological Monographs Vol. 64 No. 4* (1992), 449.
11. J. Baird Callicott, "Lamarck Redux: Temporal Scale as the Key to the Boundary Between the Human and Natural Worlds" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 24.
12. Irene J. Klaver, "Boundaries on the Edge" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 122.
13. J. Baird Callicott, "Lamarck Redux: Temporal Scale as the Key to the Boundary Between the Human and Natural Worlds" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 24.
14. Micheal Pawlyn, *Biomimicry In Architecture* (London, UK: RIBA, 2011), 1.
15. A. V. Miller, *Hegel's Philosophy of Nature* (Oxford: Clarendon Press, 1970), 24.
16. Stephen Jay Gould, *I Have Landed: The End of A Beginning in Natural History* (Cambridge, Massachusetts: Belknap of Harvard UP, 2011), 227.
17. Beth Dempster, "Boundarylessness: Introducing a Systems Heuristic for Conceptualizing Complexity" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 97.
18. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 153.
19. Ibid, 153.
20. Irene J. Klaver, "Boundaries on the Edge" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 113.
21. Ibid, 120.
22. Charles S. Brown, "An Introduction to the Problem of Boundaries in Ecological Theory and Practice" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), ix.
23. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 152.
24. Ibid, 152.
25. Irene J. Klaver, "Boundaries on the Edge" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 123.
26. Frank Remiz, "Toronto's Geology." (Toronto Field Naturalists, Toronto, 2012), 5.

27. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 154.
28. Carl Benn, "The History of Toronto: An 11,000-Year Journey," City of Toronto. 2006. Accessed: October 21, 2014. <http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=11552118b7412410VgnVCM10000071d60f89RCRD>.
29. Ibid.
30. Frank Remiz, "Toronto's Geology." (Toronto Field Naturalists, Toronto, 2012), 6.
31. Ibid, 6.
32. Ibid, 6.
33. Michael Moir, "Planning for Change: Harbour Commissions, Civil Engineers, and Large-scale Manipulation of Nature" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 31.
34. Frank Remiz, "Toronto's Geology." (Toronto Field Naturalists, Toronto, 2012), 6.
35. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 162.
36. Carl Benn, "The History of Toronto: An 11,000-Year Journey," City of Toronto. 2006. Accessed: October 21, 2014. <http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=11552118b7412410VgnVCM10000071d60f89RCRD>.
37. Javier Senosiain, *Bio-Architecture* (Oxford, England: Elsevier Ltd, 2003), 61.
38. Carl Benn, "The History of Toronto: An 11,000-Year Journey," City of Toronto. 2006. Accessed: October 21, 2014. <http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=11552118b7412410VgnVCM10000071d60f89RCRD>.
39. Ibid.
40. Javier Senosiain, *Bio-Architecture* (Oxford, England: Elsevier Ltd, 2003), 68.
41. Carl Benn, "The History of Toronto: An 11,000-Year Journey," City of Toronto. 2006. Accessed: October 21, 2014. <http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=11552118b7412410VgnVCM10000071d60f89RCRD>.
42. George Perkins Marsh, *Man and Nature*, ed. David Lowenthal (Seattle, Washington: University of Washington Press, 2003), 30.
43. Paul J. Crutzen, Will Steffen and John R. McNeill. "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?," *Ambio Vol. 36, No. 8* (2007), 614.
44. J. Baird Callicott, "Lamrack Redux: Temporal Scales as the Key to the boundary between the human and natural worlds" in *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*, eds. Charles S. Brown and Ted Toadvine (Albany, New York: State University of New York Press, 2007), 21.
45. Ibid, 33.
46. Ibid, 33.
47. Paul L. Angermeier, "The Natural Imperative for Biological Conservation" in *Conservation Biology Vol. 14 No. 2* (2000), 374. Doi:10.1046/j.1523-1739.2000.98362.x.
48. Paul J. Crutzen, Will Steffen and John R. McNeill. "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?," *Ambio Vol. 36, No. 8* (2007), 614 - 615.

002 //

PART TWO - ANTHROPOCENE

1800 - PRESENT

// ANTHROPOCENE // noun //

Geologic chronological term for an epoch that begins when human activities have had a significant global impact on the Earth's ecosystems.

"When humans built for the first time, the face of the earth changed" - Senosian

Figure 012 // Toronto Skyline and Smog, 1912.

THE ANTHROPOCENE //

The Anthropocene is a proposed geologic epoch that marks a period of time which humans have had a significant impact on the Earth's natural ecology and geography.¹ Suggested in 2000 by Paul J Crutzen and Eugene Stoermer, the Anthropocene is a new period starting with the European Industrial Revolution, when global changes as a result of human activity became noticeable.² Even though technology existed before the European Industrial Revolution, as seen in **Part One**, it is at this period in time that advances to technology accelerated exponentially and has, since, continued to development at an unprecedented rate. The development of more sophisticated technology has empowered people to inflict ever greater influence on Nature. D.W. Meinig describes the consequence of the Anthropocene in *The Beholding Eye: Ten Versions of the Same Scene*, he writes, "What we see before us is man continuously working at a viable relationship with nature, adapting to major features, altering in productive ways, creating resources out of nature's materials; in short, man domesticating the earth."³

We currently live in the Anthropocene as our social, cultural and economic activities continue to impose global transformations that rival some of Nature's geological forces in our impact to the Earth and its systems.⁴ Key contributing factors in the Anthropocene are global population growth, exploitation of natural resources and environmental services, dependence on fossil fuels, land use change and urbanization.⁵ The transformation of the Don River

mouth and the 'unproductive' Ashbridge's Marsh into a post-industrial port land no longer able to support a healthy ecosystem highlights our destructive power in the Anthropocene.

ANTHROPOGENIC SITE //

Early Port Settlement

Toronto, like most European settlement in North America, began at the water's edge, where naturally sheltered harbours offered essential protection to water-borne vessels. Access to a regional network of waterways could stimulate the exchange of staples and manufactured goods.⁶ It was the favourable landscape features of Ashbridge's Marsh, the north shore and islands that pioneer, Joseph Bouchette, described in 1831 as similar to the "untamed aspect which the country exhibited when [he] first entered the beautiful basin, dense and trackless forests lined the margin of the lake, to the east, the Don River meandered into marsh [Figure 013] of almost 525 hectares, entering the bay through a cut in the sandbar running from the north shore to the oblique peninsula that separated the bay and wetlands from Lake Ontario".⁷

Figure 013 // Ashbridge's Marsh, 1909.

Definition // Port

Boats require an infrastructure of wharves, quays, cranes, and yards that became a port, an area where ships could be loaded or unloaded, tendered, repaired, and berthed when not in service. (Moir, 23)

Since Toronto's early history as a lakeside trade post at the turn of the 19th century, there has been a need to control Nature's influence on the landscape surrounding the harbour that was essential for commercial growth, as shifting sand shoals threatened ship navigation in and around the **port**.⁸ It became apparent that the inherent dynamism that shaped the

harbour's landscape was directly at odds with attempts to stabilize the waterway and land allocated for the production and transportation of goods.⁹ This led to the creation of several bodies entrusted with the harbour's maintenance and improvement. They implemented a series of breakwaters to control the accumulation of silt and sand as well as coordinated systematic dredging to maintain water depths within the inner harbour.¹⁰

Figure 014 // Dredging boat depositing material on Ashbridge's Marsh sandbar, 1890.

Accrued silt and material from active dredging was placed along the lakeshore in hopes to reverse signs of land erosion [Figure 014]. This was the first evidence of a sharpening of the land-water boundary.¹¹ As the original settlement expanded towards the Don River and Ashbridge's Marsh, a piecemeal of docks, wharfs and quays began to populate the edge of the water in order to facilitate the service of boats. As marine technology advanced, the size of ships grew and the port evolved to accommodate these larger ships.¹²

Arrival of the Railway

The arrival of the railway in the 1850's accelerated the ad hoc evolution of the North shore as wharfingers, shipbuilders, ferry operators, lumber and coal yards competed for the creation and use of new waterfront property.¹³ Proximity to industrial amenities such as fuel supplies, warehousing, cranes and connections between land and marine transportation networks made the central waterfront a desirable and strategic location to establish new industry. By the end of the 19th century, urban growth forced the city's boundaries to encroach on

Figure 015 // Dock wall in construction, 1912.

Figure 016 // Aerial View Looking Northwest from the Inner Harbour, 1921.

established communities that surrounded Toronto and the railway that was once the bloodline of a growing economy was now seen as a plagued infrastructure that tied up streets and remaining vacant land.¹⁴ The only solution to alleviate the pressure from the railway seemed to encroach further into the Toronto harbour with new land. By 1912, the lower Don River no longer presented a limit to human activity. The river's course was straightened, its marshy flood plains were filled and bridges connected the city eastward to undeveloped land along the north perimeter of Ashbridge's Marsh.¹⁵

Landfilling Ashbridge's Marsh

Seen as an unproductive expanse of wetland and the source of an impending Cholera outbreak due to over-pollution and a lack of water circulation, Ashbridge's Marsh presented an opportunity for the creation of a modern deep-water port.¹⁶ Ashbridge's Marsh was lost to sequential landfilling between 1914 and 1920 to create stable land to support new industrial infrastructure. The lower Don River was redirected into the Keating Channel before entering lake Ontario. The following maps depict the land transformation and industrial activities along Toronto's waterfront and port lands since 1818.

1851 //

LANDFILL m2 //

TOTAL LANDFILL m2 //

POPULATION //

000 000 650

000 000 650

000 030 000

LEGEND //

- Existing Land //
- Wetlands //
- Constructed Land //
- Buildings //
- Railway Tracks //

1884 //

LANDFILL m2 //

TOTAL LANDFILL m2 //

POPULATION //

000 127 286

000 127 746

000 065 085

Gooderham and Worts Distillery //

LEGEND //

- Existing Land //
- Wetlands //
- Constructed Land //
- Buildings //
- Railway Tracks //

Figure 017 // Ashbridge's Bay Looking West, 1920.

// Keating Channel

The course of the Don River has been redirected many times since early European settlement, the first of which was as a defensive measure during the American invasion of 1813. A constructed channel disconnected the sandbar from the mainland, which allowed the river to empty directly into Toronto harbour rather than dispersing through Ashbridge's Marsh. By the 1890's, Ashbridge's Marsh had become over polluted as it collected sewage, industrial and animal waste and the Don River no longer provided the marsh with fresh water. Because of rising health concerns a second channel was constructed through the sandbar and along the northern edge of Ashbridge's Marsh to provide adequate water circulation to the marsh. It was constructed from 1893 to 1895 with sheet piling and dredging. In 1915, the Channel was widened and its banks reinforced with concrete to allow the Don River to be diverted into the channel. Today the Keating channel is considered a historical character defining element of the port lands that must be maintained. [Desfor, 2011: 28, 44, 164]

Erasing Ecotones and Sharpening Boundaries

There are two major changes that occur to land-water ecotones when its landscape is dominated by human intervention. The first change manifests as networks of transportation, infrastructure and land use generate socio-economic divisions that fragment existing terrestrial habitats. These networks lack any consideration for how natural flows operate within the same landscape. In addition, they are located along the land-water ecotone increasing the distance between terrestrial and aquatic ecosystems. Second, is that the properties of these boundaries change. We tend to solidify boundaries by sharpening ecotones into static, rectilinear edges [Figure 017] essential in supporting economic connections. ¹⁷ The **Keating Channel** is a product of sharpening the land-water boundary.

These changes ultimately effect how organisms and their associate systems interact across the landscape boundary. It alters bio-physical and human flows as well as impedes new ones from developing naturally. ¹⁸ In respect to Ashbridge's Marsh, what was an evolving and dynamic sandbar that defined the boundary, continuously moulded by the force of waves and offering opportunity for organisms to thrive, was now a static, impenetrable barrier that offered no new opportunity in its unchanging stability against natural forces. The amount of hard land-water boundaries more than doubled from the infilling of Ashbridge's Marsh [Figure 018] which further obstructed the transfer of materials from water to land and was responsible in creating a poor biodiversity. ¹⁹

001

EXISTING SYSTEM //

FLOATING EXCAVATOR

NET CAPACITY / 64M³ / 10s

Figure 018 // Dredging of Keating Channel, 1914.

New Technologies such as excavators made possible the large-scale transformations of the Don River and Ashbridge's Marsh. "Deck walls outlined linear boundaries creating regular geometric shapes consistent with the proposed grid pattern of streets behind which solid land was to be created to facilitate manufacturing, warehousing and commercial sites." [Desfore, 2011: 66] This calculated transformation of land was rectilinear and gridded so that the industrial infrastructure and machines could operate efficiently on site. Nature's contours had very little influence on the infilling of land as a rigid linear geometry was imposed over the varied curves of the site. Is it possible to reintroduce the varied curves or gradients of Nature back into the site while maintaining the functional grid?

Ashbridge's Marsh //

Keating Channel //

1947 //

LANDFILL m2 //

000 578 736

TOTAL LANDFILL m2 //

001 596 318

POPULATION //

001 176 622

Victory Soya Mills //

Imperial Oil Limited //

Texaco Canada Limited //

LEGEND //

- Existing Land //
- Wetlands //
- Constructed Land //
- Buildings //
- Railway Tracks //

VICTORY SOYA MILL

Figure 019 // Victory Soya Mill Silos

The Victory Soya Mill silos were constructed between 1944 - 1948 as the largest soybean extraction and processing plant in Canada. Made entirely of concrete, the silos functioned like large urban grain elevators, storing the annual production of soybeans consolidating the storage from small rural Canadian elevators to be sold to processors or processed on site. The factory itself processed 400,000 to 540,000 tons of soybeans per year into oil for margarine, cooking oil, and protein supplements for livestock feed.

Urban silos are rarely an integral part of the urban fabric. They are typically placed on the edge of the city near railways or, in the case of the Victory Soya Mill silos, near a waterway to facilitate the transportation of goods. Unlike rural elevators, which take their place at the centre of a town, urban elevators have little impact on the arrangement of a city. [Mahar-Keplinger, 1993. 13]

The Victory Soya Mill silos will be explored for potential spatial and functional opportunities in engaging the existing constructed environment of the site. There are four components of a grain elevator: work floor, storage bins, distributing floor, head house. These will be converted to support new systems and programs within the site. The work floor will be used as a community centre, storage bins will be used to contain aquaponic and water storage systems, while the distributing floor and head house will be used as a communication centre that manages all systems on site.

Figure 020 [left] // View of silos from Queen's Quay East.

Figure 021 [right] // Victory Soya Mill during production, 1947.

1957 //

LANDFILL m2 //

000 164 016

TOTAL LANDFILL m2 //

001 742 752

POPULATION //

001 824 481

LEGEND //

- Existing Land //
- Wetlands //
- Constructed Land //
- Buildings //
- Railway Tracks //

THE PORT LANDS TODAY //

Port lands are described by Gordon Jackson in *'The History and Archeology of Ports'* as a rarity "in the world of modern redundant industry" that "are quite so vast, solid and impressive as docks and their related works. They look, for the most part, as if they have always been there and always will be"²⁰ Port lands provide stable land for industrial operations and their related activities. It is landfilling and the construction of dock walls to contain the land that makes ports so solid and anchored into the landscape. By encompassing the land, the dock

Figure 022 // Former Site of Victory Soya Mills, North Shore, 2011.

The post-industrial landscapes of the north shore and the Toronto port lands have remained vacant since industry has moved away from the waterfront and closer to highway transportation in order to facilitate the transportation of goods. Now that the industry has left the site there are pressures to develop the waterfront land along Lake Ontario and the Toronto harbour.

walls separate land from water with a hard boundary. It enables natural forces of the waves from destabilizing the port land. The current hard land-water boundary has encroached into the Toronto harbour by approximately eight hundred meters from its natural location prior to human intervention. Landfilling continued until the mid 1950's at the height of industrial activity in the port lands.

The port lands need to be remediated as contaminations in the soil are above healthy concentrations.²¹ Soil contamination in the port lands emerged from three major sources: industrial and storage facilities, dumping of waste materials and fill material used in the construction of land. The contaminated soils vary between 2m and 6m in depth. Infill materials include cinders, tar, wood, brick and other industrial by-products. In addition to these solid infill materials there may exist buried remnants of industrial structures within the site's landmass such as the National Iron Works, the Toronto Iron Works, and the Toronto Ship Building Company.²² Heavy industrial activity from the British American Oil (1913), Victory Soya Mills (1948 - 1991), National Iron Works, Toronto Iron Works and numerous oil-holding facilities on site have elevated the presence of contaminants in the soil. Contaminates in the soil include metals, polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons (PHCs), volatile organic compounds (VOCs) (including chlorinated solvents), and general chemistry parameters.²³ These contaminants are present at relatively shallow depths due to the site's high water table.²⁴

Cultural Landscape

The Toronto port lands and former Ashbridge's Marsh is a cultural landscape. There is no longer any indication of the natural landscape that once characterized the site, the gradient of a marsh ecotone connecting water and land ecosystems, rather, the expanse of land has been infilled and segregated, characterized by cultural, industrial and transportation infrastructures such as the Gardiner expressway, the Victory Soya Mill silos and the Keating Channel as remnants of its past as a heavily industrial site. As a result of this industrial activity the site is currently in an ecological disequilibrium. Moving forward, this thesis considers the cultural elements that define the site and its history as important infrastructures to be integrated into the project. The following figure [Figure 023] examines the existing cultural elements and their contribution to the development of the site in the Anthropocene. In **Part Three** the project seeks to conserve and integrate these constructed elements into the project as abiotic infrastructure that will support new programs and systems. They will become part of the ecotone structure although they will remain static.

CONSTRUCTED ELEMENTS

Gardiner Expressway //

Began as a public esplanade in the 1840's which created a separation between industry along the waterfront to the south and commercial and residential activities to the north. Built as an elevated expressway in 1964.

Railway Tracks //

Built in the 1850's, Toronto's first railway corridor connected the city to an expanding network of quick land transportation allowing the movement of goods and people in and out of the city's core. Between 1925 to 1930 major portions of the railway were elevated via a series of viaducts constructed from soil berms. [Desfor, 2011: 12]

Victory Soya Mill Silos //

Constructed Landmass //

Made from infill material and dredging. Is now contaminated from heavy industrial activity.

Keating Channel //

Don River Water //

s very little aquatic habitat that exists along the constructed edge and the quality of water is poor due to sediment. As the surrounding watershed of the Don River has become more urbanized, particularly in the 40's and 50's, larger amounts of silt and debris collect in the Keating Channel and need to be systematically dredged. [Desfor, 2011: 28]

Figure 023 // Constructed Infrastructure of the Site

PORT-LANDS REDEVELOPMENT//

Figure 024 // Master Plan proposed by Michael Van Valkenburgh Associates, 2010.

Figure 025 // Proposed Don River Mouth, Looking North-west, 2010.

With support from the City of Toronto and the Provincial and Canadian governments, Waterfront Toronto was created in 2001 to lead the revitalization of Toronto's waterfront area and port lands. Their largest initiative, the Lower Don Lands redevelopment [Figure 024], is a proposal to revitalize Toronto's port lands into a new sustainable community focusing on the integration of the natural and urban fabric.²⁵ The first community to be developed in this masterplan is the Keating Channel Precinct plan located north of the Keating Channel at the former site of the Victory Soya Mill.²⁶ This development relies heavily on the re-naturalization of the mouth of the Don River through the heart of the existing port-lands as a way of restoring the soft land-water ecotone [Figure 025].²⁷ The construction of 1000 meters of new river channel will generate 13,000 square meters of new coastal wetland and aquatic habitat, 4,000 square meters of terrestrial habitat and provide flood protection to 240,000 square meters of land.²⁸ The proposal aims to remediate the site of all contaminants via soil washing and the construction of a new river mouth will generate the requirement of mechanical management and processing of 2,000,000 cubic meters of contaminated soil.²⁹

If the goals of the development are to integrate nature with the urban fabric, then the architecture and the existing industrial infrastructure on the site should be engaged in the processes of remediation and naturalization. Unfortunately, in the current proposal, the remediation, re-generation and re-naturalization of the site are separate processes from the architecture, which is constructed

Figure 026 // Aerial of lower port lands looking west, 1959.

Figure 027 // Aerial view of Lower port lands after proposed naturalization, 2010

only when the land is considered healthy. This thesis argues that the proposed landscape will be no more natural than the current condition of the site because of the level of artifice, prescription and maintenance to create the desired form and arrangement that most people associate with a healthy landscape found in Nature. This thesis argues that this proposal does not re-establish Nature, but a sanitized nature typical of urban environments, devoid of the processes and systems that enables Nature to systematically evolve over time. This is the nuance that the thesis attempts to create within the project.

The current proposal and its fixed architecture will not adjust or innovate with emerging technological / environmental development. Because of the scale of their proposed project, they are typically out-of-date by their completion.

This thesis creates an architecture that is dynamic and can evolve over time as mechanical systems and associated technologies improve. The open frame structure allows for programs, mechanical system or biological systems to be added, improved or replaced. In addition, the series of standardized parts that make up the structure ecotone present a wide variation of spatial configurations that meet the changing needs of the programs and systems.

The proposed architecture and landscape by Waterfront Toronto will remain disconnected as the static boundaries of the architecture will not engage with any processes that may flourish within

PROPOSED //

LANDFILL m2 //

000 020 000

TOTAL LANDFILL m2 //

001 762 752

POPULATION //

002 615 060

LEGEND //

- Existing Land //
- Wetlands //
- Constructed Land //
- Buildings //
- Railway Tracks //

the landscape over time. In addition, it does not bring the environmental ethos to the architecture. Much like how we perceive the city as a human-made object on a field of nature, the architecture is considered as an object on the land.³⁰ In contrast, this thesis considers the architecture of the project as a gradient boundary that is connected to the land and water as part of the ecosystem. The next section explores how architecture can accomplish this connectivity as it manifests as an ecotone. ecotone.

ARCHITECTURE AS ECOTONE //

Conventional architecture, fixed and static in function, can not connect with the dynamics of Nature and its processes. If the architecture aims to rehabilitate the ecological equilibrium of the site over a long period of time it must be able to adapt to the biological systems as they evolve. In order to connect the constructed environment with Nature this project defines the elements in architecture that will remain as constructed and which elements can easily implement biological systems. In the following section the thesis examines a number of theories of architecture and takes a cursory glance at a number of precedents in order to formulate how architecture as ecotone may begin to operate.

Separation of Structure and Services

This project begins with a division in architecture that separates structure from mechanical or environmental services, a concept introduced by Reyner Banham in the mid-20th century.

He stated in his book, *Architecture of the well-tempered environment* that architecture should “express the difference between structure, which is suppose to be permanent, and the services, which are hoped to be transient”.³¹ Banham’s concept has influenced the project to distinguish a division in the architecture as **structure**: distinctively constructed and something that will inevitably impose some level of separation between people and Nature, and **services**: that present a wide range of constructed and biological systems that exist within the structure. The former will be explored as a constructed abiotic structural ecotone while the latter as a series of entities varying from constructed, natural and hybrid supported by the ecotone.

Structure

The ecotone structure must contain elements that are conducive to both Nature and the constructed environment in order to sustain each within the gradient of the structure. It offers a physical environment that promotes connectivity and facilitates the movement of materials and resources exchanged between systems. It is a rectilinear standardized system so that it can be implemented into the existing infrastructure of the Toronto port lands while at the same time be adaptable and dynamic in the way that it can easily be transformed or modified as Nature evolves on the site.

Figure 028 // The Plug-In City By Peter Cook of Archigram. 1964 .

The City Interchange, a space-grid megastructure, gives form to the layers of exchange whether of energy, goods or services while providing necessary circulation, transportation and infrastructure to the city. Units that cater to needs and programs are placed into the space-grid. They are planned for obsolescence as new technologies will inevitably affect the way people live. The plug-in system, supported by a series of cranes to maneuver the unit, offers a transformation of certain program while maintaining the over-all essential network. In this society, the architect's responsibility is to provide a framework that encourages and supports a transfer of control over the environment to the individual. Oblique connections in the megastructure minimize hierarchy and decentralizes information into a true network. [Hadas, 2009: 182, 185]

To have a symbiotic relationship with Nature, the structure must be explored as a dynamic ecotone - one of standardized, moveable and interchangeable parts.³² This will allow it to evolve over time in response to Nature's needs as they change through time. Firstly, by supporting biological systems in the remediation of soil and water to restore the ecological equilibrium of the site and second, to sustain healthy and active conditions within the constructed environment for Nature to thrive indefinitely. Through its flexibility, the structure of this project aims to maximize the opportunity for interconnectivity between systems and programs that are artificial or living. The standardized ecotone allows parts of the structure to be reused in a larger system of components.³³

As a dynamic ecotone, this project allows for a diversity of systems, services and programs to inhabit and interact with one another in a multitude of possible connections within the structure - similar to the relationship of organisms and their habitat. Connectivity is essential in creating a symbiotic relationship between Nature and the constructed environment. With connectivity, this project argues, that it can dissolve existing hard boundaries that separate the constructed environment with Nature. Archigram explored such ideas of connectivity in the attempt to break down the conventional boundaries of architecture and technology. The Plug-in City [Figure 026] is a networked conception of society that prioritizes exchange and transformation within a three dimensional grid.³⁴ Although Archigram is very different in that they did not address environmental issues, it is their 'systems thinking' approach of the

Figure 029 // The Plug-In City By Peter Cook of Archigram. 1964.

Figure 030 // Scheme for a modern city by 'Metabolist' Group, 1963.

By creating a clear distinction between fixed and changeable elements, the Metabolist Group often produced large structural cores from which small standardized elements or pods could be attached. [Curtis 1987: 341]

constructed environment as an evolving entity of parts that form a whole and exploring the connection between these parts that this thesis attempts to rectify in the final design.

The Metabolist position was similar to that of Archigram. The Metabolist Group argued that the modern city should be a “dynamic machine of moving and variable parts” that was capable of “meeting the changing requirements of the contemporary age. In order to reflect dynamic reality, what is needed is not a fixed, static function, but rather one which is capable of undergoing metabolic changes”.³⁵ The Scheme for A Modern City [Figure 028], unlike that of the Plug-In City, presented a fixed framework in the form of a circulation core in which a variety of units attach. The function and form of each unit was influenced by existing mechanical and electronic systems.³⁶ By expressing function rather than form, a deeper

understanding of a system's operation and possible connections to other systems was achieved. This research moves beyond Archigram and the Metabolist Group by exploring how biological systems can be incorporated into the evolution of technology and how architecture as a dynamic and evolving entity can facilitate this shift. The dynamism of the architecture will also help the biological systems become Nature by evolving to its needs over time.

While today the field of bio-mimesis, bio-morphism and structural-morphism is topical in architecture, this project takes a parallel approach. While it might touch on topics of mimesis, it is not the focus of the project. Biomimetic design is often associated with the notion that architecture that appears natural is more connected with nature. Unfortunately, this architecture would still have to accommodate for, or restructure entirely, existing technical systems resulting in more necessary control over the system, rather than capitalizing of processes that nature can accomplish naturally.³⁷

In contrast, this thesis recognizes that existing mechanical systems operate within a rectilinear network and that the role of architecture in this project is to facilitate and promote the interaction between systems and the exchange of resources. The focus is to create an adaptable framework where systems can be introduced into the network by connecting to other systems. Flexibility is important in new systems connecting to the network or technological improvements integrating into the existing systems. It prioritizes all systems

within the network by providing flexibility and access for continual maintenance and upgrade. An important goal is to not hinder technological improvements at any scale of system operating within the architecture.

Figure 031 - Typical plan of the Centre George Pompidou, 1971.

Figure 032 // Section of the Centre George Pompidou, 1971.

The Centre George Pompidou by Richard Rogers and Renzo Piano (1971) is an example of architecture that prioritizes a building's systems by exposing them as formal elements of the architecture [Figure 031]. By exposing all building systems on the exterior facade, the repair and replacement of systems become more accessible. The systems themselves were highly designed and custom-built for this specific project. While access to the systems were facilitated to emphasize the notion that they can be rearranged and replaced, the replacement of parts with new standard parts become more difficult. It explores the relationship between a flexible, indeterminate machine-inspired architecture and the changing cultural activities that happen within it.³⁸ The building is designed as a serviceable mega-structure of steel tubes

Figure 033 // Section of the Centre George Pompidou, 1971.

which support an array of mechanical tubes, water pipes, air ducts, maintenance equipment and escalators that are essential in the function of the 'machine à cultiver'.³⁹

Services

"[Richard] Rogers [and Renzo Piano] came to see buildings themselves as constantly changing entities. The aim, he argued, should be 'controlled transformation' - impossible in 'an architecture of total, finite perfection'. Services would wear out or become obsolete many times during the life of the building. The architecture should provide for ease of replacement, with the services clearly separated from the structural elements."⁴⁰ This thinking is parallel to that of Banham. While separating services and systems from the structure prioritizes their accessibility and replacement, they should also consist of standardized components that attach to the structure in such a way that allows one component of the system to be replaced without disrupting the entire system.

Figure 034 // Habitat 67

While there have been numerous opportunities in architecture where customizable or replaceable systems have been designed, these rarely have worked because they are bespoke with one-of-a-kind elements. Habitat 67 by Moshe Safdie (1967) is an interchangeable housing complex of standardized prefabricated living units [Figure 032]. While each unit has a level of variability of their arrangement in an overall structure, the components of services and systems in the unit were embedded into the prefabricated

Figure 035 // Diagram comparing scales in Nature with scale of the constructed environment

Unlike typical biological projects, because integration make it difficult to distinguish parts, this thesis explores the proposal as a series of parts so that it may look at things in isolation and as part of the larger whole simultaneously. By comparing functional scales of Nature with the scales of the existing constructed environment the thesis will generate a symbiotic relationship between the two within the project. By identifying the levels of hierarchy in the constructed environment this thesis explores the many connections that are possible between systems and programs, and using architecture to create and facilitate these connections as an ecotone.

structure making the unit obsolete to any future improvements. For this specific project to evolve, it understands that it will be far more beneficial if the units were constructed from smaller off-the-shelf components and technologies that are accessible to maintenance and replacement than to see the individual units as one bespoke entity. Each service or program can be divided into its components, which are standardized, each component can be replaced with a new one. It is the composition of the materials and technology in the new component that makes it more efficient or more in tuned with Nature than its predecessor.

Structure and Services at the Functional Scales

The previous diagram [Figure 033] outlines the five functional scales of Nature examined in **Part One** and applies these in respect to the structure and services as described by

Banham. The structure is explored as the scale of the habitat and ecosystem while services are explored at the scale of the organism, organ and cell. **Part Three** will present the design project according to these scales.

TECHNOLOGY VS. NATURE //

As we move forward we need to consider that the constructed environment contains hybridized systems of techno-nature.⁴¹ This project uses technology when it is best and biological systems when it is best but they interface in a unique way that optimizes the process that each does most efficiently. Technology is always improving and there are continuous opportunities for technology to engage new ways of operating. This can happen with the replacement of a component with another that is more efficient, either it uses less energy, produces a greater yield or is easier to produce than the component it preceded. This is an evolution of the technology. More frequently, these new components are smart materials, bio-materials or even a living biological system replacing the function of a mechanical part. When technology is improved with a part like a bio-material it could be considered more in tune with Nature than its predecessor. By allowing technology or the constructed environment and biological systems to inhabit the ecotone, the project attempts to create a symbiotic relationship between the two, the ecotone as an adaptable structure will promote the evolution of both technological and biological systems and facilitate connections between them.

Figure 036 // La Tourette Monastery,
Le Corbusier ,1960.

Figure 037 // Siedlung Halen Housing, Atelier 5, 1961.

Figure 038 // National Library of France, 1996

When to leave Nature “be”

This is not about leaving Nature alone, as an isolated reserve - it is about using Nature but also understanding or attempting to understand and define a possible limit for that control, beyond which Nature is allowed to just ‘be’. This is a very difficult position to rectify in a project, which attempts to use biological systems to heal the Toronto port lands. When a biological system has successfully remediated soil and water - when equilibrium has developed - control over the system will be reduced as the biological system is left to become Nature. The loss of control (is not a loss of control) it is an enactment of ‘being’. In sharp contrast, the constructed environment establishes control as well as requires a level of control in its maintenance.

Spontaneous vegetation is important in developing Nature in the project. La Tourette Monastery by Le Corbusier (1960) and Siedlung Halen Housing by Atelier 5 (1961) relied on spontaneous vegetation and self-colonization as tools to generate green roofs with rich biodiversity [Figure 034 + Figure 035]. This was closely linked to ‘ecological correctness’ for the displacement of native species and landscape consumption as a result of urbanization.⁴² More recently, the National Library of France by Dominique Perrault (1996) is another example where Nature is left to exist within a constructed environment as the library encompasses a region of native oak, wild pine and birch trees [Figure 036].⁴³ Spontaneous vegetation offers a removal of human prescription of the type of species that may exist, their location and survival. Such a tool makes it difficult for the designer to predict or anticipate an outcome as organisms are left to find an ecological balance on their own.

NOTES //

1. Paul J. Crutzen, Will Steffen and John R. McNeill. "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?," *Ambio Vol. 36, No. 8* (2007), 614.
2. Ibid, 615.
3. D. W. Meinig. "The Beholding Eye: Ten Versions of the Same Scene." In *The Interpretation of Ordinary Landscapes: Geographical Essays*, eds. D. W. Meinig and John Brinckerhoff Jackson (New York: Oxford University Press, 1979), 35.
4. Frans Berkhout. "Anthropocene Futures," *The Anthropocene Review 2014 Vol. 1* (2014), 154.
5. Ibid, 155.
6. Michael Moir, "Planning for Change: Harbour Commissions, Civil Engineers, and Large-scale Manipulation of Nature" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 23.
7. Ibid, 25.
8. Ibid, 27.
9. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 151.
10. Michael Moir, "Planning for Change: Harbour Commissions, Civil Engineers, and Large-scale Manipulation of Nature" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 31.
11. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 156.
12. Michael Moir, "Planning for Change: Harbour Commissions, Civil Engineers, and Large-scale Manipulation of Nature" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 23.
13. Ibid, 39.
14. Ibid 44.
15. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 162.
16. Michael Moir, "Planning for Change: Harbour Commissions, Civil Engineers, and Large-scale Manipulation of Nature" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 44.
17. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 153.
18. Ibid, 153.
19. Ibid, 167.
20. Gordon Jackson, *The History and Archeology of Ports* (Tadworth, Surrey: World's Work, 1983), 10.
21. Waterfront Toronto, *Lower Don Lands Environmental Assessment Master Plan Addendum & Environmental Study Report* (Waterfront Toronto, Toronto, 2014), 107.
22. Waterfront Toronto, *Keating Channel Precinct Plan*, ed. Michael Van Valkenburgh Associates, Inc. (Brooklyn, New York: Michael Van Valkenburgh Associates, 2010), 29.

23. Waterfront Toronto, *Lower Don Lands Environmental Assessment Master Plan Addendum & Environmental Study Report* (Waterfront Toronto, Toronto, 2014), 107.
24. Hon Q. Lu and Gene Desfor, "Cleaning Up on the Waterfront: Development of Contaminated Sites" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 248.
25. Gene Desfor and Jennifer Bonnell, "Socio-ecological Change in the Nineteenth and Twenty-first Centuries: The Lower Don River" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 307.
26. Waterfront Toronto, *Keating Channel Precinct Plan*, ed. Michael Van Valkenburgh Associates, Inc. (Brooklyn, New York: Michael Van Valkenburgh Associates, 2010), 4.
27. Tenley Conway, "Boundaries and Connectivity: The Lower Don River and Ashbridge's Bay" in *Reshaping Toronto's Waterfront*, eds. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), 173.
28. Waterfront Toronto, "Mouth of the Don River," Waterfront Toronto, Accessed: March 03, 2016, http://www.waterfronttoronto.ca/explore_projects2/lower_don Lands/don_mouth_naturalization_and_flood_protection.
29. Ibid.
30. Bruce Mau, "Design and the Welfare of All Life" in *Design Ecologies: Essays on the Nature of Design*, eds. Lisa Tilder and Beth Blostein (New York: Princeton Architectural, 2010), 24.
31. Reyner Banham, *Architecture of the Well-tempered Environment* (Cambridge, MA : MIT, 1986), 242.
32. J. R. William Curtis, *Modern Architecture since 1900* (Englewood Cliffs, New Jersey: Prentice-Hall Inc, 1987), 341.
33. Monica Ponce de Leon, "Constructing green: Challenging Conventional Building Practices" in *Constructing Green: The Social Structures of Sustainability*, eds. Rebecca L. Henn and Andrew J. Hoffman, (Cambridge, Massachusetts: MIT, 2013), 338.
34. Hadas A. Steiner, *Beyond Archigram: The Structure of Circulation* (London, UK: Routledge, 2009), 182.
35. J. R. William Curtis, *Modern Architecture since 1900* (Englewood Cliffs, New Jersey: Prentice-Hall Inc, 1987), 341.
36. Ibid, 325.
37. Cameron Tonkinwise, "Weeding the City of Unsustainable Cooling, or, Many Designs Rather Than Massive Design" in *Design Ecologies: Essays on the Nature of Design*, eds. Lisa Tilder and Beth Blostein (New York: Princeton Architectural, 2010), 28.
38. Kenneth Powell, *Richard Rogers: complete works* (London, UK: Phaidon, 1999), 10.
39. J. R. William Curtis, *Modern Architecture since 1900* (Englewood Cliffs, New Jersey: Prentice-Hall Inc, 1987), 374.
40. Kenneth Powell, *Richard Rogers: complete works* (London, UK: Phaidon, 1999), 19.
41. Cameron Tonkinwise, "Weeding the City of Unsustainable Cooling, or, Many Designs Rather Than Massive Design" in *Design Ecologies: Essays on the Nature of Design*, eds. Lisa Tilder and Beth Blostein (New York: Princeton Architectural, 2010), 27.
42. Christian Werthmann, *Green Roof - A Case Study* (New York: Princeton Architectural, 2007), 118.
43. Dominique Perrault Architecture, "National Library of France," *Dominique Perrault Architecture*. Accessed: March 29, 2016. http://www.perraultarchitecture.com/en/projects/2465-national_library_of_france.html

003 //

PART THREE - COEXISTENCE

NEAR FUTURE

// COEXISTENCE // noun // ...

The state of existing together at the same time or
in the same place.

COEXISTENCE //

This project explores the opportunities that can be generated from a symbiotic coexistence between people and Nature, either from people using Nature or by simple letting Nature “be”. This is not about tolerance or compromise but it is about collaboration - that is true coexistence. First, to help with the remediation of the land and water to create an ecological balance, then to create a sustainable, less dependant life style and finally to find a equilibrium where people, the constructed environment and Nature can exist in symbiosis. The project manifest at two distinct elements: Ecotone structure and all systems and entities that inhabit the structure. They will be presented in the five scales of functional connectivity discussed in **Part One** and **Part Two**. Each scale will address two key ideas: the relationship of the parts to whole and identifying where Nature is being used as a system and where is left to just “be”.

Ecotone Structure

To pursue a coexistence between the constructed landscape of the site and Nature the project will adapt existing infrastructures and propose an architectural ecotone that can adapt over long periods of time in response to the changing needs of the site's ecology. At its most basic function, architecture provides a stable environment for human activity to occur. The ecotone is a standardized structure that aims to simultaneously support human activity as well as any form of Nature through its ability to adapt and interchange. While a rigid framework, the architecture allows opportunity.

ECOTONE STRUCTURE

Each structural unit comprises of 12 standard crucifix members, each spanning 6 meters respectfully and are connected by one universal structural node. One crucifix member is shared between two to four adjacent units. The standardization of the structure is cost effective and is easily assembled.

Along all three axis of the ecotone are intermediate connection points at 1 meter intervals for the assembly of a secondary structure within the unit. The crucifix profile of the ecotone allows the secondary structure to be installed, modified or completely disassembled in isolation from neighbouring units. The flexibility of the secondary structure within each matrix unit caters to all programs and systems facilitating their function and connection to other systems. It also promotes the replacement of obsolete systems with new systems without disrupting the larger operating network.

Figure 039 // Possible configurations of sub-structure within the ecotone structure

NEW STRUCTURE TYPOLOGIES

A series of new infrastructure typologies are integrated with the existing constructed landscape of the site. These structures are flexible and standardized to achieve maximum adaptability to evolve as needs change. It is this structure that will support program, systems and Nature simultaneously while allowing as many possible interactions to occur between them.

The ground structure allows for future steel components to be added. Concrete circulation cores support the ecotone structure from lateral movement. Circulation cores are essential hence their location at the centre of a building allows the ecotone to soften their boundary.

The looseness of the project is in the interchangeability of parts not an adaptability of the system however, the ecotone is forgiving, it creates a universal scaffold that allows systems and programs to expand and contract without spatially affecting neighbouring systems.

Typical Ecotone //

Open Circulation //

Core Circulation //

Top of Foundation //

Circulation + Services //

Side of Foundation //

Circulation + Services //

EXISTING INFRASTRUCTURE

This project considers the existing structural typologies much like how Nature takes advantage of the abiotic world as a foundation to build up life. The existing infrastructure is adapted to support the connection to new structural typologies to construct dynamic habitats. This set of drawings examines the existing typologies in relationship to the implemented grid. All have the potential to be adapted for new uses. Existing infrastructure can be managed to become more productive. They were built for industrial use therefore they have structural integrity and are suitable for the project's foundation.

Figure 040 // Phytoremediation

Phytoremediation is a biological technology that uses natural plant processes and their associated microorganisms to stabilize and remove contaminants in soil and groundwater. These processes occur at the root structure of the plant therefore it is most effective in treating shallow and low soil contamination levels similar to conditions found on the site. Phytoremediation relies heavily of the process of direct plant uptake which occurs when the plant absorbs water from the soil through transpiration. Once absorbed into the root system, the contaminates are converted into less harmful toxins. [R. Kamath. 2012]

Healing The Landscape

The project begins with the remediation of the site's contaminated soils using phytoremediation: a natural process that occurs at the root of trees and plants. When tree outgrows planter the remediation soil is complete. Roots will spread to all 36 m² of soil in planter. Contamination is present only in root system. On site phytoremediation saves money over alternative methods which require the transportation of large quantities of soil to off-site washing facilities or disposal sites. The phytoremediation panter is the first organism to inhabit the ecotone structure followed by other systems and programs that support the function of the city.

Nature is self-healing and self-organizing. The project allows this to happen by minimizing any constraint enforced on Nature by creating a flexible framework that responds and adapts to current ecological pressures. The 24m by 24m grid markers do not affect the evolution of the landscape. They provide a sense of scale in order to read the landscape.

HEALING THE LANDSCAPE

The constructed landscape is divided into a 6 meter by 6 meter grid of structural piers.

Each quadrant is excavated based on the depth of contamination present within the quadrant. Contamination depths can vary from each quadrant depending on the infill material and the industrial activity associated with each section of soil. The variation in contamination among the site generates a landscape which is left to be shaped over time by natural forces. Lake water is allowed to enter the site where excavation is below current water levels. Within the dynamic landscape, the piers are left in place and become the foundation on which the ecotone structure may attach to. Contaminated soil is removed from the landscape and placed within the structure to be remediated by native plant species. Once the soil is remediated it can be returned to the landscape.

ORGANISM

/ noun / or · gan · ism /

Consisting of one or more cells, is any contiguous living system, such as an animal, plant or bacterium.

SYSTEM / PROGRAM

Once the architecture is identified we begin to populate the existing and proposed architecture with program and systems which will be referred to as organisms. At this scale they are explored in isolation with the technologies and parts that make them up. Technological advancements allow the system or program to evolve, adapt and become more efficient over time.

Building systems and programs operate similar to plant and animal organisms and their dependence on one another is essential. Both require resources to function and generate waste resources as by-products of their operation. These inputs and outputs are identified for each individual organism in order to rectify possible connections with other organisms.

Each system or program is considered as one unit of a larger network rather than systems with open ended framework with ambiguous boundaries. To expand the network, the thesis will add an additional unit as opposed to trying to build in a larger variability from the onset.

PHYTOREMEDIATION PLANTER

The remediation of soil can be done in-situ or by being displaced into remediation planters that inhabit the structure. Plant species are chosen for their ability to treat certain soil contaminants. Once excavated, soil will be tested to identify contaminants present and the biology that will inhabit the container. The biology in each container will reflect the contamination present. Because of the presence of multiple contaminants, there will be a diversity of native plant matter that will support local biodiversity. Nature does not have the power to the most efficient biological system to clean soil therefore the project identifies and prescribes which plants are used in remediation at which time they are left alone to become Nature. Once contaminated soil is cleaned the planter can be re-used and soil returned to the ground.

03-002

ORGANISM //

PHYTOREMEDIATION IN SITU

Soil is not a passive material, it is alive. Communities of bacteria and nutrients accompany plants in their root systems which help remediate the soil.

WATER STORAGE + FILTRATION

Stormwater is collected by the facade system and filtered through natural remediation systems with greywater from sinks and showers before entering the final mechanical cleaning process to generate potable water. The water treatment silos will process enough potable water to sustain the population of the site. The final water treatment can not utilize a biological system in its process due to the level of filtration needed to obtain potable water standards only achieved with a mechanical system.

An integrated floatation device gauges water levels in the silo to determine the source of water needed. When low, the system will extract water from the Keating channel or from another system in the grid to be processed. Water turbines generate additional energy during storm events.

LED AQUAPONIC FARMING

LED aquaponic farming inside the silo operates during all seasons and 24 hours a day in a controlled environment that does not require exposure to natural light. Production rates can be maximized by 40 to 60% compared to standard growing processes in an environment where temperature, humidity, and air circulation to water level and salinity, and light are controlled.

Plant trays configure to the circular shape of silo and a central structural core house the circulation of water and series of purple LED lights to extend vertically in the system.

Each aquaponic systems is connected to a Tilapia fish tank that delivers nutrient-rich water to the plants. Tilapia is a species that thrives in a cultivation environment. [Beatley, 2014: 52-53]

ORGAN

/ noun / or · gan /

A part of an organism that is typically self contained and has a specific vital function.

MACHINE / COMPONENT

A machine or component is an apparatus using or applying mechanical power and comprised of many parts, each with a definite function and together performing a specific task. [1]

First operating to accomplish specific tasks; as more technologies and parts come together they can perform multiple tasks - a system. Over time, as new parts are replaced in a technology it can be considered more biological but will continue to function as a machine – techno-nature.

At the scale of the organ the project explores how parts of constructed technology can slowly be replaced with ones that operate as a biological process. These replacements of parts can be minute but over time but enough small changes to a typical mechanical system will result in a more functional and efficient system that is more in-tuned with Nature. By using standard components, this project allows these changes to be implemented easily.

02-001

ORGAN //

AQUAPONIC COMPONENTS

Settling tank for solids collection and biofiltration (fish waste and ammonia are broken down into nitrates and nitrites). Shallow water culture beds for hydroponic gardening (plants remove nitrates/nitrites from the system). Sump tank with pump pushing clean, aerated water back to fish rearing tank. Nutrient rich water is pumped from the fish farm tank to the aquaponic plants. Purple LED lights provide light for plant photosynthesis.

03-005

ORGANISM //

RESIDENTIAL HOUSING

People in this project Talk about residential unit
High amount of waste generated

Soil remediation is on-going in localized areas to
reduce possible cross contamination with food
produce and minimize contact with people.

03-005

ORGANISM //

RESIDENTIAL HOUSING

02-002

ORGAN //

WALL COMPONENTS

CELL

/ noun / cell /

The smallest, most basic structural and functional unit of a living organism, typically microscopic in size a cell consists of a cytoplasm, a nucleus enclosed in a membrane.

PARTS / TECHNOLOGY

There is an established relationship between technology and its parts. This thesis defines technology as a tool or machine developed from the application of scientific knowledge and is made of smaller parts in order to function. These parts make up the smallest scale of our constructed environment and are assembled in various configurations to produce different technologies or machines. They are easily changed and updated as they continuously evolve from technological or material advancements to be more efficient. Advancements to the part will advance the technology but efficiency will occur in the system as a whole.

Technology and its parts is referred to as cells that come together to create larger, more complex components - the organ. The cell refers to how they are assembled and with what materials.

WALL COMPOSITION

As the wall composition evolves over time to include different exterior surface materials it may attract different species to inhabit the wall system and begin to connect to it. Technological advances in common building materials have implications to larger scales of the constructed environment.

ANAEROBIC DIGESTER

Under a controlled environment, an anaerobic digester optimizes a naturally occurring process of decomposition of organic matter to generate renewable energy. In the absence of oxygen, microorganisms transform municipal solid waste, sewage sludge or organic industrial waste into methane that is converted into electricity and heat.

Residual solids undergo a drying process before it is used locally as a natural compost. This system helps to divert organic waste from landfill sites, it generates clean renewable energy while restoring natural nutrients in the soil.

03-007

ORGANISM //

FLOATING WETLAND

Floating Wetlands extend the landscape of the waterfront past the constructed edge of the Keating Channel. They offer an opportunity to filter sediment and silt that is generated up-stream. The constructed edge of the Keating Channel offers little habitat for native species of fish. By introducing native vegetation near / in the water, the project aims to re-instate the ecological balance and biodiversity in the water.

Organic beds can be removed in isolation to adjust as needed.

LIVING WALL

Over time, connections between organisms are explored spatially in addition to serving as functional linkages. Advances in 3D printing technology could allow opportunities where pipes and other services are integrated into a living wall system that acts as an extension of the landscape into the ecotone structure. This is where the project breaks free of the grid in order to produce a constructed landscape.

3D printed wall panels can be integrated into the housing units to strengthen the connection of the living wall with other organisms. This is another example where technology allows for greater integration. Large-scale 3D printing is used to construct the living wall network that will support various native species of plants. Made of recycled 3D printed wood, each section of wall consists of 6 individual panels that are assemble together. Control over the shape of the structure will allow for deeper growing medium and promote plant diversity. In addition, by constructing multiple scales of structure simultaneously in the wall system, irrigation and services are embed into the structure. Because it is made of wood, there are opportunities for certain plants and fungi to eat the wood or for roots to penetrate the structure and access water.

Grey water from the housing unit can enter directly into the wall structure and begin the remediation process.

01-002

CELL //

LIVING WALL

001

NEW NATURE //

MUSHROOM

NUTRIENTS / DECOMPOSING WOOD
BENEFITS / ADAPTED TO CLIMATE
HABITAT / SHADY AND DAMP AREAS
GIVES BACK / SPEEDS UP DECOMPOSITION

002

NEW NATURE //

NATIVE PLANTS

NUTRIENTS / SOILS
BENEFITS / ADAPTED TO CLIMATE
HABITAT /
GIVES BACK / WATER FILTRATION

003

NEW NATURE //

HONEY BEES

NUTRIENTS / POLLEN
BENEFITS / POLINATE PLANTS
HABITAT /
GIVES BACK / GERMINATION OF PLANTS

2

70.20

70.20

70.20

Victory Soya Mill Silos //

KEYPLAN //

- 1 - Residential Housing //
- 2 - Soil Remediation //
- 3 - Matrix //
- 4 - Living Wall //
- 5 - Megastructure //

SYSTEMS DIAGRAM

So far the paper has explored the three scales of services and programs as organism, organ and cell and their relationship to each other. Their connections are rectified in this systems diagram in order to produce a closed network. These connections have only been explored functionally. At the scale of the habitat and ecosystem these connections will be explored within the physical landscape of the ecotone structure.

HABITAT

/ noun / hab · i · tat /

The place where an organism lives, which is characterized by its physical, abiotic features and by its biotic characteristics such as the dominant plant type.

ARCHITECTURE / INFRASTRUCTURE

It is at this scale the matrix is explored as a kit of parts to create a scaffolding for programs and systems. It is configured into an architecture where systems and programs are arranged to maximize their efficiency and their inter-connectivity with one another.

At the scale of the architecture, adaptability through changeable structural units will support the organism and encourages possible connections with other organisms. This scale is important in the way that buildings systems and programs interface with one another in a physical environment.

At the scale of the habitat, multiple building systems and programs connected to exchange resources. These connections can happen within close proximity or over large distances. A habitat consists of 16 units.

04-001

HABITAT //

GARDINER EXPRESSWAY

The ecotone attaches to the underside structure of the Gardiner Expressway while not affecting ground level transportation. Water run-off from the expressway is collected and stored underneath the highway to be use during water shortages.

LEGEND //

- 1 - Elevated Gardiner Expressway //
- 2 - Storm water storage //
- 3 - Railway Transportation //

04-002

HABITAT //

GARDINER EXPRESSWAY

The ecotone attaches to the underside structure of the Gardiner Expressway while not affecting groundlevel transportation. Water run-off from the expressway is collected and stored underneath the highway to be use during water shortages.

LEGEND //

- 1 - Elevated Gardiner Expressway //
- 2 - Storm water storage //
- 3 - Railway Transportation //
- 4 - Elevated walkway //

VICTORY SOYA MILLS

Repurposing the structure as a central storage facility in the development will not only honour its history as a grain silo but will take advantage of its impressive engineering. This capacity will be used as an overflow storage of stormwater and wastewater until it can be treated. Community programs will be inserted into the silos to enhance community participation and knowledge of the active systems in their community.

They are maintained as a constructed system because of the required upkeep as an existing constructed environment. Only existing technical systems or hybridized systems of bio-technology will be implemented in the structure. Nature will not be able to thrive in this environment because of the amount of artifice that is required to adapt the silos to the systems. The potential reuse of the silos to support new sustainable infrastructure such as the systems explored in this thesis has been identified as feasible in the Keating Channel Precinct Plan. [Valkenburgh, 2010: 29]

The silos have been a constant interest for the project and have grown in importance in influencing the formal arrangement of the design. They play a major role in the connectivity of the systems on site because of their storage capacity. Each silo contains a storage capacity of 415 cubic meters for a total of approximately 1500 cubic meters.

KEYPLAN //

- 1 - Aquaponics // see page #
- 2 - Water storage and filtration // see page #
- 3 - Anaerobic Digester // see page #

04-002

ECOSYSTEM //

VICTORY SOYA MILL SILOS

The Victory Soya Mill silos are adapted to support the operation of different systems and programs simultaneously. Aquaponics, water storage + filtration systems and anaerobic digesters operate in the controlled environment of the storage bins while public engagement programs operate on the work floor of the structure at ground level. Interstitial space between adjacent storage bins is used for services and other times for fish holding tanks. Because of limits inherent to the structure of the silos, it becomes difficult to create opportunities for Nature to exist in this habitat hence the systems used here are ones that require higher levels of control and artifice to maintain and operate.

Sections of the silo structure are removed to create space for the continued operation and maintenance of the systems.

The work floor located at grade is transformed into a large interior community space to include a museum and community engagement programs.

The distributing floor and head house located above the storage bins will be repurposed as a main control room that will monitor all onsite systems simultaneously to ensure optimal production and communication.

LEGEND //

- 1 - Work Floor //
- 2 - Diving Tank //

04-006

HABITAT //

KEATING CHANNEL

LEGEND //

- 1 - Keating Channel Dock Wall //
- 2 - Contaminated Soil //
- 3 - Elevated Pathway //
- 4 - Excavator + Retaining wall //

KEATING CHANNEL

The Keating channel is transformed into a network of remediation systems. Nature will be used in a series of remediation planters, constructed wetlands and floating wetlands to remediate contaminated soil and water on the site. Once the remediation is complete, certain structural units will be left alone to be enjoyed by people while others will be repurposed for new program and system as needed. Top cap quarantines contaminated soil until remediation of that section begins. The continuous remediation of soil results in a changing landscape.

Floating wetlands provides a first step in reinstating an aquatic habitat for native fish species which was lost in the construction of the channel.

The structure of the Keating Channel is preserved as a constructed edge condition along the water but constructed and floating wetlands begin to blur its presence.

LEGEND //

- 1 - Keating Channel Dock Wall //
- 2 - Constructed Wetland //
- 3 - Contaminated Soil //

TYPICAL GROUND

After more than a century of unchanging conditions, Nature is once again left to shape the landscape. In this Habitat scenario Nature is represented symbolically rather than functionally. Because it is impossible to predict with any accuracy how the landscape will be shaped over time by wind, waves and other natural forces, this project does not seek to represent a desired shape, rather, a conceptual representation of what it may look like.

04-008

HABITAT //

ADDITIONAL HABITATS

Additional explorations reveal a broader set of variations in habitats and new possible connections between organisms within the structure. There are an infinite amount of possible configurations of habitats that could be explored although what is most important to highlight are the set of underlining rules that produce these scenarios.

LEGEND //

- 1 - Seafood Restaurant and Aquaponic Fish Farm //
- 2 - Victory Soya Mill Silos //
- 3 - Public Pool and Water Collection //
- 4 - Residential Housing Core //

04-011

HABITAT //

RESIDENTIAL TOWER

04-012

HABITAT //

BASE OF RESIDENTIAL TOWER

03-005

ORGANISM //

RESIDENTIAL HOUSING

03-008

ORGANISM //

LIVING

03-002

ORGANISM //

GROUND REMEDIATION

2

3

1

4

KEYPLAN //

- 1 - Victory Soya Mill Silos //
- 2 - Restaurant + Aquaponics //
- 3 - Public Pool + Water collection //
- 4 - Downtown Toronto //

ECOSYSTEM

/ noun / ec · o · sys · tem /

A biological community of interacting organisms and their physical environment or habitat. - a complex network or interconnected systems includes all living organisms and their surroundings

MASTER PLAN / CITY

At the scale of the master plan, buildings operate independently from one another. While individual buildings generate their own resources at the scale of the habitat by systems and programs inhabiting the structure, they are interconnected as a part to the whole within the master plan. This can allow buildings to specialize in certain services while receiving other resources from adjacent buildings. The master plan is contingent of neighbouring communities and the greater Toronto area. It responds to changes in the city as the ecotone can expand and be integrated into the existing constructed landscape of the city.

The ecotone connects to larger geographic features of the port lands at the scale of the ecosystem. It becomes an extension of the natural landscape by connecting ecosystems to the surrounding urban centre. Over time, as the ecotone at the scale of the ecosystem will mature, the more the environment will generate greater opportunity through constructed and biological diversity. [Pawlyn, 2011: 54]

05-001

ECOSYSTEM //

SECTIONAL SITE MODEL

05-002

ECOSYSTEM //

SECTIONAL SITE MODEL

05-004

ECOSYSTEM //

SECTIONAL SITE MODEL

05-004

ECOSYSTEM //

SECTIONAL SITE MODEL

CONCLUSION //

Figure 037 // A New Nature

This thesis does not intend to predict its future or produce an absolute outcome. Through architecture, it seeks to create a constant dialogue with Nature and its processes, continuously at work. The architecture of the project is a process - an evolving entity in which the collaboration between people and Nature propel the architecture to adapt to the current socio-ecological pressures of the site. By exploring how the constructed environment, river, lake and people interact in a dynamic and mutual relationship, this thesis has rejected the tradition view of the city as a human-made object on a field of nature. As the project embraces the fundamental principles of Nature, it accepts any outcome that may result from the process, which may offer new, unexpected and unplanned opportunities.

The development of this project since its initial attempt to blur the lines between the constructed environment and Nature revealed a more compelling and fundamental question. Can Nature exist symbiotically within the constructed environment and if so, is it possible to define a specific moment in time when this occurs? In order for Nature to exist in symbiosis with the constructed environment a state of equilibrium must be achieved between the two. This project has attained equilibrium by integrating architecture into the process of healing the site, by rethinking the scales of the constructed environment in order to connect to scales of Nature, and by creating an adaptable architecture. Equilibrium can be achieved when the constructed environment enables people to use technology when it is most efficient and biological processes when it is most efficient.

D.W. Meinig writes gracefully in *The Beholding Eye* that every landscape is a “blend of man and nature. Man makes mistakes, damages nature and thereby himself, but in the long run man learns and nature heals.”¹ If we consider both the definition of Nature and Anthropocene in the context of this statement then the present state of Nature today is a synthesis of global human activities and biological systems responding to these activities. It can be argued that a biological Nature, as described by Hegel, no longer exists because as it has been influenced in some way by humans.

The perpetual state of Nature is continuously evolving. It is capable of healing. This is an important statement as more recently there is an increasing shift to move away from our past as a damaging force and explore how the constructed environment and Nature can exist together for the benefit of both. The solution is not to return and submerge ourselves into a lifestyle similar to our far ancestors nor is it to think of Nature as something that is left in a reserve, conserved from any future human influence. It is by rethinking the boundary between the two as a dynamic threshold that will produce a new type of Nature. A Nature, dissimilar to the current state as a result of human influence, but instead, one which is a result of the conscious effort to reinstate our coexistence.

NOTES //

1. D. W. Meinig. “The Beholding Eye: Ten Versions of the Same Scene.” In *The Interpretation of Ordinary Landscapes: Geographical Essays*, eds. D. W. Meinig and John Brinckerhoff Jackson (New York: Oxford University Press, 1979), 36.

BIBLIOGRAPHY //

- Allaby, Michael. *A Dictionary of Plants Sciences*. New York: Oxford University Press, 2012. Print.
- Angermeier, Paul L. "The Natural Imperative for Biological Conservation," *Conservation Biology* Vol. 14 No. 2 (2000): 373-381, Doi: 10.1046/j.1523-1739.2000.98362.x.
- Banham, Reyner. *A Concrete Atlantis: U.S. Industrial Building and European Modern Architecture, 1900-1925*. Cambridge, MA: MIT, 1986. Print.
- Banham, Reyner. *The Architecture of the Well-tempered Environment*. Chicago, Illinois: The University of Chicago Press, 1969. Print.
- Beatley, Timothy. *Blue Urbanism: Exploring Connections Between Cities And Oceans*. Washington: Island, 2014. Print.
- Benn, Carl. "The History of Toronto: An 11,000-Year Journey." City of Toronto. 2006. Accessed: October 21, 2014. <http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=11552118b7412410VgnVCM10000071d60f89RCRD>.
- Berkhout, Frans. "Anthropocene Futures," *The Anthropocene Review* 2014 Vol. 1 (2014): 154-159, Doi: 10.1177/2053019614531217. Accessed: May 13, 2015.
- Brown, Charles S., Ted Toadvine, eds. *Nature's Edge: Boundary Explorations in Ecological Theory and Practice*. Albany, New York: State University of New York Press, 2007. Print.
- Busby, Peter. "Towards Regenerative Design." *Sustainable Architecture & Building Magazine*, Winter 2015/2016.
- Cook, Peter. *Archigram*. New York: Praeger Publishers Inc, 1973. Print.
- Curtis, J. R. William. *Modern Architecture since 1900*. Englewood Cliffs, New Jersey: Prentice-Hall Inc, 1987. Print.
- Crandell, Gina. *Nature Pictorialized: "the View" in Landscape History*. Baltimore: Johns Hopkins UP, 1993. Print.
- Crutzen, Paul J, Will Steffen and John R. McNeill. "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?," *Ambio* Vol. 36, No. 8 (2007) https://www.pik-potsdam.de/news/public-events/archiv/alter-net/former-ss/2007/05-09.2007/steffen/literature/ambi-36-08-06_614_621.pdf. Accessed: February 03, 2016.
- Desfor, Gene and Jennifer Laidley, eds. *Reshaping Toronto's Waterfront*. Toronto, ON: University of Toronto Press, 2011. Print.
- Fortey, Richard A. *Life: A Natural History of the First Four Billion Years of Life on Earth*. New York: Alfred A. Knopf, 1998. Print.
- Gould, Stephen Jay. *I Have Landed: The End of A Beginning in Natural History*. Cambridge, Massachusetts: Belknap of Harvard UP, 2011. Print.
- Grant, Gary. *Ecosystem Services come to home: Greening cities by working with nature*. West Sussex, UK: John Wiley & Sons, 2012. Print.
- Head, Peter. Peter Head, "Entering the Ecological Age: The Role of the Engineer" ARUP, London, UK, 2008. http://publications.arup.com/publications/e/entering_the_ecological_age_the_engineers_role. Accessed: October 10, 2014.
- Henn, Rebecca L., and Andrew J. Hoffman, eds. *Constructing Green: The Social Structures of Sustainability*. Cambridge, Massachusetts: MIT, 2013. Print.
- Holling, C. S.. "Cross-scale Morphology, Geometry, and Dynamics of Ecosystems." *Ecological Monographs* Vol. 64 No.4 (1992): 447-502, DOI: 10.2307/2937313.
- International Living Future Institute. *Living Building Challenge 3.0*. Seattle: International Living Future Institute, 2014. *Living Building Challenge*. Oct. 2014. <<http://living-future.org/lbc>>.
- Lemon, James. *Toronto since 1918: an illustrated history*. Toronto, ON: James Lorimer & Company, Publishers, 1985. Print.

BIBLIOGRAPHY //

- Mahar-Keplinger, Lisa. Grain Elevators. New York, NY: Princeton Architectural, 1993. Print.
- Marsh, George Perkins. Man and Nature, Edited by David Lowenthal. Seattle, Washington: University of Washington Press, 2003. Print.
- Mazzoleni, Ilaria, and Shauna Price. Architecture Follows Nature: Biomimetic Principles For Innovative Design. Boca Raton, Florida: CRC, 2013. Print.
- Meinig, D. W. "The Beholding Eye: Ten Versions of the Same Scene." In The Interpretation of Ordinary Landscapes: Geographical Essays, edited by D. W. Meinig and John Brinckerhoff Jackson. New York: Oxford University Press, 1979.
- Michael Van Valkenburgh Associates, Inc. "Keating Channel Precinct Plan: Keating Channel, Toronto, Ontario." Waterfront Toronto, Toronto, 2010. http://www.waterfronttoronto.ca/explore_projects2/lower_don Lands/keating_channel_neighbourhood. Accessed: October 21, 2014.
- Miller, A.V. Hegel's Philosophy of Nature. Oxford: Clarendon Press, 1970. Print.
- Pawlyn, Michael. Biomimicry In Architecture. London, UK: RIBA, 2011. Print.
- Powell, Kenneth. *Richard Rogers: complete works*. London, UK: Phaidon, 1999. Print
- Remiz, Frank. "Toronto's Geology." Toronto Field Naturalists, Toronto, 2012. <http://www.torontofieldnaturalists.org/v-resources.htm>. Accessed: October 21, 2014.
- Royal Commission on the Future of the Toronto Waterfront. *Regeneration: Toronto's Waterfront and the Sustainable City: Final report*. Toronto: Minister of Supply and Services Canada, 1992. <http://www.publications.gc.ca/site/eng/9.699883/publication.html>. Accessed: March 03, 2016.
- Steele, James. Ecological Architecture: A Critical History. London, England: Thames & Hudson, 2005. Print.
- Steiner, Hadas A. Beyond Archigram: The Structure of Circulation. London, UK: Routledge, 2009. Print.
- Senosiain, Javier. Bio-architecture. Oxford, England: Elsevier Ltd, 2003. Print.
- Thompson, D'Arcy W., and John Tyler Bonner. On Growth and Form. Cambridge: Cambridge UP, 1961. Print.
- Tilder, Lisa, and Beth Blostein. Design Ecologies: Essays On the Nature of Design. New York: Princeton Architectural, 2010. Print.
- Waterfront Toronto. "Lower Don Lands Environmental Assessment Master Plan Addendum & Environmental Study Report." Waterfront Toronto, Toronto, 2014. http://www.waterfronttoronto.ca/explore_projects2/lower_don Lands/planning_the_community. Accessed: October 21, 2014.
- Waterfront Toronto. "Lower Don Lands Infrastructure Master Plan and Keating Channel Precinct Environmental Study Report: Main Report." Waterfront Toronto, Toronto 2010. http://www.waterfronttoronto.ca/explore_projects2/lower_don Lands/planning_the_community. Accessed: October 21, 2014.
- Waterfront Toronto. "Mouth of the Don River." Waterfront Toronto. Accessed: March 03, 2016. http://www.waterfronttoronto.ca/explore_projects2/lower_don Lands/don_mouth_naturalization_and_flood_protection.
- Werthmann, Christian. Green Roof - A Case Study. New York: Princeton Architectural, 2007. Print.