Co-Habitat: Innovative Solutions for Coexistence between the Human and Non-Human within the Port Lands

by

Janae Rodrigues

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Architecture (M.Arch)

The Office of Graduate Studies
Laurentian University
Sudbury, Ontario, Canada

THESIS DEFENCE COMMITTEE/COMITÉ DE SOUTENANCE DE THÈSE
Laurentian University/Université Laurentienne
Office of Graduate Studies/Bureau des études supérieures

Title of Thesis Titre de la thèse	Co-Habitat: Innovative Solutions for Coexistence between the Human and Non-Human within the Port Lands
Name of Candidate Nom du candidat	Rodrigues, Janae
Degree Diplôme	Master of Architecture (M.Arch)

Department/Program Département/Programme	Architecture	Date of Defence Date de la soutenance	April 15, 2023

APPROVED/APPROUVÉ

Thesis Examiners/Examinateurs de thèse:

Shannon Bassett
(Thesis Advisor / Directeur(trice) de thèse)

Megan Torza
(Thesis Second Reader / Deuxième lecteur(trice) de thèse)

Janna Levitt
(External Examiner / Examinateur(trice) externe)

Approved for the Office of Graduate Studies
Approuvé pour le Bureau des études supérieures
Tammy Eger, PhD
Vice-President, Research (Office of Graduate Studies)
Vice-rectrice à la recherche (Bureau des études supérieures)

ACCESSIBILITY CLAUSE AND PERMISSION TO USE

I, **Janae Rodrigues**, hereby grant to Laurentian University and/or its agents the non-exclusive license to archive and make accessible my thesis, dissertation, or project report in whole or in part in all forms of media, now or for the duration of my copyright ownership. I retain all other ownership rights to the copyright of the thesis, dissertation or project report. I also reserve the right to use in future works (such as articles or books) all or part of this thesis, dissertation, or project report. I further agree that permission for copying of this thesis in any manner, in whole or in part, for scholarly purposes may be granted by the professor or professors who supervised my thesis work or, in their absence, by the Head of the Department in which my thesis work was done. It is understood that any copying or publication or use of this thesis or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that this copy is being made available in this form by the authority of the copyright owner solely for the purpose of private study and research and may not be copied or reproduced except as permitted by the copyright laws without written authority from the copyright owner.

ACKNOWLEDGEMENTS

Thank you to my advisor, Shannon Bassett, for the encouragement and knowledge throughout the thesis. I am grateful for your time and the valuable resources you provided that have supported my thesis.

Thank you to my second reader, Megan Torza, for the helpful comments and suggestions that have helped guide the design of my proposal.

Thank you to my family for the constant love, support, and encouragement throughout my life. Thank you for constantly believing in me and my success, even when I doubt myself, and for pushing me to be the best version of myself.

Thank you to my friends for the late nights, work sessions, and editing of my work. Your constant words of encouragement and support kept me emotionally grounded and resilient even through the most challenging parts of this journey.

ABSTRACT

Key Words
Ecological Urbanism
Wildlife Inclusivity
Biophilia
Green Buildings
Landscape as a Medium
Cohabitation

How can architecture foster cohabitation through the multiple scales of the built environment? Part of this answer lies within the theoretical framework which explores ecological urbanism, specifically through the theories of landscape as a medium, biophilia, and wildlife inclusivity. The other part of the answer is a study of the building components and architectural forms informed by case studies of green buildings. This will impart the move to integrate nature within the site of Villiers Island, located in the Toronto Port Lands. The site is part of an ongoing revitalization project and an active bird flyover. The issue with the current master plan is that it proposed a harsh divide between the urban and natural ecosystems, causing the conflict. As humans dominate a large part of the Earth, the goal is to seek cohabitation for both humans and non-humans within this new ecosystem through a mid-rise, mixed-use residential building.

TABLE OF CONTENTS

LIST OF FIGURES

This part is the introduction which presents Villiers Island as the site for the focus of the study and the issues of urban and natural separation. It highlights vital components of the theoretical framework and the use of the methodology to explore the interaction between the different human and non-human users within a mixed-residential building.

INTRODUCTION

INTRODUCTION

"To cohabit is to live together in an intimate relationship, to dwell with one another, and to share the same space."[1]

1 Kate Orff, *Toward an Urban Ecology* (The Monacelli Press, 2016), 81.

The human species has failed to share the Earth's landscape, constantly putting human needs over other non-human creatures. With the current trend for more urban development, cohabitation has become necessary for balancing the needs of non-humans and the natural ecosystem with the urban environment (See Figure 1). For this change to occur, we must consider a more inclusive urban realm; how can a wide range of animal species make their homes within the built environment? This question requires careful consideration as the urban and natural ecosystems have continually been opposing environments. Toronto is undergoing significant changes toward building sustainable and dense cities by introducing the Green Roof By-law and restoration projects along the waterfront.[2] As Toronto expands and becomes denser, balancing the needs of non-humans and the natural ecosystem with humans is becoming extremely important. This balance considers biodiverse cities as a solution to issues like air pollution, poor drainage, and heat islands, preventing harm to its inhabitants while potentially enticing new species to adapt to the city. These issues require a solution to bridge these two opposing ecosystems, going beyond the divide usually created by designing and planning for pockets of nature around urban infrastructure. These solutions must focus on how architecture and infrastructure can be efficiently designed to respond meaningfully to ecological environments. This means considering biodiverse cities to attract species rather than deter them.

2 "City of Toronto Green Roof Bylaw," City of Toronto (City of Toronto, July 4, 2022), https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/.

Currently, solutions at the urban scale are already being integrated into the Toronto landscape. The Port Lands is undergoing significant change to revitalize the site and increase land usage. This project is undergoing the construction of a new river and marshland system to restore the previous industrial site, restoring the Mouth of the Don to a thriving marshland-river ecosystem.[3] In the center of this revitalization project is Villiers Island, a proposed new community of mixed-use residential, commercial, recreational and institutional buildings. The restoration plans to reintroduce over a hundred species of flora and fauna onto the site, but does plan for this interaction of animal wildlife to extend into the urban landscape. Some animals, like bird species, are expected to return due to the Port Lands being in the direct path of the Mississippi and Atlantic bird flyway.[4] Some bird species need help adjusting to cities because large buildings, glass windows and nighttime lighting hinder their daily life. This site highlights the current divide between humans and non-humans on the architectural scale. Therefore this thesis

3 Shannon Bassett, "Recalibrating Infrastructure and Ecologies: Port Lands, Toronto, Ontario," Canadian Architect (iQ Business Media Inc., October 14, 2022), https://www.canadianarchitect.com/port-lands/.

4 "Birds of Toronto: A Guide to Their Remarkable World," City of Toronto (City of Toronto, 2018), https://www.toronto.ca/wp-content/uploads/2020/05/8ea3-City-Planning-Birds-of-Toronto-Biodiversity-Series.pdf.

seeks to explore the following:

How can architecture bridge the multiple scales of the “built environment” to design a new ecosystem within the city?

How can building for animals to coexist with humans promote a better quality of urban life?

The answer to these questions lies within the ecological urbanism theory, which bridges urban systems with natural ecosystems. From this theory, two core strategies will direct the project’s design. The first is landscape as a medium through biophilia which explores the use of natural ecosystems as a material with which to integrate into the city. This strategy means going beyond the mere addition of trees and by understanding the human associations with nature and other living organisms. Biophilic design in the city allows for nature to be present in the day-to-day lives of human residents. The benefits of this improve the health of its residents as the vegetation can absorb air pollution, manage stormwater, and improve human cognitive performances and mental health. The second strategy is a wildlife-inclusive urban design focusing on methods and techniques that entice animals to enter the city, rather than hinder their natural pattern. As a wide variety of non-human species return to the site, it becomes essential to consider negative interactions caused by the city, and the ways to reverse the effects of these elements. This requires analyzing the current infrastructure of cities today.

The site’s proximity to the Port Lands restoration project and Don River’s ravine system, puts it in direct contact with numerous non-human species. In short, the project has created a restored landscape which ends at the edge of urban development, continuing the narrative of human dominance over the landscape. This thesis project uses the currently empty plot of Villiers Island as a test bed for reimagining the architecture and urban infrastructure forms to integrate the wildlife surrounding the proposed community. This thesis explores the typology of mixed-use residential buildings through the different scales of the urban context to the building components. This project means looking at how the architecture can accommodate natural ecosystems. A portion of the methodology will dissect the current architectural elements and explore forms that embody the idea of cohabitation. Parallel to this analysis, is understanding different species’ habitats and behavioural patterns that inform the stresses the city causes to their lifestyles. As ecological urbanism explores sustainable green designs through a series of scales, this thesis will also investigate the design proposal throughout a series of design scales, the expanded landscapes, the block, lot, and building

scale. This exploration of scale will highlight architecture's relevance in actively extending the natural ecosystem and the effects these scales have on each other. This thesis will propose a kit of building components that will look at elements such as materials, green roofs, wall treatment, balconies, courtyards, and renewable energy sources. These elements will connect to the larger architectural forms. The architectural scale will draw from the research from the housing typology study and explore the most viable option in depth. This architectural form will then help form the proposal of the urban grid and possible extensions to the regional context.

Part 1 of this thesis begins with exploring the strategies obtained from the theories of ecological urbanism, landscape as a medium through biophilia, and wildlife inclusivity and the benefits of integrating these two systems. Part 2 highlights the historical conflict between the urban and natural ecosystems within the Don River's ravine system and the creation of the Port Lands. It also examines the City of Toronto and Waterfront Toronto documentation regarding the current plans for the Port Lands and Villers Island and the Mouth of the Don Competition entries. Part 3 is the kit of part designs of the building components and the analysis of the architectural forms and case studies that promote cohabitation. Finally, Part 4 contains the project's final design, which explores urban strategies to entice animals in the city and then to the building itself, followed by a conclusion.

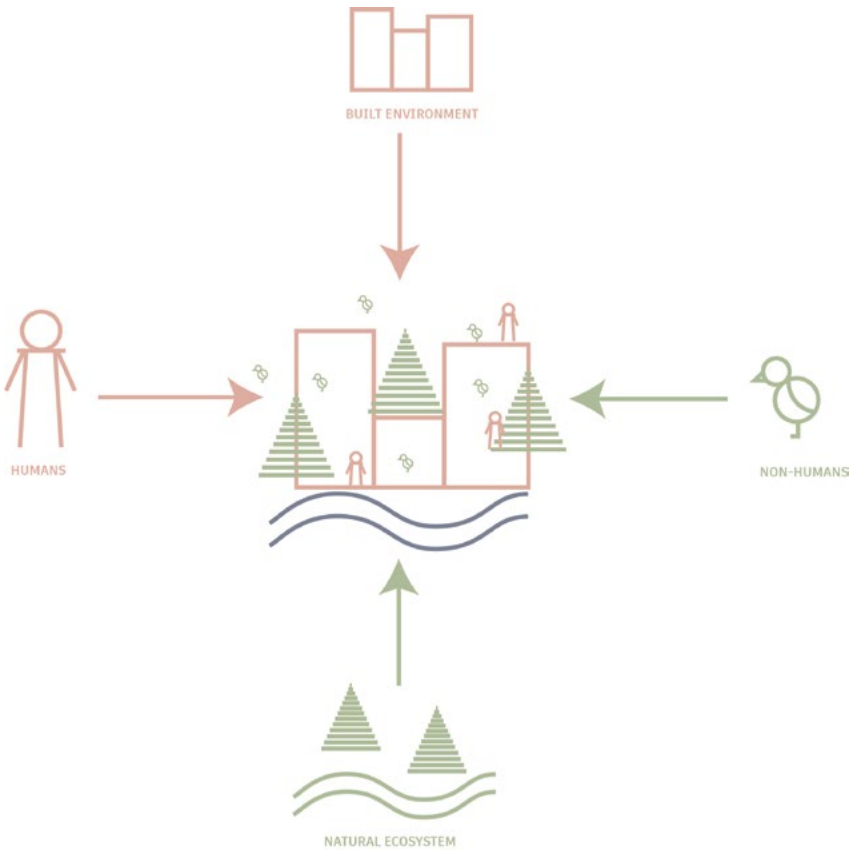


Figure 1: Co-Habitat Concept Diagram

This part of the thesis booklet examines ecological urbanism as a solution to the conflict between urban and natural ecosystems. It examines how humans, the urban landscape, the non-humans, and the natural landscape can benefit from this coexistence and the key strategies that push this balance and its conflicts.

1.0 ECOLOGICAL URBANISM

ECOLOGICAL URBANISM

1.1 DEFINING TERMINOLOGY

Ecological urbanism is a powerful terminology that pushes forth new ideas of transforming the urban space. To understand this sustainable term requires understanding its components. Firstly, the origin of modern ecology, defined by German zoologist Ernst Haeckel as "the environmental influence on the development of individual organisms."[5] Only in the twentieth century did ecology become associated with spatial terms like ecosystems and "human ecology" and gradually shifted towards different studies like human ecology (examines human interactions with their environment) and applied biology.[6] With the distinction between natural and urban as its own separated ecology, sub-fields like urban ecology began to emerge that focused explicitly on the idea of the spatial and ecological dynamics between these two ecosystems coexisting in the city.[7] Conversely, "urbanization is the process through which cities grow."[8] Urbanism can be understood as "the city as an object of study, its lived experience, and its influence through design and planning… and intervention upon process and products of urbanization."[9] Therefore, using the term ecological urbanism together means understanding urbanism through the lens of ecology. In order to do so, ecological urbanism needs to bridge the gap between natural and urban ecosystems. Human activity completely influences the urban ecosystem, mostly using hardscape materials. In contrast, the natural ecosystem is independent of human influence to sustain itself and the non-humans that inhabit it. The defining difference between urban ecology and ecological urbanism is the movement towards considering the density, scale and how the individual building can work with its neighbourhood, city, and entire region.

This thesis will define ecological urbanism as the process of bridging two opposing ecosystems together: one is the hard landscape lived and built by the human, and the other is the soft landscape that is majority inhabited by non-human wildlife.[10] The process of overlapping these two systems that intentionally elevate the needs of both humans and non-humans comes from understanding nature in the city and human activity through these multiple scales allowing it to address animals within the city.

> "History is filled with examples of things we thought were the top priority turning out not to be the top. In fact, what the environmental movement should teach us above all else is that the moment we take a singular view and try to solve a problem in isolation, that's the moment we cause problems for ourselves in other areas."[11]

5 Matthew Gandy, "From Urban Ecology to Ecological Urbanism: An Ambiguous Trajectory" *Area* (London 1969) 47, no. 2 (2015): 150.

6 Gandy, 150.

7 Gandy, 151.

8 National Geographic Society, "Urbanization," National Geographic, May 20, 2022, https://education.nationalgeographic.org/resource/urbanization/.

9 Charles Waldheim, *Landscape as Urbanism: A General Theory* (Princeton, NJ: Princeton University Press, 2016), 2.

10 Mohsen Mostafavi, "Why Ecological Urbanism? Why Now?," in *Ecological Urbanism*, ed. Mohsen Mostafavi and Gareth Doherty, vol. 1 (Zurich: Lars Muller Publishers, 2013), 17.

11 Roman Espejo, ed., *Eco-Architecture* (Farmington Hills, MI: Greenhaven Press, 2013), 159.

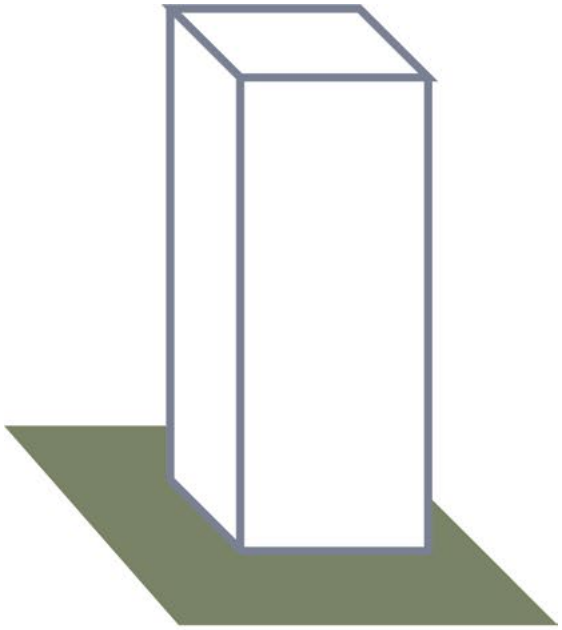


Figure 2: Landscape as a Medium.

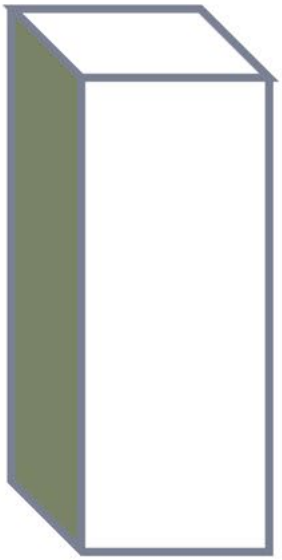


Figure 3: Biophilic Buildings.

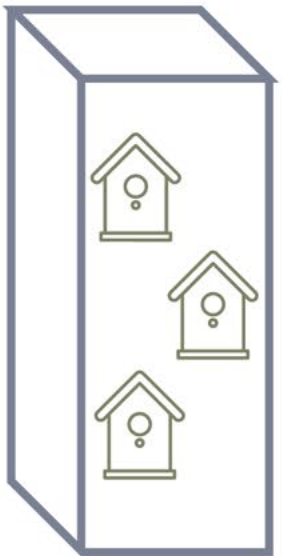


Figure 4: Multi-Species Buildings.

In the same sense, animals in the city are not considered the top priority when it comes to city designs. Despite cities expanding and becoming denser, animals are often ignored in the city even though obvious signs of their existence in the urban environment. The following will talk about two key theories which will direct the lens for the following research approach and the final design proposal. These theories are landscape as a medium through biophilia, which will look at the study of landscape urbanism and the design approach to revitalization on the horizontal planes of the city (See Figure 2). It then explores biophilia as a means to bring the horizontal landscape into the vertical plane of the architectural forms that populate large portions of the city (See Figure 3). The second topic will look at wildlife-inclusive urban design, which will argue the relevance of animals in the city and the strategic approach to designing for them in the denser areas of the city (See Figure 4). These strategies will be brought together in this thesis's design approach section, examining how the wildlife elements can improve and realize Villiers Islands' goals of an innovative hub in the city.

Figure 5: Central Park, New York Aerial.

Figure 6: Aerial view of Northeastern's campus and the Back Bay Fens.

1.2 LANDSCAPE AS A MEDIUM THROUGH BIOPHILIA

Landscape as a medium is "where a traditional understanding of the city... is no longer viable given the prevalence of larger forces or flows. These include ruptures or breaks in architectonic logic of traditional urban form as compelled by ecological, infrastructural, or economic change."[12] It is a concept that was useful in transforming vacant and toxic industrial sites and restoring the site using nature in an organized fashion.[13] It is through the use of nature with the urban elements that landscape can be used as a medium for design. According to Charles Waldheim, the landscape is an "urban cultural construct" which is dependent on the cultural activities present on the site.[14] He argues that the word landscape has been informed by "...depopulation abandonment, and decay of previously urban territories," and it is an image that attempts to reimagine the space with a pleasing and healthier visual.[15] This idea can be seen in the surrounding of the proposed built environment of Villiers Island. The Port Lands are currently undergoing a process of ecological urbanism by transforming the partially vacant and toxic industrial site into a new ecosystem. This project aims to push further what this means to fully integrate these two elements together - to equally address non-human and human necessities. This means exploring the transformation of key elements of the city, specifically to that of the architectural scale. This portion of the theoretical framework will look at the landscape as a medium and landscape urbanism which is a horizontal concept, and how that can be brought to the architectural scale through biophilia.

12 Waldheim, *Landscape as Urbanism: A General Theory*, 3.

13 Waldheim, 78.

14 Waldheim, 93.

15 Waldheim, 93.

Landscape urbanism has gone through stages of transformation; the first is through the activism of landscape design which started near the end of the twentieth century, paralleling the rise of environmentalism.[16] Through design, landscape urbanism looked to critique and innovative solutions to the conflicts between urban planning and architecture with ecological thinking.[17] It has quickly transitioned into the compromise between the "ecological function [and] the spatial and social order of the contemporary city," critiquing the architectural and urban design.[18] It is important to note that landscape proved itself to be a necessity to the city as designs led by architecture ignored creating valuable - natural - environments. One of the major changes landscape urbanism has brought to the discourse of environmental change is the urban park. The urban park is the beginning of the integration of soft landscape materials and integrated itself into the urban ecosystem. Early examples of this are in Olmsted's Central Park in New York and the Back Bay Fens in Boston (See Figures 5 and 6). Both highlight the positive effects that nature has within the city on the physical health and well-being of city dwellers and the function of the city itself. These natural spaces also redefine a new program, the park, lost in the city. The realization of the importance of natural spaces pushed for innovation, which was pushed

16 Waldheim, 4.

17 Waldheim, 4.

18 Waldheim, 5, 13.

forward through visuals that reimagined degraded or empty sites. This is a strategy that has been used in Toronto's revitalization process of the Don River, which is mentioned in the next chapter.

One of the difficulties of incorporating landscape as a medium into the urban setting is its infrastructure. Kenneth Frampton, an architectural historian and theorist, notes that there is a limit to urban form because of the rise of motorized transportation and the preference the city gives for roadways.[19] Frampton critiques the modern infrastructure and the limitations it brings to the urban plan "... to such a degree that any intervention tends to be reduced to the manipulation of elements predetermined by the imperatives of production, or to a kind of superficial masking which modern development requires for the facilitation of marketing and the maintenance of social control."[20] This quote extends to both roadways and modern buildings. Ludwig Hilberseimer, an architect, also highlights the conflict the city street grids cause when considering the pedestrians; he wrote,

> "Our existing street system is going back to ancient times; however motor vehicles have rendered this once perfect system obsolete. Therefore we construct highways but usually forget the pedestrians for whom each street corner is a death-trap. To avoid this, there should be no through traffic within a residential area but it should be possible to reach each house or building by car."[21]

19 Waldheim, *Landscape as Urbanism: A General Theory*, 10.

20 Waldheim, 17.

21 Waldheim, 118.

Hilberseimer highlights the major problem when designing for the city and nature. Despite the great desire to cover the city grid with beautiful gardens and non-human habitats, it is a difficult task to achieve as the street infrastructure is very necessary. Even in a future where there is a shift away from individual use of motor vehicles, roads will still be necessary for fire trucks and emergency services. At the same time, cities have proven to be entirely focused firstly on transportation to and from the building. The urban scale section of this thesis will look at strategies to shift toward creating a more pedestrian and animal-friendly urban ground floor.

Landscape as a medium is a term used in the horizontal plane - the spaces around the architectural forms. It describes the transformation of the predominant human land use into a systematic integration of the natural and built environment. As both Hilberseimer and Frampton point out, this integration is not simple as it would require a strategy that elevates the current pedestrian walkways, which in turn will elevate places where wildlife habitats can feature, while still maintaining the necessary urban requirements for buildings and the roads that connect them together. This raises the question, how can architecture adapt to the practices led by

landscape urbanists and start redefining the building in ways that break the predefined mould of the city? Does the city need to be defined by the grid structure that prevents meaningful urban forms, or can these forms take precedence over the current model of city infrastructure? Answering some of these questions requires a different approach to thinking about where the landscape can extend in the vertical plane. This means that the architectural facade of the building becomes an organic form that can support vegetation. These forms will be further elaborated on in the architectural scale section of this thesis. An approach to generate these designs is seen within biophilia.

E.O. Wilson defines biophilia as "the innately emotional affiliation of human beings to other living organisms. Innate means hereditary and hence part of ultimate human nature."[22] This means that humans have adapted to the natural landscape in ways that helped their survival. Research has shown that nature benefits mental, physical, and emotional well-being. According to the Attention Restoration Theory (ART) by Rachel and Stephan Kaplan, nature plays an essential role in helping humans recover from emotionally taxing or attention-focused tasks.[23] Elements of nature, such as seeing greenery and hearing birds and other non-human species, can help lower the stressor to mental health from the city. Although being surrounded by natural landscapes is valuable in lowering human stress levels, it is not always present in daily life, especially in mid and high-rise buildings. A majority of enclosed spaces are away from natural elements, like warehouses, office spaces, and residential units. Cities are designed with this concept of bifurcation, where nature is a place to visit rather than a fully integrative system. It becomes a place "over there" where an individual will need to visit the park rather than walk outside to experience being in nature fully. By incorporating nature into the building form, it becomes part of the spaces that humans inhabit. Additionally, the natural spaces will facilitate opportunities for non-humans to engage in the urban environment positively. Biophilia can be defined into five principles, which is a summary of goals defined by Timothy Beatley's Handbook of Biophilic City Planning and Design. These principles include: **(1) having an abundance of biodiverse natural landscapes (aquatic and terrestrial) and natural experiences at various design scales; (2) a multisensory city that invests, inspires, and mimics nature; (3) creating interconnected, integrative spaces that immerse and surround us in nature; (4) designing for other species' existence; and (5) engages citizens to enjoy, learn, and participate in nature.**[24] These embody the type of spatial qualities this design proposal hopes to take, specifically in its attempts to design for other species beyond humans.

22 Timothy Beatley, *Handbook of Biophilic City Planning and Design* (Washington: Island Press, 2016), 4.

23 Beatley, 5.

24 Beatley, 25.

1.3 WILDLIFE-INCLUSIVITY

Animals are adapting to cities. Squirrels can climb brick facades, pigeons nest in nooks of buildings, and raccoons sneak into garbage bins. Research has shown that "some species of ants thrive better in cities, and birds are changing the frequency of their calls in response to urban noise."[25] Even when we design exclusively for humans, animal species will make their homes in the urban fabric, which is barely addressed in the design of the city. Presently, no modern buildings focus on fine-scale habitat development for wild animal life despite the movement to establish biodiverse cities.[26] Animal-Aided Design (ADD) is a firm that researches animals in the city's design; their goal is to integrate methods that "...promote biodiversity and urban nature within urban development, landscape architecture, and architectural projects."[27] It intends to integrate urban architectural design with natural reimagination to create an environment that seems to conflict with one another. ADD strategy for design follows a 'species-specific approach' which focuses on species' individual needs and integrates those needs onto the site.[28] This approach aims at "wildlife-inclusive urban design" that addresses conservation in the city's built-up areas, for example, residential buildings.[29] The following section will explore the concept of wildlife inclusivity, mutualism, and its potential to increase the biodiversity of both vegetation and animal life in dense urban environments. Additionally, it will look at the effects of vegetation on the urban environment, which will encourage more animals to adapt to a higher-density city.

25 Timothy Beatley, *Handbook of Biophilic City Planning and Design*, 14.

26 Beate Apfelbeck et al., "Designing Wildlife-Inclusive Cities That Support Human-Animal Co-Existence," *Landscape and Urban Planning* 200, (August 2020): 1-11, accessed September 10, 2022, https://doi.org/10.1016/j.landurbplan.2020. 103817, 2.

27 "About Us," Studio Animal-Aided Design, January 27, 2023, https://animal-aided-design.de/en/about-us/.

28 Beate Apfelbeck et al., "Animal-Aided Design in the Living Environment," ed. Thomas E. Hauck and Wolfgang W. Weisser, Studio Animal-Aided Design (German Federal Agency for Nature Conservation, December 13, 2021), https://animal-aided-design.de/en/portfolio-items/animal-aided-design-im-wohnumfeld/, 8.

29 Apfelbeck et al., "Designing Wildlife-Inclusive Cities That Support Human-Animal Co-Existence," 2.

Wildlife-inclusive urban design focuses on fostering the needs of humans with an emphasis on wildlife needs.[30] It is meant to build off of present strategies like biophilic and green infrastructure design, which are designed to combat urban and human issues with the assumption that biodiversity will follow.[31] Although the most effective areas for wildlife habitats are outside the built-up cities, it is important to consider the negative impacts that urban development has on the natural environment.[32] Kate Orff, in her book *Towards an Urban Ecology*, proposes the question, "how do we not make landscapes, buildings, and public spaces, but make change?"[33] This question, situated in the discussion of climate change and the effects of human dominance, has created on our natural environment - from the loss of biodiversity to the urban problems of heat islands and pollution. In order to start change, there needs to be recognition of the city's current practices. Toronto has considered animals in the city's design. Still, these are strategies that promote safety for bird species that travel through rather than a strategy to foster cohabitation or consideration for other species in the city. To create wildlife-inclusive cities means taking on a species-specific approach that "considers the entire life-cycle of target wildlife species."[34]

30 Apfelbeck et al., 4.

31 Apfelbeck et al., 4.

32 Apfelbeck et al., 4.

33 Kate Orff, *Toward an Urban Ecology* (The Monacelli Press, 2016), 7.

34 Apfelbeck et al., "Designing Wildlife-Inclusive Cities That Support Human-Animal Co-Existence," 5.

There is a lot to consider when designing for non-humans that have not adapted to city life, as it requires resources to support that biodiversity and an understanding of the effects of human activity on these proposed ecosystems.[35] A strategy to help foster an inclusive environment is designing for mutualism - "a relationship between two species in which both benefit from the association... it means recognizing and fostering links between environment, organisms, and land-use practices - both humans and animals identifying complex cycles that tie together different species and systems."[36] This means exploring how animals and humans can share a space together that can benefit each other without conflict. One firm that embodies this concept well is the Ants of the Prairie firm by Joyce Hwang. It is an architecture and research practice that emphasizes animal design. Her works, such as Co-Habitat (See Figures 7 and 8), look at how animals can stimulate roof-top garden growth by understanding the food chain cycle from vegetation to insects to birds and bats, then back to vegetation.[37] Hwang proposes issues for architects to consider as we move forward to creating new ecological urban cities, which are: (1) Reconsidering architectural forms, materials, and construction methods; (2) reimagining urban maintenance; (3) taking a position of ethics of bringing species into the city.[38]

35 Miller, James R. "Conserving Biodiversity in Metropolitan Landscapes: A Matter of Scale (but Which Scale?)." *Landscape Journal* 27, no. 1 (2008): 114–26. https://doi.org/10.3368 /lj.27.1, 114.

36 Kate Orff, *Toward an Urban Ecology*, 83.

37 "Living Among Pests," Ants of the Prairie (Ants of the Prairie, 2023), https://www.antsoftheprairie.com/?page_id=1589.

38 "Living Among Pests,"

The first issue Hwang proposes is a strategic approach to how this thesis will consider exploring a species-specific approach to building designs in the city as it considers how we currently design for animals in the city to generate new ideas.[39] This means questioning how the components of the exterior facades can become more than just an appearance but a way to foster wildlife habitats. It also aims to understand the harmful design elements that deter animals, such as bird-deterrent spikes on window edges. Understanding the components of the building is part of the methodology for this thesis and will be further explored in the building component scale. The next issue looks at urban maintenance, which is different from the conventional idea of lawn mowing and street cleaning; instead, maintenance means cleaning the city from pests like mice or insects.[40] It questions how city maintenance can become a joint endeavour between humans and non-humans. For example, understand the food chain and understand how fostering homes for birds of prey or stray cats can keep the mice population down.[41] It also rethinks the idea of cleanliness, of turning cultivated green lawns into wildlife supporting the city's animals.[42] The idea is to break the structure of the typical city in a way that allows for growth. The third issue is taking a stance on what species enter the city. This article argues that there is a conflict in designing for specific species as it brings up the conversation of ethics and usefulness.[40] This means that as cities construct themselves with the intention of wildlife into the city, there will eventually be a hierarchy of

39 "Living Among Pests,"

40 "Living Among Pests,"

41 "Living Among Pests,"

42 "Living Among Pests,"

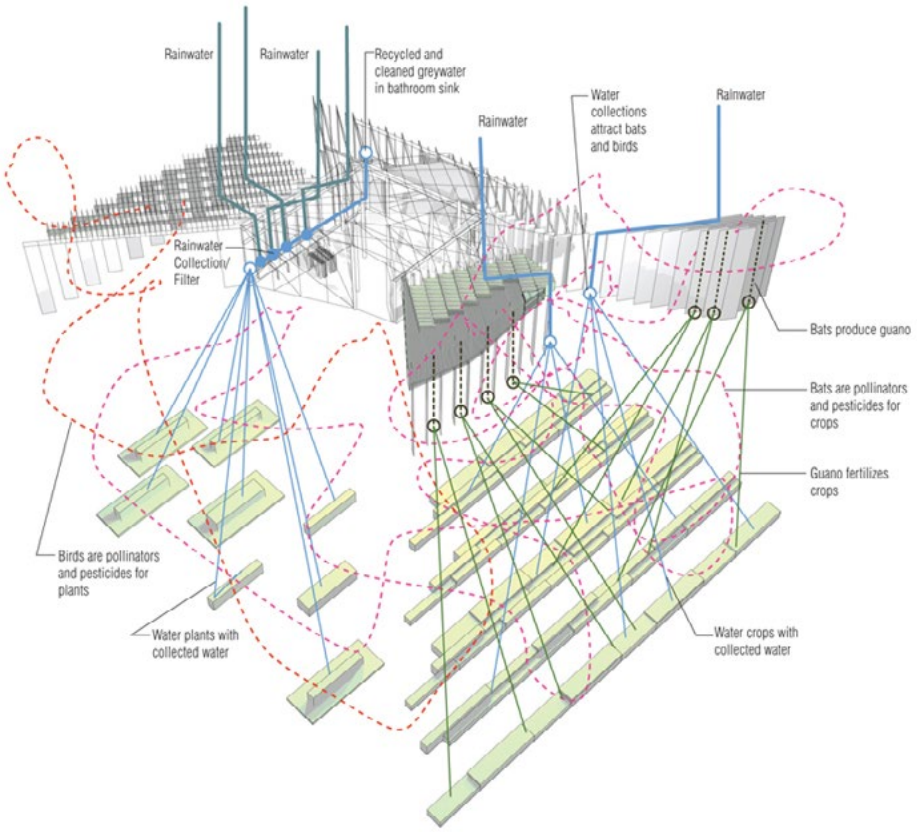


Figure 7: Roof Ecosystem Diagram.

Figure 8: Pest Wall-Proto 1.

what animals will benefit the city over the extension of wildlife habitats.[43] As this thesis intends to explore animals in the city, it is important to address the negative possibility of unwanted species, like coyotes, entering the city. As such, the appendix provides insight into awareness initiatives that residents must be aware of when living next to or within a natural ecosystem. Parallel to this thought is considering the resident's role, the building's management, and the municipality in bringing awareness and educating all users on the site of the dangers to themselves and helping maintain and engage with this new environment.

43 "Living Among Pests,"

This part of the thesis booklet analyses the current plans for the site and the possible areas where the design project can push forth this coexistence of the urban within the natural environment. This section begins with a glance at the historical context of the Don River and its importance to the creation of the Port Lands and the current conflict between natural and built environments. Then, it will analyze the plans of the City of Toronto and the Toronto Waterfront for the Port Lands and Villers Island, emphasizing areas that showcase why this site is best suited for this proposed ecological urban city.

2.0 SITE ANALYSIS: THE PORT LANDS

SITE ANALYSIS: THE PORT LANDS

2.1 DEGRADATION TO REVITALIZATION: THE PORT LANDS

The history of Toronto's Waterfront and the Don River showcases the conflict between the natural and built environments. The focus on urban society over the spatial needs of the natural landscape resulted in the major loss of wildlife habitats. Before European settlers transformed the land, the area around the Don River was entirely a natural ecosystem. The Indigenous respect and understanding of the natural environment, habitats and animals allowed these lands to flourish and coexist with humans. This changed in 1793 when John Simcoe decided to start a settlement in Ashbridges Bay, as the surrounding water created a natural defence system for the town and an easy way to transport lumber.[44] With this decision, the natural landscape began to change rapidly. Fields of agriculture replaced the natural forest in the north and sawmill in the south, using the water's circulation for power and waste disposal.[45] The loss of the natural wetland systems allowed soil erosion into the river, slowing its circulation. This lack of understanding of vegetation's role in filtering sediments from the Don River and the impact of waste material disposal allowed for the river's prolonged degradation. By the 1850s, Southern Ontario lost one-third of its original forest and ninety percent of the forest by the First World War.[46] This shift towards establishing the urban society lacked the foresight of the effect on the natural environment, causing a significant decline in the biodiversity of animal wildlife habitats.

44 Jennifer L Bonnell, *Reclaiming the Don: An Environmental History of Toronto's Don River Valley* (Toronto: University of Toronto Press, 2014), 6.

45 Bonnell, 8 and 21.

46 Bonnell, 20.

Despite the degradation of the river's condition, the city continued to construct more industrial buildings and a disposal site for its waste. The poor water circulation prevented waste materials from quickly exiting the site, causing increased health problems, and soon, the river and the marsh became associated with illness.[47] The stigma around the natural water systems increased the desire to cover the natural environment with a new "urban" solution. In 1878, the Don Improvement Plan intended to straighten the Don River with the expectation that it would help sanitize and promote the use of the waterfront through boats, trains, and industrial buildings.[48] The project's construction began in 1887 due to the cost and the extended time needed for its completion.[49] Construction stopped in 1891 after completing two-thirds of the project.[50] Despite the project's failure to resolve the pollution in the water, the city continued to move forward with the urbanization of the waterway, commissioning E.H. Keating, who developed the Keating Channel as a temporary solution for better water circulation.[51] The second part of the plan was to infill Ashbridges Bay, removing most of the marshland for a new industrial site - the Port Lands.[52] The Keating Channel was completed in 1906, then widened by 1915,[53] and the Port Lands was completed by 1922 with an extension that started in the 1950s.[54] These urban solutions failed to solve the issue of the river system and instead made the city prone to flooding, polluted the air quality, which affected the health of residents in the area, and cost the city. This failure highlighted the dire need for nature in the urban realm rather than its extermination.

47 Bonnell, 28.

48 Bonnell, 28.

49 Bonnell, 55 and 59.

50 Bonnell, 55 and 59.

51 Bonnell, 42.

52 "History of the Port Lands," The Port Lands (Waterfront Toronto, September 25, 2019), https://portlandsto.ca/history-of-the-port-lands/. - CHECK

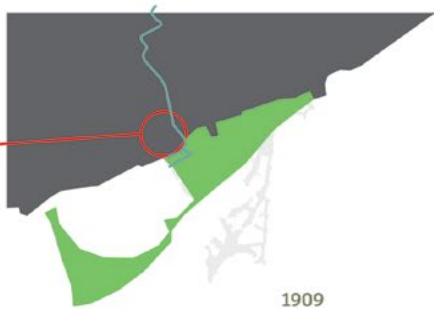
53 Bonnell, *Reclaiming the Don*, 69.

54 "History of the Port Lands," The Port Lands (Waterfront Toronto, September 25, 2019), https://portlandsto.ca/history-of-the-port-lands/.

Timeline of Mouth of the Don River

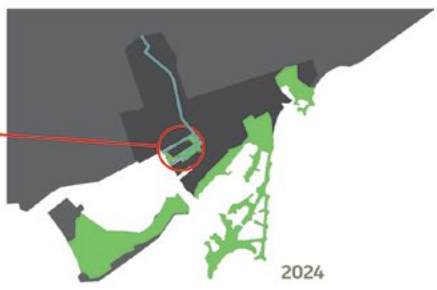
Completely natural enviroment
Human activity worked with nature and animals

Settlement along the river
Agriculture to the north and industrial building allowed for the degradation of the Don River
Separation between humans and non-humans



Heavy industrial programs along the river
South of the river was channelized

Creation of the Keating Channel to increase water circulation
New Port Lands replaced the natural Ashbridge's Bay



Movements towards sustainable environments led initiative to improve the natural environment
Introduction of the Villiers Island new river and marshland system

Figure 9: Timeline of Development around the Mouth of the Don.

Due to the lack of resolution to provide a safe environment, more people began to protest against the condition of the river. As the environmental movement began to gain traction, people's understanding of the benefits of nature in creating a sustainable and safe environment increased. In 1946, the Ontario government passed the Conservation Authority Act, which allowed residents to request a government-funded conservation authority to manage and conserve watersheds.[55] This recognized the residents' desire for a proper solution to their contaminated environment. This movement towards conservation continued to push the government to create initiatives and help promote more initiatives to restore the river and its mouth. These plans included the creation of green recreational spaces proposed in 1967, [56] with the intention of bringing people to the waterfront, as well as the creation of Leslie Street Split (now Tommy Thompson Park) in the 1970 Toronto Harbour Commission to provide a protective outer harbour.[57] Although these plans did not stem from the intention of revitalization, the lack of human activity on these sites and unused industrial areas in the Port Lands allowed nature to reclaim space for growth. Between 1974 and 1992, the decrease in industrial usage on the Port Lands site led to more unintentional green spaces, increasing the vegetation by fifty-two percent and the return of several animal wildlife.[58] With the benefits of the natural environment finally recognized, the government established the Toronto Waterfront in 2001 to revitalize the city's water edge.[59] Presently, the city's ongoing issue is establishing a balance between the urban and environmental factors to create a new type of urban habitat - the ecological urban habitat. This ecological urban typology can be recognized with the Toronto Waterfront's new plan for the Port Lands (See Figure 9).

55 Bonnell, *Reclaiming the Don*, 122.

56 Tenley Conway, "Boundaries and Connectivity: The Lower DonRiver and Ashbridge's Bay," in *Reshaping Toronto's Waterfront*, ed. Gene Desfor and Jennefer Laidley (Toronto, ON: University of Toronto Press, 2011), pp. 151-174, https://books-scholarsportal-info.librweb.laurentian.ca/uri/ebooks/ebooks3/utpress/2015-02-25/1/9781442661912, 167.

57 Tenley Conway, "Boundaries and Connectivity: The Lower DonRiver and Ashbridge's Bay," in *Reshaping Toronto's Waterfront*, 167.

55 Tenley Conway, "Boundaries and Connectivity: The Lower DonRiver and Ashbridge's Bay," in *Reshaping Toronto's Waterfront*, 169.

59 "History of the Port Lands."

Figure 10: Port Marsh/Don Delta Strategy by the Bring Back the Don Task Force.

Figure 11: Waterfront Projects by Waterfront Toronto.

2.2 THE PORT LANDS: A NEW URBAN AND NATURAL HUB

Similar to the degradation of the former Ashbridge's Bay, the revitalization efforts of the Port Lands start with the Don River. The damage caused by flooding from Hurricane Hazel in 1954 emphasized the importance of Toronto's natural landscapes - the ravine systems which act as stormwater management.[60] This realization of the need for ravine systems within the urbanized city started community activism to promote and push the city to introduce initiatives for revitalization. In 1989, a group of citizens began the Task Force to Bring Back the Don, which reimagined revitalizing the river and returning it to its previous wetland condition (See Figure 10).[61] From this, more plans came forth to revitalize the Don River and its surrounding area, like the Don Mouth Naturalization of the Port Lands Flood Protection Project (DMNP).[62] In the early 2000s, the City of Toronto had documents like the Central Waterfront Secondary Plan (2001) and the DMNP Environmental Assessment (EA) (2004).[63] These documents reinforced the Task Force's goals for naturalization.[64] Over a decade, Waterfront Toronto, the City of Toronto, and the Toronto Region Conservation (TRCA) have started several projects, initiatives, and goals aimed at the Port Lands and Toronto's Waterfront (See Figure 11).[65] These plans include the 2007 Lower Don Lands Design Competition.[66]

60 Shelagh McCartney et al., eds., A Landscape Approach: From Local Communities to Territorial Systems (Novato, CA: ORO Editions, 2022), 94.

61 "Don Mouth Naturalization and Port Land Flood Protection Project: Environmental Assessment," The Port Lands (Toronto and Region Conservation for the Living City and Waterfront Toronto, June 2016), https://portlandsto.ca/wp-content/uploads/103331.pdf, 1.

62 "Project Timeline," The Port Lands (Waterfront Toronto, September 24, 2019), https://portlandsto.ca/project-timeline/.

63 "Don Mouth Naturalization and Port Land Flood Protection Project:Environmental Assessment," 1.

64 "Don Mouth Naturalization and Port Land Flood Protection Project:Environmental Assessment," 1.

65 "Project Timeline."

66 "Project Timeline."

The Port Lands is 325 hectares southeast of Downtown Toronto that is currently part of the ongoing change towards urban and environmental renewal (See Figure 12), which shows the Port Lands master plan).[67] The Port Lands is valuable for several reasons due to it potential for more residential development, natural and recreational parks, job opportunities at the center of the harbour and media production, and proximity to major traffic routes.[68] The challenge is balancing these programs within the Port Lands that will benefit the city, people's experience of the city, and wildlife habitats. This challenge results in the Port Lands creating segmented spaces where areas will be delegated to the specific programs. The current goals are to: **(1) introduce new programs and activities, (2) restore natural and urban landscapes, (3) utilize waterways on site for unique experiences, (4) highlight the existing history, (5) enhance key mobility routes for all users, and (6) supporting the existing industrial programs and film production.**[69] These goals focus on human needs rather than the full ecological scope. With the ravine system leading directly toward the site, the Port Lands are equally valuable to the non-human inhabitants. The problem is finding a balance between the two, which is not an issue that can be completely solved in the zoning of land use. It separates the programs from each other, separating the residential from the natural landscape from the industrial. Therefore, part of the solution lies with the architecture in itself. How can architecture become a place for natural landscape and restoration? Furthermore, how can revitalizing the lost ecology on site become a part of the everyday urban infrastructure?

67 "Port Lands Planning Framework," Waterfront Toronto (City of Toronto and Waterfront Toronto, September 2017), https://www.waterfrontoronto.ca/sites/default/files/documents/port-lands-planning-framework-aoda---reduced.pdf, 3.

68 "Port Lands Planning Framework," 88.

69 "Port Lands Planning Framework," 24-26.

Figure 12: Port Lands Planning Framework by Waterfront Toronto

Urban Area: 25 ha

Natural Area: 70.5 ha
Water: 41.5 ha
Green: 30 ha

Total Area: 95.5 ha

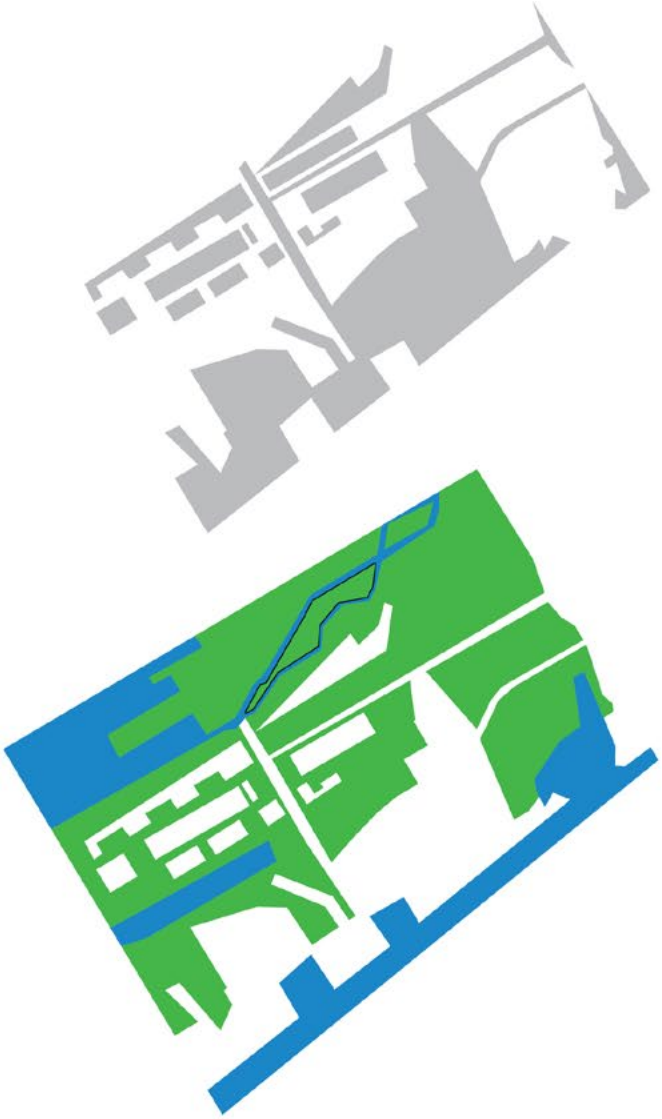
Figure 13: Girot's Mouth of the Don Competition - Land Use Comparison.

2.3 LOWER DON LANDS DESIGN COMPETITION

This led to the Lower Don Lands Design Competition, which included a public exhibition held between April 16th to 24th, 2007, where the winner of the four competing teams would be announced.[70] The design competition aimed to promote sustainable development, revitalize the mouth of the Don, and provide space that explored the relationship between creating a natural landscape and the urban environment. This competition attempted to start answering the questions of architecture and landscape design and how these two opposing ecosystems conflict with one another. This section will review three teams in the exhibition, including the winner, Michael Van Valkenburg's initial submission, Stoss and Brown + Storey Architects, and Atelier Girot, who had a design with unique ideas about the relationship between urban and natural environments. It will analyze how these firms looked at the site and how these plans can foster a new relationship with the environment from an architectural perspective.

70 "Waterfront Corporation Unveils Submissions for Lower Don Lands Design Competition," Waterfront Corporation unveils submissions for Lower Don Lands design competition (Waterfront Toronto, April 13, 2007), https://www.waterfrontoronto.ca/news/waterfront-corporation-unveils-submissions-lower-don-lands-design-competition.

Atelier Girot's submission designed a landscape that explores a new urban form. Instead of separating the urban and natural landscapes, this masterplan integrates them so that every infrastructure block is surrounded by nature or water. This means the building is integrated into the natural landscape where the two ecosystems work symbiotically instead of as neighbours. Using cues from both the urban landscape and the natural formation of the river, the firm uses a pattern of land and water branches. These branches specifically focus on creating a marshland system that will manage the runoff into the water. The branches also allow for a balance of structure and organic forms, catering to the need for the structural organization while keeping the natural zone for the area to grow freely. This integration of the two ecosystems focuses on nature in the everyday lives of city dwellers, where they are immersed in nature the moment they go outside. This concept of an ecological urban city has precedent when thinking directly about the architectural scale. However, this iteration of the plan does not imagine the architecture's condition, leaving room to explore the experience for both the humans and the non-humans on the site with the built infrastructure. Figure 13 compares the urban and natural land use on the site. The urban landscape only takes up 25% of the total site area. This means that the design of these strips allows for 17 ha of natural landscaping to surround the urban infrastructure on the site.



Urban Area: 27.7 ha

Natural Area: 67.8 ha
Water: 20 ha
Green: 47.8 ha

Total Area: 95.5 ha

Figure 14: Stoss Landscape Urbanism and Brown + Storey Architects' Mouth of the Don Competition - Land Use Comparison.

The second entry is by Stoss and Brown + Storey Architects. The axonometric perspectives of the site show the multiple ways that the infrastructure can work with the landscape by elevating the building. The ground floor focuses on remediation by creating a natural river system that cuts the site into three pieces connected through bridges for "pedestrians, cycling, public transit and vehicular systems in street compositions scaled incrementally to the relationship of courtyards, esplanades and promontories."[71] The use of bridges is a means of separating the urban from the natural landscape to protect one from the other while still allowing the spaces to overlap. Figure 14 compares the site's urban and natural land use, which shows that this submission's urban landscape only takes up 30% of the total site area. Similar to Griot's submission, the urban strips are surrounded by the natural environment, allowing for the vegetation on the site to increase.

71 "Lower Don Lands International Competition," BSA (Brown + Storey Architects), accessed December 15, 2022, https://www.brownandstorey.com/project/lower-don-lands-international-competition/.

The firm summarizes that the success of Toronto communities depends on the gradual evolution, using and iterating the urban grid typology to organize the buildings on site and meaningfully integrating the natural ecologies while not limiting themselves to a generic grid.[72] The firm also explores 11 built-form typologies, which create interesting conditions for road infrastructure and public look-out spaces towards the water. Figure 15 shows the connection of vegetation as part of the passive strategies to help shade the building in the summer, along with exploring the roof shape for passive ventilation. The shape of the roof is also ideal as a water collection strategy that can be used to water the vegetation on site. It explores ways the urban infrastructure can benefit natural elements within the city. The actual layout of this new city breaks the standard of the city grid by dispersing the high-rise building throughout the site to allow all green facades to have enough light to grow.

72 "Lower Don Lands International Competition."

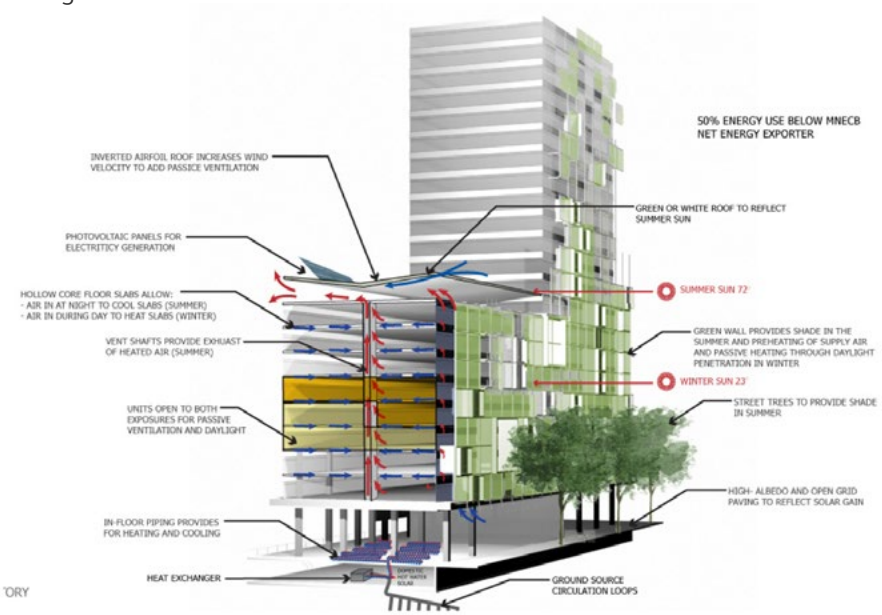


Figure 15: Integrated Green Strategies for Buildings.

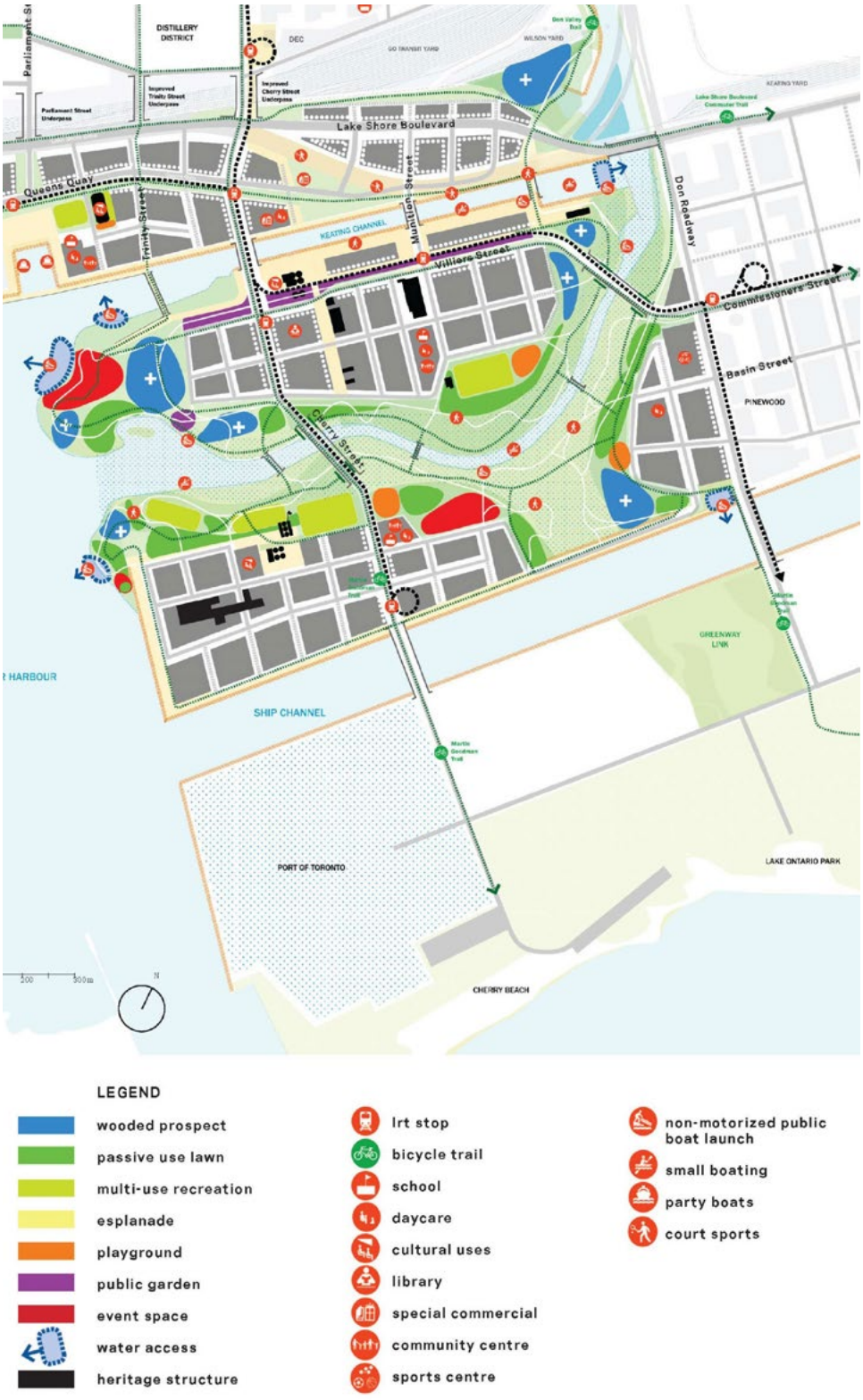


Figure 16: Michael Van Valkenburgh's Framework Plans - Program.

Lastly, looking at Michael Van Valkenbrugh's team's submitted master plan (See Figure 16), the proposed plan includes creating a new river and wetland system that redirects the water into Lake Ontario through the current infilled industrial site. The strategy was to extend the river through the current infrastructure, giving the river curves to promote a natural current. To prevent flooding, the plan has three exit points for water; the main one is the new river through River Valley, the Don Greenway and the existing Keating Channel. Additionally, a vegetation buffer that reflects the natural ecosystems of a wetland will be created alongside the new river, protecting the river from soil erosion and pollution and providing healthy wildlife habitats.[73] Unlike the other two, the built and natural environments are separate. The plan also focuses on preserving historical elements of the Port Lands rather than creating a new slate for development. This includes the Keating Channel, which could have easily been replaced with a more naturalized river system, as seen in the previous submissions. The plan focuses on existing public transportation lines, recreational trails, bicycle routes, and pedestrian pathways and how the future site can be integrated into this web.[74]

In 2012, the plan of the winning entry was refined in a document called the Port Lands Planning Framework, which revised the previous EA DMNP.[75] The document, updated in 2017, highlighted the framework for the Port Lands site, including Villiers Island, and compiled the information on the objectives and strategies for the urban plans and biodiversity, site analysis, and design intention.[76] This includes the change made on Valkenburgh's master plan submission. One of the changes turned Commissioners Street into the main line for transportation.[77] This means the community's urban layout follows a standard grid pattern. Another change was the design of the new river, which stops the natural marshland system bottom left, to preserve the historical building on site and the shortening of the Don Greenway due to limits of the site.[78] While the site plan integrated various human and non-human spaces within the natural restoration, it does not explore how this extends into the built infrastructure and can become a community space. Figure 17 shows the site land use analysis, which shows the site is split roughly 50% for urban and natural elements. The issue is that this begins to separate the two ecosystems instead of this overlapping concept. It puts human activity and needs above non-human ones, as it does not meaningfully consider how land animals might try to move from one ecosystem to another. At the same time, with the theme of innovation that the Port Lands is attempting to achieve, is it enough for the site to accomplish a restoration project, or can it bring to life a new concept where there is no hard line between the urban and the natural?

73 "Port Lands Flood Protection," Michael Van Valkenburgh Associates Inc (Michael Van Valkenburgh Associates Inc), accessed November 1, 2022, https://www.mvvainc.com/projects/port-lands-flood-protection.

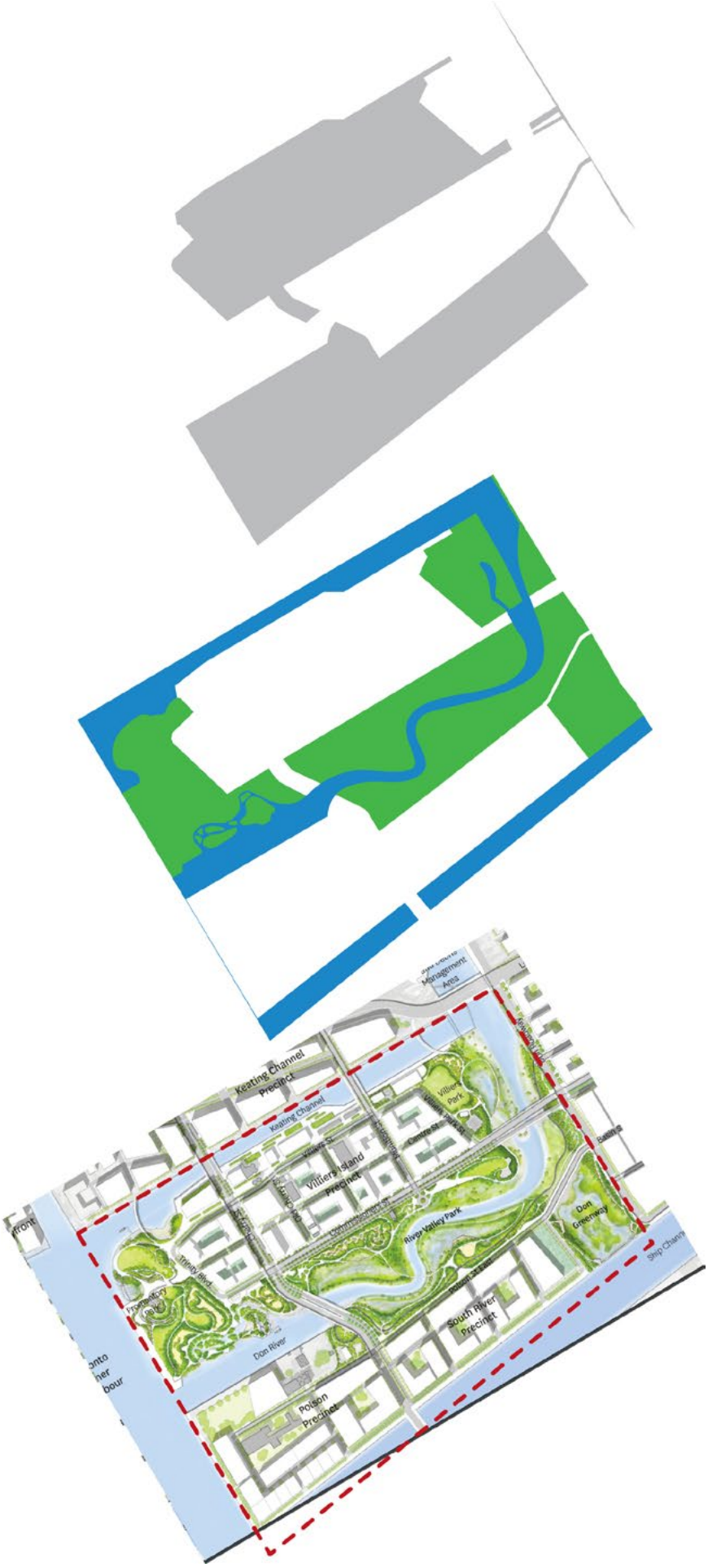
74 "Lower Don Lands Framework Plan," Michael Van Valkenburgh Associates Inc (Michael Van Valkenburgh Associates Inc), accessed November 1, 2022, https://www.mvvainc.com/projects/lower-don-lands-framework-plan.

75 "Project Timeline."

76 "Port Lands Planning Framework."

77 "Port Lands Planning Framework," 46.

78 "Port Lands Planning Framework," 46.



Urban Area: 45 ha

Natural Area: 50.6 ha
Water: 20.6 ha
Green: 30 ha

Total Area: 95.5 ha

Figure 17: Valkenburgh and Associates' Mouth of the Don Competition - Land Use Comparison.

2.4 VILLIERS ISLAND PRECINCT PLAN

Villiers Island is the proposed community at the heart of the restoration of the Don River and the surrounding parks, located ON the northwest side of the Port Lands. The Villiers Island Precinct Plan aims to "become a special island community that demonstrates a new relationship between the city, river and lake predicated on sustainability, resiliency and innovation."[79] The location of the site and the current revitalization puts the river at the center of both the heart of the ecological and urban pathways and is surrounded by current major development, from the West Don Lands, East Bayfront to the future Port Lands development to the south and the east.[80] The project uses six main moves to direct the urban design. One is to embed itself within the natural ecosystems around it, creating focal points for commercial and recreational spaces, connecting the island through road infrastructure, providing a variety of programs to support the community, promoting visitors, and preserving the remaining historical buildings.[81] This will create a second move which is creating a "living room space" that caters to human activities, which this thesis is critiquing.[82] The third move is connecting the island to the rest of Toronto and the Port Lands, which will elevate move four to a destination island that will become a relief space from city life.[83] Five is creating a community space that would prevent the need for increased traffic movement as commodities will be within a 5-minute walking space, and six is celebrating the historical elements of the city.[84]

Villiers Island will have five distinct areas that are influenced by the natural and built environment. The first is Keating Channel Promenade and Old Cherry Street at the north of the site, which will focus on low-scaled buildings with a nineteen-meter pedestrian walkway, add programs that promote public gatherings and recreation and highlight the historic buildings and structures that remain on site.[85] The second is Harbourside and New Cherry Street at the west of the site, which will focus on recreation park trails with a community center at the north end.[86] Center Street is the middle of the site, which intends to be pedestrian-centred but is currently vehicular-focused. Villiers Park on the east of the site will be an elementary school and a recreational park for sports. Lastly, Commissioners Street and River Park, located at the southeast corner of the site, will be the area for the proposed design as part of the plan proposes a road that divides the natural revitalization project and the built environment. Based on the proposal, this site will be the main circulation point for vehicular traffic for both cars and transit.[87] This road will make it difficult for pedestrians to cross over and hazardous for non-humans who might attempt to cross this street. According to the Port Lands reports, turtles are likely to appear on the site, and some species of turtles tend to migrate far distances on land to lay eggs.[88] Although the design does not specifically add species to the Port Lands, it is important to consider the risks that the animals might face to design a community that can sustain all who live on the site. Overall, the plan for Villiers Island

79 "Villiers Island Precinct Plan ." The Port Lands. Waterfront Toronto, September 2017. https://portlandsto.ca/wp-content/uploads/2017.10.04_Villiers+Island+Precinct+Plan+AODA+Attachment+2.pdf, 1.

80 "Villiers Island Precinct Plan," 12.

81 "Villiers Island Precinct Plan," 30-31.

82 "Villiers Island Precinct Plan," 30.

83 "Villiers Island Precinct Plan," 30-31.

84 "Villiers Island Precinct Plan," 28, 30.

85 "Villiers Island Precinct Plan," 37, 39.

86 "Villiers Island Precinct Plan," 42.

87 "Villiers Island Precinct Plan," 30-31.

88 "Blanding's Turtle," Ontario Nature (Ontario Nature, November 23, 2020), https://ontarionature.org/programs/community-science/reptile-amphibian-atlas/blandings-turtle/.

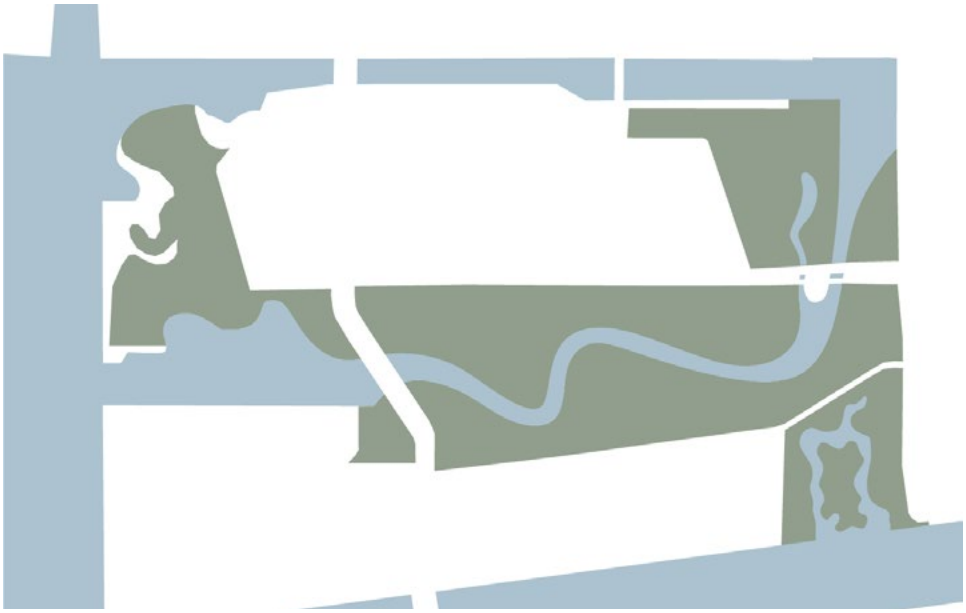


Figure 18: Critique of the Current Viller's Island Proposal - Divide between Nature and Urban Spaces.

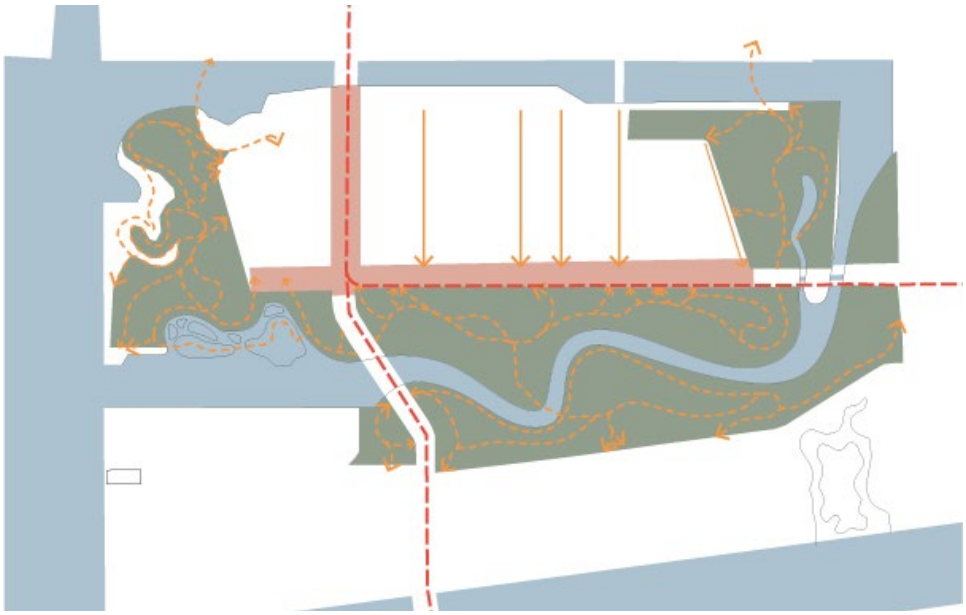


Figure 19: Critique of the Current Viller's Island Proposal - Divide by Road Infrastructure.

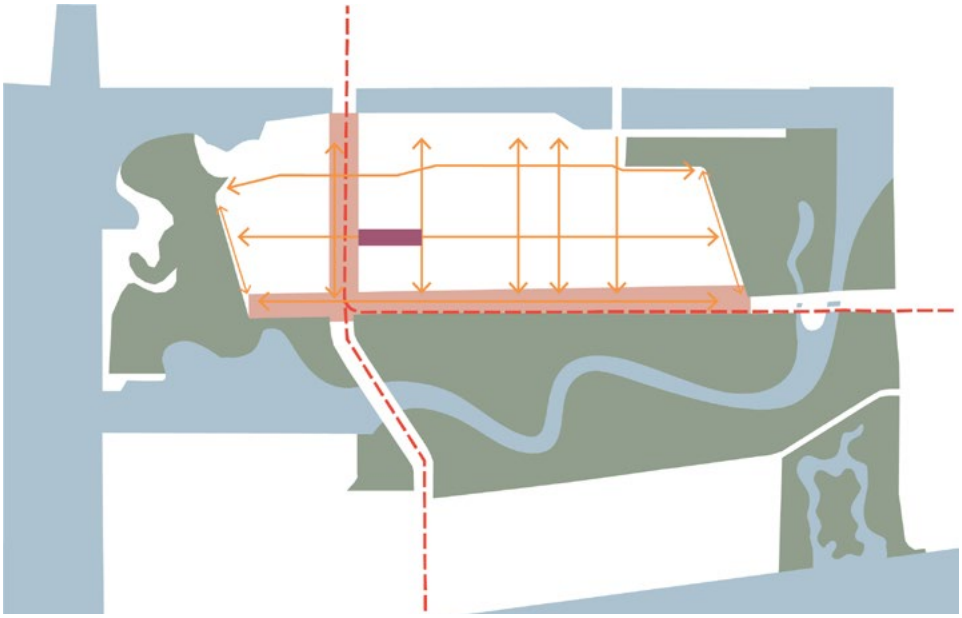


Figure 20: Critique of the Current Viller's Island Proposal - Divide of Roads and Pedestrian Only Streets.

seems to keep the green spaces out of the actual "city" instead of integrating the systems into the urban fabric. As the Port Lands will become this new stunning example of urban design in Toronto, it is important to reconsider excluding nature from the city as nature has the capabilities to protect and enhance the city. Additionally, if the city is attempting to increase the amount of housing, nature will be a useful tool to give residents backyards in the high-density building that they might not receive if they live in a regular apartment building.

Parks, Open Space, and the Public Realm Strategy

As stated multiple times, Villiers Island is surrounded by multiple different types of parks and open spaces. Figure 18 shows the separation of the natural parks from the proposed urban development. From east to west, this includes Villiers Park, the Keating Promenade, River Park, and Promontory Park. This section will highlight the street conditions of the city and ways that these elements can be explored through the wildlife-inclusive lens. Figure 19 shows the divide the public transportation route created between the natural and urban spaces. Figure 20 shows the pedestrian-only pathways compared to the shared and vehicular pathways and the two current ecological urban conditions, which show the integration of the natural environment beyond the parks surrounding the infrastructure. This plan highlights the imbalance of power between transportation and pedestrian. Currently, the main points of vehicle traffic are Commissioner Street, New Cherry Street, and New Munition Street, local streets include Villiers (Park) Street, and the shared streets include Centre Street, Trinity Boulevard, and Old Cherry Street. This encompasses the whole circulation grid. Therefore, it is important to reconsider how this imbalance can be revised along with overlaying the corridors for animals. This means questioning what is relevant for car travel and what is relevant for pedestrian travel. The pedestrians want access to the buildings, the stores, and the retail spaces; cyclists will move towards the closest building corners; the vehicles are driving to a general location, the closer they get, the better; and animals will travel along ecological corridors. The site also has the potential to integrate better permeable sidewalk materials that are currently not being displayed. Figure 21 shows some of the animals that Waterfront Toronto expects to return to the site based on the habitats within the New River.

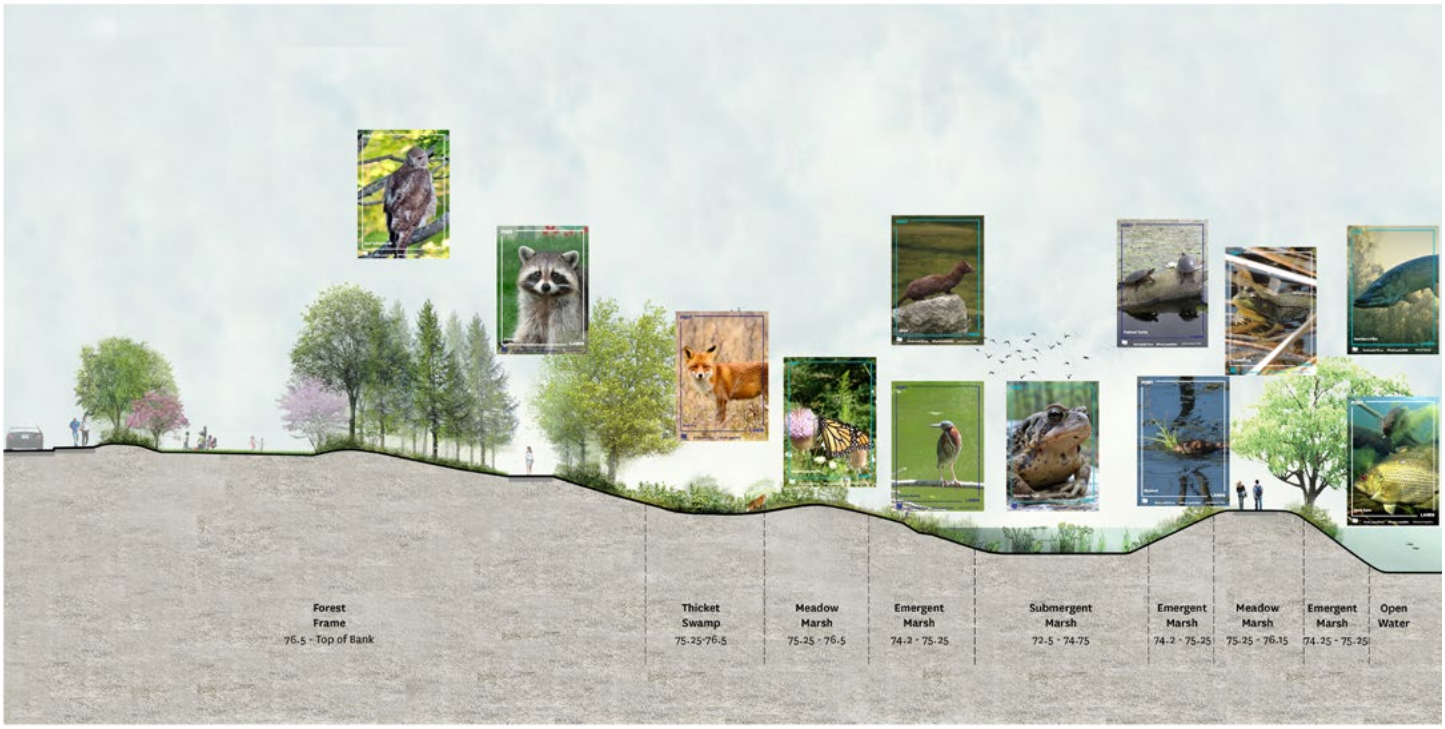


Figure 21: Cross Section of new Don River showing fauna habitats it will create by Waterfront Toronto.

Built Form Strategy

Villiers Island's strategy for the location of the architectural forms on the site carefully considers the spatial qualities of public and pedestrian spaces. The programs for the site are mixed residential, which will contain a secondary program for employment or commercial space, and destination use, which will look at a range of spaces targeted for events, cultural centers, institutions, or community hubs.[89] Villiers Island contains multiple heritage buildings on site along the Keating Channel, Old Cherry Street, and Foundry Street.[90] With the multiple components contained within the proposed urban development; the building principles that are directing their project are summarized as follows: **(1) a variety of building types and scales that contribute to Toronto's interesting skyline, (2) create a distinct character through the unique relationship between water and public spaces, (3) contribute to comfortable parks and open spaces, (4) designing buildings that animate the ground floor and frame the open sky and water, (5) preserve and showcase the built, cultural, industrial, and natural heritage of the site, (6) strategic placing tall buildings and traffic nodes, and (7) optimizing the location, design, and massing of the building to achieve climate positive goals.**[91] Achieving these principles partially relies on the placement of low, mid, and high-rise buildings.

89 "Villiers Island Precinct Plan," 94.

90 "Villiers Island Precinct Plan," 89.

91 "Villiers Island Precinct Plan," 102.

Low-rise buildings - up to five stories - will be majority located along the north below the Keating Channel and on the east side of Old Cherry Street (See Figure 22). The building height at this location responds to the scale of the Harbour Commissioner and Dry Dock building (which is an opportune location for a human pedestrian space) and the location of heritage buildings.[92] All ground floors will have a minimum of five-meter floor-to-floor height.[93] Mid-rise building - building six to ten stories - which makes up the typical building height in the area will have a total width no longer than eighty-five meters and a base height no taller than eight stories.[94] The mid-rise plan has the opportunity to create unique character conditions to the overall plan. With this building typology paralleling the natural river ecosystem, there is an opportunity to discover ways these two environments converse with each other. The plan highlights using staggered heights - lower along Commissioner Street and higher towards Villiers Street - and establishing setbacks allowing for better pedestrian walkways. To maximize sunlight onto Centre Street, setbacks should be used on the north face of the building. This will inform the best location to place the natural corridors in the city plan. Finally, tall buildings - twenty to twenty-nine stories - will be strategically placed at the further end of the site in order to optimize sunlight.

92 "Villiers Island Precinct Plan," 104.

93 "Villiers Island Precinct Plan," 103.

94 "Villiers Island Precinct Plan," 106.

Figure 22: Building Height Strategy
Adapted from Michael Van Valkenburgh's
Villiers Island Plan.

This part of the thesis booklet establishes building components allowing non-human inhabitants to integrate into the urban realm. This section will compile best-case practices of architectural forms that start integrating nature into its forms or have the potential to foster cohabitation.

3.0 DESIGN RESEARCH

DESIGN RESEARCH

3.1 BUILDING COMPONENT SCALE

This section of the thesis presents a kit of building component parts that explore how wildlife can integrate within the built environment. This means exploring key factors that prevent wildlife from adapting to the city and ways to counter them. This section means critically looking at roads and buildings that hinder animals from safely entering the site. In order to design with wildlife in mind means starting to incorporate green landscaping and possible habitat location in the urban floor and buildings. Also, consider materials and colours that mimic the surrounding landscape and lower the likely impact on wildlife. Parallel to this, this section will argue the benefits these components have in helping reduce pollution directly caused by urban elements like cars. This would help Toronto achieve its goal of reducing greenhouse gas emissions by 80% by 2050.[95] Additionally, this section will look specifically at birds due to the flyover path following the ravine system and the issues they face within the city. The components that will be covered in this section are ecological corridors, permeable paving, green roof, living walls, lighting strategies, bird-friendly glass, birdhouses, interior green walls, and interior corridors. These components are not all part of the final design but seek to explore interesting possibilities incorporating wildlife that can help support both humans and non-humans.

95 "Port Lands Planning Framework," Waterfront Toronto (City of Toronto and Waterfront Toronto, September 2017), https://www.waterfrontoronto.ca/sites/default/files/documents/port-lands-planning-framework-aoda---reduced.pdf, 330

Figure 23: Florida Wildlife Corridor.

3.2 ECOLOGICAL CORRIDOR

Ecological corridors are "areas of land and water that aim to maintain and restore ecological connectivity," which allows for animal species to move through the site (See Figure 23).[96] Ecological corridors are beneficial as they help species adapt to climate change, minimize the impacts of urban development, support ecosystem services like food and clean air, promote cohabitation, and improve ecological integrity.[97] There are three types of ecological corridors linear (continuous unbroken strip), stepping stone (small scattered patches of habitat), and landscape (patches of landscape features.[98] Villiers Island's new revitalization project would be considered a landscape ecological corridor as it will be a large ecosystem connecting the Don River to Lake Ontario. It is still somewhat disconnected from the overall Don River ravine system (which would be considered a linear ecological corridor) due to the placement of the urban community and the road infrastructure of the Gardiner Expressway and Lake Shore Boulevard. The end of the Don River ecological corridor (meaning there is a significant amount of vegetation to support the river and animal movement) ends roughly 18.8 kilometres from the north edge of the Keating Channel.

96 "National Program for Ecological Corridors," Parks Canada Agency (Government of Canada, November 30, 2022), https://parks.canada.ca/nature/science/conservation/corridors-ecologiques-ecological-corridors.

97 "Ecological Corridors," Parks Canada Agency (Government of Canada, November 26, 2022), https://parks.canada.ca/nature/science/conservation/info-corridors.

98 "Ecological Corridors."

Overall, the ravine systems are essential ecological systems in Toronto as it is a central travel hub for migrating birds and other animal species within the city (See Figure 24). As previously mentioned in the history of the Don River, preserving the natural ecosystems, like the ravine systems, has gained more attention and importance within the city. The city's ravine strategy supports a "ravine system that is a natural, connected sanctuary essential for the health and well-being of the city, where use and enjoyment support protection, education and stewardship."[99] According to Timothy Beatley, setting aside land for natural conservation may not be an adequate strategy.[100] The ecological health of the ravine depends on the biodiversity at various heights, from small shrubs to trees. One major threat to this biodiversity is from non-native species like the Norway maple trees.[101] This means there needs to be active management of the natural environment to allow various species to thrive. Tommy Thompson Park is a good example, as the research has gone into understanding humans' role in preserving and letting wildlife take back the land.[102] As a result, the park can host a diversity of species which is lost within the city. Nature needs to start going beyond the main corridors currently in the city. Beatley argues that Toronto's efforts to protect birds are incomplete due to the conflict between creating more natural parks and increasing urban development.[103] For species that depend on land travel, the urban development spaces hinder travelling between natural systems.

99 "Toronto Ravine Strategy," City of Toronto (City of Toronto, 2017), https://www.toronto.ca/wp-content/uploads/2017/10/9183-TorontoRavineStrategy.pdf..

100 Timothy Beatley, *The Bird-Friendly City: Creating Safe Urban Habitat* (Washington: Island Press, 2020), 158.

101 Beatley, 158.

102 Beatley, 170.

103 Beatley, *The Bird-Friendly City: Creating Safe Urban Habitat*, 158.

Examples of Migratory Birds in Toronto

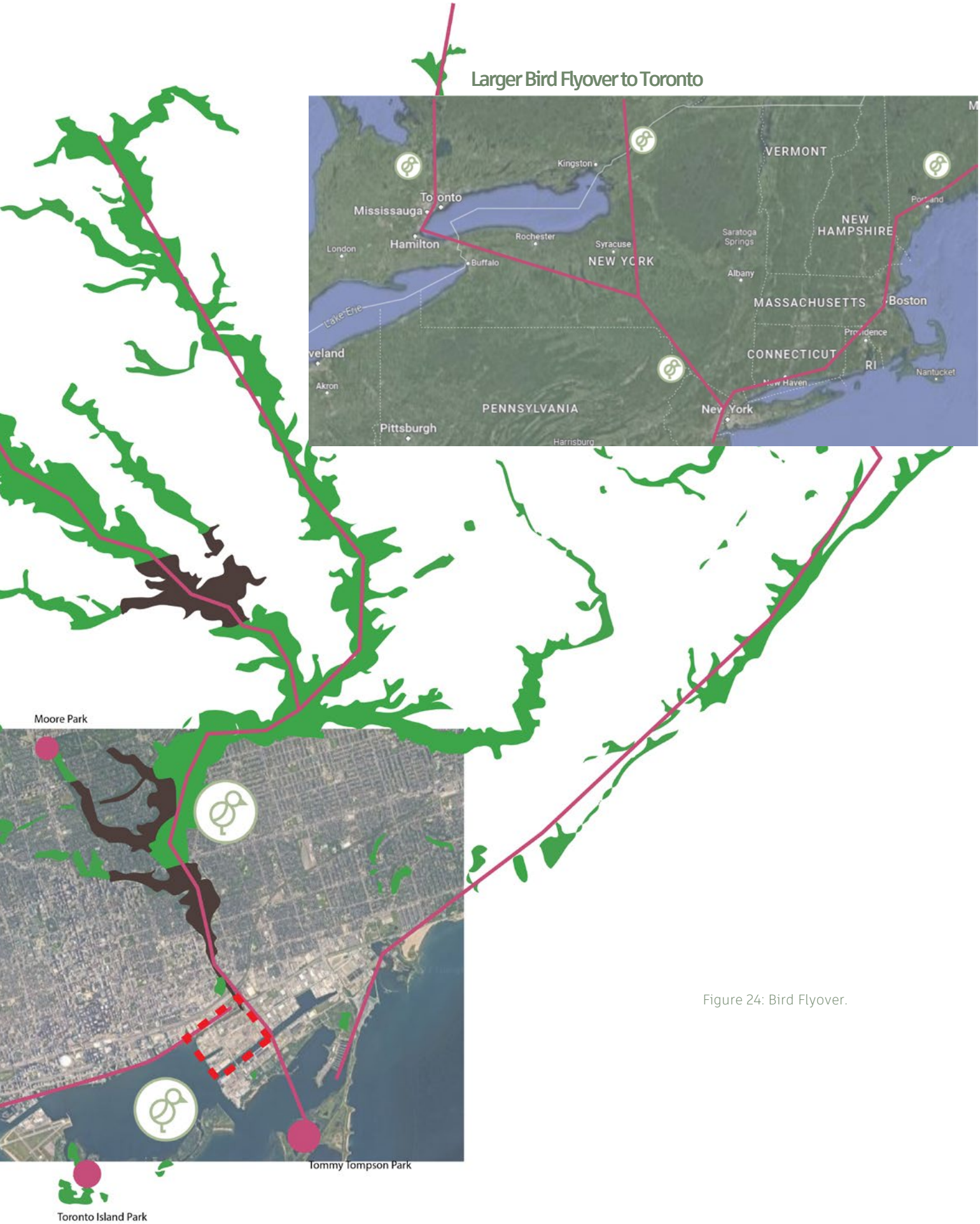


Figure 24: Bird Flyover.

Figure 25: A wildlife corridor in the Netherlands.

This means considering more ecological corridors connecting the Don River ravine system and the new mouth of the Don revitalization project. The first consideration is the width of an ecological corridor. According to a few articles, urban corridor widths are still debated due to the need to balance effective ecosystems with wildlife inhabitants and allow for urban development. For effective ecological corridors to occur, ecologists studying animal travel and habitat requirements are essential to discussing viable width dimensions. A general rule of thumb is two kilometres of space, which would keep the areas separated from human activities.[104] (This is not possible for the Villiers Island urban development site because its current width is roughly 750 meters.) On the other hand, some animals, like bears, can circulate within passages 2 meters wide.[105] Ecological corridors must consider the site's purpose, whether to foster animal habitats or create safe crossing conditions like an animal bridge. Therefore, the design proposal will use the dimensions of an animal bridge, which sole purpose is to create safe passage over urban infrastructure (See Figure 25). An animal bridge is roughly around 165 feet to 230 feet wide (50 meters to 70 meters).[106]

104 Adam T. Ford et al., "Effective Corridor Width: Linking the Spatial Ecology of Wildlife with Land Use Policy," *European Journal of Wildlife Research* 66, no. 4 (July 29, 2020), https://doi.org/10.1007/s10344-020-01385-y.

105 Ford et al., "Effective Corridor Width: Linking the Spatial Ecology of Wildlife with Land Use Policy."

106 "Design Considerations for Wildlife Crossings," Contech Engineered Solutions (Contech Engineered Solutions LLC, 2023), https://www.conteches.com/knowledge-center/pdh-articles/design-considerations-for-wildlife-crossings#:~:text=Structure%20Size%20and%20Placement.,by%2015%20feet%20in%20height.

Liam Brennan, Emily Chow, and Clayton Lamb, "Wildlife Overpass Structure Size, Distribution, Effectiveness, and Adherence to Expert Design Recommendations," PeerJ 10 (December 12, 2022), https://doi.org/10.7717/peerj.14371. "Scientist suggest that overpasses for large mammals should be approximately 50 m wide."

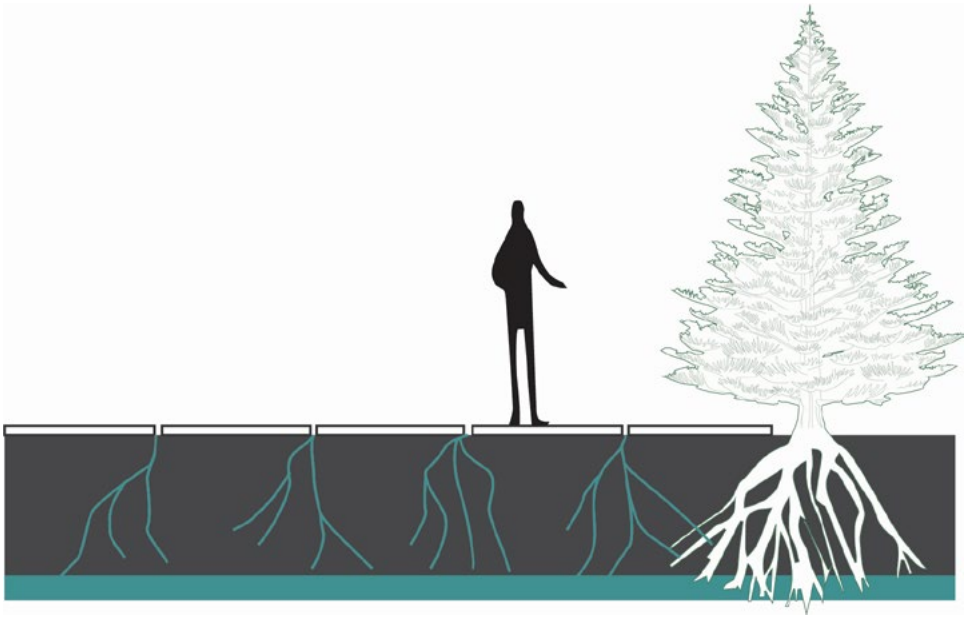


Figure 26: Permeable Paving Diagram.

Figure 27: Glen Oaks Branch Library.

3.3 STREET PAVING

Stormwater runoff is a major cause of water pollution which is due to the large amount of hardscape and its inability to absorb water. Figure 26 shows a permeable sidewalk that is able to absorb water rather than let it run off to street edges to be drained out of the city. The Harvesting Sidewalks design by SCAPE for the Glen Oaks Branch Library in Queens, New York, which uses the panels along the public perimeter of the building (See Figure 27).[107] The spaces in the paving material allow for water to seep through the cracks and filter through. Permeable paving does two things; for one, it reduces runoff and allows the soil to trap or break down contaminants through filtration.[108] An Evaluation of Permeable Pavements in Cold Climates report was prepared by the University of Guelph in 2012, which noted that permeable paving offered significant benefits in managing stormwater runoff throughout all seasons.[109] The elevation surveys showed that freezing temperatures did not cause significant surface changes or movements.[110] It also reduces salt or sand used on icy sidewalks during winter due to the melt-freeze cycle - where ice melts in the morning and is absorbed into the soil rather than freezing at night.[111]

Additionally, adding vegetation will help create a cooler microclimate, as shown in the Villier Island Precinct Plan, this thesis argues that it should be more intricate in the city. The added vegetation will work together with the absorption street by increasing water infiltration. To make an effective system would require a tier of vegetation from trees to understorey plants that are native and resilient to the urban environment. By using vegetation that ground animals would eat. The Eastern Cottontail rabbit for example eat various shrubs like goldenrod, clovers, various leaves of saplings and grass.[112] It also eats weeds like dandelions, which can help manage the biodiversity of plant life.[113]

107 Kate Orff, *Toward an Urban Ecology* (The Monacelli Press, 2016), 54.

108 University of Guelph, "Evaluation of Permeable Pavements in Cold Climates," Permeable pavements: Maintenance - LID SWM Planning and Design Guide (Toronto and Region Conservation Authority, December 2012), https://wiki.sustainabletechnologies.ca/wiki/Permeable_pavements:_Maintenance, 12.

109 University of Guelph, "Evaluation of Permeable Pavements in Cold Climates," v-v.

110 University of Guelph, "Evaluation of Permeable Pavements in Cold Climates,"47.

111 "Ecoraster Permeable Pavement System Perfect for Canadian Winters," LID Permeable Paving (LID Permeable Paving Canada, February 23, 2021), https://lidpermeablepaving.ca/ecoraster-permeable-pavement-system-perfect-for-canadian-winters/.

112 Christine Hanrahan, "Eastern Cottontails at the FWG," Ottawa Field-Naturalists' Club (OFNC, June 25, 2020), https://ofnc.ca/programs/fletcher-wildlife-garden/flora-and-fauna-at-the-fwg/eastern-cottontails-at-the-fwg.

113 Hanrahan, "Eastern Cottontails at the FWG."

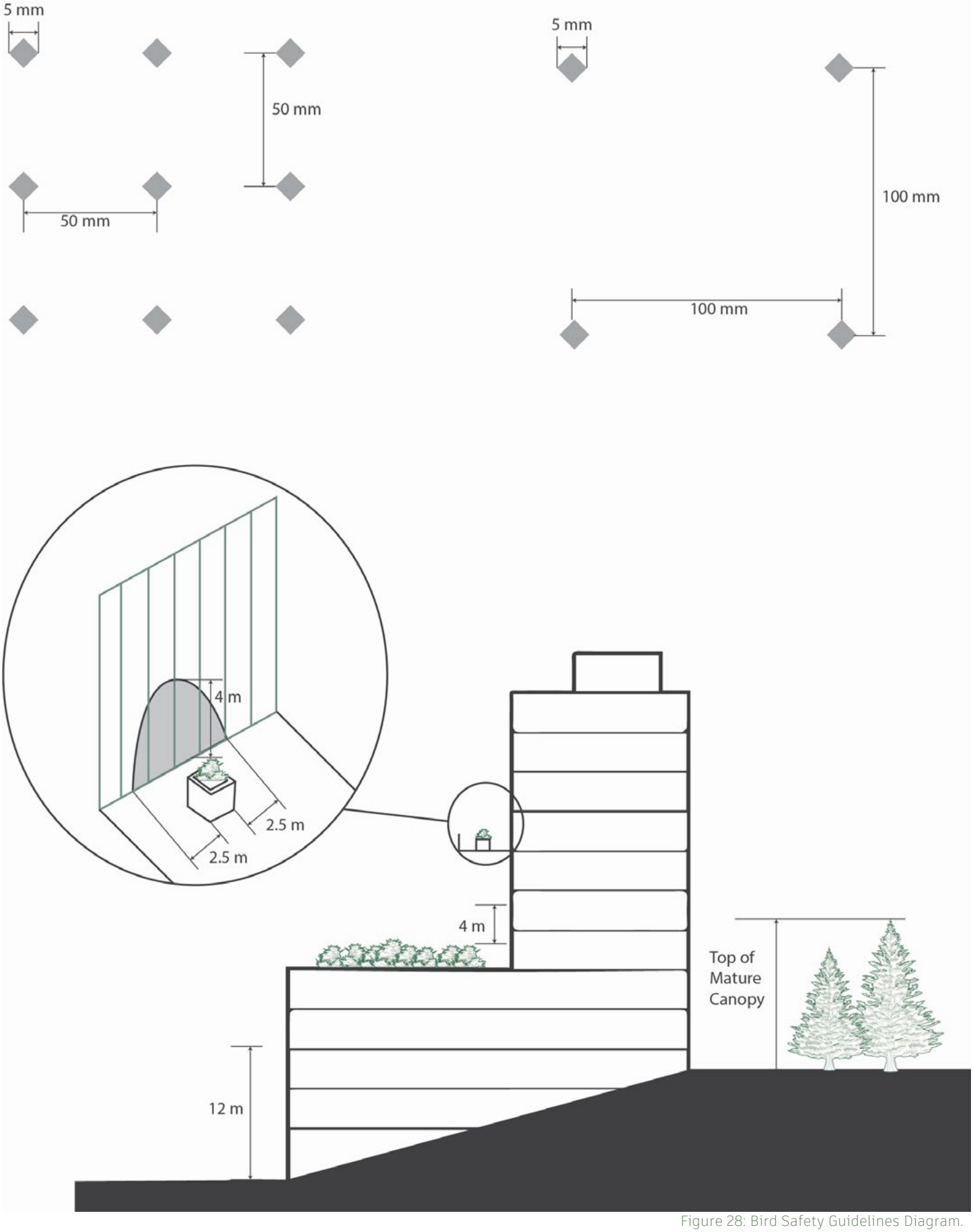


Figure 28: Bird Safety Guidelines Diagram.

3.4 DESIGNING FOR SPECIES: BIRDS

Toronto is one of the earliest cities to think about how birds are affected by the urban infrastructure.[114] The Fatal Light Awareness Program (FLAP) founded by Michael Mesure in 1993, aims at "raising awareness about the danger of glass-walled buildings in Toronto" and designing bird-friendly buildings.[115] The advocacy this group brought helped push the City of Toronto to develop its Bird-Friendly Development Guidelines in 2007 as part of the Green Development Standard.[116] According to Mesure, birds are mostly likely to strike windows during the day more than at night and about 90% occur within 16 meters of the ground floor.[117] Buildings like the Ryerson Student Centre by Snohetta propose a solution to the trend of designing the exterior walls with windows through the use of fritter glass.[118] This will allow birds to see the glass but it can also help minimize solar heat gain due to the varying colour conditions.[119]

Toronto Bird-Friendly Guideline standards for bird friendly glazing for mid- to high rise buildings outline that glazing must be: **(1) treated with a minimum of 85% of all exterior surfaces within the greater of the first 16 meters of the building above grade of the height of a mature tree canopy.**[120] With this in mind any floors that are designed with trees might reconsider this height to whatever the height of that tree is.[121] If a tree is placed on the second or third floor of the building, that space should take extra precautions to prevent bird mortality. **(2) Using materials like low reflective or opaque materials, visual markers applied to the glass with a maximum space of 50 mm by 50 mm, building integrative structures to mute the reflections of the glass.**[122] **(3) Balcony rails that are made of transparent materials within the first 12 meters should be treated with a grid no greater than 100 mm by 100 mm (4) Fly through conditions which are areas like the corners and parallel glass walls should be treated with a visual marker with a spacing no greater than 100 mm by 100 mm.**[123] **(5) Rooftop vegetation should treat the first 4 meters of glazing above the feature and a buffer of 2.5 meters on either side of the feature.**[124] **(6) All exterior light fixtures should be dark sky compliant which in short means any exterior lights must be turned off between the hours of 11 pm and 6 am** (See Figure 28).[125]

114 Timothy Beatley, *The Bird-Friendly City: Creating Safe Urban Habitat* (Washington: Island Press, 2020), 169.

115 Beatley, 158-159.

116 Beatley, 160.

117 Beatley, 160.

118 Beatley, 160.

119 Beatley, 160.

120 Timothy Beatley, *The Bird-Friendly City: Creating Safe Urban Habitat*, 162.

121 Beatley, 162.

122 Beatley, 162.

123 Beatley, 162.

124 Beatley, 162.

125 Beatley, 162.

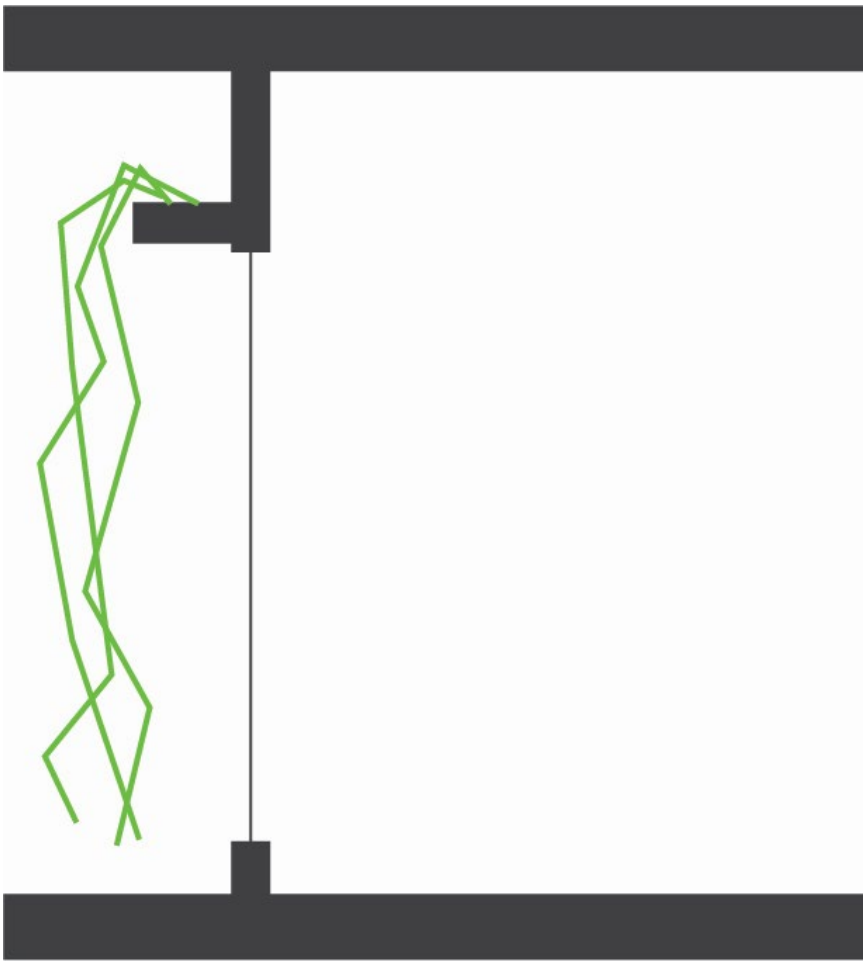


Figure 29: Living Green Shading Device.

3.5 LIGHTING AND SOLAR ENERGY

Artificial lighting is an interesting element in the city. While it creates a dynamic nighttime experience it hinders some species ability to move throughout the space while attracting others species like insects. Artificial light effects both humans and non-humans psychological and behavioural norms.[126] According to Ellen Schwartzel, (Ontario's acting environmental commissioner) "Nighttime darkness should be treated as part of a species' habitat - one that is worthy of the same level of protection as other habitat features."[127] Hypothetically, light pollution can be solved by turning off the lights at night, but there is a human need for lights for safety and travel that make it highly unlikely to remove all exterior lights. This means rethinking placements of the urban elements for the least amount of disruption. As stated in the the Designing for Birds section, there is a standard to exterior building lights that limits its nighly time of operation. But this does not extend to the interior spaces of the buildings that emit light nor street lights.

126 Therésa Jones and Kathryn McNamara, "Artificial Light at Night Can Change the Behaviour of All Animals, Not Just Humans," Phys.org (Phys.org, July 28, 2022), https://phys.org/news/2022-07-artificial-night-behaviour-animals-humans.html.
127 Therésa Jones and Kathryn McNamara, "Artificial Light at Night Can Change the Behaviour of All Animals, Not Just Humans."

Apart from placing an hours of operation on streets that share an edge with the natural ecosystems and parks, designing the city so that the roads are away from the parks so that the building infrastructure can block the lights. This means creating a new main street for nighttime travel that will limit the destruction to other animals lifestyles. Plants and different species of vegetation can become the natural curtains to buildings - a shading device for interior and exterior spatial qualities on top of becoming integrated with the exterior wall becoming a live wall (See Figure 29). Although the users of the building would have control over the windows these shading devices, having residents be aware of the effects light has and requiring shading devices be used to block artificial light at night.

Figure 30: Early Turkey Birdhouse.

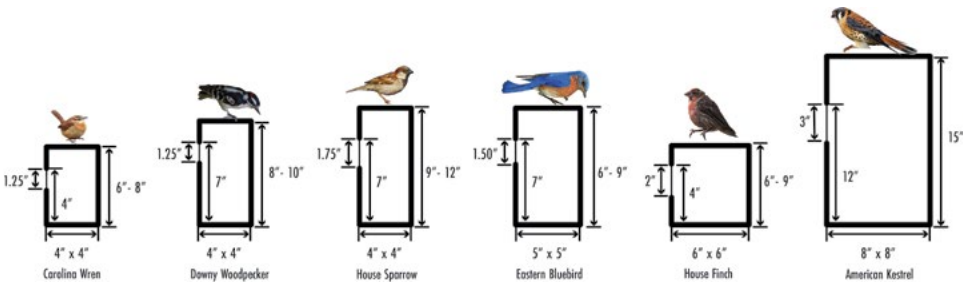


Figure 31: Birdhouse Dimension.

Figure 32: Birdhouse Facade.

3.6 BIRDHOUSE FACADE

Birdhouses have a history that dates back to thirteenth century Turkey (formally Anatolia) as the people highly valued birds (See Figure 30).[128] During this time, birdhouses reflected the current architectural styles of that period and symbolized the people's love and compassion for birds.[129] Additionally, birdhouses were a part of the architecture itself as many objects were situated on the external walls of buildings or openings carved into a stone wall.[130] Most of these birdhouses were made out of marble, brick, stone, tile and mortar and were usually carved out of these materials.[131] Currently, birdhouses are being used as a shelter for birds due to the lack of available habitats in the natural environment, hollows in dead trees or other small cavities.[132] Similarly there are designs for bird feeders that allow for residences to have direct interactions with birds.

The bird house facade design is another way that this interaction can happen within the building walls itself. From studying six different bird species, all of which are adapted to live in city parks (See Figure 31 and 32). The bird houses are designed based on the bird spatial needs for nesting and a series of them will be built at various heights from the ground or balcony floors. It is interesting to note that these homes may not be solely used for the birds that they are designed for. Like in the wild spaces - empty logs and burrows - different small species of animals can also use or interact with these spaces as well. Squirrels for example might use the dynamic facade as a means to easily scale up buildings in the city or might make their homes in the larger birdhouses. The bird house facade has the potential to create a more lively building exterior that is full of wildlife. Kate Orff argues that "Nature doesn't just come back into to the city without an invitation," artificial habitats mimics lost habitats which will foster their return into the urban environment.[133] Therefore, using visual cues like birdfeeders or other food sources can help attract bird species to explore urban balconies. Another strategy is making the space feel safe by using birds noises, chirping, as birds will identify that other birds are inhabiting that space and so it is safe for landing.[134]

128 Rahşan Özen, "Bird Shelters in Turkey: Birdhouses and Dovecotes," *Kafkas Universitesi Veteriner Fakultesi Dergisi* 18, no. 6 (2012): pp. 1079-1082, https://doi.org/10.9775/kvfd.2012.6337, 1080.

129 Özen, 1080.

130 Özen, 1080.

131 Özen, 1080.

132 Katie Valentine, "Build a Nest Box to Welcome Spring Birds," *National Audubon Society*, April 1, 2017, https://www.audubon.org/news/build-nest-box-welcome-spring-birds.

133 Kate Orff, *Toward an Urban Ecology*, 120.

134 Paul Dobraszcyk, Animal Architecture Beasts, Buildings and US (London, UK: Reaktion Books Ltd, 2023), 116. Identifies Logan's Meadow in Cambridge as the successful case study for this method.

Figure 33: Outdoor Living Walls in Toronto.

3.7 GREEN/LIVING WALL

Exterior walls make up the majority of hardscape surfaces in the city, therefore, covering them with a softer material will bring forth numerous benefits (See Figure 33). Green walls are vertical structures that house different plants, and other greenery.[135] Green walls are different from green facades. In green walls, the growth medium is on the wall's surface, which allows these components to have a built-in irrigation system.[136] Whereas green facades are rooted in the ground and, over time, grow enough to cover the entire wall.[137] The benefits include removing air pollutants, reducing urban temperatures and thermal conditions in the building, improving biodiversity, stormwater management, reducing noise, increasing productivity and creativity, improving the sense of well-being, and other health benefits.[138] Green walls have dimensional restraints, but consideration needs to be given to the amount of natural lighting, the seasonal condition (wind, pollution), and weight restriction to support the wall.[139] Canada is a cold climate; therefore, the following is an important question: How realistic is it that a green wall will be able to thrive in an environment of high winds carrying ice off the lake for several months of the year? First, it is important to note that green walls can survive in winter conditions. According to a study of the energy performance of buildings using green walls during winter weather, it states that "greatest benefits were associated with more extreme weather."[140] This means green walls can help reduce heat energy consumption during winter.[141] Experts in green infrastructure focus on Living walls in cold climates. In order to maintain green walls, specifically ones that use perennial plants, the soil must not dry out.[142] Another company suggests having monthly maintenance sessions.[143] The reason is to monitor moisture levels during winter and manually activate the irrigation system if necessary and reset the irrigation system at the end of winter, and trim and clean plants.[144] For the rest of the seasons, it is to check the system operation, moisture levels, and plant health.[145] This means that replacing the plants on green walls depends on the proper care and plant material.[146]

135 Naava, "What Are Green Walls - the Definition, Benefits, Design, and Greenery," Experience the power of Nature. Indoors. (Naava Group Oy, April 13, 2023), https://www.naava.io/editorial/what-are-green-walls.

136 Naava, "What Are Green Walls - the Definition, Benefits, Design, and Greenery,"

137 Naava, "What Are Green Walls - the Definition, Benefits, Design, and Greenery,"

138 Ashley Carlton, "What Are the Benefits of Green Walls?," Citygreen (Green Cities Urban Landscape Solutions, September 29, 2021), https://citygreen.com/what-are-the-benefits-of-green-walls/.

139 Naava, "What Are Green Walls - the Definition, Benefits, Design, and Greenery,"

140 Cameron, Ross W.F., Jane Taylor, and Martin Emmett. "A Hedera Green Façade – Energy Performance and Saving under Different Maritime-Temperate, Winter Weather Conditions." *Building and Environment 92*, no. Complete (October 1, 2015): 111–21. doi:10.1016/j.buildenv.2015.04.011.

141 Ross "A Hedera Green Façade – Energy Performance and Saving under Different Maritime-Temperate, Winter Weather Conditions."

142 Ross "A Hedera Green Façade – Energy Performance and Saving under Different Maritime-Temperate, Winter Weather Conditions."

143 "Maintenance - Livewall Vertical Plant Wall System," LiveWall Green Wall System, November 16, 2021, https://livewall.com/technical/maintenance/.

144 "Living Wall : Maintenance and Set-up: Vertiss the Green Wall." Vertiss, 2019. https://www.vertiss.net/mur-vegetal-entretien-mise-en-oeuvr?lang=en.

145 "Living Wall : Maintenance and Set-up: Vertiss the Green Wall."

146 "Maintenance - Livewall Vertical Plant Wall System."

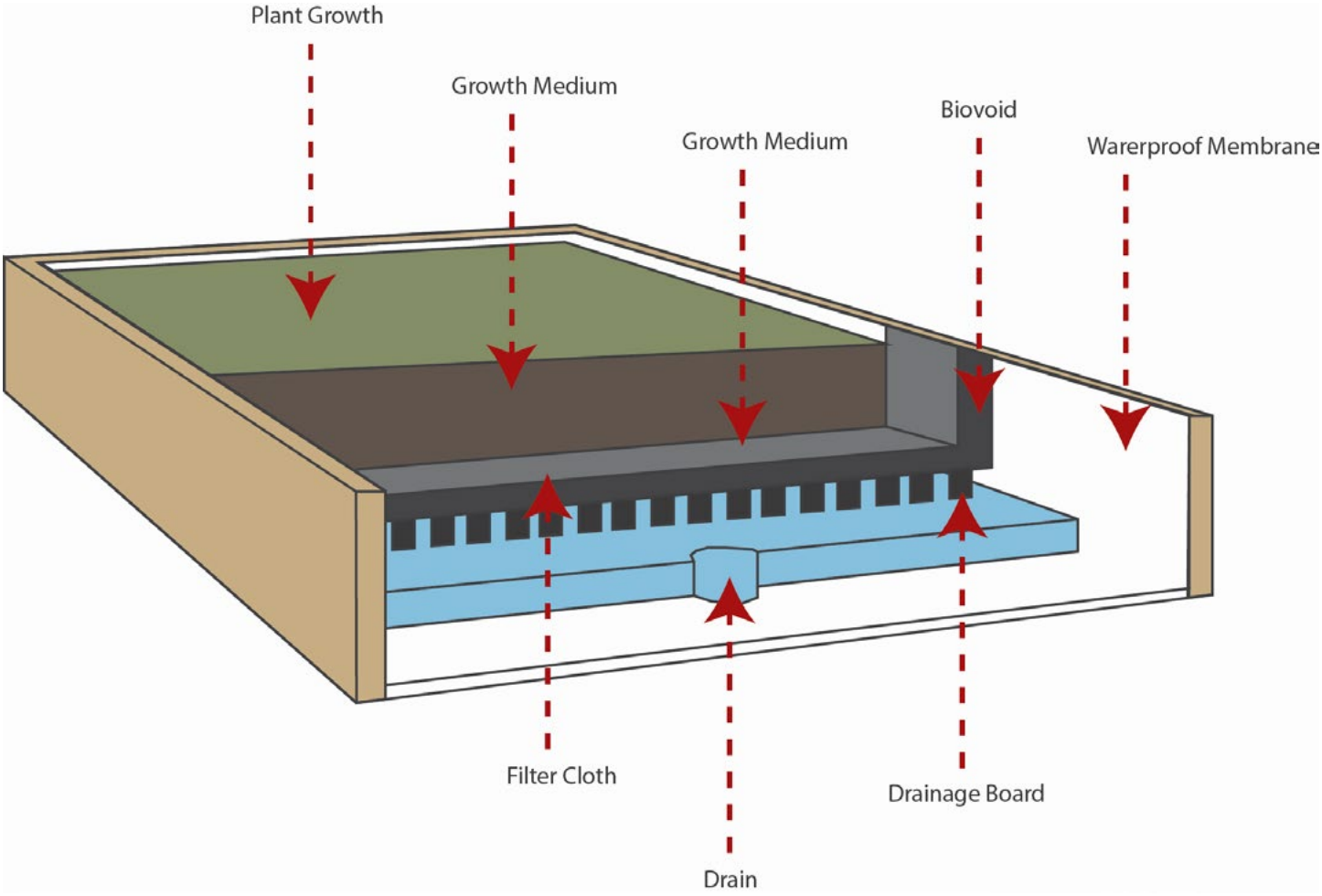


Figure 34: Green Roof Components.

3.8 GREEN ROOF STRATEGY

Green roofs absorb water, provides insulation, and are an optimal space to create homes for wildlife which helps lower the temperature on an average of three to eight degrees in the urban environment.[147] Toronto currently has a Green-Roof Bylaw in place which requires green roof to be designed within the architectural form. Currently, the by-law section of plant selection states, "vegetation on green roof shall not contain noxious weeds…"[148] Additional, it recommends the use of alphine species because it can "resist extreme conditions of heat, cold, high winds, extreme sun exposure and long drought periods."[149]

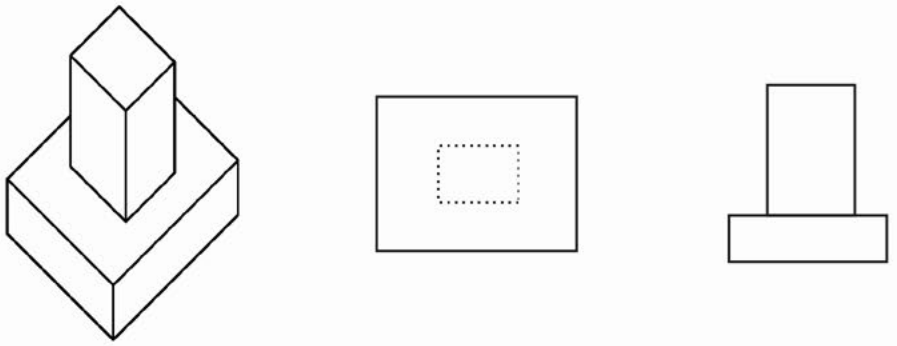
Flat roofs used in most mid- to high-rise building have the benefit of being an effective tool for stormwater collection. Currently, the by-law focuses on the green roofs and its biodiversity benefits which creates a missed opportunity to consider this in the overall building system - specifically in stormwater management. This thesis is reconsidering the exterior materials that make up the infrastructure of the city, this creates a problem of maintenance and part of that maintenance problems can be solved through water collection and extending the plumbing to an exterior sprinkler condition. Additionally, having an open water source can attract more insects, bats, and bird species to the site, which will create its own ecosystem where the plants benefit from the animals that interact with the site (See Figure 34).

147 Kate Orff, *Toward an Urban Ecology*, 56.

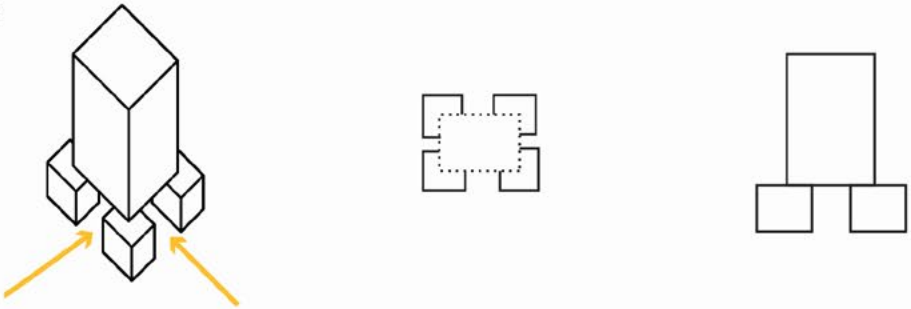
148 "Toronto Green Roof Construction Standard," City of Toronto (City of Toronto, 2017), https://www.toronto.ca/wp-content/uploads/2017/08/7eb7-Toronto-Green-Roof-Construction-Standard-Supplementary-Guidelines.pdf, 11.

149 "Toronto Green Roof Construction Standard," 11.

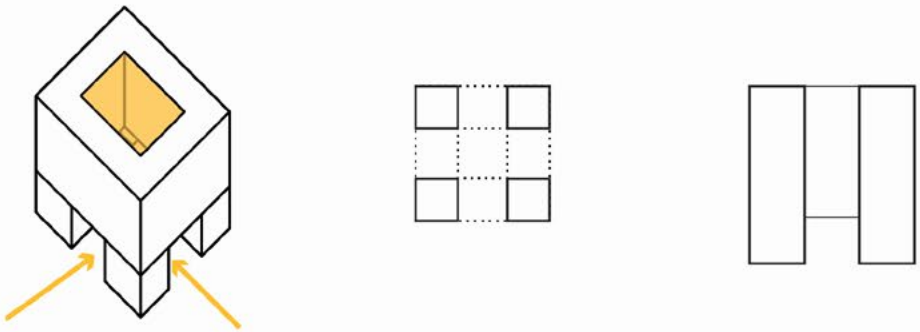
Tower on a Podum
Standard Building Typology



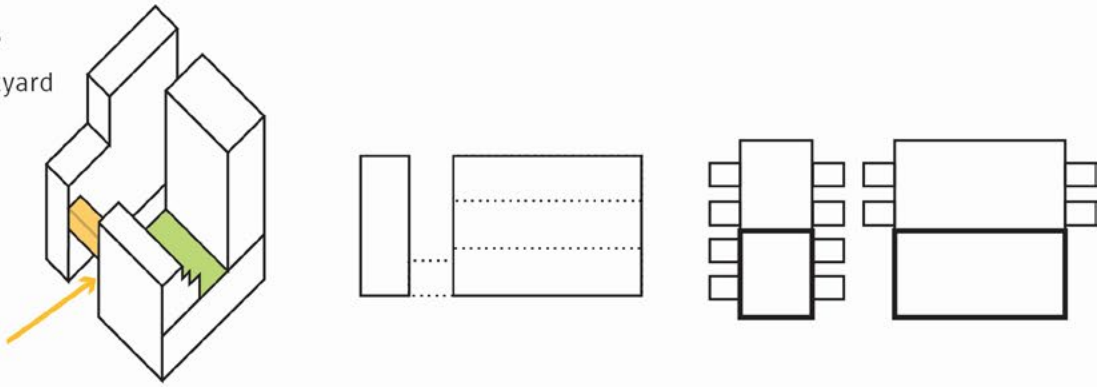
Tower on a Stilts
Creating Ground Floor Circulation



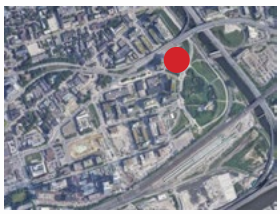
Courtyard on a Stilts
Opening a Space for Light



River City 1 and 2
Saucier + Perrotte Architects
Elevated Building Massing
Elevated Shared Green Courtyard



River City 3
Saucier + Perrotte Architects
Various Balcony Extrusion



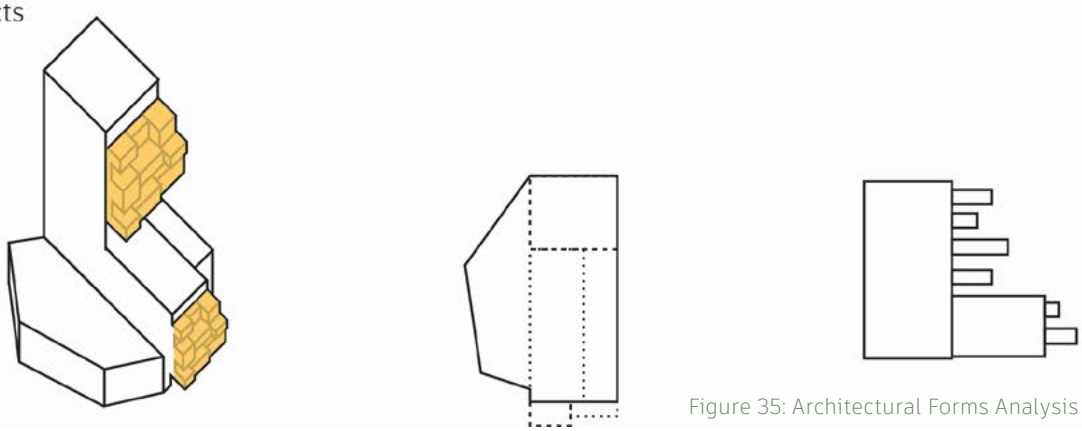


Figure 35: Architectural Forms Analysis 1.

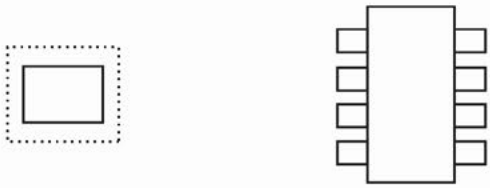
3.9 THE ARCHITECTURAL SCALE

The Architectural Scale section will be used to explore building massing and forms that explore the theories of landscape as a medium and biophilia discussed in previous sections as universal building forms. The intent is to gather a visual board of ideas to explore how nature can be brought into the architectural scale in addition to other non-human habitats and movements. The first three forms in Figure 35 explores the typical massing forms that are universally found in the city. It starts with a typical building from the **tower and the podium**, which is a universal design for tall buildings. The form can give green space on the podium and tower roofs, but the wide base makes it mandatory for ground-floor travel to move around it. Therefore the second iteration, the **tower on stilts**, looks at dividing the ground floor to allow for circulation under the building. This gives the opportunity to separate different program types, like commercial and residential, to open up the space for travel. The tower in the center, however, may block the light underneath the space of the building. The courtyard is a typical example of a universal massing form which can be found in numerous parts of the world. The courtyard is able to let light penetrate the floor below and allow for light onto the ground floor. Iteration three, the **courtyard on stilts**, looks at elevating this form to allow it to connect to a greater corridor of travel.

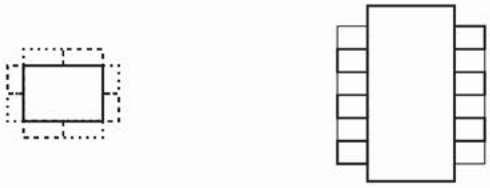
The last two massing and figurations forms look at the R**iver City buildings by Sacier + Perrotte Architects**. River City is located in the West Don Lands, which is directly north of the proposed site. River City is made up of three buildings that explore unique massing forms not typically seen in Toronto. River City one and two look at two massings connected by a bridge. This bridge allows for more building mass while allowing for movement on the ground floor. The second massing is similar to the tower on a podium typology, however, in this form, the tower is split in two. This split allows for the towers to view down to the green roof podium that it sits on. River City three looks at a unique "L" shape that emphasizes the balcony's unique extrusions. This iteration does not explore the potential for these "push and pull" balconies to become a host to green spaces and the interactions that animals can have with the overall exterior building envelope.

Exploring Forms of Habitat-Friendly Tall Mixed-Uses Buildings

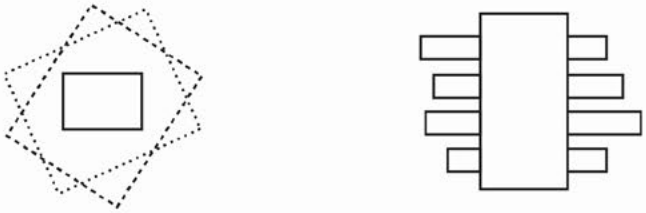
Tower with Balcony Rings
Exploring Balconies as Green Spaces



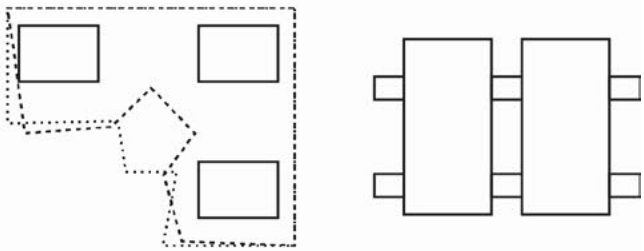
Tower Patterned Balcony
Exploring Balconies as Green Spaces



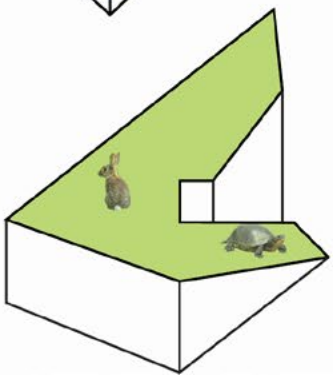
Rotating Balcony
Exploring Balconies as a Green Landscape



Flying Planame
Kevin Hemertck
Exploring Balconies as a Green Landscape



CopenHill
BIG
Exploring Balconies as Green Landscapes



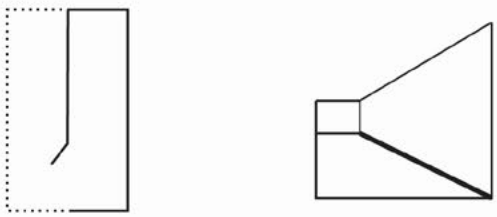


Figure 36: Architectural Forms Analysis 2.

The massings in Figure 36 look specifically at how the balconies can become green space, or how they can become landscapes that integrate themselves into the building. These forms are a series of sketches and case studies that look at the opportunity to extend nature on the vertical plane. The first two iterations explore typical balcony configurations. The **tower with balcony rings** is a showcase of connected balconies that offsets the perimeter of the tower. These rings allow for a continuous plane of green space. However, most of these forms typically offset the balconies to meet the minimum spatial requirements for residents to stand outside, or to have space for a small coffee table and chair (which is roughly two meters). The other typical balcony configuration is the **Patterned Balcony**, where the balconies are broken up per unit; this, like the iteration, usually meets the minimum spatial requirements. Therefore, the iteration of three **rotating balconies** look to explore the Tower with the rings configuration as a means to enhance its capability to host animals. By extending the balcony spaces to allow for a more biodiverse green roof and by rotating the rings light, it can reach more green space than if the space was connected linearly. The last two iterations are case studies; the first is a simplification of the design, **Flying Planame, by Kevin Hemertch** for the Evolo Skyscraper competition. It explores these extended landscapes that host not only opportunities for animal habitats but also recreational parks. The changing shape of the landscape allows for levels to become private residential spaces or shared park spaces. The last iteration is **CopenHill by BIG** which brings the landscape onto the roof from the ground level. This design move can become a literal bridge for ground-floor animals to move around the city.

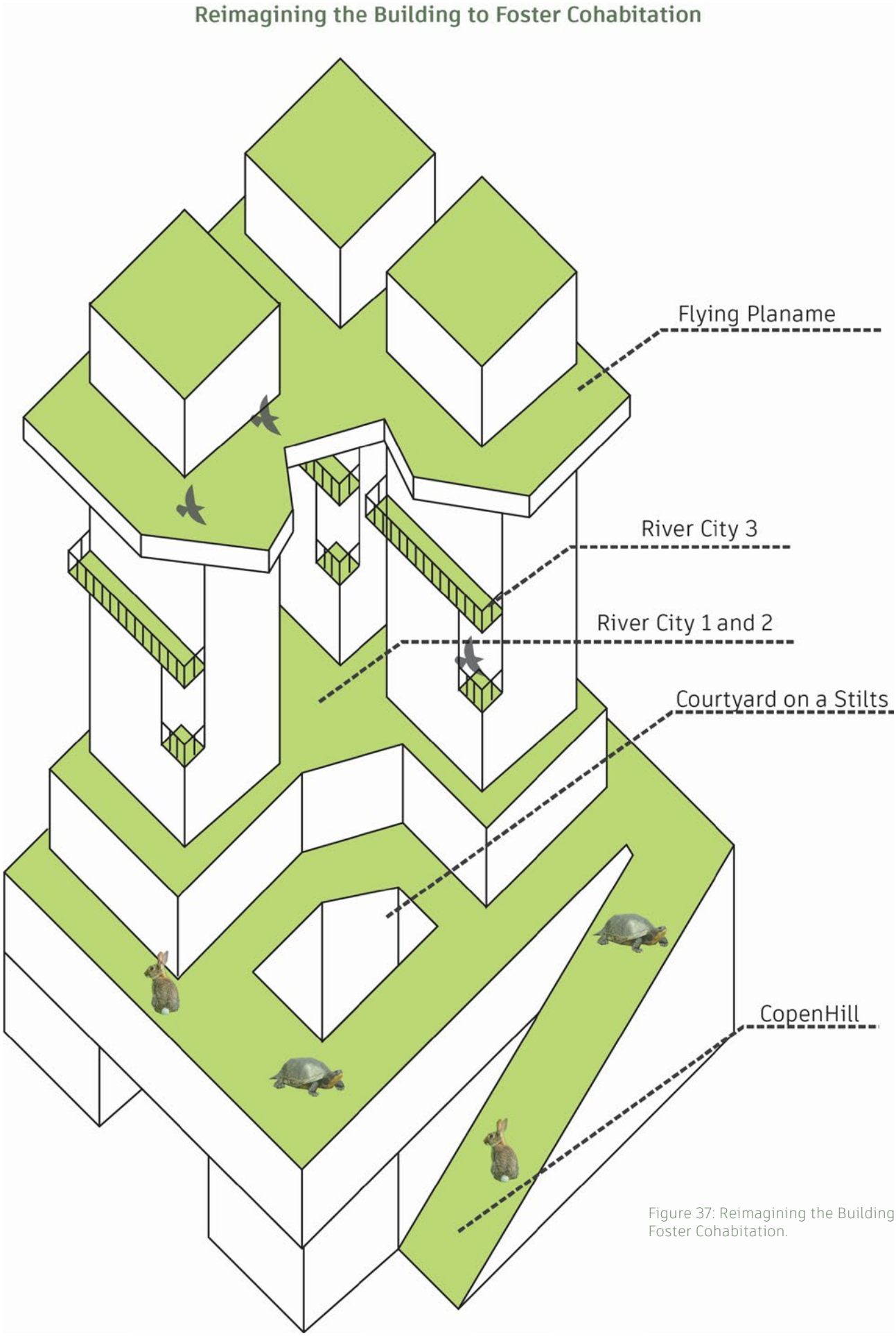


Figure 37: Reimagining the Building to Foster Cohabitation.

Figure 37 looks at a sketch that attempts to bring these massing forms together to create an imagined massing form. The form takes the courtyard on stilts to create a commercial active ground floor, which allows for light to provide nice courtyard green spaces for humans and non-humans that circulate through. The second floor uses the CopenHill strategy which extends the landscape into the building itself allowing more nature and small non-human species to inhabit roof space. This has the potential to become a residential amenity space for residents to rent out which will give a unique experience of being surrounded by nature from their own homes. The upper floors combine the strategies of River City three and Flying Planame to create these balcony forms that provide space for the residents while still continuing the green space on the vertical level. The green roof continues this organic shape to allow views of the wildlife landscape below.

This part of the thesis booklet incorporates the building components from the previous chapter and looks at how elements of the natural environment can immerse itself into the building envelope or work with the efficient energy solutions. These components will define the final design and massing of the architectural form, which will define the overall urban context. This part will also look at the regional scale and how solutions that are applied to the new development in and around the Port Lands can extend the ravine system.

4.0 FINAL DESIGN PROPOSAL

FINAL DESIGN PROPOSAL

4.1 PROJECT DESIGN

The design of the thesis proposal will be discussed in this section of the booklet. This section will use strategies gained from the previous sections to start to inform the design decisions of the proposal. The proposal aims to foster cohabitation through the architectural form designed for mix-use residential, mid-rise buildings. The first part of this section will look at the urban design, starting from the urban design strategies and to how these plans aim to link themselves with the greater Don River ravine system. The urban plan will then help inform the design and placement of the forms and ways the landscape to start climbing the exterior envelope of the overall massing. The massing will explore how the building components can start to work together as a single building.

4.2 SHADOW STUDY

Before designing the green spaces on the site, a shadow study was conducted using Revit with the new proposal within the massing of the Villiers Islands' current plan. First, a shadow study was used to define the quality of light that was able to penetrate the city's south edge. The shadow study shown in Figures 38-41 looks at four different months: March 21, June 21, September 21, and December 21. The images are then overlaid with shadows taken at four specific hours of the day, which are at 9:00 am, 12:00 pm and 3:00 pm throughout the day. In all four figures, the shadow study identifies that the corridors opened on the north-south axis allow the most sunlight to penetrate the site. This means that placing the ecological corridors along this north-south edge will allow a lot of sunlight to penetrate through the day despite the scale of the buildings proposed to be on the site. In comparison, the areas on the east-west edge receive the most sunlight during the day, except for the June 21 study, which shows that more light is received on the ground floor on the east-west axis between the thesis design proposal buildings. Overall, since the east-west axis is mainly concealed with shadows during most of the year, activities that do not require a lot of light, like roadways, will be placed along those edges or permeable hardscape materials to allow for extensions of the commercial floor during the summer months. This will help inform the urban design strategies on the site.

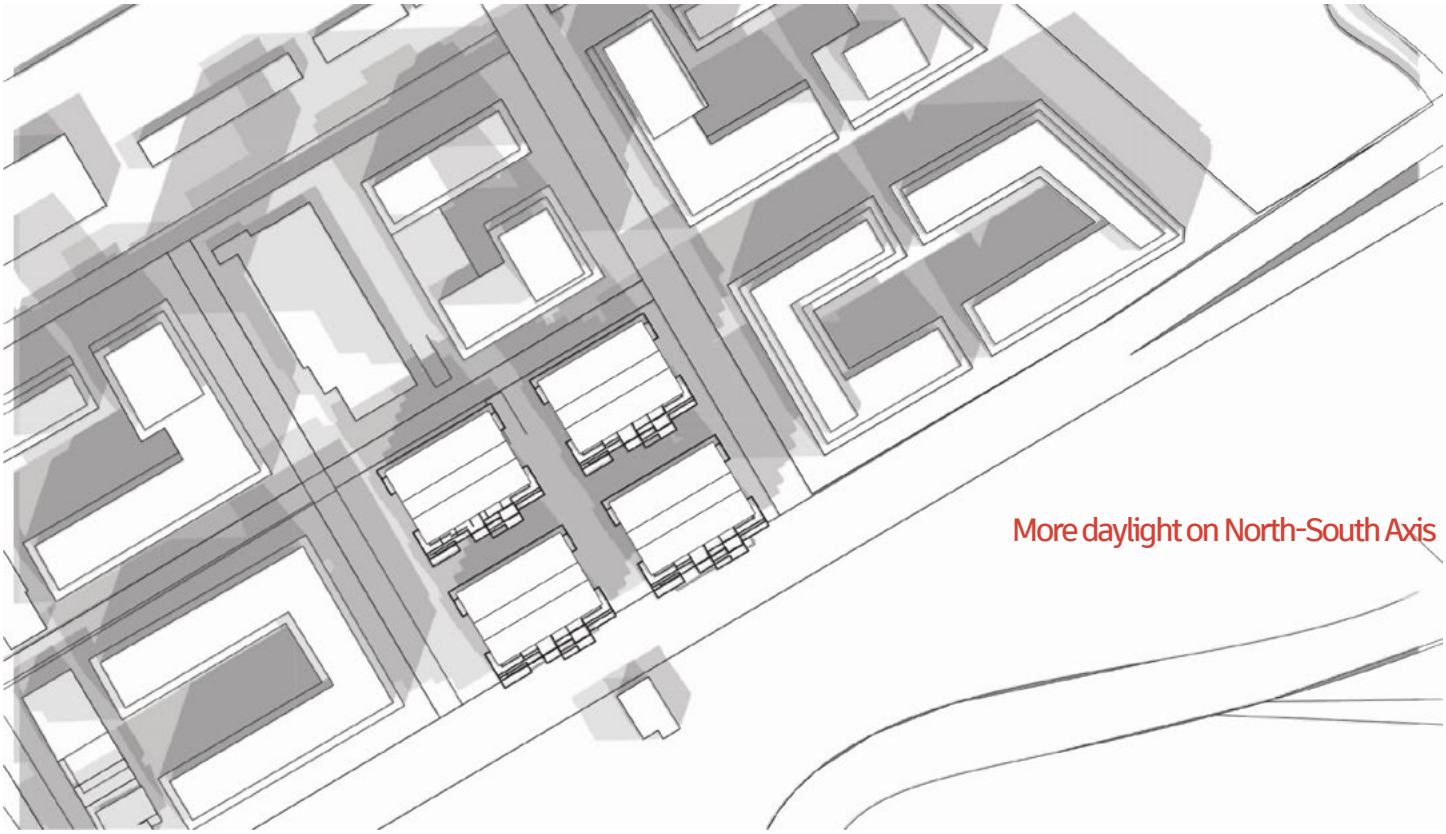


Figure 38: Shadow Study March 21, 9am,12pm and 3pm.

Figure 39: Shadow Study June 21, 9am,12pm and 3pm.

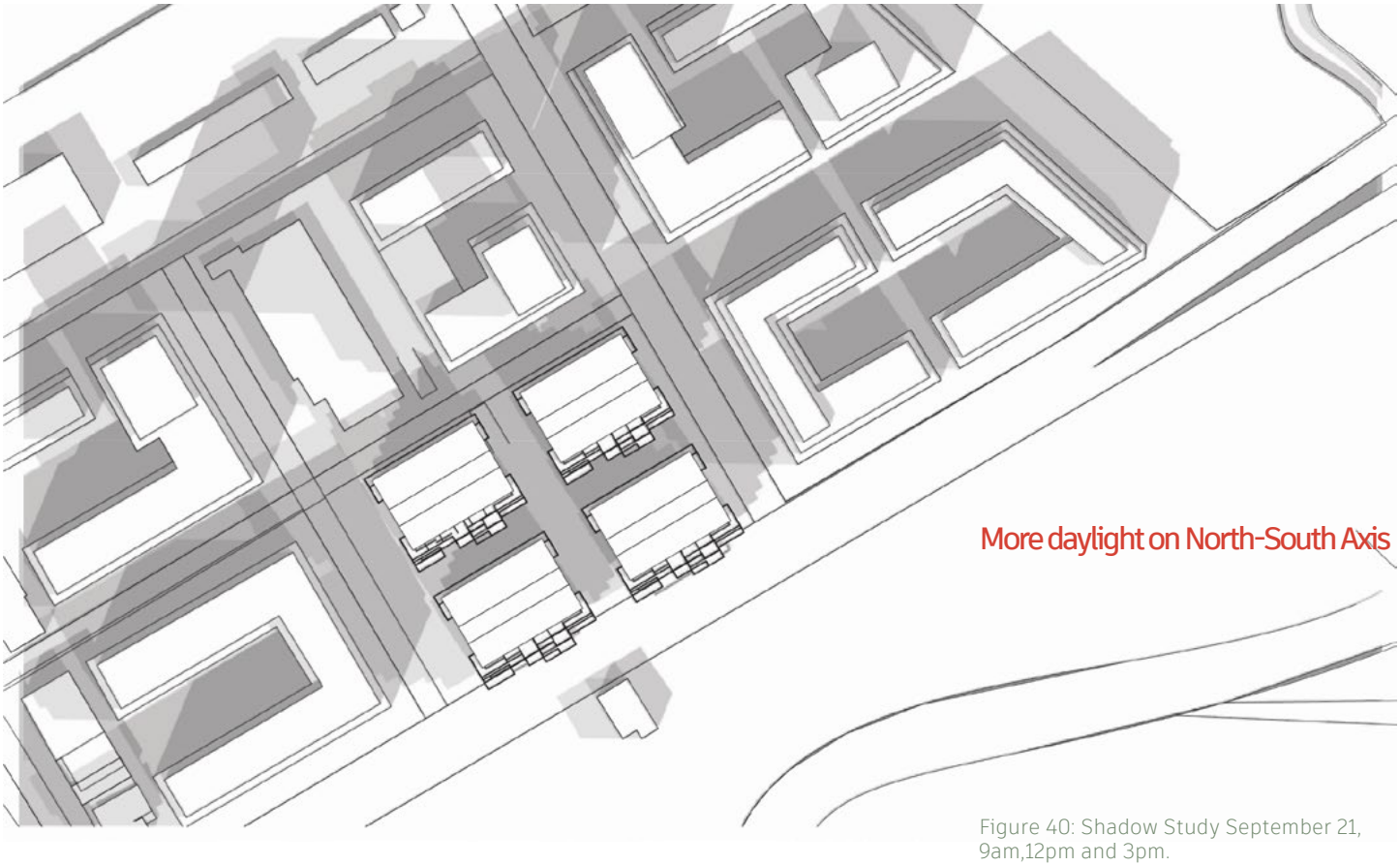


Figure 40: Shadow Study September 21, 9am,12pm and 3pm.

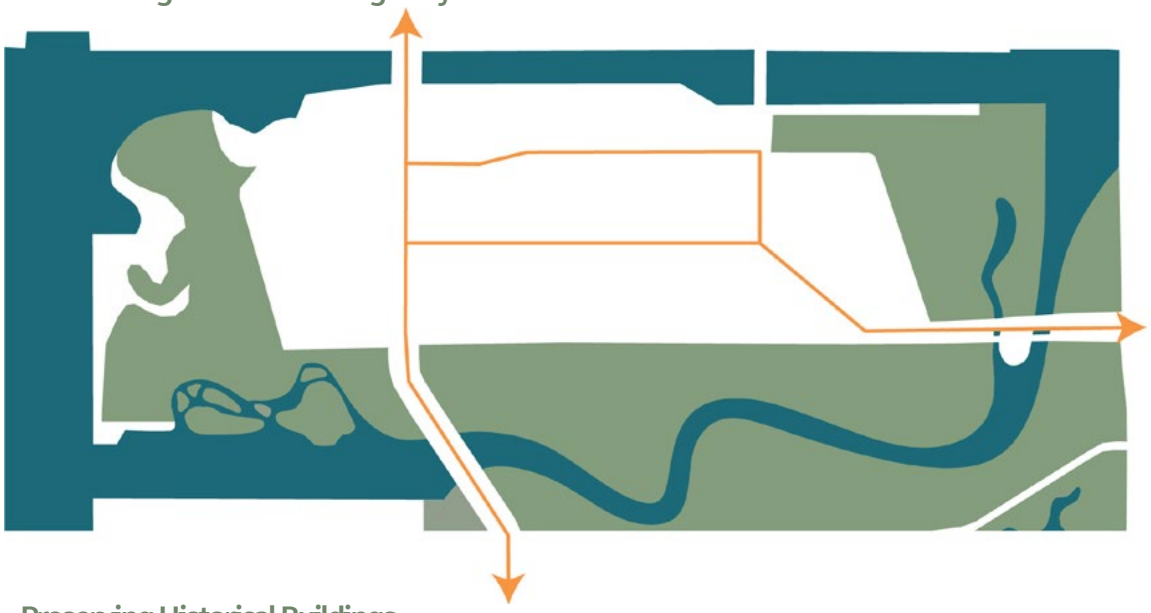
Figure 41: Shadow Study December 21, 9am,12pm and 3pm.

4.3 URBAN STRATEGIES

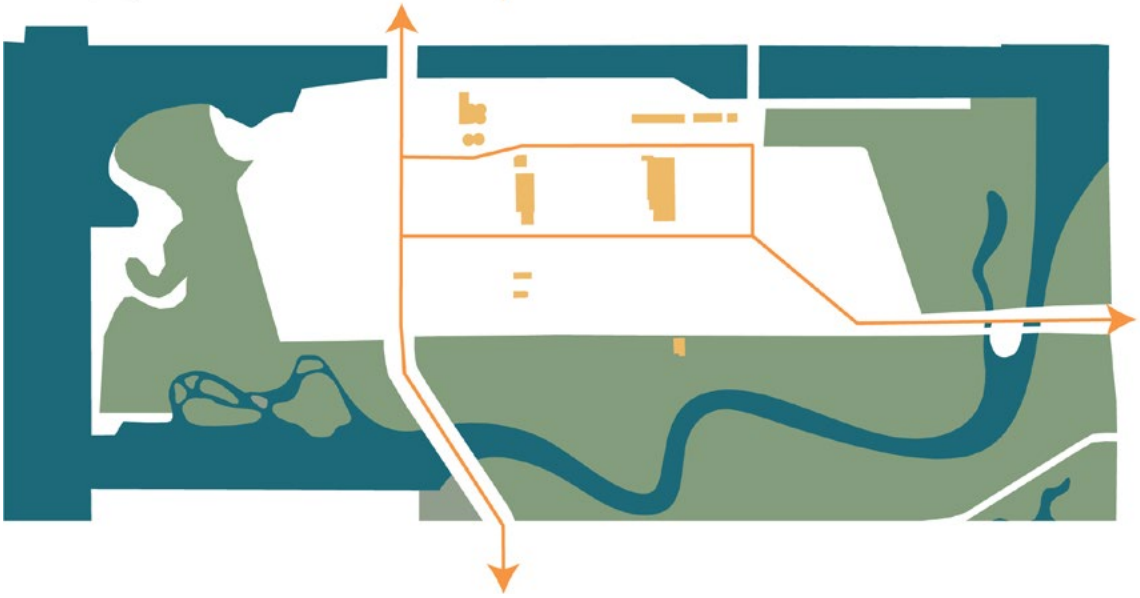
The first step to fostering animals in the city, is creating a more permeable city which requires more vegetation. In the Villiers Island Analysis section, the proposal was critiqued for having a pocket of urban space without any meaningful green space for wildlife. Additionally, the roads split this site and take up more space than necessary for circulation. Figure 42 shows urban strategies' designs that aim to address these issues. The first is to rethink the circulation around the site. Having circulation that surrounds each block on both sides is not necessary to access the buildings on site. Therefore, removing the roads along the green edge and making the center the main travel path for circulation prevents redundancy. Moving the streets away from the green parks, also means removing the exterior lighting for cars away from the natural park where the building infrastructure can help block a majority of the light. This will allow the park to extend into the urban perimeter and the edge between them. It is additionally replacing Commissioner Street to become more permeable and create a wildlife and pedestrian-friendly site for movement. The following strategy is extending nature using arms through the site, similar to the Atelier Griot's competition submission, using ecological corridors and bioswales. This will allow for animal pathways through the city and across Lake Shore Boulevard to other nodes of nature within the vicinity. The design of the ecological corridors will use the metric of 50 meters as established in the building component section. Next, is creating a porous ground floor for proposed buildings that promote movement throughout the site. This will create more opportunities for shops to have outdoor spaces for restaurant seating and courtyard spaces, allowing for nature to be embedded into the daily routine of residents. It will also create a unique city experience, as these corridors that foster animals will coexist alongside human activity.

The amount of greenery will foster a balance of biodiversity of humans and non-humans, which aims to match the urban land use percentages from the Mouth of the Don Competition entries. The Stoss and Girot submissions have around 25-30 percent of urban space and 70-75 percent of natural area compared to the current Villiers Island plan, which is roughly 45 (natural)-55 (urban) percent of the site. Therefore, the aim is to get close to the same land percentages as the other two submissions for this site. Figure 43 shows the finalized annotated master plan of the site. As stated in the urban strategies, the ecological corridors will replace roads that are not required for circulation, which means removing the access hardscaping from the plan and identifying the animal crossing bridges on the north edge of the site. The ecological corridors needs to be 50 meters long, the recommended length to support an animal crossing bridge discussed in the previous chapter. Figure 44 shows the proposed urban plan percentages if all the unnecessary north to south streets were replaced with the 50 meter wide ecological corridors and compares it to Valkenburgh's plan for the site (See Figure 45). This would give the site 35 percent of urban space to 65 percent of natural space.

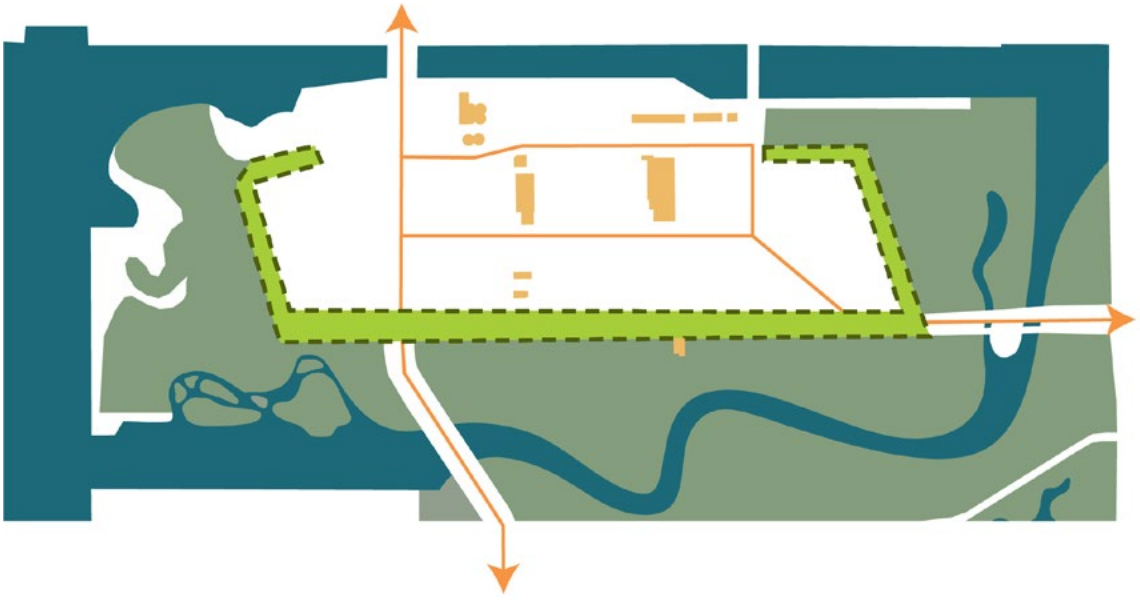
Minimaizing Vehicular Passageways



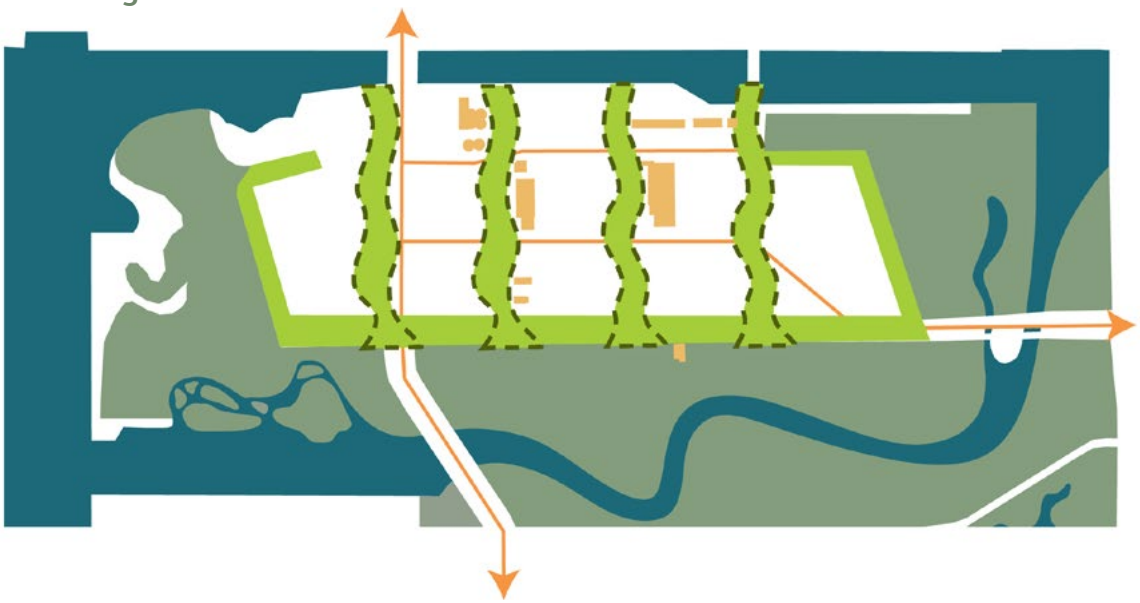
Preserving Historical Buildings



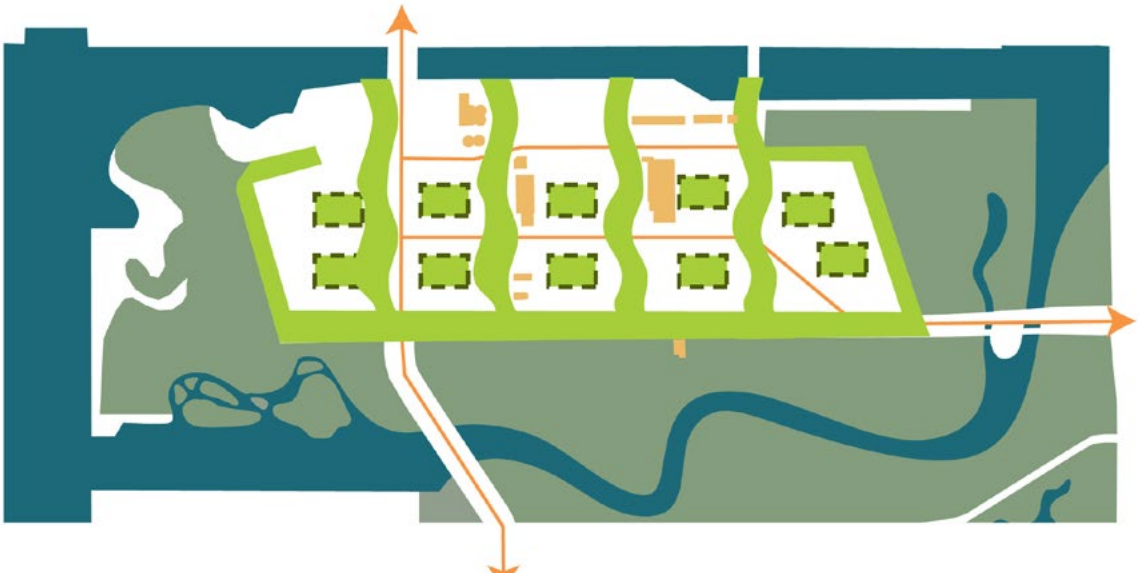
Extending to the Architectural Building Edge



Extending Green Arms



Establishing Green Nodes



Creating Porous Building Forms to Connect Green Spaces

Figure 42. Urban Strategy.

1 Valkenburgh`s Plan in construction
2 Ecological Corridors
3 Ecological Corridor connectig to Corktown Commons
4 New Commissioner Greenway
5 Proposed Architectural Design
6 New Green Edge
7 New Green Edge Park

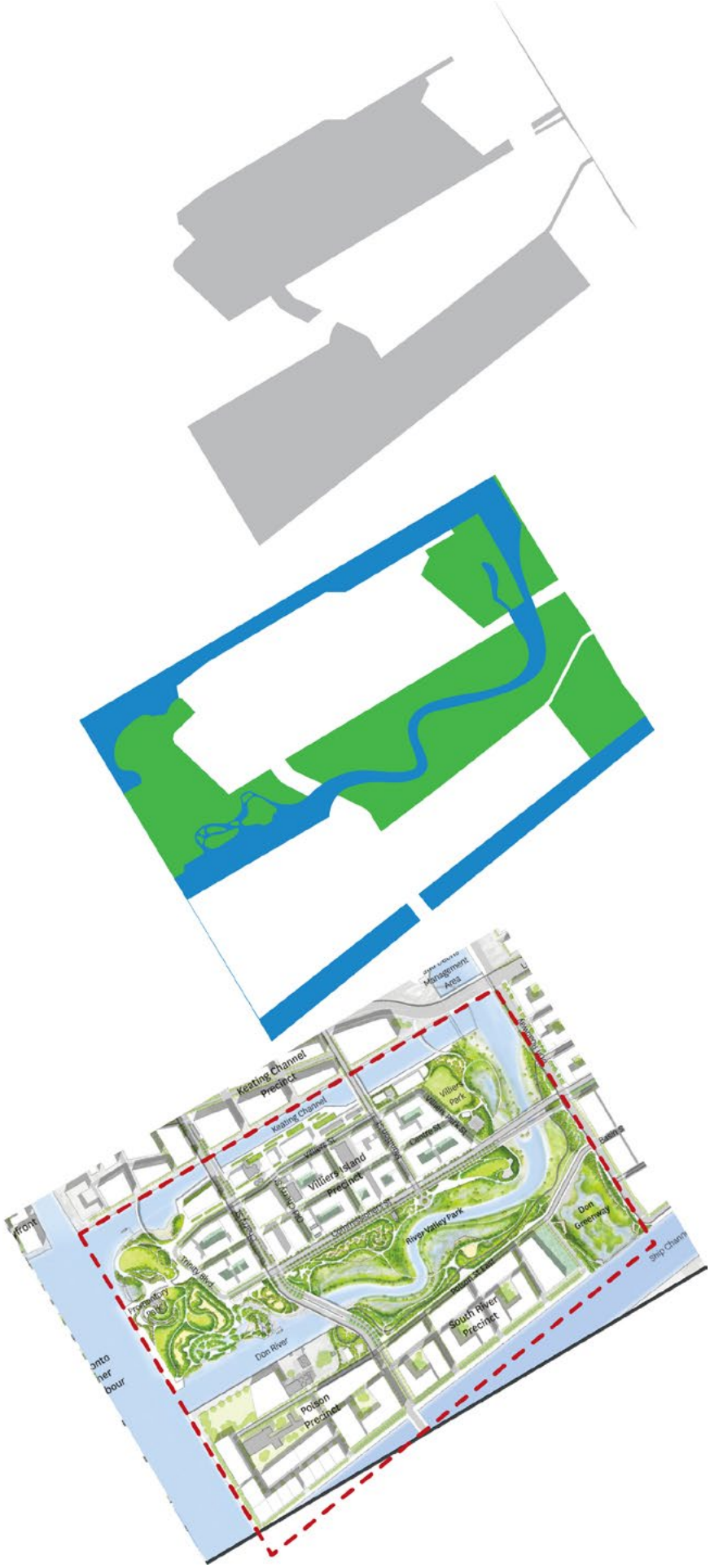
Figure 43: Proposed Villiers Island Master Plan.

Urban Area: 34.4 ha

Natural Area: 50.6 ha
Water: 20.6 ha
Green: 40.5 ha

Total Area: 95.5 ha

Figure 44: Proposed Master Plan- Land Use Comparison.



Urban Area: 45 ha

Natural Area: 50.6 ha
Water: 20.6 ha
Green: 30 ha

Total Area: 95.5 ha

Figure 45: Valkenburgh and Associates' Mouth of the Don Competition - Land Use Comparison.

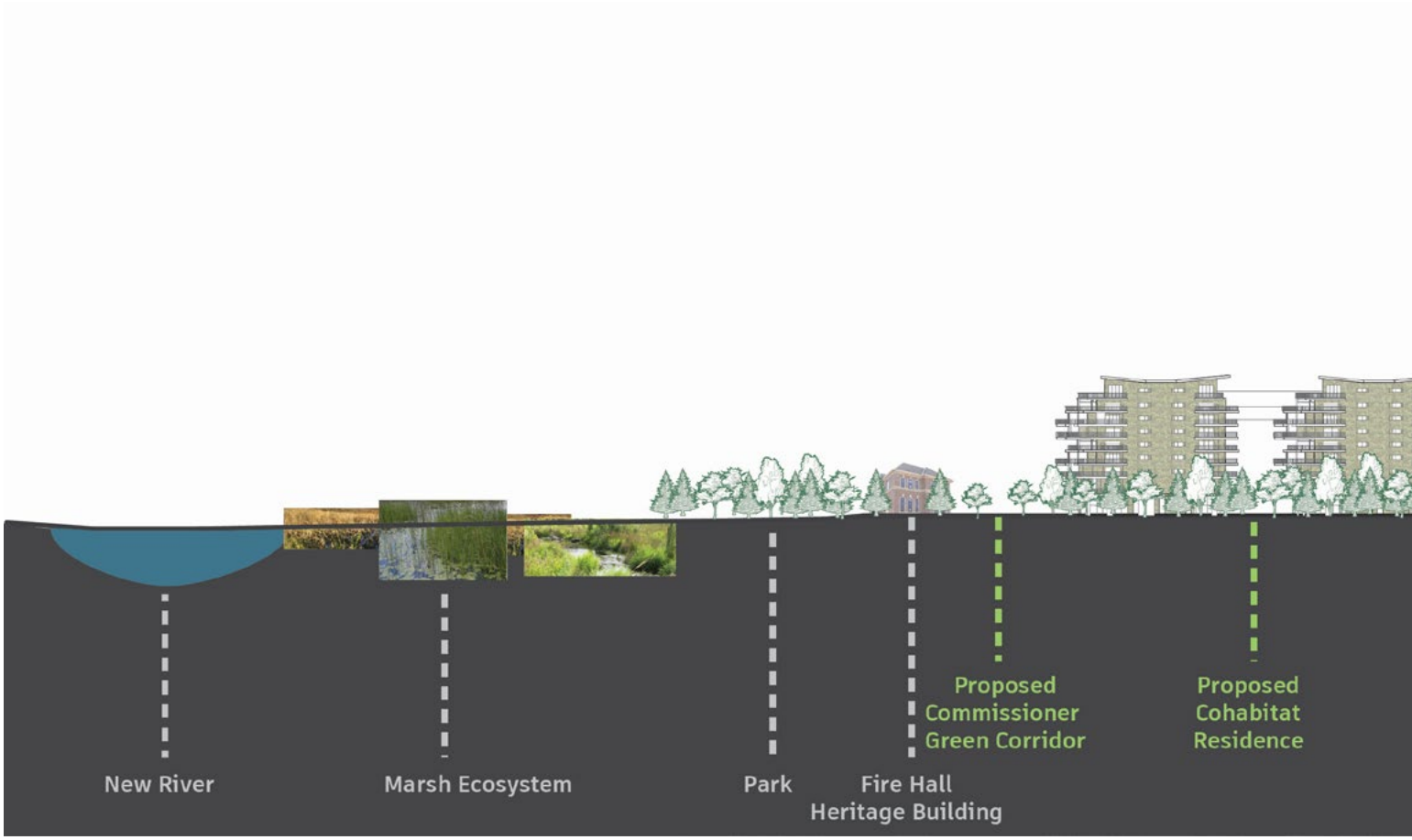


Figure 46: Transect through Ecological Corridor from New River to Lake Shore Boulevard.

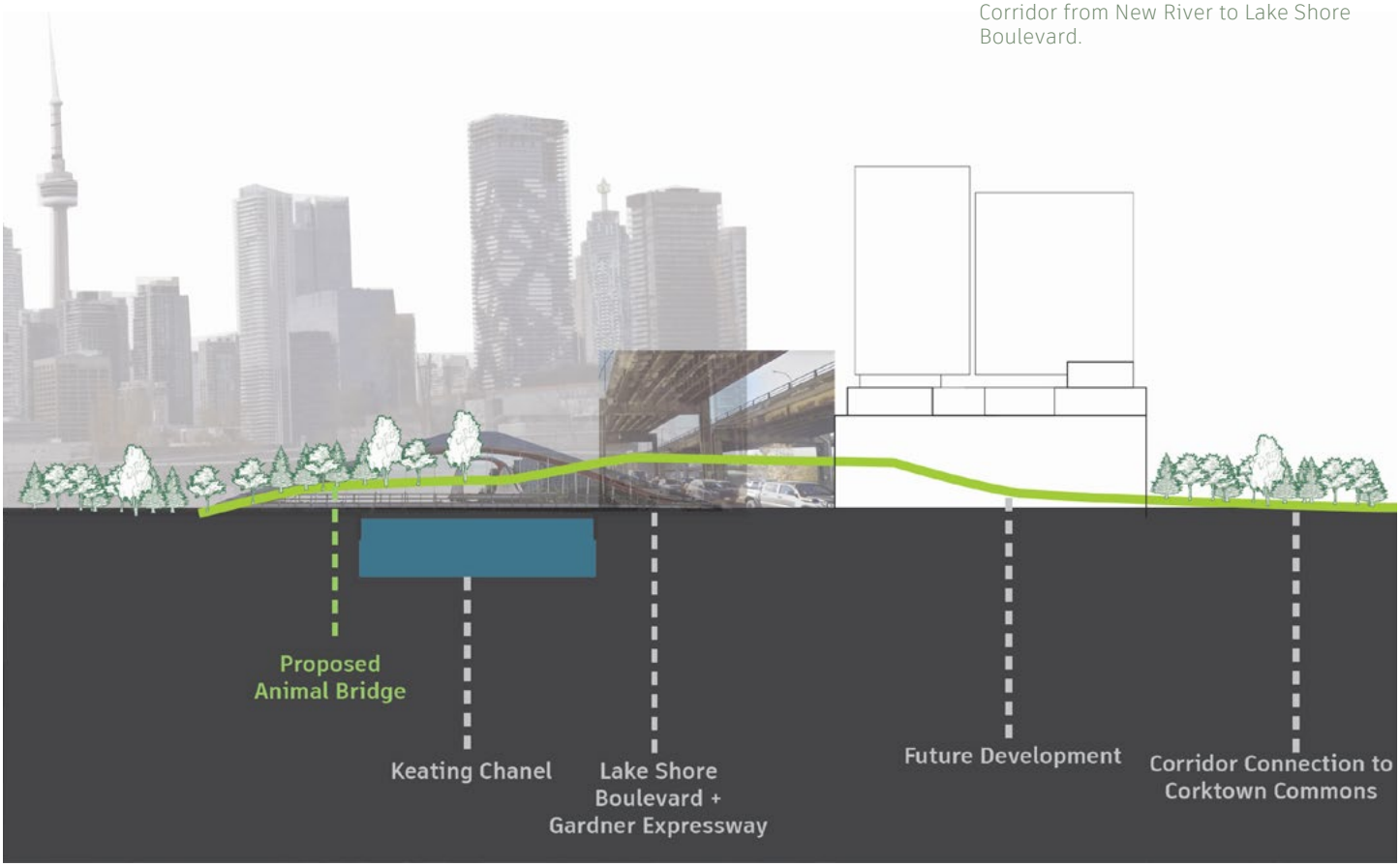


Figure 47: Transect through Ecological Corridor from New River to Lake Shore Boulevard.

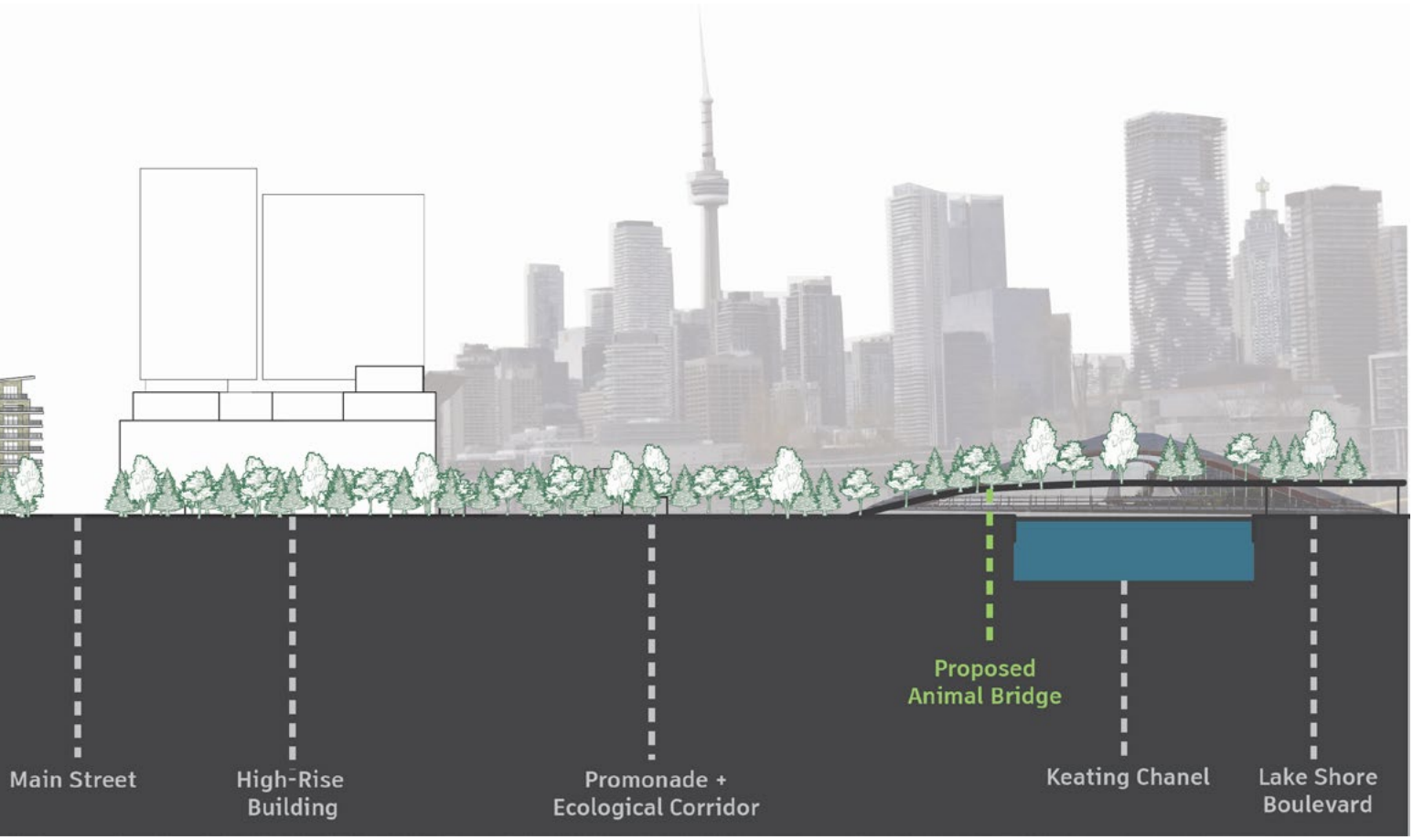


Figure 46 diagrams the ecological corridor that connects the New River on the left to the animal crossing bridge. Figure 47 shows a diagram of this proposed bridge that images itself weaving through the infrastructure of Lake Shore Boulevard, under the Gardiner Expressway and over the tracks to connect to the Corktown Commons Park. This can then be imagined to connect to the bigger picture of the city's parks following Bayview Avenue and connecting to the Don River Ravine system (See Figure 48). Figure 49 shows a diagram of the ecological corridor highlighting how streams and animals can start to use the site to move back and forth between the sites. The different building heights and overhangs can decorate the area creating a unique atmosphere for residents and visitors to experience the site. This diagram shows how landscape as a medium and biophilia work to paint wildlife vegetation from the corridor and onto the building itself, creating visual frames directly into nature. These views will allow residents to experience nature into their daily routines as they circulate the site.

Figure 48: Blanding Turtle's Travel Area.

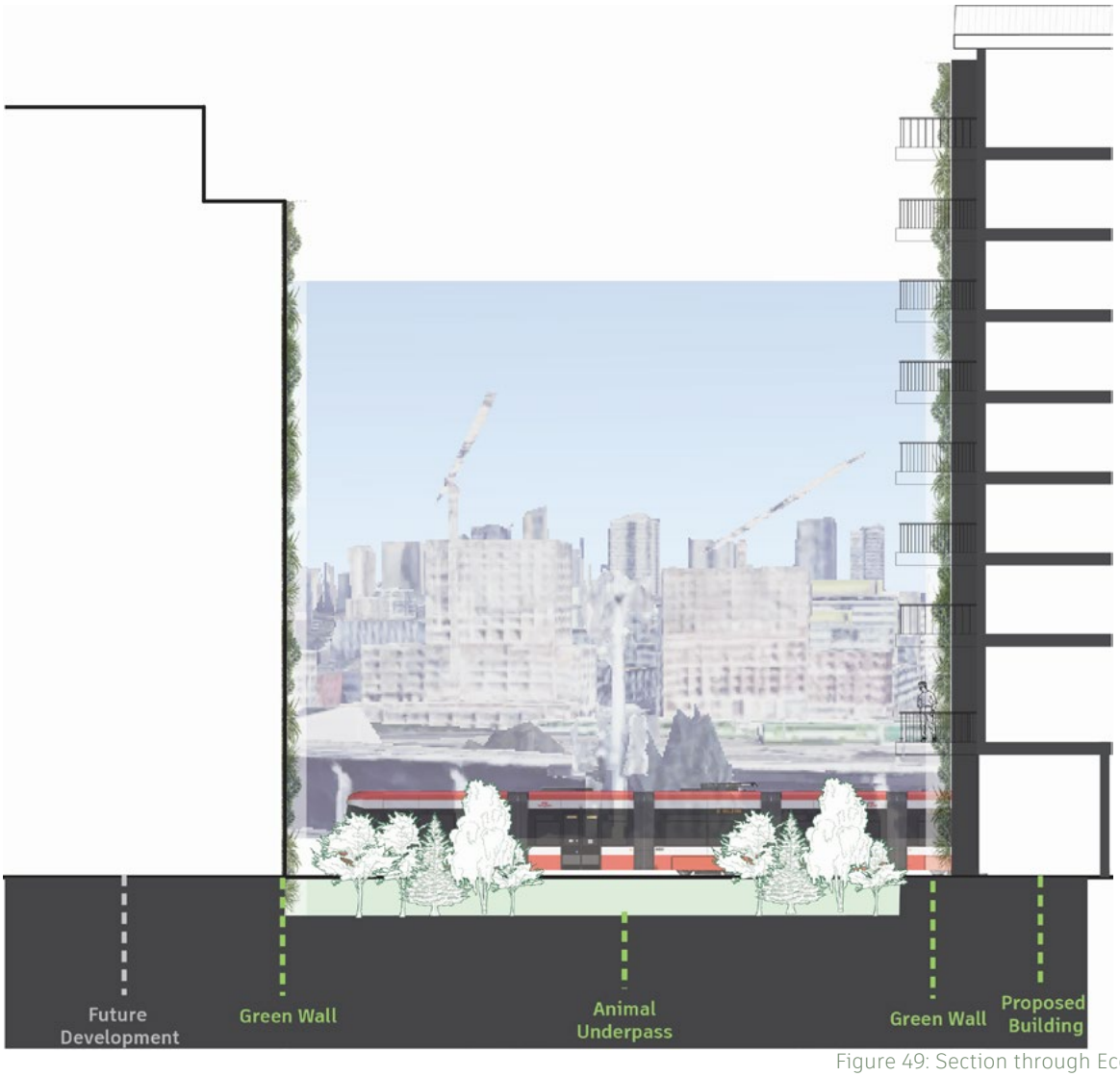


Figure 49: Section through Ecological Corridor.

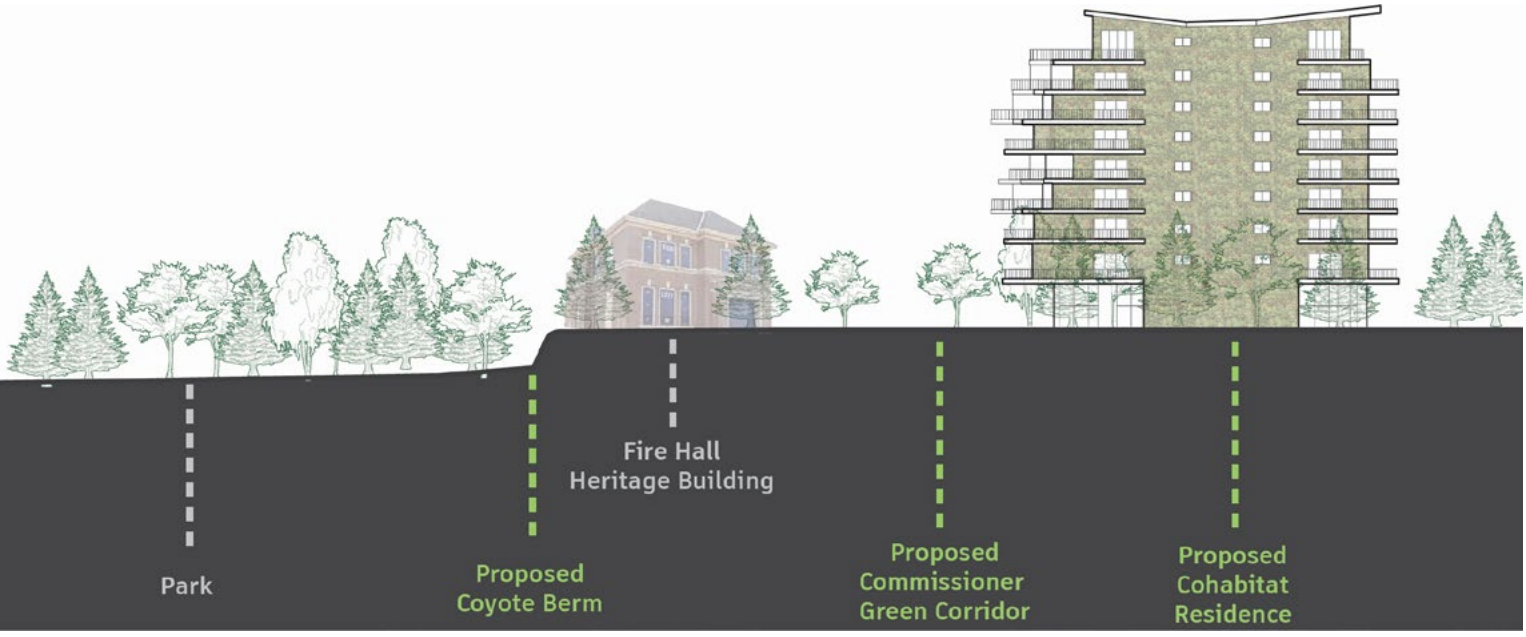


Figure 50: Transect through New River to Proposed Design.

Figure 51: Co-Existing with Coyotes Poster.

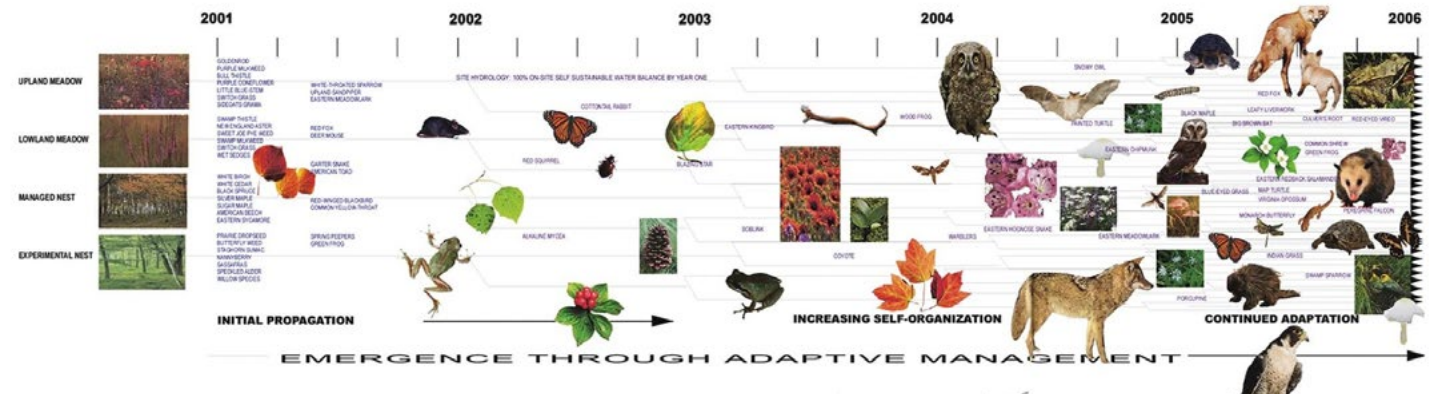


Figure 52: A New Ecology, Emergence and Adaptation at Downsview Park. by James Corner, Stan Allen, and Nina-Marie Lister.

4.4 THE UNINTENDED CONSEQUENCES

There are some unintended consequences to attracting animals into the city. For example, coyotes or other predatory species might enter the city. Animals will hunt each other and die, and the remains of these animals will be left in the city. However, these negativities already happen in the city and would not be a result of the suggested designs. Currently, animals like coyotes are more adapted to urban environments and human activities. A large ecosystem will invite them to explore the edges of the urban landscape regardless of design proposals and components. One crucial aspect to consider is a safety measure for undesirable or unsafe animals in the urban environment, like coyotes.

Coyotes are a species that are not hindered by the urban environment as long as the site meets their spatial requirements. This means considering ideas on how to monitor the site and ecological corridors. Another important strategy is bringing awareness to the situation if coyotes are going to be the neighbourhoods of the human residents (See Figure 51). How will the city, the managers of the residential and commercial buildings, the school, and the community center let the user become aware of the dangers within the site? Vancouver is a great case study that explores how humans can coexist with coyotes. This includes a number of initiatives taken by the Stanley Park Ecology Society (SPES) to educate and advise residents about coyotes.[150] The first thing to note is that coyotes are attracted to urban areas that have a lot of space and food sources.[151] Coyotes, for the most part, will actively avoid interactions with humans in the daytime and mostly hunt during the night, although they are active during the day and night.[152] One thing the SPES does is actively record the number of coyote sightings in the area to identify increasing activity.[153]

A big part of coyote safety is to understand that they are more scared of humans, so key behaviours like not running away, acting aggressively, and shouting will scare the coyote and alert others of its presence.[154] Figure 50 shows another solution on the south half of the ecological corridor connecting with the natural ecosystems of the river. According to Stanley Park Ecology Society in Vancouver, coyotes are unable to jump over 2-meter barriers. [155] This can be done by creating a berm, a hedge or a regular fence. This design proposal will take advantage of the sites changing landscape by using soil that was excavated to incorporate a 2 meter high berm into the overall site.

150 "Understanding Urban Coyotes," Stanley Park Ecology Society (SPES), September 13, 2021, https://stanleyparkecology.ca/ecology/co-existing-with-coyotes/understanding-urban-coyotes/.

151 Timothy Beatley, *Handbook of Biophilic City Planning and Design* (Washington: Island Press, 2016), 4.

152 "Understanding Urban Coyotes," Stanley Park Ecology Society (SPES), September 13, 2021, https://stanleyparkecology.ca/ecology/co-existing-with-coyotes/understanding-urban-coyotes/.

153 "Understanding Urban Coyotes."

154 "How to Co-Exist with Coyotes," Stanley Park Ecology Society (SPES), September 13, 2021, https://stanleyparkecology.ca/ecology/co-existing-with-coyotes/how-to-co-exist-with-coyotes/.

155 "How to Co-Exist with Coyotes."

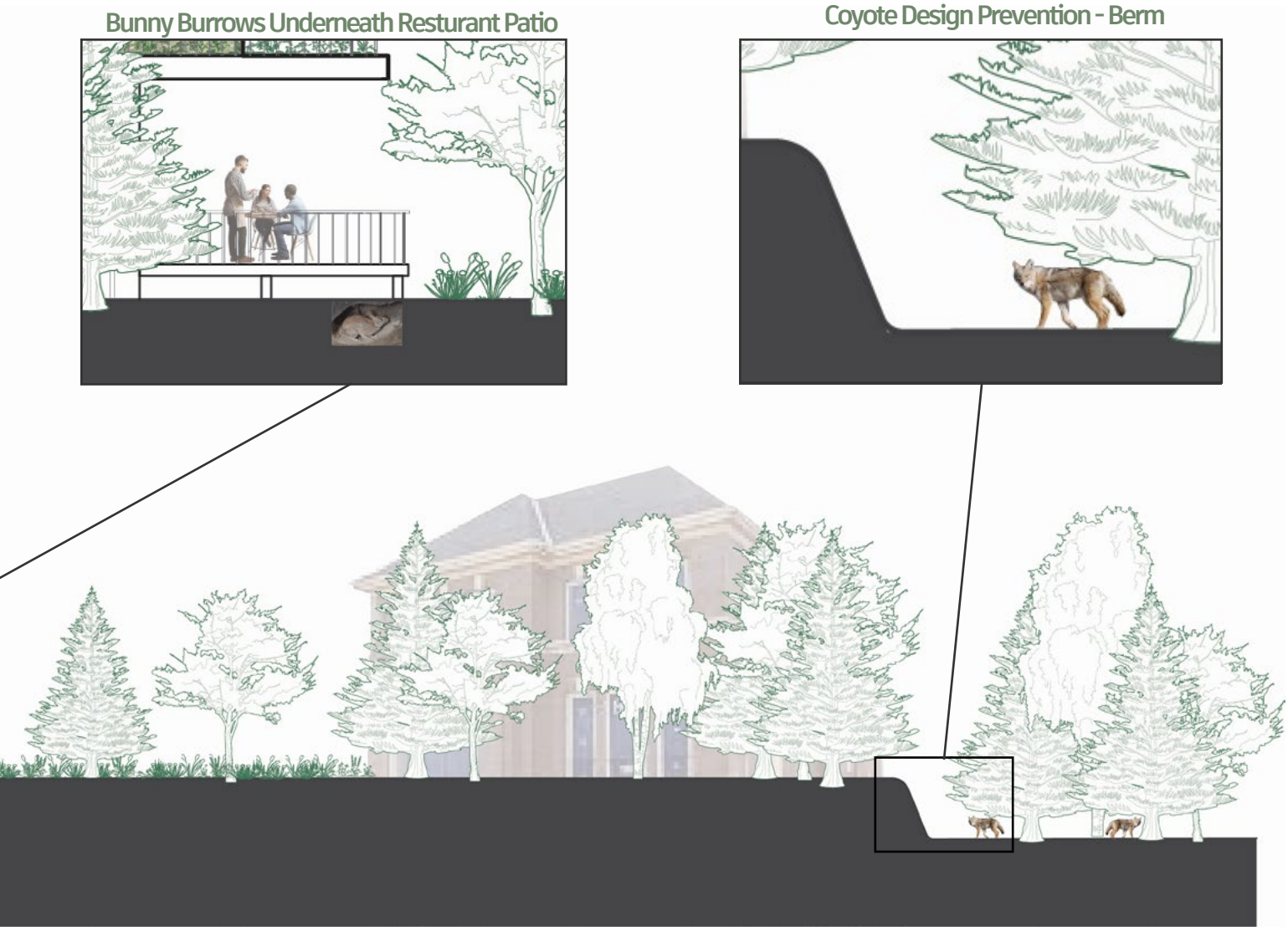


Figure 53: Berm Design - Coyote Barrier.

Figure 53 shows how this 2 meter high berm can be integrated into the landscape to prevent coyotes from entering the site while preserving pedestrians view of the natural landscape. The figure also shows the ecological corridor opening into the extended parkway for humans and non-humans to share. The west and east elevations of the building shows the use of the green wall along the building. These green walls along the east and west sides create a relationship between the ecological corridor by giving a continuous coating of natural elements and lessening the impacts of the surrounding building.

Figure 54: Proposed Building.

4.5 THE ARCHITECTURAL DESIGN

The design proposal is a nine-storey mixed-use residential building. Through the use of these staggering unit sizes, the balconies become host to different species of wildlife plants (See Figure 54). The lot for the project will contain four of these buildings to allow for residential density on the site. The design of the building stems from exploring the outer shell of the building along with exploring how animals and people can share the same space for living. This is done in a series of components, starting with the ground floor condition, the east and west walls, the balconies, and the roof.

Figure 55 shows the ground floor condition, consisting of four residential units surrounded by green wild plant swatch. In order to expand on the total exterior area, the ground floor takes up a small portion of the overall gross floor area of the building. The exterior conditions of the building's use of blue and green swatches will help address the site's remediation and bring in the vegetation necessary to feed and entice animals to explore the site. The site plan also looks at using a green light rail as a tool for water management. Another strategy is permeable paving which will be used on the sidewalks, as mentioned in the previous chapter, this paving will lower the amount of pollutants (salt and sand) used during winter and is also a useful water management tool in the city. As this thesis looks at cohabitation, understanding the relationship between humans and non-humans is essential. Since human travel can disturb wildlife, distinguishing areas for human activity is important. The colour swatches of green on the plan help narrate areas that are shared spaces and those that are exclusively for non-humans. This will be the ecological corridors on either side of the proposed buildings which will help remediate the site.


2
1
3
4
5
6
7
8
9

1 Ecological Corridor (Animals Only)
2 Green Light Rail
3 Permuable Paving
4 Recreational Park
5 Retail Stores
6 Residential Lobby
7 Resturants / Bars
8 Outdoor Patio
9 Pathways connect to trail that lead to the New River

Figure 55: Ground Floor - Green and Blue Swatches.

Figure 56: New Commission Wildlife Street.

Figure 57: Living Under the Deck.

Figure 58: Cohabit Animals and Humans.

The interior spaces of the ground floor look at creating opportunities for various retail and restaurant spaces as well as a residential lobby space. In addition, restaurants that are on the south edge have patio spaces. This will allow opportunities for outdoor dining spaces, giving humans the experience of eating outdoors surrounded by nature while still being in the city. Figure 56 shows a perspective of the new Commissioner Street in front of the proposed building, where the wildlife extends to the patio allowing for humans and non-humans to interact with each other. The patio can also be an opportunity to foster habitats as Figure 57 shows how rabbits and small rodents can make their homes within the tight spaces between the ground and the decks. Figure 59 is the south elevation of the building and shows this overlay of human and non-human interaction as Commissioner Street becomes a hub for nature. The diagram also shows the use of bird-friendly glass on all levels of the building, which goes beyond the Toronto Bird-Friendly Guideline standards for bird friendly glazing. This measure is to allow birds to safely enter any of the balcony spaces, while still allowing plenty of light and views of the parks for the residents. At night, blinds will be used to prevent artificial light from escaping the residential units outside to prevent disruption to non-humans that are active or sleeping.

Figure 58 shows the condition of the recreational park which is the space between the four buildings proposed in this thesis. The image highlights areas where humans can walk on the vegetation and immerse themselves in these pockets of nature within the city. These pockets also can foster wild animals that are likely to interact with humans. This creates interactions seen in Figure 60, which shows animals, frogs, and turtles walking through the site, and squirrels climbing up the green walls.


Bird-Friendly Glass +
Garden + Habitats
Nighttime Shading
Devices
Human on Patio
Animal Zone

Figure 59: South Section- New Commissioner Street Overlay.

Figure 60: Green Wall for Animals.

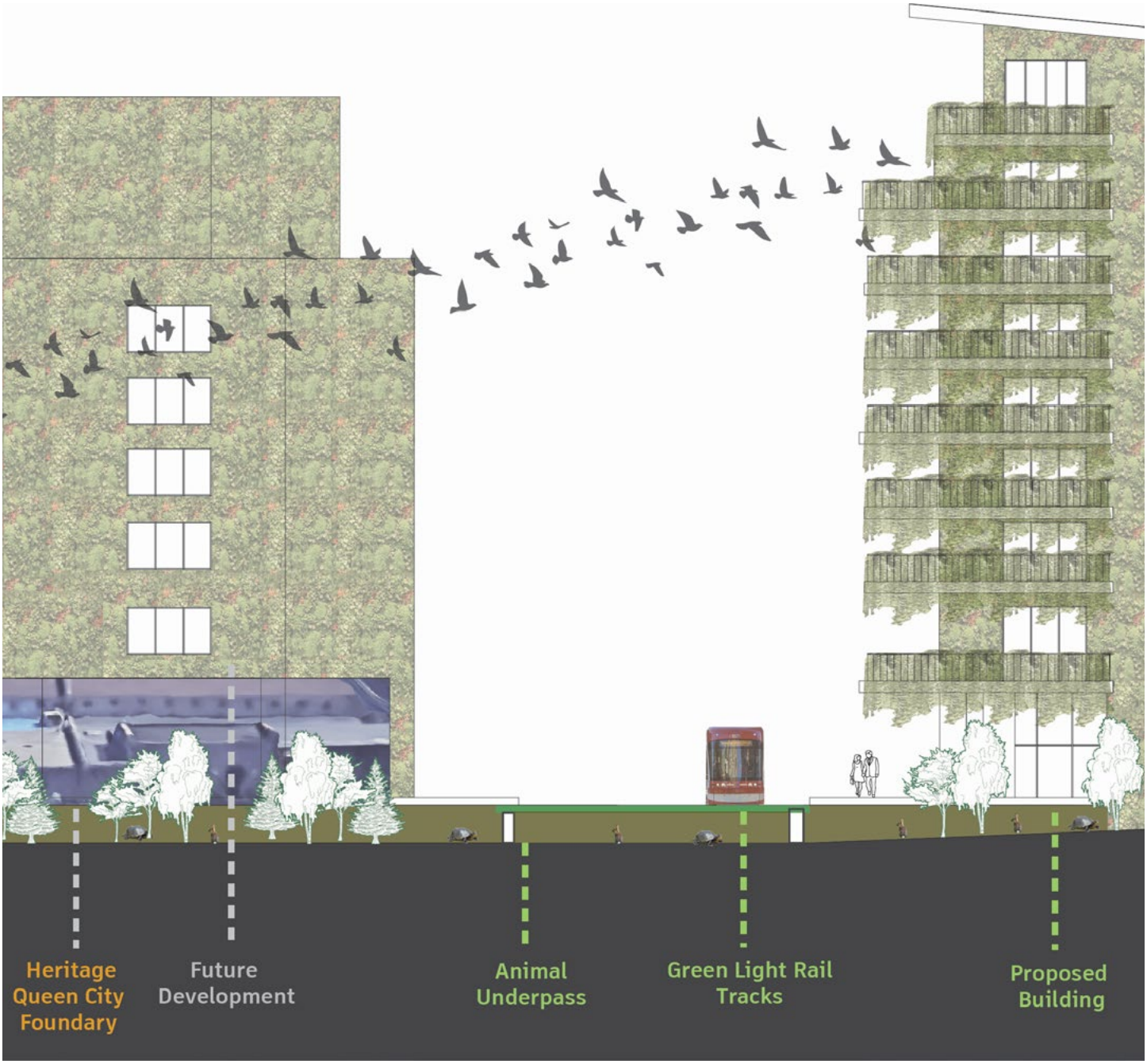


Figure 61: Section through Main Street.

Figure 61 shows how to approach the intersection design between the road and the ecological corridor. Roads can become a mortality risk to most small animals traveling to the site. This proposal looks at having the landscape slope down so that an ecological corridor can run under the two roads that exist on the site. This method will lessen the chance of animals exploring the urban roads on the site due to the change in grade. This will allow the light rail, which runs through the site, and other vehicles to navigate the city while decreasing the chance of causing animal fatalities. Additional methods to help prevent harm to animals along these intersections are increasing signage, setting the speed limit to match residential neighbourhoods, and implementing speed bumps.

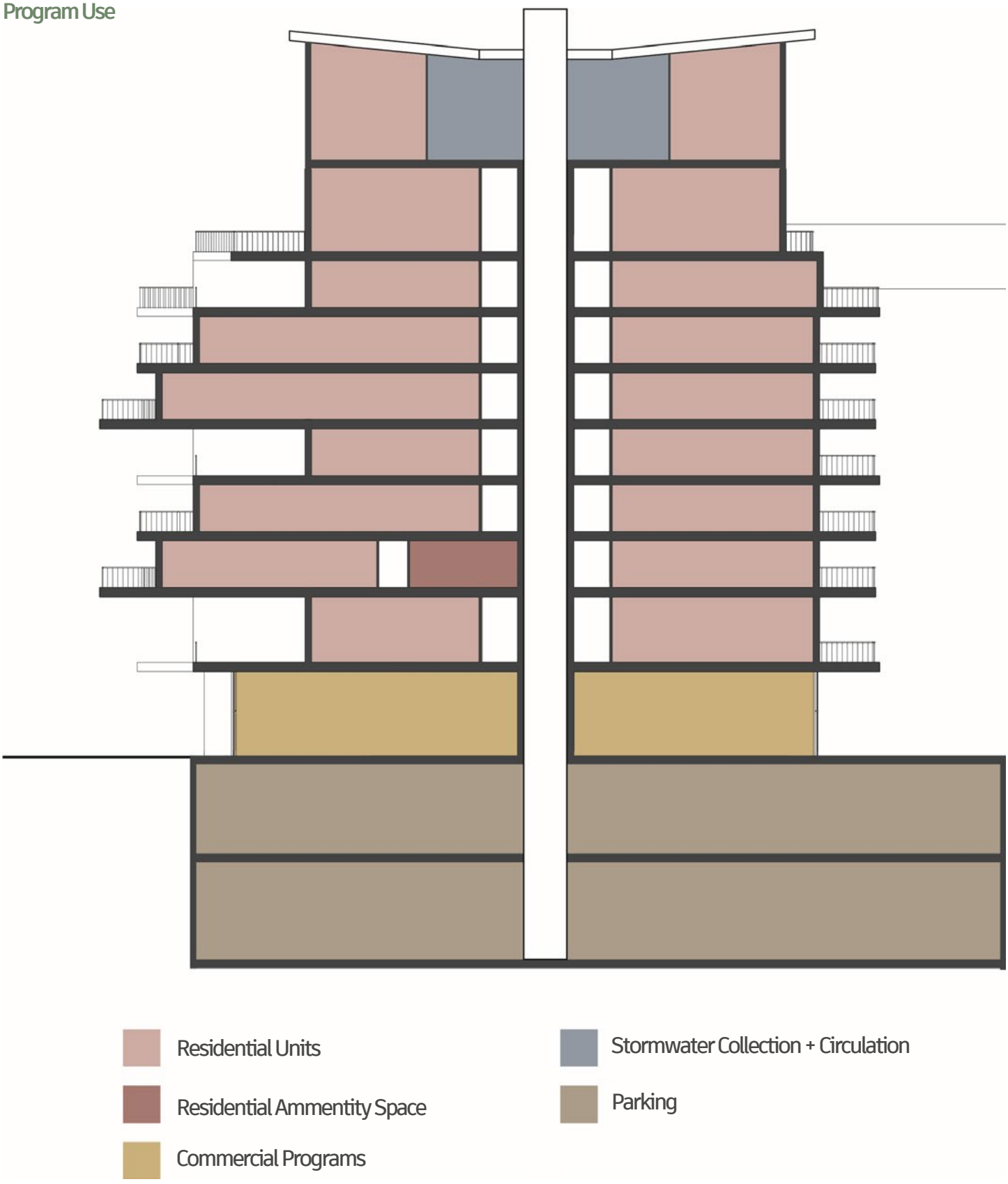


Figure 62: Section of Proposed Building Programming.

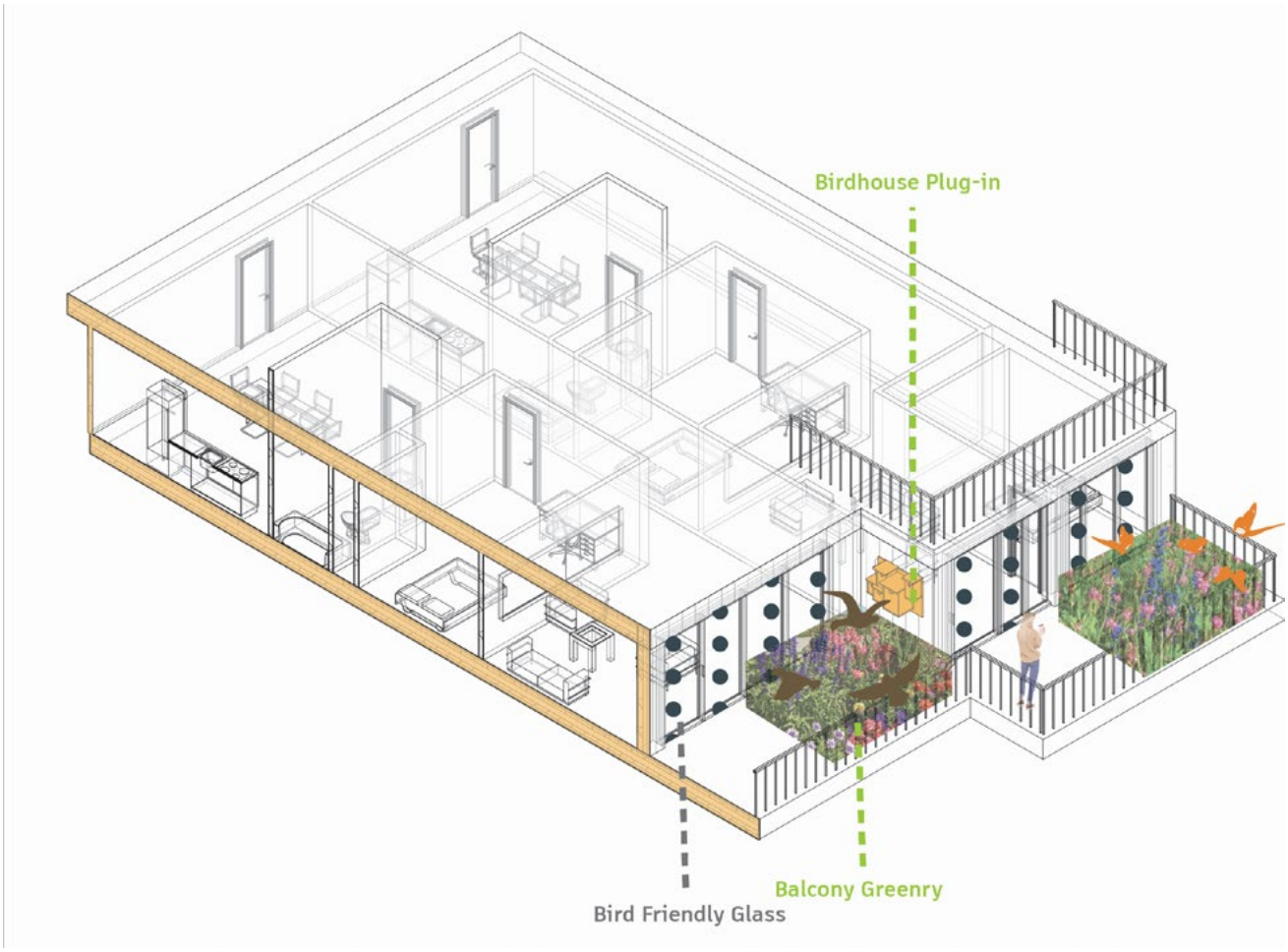


Figure 63: Typical Floor Units Axonometric.

Figure 62 is a section that breaks down the interior programming of the building. The ground floor will mainly contain commercial spaces while the rest will contain residential programming. The blue space on the diagram is designated as areas for water collection and the mechanical rooms. The water collected and filtered ,from the roofs, would then be used for watering the green components of the building (the balconies, green walls, and roof garden) as well as used as grey water for toilets. Figure 63 shows the typical floor plan unit in the building, which varies in size depending on the unit. The units available are one-bedroom, two-bedrooms, and three-bedrooms. Figure 64 shows the penthouse unit will be a double-height walk-up space. Both these figures explore the different strategies that will promote animal use in this space. The bird-friendly glass will be used for birds to read the surface as a solid but still allow humans to have a view of nature. Using plant materials that attract species like butterflies will also make the view into the balcony more interesting and bring nature into the users' daily lives. The birdhouses will be placed above the windows to limit the amount of human interaction within the facade, allowing birds the space they need for nesting. The birdhouse can be switched to house different wildlife species like insects, bats and owls. Figure 65 shows an image depicting the interaction between humans and non-humans in the daily life of the residents.

Bird Species Designed for

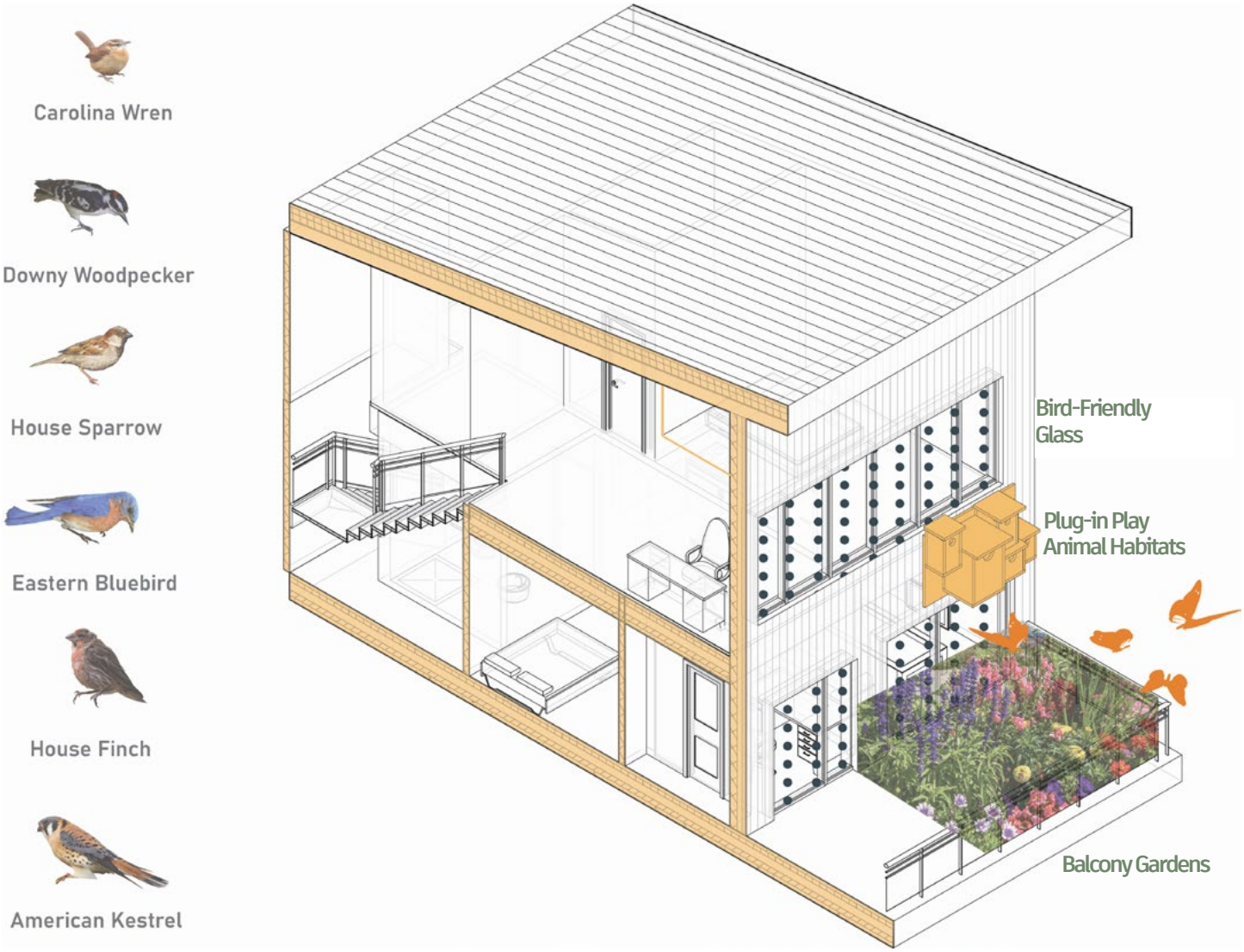


Figure 64: Penthouse Units Axonometric.

Balcony Unit Render

Figure 65: Cohabitation on the Balcony.

Green Roof Garden+ Stormwater Management

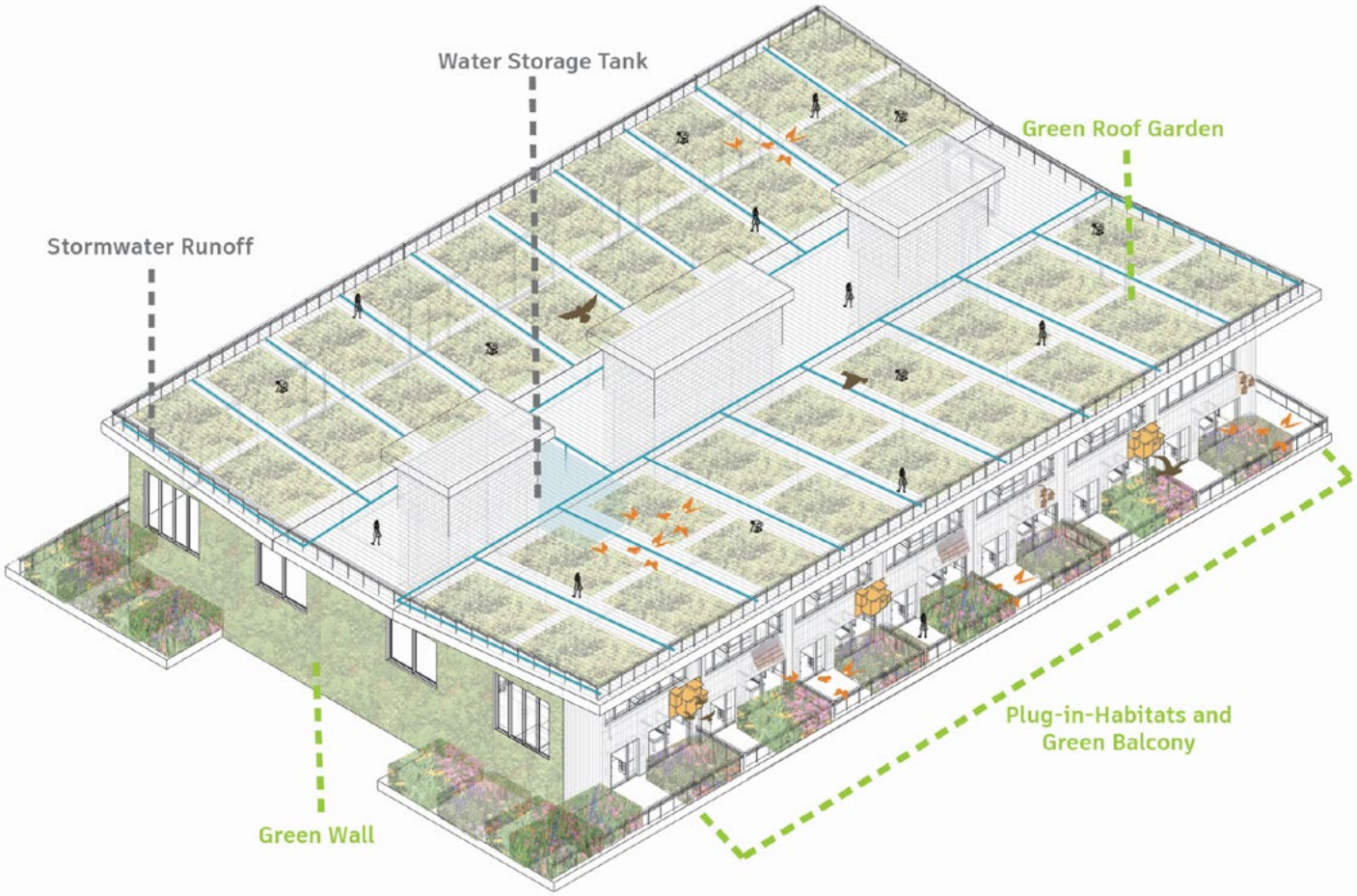


Figure 66: Roof Condition Facilitating Ecosystems.

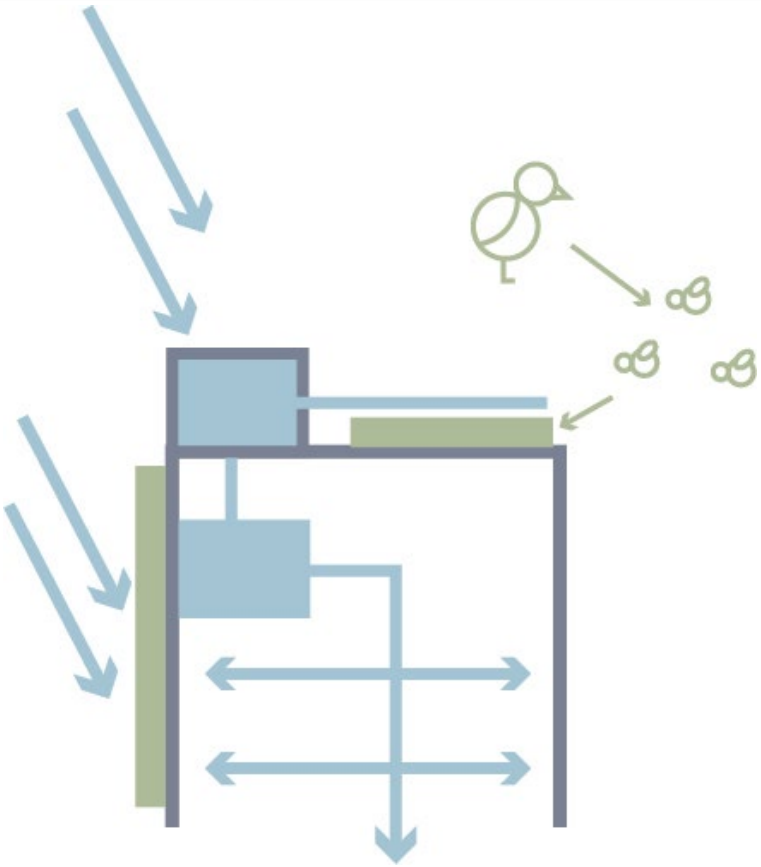


Figure 67: Stormwater Management Strategy.

Cohabitation on the Roof

Figure 68: Roof Condition.

Figure 66 shows the roof condition of the building, which contains a rooftop garden. The butterfly roof style allows water to drain into the stormwater tanks circulating through the garden and the units. The vegetation and water circulation on the roof will help generate an ecosystem for both humans and non-humans to thrive in. Figure 67 diagrams how the vegetation and water will attract insects to the site, which in turn will attract birds and bats on the site. These animals will then leave waste that can be used as plant fertilizer. The produce grown on the roof gardens can then be used for restaurants within or around the building. This can produce money for the building, which can be used to offset maintenance costs for the green infrastructure. For example, Figure 68 shows how bee hotels on the roof can be managed and harvested to be used by the residents or to be sold off site. Finally, Figure 69 shows a perspective outlining half of the proposed site. It highlights the move of bringing landscape into the city, first on the ground floor, then up the building envelope as a means to foster cohabitation between humans and non-humans in this new urban realm.

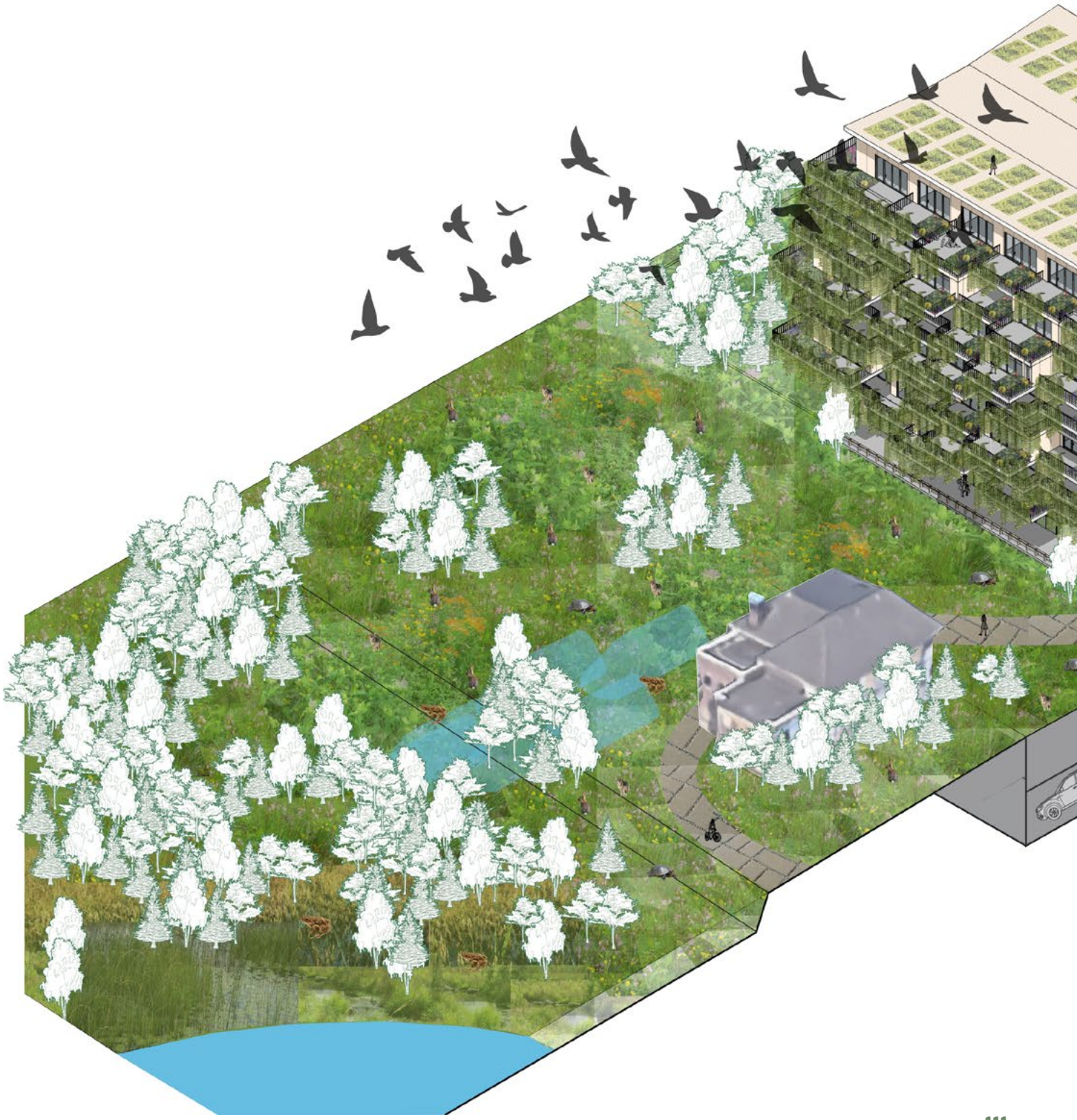


Figure 69: Reimaging Architecture for Biodiversity.

This part is the conclusion which summarizes the thesis project and reflects on the cohabitation of humans and nonhumans. It also reflects on the idea of what it means for people to live in an active ecosystem, and what is the role of the human inhabitants within the building? It also looks at a case study of coyotes awareness programs, which inform residents about the dangers of living close in proximity to nature and how to protect themselves.

CONCLUSION

CONCLUSION

The majority of land space throughout cities are zoned for architectural buildings and urban infrastructure. This is clearly evident in Toronto, in which the city is required to build 285 thousand homes according to Bill 23 (the More Homes Built Faster Act, 2022). The city of Toronto is only looking to become denser and the conflict to accommodate a harmonious connection between nature and urban space is crucial. The design proposal takes a stance to advocate for the animals who are sorely overlooked in terms of city planning and design.s. The first question was to look specifically at architecture and to understand what needed to be done in order for cohabitation to occur within the building envelope. The second question looked at how this interaction can promote a better quality of urban life. To answer these questions meant understanding the conflicts these ecosystems have with each other and why it was important to bring these elements together in the first place. The non-human elements had the issue of space and discontinuity between natural parks for safe circulation, whereas the urban components suffer from a lack of natural elements. This causes issues like flooding, heat islands, air, light, and noise pollution, and impacts the health of the residents of the city.

Therefore, the solution to the problems of both the urban and natural ecosystems was to bridge them together by bringing nature into the city first on the horizontal plane through the use of ecological corridors for animal movement. Next, was to design for the interaction between the natural environment and the architectural forms on the vertical plane through the use of green walls and roofs. Finally, the design incorporates habitats to prioritize the animals who will occupy the spaces. For example, birdhouses and feeders situated outside the balconies of residential units, insect hotels on the roof for bees, and raised patios for small rodents such as mice or rabbits can inhabit. The overall design proposal solves for the issues at hand while critiquing the standard practices, and methodology that contribute to how cities are designed such as the urban grid. Additionally, it highlights the benefits of limiting these infrastructural components such as roads for natural programming.

However, these solutions are not the limit of what can be done but a hopeful indication that it is possible for humans and non-humans to coexist and inhabit the same space. In fact, there is a greater positive impact when fully integrating nature and biodiversity into the city allowing for the reintroduction of animals on the site. Architecture is crucial in this discussion to to invite animals rather than deterring them while simultaneously increasing opportunities for sustainability practices and biodiversity, resulting in countless benefits to humans on the site. As mentioned in part 1, biophilia has numerous benefits to human mental and physical health which increases attention as well as productivity. Additionally, increasing nature and gardens throughout the city has the potential of creating its own circular

economy in which designing space for food growth results in fresh produce which can be sold to restaurants within the community or off-site to generate money and maintain the production. The proposal takes a positive outlook when designing for non-humans in the city. However, it highlights that there will be unintended consequences of bringing animals into the city such as coyotes. This area of exploration requires more research as bringing animals results in a larger web of connectivity between multiple species. Therefore, while cohabitation between animals in the urban environment can pose other challenges, ultimately, the benefits lead to more harmonious and biodiverse relationships between humans and non-humans.

BIBLIOGRAPHY

Apfelbeck, Beate, Thomas E. Hauck, Christine Jakoby, Jan Piecha, Rebecca Rogers, Alice Schröder, and Wolfgang W. Weisser. “Animal-Aided Design in the Living Envronment.” Edited by Thomas E. Hauck and Wolfgang W. Weisser. Studio Ani mal-Aided Design. German Federal Agency for Nature Conservation, December 13, 2021. https://animal-aided-design.de/en/portfolio-items/animal-aided-de sign-im- wohnumfeld/.

Apfelbeck, Beate, Robbert P.H. Snep, Thomas E. Hauck, Joanna Ferguson, Mona Holy, Christine Jakoby, J. Scott MacIvor, Lukas Schär, Morgan Taylor, and Wolfgang W. Weisser. “Designing Wildlife-Inclusive Cities That Support Human-Ani mal Co-Existence.” *Landscape and Urban Planning 200* (August 2020): 1–11. https://doi.org/10.1016/j.landurbplan.2020. 103817.

“About Us.” Studio Animal-Aided Design, January 27, 2023. https://animal-aided-design. de/en/about-us/.

Bassett, Shannon. “Recalibrating Infrastructure and Ecologies: Port Lands, Toronto, Ontario.” Canadian Architect. iQ Business Media Inc., October 14, 2022. https:// www.canadianarchitect.com/port-lands/.

Bonnell, Jennifer L. *Reclaiming the Don: An Environmental History of Toronto’s Don River Valley*. Toronto: University of Toronto Press, 2014.

Beatley, Timothy. *The Bird-Friendly City: Creating Safe Urban Habitat*. Washington: Island Press, 2020.

Beatley, Timothy. *Handbook of Biophilic City Planning and Design*. Washington: Island Press, 2016.

“Birds of Toronto: A Guide to Their Remarkable World.” City of Toronto. City of Toronto, 2018. https://www.toronto.ca/wp-content/uploads/2020/05/8ea3-City-Planning-Birds-of-Toronto-Biodiversity-Series.pdf.

“Blanding’s Turtle.” Ontario Nature. Ontario Nature, November 23, 2020. https:// ontarionature.org/programs/community-science/reptile-amphibian-atlas/ blandings-turtle/.

Brennan, Liam, Emily Chow, and Clayton Lamb. “Wildlife Overpass Structure Size, Distribution, Effectiveness, and Adherence to Expert Design Recommendations.” *PeerJ 10* (December 12, 2022). https://doi.org/10.7717/peerj.14371.

Carlton, Ashley. “What Are the Benefits of Green Walls?” Citygreen. Green Cities Urban Landscape Solutions, September 29, 2021. https://citygreen.com/what-are-the-benefits-of-green-walls/.

“City of Toronto Green Roof Bylaw.” City of Toronto. City of Toronto, July 4, 2022. https:// www.toronto.ca/city-government/planning-development/official-plan-guidelines/green-roofs/green-roof-bylaw/.

Conway, Tenley. “Boundaries and Connectivity: The Lower DonRiver and Ashbridge’s Bay.” Essay. In *Reshaping Toronto’s Waterfront*, edited by Gene Desfor and Jennefer Laidley, 151–74. Toronto, ON: University of Toronto Press, 2011. https://books-scholarsportal-info.librweb.laurentian.ca/.

"Design Considerations for Wildlife Crossings." Contech Engineered Solutions. Contech Engineered Solutions LLC, 2023. https://www.conteches.com/knowledge-center/pdh-articles/design-considerations-for-wildlife-crossings#:~:text=Structure%20Size%20and%20Placement.,by%2015%20feet%20in%20height.

Dobraszcyk, Paul. *Animal Architecture Beasts, Buildings and Us*. London, UK: Reaktion Books Ltd, 2023.

Don Mouth Naturalization and Port Land Flood Protection Project: Environmental Assessment." The Port Lands. Toronto and Region Conservation for the Living City and Waterfront Toronto, June 2016. https://portlandsto.ca/wp-content/uploads/103331.pdf.

Gandy, Matthew. "From Urban Ecology to Ecological Urbanism: An Ambiguous Trajectory." *Area* 47, no. 2 (2015): 150–54. https://doi.org/10.1111/area.12162.

"Ecological Corridors." Parks Canada Agency. Government of Canada, November 26, 2022. https://parks.canada.ca/nature/science/conservation/info-corridors.

"Ecoraster Permeable Pavement System Perfect for Canadian Winters." LID Permeable Paving. LID Permeable Paving Canada, February 23, 2021. https://lidpermeablepaving.ca/ecoraster-permeable-pavement-system -perfect-for-canadian-winters/.

Espejo, Roman, ed. *Eco-Architecture*. Opposing Viewpoint Series. Farmington Hills, MI: Greenhaven Press, 2013.

Ford, Adam T., Emily J. Sunter, Catherine Fauvelle, Jacob L. Bradshaw, Brett Ford, Jenna Hutchen, Nicholas Phillipow, and Kristine J. Teichman. "Effective Corridor Width: Linking the Spatial Ecology of Wildlife with Land Use Policy." *European Journal of Wildlife Research* 66, no. 4 (July 29, 2020). https://doi.org/10.1007/s10344-020-01385-y.

Hanrahan, Christine. "Eastern Cottontails at the FWG." Ottawa Field-Naturalists' Club. OFNC, June 25, 2020. https://ofnc.ca/programs/fletcher-wildlife-garden/flora-and-fauna-at-the-fwg/eastern-cottontails-at-the-fwg.

"History of the Port Lands." The Port Lands. Waterfront Toronto, September 25, 2019. https://portlandsto.ca/history-of-the-port-lands/.

"How to Co-Exist with Coyotes." Stanley Park Ecology Society (SPES), September 13, 2021. https://stanleyparkecology.ca/ecology/co-existing-with-coyotes/how-to-co-exist-with-coyotes/.

"Human Ecology." Encyclopædia Britannica. Encyclopædia Britannica, inc. n.d. https://www.britannica.com/topic/human-ecology.

Jones, Therésa, and Kathryn McNamara. "Artificial Light at Night Can Change the Behaviour of All Animals, Not Just Humans." Phys.org. Phys.org, July 28, 2022. https://phys.org/news/2022-07-artificial-night-behaviour-animals-humans.html.

Orff, Kate. *Towards an Urban Ecology*. New York: The Monacelli Press, 2016.

Özen, Rahşan. "Bird Shelters in Turkey: Birdhouses and Dovecotes." *Kafkas Universitesi Veteriner Fakultesi Dergisi* 18, no. 6 (2012): 1079–82. https://doi.org/10.9775/kvfd.2012.6337.

"Living Among Pests." Ants of the Prairie. Ants of the Prairie, 2023. https://www.antsoftheprairie.com/?page_id=1589.

Living Architecture Monitor. "How to Keep Exterior Green Walls Alive in the Winter." Living Architecture Monitor. Green Roofs for Healthy Cities, November 18, 2022. https://livingarchitecturemonitor.com/articles/how-to-keep-exterior-green-walls-alive-in-the-winter-w21.

"Living Wall : Maintenance and Set-up: Vertiss the Green Wall." Vertiss, 2019. https://www.vertiss.net/mur-vegetal-entretien-mise-en-oeuvr?lang=en.

"Lower Don Lands Framework Plan." Michael Van Valkenburgh Associates Inc. Michael Van Valkenburgh Associates Inc. Accessed November 1, 2022. https://www.mvvainc.com/projects/lower-don- lands-framework-plan.

"Lower Don Lands International Competition." BSA. Brown + Storey Architects. Accessed December 15, 2022. https://www.brownandstorey.com/project/lower-don-lands-international-competition/.

McCartney, Shelagh, Samantha Solano, Sonja Vangjeli, and Hannes Zander, eds. *A Landscape Approach: From Local Communities to Territorial Systems.* Novato, CA: ORO Editions, 2022.

"Maintenance - Livewall Vertical Plant Wall System." LiveWall Green Wall System, November 16, 2021. https://livewall.com/technical/maintenance/.

Miller, James R. "Conserving Biodiversity in Metropolitan Landscapes: A Matter of Scale (but Which Scale?)." *Landscape Journal* 27, no. 1 (2008): 114–26. https://doi.org/10.3368 /lj.27.1.114.

Mostafavi, Mohsen, and Gareth Doherty, eds. *Ecological Urbanism*. 1. Vol. 1. 2 vols. Zurich: Lars Muller Publishers, 2010.

Naava. "What Are Green Walls - the Definition, Benefits, Design, and Greenery." Experience the power of Nature. Indoors. Naava Group Oy, April 13, 2023. https://www.naava.io/editorial/what-are-green-walls.

National Geographic Society. "Urbanization." National Geographic, May 20, 2022. https://education.nationalgeographic.org/resource/urbanization/.

"National Program for Ecological Corridors." Parks Canada Agency. Government of Canada, November 30, 2022. https://parks.canada.ca/nature/science/conservation/corridors-ecologiques-ecological-corridors.

"Port Lands Flood Protection." Michael Van Valkenburgh Associates Inc. Michael Van Valkenburgh Associates Inc. Accessed November 1, 2022. https://www.mvvainc.com/projects/port-lands- flood-protection.

"Port Lands Planning Framework." Waterfront Toronto. City of Toronto and Waterfront Toronto, September 2017. https://www.waterfrontoronto.ca/sites/default/files/documents/port-lands- planning-framework-aoda---reduced.pdf.

"Project Timeline." The Port Lands. Waterfront Toronto, September 24, 2019. https://portlandsto.ca/project-timeline/.

"Toronto Green Roof Construction Standard." City of Toronto. City of Toronto, 2017. https://www.toronto.ca/wp-content/uploads/2017/08/7eb7-Toronto-Green-Roof-Construction-Standard-Supplementary-Guidelines.pdf.

"Toronto Ravine Strategy." City of Toronto. City of Toronto, 2017. https://www.toronto.ca/wp-content/uploads /2017/10/9183-TorontoRavineStrategy.pdf.

"Understanding Urban Coyotes." Stanley Park Ecology Society (SPES), September 13, 2021. https://stanleyparkecology.ca/ecology/co-existing-with-coyotes/understanding-urban-coyotes/.

University of Guelph. "Evaluation of Permeable Pavements in Cold Climates." Permeable pavements: Maintenance - LID SWM Planning and Design Guide. Toronto and Region Conservation Authority, December 2012. https://wiki.sustainabletechnologies.ca/wiki/Permeable_pavements:_Maintenance.

Valentine, Katie. "Build a Nest Box to Welcome Spring Birds." Audubon. National Audubon Society, April 1, 2017. https://www.audubon.org/news/build-nest-box-welcome-spring- birds.

Waldheim, Charles. *Landscape as Urbanism: A General Theory*. Princeton, NJ: Princeton University Press, 2016.

"Waterfront Corporation Unveils Submissions for Lower Don Lands Design Competition." Waterfront Corporation unveils submissions for Lower Don Lands design competition. Waterfront Toronto, April 13, 2007. https://www.waterfrontoronto.ca/news/waterfront-corporation-unveils- submissions-lower-don-lands-design-competition.