# Nature-Oriented Preventative Environments in Urban Areas

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ON030014
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## Table of Contents

**Acknowledgements**

Throughout my educational journey I have received considerable support and encouragement from my educators, colleagues, friends and family.

My gratitude is extended to all the Syllabus coordinators and mentors, past and present, for volunteering their time and expertise, for without them the Syllabus program could not exist.

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# Part 1: Thesis Outline

## 1.0 Thesis Outline

Note: The Thesis Outline is for record of submission purposed only. Refer Thesis Statement on Page 5. The Literature Search can be found in Appendix A.

### 1.1 Thesis Statement

Cities have long been the central hubs of economic and intellectual power attracting countless people to the urban lifestyle. In fact, now over half of the world's population live in cities, and that number will continue to rise. The fast-paced, stimulating city life is exciting, yet at the same time chaotic and overwhelming. What energizes and excites us also has the polar effect, mentally and physically draining us. The constant activity puts our brains into overdrive resulting in fatigue. Overstimulation can have adverse effects on our mental health by inhibiting our memory, reducing attention and creating cognitive deficits. It has also been linked to heightened ailments such as ulcers and acne.

Respites from the exuberant stimuli of the city can restore our minds. However, it can be difficult to find a place to take a restorative break in the city. Nature could be the answer to the overstimulation induced by metropolises. However, our perception of nature has

traditionally viewed it as an element separate from the city: a destination, a place (outside) to visit.[1] Unfortunately this belief has been reflected in the development of our cities. Minor fragments of nature are scattered through the hard cityscape but pale in comparison to the volume of the concrete jungle.

Nature has restorative properties and offers mental, physical and spiritual benefits. It's powerful restoration aspects range from physical healing to improved mental awareness. Experiencing nature has the potential to reduce stress, lower blood pressure an

d retain focus among other benefits. But can the benefits of nature counteract the mental and physical demands of the city? This is an important question as urban populations continue to escalate and cities are intensified.

## 1.2 Hypothesis

If certain ailments are common in the urban environment and nature can alleviate such ailments, then would our physical and mental health improve if nature were more integrated into the City?

[1] 'According to urban historians, this view is largely a phenomenon of the Enlightenment and Romantic periods'. http://sciencenetlinks.com/lessons/urban-ecosystems-1

## 1.3 Methodology

1. Literature Review:
    a. Ailments caused by the urban environment.
    b. Causes and effects of urban stressors on humans.
    c. Why existing urban nature does not offer relief.
    d. The urban nature deficit.

2. Facts and Proof Collection:
    a. Empirical studies.
    b. Relative statistics.

3. Conference and Journal Review: Documentation of ground-breaking research and emerging trends.

4. Case Studies: In depth analysis of relative and specific examples of
    a. Nature benefiting urban populations.
    b. Successful integration of nature in urban settings.

5. Conclusions: A summary of recommendations that will guide the design portion of the thesis.
    a. Potential Barriers to Nature Integration.
    b. Design Recommendations for Integrating Nature into the Urban Built Environment.

## Solutions

The design demonstration will confirm the validity of the hypothesis. Potential opportunities to integrate Nature into the urban fabric of the city will be illustrated. The intent is not to insert a series of 'green' elements into the city, but rather to integrate the natural and urban domains into one cohesive environment. Rather than constraining nature integration to a single building, the design solution may likely be a series of buildings, like an urban campus, including the spaces between. In this scenario, voids between the built form become as important as the volumes themselves and may allow for a seamless integration of nature between varying degrees of enclosure.

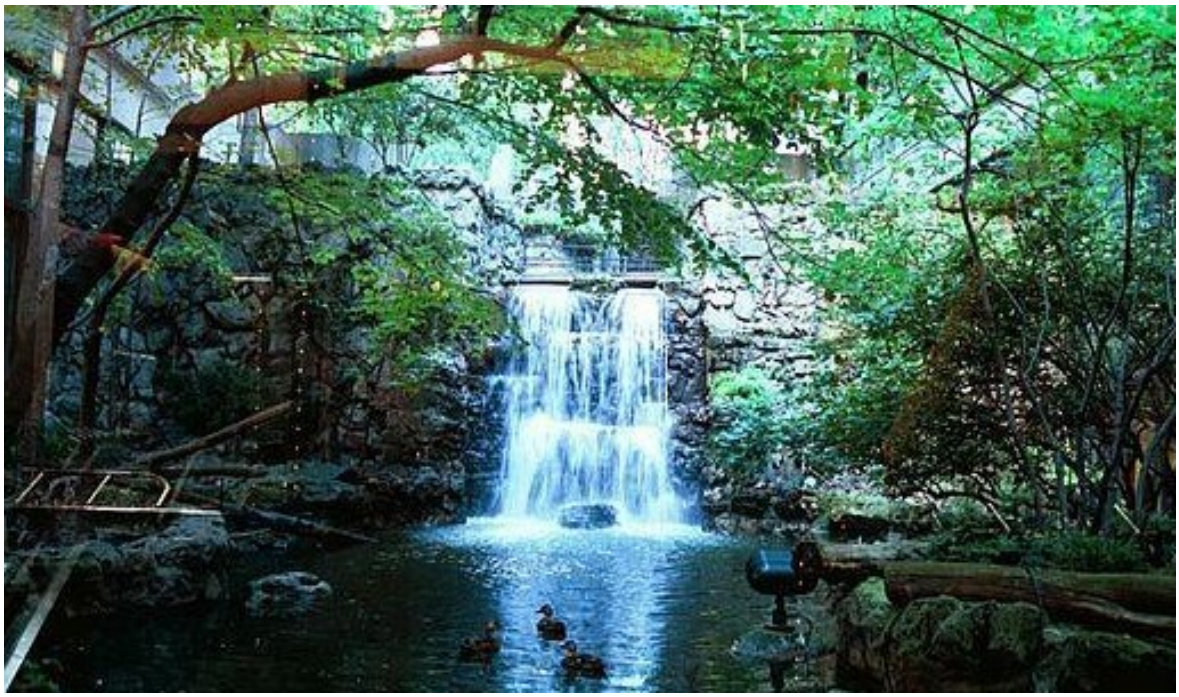
The campus is envisioned as a prototype that will produce a comprehensive array of guidelines that will intertwine nature with the building(s). These notions would be implemented into an architectural solution that potentially include nature penetrating indoors, vertical densification of nature (nature above the ground plane) and natural spaces with enclosures that change with the seasons/weather. Once implemented, such strategies will create a holistic approach to urban development and improve the health of the city.

# Part 2: Research

## 2.0 Thesis Statement

*Certain characteristics of urban environments impose stresses that may impact our physiological and psychological health. The benefits of nature, particularly in restorative environments, have been recognized as valuable for improving health. If increased stress can lead to chronic illnesses, such as cardiovascular disease, then reducing stress should lessen the effects and incidence rate of these chronic ailments.*

*By increasing exposure to recuperative settings in urban environments, stress can be combated more frequently, preventing compound stress, and potentially reduce the occurrence of physiological and psychological illnesses. Using restorative environments within the city as preventative measures could essentially reduce the build-up of stress and depletion of mental resources, resulting in a fewer occurrences of stress related health conditions, a healthier urban population and better quality of living.*



**Toronto Sheridan Courtyard Garden**

## 3.0 Executive Summary

Over half of the world's population now resides in cities. However, common urban conditions, such as noise and distractions, experienced in large metropolises can negatively impact our physiological and psychological health by stressing our bodies and affecting our mental well-being. Conditions such as hypertension and mental fatigue can be induced when experiencing the city.


**The hustle and bustle of Toronto's Yonge Street**

Fortunately, researchers believe that nature can be beneficial in reducing the effects of these stresses. Its powerful therapeutic qualities range from physical healing to improved mental awareness and have been proven to reduce stress, lower blood pressure and alleviate mental fatigue.

> *'The quality of living in a healthy environment is one of the basic demands of the modern society, particularly in urban settings where the opportunities for contact with green urban spaces are sparser.'* [2]
>
> Tanja Simonic

[2] Tanja Simonic, "*Urban Landscape as a Restorative Environment Preferences and Design Consideration*", Acta Agriculturae Slovenica, (September 2006), 89.

Epidemiologists have postulated multiple theories regarding the benefits of nature, which have been backed by numerous experiments and studies. Philosophies such as Robert Ulrich's *Stress Reduction Theory* and *Attention Restoration Theory* by Stephan and Rachel Kaplan attest that nature, in the form of restorative environments, can provide relief and recovery from stress caused by urban conditions.

**Don Valley Brick Works is located minutes east of the downtown core.**

Current research focuses on recovery therapy for reversing the negative effects of the city. Rather than city dwellers seeking respites for recovery, what if such settings were sought out as preventative measures? This is an important question as urban populations continue to escalate and cities are intensified. The key to a healthy city may be to increase opportunities for interaction with nature by promoting revitalization in ways that it becomes part of a preventative process.

*'Nature is something within which we flourish, so having it be more a part of our lives is critical, especially when we live and work in built environments.'* [3]

Richard M. Ryan

[3] Richard M. Ryan et. al., "Vitalizing Effects of Being Outdoors and in Nature," Journal of Environmental Psychology 30, (2010).

The density of urban environments can make finding refuge from the city's stressors difficult. Expanding the city's network of parks and public spaces plus enhancing them with characteristics of restorative environments could potentially increase the viability of implementing such environments as preventative measures.

**Devonian Gardens – an indoor urban oasis**

The objective is to exploit the benefits of nature through integrating the natural and urban domains and in doing so to create a network of urban relief within the city. Integrating nature into the urban fabric of the city may not only increase opportunities for restorative therapy but could potentially provide preventative means as well. Rather than limiting the integration of nature to a single building, the design solution could incorporate the concept into a series of buildings, like an urban campus, including the spaces between. In this scenario, voids between the built form become as important as the volumes themselves; and may allow for a seamless integration of nature between varying degrees of enclosure.

## 4.0 Environmental Stress and Impairments


**New York City's Time Square**

### 4.1 Environmental Stress

Professor Roger Ulrich, a renowned researcher in stress recovery, argues that urban environments are unnatural for humans and spending time in the city results in stress.[4] Defined as response to a negative environment or situation, stress can be triggered by a number of factors and it can affect each individual differently. For instance, audible and visual pollution compounded with traffic and crowds of people can result in stressful experiences.

Excessive environmental sound that can be harmful to humans is considered noise pollution. Unfortunately for urban dwellers, larger cities traditionally have higher rates of noise pollution. Increased sound sources, such as vehicles, construction and people,

[4] Roger S. Ulrich, "*Effects of Gardens On Health Outcomes: Theory And Research*", New York, Wiley & Sons. (1999)

create sound that is often amplified by the surrounding hard surfaces. Furthermore, this noise can be perceived as louder since it is often unwanted and considered an annoyance.

Acoustics professor and researcher Jain Kang, who specializes in architectural acoustics and noise control, has studied the effects of sound in urban environments. Results from his 2000 report concluded that with a constant sound pressure level (SPL), longer reverberation results in increased noise annoyance.[5] The reverberation effect in city streets is significant and can increase noise by as much as 10% depending on the location of the source.[6]

The National Urban Noise Study (UNS), conducted by the U.S. Environmental Protection Agency's Office of Noise Abatement and Control, concluded that noise annoyances where reported higher in neighbourhoods with elevated noise levels suggesting a strong link between population density and the magnitude of noise annoyance and exposure level.[7] 'More respondents in the high noise exposure subsample reported annoyance from construction noise (9% more), people's voices (24% more), radio and TV sets (11% more), motor vehicle noise (13% more), large trucks (15% more), buses (19% more), and constant traffic (38% more).' [8] Further studies, by Debus and Klein (1984) and Kryter (1985), confirm the UN's findings that the subjective annoyance of sound increases with sound level.[9]

Not only do cities present noise pollution, but also the sheer volume of visual information found in the city can be tremendous. Excessive amounts of signage such as store signage,

[5] Jain Kang, *Modelling the Acoustic Environment in City Streets; Proceedings of the PLEA*, 2000, Cambridge, England, 514.
[6] Ibid.
[7] The Urban Noise Survey, U.S. Environmental Protection Agency, Office Of Noise Abatement And Control, Washington, D.C. 20460, August 1977, 82.
[8] Ibid. 16.
[9] Uta Sailer and Marc Hassenzahl, *Assessing Noise Annoyance: An Improvement-Oriented Approach*, Ergonimics, Munich, Germany 2000, VOL. 43, NO. 11, P1920.

advertisements and billboards in an array of colours and flashing lights create distractions. The constant movement from pedestrian and traffic circulation in these situations also adds to the disruption, and clearly creates stress.

A recent study, led by Jessica Edquist from the Monash University Accident Research Centre (MUARC), concluded that billboards are distracting, especially when visual clutter is presence. The study analyzed the time participants took to notice a change in scenery. Scenes containing both billboards and other visual clutter recorded increased reaction times than those without; indicating that higher levels of visual information are more distracting.[10]

Another study, led by scholars at the Swedish National Road and Transport Research Institute, concluded that subjects observed digital billboards considerably longer than other signs in the same proximity. The brighter and continuously changing display attracted easily attention and maintained it longer.[11]

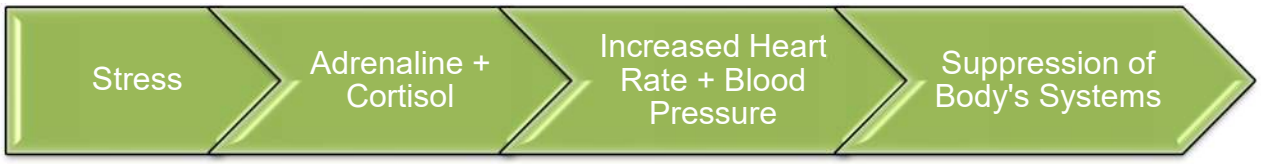
Not only do urbanites have to contend with noise pollution and visual distractions but increased population correlates with crowded city streets and sidewalks. This added volume of movement makes navigating busy city routes difficult and frustrating. Such crowdedness creates anxiety and stresses in most individuals, but especially in those suffering from agoraphobia, the fear of crowds. Fear, instability and a sense of self-helplessness are trademarks of agoraphobia and symptoms include rapid heart rate, trouble breathing and chest pain.[12] According to Statistics Canada, agoraphobia affects 1.5% of Canadians.[13]

[10] Jessica Edquist et al., *Advertising Billboards Impair Change Detection In Road Scenes*, 2011 Australasian Road Safety Research, Education & Policing Conference, Perth, 6-9 November 2011, 5.
[11] Tania Dukic, Effects of electronic billboards on driver distraction, Traffic Injury Prevention, July 8, 2012, 2.
[12] http://www.mayoclinic.com/health/agoraphobia/DS00894/DSECTION=symptoms

### 4.2 Physiological Impairments

Exposure to urban environments can create stress and negatively impact the human body. American physiologist Walter Bradford Cannon postulates, in his Fight or Flight Theory, that stressful events cause the body to produce more adrenaline and cortisol in preparation to protect itself.[14] While this reaction was originally developed to protect us from dangers, such as predators, it has evolved to urban life in that the same effects are experienced when encountering urban dangers, such as a close call with a car.

When danger is sensed, adrenaline increases heart rate, raises blood pressure and boosts energy supplies.[15] As a result, muscles are ready to be engaged, and alertness is heightened. In order to achieve this state, the body moderates non-essential functions to be able to increase blood flow in preparation to fight or flight.[16] The build up of cortisol 'alters immune system responses and suppresses the digestive system, the reproductive system and growth processes.'[17] The dangers occur when these systems are continuously suppressed and become more susceptible to infection or operate in an inefficient capacity.[18]




Physical stress can be positive as it keeps us alert; however, if stressors are continuous without relief, distress may be experienced. Distress can lead to a range of physical ailments including an array of heart conditions. Elevated heart rate and blood pressure

[13] http://www.statcan.gc.ca/pub/82-619-m/2012004/sections/sectionb-eng.htm
[14] Philippe Harari + Karen Legge, Psychology and Health, Heinemann Educational Publishers, Oxford, 2001, 75.
[15] The Mayo Clinic, *Stress: Constant Stress Puts Your Health At Risk,* www.mayoclinic.com, June 9, 2011.
[16] http://www.medicalnewstoday.com/articles/145855.php
[17] The Mayo Clinic, *Stress: Constant Stress Puts Your Health At Risk,* www.mayoclinic.com, June 9, 2011.
[18] Ibid.

increase the risk of cardiovascular disease that can lead to heart, stroke and kidney failure.[19] The World Health Organization reported that cardiovascular disease is the number one cause of death globally representing 30% of all fatalities.[20]

Exposure to noise has been shown to increase blood pressure and heart rate. A group of researchers, led by Mette Sørensen, found that excess noise from road traffic increased systolic blood pressure and heart rate resulting in the release of stress hormones; and they concluded that such noise interferes with the ability to relax and concentrate.[21] Another study, by Dr. Sally L. Lusk and colleagues, indicated that noise experienced by workers at an auto assembly plant increased both heart rate and blood pressure.[22] The results of these and other studies suggest that decreasing exposure to excess noise reduces cardiovascular stress.

### 4.3 Psychological Impairments

Stressors in the urban social environment can have negative impacts on mental health. Researchers have documented that there are higher rates of mental illnesses in urban areas as a result of environmental provocations.[23] Urban environments can be difficult for our brains to process and deplete valuable mental resources. As a result, we are susceptible to mental fatigue that affects our behaviour and the way we think.

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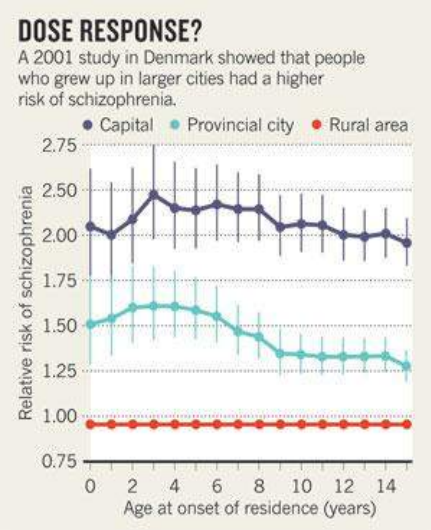
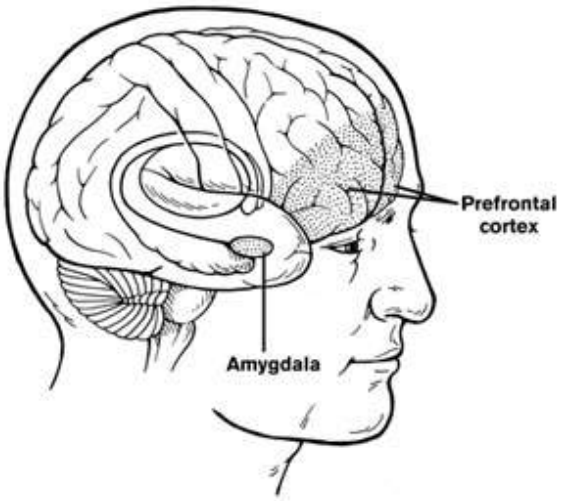
[19] The Mayo Clinic, *Stress: Constant Stress Puts Your Health At Risk,* www.mayoclinic.com, June 9, 2011.
[20] *Global Status Report On Noncommunicable Diseases* 2010. Geneva, World Health Organization, 2011.
[21] Mette Sørensen, et al. "Exposure To Road Traffic And Railway Noise", Environmental Health (2011).
[22] S.L. Lusk, et. al., "Acute Effects *Of Noise On Blood Pressure And Heart Rate"*, Architectural Environmental Health, August 59:8 (2004), 392.
[23] Lederbogen F, et al. *City Living And Urban Upbringing Affect Neural Social Stress Processing In Humans",* Nature, 474 (7352), (2011), 498.

Epidemiologists have shown that urbanites are 39% more at risk for mood disorders such as depression, and 21% higher for anxiety disorders.[24] Furthermore, studies, some dating back decades, have continuously indicated that those raised in cities are twice as likely to develop schizophrenia than their rural counterparts.[25] Research indicates that the risk of psychiatric illness increases with the size of the city.[26]




**Risk of schizophenia**

City living affects the regions of the brain that regulate emotion and stress.[27] Professor Andreas Meyer-Lindenberg of the University of Heidelberg in Germany has determined that two areas of the brain, the amygdala and the cingulate cortex, are over-stimulated in urban inhabitants when stress is endured. MRI scans conducted as part of Lindenberg's study illustrated that stress triggers the amygdala, the part of the brain that senses danger, such as an oncoming vehicle, and is linked with fear, anxiety and depression. The other area found to be aroused by stress, the cingulate cortex, regulates stress and is involved with emotion formation and processing, learning, and memory. Study 'results suggest that city living




**Areas of the brain affected by stress**

[24] Lederbogen F, et al. *City Living And Urban Upbringing Affect Neural Social Stress Processing In Humans",* Nature, 474 (7352), (2011), 499.
[25] Ibid.
[26] Ibid.
[27] Ibid, 501.

causes changes in the brain that may be related to the increased incidence of mental illness among city dwellers.'[28]

### 4.4 Behavioural Impairments

The human brain has a limited capacity when it comes to processing information.[29] When the brain is continuously overloaded, as it may be in the city, it becomes stressed which can lead to fatigue. As a consequence, our ability to focus and concentrate is drastically affected to the point that our behaviour is altered. Stress caused by urban conditions can affect functions of the brain such as directed attention, working memory and self-regulation.

> *'Directed attention plays an important role in human information processing; its fatigue, in turn, has far-reaching consequences.'* [30]
>
> Stephan Kaplan

Directed attention (DA), also referred to as executive attention, requires effort to maintain focus on a specific task while deflecting distractions. DA allows for the mind to focus on the important and avoid distractions that are more interesting. Executive attention is a fundamental resource for processing information and is essential for problem solving. Tasks that are perceived as uninteresting and mundane demand directed attention if they are to be successfully completed. The importance of directed attention is recognized more from the 'consequences of its absence.'[31]

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[28] http://drsamgirgis.com/2011/06/22/life-in-the-city-causes-changes-in-stress-center-of-brain/
[29] Torkel Klingberg, "The Overflowing Brain: Information Overload and the Limits of the Working Memory", Oxford University Press, NY, (2009).
[30] Ibid.
[31] Kaplan, Stephen. *The Restorative Benefits Of Nature: Toward An Integrative Framework*. Journal of Environmental Psychology. Volume 15, (1995).

Unfortunately, voluntary control of concentration is of limited capacity and susceptible to fatigue. Directed attention is a scarce resource and it can leave devastating effects when exhausted. This phenomenon is referred to as *Directed Attention Fatigue (DAF)*.

Leading researchers of Directed Attention Fatigue, Rachel and Stephan Kaplan, environmental psychologists at the University of Michigan, claim that DAF is the result of prolonged mental effort.[32] They argue that mental resources become depleted from intense mental activity, such as multitasking (i.e. navigating a busy street while engaging in conversation), or when used for extended periods of time.[33] Overuse of directed attention could leave us ineffective, error prone and apt to impulsive decisions.

Stress has similar effects on the brain's memory capacity and on its ability to focus. Working memory is the active component of our memory that simultaneously stores and processes information. It retains auditory and visual information required to complete tasks relating to learning, reason and comprehension.[34]

Torkel Klingberg, Professor of Cognitive Neuroscience at the renowned Karolinska Institute in Sweden, has conducted extensive research in the field. In his book, 'The Overflowing Brain', he states that working memory is essential for controlling attention and that without it, difficulties remembering the task at hand would occur.[35] Working memory is also responsible for blocking out distractions and processing information about our surroundings

[32] Kaplan, Stephen. *The Restorative Benefits Of Nature: Toward An Integrative Framework*. Journal of Environmental Psychology. Volume 15, (1995).
[33] Ibid.
[34] Torkel Klingberg, "The Overflowing Brain: Information Overload and the Limits of the Working Memory", Oxford University Press, NY, (2009).
[35] Ibid.

(i.e. assessing if it is safe to cross the street). It allows us to navigate through an environment by tracking our relationship to surrounding objects (i.e. location relative to destination).[36] A stimulating area, such as a city street, would place a great demand on this valuable resource. Unfortunately, working memory has a limited capacity. Torkin explains that the brain is unable to process multiple tasks simultaneously within the same component (i.e. amygdala).[37] Furthermore, it is susceptible to impairment from stress.


Just as directed attention and working memory can become depleted, experts believe that our capacity for self-regulation also has limitations. The ability to control one's emotions, behavior and desires is known as self-regulation, or self-control.[38] It allows us to exert control over decisions and regulate behavior for the long-term benefit.

The city has an abundance of shops and restaurants that offer an unlimited number of temptations. As a result, self-regulation must constantly be exerted to suppress urges to purchase and consume on impulse. Psychology professors Mark Muraven and Roy Baumeister argue that self-regulation is a limited and consumable resource that is subject to depletion. Their research suggests that repetitive stress and temptation resistance diminish the ability to control one's self, resulting in impaired decision making ability and lowered inhibitions, thus making it difficult to resist impulses, temptations and postpone

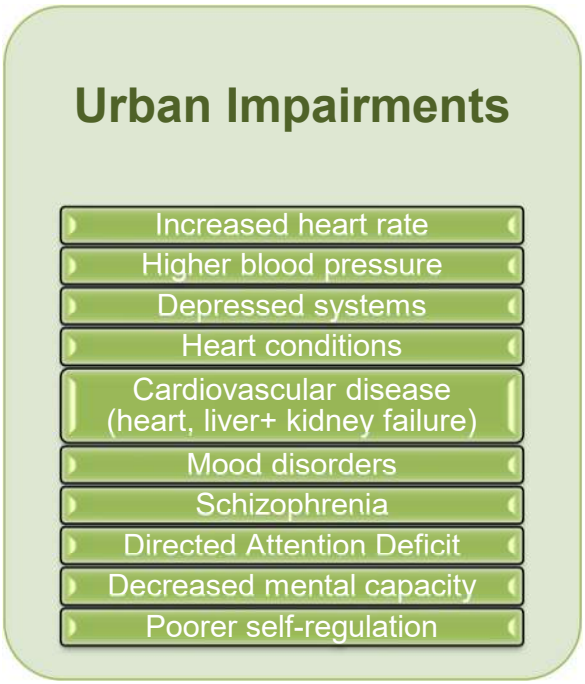
[36] Alan Baddeley, "*Working Memory*". Science, January 31, 255(5044), Review, (1992) 556.
[37] Ibid.
[38] http://en.wikipedia.org/wiki/Self-control

gratification.[39]

As illustrated above, the brain has limited processing resources that are adversely affected by stress. Unfortunately, several functions of the brain share common processing components that can lead to a bottleneck when processing data. The pressures of the city can deplete these consumable supplies. Consequences of such blockage can affect the brain's capacity for directed attention, working memory and self-regulation that may affect the way we behave. It is possible that these intellectual demands are linked to the reported increased mental illnesses in urban settings.

### 4.5 Solution

As urban populations continue to increase, it is important to understand the impact of living in such surroundings. A setting with physical and mental stressors is not beneficial to the well-being of its inhabitants and begs the question: What can be done to counteract the frequency and severity of the effects of urban conditions? As Ulrich declared, it is unnatural for humans to dwell in urban domains. So, what urban deficiency has acerbated these stress-related ailments? The absence of nature.




[39] M. Muraven, D.M. Tice, and R.F. Baumeister, "*Self-Control As A Limited Resource: Regulatory Depletion Patterns". Journal of Personality and Social Psychology, 74,* (1998), 774.

## 5.0 Nature

### 5.1 Nature Defined

Since nature is an important element in relieving stress, it is essential that it's meaning be investigated and defined in the context of this thesis. The term nature has evolved to embrace many different meanings depending on the source and the context. Here, the term nature will refer to the material world, as opposed to the quality of a person or object.

'The word nature is derived from the Latin word natura, meaning *essential quality*, *origin*, *innate disposition*, and in ancient times, literally meant *birth*, coming from nasci, *to be born*. Natura was a Latin translation of the Greek word physis, which originally related to the intrinsic characteristics that plants, animals, and other features of the world develop of their own accord.'[40]

Many descriptions of nature define it as the physical world and its phenomena, including all living things and abiotic entities. This meaning encompasses living organisms, inanimate objects, ecosystems, landscapes and phenomena including plants, rocks, wetlands, rivers and weather. Some connotations include humans but distinctly pronounce that nature exists independent of human activities and does not include human creations.[41,42,43]

Two arguments arise out of the widely accepted definitions of nature. Firstly, one can argue that since humans are living things, that they and their creations are considered nature. Bees, which are living things, create hives to live in that are considered natural. Humans

[40] http://www.newworldencyclopedia.org/entry/Nature#cite_ref-0
[41] http://dictionary.reference.com/browse/nature
[42] http://www.thefreedictionary.com/nature
[43] http://www.newworldencyclopedia.org/entry/Nature#cite_ref-0

are living things, so under the same premises, the skyscrapers they create should also be considered natural, but many definitions exclude human creations as natural. Secondly, if nature exists independent of human activity there could arguably be no, or very little, nature on Earth as the human species has roamed and explored the Earth for thousands of years manipulating it over time and affecting its ecosystems and atmosphere.

The term natural is helpful in defining the meaning of nature. By definition natural elements are inherent, not artificial and have not been significantly processed or changed.[44,45] This would explain why some human creations, such as skyscrapers and automobiles, are not considered nature and why living entities and environments, although at some point in time touched by humans, are considered nature.

For the purposes of this thesis, nature will include the material world, including all living things and abiotic entities that have not been unduly altered by manipulations or process rendering them artificial.

### 5.2 The Human Need for Nature

Numerous researchers postulate that humans have a profound connection to nature; and that living organisms have advanced research and evidence to support this notion. This inclination towards nature is known as *Biophilia*.

These scientists contend that the human appeal for nature is biological and a result of human evolutionary roots, which developed in a biometric world; we are programed to seek

[44] www.thefreedictionary.com/natural
[45] http://dictionary.reference.com/browse/natural

nature.[46] The idea of Biophilia or being attracted to living things was first introduced by German social psychologist Erich Fromm in his 1964 book *The Heart of Man*.[47] However, it was Harvard entomologist Edward O. Wilson who the coined the term and defined the concept in his 1984 book *Biophilia*. Wilson describes Biophilia as 'the innately emotional affiliation of human beings to other organisms.'[48] Biophilia supports the expanding body of health research that suggests contact with nature offers benefits to humans.

*The Biophilia Hypothesis*, by Wilson and Stephan Kellert, proclaims a human dependence on nature that extends far beyond the simple issues of material and physical sustenance to encompass human aesthetic, intellectual cognitive and even spiritual meaning and satisfaction.[49] The philosophy argues that humans have a preference to observe natural elements over built structures.[50]

Kellert has expanded the philosophy to the built environment through *Biophilic Design*, which is 'about creating good habitat for people in a modern built environment that satisfies their need for beneficial contact with the natural world.'[51] The nature-oriented design is not about inserting nature in the urban landscape, but more about the mutual benefits between humans and nature.[52] Biophilic design blurs the line


**University of Guelph-Humber**

[46] Stephan R. Kellert and Edward O. Wilson, *The Biophilia Hypothesis*, Washington DC, Island Press, 1983, 32.
[47] Erich Fromm, *The Heart of Man*, Harper & Row, 1964.
[48] Stephan R. Kellert and Edward O. Wilson, *The Biophilia Hypothesis*, Washington DC, Island Press, 1983, 31.
[49] Ibid, 20.
[50] Ibid, 24.
[51] Stephen R. Kellert and Bill Finnegan, Biophilic Design: The Architecture of Life, 2011 (film).
[52] Stephan R. Kellert, et al. Biophilic Design: *The Theory, Science and Practice of Bringing Buildings to Life*, John Wiley & Sones Publishing, Hoboken, NJ, 2008.

between buildings and natural elements by promoting the use of natural materials and plants while promoting natural lighting and ventilation.

If humans require nature to thrive, there must be consequences of its absence. Nature Deficit Disorder, hypothesised by Richard Louv in his 2005 book '*Last Child in the Woods,*' describes the effects of alienation from nature, particularly in children. The theory focuses on the effects of nature deficiency rather than our deep desire for it. Louv argues that nature is essential to the physical and emotional health of humans.[53] His studies reveal that children now spend less time in contact with nature and as a result are prone to attention disorders such as ADD and depression.

In his latest book, '*The Nature Principal,*' Louv expands his concept to adults. 'The principal holds that a reconciliation to the natural world is fundamental to human health, well-being, spirit and survival.'[54] Louv questions what our lives would be like if we were immersed in nature as much as we are in technology.

> *'The agrarian, nature-oriented existence hard-wired into human brains isn't quite ready for the over-stimulating environment we've carved out for ourselves.'*
>
> Richard Louv

[53] www.richardlouv.com/books/last-child
[54] Richard Louv, The Nature Principle: Human Restoration and the End of Nature-Deficit Disorder, Algonquin Books of Chapel Hill, North Carolina, 2011, 3.

### 5.3 The Benefits of Nature

Over the past several decades' researchers have documented the many benefits of nature. Many theories have been postulated and backed by numerous experiments. The beneficial effects of nature are most prominent when it comes to reducing stress and its associated side effects. Nature has also been documented for improving coping skills,[55] increasing self-control as well as enhancing health and wellness.[56] The following examples illustrate nature's therapeutic properties.

Professor Ulrich researched the effects of nature on patients in surgical recovery. One study resolved that surgery patients recovered quicker and with fewer complications when their recovery room overlooked a courtyard with trees. It also indicated that fewer medications were taken.[57] Ulrich also documented that natural scenes could reduce pre-surgical tension and anxiety.[58]

**Florida's Celebration Health Courtyard**

In another study, Ulrich exposed participants to a short stressful video followed by another video of either an urban environment or a natural one. The results indicated that experiencing the natural environment resulted in reduced stress through lower blood pressure and reduced muscle tension. The results reason that functioning in natural

[55] V. M. Kasser, and Richard M. Ryan, "The Relation Of Psychological Needs, Journal of Applied Social Psychology, 29, 935, 1999. Richard M. Ryan and C. Frederick, "On Energy, personality, and Health: Subjective Vitality as a Dynamic Reflection of Well-Being," Journal of Personality, 65, 529, 1997.

[56] M. Muraven, D. M. Tice NDR. F. Baumeister, "Self-control as a limited resource: Regulatory depletion patterns," Journal of Personality and Social Psychology, 74, 774, 1998.

[57] Roger S. Ulrich, "View Through A Window May Influence Recovery From Surgery", Science 224, 1984, 420.

[58] Roger S. Ulrich, "Human Responses to Vegetation and Landscape", Landscape and Urban Planning, 13, 1986, 29.

surroundings demand less energy than functioning in urban settings, regardless if the latter is more familiar.[59]

Professor Ulrich has conducted many experiments using landscape scenes to demonstrate the benefits of nature. One of his earlier experiments concluded that stress is reduced when viewing scenes of nature.[60] In another, participants viewed slides of either nature, nature with a water element or urban environments. Results indicated that natural scenery, especially those with water, are more successful at retaining attention that urban scenes. Views of nature also offer more positive influence on psychophysiological states than the urban scenes.[61]


Nature Scene


**Nature Scene with Water**


**Urban Scene**

Ulrich credits such health benefits to the attention holding properties of nature. 'Natural scenes, especially those with water, are more successful at retaining involuntary attention than urban scenery. Views of nature also offer more positive influence on psychophysiological states than the urban scenes.'[62] Furthermore, research demonstrates that natural environments tend to be perceived as more restorative than urban

[59] Sacks, O. "The Man Who Mistook His Wife For A Hat And Other Clinical Tale," New York: Harper. 1987.
[60] Roger S. Ulrich, "Landscape Restoration", Environmental Behavior, 13, 523, 1979.
[61] Roger S. Ulrich, "Natural Versus Urban Scenes," Environment & Behavior, *13*(5), 1981, 523.
[62] Ibid.

environments.[63,64 ,65]

Russ Parsons and his research team furthered Ulrich's research exposing mildly stressed participants to simulated outdoor drive. Those who experienced a simulated drive in a nature dominated environment showed lower levels of stress than those who experienced the more urban drive simulation. The nature viewers recorded lower blood pressure and electrodermal activity than their counterparts after their respective simulated drives.[66]

'People with access to nearby natural settings have been found to be healthier overall than other individuals' [67] as exposure to nature can increase vitality and improve health, presumably by reducing susceptibility to ailments through building resilience to viral and physical conditions.[68] Contact with nature can heighten the vitality experienced while outdoors, but even in isolation nature can create the same positive effects.

**Nature in the workplace**

'Moreover, empirical literature suggests that the rejuvenating effect of nature extends to far less "pure" forms of nature than wilderness (nature primarily unaltered by human interaction) and that it results in systematically greater effectiveness on a wide variety of tasks.'[69] In a study investigating the

[63] Rita Berto, "Exposure To Restorative Environments," Journal of Environmental Psychology, 25, 249, 2005.
[64] T. R., Herzog, C. P. Maguire and M. B. Nebel, "Assessing The Restorative Components Of Environments," Journal of Environmental Psychology 2, 159-170, 2003.
[65] K. Laumann, T. Gärling, and K. M. Stormark, "Rating Scale Measures Of Restorative Components Of Environments". Journal of Environmental Psychology, 21 (1), 31, 2001.
[66] Russ Parsons, et al., "The View From The Road," Journal of Environmental Psychology, 18, 113, 1998.
[67] Rachel Kaplan and Stephan Kaplan, "The Experience Of Nature," New York: Cambridge University Press, 1989, 173.
[68] Benyamini 2000, Cohen 2006, Polka 2005.
[69] Frances Kuo, "Coping with Poverty," Environment and Behaviour, Volume 33 No. 1, January 2001.

benefits of indoor plants, research led by Virginia Lohr documented that those workers with exposure to indoor plants experienced increased productivity, reduced stress and reported better concentration.[70]

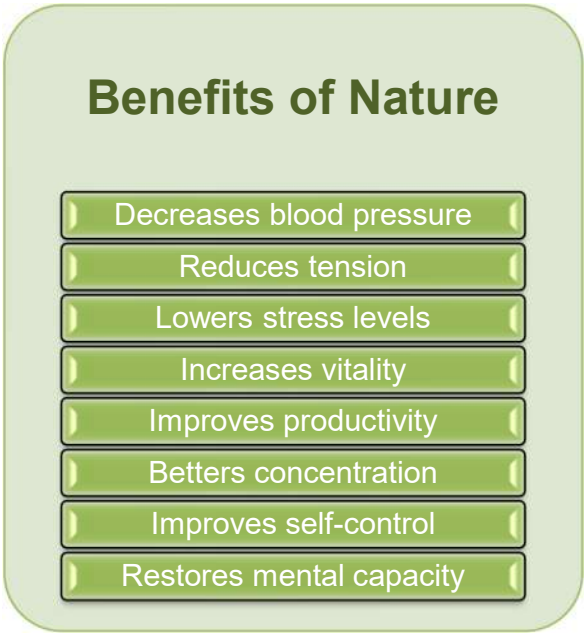
Researchers at the University of Illinois investigated the impact of views of nature and concluded that exposure to nature can increase concentration, impulse control, and delay of gratification. Higher levels of self-discipline were recorded for girls with a view of nature from the home than those without.[71] The study also referenced instances of exposure to nature as increasing mental capacity in children, including those with Attention Deficit Disorder.

While most of the above-mentioned studies used visual images and videos in their research, these methods were employed to isolate specific environmental characteristics to ensure the accuracy of the data collected. However, it has been determined that the restorative effects of nature are enhanced when experiencing natural surroundings as opposed to viewing them.

Professor of Environmental Psychology Terry Hartig and his team of scholars have, through a series of studies, developed a means for measuring the relative restoration of environments called the *Perceived Restoration Scale* (PRS). It measures psychological factors of environments based on the characteristics of restorative surroundings (fascination, being away, extent and compatibility) and distinguishes the potential for

[70] Virginia I. Lohr, Caroline H. Pearson-Mims, and Georgia K. Goodwin, “Interior Plants may Improve Worker Productivity and Reduce Stress in a Windowless Environment”, Environmental Horticulture, 14 (2), June 1996, 97.
[71] Andrea Faber Taylor et all. Views Of Nature And Self-Discipline. Journal Of Environmental Psychology. June 11, 2001, 175.

rejuvenation between settings.[72] The technique has been tested against different presentation modes (photographic, video and in-person) to assess the validity and reliability of the method.[73] It was determined that visual contact with nature would not be as restorative as actually experiencing the environment, as the interaction in a visual setting would be limited.[74]




[72] Andrea Faber Taylor et all. Views Of Nature And Self-Discipline. Journal Of Environmental Psychology. June 11, 2001, 179.
[73] Ibid, 175.
[74] Ibid, 192.

## 6.0 Recovery + Restorative Environments

**Manhattan's Central Park**

### 6.1 Restorative Environments

The concept of restorative environments dates back over 150 years. Landscape architecture pioneer Fredrick Law Olmsted believed that 'scenery worked by an unconscious process to produce relaxing and "unbending" of faculties made tense by the strain, noise and artificial surroundings of urban life.'[75] While the empirical evidence for the benefits of nature did not exist at that time, it was evident that people realized that they needed a place to escape from the city. Central Park in Manhattan is a prime example of this realization.

[75] Yannick Joye, Agnes Van Den Berg, and Linda Steg, "*Sensory Dimensions Of Restorative Experiences",* University of Leuven, Leuven, Belgium, (2011), 58.

Restorative environments are defined as spaces that allow for recovery from psychological and physiological conditions. Recovery, or restoration, can be defined as 'the process of renewing physical, psychological and social capabilities diminished in ongoing efforts to meet adaptive demands'. [76] Such spaces can be either dynamic or static in composition allowing for both active and passive activities.[77]

> *'Restorative Landscapes, particularly in an urban context, can importantly contribute to healthier lifestyle and greater awareness of nature by users.'* [78]
>
> Tanja Simonic

Researchers have determined that natural settings provide an opportunity to alleviate stress and revive depleted resources. There are two well-documented theoretical explanations that support the importance of nature in rejuvenation setting. The first, *Stress Recovery Theory* (SRT) developed by Roger Ulrich (1983) focuses on recovery from stress by removing stressors from the environment. The second, *Attention Restoration Theory* (ART) established by Stephan and Rachel Kaplan concentrates on restoring depleted attention by allowing it to rest. More recently there have been a number of emerging theories that build on the aforementioned research, such as Perceptual Fluency Account.

Ulrich's Stress Recovery Theory and Kaplan's Attention Restoration Theory share complementary perspectives stating that restorative environments are beneficial and nature is an important element in such settings. Both theories consider that the psychological

[76] Terry Hartig, 'Toward Understanding the Restorative Environment as a Health Resource', Institute for Housing and Urban Research, Uppsala University.
[77] Tanja Simonic, *Urban Landscape as a Restorative Environment Preferences,* Acta Agriculturae Slovenica, September 2006, 327.
[78] Tanja Simonic, *Urban Landscape as a Restorative Environment,* Acta Agriculturae Slovenica, 86-2, September 2006, 326.

effects humans experience from nature are a result of the evolutionary process. The difference between the two theories lies in the aspect requiring restoration and the lengths of time for strain and recovery.

### 6.2 Stress Recovery Theory

Stress Recovery Theory (SRT) concentrates on the recovery from stress. It declares that stress is both triggered and recuperated from in a short period of time. SRT argues that emotional, attentional and physiological aspects of stress can be rejuvenated through restorative environments.[79] Ulrich reasons that an individual's initial response to an environment is generalized in terms of pleasure or dislike and that positive feelings are often achieved in preferred environments. Reduced stimulation and negative feelings experienced in preferred environments allow for the restoration process to take affect.[80] The restoration affect is enhanced when there is interest in the environment that allows for cognitive processing.[81]

> *'Experience in natural environments can not only help mitigate stress; it can also prevent it through aiding in the recovery of this essential resource (directed attention).'* [82]
>
> Stephan Kaplan

[79] Roger S. Ulrich, "Aesthetic And Affective Response To Natural Environment," Human Behavior & Environment, Vol 6, 85,1983.
[80] Ibid, 120.
[81] Ibid.123.
[82] Stephan Kaplan, "The Restorative Benefits Of Nature," Journal of Environmental Psychology, 15, 169, 1995.

### 6.3 Attention Restoration Theory

*Attention Restoration Theory* (ART) focuses on the fatigue of directed attention that occurs from prolonged or intense focusing. Unlike stress, directed attention takes longer to become depleted, but it also takes longer to replenish, possibly making recovery from mental fatigue more resilient.[83]

ART argues that people concentrate better after contact with nature and that the characteristics of restorative environments should be harmonious with nature. *Fascination*, Kaplans' term to describe involuntary or effortless attention, is easily facilitated by nature's interesting patterns and objects. This 'form of attention requires no effort,' allows directed attention to rest and is resistant to fatigue.[84] Furthermore, the restorative effects are amplified when users have an increased demand for restoration.[85]

> *'Attention Restoration Theory provides an analysis of the kinds of experiences that lead to recovery from such fatigue. Natural environments turn out to be particularly rich in the characteristics necessary for restorative experiences.'*[86]
>
> Stephan Kaplan

### 5.4 Perceptual Fluency Account

*The Perceptual Fluency Account* (PFA) is based on the phenomenon of perceptual fluency, or the ease by which information, such as stimuli, is processed by the human mind. It aims

[83] Terry Hartig, "Toward Understanding the Restorative Environment," Institute for Housing and Urban Research, Uppsala University, 1993.
[84] Stephan Kaplan, *The Restorative Benefits Of Nature*, Journal of Environmental Psychology, 15, 172, 1995.
[85] Hartig, Terry and Henk Staats. "Linking Preference For Environments," Environment And Behavior..
[86] Stephan Kaplan, "The Restorative Benefits Of Nature," Journal of Environmental Psychology, 15, 1995. 172.

to provide an integration of both SRT and ART.[87] The fundamental postulation of PFA is that natural environments are processed more fluently than urban settings and increases in fluency resulting in increased potential for restoration.[88]

### 6.5 Qualities of Restorative Environments

Fascination is an important quality of recuperative settings and can be experienced with numerous biological components. Natural phenomena such as clouds and snowflakes, and elements such as water and wildlife all allow for effortless attention, thought and reflection, which allow directed attention to rest.[89] *Fascination* is a central component of restorative environments, but alone not enough to replenish directed attention.[90] In 1983, Kaplan and Talbot introduced three additional characteristics of revitalizing spaces: being away, extent and compatibility.

*Being away* is ability to take a mental vacation. It does not require a distant setting but rather a break from using directed attention.[91] Natural settings are often preferred for mental escapes; the contrast from the norm allows for thoughts to shift and allow directed attention to rest.

*Extent* is the magnitude of the environment. It should be rich and coherent enough to encompass a substantial amount of the mind and comprise an entirely different world. The extent of a setting can be expanded through perception, use of miniature components or a

[87] Yannick Joye, Agnes Van Den Berg, Linda Steg, "Sensory Dimensions Of Restorative Experiences," University of Leuven, Leuven, Belgium, 2011.
[88] Ibid.
[89] Stephan Kaplan, *The Restorative Benefits Of Nature*, Journal of Environmental Psychology, 15, 174, 1995.
[90] Stephan Kaplan, *The Restorative Benefits Of Nature*, Journal of Environmental Psychology, 15, 169, 1995.
[91] Rachel Kaplan and Stephen Kaplan, *The Experience Of Nature,* New York: Cambridge University Press, 1989.

connection to the past (history). [92]

Compatibility is when an environment matches the user's purpose for being there and will thus facilitate recovery. Incompatible environments may present unnecessary distractions that could further strain directed attention. Certain activities relate to natural settings and when people seek nature with purpose the compatibility increases. Since natural environments are experienced as highly compatible with restoration, functioning within them seems more effortless than in urban environments.[93] Functioning in natural surroundings seems to demand less energy than in more urban settings, regardless if the latter is more familiar.[94]

> *'As a culture we might want to think about the importance of sustaining the natural elements that surround us and enhancing people's opportunities to access them.' [95]*
>
> Richard M. Ryan

### 6.6 Preference for Environment

Researchers have determined that preferences for rejuvenating settings impact the effects of restoration. In many cases nature is a key component of such surroundings as it supports the elements that facilitate recovery. Similar to Kaplan and Talbot's concept of compatibility, preference for an environment varies with the user's intent and purpose for being in a place.

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[92] Stephan Kaplan, *The Restorative Benefits Of Nature*, Journal of Environmental Psychology, 15, 174, 1995.
[93] Sacks, O. "The Man Who Mistook His Wife For A Hat And Other Clinical Tales," New York: Harper, 1987.
[94] Ibid.
[95] Richard M. Ryan, et al. "Vitalizing Effects of Being Outdoors and in Nature," Journal of Environmental Psychology 30, 159, 2010.

A study, by Agnes E. van den Berga and colleagues, suggests that preference for an environment can improve restoration from mental fatigue and also from anxiety-based stress. In the study, participants watched a film of a simulated walk through either a natural or urban environment. The report indicated that stress recovery is facilitated when an environment's potential for restoration is apparent. It also linked elevated stress to stronger desires for natural surroundings over built settings.[96] The research reinforces previous findings, including those of Hartig, Kaplan and Ulrich.

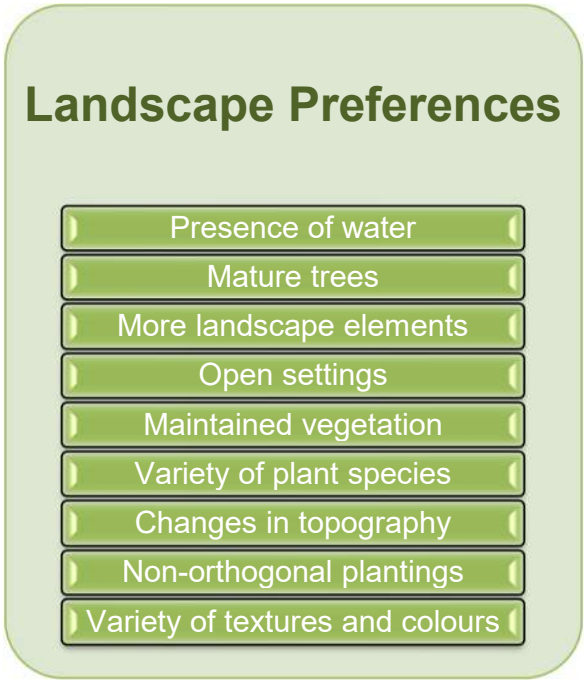
**High Park London**

Further research, by Tanja Simonic, investigated preference for environment. In a visual questionnaire, visual preference was examined using twenty-one landscape images representing eight different landscape types in three categories; natural landscapes, naturalistic landscapes and geometric landscapes. Preferred active and passive activities

[96] Agnes E. van den Berga, Sander L. Kooleb, Nickie Y. van der Wulpb. "Environmental preference and restoration: (How) are they related?" Journal of Environmental Psychology 23 (2003) p 135.

were also noted for each landscape.[97]

Results of the study indicated that the most preferred scenes included trees and water. The diversity of landscape elements and colour played a role in the preference of for organic and naturalistic environments. As with other studies, such as those by Ulrich, Kaplan and Peron, settings with more landscape elements were more favoured, especially when compared to geometric designs.[98]




Expanses of open, maintained grassland with trees and clustered patches of vegetation where most preferred. The least preferred landscapes included those with uniform species and arrangement, orthogonal flowerbeds and spaces that were more vegetative, but less open and maintained.[99] The study indicates that the form and content of restorative spaces, such as more natural elements (with texture and diversity), views with more vegetation than man-made features, changes in topography, more distant views and the presence of water are factors in preference of a particular landscape.[100]

[97] Tanja Simonic, "Urban Landscape as a Restorative Environment," Acta Agriculturae Slovenica, September 2006, 326.
[98] Ibid.
[99] Ibid. 329.
[100] Ibid. 326.

## 7.0 Case Studies

Introducing nature into the city is not a new concept and various methods have been attempted in the past. Urban nature in the form of gardens and parks has been fashioned for centuries. Urban oases such as Hanging Gardens of Babylon (605 BC), Central Park (1857) and the Gardens of Versailles (1661) are a few examples. More recent efforts to integrate nature into the urban fabric have taken different directions. Some instances have had more success than others and can provide pertinent lessons for future attempts.

The following case studies provide an in-depth analysis of recent, relative and specific examples of nature benefiting urban populations as well as successful integration of nature in urban settings. An assessment of the characteristics of restorative environments (fascination, extent, being away and compatibility) will be conducted for each case study to document opportunities and constraints of the particular method used to integrate nature into the city and further define qualities of restorative environments.

**Bosco Vertical**

**Dockside Green**

**NYC Highline**

The analysis of these case studies will strengthen the understanding of how nature can prosper in urban environments. Hopefully this knowledge will illustrate ways to integrate the natural and built realms in a coherent environment that benefits its inhabitants and makes the city more hospitable.

## 7.1 Bosco Vertical (2013)

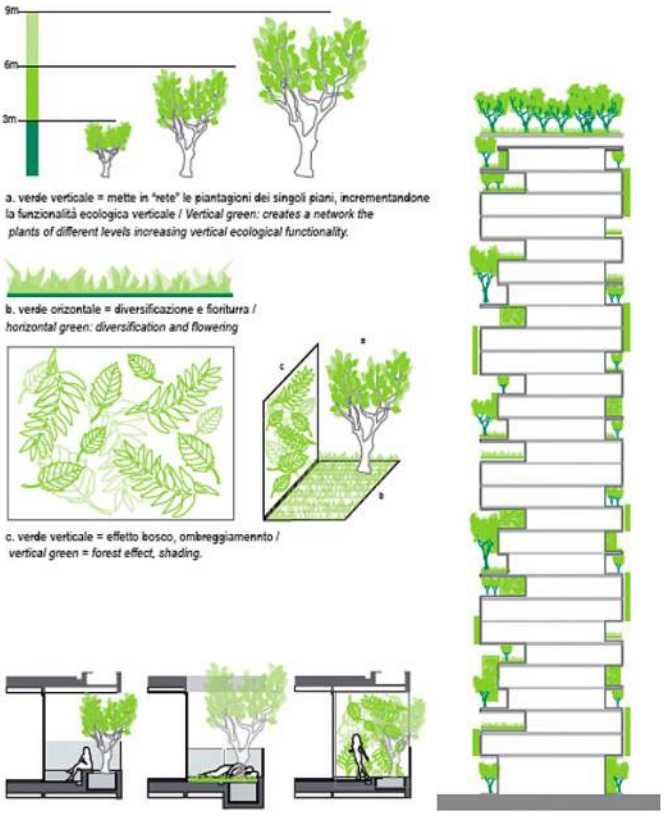
**Conceptual rendering of Bosco Vertical**

Bosco Vertical, located in Milan, Italy, is a ground-breaking development in vertical forestation and urban densification. Designed by Stephano Boeri, the scheme takes 10,000m$^2$ of forest plus 50,000m$^2$ of residential space and stacks it vertically into two residential towers (24 + 17 storeys, 110m + 76m). 'The design of the Bosco Vertical is a response to both urban sprawl and the disappearance of nature from our lives and on the landscape.'[101]

[101] http://inhabitat.com/bosco-verticale-in-milan-will-be-the-worlds-first-vertical-forest/_bosco-verticale-lead/?extend=1

Bosco Vertical, which translates into ‘vertical forest’, hopes to improve both the environment and the quality of living in urban centres. The concept is expected to rejuvenate the environment and spawn urban biodiversity. The buildings intend to optimize, reclaim and yield energy, further reducing the buildings’ ecological footprint. The extensive plant life will improve the urban environment by reducing urban contaminates such as $CO^2$ and dust particles. The vegetation will improve the air quality by producing oxygen and humidity. Furthermore, the vegetation will act as a buffer, acoustically dampening the noise of the city and creating a microclimate for its residents.

The communal trees and vegetation of the development, including a planted tree on each balcony, will foster insects, birds and creatures similar to that of traditional parks. The planters, which vary in height between 3m to 9m, provide shade in the summer and allow light to penetrate through in the winter. Furthermore, the variety of plantings will offer an ever-changing array of colours and patterns on the building façade.




**Vegetation details and conceptual cross-section**

Forest in the sky (without structure)

Forest in the sky (with structure)

While Bosco Vertical is setting trends for urban densification and reforestation it also can provide insight into creating spaces for rejuvenation in an urban setting. The following is an analysis of Bosco Vertical using the characteristics of restorative environments.

**Fascination:** Bosco Vertical provides many opportunities for fascination. The diverse collection of vegetation including evergreens, deciduous trees, shrubs and floral plants mixed with the potential for wildlife and views of the sky could easily sustain one's attention. Sunrises and sunsets would be particularly fascinating seen from a forest in the sky. Patterns of sun and shade could potentially cast interesting and ever-changing patterns within the environment.

**Being Away:** Experiencing nature with a vertical separation from the city and its chaos could potentially qualify as a get away. The privacy that individual balconies afford would enhance the concept of being away. Both the trees and vertical separation would dampen the noises of the city below making the balconies an ideal location for thought and reflection.

**Extent:** While the vertical network of trees and plant life covers the equivalent of 10,000m$^2$ of traditional forest, the relatively small planters (length of unit by a few feet deep) on the balconies would likely not provide the feeling of magnitude that a typical forest would. However, if one views the project from a distance prior to experiencing it, the vertical scope and thought of being part of the whole may increase the perception of extent. A connection to a naturalized common area would strengthen the extent.

**Compatibility:** While a person might visit a traditional forest with the intent of recreating (hiking, hunting etc.) or observing nature, the intent for spending time in the vertical forest would have to be paired with less active ambitions. Activities that would be compatible with Bosco Vertical would be restricted to passive actions such as relaxing, reading or observing the city.

**Private terrace at Bosco Vertical**

Bosco Vertical definitely has some captivating features that could potentially provide an atmosphere for involuntary attention through fascination. It provides an opportunity to escape the excitement of the city and spend time with nature. While it may allow for a mental vacation, the physical extent that can be experienced is limited. In terms of compatibility, the user must realize that the characteristics of a vertical forest are different than those of a traditional forest and set their intentions accordingly.

**Bosco Vertical towers under construction**

It is likely that the design team has addressed many of the potential issues of creating a forest around a high-rise. Issues such as adequate light for vegetation on all sides of the building and all sides of the trees, the selection of vegetation for shallow beds in a high wind area, as well as the maintenance of vegetation and replacement of dead trees are likely to already have been considered. It may take a few years for the vegetation to mature before the full affects of Bosco Vertical can be realized. A negative aspect to this type of project is

the cost associated with replenishing and maintaining the vegetation as well as to mitigate damage from roots and limbs.

Bosco Vertical is currently under construction and expected to be completed in 2013. While the concept of wrapping vegetation around buildings is not new, the sheer scale of the project and amount of vegetation incorporated certainly presents new challenges and opportunities. Other recent projects have integrated vegetation into the façade in varying scope and scale. Some notable examples include Stacking Green in Ho Chi Minh City, Vietnam, La Tower Flower in Paris, France and Torre Huerta in Valencia, Spain.

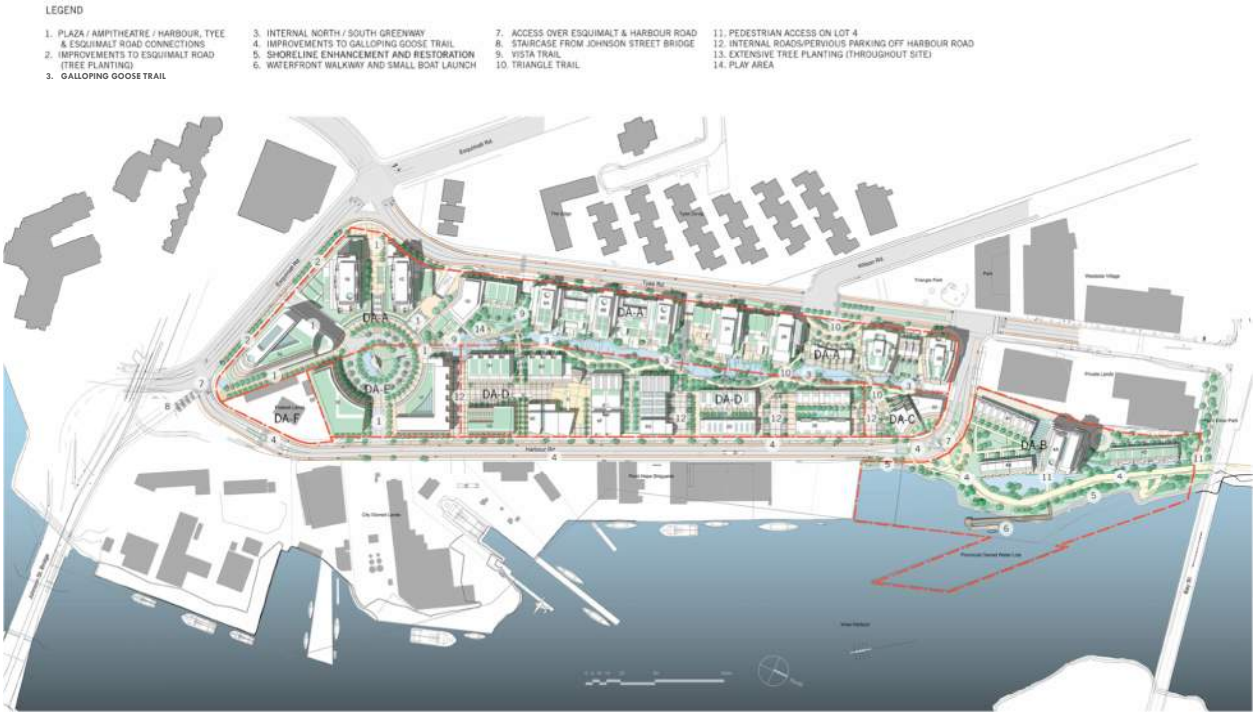
Stacking Green in Saigon is a 20m high residence designed by Vo Trong Nghia in 2011. Its notable feature is a series of cantilevered concrete planters containing low growth vegetation on two facades. La Tower Flower is a 10-storey residential block containing 30 units that has 380 concrete pots planted with bamboo encompassing its perimeter. The project was designed by Edouard Francois and constructed in 2004. Torre Huerta, as conceived by Mexico's MVRDV Architects, is planned as a 21-storey apartment tower featuring a terrace for each unit with orange, lemon and olive trees in an attempt to maintain growth of such plants in the city.

**Stacking Green**

**La Tower Flower**

**Torre Huerta**

## 7.2 Dockside Green (2011)




**Site plan of Dockside Green**

Dockside Green is a 120,000 $m^2$ (1,300,000 s.f.) sustainable community located in Victoria British Columbia's Inner Harbour. 'This new-generation, master-planned waterfront community is designed to reflect a more responsible approach to the environment.'[102] The densely populated mixed-use development covers 6.1 ha (1.5 acres) and is built around a central greenway that incorporates a pedestrian trail, native and adopting plants, as well as irrigation creeks and ponds. Its pedestrian friendly design encourages walking within the site and facilitates experiencing nature. Naturalized elements, extending to the buildings' edges, dominate the central spine and could be viewed from habited areas of the site.

[102] http://www.docksidegreen.com/Home.aspx

**Fascination:** Water is a fascinating feature and can easily engross one's thoughts. On breezy days, the wind may create patterns of ripples on the water's surface, distorting its reflections. The storm water filtration ponds support an array of wildlife inhabiting the tall grasses. The variety of grasses and greenery provide interesting patterns and textures.

**Internal pedestrian circulation**

**Variety of plant textures**

**Being Away:** The most prominent feature enforcing the escape is the inwardness of the site. Locating the natural elements on the inside of the westerly site isolates it from auditory and visual distractions, such as vehicular traffic, thus enhancing opportunities for a mental break. The water running through the site enhances the getting away effect. Furthermore, the internal pedestrian trail and waterfront exposure provide excellent opportunities for retreat.

**Extent:** The horizontal distance that the project stretches combined with its walkability enhances the magnitude of the site. The anticipation that the footpath connects to a larger whole is realized as it reaches the waterfront and extends into the water as a boardwalk. The extended visual reference of the harbour's horizon increases the perceptual scope of the environment.

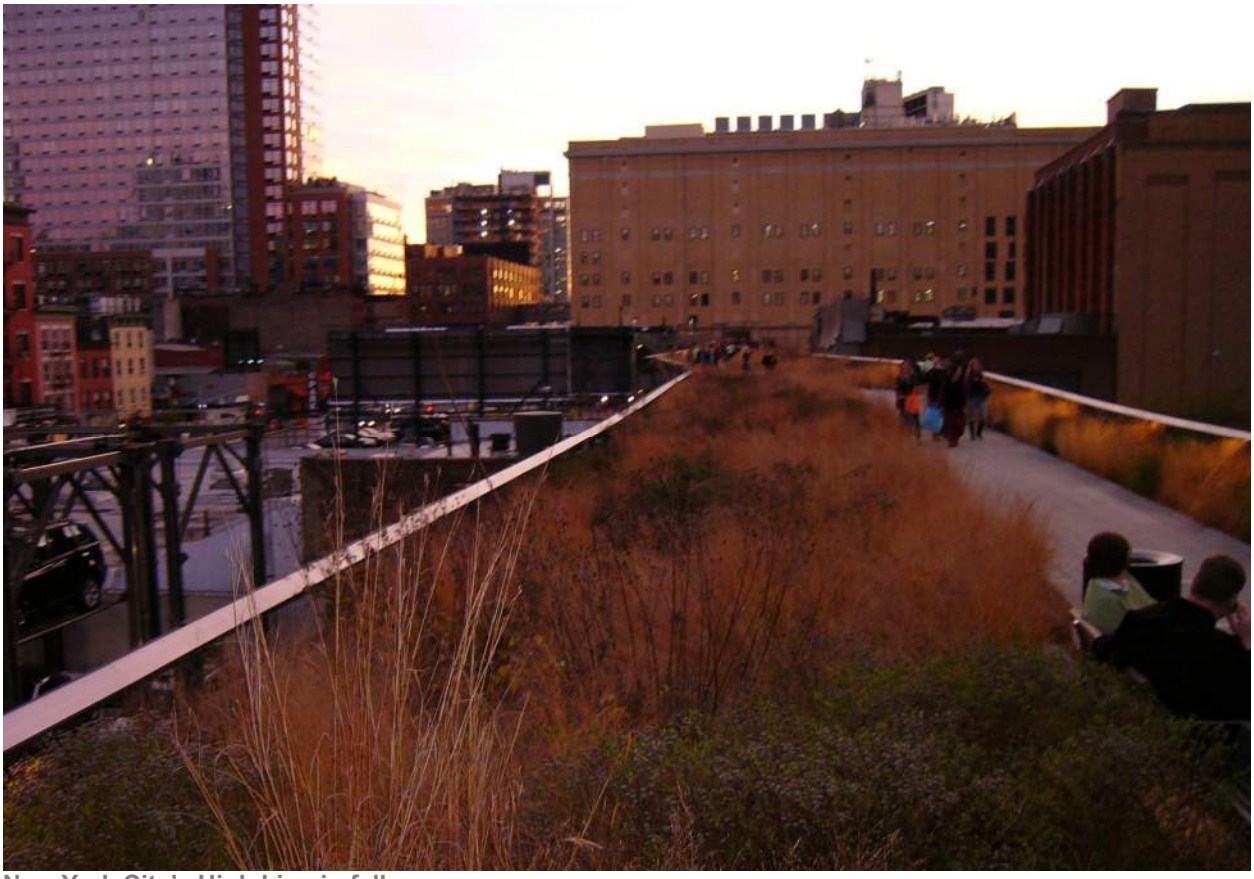
**Compatibility:** The linear characteristic of the site lends itself to movement. However, the

harbour plaza to the west and waterfront to the east could allow for a place to stop and reflect. The trail that runs through the site may allow for a temporary pause, but does not appear to have places to stop and sit.

The spatial organization of Dockside Green and integration of natural elements provide the necessary elements of a restorative environment. The combination of protection and exposure creates contrasting events and varies the user's experience. Dockside Green is a great example of how to incorporate nature into a medium density community in a sustainable fashion.

**Waterway and pedestrian footpath**

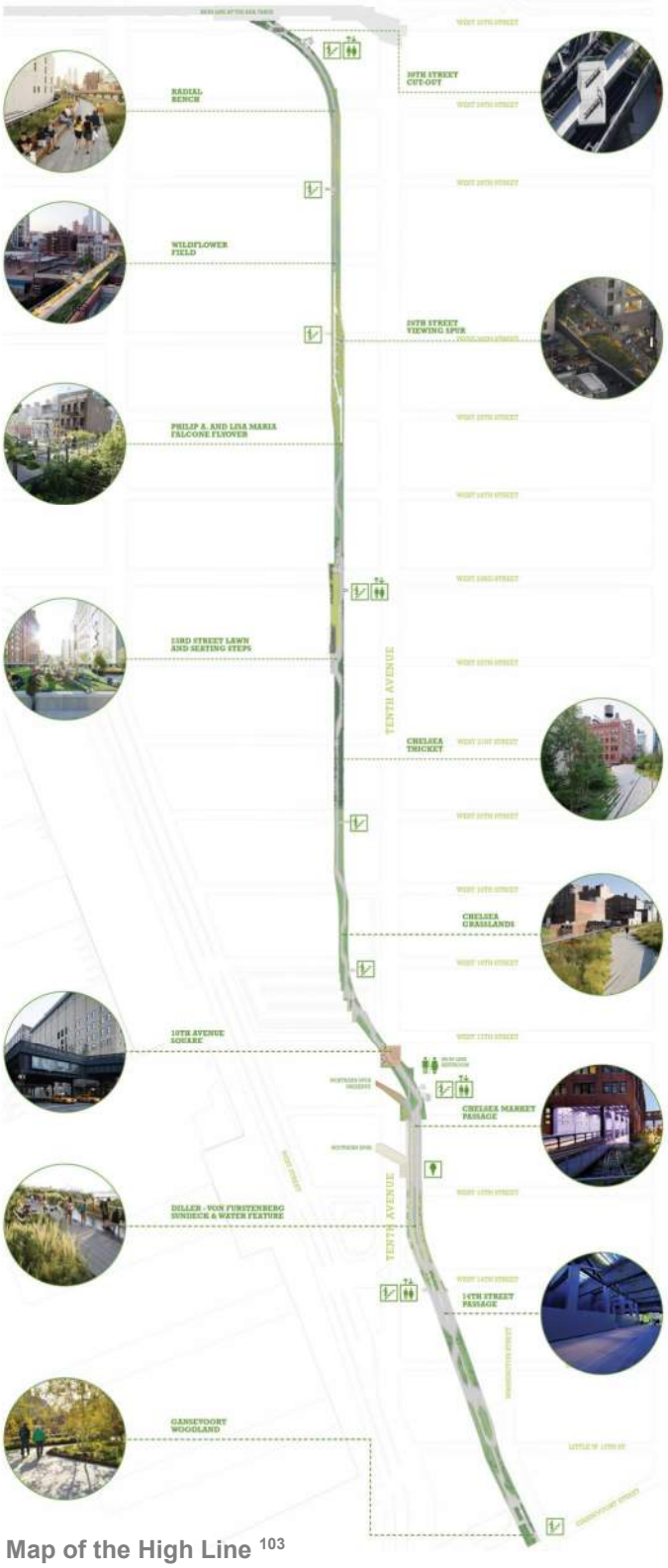
## 7.3 NYC High Line (2009, 2011, 2014)



**New York City's High Line in fall**

New York City's High Line is an urban public park created by repurposing remains of a decommissioned elevated railway. The linear greenway runs through the west side of Lower Manhattan, featuring an extensive naturalized planting, expansive views of the city and historic relics of the old freight railway. The High Line has nine entrances from grade, including accessible access from selected locations.[103]

[103] www.friendsofthehightline.org




**Map of the High Line** [103]

The High Line is symbolic of New York City's past as a manufacturing and freight empire. It was constructed in the 1930's to separate freight traffic from the street, where numerous accidents and deaths occurred. The park has renovated and reused the existing structure from the railway that travels around and through the area's buildings. Aspects of the original iron structure are evident from street level and in the riveted details of the railings as seen from the park.[104]

Just as the park is integrated into the fabric of the city, elements of the park are merged into one another. The deck is the unifying element of the park. Not only does it physically connect the original structure to the park, it also protrudes upward creating benches and breaks away to

[104] www.friendsofthehightline.org

allow for vegetation. Sections of original rail track are incorporated into the design linking the present to the future.

**Fascination:** The High Line offers fascination in both an urban and natural contexts. The sheer size of New York City, the heights of the buildings and the panoramic views can be experienced from a different perspective. Such urban landscapes can distract the mind from the stress of the city but may not allow directed attention to rest, as the amount of information presented requires processing. On the other hand, within the park, the long expanses of natural plant life can initiate involuntary attention. The long grasses sway in the breeze while the bright colours and natural shapes create an array of patterns. Greenery sprouting from between remnants of the original track may spur the imagination to wander back in time to the era when manufacturing and freight dominated the district. Variations in the walkway configuration and diverse features along the line maintain users' interest. The rolling loungers on the sundeck provide an excellent location to observe the sunset as framed by the city.

**Integration of deck, benches and vegetation**

**Being Away:** The elevated level of the High Line physically separates the park from the chaos of the city below. While it is still evident from the surrounding views that you are in the city, there is a sense of being somewhere else. The viewing platform allows observation of the traffic below as if it were in a fishbowl. Being away on the High Line is achieved when observing the city from a new perspective. The contrast of the lush vegetation and

colourful flowers against the harsh backdrop of the city reinforces that you are in ‘a different place’.

Refurbished iron railing

Original tracks integrated with plantings

**Extent:** The linear aspect of the High Line’s form creates a sensation that increases its perceived magnitude. The park’s 1.6 km (1 mi) length compensates for its relatively narrow width. When the park is completed, it will span 2.33 km (1.45 mi), making it physical and perceivably larger. The High Line is not isolated from the city. The relationship of the raised platform to adjacent buildings as it weaves around and through them integrates the park into the city. The scope of this urban park extends beyond the limits of its edges into the city. Furthermore, integrating the structure’s history as a freight railway from a distant era enhances interest of the park.

**Compatibility:** The High Line offers an escape from the hustle and bustle of the city without losing the urban context. If one’s intent is to forget about the city, this may not be the park to visit, as the experience is inline with observing the city from a different perspective. However, enjoying a more natural surrounding may prove to be restorative if observations are focused within the park.

New York City's High Line is a uniquely captivating urban park that seamlessly integrates nature and architecture in a rich and coherent environment. The urban backdrop allows the user to remain a part of the city while stepping back from the excessive, directed attention draining, stimuli experienced at street level. The contrast, views and variety experienced on the High Line provide a different perspective of the city, while the linear format of the park facilitates movement with tributaries for hiatuses.

**Aerial view of the High Line above the city streets**

Urban linear parks are a great vehicle for providing park amenities and facilitating movement. Often abandoned or underused right-of-ways are retrofitted to accommodate recreation uses. Such parks can vary in configuration and integration but are important urban features. The following are some notable linear urban parks. New York City has a proposed subterranean park dubbed 'Delancey Underground'. Intended to occupy an unused trolley terminal below Delancey Street in the lower East Side, daylight would be transported trough fibre-optic cables and support underground vegetation. Paseo del Rio is a walkway network one level below downtown San Antonio, Texas that lines the San Antonio riverbank. While this linear feature boasts commercial activity, the concept is worthwhile noting. Paris' Promenade Plantee is the predecessor of linear urban parks. The tree lined walkway stretches 4.7 km (2.9 mi) through the 12$^{th}$ arrondissement trailing the old Vincennes railway line.

**Delancey Underground**

**Paseo del Rio**

**Promenade Plantee**

### 7.4 Case Study Findings

The preceding case studies highlighted some of the opportunities and challenges for integrating nature into the urban fabric of the city. They display innovative strategies that enhance the merging of the natural and built realms to create urban retreats. The success of these projects as places for revitalization depends to some degree on to the effective inclusion of the four prime characteristics of restorative environments: fascination, being away, extent and compatibility. Through the analysis of these characteristics, qualities of recuperative settings were further defined.


**Fascination:** In all cases, the degree of natural elements present provided fascination. However, the layering multiple natural features appeared to enhance the level of captivation experienced. For example, the use of vegetation, and in some instances water, attracts wildlife that adds another dimension of captivation. Also, the sun casting shadows over vegetation produces interesting and constantly changing patterns. Difficulty arises, for colder climates, in providing natural elements that offer year-round fascination.

**Being Away:** The sense of being away can be achieved by providing a degree of separation from the city as the reduced noise and distractions can facilitate a mental escape. Vertically disconnected spaces can provide a new perspective of the city without completely disregarding it. Alternatively, inward focused environments use a buffer, such as buildings, to lessen the impact of negative urban conditions and enhance the feeling of escape.

**Extent:** The examples illustrate that incorporating nature is more easily achieved in horizontal formats than vertical ones. Linear spaces can seem larger due to the perception that they extend beyond the immediate vicinity. On the other hand, vertical fragments may be perceived as a whole if they can be understood as such and common elements can further create unity. The extent of a space is important as it can influence the user's intentions and the type of activities that occur.

**Compatibility:** The visitor's expectations must be compatible to an environment for restoration to occur. Linear spaces that facilitate movement differ from vertical spaces, which are more geared to passive activities. The degree of separation from the city would also affect the anticipated experience of an environment, depending on the user's objectives. Common spaces that can accommodate numerous people and types of activities may not be compatible with those seeking more intimate or less active settings for reflection.

## Elements to Consider for Restorative Environments

- Vegetation with a variety of colours, patterns and textures
- Vegetative buffers to mitigate sights, sounds and provide physical separation
- Water features such as fountains, ponds and waterfalls to improve ambient noise and provide a point of interest
- Enclosure from buildings or tree canopy to provide a sense of scale
- Mitigate distractions by vertical separation, internal courtyards and perimeter buffers
- Provide adequate extents in limited space
- Allow for both active and passive activities such as walking and sitting to serve a variety of users

## 8.0 Urban Nature Relationship

Since nature is an important aspect of rejuvenating settings it is important that both the quantity and quality of existing nature in an urban atmosphere be examined. The City of Toronto will be used as an example.

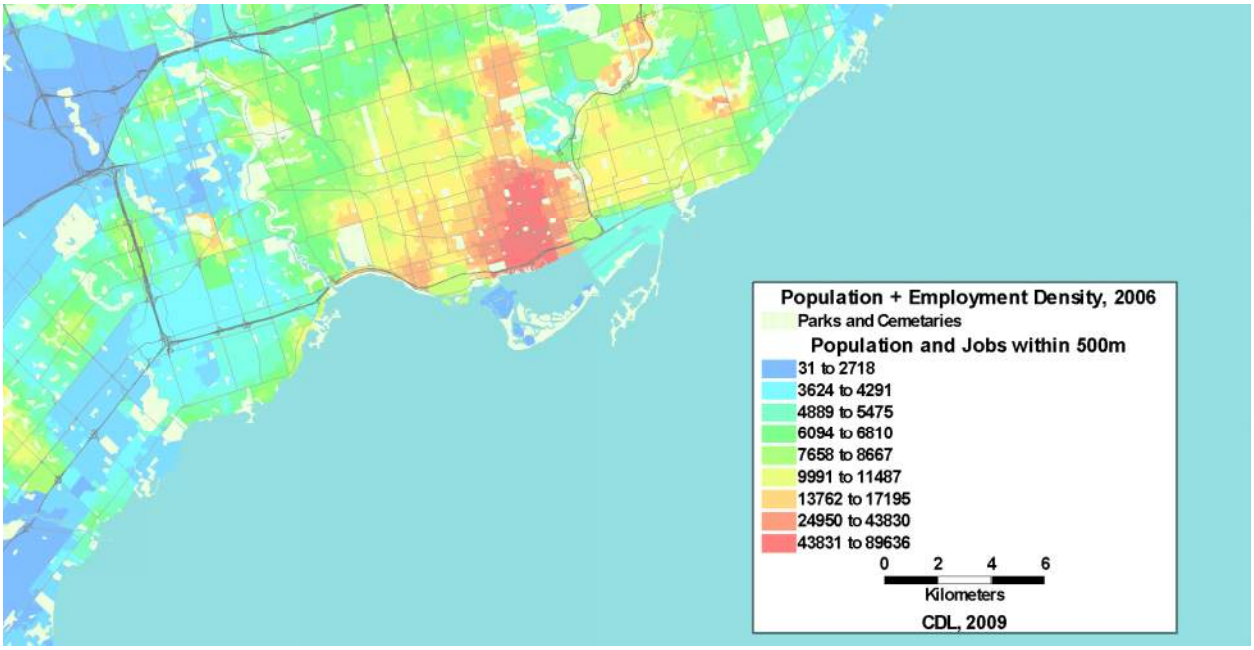
### 8.1 The Quantity of Urban Nature as Restorative Environments

The Greater Toronto Area (GTA) has fortunately been developed around an abundant amount of natural features, including rivers feeding Lake Ontario. As a result, the metropolis has maintained a system of green spaces, along riverbanks, that have been spared from development. However, upon entering the densely developed downtown core, the ratio of green spaces to population diminishes. Traditionally parks have provided respite from the city, but unfortunately urban parks are not always within reach.

Both the temporary and permanent populations of downtown Toronto have been increasing steadily over the last decade, thanks to the surge of condo developments and trend of large corporations moving back to the downtown core. The daytime population of the core spikes as droves of commuters head downtown. This temporary population seeks and occupies our urban nature in the meagre way it is provided.

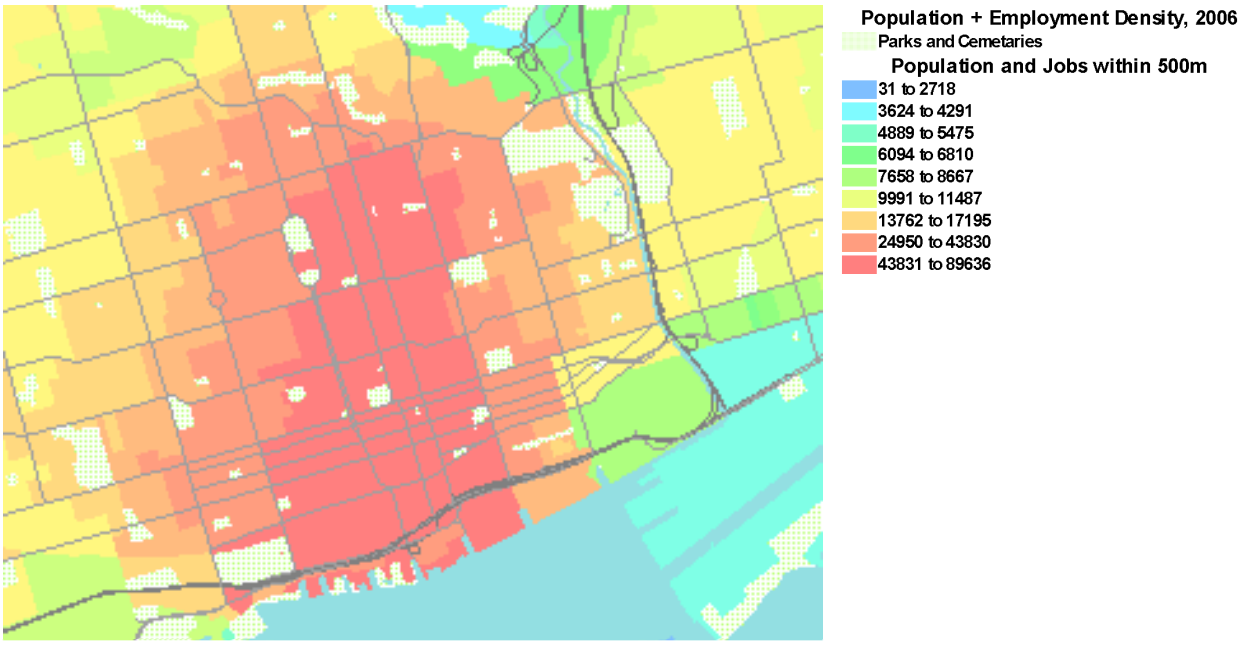
As the downtown core is more densely populated than outer regions, parks and nature become increasingly important as reprieves from the city. Toronto's core has the benefit of a network of urban parks and public spaces. However, these places were not necessarily designed, or intended, to be restorative environments and often do not contain all the essential characteristics for respite. Since parks and public plazas serve a variety of social

and recreational purposes it would be unjustified to transform these spaces for the sole use of urban recovery.




**Population and Employment Density in Toronto**

The above map illustrates employment and population density in the Toronto area. Fluctuations for parks and cemeteries have been factored. The most heavily populated area, as shown in red, is the downtown core. A closer look, as illustrated below, indicates that the quantity of parkland does not increase with the population and employment density. Based on the previously presented empirical evidence, one could reason that the amount of parkland should increase with density.




**Population and Employment Density in Toronto's Downtown Core**

The maps below highlight the approximate extent of highest density area illustrated above. A selection of urban nature within the identified area will be further investigated. Sites will be chosen based on characteristics, type (park, parkette, square, rooftop) and size to provide a variety within the case studies.


**Downtown Map**

**Downtown Density**

**Downtown Parks**

## 8.2 The Quality of Urban Nature as Restorative Environments

A sample of urban nature in downtown Toronto will be analyzed to determine the qualities of the existing stock in terms of restorative environments based on criteria formulated from the preceding case studies. The documentation of existing conditions in Toronto will highlight examples of good spaces for rejuvenation, outline opportunities for improvement, and note challenges that exist for restorative environments in urban areas to determine how to better incorporate spaces for revitalization into metropolitan settings.


1. Berczy Park


2. City Hall Roof Garden


3. Cloud Gardens


4. Courthouse Square

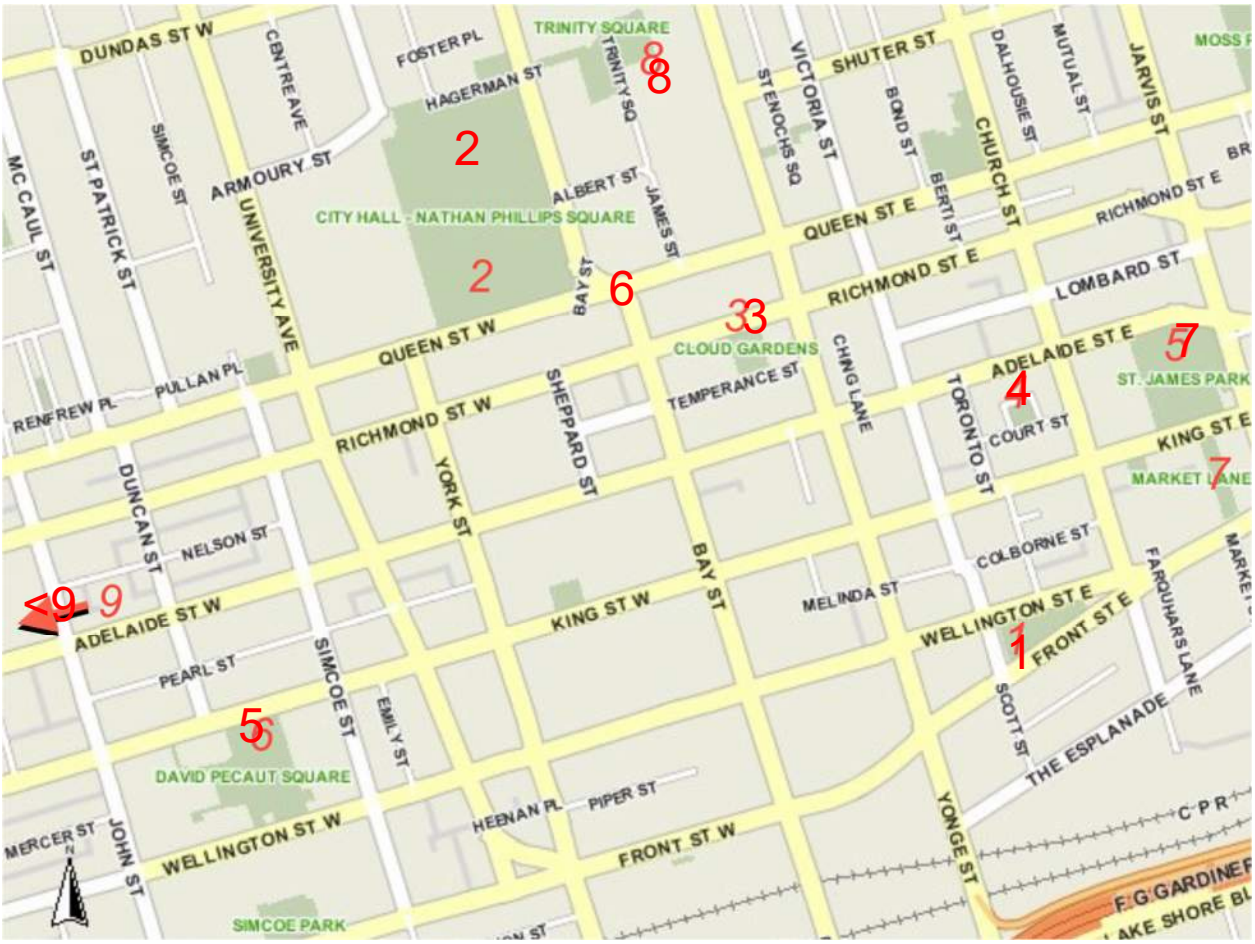

5. David Pecaut (Metro) Square


6. Toronto Sculpture Garden


7. St. James Park


8. Trinity Park

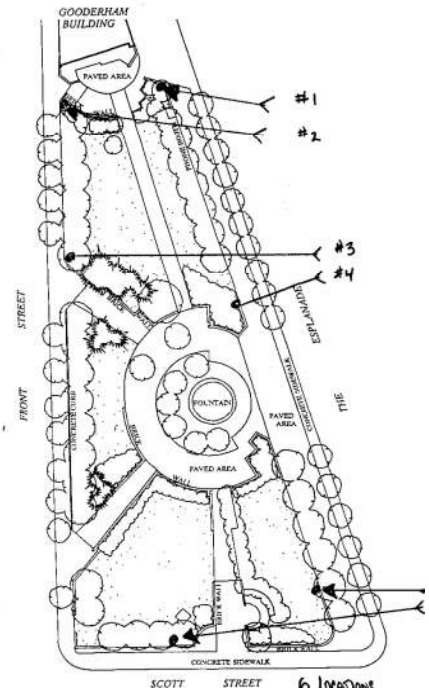

9. 401 Richmond W. Terrace




Urban Nature Study Locations

### 8.2.1 Berczy Park

Berczy Park is a wedge-shaped public space amidst the backdrop of the Financial District's skyscrapers. During the warmer months it is an urban oasis. Walkways radiate from a water fountain and raised planters give the circular gathering area a sunken effect. Mature trees around the perimeter create a soft boundary at the urban edge and contribute to the 'oasis' character of the space. The adjacent Gooderham Flatiron Building offers a trompe-l'oeil mural facing the park.



Map of Berczy Park

Being surrounded by heavily used vehicular arteries is the only drawback during the warmer months. However, as the weather cools down the park loses much of its lustre. The very features that make this park an urban oasis, the lush green trees, blooming flowers and the dancing water fountain, cease to exist resulting in a desolate space.


The stark contrast in seasons at Berczy Park

### 8.2.2 City Hall Roof Garden

Referred to as the City's largest publicly accessible green roof, the garden terrace at Toronto City Hall covers 3,200 $m^2$ (35,000 s.f.) featuring a progression of colour in planted beds. The podium revitalization was led by Plant Architects in joint venture with Shore Tilbe Irwin + Partners and completed in 2012.

**Aerial of the rooftop garden**

Users can stroll trough the planted areas consisting of seasonal flowers, grasses and blooming perennials. The raised podium creates a secluded escape in the middle of the city. The variety of planting creates a highly textural visual experience while providing a habitat for birds and other small animals. IPE wood benches and sunshades provide a place to observe the podium's unique views of the City. However, there are few benches provided and the sunshades appear more aesthetic than functional given their size and location relative to the benches. Additional opportunities for seating and seasonal shading devices would increase the pleasure of this urban asset.

**A seating area overlooking the city**

### 8.2.3 Cloud Gardens

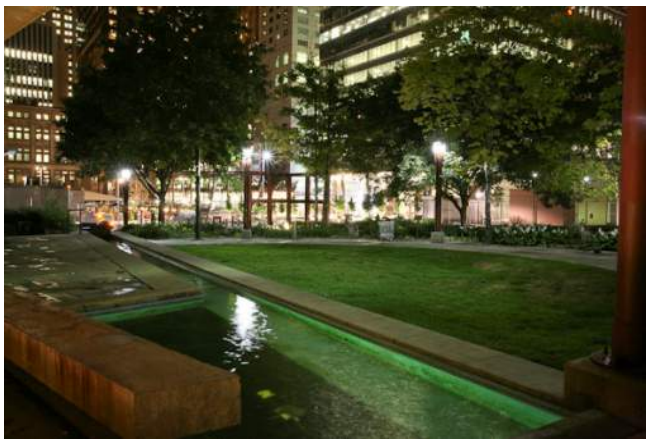
Cloud Gardens is a public park built on the air rights of the Bay Adelaide Centre. The 2400 $m^2$ park design, led by Baird Sampson Neuert Architects, contrasts rigid built form with textural vegetation. It features a succession of paths and ramps connecting a waterfall, reflection pools and a monument to the Buildings Trade Union. A small greenhouse and belvedere greet the vertical ramp's apex and overlooks the park.

**Aerial of Cloud Gardens illustrating its context**


**The Construction Workers' Monument**

The vertical ramp and monument to construction workers creates a strong vertical element in an area surrounded by skyscrapers, creating a scale to the park. The greenhouse atop the ramp offers a year-round lush retreat. The vegetation climbing over the ramp's walls softens the hardness of the space. Mature trees act as a sound buffer to adjacent traffic and help define space. A year-round 5-storey waterfall feature further dampens city noise. The commissioned artwork highlights the City's construction heritage and could elicit thoughts of the City's past.

While the waterfall and reflection ponds area are key components, their water quality and amassing litter pose a challenge. Furthermore, the hard surfaces of the ramp and adjacent buildings are exposed in the winter months when the vegetation sheds its leaves creating a much different atmosphere and acoustics for the park. The experience of the park will be further changed once the adjacent tower is constructed, hopefully in a positive way.


**A reflection pond at night**

### 8.2.4 Courthouse Square

Courthouse Square is located at the old York County Courthouse on Adelaide Street E. The courtyard was the location of political and public gatherings. The square layout is very rational and maintains vistas of the street and courthouse. Features include public art, a waterfall, small patches of lawn and a rose arbour covering a seating area.

**Aerial of Courthouse Square**

The rose arbour shelters the inward facing seating creating an intimate space. When in season the roses partially enclose the space below while creating patterns of shadow on the ground below. The cobblestone pavers and textural plantings add extra layers of interest. Plantings and sculptures have been carefully placed along the perimeter of the park to define the edges and separate it from the adjacent roads.

**Serenity under the rose abour**

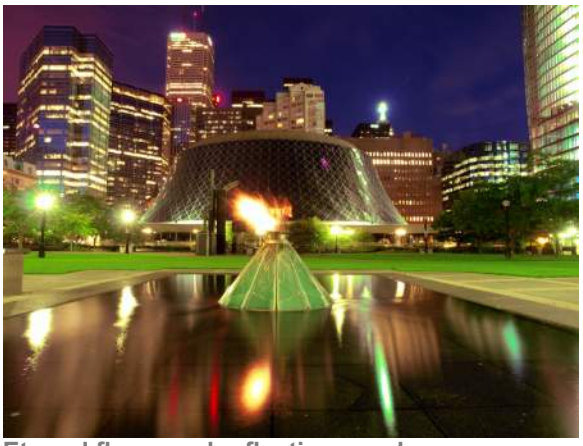
The noise created by servicing vehicles distracts from the beauty of the park and potential restoration opportunities.

### 8.2.5 David Pecaut (Metro) Square

Flanked by the three post-modern Metro Hall buildings and Roy Thompson Hall, David Pecaut Square is frequently used for events, movie screening, a farmer's market and various performances. The space features a sculptured waterfall and reflecting pool, a grass lawn and mature perimeter trees.

**Sculpture fountain and reflection pond**

The surrounding buildings enclose the square, mitigating noise and activity of the street and create a microenvironment. Deciduous trees complete the perimeter and alleviate some of the built form's rigidness and provide shaded areas. The adjacent tall structures can create large expanses of shade depending on the time of the year and day.



**Eternal flame and reflection pond**

The events that take place within the square create interest and attract people, but can lessen the restorative aspects of the environment.

### 8.2.6 Toronto Sculpture Garden

Since 1981 the Toronto Sculpture Garden has been home to outdoor contempory sculpture exhibits. The park, previously a parking lot, was designed by the City of Toronto's (then) Civic Design Group.

**Temporary exhibit at the waterwall**

The surrounding buildings define the space and create a sense of enclosure. A decorative wrought iron fence along with trees and planters complete the perimeter while buffering sounds and screening views of the street. The softness, colour and textural patterns of the climbing vines contrast the hard surfaces of the buildings. A waterfall adds ambient sound, dampening vehicular noise. Changing art exhibits are the focal point of the park.

**Temporary exhibit with ivy covered wall behind**

There is an apparent lack of conventional seating that results in most people observing the art displays as they pass by. Places to sit would allow for one to stop and observe the exhibits and potentially allow for reflection.

### 8.2.7 St. James Park

St. James Park is a more traditional urban public park located slightly east of Toronto's financial district. Adjacent to St. James Cathedral, this park sizes in at 1 hectare (2.7 acres). It is one of the largest parks downtown and offers a variety of features.

**St. James Park formal garden with fountain**

Dating back to the early 20th century, St. James Park has graced the city with a landscape featuring a Victorian inspired garden. The formal garden, meticulously maintained by the Toronto Garden Society, provides a changing colour pallet. Anchored by a central water fountain, the gardens provide respite from the city. The expansive tree canopy creates a sense of place while separating the park from the city. A large ornamental gazebo acts as a meeting place and stage for musical performances.

Large expanses of grass and a network of walkways make St. James Park a very active place. The wide diagonal sidewalks encourage movement and result in the park being used as a thoroughfare as much as a park. The outskirts of the park are affected by vehicular noise from the adjacent city streets.

### 8.2.8 Trinity Park

Located next to its namesake, Trinity Church, the park nestled between adjacent buildings, including the Eaton's Centre. The buildings that surround Trinity Park create a courtyard and isolate it from the noise of the city beyond. Mature trees at the perimeter mask the buildings' hard surfaces. A powerful waterfall with a large reflecting pool is the focal point of the space while a labyrinth maze fills out the courtyard. Shallow steps descend to the labyrinth creating an informal terraced effect. The simple task of walking the labyrinth allows for reflection.

**Tree canopy with labyrinth beyond**

Much of the park has a hard ground surface to accommodate the heavy traffic generated by the mall but the overhead canopy lessens the impact. While restaurant patios animate the area, they also create noise distractions from potential relaxation opportunities. Buffers between restorative and social activities may be beneficial when creating spaces for rejuvenation.

**Changing seasons**

**Waterfall and reflection pond**

### 8.2.9 401 Richmond W. Roof Terrace

The roof top terrace at 401 Richmond Street West highlights how a roof can be beautified without a permanent green roof. The space is overflowing with a variety of flowers and blooming shrubs in wooden containers creating a green oasis perched above the street. Once a publicly accessible space, access is now restricted to building occupants due to its overwhelming popularity.

The wooden planters are large enough to contain larger species of plants. The variety of flora and fauna provides an ever-changing palette of colour while attracting an array of wildlife from birds and butterflies to squirrels and insects. The 4th floor roof garden is high enough above the street to be isolated from its noise but low enough not to be subject to harsh winds.

**A green oasis amidst the city**

Container gardening typically requires more maintenance due to the limited capacity for water retention. However, gardening can be relaxing and could become a community feature.

### 8.2.10 Summary

Analyzing a sample of downtown Toronto's urban nature has illustrated some of the challenges and opportunities of integrating restorative environments in an urban setting. While many of the examples analyzed offer positive elements for prospective places for revitalization, a few negative characteristics persisted.

The most significant feature of the examples studied is the quantity and quality of vegetation within and around the space. The lush, green vegetation highly contrasts with the hardness of the city. A variety of vegetation types provide an array of colours and textural patterns that could facilitate fascination.

Several of the examples contain water features, such as fountains and reflection ponds, which create ambient noise by dampening outside sounds. Not only do such features provide a point of interest, but they also instill a calming effect and which allows for thought and reflection.

A noteworthy characteristic of these areas is the sense of place and scale created. Even though many of the examples are nestled amongst buildings (some quite tall) they provided a sense of comfort and security. In many cases there is a sense of enclosure, albeit from adjacent buildings or a canopy of trees. The scale of these areas is geared to a human activity with, in some cases, intimate areas created within the whole.

Since real estate is at a premium in urban cores, large expanses of space are not often available. A challenge is presented in balancing the space available while providing

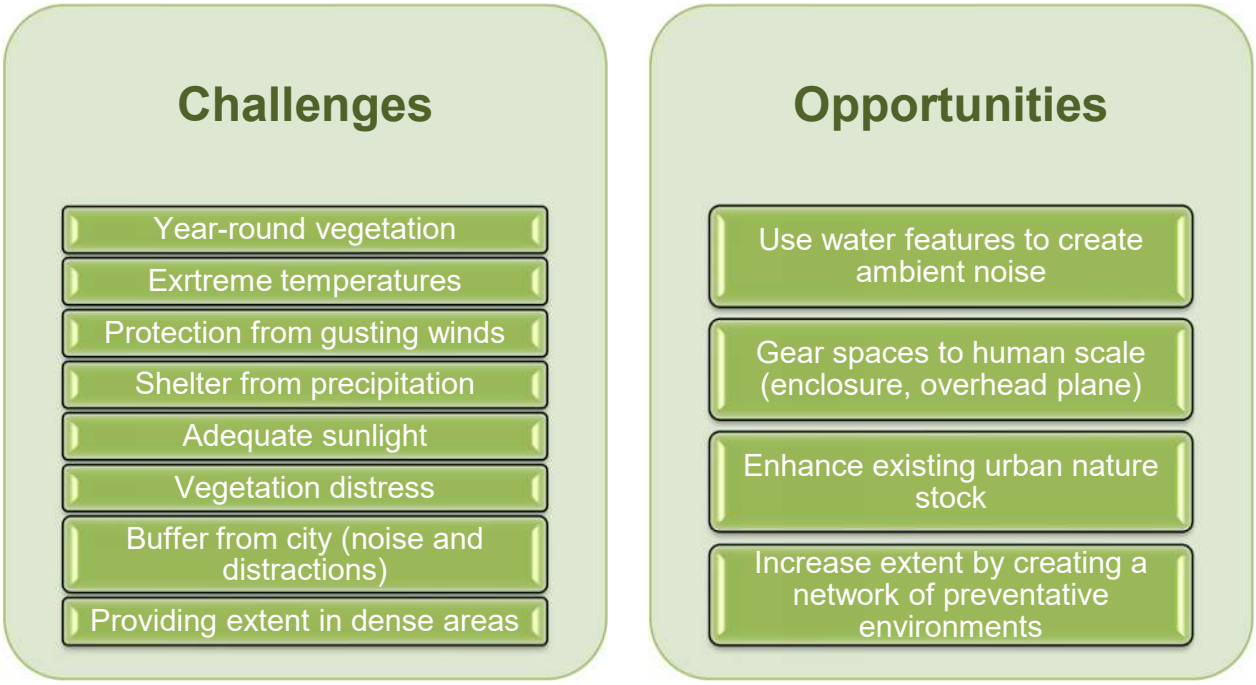
adequate extent. Spaces may require manipulation to be perceived as more expansive. Creating a system of urban retreats could create a sense of being part of a whole and expand the perceived scale of a space.

It would be beneficial to accommodate both dynamic and static activities, such as walking and sitting, as people's preferences for recover vary. In order to facilitate relief for stress and mental fatigue, retreats should allow for both brief respites as well as longer escapes since the duration for recovery differs. Thus, the size of restorative urban settings is important. With the limited space available in urban centers, larger extent may be realized by creating a network of places for reflection.

The greatest challenge in providing places for rejuvenation in an urban setting may be the ability to provide an area that mitigates urban distractions. The ability to reduce noise and distance the constant activity of busy city streets is of great importance in facilitating the engagement of involuntary attention. Urban noises from vehicular traffic and construction can prove to be rather distracting and make it difficult to focus. In most cases, perimeter trees and other forms of vegetation creates a buffer from the urban edge, visually masking thoroughfares and supressing street noise. The examples illustrate how internal courtyards elevated spaces and perimeter buffers can increase the perceived distance from the city.

Toronto's climate also poses challenges for creating urban retreats. While many parks and green spaces are heavily used in warmer months, cold temperatures can make such places desolate unless winter conditions are taken into account in the design. Cold temperatures drastically change the landscape with green canopies and colourful flowers disappearing

and seasonal features, such as water fountains, vanishing. Furthermore, few of the examples studied provided a place of refuge from gusting winds and frigid temperatures. Increased coniferous and perennial vegetation, sheltered areas and incorporation of indoor spaces would improve winter use for these landscapes. Year-round features are important, as our need for restoration does not hibernate in the winter months.




Given all the health benefits of restorative environments, opportunities to incorporate nature into the built environment should be actively pursued and realized. Challenges such as reducing distractions, providing a buffer from the city and providing year-round use need to be addressed and overcome. If these challenges and opportunities can be exploited, the creation of places for rejuvenation in urban environments could be better achieved and perhaps be used as preventative measures.

## 9.0 Conclusions + Recommendations

As people increasingly inhabit urban areas, we need to assess these environments and ensure that an acceptable quality of living is maintained. While most research focuses on restoration, it would be beneficial to look at recuperative settings in terms of preventative measures. Pursuing design that takes nature's benefits into consideration could improve the health of urban habitants. After all, an ounce of prevention is worth a pound of cure.

If increased stress can lead to these chronic illnesses, such as cardiovascular disease, then reducing stress should lessen the effects and incidence rate of these chronic ailments. At the very least, pauses from stress would allow the brain to rest and restore its depleted resources.

By increasing exposure to recuperative settings in urban environments, stress can be combated more frequently, preventing compound stress, and potentially reduce the occurrence of physiological and psychological illnesses. Using restorative environments within the city as preventative measures could essentially reduce the buildup of stress and depletion of mental resources resulting in a fewer occurrences of stress related health conditions, resulting in a healthier urban population and better quality of living.

Benefits of restoration and preventative measures:

- Respites would allow city dwellers regular opportunities to step away from urban stressors.
- The brain's limited processing resources could be recharged frequently resulting in improved directed attention, working memory and self-regulation and reducing

associated behavioural changes.

- Breaks from stressful occurrences could lower elevated blood pressure and heart rate potentially eliminating compounded stress and reduce the incident rate of heart related conditions.


Researchers, including Ulrich and Kaplan, argue that respites from the chaos of the city can alleviate stress and revive depleted resources. However, it can be difficult to find places for rest, restoration and reflection in urban areas. Since city life is becoming the norm for human populations, it is important that we find a method for coping with negative urban conditions. Frequently leaving the city for respite is not feasible. Solutions within the city that provide regular relief could allow for nature, in the form of restorative environments, to be used as a preventative measure in reducing stress and its associated side effects.

Downtown Toronto has a network of parks and public spaces that feature some of the characteristics that allow for rest and revitalization. Exploiting existing opportunities and improving current deficiencies could potentially transform some of these spaces into respites. However, it is important that these existing commons continue to operate in their current capacity as both social and recreation spaces. Preventative spaces should not be a restricted typology but characteristics integrated into other compatible settings. Expanding the existing network of urban relief to provide preventative therapy, address underprovided areas and accommodate increasing populations is necessary.

**An urban retreat in downtown Chicago**

It also needs to be considered that as cities populations and land values continue to increase open spaces at ground level, including urban parks, will become scarcer. If such amenities are to survive in densely populated areas their characteristics and locale will need to be reassessed. Less traditional configurations for future respites may include suspended spaces, rooftops, and cantilevered parasites or floating designs. Special attention will be

required to ensure that these alternative spaces receive adequate sunlight and can function over four seasons. Planning for such replacement options should be considered now to ensure the longevity of urban reprieves for the health and wellness of current and future generations.

In order to successfully integrate a network of rejuvenating settings into the urban core both existing and new locations must be considered along with the following key objectives.

- Expand on the existing network of parks and public urban spaces to allow for increased compatibility specific to restorative environments.
- Integrate nature and design to include the qualities for rejuvenation (fascination, being away, extent and compatibility).
- Ensure that urban retreats are easily available in terms of proximity and access (vertical and horizontal).
- Connect multiple spaces to create a network/urban infrastructure of preventative environments.
- Create intimate spaces within larger environments.
- Make provisions for year-round use that may include indoor or sheltered spaces.
- Implement technologies, such as sliding glass walls, which allow for interior spaces to open to the outdoors.
- Revitalize previously unconsidered real estate, such as rooftops and voids between existing buildings as respites within existing developments.
- Include settings for rejuvenation as part of the building/complex design for new complexes, not as an afterthought or use for left over space.
- Take advantage of innovative technologies, such as green roofs and living walls, to

integrate natural elements with built form.

- Provide a variety of sizes and forms based on the built environment and site-specific characteristics to accommodate the various needs of a large demographic.

The successful integration of restorative environments in the urban core will provide an escape within the city and aid in the prevention of chronic stress and mental exhaustion. Allowing our minds and bodies to frequently recuperate from urban stresses might provide the necessary measures to reduce the effects of urban ailments and increase the quality of city life.

## 10.0 Design Strategies

The design portion of the thesis will develop an approach to incorporate nature, in the form of preventative environments, into the urban fabric of the city using downtown Toronto as a pilot case.

**Nature meets built form**

The intent is to integrate environments with healing properties, which could prevent chronic illnesses, in the urban domain to balance the demands of city life. Integrating nature into the urban fabric of the city will not only provides increased restorative therapy, but could potentially provide preventive means as well.

Rather than constraining the integration of nature into a single building, the design solution may be, for instance, a series of buildings, like an urban campus which would include planned outdoor areas and adjacent interior spaces comprised of voids between the built form such that it would become as important as the volumes themselves; and may allow for the integration of nature between varying degrees of enclosure.

The campus might be envisioned as a prototype that will produce a comprehensive array of guidelines that will intertwine nature with the built form. These notions would be implemented into an architectural solution that potentially includes: nature penetrating indoors, vertical layering of park space (above the ground plane) and natural spaces with enclosures that change with the seasons/weather. Once implemented, such strategies will

create a holistic approach to urban development and improve the health of the city's residents.

The following steps will be completed during the conceptual stage.

- Site criteria will be formulated to identify and then analyze potential sites and determine the most suitable.
- Based on the information documented in the research portion of the thesis, a catalogue of nature's qualitative characteristics and an inventory of restorative environment qualities will be assembled.
- Additional case studies and design examples will be researched as required to provide supplementary information.
- An architectural program will be developed defining functional and spatial requirements in both qualitative and quantitative terms.
- Research data will be analyzed through a series of conceptual, diagrammatic, solutions in schematic form.
- Investigation of alternative conceptual solutions related to site, massing and functional relationships.

# Part 3: Design Research + Program

## 11.0 Nature-Oriented Preventative Environments (NOPEs)

Nature-Oriented Preventative Environments, or NOPEs, are proposed specialized architectural settings that facilitate stress relief through the use of natural elements. They allow users to recover from the mental and physical effects caused while experiencing the city. When such environments are used proactively to mitigate negative urban conditions, they have the potential to prevent compound stress and other urban impairments.

The key objective of the proposed NOPEs is to provide year-round nature-based preventative experiences within urban settings to mitigate the effects of negative urban aspects. Aside from nature, the fundamental feature of these environments is the combination of indoor and outdoor spaces that make them usable over four seasons and in all weather conditions.

The intent for NOPEs is not to stand alone, but to build upon and enhance the city's existing network of parks and open spaces, make pedestrian friendly links between green spaces, and make nature readily available and easily accessible to all residents year long. Priority should be given to under serviced areas and models should allow for the ability to incorporate into dense urban areas. A variety of applications to suit an array of existing and new conditions will be required.

There are two types of NOPEs within the Nature Network: Regional NOPEs and Site NOPEs. Regional NOPEs are larger community-based centres serving a larger population, while Site NOPEs are smaller site interventions with a looser distribution of nature throughout private/semi-private spaces. Both types work together to create a holistic approach to providing nature in the city.

## 12.0 Characteristics of NOPEs

**Year-round use** is proposed as one of the fundamental characteristics of NOPEs as our need for nature does not hibernate during the winter months. Our climate presents challenges for experiencing quality nature during the winter months. In fact, research indicates that we tend to spend more time indoors during the cold winter months due to shorter days and colder temperatures.[105] In order for NOPEs to truly be preventative environments, they need to function year-round.

**Indoor space** is proposed as another key aspect of NOPEs. Much of the rejuvenating vegetation that thrives during the warm summer months perishes during the cold winter. Deciduous trees and annual plants lose the lush green foliage resulting in once revitalizing spaces becoming void of life. Providing indoor spaces would permit a variety of greenery to be maintained during this inert period.

To further the argument for indoor spaces, some people have health problems and potentially cannot use NOPEs during some seasons. For example, the heat, smog, humidity and intense sun can have negative effects on the elderly and those with health issues such as asthma.

For these reasons, it is important that alternate spaces be offered to provide year-round access to NOPEs. A combination of outdoor shelters, adaptable spaces and indoor areas with nature should be considered. Not only would such enclosed spaces allow for climate control, but innovative technologies could also be implemented to improve the experience.

[105] Seasonal Variations in Physical Activity, Canadian Fitness and Lifestyle Research Institute, Issue 01-01/10.

Technology has advanced to a point that cultivating plants indoor in a vertical format is both possible and feasible. Vertical living walls can be sustained indoors with supplemental lighting when necessary.

'Living walls or green walls are self-sufficient vertical gardens that are attached to the exterior or interior of a building. They differ from green façades (e.i. ivy walls) in that the plants root in a structural support, which is fastened to the wall itself. The plants receive water and nutrients from within the vertical support instead of from the ground.'[106]

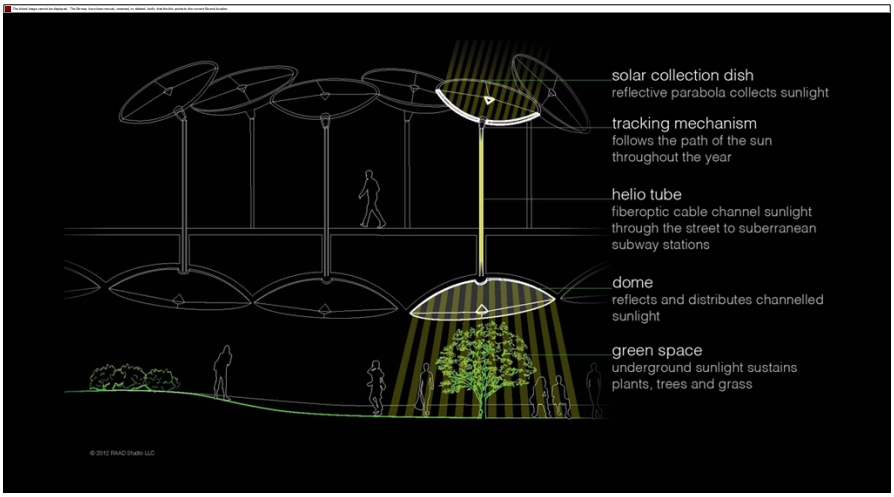
Living walls typically consists of a frame, waterproof panels, an automatic irrigation system, soil or porous fill, and of course plants. The frame is erected in front of an existing wall and secured at various points. Rigid waterproof panels are mounted to the frame and provide structural support.[107]

Soil can be used for the plant substrate but may present the possibility of soil-borne pathogens. An alternative to soil for the substrate is a porous material, which allows the system to be hydroponic (waterless). Such porous materials provide structural support for the plant roots and can evenly distribute moisture and nutrients.[108]

[106] http://www.greenovergrey.com/living-walls/what-are-living-walls.php
[107] http://www.greenovergrey.com/living-walls/what-are-living-walls.php
[108] http://www.greenovergrey.com/living-walls/what-are-living-walls.php

'Remote skylights' could be used to enhance natural light inside the building. 'This technology would transmit the necessary wavelengths of light to support photosynthesis, enabling plants and trees to grow.[109] This innovative technology would allow vegetation to flourish deep inside the building year long.

The solar technology designed by James Ramsey of Raad Studio was designed for the proposed New York Low Line, an underground park. The technology passes sunlight through a glass shield above a parabolic collector, reflects the light and gathers it at one focal point before redirecting it. Sunlight is transmitted onto a reflective surface on a distributor dish at the destination, broadcasting that sunlight into the space.[110]




The remote skylight could be supplemented with 'light boxes' when necessary. These devices emit light with brightness equivalent to the outdoor light of dawn or dusk that is brighter than standard indoor lighting. The light cast from fluorescent bulbs behind a protective filter not only improves lighting but also has been proven to improve symptoms of Seasonal Affective Disorder.[111]

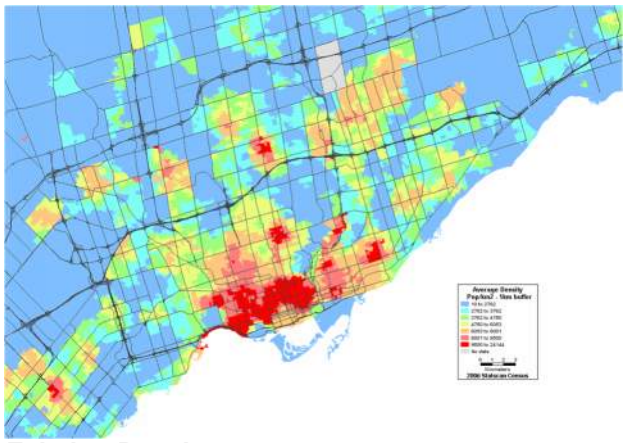
[109] http://www.thelowline.org/about/project
[110] http://www.thelowline.org/about/project
[111] www.ucdmc.ucdavis.edu/welcome/features/20090211_healthtip_winterblues

## 13.0 The Nature Network

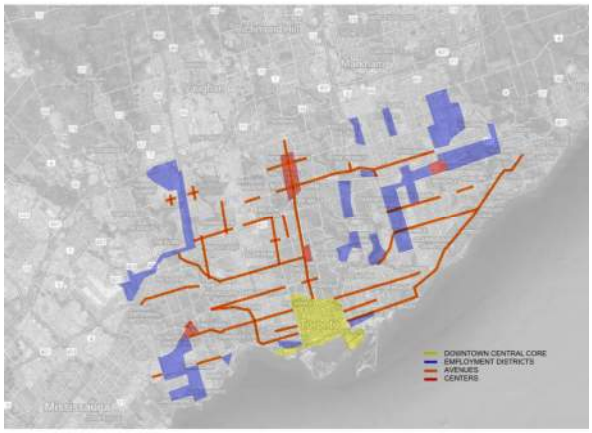
In order to achieve preventative measures for the entire urban population, a comprehensive network of NOPEs must be implemented. Such a system will afford residents the opportunity to easily and frequently access quality urban nature and provide relief from negative urban conditions.

The nature network is envisioned to be similar to other urban amenity networks, such as a health care system, an education system or library system that employ a hierarchy organization. For example, a local health care system may consist of a hospital, some satellite walk-in clinics and many doctors' offices. Hospitals are typically larger facilities, which serve a large population and offer many services including specialized ones. Walk-in clinics and doctors' offices are more numerous than hospitals and serve a smaller community within the city. They provide some of the fundamental services of a hospital but are not as specialized or comprehensive.

The nature network is envisioned as a hierarchy of NOPEs types with different scales that serves the city's entire population, taking into consideration the city's current and predicted population trends. The network will consist of two main categories of NOPEs; regional and site. Each classification of NOPEs will be supported by infrastructure that provides easy access.

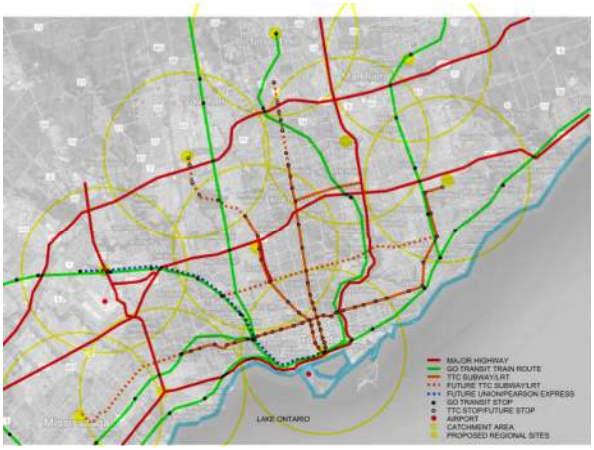


**Existing Density**




**Predicted Areas of Growth**

At the regional level, a network of large - scaled NOPEs is connected by the existing transportation infrastructure, including public transit and major arterial roads. Distance between sites is based on spatial separation and catchment area. The locations are intended to serve as many people as possible and as such are located at key destinations where major roads intersection with transit hubs. In many instances Regional NOPEs will be within proximity of highway(s) to increase accessibility.




**Access Infrastructure and NOPEs Network**

At the site (or local) level, NOPEs are distributed at urban centers throughout the city as well as at nature-deprived areas and locations with a higher occurrence of negative urban conditions. Site NOPEs are located based on population density and time required to access the site. This type will be more numerous in denser populated areas.

At both levels, connectivity is an important factor for planning. Designs are encouraged to make strong connections to local parks, open spaces and other urban nature to create mini green networks within the area. Overtime as more NOPEs are created and additional green spaces connected, the city will have an integrated network of nature that is available year round to its residents.

Building a comprehensive network of NOPEs will take the investment of the public and private sectors. While some NOPEs will be publicly owned and operated, the success of the system will rely heavy on private sector involvement. Site NOPEs will mostly be private installations that are considered Privately-Owned Public Spaces (POPS). Just as the name expresses, POPS are open spaces that privately owned and operated but accessible to the public. These are important, specifically in dense areas when standard parks may not be feasible.

The infrastructure to support the NOPEs network is provided and maintained the city. Regional centers would be publicly owned and funded and possibly have long-term leases on commercial properties depending on the availability of appropriate sites. Site NOPEs could be either public or private depending on the owner of the property.

## 14.0 Regional NOPEs

Considered the heart of the network, Regional NOPEs are principal destinations that people seek as preventative measures to relieve stress. These large-scale public installations provide complementary programmed spaces that facilitate the restorative process. Such amenities may include opportunities for learning about nature and having direct interaction with nature through hands on activates such as planting and cultivating.

Regional NOPEs have the potential to be multileveled, provide connections to multiple spaces and offer connections with the street level, rooftops and potentially underground spaces. They may be built over streets, between buildings, on raised planes or over transit facilities.

## 15.0 Site NOPEs

Many Site NOPEs will be privately owned publicly accessible spaces (POPS) and may encompass of a combination of properties. These NOPEs can be introduced as sites are redeveloped or upgraded to incorporate preventative characteristics.

Any site or building could implement a NOPE through a variety of means including rooftops, parasites (projections from a host building) or courtyards that provide buffers from negative urban conditions. Site NOPEs may be integrated with existing or new buildings, but the design should allow for connection to the community network. All instances should include both indoor and/or outdoor spaces as well as sheltered spaces to provide yearlong use.

Site NOPEs should incorporate ample vegetation as well as a water feature or focal point. Way finding and connections to adjacent building and streets is an important factor for private sites. In all instances, the pedestrian scale should be a key factor in the design.

## 16.0 Urban Interventions

*An intervention is an action taken to improve a situation, especially a medical disorder.*[112] *Urban interventions are installations that create opportunities for citizens to interact and experience nature in dense, otherwise sparse, urban environments.*

Urban interventions are opportunities to introduce nature, in the form of NOPEs, into urban environments. Such structures allow nature, both indoors and out, to be inserted in the city. They provide and opportunity to experience nature year-round where adequate nature may not normally be present.

Where space permits, new construction may follow more traditional building forms. However, in denser urban settings where space is at a premium, these urban reprieves will likely be non-traditional forms inserted into the existing urban infrastructure.

Opportunities for urban interventions include designs over, attached to, between and/or within buildings and roads. The existing urban context can provide ample opportunity for structures to be attached to existing buildings in a parasitic or bridge format. There are also ample instances where rooftops can be transformed into NOPEs with the addition of some indoor space. Where space permits, elevated platforms with enclosures can be constructed over roads intersections bringing direct access to NOPEs to the street.

[112] https://www.google.ca/?gws_rd=ssl#q=intervention+definition

## Examples for NOPEs Interventions

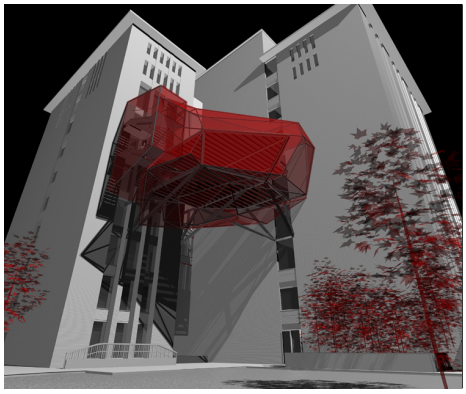
- Platforms over roads and intersections
- Parasites attached to buildings
- Bridges between buildings
- Underused streets and alleys
- Floating designs
- Suspended spaces
- Improved deficient courtyards
- Roooftop retreats
- Deconstructed Volumes

With new construction, the building form can be deconstructed, carving out space for indoor and outdoor programs within the form of the building. This scenario could provide a high level of integration of nature between the interior and exterior spaces.

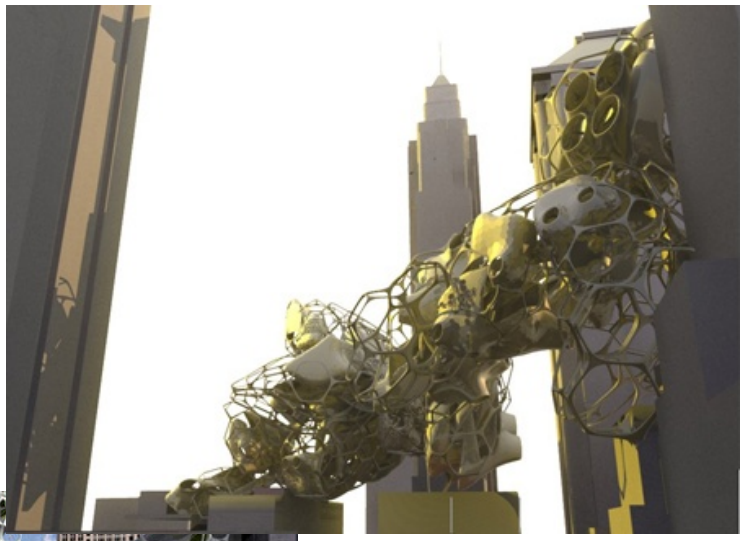
Converting indoor spaces adjacent to nature and enhancing such existing courtyards with restorative properties could transform these spaces into NOPEs. Under utilized spaces between buildings could also potentially be transformed into NOPEs.

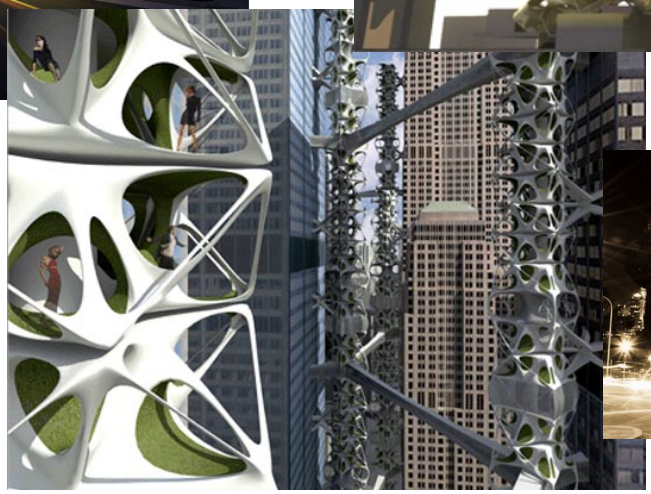
Urban interventions can be applied to a variety of building typologies and encompass diverse of forms in a range of sizes. The existing parks and open spaces network can be expanded and enhanced by such urban interventions to create a stronger network of urban relief. The following are example of the types of forms urban intervention could take to insert nature into the built environment.

### 16.1 Parasites



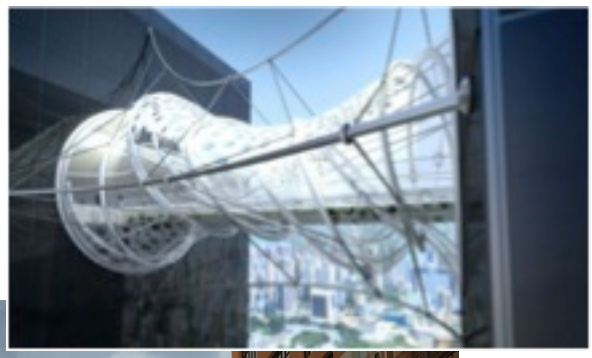
Parasites are structures attached to and supported by a host building(s). This type of urban intervention could work well with existing buildings to introduce green areas above the ground plane. Voluminous spaces may connect to multiple connection points at different levels and potentially connect multiple buildings. However, the mass could be separate from the building and provide connection to the host. The NOPEs could be a hybrid integrated into the host building to create a larger environment. Parasites should be oriented to maximize direct and/or indirect sunlight.

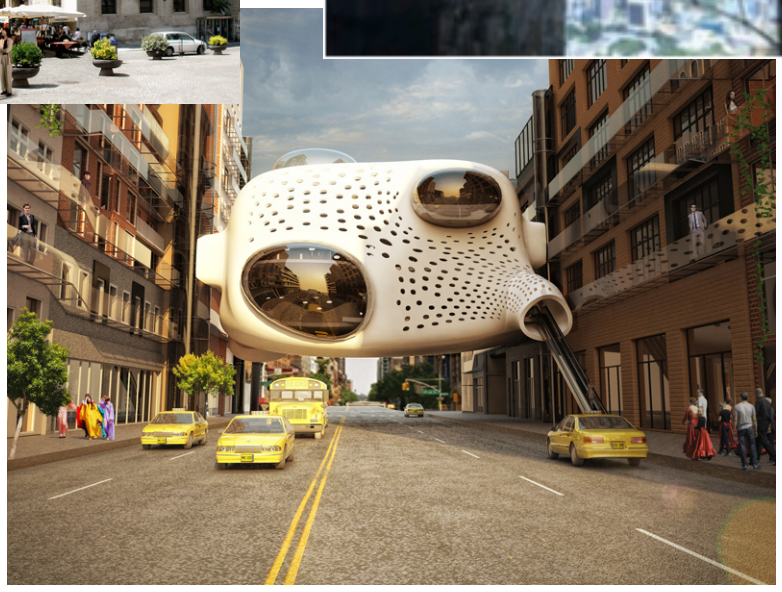




### 16.2 Bridges

Bridges are connecting structures that span between two buildings. Such spaces are not conceived merely as a circulation route between two buildings but as an opportunity to insert nature above the ground plane. Bridges have the potential to be multiple levels and include both indoor and outdoor spaces with expansive vistas. Depending on the size of the bridge, compatible programmable spaces may occur. Bridges must be considerate in height above grade and size to minimize shadows beneath.



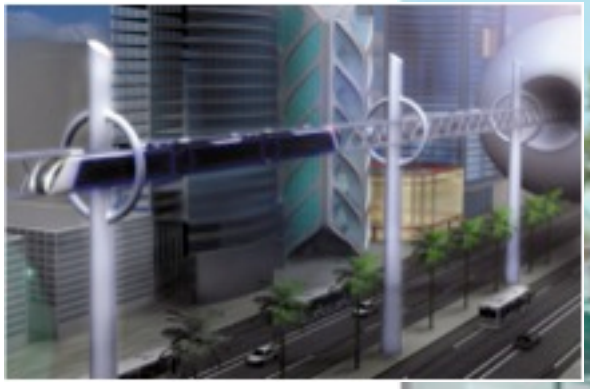


### 16.3 Rooftop Retreats

Where space is at a premium or costs prohibit other types of urban interventions, rooftop retreats can be implemented to introduce a natural area in the city. Additionally, indoor space can be incorporated to provide yearlong use or other provisions to provide protection from the elements, such as shelters and wind barriers.

### 16.4 Elevated Platforms

These spaces include large, raised platforms, potentially linear in form that partially covers streets, intersections and/or private streets. Opportunities to connect with adjacent rooftops and grade should be exploited to provide multiple access points. Such interventions could be multiple levels or even have changing terrain. Provision should be made to allow for sunlight to penetrate to the streets below. As with other urban interventions, enclosed (greenhouse, etc.) and covered areas (trellis, arbor, etc.) should be included.

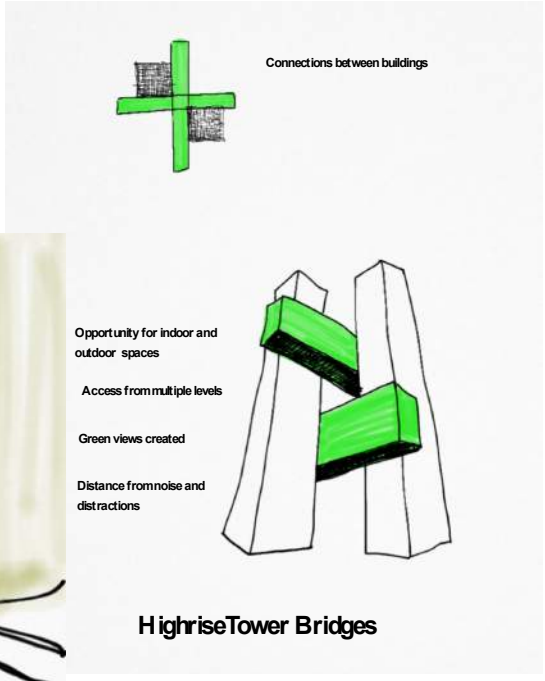


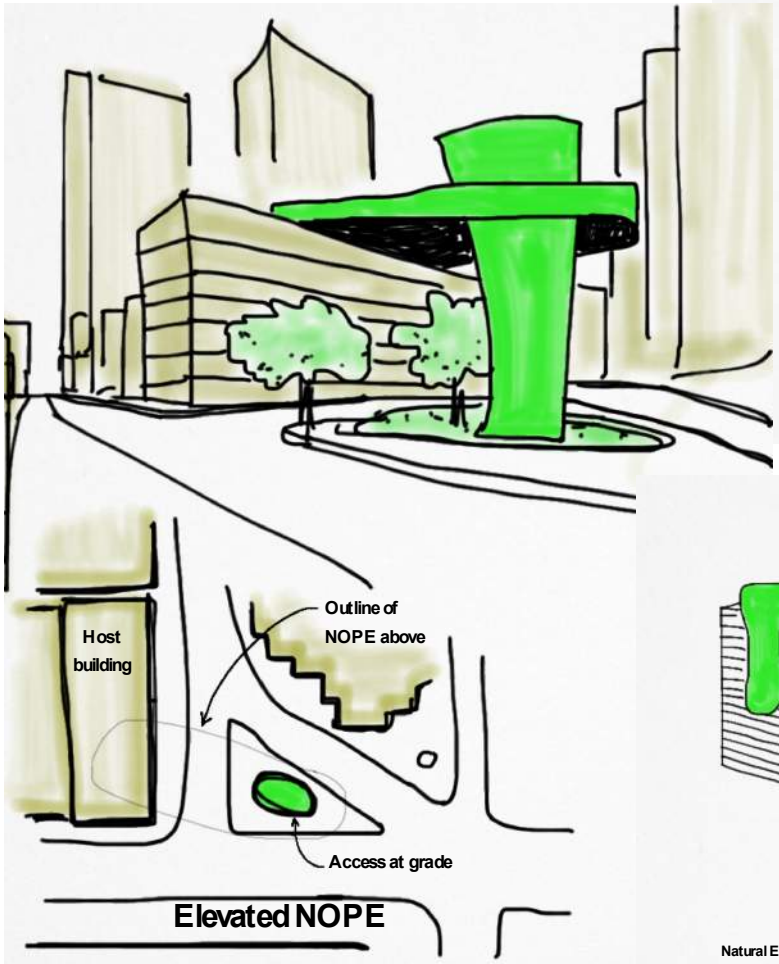
### 16.5 Deconstructed Volumes

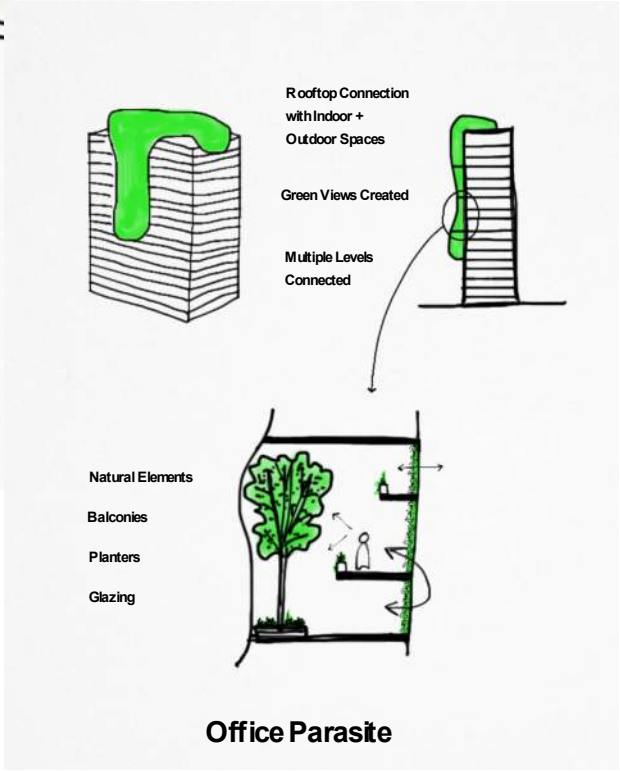
Outdoor space is carved to the core of a building by deconstructing the volume. The voids in the built form allow light to penetrate deep into the building while projections provide shelter. This method permits interior courtyards and terraces at multiple levels that become a extension of the natural environment.

### 16.6 Sample Interventions

These urban interventions are intended to be conceptual examples suggesting possible forms that could be used to introduce NOPEs into the urban environment. Program space, including nature can be inserted in a combination of indoor and outdoor spaces to provide environments that can sustain nature year long.



## 17.0 NOPEs Support and Implementation

Creating a solid infrastructure of NOPEs will be a long-term undertaking and evolving process. It will involve many supporters, contributors and benefactors. Several factors are required to ensure the success of urban NOPEs.

Firstly, the population would need to be educated about the benefits of nature towards their health and that the fullest potential of NOPEs is realized when these environments are used as preventative as opposed to restorative.

Secondly, support would be needed from the governing agencies to initiate the incorporation of NOPEs. At the city level, zoning incentives, tax breaks and other incentives could assist the establishment of the NOPEs infrastructure. Park funding could also be allocated to raise capital. The higher levels of government (federal and provincial) could subsidize the creation of NOPEs as part of healthcare spending.

Finally, the incorporation of NOPEs has the potential to increase property value. Large corporations could use this as a selling feature to lure tenants and charge a higher premium for rent to offset the cost of construction. Companies could mandate the investment of NOPEs, similar to recycling and energy conservation targets. Furthermore, urban interventions could be wholly or partially funded through naming rights.

## 18.0 Design Resolution

The thesis design resolution will consist of two components, each a different scale and program, to illustrate how NOPEs can be incorporated into urban environments. Both a regional program and site program will be developed to illustrate how public and private NOPEs could be implemented.

The proceeding examples illustrate the potential for NOPEs in an urban setting. These urban interventions highlight how nature can be integrated into the urban fabric and architecture to improve existing negative conditions. The study incorporates a variety of different options that could suit various scales and building typologies. The design of such an urban intervention will be developed as part of the thesis design resolution.

A large-scale regional NOPEs facility with a full program will be designed to suit a specific site. This demonstrational prototype will be the catalyst for nature-oriented preventative environments.

Both programs will include natural elements and interactive program components that will enhance the health benefits of NOPEs.

## 19.0 Program Elements

As nature is key to the preventative process, the primary focus of both programs nature and interacting with it. The Site NOPEs will have simple and flexible program that can be adopted to existing conditions of various scales. On the other hand, the Regional NOPEs share the same basic elements but also provide a wider range of opportunites for learning about nature and interacting directly with it. The later will also have the opportunity to include specialized program elements based on the local needs to further enhance the experience and increase the benefits of nature.

A sizeable portion of the nature aspect will consist of vegetation; including trees, shrubs, plants, flowers, vines and green walls. Gardens and water features such as ponds and fountains complete the basic program.

In addition to the basic nature noted above, Regional NOPEs will have further opportunities for interaction with nature. Elements such as natural play areas (for children and adults) and spaces for interaction with wildlife (i.e. aviary, butterfly sanctuary, aquatic ponds) increate the potential for restorative and preventative benefits. A learning area and workshops for nature-based projects will offer users a wide range of activities to aid in restoration and prevention.

Beyond the enhanced program, Regional NOPEs can customize additional program to meet the needs specifics to it's local. The community program elements are organized into series of categories, each with nature-focused activities and programs. One or more of these elements can be added to each facility. Categories for community programs include retail, food, physical activity, educational, cultural, services and accommodations (optional). Refer to the next page for a chart of optional community programs.

The interactive components of the program could potentially be surrounded by and/or connected to the nature by paths for walking and observing. A series of multifunctional areas provide space for gathering, learning about nature, meditating, practicing yoga, etc. The learning area offers a place for lectures and presentations about nature. The workshop exposes visitors to experience hands on interactive nature projects.

The interactive program would allow users to experience nature first hand while learning more about it. Planting seeds, cultivating gardens, pruning, etc. gives visitors hands on experience allowing them to immerse themselves in nature. Such experiences with nature are reported to increase the calming effects of nature.

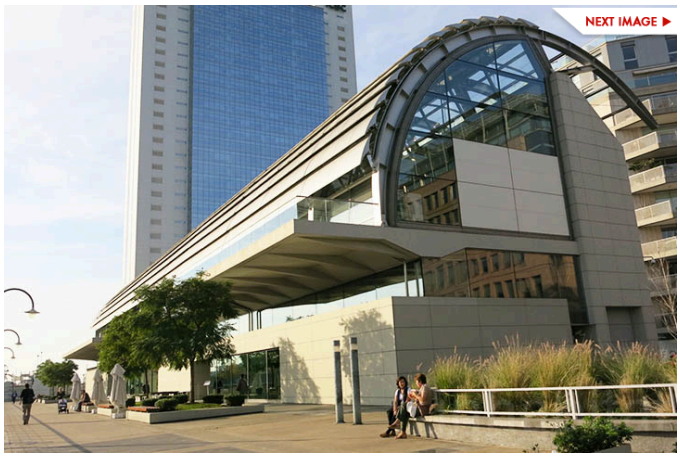
## 20.0 Community Programs

| Category | Program |
|---|---|
| Retail | • Nature based retail (organic plant, crafts, natural remedies, etc.)<br>• Farmer's market<br>• Nature based manufacturers |
| Food | • Restaurant (fresh, organic)<br>• Cafe<br>• Cooking classes (indoor/outdoor)<br>• Urban farm |
| Physical Activity | • Fitness gym/classes<br>• Indoor swimming lagoon<br>• Athletic center<br>• Rock/tree climbing<br>• Fishing ponds (catch and release)<br>• Outdoor skating rink<br>• Indoor snowshoeing |
| Educational | • Research facility<br>• Education facility (specialized school)<br>• Arts and crafts classes (nature inspired)<br>• Lecture hall<br>• Theatre (nature inspired films and documentaries)<br>• Daycare center (day camps) |
| Cultural | • Nature museum<br>• Artist community (i.e. pottery)<br>• Library<br>• Wood carving studio<br>• Boat building studio |
| Services | • Conference/meeting facilities<br>• Holistic medical facilities (naturopath, acupuncture, etc.)<br>• Facility rentals (weddings, parties, etc.)<br>• Wedding chapel |
| Accommodations (optional) | • Boutique hotel<br>• Hospice<br>• Hostel<br>• Indoor camping |

These community-based programs offer opportunities for socialization, physical activity and mindful learning, which are beneficial to the mind, body and soul. When such activities are performed in a natural environment, they have the potential to enhance the benefits of nature. In addition to the health benefits of these community-based programs, they foster a stronger sense of community, making the city a better place to live.

## 21.0 Degrees of Enclosure

As our climate is not hospitable to many forms of vegetation year long, having indoor program space is important. However, as experiencing nature outdoors can enhance the benefits of nature, having outside program is also beneficial. In order to maximize the usability of the program space during all seasons, convertible spaces be considered where possible.




Convertible spaces are flexible enclosures that can partially or fully open and close to maximize connection to the outdoors. They allow for flexibility between the indoor and outdoors environments. Convertible spaces permit the enclosed environment to expand and contract depending on the temperature and climatic conditions. They could also be used as transitional environments between the interior and exterior program areas.

As convertible spaces allow for flexibility to maximize the benefits of nature between seasons, a larger portion of the Regional NOPEs program should be encompassed by these spaces with the remaining program areas split between the indoor and outdoor environments. Depending on the full program, Regional facilities could potentially have between 40% and 60% of the programmable space as convertible. The remaining area could be split between indoor and outdoor space. This would allow the degree of enclosure to vary according to the climatic conditions.

Convertible spaces could be realized through operable roofs and walls. Options may include retractable roofs (fabric, glass or otherwise), large-scale operable skylights, telescopic or overhead doors and collapsible tent structures.

Transitional spaces should also be considered to make outdoor spaces more hospitable in less than ideal weather conditions. Providing protection from the elements with trellises or overhangs while taking advantage of solar gain could extend the useable season for outdoor spaces.

## 22.0 Program Size

As nature and nature-based activities are typically experienced outdoors, facilities that enclose traditional outdoors activities/elements where investigated with relation to size, function and/or volume. To estimate area required for a Regional NOPEs (less specialty programs) a number of indoor waterparks were examined. The average size varied from approximately 75,000 s.f. to 125,000 s.f. and included a large multi-story space containing smaller spaces within.

As a reference to the potential size for a Regional NOPEs, common buildings were compared. The average size of 100,000 s.f is similar to a typical mall anchor (such as Target) and three large-scale grocery stores (such as Metro).

The area required for the specialty programs component will vary depending on the quantity included, facility site and needs to the local area.

The average area of a Site NOPEs will vary depending on the type, location and space available. There is not set minimum size but it should be large enough, based on the design, to provide adequate extent to facilitate the preventative process. Site NOPEs could potentially range from 1000 s.f. to upwards of 10,000 s.f.

For comparison of the upper end of the scale, a number of conservatories (butterfly and plants) were examined and found to have an average size of 13,000 s.f. This is comparable to in size to a recreational (non-regulation) hockey rink (3,000 s.f. less).

## 23.0 Program Purpose + Rational

| | Purpose and Rational |
|---|---|
| Basic Program | |
| Garden plots | Allows for direct interaction with nature by culturing plants and produce. 'Studies show that people who spend time cultivating plants have less stress in their lives. Plants soothe human beings and provide a positive way for people to channel their stress into nurturing.'[113] |
| Greenery | Foliage allows for fascination that facilitates relaxation and rejuvenation. It also improves air quality and dampens noise. |
| Water elements | Water features such as ponds, waterfalls and fountains improve ambient noise and provide a point of interest. Water has the ability to hold interest allowing direct attention to rest thus facilitating restoration and preventative measures. |
| Green walls | Foliage improves air quality, dampens noise and allows for fascination, which facilitates relaxation. |
| Gathering | Flexible space for activities that facilitate relaxation and restoration such as yoga or mediation. Larger spaces allow for group activities while smaller one are more intimate. |
| Enhanced Program | |
| Lobby | Information kiosk provides literature about the benefits of nature how to engage in preventative activities. |
| Nature play area | Direct interaction with nature improves academic performance, reduces ADD symptoms, improves self-discipline and reduces stress.[114] |
| Animal interaction | Watching and interacting with animals such as birds, fish and butterflies can be therapeutic and help to relieve tension and lower blood pressure. |
| Nature Trails | Walking in nature can increase the health benefits gained because of the physical activity. |
| Learning area | The awareness created from learning about nature and its benefits often leads to more engagement with nature. |
| Workshops | Space for interactive nature programs such as seeding, nature crafts and creating green walls. Cultivating plants reduces stress. |
| Seed + supply shop | Tools and supplies storage for gardens and workshops. |
| Community Programs | |
| Varies by facility | Additional nature related services and activities based on the needs of the local community. Refer to list of potential elements below. |

[113] http://ellisonchair.tamu.edu/health-and-well-being-benefits-of-plants/#.VUdbGkuWUds
[114] Benefits of Connecting Children with Nature, Nature Learning Initiative, NY State University, January 2012.

## 24.0 Regional NOPEs Program

| | quantity | area (s.f.) | total area (s.f.) | notes |
|---|---|---|---|---|
| Core NOPEs Elements | | | | |
| Garden plots | 200 | 25 | 5,000 | Cultivated by visitors |
| Greenery | | | 35,000 | Permanent plantings |
| Ponds | 3 | | 1,000 | Containing koi fish |
| Waterfall | 1 | | 250 | Multiple levels and/or stream incorporated |
| Nature play area | 1 | 30,000 | 30,000 | Nature inspired play and exploration area |
| Animal interaction | 1 | 1,500 | 3,250 | Aviary, fish ponds, butterfly sanctuary, etc. |
| Green walls | 1 | 1000 | 500 | Planted and assembled by visitors |
| Gathering (l) | 2 | 500 | 1000 | Multi-functional space (i.e. yoga) |
| Gathering (m) | 6 | 150 | 900 | Small groups (i.e. group meditation) |
| Gathering (s) | 12 | 50 | 600 | Intimate scale (i.e. meditation) |
| Learning area | 1 | 500 | 500 | Nature based lectures + presentations |
| Workshops | 2 | 750 | 1500 | Benched + tables for nature projects |
| Seed and supply shop | 1 | 500 | 500 | Tool rentals + seed sales |
| | | | **80,000** | |
| Specialty Elements | | | | |
| Promenade | | | 40,000 | Flexible space for specialty items such as Farmers' Market, Artists' Market and other activities |
| Climbing Center | | | 10,000 | To engage physical activity and reset direct thoughts |
| Artist Community | | | 15,000 | Communal space for individual and collaborative nature-based creativity and learning |
| | | | **65,000** | |
| Support | | | | |
| Entrance/ Lobby | 1 | 2000 | 2000 | |
| Public washrooms | 2 | 700 | 1400 | |
| Family washroom | 2 | 50 | 100 | |
| General office | 1 | 300 | 300 | |
| Offices | 2 | 100 | 200 | |
| Storage | 3 | 100 | 300 | |
| Storage | 1 | 200 | 200 | |
| Staff Room | 1 | 400 | 400 | |
| Staff Washrooms | 2 | 150 | 300 | |
| Staff Lockers | 2 | 150 | 300 | |
| Maintenance | 1 | 400 | 400 | |
| Mechanical | 2 | 150 | 300 | |
| Electrical | 1 | 100 | 100 | |
| Sprinkler | 1 | 100 | 100 | |
| Janitor | 4 | 25 | 100 | |
| | | | **6500** | |
| | | | **151,500** | |

## 25.0 Site NOPEs Program

| | quantity | area (s.f.) | total area (s.f.) | notes |
|---|---|---|---|---|
| Core NOPEs Elements | | | | |
| Greenery | | | 3520 | Permanent plantings |
| Ponds | 1 | 180 | 180 | Containing fish |
| Green walls | 1 | 200 | | Variety of plant species |
| Seating | | | | Informal resting |
| Outdoor Space | 1 | 500 | 500 | Connection between indoors and outdoors |
| | | | **4,200** | |
| Support | | | | |
| Public washrooms | | | | Within host building |
| Office | | | | Within host building |
| Storage | | | | Within host building |
| Maintenance | | | | Within host building |
| Mechanical | | | | Within host building |
| Electrical | | | | Within host building |
| Sprinkler | | | | Within host building |
| Janitor | | | | Within host building |
| | | | | |
| Overall Program | | | **4,200** | |

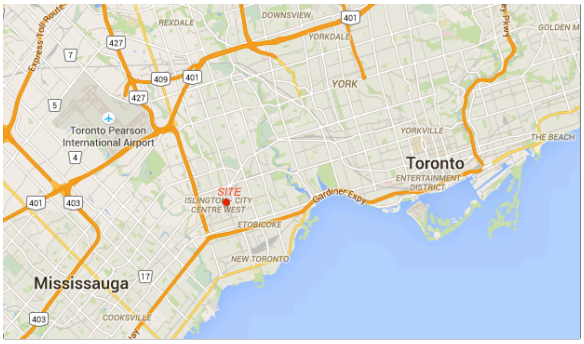
## 26.0 Regional NOPEs Site Selection Criteria

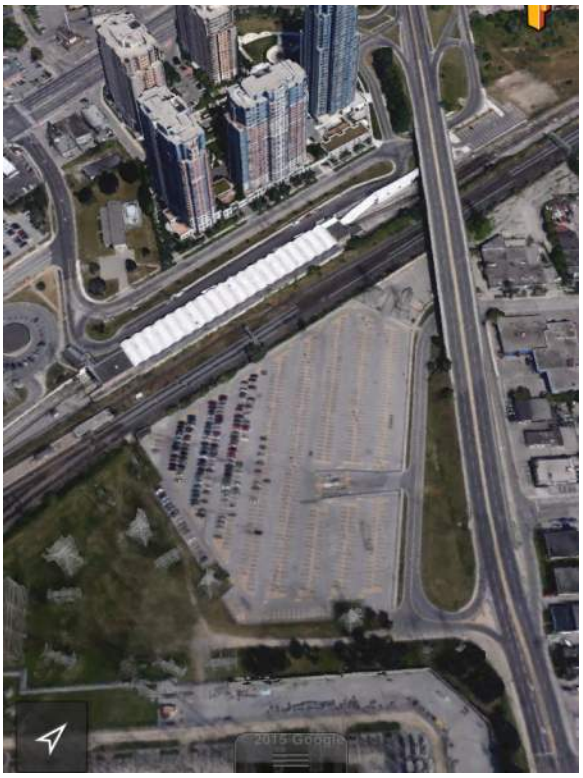
| | |
|---|---|
| Sunlight Potential: | Present and future; adjacent buildings should not overshadow the site for the most part of the day. |
| Pedestrian Access: | Strong connections to public transit with easy access by foot at one or more locations or levels. |
| Density: | A densely populated area that is currently underserved or an area that is expected to densify in the near future should be studied to provide reprieve to as many people as possible. |
| Links: | Connections (or future potential for) to other parks, green spaces and public places are possible. |
| Noise: | The amount of noise generated around the site is minimal or can be easily mitigated. |
| Adjacent Uses: | Sites that compliment or benefit the program should be exploited. Neighbours with compatible uses could increase accessibility and connectivity. |
| Orientation: | Southern exposure is important to allow natural sunlight into the building and support vegetation. |

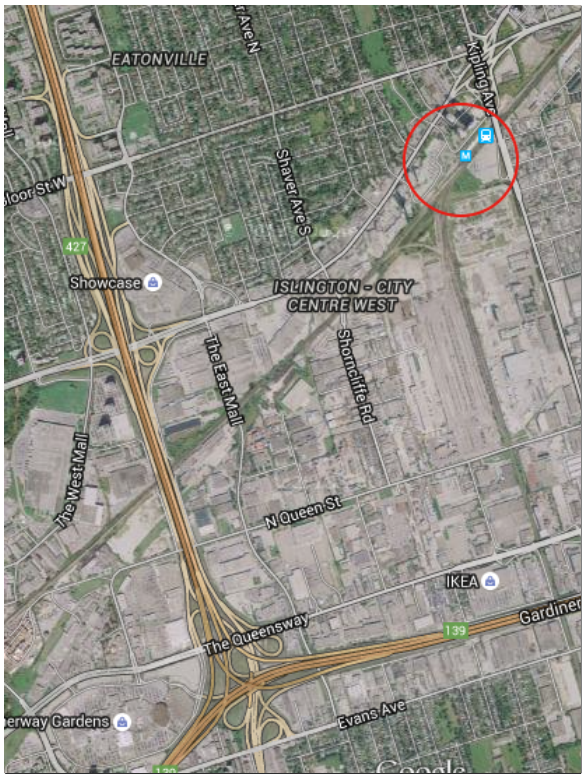
## 27.0 Regional NOPEs Site Selection

The site selection for the Regional NOPEs investigated a number of sites. Local areas around each of the proposed regional nodes were looked at in addition to a few others. While there are many suitable locations for a Regional NOPEs, the specific site was chosen based on the preceding criteria as outlined below.

The location of the site is in Etobicoke, just southwest of the junction of Dundas Street W, Bloor Street W and Kipling Avenue. It straddles the train tracks and encompasses both the TTC and Go Transit stations.





## 28.0 Regional NOPEs Site Analysis

Sunlight: The existing rail line and hydro line ensure that there will be open space in the future and allow sunlight to penetrate the area. Planning of future development can be designed to ensure adequate sunlight reaches the NOPES site.

Access: The site is near the junction of three major streets, Dundas Street West, Bloor Street West and Kipling Avenue. It is close to both the 427 and QEW highways. This location is a major hub for public transit with a GO Transit station, TTC subway station and TTC bus station.

Density: The area is currently home to a medium density population and is slated for intensification for both residential and employment. Bloor Street West is also planned for development as part of the city's avenues intensification plan.

Links: This location has an abundance of opportunity for future connections with new and existing green spaces. There is a hydro corridor to the north of Dundas Street that could potentially be linked to the site. The green belt to the east may be connected by a trail adjacent to the tracks. Also, if rail traffic south of the site diminishes, there is opportunity to transform the old rail lines into linear green spaces.

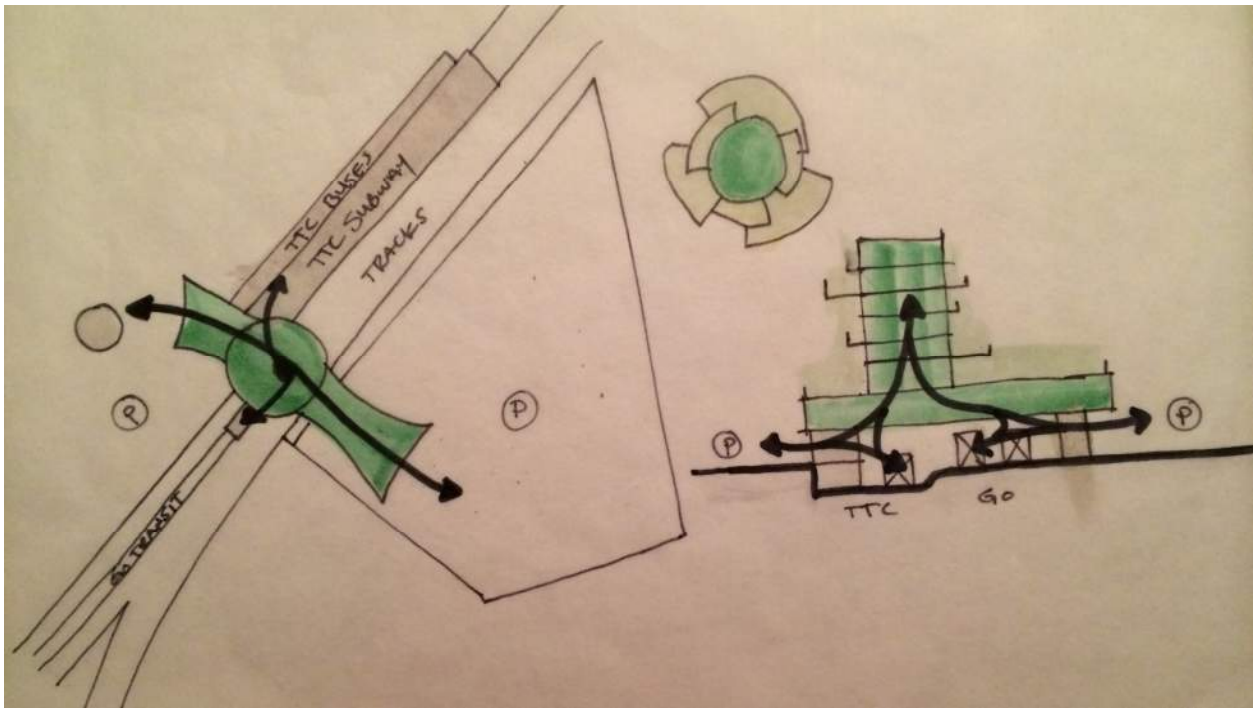
Noise: The rail corridor will generate significant noise from train traffic but may be mitigated by building and site design.

Adjacent Uses: The site straddles the train track connecting the residential and commercial properties to the north with the employment lands to the south. The hydro station to the south ensures that no tall building will be constructed and block the sun.

Orientation: The site allows for the building to be orientated to maximize potential sunlight.

## 29.0 Regional NOPEs Concepts

### 29.1 Concept A

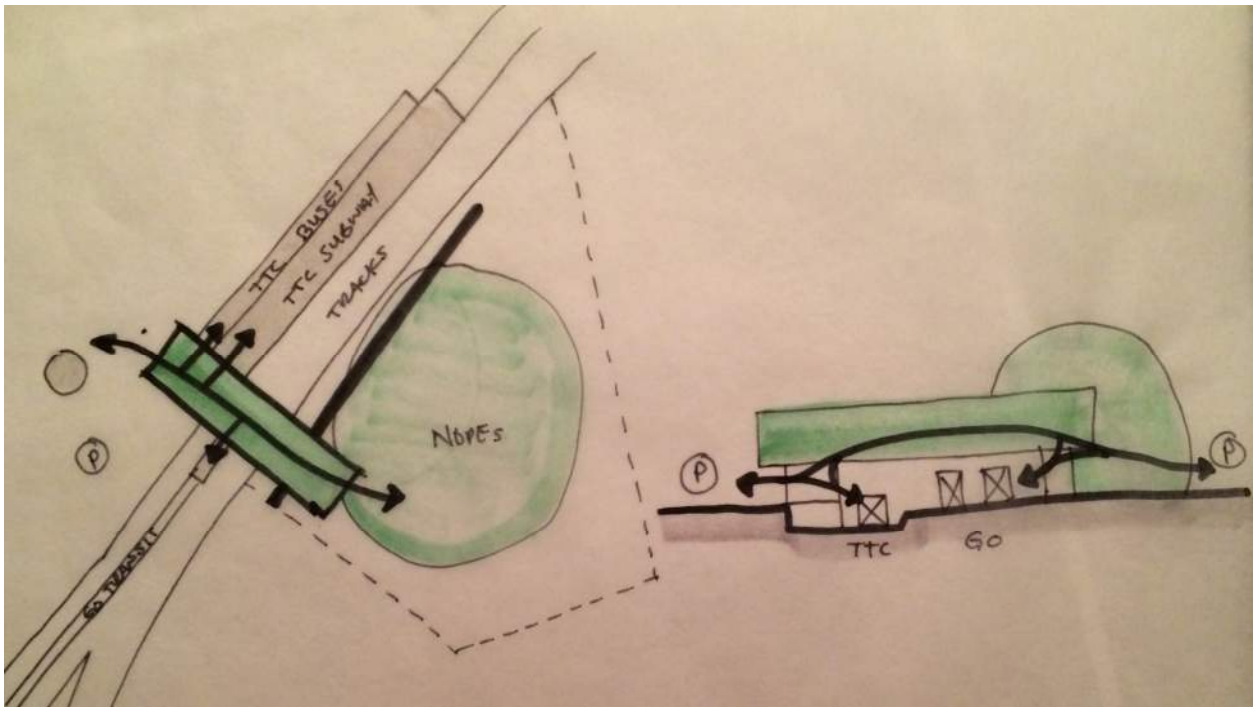



Regional NOPEs Concept A

### 29.2 Concept B


Regional NOPEs Concept B

### 29.3 Concept C




Regional NOPEs Concept C

## 30.0 Site NOPEs Site Selection Criteria

Negative Conditions: High incidences of traffic, congestion, crowds and distractions such as busy intersections or urban destinations.

Lack of Nature: Minimal nature present in the immediate surroundings.

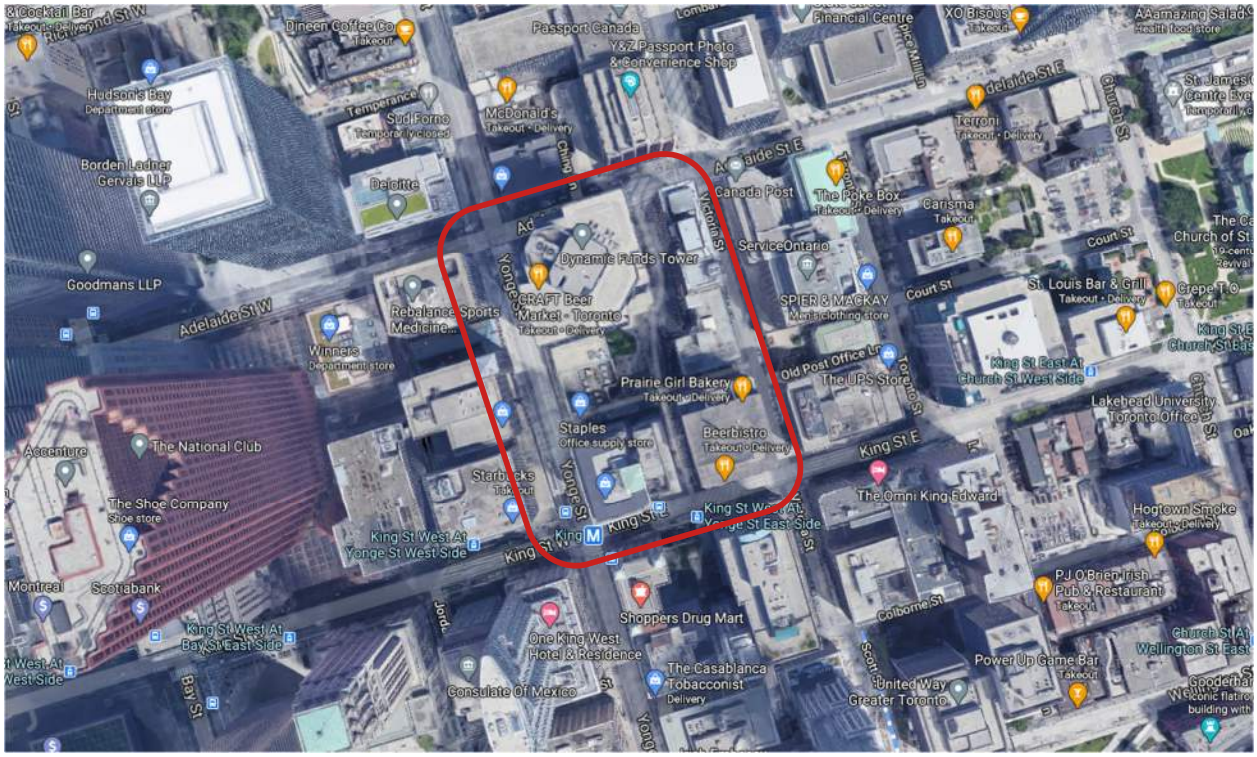
Density: The area is heavily populated in terms of volume (i.e. includes employment population and those passing through in addition to the residential population.

Sunlight: The site must be at a minimum partial exposed to sunlight.

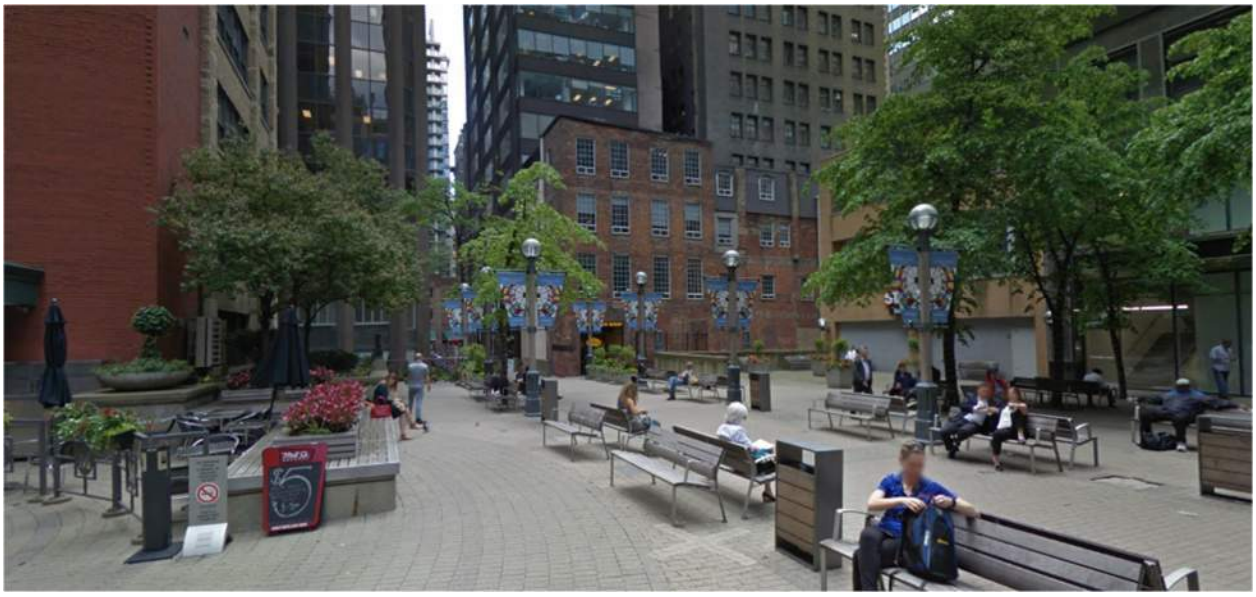
Access: The site should provide direct access or can be entered through a public building or public area of a private building.

## 31.0 Site NOPEs Site Selection

The site selected for the prototype Site NOPEs was chosen on a Privately Owned Publicly Accessible Space (POPS) to build upon and expand the City's network of open spaces and parks. The site location is within the existing 1 Adelaide E courtyard bound by Adelaide Street East to the north, Victoria Street to the east, King Street East to the south and Yonge Street to the west. Several buildings on the perimeter define the courtyard.



## 32.0 Site NOPEs Site Analysis



**Sunlight Potential:** As with many areas in the downtown core, the surrounding tall buildings cast shadows and limit the amount of daylight at grade. The courtyard receives some direct sunlight depending on the time of year. Supplemental day lighting will be required to support plant growth.

**Access:** The site is very easily accessible by both transit and foot. The King subway station is at the southeast corner of the site, the streetcar runs east to west along both King Street and East Adelaide Street East and bus service runs north-south along Yonge Street. Some the adjacent buildings have direct access to the courtyard and there is a street connection on each side of the courtyard.

**Density:** The site is located in one of Canada's densest neighbourhoods.[115]

**Links:** The courtyard is linked to the underground Path network through 1 Adelaide East.

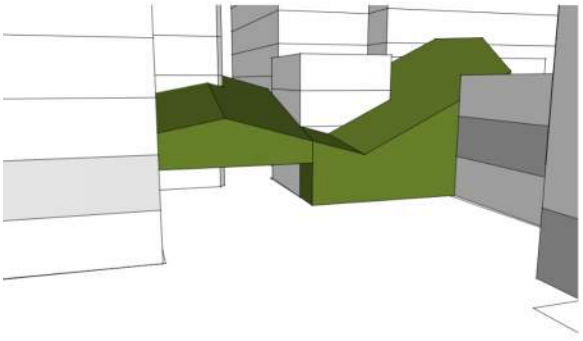
Noise: As buildings surround the courtyard, most of the noise will come from street traffic from access point.

http://urbantoronto.ca/forum/showthread.php/20509"Canada"s"Densest"Neighbourhoods"(2011"data)

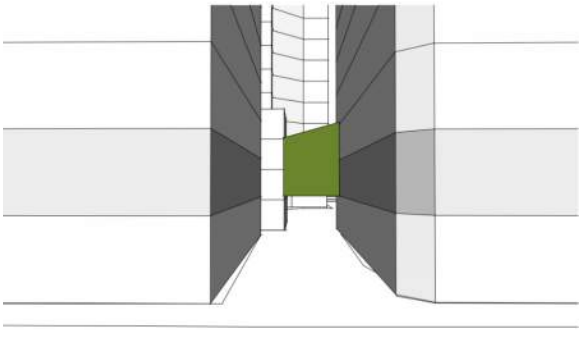
## 33.0 Site NOPEs Concepts

### 33.1 Concept A

Overhead View

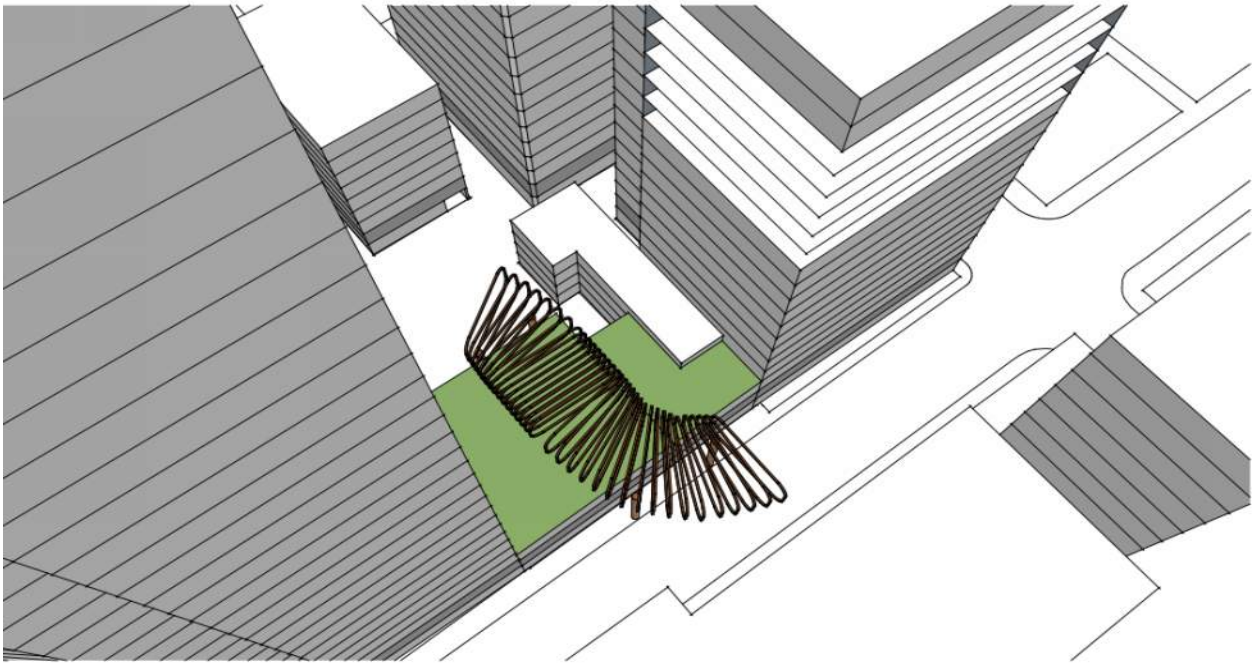


View from Courtyard

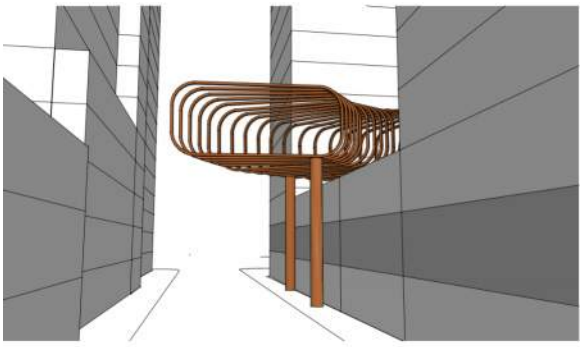


View from King Street East

### 33.2 Concept B

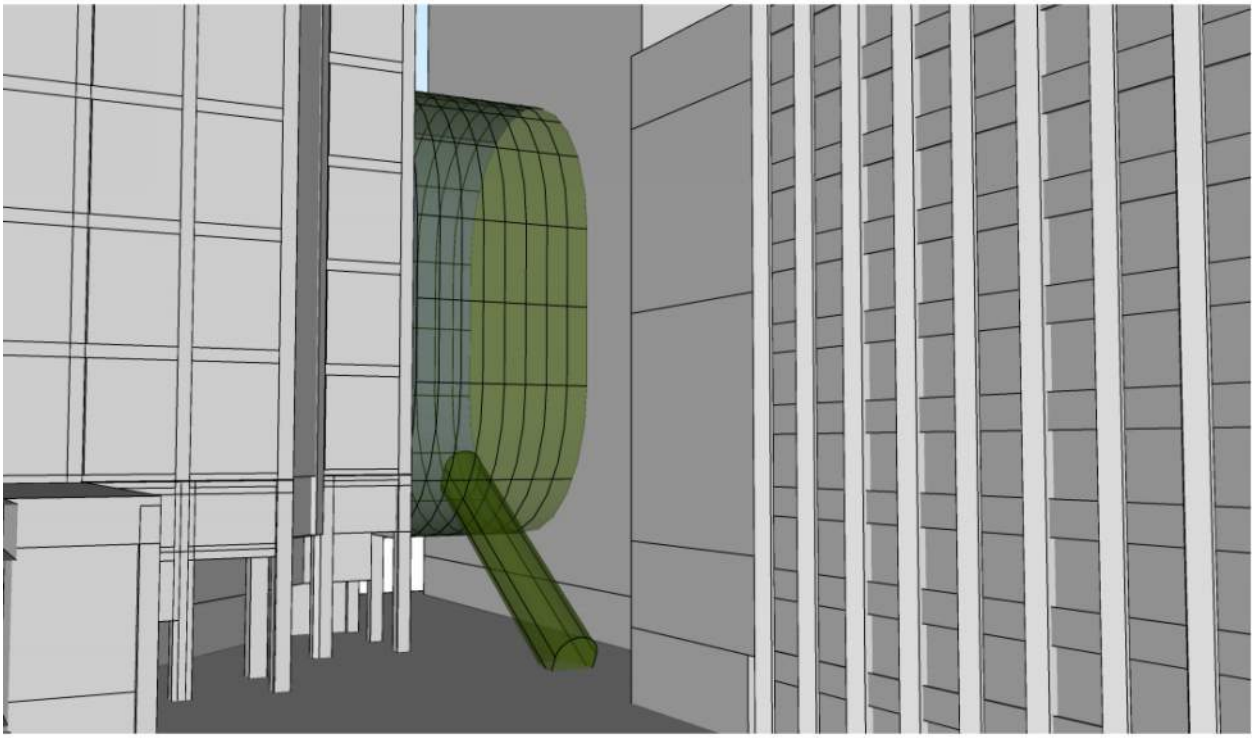


View from Courtyard

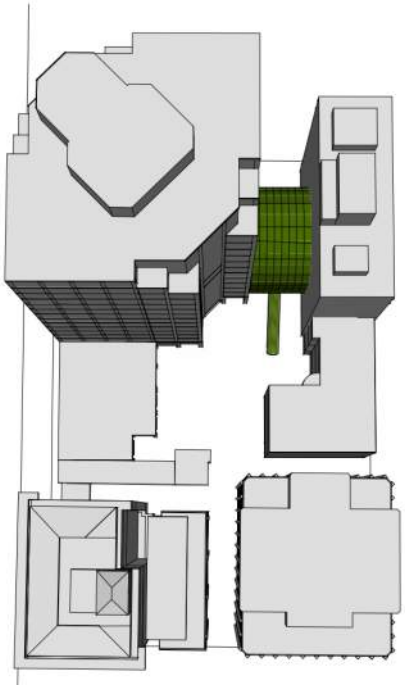


View from Yonge Street

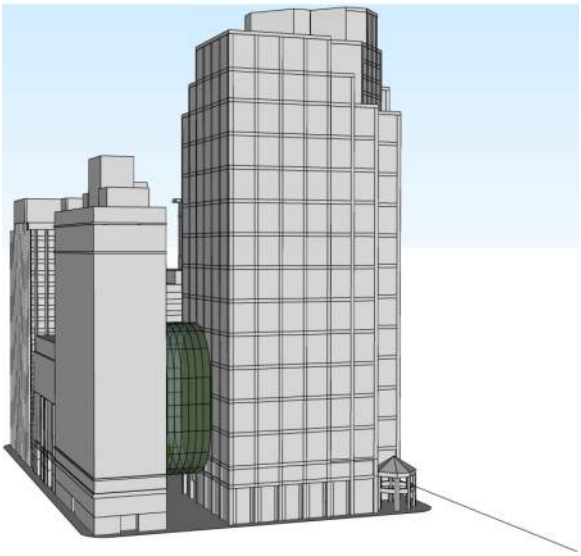
### 33.3 Concept C



View from Courtyard



Overhead View



View from Adelaide Street East

# Part 4: NOPEs Design

## 34.0 Research Based Design

The Regional NOPEs and Site NOPEs prototypes illustrate how research-based design can be incorporated across the Nature Network. The research indicated that some environments are more restorative than others. Based on the findings, the NOPEs may include design elements incorporating the following:

- organic landscapes over geometric designs
- expanses of maintained grassland
- a variety of (vegetative) species
- changes in topography
- more natural than man made features
- distant views
- the presence of water
- layering of natural features (shadows cast on natural elements make interesting patterns)
- wildlife
- opportunities for contact with nature
- passive and active experiences with nature

There were several challenges identified in the research document which have been addressed in the NOPEs designs.

- Year-round use is provided through a combination of transitional indoor and outdoor spaces as well as protective roof overhangs and sliding glass walls.
- Urban noise is mitigated by orienting the structure so that outdoor areas are distanced and physically blocked from major noise sources. Acoustic materials are used in areas of high noise. Also, waterfalls are implemented to dampen interior noise in the Regional NOPEs. The amount of vegetation also aids in the dampening of interior

noise.

- The majority of the perimeter is treated with vegetation to limit external view and stressors. There are strategically placed areas which provide a connection.
- Growing vegetation inside can be a challenge. The NOPEs use a ETFE roofing system which allows sunlight to penetrate into the building. In areas deeper in the building or below other floors a series of solar collectors capture daylight and transfer it to below using solar tubes and solar canopies to spread the light. This technology was successfully tested at the Low Line, an underground park, in New York City. Other areas use solar tubes to horizontally transfer sunlight.
- To encourage safety within the building, enclosed spaces are limited both physically and acoustically.
- Movement is facilitated in the Regional NOPEs by a promenade through the building, which links with an outdoor promenade. A gently sloped walkway connecting levels provides more opportunities for movements and different vistas. In the Site NOPEs, the smaller space provided movement between levels and between access points.
- The Regional NOPEs physically separated the program by raising it over the train tracks, providing washroom facilities in line with the tracks and turning the program inward. The Site NOPEs limits exposure to the streets and opens mainly to the quieter courtyard.

There were several opportunities identified in the research document which have been included in the NOPEs designs.

- A variety of nature is incorporated, including deciduous and evergreen trees, shrubs and plantings.

- Patterns are present in the form of planting designs as well as the roof structures.
- Textures are present in the form of a variety of vegetation leaves and natural materials used for finishes.
- Wildlife is present in the form of fishponds but could be extended to other forms, such as an aviary, at other sites.
- The built environment is contrasted through the use of a natural materials, vegetation and curves.
- A sense of scale is created through the use the soaring self-supported roofs.
- A sense of enclosure is achieved through tree canopies as well as the roofs.
- New perspectives of the city are created from experiencing nature incorporated into the built form.
- Vegetation buffers mitigate sights and sounds and to provide physical separation.
- Enclosure from buildings and tree canopies provide a sense of scale.
- Distractions are mitigated by vertical separation.
- Extent is provided in limited space by creating a variety of nature area and a sense of enclosure.
- Both active and passive activities such as walking and sitting to serve a variety of users.
- Human scale is emphasized using raised planter beds, site furniture and intimate areas as well as overhead trellises.
- Opportunities for brief visits allow direct attention to rest facilitating restoration.
- Longer durations allow for working memory repairs.
- Wind protection is provided through building orientation and protective planting.

## 35.0 Regional NOPEs

Considered the heart of the network, the Regional NOPEs is a principal destination that people seek as preventative measures to relieve stress. This large-scale public installation provides complementary programmed spaces that facilitate the restorative process. Such amenities include opportunities for learning about nature and having direct interaction with nature through hands-on activities such as planting, cultivating and playing. The Regional NOPEs is a multilevel facility which provides connections to key transit facilities and offers connections with the street level access and parking. The structure essentially links the two sides of the train tracks, connecting the community and providing valuable, year-round, easily accessible nature to a large population.

South Perspective

### 35.1 Site

The site for the prototypical Regional NOPEs is at Kipling Station, a bustling transit hub, located in Etobicoke, Ontario. Positioned just southwest of the junction of Dundas Street W, Bloor Street West and Kipling Avenue, the site straddles the train tracks and encompasses both the TTC and Go Transit stations.

North of the station is the commercial strip along Bloor Steet West with low rise residential beyond. Immediately north of the site there is several high-rise residential towers. To the south of the site is the Hydro One A.W. Manby Transformer Station. To the east, is mainly low rise industrial with low rise housing beyond.


LOCATION MAP



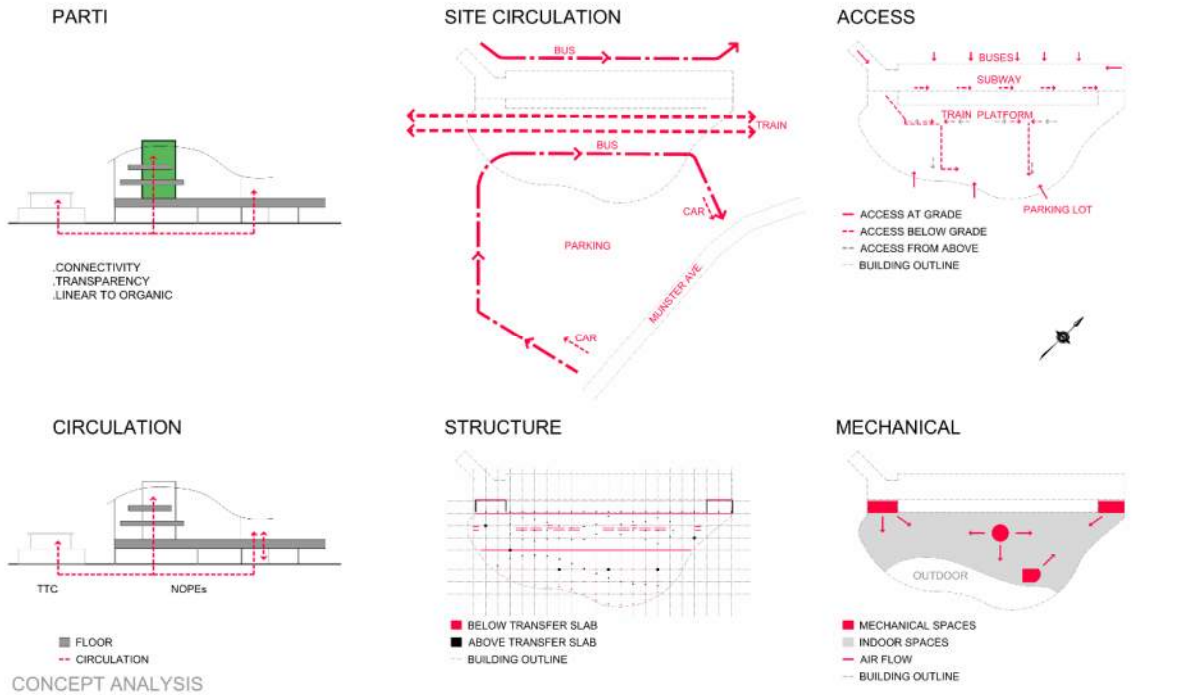

SITE VIEWS


CONTEXT MAP

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS
RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE KIPLING REGIONAL NOPEs

### 35.1 Concept

The concept for the Region NOPEs was to create a strong, nature intensive link between the two sides of the track while maintaining the existing bus terminal and parking lot. The NOPEs mezzanines are anchored by a massive 15m tower wrapped in a green wall which is a focal point of the interior. In both plan and section, the building transitions from a rigid linear form to a curvilinear, transparent form.




The arrangement loosely mimics the structure of a tree with the tower as the trunk and the mezzanines extending out like branches. The transfer slab and structure below L100 mimics the roots, transferring the loads from above to the roots and anchoring it to the ground.

The roof creates a canopy over the program space. Like a tree, it cast shadows below that change with the sunlight.

### 35.3 Site Plan

The building is designed around a series of constraints which form its shape. The building's footprint is a response to respecting setbacks from the nearby hydro towers and offsetting to preserve the existing TTC bus terminal. The design bridges the two sides of the train tracks creating multiple experiences for crossing.

The site is accessed from both the TTC Station to the north and from Kipling Avenue via Munster Avenue. Bus and car circulation is separated to provide a direct route for buses in and out of the site, avoiding congestion.

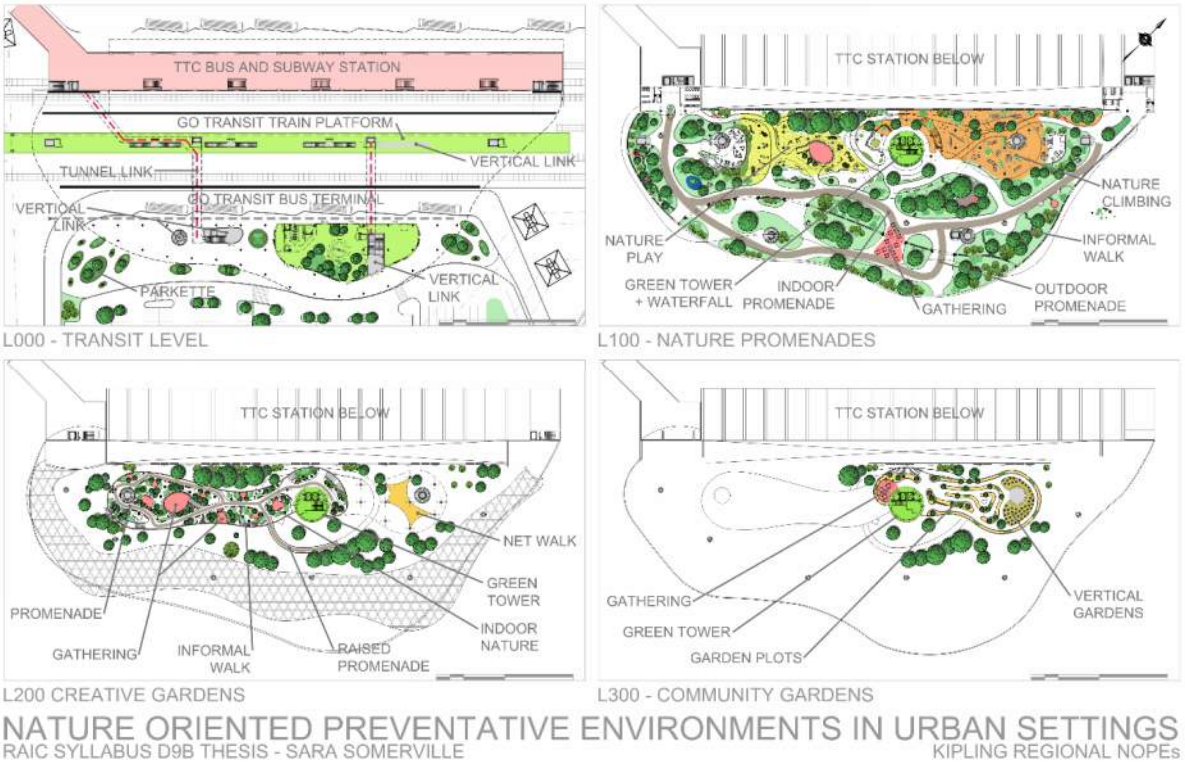

SITE PLAN

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE KIPLING REGIONAL NOPEs

### 35.4 Program

The NOPEs integrates program elements that enhance the nature experience and provide community amenities while allowing for preventative therapy and reversing the physical and mental ailments caused from urban stressors.




Level 000 is the Transit Level which feeds the NOPEs from the GO Train platform, Go Bus Station and adjacent TTC bus and subway station.

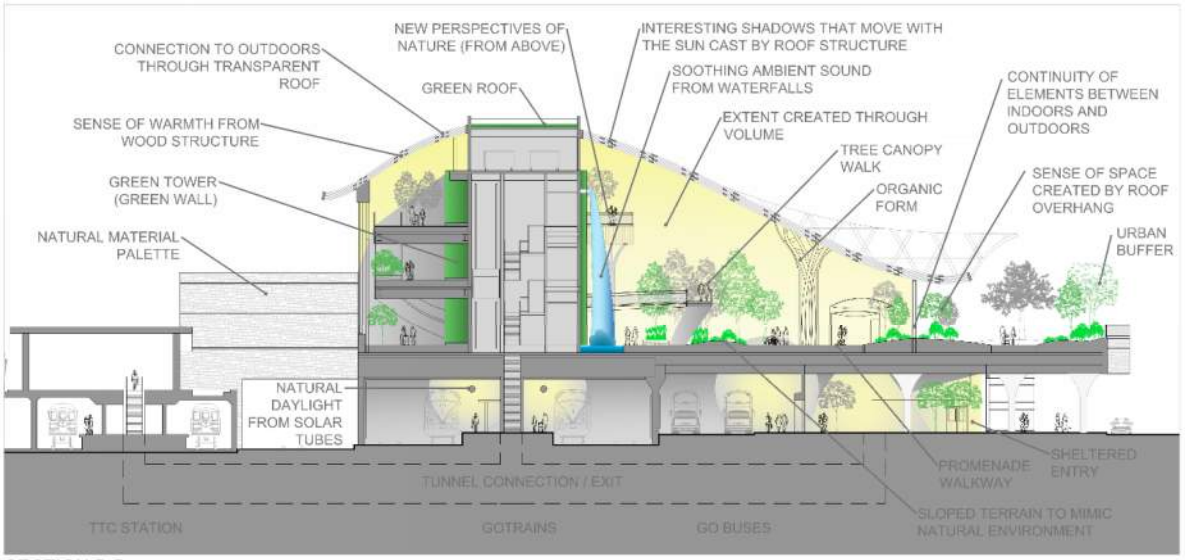
Level 100 is the base of the NOPEs. It consists of expanses of nature connected by a generous promenade which links the program areas together as well as the inside with the outside. The promenades is a multipurpose feature that accommodates program features such as the Farmer's Market and the Artist's Market. There is also a Nature Play area and Nature Climbing area.

Level 200 houses the Creative Gardens for the Artists' Community. Here, pods of various sizes are connected by a promenade.

Level 300 houses the Community Gardens which consists of combination of planter beds and vertical gardens as well as a gathering area.

### 35.5 Overview

The building transforms from a heavy, linear form at its base to a light, organic form with it's transparent roof opening to the sky above, filling the interior with daylight. Natural light is transported to dimmer areas though solar collector, tubes and solar canopies. A central core anchors the mezzanines, concealing functional spaces. The tower's green wall and waterfalls creates a focal point while dampening noise.




SECTION B-B

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE KIPLING REGIONAL NOPEs

The transparent roof covering affords views to the sky while its wood trusses create visual interest casting shadows in the interior. Section of glazed window walls aligned with the

promenade and a continuous roof plane create a seamless transition between the indoor and outdoor environments.

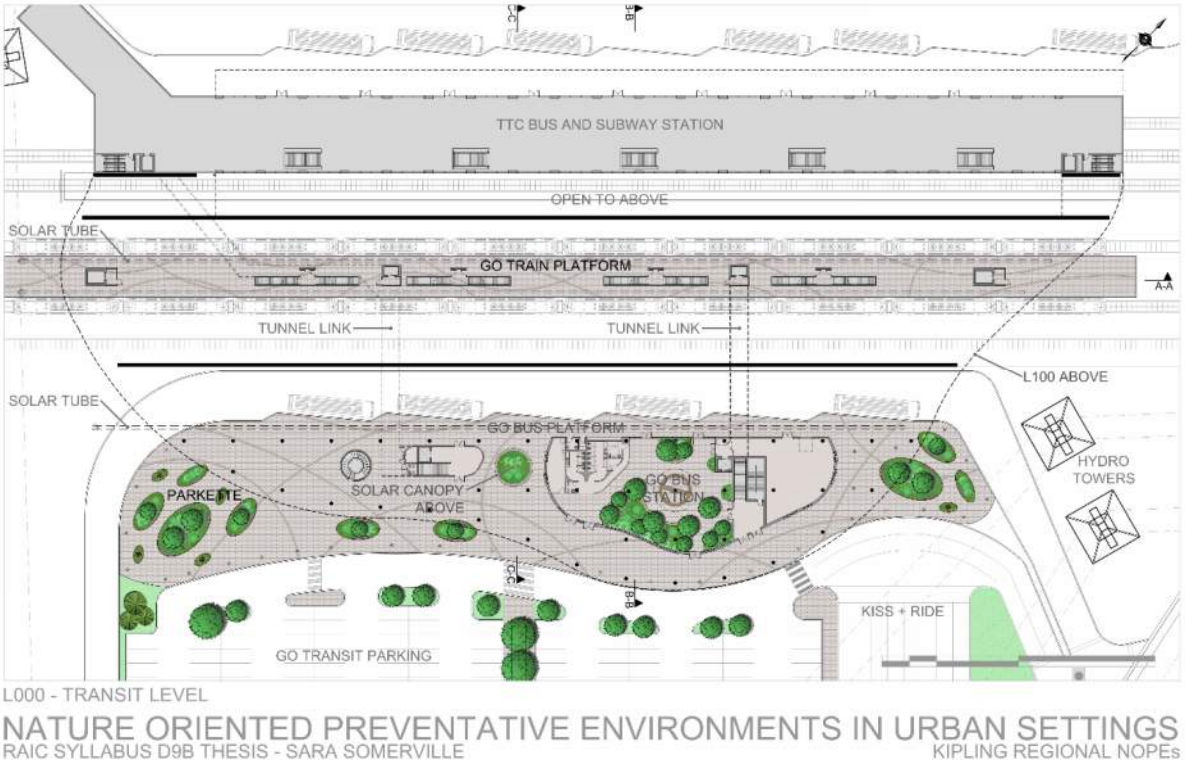
### 35.6 Level 000: Transit Hub

Level 000 is the Transit Level. It feeds the NOPEs. As Visitors that have recently or will be experiencing urban stressors filter from the TTC bus and subway station, GO trains and new bus terminal, they have the opportunity to pass through the NOPEs located directly above the transit hub. Nature extends to L000 with urban parkettes, consisting of a series of elliptical garden pods which provide a calm, sunny waiting places. Nature is carried into the new bus terminal.

While the transit stations are not a core part of the NOPEs program, they play an important part at this site. The proximity of the NOPEs to the mass transit allows masses of urban

dwellers to easily access the restorative benefits of nature year-round.

The train tracks create a divide between the TTC and GO stations, preventing a direct connection between the two at grade. Tunnel links from the train tracks to both sides of the track provide connections and serve as emergency exists for a portion of the NOPEs above.




The generous width of the track platform affords direct stair and elevator access to the NOPEs above as well as the exit tunnels below. The Go Bus Terminal is tucked under the cantilevered NOPEs proving a protective shelter against the elements. A series of parkettes provide brief nature respites and a preview of what lies above.

Inside the bus terminal, a tree canopy greats riders as they pass through. A generous landscaped area in a raised planter bed provides seating and a waiting area. Other areas

include a staff room, washrooms, ticket kiosk, cafe and receiving room. Mechanical and electrical spaces are provided on mezzanines above the washrooms and receiving room. There is an elevator and stair to access to the NOPEs above.

### 35.7 Level 100: NOPEs Main Level

L100 is the base level for the NOPEs. Nature is the primary element for L100. This level is lush with a variety of evergreen and deciduous plantings ranging from trees and shrubs to ground coverings, grasses and flowers. The Promenade walkway connects the various entry points and program areas. In terms of accessing the NOPEs, there are entry points at both ends of the TTC station, connections aligning the GO train tracks and access to the GO bus station. All stairs serve as exits and connect to the below grade exit tunnels.


Research indicates that the benefits of nature are increased when experiences are real. Benefits can be future increased by actively observing nature and even more so by physically experiencing nature.

To suits vast array of user preferences, there are three ways to experience nature within the NOPEs;

- Passively by sitting and observing nature.
- Actively by moving about the space and taking in nature.
- Hands on by taking part in gardening activities and nature-based play.

Users may choose to passively walk along the Promenade walkway which connects the

NOPEs access points and weaves between the indoors and outdoors gardens. This multipurpose walk doubles as space for the Farmer's Market and Artists' Market.

Walking the Promenade is a nature-based journey surrounded by dense vegetation, waterfalls and ponds. It provides vistas of the green tower from multiple viewpoints. The walking experience is continued with a series of paths, both formal and informal, which connect the program areas. A curving sloped walkway wraps around the green tower and through the tall trees connecting L100 to L200.

There are opportunities for passive nature experiences through the NOPEs. Benches and seating are scattered along the pathways. For those wishing closer contact, there are grassed areas for sitting and laying. A variety of gathering opportunities are scattered through the level.

The Nature Play area is just that, playing in nature. From running up hills and walking on rocks to balancing on wood posts and hopping along tree stumps, physical activity in a natural setting increases the benefits of nature.

The Nature Play area is design to provide opportunities to play on and manipulate natural elements. All play structures incorporate trees in their natural form.


Activities such as tree peg climbing and log balancing promote physical activity and direct contact with nature. The play area is enhanced by the surrounding trees and plantings as well as hills integrated into the play activities. Examples include a hill slide and tree stump climbing.

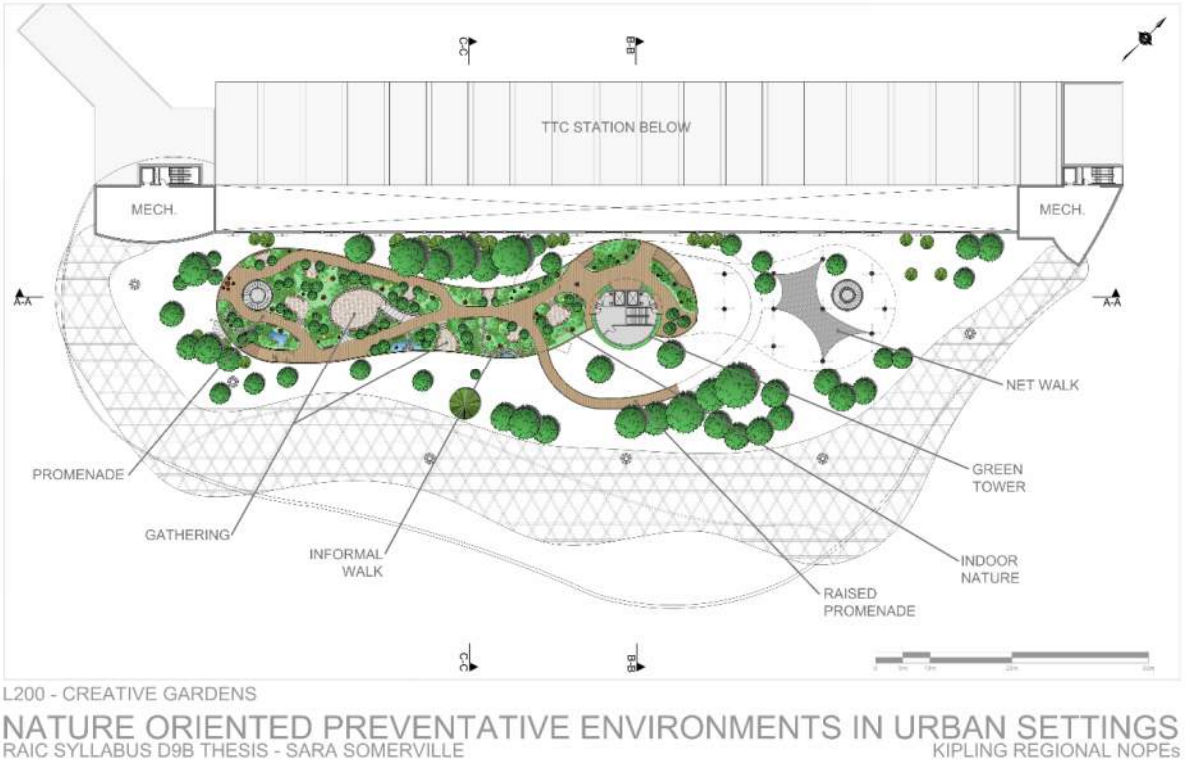
The Nature Climbing area is an enhanced program element which requires intense focus, thus allowing the climber's direct attention to rest.

The climbing features include large scale tree and rope structures in addition to natural rock formations and a climbing wall. The climbing features are set on a hilly terrain surrounded by trees and plantings. The scale and level of difficulty of the features set the Nature Climbing area apart from the Nature Play area.


### 35.8 L200 Creative Gardens

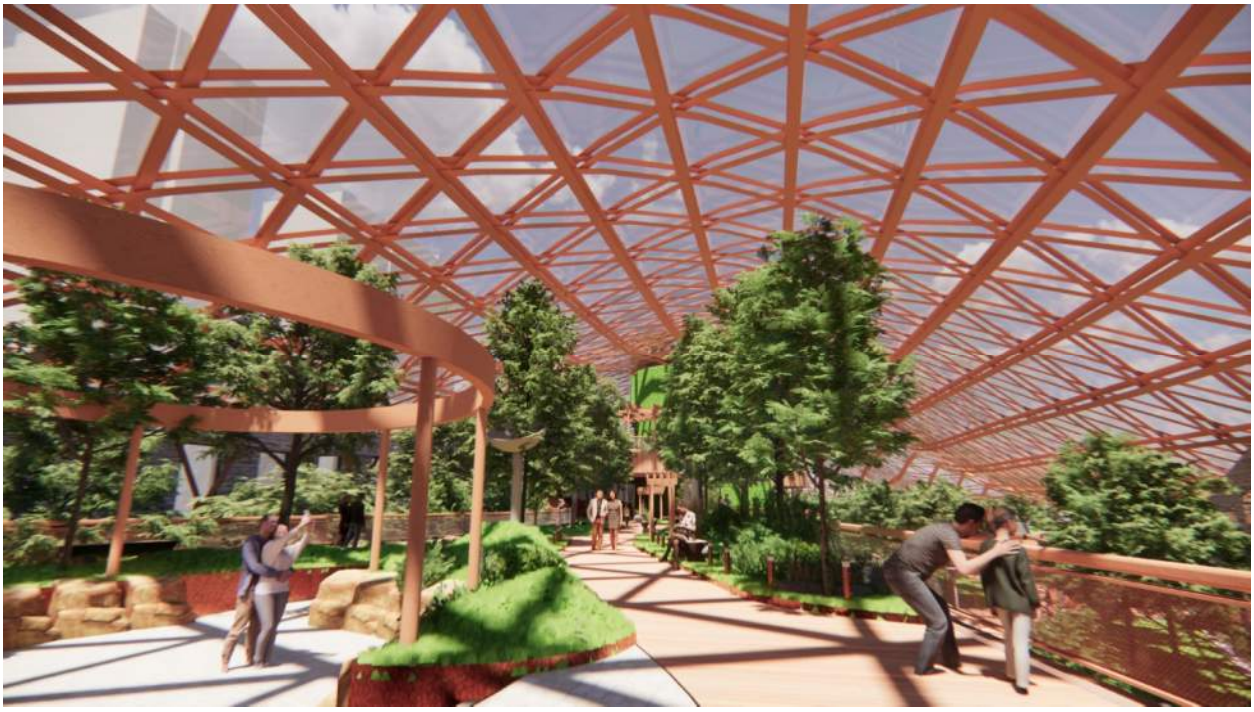
Level 200 houses the Creative Gardens, which is a community of artists that express their talents through a nature based medium and themes. Painters, sculptures, writers and designers congregate here to create work for display within the gardens and for trade at the

Artists' Market. The physical manipulation of nature has been proven to be therapeutic, while observing such creations can also be beneficial to reducing stress. While not restricted to this level, the Artists' Gardens provide a concentrated area for activities which aid in fostering a community. Paths connect pods of various sizes that can be used for creating, teaching, observing works and gathering.




The Creative Gardens feature a promenade connecting a series of pod-like gathering spaces of various sizes encompassed with lush vegetation. The multipurpose pods serve a workspace for creative collaborations among the Artists where visitors can observe, learn and take part in group classes. The pods also function gathering space for visitors where meditation, yoga and other rejuvenating activities can take place.

A centrally located, sunken gathering area provides for larger groups functions. Perimeter rockery defines this pit while providing informal seating. A trellis creates an overhead plane while greenery provides a sense of enclosure for this wall less room.



The promenade weaves between gardens and brushes along side the edge, affording views into the tree canopy and the gardens below. This type of view creates fascination, (which is a characteristic of restoration). It is enhanced by the passive observing of passers by below. The orientation of the promenade allows for continuous movement throughout the level while branching off to connect with the vertical circulation.

Informal walkways branch off from the promenade to allow for closer contact with nature and an opportunity to explore deeper into the gardens.

There are a several fascination elements through the Creative Gardens which allow for

imaginative though, thus resting direct attention. A series of ponds, some of which feed the waterfalls that spill over the edge another that features fish. Artists' creations are displayed throughout the gardens for observation and learning how nature was incorporated in the creations.

### 35.9 Level 300 Community Gardens

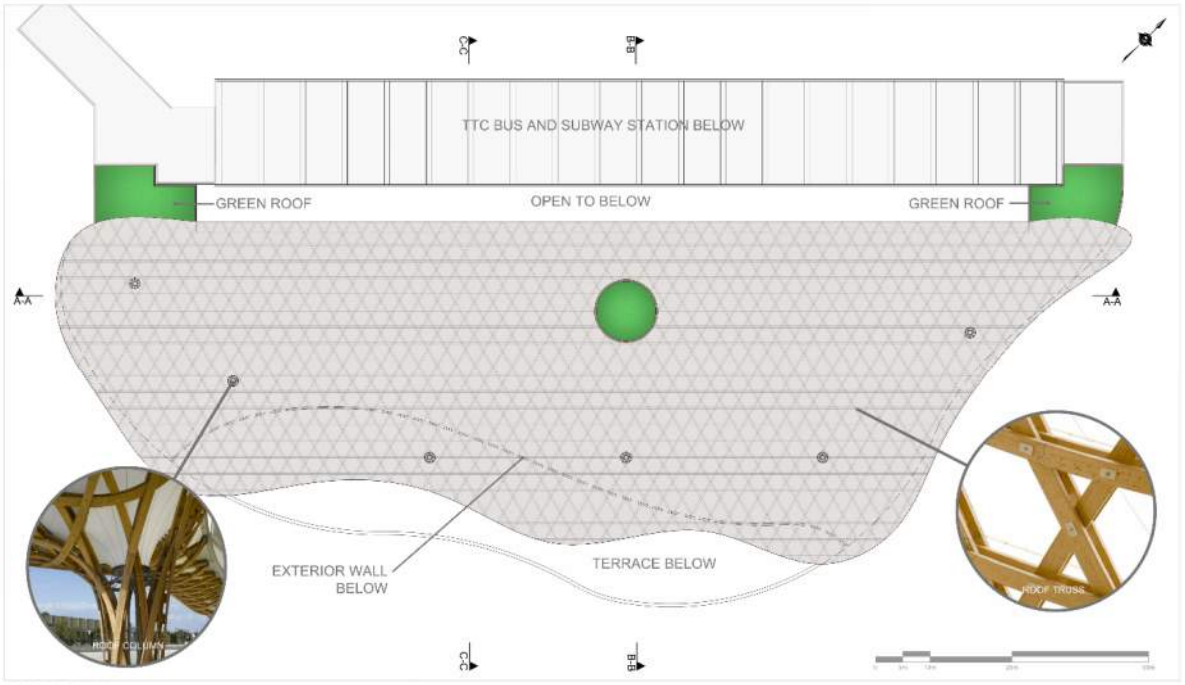
Level 300 is home to the Community Gardens. This upper level allows optimal sunlight for growing crops. The program is concentrated on the upper level to provide an intimate atmosphere to foster a strong community among the gardeners. The garden plots are a combination of traditional raised beds as well as a series of vertical gardens for growing fruits, vegetables and herbs. In addition to the garden plots, there are areas for gathering and learning.

The gardening program allows visitors to get dirty and experience nature hands on through planting, cultivating and harvesting. The gardens supply organic fruits and vegetables to the community organizations and supplement the Farmer's Market. Nature oriented physical activities such as gardening have been proven to reduce stress. The Gardener's Community assists with the maintenance of the NOPEs vegetation by providing planting and pruning. Visitors can also take part in this process.

### 35.10 Roof

Using wood to create a soft natural feel, the roof consists of a layered wood frame that weaves into large lattice columns ending at the transfer slab. The hexagonal grid system used increases the structural efficiency by reducing the quantity and weight of structural members allowing for long spans and unique forms. The roof is clad in transparent ETFE to

allow ample light to filtrate and sustain life to the vegetation within. The material's transparency also allows for views to the outdoors and sky above. The pattern of the roof structure creates a continuously moving pattern of shadows on the spaces below.




ROOF PLAN

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS
RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE KIPLING REGIONAL NOPEs

'The roof consists of curved, double glue-laminated beams running in three directions forming a hexagonal lattice. In total there are six layers of wood beams woven together, with four layers (or two double beams) intersecting at any single connection point. Connections are made with pre-stressed threaded bars and disk springs.'

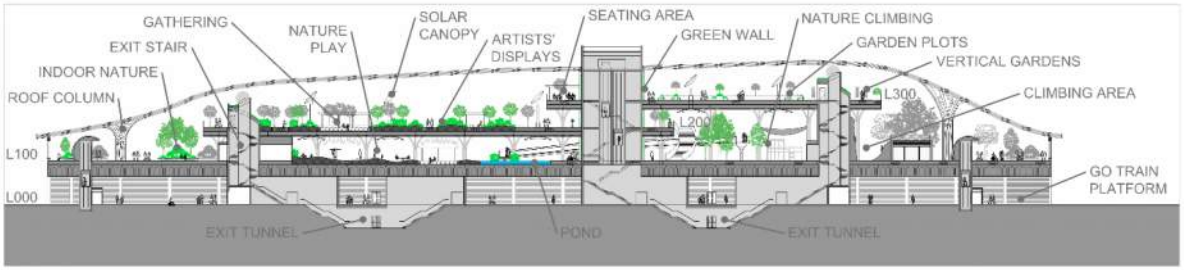
'The wood structure spans from a steel ring at the top of the central tower to woven columns below resembling tulips. The maximum spans are approximately 40 meters (131 feet). As built, there are six tulip columns. At the north side of the building, a steel beam running the entire length of the facade receives the wood structure and transfers the loads to the

concrete transfer slab below.'

### 5.11 Structural

The structure is designed to minimize the impact on the railways below. The NOPEs is designed to sit on a transfer slab over the train tracks and bus station below. This allows for long spans and fast installation of the structure over the tracks in which the precast can be installed overnight and at off hours.

The transfer slab at L100 spans 28m between north track and bus terminal with pre-tensioned precast concrete t-beams (1800 deep, 600 wide, 1800 o/c). A 14m span of conventional cast in place (CIP) transfer slab (900 deep) over the bus terminal. Two 600 wide concrete walls support the large spans while the area above the bus terminal is supported by 600 diameter concrete columns. Load-bearing concrete walls support the transfer slab at openings such as stairs.




SECTION A-A


SECTION C-C

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS
RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE KIPLING REGIONAL NOPEs

The floors above L100 use steel to transfer the loads to below. Floor assemblies consisting of 76 deck with 114 concrete take advantage of the prescriptive fire code and do not require rating due to the assembly depth. Steel columns on an optimized structural grid of 9m x 9m support the floors. The stair and elevator walls are concrete walls below the highest floor.

The ramps have a similar construction as the upper floors. Steel columns support curved steel beams with cantilevered outriggers in the short direction. C-channels provide intermediate support.

### 5.12 Code Analysis

The program is separated into two 'buildings' through fire separations. Level L000 is considered a separate building from the remainder of the program by the transfer slab. The NOPEs portion has two large mezzanines totalling approximately 40% of level L100. As it has open floor areas, it is not required to extend to a wall or be enclosed.

Exiting is provided through a series of exit stairs which spill out to grade or exit tunnels. As the core of the NOPEs straddles the tracks, exits are strategically placed between the tracks and extend below the track level to tunnels which run below the tracks. The tunnels are rated exit corridors.

### 5.13 Fire Safety

Fire modelling and descriptive analysis (as opposed to prescriptive measures) for fire protection are proposed for the building due to its complexity. Intumescent paint/stain is used for fire protection on the supporting structural elements.

## 36.0 Site NOPEs

Site NOPEs are a looser distribution of year-round nature throughout private/semi-private spaces. This series of small infills within the urban fabric are places that urbanites can take a brief respite from urban stressors. The programs are much simpler, mostly nature for passive experiences or brief active ones.


### 36.1 Site

The site selected for the prototype Site NOPEs was chosen on a Privately Owned Publicly Accessible Space (POPS) to build upon and expand the City's network of open spaces and parks. The site location is within the existing 1 Adelaide E courtyard bound by Adelaide Street East to the north, Victoria Street to the east, King Street East to the south and Yonge Street to the west. The courtyard is defined by several buildings on the perimeter.

ADELAIDE COURTYARD LOOKING SOUTH

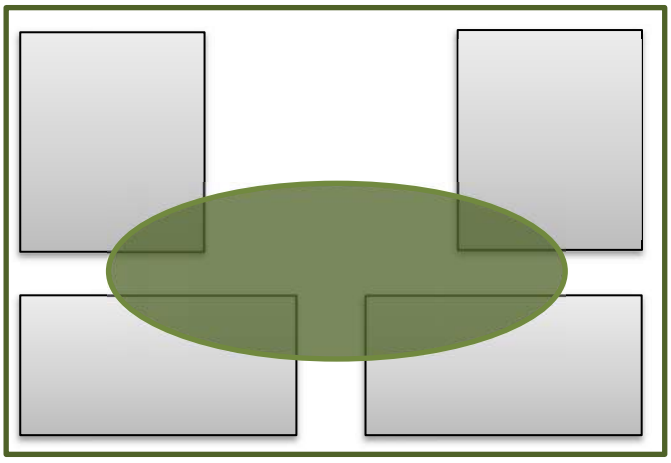
ADELAIDE COURTYARD LOOKING NORTH


SITE PLAN

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS
RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE ADELAIDE COURTYARD SITE NOPEs

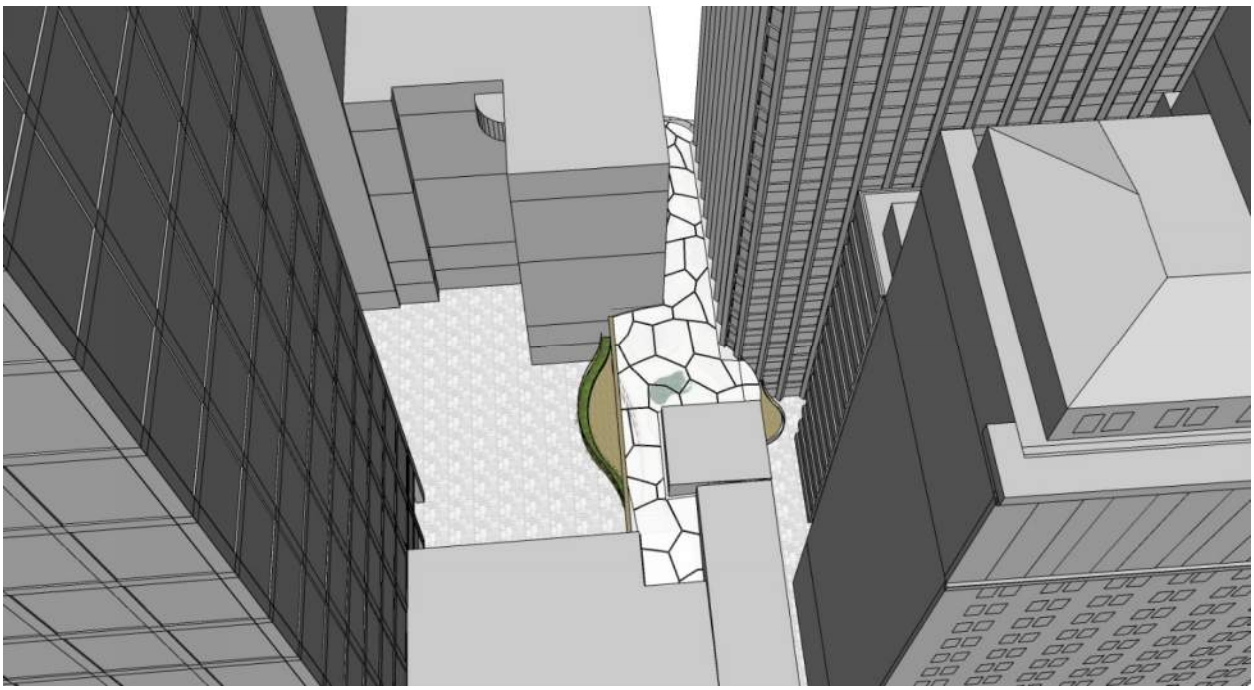
### 36.2 Concept

The Site NOPEs infills much needed year-round nature in the urban core. The concept for the prototype is for nature to link the surrounding streets, courtyard and buildings. It has the potential to be the catalyst for a network of green spaces connecting the city above the streets.



Raising the bulk of the program above grade maintains the existing courtyard and pedestrian circulation. The ground level encompasses the pedestrian link from Yonge Street to the courtyard, maintaining pedestrian flow while offering a brief nature filled respite from urban stressors. Pedestrians may be intrigued to explore and ascend the second level through a tree canopy. The upper-level rests between four existing buildings with direct connections to two, providing workers with direct access to nature.

The Adelaide Site NOPEs is a parasite. It is attached to the adjacent buildings, relying on them for structural support, ventilation, power and access. But this parasite doesn't only take, it also gives back. It gives back in the form of a nature-based respite for the buildings' tenants and the urban population. It organically grows in the crevasses between four existing buildings and rises above the internal courtyard to maintain the open pedestrian space and circulation.

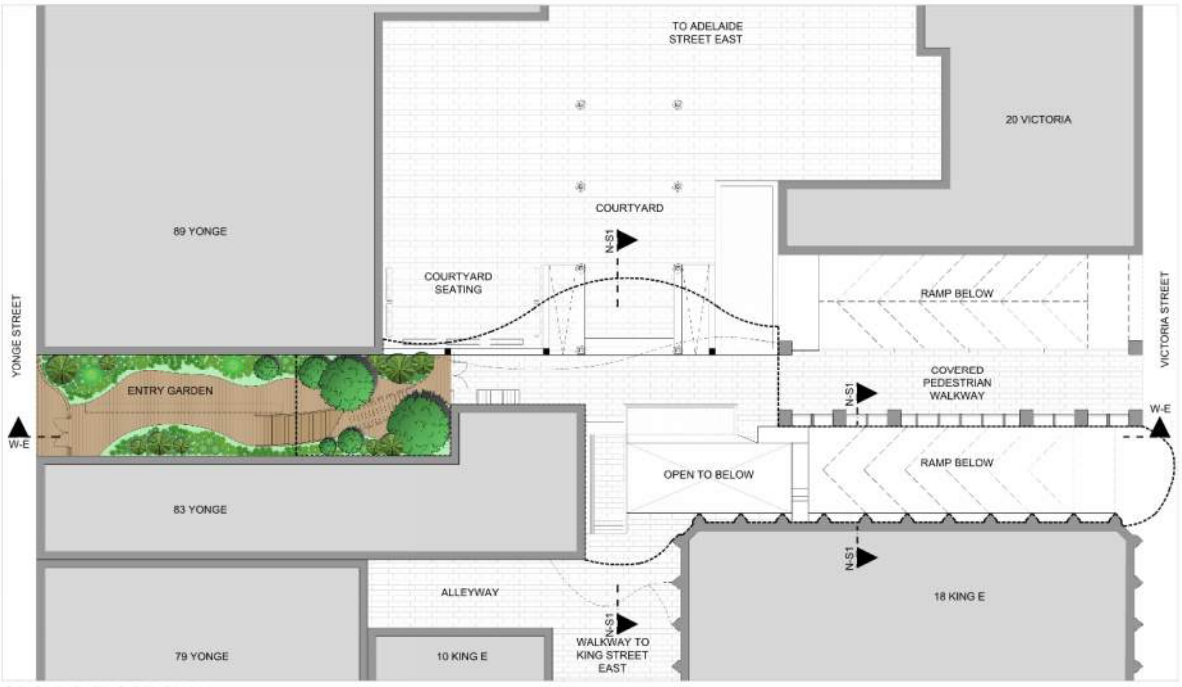


### 36.3 Program

The Site NOPEs program consists of nature.

The ground level is designed as a nature filled throughfare. Raised planting beds filled with lush vegetation, flowers and trees line a walkway connecting Yonge Street to the courtyard. Mature trees connect the two-storey volume between levels. The upper-level welcomes visitors with a large green wall and opens to the terrace which overlooks the courtyard. Beyond, trees and tall grasses lead users to the grassy meadow, pond and forest where they may take a break amongst the tree canopy.

### 36.4 Ground Floor




GROUND FLOOR PLAN

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE ADELAIDE COURTYARD SITE NOPEs

The ground level encloses the existing pedestrian way between Yonge Street and the courtyard. It improves the courtyard by limiting the street noise and wind. Pedestrians are greeted by gardens and trees which provides a brief respite while passing by. The passed planter bed provides a ledge for seating and observing. The wide stair intrigues visitors to ascend to the second level through the tree canopy.

### 36.5 Second Floor

The stair opens onto a green wall and sliding glass wall which opens onto a vegetative lines terrace. Inside, visitors are guided to a meadow overlooking a fishpond. The walkway continues into a forest with trees surrounding both sides. Building access and NOPEs exists are provided to 20 Victoria and 18 King East.

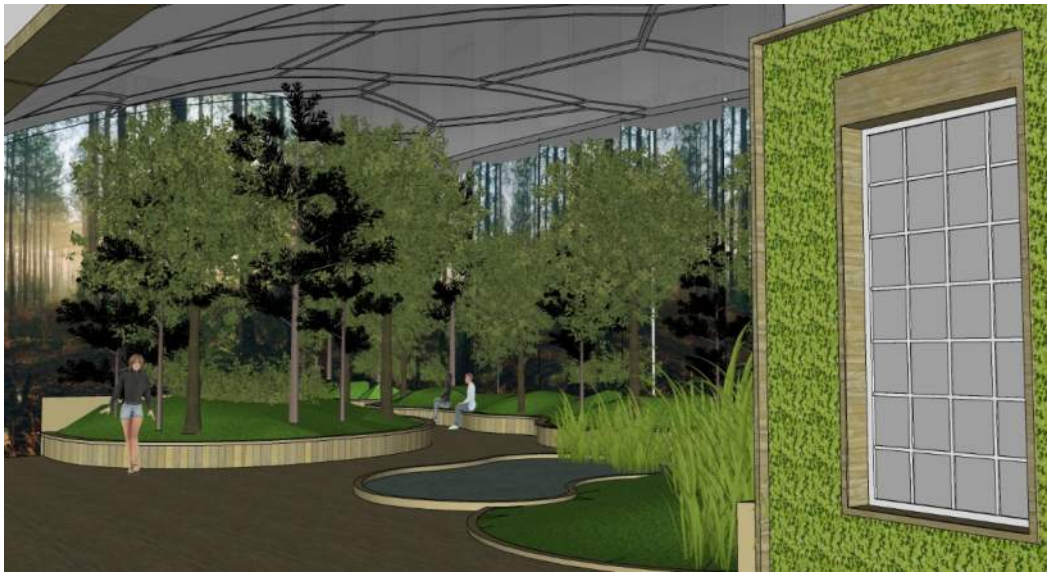

SECOND FLOOR PLAN

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE ADELAIDE COURTYARD SITE NOPEs

### 36.6 West Perspective

As visitors pass the green wall, a meadow and fishpond emerge. Beyond a forest emerges with a mural on the existing buildings to emphasize the effect of walking through a forest.

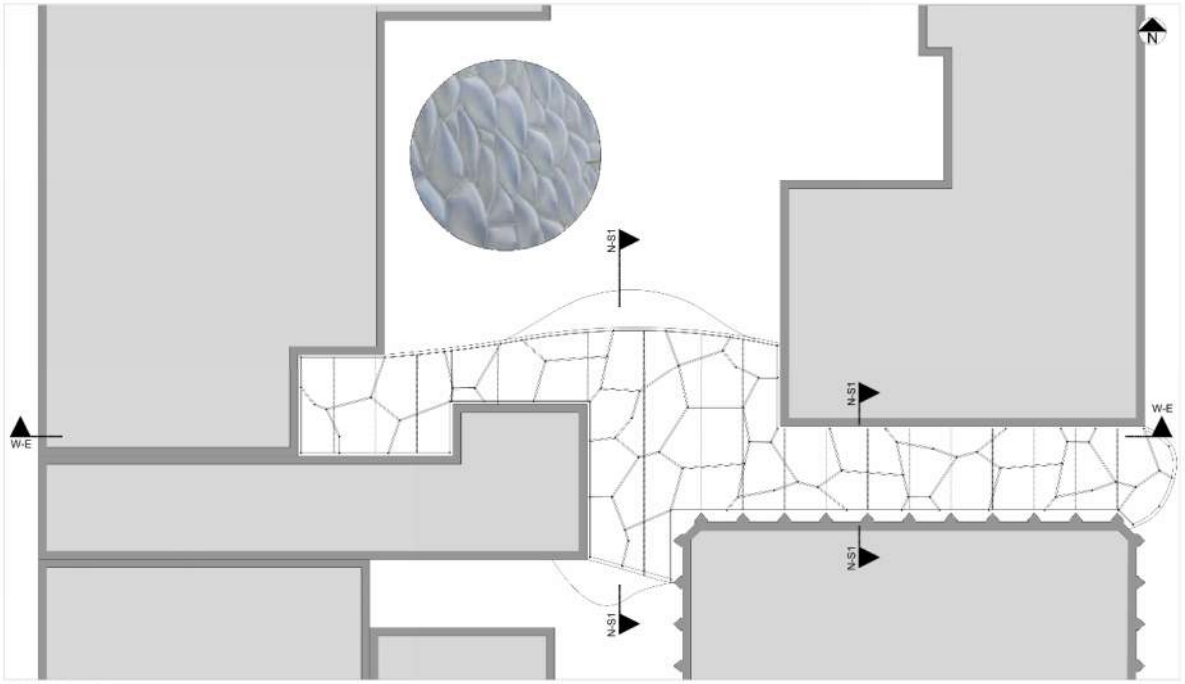


### 36.7 East Perspective

From the east, a tree canopy covers the walkway, The raise planter beds provide informal seating while the sloped terrain is used to lay on.

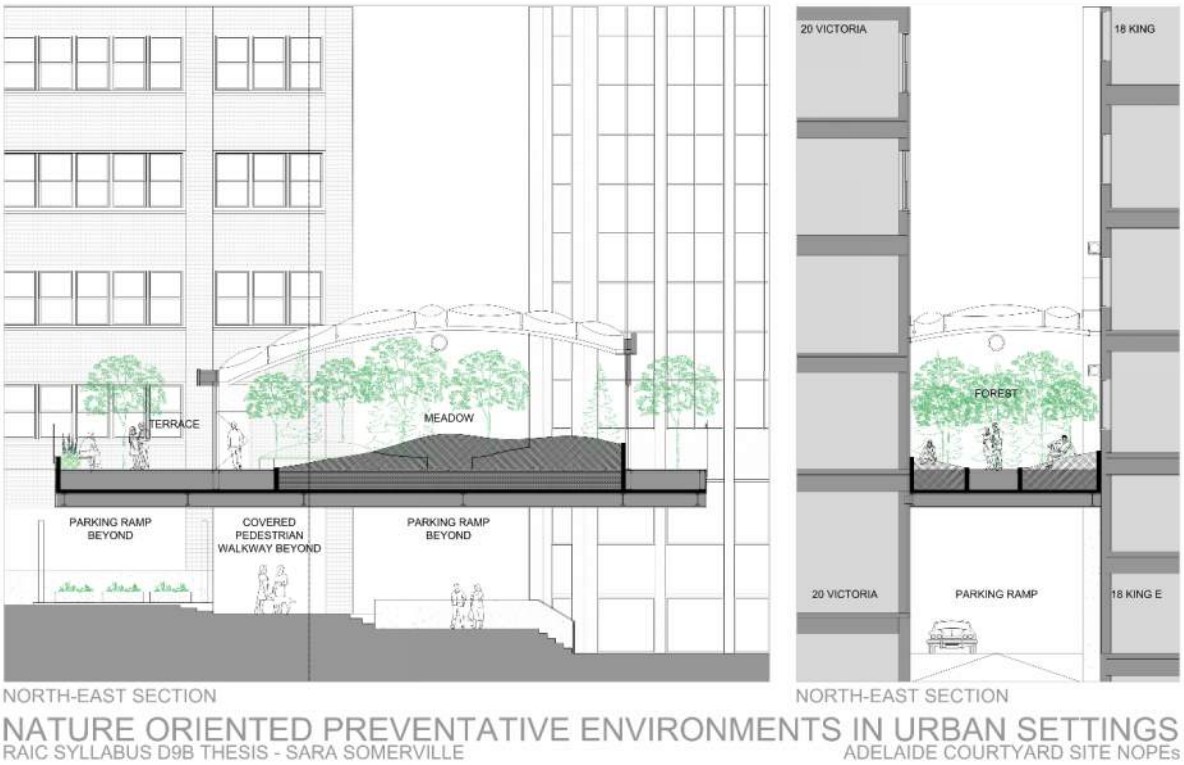
### 36.8 Roof Plan

The random pattern of the roof resembles a geometric pattern of clouds which is enhances by the semitransparent bubbles of the roof assembly. The roof consists of a lightweight steel skeleton which supports a ETFE (Ethylene tetrafluoroethylene) membrane which obscures views of the adjacent buildings while allowing changes in daylight to be observed. The roof structure ties into the adjacent structures.




### 36.9 Structural

A steel structure with a metal deck and concrete slab was chosen for its light weight relative to concrete and ability to tie into the adjacent structures. The moment frame is physically attached to 20 Victoria Street (as it has the most contact surface). The frame has slip connections at the other adjacent structures and a row of columns supports the cantilevered portion to the north.



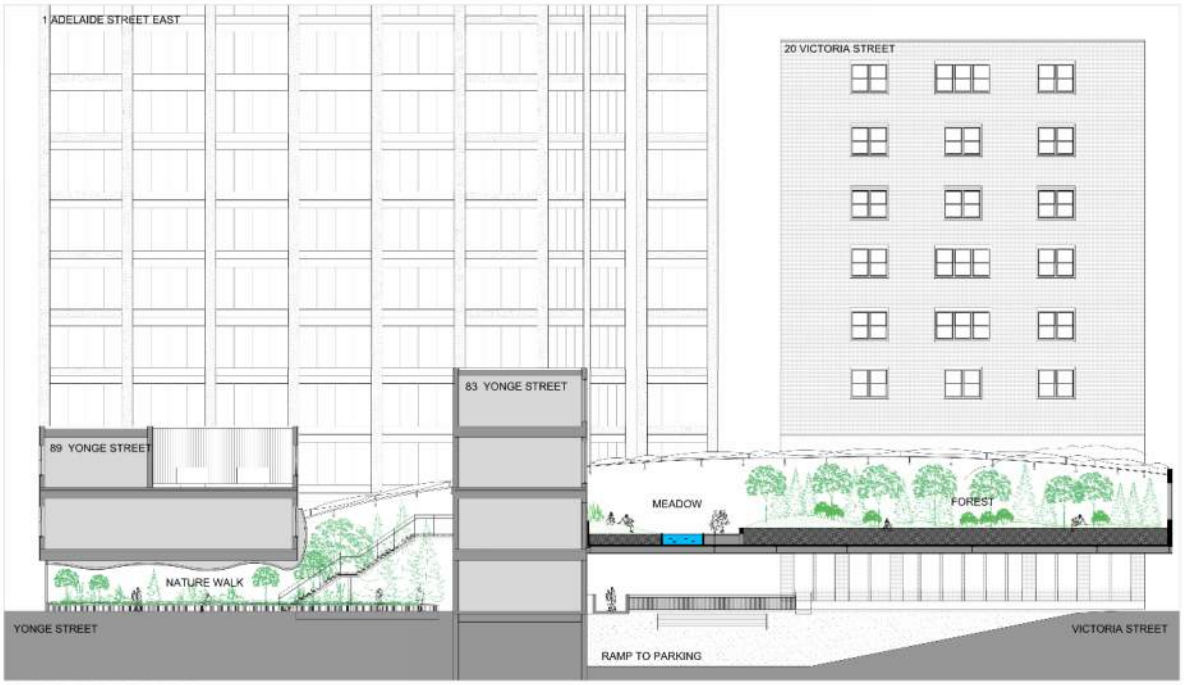

### 36.10 Roof Structure + Roofing

The roof structure ties into the adjacent building structures. A lightweight steel skeleton supports a ETFE membrane roof.

The roof is a ETFE (Ethylene tetrafluoroethylene) system which is a highly transparent extruded film applied as a multi layer pneumatically inflated cushion supported with aluminum extrusions and supported by a lightweight structure. These cushions are filled with low-pressure air, providing thermal insulation and structural stability against wind or snow loads.

The system was chosen for its lightweight structure and transparent features. At just 1% the weight of glass it allows for up to 95% light transmission and has a high permeability to

light in UV wave ranges. ETFE absorbs noise, is non-flammable, self-cleaning and has a 30-year lifespan.




WEST-EAST SECTION

NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE ADELAIDE COURTYARD SITE NOPEs

### 36.11 Code Analysis + Fire Safety

Exiting is provided through 20 Victoria and 18 King East. Rated corridors are provided to the buildings exits. It is assumed that the existing buildings' exterior walls provide a fire resistance rating due to their proximity to each other. Fire shutters are provided as required at window locations within the NOPEs and above as required by code. The NOPEs structure will have a 2-hour FRR achieved by spray fireproofing the steel structure. The sprinkler system for 20 Victoria will be extended to the NOPEs and a dry sprinkler system will be provided at the roof level in lieu of a rated roof.

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# Appendix B: Presentation

# Nature Oriented Preventative Environments (NOPEs)

## Final Thesis Presentation

Sara Somerville
ON030014TOR

# Thesis Statement

Certain characteristics of urban environments impose stresses that may impact our physiological and psychological health. The benefits of nature, particularly in restorative environments, have been recognized as valuable for improving health. If increased stress can lead to chronic illnesses, such as cardiovascular disease, then reducing stress should lessen the effects and incidence rate of these chronic ailments. By increasing exposure to recuperative settings in urban environments, stress can be combated more frequently, preventing compound stress, and potentially reduce the occurrence of physiological and psychological illnesses. Using restorative environments within the city as preventative measures could essentially reduce the build-up of stress and depletion of mental resources, resulting in a fewer occurrences of stress related health conditions, a healthier urban population and better quality of living.

# Executive Summary

# The Nature Network

## Nature Oriented Preventative Environments (NOPEs)

- Specialized architectural settings
- Facilitate stress relief
- Allow for recovery from metal and physical stresses
- Employ Natural Elements
- Prevent Compound Stress

# The Nature Network

## Regional NOPEs

- Public Installations
- Easily Accessible
- Larger Scale
- Brief to Longer Visits

## Site NOPEs

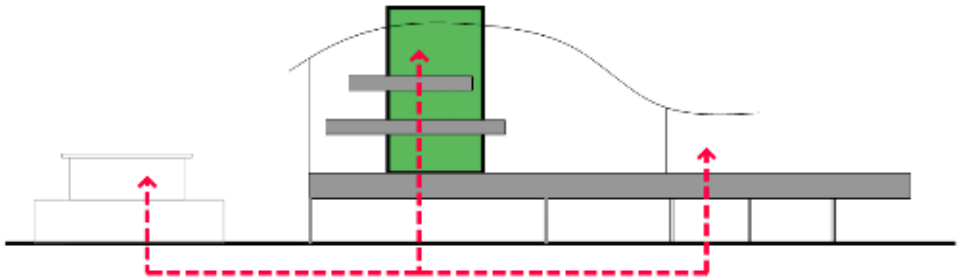
- Privately Owned Publicly Spaces (POPs)
- Smaller Scale
- Infill in Dense Urban Areas
- Brief Respite

# Site NOPEs

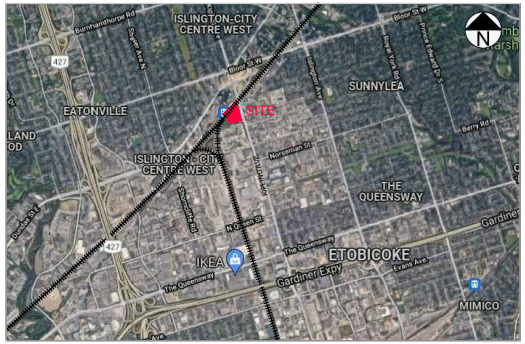
## Urban


## Urban Nature

# Regional NOPEs . Kipling Site



.CONNECTIVITY
.TRANSPARENCY
.LINEAR TO ORGANIC




LOCATION MAP




SITE VIEWS


CONTEXT MAP

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs

## SITE


--- SITE BOUNDARY

## VEHICULAR ACCESS


Ⓟ PARKING LOT
→ DIRECTION OF TRAVEL

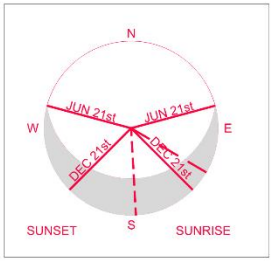
## PEDESTRIAN ACCESS


● ENTRANCE
-- TUNNEL

## SITE CONSTRAINTS

■ HYDRO TOWER
-- OVERHEAD HYDRO LINES
TRAIN TRACKS
OVERPASS

## DAYLIGHT




SUN PATH
SUNRISE/SUNSET
-- NOON SUN - DEC 21st
NOON - JUN 21st

## NOISE

NOISE SOURCES

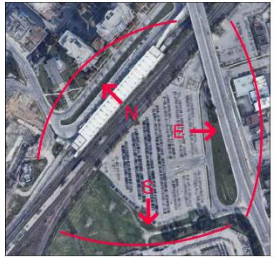
## WIND

→ PREVAILING WIND DIRECTION

## VEGETATION

TREE
SHRUB
GRASS

## VIEWS




N RESIDENTIAL AND COMMERCIAL TOWERS
S PARKING LOT AND HYDRO STATION
E 1-2 STOREY BUILDING AND MATURE TREES

## VIEWS

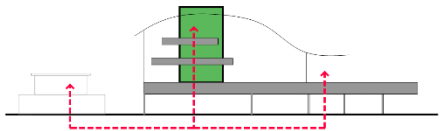

SITE ANALYSIS

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

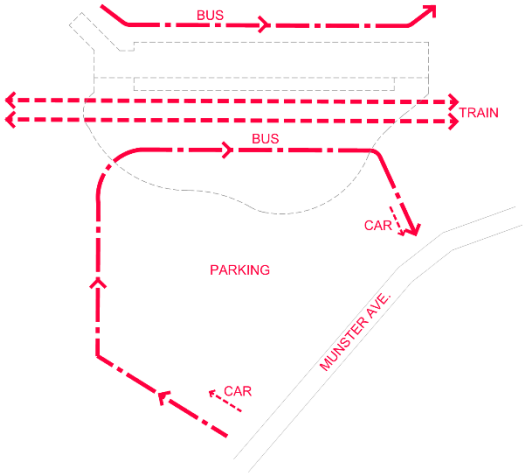
KIPLING REGIONAL NOPEs

## PARTI

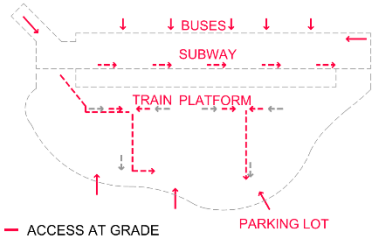


.CONNECTIVITY
.TRANSPARENCY
.LINEAR TO ORGANIC

## SITE CIRCULATION

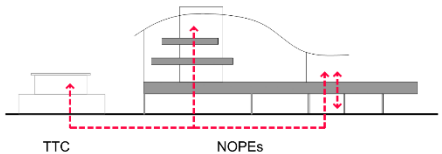



## ACCESS



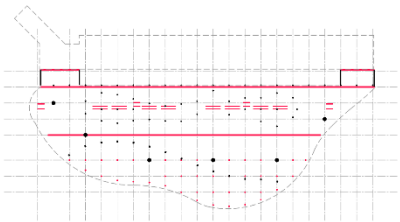

ACCESS AT GRADE
ACCESS BELOW GRADE
ACCESS FROM ABOVE
BUILDING OUTLINE

## CIRCULATION



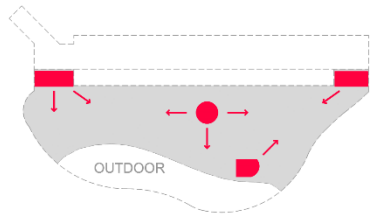

FLOOR
CIRCULATION

## STRUCTURE



BELOW TRANSFER SLAB
ABOVE TRANSFER SLAB
BUILDING OUTLINE

## MECHANICAL



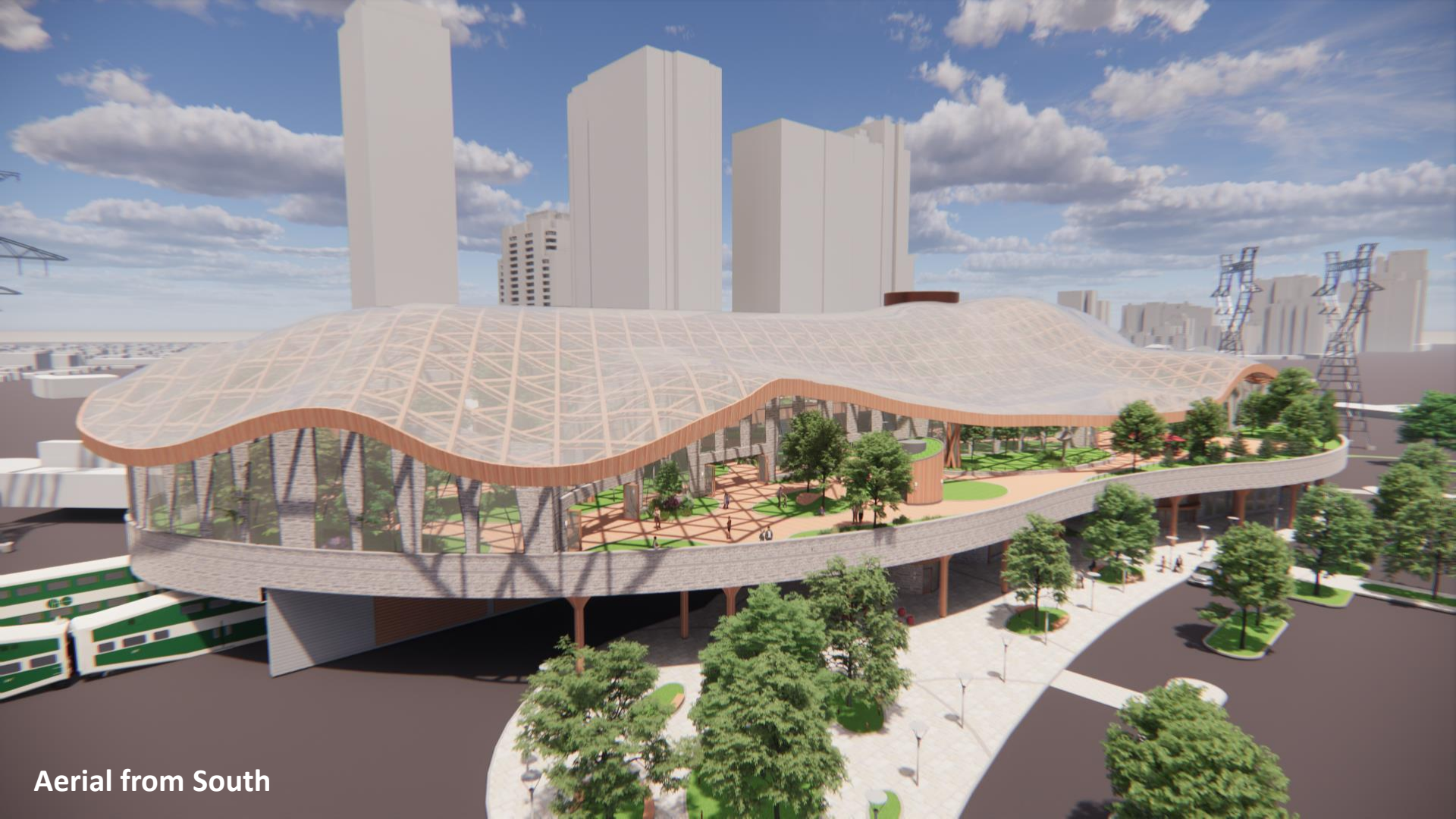

MECHANICAL SPACES
INDOOR SPACES
AIR FLOW
BUILDING OUTLINE

CONCEPT ANALYSIS

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

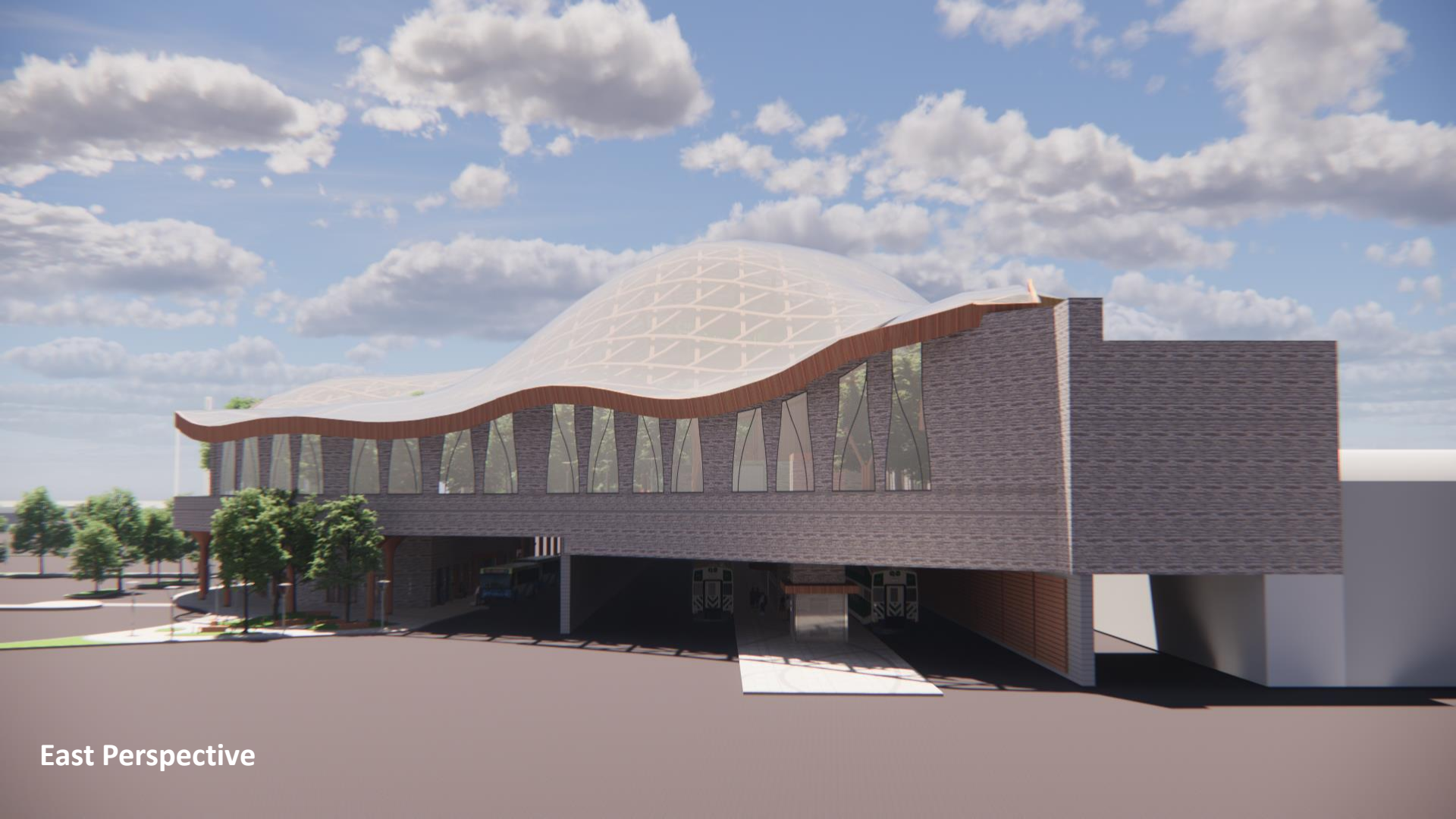
RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs

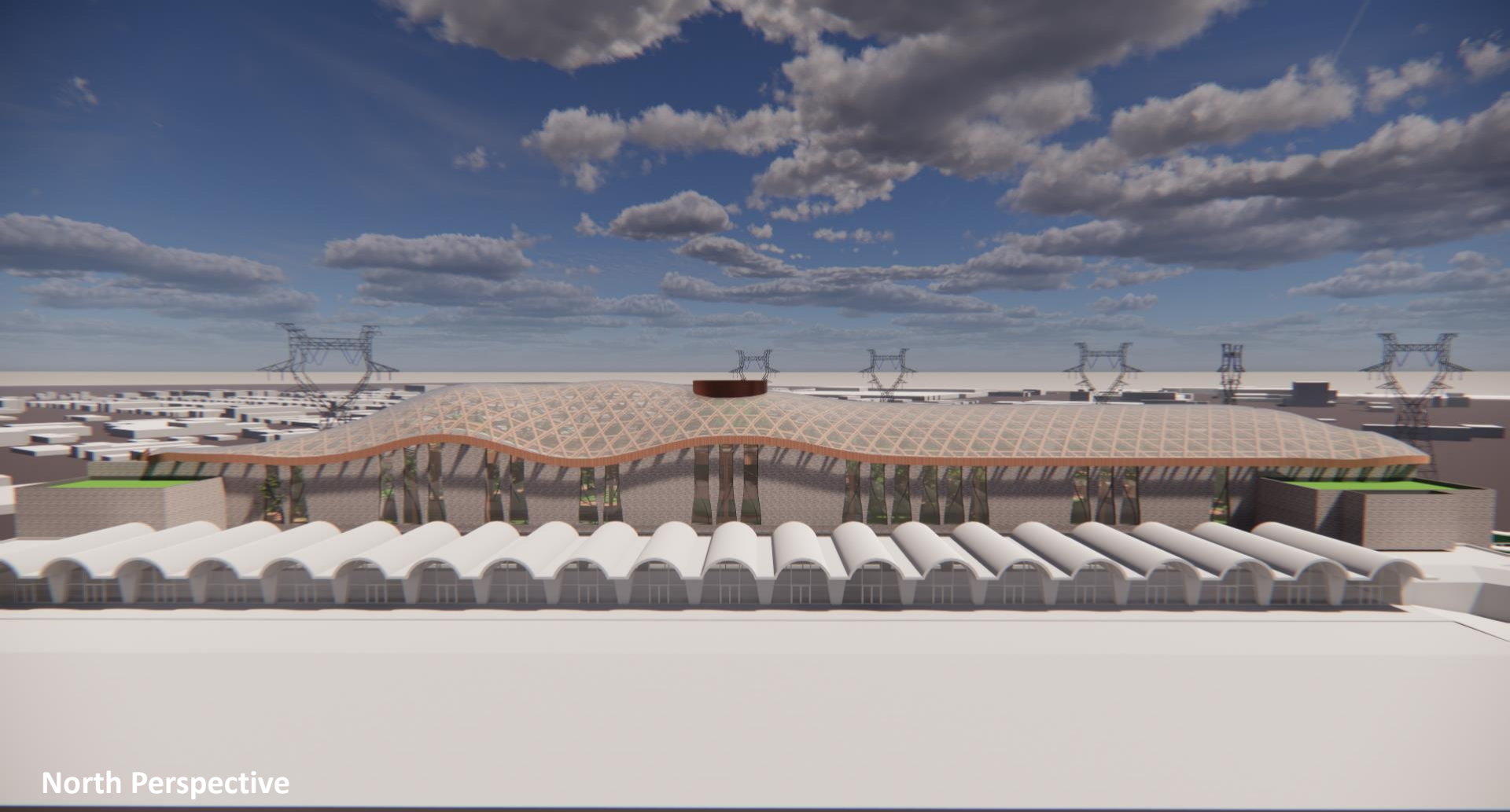


Aerial from South

South Perspective

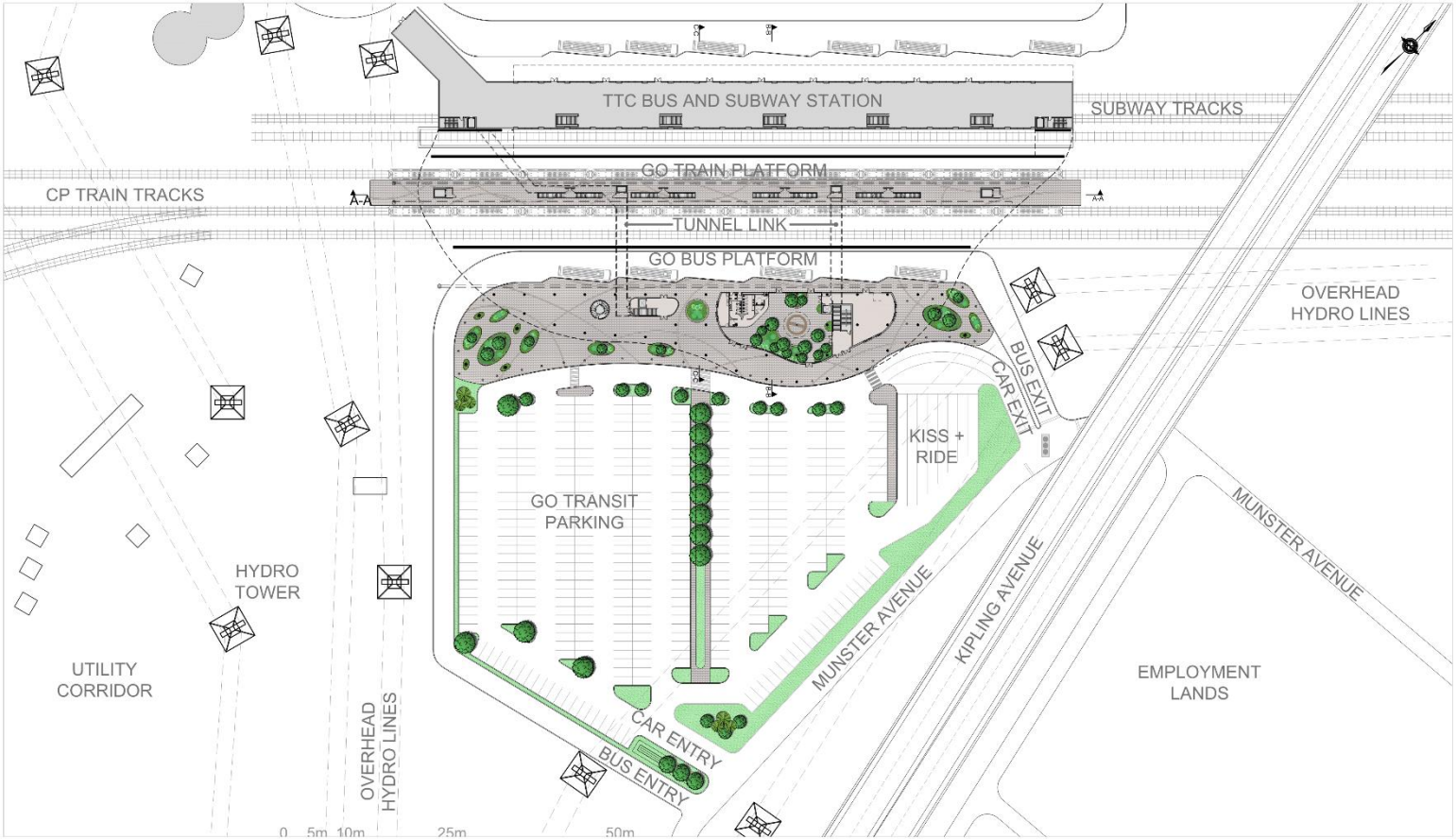


East Perspective



North Perspective

West Perspective

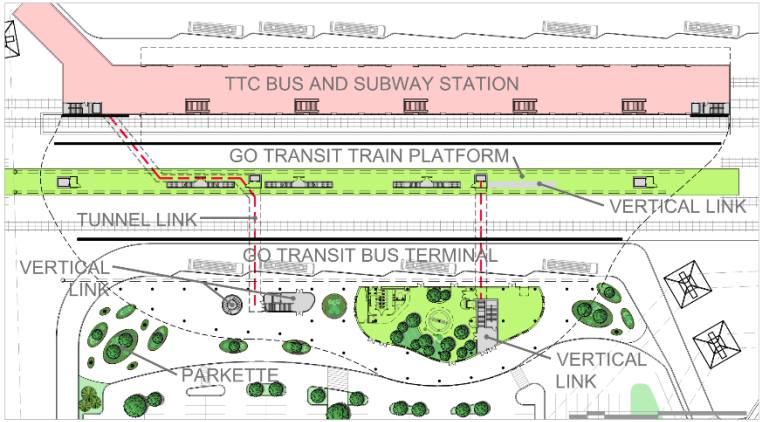



SITE PLAN

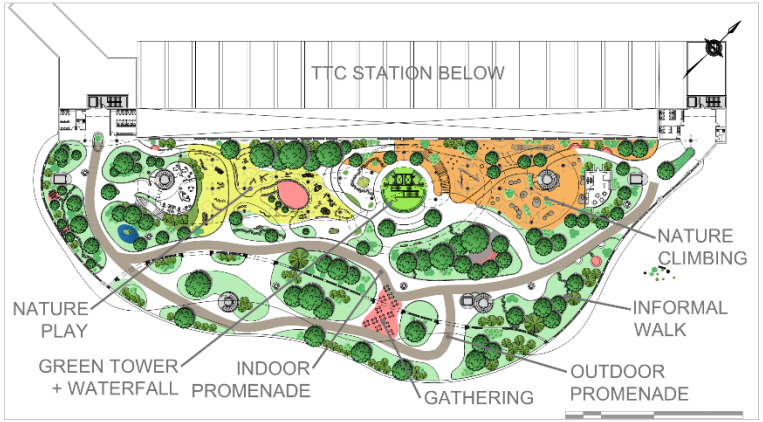
# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

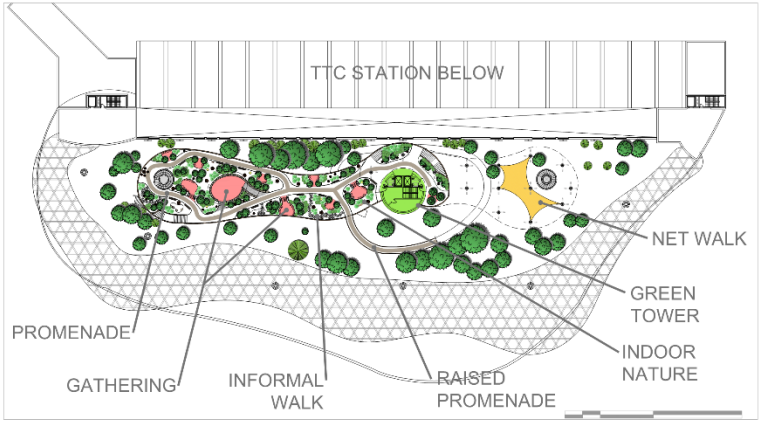
KIPLING REGIONAL NOPEs



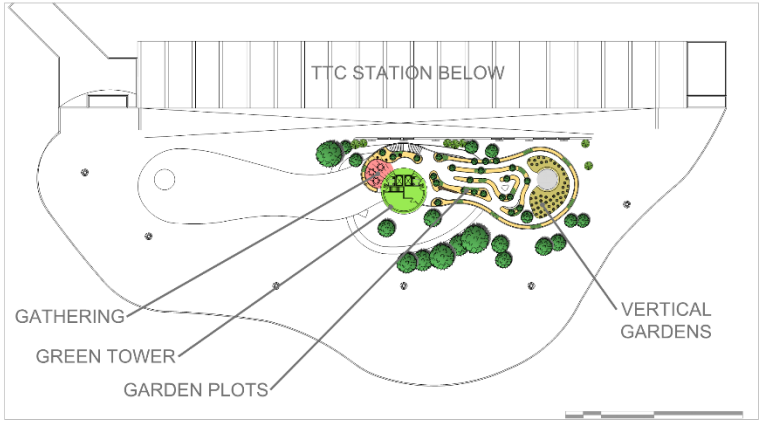

L000 - TRANSIT LEVEL




L100 - NATURE PROMENADES




L200 CREATIVE GARDENS

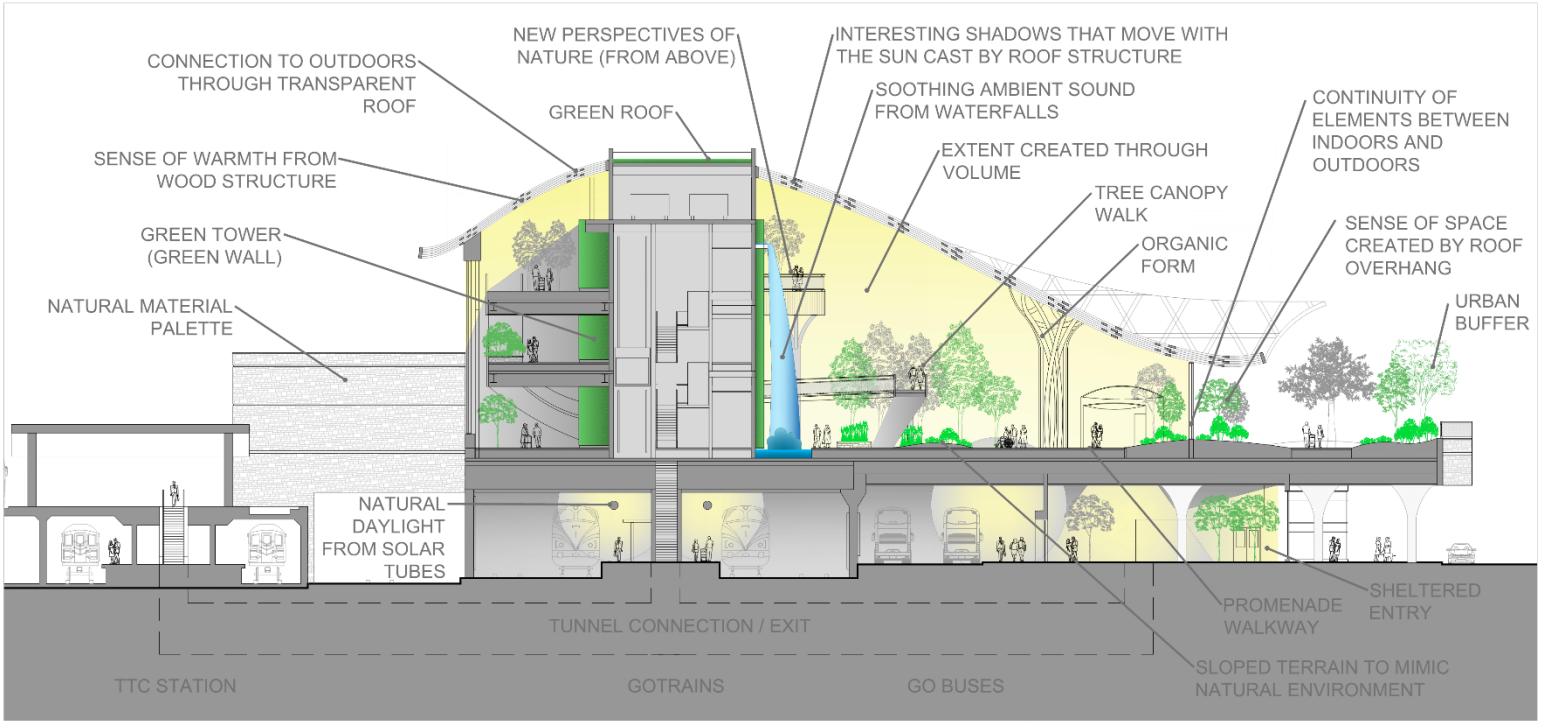



L300 - COMMUNITY GARDENS

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs

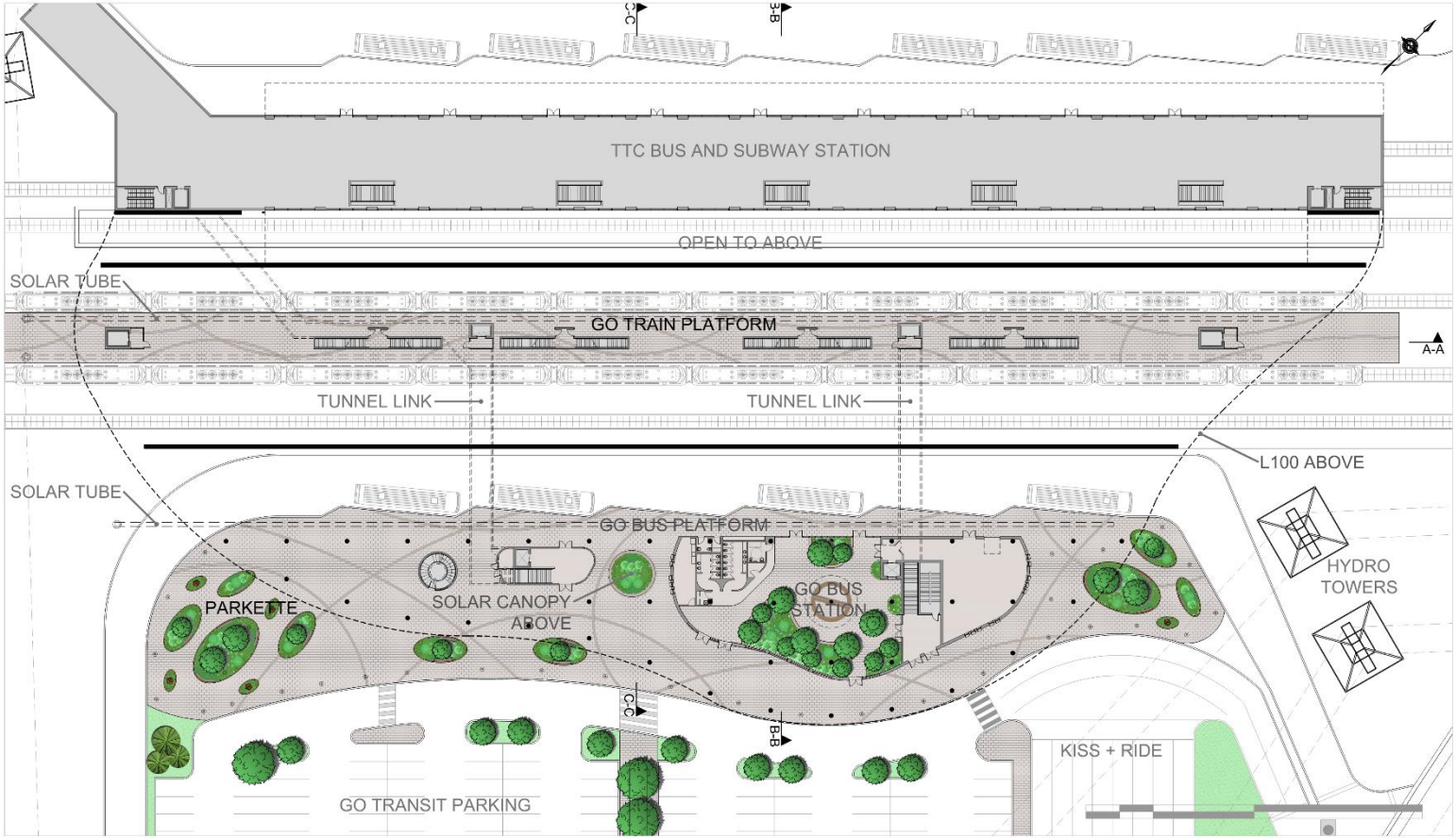



SECTION B-B

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs

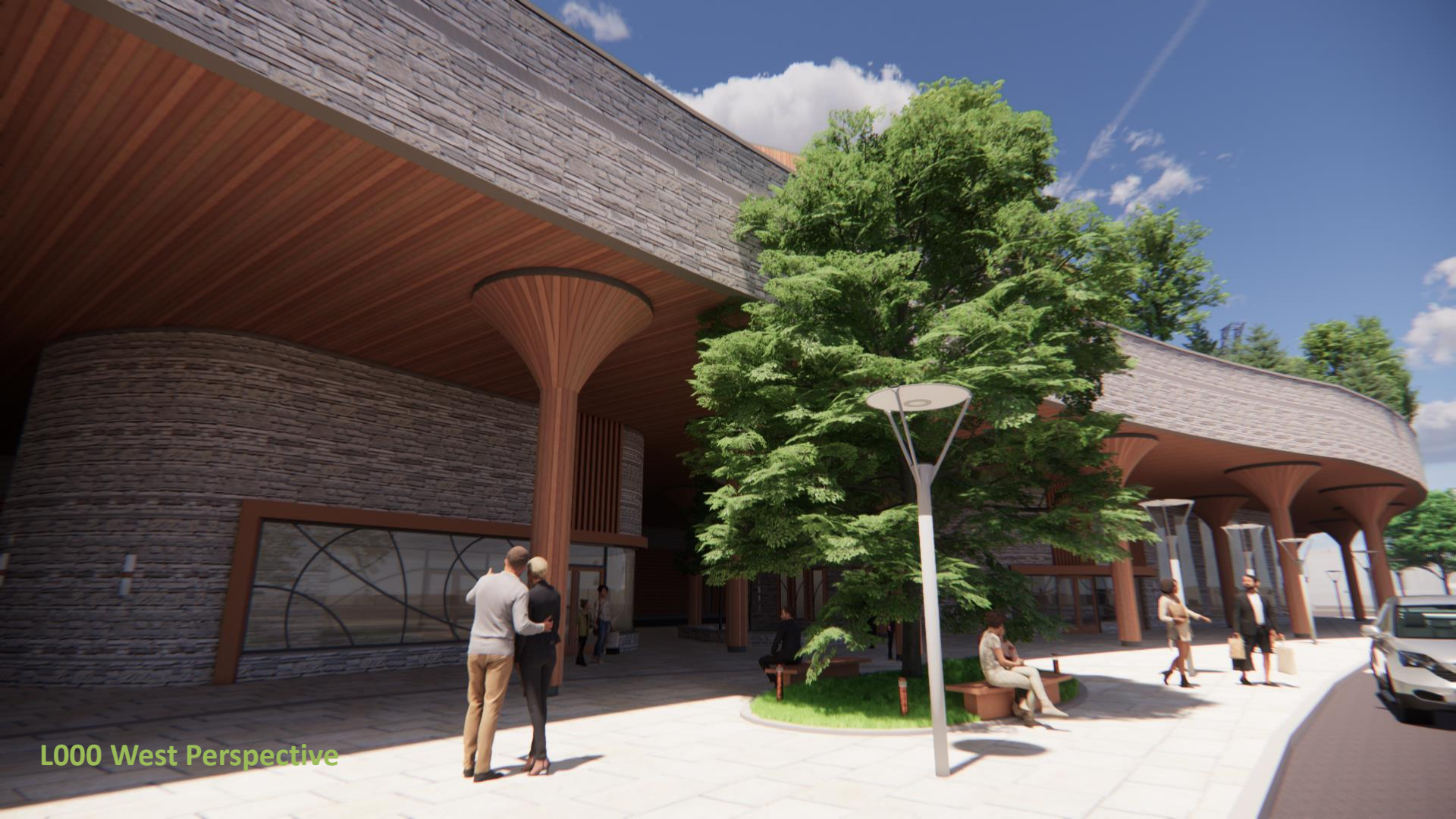



L000 - TRANSIT LEVEL

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs



L000 West Perspective


GO Train Platform


L000 Bus Platform

L000 Exterior Perspective Looking West at Night


L100 - NOPEs MAIN LEVEL

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs

L100 Perspective at Green Tower

L100 Interior Perspective Looking East

L100 Perspective Looking West


L100 - NATURE PLAY

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs


L100 - NATURE CLIMBING

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs

L100 Terrace Viewing East

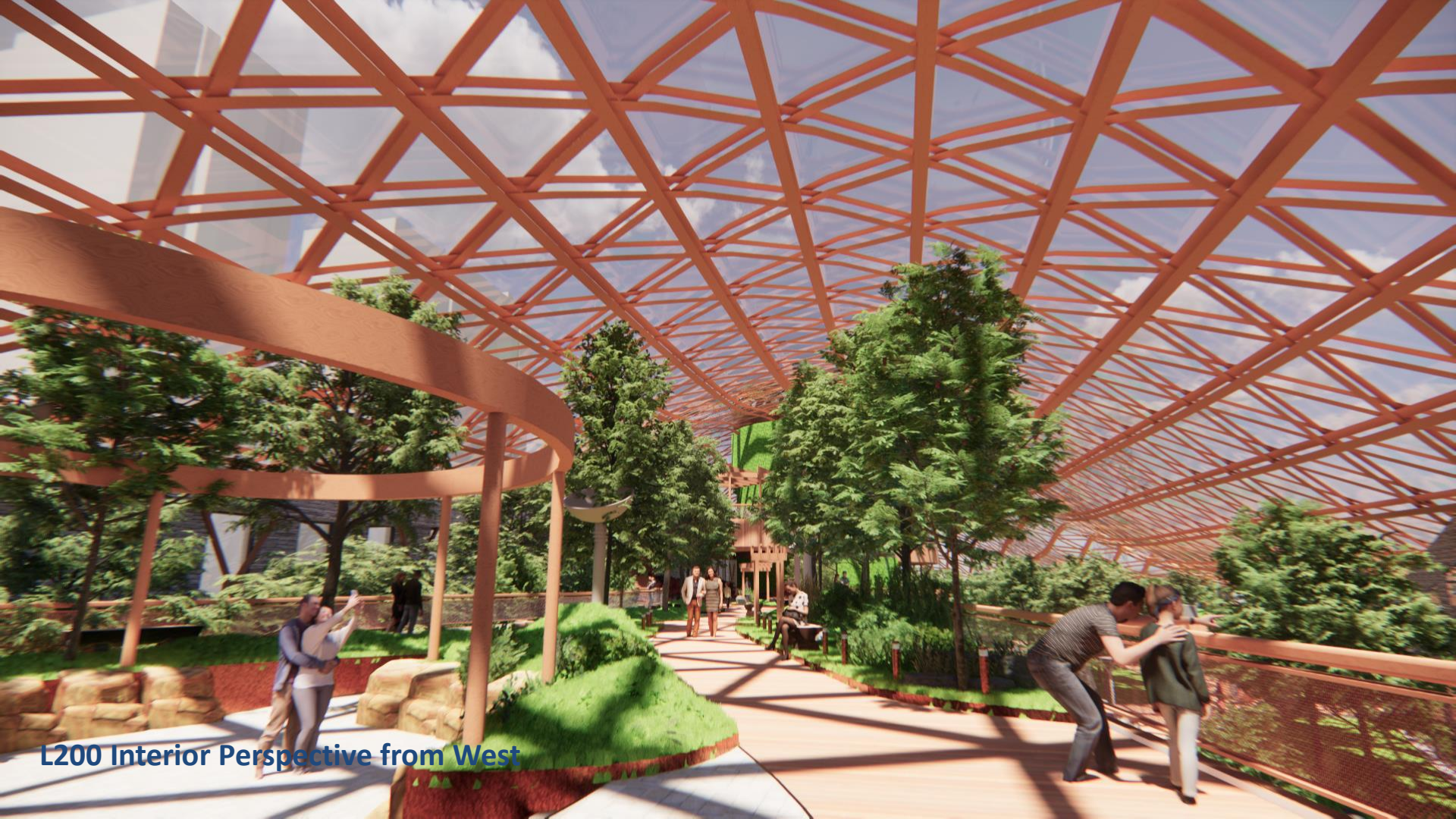
L100 Terrace Viewing West


L200 - CREATIVE GARDENS

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs



L200 Interior Perspective from West

L200 Interior Perspective Looking West


L300 - NOPEs LEVEL 3

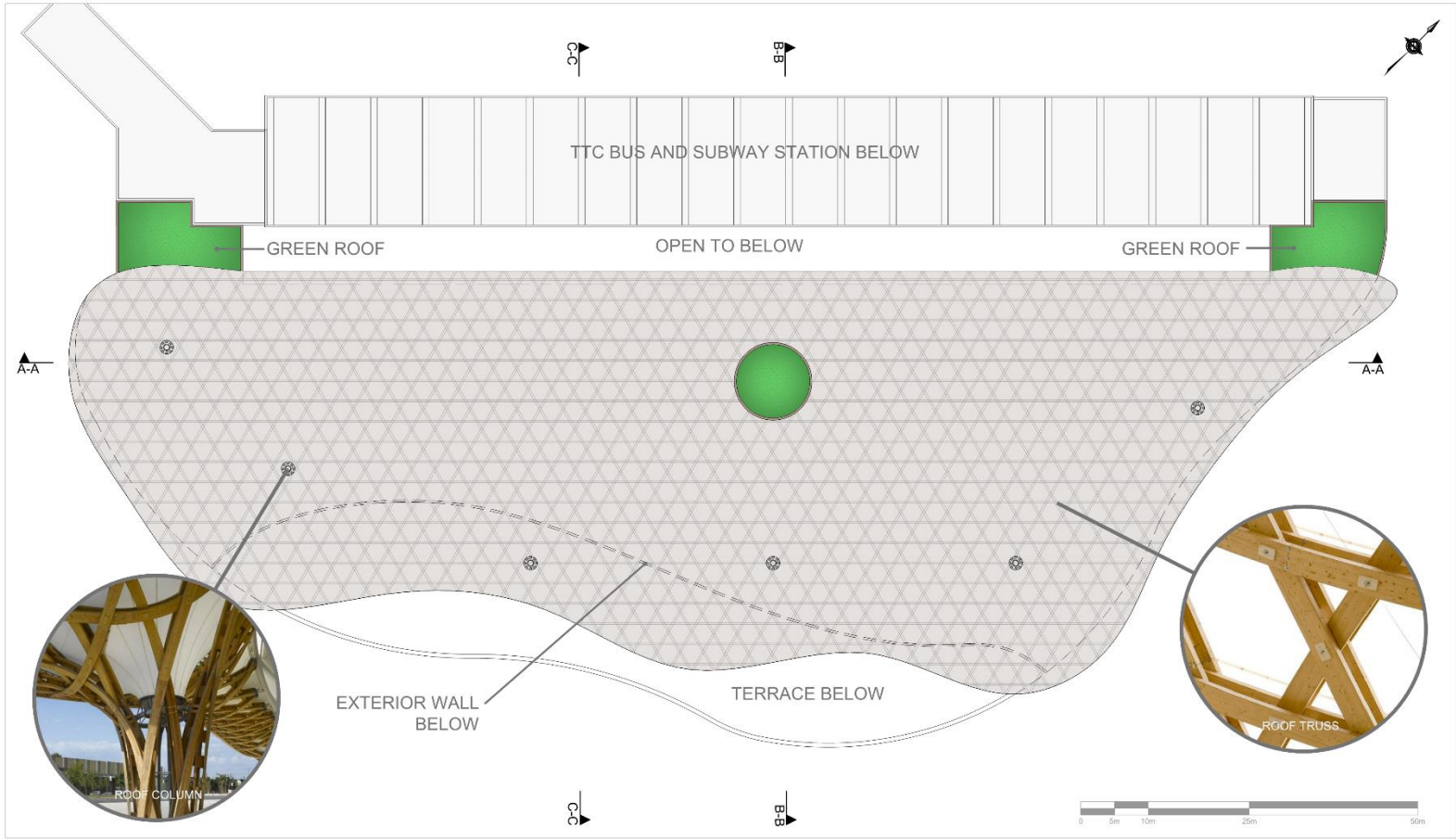
# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs

L300 Interior Perspective Looking West

L300 Interior Perspective Looking East

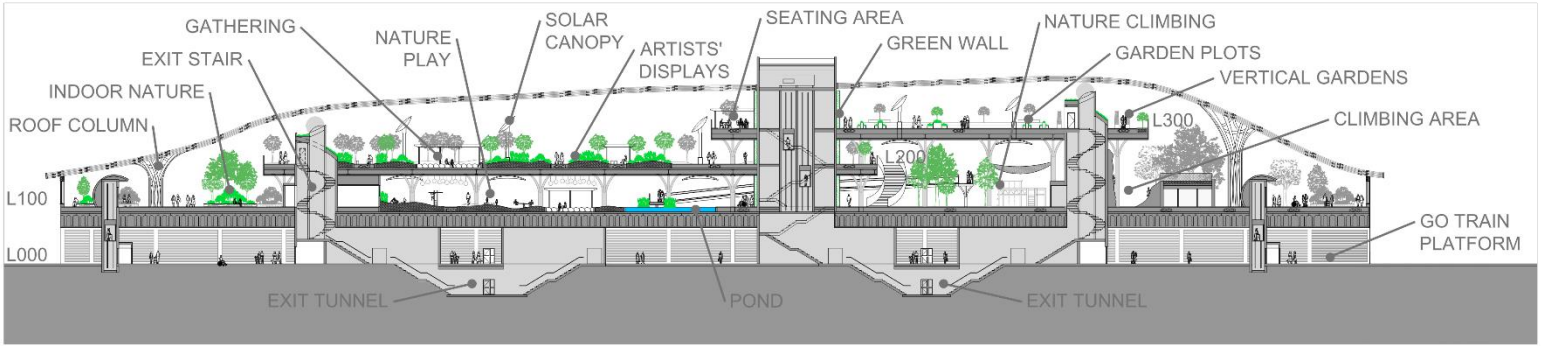



ROOF PLAN

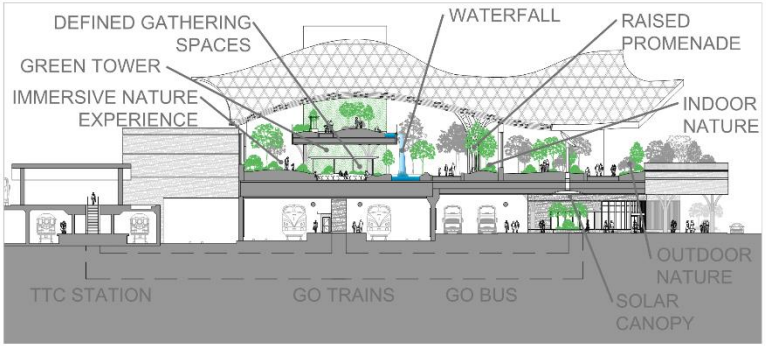
# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

KIPLING REGIONAL NOPEs




SECTION A-A




SECTION C-C

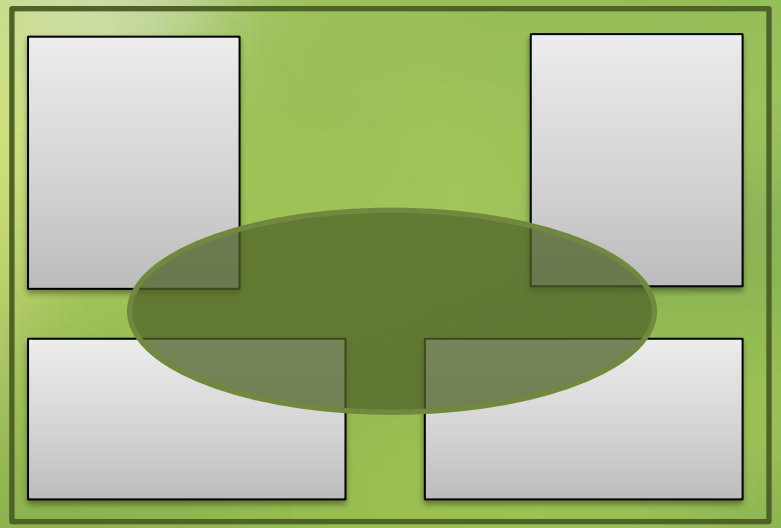
# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

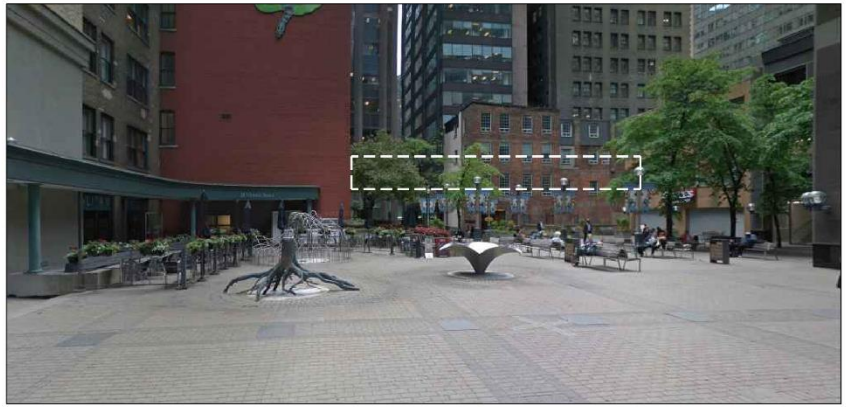
KIPLING REGIONAL NOPEs

Aerial from South at Night

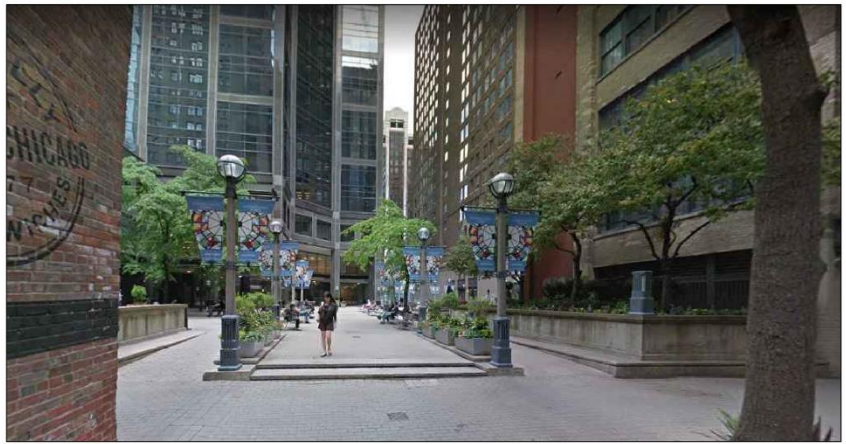
# Site NOPEs . Adelaide Site



The Green Parasite



ADELAIDE COURTYARD LOOKING SOUTH



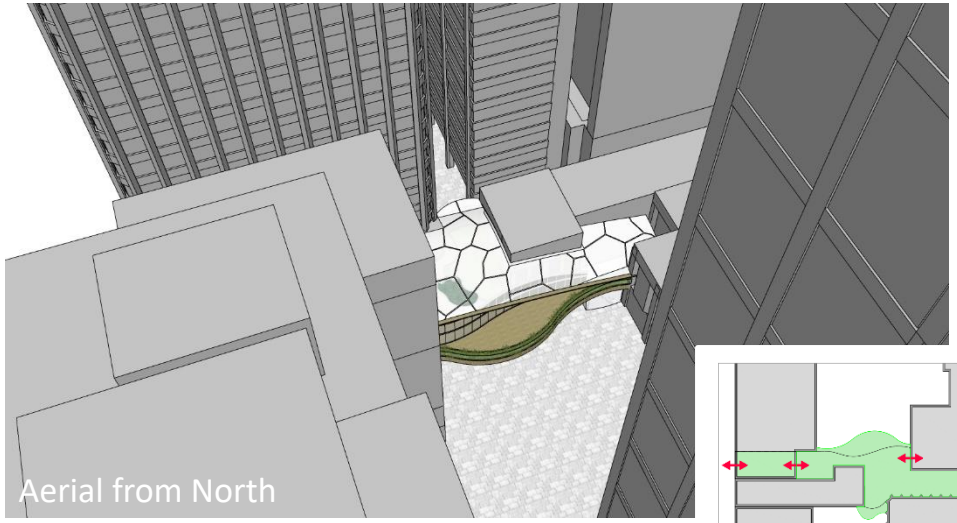
ADELAIDE COURTYARD LOOKING NORTH


SITE PLAN

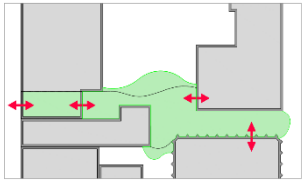
# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

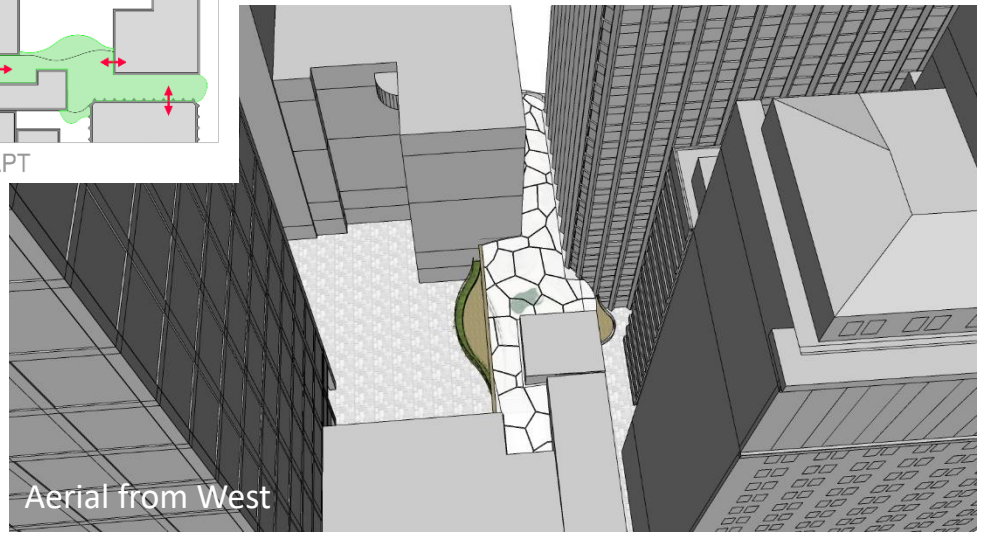
ADELAIDE COURTYARD SITE NOPEs







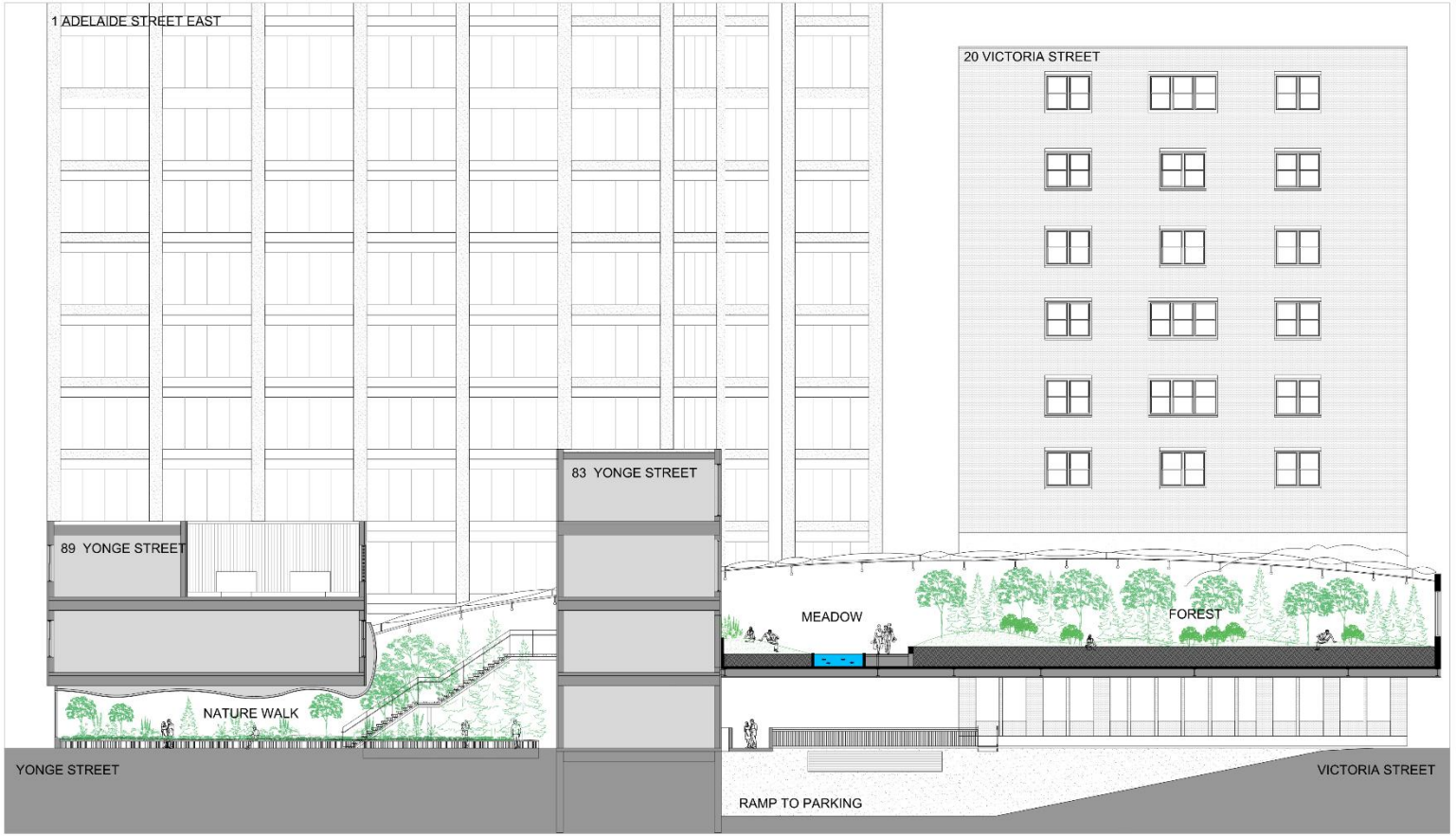
CONCEPT


# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

ADELAIDE COURTYARD SITE NOPEs

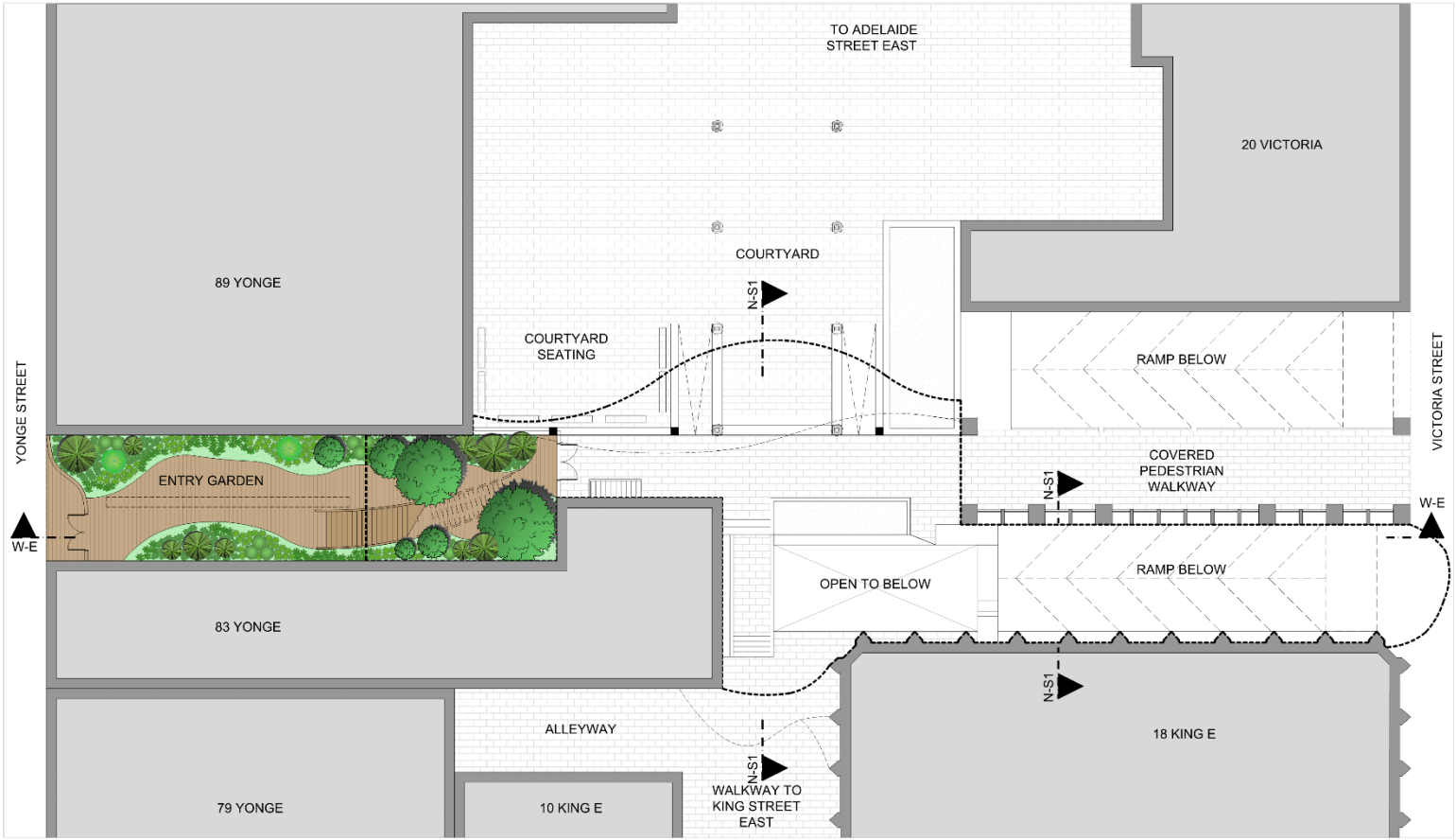



WEST-EAST SECTION

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

ADELAIDE COURTYARD SITE NOPEs

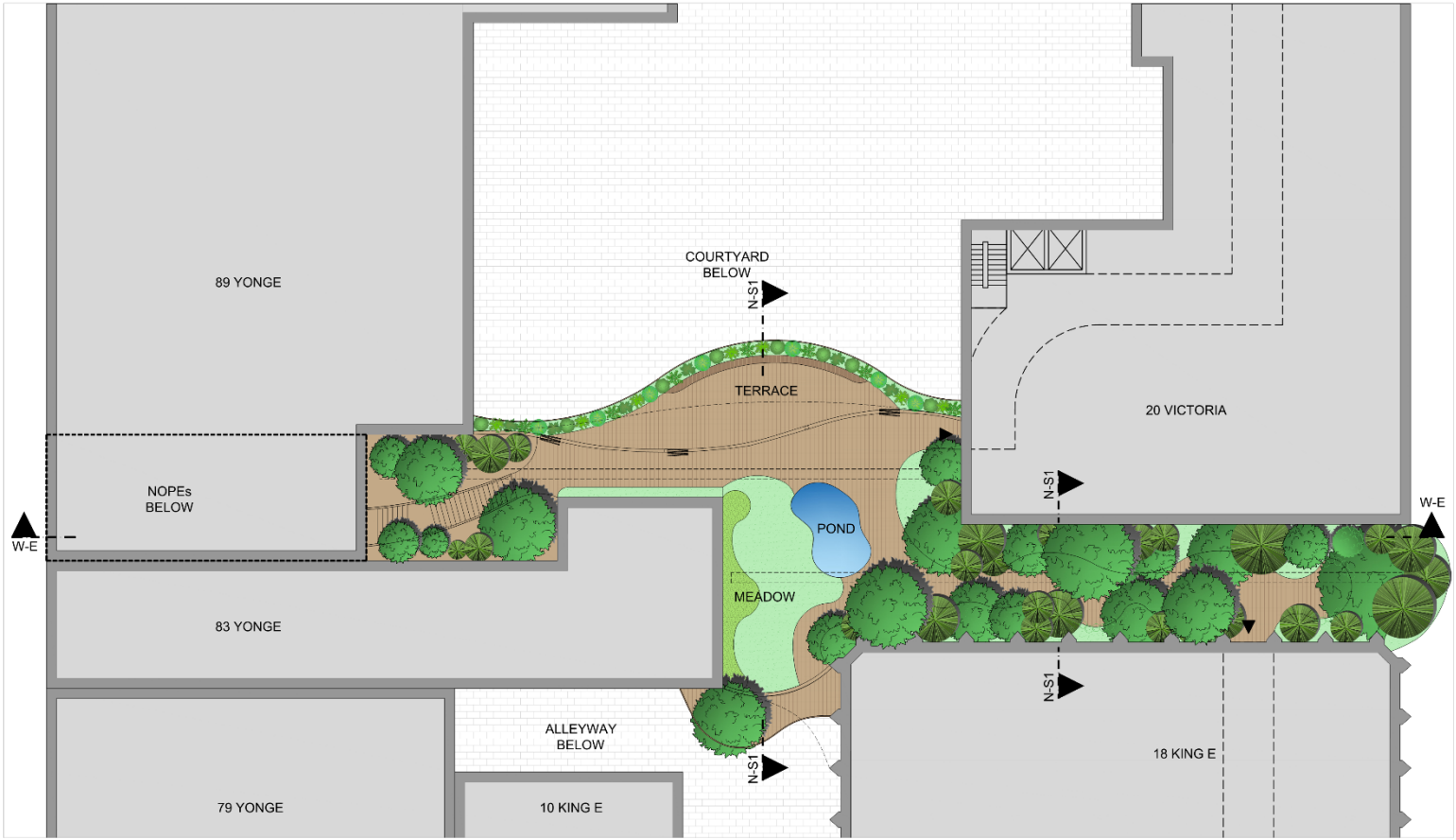



GROUND FLOOR PLAN

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

ADELAIDE COURTYARD SITE NOPEs

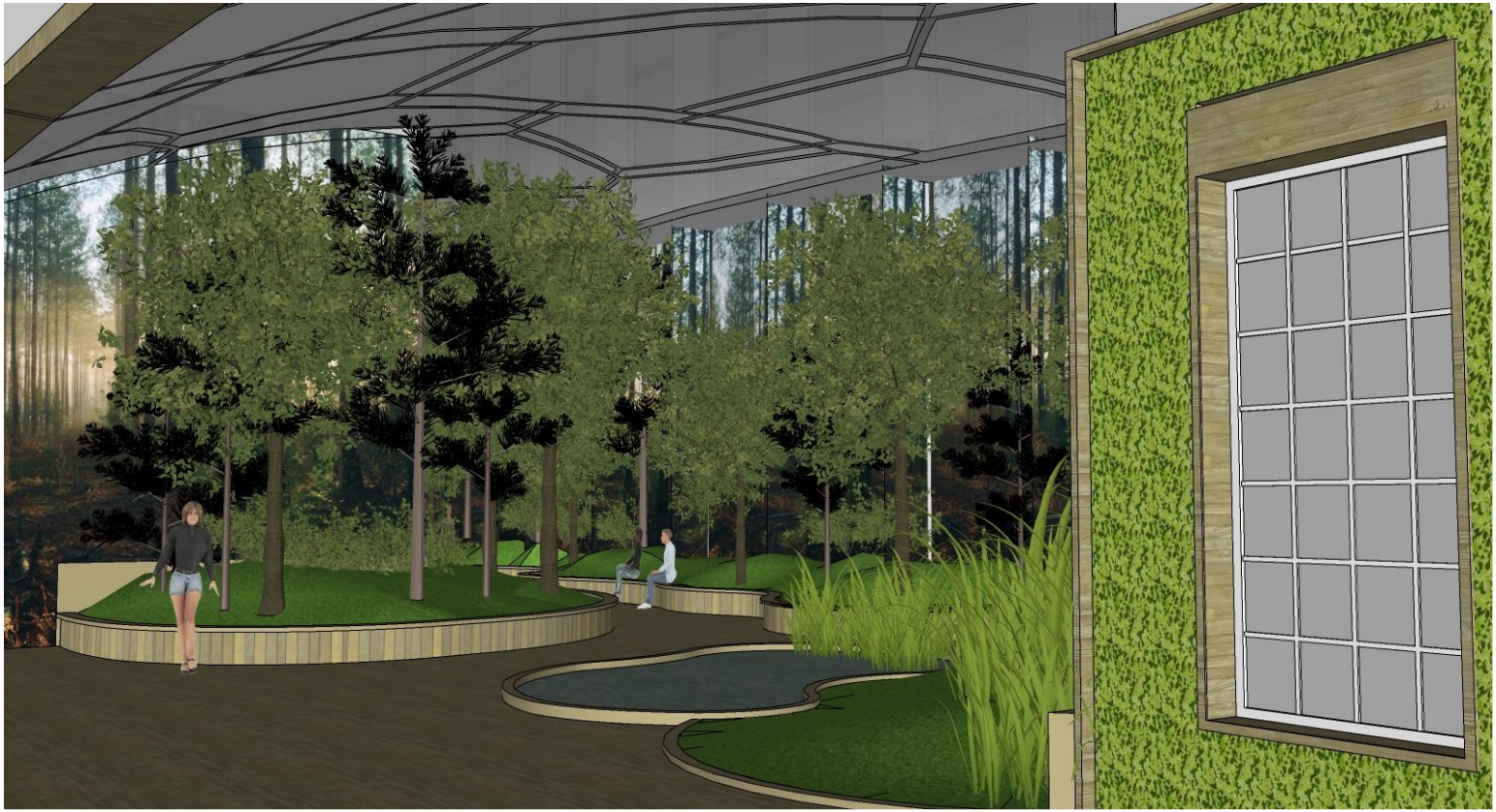



SECOND FLOOR PLAN

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

ADELAIDE COURTYARD SITE NOPEs



L200 FROM WEST

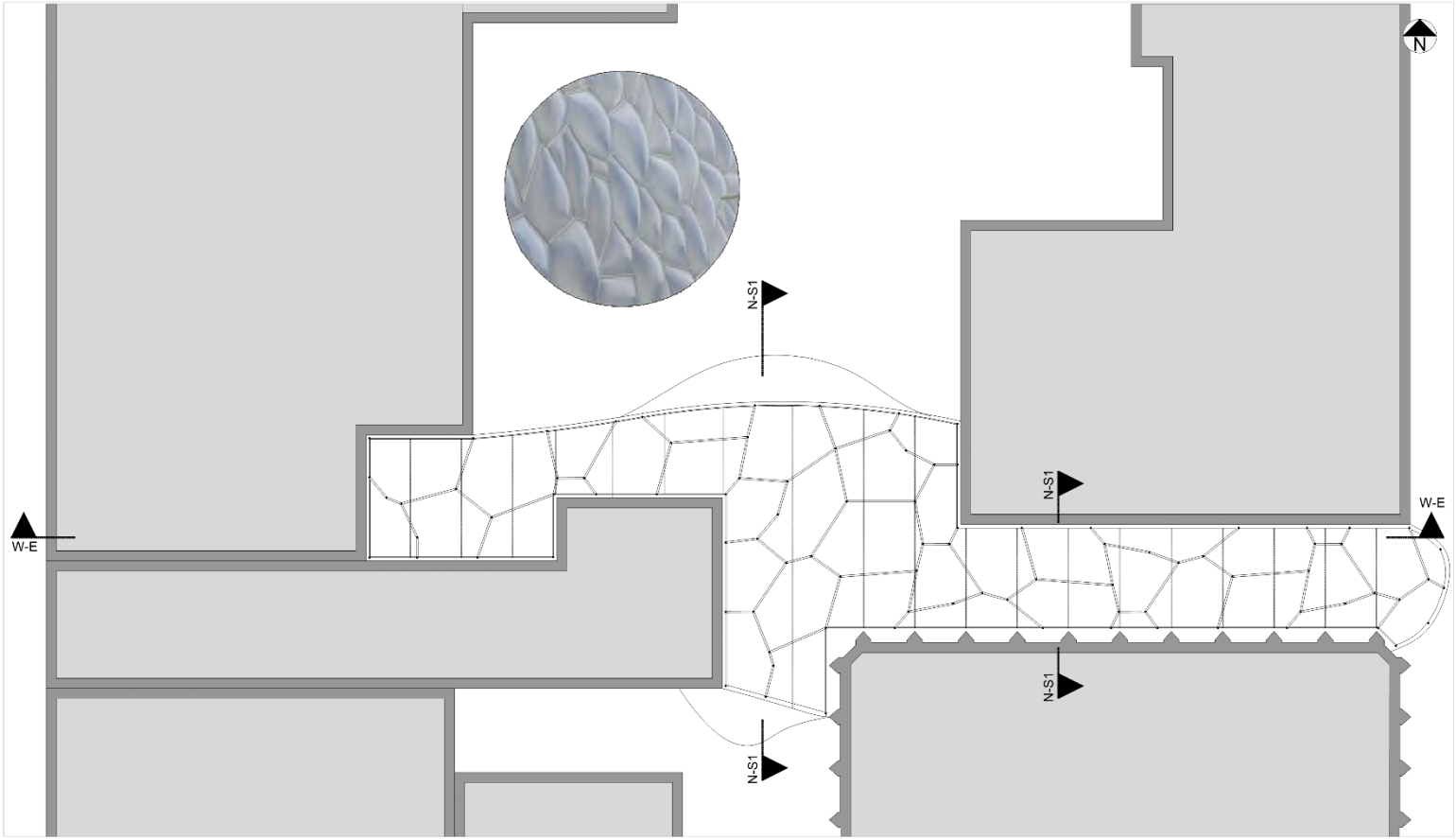
# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

L200 FROM EAST

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

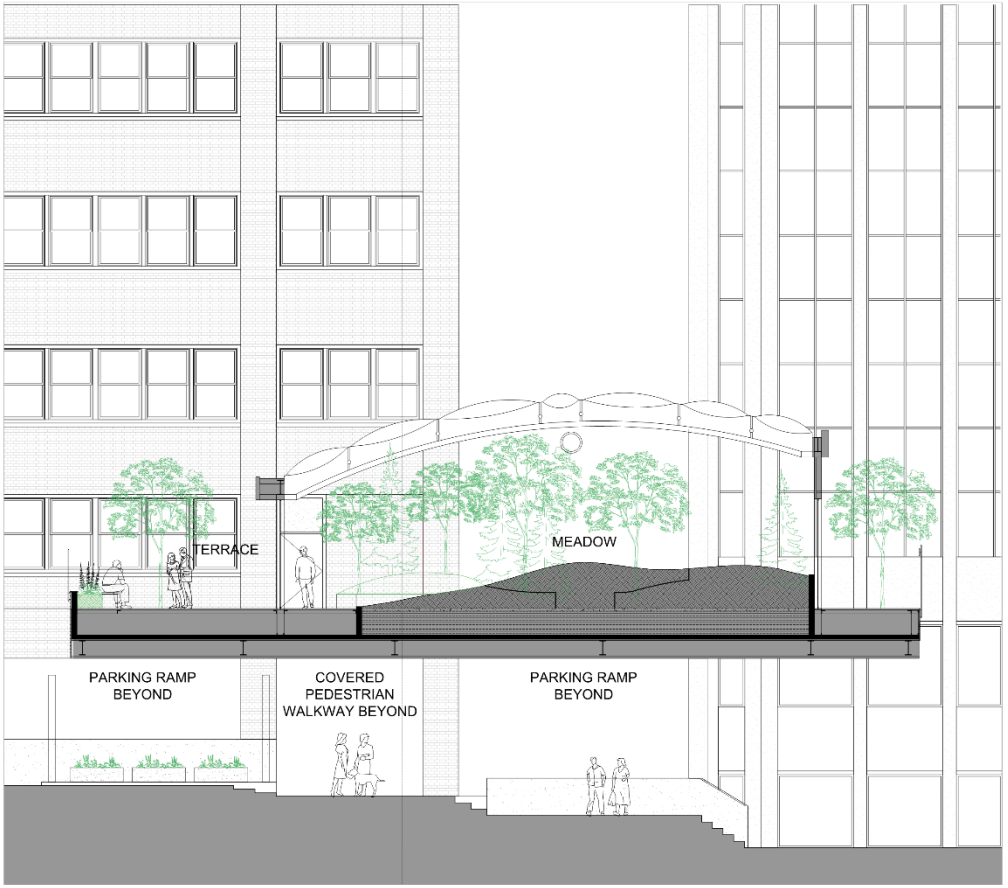



ROOF PLAN

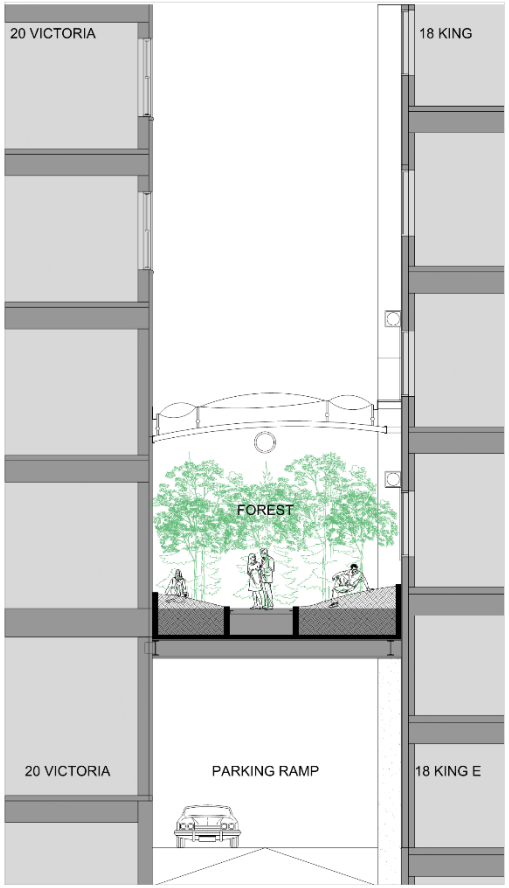
# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

ADELAIDE COURTYARD SITE NOPEs




NORTH- SOUTH SECTION




NORTH- SOUTH SECTION

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

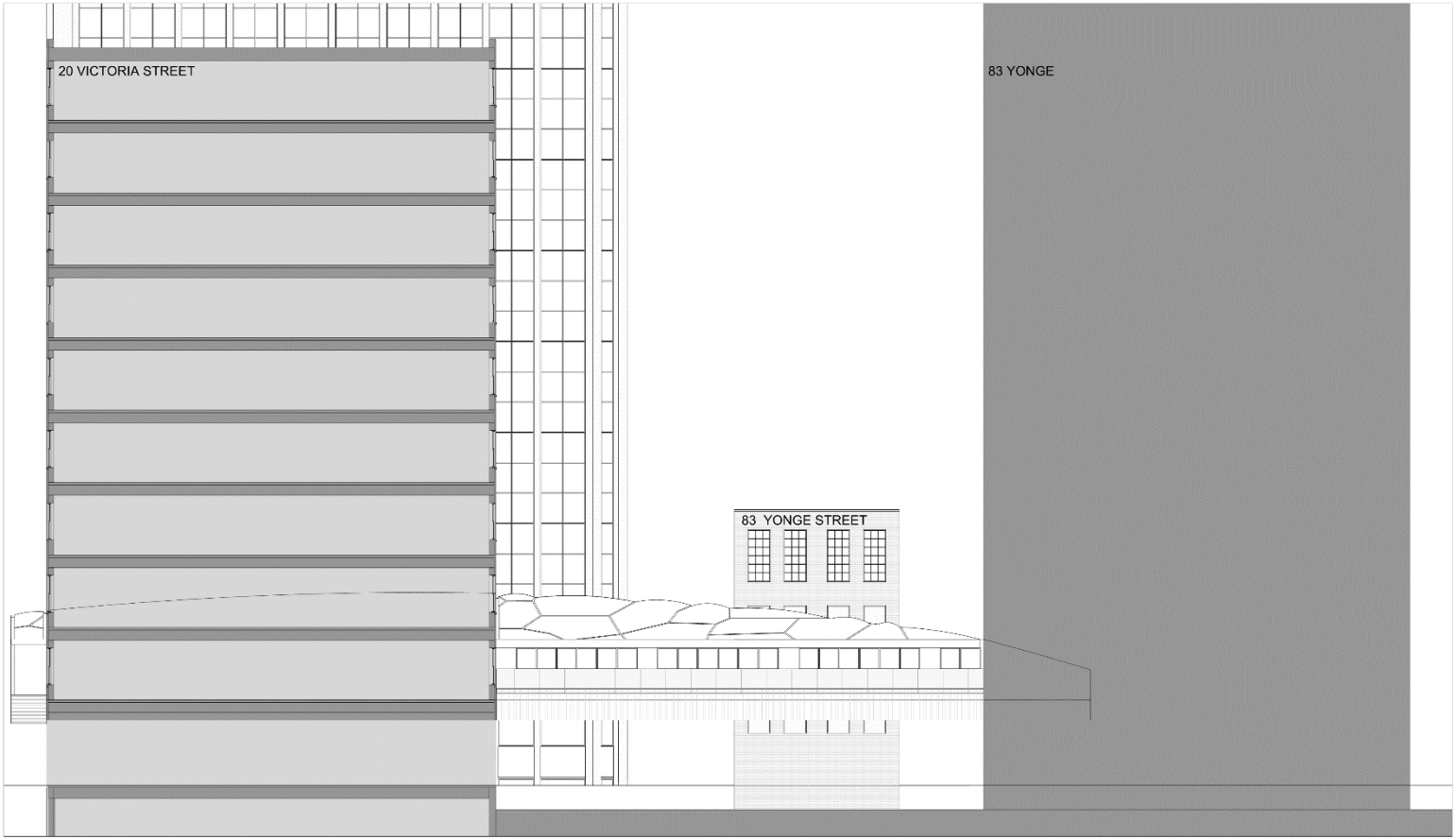
RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

ADELAIDE COURTYARD SITE NOPEs

AERIAL VIEW FROM NORTH-EAST

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

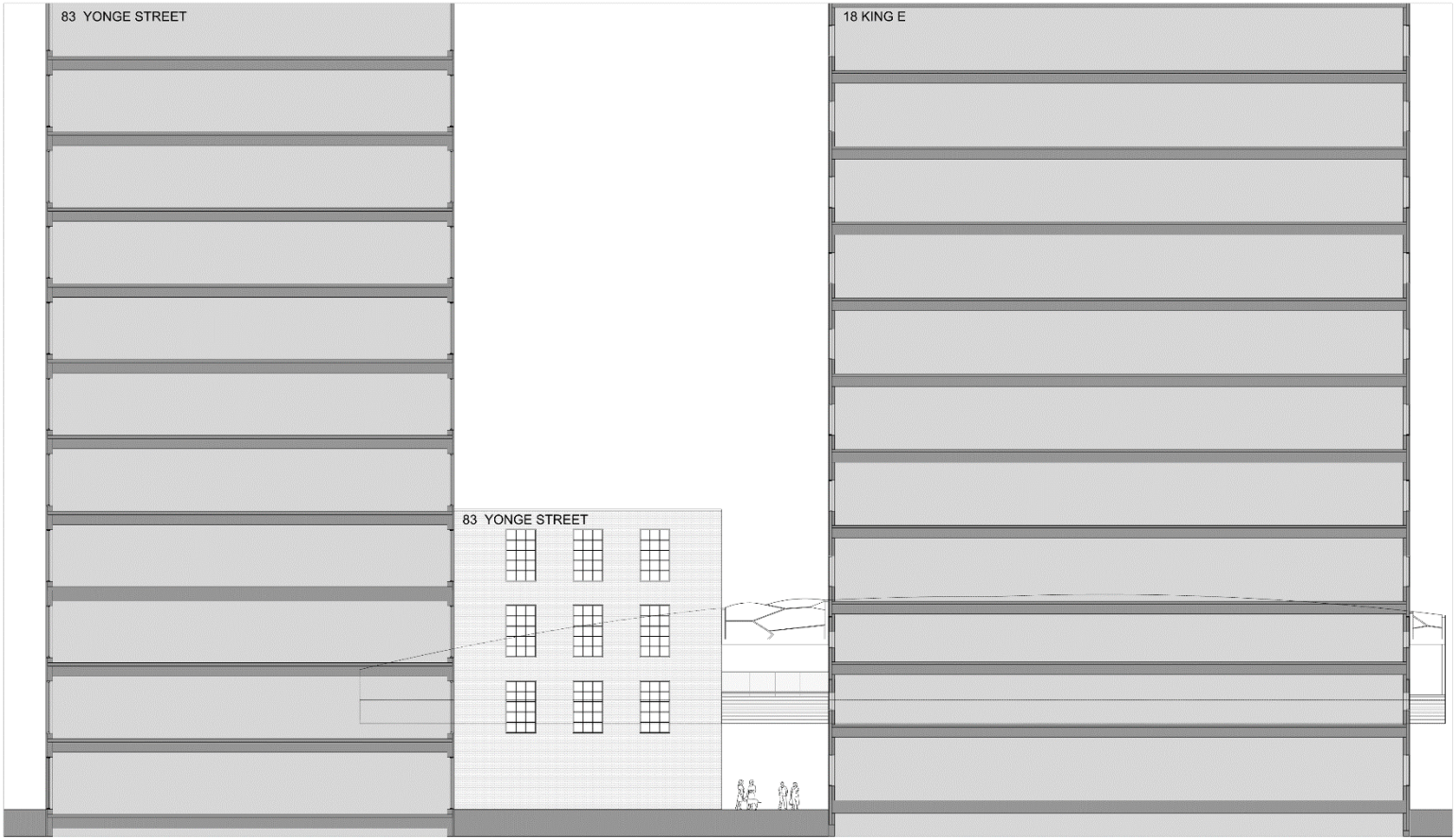



NORTH ELEVATION

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

ADELAIDE COURTYARD SITE NOPEs




SOUTH ELEVATION

# NATURE ORIENTED PREVENTATIVE ENVIRONMENTS IN URBAN SETTINGS

RAIC SYLLABUS D9B THESIS - SARA SOMERVILLE

ADELAIDE COURTYARD SITE NOPEs