Green Infrastructure

and the Sustainable Metropolitan Village

by

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author's declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

abstract

The current model of suburban development in Canadian cities has serious consequences for the natural environment. The ubiquitous landscape of sprawl consumes excessive amounts of greenfield land and natural resources, while maintaining an artificial relationship with nature that is more concerned with the aesthetics of lawns and trees than with natural ecosystems.

This thesis proposes a new planning paradigm that is derived from the ideals of the Garden City, but is steeped in the notion of green infrastructure as the foundation for ecological health. It makes use of greenbelts and greenways as circulation systems for people, plants, wildlife, water, and natural processes.

The towns of Newmarket and Aurora, which are situated within a pocket of developable land amid the Greater Toronto Area Greenbelt, are selected as a case study area. An in-depth analysis of the cultural and natural ecosystems that function at various scales across the region provides the framework upon which the design is structure.

The design is twofold. First, it is primarily a planning thesis with an ecological approach to design. It provides a working methodology for green infrastructure at the regional scale, and illustrates a schematic plan for a sustainable metropolitan village, "Leslie Village", that is tied to Newmarket and Aurora's existing suburban fabric. Secondly, it illustrates the schematic design response to the planning thesis, by providing nominal visualizations of key areas where the proposed greenway intersects public space. Leslie Village challenges the traditional model of development and provides a new planning system whose methods and principles can be transferred to other communities in the GTA, and across the country.

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dedication

to my dad.

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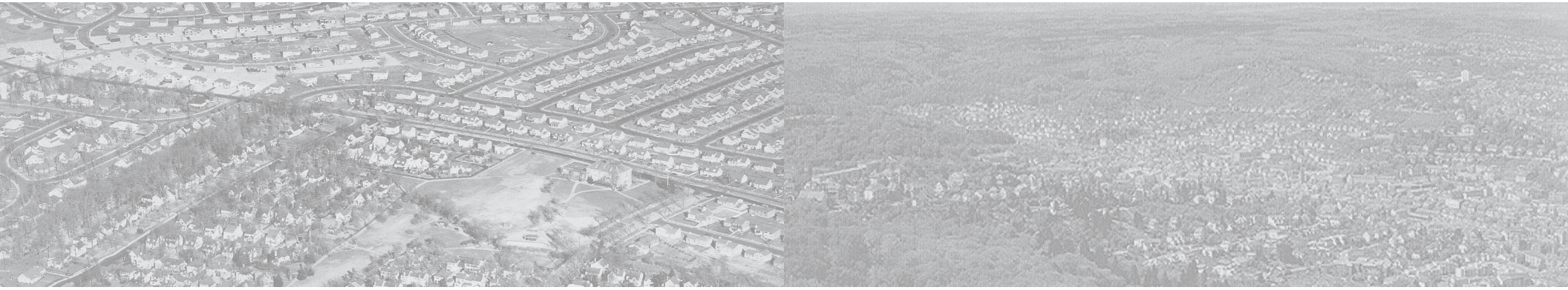
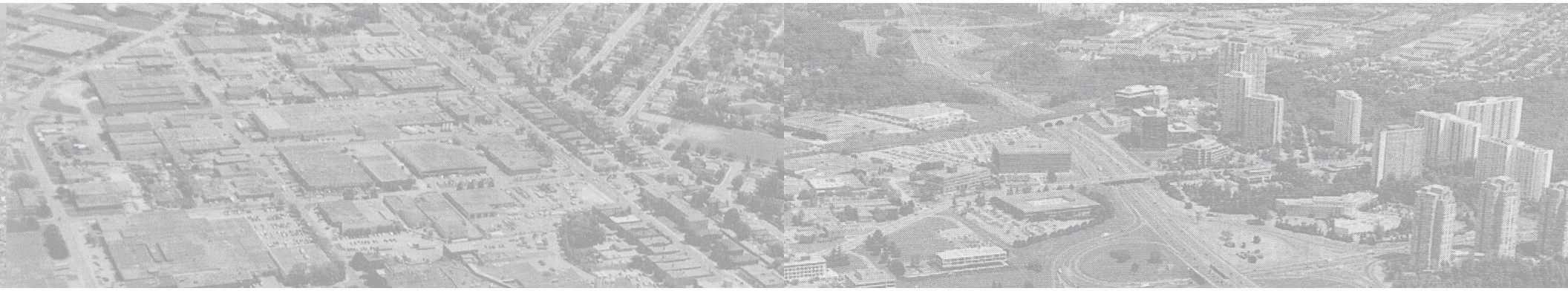


fig 1.01 sprawling cities



01 introduction

**There are many problems caused by the form of metropolitan growth - the lack of institution which diminishes the power to effect even local decisions, the trauma that is the journey to work, the increasingly difficult problem of providing community facilities. Perhaps the most serious is the degree to which the subdivision, the suburb, and the metropolitan area deny the dream and have failed to provide the smiling image of the advertisements. The hucksters made the dream into a cheap thing, subdivided we fell and the instinct to find more natural environments became the impulse that destroyed nature, an important ingredient in the social objective of the greatest of all population migrations."* [1]

-Ian McHarg, *Design With Nature*

1 McHarg, Ian L. *Design with Nature.* New York: John Wiley & Sons Inc, 1995, p.153-4.

The quality and structure of today's cities and suburbs are the product of a building-boom that occurred after the Second World War. Cheap oil and the mass production of automobiles provided a gateway into the undeveloped, inexpensive, and seemingly expansive countryside beyond the city's fringe. Following the Great Depression, there was a desire to escape the over-crowded and polluted slums of the new industrial city. There was a lust for more space, privacy, and fresh air that could only be afforded by the countryside. As automobiles increased in popularity among middle-class households, this newfound freedom of mobility allowed the dream of combining the beauty of the countryside with the conveniences of the city to be realized. As a result, the outskirts of almost every urban centre in North America were rapidly developed in an attempt to achieve the suburban dream. Unfortunately, this rapid growth was conceived on the principle that land was a tool for profit rather than a public trust. Combined with a substantial lack of proper planning, the result of the post-war building-boom has produced a sprawling, ubiquitous, metropolitan landscape that is entirely disconnected from nature.

The deterioration of the concept of land stewardship, and the failure to respect the limits of the natural landscape, have resulted in the complete segregation of city and nature. In the past fifty years, enormous amounts of greenfield land have been cleared away for urban development and agriculture. Natural habitats around cities have become largely fragmented and interrupted. Ecological processes that sustain life in cities are buried, isolated, or invisible to citizens, creating a psychological detachment from nature. Urban sprawl has put strain on the entire ecosystem by consuming huge sections of the landscape and excessive natural resources. These cities also create an ever-growing need for the consumption of more resources, in the form of water, energy, and materials, simply to maintain a satisfactory quality of life.

A serious shift in the way our cities grow is needed in order to minimize the destructive consequences produced by the traditional pattern of development, and even reverse the detrimental effects of such development. What is missing is the perception of environmental, social, and economic value that is inherently associated with the natural processes that support life in cities. The protection of these natural processes will not only benefit the flora, fauna, air, and water systems, but will also enhance the quality of the human environment.

The concept of "green infrastructure" takes into account this notion of nature as a valuable part of cities. It recognizes natural processes as having the same level of social and economic value as other infrastructural systems such as transportation, energy, water and waste management, and communications. The term "green infrastructure" is used in various forms. For the purpose of this thesis, the term is best described by Mark A. Benedict and Edward T. McMahon, who define green infrastructure as "an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife. Used in this context, green infrastructure is the ecological framework for environmental, social, and economic health - in short, our natural life-support system".[2]

This thesis employs green infrastructure as a means to negotiate the relationship between city and nature in Canada's suburban model. It is a reconsideration of large scale planning along the edge of the Ontario Greenbelt in the Greater Toronto Area, and focuses on the towns of Newmarket and Aurora as

2 Benedict, Mark A. and Edward T. McMahon. *Green Infrastructure: Linking Landscapes and Communities.* Washington: The Conservation Fund, 2006, p.2.

the primary case study area. Through an in-depth analysis of various cultural and natural ecosystems, this thesis provides a working methodology for green infrastructure in Newmarket and Aurora.

The design proposal of this thesis is twofold. The first aspect of the design is primarily a planning thesis with an ecosystems approach to design. At the regional scale, it proposes a greenway system that serves the communities in and around the Newmarket and Aurora area, and creates linkages between natural areas that are located both in town and in the surrounding rural landscape. At the local scale, the design proposes a plan for a dense metropolitan village, called Leslie Village. This new village is located on several parcels of undeveloped land that remain among the existing urban sprawl, along the eastern boundary of Newmarket and Aurora. The design presents a schematic plan for this village that identifies its density and location of function at a rudimentary level, in order to understand how it is situated in relation to the proposed greenway system and the surrounding urban landscape.

The second aspect of the design illustrates the schematic design response to the planning portion of this thesis. It provides nominal visualizations of the key areas where the greenway interacts with public space. The design demonstrates how to negotiate the edge conditions between the greenway and the built environment in a way that enhances the quality of the public realm.

1.1 methodology, scope, and structure

This thesis employs an ecosystems approach to urban design. The scope of research is centered around the current model of urban development and its implications on natural processes, as well as the environmental principles that support the argument for green infrastructure and sustainable urban design.

This thesis is organized into three sections. The introductory section, in addition to introducing the thesis, includes a review of the literature and resources that are relevant to the research, theory, and design proposal. This includes a review of the texts that analyse the evolution of the suburban model, texts that explore the precedents and origins of green infrastructure, and texts that support the argument for green infrastructure and an ecological approach to design.

The second section of this thesis contains an in-depth analysis of the case study area: Newmarket and Aurora within the Greater Toronto Area Greenbelt. The first chapter of this section explores the historical narratives of the Newmarket-Aurora region and provides a background understanding of the impacts of urban development on the local natural environment. The second chapter employs the method of mapping to examine the various cultural and natural systems that function at a variety of scales within the region, from the wider environments of Southern Ontario and the Manitoulin-Lake Simcoe Ecoregion to the local systems in Newmarket and Aurora's natural and urban landscape. The final chapter of this section presents the existing initiatives and legislations of various groups and governments that are relevant to the site and the design proposal.

The third section of this thesis presents the design proposal for green infrastructure and a sustainable metropolitan village in Newmarket and Aurora. Its first chapter discusses the design strategy and principles. The second chapter focuses on the planning portion of the design at the regional scale. It employs a systematic approach to defining the location and boundaries of a regional greenway system, and selecting the locations for two new sustainable villages, Green Lane Village and Leslie Village. The third chapter focuses on the design proposal for Leslie Village. It provides a close examination of how the village is situated within the existing built fabric and how it relates to the proposed greenway. It examines the edges of the greenway and how the proposed trail network is linked to the surrounding suburbs. It also proposes the location and density of urban functions at a schematic level. Finally, it proposes new transportation routes and transit hubs. These layers are then combined to form a conceptual plan for Leslie Village. The final chapter identifies five key areas where the greenway intersects civic space, such as where the greenway crosses an arterial road, how the greenway relates to residential streets, and where the greenway intersects a transit hub. Each key area in this section is illustrated in the form of sections and vignettes, which present a visualization of how green infrastructure functions at the human scale.

Many professionals and academics within the planning and architectural community support the notion of greenbelts and greenways as a tool for sustainable urban design. However, there is insufficient research in how these green systems interact with the built environment at the scale of the pedestrian. For this reason, the primary objective of the design is to address the complex challenges that exist at the junction between green systems and the built environment at the human level. This thesis demonstrates how green systems work to enhance the quality of the public realm, and mitigate the relationship between

nature and the city. This thesis will not, however, focus on the design of the main street or the architecture of the village beyond a general scheme of density and function, as these areas of research and design have been widely explored and well documented. The design proposal assumes that the architectural character of Leslie Village is in keeping with the design principles stated in this thesis. For example, buildings should be oriented toward the street to frame the public realm; sustainable practices should be employed wherever possible; and public buildings, squares, and art should be used to create visual focal points and foster a greater sense of place.

1.2 literature review

This thesis utilizes a variety of resources that support the research and arguments for green infrastructure and sustainable village design. These resources are relevant to this thesis in three ways. The first set of texts provides an understanding of the background of city planning. These explore the historical and theoretical development of the suburban model, and the implications that such development has had on the current state of cities in Canada and the United States. The second series of texts explores the movement toward green cities and park systems. These texts study the work of Howard, Olmsted, and Stein, who gave birth to the notion of green infrastructure. The final series of texts supports the argument for green infrastructure in its current definition. These texts support an ecological approach to city planning, and move beyond the "trees and grass" approach to greenway systems.

background: the evolution of canadian cities

The present state of Canadian cities primarily stems from the urban reform era, which took place at the turn of the twentieth century. In the text The Usable Urban Past, Alan F.J. Artibise and Gilbert A. Stelter examine the two urban planning movements from this era that had the most profound effect on Canadian cities. Over-population of cities had led to poor living conditions and inadequate housing for the working class, and it was clear that improvements in city planning were needed to address the issue of city slums. As a result, two movements came about: the "City Beautiful" movement and the "Garden City" movement. The City Beautiful movement focused primarily on urban aesthetics. According to Artibise and Stelter, it visualized "a civic landscape of monu-

mental public buildings, great diagonal boulevards, squares, and parks, and especially a magnificently designed civic centre".[3] However, the City Beautiful movement had two main areas of concern: it did not tackle the issues of providing housing for the working class, and it had a very high cost of implementation. Conversely, the Garden City movement addressed these issues directly. The Garden City movement was led by Ebenezer Howard, who proposed self-sufficient smaller towns surrounded by a greenbelt, which combined the benefits of both town and country. Although these two movements differed in many ways, they were similar in that they both gave planners a high level of authority in determining the changing structure of existing cities and the planning of new towns. In addition, both movements stressed the segregation of urban functions, such as residential, commercial, cultural, and industrial zones. As Canadian cities experimented with both of these movements during the early twentieth century, the priorities of planning changed over time: "The emphasis shifted successively from aesthetics and the large-scale plan to the regulation of suburban expansion, to providing housing for workingmen, to zoning in order to segregate functions and protect property values."[4]

Although the development and growth of Canadian cities were heavily influenced by both the City Beautiful and Garden City movements, Artibise and Stelter discuss how Canada never settled on either. Instead, the general trend of urban growth was actually determined by very little planning at all. Near the end of the Second World War, the Central Mortgage and Housing Corporation was established, which created a house-building industry that spurred on an accelerated rate of growth in Canada's urban areas. Artibise and Stelter dis-

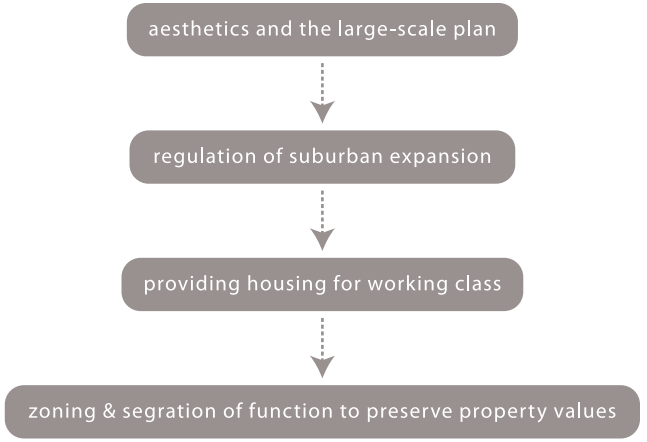


fig 1.02 the shift in planning priorities during the urban reform era
This diagram depicts the shift in planning priorities, as stated by Artibise and Stelter in *The Usable Urban Past*.

3 Artibise, Alan F.J. and Gilbert A. Stelter. *The Usable Urban Past: Planning and Politics in the Modern Canadian City.* Toronto: Macmillan of Canada, 1979, p.168.

4 ibid, p.169.

"It was the old romantic idea – going back to William Penn – of combining the urban with the rural, of living close to nature, of creating a city out of buildings in a park. That it might end up, in practice, as "buildings in a parking lot," as Lewis Mumford put it, was a possibility that planners and architects did not admit."[5]

fig 1.03 buildings in a parking lot
This diagram illustrates the paradoxical relationship between the vision and reality of the suburban ideal, as referenced in James Howard Kunstler's above quote.

5 Kunstler, James Howard. *The Geography of Nowhere: The Rise and Decline of America's Man-Made Landscape*. New York: Simon & Schunster, 1993, p.79.

cuss how this rapid growth was accompanied by minimal planning, and ultimately resulted in the sprawling and formless suburbs that dominate Canada's urban landscape today.

It is important to understand the theory and implications of the development of today's suburbs in order to make progressive planning decisions. Several authors, including Jane Jacobs, James Howard Kunstler, and Richard Harris, critically examine the way in which cities and suburbs in North America have changed. Jacobs' book, *The Death and Life of Great American Cities*, is a highly influential text on urban theory. It criticizes the orthodox city planning that has shaped modern cities and suburbs, including the City Beautiful and Garden City movements. She advocates the role of streets as civic space, and discusses the function of neighbourhoods within the greater fabric of the city. Jacobs also addresses the influence of the automobile on the urban environment and the issues associated with the segregation of urban functions. Her text provides a theoretical framework that addresses the vitality of North American cities. Similarly, James Howard Kunstler examines the evolution of American cities from their original settlements to the sprawling suburbs of the twenty-first century, in his text *The Geography of Nowhere: The rise and decline of America's Man-Made Landscape*. Kunstler explores the origins of the prototypical suburban house, and describes the unanticipated effects of automobile-oriented design, and the failure of the suburban dream. He also addresses how modern development failed to respect the limits of resource consumption, and observes the unforeseen consequences that modernism effectuated on the natural environment. This text is important because it provides a critical analysis of how cities have evolved into the bleak, ubiquitous sprawl that surrounds most North American cities. It advocates the need for a dramatic shift in city building that focuses on civic space and prioritizes the realm of the pedestrian.

While Jacobs' and Kunstler's works focus primarily on the urban theory of American cities, Richard's Harris' book, *Creeping Conformity: How Canada Became Suburban, 1900-1960*, explores suburbanization in Canada. Harris discusses the great social promise that is affixed to the suburban paradigm, and how the "American Dream" has had a significant impact on the development of Canadian cities. He explores the various factors that contributed to the shift toward low-density sprawl, including decentralized employment, the expanded use of streetcars, and the growing popularity of the automobile. He also discusses the anticipated effects of urban sprawl, such as the deterioration of the natural environment, standardization, and the negative social impacts of suburban life.

garden cities, parks and park systems

The recognition of the need for nature and open space in cities began in the mid-nineteenth century, as a response to the degraded quality of life in urban slums. There have been several primary contributors to the movement toward bringing nature to cities, whose concepts of open space and park systems have formed the precedent for green infrastructure. The works of Frederick Law Olmsted, Ebenezer Howard, and Clarence S. Stein, are particularly pertinent to this thesis.

In his text, *The New Urban Landscape*, David Schuyler closely examines the work of Olmsted and his colleague Charles W. Eliot, and how they influenced the character of expanding cities, as well as their suburbs and residential subdivisions. He focuses on Olmsted's advocacy for parkways and park systems, which he describes as beneficial to all neighbourhoods within a growing metropolis. Olmsted viewed these park systems as the antithesis of the urban form, and advocated their benefits in terms of their aesthetic, social, and recreational

(opposite top)

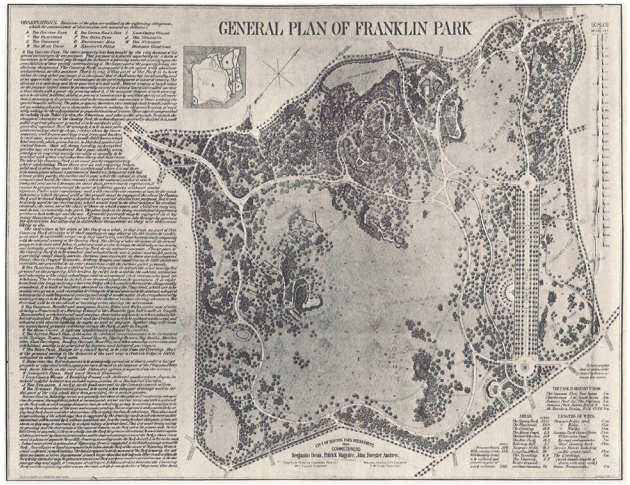
fig 1.04 plan of franklin park, boston, massachusetts

Olmsted's plan for Franklin Park became one of the principal elements of Boston's Emerald Necklace.

(opposite bottom)

fig 1.05 existing and proposed open spaces for metropolitan boston

Charles Eliot proposed that open space be conserved beyond the city's periphery, in preparation for imminent urban encroachment.



function:

> *"Olmsted and his contemporaries urged the creation of parkways and park systems that would extend the benefits of parks to all neighbourhoods of the city. By the end of the century, under the leadership of Olmsted and his colleague Charles Eliot, the park system became a comprehensive metropolitan solution to the recreational needs of the modern city."*[6]

In his view, these park systems served the city by providing naturalistic scenery, and places of leisure and quiet contemplation.

The most significant example of Olmsted and Eliot's implementation of park systems is Boston's Emerald Necklace, which became the first comprehensive metropolitan park system in the United States.[7] Since Boston was already intensely developed by the second half of the nineteenth century, it was deemed that a large park, such as Olmsted's design for Central Park in New York, would not be feasible. Instead, Olmsted proposed a series of smaller parks in the populated areas of the city and larger recreational areas in the outer annexed wards, which would be joined together by a system of parkways.[8] "The land included in this scheme eventually became the three principle elements of the Boston park system – the Fens, Jamaica Pond, and Franklin Park."[9] While Olmsted focused on the design of the park systems within Boston's municipal boundary, Eliot had recognized that suburban growth around the city's periphery was threatening to destroy the natural features of the region. For this reason, Eliot advocated the need to extend the park system beyond the local boundaries in anticipation of future growth along the urban fringe. Eliot's contributions to Boston's metropolitan park system are a significant precedent to

6 Schuyler, David. *The New Urban Landscape: The Redefinition of the City Form in Nineteenth-Century America.* Baltimore: The Johns Hopkins University Press, 1986, p.5.

7 ibid, p.140.

8 ibid

9 ibid, p.140-141.

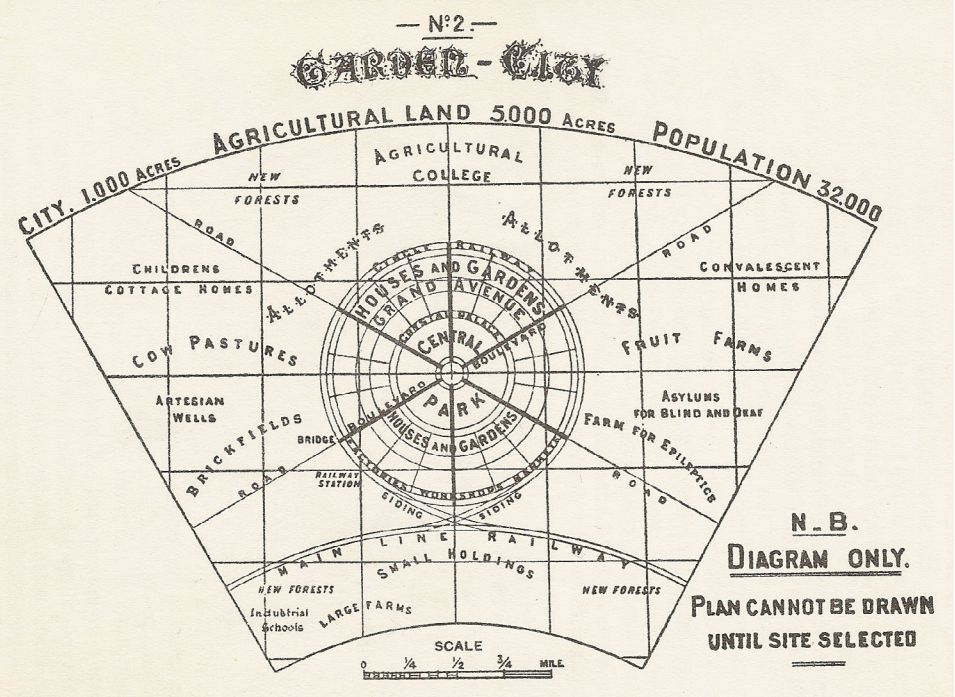


fig 1.06 the garden city

Ebenezer Howard's diagrammatic plan of a Garden City for 32,000 residents, which consists of a 1,000 acres urban centre surrounded by 5,000 acres of countryside.

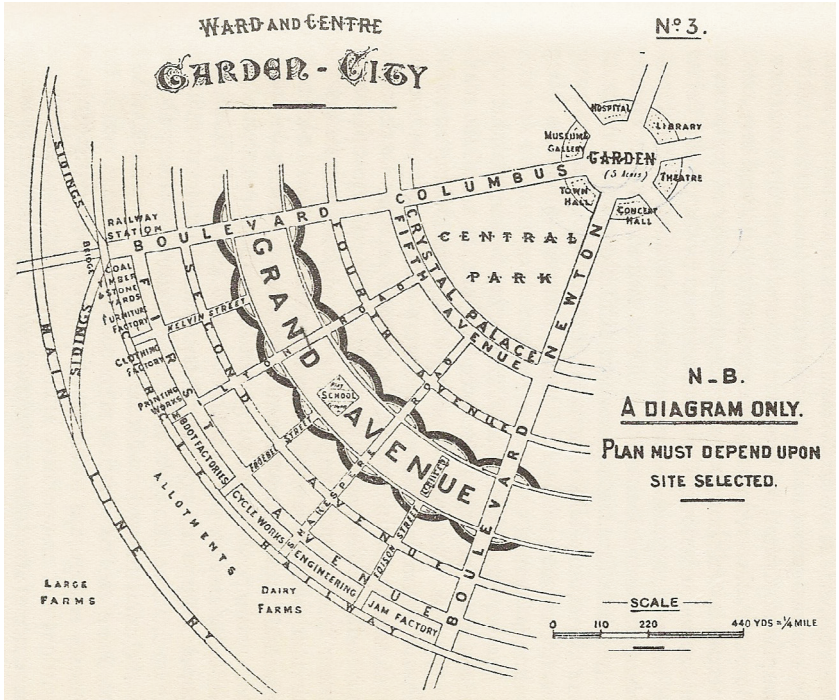


fig 1.07 garden city ward and centre

A diagrammatic plan of a ward in the urban centre, which is characterised by long, diagonal boulevards; a central garden surrounded by civic buildings; a large central park; and a grand avenue that contains parklands, playgrounds, gardens, schools, and churches.

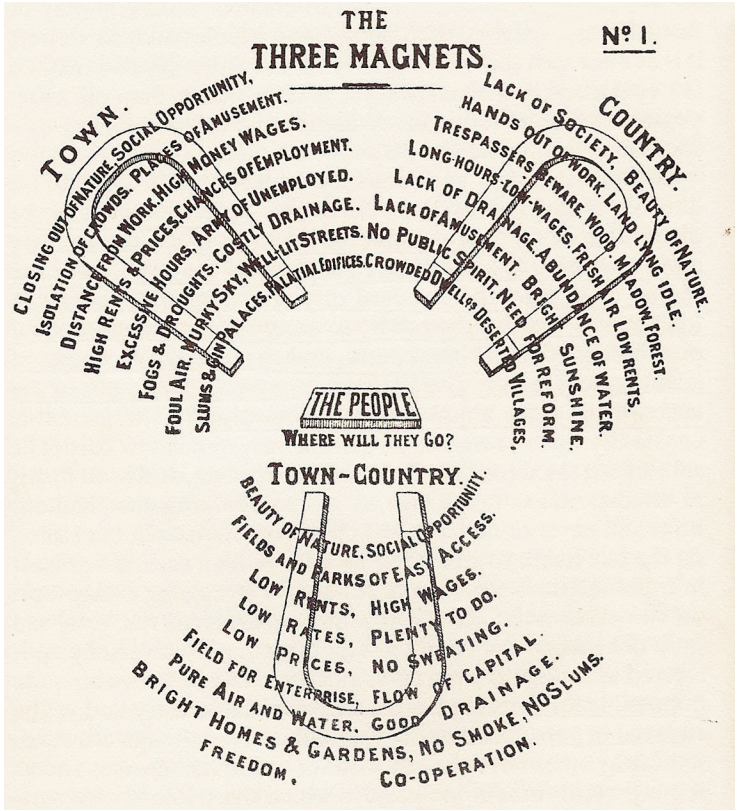


fig 1.08 "the three magnets"
Howard's diagram of the three magnets, which illustrate his vision for combining the town and country.

the current idea of green infrastructure. As Schuyler states "he grafted on to the evolving ideology of the public park the conservationist principles of the Progressive Era."[10]

While Olmsted's work focused on the expansion of cities and park systems, Ebenezer Howard proposed his own solution to the ills of the city through the creation of a new town, which he appointed the "Garden City". In his book *Garden Cities of Tomorrow,* Howard proposed a third alternative to country and town life, which he referred to as the town-country. He advocated this third alternative as a means to combine "all the advantages of the most energetic and active town life, with all the beauty and delight of the country." [11] Howard's concept of the Garden City was highly influential in modern city planning, although the result of such planning is a perverse shadow of Howard's original vision. As Richard Harris observes, the modern suburb "has neither the advantages of the town nor the open freedom of the country, but manages to combine in nice equality of proportion the disadvantages of both."[12] Although many shortcomings have been revealed in the implementation of the Garden City ideal, it is still a significant precedent for the design of sustainable cities. Howard's concept of the greenbelt – an area of rural and natural land that encircles a built-up area – is particularly relevant to this thesis, as it is a fundamental aspect of green infrastructure.

One of the many planners to be influenced by the idea of Howard's Garden City was Clarence S. Stein. In his text, *Toward New Towns for America*, he discusses

10 Ibid, p.144.

11 Howard, Ebenezer. *Garden Cities of To-Morrow.* London: Faber and Faber, 1960, p.45.

12 Harris, Richard. *Creeping Conformity: How Canada Became Suburban 1900 – 1960*. Toronto: University of Toronto Press, 2004, p.48.

his attempts at creating a Garden City in America. His designs for Sunnyside Gardens and Radburn were Stein's first experimental Garden Cities, which embraced the use of green space, greenbelts, and the separation between automobile and pedestrian realms. Stein viewed Sunnyside Gardens as a laboratory for the first Garden City in America. One of the primary objectives of Sunnyside Gardens was to preserve open space for "natural green, for recreation, for light, for healthful living, and for more spacious and beautiful living without additional cost."[13] While Sunnyside Gardens was an experimental project that was based on Howard's principles, Radburn was originally intended to be a complete Garden City. However, the site for Radburn was not large enough to accommodate a greenbelt, so it accepted its position as a suburb. Radburn was designed as a community for the motor-age, marking it as one of the first developments to address the issues of the automobile. Stein advocated the complete separation of automobiles and pedestrians, which included large open areas that formed a continuous park. He turned around the traditional orientation of the home, to face the park rather than the street, and designed a pedestrian underpass below a major roadway to allow children and residents a safe passage between home, school, and parks. Stein's work examines the successes and failures of Radburn and Sunnyside Gardens, and discusses the challenges involved with their implementation.

Olmsted, Howard, and Stein each had a profound impact on the development of today's cities and suburbs. They provide a framework for urban design that addresses the need for green spaces, park systems, and greenbelts in cities. However, one of the common threads between each of these planners was their view of green space as an aesthetic, recreational, and social tool. They

13 Stein, Clarence S. *Towards New Towns for America.* 2nd Ed. Liverpool: Liverpool University Press, 1958, p.22.

(from top to bottom)

fig 1.09 sunnyside gardens courtyard
Community courtyards provide shared open space that serves the adjacent housing complexes. This inner courtyard was built in 1926. Photograph taken in 1949.

fig 1.10 sunnyside gardens courtyard
Another inner court in Sunnyside Gardens. Photograph taken in 1949.

fig 1.11 a pedestrian underpass in radburn
This pedestrian underpass provides safe passage below the street, linking houses, recreational open space, and schools.

fig 1.12 radburn open space
The houses in Radburn are situated within a landscape of open space.

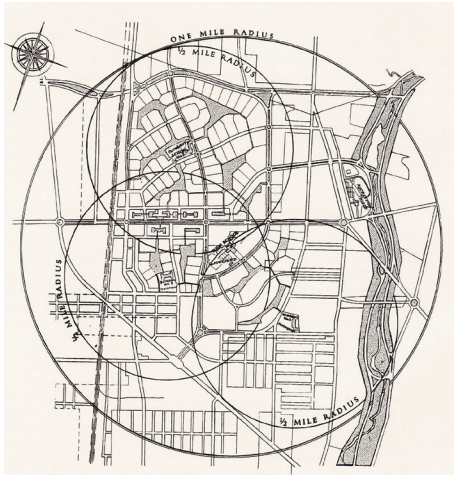


fig 1.13 general plan of radburn
This plan shows the neighbourhoods of Radburn, which are situated within a 1/2 mile and 1 mile walking radius.

fig 1.14 plan for the complete town of radburn
This plan illustrates how the town is situated in relation to its open space network (shown in green).

fig 1.15 aerial view of radburn
Photograph taken in 1955.

each failed to acknowledge the fourth component that attributed value to such green systems – the ecological benefit.

green infrastructure: a new direction for sustainable cities

In more recent years, a growing concern for the state of the natural environment has become a top priority that is starting to be addressed in the design for cities. Issues of climate change, the pollution of air and water systems, and the depletion of natural resources are among the many concerns that are having adverse effects on the environment, which lead to social and economical consequences. These concerns provide a legitimate argument for rethinking the way cities are built, in order to minimize their effect on ecosystems and enhance the quality of life in cities.

The concept of negotiating the relationship between city and nature is derived from the principles proposed by Olmsted, Howard, and Stein. However, the emphasis has shifted from a human-oriented design, which focuses on aesthetic and social benefits, to an ecological approach to planning. Over the past several decades, an increased awareness of environmental concerns has prompted the need for sustainable practices in city design. The concept of green infrastructure, which includes the use of greenways, greenbelts, and ecological design principles, is becoming a prominent aspect in the design of sustainable cities. The concept of green infrastructure and an ecological approach to urban design is expressed in the writings of Michael Hough, Ian McHarg, Robert Dorney, Johnathan Labaree, and Julius GY. Fabos and Jack Ahern.

The writings of each of these authors point to the fact that the failure to inte-

grate nature within urban regions is one of the fundamental flaws associated with the current model of metropolitan growth. In his text *Design With Nature*, Ian McHarg explores how the current model has failed to address the intrinsic social, economical, and environmental value that is inherently associated with natural processes. The ecosystems that function within a given region produce invaluable outputs that support and sustain civilization, and are a product of the climate, soils, geology, hydrological processes, plants, and wildlife that are native to that region. Ian McHarg emphasizes the value of these outputs and the need for them to be protected and regulated:

> *"...there is a need for simple regulations, which ensure that society protects the values of natural process and is itself protected. Conceivably such lands wherein exist these intrinsic values and constraints would provide the source of open space for metropolitan areas. If so they would satisfy a double purpose: ensuring the operation of vital natural processes and employing lands unsuited to development in ways that would leave them unharmed by these often violent processes."*[14]

McHarg illustrates that land that often supports the most diverse natural processes, such as the riparian zone along watercourses, flood plains, and wetlands, is usually not suitable for urban development. This provides a logical framework for the beginnings of a greenway system.

Another fundamental text that supports the argument for an ecological approach to design and the concept of green infrastructure is *Cities and Natural Process* by Michael Hough. Hough addresses the need for urban design to become grounded in natural process. He expresses his goal of adopting design theories that draw from natural process in the attempt to create a method for sustainable urban design. He describes the effect of urbanization on natural systems and proposes design solutions that allow cities to coexist in balance

14 McHarg, Ian L. *Design with Nature.* New York: John Wiley & Sons Inc, 1995, p.55-56.

with nature. He explores how various ecological functions relate to the urban environment, such as water, plants, wildlife, climate, and city farming, and proposes design initiatives that protect and enhance these functions within an urban setting. Hough also discusses the issue of fragmentation of forests and habitats, which he believes to be one of the most currently pressing environmental issues:

> *"Landscape ecology suggests that the primary consequence of human development on the natural environment is fragmentation, which converts extensive or continuous areas of forest, wetlands, meadows and other types of habitat into isolated islands. Typically, human activities disrupt ecological functioning and inhibit interactions between the systems, nutrient and gene flows among habitats. The fragmentation of biological communities, in fact, is recognized as one of the most crucial environmental issues affecting urbanizing regions and ecologically diverse protected areas and parks beyond the city."*[15]

The use of greenbelts, greenways, and natural linkage corridors are among the primary measures that propose to solve the issue of fragmentation in urban areas. Hough illustrates how these green systems can be implemented, as well as their ecological and social benefits.

Robert Dorney's text *Ecoplanning: The Contribution of Ecology to the Process of Urban Planning* is a collection of interrelated studies prepared by the School of Urban and Regional Planning at the University of Waterloo. Dorney proposes an "Ecoplan" for the development of Erin Mills, Ontario. This plan involves a collaboration of several studies that were conducted by experts from variety of scientific disciples, to explore how interrelated ecosystems would respond to urban development in the region. The study explores ways to minimize the detrimental effects of such development by recognizing the potential environmental conflicts that could arise, and by establishing an ecological balance

15 Hough, Michael. *Cities and Natural Process: A basis for sustainability.* 2nd ed. New York: Routledge, 2004, p.228.

that would enhance the quality of both the natural and human environment. The methodology used in this study is relevant to this thesis, as it supports the concept of an ecosystems approach to city planning. Dorney examines the cultural and natural history of the site, and conducts a thorough analysis of the ecology of the area including a study of the vegetation, soil, water quality, and bird populations. Although this thesis takes an ecological approach from a design point-of-view, Dorney's study of Erin Mills demonstrates how this thesis could benefit from the insights and collaborations of multiple disciplines, which could be applied at a second phase of design. Dorney's Ecoplan also provides a framework of methodologies for ecological city design.

Two other texts that are significant resources for the research and theory of green infrastructure are *Greenways: The Beginning of an International Movement,* by Julius GY. Fabos and Jack Ahern, and *How Greenways Work: A Handbook on Ecology,* by Jonathan M. Labaree. Both of these texts focus primarily on greenway systems and their function in urban and rural settings. Fabos and Ahern's book includes a collection of written works that discuss the use of greenways in the United States, Canada, and Europe. These writings include the history and origins of greenways and greenway planning, the various types of greenways, and the strategies and challenges of implementing greenways in urban areas. Fabos and Ahern define the greenway as a giant circulation system that is provided by nature. It provides public access to open space, and links urban and rural areas together. Their book evaluates the three main functions of greenways: ecological, recreational, and cultural. Each of these greenway functions is considered in the proposal for a greenway network in this thesis.

Fabos and Ahern's book also discusses the application of greenway systems in decentralized cities and metropolitan areas. They argue that planning priori-

ties have shifted away from dense cities with central parks, toward solving the issues of the sprawling urban fringe. They argue that greenway systems work best in decentralized cities. This notion supports the idea that smaller, dense villages can fit within the existing urban landscape, and can be connected by public transportation, road networks, greenways, and greenbelts. This concept of design is well suited to the Greater Toronto Area, where urban sprawl is filling in the landscape between urban centres.

The second text, *How Greenways Work: A Handbook on Ecology*, provides a practical approach to designing and implementing greenways. It discusses how greenways are beneficial to the various ecological functions that would otherwise be impacted by urban development. It explores the many roles of the greenway, which include acting as a habitat for wildlife; as a conduit for the movement of people, plants, wildlife, and water; and as a filter for various species and nutrients. It proposes a method of designing and managing greenways, which is adopted in the design of the greenway system in this thesis.

Each of the texts discussed in this chapter provide the background of the theoretical concepts that are relevant to this thesis. They provide a basic understanding of the influences that have shaped Canadian cities, as well as the historical precedents for green infrastructure. The writings of Hough, McHarg, and Dorney articulate the need for a new approach to urban design that works in balance with nature. The research, concepts, and theories that are extracted from these works form the basis for the arguments and design proposal of this thesis.

fig 2.01 newmarket and aurora

02 newmarket & aurora in the greater toronto area greenbelt

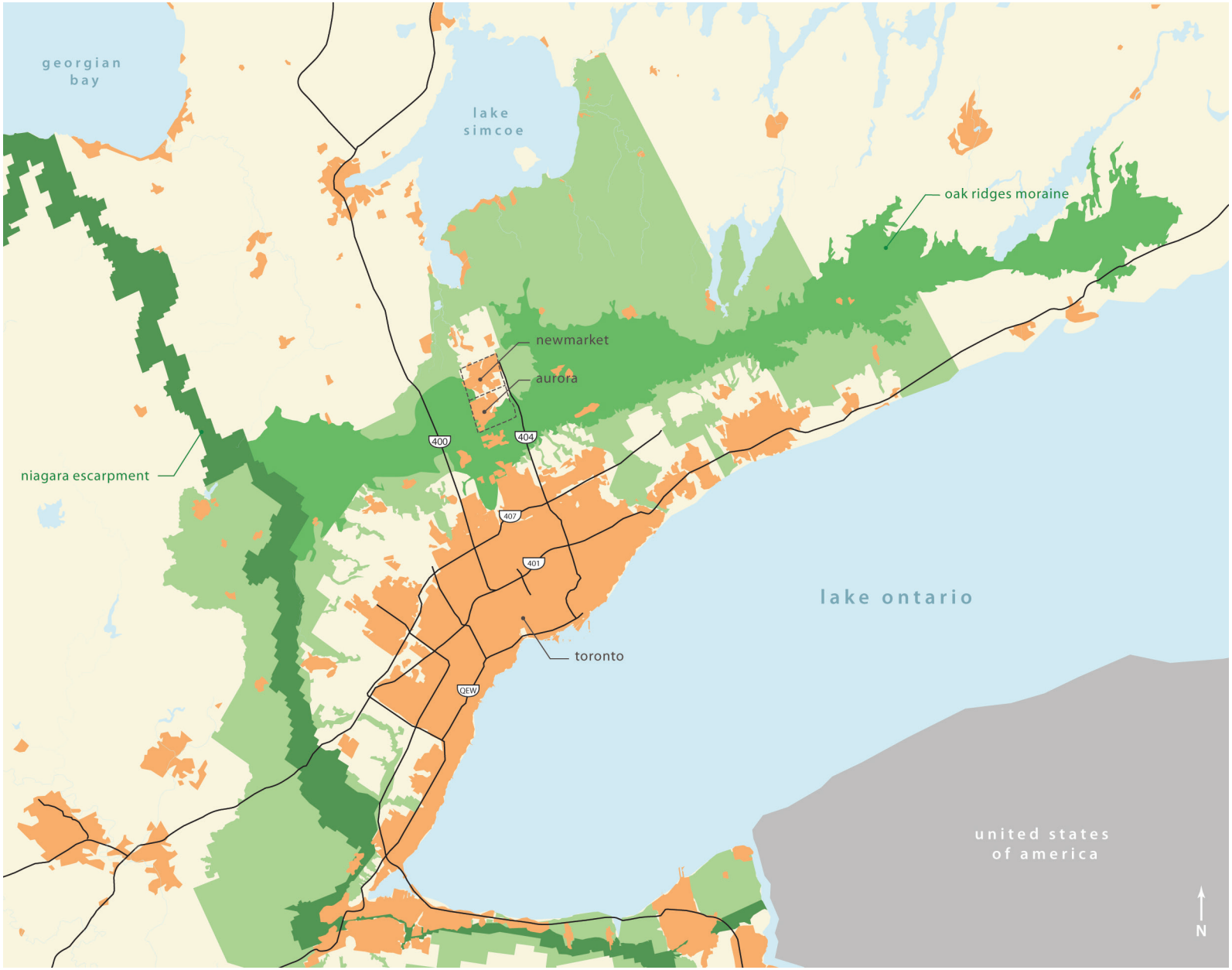
"How and in what context environmental knowledge is delivered is crucial to ecological understanding, and to the patterns of behaviour that can be positively influenced by that knowledge. Conceptually, the way natural sciences are taught externalize our understanding of 'nature'. It implies that we are simply observers of natural processes but not a part of it. It is here that the overall theme of sustainability provides the foundation for environmental literacy. The infrastructure that keeps us alive and healthy, such as the need for clean water, wastewater systems, energy, recycling and composting, provides a foundation for linking people to these processes. From here it is a short step to understand that the same processes also sustain national parks and wild places. Their varying climates, geology and geomorphology, hydrological processes, soils, plants and compelling and beautiful scenery, are the same as those that sustain life in cities." [1]

- Michael Hough, *Cities and Natural Process*

The issues that are associated with urban sprawl, such as the inefficient consumption of land and resources, automobile dependency, and the fragmentation of natural areas, are clearly apparent in the Greater Toronto Area (GTA), particularly along its periphery. The economic, social, and environmental problems that are caused by decentralized development are beginning to be recognized by citizens and governments in Ontario, and new legislative measures are being implemented to curb the effects of sprawl. For example, The Greenbelt Plan, which was established by the Government of Ontario in 2005, is an initiative that directly addresses these issues of sprawl. The plan establishes a permanently protected area of green space around the perimeter of the GTA. It helps to sustain the local economy, as well as social and environmental health, by preserving important natural features, agricultural land, and recreational and tourist areas. This thesis views greenbelts as a fundamental element of green infrastructure, and focuses on reconsidering planning methodologies along the edge of the Ontario Greenbelt.

The towns of Newmarket and Aurora have been selected as the case study area for this thesis. Newmarket and Aurora are neighbouring towns that are located in the Regional Municipality of York, directly north of the City of Toronto along the Yonge Street corridor, and directly south of Lake Simcoe. The towns are uniquely situated within the greenbelt, as they are located within a pocket of developable land that is surrounded by protected green space and rural land on all sides. They are also located in close proximity to several significant natural areas, including the Oak Ridges Moraine and Holland Marsh. The towns' unique relationships with the natural landscape, combined with their display of traditional suburban typologies, make Aurora and Newmarket the ideal site for this thesis.

1 Hough, Michael, *Cities and Natural Process: A basis for sustainability.* 2nd ed. New York: Routledge, 2004, p.258-9.


georgian bay
lake simcoe
oak ridges moraine
newmarket
aurora
niagara escarpment
400
404
407
401
lake ontario
toronto
QEW
united states of america
N

An ecosystems approach is employed for analysis of the Newmarket and Aurora area, providing an ecologically informed framework upon which the design will be structured. This section is divided into three chapters that outline the analysis of the site. The first section consists of a brief history of Newmarket and Aurora. It explores the natural and cultural history of the site, and how urban development has impacted the natural environment of the region. The second section involves in-depth mapping of the many natural and cultural ecosystems that function at various scales. The third section explores pertinent initiatives of various groups and levels of government, and how they are relevant to this thesis proposal.

fig 2.02 newmarket and aurora context map
This map illustrates how Newmarket and Aurora are situated in relation to the urban fabric of the GTA and its highway network, as well as the Ontario Greenbelt and two significant natural features: the Oak Ridges Moraine, and the Niagara Escarpment.

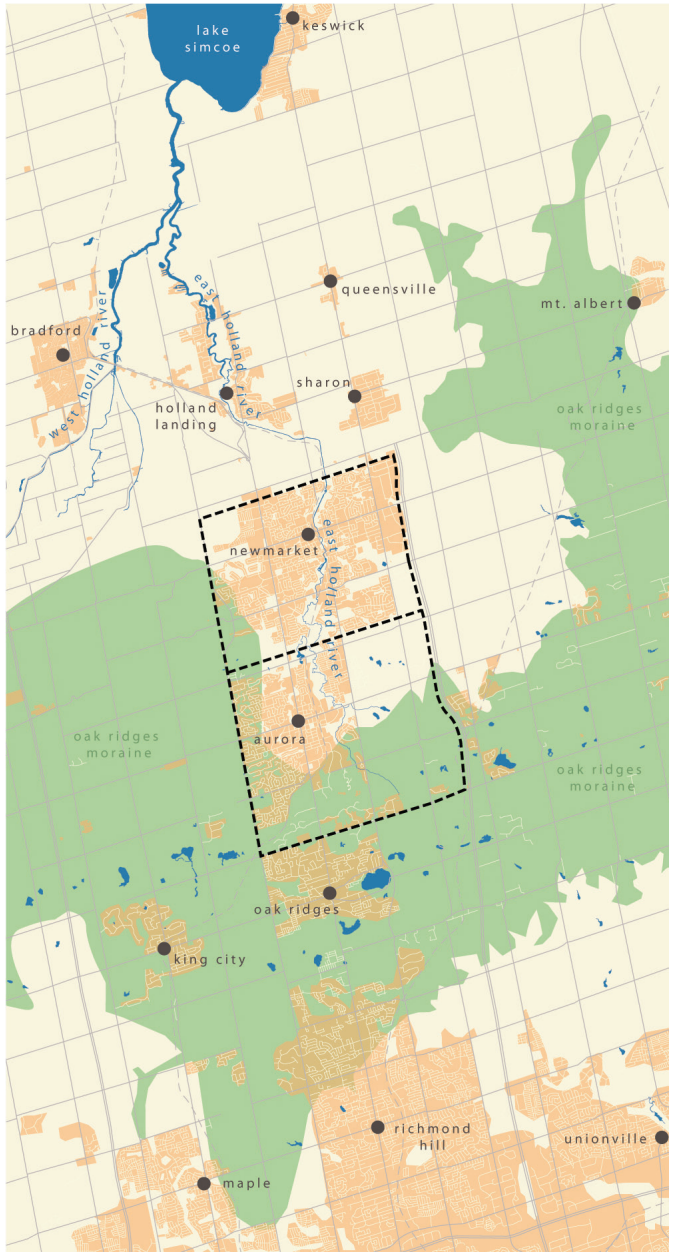


fig 2.03 oak ridges moraine context map
This map illustrates how Newmarket and Aurora are situated in relation to the Oak Ridges Moraine, the East Holland River, and the surrounding urban centres.

2.1 historical narratives

The towns of Newmarket and Aurora are located along the East Holland River on a large area of fertile land within the Lake Simcoe Watershed. The rolling hillsides and unique physiographic features of the region are a product of the Wisconsin Glacier, which carved, formed, and shaped the landscape during the last glacial period, many centuries ago. As the glacier retreated, it left behind a linear ridge of rock debris now known as the Oak Ridges Moraine - a unique geological landform with significant ecological and hydrological functions. The Wisconsin Glacier also affected the area north of the moraine, where Newmarket and Aurora are now located. Glacial till deposits consisting of rock, sand, and clay, formed a till plain that covers the region north of the moraine. An ancient glacial lake, called Lake Schomberg, also affected the physiography of the region. Clay sediments from the lake were deposited over the existing till plain, forming the Schomberg Clay Plain.[2] These deposits resulted in the rich clay loam that dominates the Newmarket and Aurora landscape, and are an integral part of the future development of the region.

The region around Newmarket and Aurora has been inhabited by humans for the past 3500 years.[3] Prior to European settlement, various native inhabitants occupied the region, including nomadic hunters, the Laurentian Indians, the Woodland Indians, and the Iroquois.[4] These original inhabitants established trails from the Holland River to the Humber, Don, and Rogue Rivers, which served as a means of north-south passage from Lake Simcoe to Lake Ontario.

2 *State of the Watershed Report: East Holland River Subwatershed*. Lake Simcoe Region Conservation Authority, 2000, p.5.

3 ibid, p.9.

4 ibid.

These trails greatly impacted the later development and settlement of the area[5] and became important trading routes for early European fur trading.

Early settlement by the Europeans began in the late 18th century. John Graves Simcoe, the first Lieutenant-Governor of Upper Canada, established York County in 1792, and land grants began to be issued to settlers in the region. A grid plan was applied to the southern part of Ontario, and the region around Newmarket and Aurora was divided into the townships of King, Whitchurch, and East Gwillimbury. These townships were further subdivided into 200 acre farming lots. This grid has predominantly shaped the current structure of Southern Ontario's urban fabric, despite the fact that it fails to account for the natural topography of the landscape.

The County of York became established during a time of much political tension. The War of the First Coalition had begun, spawning hostilities between the French and British. Simcoe became concerned about a possible invasion by the Americans, and decided to build a military road between Lake Ontario and Lake Huron. In 1796 the first portion of this road was built, and named "Yonge Street".

The development of Newmarket and Aurora began shortly after the first section of Yonge Street was completed, between York and Holland Landing. A group of Quaker families, led by Timothy Rogers, were among the first to establish permanent settlement in the region. The settlers were met with dense, mixed hardwood forests that covered the rolling landscape. The soil in the area north of the Oak Ridges Moraine was rich, fertile, and well suited for their

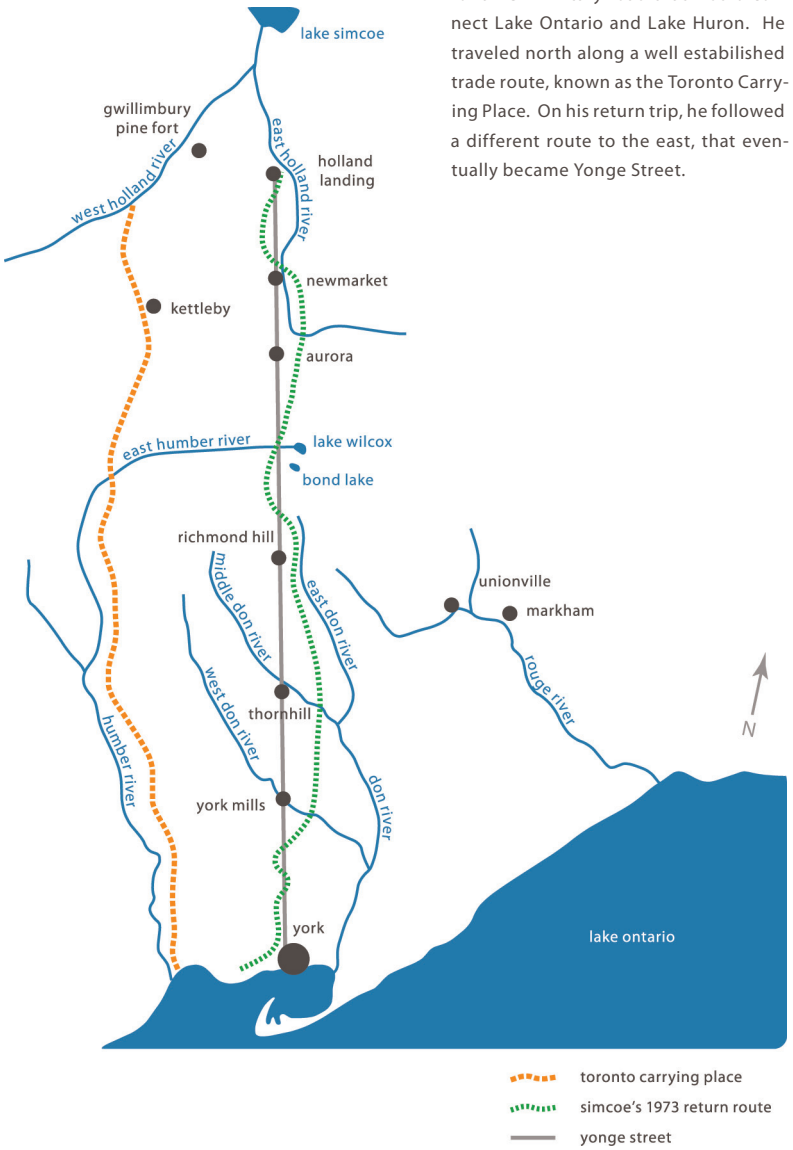


fig 2.04 establishing yonge street
In 1793, John Graves Simcoe began an exploration to determine the best route for a new military road that would connect Lake Ontario and Lake Huron. He traveled north along a well estabilished trade route, known as the Toronto Carrying Place. On his return trip, he followed a different route to the east, that eventually became Yonge Street.

5 ibid.

fig 2.05 john graves simcoe

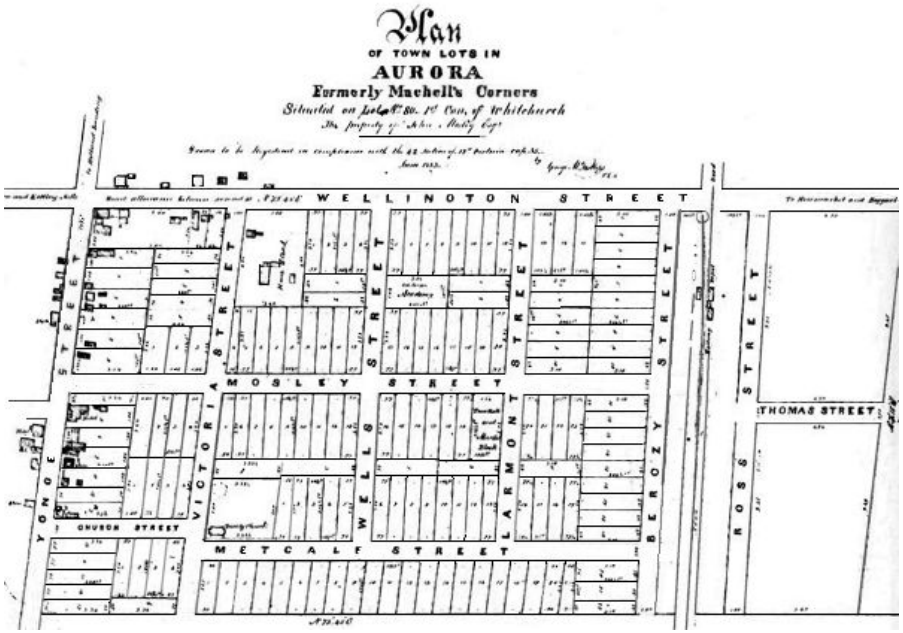


fig 2.06 map of machell's corners, 1854

agricultural needs. Large parcels of land were cleared away along Yonge Street and converted into farmland. Grain and saw mills were constructed along the East Holland River, in what is now the centre of Newmarket's historical downtown core. These mills supplied important materials to settlers in the region, and the town quickly became a major trading post and milling centre for the regions north of York. The prosperous community grew at a steady rate and became known for its farmer's markets, which were held every weekend. This is where the town developed its name as the "new market".[6]

While Newmarket became established as an important trading centre along Yonge Street, Aurora experienced very minimal growth. Until 1853, Aurora was only a small hamlet on the corner of Yonge and Wellington Streets, known as Machell's Corners. It was not until then that Aurora began to experience any significant growth. This growth was primarily attributed to the completion of the Simcoe and Huron Railway – the first railroad built in Upper Canada. The railway linked Toronto to Collingwood, passing through Aurora and Newmarket on its way. The railway brought new opportunities for industry and growth, and in 1888 Aurora became incorporated as a town.[7]

Although the railway brought growth and opportunity to Newmarket and Aurora, the natural landscape began to feel the detrimental effects of development. Soil erosion became a significant problem in the late 19th century as extensive amounts of forested land was cleared for homesteads and farmland, and for the production of lumber. The tree cutting left soil vulnerable to wind

6 *The Market Town*. 2009. Retrieved July 27, 2010 from Town of Newmarket. <http://www.newmarket.ca/en/lifestyle/themarkettown.asp>

7 *History of Aurora*. Retrieved July 27, 2010, from Aurora Public Library. <http://www.library.aurora.on.ca/static/community/history.htm>

and erosion, as well as severe flooding in the spring and droughts in the summer.[8] This led to a collapse in forest resources, resulting in the decline of the lumber industry and the closure of many sawmills in the region.[9]

In the early 1900's, local farmers and business people became upset by the high cost of railroad freight rates, and the construction of a canal system was proposed. Construction of the canal, which linked the Holland River to the Trent Waterway, began in 1906. Three locks, four bridges, a dock and turning basin were constructed. However, the project was faced with design problems, construction delays, and budget issues. In addition, a study was conducted that determined the canal was not feasible due to lack of water, and the project was abandoned in 1912.[10] Remnants of the "ghost canal" are still present in the region today.

Until the 1900's, most of the roads in the region were "nothing more than simple reinforced earthen paths which usually turned to rivers of mud after rainfall".[11] As the communities grew and prospered, road improvements became a priority in order to accommodate the increasing number of people and goods that required transportation. In order to meet these needs, an electric railway was built along Yonge Street in 1899. This "radial system" connected Newmarket to Toronto, and was used for daily commuting, social trips, and transporting agricultural goods. It also improved access to Lake Simcoe, and many seasonal resorts and cottages were built along the lake, establishing a local tourist in-

8 *The East Holland River Subwatershed Management Plan, 2000*. Lake Simcoe Region Conservation Authority, 2000, p.11.

9 ibid.

10 ibid, p.13.

11 ibid, p.11.

(from top to bottom)

fig 2.07 fairy lake, newmarket
A view of Fairy Lake, near the historical downtown core in Newmarket, circa 1910.

fig 2.08 main street, newmarket, 1890
A view of Main Street in Newmarket, before the road had been paved.

fig 2.09 map of aurora, 1878
A map of Aurora in 1878, depicting a large mill pond that is no longer present.

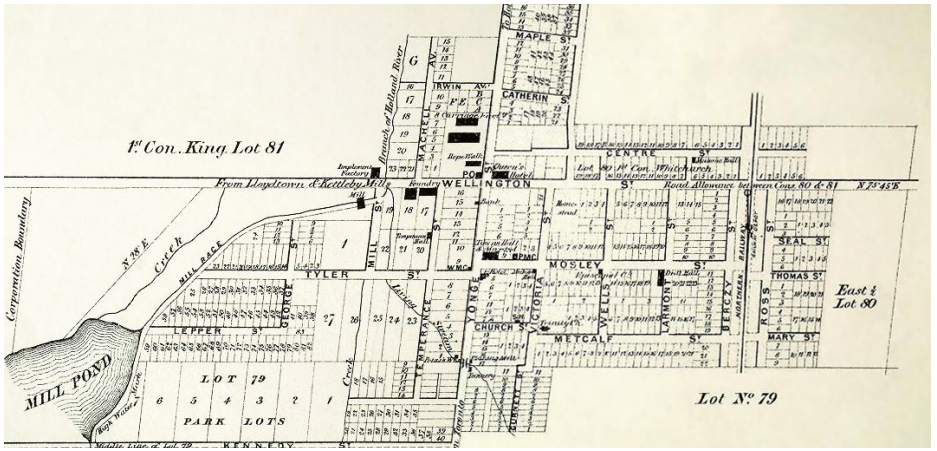


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fig 2.10 grand trunk railway station, aurora
A view of a train approaching the railway station in Aurora.

fig 2.11 yonge street, aurora, 1870
A view of Yonge Street in Aurora, before the road had been paved.

fig 2.12 aerial view of yonge street, aurora.
A view of Yonge Street in Aurora in 1890, showing the rolling natural landscape beyond the village.

fig 2.13 mill at fairy lake
A view of a mill at the edge of Fairy Lake in Newmarket.

fig 2.14 yonge street, aurora, 1910
A view of the streetcar tracks along Yonge Street in Aurora.

dustry.[12] However, it was the agricultural and manufacturing industries that benefited most from the streetcar line. Transporting goods became faster and more economical, spurring a movement toward mass production.[13] The radial railway eventually became discontinued in 1930, as automobiles increased in popularity and ridership on the streetcar declined. Roads expanded and improved in order to support the growing number of automobiles.

The increase in population and industrialization during this period impacted the natural environment in several ways. Toxic discharges from local factories and farms began to pollute the water and air. As the landscape was paved over by impermeable surfaces and vegetation decreased, stormwater discharges increased dramatically, carrying pollutants from the streets into the waterways. The lack of a stormwater management system caused an increase in flow, and therefore erosion in the river system.[14]

A trend towards urbanization in the region began near the beginning of the Second World War. Mass production of materials and equipment was needed to support the military, which resulted in improvements to the transportation networks, and industry.[15] After the war ended, the populations of Newmarket and Aurora grew rapidly. To support the growth of these urban centres, new roads, stormwater management systems, and sewage treatment systems were constructed, which helped reduce the pollution of waterways.

During this time, new farming practices were introduced that greatly impacted

12 ibid, p.12.

13 ibid.

14 ibid, p.13.

15 ibid, p.13-14.

the agricultural areas in the region. The pressure for farmers to produce more for less created a shift from many small farms to fewer larger farms.[16] These new farming practices involved the use of machinery to allow farms to function on a larger scale. Chemical fertilizers and pesticides were introduced to improve crop yield[17] and larger fields were used to increase the concentration of livestock herds. These new, intensely managed farming methods had a detrimental effect on the environment that was present across North America.

> *A way of life became simply a means of production. Human husbandry gave way to the industrial exploitation of land. Left behind was the knowledge of how to care for land, so plainly evinced in today's problems of soil erosion and in pollution from chemical pesticides and fertilizers.*[18]

Currently, the populations of Newmarket and Aurora are 84,000[19], and 53,000[20] respectively. In Newmarket, almost all of the land within the municipal boundary is consumed by urban development. Aurora is also highly developed, with the exception of a portion of protected land that falls within the Oak Ridges Moraine. There are few parcels of greenfield or agricultural land that have remained untouched by urban development. With the exception of the historical downtown core, Newmarket is primarily a car-oriented community. In the early 1980's, the north-south major highway, Highway 404, was extended north to Davis Drive in Newmarket, and became a main transportation artery for commuters. In 2001, the highway was extended to Green Lane - Newmarket's northernmost arterial road. Highway 400, the parallel major highway lo-

16 ibid, p.14.

17 ibid, p.14

18 Kunstler, James Howard. T*he Geography of Nowhere: The Rise and Decline of America's Man-Made Landscape.* New York: Simon & Schunster, 1993, p.94.

19 *About Us*. 2009. Retrieved July 27, 2010, from Town of Newmarket. <http://www.newmarket.ca/en/aboutus.asp>

20 *Demographics & Income*. Retrieved August 21, 2010 from Town of Aurora. <http://businessaurora.ca/demographicsc55.php>

(from top to bottom)

fig 2.15 grand trunk railway station
Photograph of Grand Trunk railway station in Newmarket, circa 1910.

fig 2.16 yonge street at holland landing
Construction crew on Yonge Street at the foot of Holland Landing in 1924.

fig 2.17 yonge street between aurora and newmarket
Yonge Street was widened in 1933, making it Ontario's first multi-lane highway.

fig 2.18 yonge street in aurora, 1940
View of Yonge Street in Aurora in 1940 after the streetcar tracks had been torn up and paved over to accomodate automobiles.

cated west of Newmarket and Aurora, provides convenient access to Toronto as well as to Barrie. York Region has also established future plans to extend Highway 404 further north and to create a new highway that connects the 404 and 400 highways along the north edge of East Gwillimbury. These highway expansions will promote substantial growth in the towns north of Newmarket.

Newmarket's commercial corridor is located along Yonge Street and includes a multitude of commercial plazas and big box stores, as well as a 1,000,000 square foot shopping mall that services the surrounding municipalities. Employment areas are primarily located along Leslie Street on the east end of town, adjacent to the 404 highway. An additional employment area is located along Industrial Parkway in Aurora, which is located east of Yonge Street, and runs adjacent to the railway line. A new business area is emerging on the east end of the town, near the 404 highway. The communities have several conservation areas, which are located along the East Holland River. However, these areas are isolated from each other. The riparian zone along the river, which

(from left to right)

fig 2.19 ghost canal in newmarket
Remnants of the ghost canal can be seen in Newmarket along the Holland River near Davis Drive.

fig 2.20 canada day on main street
Nemarket residents celebrate Canada Day on Main Street.

fig 2.21 commercial zone on yonge street
In Newmarket, Yonge Street is lined with big box stores, fast food chains, shopping centres and strip plazas.

NEWMARKET ANTIQUE MALL

(opposite from top to bottom)

fig 2.22 water street, newmarket
A panoramic view of Water Street, which intersects the southern edge of Main Street, and borders the northern edge of Fairy Lake - a conservation area and recreational park along the East Holland River in central Newmarket.

fig 2.23 new development along the east holland river
A construction site abuts the floodlands of the East Holland River in Aurora, near Wellington Street and Bayview Avenue.

(from left to right)

fig 2.24 residential construction in newmarket
The remaining parcels of greenfield land in Newmarket are being developed at a rapid rate.

fig 2.25 green lane, newmarket
A view of Green Lane, which borders the north edge of Newmarket and the south edge of East Gwillimbury.

fig 2.26 development along green lane
Parcels of greenfield land are starting to be cleared away for development along Green Lane, near Yonge Street.

provides natural linkage corridors between these conservation areas, remains largely undeveloped and in a naturalized state, and is not protected under any current conservation legislation.

Urban expansion, which is primarily characterized by sprawling, low-density development, has gradually filled in the areas surrounding the urban centres that once dotted the landscape around Toronto. As a result, Newmarket and Aurora are now a part of the larger, connected, metropolitan fabric that defines the Greater Toronto Area. As developable land has become scarce within the municipal boundaries of Newmarket and Aurora, developers have started to expand north into East Gwillimbury, towards the small towns of Holland Landing, Queensville, and Sharon. This area is not protected under the Greenbelt legislation, and has few restrictions for development. For this reason, it is likely that low-density development will continue to dominate the landscape unless strategic interventions are put in place to prevent sprawl and encourage intensification.

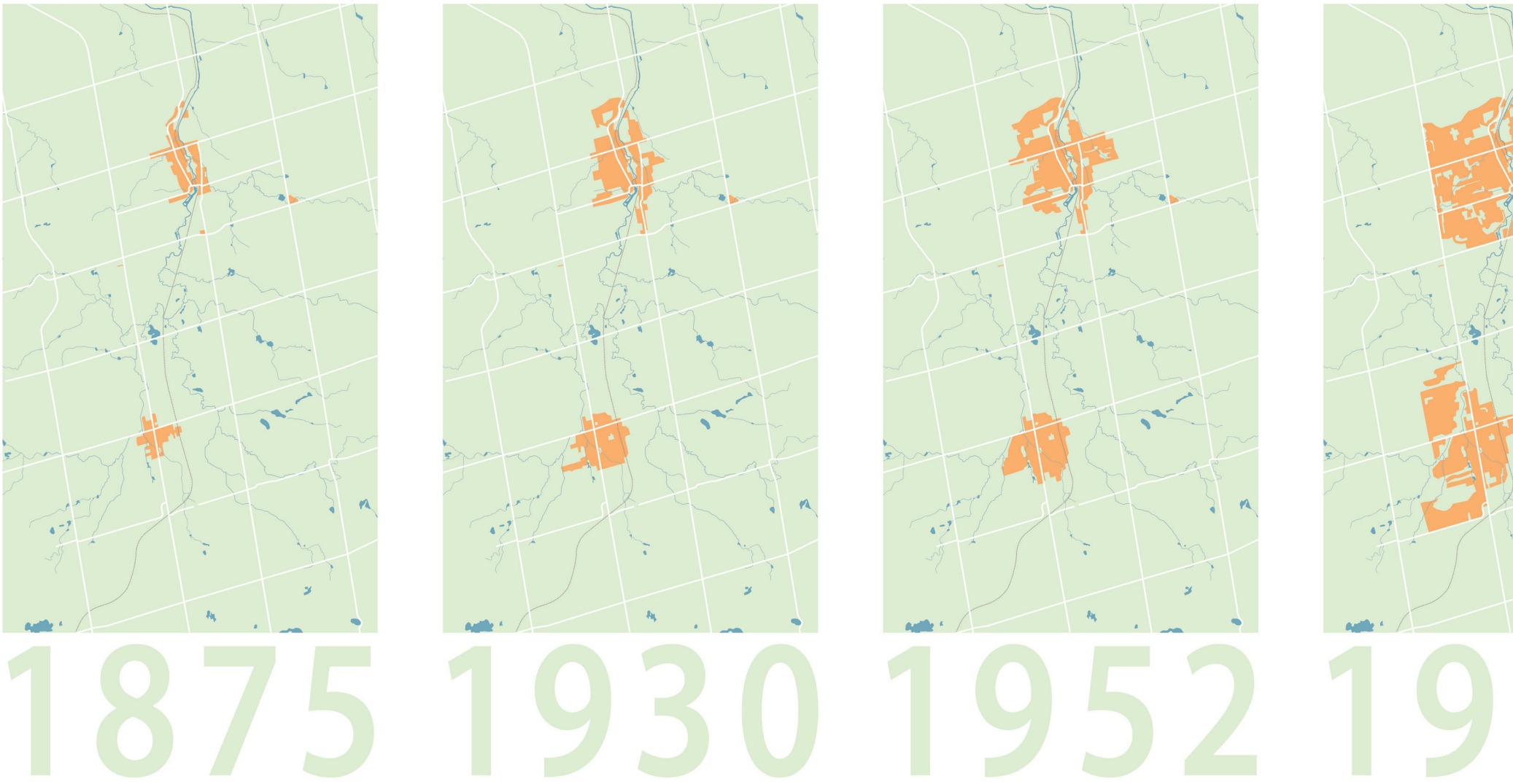
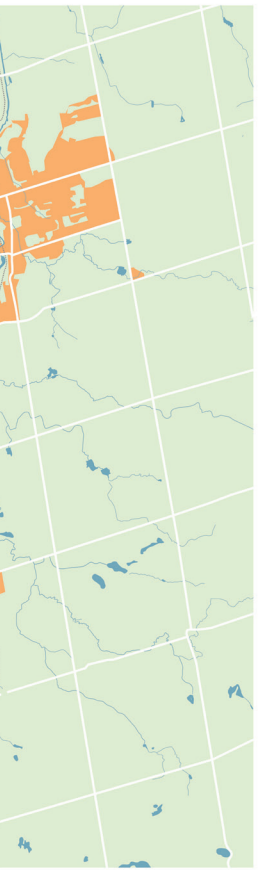


fig 2.27 urban mosaics
Urban growth in the Newmarket and Aurora region from 1875 to 2007.



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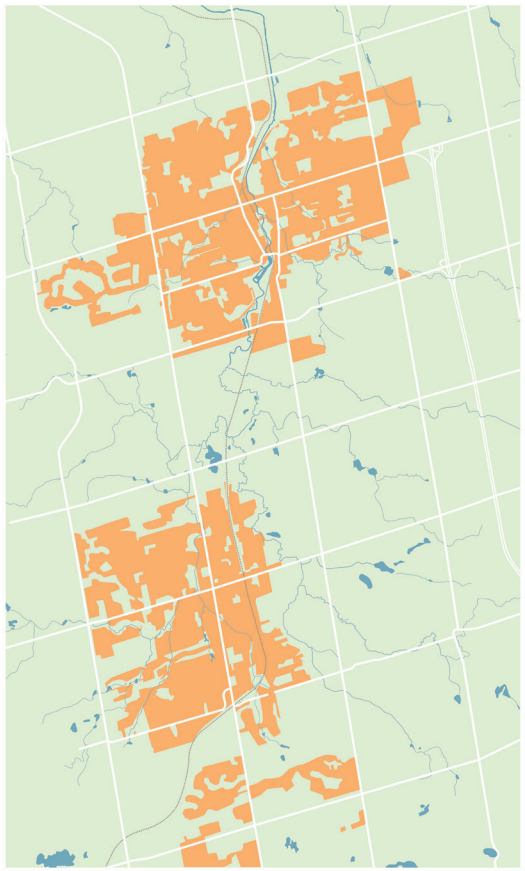

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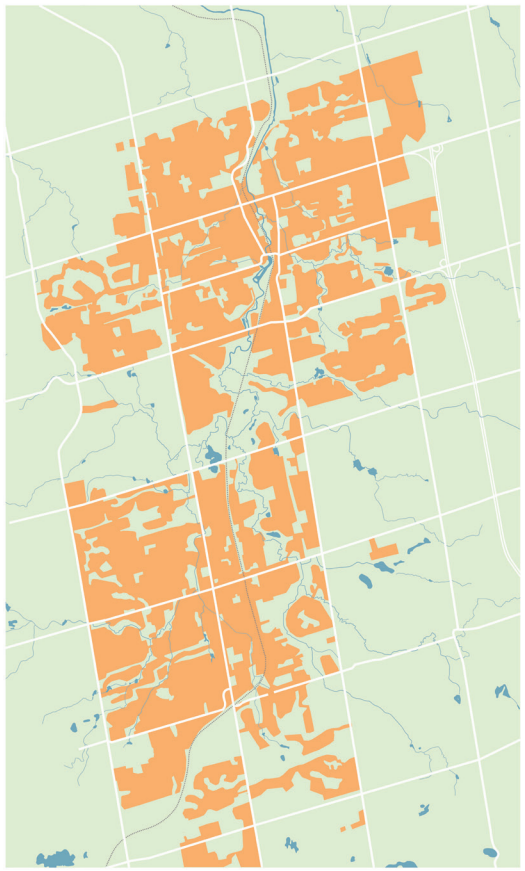
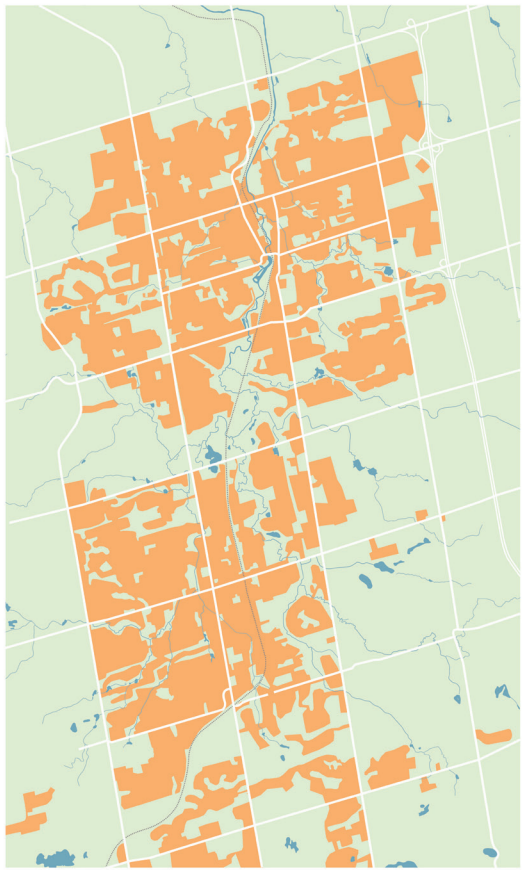


1999



2007

2.2 ecosystems and the urban landscape

This thesis employs the method of 'mapping' to analyse the various cultural and natural ecosystems that function within the region of Newmarket and Aurora. This method of analysis is conducted in two ways. The first approach takes into account the complexity of the systems that are being analysed by dividing the analysis into a hierarchical structure. The 'system' is the chosen area of study, in this case Newmarket and Aurora's urban landscape. Since the system is a complex structure that includes abiotic, biotic, and cultural layers, it is better understood when viewed through a wider perspective. Expanding the context of the system and dividing the system into smaller sub-systems allows each level to be methodically analysed at the hierarchical level to which it pertains. These levels range from the wider environment to the local system. It also important to note that the systems that function within the wider environment affect the smaller systems, while the smaller systems have no effect on the systems above them.

The second approach differentiates the two parallel systems: natural versus cultural. Cultural and natural systems function within separate boundaries along the hierarchical structure. For example, natural systems are better understood when they are examined within a natural boundary such as a bioregion, ecozone, or watershed, while cultural systems are better analyzed using political or municipal boundaries. For this reason, cultural and natural systems have been divided into two distinct groups of analysis.

Cultural systems are all systems that are relevant to the function of the urban machine. They are the human-made systems that form the urban and agricultural landscape. For example, they include transportation networks, urban

fig 2.28 bailey ecological park, newmarket
Bailey Ecological Park is one of several conservation areas that are located in Newmarket and Aurora, and managed by the Lake Simcoe Region Conservation Authority. This park conserves valuable natural land that is adjacent to the Holland River.

development, land use, public transportation and employment areas. These systems are examined at various levels along the hierarchy, including: Southern Ontario (wider environment), the Greater Toronto Area (environment), York Region (wider system), and Newmarket and Aurora's urban landscape (local system).

Natural systems are the existing abiotic and biotic processes that form the natural landscape. They include climate, soils, waterways, natural features, topography, forests, wetlands, and wildlife. These systems are analysed at the following levels: the Manitoulin-Lake Simcoe Ecoregion (wider environment), Lake Simcoe Watershed (environment), East and West Holland River Subwatersheds (wider system), and Newmarket and Aurora's urban landscape (local system).

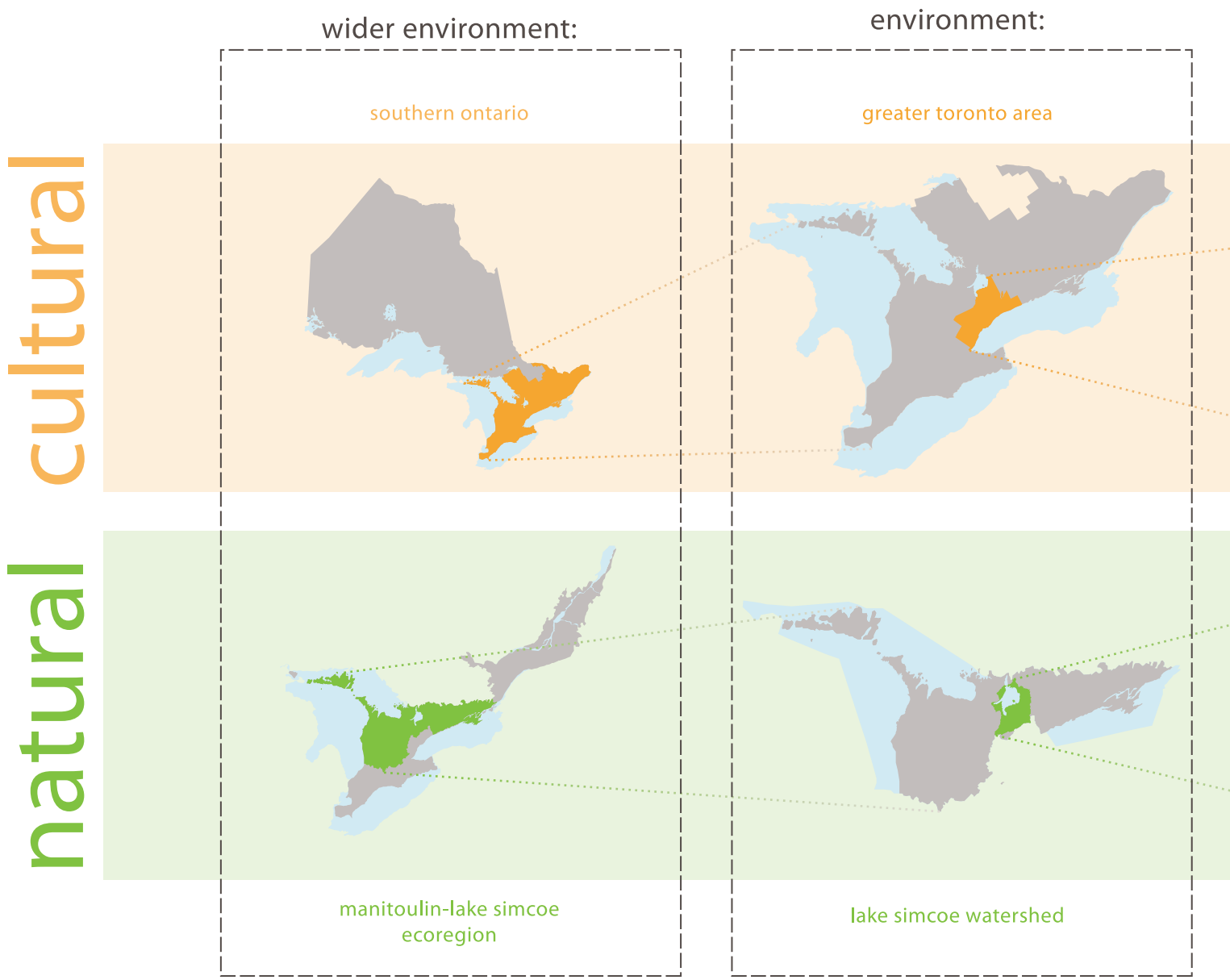
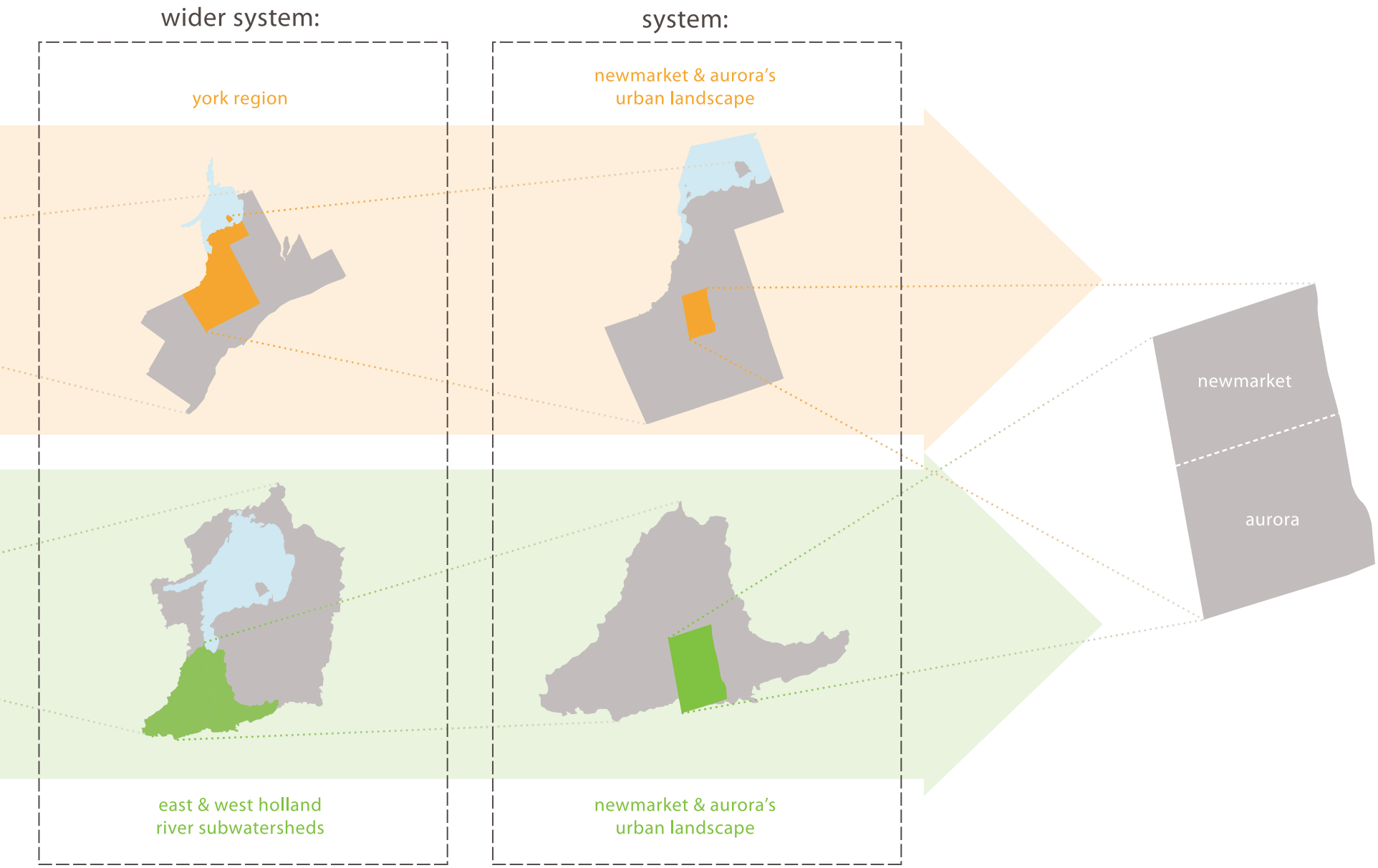


fig 2.29 hierarchy of natural and cultural ecosystems

This diagram illustrates the hierarchical structure of each scale of ecosystem that is being analysed. It demonstrates how each system, cultural or natural, is contained within a wider system.


wider system:
system:
york region
newmarket & aurora's
urban landscape
newmarket
aurora
east & west holland
river subwatersheds
newmarket & aurora's
urban landscape

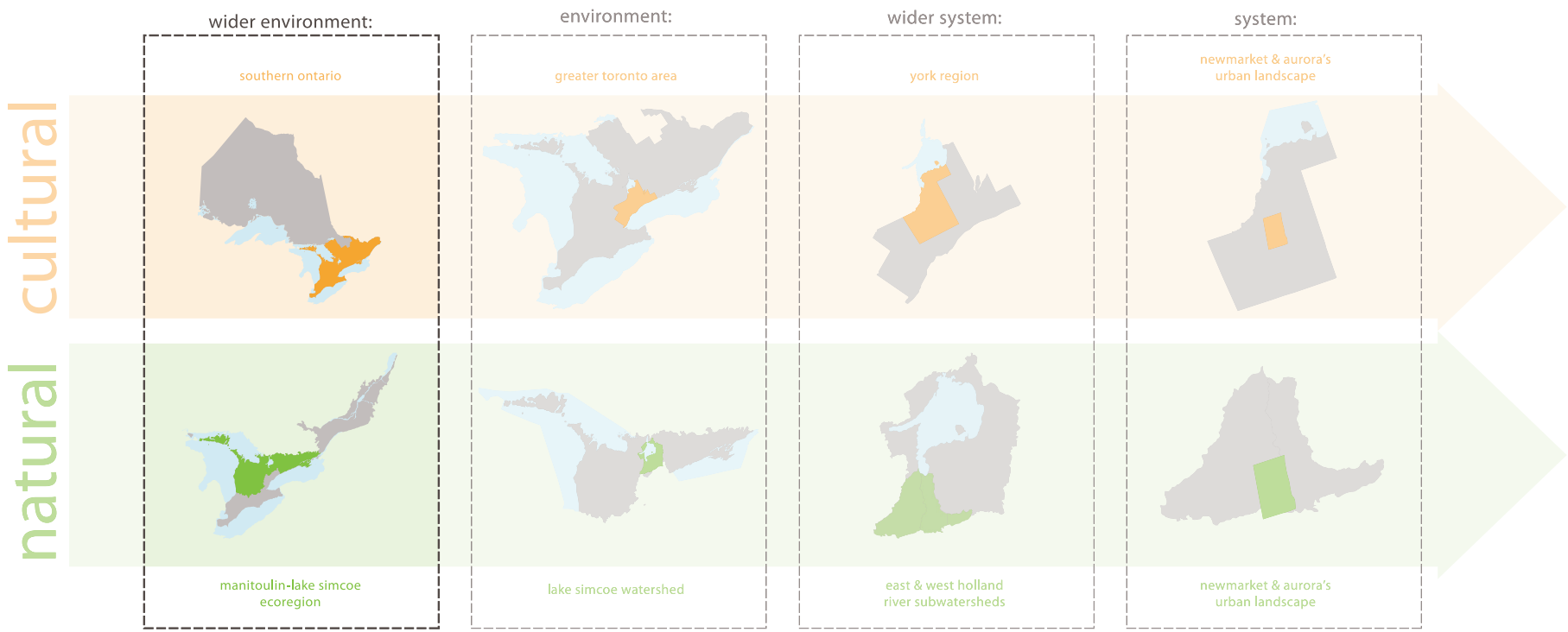


fig 2.30 hierarchy of natural and cultural ecosystems: wider environment
Southern Ontario (highlighted in orange), which is part of the provincial boundary of Ontario (shown in grey), defines the area of study for the cultural wider environment. The natural wider environment is defined by the Manitoulin-Lake Simcoe Ecoregion (highlighted in green), which is located within the Mixedwood Plains Ecozone (shown in grey).

wider environment

Analysis of the wider environment explores systems that function at the largest scale. These systems operate across a wide area, but impact the smaller systems as well. The wider cultural environment is defined by the Southern Ontario boundary. Cultural systems that function at this scale include: census divisions; urban development; major highway infrastructure; and the Ontario Greenbelt.

The natural systems that are relevant to the wider environment include geological land features, climate, precipitation, and soil types.

fig 2.31 southern ontario: census divisions

Southern Ontario is divided into many census divisions. These divisions include: single-tier municipalities, which are usually urban in nature, such as the City of Toronto and City of Ottawa; regional municipalities, such as the Regional Municipality of York; counties; and districts.

This map depicts the census divisions of Southern Ontario, and their census division code, as determined by Statistics Canada.

01 stormont, dundas, and glengarry united counties
02 prescott and russell united counties
06 ottawa division
07 leeds and grenville united counties
09 lanark county
10 frontenac county
11 lennox and addington county
12 hastings county
13 prince edward county
14 northumberland county
15 peterborough county
16 kawartha lakes division
18 durham regional municipality
19 york regional municipality
20 toronto division
21 peel regional municipality
22 dufferin county
23 wellington county
24 halton regional municipality
25 hamilton division
26 niagara regional municipality
28 haldimand-norfolk regional municipality
29 brant county
30 waterloo regional municipality
31 perth county
32 oxford county
34 eglin county
36 chatham-kent division
37 essex county
38 lambton county
39 middlesex county
40 huron county
41 bruce county
42 grey county
43 simcoe county
44 muskoka district municipality
46 haliburton county
47 renfrew county
49 parry sound district
51 manitoulin district

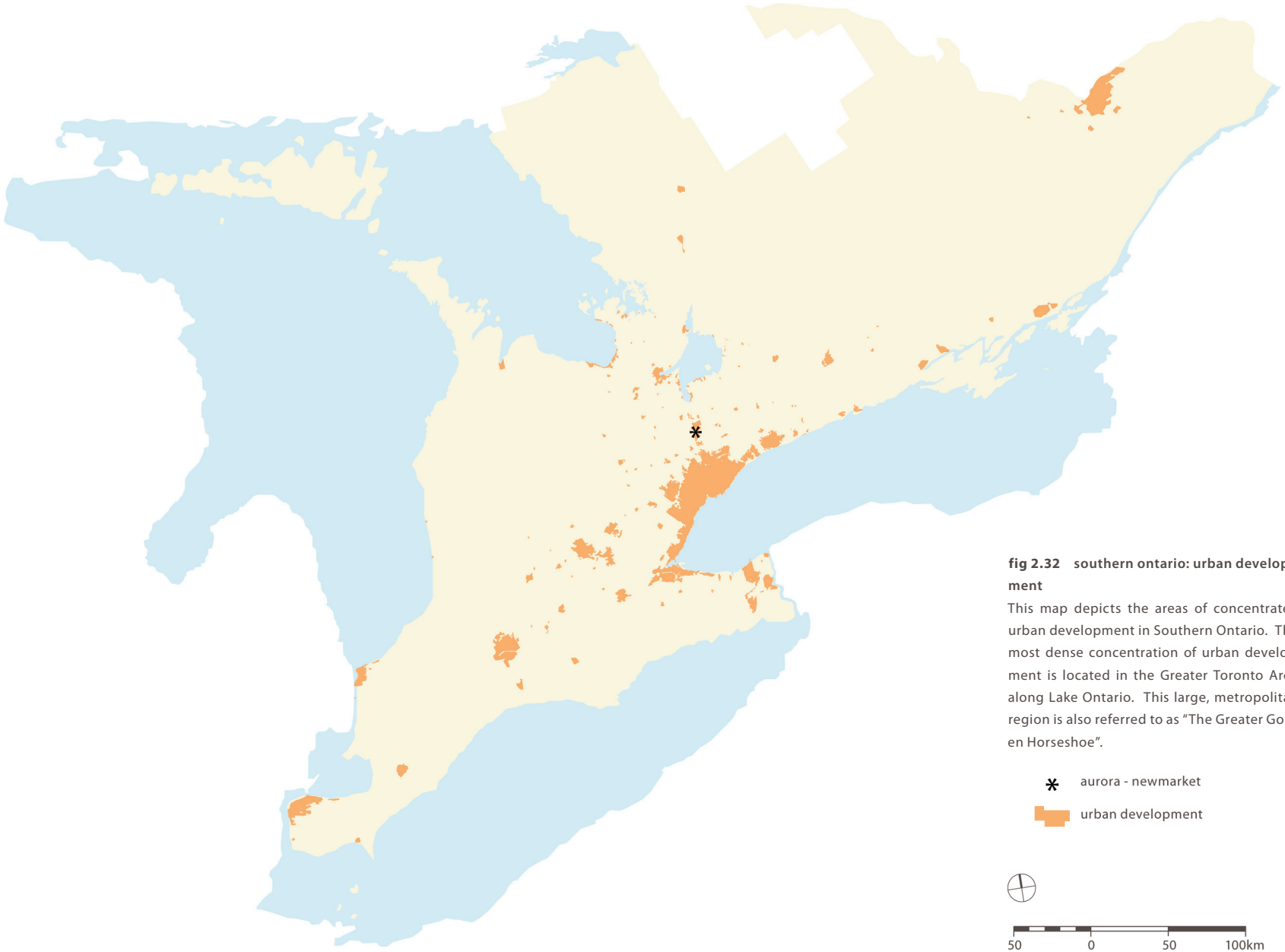


fig 2.32 southern ontario: urban development

This map depicts the areas of concentrated urban development in Southern Ontario. The most dense concentration of urban development is located in the Greater Toronto Area, along Lake Ontario. This large, metropolitan region is also referred to as "The Greater Golden Horseshoe".

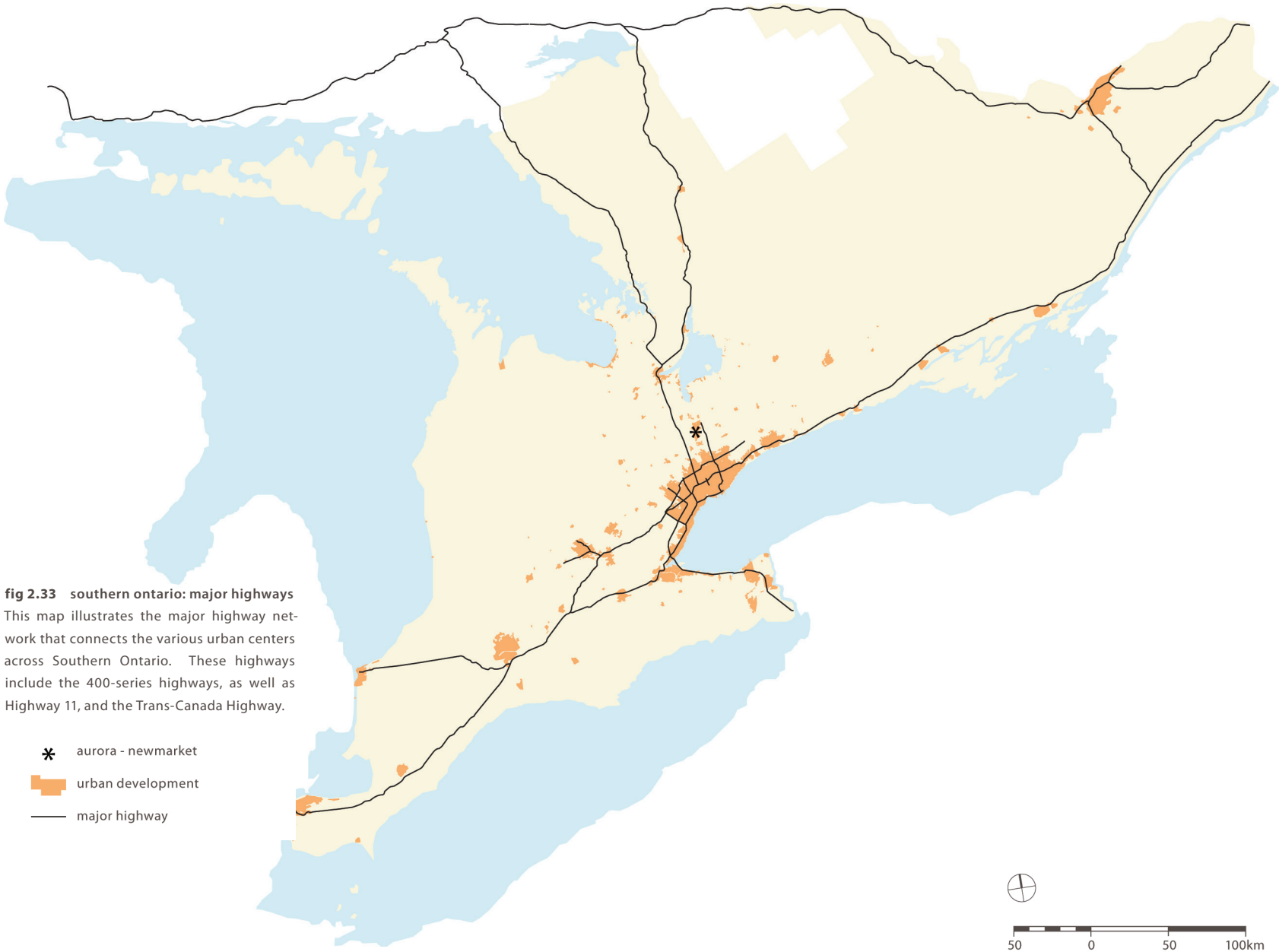


fig 2.33 southern ontario: major highways
This map illustrates the major highway network that connects the various urban centers across Southern Ontario. These highways include the 400-series highways, as well as Highway 11, and the Trans-Canada Highway.

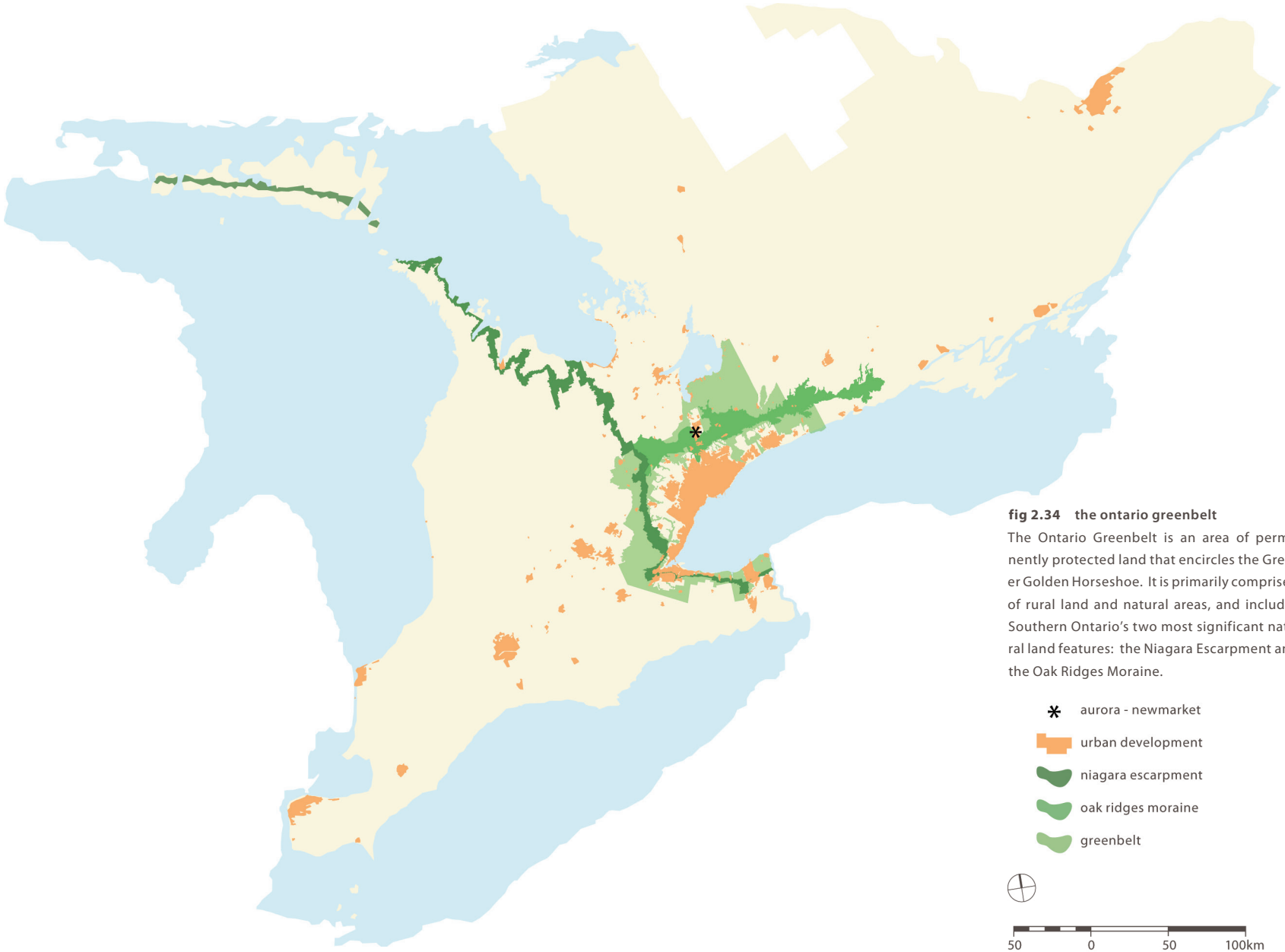


fig 2.34 the ontario greenbelt

The Ontario Greenbelt is an area of permanently protected land that encircles the Greater Golden Horseshoe. It is primarily comprised of rural land and natural areas, and includes Southern Ontario's two most significant natural land features: the Niagara Escarpment and the Oak Ridges Moraine.

fig 2.35 manitoulin-lake simcoe ecoregion: natural land features

There are two main natural land features that are a significant part of the Manitoulin-Lake Simcoe Ecoregion: the Niagara Escarpment and the Oak Ridges Moraine.

The Niagara Escarpment is a prominent topographical and hydrological feature in Southern Ontario. Its diverse ecosystem supports a wide range of flora and fauna, including 300 species of birds, 53 of mammals, 36 of reptiles and amphibians , and 90 species of fish.[21]

The Oak Ridges Moraine is a unique and environmentally sensitive geological landform that is characterised by an irregular ridge of sandy, rolling hills. It also provides a habitat for many sensitive and threatened species of plants and animals.[22]

Both the Niagara Escarpment and the Oak Ridges Moraine are important hydrological features that contain the headwaters for many rivers in the region. They are also important areas of groundwater recharge.

21 *About the Niagara Escarpment*. Retrieved July 30, 2010 from Ontario's Niagara Escarpment. <http://www.escarpment.org/about/index.php>.

22 *More Facts about the Oak Ridges Moraine* Retrieved July 30, 2010 from Ontario Ministry of Municipal Affairs and Housing. <http://www.mah.gov.on.ca/Page1705.aspx>.

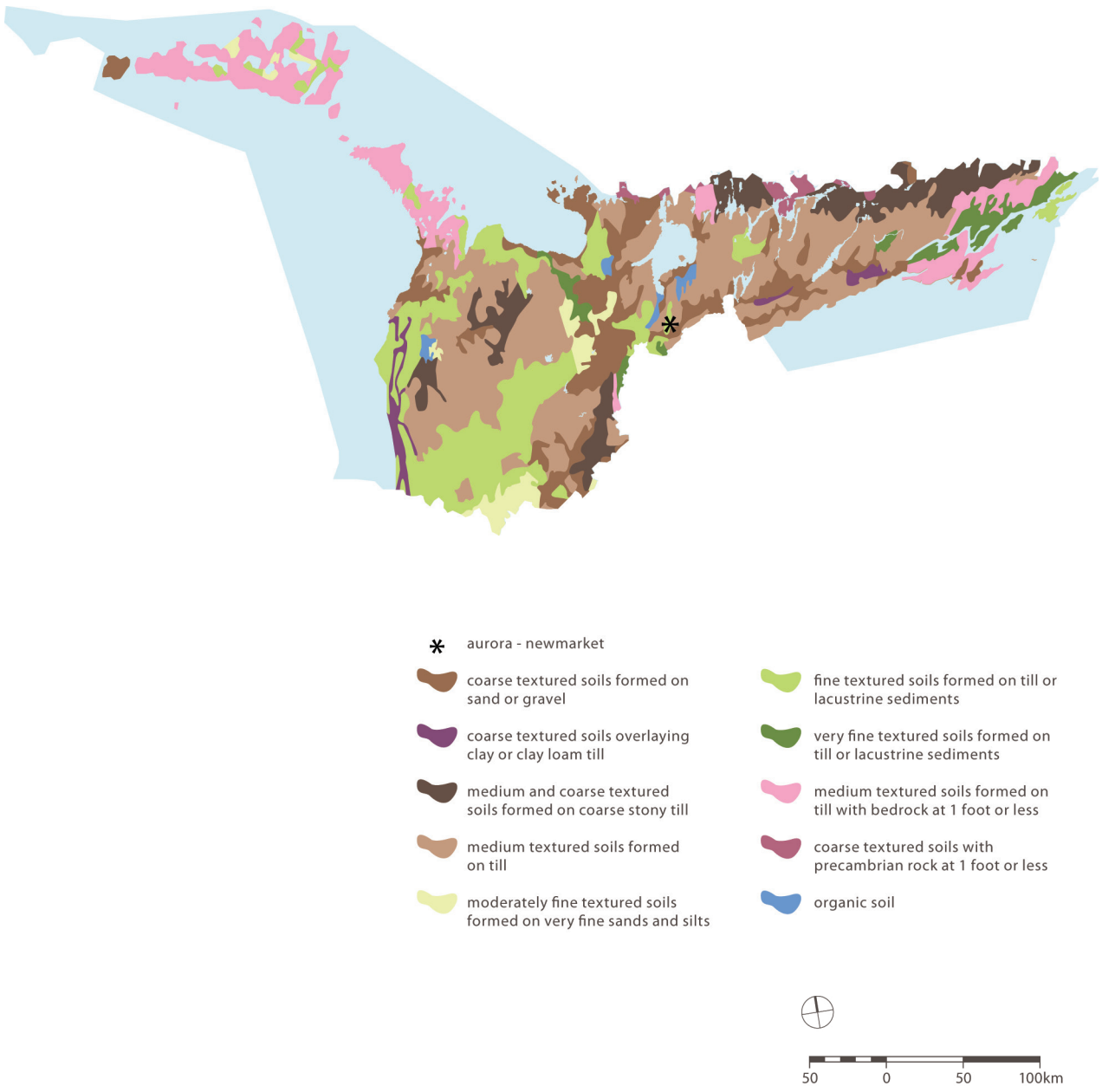


fig 2.36 manitoulin-lake simcoe ecoregion: soil types

Soils are the foundation of terrestrial ecosystems,[23] where nutrients, minerals, and water are stored to provide nourishment for vegetation and wildlife. Soil conditions are a significant factor in determining the types of forests and vegetation that can grow in a particular region. They are also important in determining the viability of agriculture, and the types of crops that are suitable in a given area.

The Manitoulin-Lake Simcoe Ecoregion is largely dominated by rich, fertile soil that is well suited for many types of agriculture. This map depicts the various soil types and textures that are present in the region.

23 *Soils*. Retrieved July 30, 2010 from Natural Resources Canada. <http://sof.eomf.on.ca/introduction/Physical_Geography/Soils/soils_e.htm>.

These maps illustrate the mean daily minimum temperatures in January and July for the Manitoulin-Lake Simcoe Ecoregion. The climate in this ecoregion is 'humid continental', consisting of warm summers and cold winters. The surrounding Great Lakes act to moderate temperatures in the summer and winter, reducing temperature extremes.

fig 2.37 mean daily minimum temperature for january (°C)

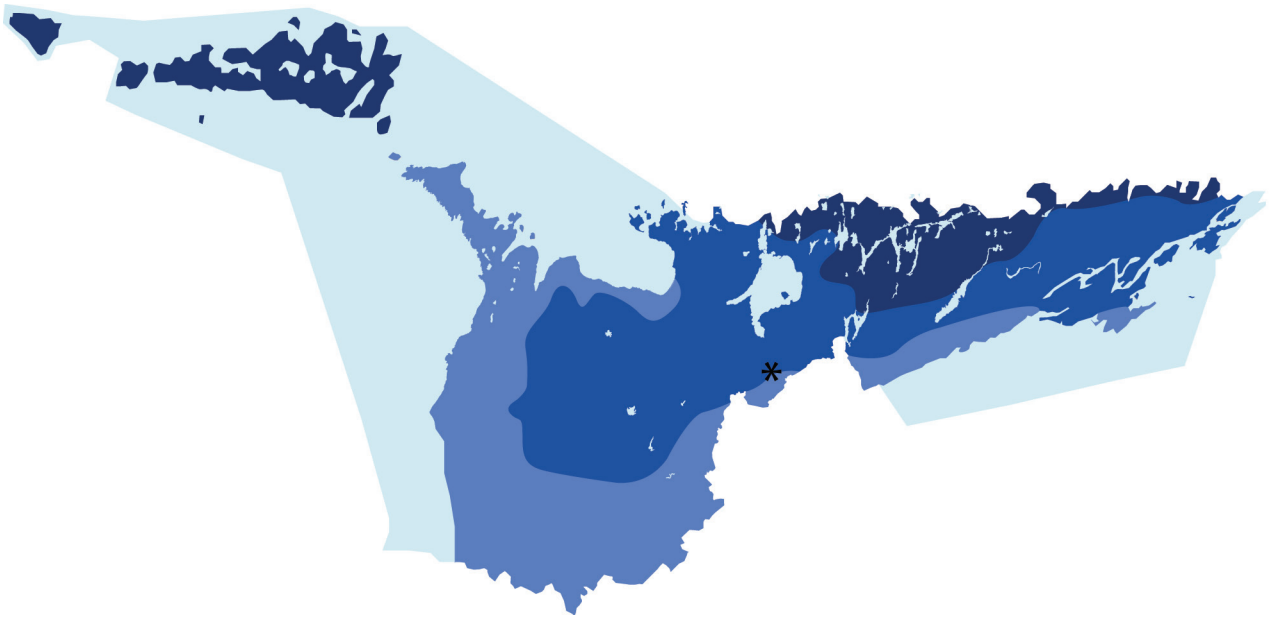
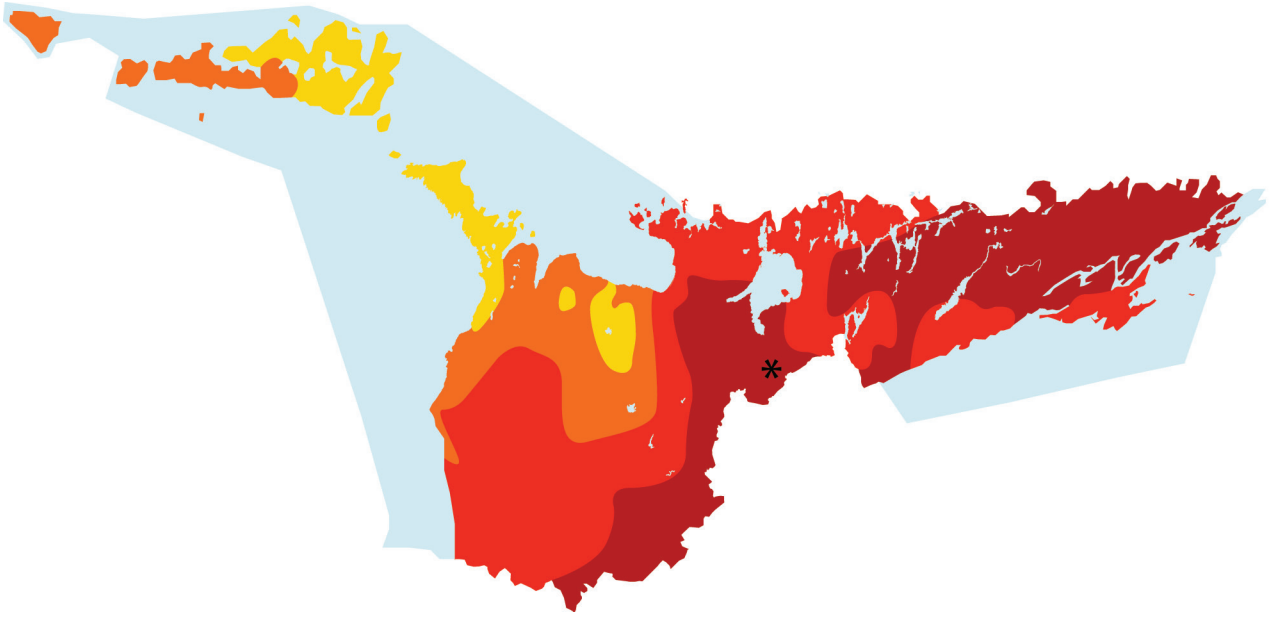
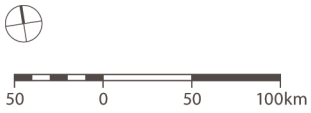


fig 2.38 mean daily minimum temperature for july (°C)





The Great Lakes influence the humidity and precipitation in the Manitoulin-Lake Simcoe Ecoregion. Precipitation in the summer months tends to be evenly distributed across the region. In the winter months, however, winds sweep across Lake Huron, collecting moisture, which is deposited along a snowbelt on the leeward side of the Lake.

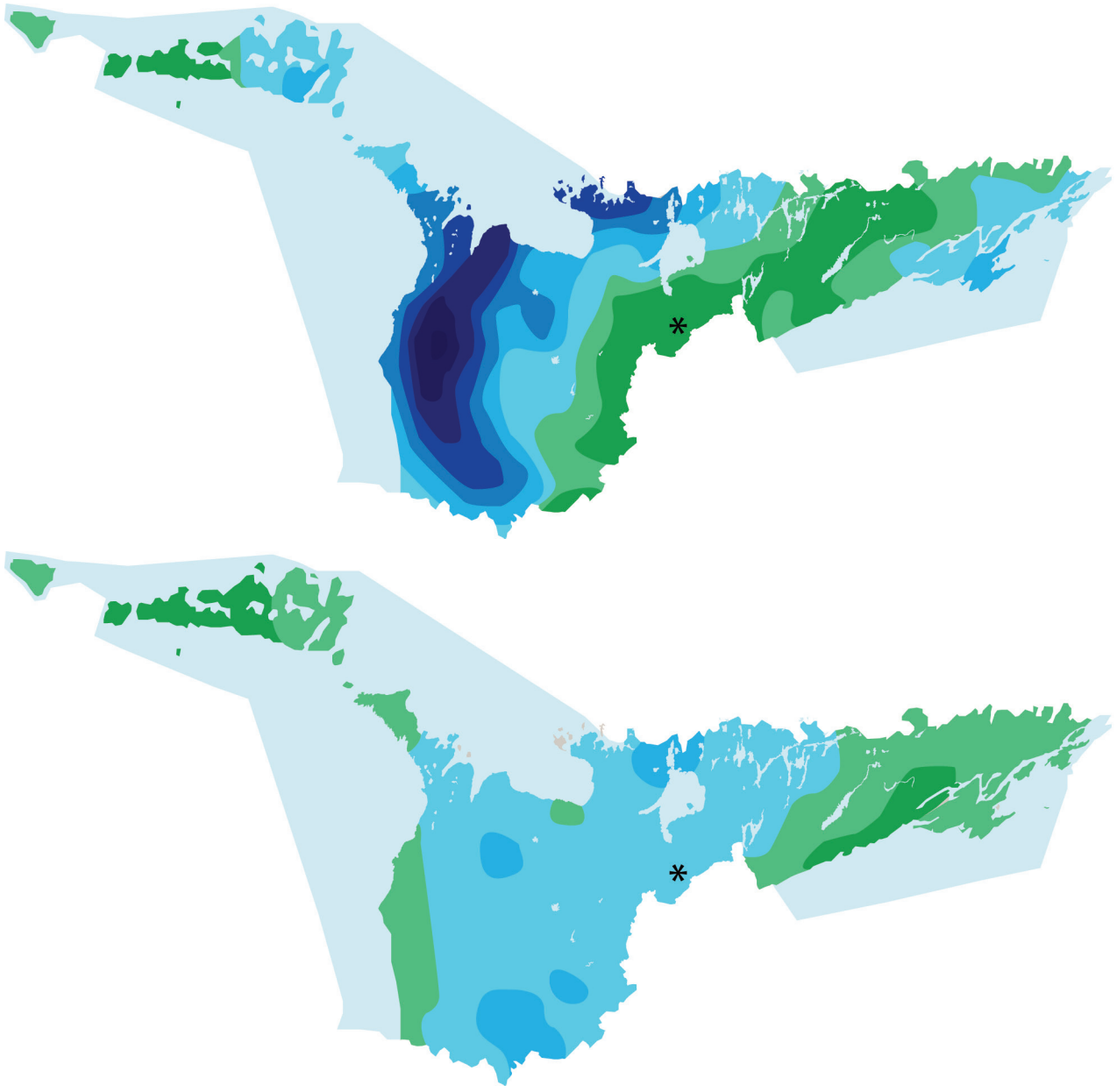


fig 2.39 monthly total precipitation for january

fig 2.40 monthly total precipitation for july

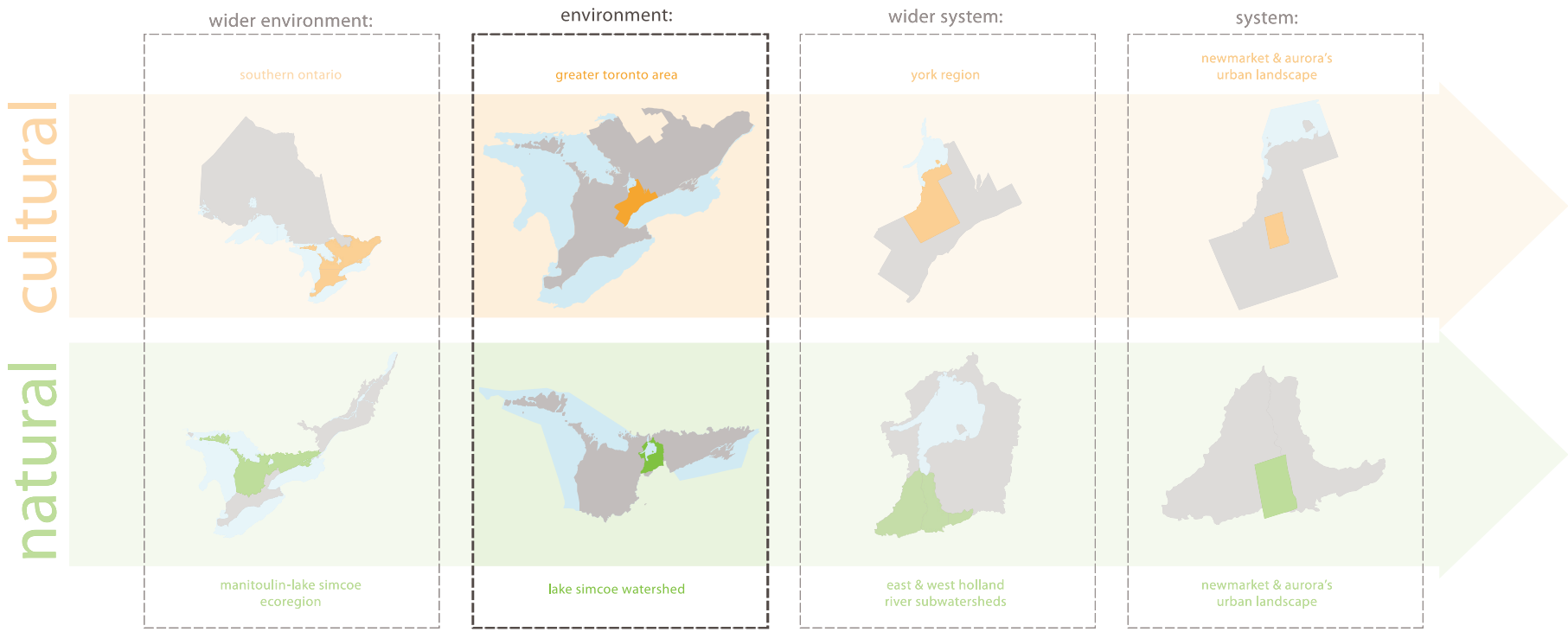


fig 2.41 hierarchy of natural and cultural ecosystems: environment

Cultural analysis at the 'environment' scale is defined by the municipal boundaries of the Greater Toronto Area (highlighted in orange). Natural analysis is conducted within the Lake Simcoe Watershed boundary (highlighted in green).

environment

The Greater Toronto Area provides the boundary for which the cultural systems are analysed at the "environment" scale. Systems that function at this scale have little effect on the wider environment, but have a significant impact on the wider system and local system. Analysis includes an exploration of the following systems: urban development; regional boundaries; highway, railway, and public transportation infrastructure; employment zones; transportation methods; and housing densities.

Natural analysis at the environment scale is examined within the Lake Simcoe Watershed. Analysis includes: natural features, soil types, forest coverage, wetlands, urbanized and cultivated land, and subwatershed boundaries.

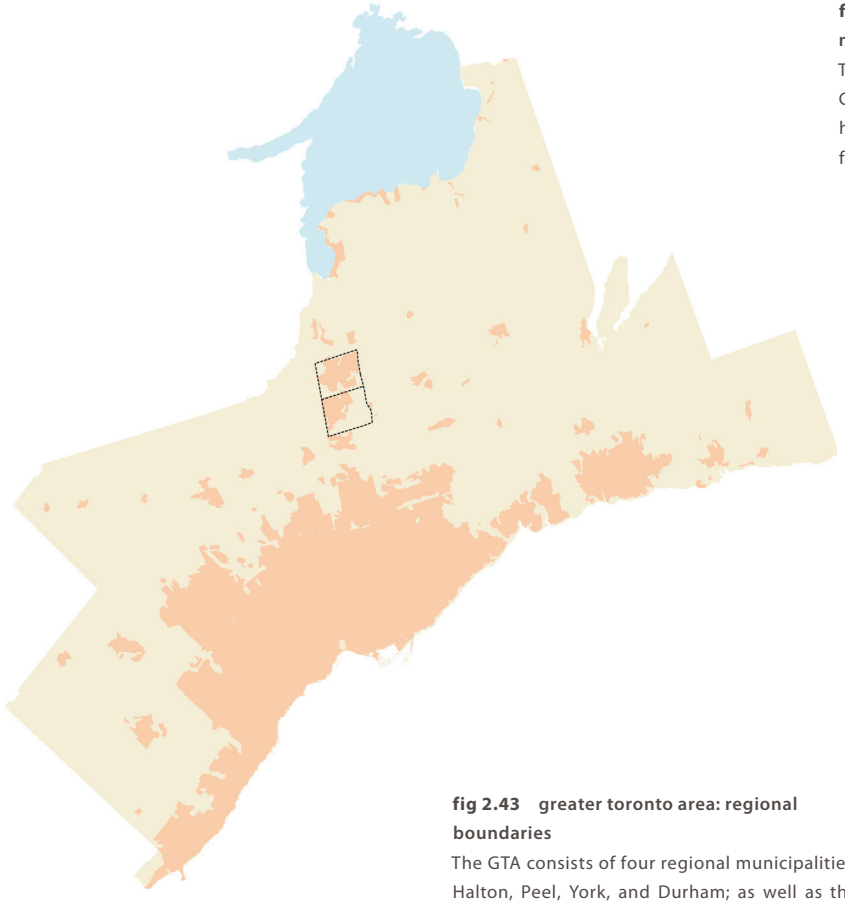


fig 2.42 greater toronto area: urban development

This map illustrates urban development in the GTA. In the last several decades, urban sprawl has filled in the gaps between urban centres, forming a single metropolis or 'mega city'.

aurora - newmarket municipal boundary

urban development

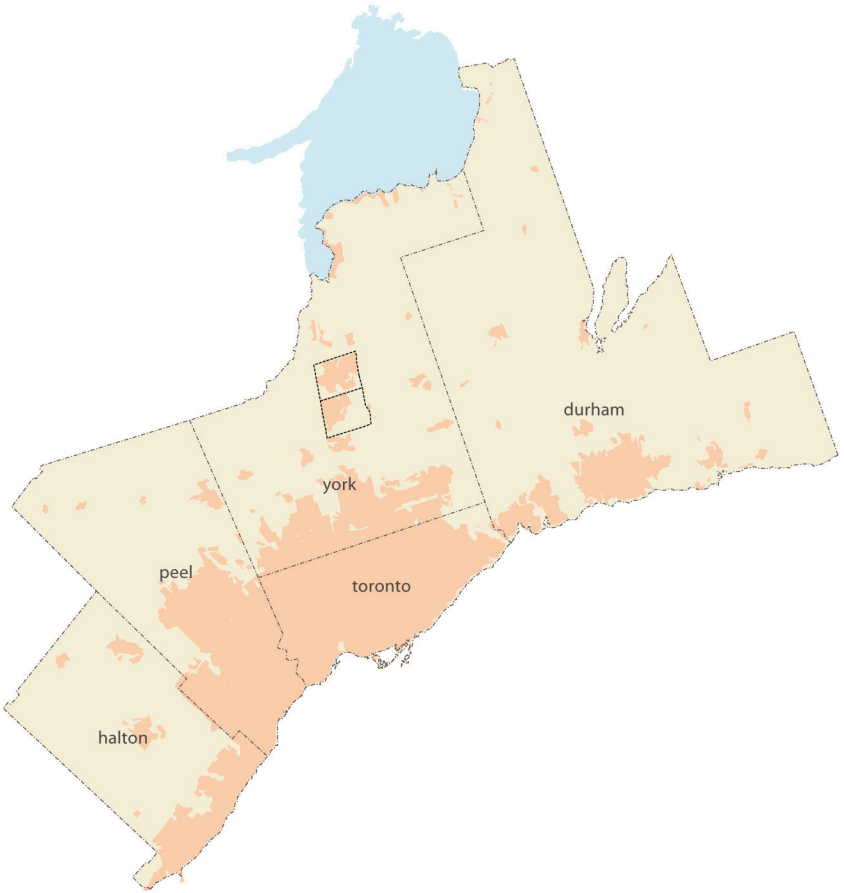


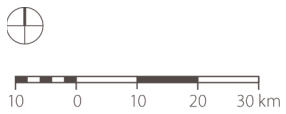
fig 2.43 greater toronto area: regional boundaries

The GTA consists of four regional municipalities: Halton, Peel, York, and Durham; as well as the City of Toronto.

aurora - newmarket municipal boundary

urban development

regional boundary



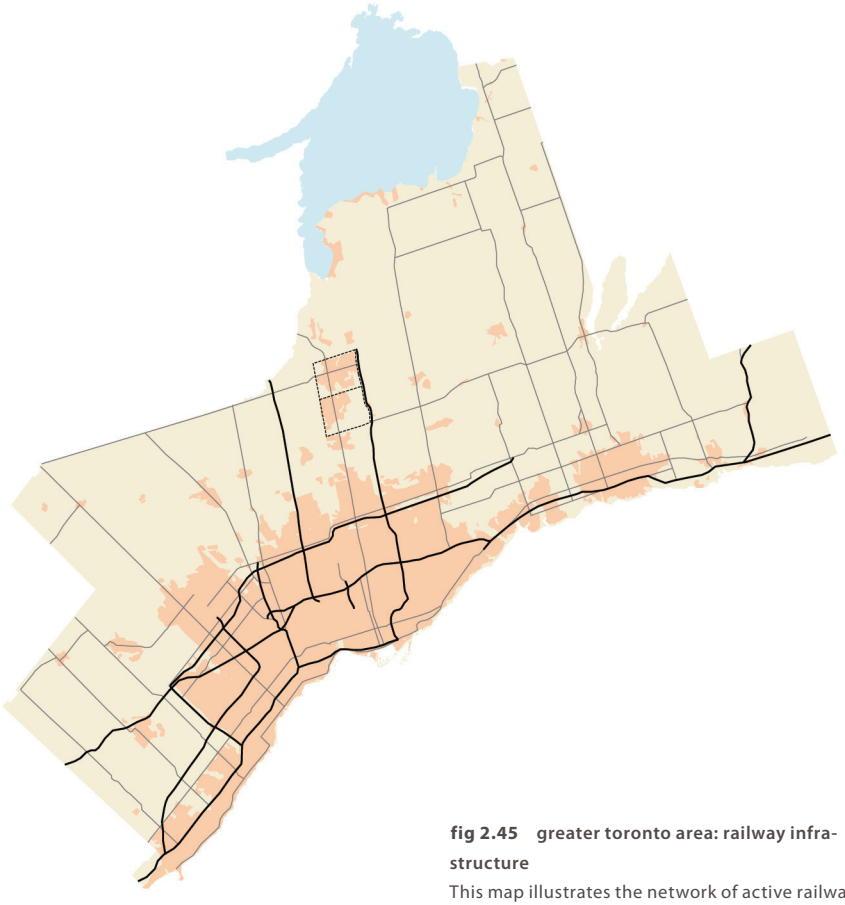


fig 2.44 greater toronto area: highway infrastructure
This map depicts the major 400-series highways, as well as the other provincial highways that create regional connections across the GTA.

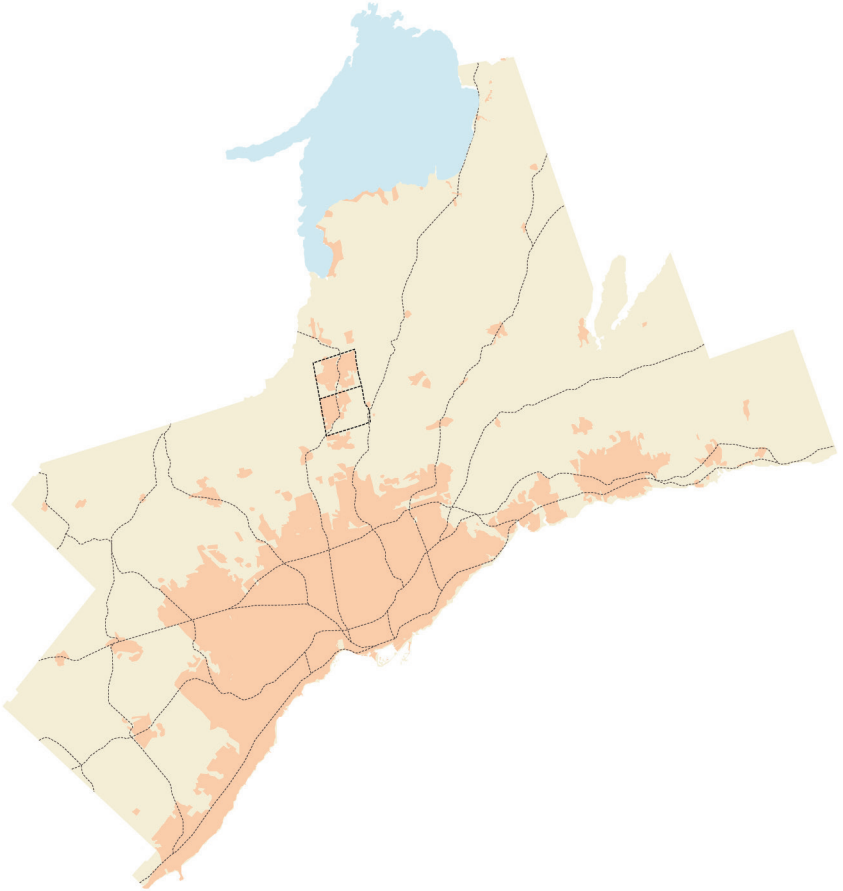
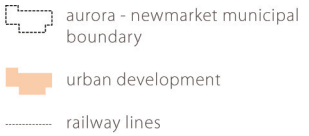
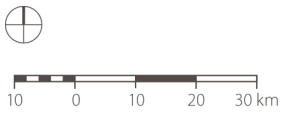


fig 2.45 greater toronto area: railway infrastructure
This map illustrates the network of active railway lines in the GTA.





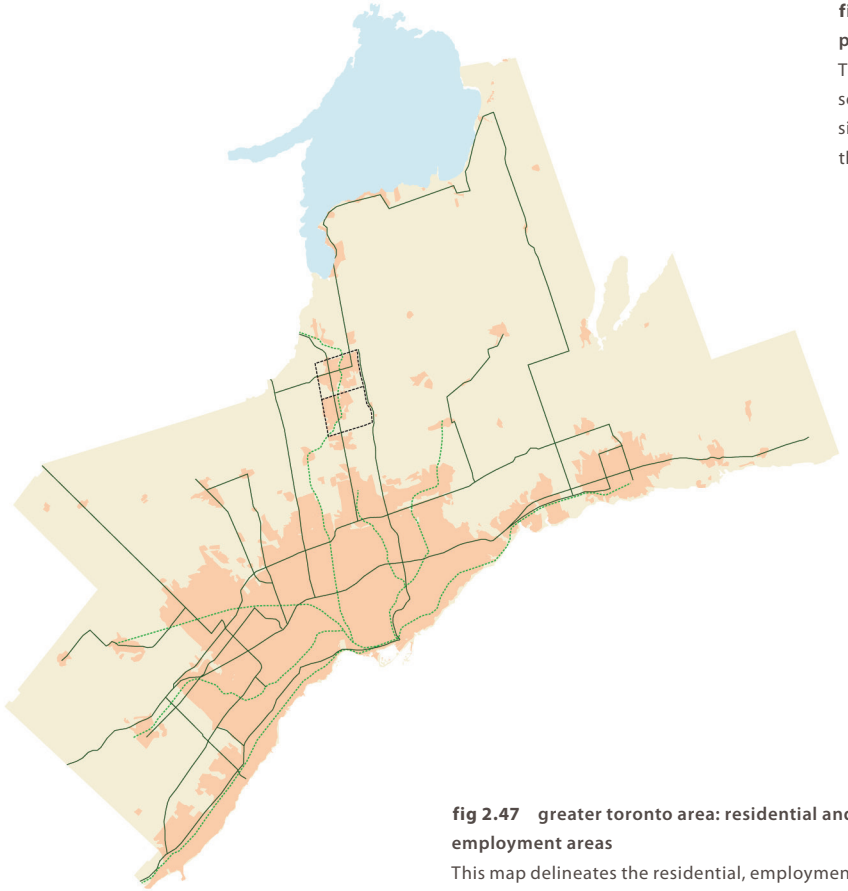


fig 2.46 greater toronto area: public transportation

The primary public transportation system that services the Greater Toronto Area is the GO Transit system. It is an interregional transit service that includes both train lines and bus routes.

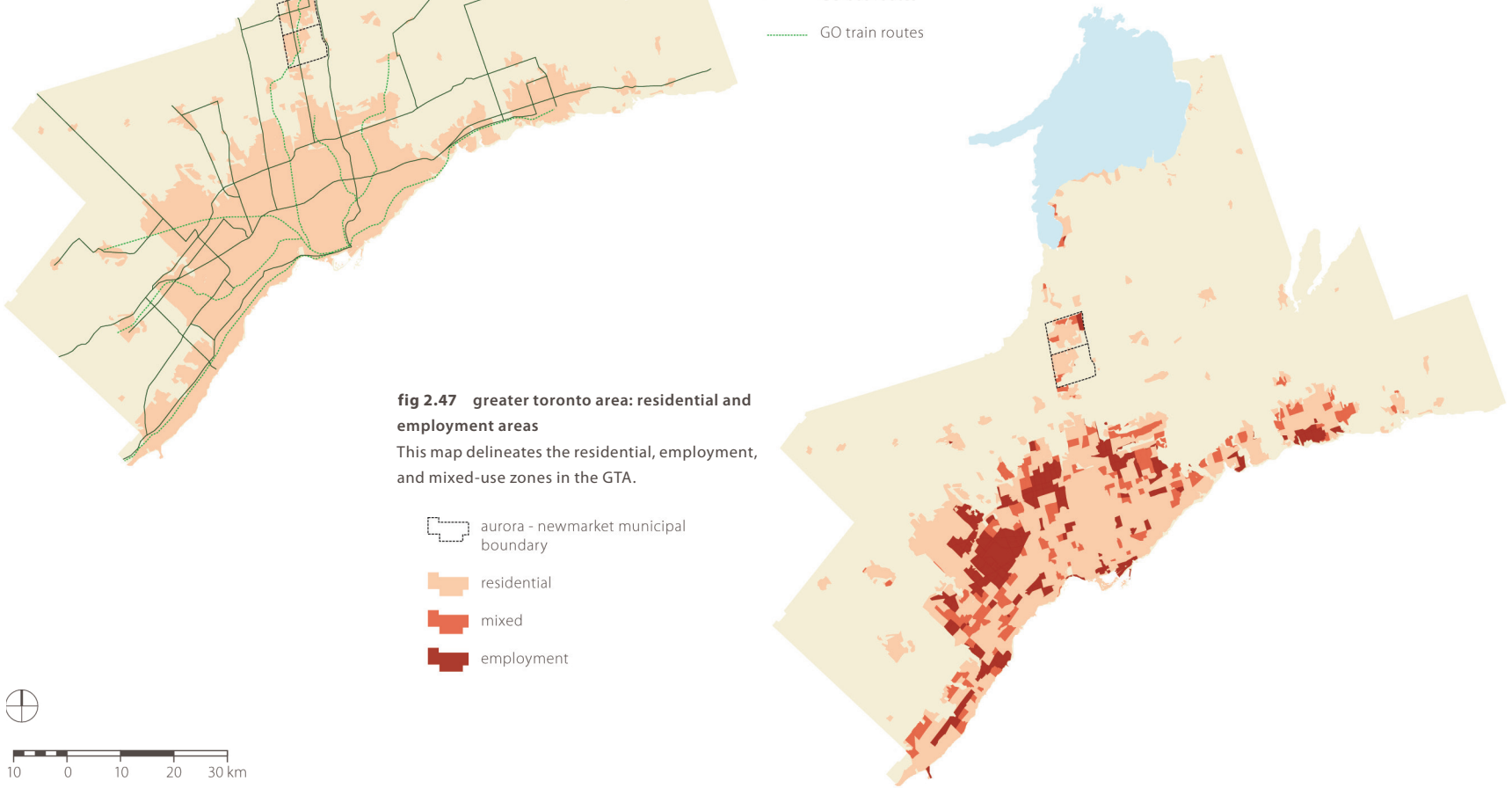


fig 2.47 greater toronto area: residential and employment areas

This map delineates the residential, employment, and mixed-use zones in the GTA.

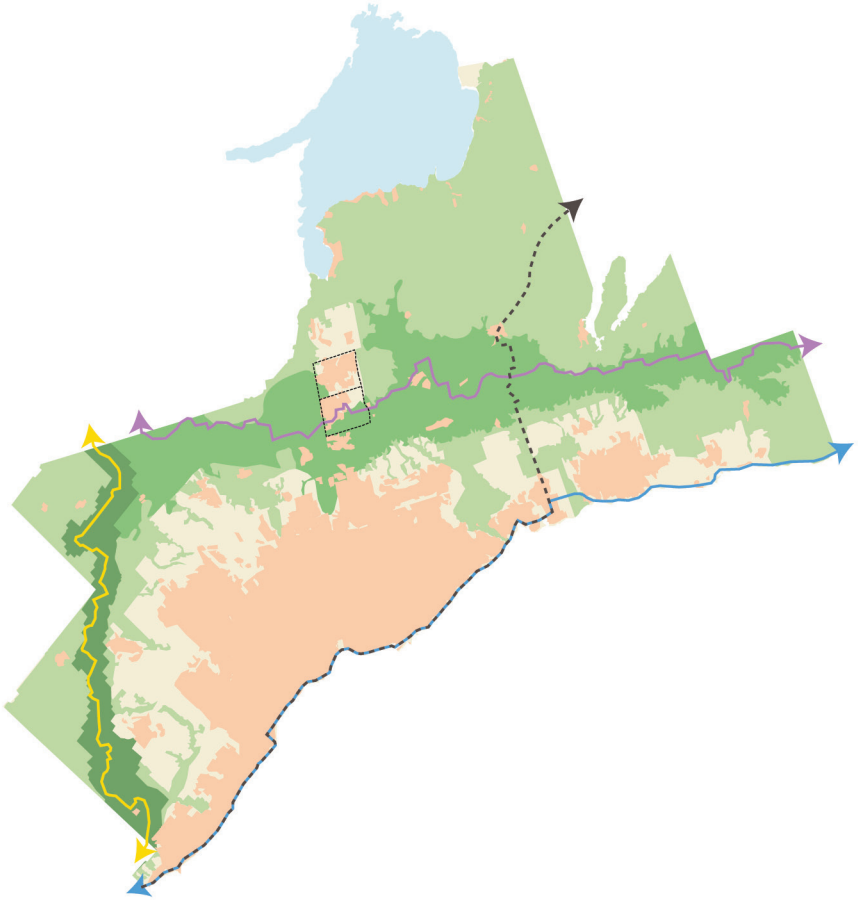


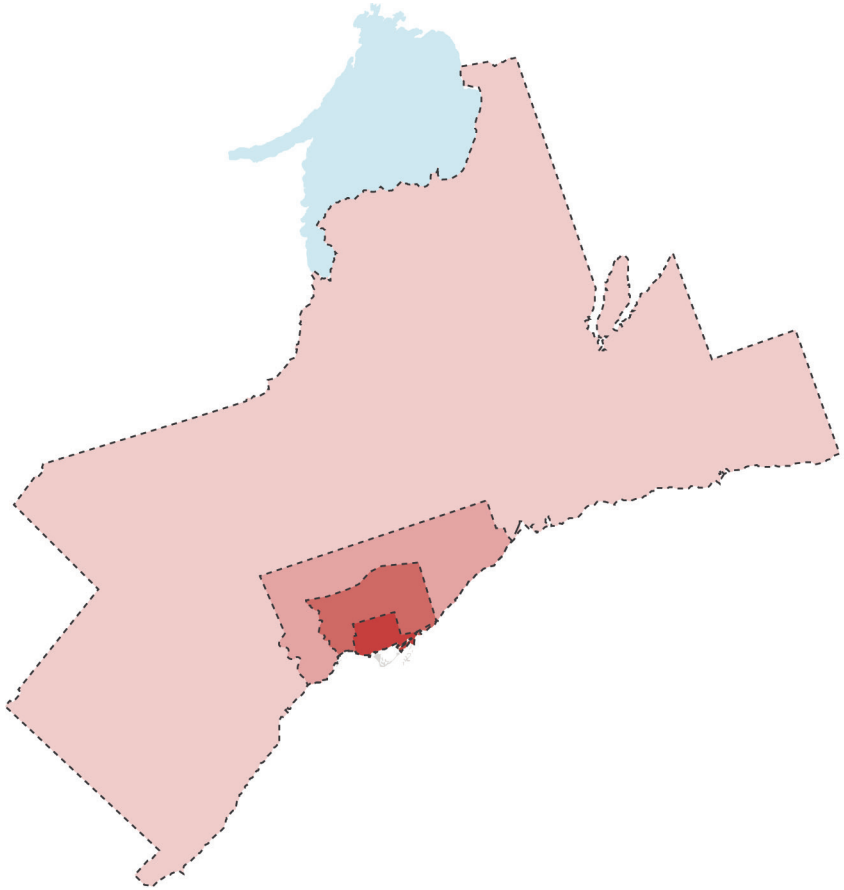
fig 2.48 greater toronto area: interregional trail networks

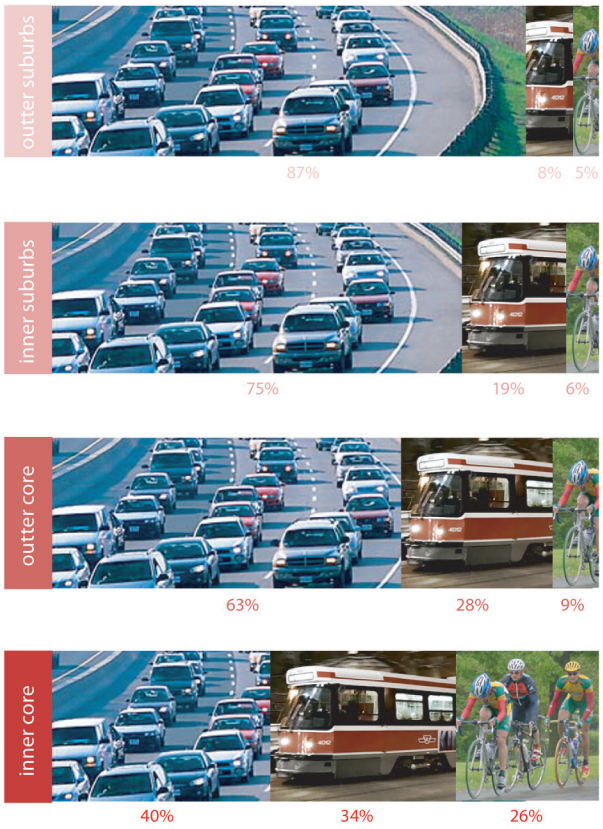
This map illustrates the regional trail networks that are present in the Greater Toronto Area, and how they relate to the Ontario Greenbelt and significant natural features.

The Oak Ridges Trail is an east-west trail that runs the length of the Oak Ridges Moraine. It connects to the Bruce Trail on the west edge of the moraine. The Bruce Trail follows the Niagara Escarpment, from the Niagara region to Tobermory. The Waterfront Trail follows the edge of Lake Ontario. A large section of the Waterfront Trail is also part of the Trans Canada Trail.

- aurora - newmarket municipal boundary
- urban development
- greenbelt
- oak ridges moraine
- niagara escarpment
- oak ridges trail
- bruce trail
- waterfront trail
- trans canada trail
- waterfront/trans canada trail

10 0 10 20 30 km





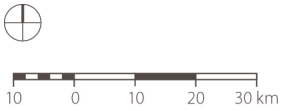
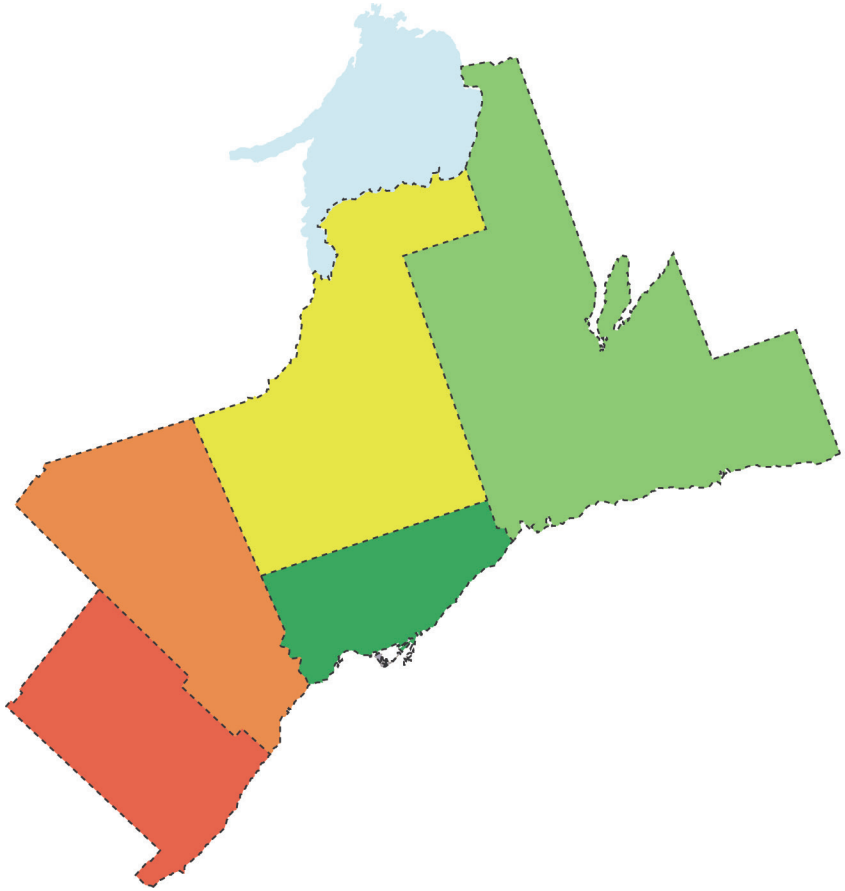


fig 2.49 greater toronto area: methods of transportation

This diagram illustrates how the uses of primary modes of transportation (automobiles, public transit, and walking/cycling) are distributed across the GTA. Automobile use increases dramatically as one moves further from the downtown core, while the use of bicycle, pedestrian, and public transportation methods decreases.



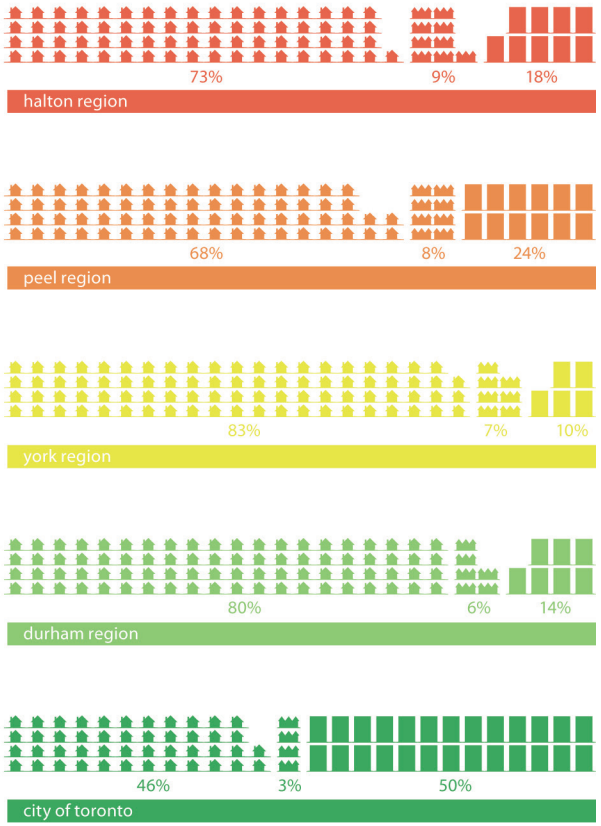


fig 2.50 greater toronto area: housing density

This diagram illustrates the distrubution of residential densities per region (low, medium, and high). The City of Toronto has the highest housing density, while York Region has the lowest.

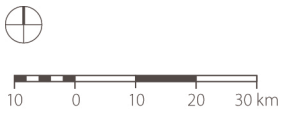


fig 2.51 simcoe watershed: natural features
This map illustrates the most prominent natural features that are located within the Simcoe Watershed. These are the Oak Ridges Moraine and the Holland Marsh. The Holland Marsh is a swath of land that is located in the floodlands of the Holland River, and boasts rich, fertile, organic soil. For this reason, it is prime agricultural land.

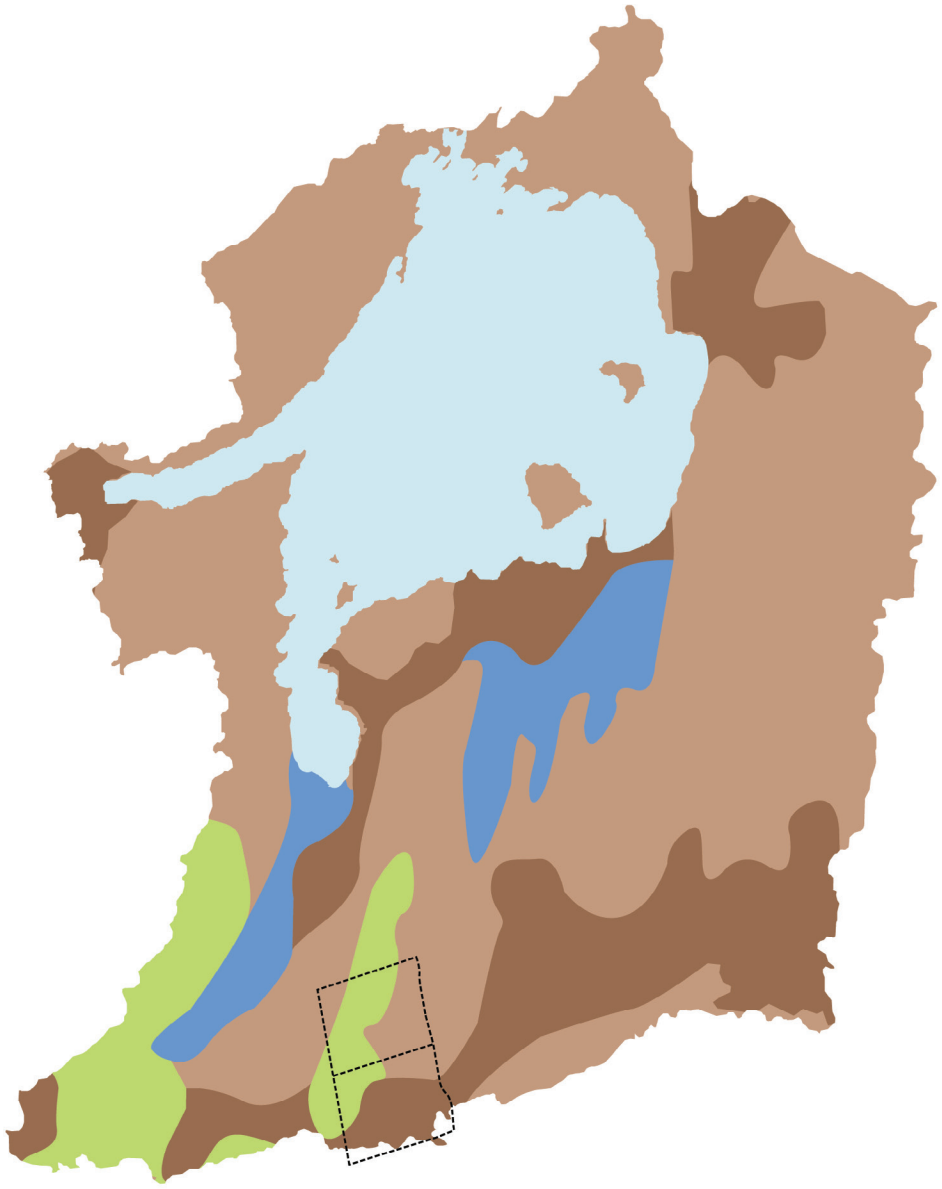
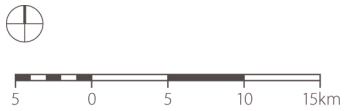
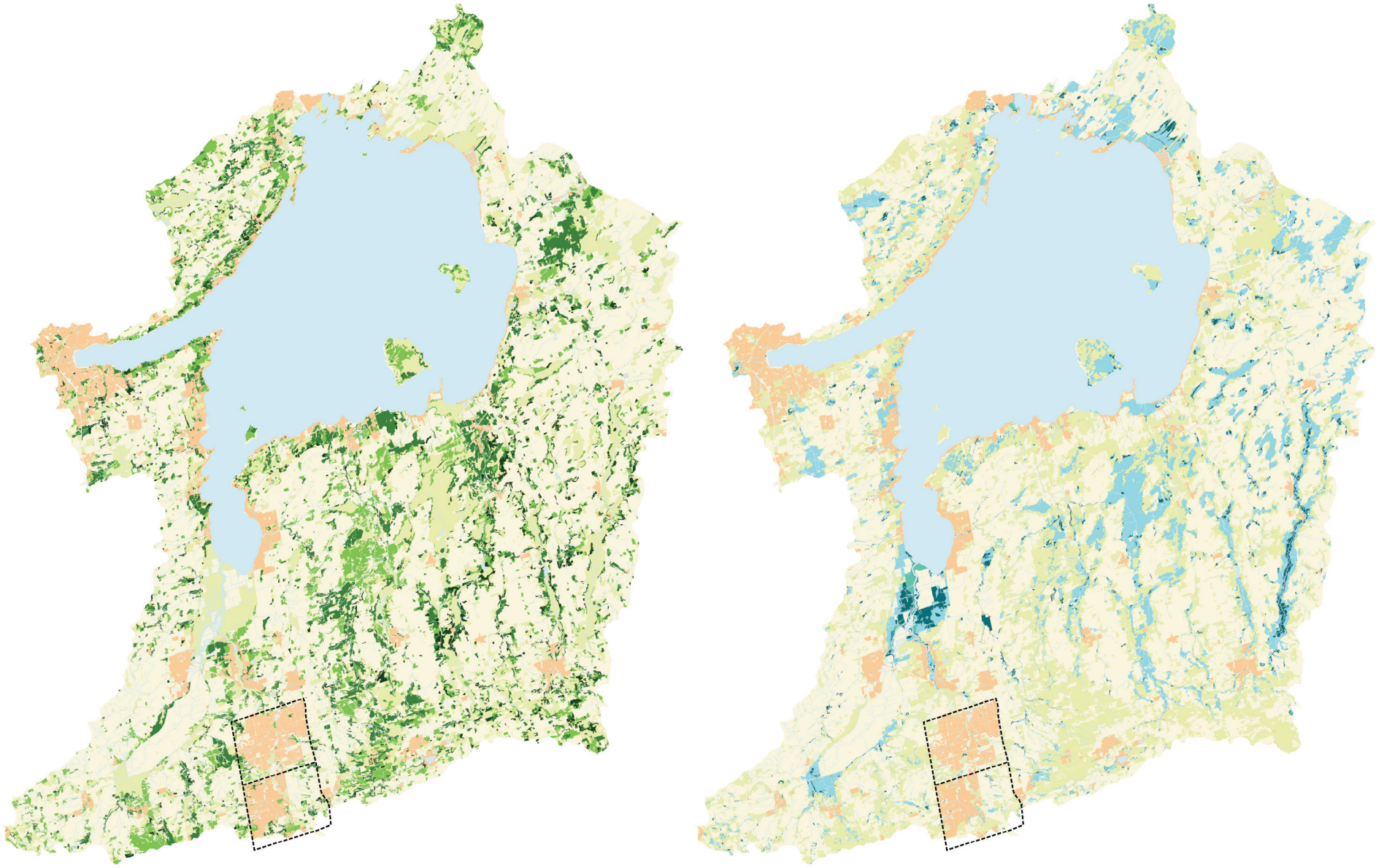
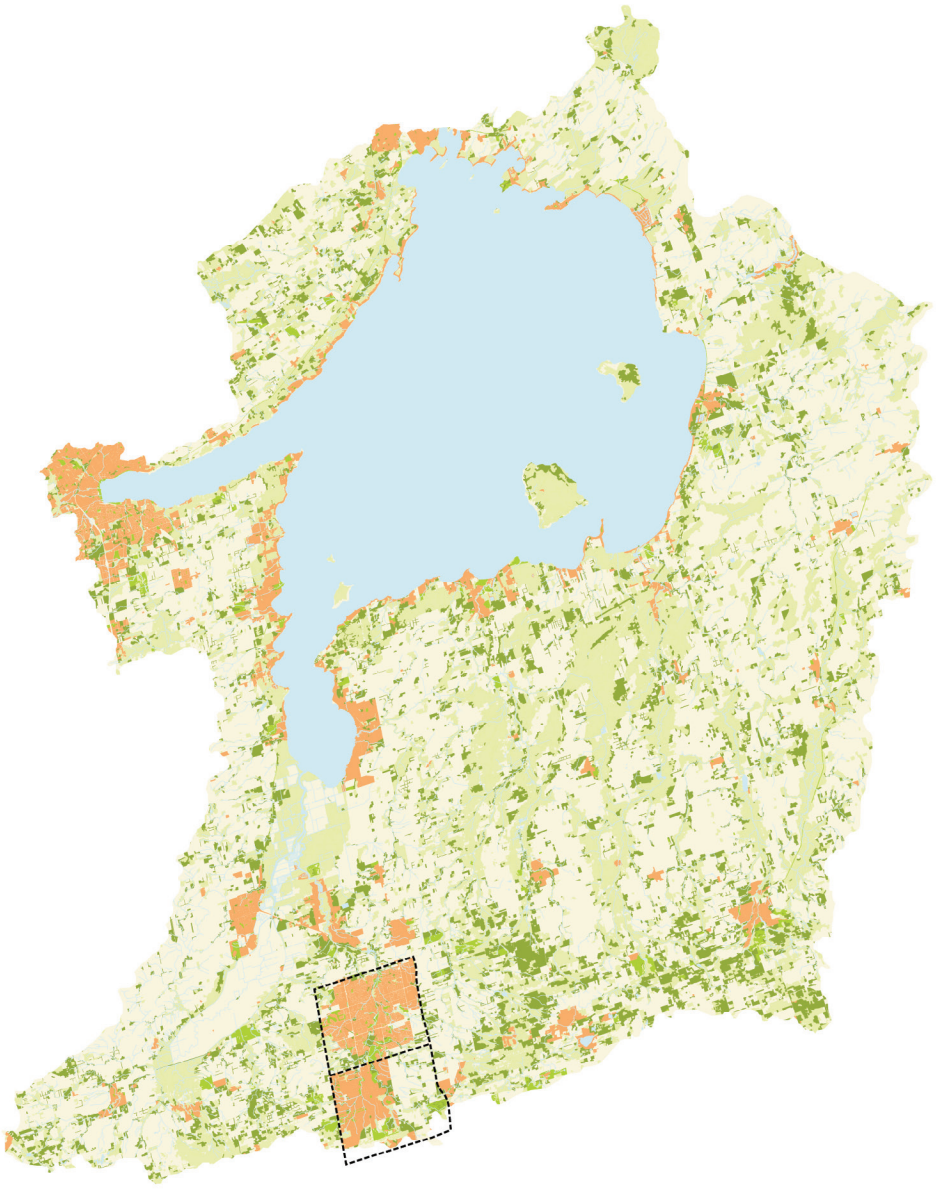


fig 2.52 simcoe watershed: soils

The most dominant soil type in the Simcoe Watershed is characterized by medium textured soil formed on till. Coarse textured soils formed on sand or gravel are also found throughout the watershed, as well as fine textured soils formed on till or lacustrine sediments. Organic soil is located along the Holland Marsh, and in a small pocket of land south of Lake Simcoe.







(far left)

fig 2.53 simcoe watershed: forest coverage

This map illustrates the forest coverage in the Simcoe Watershed. It delineates the areas of deciduous, mixed, and coniferous forest cover.

- aurora - newmarket municipal boundary
- open water
- urban
- agriculture
- coniferous forest
- deciduous forest
- mixed forest
- other green space

(centre)

fig 2.54 simcoe watershed: wetland classification

This map isolates the wetlands in the watershed, which are categorized as a fen, marsh, swamp, or aquatic wetland.

- aurora - newmarket municipal boundary
- open water
- urban
- agriculture
- fen
- marsh
- aquatic
- swamp
- other green space

(right)

fig 2.55 simcoe watershed: urbanized and cultural communities

This map isolates areas that are classified as cultural communities and manicured open space. Cultural communities are defined as "a vegetation community originating from, or maintained by, anthropogenic influences and culturally-based disturbances; often containing a large proportion of non-native species"[24] They include meadows, plantations, thickets, and woodlands.

24 Lee, H.T., W.D. Bakowsky, J. Riley, J. Bowles, M. Puddister, P. Uhlig and S. McMurray. 1998. *Ecological Land Classification for Southern Ontario: First Approximation and its Application*. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02.

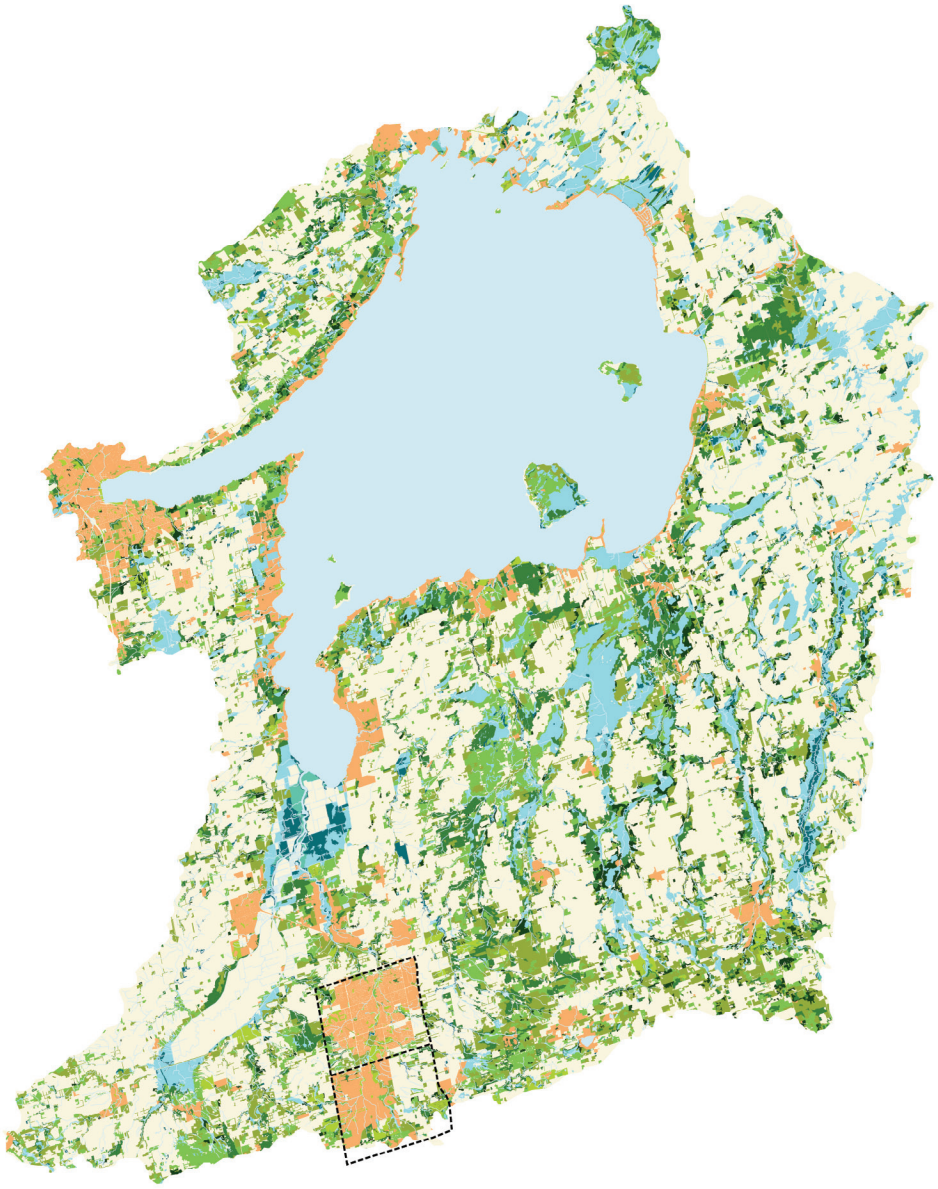
- aurora - newmarket municipal boundary
- open water
- urban
- agriculture
- manicured open space
- cultural community
- other green space

5 0 5 10 15km

fig 2.56 simcoe watershed: complete ecological land classification

This map illustrates the each layer of ecological land classification for the Simcoe Watershed, including urban areas, cultural communities (meadows, plantations, woodlands, and thickets), wetlands (fens, marshes, aquatics, and swamps), forests, and agricultural land. Natural areas, such as woodlands and wetlands, consist of 35% of the watershed's total land area. However much of these natural areas exist in a fragmented state.[25]

25 *Lake Simcoe Protection Plan, 2009.* Lake Simcoe Region Conservation Authority, July 2009, p.41.



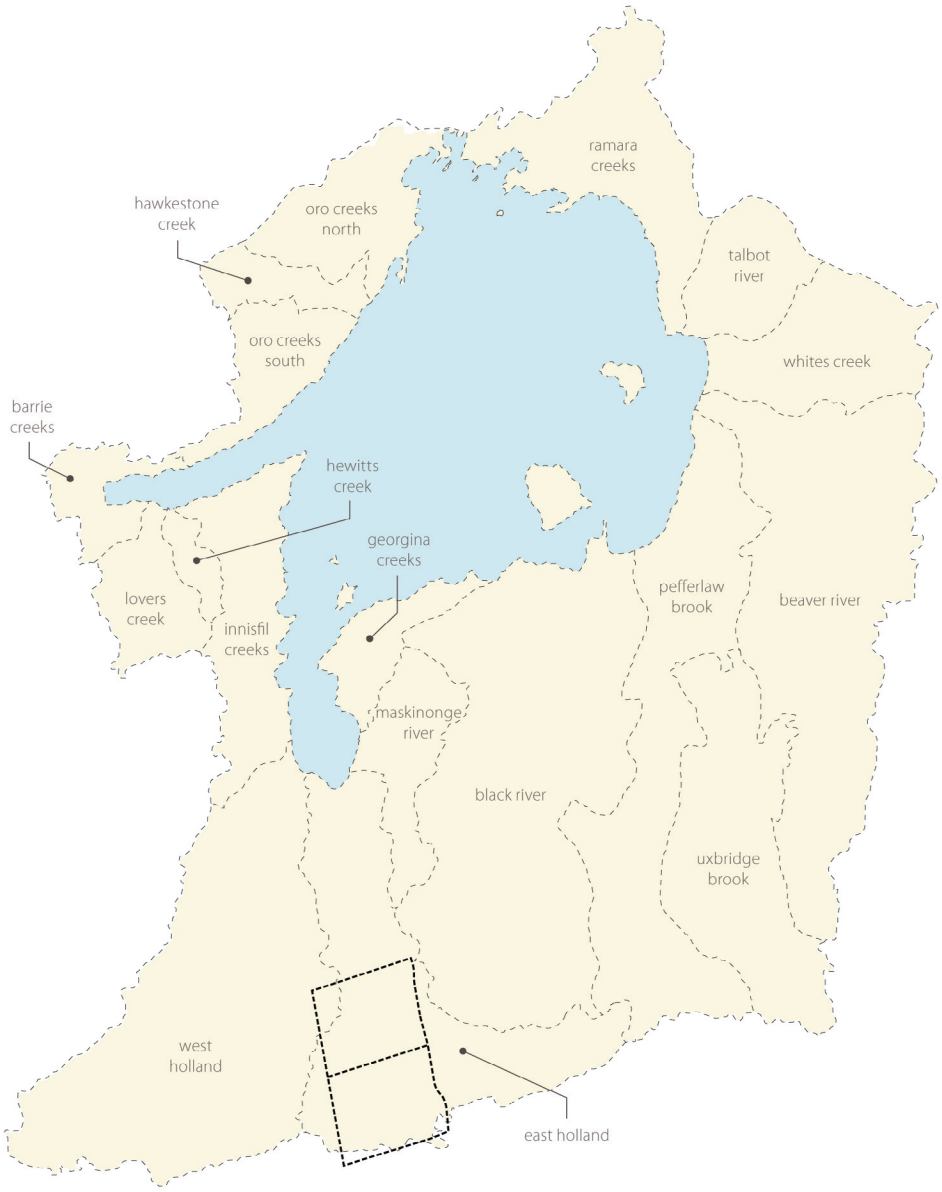


fig 2.57 simcoe watershed: subwatersheds
The Lake Simcoe Watershed is divided into 18 subwatersheds, which include the East Holland River Subwatershed, and the West Holland River Subwatershed, on which Newmarket and Aurora are located.

aurora - newmarket municipal boundary

subwatershed

5 0 5 10 15km

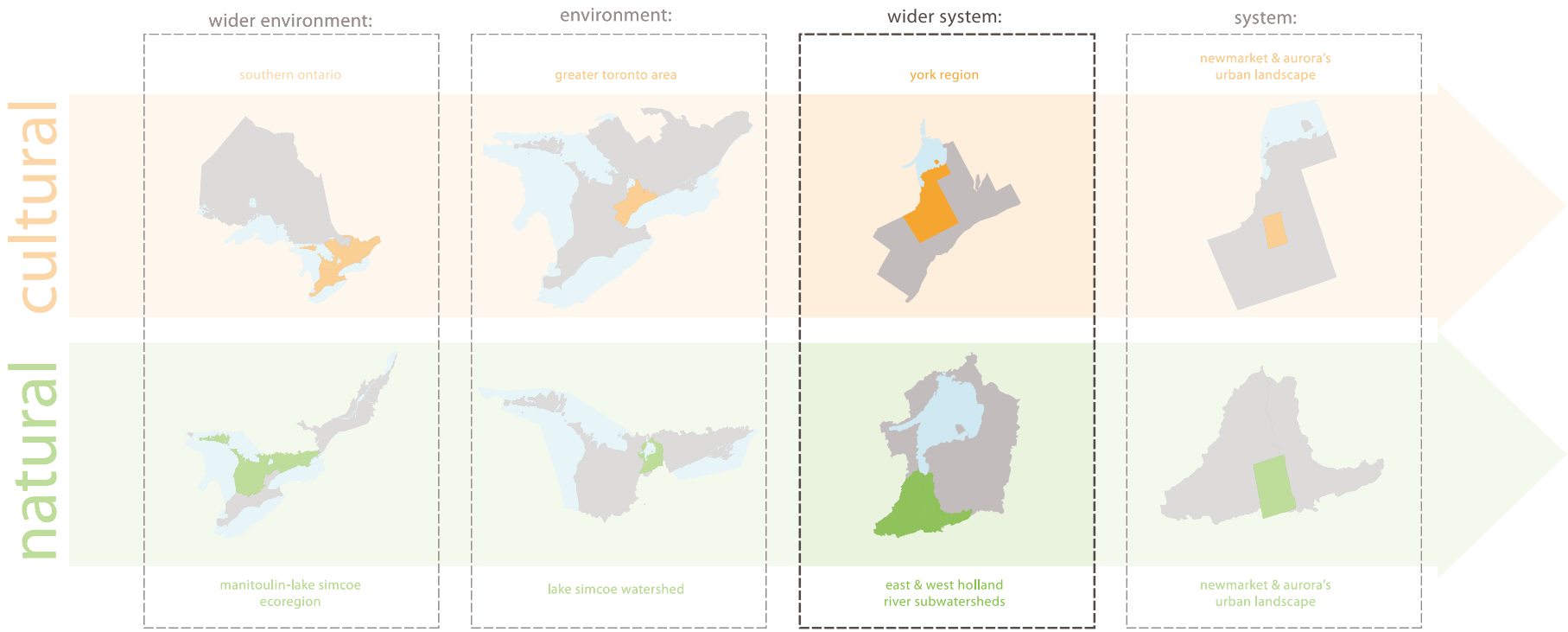


fig 2.58 hierarchy of natural and cultural ecosystems: wider system

Cultural analysis at the scale of the 'wider system' is defined by the Regional Municipality of York (highlighted in orange), which is a part of the Greater Toronto Area (grey). Natural analysis is defined by the East and West Holland River Subwatersheds (highlighted in green), which are located within the Lake Simcoe Watershed (grey).

wider system

In the cultural analysis, the wider system is defined by the Municipal Region of York, which is located north of the City of Toronto in the GTA. Analysis includes municipal boundaries, transportation infrastructure, regional public transportation, employment areas, the greenbelt, canal systems, and regional trail networks.

Analysis of the natural systems at this level is defined by the East and West Holland River Subwatersheds, which are located within the Lake Simcoe Watershed. Natural systems include watercourse, urban and rural land use, forest coverage, wetlands, areas of natural and scientific interest, and environmentally sensitive areas.

fig 2.59 york region: municipal boundaries
York Region encompasses several municipalities, including the towns of Newmarket, Aurora, Richmond Hill, Markham, Whitchurch Stouffville, East Gwillimbury, and Georgina; as well as the Township of King and the City of Vaughan. Newmarket, Aurora, Richmond Hill, Vaughan, and Markham are predominantly urban while the other towns are predominantly rural.

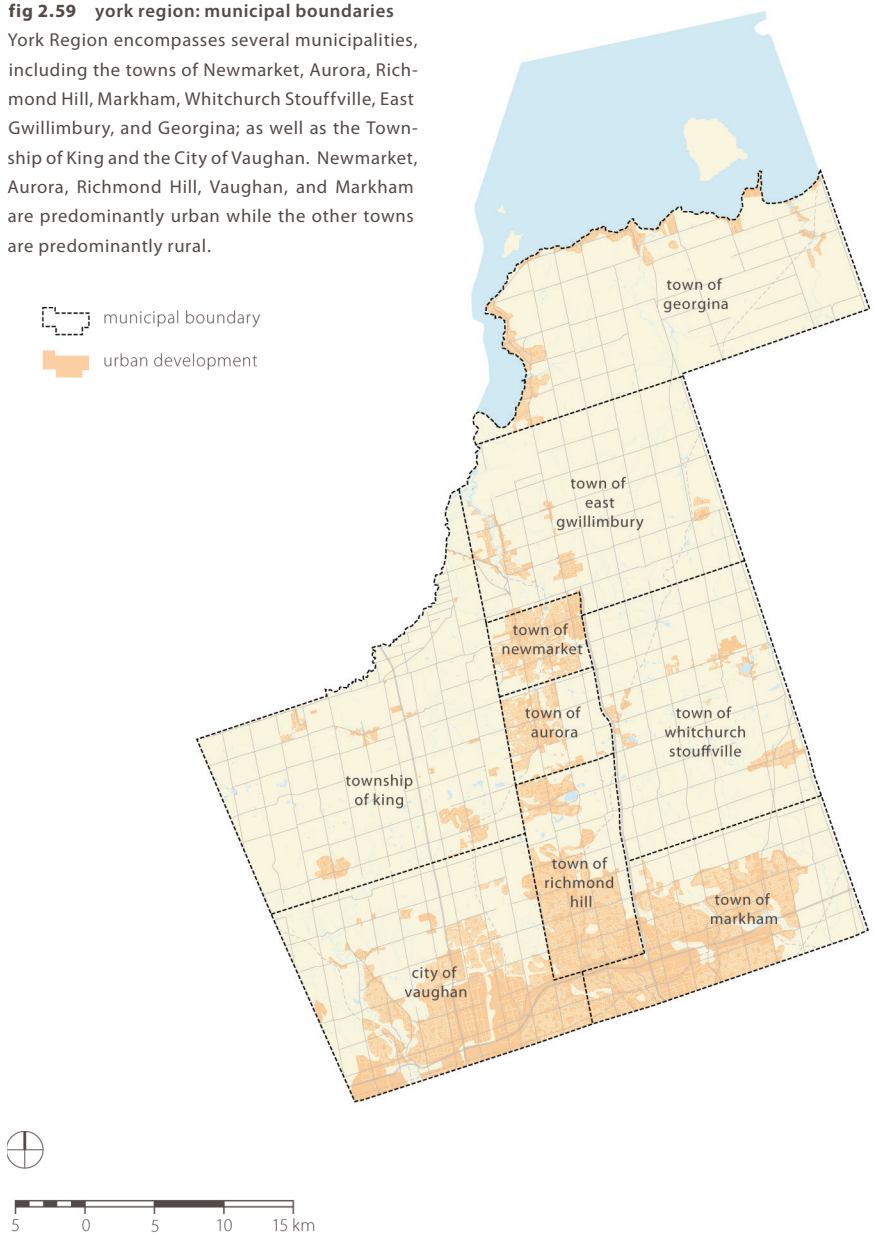


fig 2.60 york region: road and railway infrastructure
This map illustrates the roadway grid that was applied to most of Southern Ontario in the late 18th century, dividing the land into 200 acre farming plots. This grid does not take into consideration the natural topography of the region, however it has largely influenced the current urban form. Unlike the roadway grid, rail lines tend to follow the path of least resistance, such as river valleys.

The 400, 404, and 407 Highways are the main highways that service York Region.

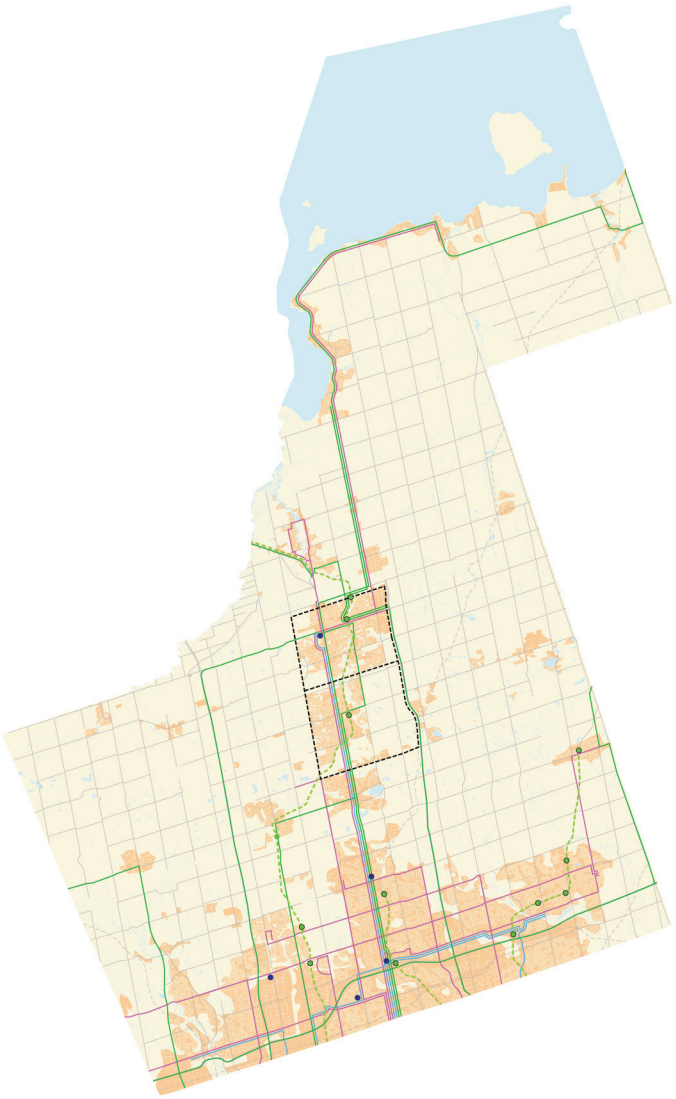


fig 2.61 york region: public transportation
Regional public transportation services include GO Transit routes, York Region Transit (YRT) routes, and Viva Rapid Transit routes.

In 2005, York Region Transit (YRT) implemented the Viva rapid transit service, which consists of several routes that are integrated into the York Region public transit network. Viva has established plans to extend their service by building new rapidways with designated bus lanes, as well as subway extensions and light rail trainsit routes.[26]

There are several GO train stations and major bus terminals that are located in the urban centres in York Region.

26 *FAQs*. Retreived September 15, 2010 from Viva Next. <http://www.vivanext.com/faqs>.

fig 2.62 york region: employment areas

This map illustrates employment zones in York Region, as well as vacant parcels that are available for industrial development.

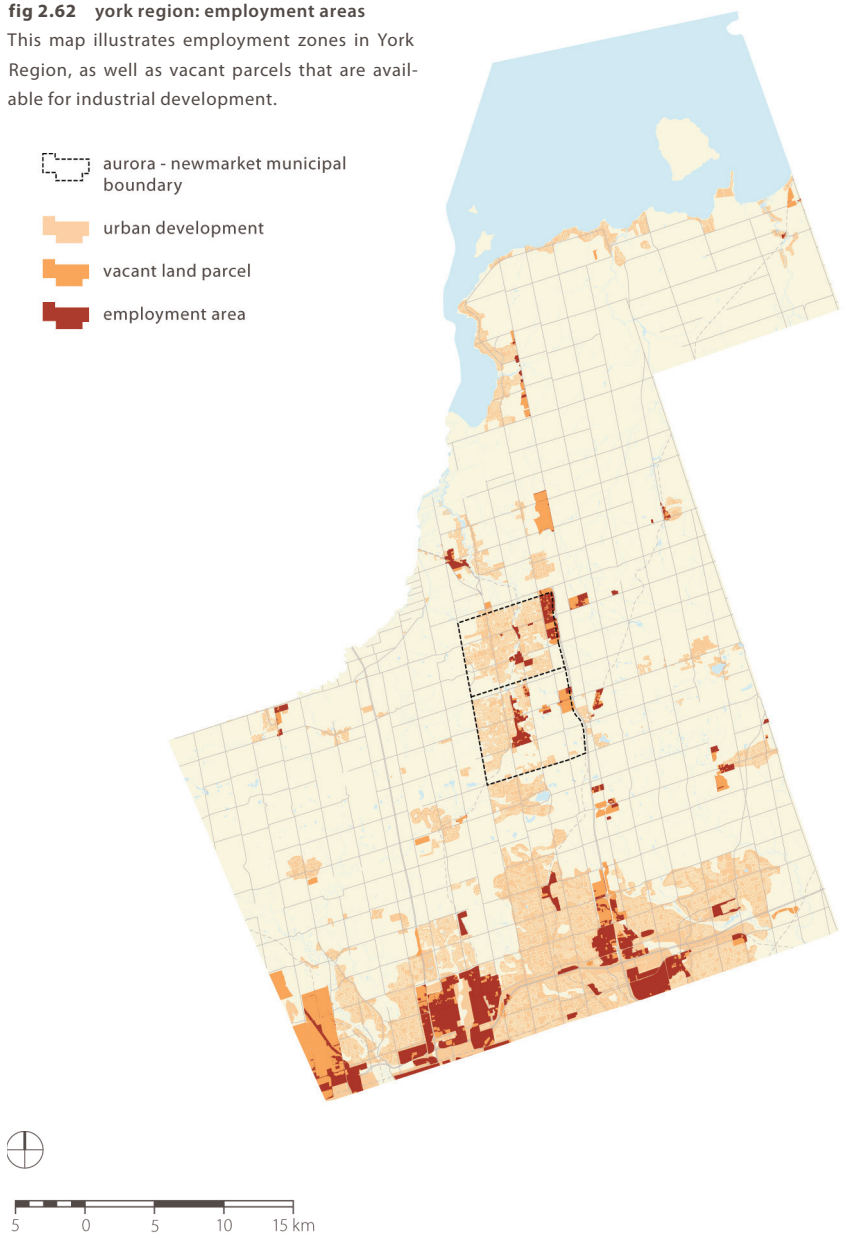


fig 2.63 york region: greenbelt

A large portion of land in York Region is protected under the Greenbelt Plan. The urban centres of Vaughan, Richmond Hill, and Markham are located south of the greenbelt boundary. Newmarket, Aurora, and part of East Gwillimbury are situated within a pocket of developable land in the centre of the greenbelt.

The Holland Marsh and the Oak Ridges Moraine are the two most prominent natural features in York Region. Development restrictions on the Oak Ridges Moraine create a natural landscape barrier between Aurora and Richmond Hill. However, a significant amount of development in the towns of King City, Oak Ridges, and Whitchurch-Stouffville occurred prior to the Greenbelt Plan and Oak Ridges Moraine Conservation Plan. For this reason there are several large patches of built-up areas on the moraine. High property values are also the cause of constant development pressures on the moraine.

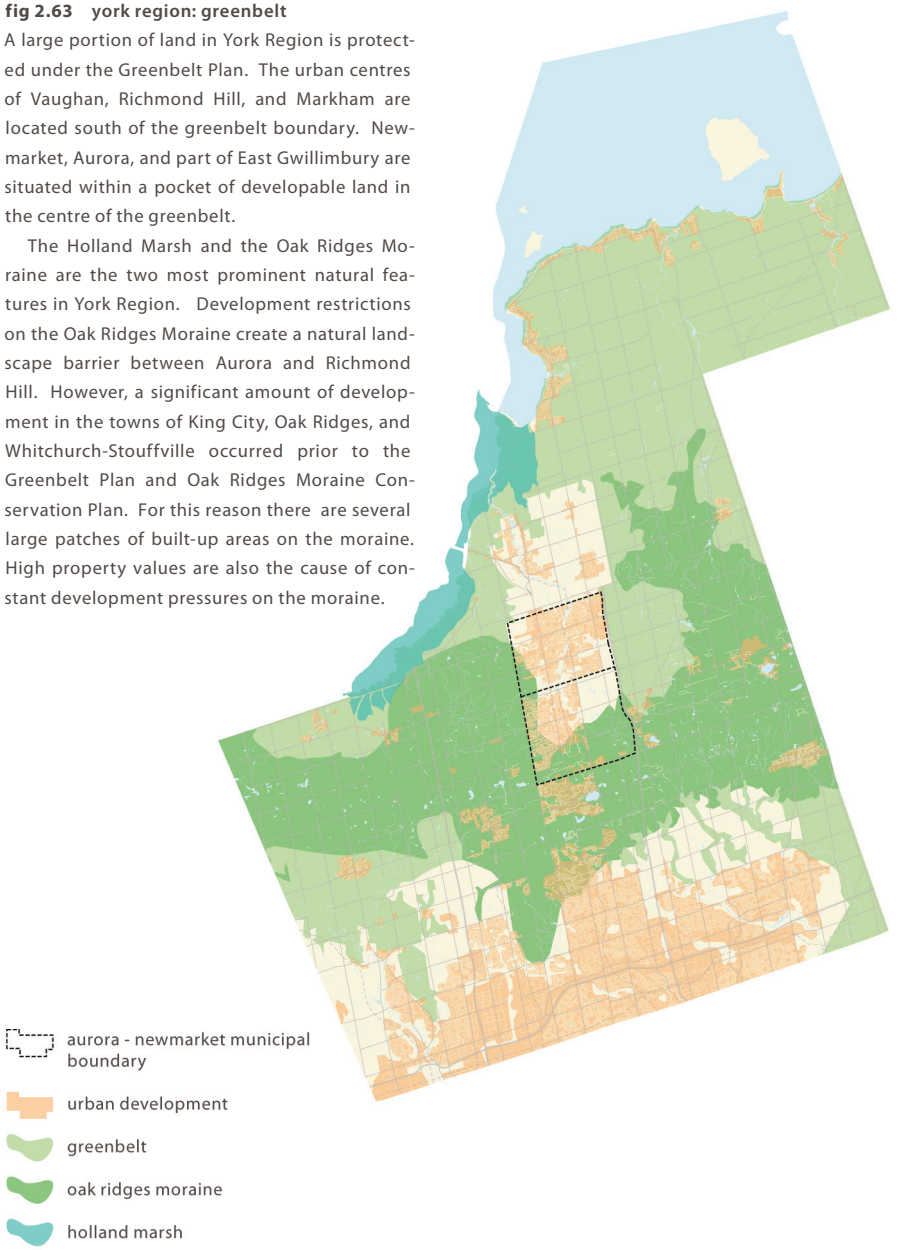


fig 2.64 york region: holland marsh canal drainage system

The Holland Marsh is comprised of rich organic soil that is ideally suited for a type of intensive agriculture called "muck farming". A complex canal drainage system was created to enhance the feasibility of agriculture on the marsh and to prevent flooding. The system is comprised of many drainage ditches and canals that flow into Lake Simcoe.

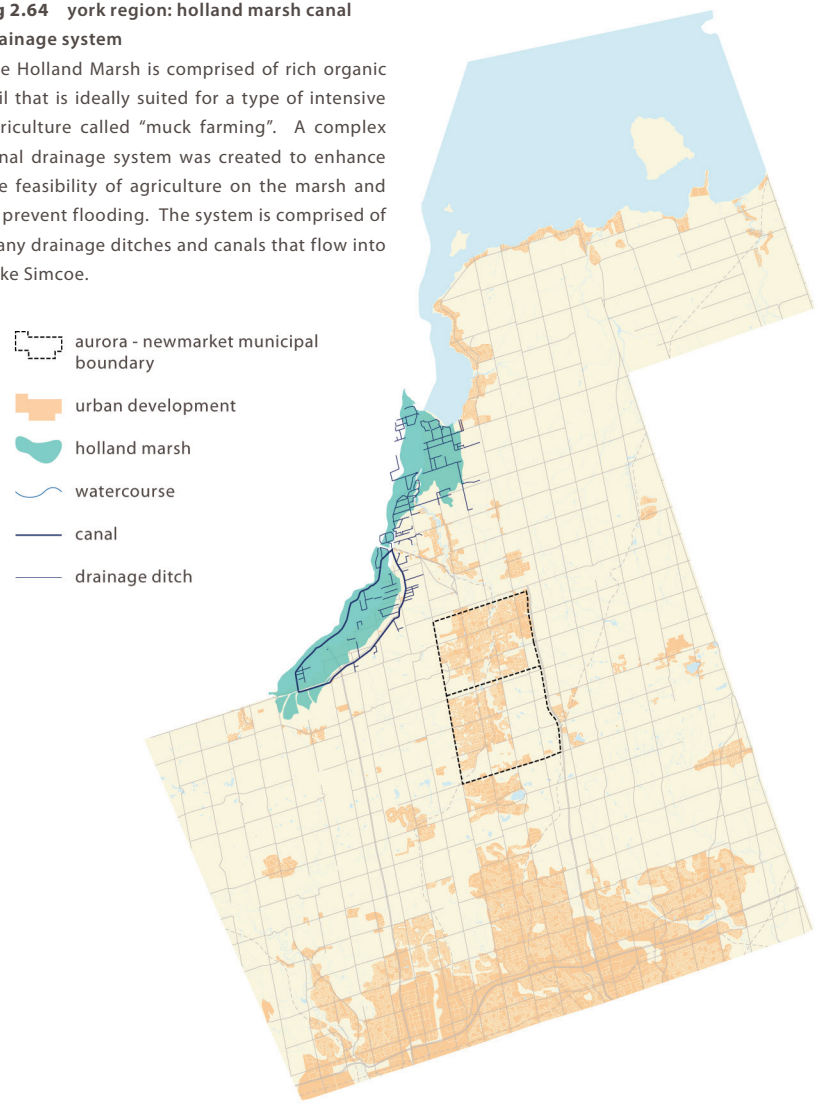


fig 2.65 york region: trail systems

There are four major trail systems in York Region: the Oak Ridges Trail, Nokiidaa Trail, Lake Simcoe Trail, and Sutton-Zephyr Rail Trail. The Oak Ridges Trail is the longest of the trails, which runs from the Niagara Escarpment in the west to Rice Lake in the east. It connects to the Bruce Trail, Nokiidaa Trail and Ganaraska Trail. The Nokiidaa Trail follows the East Holland River, linking East Gwillimbury, Newmarket, and Aurora. The Lake Simcoe Trail follows the southern shore of Lake Simoce, and the Sutton-Zephyr Rail trail follows an abandoned railway line in East Gwillimbury.

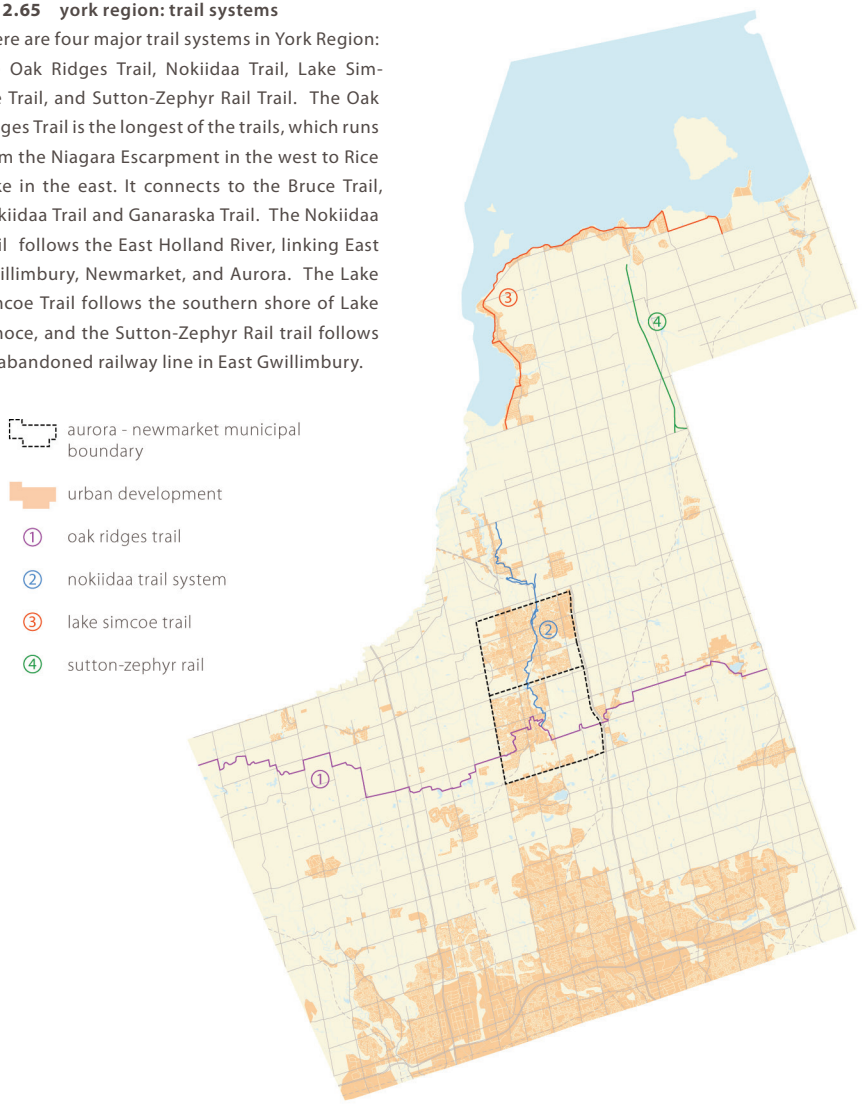
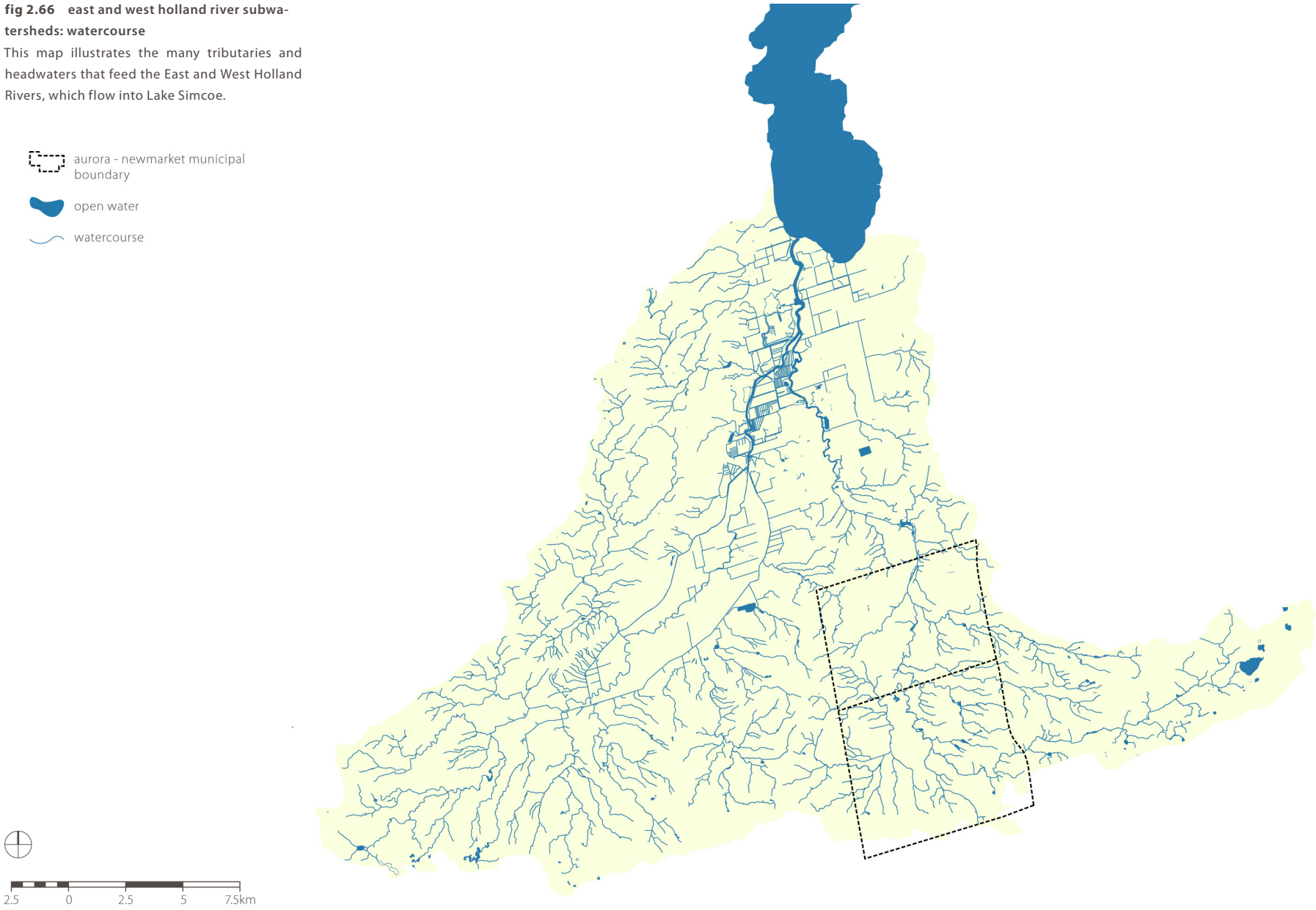


fig 2.66 east and west holland river subwatersheds: watercourse

This map illustrates the many tributaries and headwaters that feed the East and West Holland Rivers, which flow into Lake Simcoe.



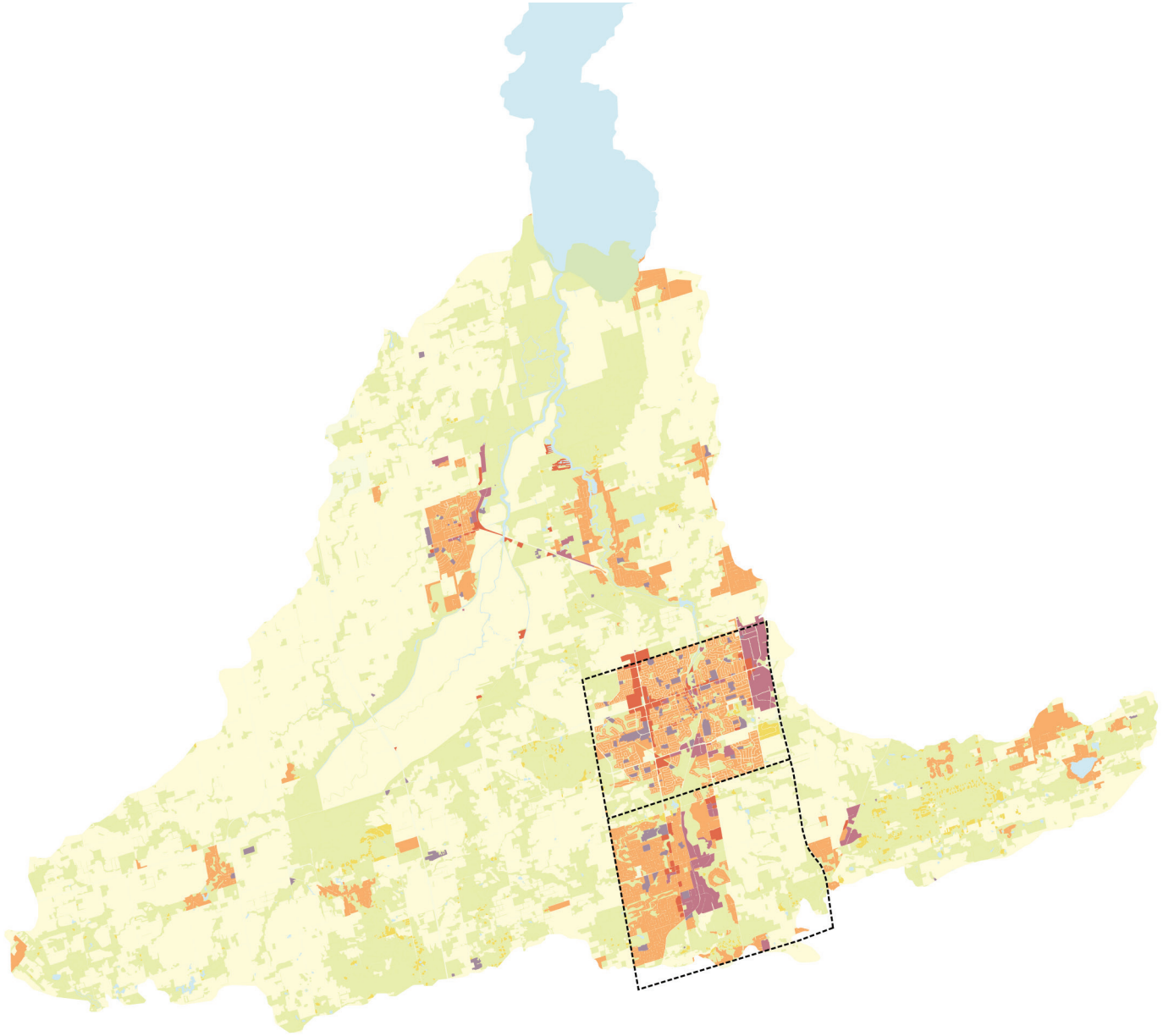


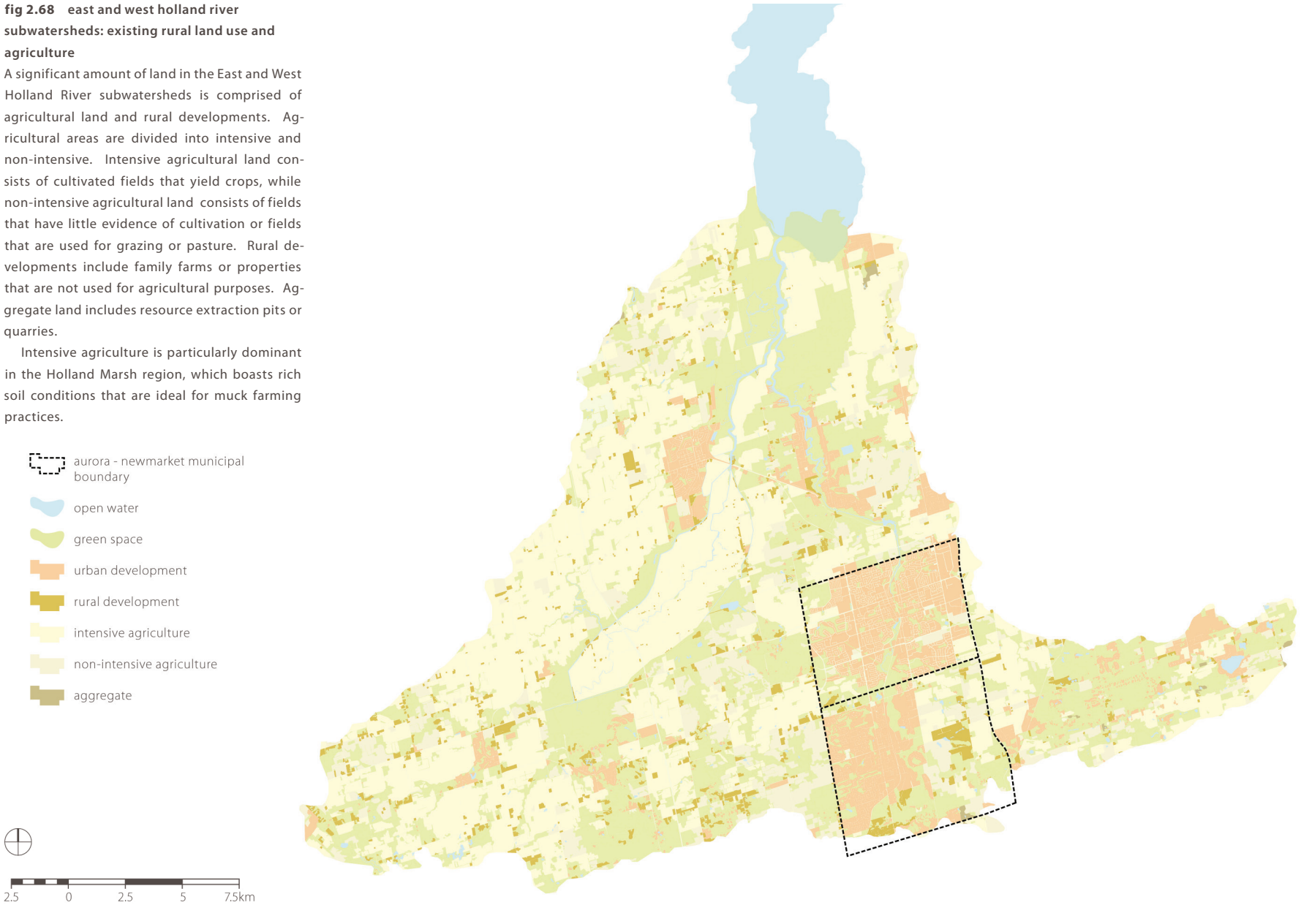
fig 2.67 east and west holland river subwatersheds: existing urban land use

This map illustrates the urban land use zones in the East and West Holland River subwatersheds. Newmarket and Aurora are the largest urban areas in the subwatersheds, and are comprised of commercial, industrial, institutional, and residential zones.

fig 2.68 east and west holland river subwatersheds: existing rural land use and agriculture

A significant amount of land in the East and West Holland River subwatersheds is comprised of agricultural land and rural developments. Agricultural areas are divided into intensive and non-intensive. Intensive agricultural land consists of cultivated fields that yield crops, while non-intensive agricultural land consists of fields that have little evidence of cultivation or fields that are used for grazing or pasture. Rural developments include family farms or properties that are not used for agricultural purposes. Aggregate land includes resource extraction pits or quarries.

Intensive agriculture is particularly dominant in the Holland Marsh region, which boasts rich soil conditions that are ideal for muck farming practices.



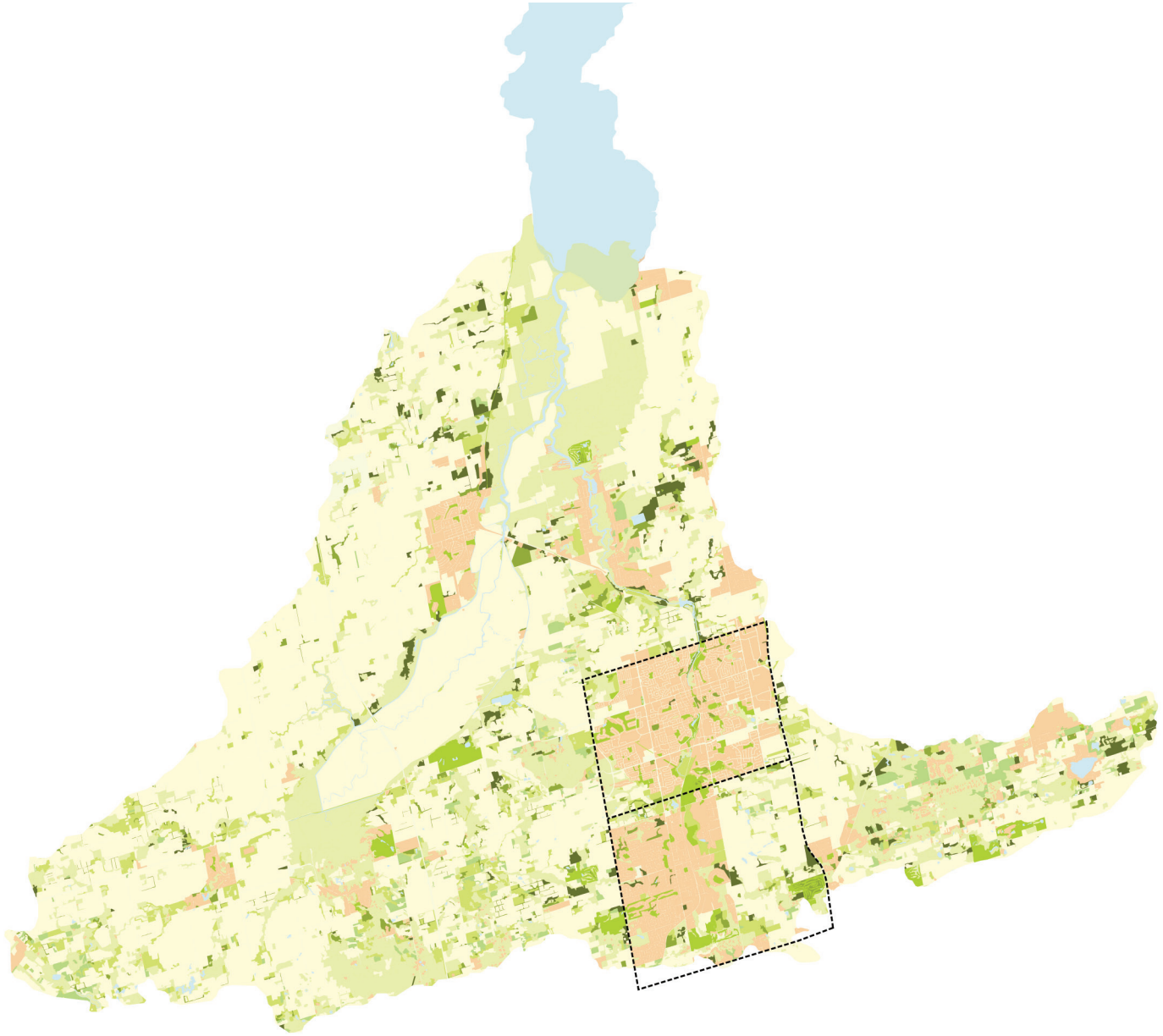


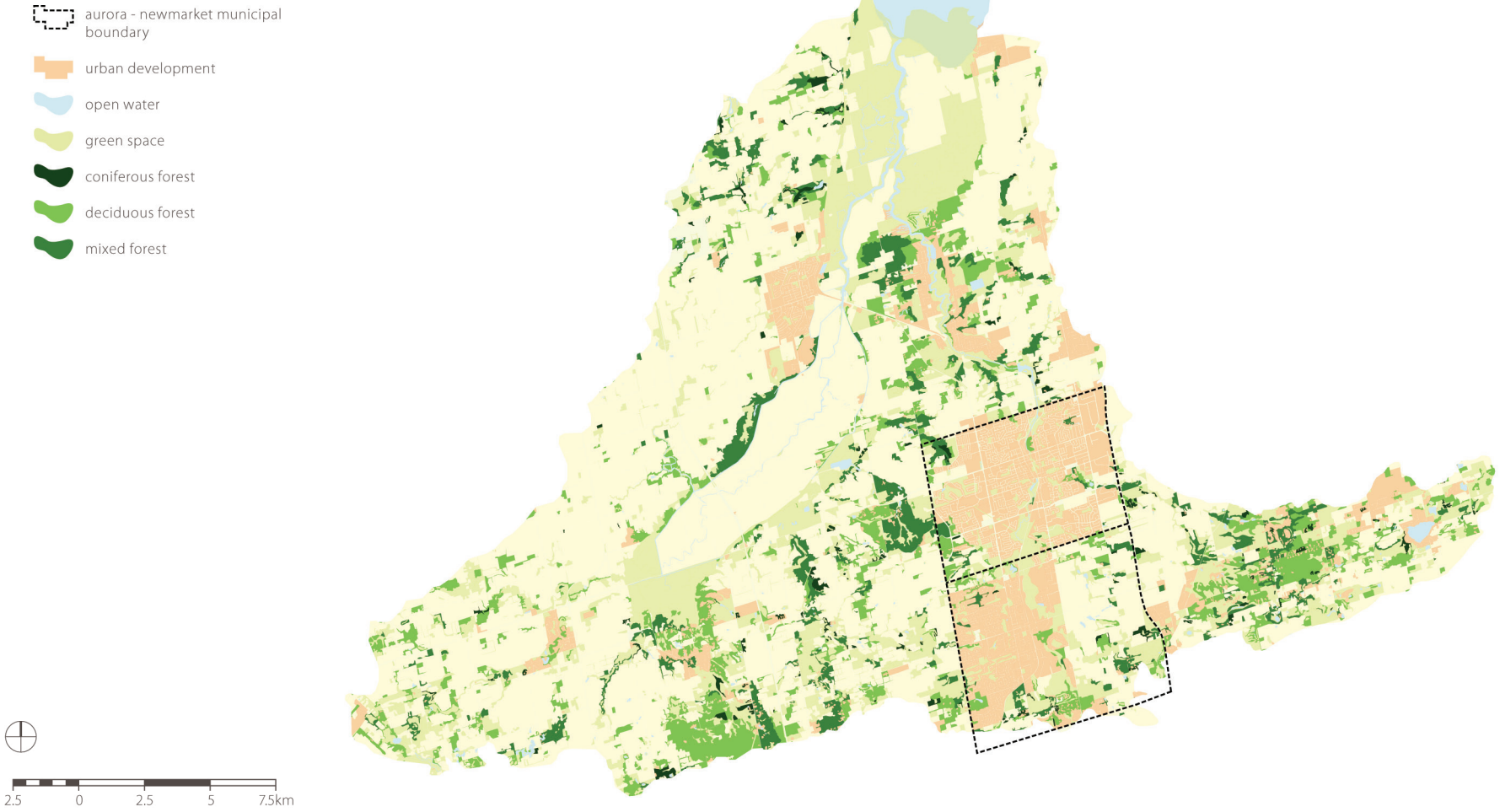
fig 2.69 east and west holland river subwatersheds: cultural communities

This map isolates the cultural communities that are located within the subwatersheds. Cultural meadows are fields with less than 25% shrub cover and less than 25% tree cover. Cultural thickets are fields with more than 25% shrub cover, but less than 25% tree cover. Cultural woodlands are areas with tree cover between 35% and 60%.27 Cultural plantations are areas that have been planted with vegetation that is not necessarily native to the site. Manicured open space includes parks, recreational fields, and golf courses that usually consist of manicured lawns.

27 *A Natural Heritage Study for the North-East Aurora Planning Area "2C".* Town of Aurora, 2006, p. 28-30.

fig 2.70 east and west holland river subwatersheds: forest coverage

Several patches of original forest remain in the subwatersheds, however they are largely fragmented. Deciduous forests and mixed forests are most prevalent in the region, although there are several small coniferous forests stands as well.



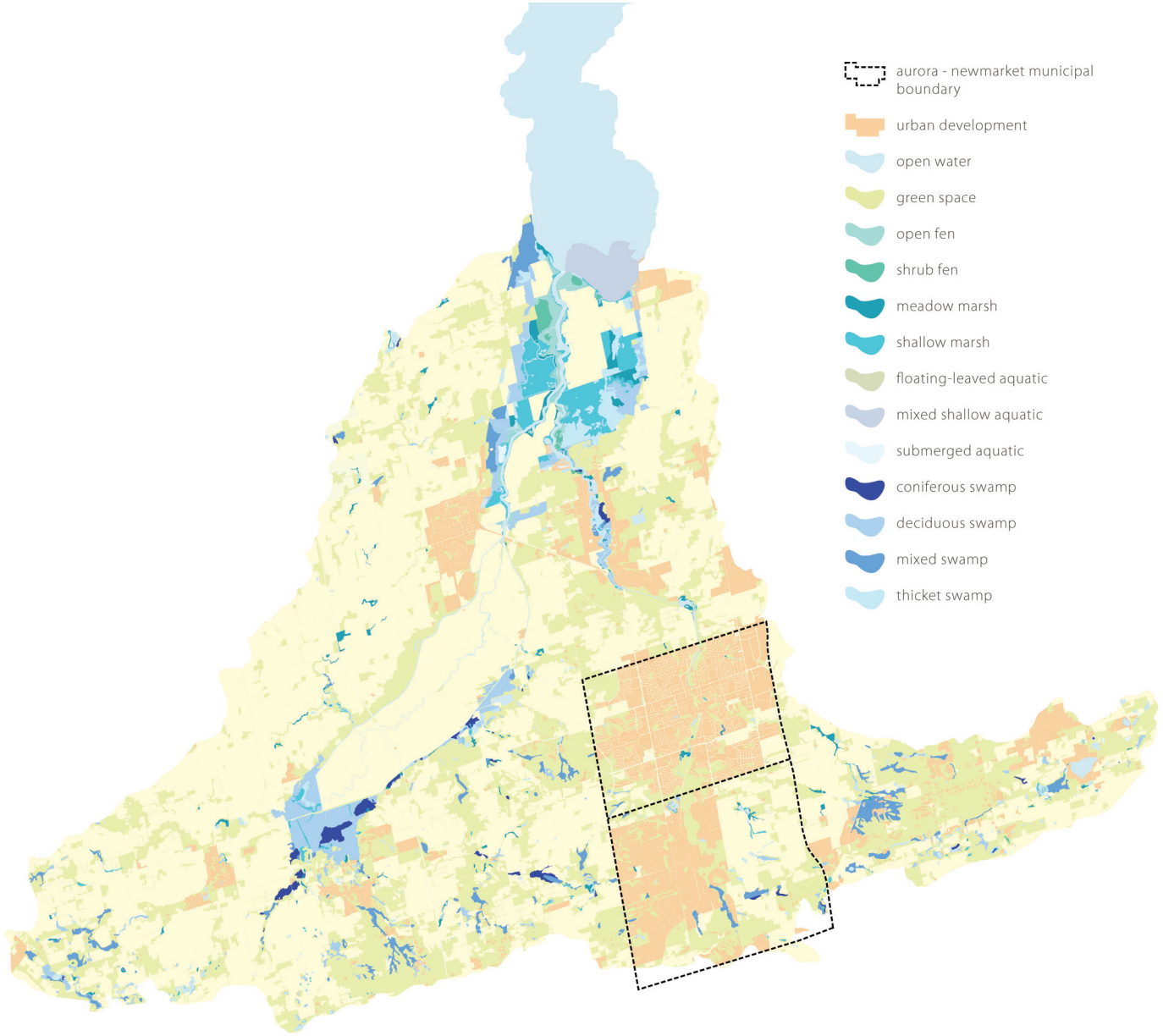


fig 2.71 east and west holland river subwatersheds: wetland classification

There are many types of wetlands that are present in the subwatersheds, including fens, marshes, and swamps. Marshes are wetlands that are generally characterised as a transition between lowland and upland.[28] They are often shallow and contain grassy or shrub-like vegetation. Swamps are generally deeper than marshes and are dominated by trees rather than grasses and shrubs. Fens are groundwater-fed wetlands that tend to be rich in nutrients and minerals that support a wide range of species. Floating-leaved, mixed shallow, and submerged aquatics are portions of lakes, ponds, or rivers, with floating-leaved or submerged plant species cover of more than 25%, and emergent vegetation cover of less than 25%.[29] The largest example of a mixed shallow aquatic is located at the southern edge of Cooks Bay in Lake Simcoe, near the mouth of the Holland River.

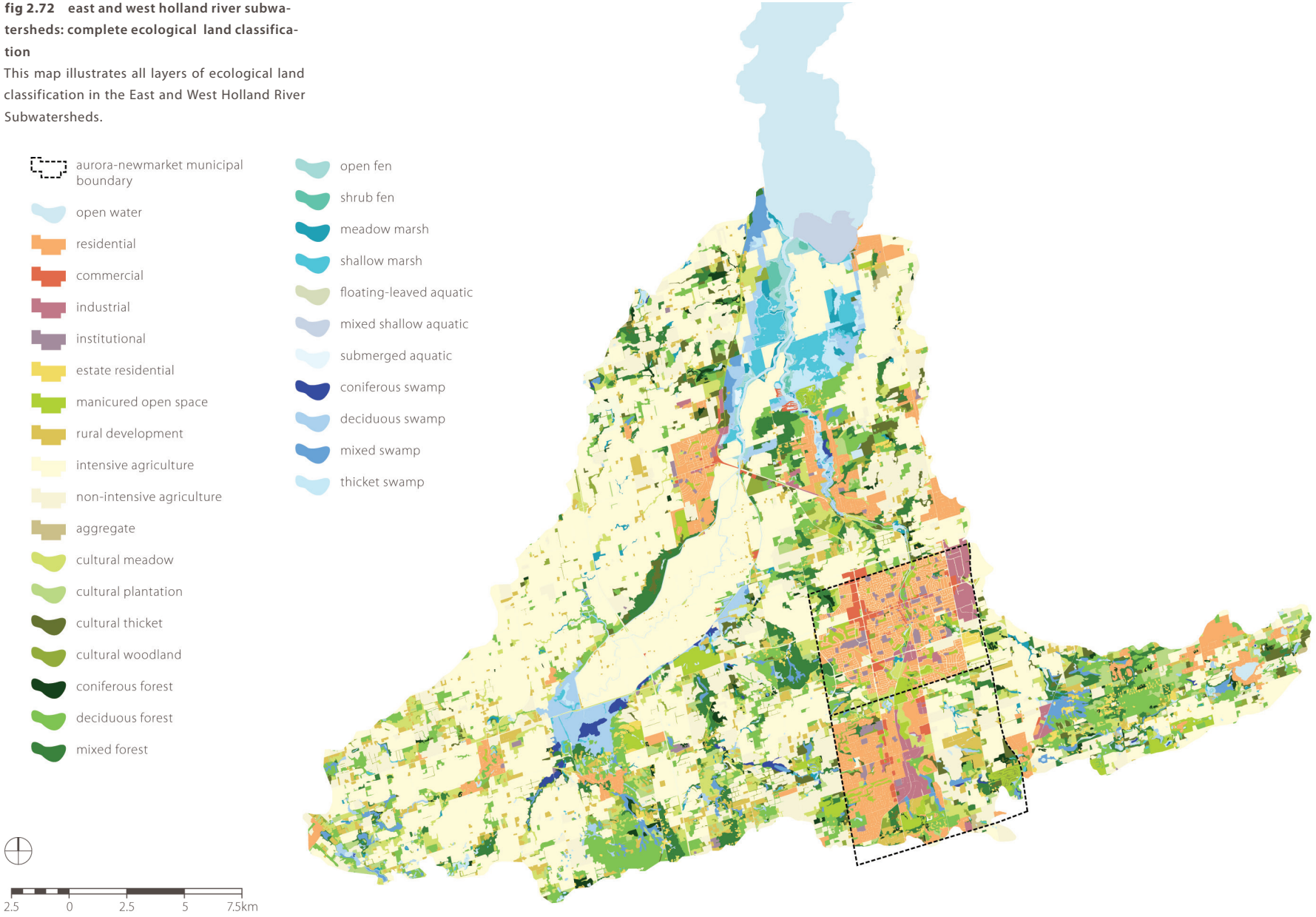
Although the Holland Marsh is naturally a wetland, much of it has been converted to agricultural land. As such, it is depicted as agricultural land on this map.

28 *A Natural Heritage Study for the North-East Aurora Planning Area "2C".* Town of Aurora, 2006, p. 40.

29 Lee, H.T., (et al). 1998. *Ecological Land Classification for Southern Ontario: First Approximation and its Application*. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer Branch. SCSS Field Guide FG-02, p.30.

fig 2.72 east and west holland river subwatersheds: complete ecological land classification

This map illustrates all layers of ecological land classification in the East and West Holland River Subwatersheds.



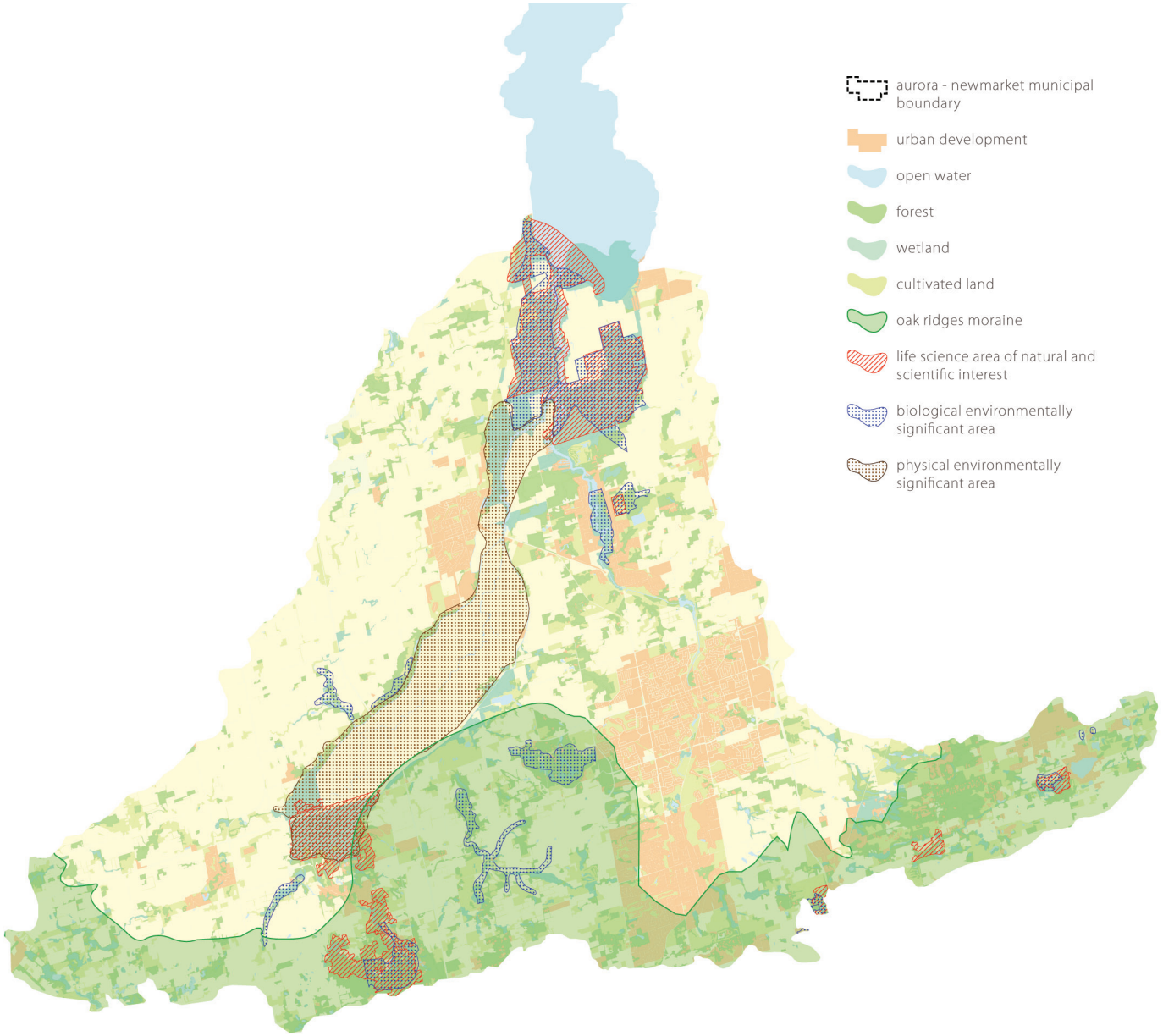


fig 2.73 east and west holland river subwatersheds: state of the environment

An Environmentally Significant Area (ESA) is a natural area that has been identified as fulfilling criteria for ecological significance or sensitivity.[30] There are many biological ESAs in the subwatersheds, including the Holland Landing ESA, Glenville Hills ESA, and several sections of the Holland Marsh. The portion of the Holland Marsh that has been converted to agricultural land is classified as a physical ESA.

An Area of Natural and Scientific Interest (ANSI) is an area of land or water that contains natural landscapes or features which have been identified as having values related to "protection, natural heritage, scientific study or education".31 Some ANSIs include the Holland River Marsh, the Holland Landing Prairie Relict, the Glenville Hills Kames, the White Rose West Forest and Spillway, the Vandorf Bod, and the Musselman Lake Complex.

30 *State of the Watershed Report: East Holland River Subwatershed*. Lake Simcoe Region Conservation Authority, 2000, p.131.

31 ibid, p.40.

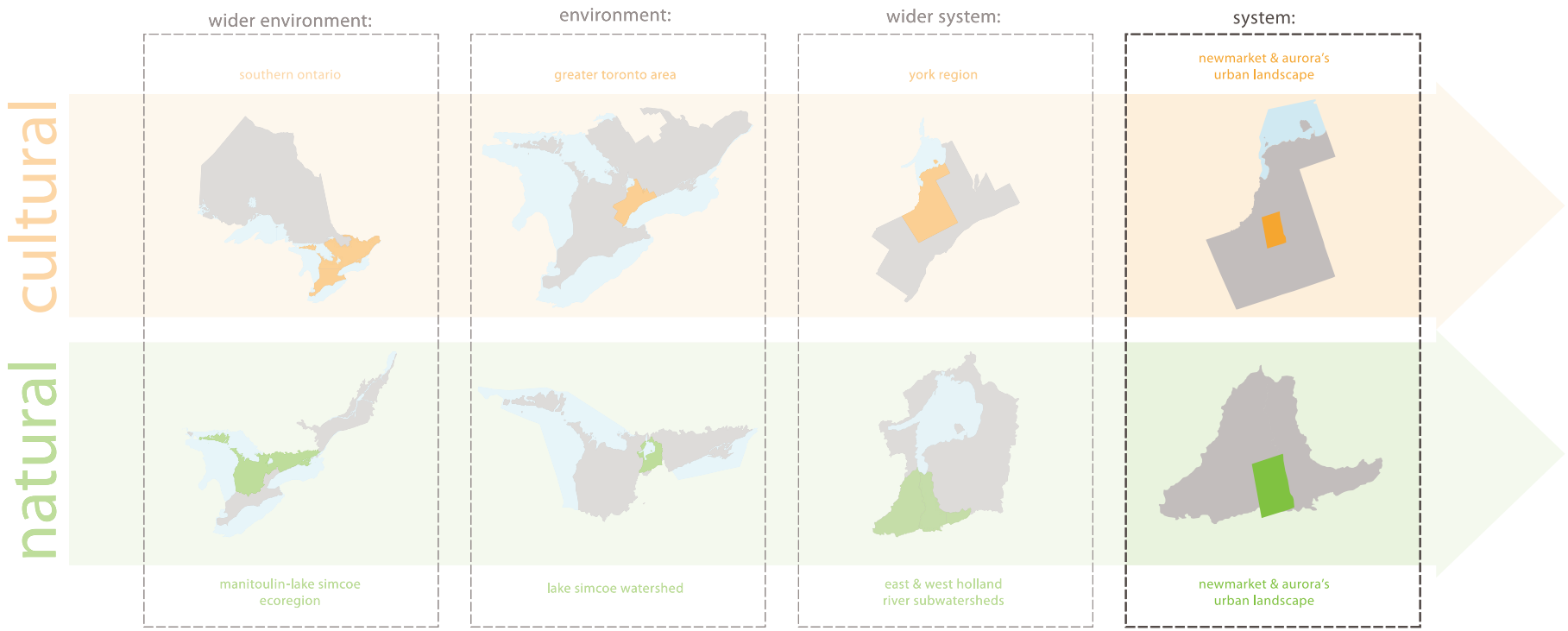


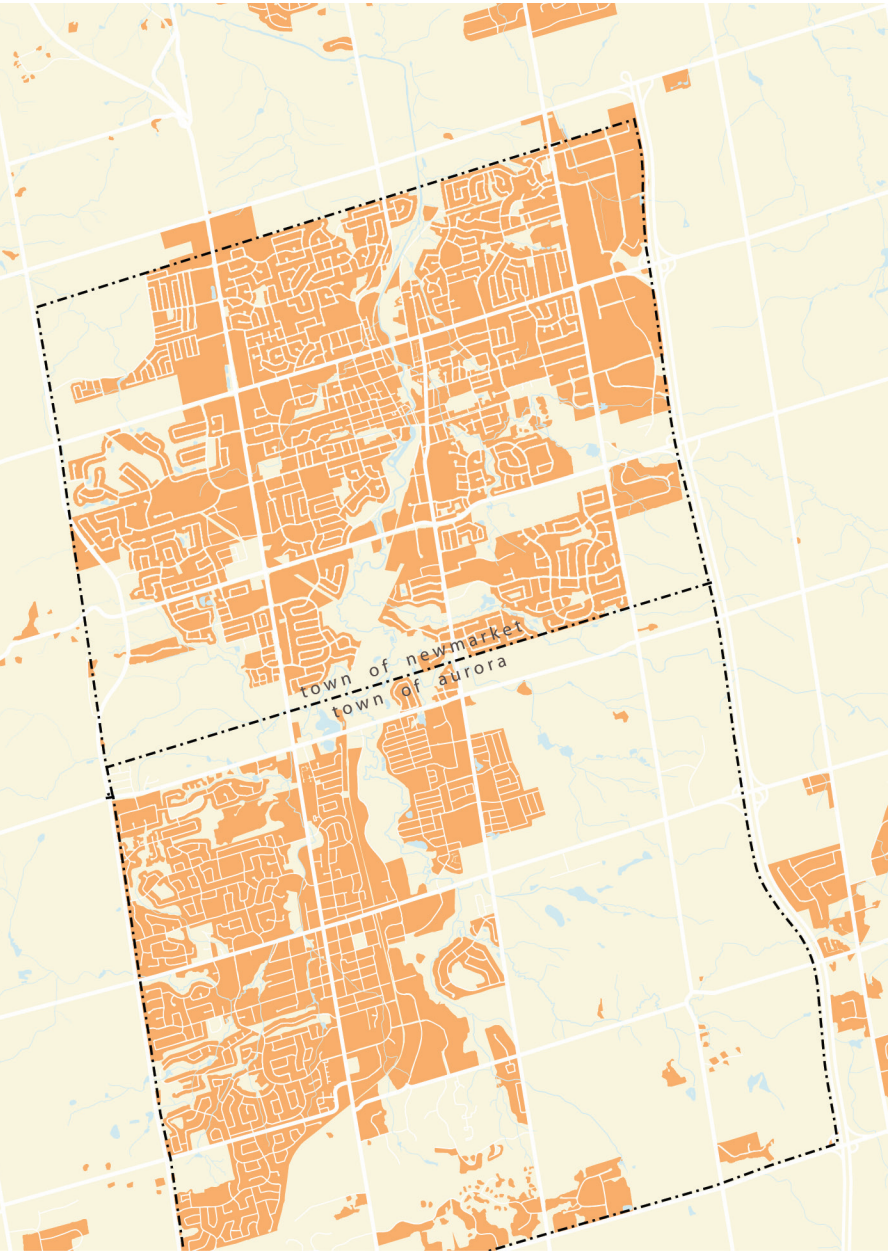
fig 2.74 hierarchy of natural and cultural ecosystems: local system

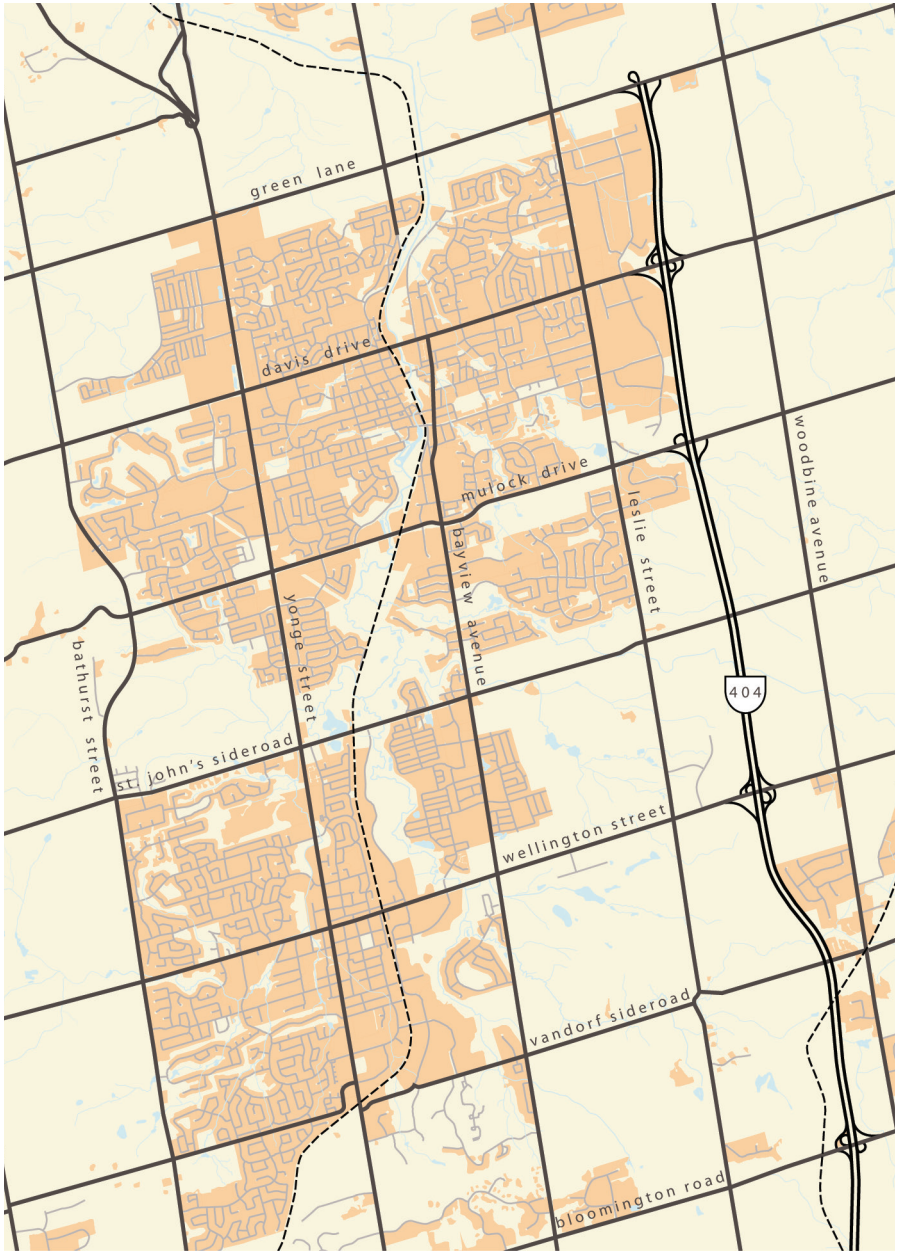
At the local scale, both cultural and natural ecosystems are analysed within the municipal boundaries of Newmarket and Aurora. The 'system' frame that is highlighted in this diagram illustrates how Newmarket and Aurora are contained within the wider system cultural boundary (York Region) and the wider system natural boundary (East and West Holland River Subwatersheds).

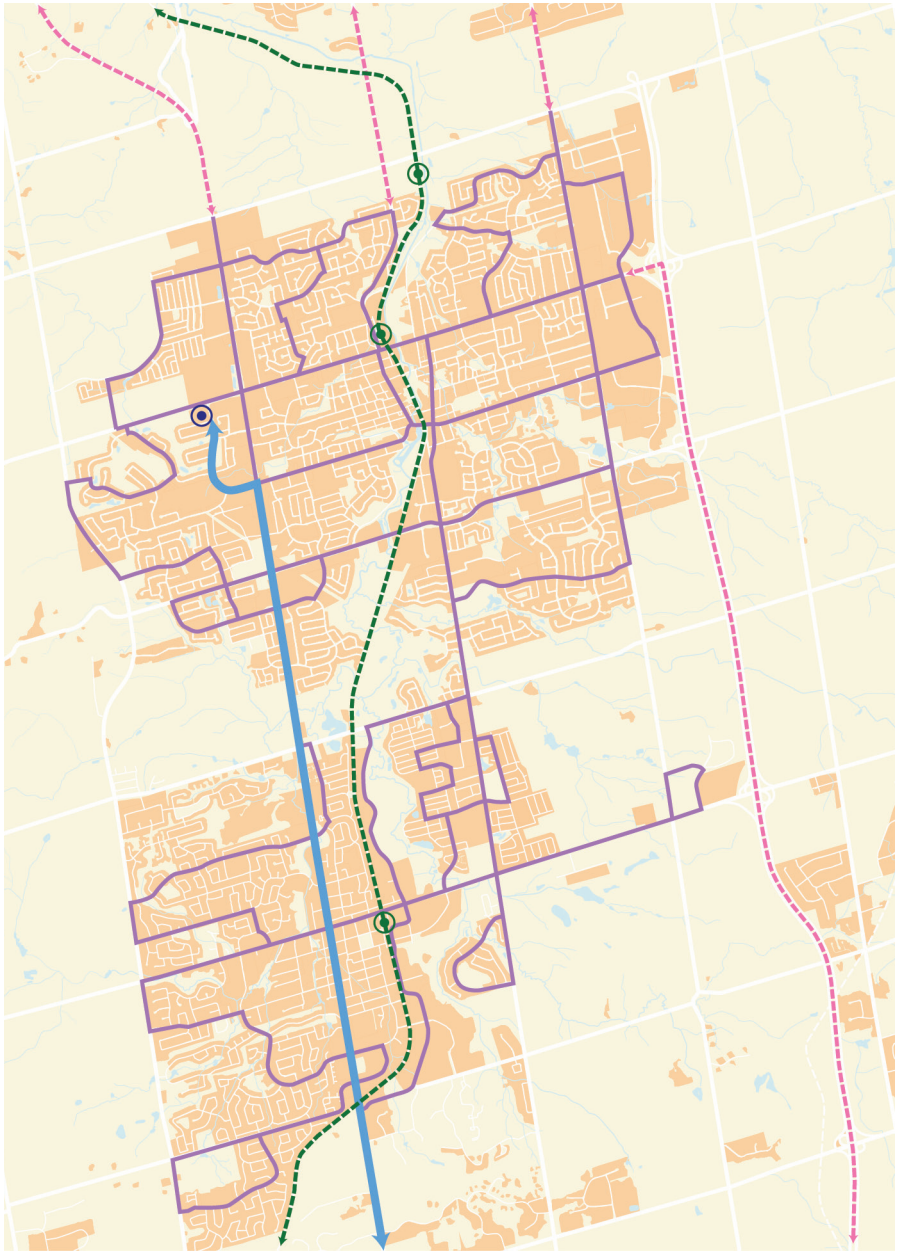
local system

Newmarket and Aurora's natural and urban landscapes are located within the York Region municipal boundary and the East and West Holland River Subwatersheds. The natural and cultural systems that function at the local scale of the analysis are closely connected and often overlap. For this reason, both natural and cultural systems will be analyzed within the same boundary - the municipal boundaries of the Town of Newmarket and the Town of Aurora.

Analysis of the cultural and natural systems that function at the local scale include the following: urban development and land use classification, transportation infrastructure, local public transportation, rural land use and open space, forest coverage, wetlands and watercourse, existing pedestrian trails, conservation areas, proximity to the greenbelt boundary and Oak Ridges Moraine, and topography.


town of newmarket
town of aurora


green lane
davis drive
mulock drive
bayview avenue
yonge street
leslie street
woodbine avenue
bathurst street
st. john's sideroad
wellington street
vandorf sideroad
bloomington road
404



(far left)

fig 2.75 aurora-newmarket urban landscape: municipal boundary

Both Newmarket and Aurora are bordered by the 404 Highway to the east and Bathurst Street to the west. Newmarket's northern boundary is located approximately 400 metres south of Green Lane. Its southern boundary is located approximately 400 metres north of St. John's Sideroad, bordering the northern edge of Aurora. The southern boundary of Aurora is located along Bloomington Road.

- aurora - newmarket municipal boundary
- open water
- urban development

(centre)

fig 2.76 aurora-newmarket urban landscape: transportation infrastructure

This map illustrates the major arterial roads that form the grid for Newmarket and Aurora, as well as the minor streets, which are curvilinear in form - a typical characteristic of most modern subdivisions. It also illustrates the location of the railway line, which follows the river valley of the East Holland River.

- major highway
- arterial road
- minor street
- railway

(right)

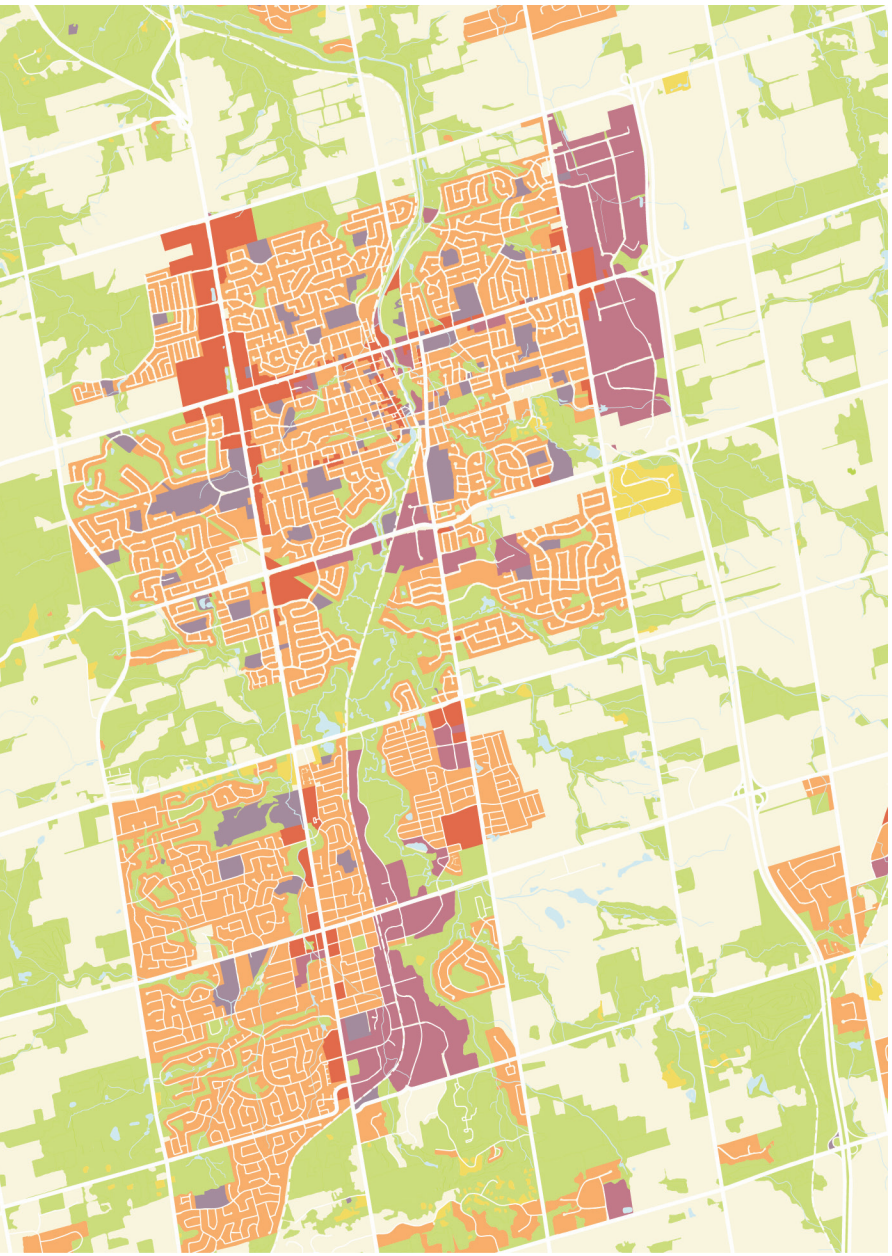
fig 2.77 aurora-newmarket urban landscape: public transit

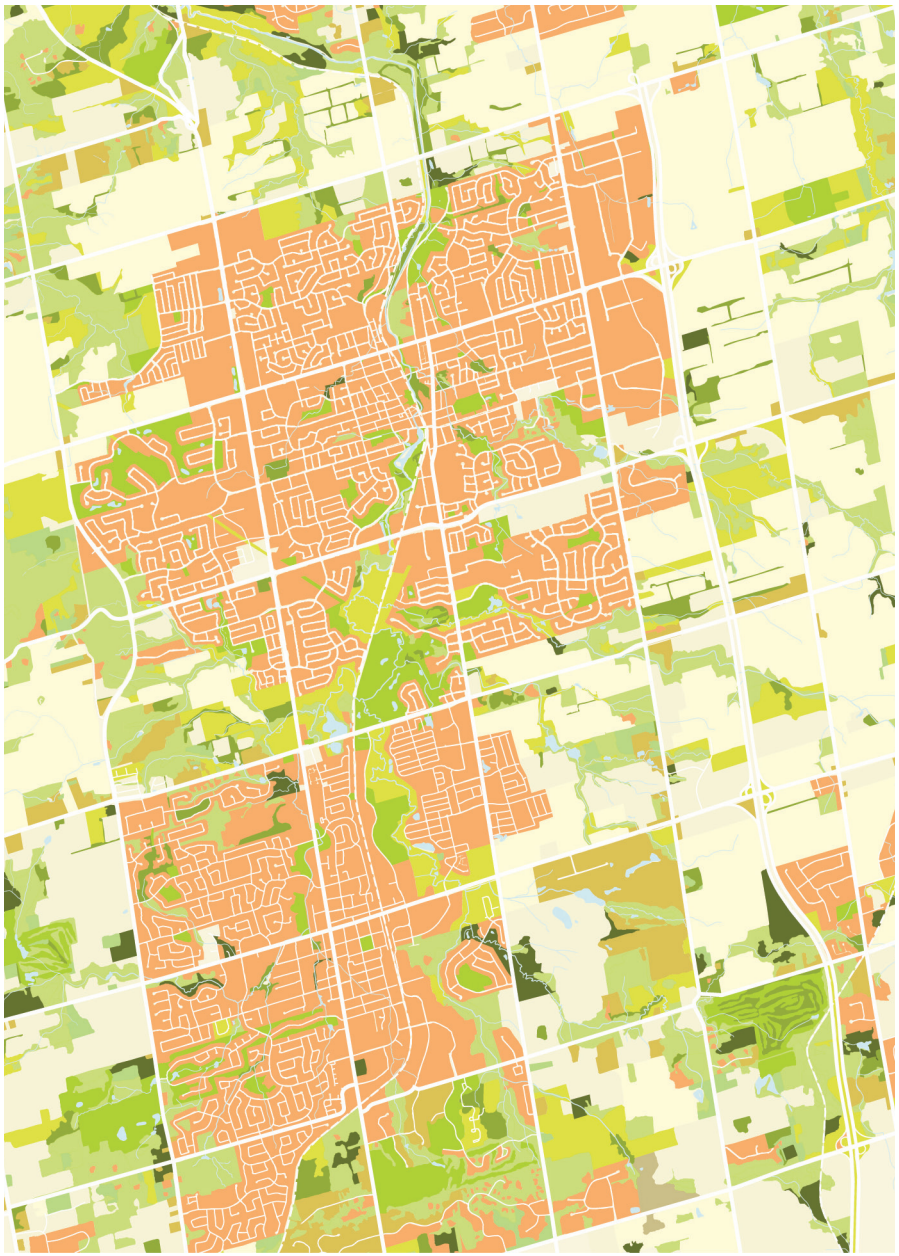
This conceptual diagram illustrates the public transportation routes in Newmarket and Aurora, including local York Region Transit (YRT) bus routes, GO bus routes, the GO train line, and the Viva rapid transit "Blue Line". The Viva Blue Line runs from Finch Avenue in Toronto to Davis Drive in Newmarket, and provides frequent bus service along this route. A plan for two new rapidways along Yonge Street and Davis Drive has recently been proposed by Viva.

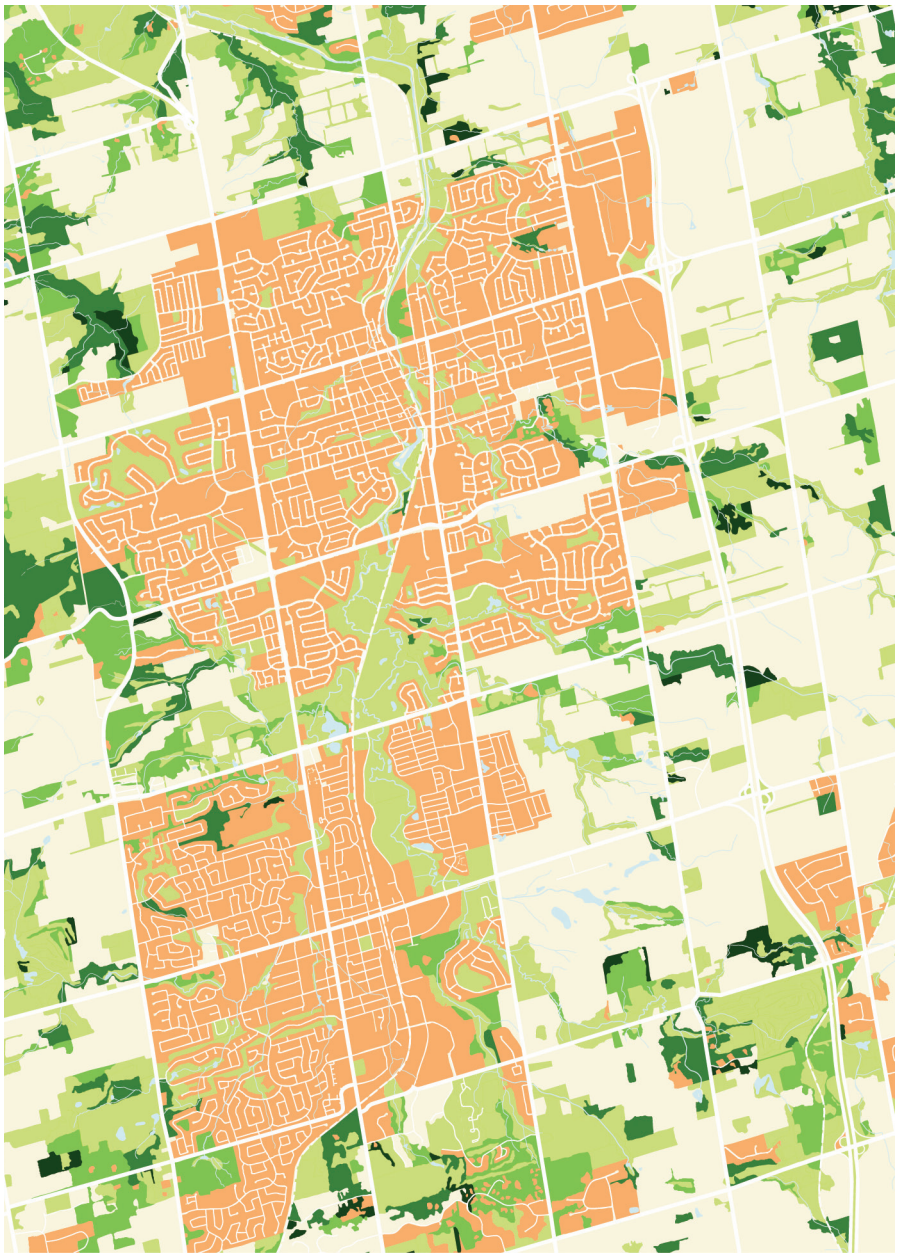
Two GO Train Stations are located in Newmarket, and one GO Train Station is located in Aurora. A major bus terminal is also located in Newmarket, near the corner of Yonge Street and Davis Drive.

- GO transit bus route
- GO transit train route
- viva bus route
- YRT local bus route
- major bus terminal
- GO train station

1 0 1 2 3 km







(far left)

fig 2.78 aurora-newmarket urban landscape: urban land use

A large commercial zone is located along Yonge Street in Newmarket, with smaller commercial areas dispersed along Davis Drive and Main Street. Aurora's commercial zones are located intermittently along sections of Yonge Street and Bayview Avenue. Newmarket's primary industrial zone is located between Leslie Street and the 404 Highway. Aurora's industrial zone is located along Industrial Parkway between Wellington Street and St. John's Sideroad. However, a new industrial zone is being established on the east edge of the town, near the highway. The remaining urban land use is comprised of institutional and residential zones of typical suburban densities, as well as several estate residences.

- open water
- residential
- commercial
- industrial
- institutional
- estate residential
- agriculture
- green space

(centre)

fig 2.79 aurora-newmarket urban landscape: rural land use

This map isolates the rural land use and cultural communities in Newmarket and Aurora. Farms, cultivated fields, and cultural communities are primarily located outside of the municipal boundaries of Newmarket and Aurora.

- open water
- urban development
- rural development
- intensive agriculture
- non-intensive agriculture
- aggregate
- manicured open space
- cultural meadow
- cultural plantation
- cultural thicket
- cultural woodland
- other green space

(right)

fig 2.80 aurora-newmarket urban landscape: forest coverage

There are very few remaining forest stands in Newmarket and Aurora's built-up areas. There are several forest stands that are located around the perimeter of the urban area.

- open water
- urban development
- agriculture
- green space
- coniferous forest
- deciduous forest
- mixed forest

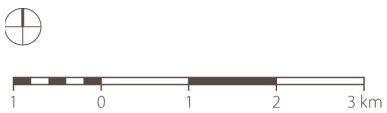
1 0 1 2 3 km

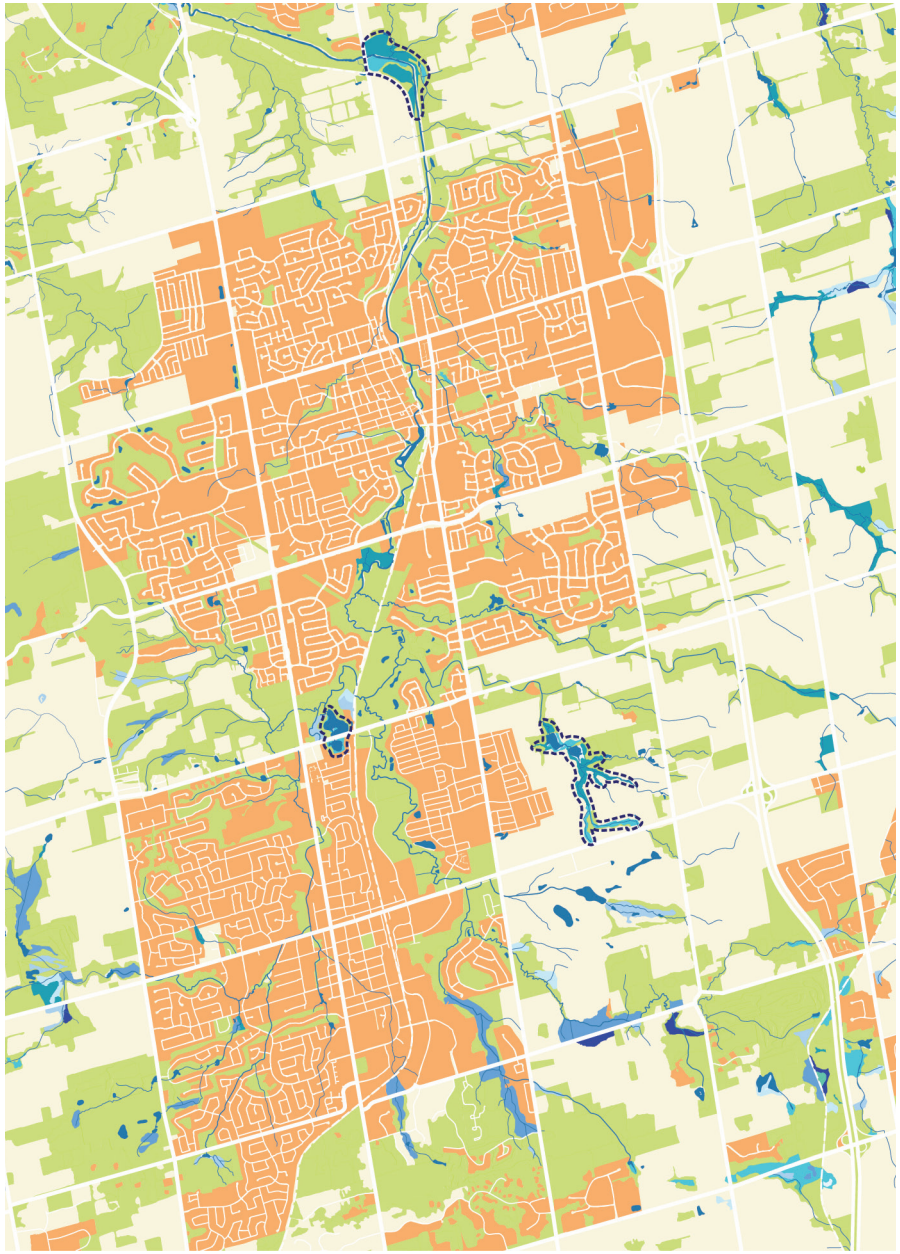
fig 2.81 aurora-newmarket urban landscape: wetland

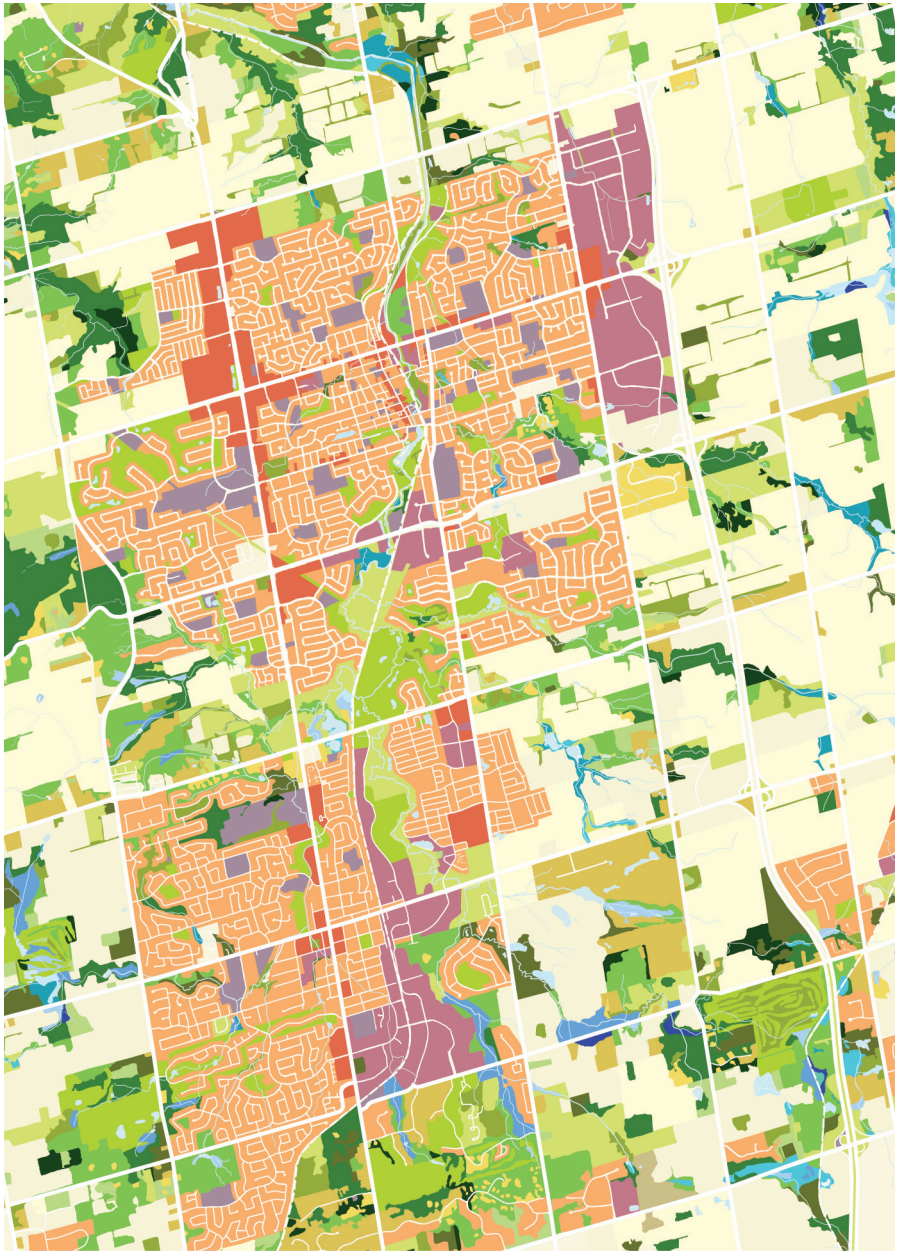
This map isolates the wetlands that are located in Newmarket and Aurora. Wetlands have an integral role in the local ecosystem. They are important areas of groundwater recharge, and store surface water during periods of heavy rain. They also help to improve water quality by trapping and filtering sediments, and provide habitats for many plants and animals.[32]

There are three wetland complexes in the Newmarket and Aurora area that are identified as Provincially Significant Wetlands. These wetlands are: Rogers Reservoir, which is located north of Green Lane, adjacent to the railway line; McKenzie Marsh, which is located east of Yonge Street on St. John's Sideroad; and the East Aurora Wetland Complex which is located between Bayview Avenue and Leslie Street, on the north side of Wellington Street.

32 *State of the Watershed Report: East Holland River Sub watershed*. Lake Simcoe Region Conservation Authority, 2000, p.37.



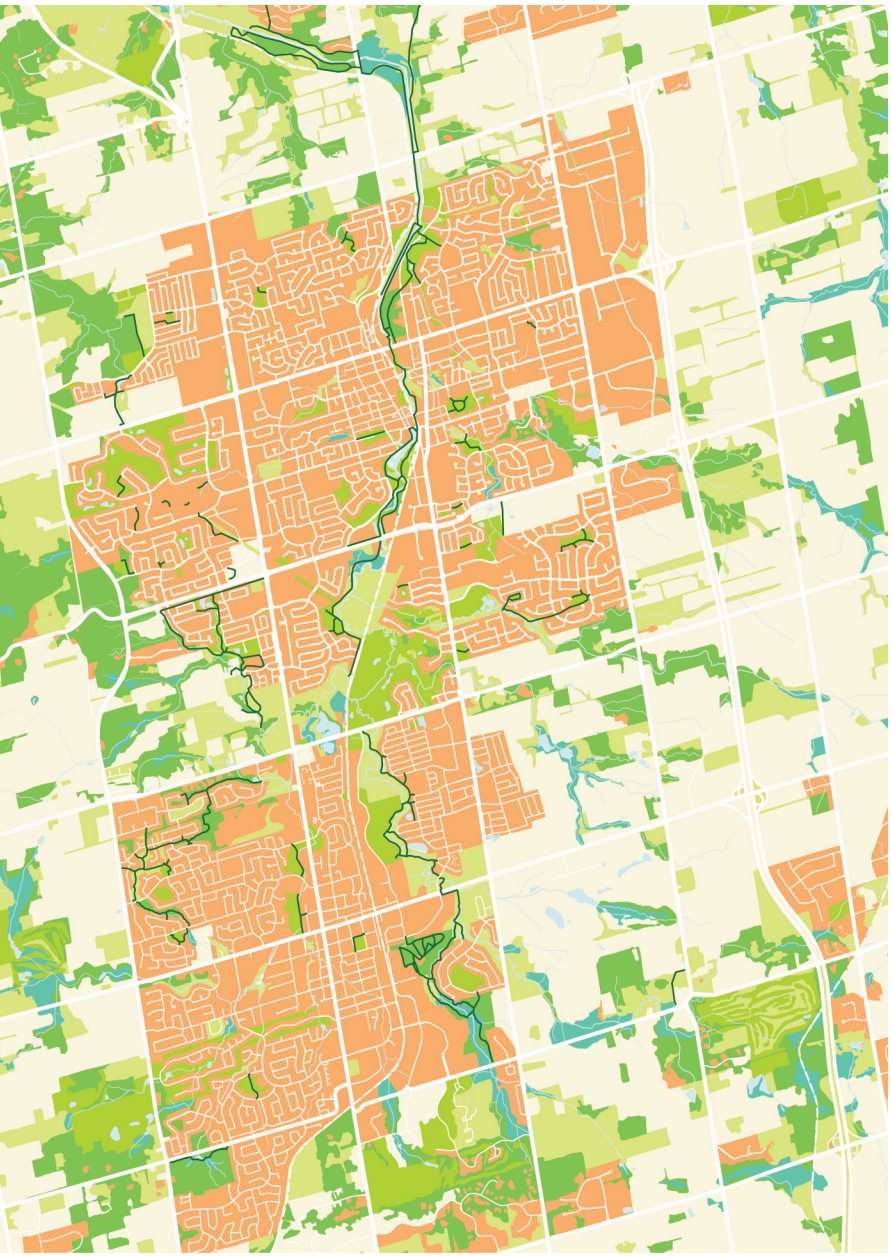


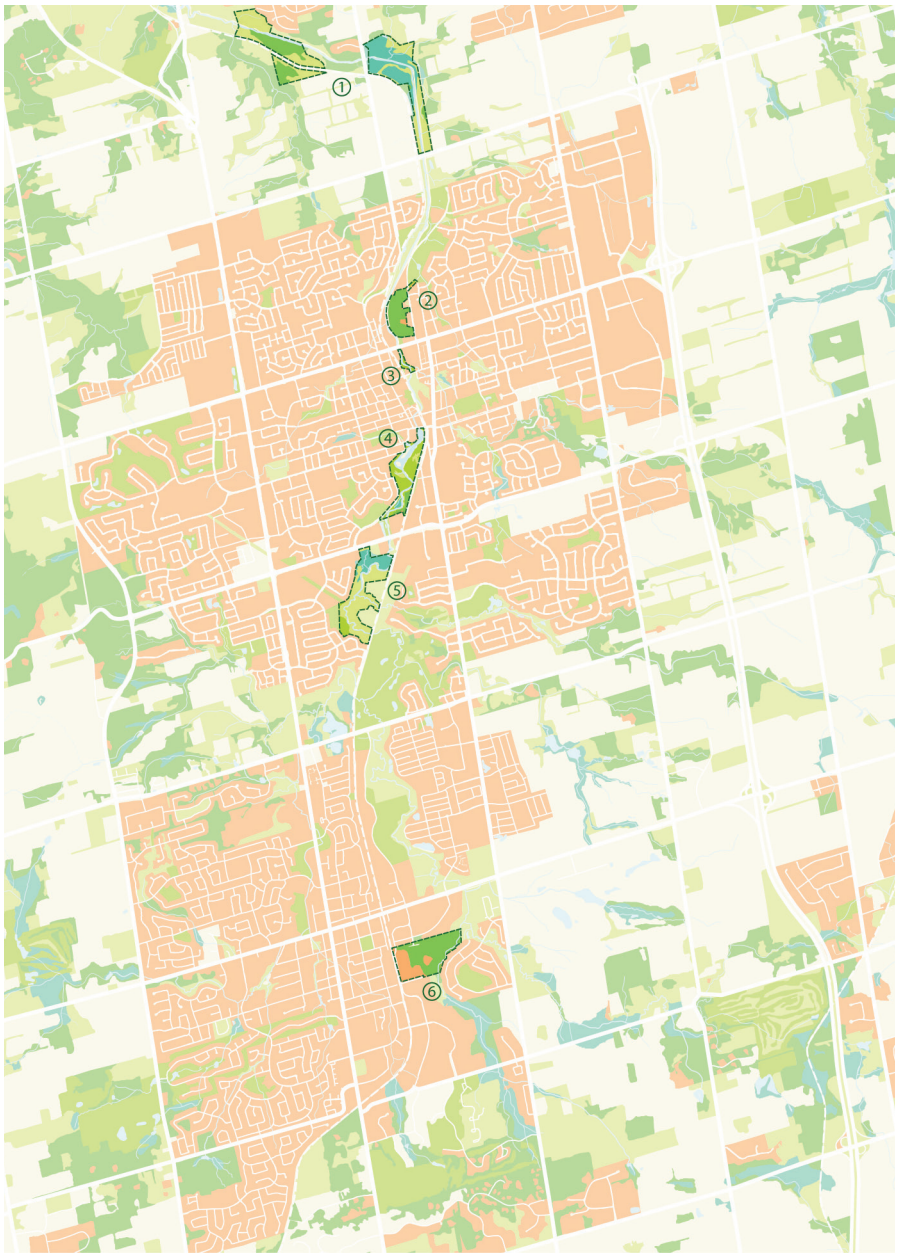


open water
residential
commercial
industrial
institutional
estate residential
manicured open space
rural development
intensive agriculture
non-intensive agriculture
aggregate
cultural meadow
cultural plantation
cultural thicket
cultural woodland
coniferous forest
deciduous forest
mixed forest
shrub fen
meadow marsh
shallow marsh
mixed shallow aquatic
submerged aquatic
coniferous swamp
deciduous swamp
mixed swamp
thicket swamp

1 0 1 2 3 km

fig 2.82 aurora-newmarket urban landscape: complete ecological land classification
This map compiles all the layers of ecological land classification to illustrate the various cultral and natural components of Newmarket and Aurora's urban landscape.

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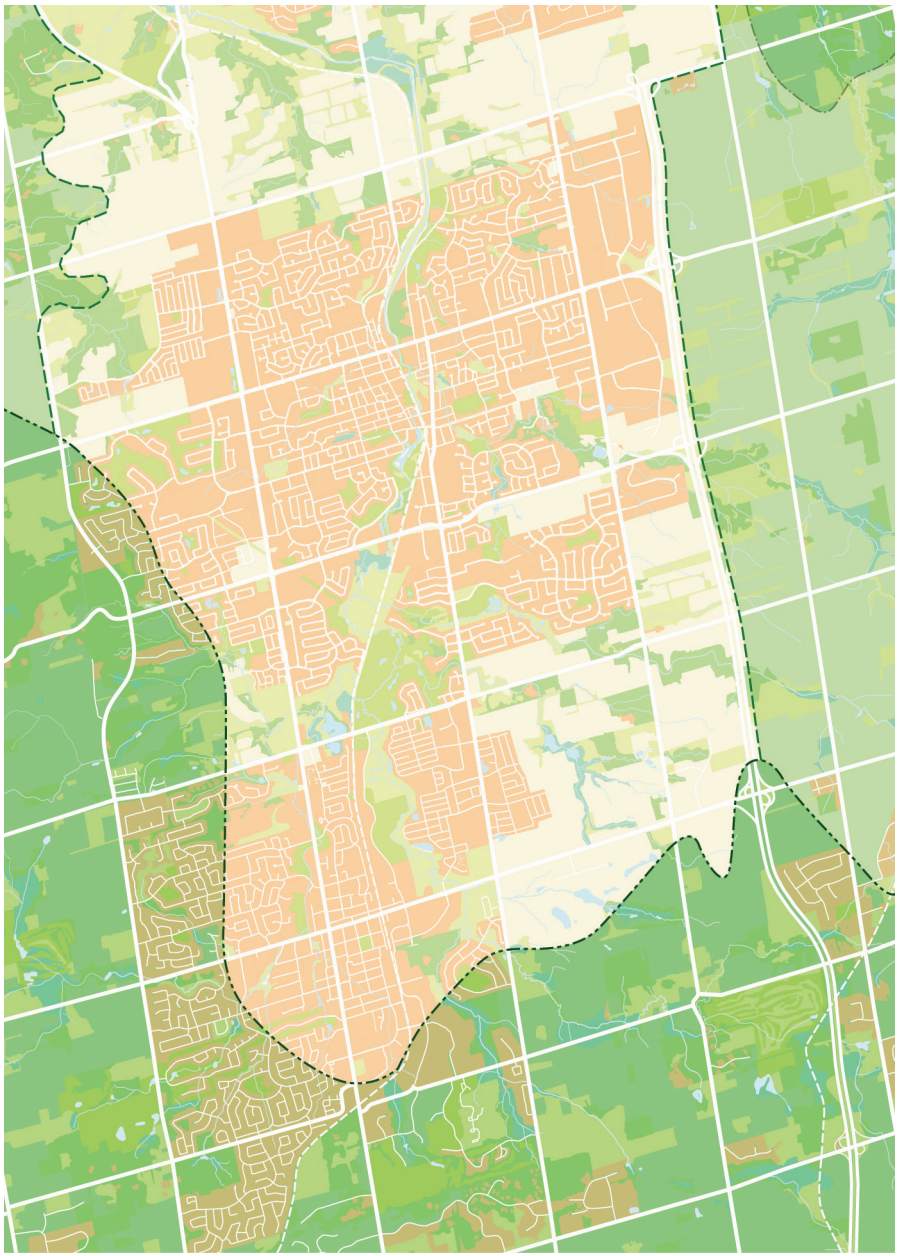

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fig 2.83 aurora-newmarket urban landscape: existing pedestrian trails

There are many existing trails in Newmarket and Aurora, although most of these trails are independent networks which are disconnected from each other. The largest trail network in the area is the Nokiidaa Trail System, which follows the East Holland River.

- existing trails
- open water
- urban development
- agriculture
- forest
- wetland
- manicured open space
- cultural green space

(centre)

fig 2.84 aurora-newmarket urban landscape: conservation areas

There are several conservation areas in the area that are located along the East Holland River. These conservation areas are significant natural areas that are owned and managed by the Lake Simcoe Region Conservation Authority. While the conservation of these natural areas is very important, the open space that links them is currently unprotected and fragmented by urban development.

- conservation area boundary
- ① rogers reservoir
- ② mabel davis
- ③ queen street
- ④ wesley brooks memorial / fairy lak
- ⑤ bailey ecological park
- ⑥ sheppard's bush

(right)

fig 2.85 aurora-newmarket urban landscape: greenbelt boundary

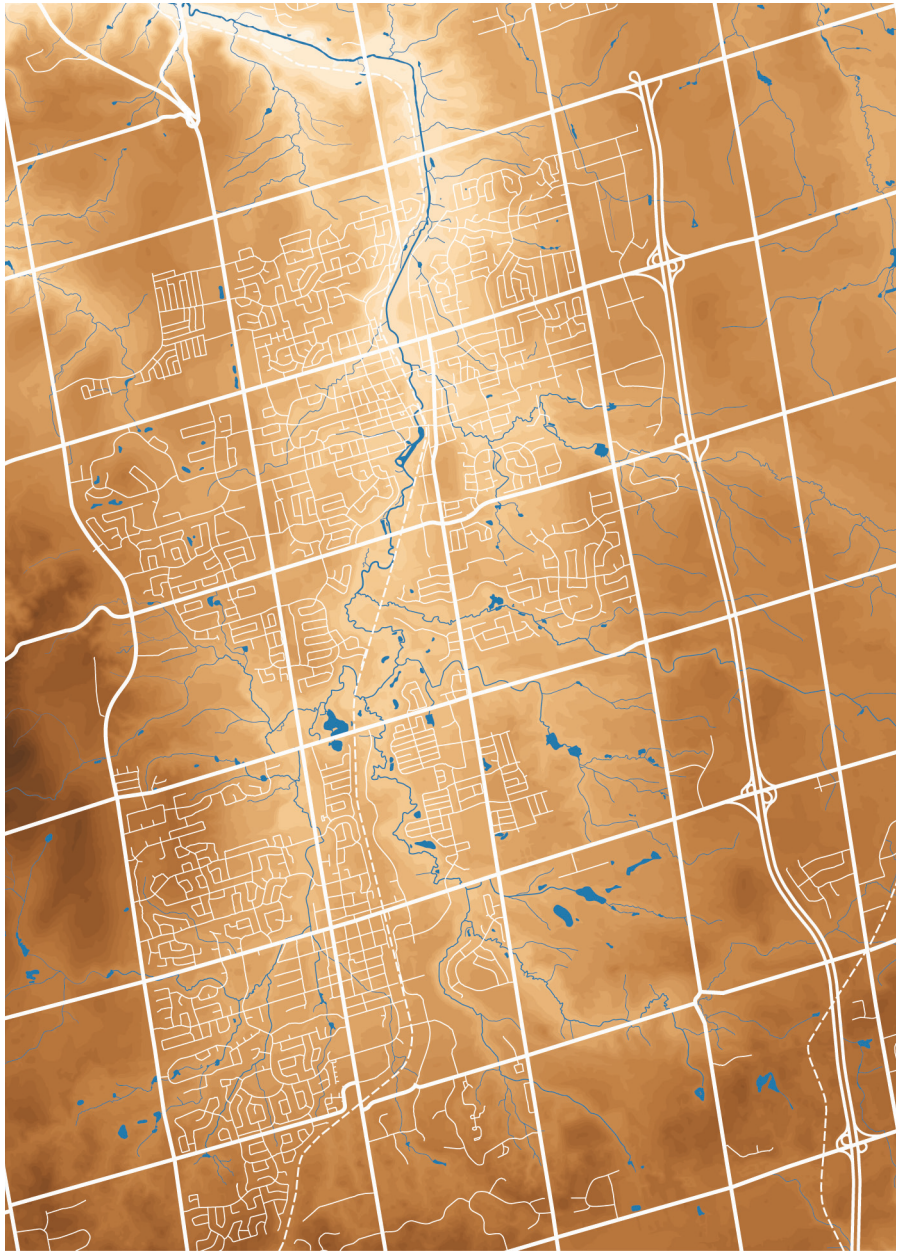
Most of Newmarket and Aurora is located within a pocket of developable land that is outside of the greenbelt boundary, with the exception of the southern and western edges of Aurora and Newmarket that are located on the Oak Ridges Moraine.

- open water
- urban development
- agriculture
- forest
- wetland
- manicured open space
- cultural green space
- greenbelt
- oak ridges moraine

1 0 1 2 3 km

fig 2.86 aurora-newmarket urban landscape: topography

This map illustrates the topography of Newmarket and Aurora's landscape. The lowest areas occur along the East Holland River valley at an elevation of 225 metres above sea level. The highest areas are located west of Bathurst Street, at an elevation of 350 metres above sea level.



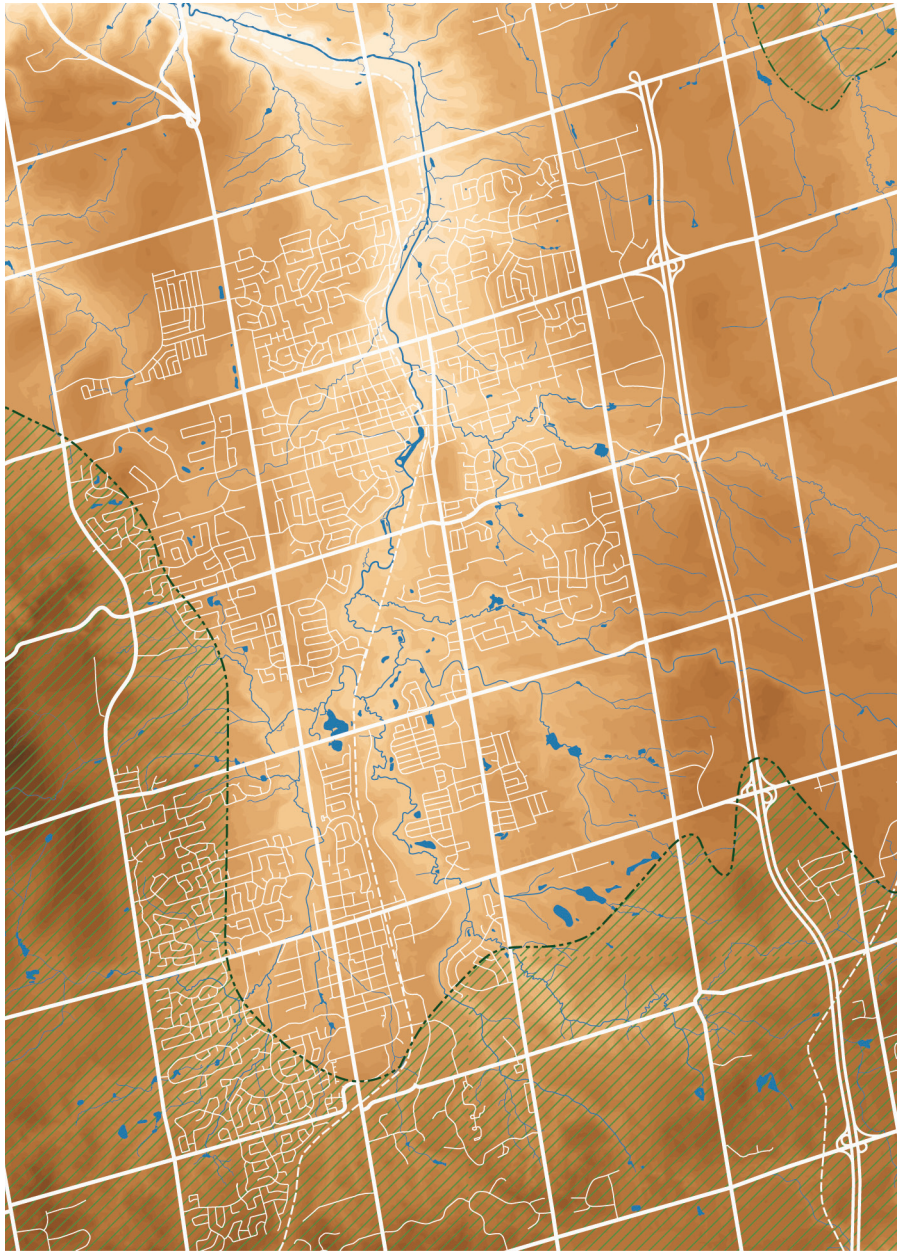


fig 2.87 aurora-newmarket urban landscape: topography and greenbelt boundary
The majority of developed land in Newmarket and Aurora is located on a gently sloped plateau and valley of the East Holland River, which is framed by the rolling hills of the Oak Ridges Moraine.

open water

oak ridges moraine

1 0 1 2 3 km

fig 2.88 niagara escarpment

fig 2.89 countryside in east gwillimbury

fig 2.90 holland marsh

fig 2.91 agricultural land on the holland marsh

2.3 current initiatives

An ecosystems approach to urban design requires an additional level of complexity that is not present in most traditional design methods, since those methods pay little attention to the natural ecology of their given site. Natural processes are in constant flux, and as a result, an ecosystems approach must design for change. It is important that legislative measures be established to manage and monitor the changing state of natural process on the site, in order to maintain the health of the ecosystem.

There are many existing initiatives that have been established by a wide variety of groups and governments that promote the conservation, restoration, and enhancement of local natural systems, and encourage "smart growth" of urban and rural areas in the Newmarket and Aurora region. This chapter lists the various groups that have a vested interest in the goals that are relevant to this thesis, and discusses their plans and initiatives to enhance the quality of the urban and natural landscapes. This includes groups and members of the community at a variety of levels, including different levels of government, advocacy groups, and local businesses and residents. These groups are categorized by scale and listed below:

Federal Government (Government of Canada):

Environment Canada

At the national scale, the mandate of Environment Canada is to "preserve and enhance the quality of the natural environment; conserve Canada's renewable resources; conserve and protect Canada's water resources; forecast weather and environmental change; enforce rules relating to boundary waters; and co-

ordinate environmental policies and programs for the federal government".[33] The roles of Environment Canada pertain to wide-scale environmental systems, such as climate, air, and water, as well as terrestrial ecosystems.

Provincial Government (Government of Ontario):

Greenbelt Plan, 2005

In 2005, the Ontario Government passed legislation to create the Greenbelt Plan, which permanently protects a large area of agricultural land, green space, forests, and wetlands in the Greater Toronto Area. The greenbelt consists of 1.8 million acres of land that includes the Niagara Escarpment and Oak Ridges Moraine.[34] Since Newmarket and Aurora are directly located within the greenbelt, this plan is one of the most important initiatives that pertains to this thesis. The greenbelt is a fundamental aspect of green infrastructure, and plays a significant role in the development of the design proposal.

Oak Ridges Moraine Conservation Plan, 2002

In 2002, the Ontario Government finalized a plan that addresses land use and resource management for the Oak Ridges Moraine, one of Ontario's most significant landforms.[35] The goal of this plan is to manage the increasing pressure for stakeholders and landowners to build residential and commercial developments on the moraine, and to direct them on how to "protect the Moraine's ecological and hydrological features and functions".[36] As one of the most important natural features in Ontario, the Oak Ridges Moraine is a key element of

33 *About Environment Canada*. Retrieved April 13, 2008 from Environment Canada. <http://www.ec.gc.ca/default.asp?lang=En&n=BD3CE17D-1>.

34 *Greenbelt Protection*. Retrieved April 13, 2008 from Ministry of Municipal Affairs and Housing. <http://www.mah.gov.on.ca/Page187.aspx>.

35 *The Oak Ridges Moraine*. Retrieved April 13, 2008 from Ministry of Municipal Affairs and Housing <http://www.mah.gov.on.ca/Page322.aspx>.

36 ibid.

fig 2.92 mckenzie marsh
McKenzie Marsh is classified as a Provincially Significant Wetland in Aurora.

fig 2.93 aurora arboretum
The Aurora Arboretum is a park that is located in the East Holland River valley. It consists of a naturalized forest, wetland, and meadow; an area for the semi-formal planting of specimen trees; and fields for sports and recreation.

the proposed greenway system for this thesis.

Places to Grow: Growth Plan for the Greater Golden Horseshoe, 2006

The Government of Ontario put together a 25-year growth plan to manage urban growth in the Greater Golden Horseshoe. The plan works with other plans, such as the Greenbelt Plan, to address the problems and challenges associated with urban sprawl. The plan addresses these challenges through the following policy directions: to direct growth to built-up areas; to promote transit-supportive densities and mixed-use planning; to preserve employment areas for future economic growth; to link urban centres with an efficient public transportation and highway network to move people and goods; to build community infrastructure to support growth; to implement sustainable water and wastewater services; to identify natural systems and prime agricultural areas, and to enhance their conservation; and finally, to protect and conserve water, energy, air, and cultural heritage while effectively managing waste.[37] The plan envisions that automobiles will be only one of many options for transportation by 2031. Options of walking, cycling, and efficient public transit will be on par with automobile usage. The plan also envisions a healthy natural environment, where significant natural features such as the Niagara Escarpment and the Oak Ridges Moraine continue to act as the key building blocks of the region's natural systems.[38] The plan is structured on the following principles: to build compact, vibrant, and complete communities; to plan and manage growth that supports the economy; to protect, conserve, enhance, and wisely use the valuable natural resources of land, air, and water; to optimize the use of existing infrastructure; to recognize diversity of communities; and to promote a collaboration among all sectors (government, private, non-profit, and

37 *Places to Grow: Growth Plan for the Greater Golden Horseshoe.* Ontario: Ministry of Public Infrastructure Renewal, 2006, p.8.

38 ibid, p.9.

residents) to achieve these visions. This Growth Plan is an important initiative that supports many of the arguments presented in this thesis. Its principles of maintaining environmental health, concentrating growth in existing urban areas, promoting higher densities and mixed land use, and enhancing the public transportation system are particularly pertinent to the design proposal for this thesis.

Regional Government (Regional Municipality of York):

Greening Strategy

In 2001, York Region adopted the Greening Strategy, which focuses on coordinating regional initiatives and agencies, as well as private sector partnerships, with the goal to improve the natural environment. The action areas of the Greening Strategy include: providing information management for stakeholders and the public, establishing the rehabilitation of natural areas, securing priority greenlands, promoting and educating the public in the significance of the region's natural heritage, maintaining urban forests, promoting green partnerships, and monitoring the results of environmental initiatives.[39] York Region also has a series of other initiatives with the goal of improving the region's land, air and water. These include: public transit initiatives, energy and environmental management systems, water conservation programs, watershed planning, groundwater planning, growth management strategies, "Smart Commute" initiatives, clean air initiatives for corporations, and waste diversion programs.[40]

fig 2.94 sheppard's bush conservation area
A panoramic view of the Sheppards Bush conservation area, which is managed by the Lake Simcoe Region Conservation Authority.

fig 2.95 boardwalk along a wetland
A wide sidewalk with a viewing platform overlooks McKenzie Marsh in Aurora, along St. John's Sideroad between Yonge Street and Bayview Avenue.

39 *York Region Greening Strategy*. 2006. Retrieved April 13, 2008 from The Regional Municipality of York <http://www.york.ca/Services/Environmental/Greening+Strategy/Default+Greening+Strategy.htm>.

40 ibid.

fig 2.96 holland river in newmarket
A view of the Holland River, south of Fairy Lake in Newmarket.

Conservation Authority:

Lake Simcoe Region Conservation Authority:

The Lake Simcoe Region Conservation Authority (LSRCA) is a community-based environmental agency that works in partnership with municipal and provincial government partners, to restore and protect the environmental integrity of the water and land in the Lake Simcoe Watershed.[41] All of the conservation areas in the Newmarket and Aurora area are managed by the LSRCA, including Bailey Ecological Park, Sheppard's Bush and Rogers Reservoir.

Municipal Governments:

Town of Newmarket

The Town of Newmarket supports a series of environmental initiatives, which include Newmarket "Enviro Days", "Smart Commute Newmarket", and pesticide-use bylaws that prohibit the cosmetic use of pesticides. Newmarket also has an Environmental Advisory Committee that works with the town council to promote ways to survey, protect, and restore the natural environment.[42]

Town of Aurora

Like Newmarket, the Town of Aurora has its own Environmental Advisory Committee. This committee acts as an advisory board to Aurora's Council in matters that pertain to the protection and enhancement of the natural environment.[43] Some of the goals of the committee are to act as a mediator between residents and government in environmental matters; and to promote environmental and educational initiatives, as well as green spaces and rehabilitation projects.

41 *About Us*. Retrieved April 13, 2008 from Lake Simcoe Region Conservation Authority. < http://www.lsrca.on.ca/about/>.

42 *Newmarket Environmental Advisory Committee*. Retrieved August 20, 2010 from Town of Newmarket. <http://www.newmarket.ca/en/townhall/newmarketenvironmentaladvisorycommitteeneac.asp>.

43 *About EAC*. Retrieved August 20, 2010 from Town of Aurora. <http://www.town.aurora.on.ca/aurora/index.aspx?CategoryID=90&lang=en-CA>.

Foundations and Organizations:

The Friends of the Greenbelt Foundation

The Friends of the Greenbelt Foundation is a non-profit organization that is "dedicated to promoting and sustaining the Greenbelt as a beneficial, valuable, and permanent feature, enhancing the quality of life for all residents of Ontario."[44] The foundation supports the relationship between urban and rural areas, and promotes initiatives that foster a healthy connection between cities and their surrounding rural communities. The foundation also tracks and reports the government's accountability in fulfilling the plans and objectives of both the Greenbelt Act and the Greenbelt Plan.

Ontario Greenbelt Alliance

The goal of this organization is to protect the greenbelt's most environmentally sensitive areas from the pressures of urban development. The Alliance also promotes the value of the greenbelt, with the goal to increase the size of protected areas within its existing boundary.[45] The group acts as a "watchdog and defender"[46] of Ontario's greenbelt, and is an important actor in advocating the health and vitality of the greenbelt.

The Oak Ridges Moraine Foundation:

The Oak Ridges Moraine Foundation promotes several initiatives to protect and enhance the health of the moraine's vibrant ecosystem. Some of these initiatives include the coordination of moraine-wide activities, promoting environmental stewardship among landowners on the moraine, educating the public on the importance of the moraine, encouraging research, and support-

44 *Vision, Goals & Approach*. Retrieved August 20, 2010 from Greenbelt Foundation. <http://greenbelt.ca/vision-goals-approach>.

45 *Ontario Greenbelt Alliance Vision*. Retrieved April 13, 2008 from Ontario Greenbelt Alliance. <http://www.greenbeltalliance.ca/?q=node/11>.

46 *Who We Are*. Retrieved August 20, 2010 from Ontario Greenbelt Alliance. <http://www.greenbeltalliance.ca/?q=node/1>.

fig 2.97 the nokiidaa trail
A stone marker along the Nokiidaa Trail in Newmarket

fig 2.98 the east holland river along the nokiidaa trail
The Nokiidaa Trail follows the East Holland River valley. This photograph depicts a part of the trail that passes through a naturalized forest along the river. Fallen trees and branches canopy the East Holland River.

ing the securement of a trail system.[47]

Ontario Trails Council

The Ontario Trails Council (OTC) is a charitable organization that promotes the development, preservation, management, and use of Ontario's recreational trails.[48] Some of the trails systems that are promoted by the OTC include the Nokiidaa Trail, which links Aurora, Newmarket, and East Gwillimbury along the East Holland River, and the Oak Ridges Moraine Trail, which spans the length of the Oak Ridges Moraine from the Niagara Escarpment to the Northumberland Forest. Both of these trails form significant branches of the proposed greenway in this thesis, and have the potential to act as natural linkage corridors between natural areas if managed properly. For this reason, the Ontario Trails Council is an important factor in the feasibility of this design proposal.

Land Developers, Local Businesses and Residents:

Developers have a huge influence on the future quality of the town's urban landscape, as they build for profit, and often put pressure on the government to allow them to build on ecologically sensitive areas such as the Oak Ridges Moraine. There is, however, an increased interest in environmental awareness, and therefore, the creation of "green" properties has become more popular. In the case of Newmarket, the first "ecologically-progressive" residential subdivision is in the process of being built by Redoe Fine Homes Inc. The subdivision includes 34 "environmental lots", 2 Habitat-for-Humanity lots, an eco-friendly recreational complex, and community trails.[49] The legislation to restrict de-

47 *What does the Oak Ridges Moraine Foundation do.* Retrieved August 20, 2010 from Oak Ridges Moraine Foundation. <http://moraineforlife.org/about/what.php>.

48 *About OTC.* Retrieved August 20, 2010 from Ontario Trails Council. <http://www.ontariotrails.on.ca/about-the-otc/>.

49 *Construction begins on Canada's greenest housing development.* Retrieved November 13, 2007 from Town of Newmarket. <http://www.newmarket.ca/en/townhall/constructionbeginsoncanadasgreenesthousingdevelopment.asp>.

velopment in ecologically sensitive areas, combined with the growing recognition of sustainable design as a profitable and viable economic venture, demonstrates an increased commitment to the quality of the natural and built environment.

It is also important that the various special-interest groups and governments mentioned in this chapter work together with local residents and businesses to promote awareness of the environmental issues that impact their communities. The participation and support of residents and businesses is fundamentally important to maintaining the health of the environment and vitality of our cities.

Each group mentioned above has a vested interest in supporting the sustainability, health, and growth of Newmarket and Aurora. In many cases, these groups have the important role of managing and monitoring the complex ecosystems of the region. Many of the foundations and non-profit groups also monitor government accountability to ensure that their objectives and initiatives are being met. The collaboration of goals and initiatives established by each group can be utilized to advance the feasibility of the design proposal for this thesis, as each of them works in parallel with the principles of sustainable growth and green infrastructure.

fig 2.99 panoramic view of aurora's natural landscape
One of the last remaining parcels of greenfield land in Aurora, located north of Wellington Street on the west side of Leslie Street.

fig 3.01 design vignettes

03 design synthesis

"The implications for urban design and management are persuasive. A new approach to our concept of the urban landscape is needed, requiring radical measures to ensure the future environmental and social viability of cities. What we are concerned with is a design philosophy that integrates the ideals of urbanism with nature. This brings us closer to the land and the biological systems from which urban people have been alienated, and gives us the practical tools with which to sustain ourselves in the future. The principles of productivity and diversity, the integration of environment and cultural diversity in the planning, design and management of urban landscapes flow from this philosophy."[1]

This thesis envisions a new approach to urban design where healthy and ecologically diverse natural systems operate in harmony with their surrounding vibrant, urban communities. The research and analysis gathered in section 02 of this thesis provides the foundation for the design proposal. The design takes into consideration the various ecosystems that operate in the Newmarket and Aurora area, and uses them as the framework for defining the green infrastructural system.

The design approach operates at three scales. First, it proposes a plan at the regional scale. This plan is primarily interested in the greenbelt, as well as the greenway and its regional connections to natural areas beyond the Newmarket and Aurora boundary. It also presents an extension of the local public transit system to link the proposed villages to existing urban centres. The second scale focuses on the study area for the proposed Leslie Village. It outlines a schematic plan for the village and offers an in-depth look at how the village is situated in relation to the greenway. The final section of the design identifies key zones in Leslie Village, and provides nominal visualizations to demonstrate how the greenway works at the human scale.

The design is based on a series of basic principles that relate to the regional and local scales, as outlined in the chart on the following page. In addition to these principles, the design adheres to the following: It views the greenway as a multifunctional public system that operates as both a recreational greenway and an ecological greenway simultaneously; and it views roads as the primary public space framework that ties the greenway to the city.

1 Hough, Michael. *Cities and Natural Process: A basis for sustainability.* 2nd ed. New York: Routledge, 2004, p.188.

	design principle	*reference*
regional scale	Maintain and utilize existing conservation areas, environmentally significant areas, and areas of natural and scientific interest.	Ian L. McHarg, *Design with Nature*; Michael Hough, *Cities and Natural Process; Places to Grow, 2006*; Johnathan M. Labaree, *How Greenways Work*.
	Propose the conservation and protection of natural areas that are currently unprotected, including significant woodlands, wetlands, watercourses and their riparian zones.	Ian L. McHarg, *Design with Nature;* Michael Hough, *Cities and Natural Process;* Johnathan M. Labaree, *How Greenways Work;* Jack Ahern and Julius GY. Fabos, *Greenways*.
	Create linkage corridors between natural areas, to reduce the effects of fragmentation by expanding terrestrial habitats and promoting the natural migration of flora, fauna, nutrients, and minerals.	Ian L. McHarg, *Design with Nature*; Michael Hough, *Cities and Natural Process;* Johnathan M. Labaree, *How Greenways Work*; Jack Ahern and Julius GY. Fabos, *Greenways*.
	Provide an extensive trail network to link communities, and provide access to the greenway in areas that are less sensitive to the impact of human activities.	Jack Ahern and Julius GY. Fabos, *Greenways*; *Central Pickering Development Plan, 2006*.
	Employ green infrastructure as a means to enhance the quality of both the natural and urban environment.	Robert S. Dorney, *Ecoplanning*; Mark A. Benedict and Edward T. McMahon, *Green Infrastructure.*
	Encourage intensification of urban centres and higher density in concentrated areas to reduce the impacts of urban sprawl.	James Howard Kunstler, *The Geography of Nowhere; Places to Grow, 2006*
	Utilize and expand upon existing government initiatives and policies to enhance the feasibility of the design.	*Places to Grow, 2006; Greenbelt Act, 2005; Oak Ridges Moraine Conservation Plan, 2002*

fig 3.02 **design principles**

	design principle	*reference*
local scale	Encourage community involvement in the use, management, and protection of the greenway to promote an educational understanding of natural process and its value to the community.	Michael Hough, *Cities and Natural Process; Central Pickering Development Plan, 2006*.
	Allow natural processes to function transparently so that they may be visible to the community to foster a greater psychological connection to the natural environment.	Michael Hough, *Cities and Natural Process*.
	Provide recreational areas along the greenway in areas that are less sensitive to the impacts of human activity.	Michael Hough, *Cities and Natural Process;* Johnathan M. Labaree, *How Greenways Work*; *Central Pickering Development Plan, 2006*.
	Use environmentally sustainable materials, methods, and practices wherever possible to reduce energy and water consumption, pollution, and waste.	Michael Hough, *Cities and Natural Process*; *Central Pickering Development Plan, 2006*.
	Encourage golf courses and other recreational areas within the greenway to adopt environmentally sustainable practices.	Michael Hough, *Cities and Natural Process*.
	Design at the human scale to accommodate the pedestrian rather than the automobile.	James Howard Kunstler, *The Geography of Nowhere;* Jane Jacobs, *The Death and Life of Great American Cities*.
	Make the spaces between buildings a priority, to enhance the quality of the public realm and foster a sense of place.	Michael Hough, *Cities and Natural Process;* James Howard Kunstler, *The Geography of Nowhere;* Jane Jacobs, *The Death and Life of Great American Cities*.

fig 3.03 view from a section of the nokiidaa trail

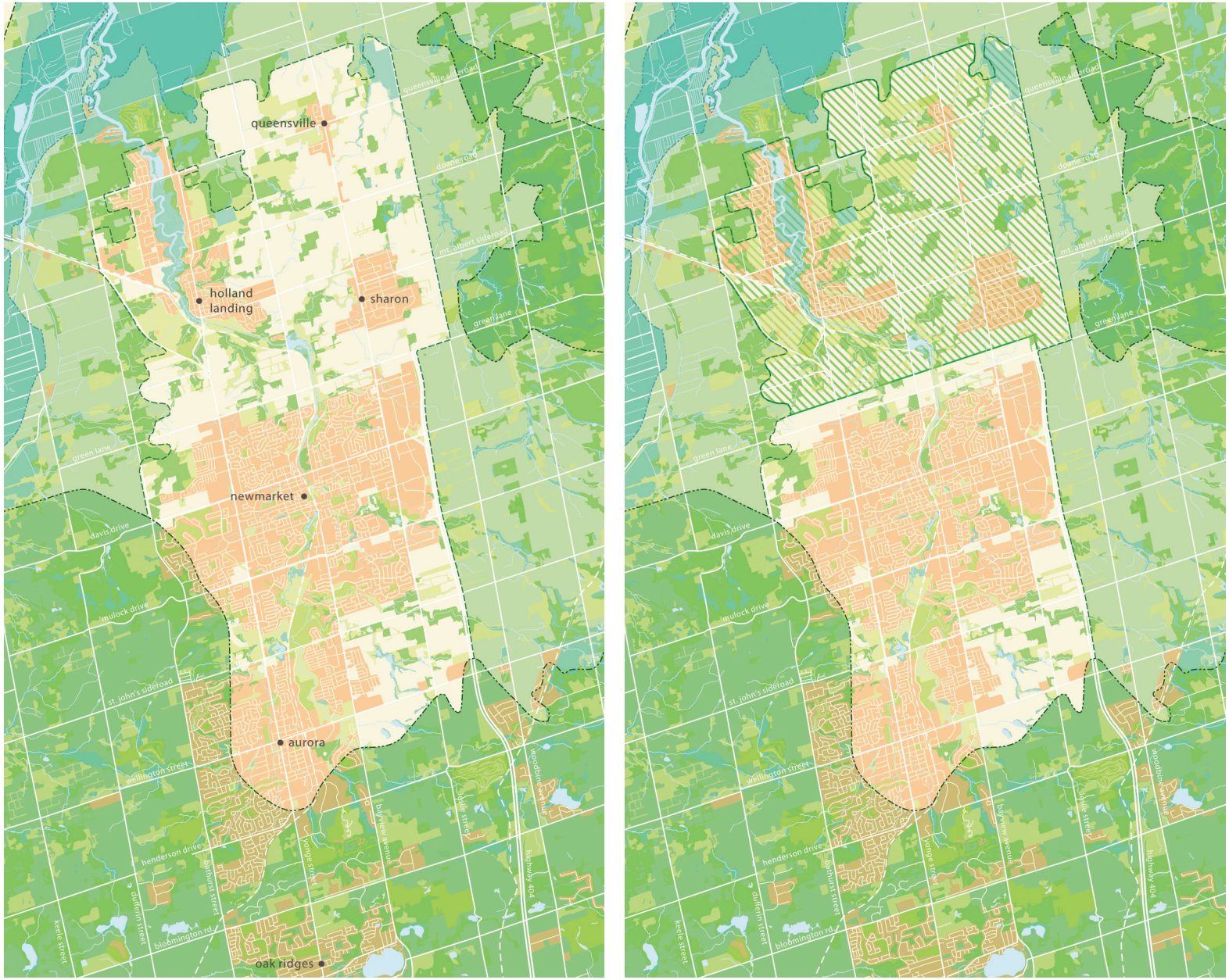
The greenway system ties into the existing trail systems with additional provisions for maintaining and conserving natural areas adjacent to these trails. The preserved natural areas create linkage corridors with regional connections to the surrounding countryside.

"The greenway may be seen as an old idea, dating back centuries in Europe and to nineteenth and twentieth centuries in North America. At the same time, their functions have diversified. Today, they represent ecological, economic, and community based ideas that play a key role in integrating natural habitats, parks, towns, and cities. Their value lies in establishing regional connections, not only with urban areas, but also with the countryside in ways that accentuate their differences as places and ensure their sustainability."[2]

3.1 the greenway and linked villages

This chapter explores the design at the regional scale. It is concerned with the aspects of the design that operate outside the study area, but are still critical to the design of Leslie Village; such as the greenbelt boundary, the greenway system and its regional connections, and the local public transportation system. It employs a methodological approach to define the greenway boundary and identify the ideal location for two new sustainable urban villages.

2 Hough, Michael. *Cities and Natural Process: A basis for sustainability.* 2nd ed. New York: Routledge, 2004, p.233-5.


queensville
holland landing
sharon
newmarket
aurora
oak ridges
queensville sideroad
doane road
mt. albert sideroad
green lane
davis drive
mulock drive
st. john's sideroad
wellington street
henderson drive
dufferin street
bathurst street
bloomington rd
keele street
yonge street
bayview avenue
leslie street
woodbine avenue
highway 404

(opposite left)

fig 3.04 existing greenbelt boundary

The rural land that surrounds the urban centres of Sharon, Holland Landing, and Queensville is currently designated as a growth area, in accordance with the Provincial Growth Plan.[3]

3 *Places to Grow: Growth Plan for the Greater Golden Horseshoe.* Ontario: Ministry of Public Infrastructure Renewal, 2006.

(opposite right)

fig 3.05 proposed greenbelt extension

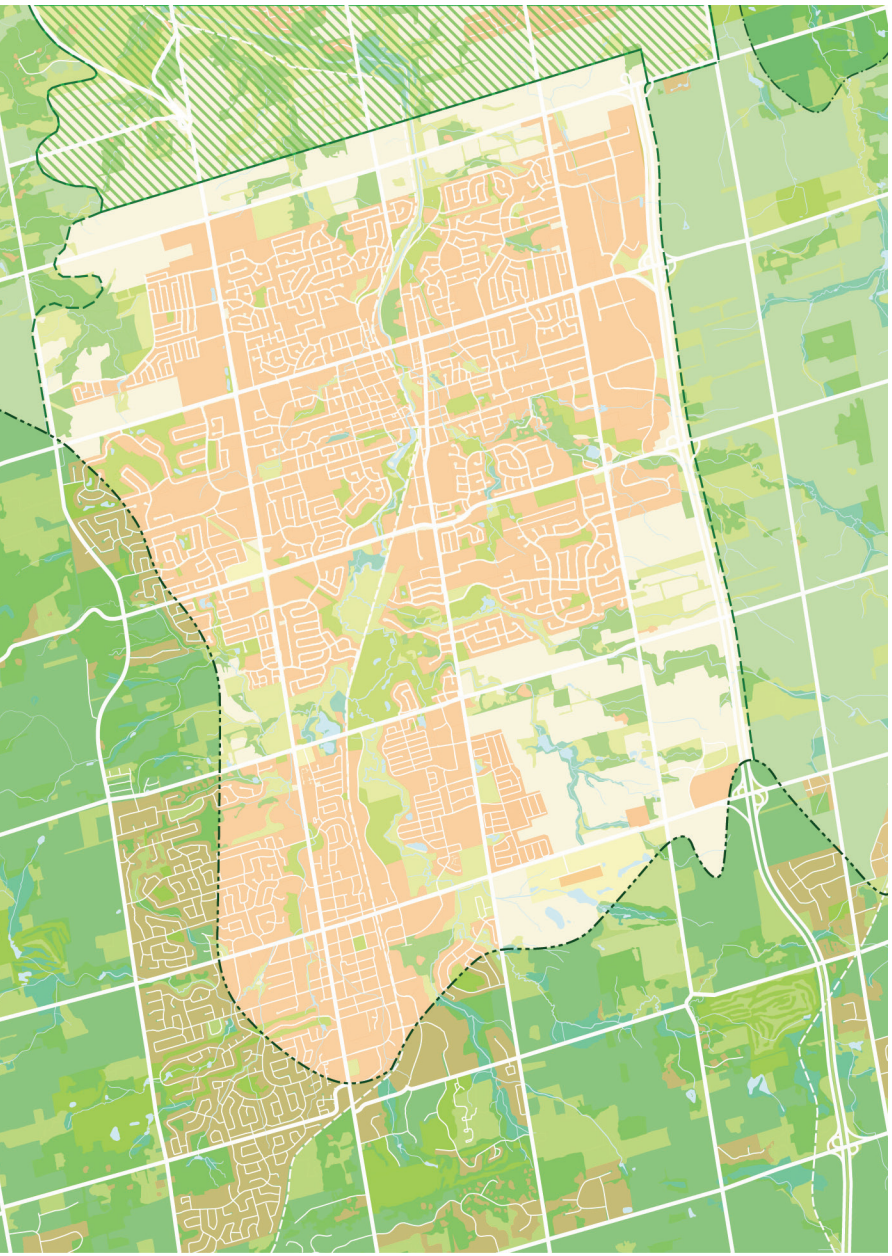
This map illustrates the proposal to extend the greenbelt boundary south, to suspend development in East Gwillimbury and encourage intensification in Aurora and Newmarket.

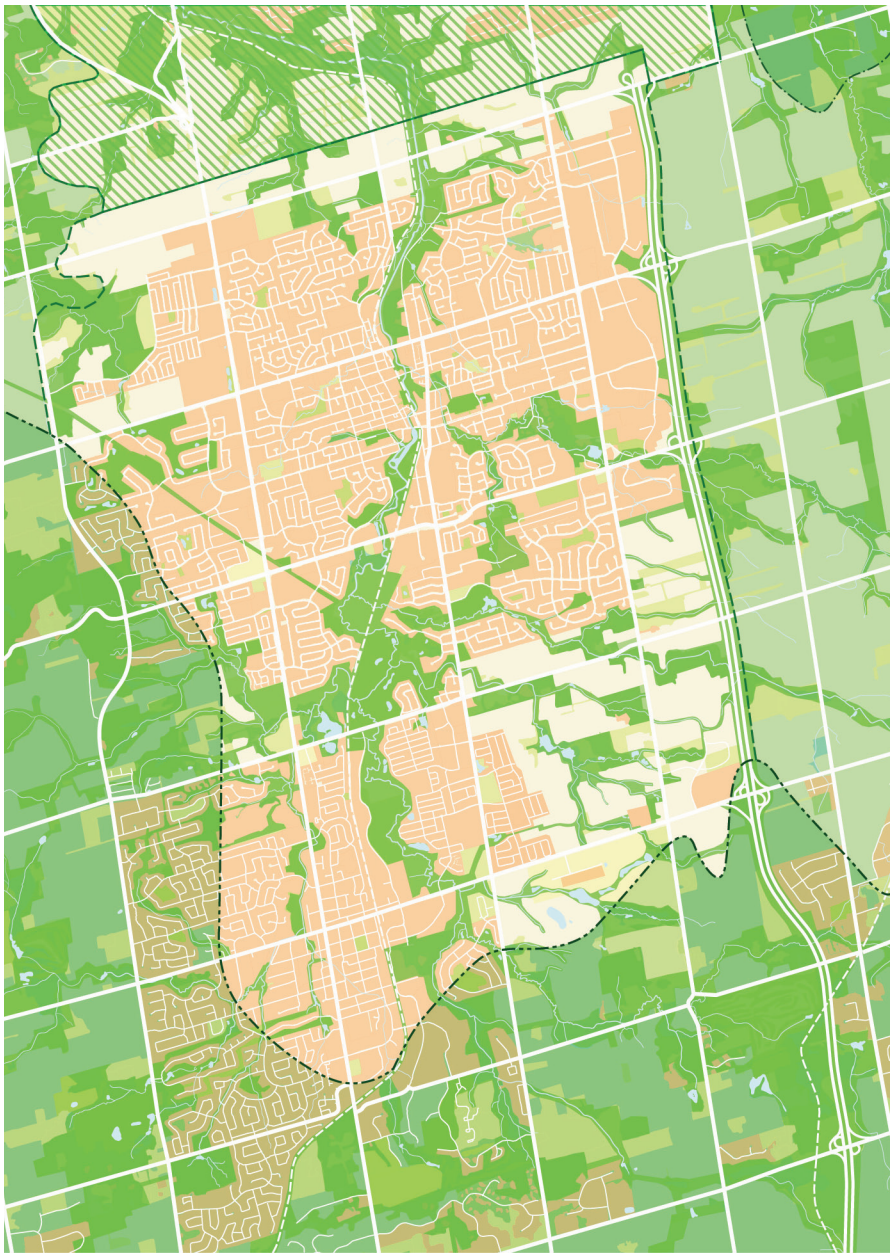
step 1: redefine the greenbelt boundary

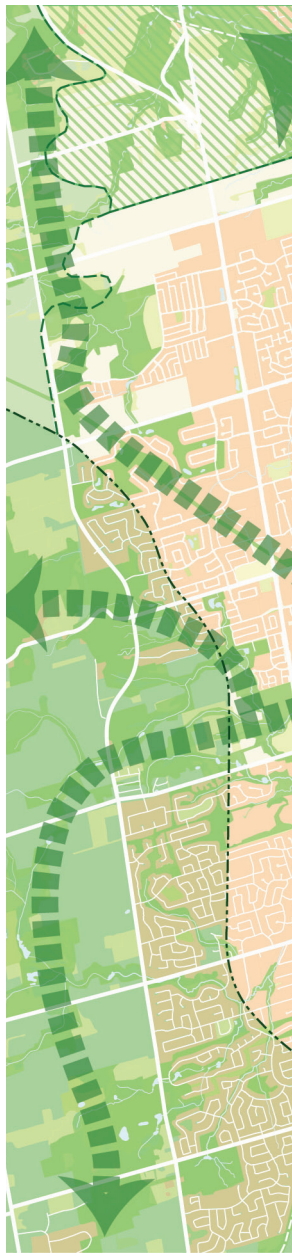
Currently, Newmarket and Aurora are located in an isolated pocket of developable land within the Ontario Greenbelt. This area of land is a designated growth area[4] which encompasses all of the land in Newmarket and Aurora, with the exception of the southern edge of Aurora that is situated on the Oak Ridges Moraine. This growth area also covers a significant portion of land in the Town of East Gwillimbury, including the urban centers of Holland Landing, Sharon, and Queensville. With the exception of these urban centres, most of East Gwillimbury is rural greenfield land. In the next several years, this expansive amount of unrestricted land is likely to experience substantial growth. It is also likely that this growth will follow the typical pattern of low-density, car-oriented development. For this reason, it is important to intervene with strategic guidelines and restrictions to prevent further urban sprawl.

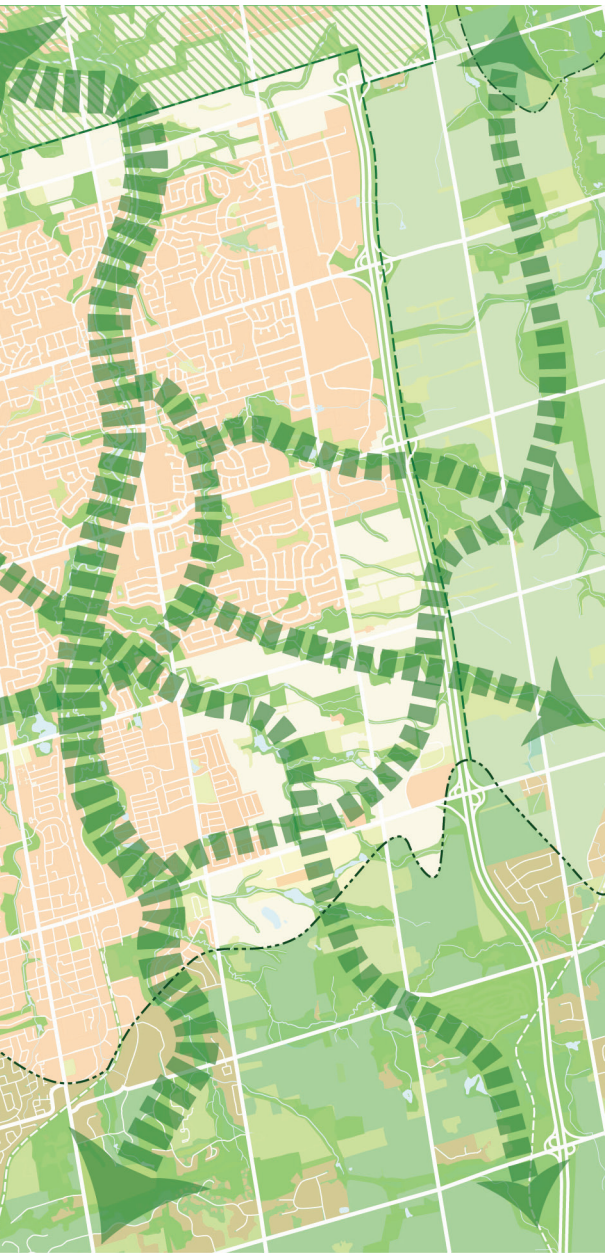
The first step in curbing sprawl in the region is to extend, temporarily, the edge of the greenbelt south toward Green Lane. This extension of the greenbelt will shift the focus of development to Newmarket and Aurora, and encourage the intensification of these existing urban centres.

4 *Places to Grow: Growth Plan for the Greater Golden Horseshoe.* Ontario: Ministry of Public Infrastructure Renewal, 2006.









(far left)

fig 3.06 existing natural areas

This map illustrates a simplified classification of existing natural areas and open space, such as wetlands, forests, cultural communites, and manicured open space.

(centre)

fig 3.07 proposed greenway

This map illustrates the proposed greenway, which creates linkage corridors between existing open space and natural areas. It provides a continuous network of green space that supports biodiversity and local ecosystems.

(right)

fig 3.08 regional greenway connections

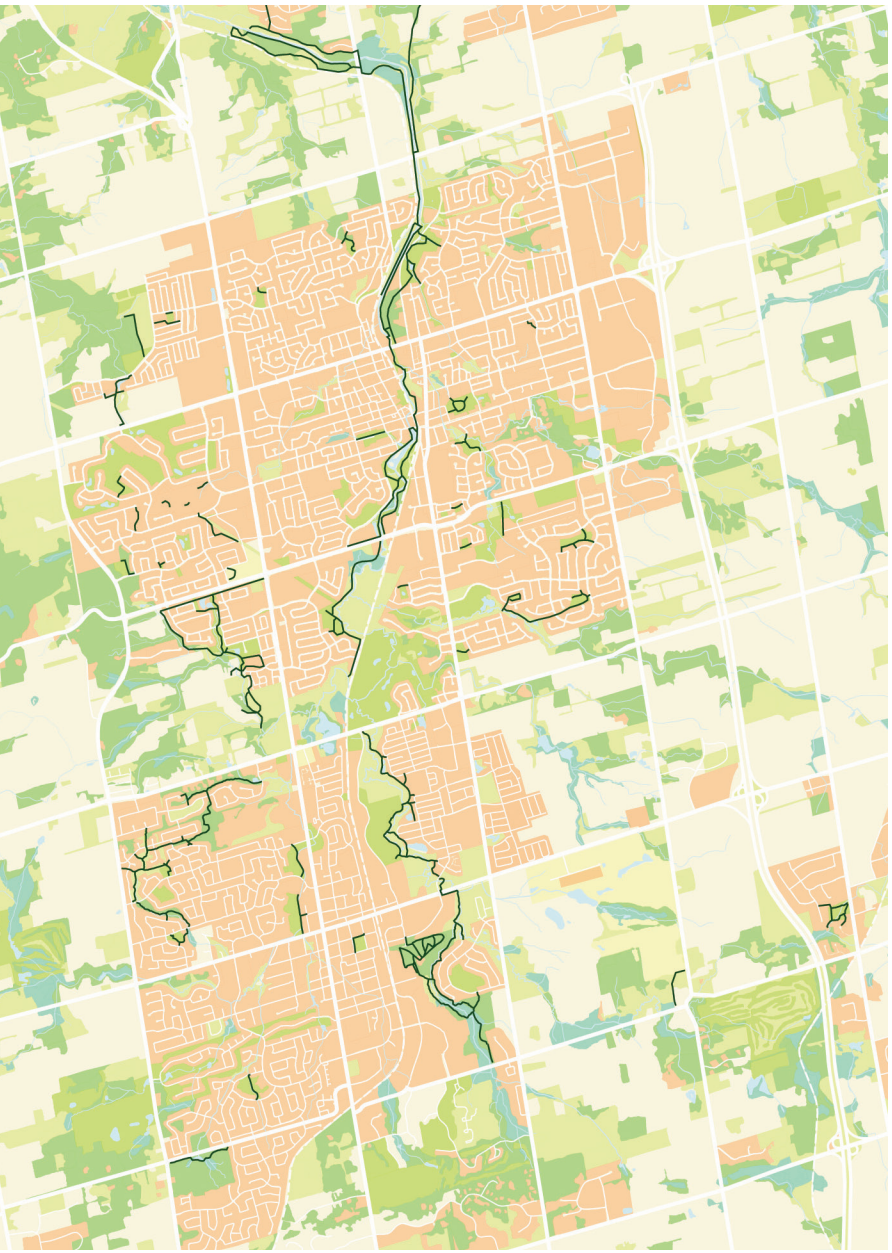
This diagram shows the main natural corridors of the greenway that connect to surrounding natural areas in the region.

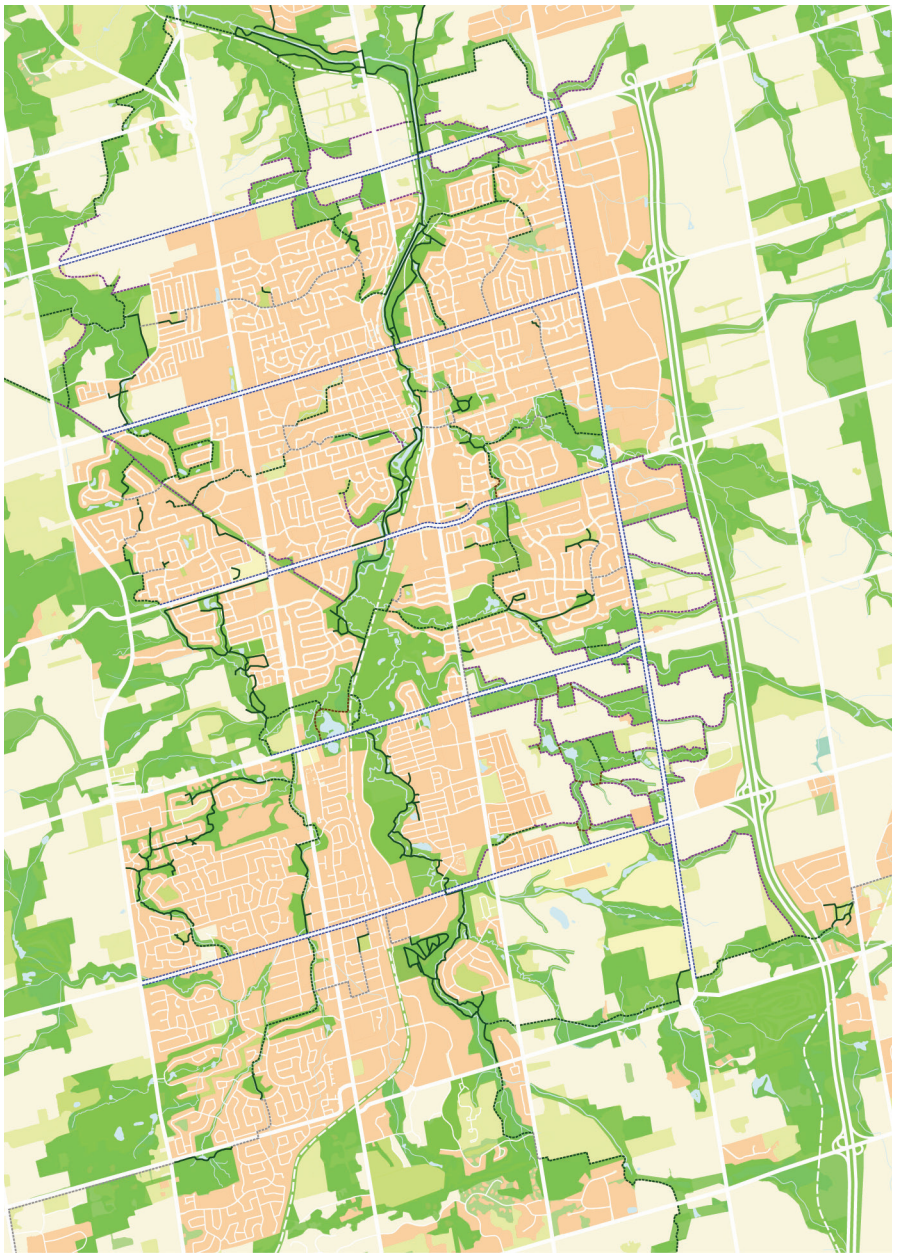
step 2: define the greenway

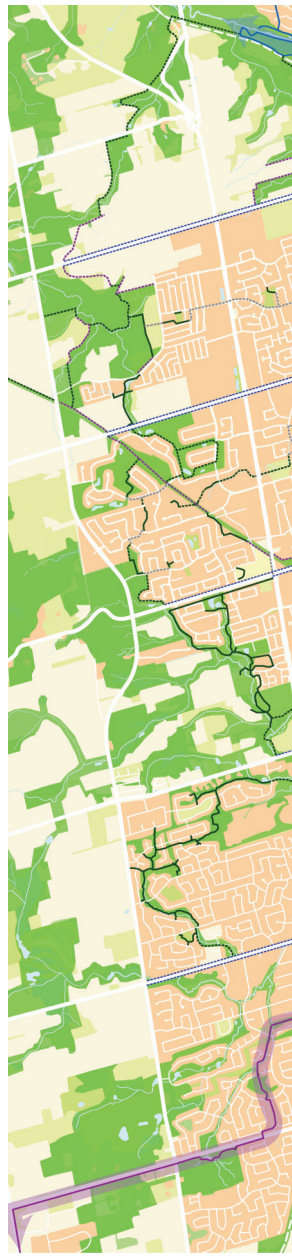
The greenway is a continuous network of open space, and one of the fundamental aspects of green infrastructure. The greenway operates in two ways: as an ecological greenway and a recreational greenway. As an ecological greenway, its primary goal is to create a network of natural corridors that encompass all environmentally significant areas, ecosystems, and natural features, in order to protect biodiversity and support the migration of flora and fauna. As a recreational greenway, it provides a network of recreational trails, parks, and open space in areas where human activities will not disrupt or damage natural ecological process. It serves as a means of integrating nature into urban areas, and provides a place of leisure with scenic views. The ecological and recreational aspects of the greenway function as parallel parts of a single entity. In essence, the greenway acts as a living circulation system for people and nature.

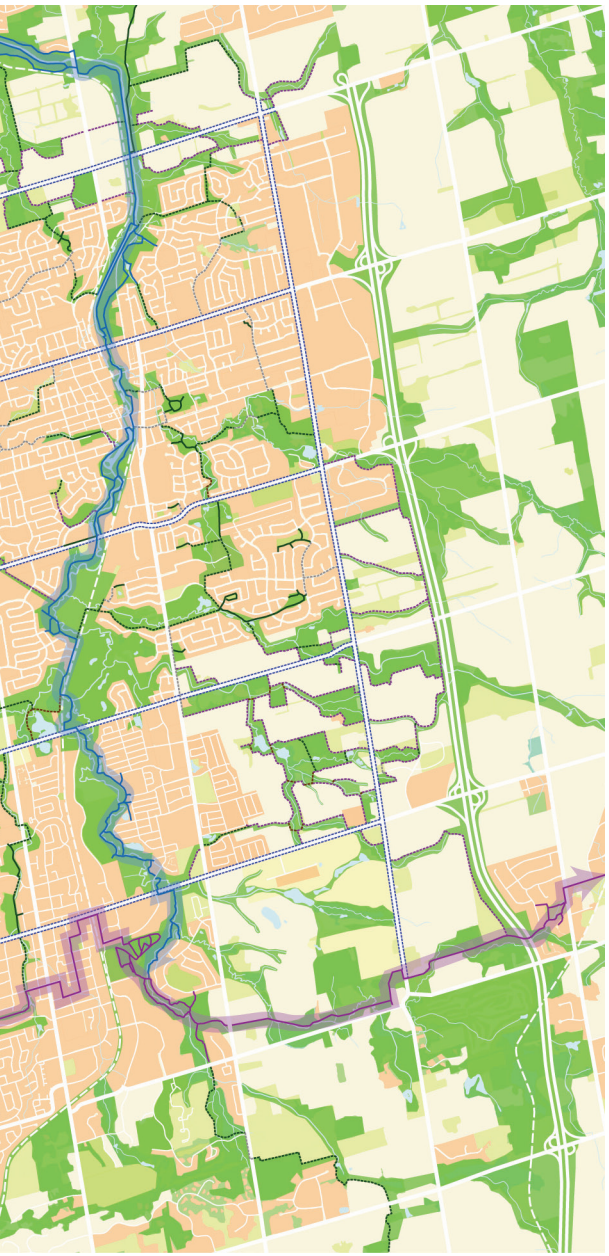
The research obtained in section 02 of this thesis is critical in determining the boundary of the greenway. The following criteria constitute the basis of the greenway:

- All existing conservation areas and areas of environmental interest
- All watercourses and their riparian zones
- Wetlands
- Significant woodlands and forests
- All natural areas that support biologically diverse terrestrial habitats
- Significant natural features, including the Holland Marsh and Oak Ridges Moraine
- Linkage corridors and buffer zones
- Adjacent recreational parks, golf courses, and public open space









(left)

fig 3.09 existing trails

The most extensive existing trail networks are part of the Nokiidaa Trail System along the East Holland River. Other trail networks include the Willow Farm, Lakeview, and Wimpey Trail, which is located in the northwest corner of Aurora; and the South West Newmarket Trail.

(centre)

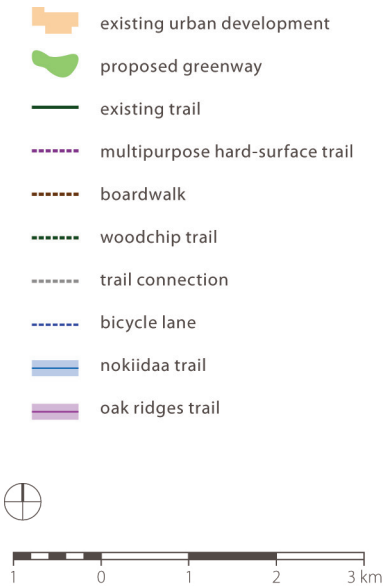
fig 3.10 proposed trail network

This map illustrates proposed trail extensions and bicycle lanes that create a continuous network of trails which are linked to the existing trails. Trail connections are provided along streets where necessary.

(right)

fig 3.11 regional trail connections

The proposed trail network ties into the Nokiida Trail and Oak Ridges Trail, providing regional connections to other provincial trail networks.

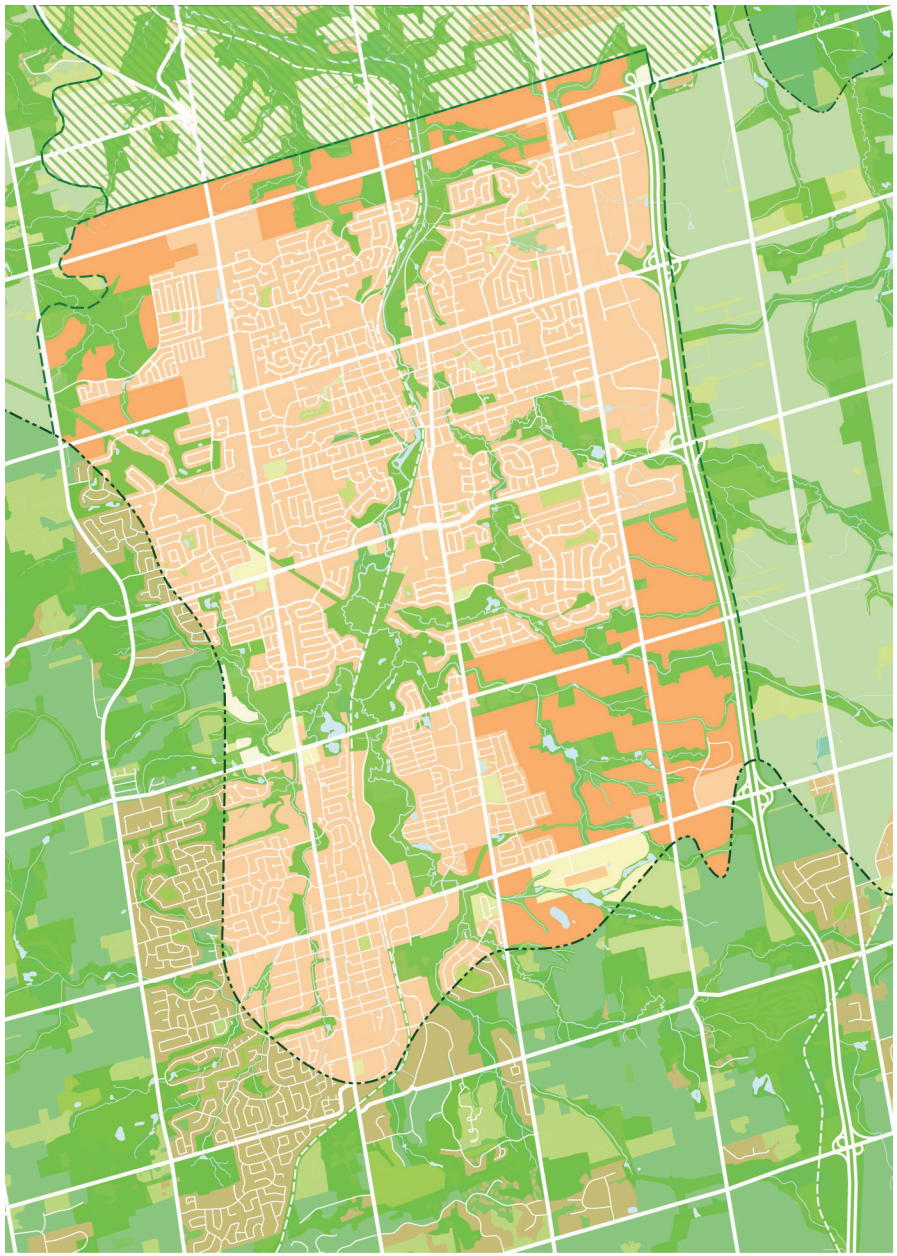


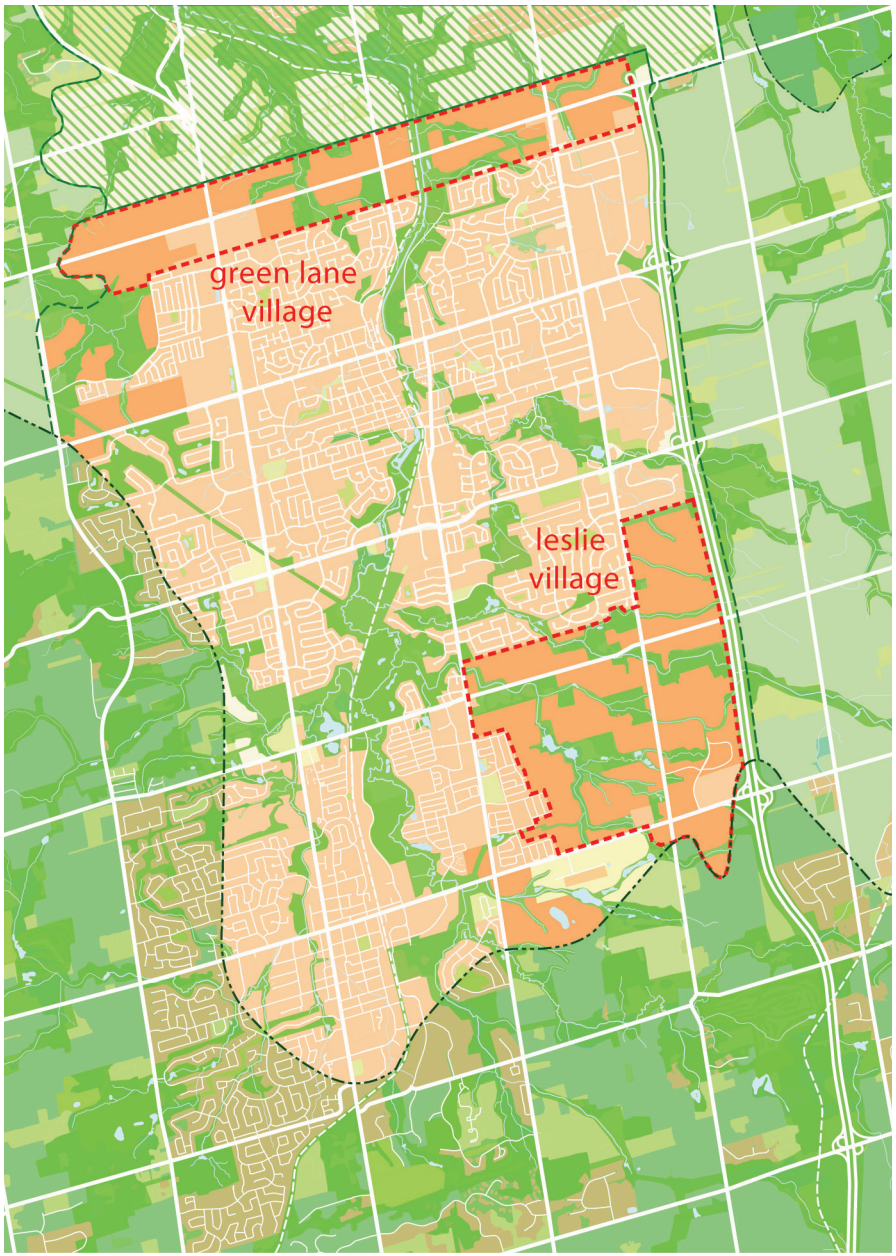
step 3: create a recreational trail network

The recreational aspect of the greenway includes an extensive network of trails. This trail system will expand upon existing local trails, as well as regional trail networks, such as the Nokiidaa Trail and the Oak Ridges Trail, to create a continuous network for walking, cycling, snowshoeing, and skiing. The trails act as the capillaries that link the greenway to the urban environment. Signage, maps, guides, and information boards along the trail provide educational information for the community.

The trail network consists of five types of trails:

1. *Multi-purpose hard surface trails:* These trails are primarily located along the edge of the greenway, with designated pedestrian and bicycle lanes. They are also wheelchair accessible. These trails are ideally made from permeable hard surfaces, such as permeable pavers or concrete.
2. *Boardwalks*: Boardwalks will be located in marshy or muddy areas, such as the edges of wetlands.
3. *Woodchip trails*: These trails are permeable to allow for natural drainage. They are located in areas that are closer to ecologically sensitive areas. They support walking, skiing, and snowshoeing.
4. *Trail connections*: Trail connections are designated routes along local streets, where new trails are not practical. They are marked with signage and maps.
5. *Bicycle Lanes*: Designated bicycle lanes are proposed on busy streets to provide a safe and efficient route for cyclists. While these lanes are not part of the greenway, they are integrated as part of the overall trail network.




green lane
village
leslie
village

(opposite left)

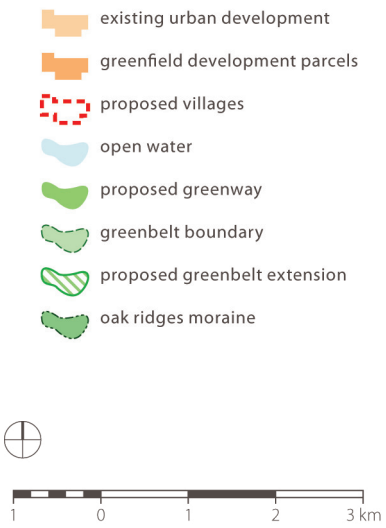
fig 3.12 proposed development areas

This map highlights the remaining parcels of greenfield land in Aurora and Newmarket that are available for development.

(opposite right)

fig 3.13 proposed villages

Development parcels are concentrated in two main zones. These zones are ideal sites for two new urban villages: Green Lane Village and Leslie Village.

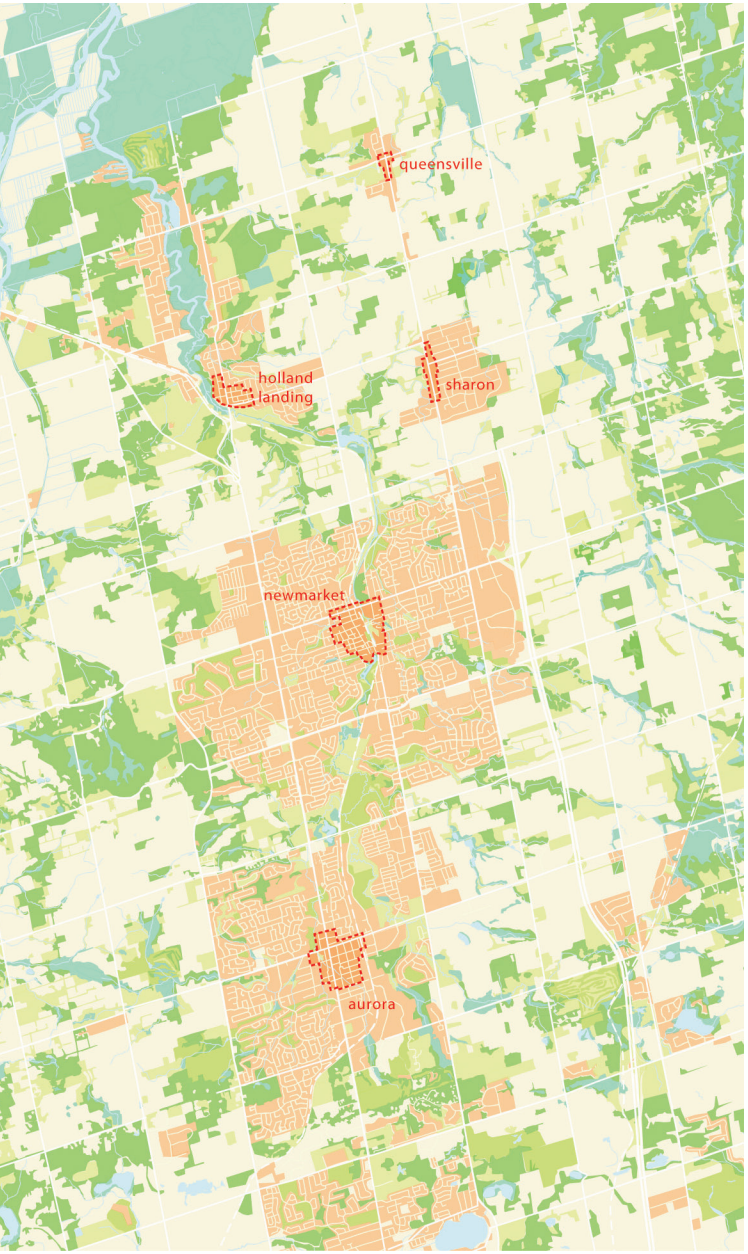


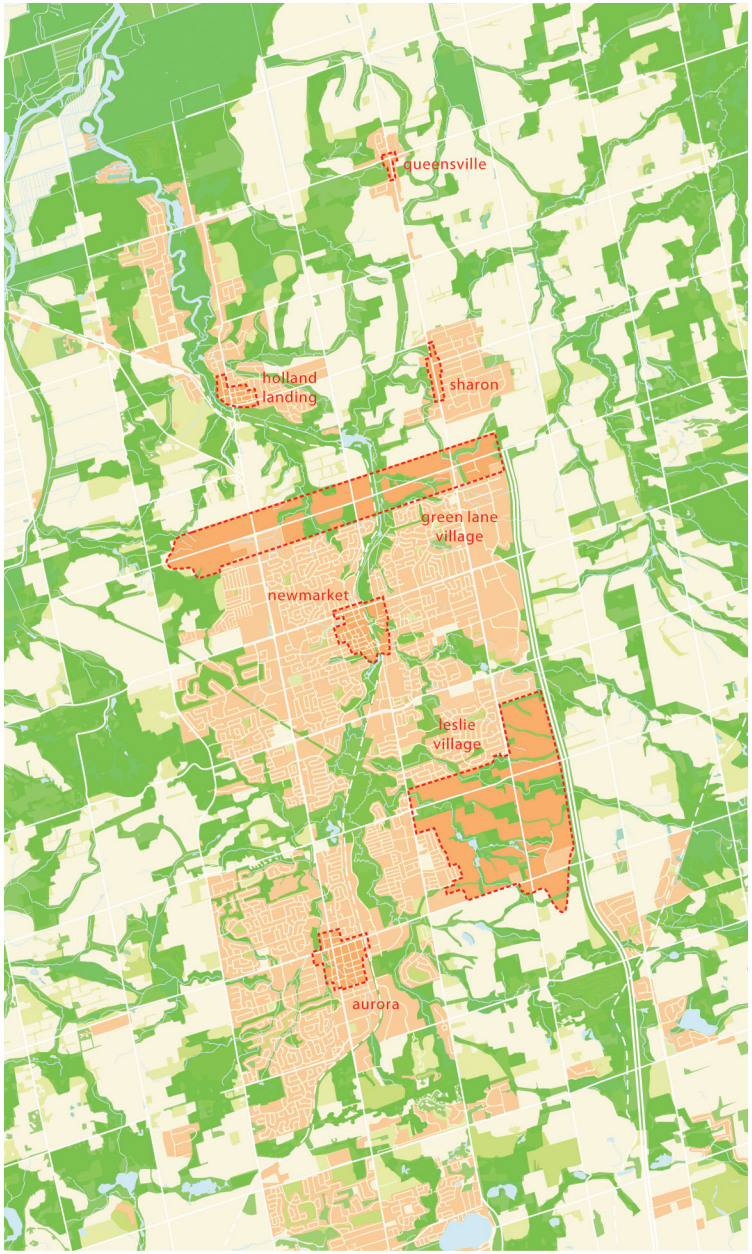
step 4: establish development zones

The remaining parcels of greenfield land that fall outside of the greenway and greenbelt boundaries are designated as suitable development zones. These parcels of land are concentrated in two areas that are ideal locations for sustainable metropolitan villages: Green Lane Village and Leslie Village.

Green Lane Village: Green Lane Village is located along Green Lane, an east-west arterial road that borders Newmarket and East Gwillimbury. This linear village straddles the north and south edge of Green Lane, which is a major roadway with direct access to the 404 highway. The west end is located in close proximity to Newmarket's commercial corridor along Yonge Street, and the east end is located near an employment area along Leslie Street. A GO train station was built in 2004, in anticipation of future growth in the area. A major branch of the greenway intersects the village along the East Holland River.

Leslie Village: Leslie Village is located along Leslie Street between St. John's Sideroad and Wellington Street in Aurora. It encompasses areas of land that fall within both the Newmarket and Aurora municipal boundaries. Unlike Green Lane Village, Leslie Village contains three separate arterial roads, and is bordered by the 404 highway to the east, and the Oak Ridges Moraine to the south. It is located adjacent to a commercial zone in Aurora, near Bayview Avenue and Wellington Street, that has expanded in the past decade. A new employment zone has recently been established along the east edge of the village, near the 404 highway. The Aurora GO train station is located 2 kilometers from the village on Wellington Street. Several significant branches of the greenway intersect the village, connecting the Oak Ridges Moraine to the central north-south greenway corridor along the East Holland River.


queensville
holland landing
sharon
newmarket
aurora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leslie village
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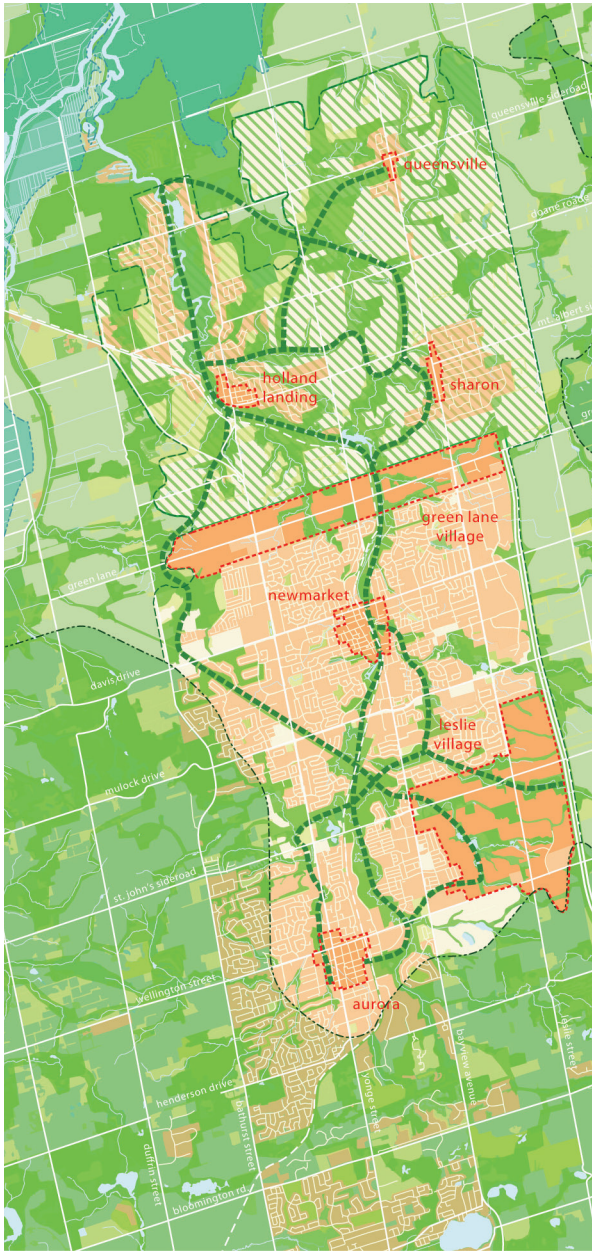
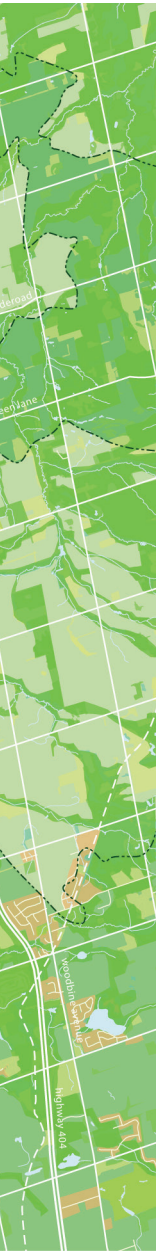

queensville
holland landing
sharon
green lane village
newmarket
leslie village
aurora
davis drive
mulock drive
st. john's sideroad
vellington street
henderson drive
bloomington rd
bayview avenue



(far left)

fig 3.14 historical downtown cores

The historical downtown cores of Newmarket and Aurora have a unique urban quality that is distinguished from the surrounding suburban fabric. They are characterised by higher densities, mixed-use main streets, and linear streets. Sharon, Holland Landing, and Queensville began as small hamlets that have expanded into rural villages. However, they have not experienced any significant suburban growth and remain as self-contained villages amid the rural landscape of East Gwillimbury.

(centre)

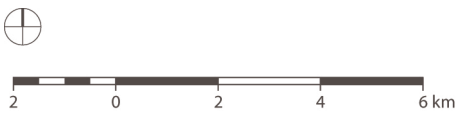
fig 3.15 proposed villages and the historical downtown cores

The proposed Green Lane Village and Leslie Village are part of a network of linked villages - old and new - that are connected by the proposed regional greenway that winds through the countryside and existing sprawl.

(right)

fig 3.16 regional greenway connections between villages

This diagram illustrates the major branches of the greenway that link each village together through a network of open space and pedestrian trails.

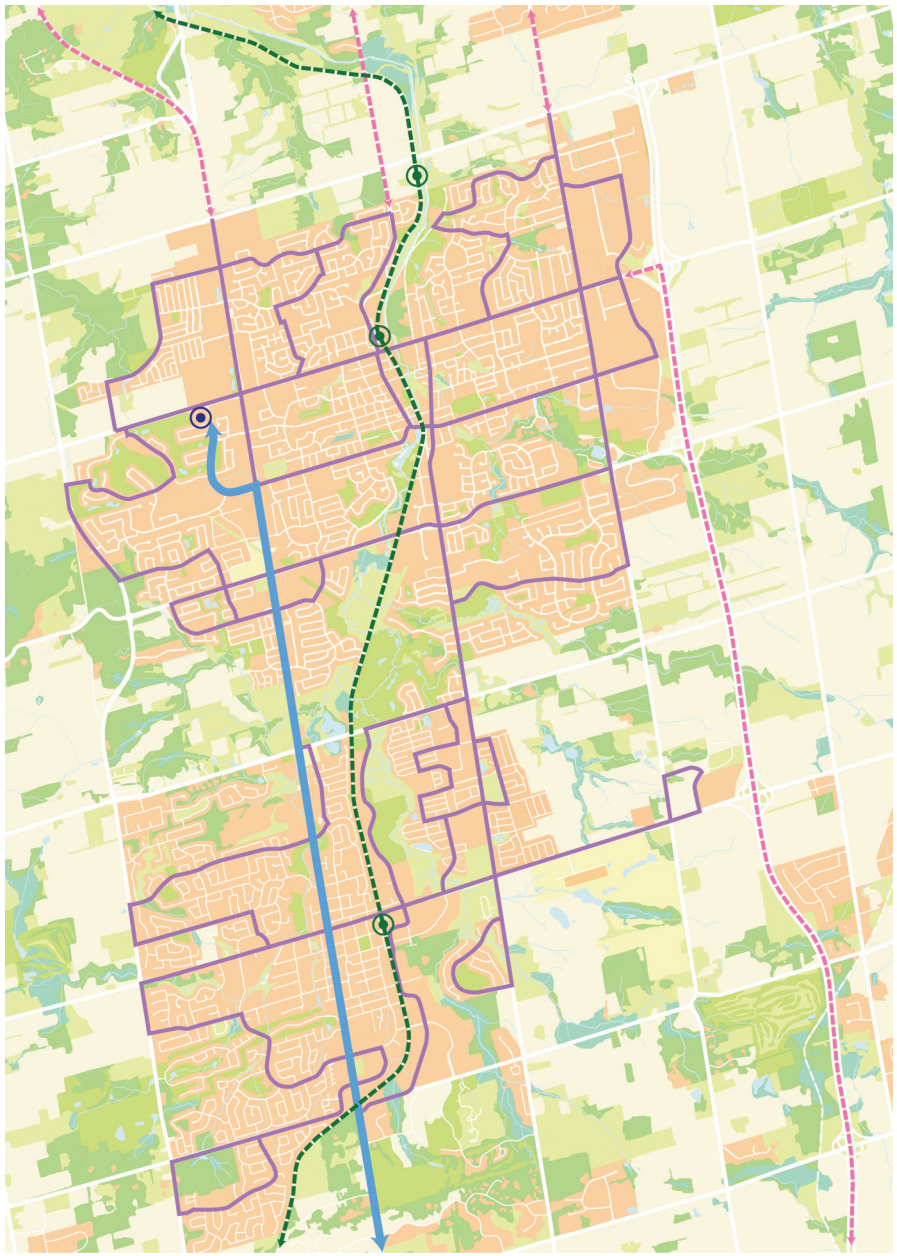


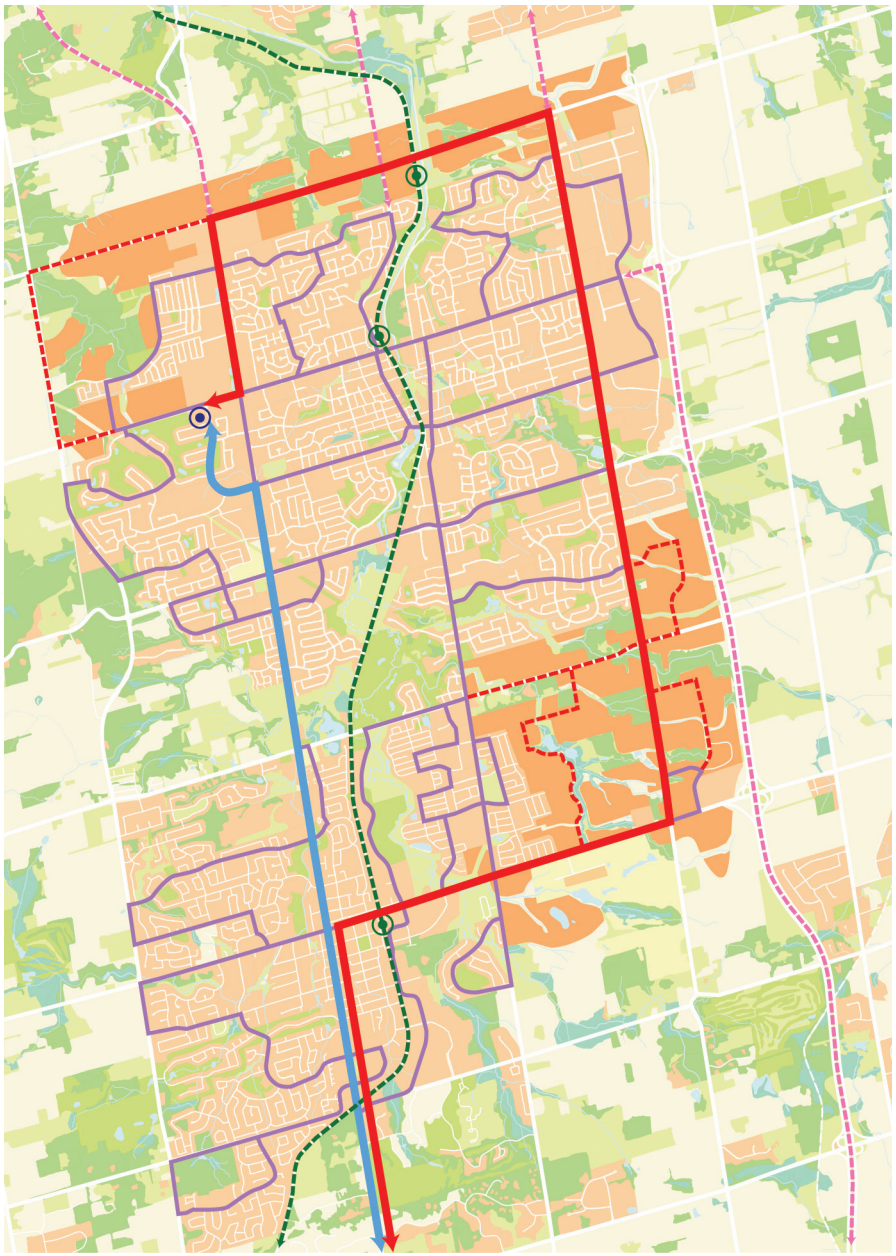
Both Leslie Village and Green Lane Village present unique design challenges. However, most of the complexities that are presented in Green Lane Village are also apparent in Leslie Village. For this reason, the design focuses on solving the issues raised by Leslie Village, with the intention that these solutions can then be applied to Green Lane Village. The plan of Leslie Village is designed to be transferable, and will serve as a model for development that can be applied to other metropolitan cities in the GTA and Canada.

step 5: identify existing villages and linkages

The proposed urban villages, Green Lane Village and Leslie Village, are situated within a landscape of historical urban villages that are connected by agricultural land and suburban sprawl. These historical villages include the downtown core of Newmarket (along Main Street); the downtown core of Aurora (along Yonge Street); and the towns of Sharon, Holland Landing, and Queensville. Each of these historical villages contains attributes that act as a precedent for the proposed villages. For example: they are characterized by higher density, mixed-use buildings; the architecture addresses the street, rather than parking lots; and the streets are scaled to the pedestrian, rather than the car.

The greenway passes through each of these villages, creating a network of natural corridors and recreational trails that link the villages through the landscape of sprawl.





(opposite left)

fig 3.17 existing conceptual public transportation routes

This map conceptually illustrates the existing public transportation routes in Aurora and Newmarket, including local bus routes, regional bus routes, the Viva rapid transit route, and the GO train line, as well as existing bus terminals and train stations.

(opposite right)

fig 3.18 proposed conceptual public transportation routes

Proposed bus routes include a significant expansion of the Viva rapid transit route along Yonge Street, as well as the addition of several local routes to service Green Lane Village and Leslie Village. New rapidways are proposed along Green Lane, Leslie Street, and Wellington Street.

step 6: expand the public transportation system

An important aspect of creating a sustainable village involves access to a viable and efficient public transportation system. York Region has started to improve its public transit systems, and has recently introduced new Viva transit routes, which include a major bus route along Yonge Street that runs from Toronto to Newmarket.

This thesis proposes to expand the Viva bus route along Green Lane, Leslie Street, and Wellington Street. This expansion will create a convenient method of transportation that connects the two proposed villages to metropolitan Toronto.

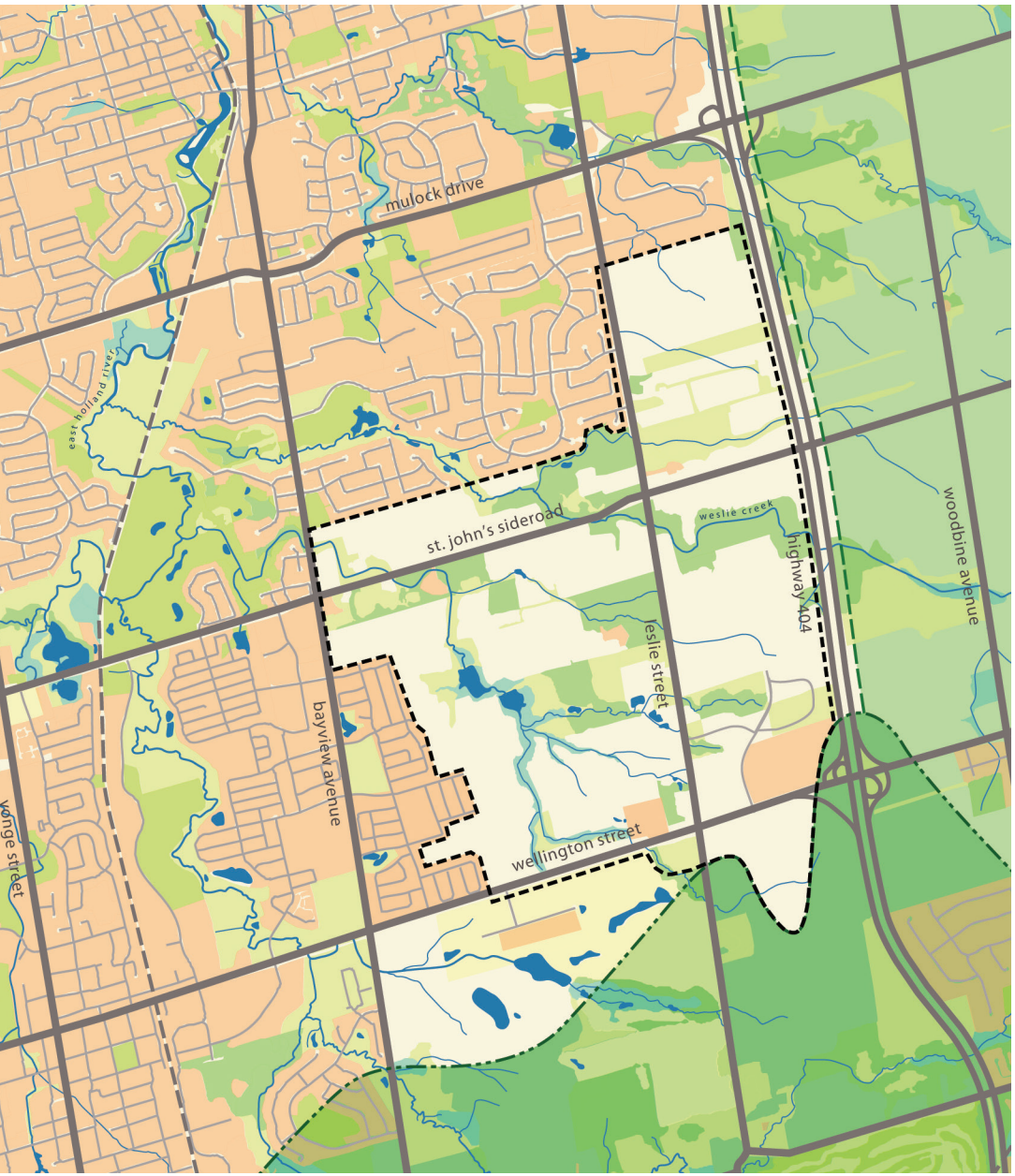
fig 3.19 panoramic view of rural field in leslie village
Leslie Village's landscape is defined by rolling hills, farmland, woodlands, and wetlands.

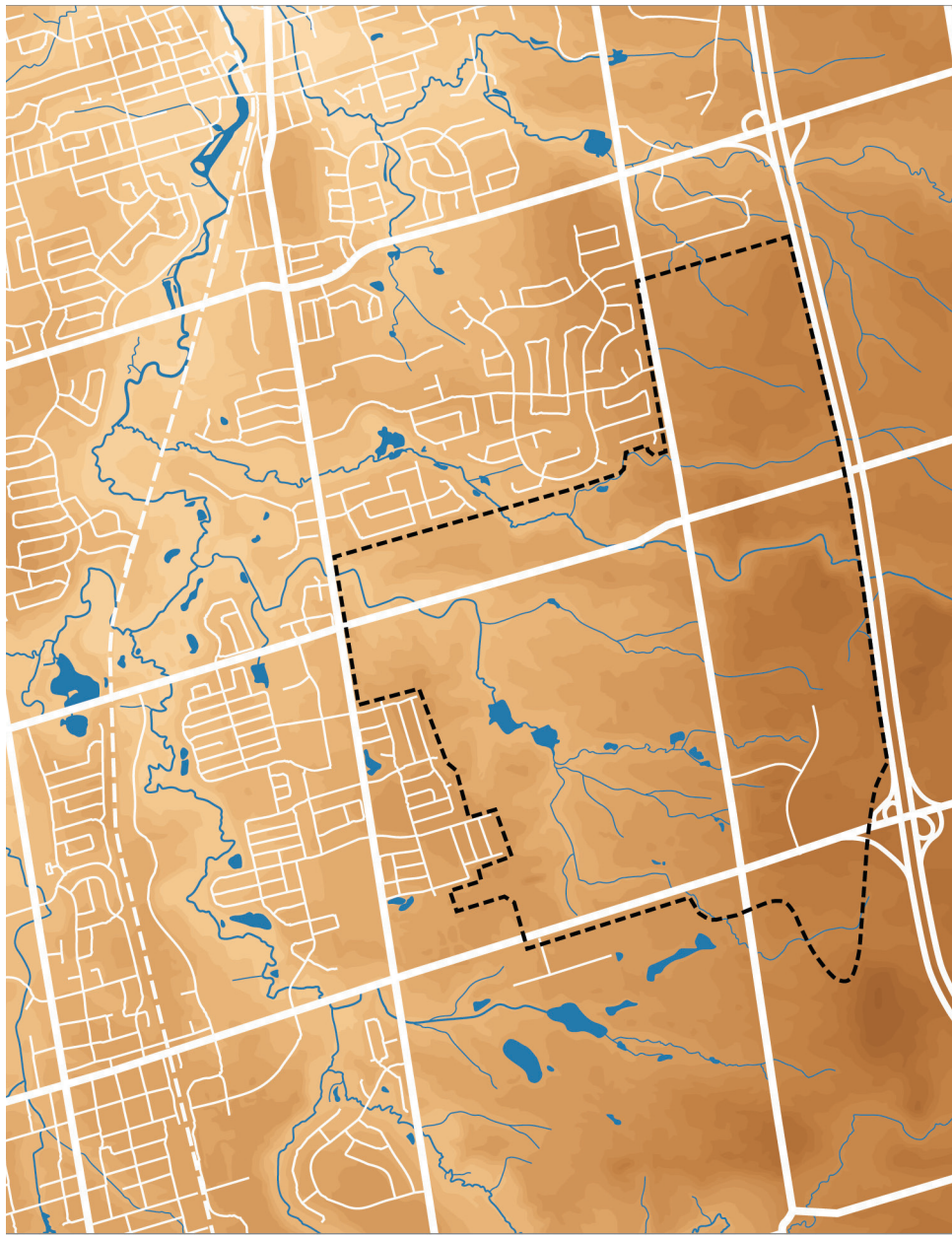
"Sustainability is defined, in part, as the conservation of energy and minimizing car emissions, encouraging accessibility without mobility (being able to walk or cycle to local places); in part by public transit that contributes to sustainable patterns of urban development, and access to the countryside. In practice this means that urban growth needs to be denser and more compact, focusing on small neighbourhoods and combining homes with jobs and services."[5]

3.2 leslie village

While the previous chapter establishes the boundaries of the greenway and village, this chapter focuses on the design for Leslie Village. It closely examines the village's situation in relation to the greenway and the surrounding suburban landscape, with a particular focus on the edge conditions between the natural and built realms. A conceptual plan for the village is provided, which includes the location and density of land use, the location of transit hubs, and the proposal of an integrated trail network. As in the previous chapter, a systematic approach is employed to construct the various layers that contribute to the plan of Leslie Village.

5 Hough, Michael. *Cities and Natural Process: A basis for sustainability.* 2nd ed. New York: Routledge, 2004, p.221.


mulock drive
east holland river
st. john's sideroad
weslie creek
highway 404
woodbine avenue
leslie street
bayview avenue
wellington street
yonge street



(opposite left)

fig 3.20 leslie village context map

This map provides the context in which the Leslie Village boundary is situated, including its relationship to the existing road network, watercourses, natural areas, greenbelt, and Oak Ridges Moraine.

- leslie village boundary
- existing urban development
- agricultural land
- manicured open space
- cultural land
- forest
- wetland
- open water
- greenbelt boundary
- oak ridges moraine
- watercourse
- major highway
- arterial road
- local street

500 0 500 1000 1500m

(opposite right)

fig 3.21 topography

The natural topography of Leslie Village is characterised by steep rolling hills on the west side and lower valleys on the east side. The lowest elevation within the boundary is approximately 250 metres above sea level, while the highest elevation is approximately 310 metres above sea level.

- open water
- 225 m
- 250 m
- 275 m
- 300 m
- 325 m

situating leslie village in the existing built environment

The first step in determining how Leslie Village is situated within the surrounding suburban landscape involves a detailed review of the existing conditions, which are derived from the research obtained in section 2.2 – Ecosystems and the Urban Landscape. This phase of the design examines the natural topography of the village, as well as the ecological land classifications within the village boundary. These classifications are then simplified into fewer categories to provide a clear and legible picture of the existing conditions. These new categories include: urban development, forest, wetland, cultivated land, manicured open space, and agricultural land. Finally, existing trails are identified, and are to be integrated into the proposed trail network to create a link between the new village and the existing suburbs.

(left)

fig 3.22 ecological land classification

The land in Leslie Village primarily consists of agricultural fields and several small rural developments, as well as many significant natural areas. These natural areas include several significant forests and woodlands, cultural communities (such as meadows, plantations, and thickets), and a Provincially Significant Wetland.

- leslie village boundary
- open water
- residential
- commercial
- industrial
- institutional
- estate residential
- manicured open space
- rural development
- intensive agriculture
- non-intensive agriculture
- cultural meadow
- cultural plantation
- cultural thicket
- cultural woodland
- coniferous forest
- deciduous forest
- mixed forest
- meadow marsh
- shallow marsh
- mixed shallow aquatic
- submerged aquatic
- coniferous swamp
- deciduous swamp
- mixed swamp
- thicket swamp

(opposite left)

fig 3.23 existing open space

This map illustrates a simplified classification of natural areas, which are divided into the following categories: urban, agriculture, manicured open space, cultural, forest, and wetland.

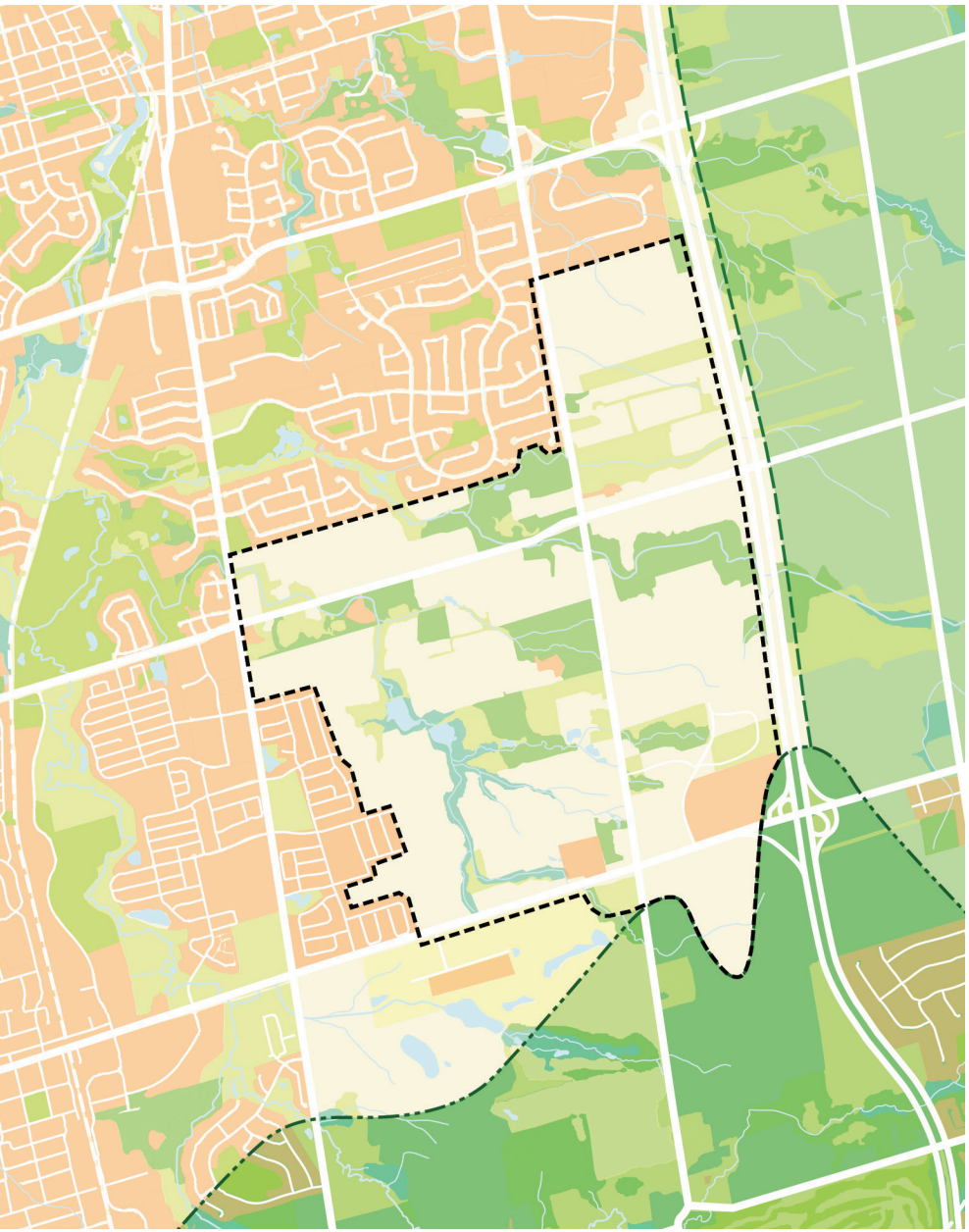
(opposite right)

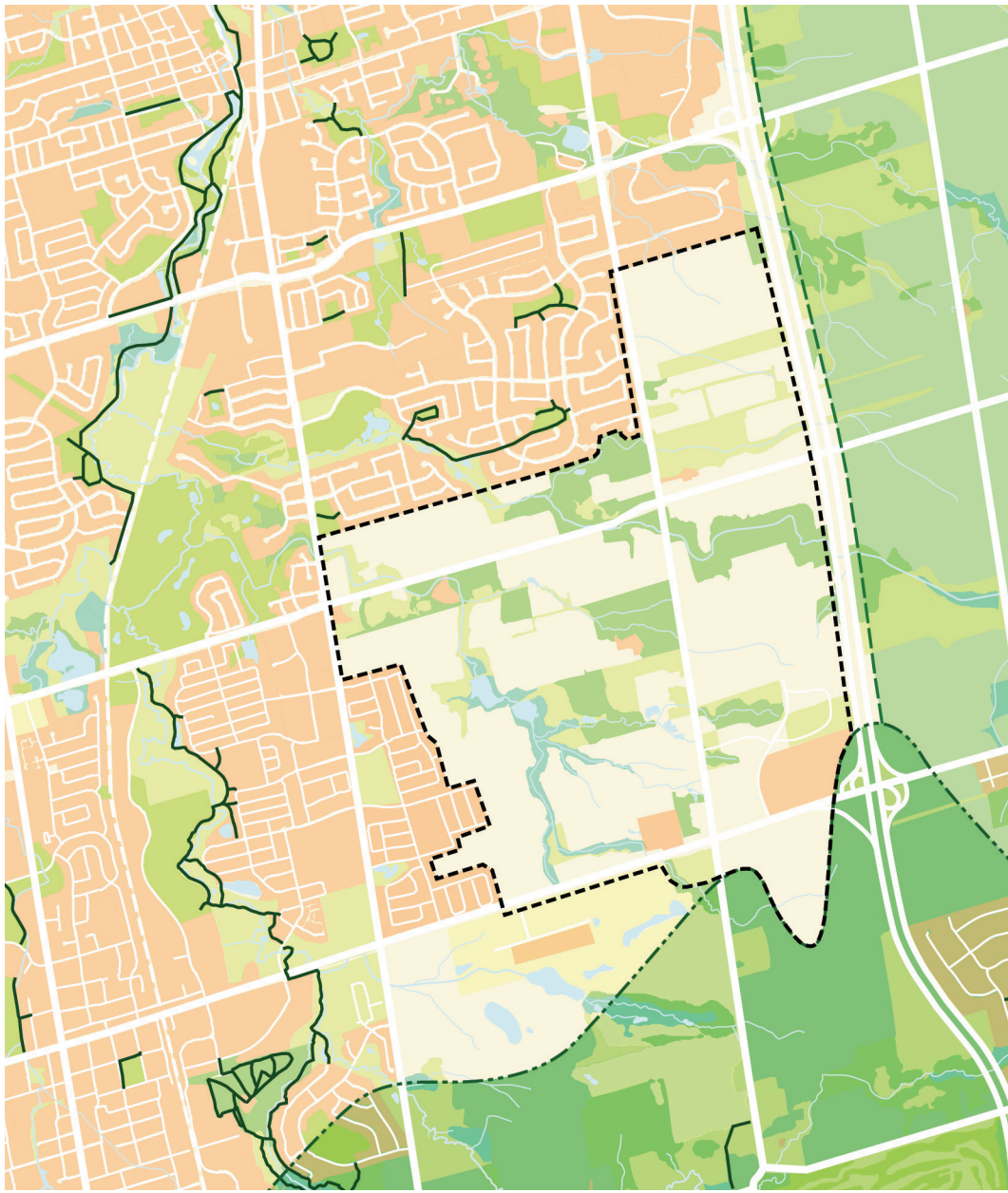
fig 3.24 existing trails

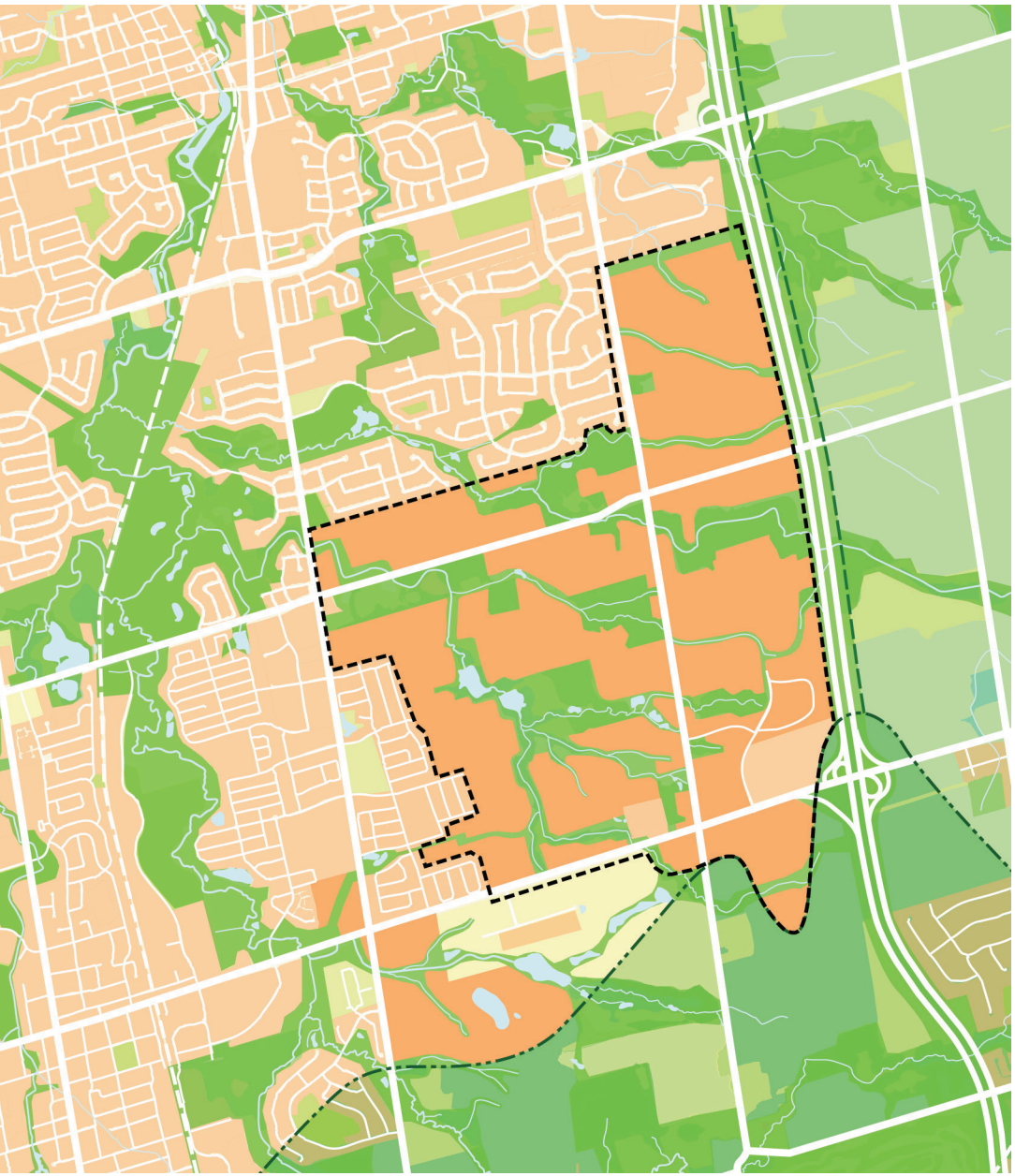
This map illustrates the existing trails that are located outside of the Leslie Village boundary. These trails will connect to the proposed trail network and will link the new village to the existing suburban fabric.

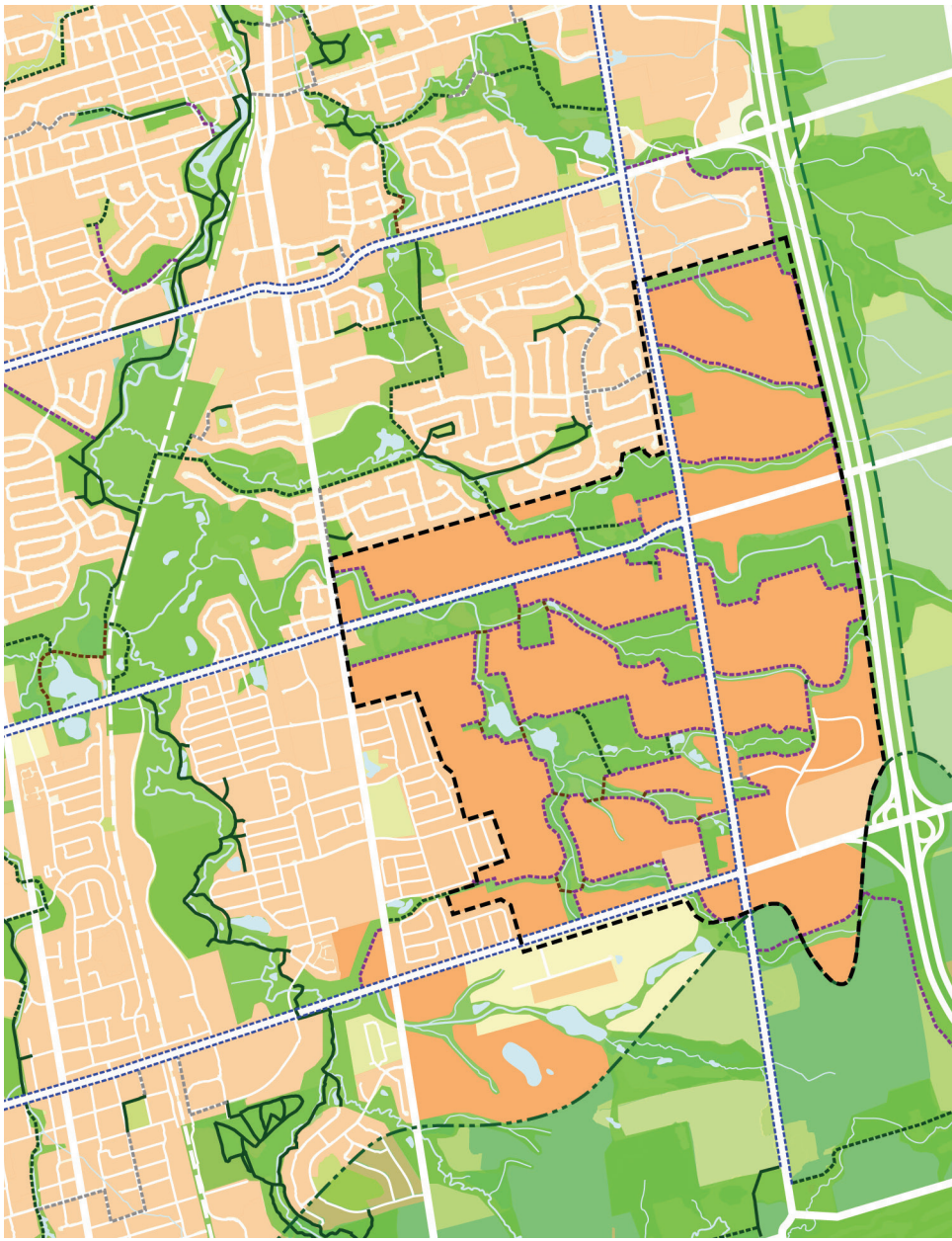
- leslie village boundary
- existing urban development
- agricultural land
- manicured open space
- cultural land
- forest
- wetland
- open water
- greenbelt boundary
- oak ridges moraine
- existing trails

500 0 500 1000 1500m









(opposite left)

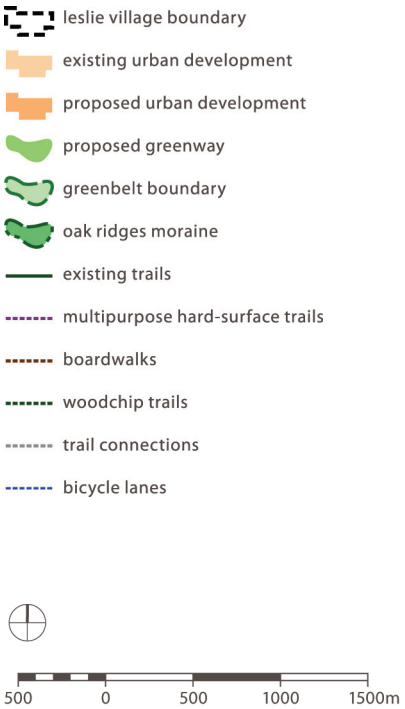
fig 3.25 proposed greenway and development areas

The greenway defines the development limit in Leslie Village. This map illustrates the parcels of land that are suitable for urban development.

(opposite right)

fig 3.26 proposed recreational trails and bicycle lanes

Trails and bicycle lanes tie into the existing trails, providing a continuous network of paths for recreation and sustainable methods of transportation, such as walking, cycling, skiing, and snowshoeing.

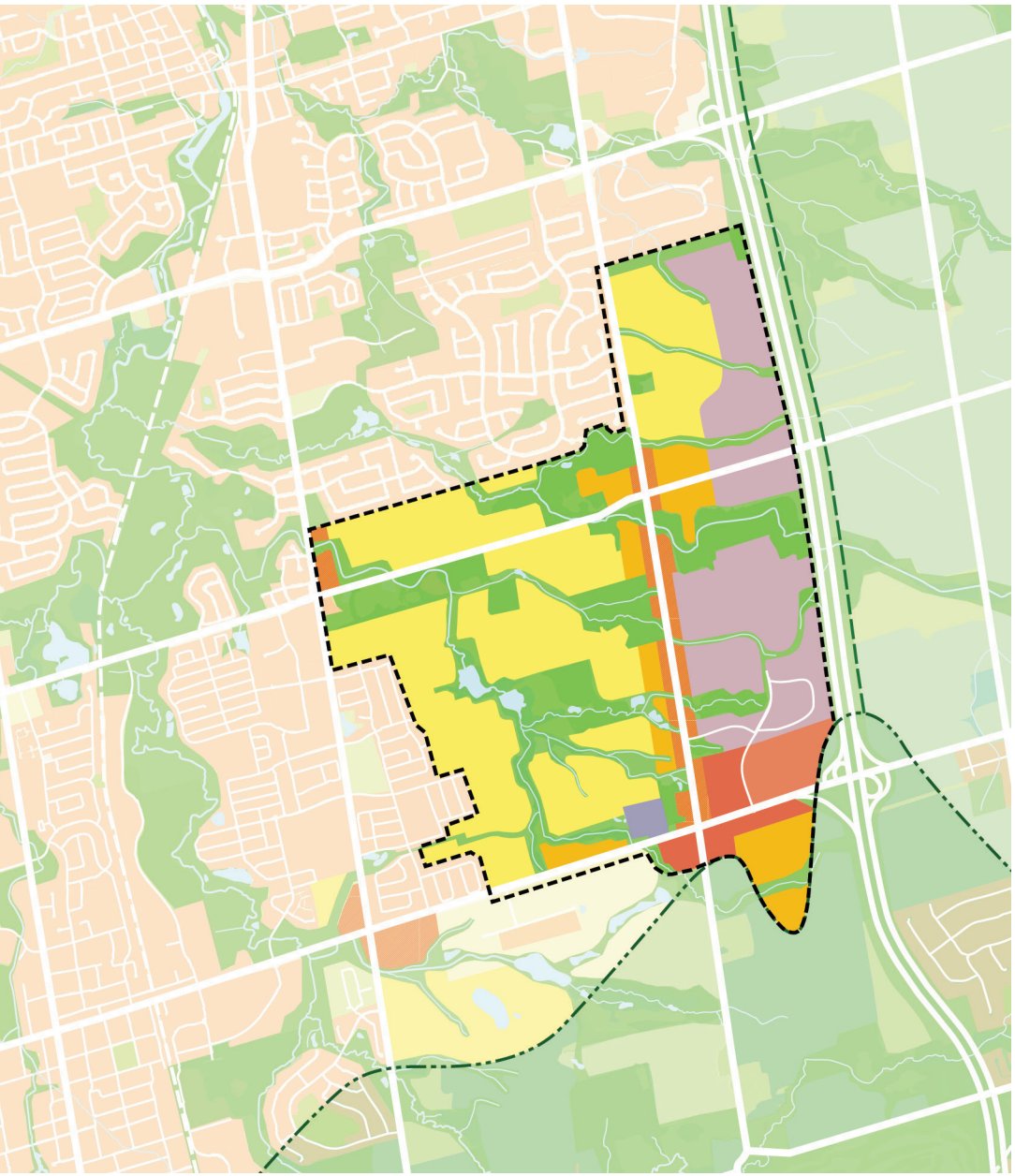


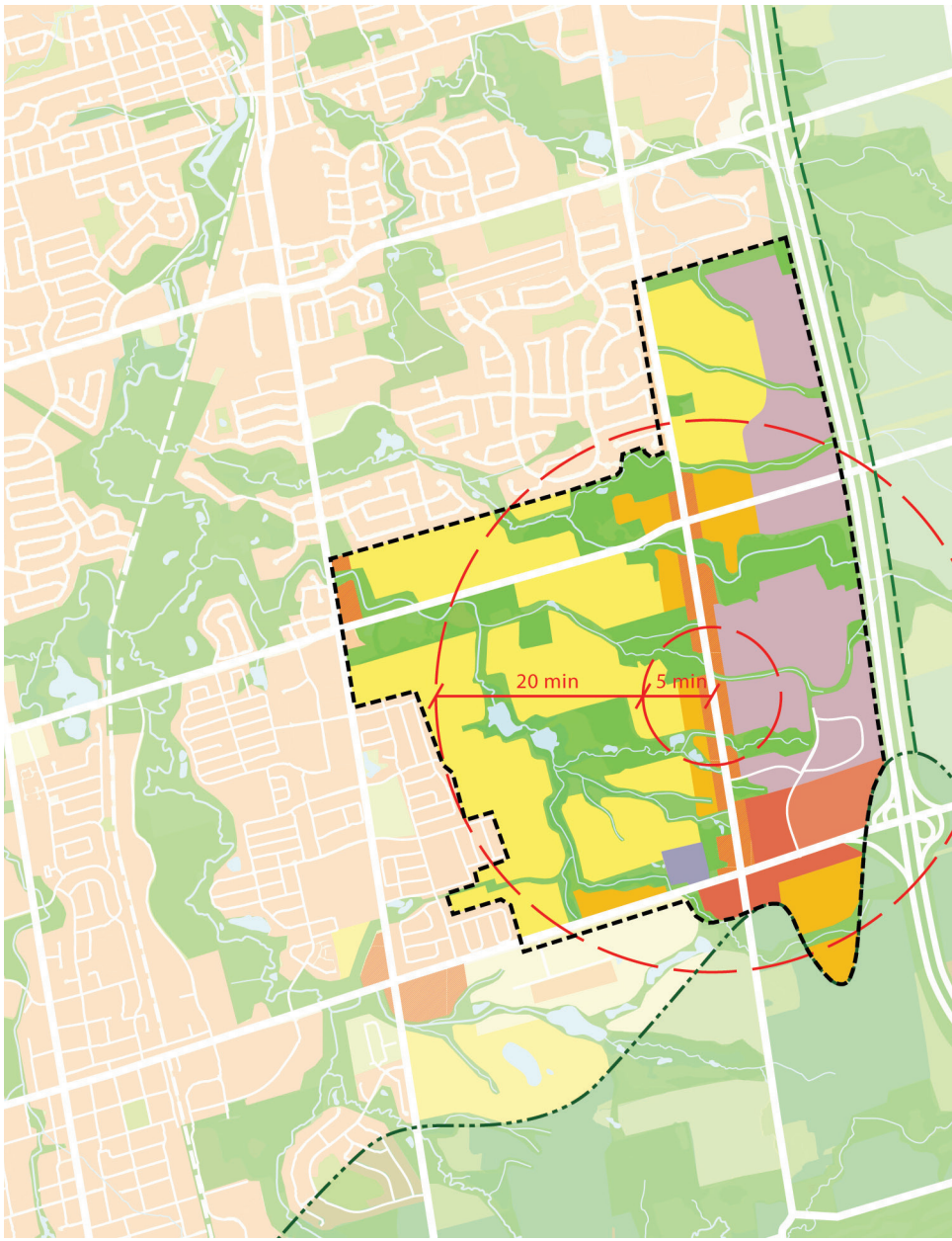
proposing greenway edges and trails

While the boundaries of the greenway are determined in the previous chapter, this chapter takes a closer look at the edges of the greenway that fall within the study area for Leslie Village. Key natural areas are identified, as well as linkage corridors between these areas. The proposed trail network is also examined in more detail, and is based on the following principles:

- Multi-purpose trails are located around the edge of the greenway, along local streets. These streets are single-loaded, with frontage that faces the greenway to enhance the public realm and promote a safe and secure environment for residents and children.
- The trail system is a continuous network of paths that allow pedestrians and cyclists to navigate the village in an efficient and convenient manner.
- Trails that cut through the greenway are to be minimized, particularly in ecologically sensitive areas, to reduce damage that can be caused by human activities. Woodchip trails and boardwalks are to be used in areas where the trail crosses through the greenway.

This proposed trail network serves the purpose of connecting Leslie Village to the surrounding suburbs as well as the greater metropolitan area.




20 min
5 min

(opposite left)

fig 3.27 land use zoning

This map illustrates the proposed land use zoning for Leslie Village, and how it relates to the greenway and existing urban fabric.

(opposite right)

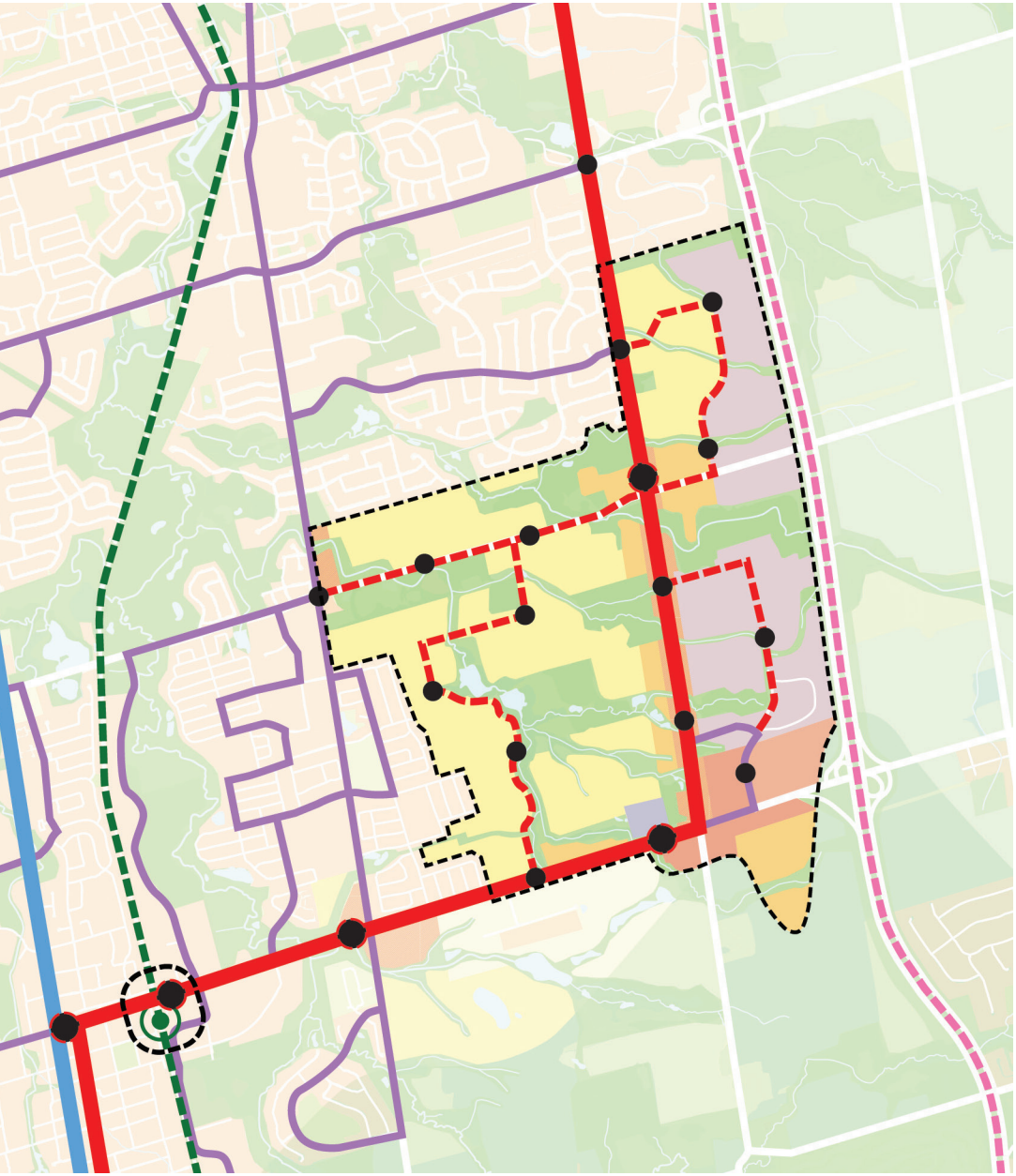
fig 3.28 walking radius

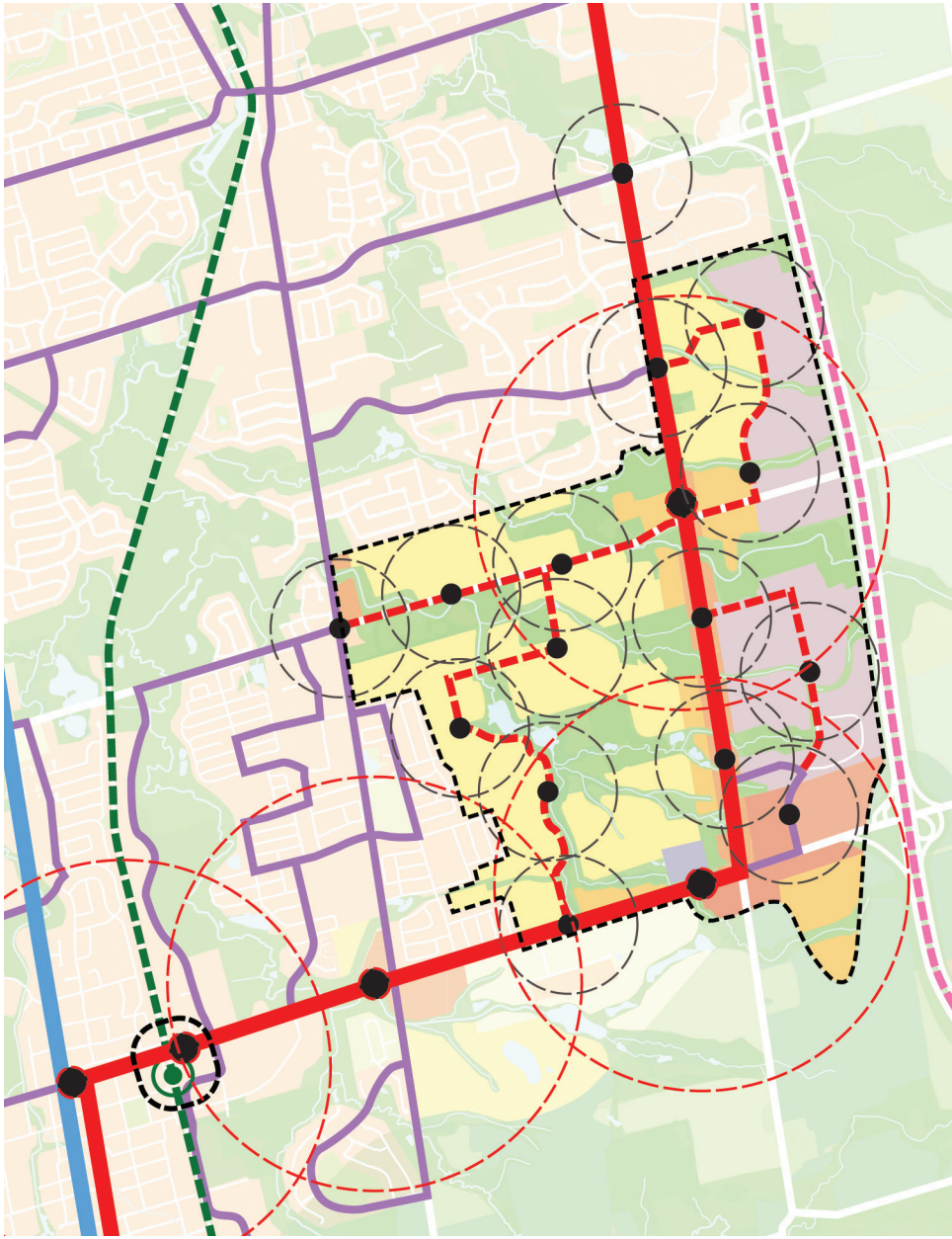
This map illustrates a 5-minute and 20-minute walking radius. Each neighbourhood in the Village is located within a 20-minute walk to the main street corridor along Leslie Street.

defining the location and density of land use zoning

The design for Leslie Village includes a schematic plan of the location and density of land use zoning. The principles of zoning are based on the objective of creating a dense, pedestrian-centered village, while respecting the existing road framework and surrounding land uses. The zoning plan enables the village to tie into the existing built environment in a seamless and logical manner.

The central downtown core of the village is located along Leslie Street between St. John's Sideroad and Wellington Street. This strip is the main street for Leslie Village, and incorporates mixed-use residential, retail, and office buildings. A major commercial zone is located near the intersection of Leslie Street and Wellington Street, with convenient access to the 404 highway. Higher density housing is located near the major arterial roads, to provide highway access as well. An industrial zone is located along the east edge of the village, adjacent to the 404 highway, and ties into the existing employment zone to the north. The remaining areas of land are defined by medium-density residential neighbourhoods, which are located in the pockets of land between the arterial roads and the greenway. The majority of the village is located within a twenty-minute walking radius from its downtown core.



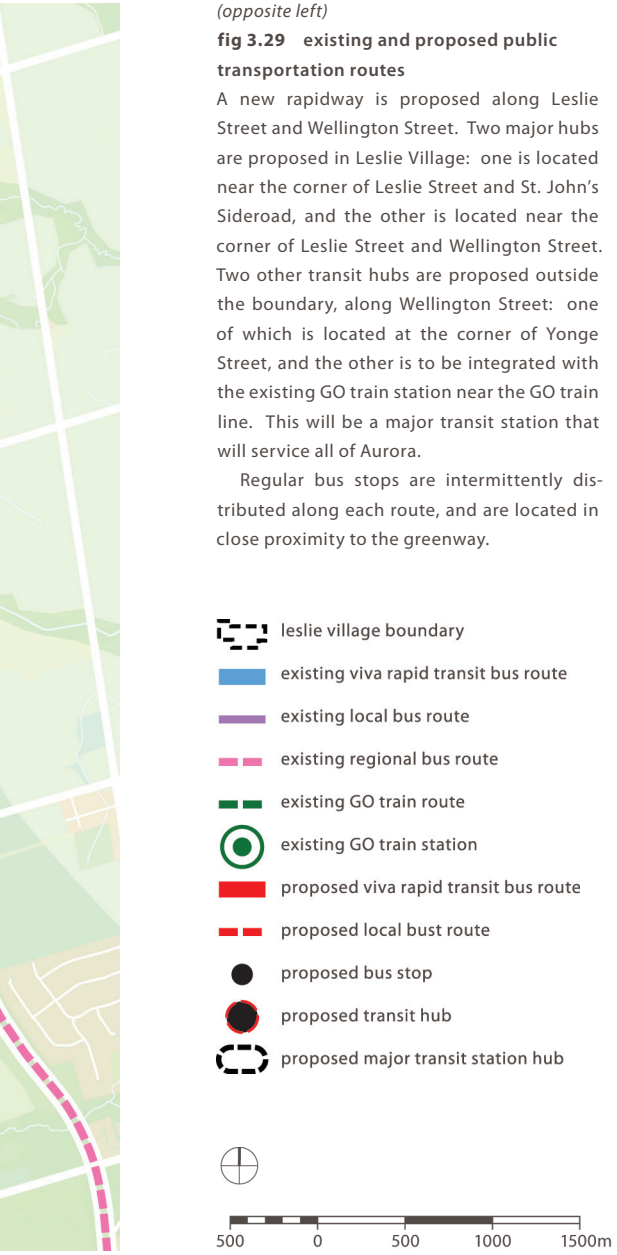


(opposite left)

fig 3.29 existing and proposed public transportation routes

A new rapidway is proposed along Leslie Street and Wellington Street. Two major hubs are proposed in Leslie Village: one is located near the corner of Leslie Street and St. John's Sideroad, and the other is located near the corner of Leslie Street and Wellington Street. Two other transit hubs are proposed outside the boundary, along Wellington Street: one of which is located at the corner of Yonge Street, and the other is to be integrated with the existing GO train station near the GO train line. This will be a major transit station that will service all of Aurora.

Regular bus stops are intermittently distributed along each route, and are located in close proximity to the greenway.



(opposite right)

fig 3.30 5-minute walking radius to transit stops

This diagram illustrates the walking radius that services each transit stop. Regular bus stops service the area within a 5-minute walking radius (shown in grey), while major transit hubs service the area within a 15-minute walking radius (shown in red).

proposing new public transportation routes and transit hubs

The design proposes a rapid transportation bus route with designated bus lanes along Leslie Street and Wellington Street, connecting the village to the existing Viva bus route along Yonge Street. In addition, an extension of existing local bus routes is proposed along smaller streets within the village.

Two types of transit stops are proposed along the bus routes – major transit hubs, and regular bus stops. Major transit hubs are located where two arterial roads or two major bus routes intersect. These hubs are primary public space nodes that include the following criteria:

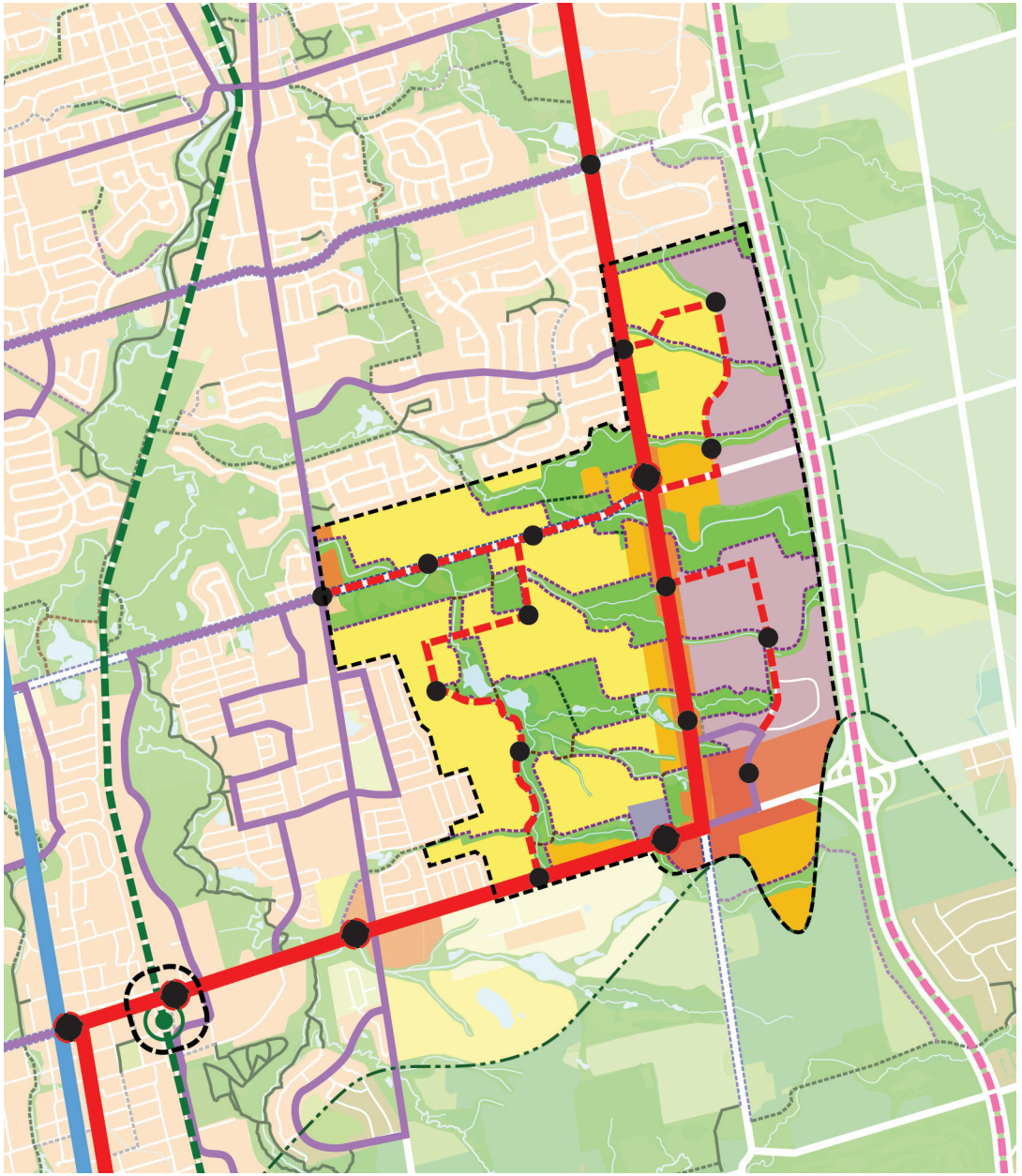
- bus shelter and seating
- secure bicycle and ski storage lockers
- direct access to the greenway trail network
- street lighting for security
- garbage and recycling receptacles
- civic art and street furniture

Regular bus stops are located at intervals along each bus route. These stops include the following criteria:

- seating
- garbage and recycling receptacles
- street lighting for security
- access to the greenway trail network
- outdoor bicycle racks

Each minor transit stop services an area within a five minute walking radius of the stop, and each major transit hub services an area within a ten to fifteen minute walking radius of the hub.

fig 3.31 conceptual plan of leslie village
This map illustrates each layer of the conceptual plan for Leslie Village including land use, the greenway, trails systems, and public transportation.



conceptual plan for leslie village

The overall conceptual plan for Leslie Village is a model for the ideal sustainable metropolitan village. It is designed in keeping with the principles outlined in the introduction of this section, and demonstrates how the elements of public transportation, road networks, and zoning correspond to the greenway and the existing suburban fabric. The design of the village also presents interesting challenges that occur in key areas where the greenway intersects civic space. The final chapter of this section explores these key areas to demonstrate how these challenges can be negotiated in a way that enhances the quality of both the natural and public realms.

fig 3.32 key areas

3.3 key areas

There are five key areas in Leslie Village that are examined in detail. These areas present the most complex challenges that are involved with introducing green infrastructure into the built environment. They are primarily located along the edge of the greenway, where the serpentine morphology of the greenway intersects the linear structure of the built environment.

Sectional drawings and vignettes are employed as a means of illustrating how the relationship between city and nature can be negotiated at the human scale.

The five key areas are:

- *Major Greenway Branch at an Arterial Road:* This area demonstrates how a major branch of the greenway, such as the riparian zone along a watercourse, intersects a major arterial road.
- *Minor Greenway Branch at an Arterial Road:* This area demonstrates how a smaller branch of the greenway, such as a linkage corridor, intersects a major arterial road.
- *Greenway:* This area looks specifically at the character of the greenway itself.
- *Greenway at Residential Streets:* This area demonstrates how the greenway relates to adjacent residential streets.
- *Greenway at Transit Hubs:* This area examines how the greenway interacts with major transportation hubs, which are the primary public space nodes in the village.

major greenway branch at arterial road

This component of the design attempts to negotiate the fluid and winding character of the greenway with the linear highway grid. The visualizations in this section illustrate how a major branch of the greenway intersects an arterial road. A major branch is defined as a wide and biologically significant section of the greenway, such as the riparian zone along a major river tributary. Since the foundation of the greenway is based on the river valley system of the East Holland River, the elevation of the greenway is generally located below street level. For this reason, the most logical approach to negotiating the junction of the greenway and the roadway grid is to allow the greenway to pass below the street, by way of an underpass.

There are three main types of conventional non-vehicular underpasses: pedestrian underpasses, wildlife crossings, and bridges over water, wetland or valleys, which could also be classified as nature underpasses. Pedestrian underpasses are commonly situated below busy streets, to provide safe and convenient passage between public spaces or parks. The pedestrian underpasses in Central Park are well known examples. Wildlife underpasses are starting to become popular along highways that have high rates of roadkill. For example, Banff National Park in Alberta, Canada, has built 22 wildlife underpasses along the Trans-Canada Highway, which are used by eleven species of large mammals.[6] The most common type of non-vehicular underpasses are bridges that are constructed to bypass bodies of water, valleys, or wetlands. While some bridges are long enough to bypass the entire width of a natural area, such as the Bloor Street Viaduct in Toronto, which crosses the Don Valley, most bridges

6 *Highway Fencing and Wildlife Crossings*. Retrieved August 25, 2010 from Parks Canada. <http://www.pc.gc.ca/eng/pn-np/ab/banff/docs/routes/routes2.aspx>.

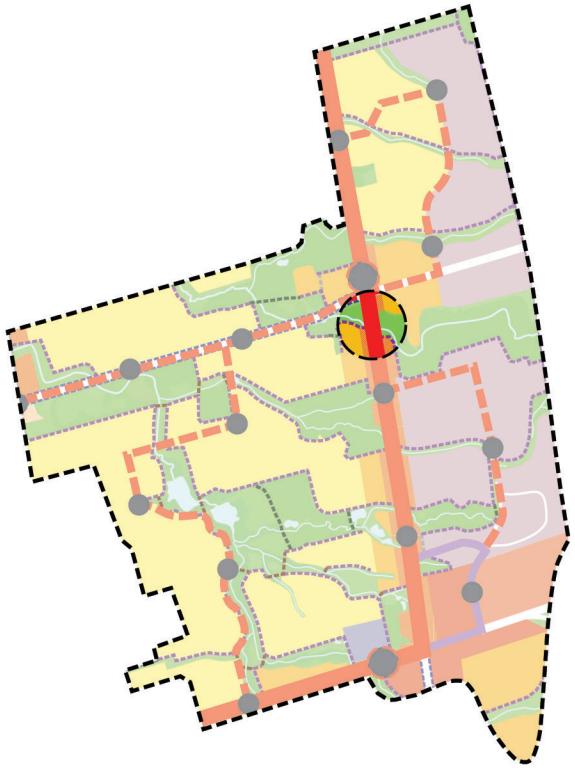
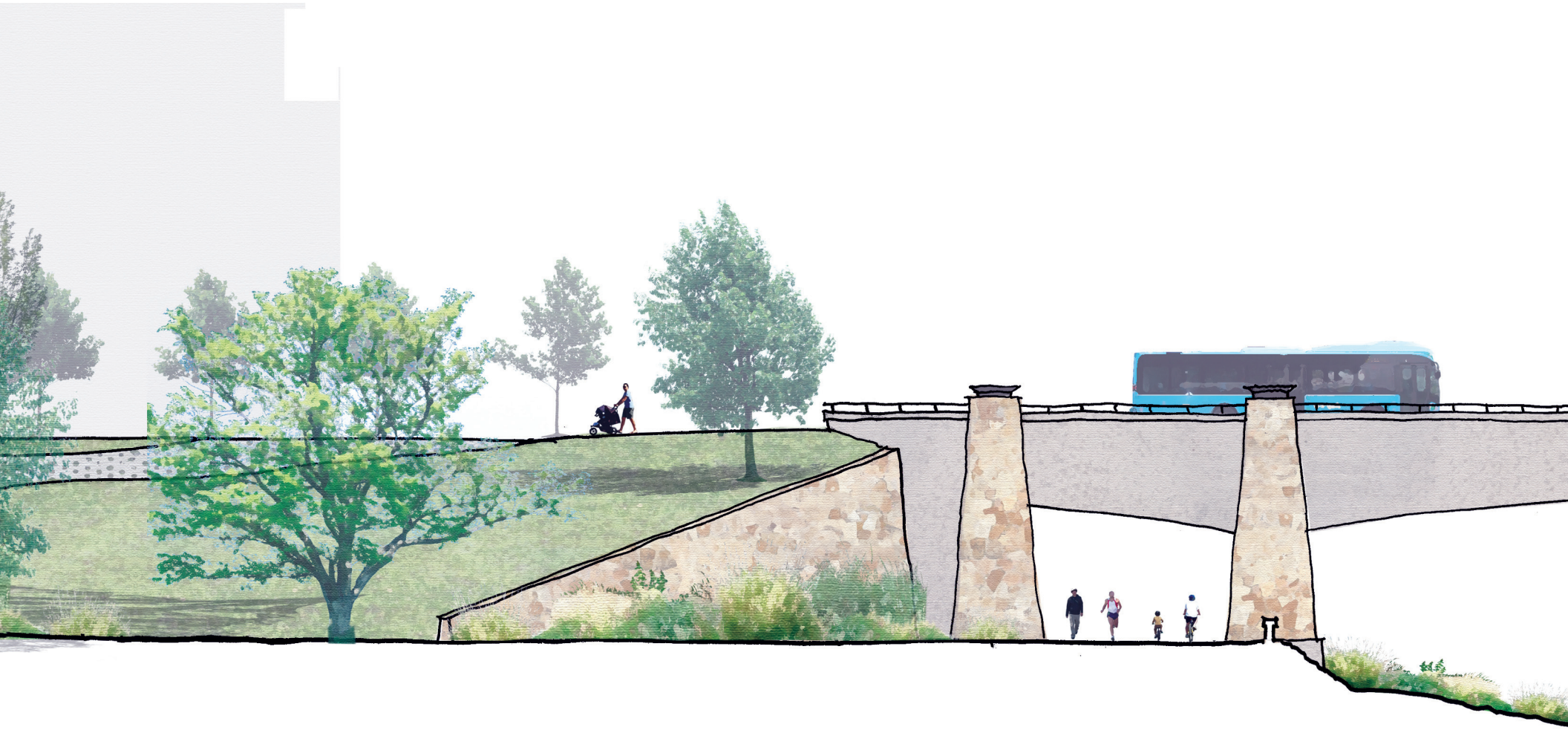


fig 3.33 key diagram: major greenway branch at arterial road

are designed to be as small as possible to minimize cost. This thesis incorporates the use of underpasses as a multifunctional tool to provide a means of passage for natural systems, wildlife, and pedestrians.

The main objective of the underpasses proposed in this thesis is that they be wide enough to allow natural processes to bypass the road with minimal interruption. The width of each underpass is variable, depending on the specific condition of the natural system it supports, and requires site-specific studies to be designed accurately and appropriately. The key area, which has been selected to demonstrate the condition of a major greenway branch at an arterial road, is located on Leslie Street, where a main tributary of the East Holland River crosses the main street. In addition to covering the entire width of this river, the underpass also accommodates a significant portion of the riparian zone. It provides enough space on either side of the river for wildlife to cross, and to allow gene-flow between plant species. The vegetation on the banks also filters toxins and nutrients from stormwater runoff, and stabilizes the soil, which prevents erosion. As a multifunctional underpass, it also serves as a safe pedestrian crossing, and is integrated into the recreational trail network. Sloped ramps connect the trails to the street level, providing a gateway to the greenway trail network.

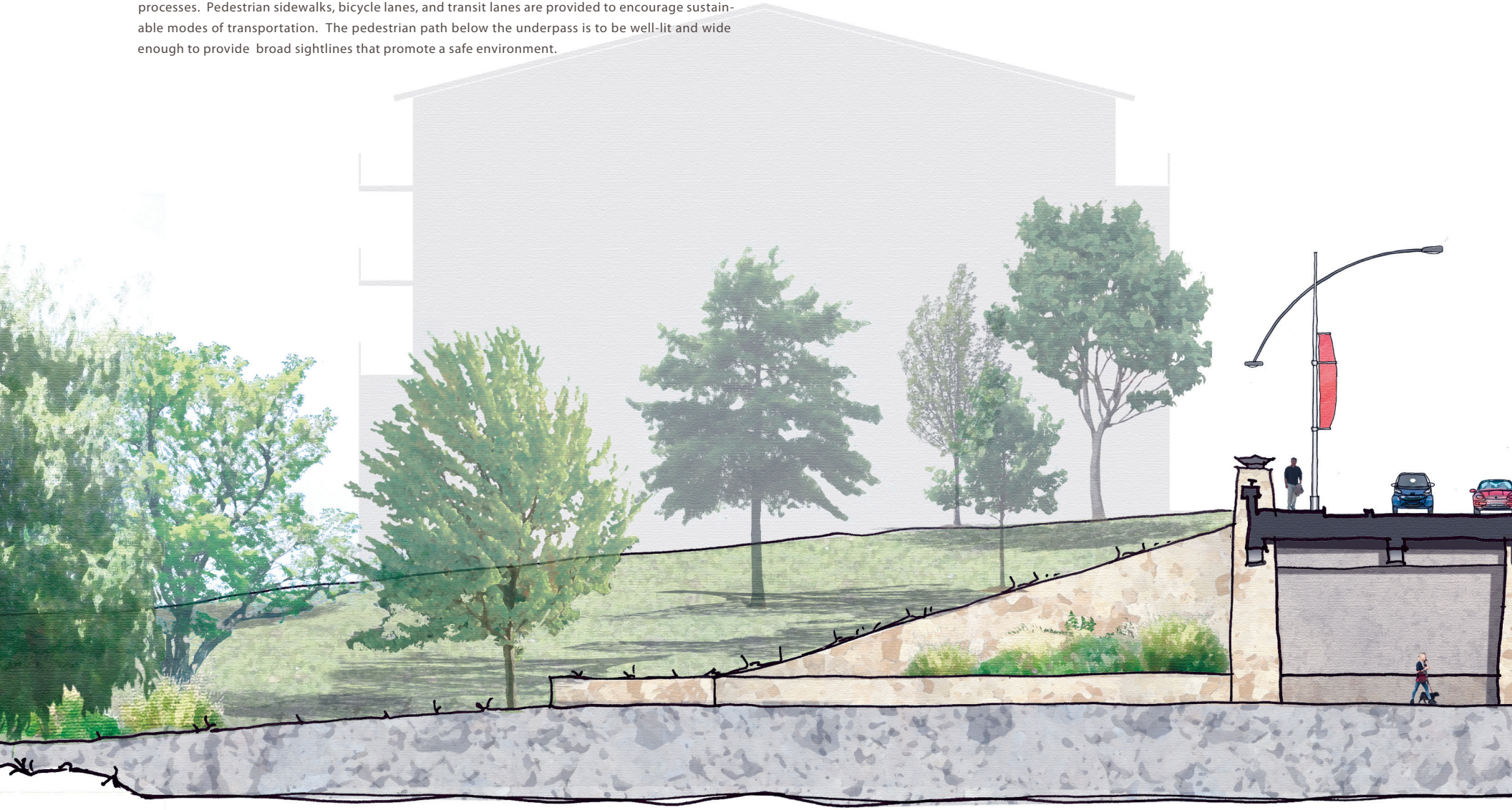
fig 3.34 section through a major branch of the greenway, near an underpass
A large, multipurpose underpass provides passage for people, water, plants, and wildlife.



5
0
5
10m

fig 3.35 section through underpass

The arterial road narrows where it crosses the greenway, to provide minimal interruption of natural processes. Pedestrian sidewalks, bicycle lanes, and transit lanes are provided to encourage sustainable modes of transportation. The pedestrian path below the underpass is to be well-lit and wide enough to provide broad sightlines that promote a safe environment.



VIVA
VIVA
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0
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fig 3.36 vignette of a major branch of the greenway at leslie street
The underpass is designed to be multifunctional. It provides safe passage below the road for people, wildlife, and natural processes. It is large enough to accommodate the full width of the watercourse and its riparian zone. Multipurpose trails for walking and cycling have a permeable surface for drainage. Grassy parkland acts as a buffer between the naturalized area and the street, and offers space for recreational activites.

minor greenway branch at arterial road

The vignettes and sections in this chapter illustrate an example of a key area where a smaller branch of the greenway intersects an arterial road. Examples of smaller branches include linkage corridors and the riparian zone along smaller streams. This particular key zone is selected because it depicts an area where a small stream, a headwater for the East Holland River, crosses Leslie Street. This small branch of the greenway intersects the center of the main street, and is close to mixed-use residential and commercial buildings, as well as an employment zone.

Like the major underpass, this underpass is wide enough to accommodate the stream and its banks on either side. However, its primary function is to act as an underpass for natural systems, and does not provide pedestrian access. Instead, ramps and stairs offer pedestrian and bicycle access between the trail network and street level. A pedestrian crosswalk is located at street level to provide safe access to the greenway on either side of the street.

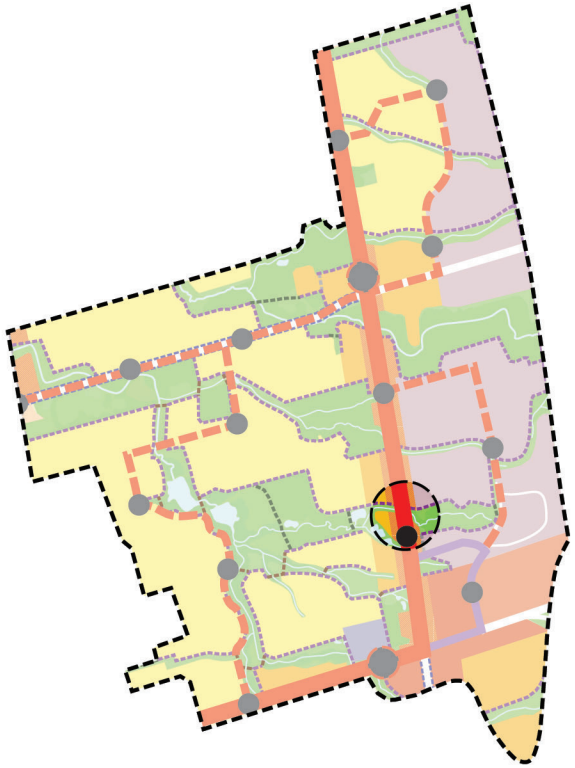
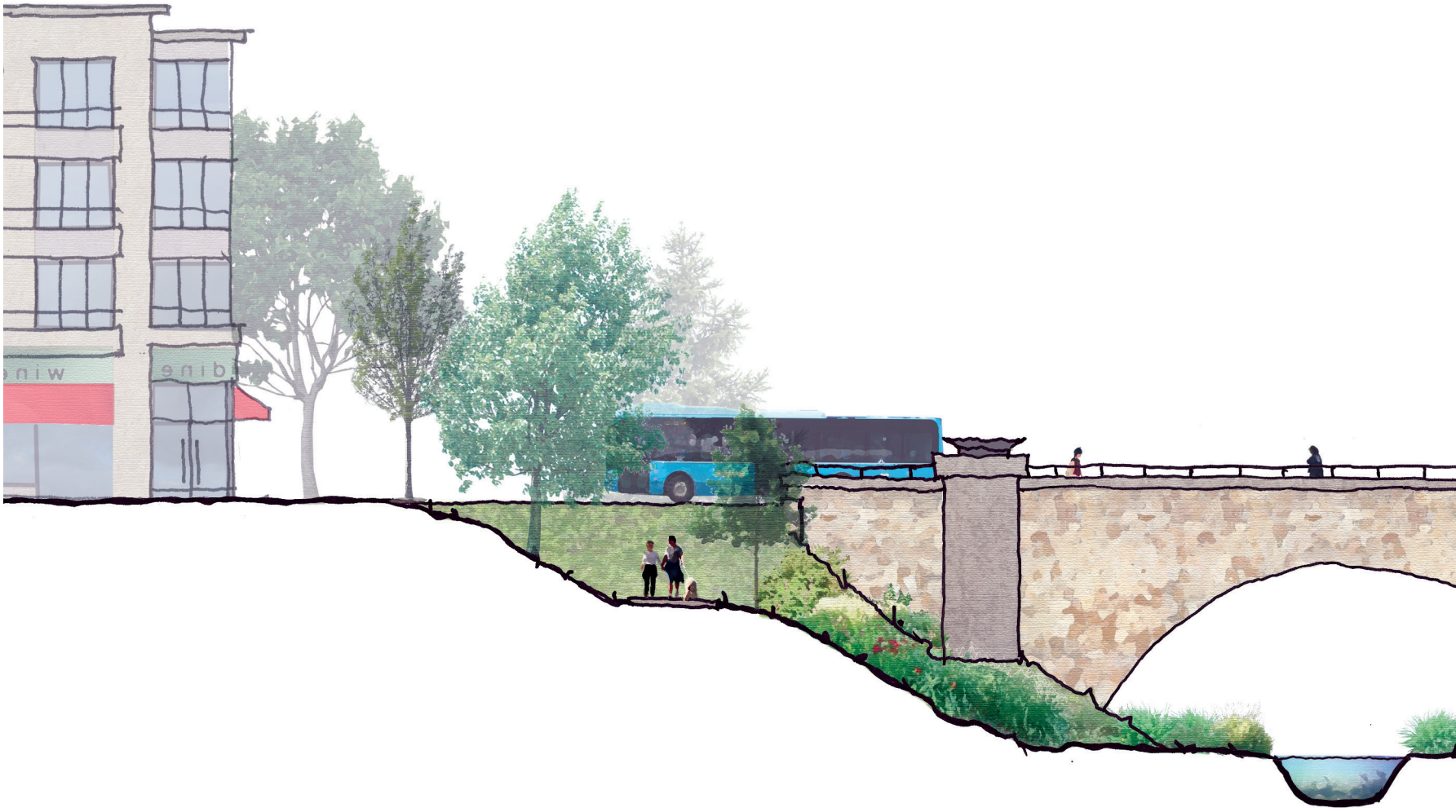
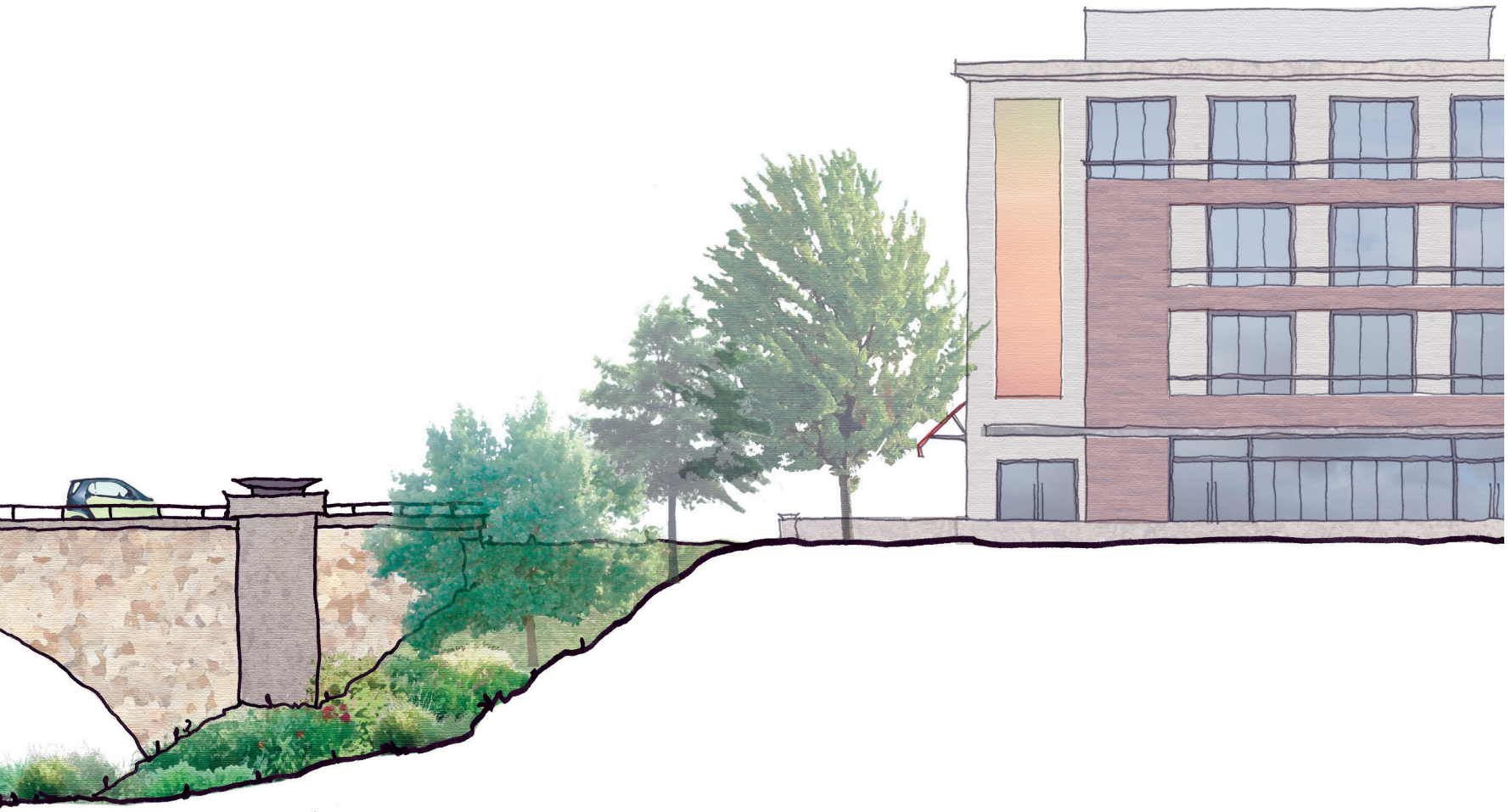


fig 3.37 key diagram: minor greenway branch at arterial road

fig 3.38 section through minor branch of the greenway, near underpass

A smaller underpass provides passage for minor river tributaries or natural linkage corridors. Medium density buildings frame the greenway, and take advantage of its views. The trail is set back from the naturalized area to reduce the impacts of human activities.





5 0 5 10m

fig 3.39 section through leslie street, adjacent to minor branch of the greenway

Sloped trails provide access to the greenway from Leslie Street. Wide sidewalks and designated bicycle lanes enhance the pedestrian realm. Medium density buildings frame the street, while corner buildings also address the greenway. Designated transit lanes are buffered with planted medians. Street parking is provided intermittently along the edge of the street between lampposts and city trees.

5 0 5 10m

VILLAGE CAFE

fig 3.40 vignette of a minor branch of the greenway at leslie street

An underpass provides a linkage corridor between natural areas on either side of the road. Sloped trails and stairs provide a gateway into the greenway trail network. Medium density buildings frame the main street, and have a mix of uses, including retail, office, and residential. Patios along the ground floor of the buildings have direct access to the greenway. Residential balconies take advantage of the views provided by the natural areas.

the character of the greenway

This section explores the character of the greenway itself. The greenway is a multifunctional system that operates as both an interconnected network of natural areas, linkage corridors, and biologically diverse habitats that sustain the natural ecosystem, and as a recreational system of trails, parks, and other recreational areas.

The greenway encompasses a wide variety of conditions that are present across the natural landscape in Newmarket and Aurora, including forests, wetlands, watercourses, and meadows. Each of these areas affords a unique opportunity to learn about local ecosystems, and to view wildlife. Information boards are posted along trails to provide the community with educational information about each natural area and the species that inhabit it. These educational initiatives help to foster a strong relationship between residents and nature, and promote community interest in the preservation and protection of local ecosystems.

The greenway supports a wide variety of winter and summer activities, including hiking, cycling, skiing, snowshoeing, tobogganing, fishing, and wildlife viewing. It also encompasses many existing recreational sports fields, playgrounds, golf courses, and an outdoor theatre. This thesis proposes that legislative incentives be offered to owners of golf courses and recreational facilities that encourage them to adopt environmentally sustainable practices in managing their properties, to reduce the negative environmental impacts produced by overly manicured lawns.

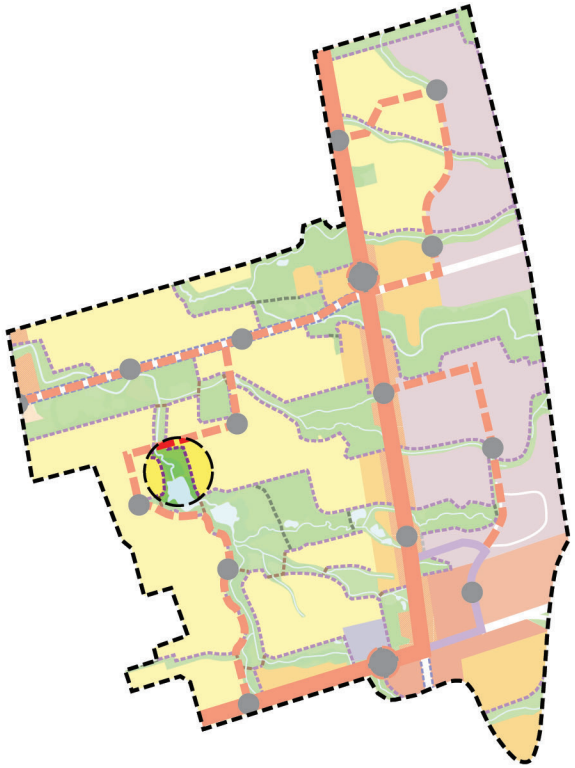


fig 3.41 key diagram: the character of the greenway

fig 3.42 the greenway and its regional connections
Boardwalks are provided along the greenway in lowland areas prone to flooding. Viewing platforms with maps and information boards are provided at key intervals along the greenway, to provide educational information about the local ecosystems. Lighting, seating, and waste receptacles are also provided to promote safety, comfort, and cleanliness. The greenway acts as a linkage corridor that connects Leslie Village to the surrounding suburbs and regional landscape.

fig 3.43 the greenway in the winter
The greenway is intended to be enjoyed during all seasons. Its extensive trail network, rolling terrain, and many ponds provide opportunities for various winter activities, such as cross-country skiing, snowshoeing, tobogganing, and skating.

greenway at residential streets

While arterial roads are strictly linear, smaller residential streets are capable of adopting a more flexible morphology. For this reason, they are able to follow the winding shape of the greenway.

This thesis envisions the residential neighbourhoods of Leslie Village to be distinctly different from the traditional subdivisions found in Newmarket and Aurora, which are characterised by curving streets lined with single-family homes with large garages and private back yards. Instead, it imagines medium density housing complexes that are similar to Clarence Stein's Sunnyside Gardens, with smaller private gardens and shared community parks. These neighbourhoods are each located within a five-minute walk to public transportation, and a twenty-minute walk to the main street.

The design proposes single-loaded streets along the edge of the greenway, as opposed to traditional suburban design where houses back on to the open space. There are many reasons for this. The first is that it opens up the greenway to the public realm of the street, rather than fencing it off with private backyards. This allows the benefits of the greenway to be accessed and enjoyed by everyone in the community. Secondly, it allows the trails that follow the edge of the greenway to take advantage of the existing road infrastructure, such as streetlights, bus stops, and street furniture. Finally, by opening up the greenway as visible public space, it reduces the safety concerns that are associated with having housing that backs on to an unlit forest or ravine.

The design also proposes the use of bioswales along the edge of the street. Bioswales are planted with indigenous vegetation that naturally filter the

toxins, minerals, and nutrients that are carried by stormwater runoff from the street. They prevent untreated runoff from entering the greenway and polluting the river system.

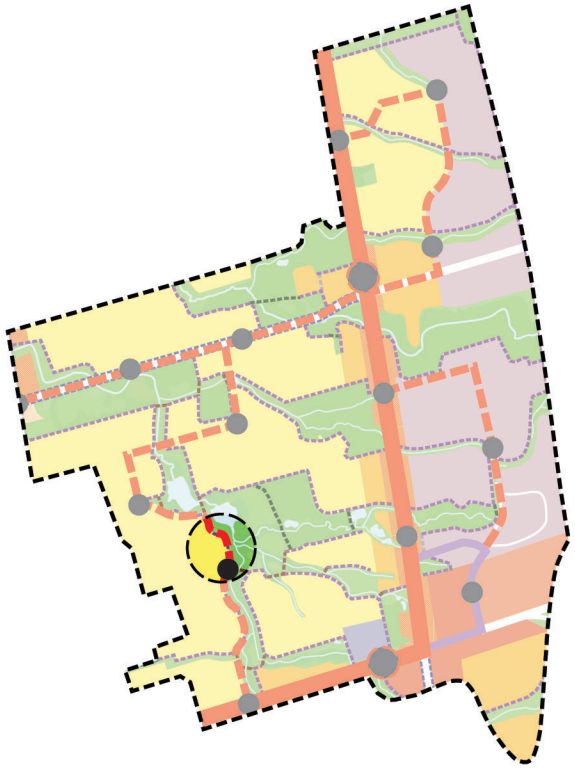


fig 3.44 key diagram: greenway at residential streets

fig 3.45 section through greenway at residential street

Streets frame the greenway and are narrow to calm traffic. Street parking is located intermittently between tree plantings, which provide shade. A sidewalk is located on the residential side of the street, and a multifunctional trail is provided along the greenway.

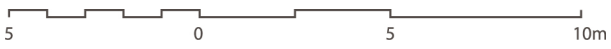


fig 3.46 vignette of the greenway at a residential street
Single-loaded residential streets run parallel to the greenway, forming its boundary. Medium density housing complexes with front porches and balconies exploit the views provided by the greenway. The orientation of the houses, combined with the use of overhangs and solar panels, maximizes passive heating and cooling techniques. Narrow streets calm traffic, and provide a safe environment for children playing. Bioswales replace traditional storm sewers, to allow stormwater to be filtered naturally and to prevent run-off from polluting the adjacent natural areas. A multipurpose trail runs along the greenway and the street, capitalizing on both the furnishings of the street and the character of the greenway.

greenway at transit hubs

One of the most significant key zones in the design proposal is the area where the greenway intersects a public transit hub. These hubs are located at major street corners, or where two or more transit routes intersect. There are two major hubs located within the Leslie Village Boundary, and two major hubs located along Wellington Street. The Wellington Street hubs are located at the corner of Yonge Street, where the Wellington bus line crosses the Viva bus route along Yonge, and at the Aurora GO Train Station. The two hubs within the Leslie Village boundary are located near the corner of Wellington Street and Leslie Street, beside the Stronach Aurora Recreational Complex, and at the corner of Leslie Street and St. John's Sideroad.

This thesis envisions these transit hubs to be primary public space nodes. The two hubs in Leslie Village act as public gateways that frame the north and south ends of the main street. These hubs are the points of convergence between the three main sustainable transportation networks: the public transportation system, the bicycle lanes and pedestrian sidewalks at street level, and the recreational trail network along the greenway. Since these hubs are located within a short walking distance of the neighbourhoods they serve, designated parking lots are not provided, with the exception of the Aurora GO Train Station, which services a much wider area. However, small private lots and street parking will be available for citizens who are unable to walk to these hubs.

There are several goals for the design of the transit hubs. The first is to provide a safe and comfortable environment while waiting for the bus. Large bus shelters with seating, lighting, and signage are located at each station. These stations are also equipped with garbage, compost, and recycling receptacles.

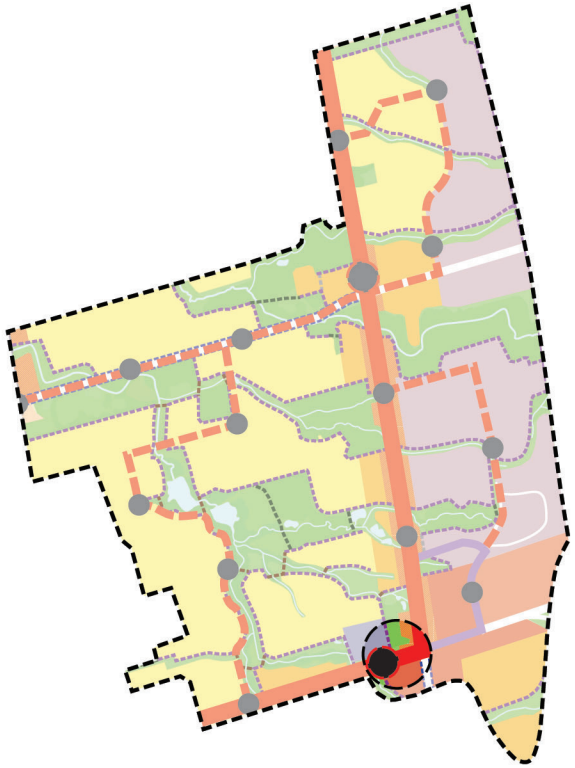


fig 3.47 key diagram: greenway at transit hub

Another goal is to accommodate alternative means of transportation to and from the hub. To this end, there are secure storage lockers for bicycles and skis, allowing people to leave their skis or bikes for longer periods of time while they are shopping or at work. Finally, the use of civic art and street furniture is implemented to provide visual focal points and enhance the sense of place.

fig 3.48 section through transit hub

Waiting platforms with large bus shelters are provided at major transit hubs. A stepped civic square provides a public space node that acts as a bridge between the greenway and the street. Buildings are set back from the street on the opposite side of the greenway, and front a public plaza. Large planters provide seating, shade, and visual interest.

5 0 5 10m

fig 3.49 pedestrian crossing at transit hub

A wide pedestrian crossing links the bus shelter and waiting platform to the gateway into the greenway trail system. The design for the bus shelter is based on a Viva Transit prototype. Buildings on the opposite side of the road to the greenway are set back from the road, creating a public plaza that faces the greenway. Road pavings of various colours and textures delineate pedestrian crosswalks and sidewalks, bicycle lanes, automotive lanes, and transit lanes. Mixed-use buildings of transit-supportive densities frame the streetscape. Designated transit lanes and bicycle lanes promote convenient and efficient alternative modes of transportation.

coffee & treats
ladies

village shop
shop

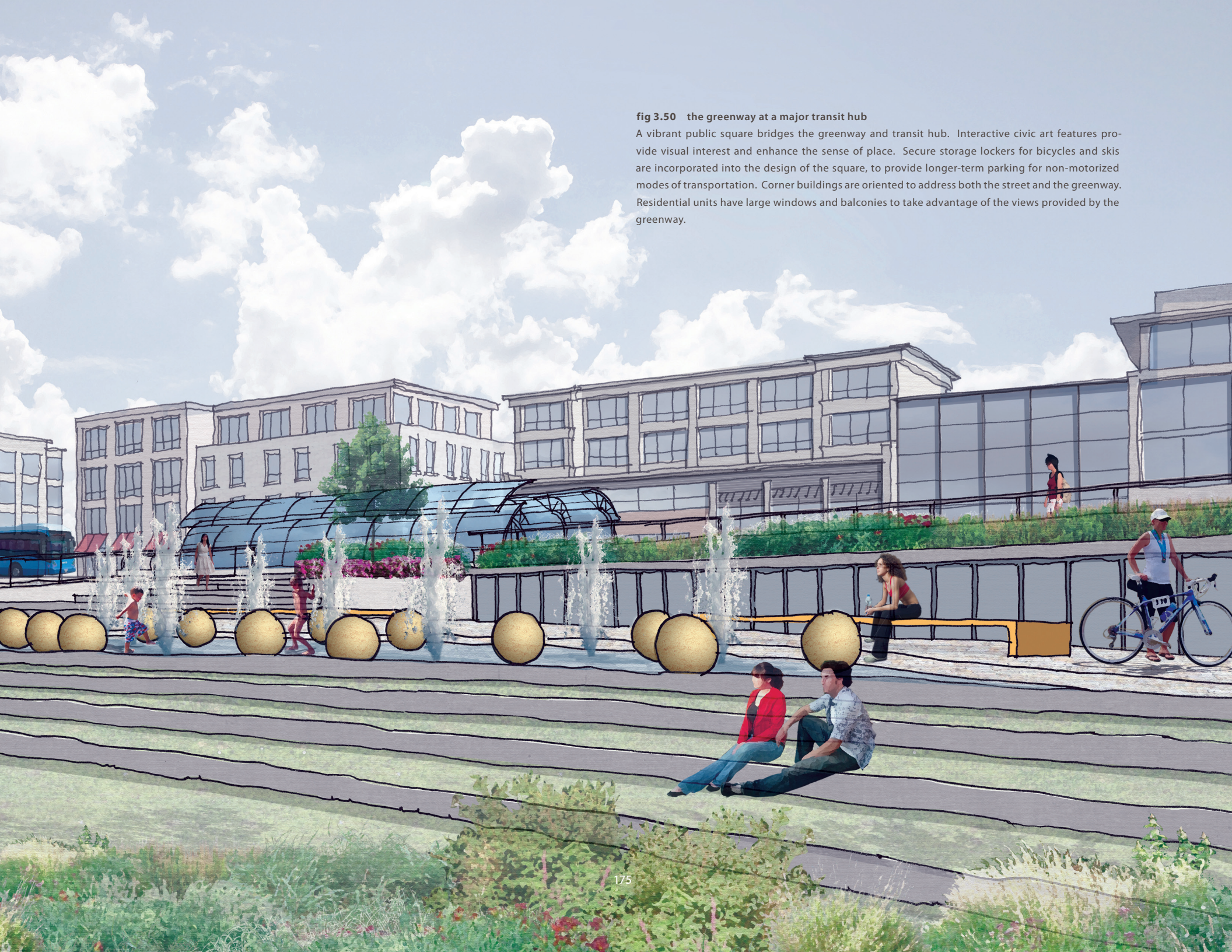


fig 3.50 the greenway at a major transit hub

A vibrant public square bridges the greenway and transit hub. Interactive civic art features provide visual interest and enhance the sense of place. Secure storage lockers for bicycles and skis are incorporated into the design of the square, to provide longer-term parking for non-motorized modes of transportation. Corner buildings are oriented to address both the street and the greenway. Residential units have large windows and balconies to take advantage of the views provided by the greenway.

"Connecting urban areas to the countryside, at a local scale and the natural regions, is about interdependence and a necessary facet of sustainability. Connecting cities in a seamless network of protected places, maintaining biodiversity and acting as an organizing framework for growth, is part of the work that must be done to contribute to a sustainable future in the twenty-first century." [1]

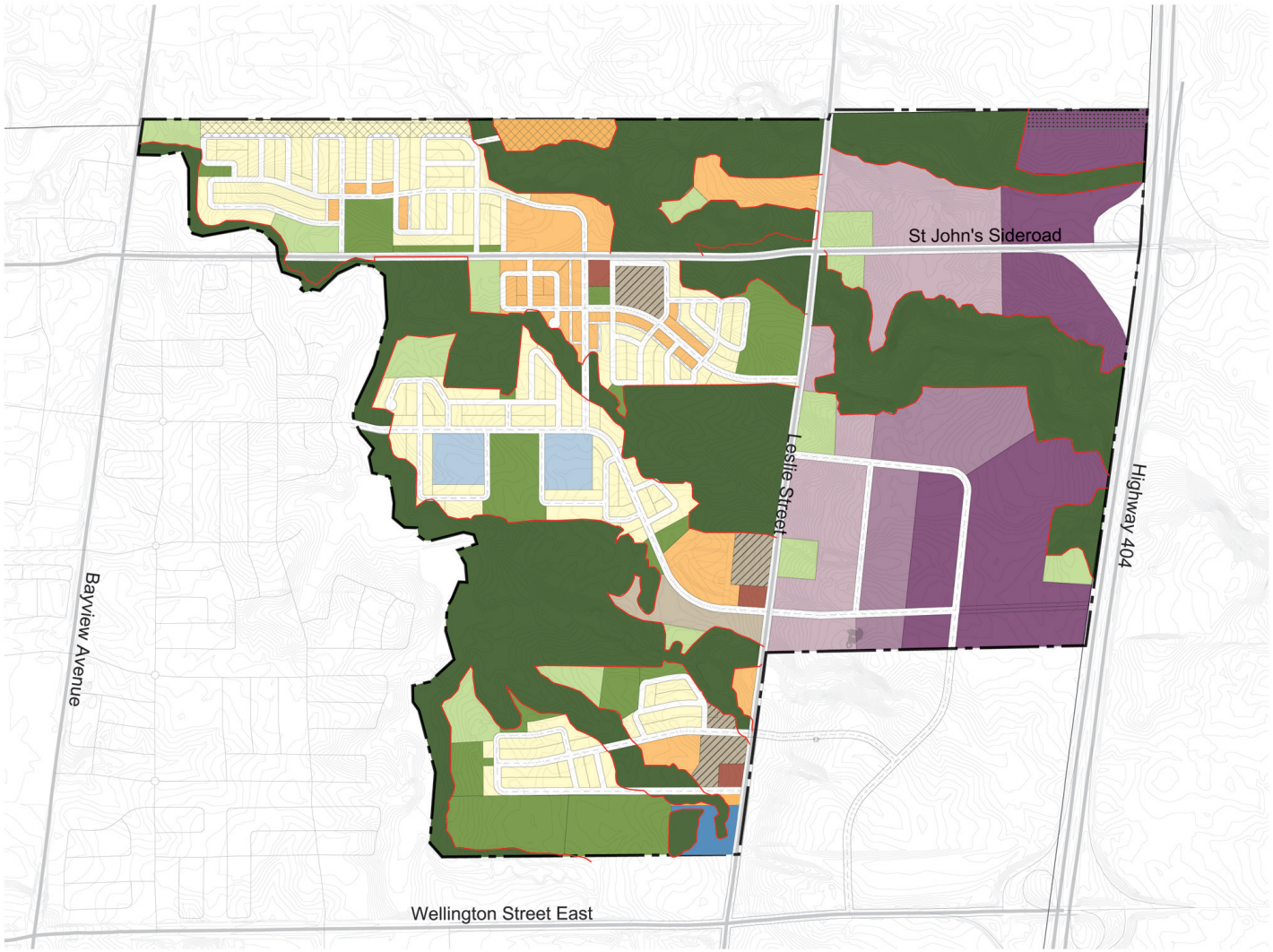
conclusion

A significant shift is needed in the way Canadian cities grow. A resolve to create healthy, vibrant cities that support a sustainable way of life in balance with nature has been established in the social consciousness. Several existing initiatives share common goals of creating more sustainable cities that protect and enhance the natural environment. In southern Ontario, the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan, and the Provincial Growth Plan, are the most significant government initiatives that address the issues of sustainable design. The objectives outlined in each plan are complementary to the principles in this thesis. They each strive to achieve healthy and viable cities, while preserving the natural resources provided by local ecosystems.

While the establishment of the goals and objectives in these plans is an important step in achieving sustainable cities, there is an absence of examples of how these principles can be manifested in practical terms. This thesis provides a working methodology for urban design, demonstrating how green infrastructure is executed as a primary tool for maintaining ecological health and integrating the built and natural realms as part of a cohesive public system. The plan for Leslie Village serves as a model for sustainable development along the edges of greenbelts in Canada's suburban landscape.

There are several events that have taken place over the course of the development of this thesis that have a significant effect on the plan for Leslie Village and its feasibility for implementation. The most significant of these events is the development of a first draft secondary plan, by the Town of Aurora, for a large area of land that is located directly within the proposed Leslie Village boundary. This plan, called the 2C Secondary Plan, includes most of the land

1 Hough, Michael. *Cities and Natural Process: A basis for sustainability.* 2nd ed. New York: Routledge, 2004, p.262.



Appendix I

Community Plan

Aurora 2C Secondary Plan

Legend

The Greenlands System

- Environmental Protection Area
- Parks/Open Space
- Stormwater Management Facility

The Residential Neighbourhood

- Urban Residential 1
- Urban Residential 2
- Urban Residential 3
- Urban Residential 4
- Mixed-Use Residential/Commercial
- Residential Interface Overlay
- Elementary School
- Place of Worship

The Business Park

- Business Park 1
- Business Park 2
- Business Park 3
- Business Park Interface Overlay

- Secondary Plan Area Boundary
- Development Limit

0 50 150 250 400 500 metres

July 2010

adjacent to St. John's Sideroad and Leslie Street (refer to figure 4.04). The plan recognizes that these lands are the last major parcels of greenfield land open for development in Aurora, and that they are situated within a landscape of many ecologically sensitive natural features, including a 'Provincially Significant Wetland', as well as extensive woodlands, wetlands, and valleys.[2] The plan's overall vision for creating an environmentally and economically sustainable community that protects the natural heritage of the site makes it one that is distinctly unique from typical suburban planning:

> *"The vision for the 2C Secondary Plan Area is to create a complete community that protects the environment and includes well-designed residential neighbourhoods and a business park. The 2C community is expected to be leading edge in implementing green building technologies, and is to be developed at densities and in a pattern that is compact and transit supportive. The community is to be beautiful and safe, and will encourage an active, healthy lifestyle through highly interconnected greenlands and trails systems."*[3]

The guiding principles and objectives that are stated in the 2C Secondary Plan parallel the design principles for Leslie Village. The plan's concern for the protection and rehabilitation of natural areas is particularly correlated to the ideals presented in this thesis. It proposes a greenlands system that is very close in scale and character to Leslie Village's greenway system. A Natural Heritage Study was conducted prior to the plan in order to gain a complete understanding of the biological and abiotic characteristics of the site, and to establish the ideal boundary for the greenlands system. The study conducted detailed field research to survey the vegetation and flora, the wildlife, and the fisheries and aquatic habitats on the site; as well as its geology, topography, soils, and hydrology. The study maintains a constant awareness that each piece of data

2 *Appendix 1: Terms of Reference, Northeast Aurora Secondary Plan "2C Planning Area"*. Town of Aurora, April 7, 2009, p.6.

3 *2C Secondary Plan Area - Draft 1.* Town of Aurora, July 9, 2010, p3.

fig 4.01 draft community plan for aurora 2C secondary plan

is gathered with the specific intention of providing an ecologically informed framework for urban development. As such, this study is similar in scope and style to Robert Dorney's ecoplan for Erin Mills, which was a precedent for the analysis portion of this thesis. The results obtained from the Natural Heritage Study provide an additional layer of ecological analysis that was beyond the scope of research for this thesis. Since specialists in the fields of ecology and environmental studies conducted these studies, they are a valuable enhancement to the design for the greenway in Leslie Village, which was established from a planning and design perspective.

In addition to a greenlands system, the 2C Secondary Plan also proposes implementing transit supportive densities, and emphasizing the quality of the pedestrian realm. The draft community plan, shown in figure 4.01, demonstrates the relationship between the proposed land use zoning for the site and the greenlands system. The plan's zoning strategy is similar to the proposed zoning for Leslie Village in several respects: It includes mixed densities of residential neighborhoods on the west side of Leslie Street, and an employment zone on the east side of Leslie Street, adjacent to the 404 Highway. However, the plan introduces small pockets of mixed-use zones that are isolated throughout the site; as opposed to Leslie Village, which proposes a mixed-use corridor along Leslie Street to bridge the residential and employment zones and serve as the downtown core of the Village. The presence of this main street corridor is a vital component of the plan that advances the design beyond the monotonous typologies of traditional suburbia. It is essential in promoting the village's identity as a self-contained community with a vibrant public realm.

While the plan moves in a positive direction, away from typical suburban plans, it lacks a larger urban picture. The proposal for Leslie Village is one cohesive

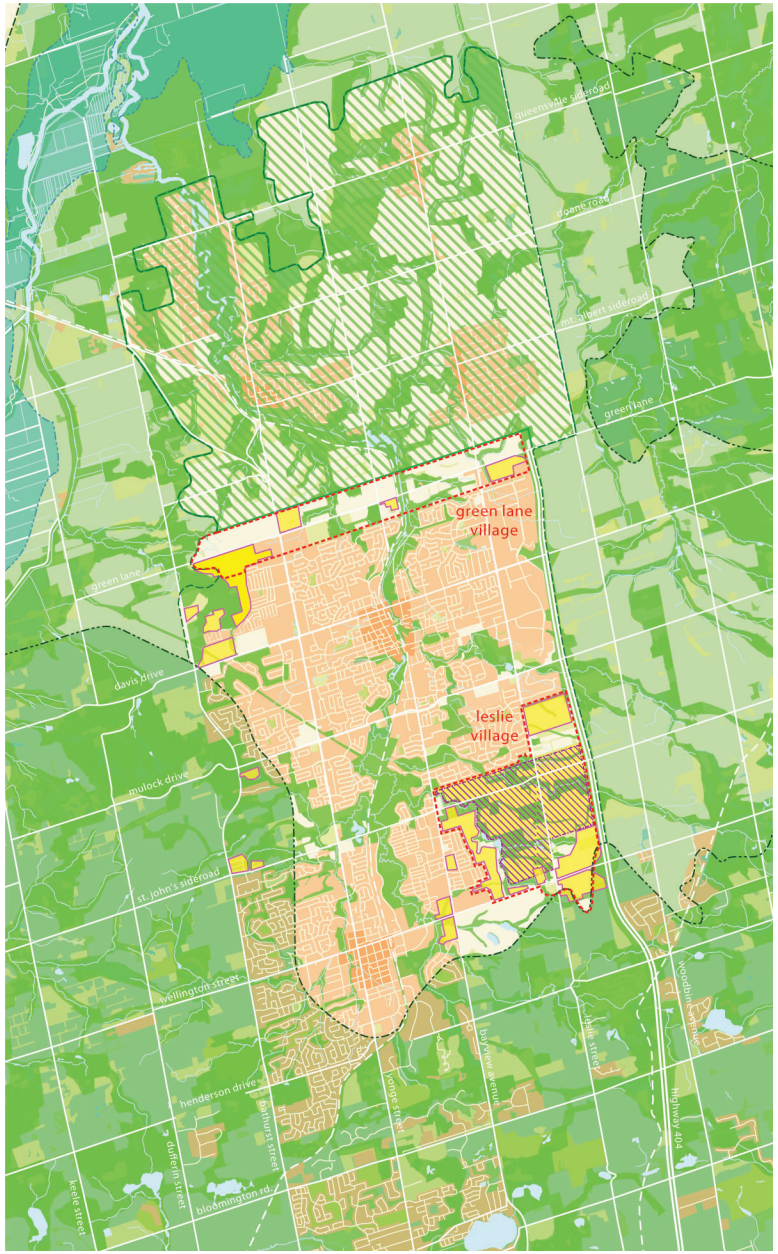
fig 4.02 panoramic view of development zone at the corner of wellington street and leslie street
A large parcel of land has been cleared away for the construction of a large commercial development at the northeast corner of Wellington Street and Leslie Street.

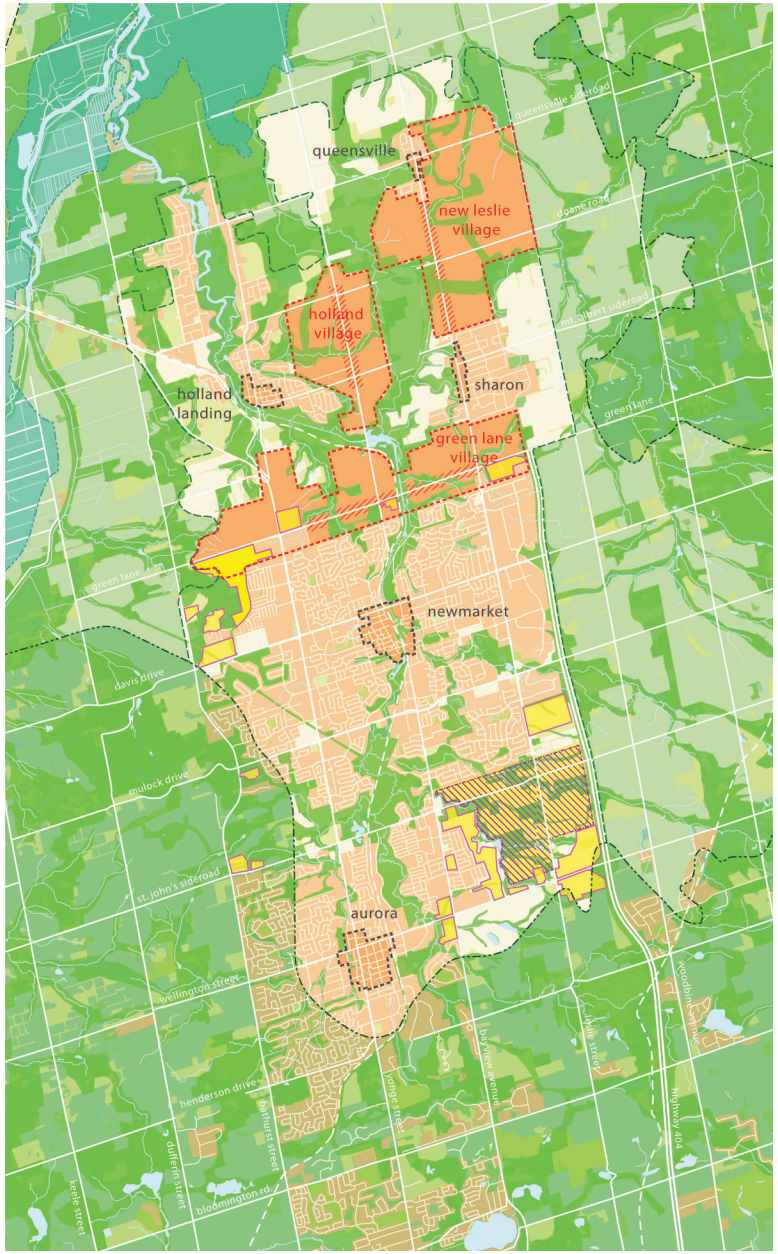
fig 4.03 development in leslie village
Many parcels of land in the Leslie Village boundary have been developed, or are in the process of being developed. A Walmart is now located at the southeast corner of Leslie Village, as well as several large office buildings.

village with its own identity, while the 2C secondary plan is simply an extension of Aurora's suburban fabric with slightly higher densities and better green corridors. The primary weakness of the 2C plan is its lack of a broad vision of public space, which is presented in Leslie Village. Their plan states that the greenlands system is to be an important component of the public realm in the 2C lands; however, it does not provide any examples of how this system will be integrated into the built realm, particularly at major road crossings. It is at these key zones – the junction points between the built and natural realms – where the potential for vibrant public space is most apparent. The vignettes that are presented in section 3.3 of this thesis provide a visual example of how these key zones can be addressed and incorporated into the civic space, which is something that the 2C Secondary Plan is lacking, and from which it could benefit. The design strategies for Leslie Village's public spaces can, and should be incorporated into the 2C Secondary Plan. These strategies would enhance its scope, and help it achieve its vision for a sustainable, healthy, and vibrant community.

Another significant event that has occurred over the course of this thesis is extensive urban development on the proposed site. Almost all of the land in Leslie Village that is not comprised of the 2C lands has already been developed, or is in the process of being developed. Residential subdivisions of typical suburban typologies, big box commercial plazas, and several office buildings are now located along the Wellington Street corridor. The portion of the village that lies within the Newmarket boundary is currently slated for the construction of a traditional residential subdivision.

Despite these challenges, there are several options that are available for making use of the proposals in this design. First, aspects of the design for Leslie

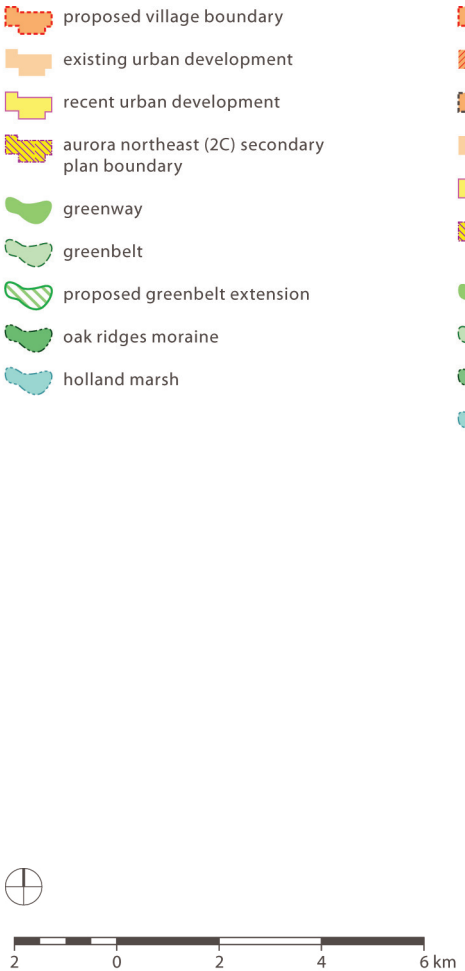

queensville sideroad
doans road
mt. albert sideroad
green lane
green lane village
green lane
davis drive
leslie village
mulock drive
st. john's sideroad
wellington street
henderson drive
bathurst street
yonge street
bayview avenue
leslie street
woodbine avenue
highway 404
dufferin street
bloomington rd.
keele street


queensville sideroad
queensville
new leslie village
doans road
mt. albert sideroad
holland village
holland landing
sharon
green lane
green lane village
green lane
davis drive
newmarket
mulock drive
st. john's sideroad
aurora
wellington street
henderson drive
bathurst street
yonge street
bayview avenue
leslie street
woodbine avenue
highway 404
dufferin street
bloomington rd.
keele street

(opposite left)

fig 4.04 recent urban development

Several large parcels of land have recently been developed in Leslie Village. The remaining portion of undeveloped land is part of the 2C Secondary Plan. Some development has also occurred in Green Lane Village, but to a lesser degree.



(opposite right)

fig 4.05 conceptual village locations in east gwillimbury

This map illustrates the conceptual locations for three new urban villages in East Gwillimbury that could easily adopt the principles and design methods employed in the plan for Leslie Village.

Village can be incorporated into the 2C secondary plan, since the plan is still in its infancy. Alternatively, since the proposal for Leslie Village is designed to be transferable, the principles and methods for the design can be applied to other sites in the region that demonstrate significant growth potential. One such site would be the proposal for Green Lane Village, as shown in section 3.1 – The Greenway and Linked Villages. The land in this area has experienced some recent growth, but still remains largely undeveloped. The situation of Green Lane Village at the northern boundary of Newmarket affords it interesting potential to become a new linear village that bridges Newmarket's sprawl with the rural countryside in East Gwillimbury.

Another example of an area that could benefit from the principles and methods proposed in Leslie Village is the region encompassing the urban centres of Holland Landing, Sharon, and Queensville that are located in the Town of East Gwillimbury. One of the early stages of the design, in section 3.1, proposes a temporary extension of the greenbelt to suspend development in East Gwillimbury. Since Newmarket and Aurora are developing at such a rapid pace, it would be interesting to investigate the scenario in which this greenbelt extension is lifted, and the next phase of the design could be explored. Holland Landing, Sharon, and Queensville each have enormous growth potential, and are also situated amid several significant natural land features and ecologically sensitive areas; such as the Oak Ridges Moraine and Holland Marsh, as well as many wetlands and forests. It is important that careful planning be applied to this growth, to ensure that the land in this area does not succumb to the traditional pattern of sprawl. For this reason, East Gwillimbury is an ideal location for applying the methodologies presented in this thesis.

The locations for three conceptual villages are presented in figure 4.05 to dem-

onstrate where the design for Leslie Village can be applied to new sites in East Gwillimbury. The first village, 'New Leslie Village', is located along Leslie Street between the northern-most edge of Sharon and the southern edge of Queensville. This village has the potential to link the main streets of both Sharon and Queensville, providing a new, vibrant downtown core to serve both communities. 'Holland Village' is located along the eastern edge of Holland Landing, and would be a standalone community with linkages to the surrounding villages. Lastly, an extended version of Green Lane Village is proposed, which would tie into both the existing downtown cores of Holland Landing and Sharon, as well as the new downtown cores of New Leslie Village and Holland Village. In addition, it would create a bridge between the villages of East Gwillimbury and the broader metropolitan fabric of Newmarket and Aurora. Each of these villages would be connected by an extensive, regional greenway that would help to maintain the ecological health in the region by providing linkage corridors between significant natural features. In addition, growth would be concentrated into smaller, vibrant, urban communities, eliminating urban sprawl and conserving the valuable countryside.

As stated earlier, there is an absence of pragmatic examples of how the theories and principles of sustainable urban design can be put into practice. The emergence of the 2C Secondary plan, along with the Provincial Growth Plan and Greenbelt Plan, confirms that there is a strong intent, at both the provincial and municipal level, to move toward building compact, viable cities that exist in balance with nature. This thesis provides the framework for a manifestation of these plans, demonstrating how these principles can be realized.

This thesis proposes a method for the design of sustainable villages within a metropolitan framework, by means of green infrastructure. It explores the

literature and theories that have contributed to the fluid notions of greenbelts, greenways, and sustainable cities. It then reviews the natural and cultural history of the selected site to provide an understanding of how the area has evolved to its current state. It provides a method of analysis through mapping the cultural and natural ecosystems that function at various scales across the region. This analysis provides the foundation upon which the design is based.

The design then demonstrates how the various layers of green infrastructure shape the plan for the village. At the largest scale, the greenbelt provides the outer boundary of the study area. The proposal of the greenway system provides the second layer, which identifies the areas designated for open space and urban development. Finally, the design addresses the challenges that occur at the junctions between the built and natural realms. It proposes pragmatic interventions to negotiate the edge conditions of the greenway, in a way that brings the aesthetic, social, and environmental benefits of the natural landscape to the city. In essence, it provides a practical example of how green infrastructure is an effective and necessary tool for fostering a sustainable future.

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appendix

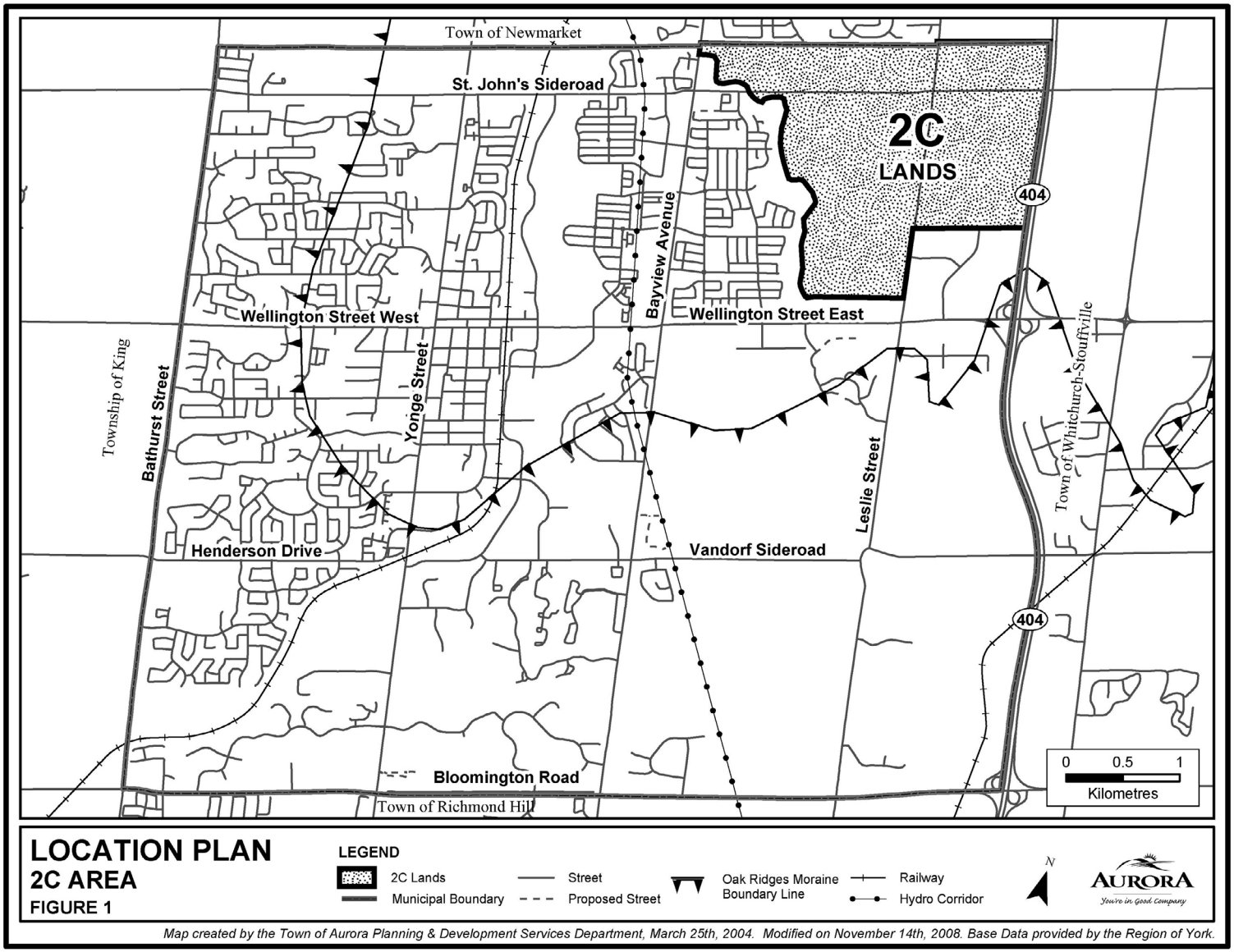

fig A.01 2C area location plan

a1.0 the aurora 2C secondary plan

In July 2010, the Town of Aurora released a draft secondary plan for the "2C" lands in Northeast Aurora. The 2C lands are located on the last remaining area of greenfield land in Aurora that has been deemed suitable for urban development. The site has several unique characteristics that require special planning considerations. The presence of several environmentally significant areas on the site requires careful planning provisions to protect and maintain the natural heritage of the area. The 2C lands are also located in close proximity to the 404 highway, creating an ideal site for employment lands.

The 2C Secondary Plan is the first secondary plan in Aurora to conform to other provincial policies, such as the Provincial Growth Plan, draft Lake Simcoe Protection Act, and 2005 Provincial Policy Statement,[1] each of which presents initiatives that promote environmental health and 'smart growth'.

1 *Appendix 1: Terms of Reference, Northeast Aurora Secondary Plan "2C Planning Area"*. Town of Aurora, April 7, 2009, p.7.

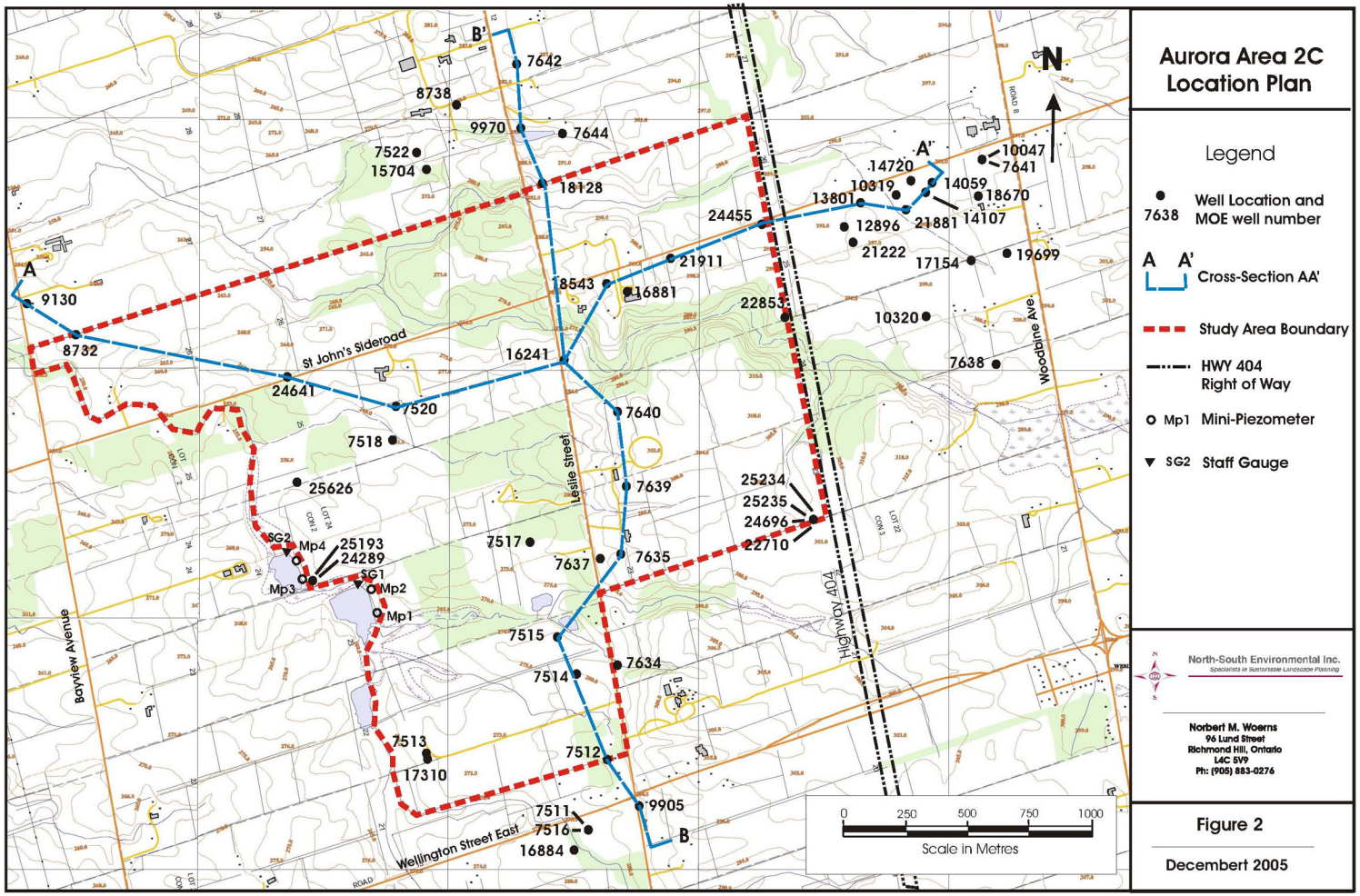

fig A.02 natural heritage study: aurora area 2C location plan

a1.1 natural heritage study

The site is located in close proximity to the Oak Ridges Moraine, and is adjacent to a Provincially Significant Wetland known as the East Aurora Wetland Complex. The site also contains extensive woodlands and naturalized areas that support a wide variety of plant and animal species. For this reason, a Natural Heritage Study was conducted by North-South Environmental Inc. to survey and assess the natural heritage features of the area, and to provide policy direction for environmental consideration for the 2C Secondary Plan.[2]

The main objective of the Natural Heritage Study was to execute a comprehensive field program to survey the biological characteristics of the site, and provide a detailed assessment of the existing ecology of the 2C lands. The study was conducted with the intention of providing environmental information and data that would be incorporated into the 2C plan.

The areas of focus for the study include: geology, physiology and drainage, slopes, soils, hydrogeology, hydrology, water balance, vegetation, floristics, fisheries, benthic analysis, wildlife, significant plant species, and significant wildlife. The analysis of the geology of the site explored both the bedrock and surficial geology conditions, such as the distribution of subsurface deposits. The studies of the physiography, drainage, slopes, and soils, provide an understanding of the physical characteristics of the site and how these characteristics affect natural processes. The study of the site's hydrogeology, hydrology, and water balance explores aquifer systems, groundwater levels and flow, river tributaries and channels, floodlines, soil moisture, infiltration fac-

2 *Natural Heritage Study*. Retrieved September 1, 2010 from Town of Aurora. <http://www.town.aurora.on.ca/aurora/index.aspx?CategoryID=388&lang=en-CA>.

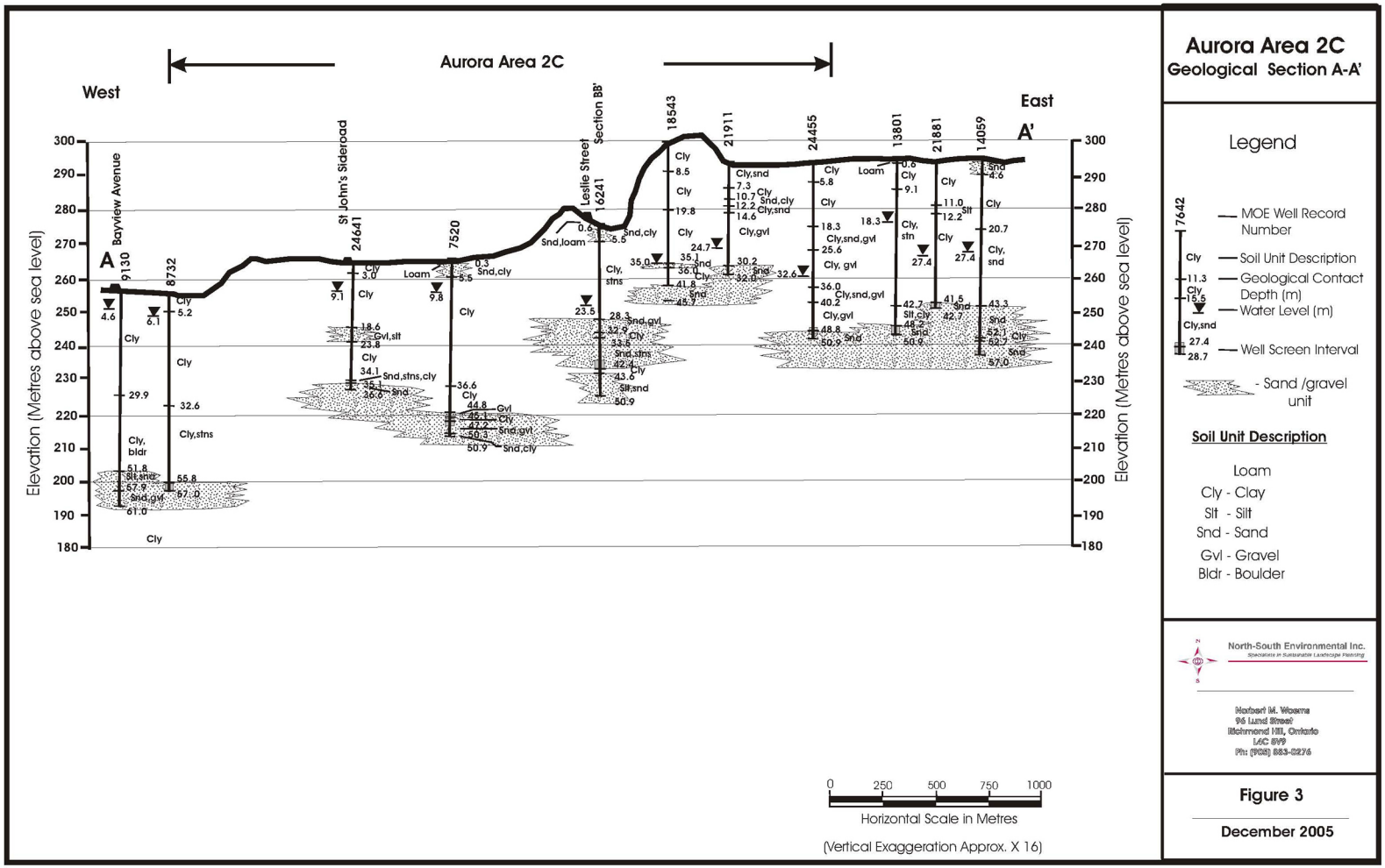

fig A.03 natural heritage study: geological section 'a-a'

tors, and hydrological functions. Field studies also surveyed the vegetation on the site, and categorized the findings based on the ecological land classification of each plant community. Fisheries were examined to determine direct fish habitats for spawning, rearing, feeding, or cover; as well as indirect fish habitats, which are watercourses that are not directly inhabited by fish, but provide food, water, and nutrients. Benthic analysis involved the sampling of macroinvertebrate, whose presence (or absence) can serve as indicators of water quality. The presence of wildlife on the site was also documented, including species of birds, mammals, amphibians, and reptiles. The identification of significant species of plants and wildlife were included in the study. Significant plant species include both provincially, regionally, and locally significant plant species. Significant wildlife includes significant aquatic species, significant reptiles, amphibians, and mammals, and significant breeding bird species.

The findings that were gathered in the Natural Heritage Study provide the foundation for determining a Natural Heritage System (NHS) for the 2C lands:

"An NHS approach recognizes the connectivity among different natural heritage features within an area, and seeks to protect them such that their structure and function can be preserved in the long-term, to the maximum extent possible." [3]

The goals of the Natural Heritage System are to help preserve local and regional biodiversity by protecting the habitat for species in the 2C lands; to create connections between principal environmental features on the site; to maximize the protection of the 2C lands' environmental functions and features; to

3 Gravely, Cathy, Lisa Guenther, Sarah Mainguy, Mirek Sharp, Norbert Woerns. *A Natural Heritage Evaluation for the North-East Aurora Planning Area "2C"*. Town of Aurora, May, 2006, p.53.

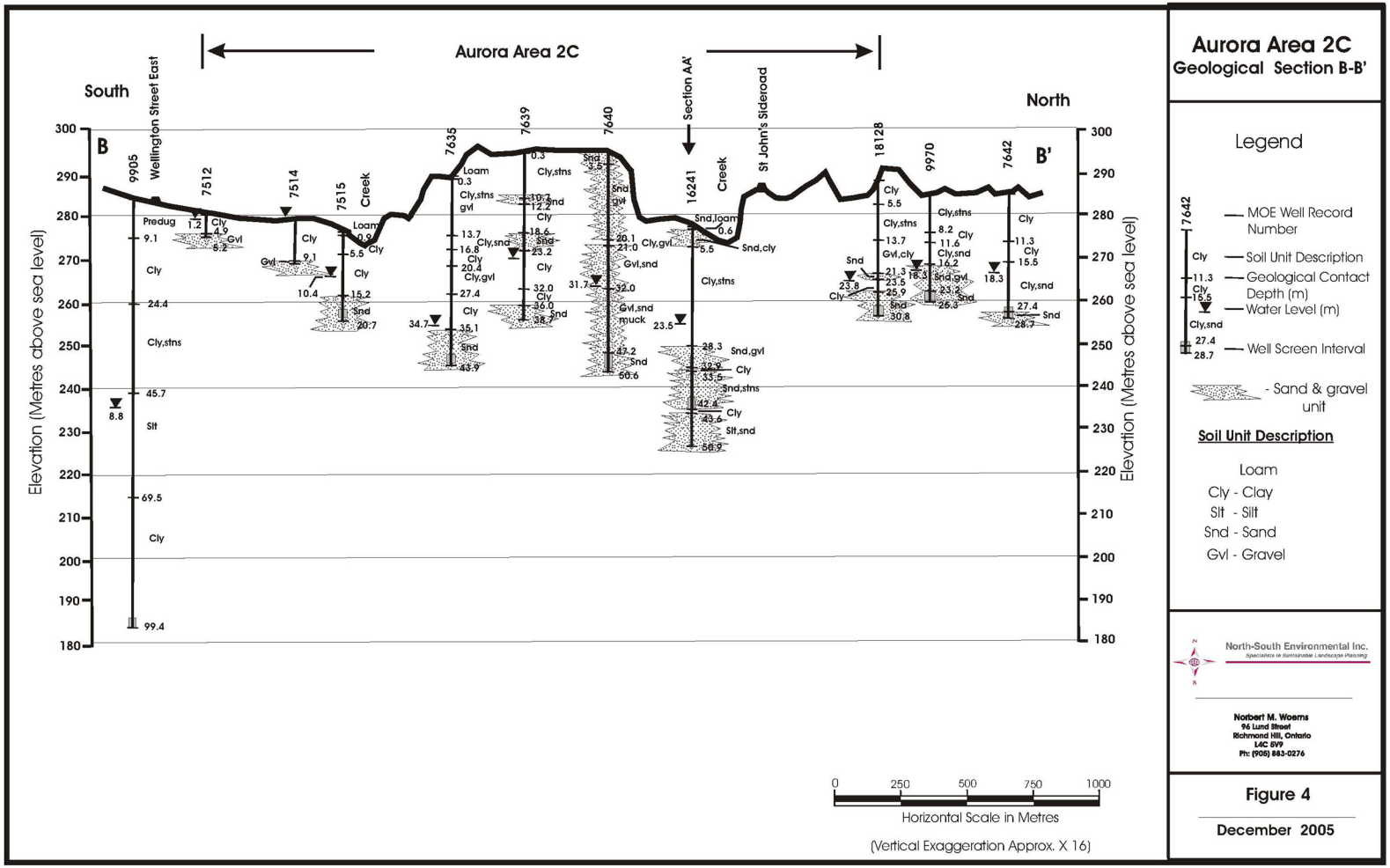

fig A.04 natural heritage study: geological section 'b-b'

mitigate the impacts of future development; to assist in the dispersal and migration of flora and fauna; and to provide the framework for an urban wildlife park and its management.[4] The study proposes that woodlands, wetlands, watercourses, floodlines, and valley features be the primary components of the Natural Heritage System.

In addition to providing the guidelines for a Natural Heritage System, the study also provides a framework for the management, monitoring, and rehabilitation of key natural areas on the site. This includes guidelines for the management of specific woodlands, buffer zones and edge conditions, fish habitats, and trails, as well as the proposal for natural rehabilitation areas and guidelines for short-term and long-term monitoring. Additionally, it proposes guidelines for urban uses adjacent to the Natural Heritage System, and identifies the location for potential road crossings, where the impacts of construction and human activities would be least detrimental to natural areas.

Finally, the Natural Heritage Study provides a detailed outline of draft policy recommendations to be incorporated into the 2C Secondary Plan. These policies directly address the protection of environmental features of the site.[5]

4 ibid, p.54-55.

5 Ibid, p.70.

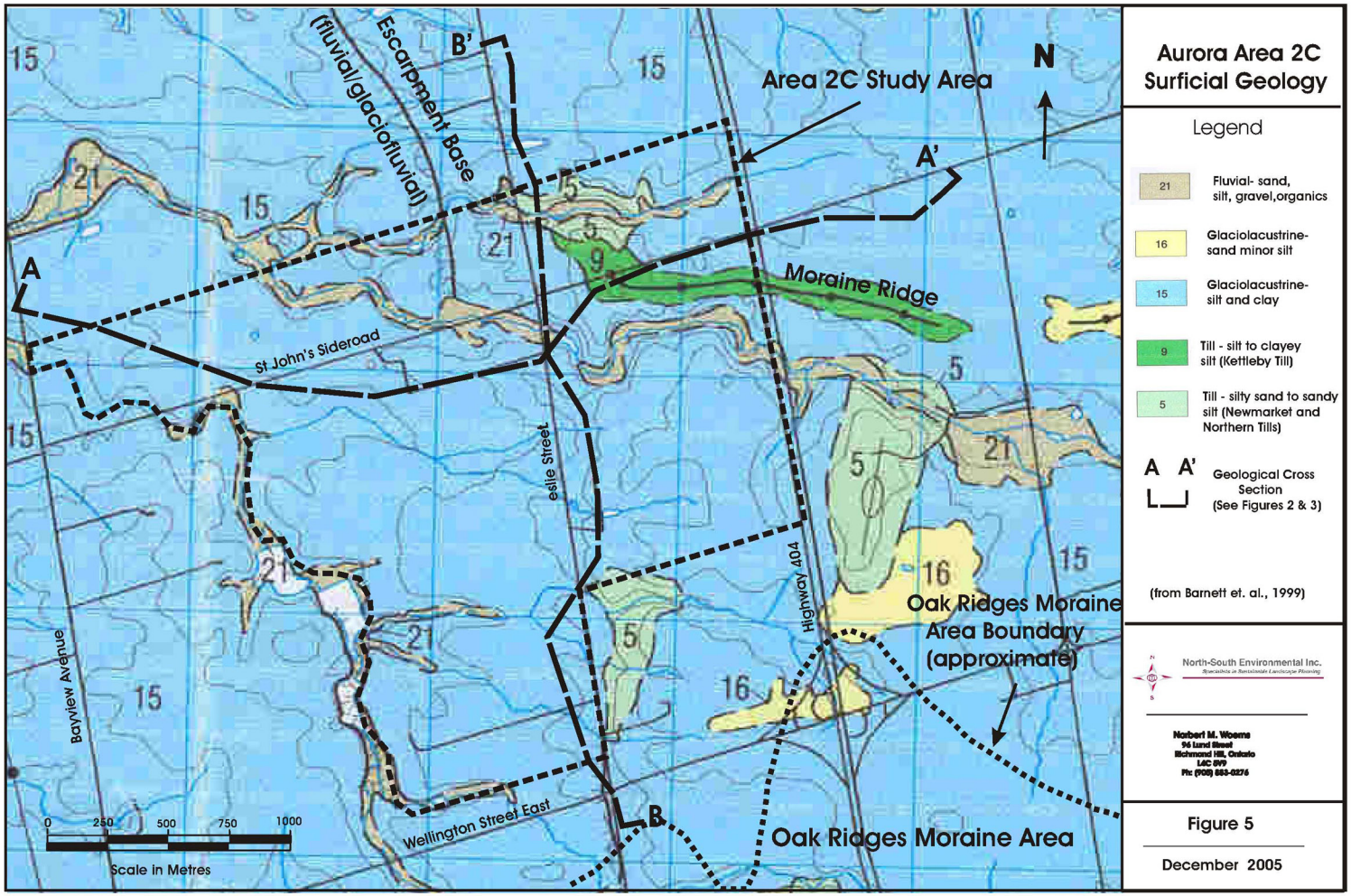

fig A.05 natural heritage study: surficial geology

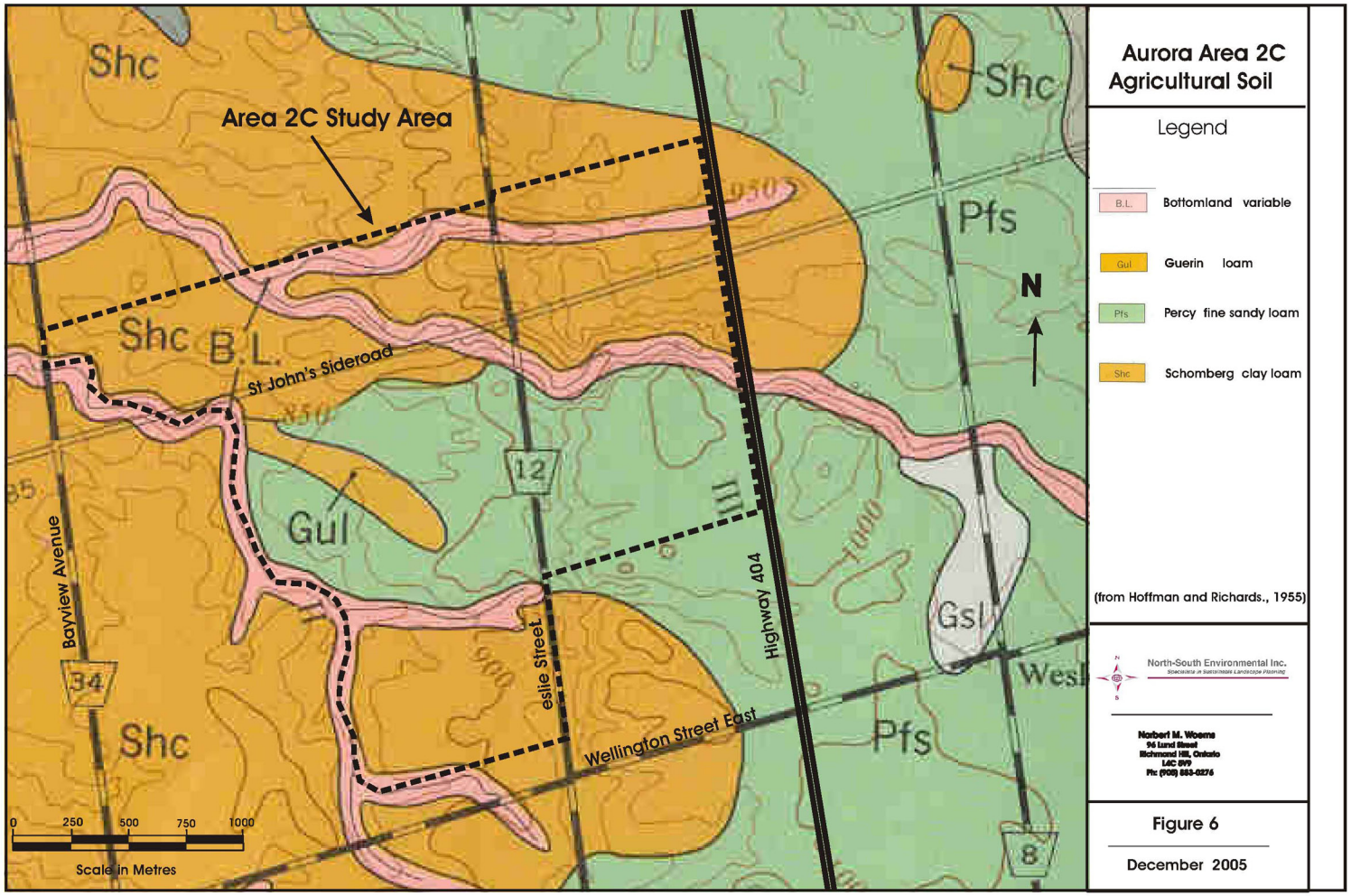

fig A.06 natural heritage study: agricultural soil

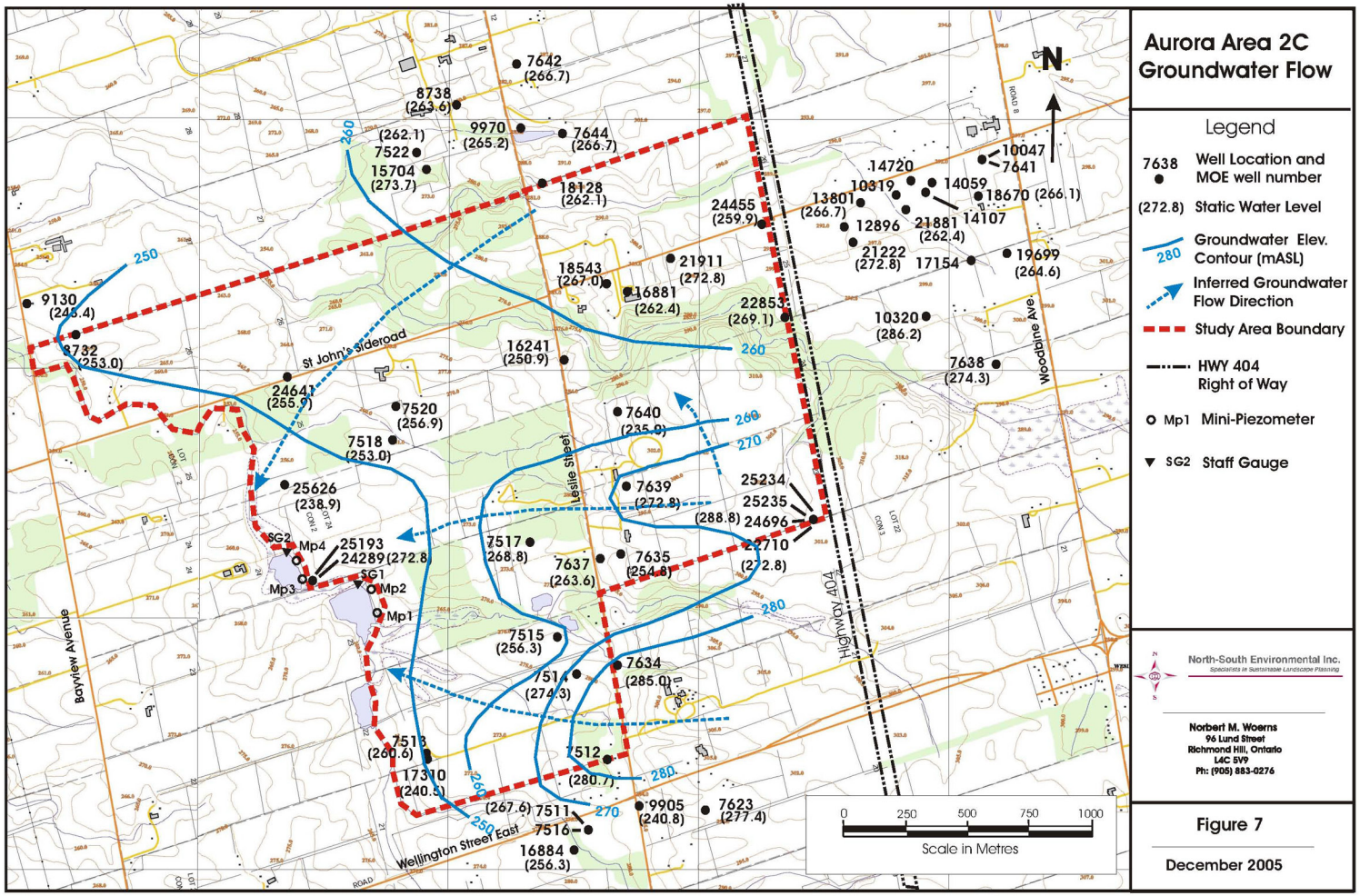

fig A.07 natural heritage study: groundwater flow

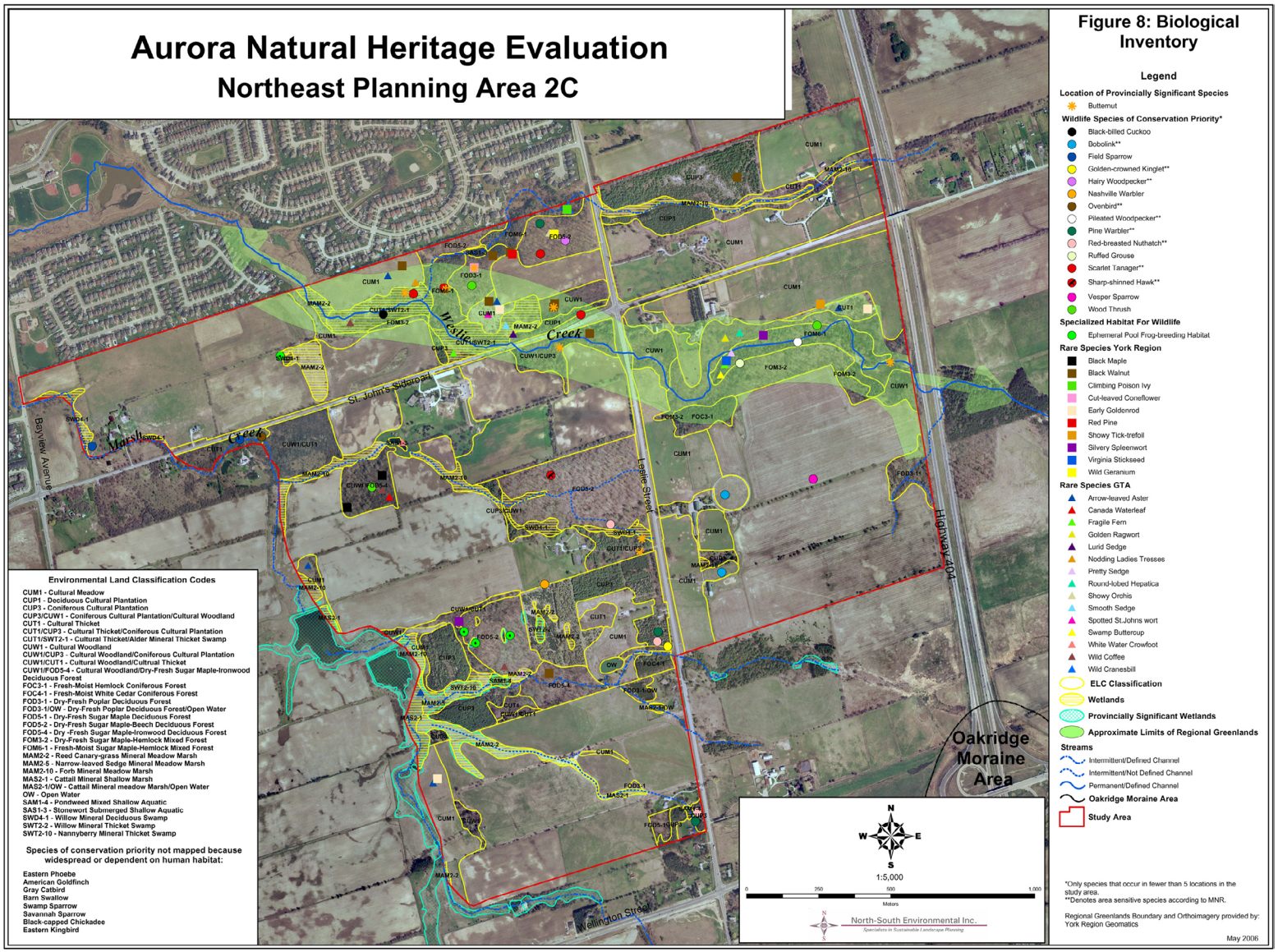

fig A.08 natural heritage study: biological inventory

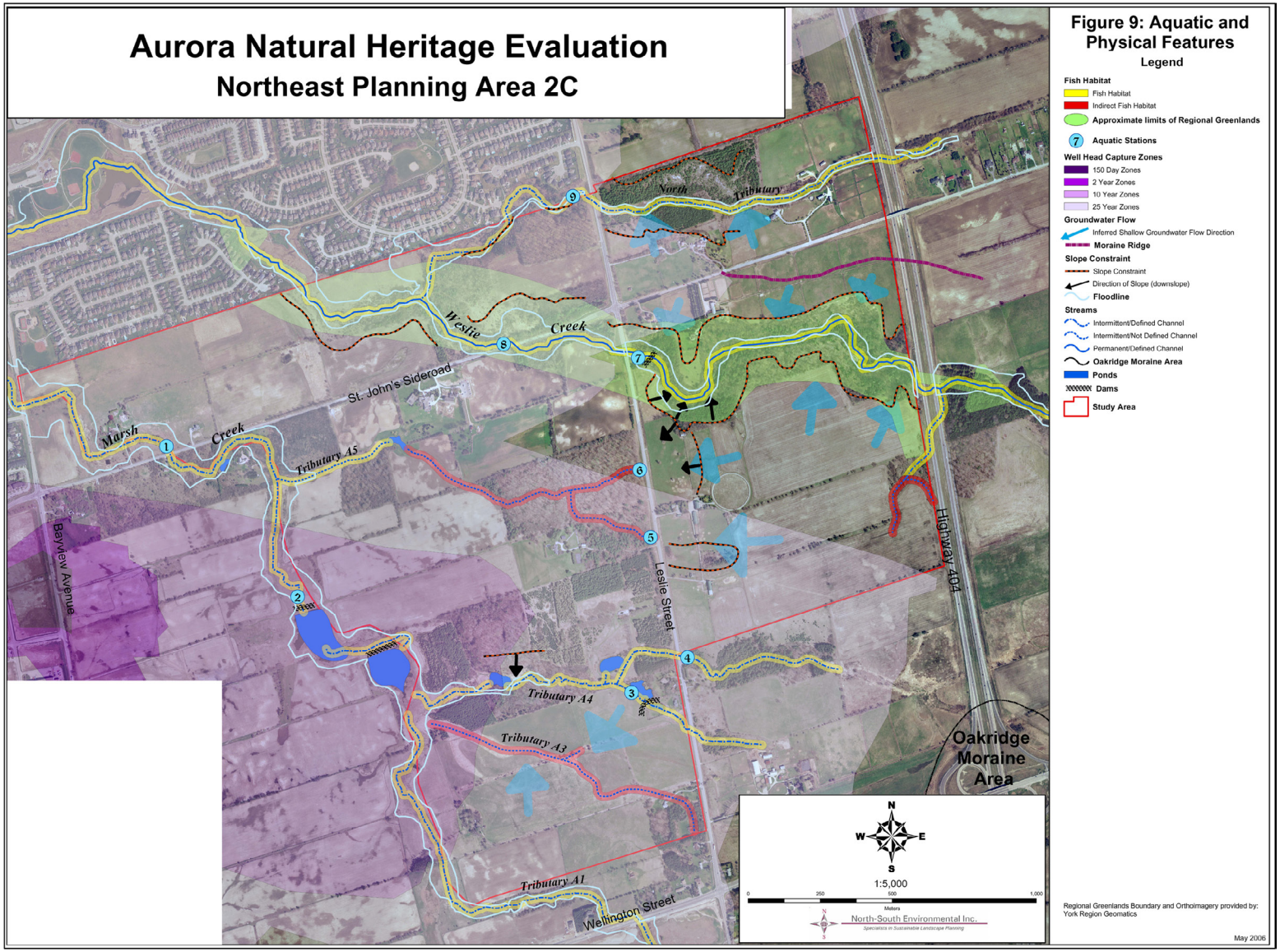

fig A.09 natural heritage study: aquatic and physical features

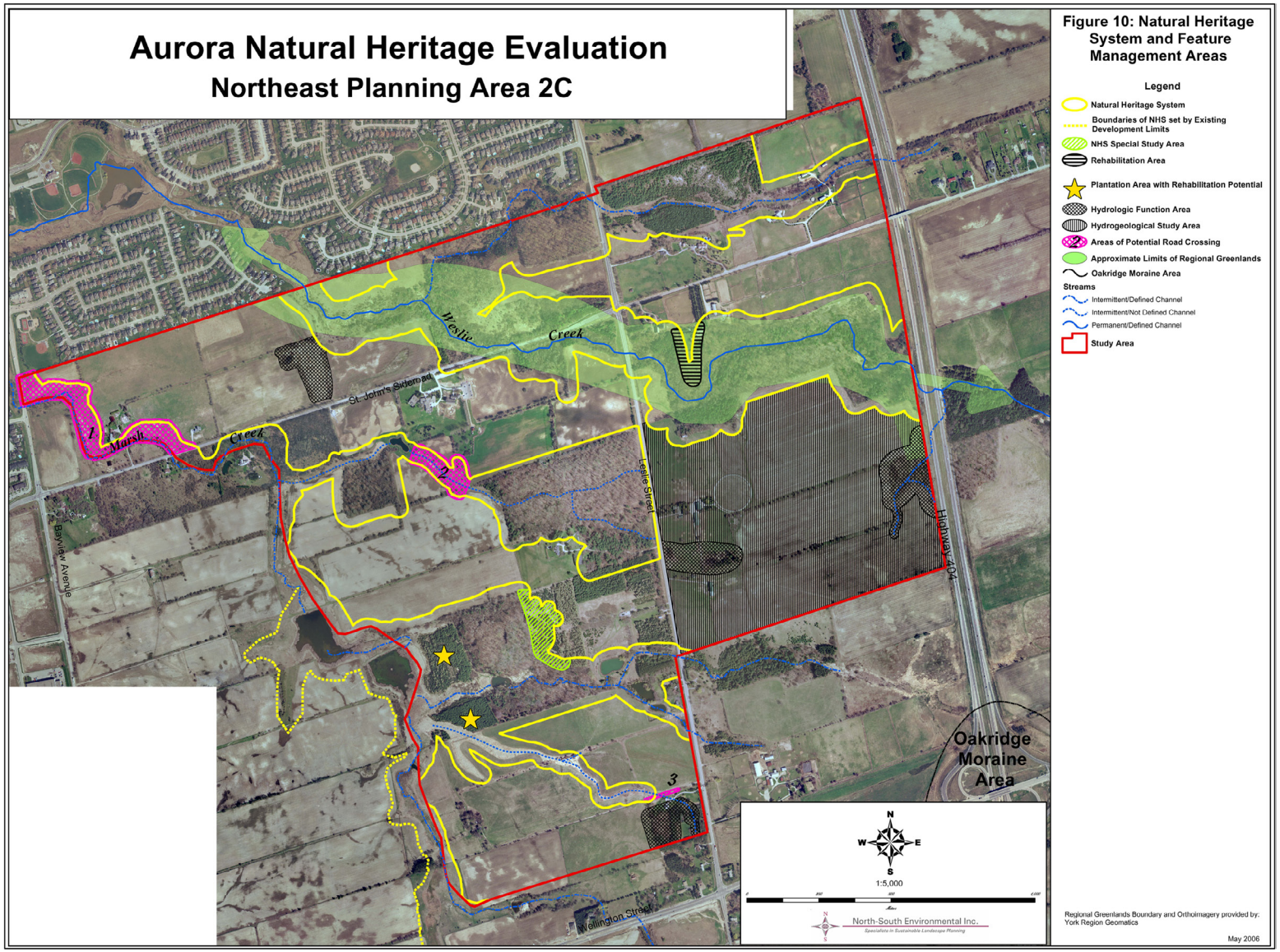

fig A.10 natural heritage study: natural heritage system and feature management areas

fig A.11 aurora 2C secondary plan: land use

"The vision for the 2C Secondary Plan Area is to create a complete community that protects the environment and includes well-designed residential neighbourhoods and a business park. The 2C community is expected to be leading edge in implementing green building technologies, and is to be developed at densities and in a pattern that is compact and transit supportive. The community is to be beautiful and safe, and will encourage an active, healthy lifestyle through highly interconnected greenlands and trails systems."[6]

6 *2C Secondary Plan Area - Draft 1.* Town of Aurora, July 9, 2010, p.3.

a1.2 the aurora 2C secondary plan area - first draft

The purpose of the first draft of the 2C Secondary Plan is to "provide a detailed land use plan and policies for the regulation of land use and development"[7] for the 2C lands in Aurora. The plan proposes a community of 8,000 residents, with between 5,200 and 6,400 employment opportunities that will be established over the next 20 years.[8] The plan is based on a list of guiding principles that are centered around the goals of economic feasibility, public health and safety, and environmental protection. The key aspects of the plan, which differ from conventional suburban secondary plans, include the proposal for an extensive Greenlands System, provisions for transit-supportive densities, emphasis of the pedestrian and public realms, and the incorporation of environmentally sustainable design initiatives.

The 2C Secondary Plan includes a detailed plan for land use designation and policy. One of the fundamental provisions for land use involves the delineation of the Greenlands System. This Greenlands System is based on the proposed Natural Heritage System that is derived from the Natural Heritage Study. It is an interconnected system of protected natural areas, public parks, stormwater management areas, and recreational trails. The plan also designates land use zones for low, medium, and higher density residential, as well as mixed-use zones, places of worship, and elementary schools. These zones are primarily located to the west of Leslie Street. The plan accounts for the distribution of various densities and housing types that will be available to residents with a range of incomes. Finally, it plans for a large business park to the east of Leslie Street, composed of three levels of employment densities. The business park

7 *2C Secondary Plan Area - Draft 1.* Town of Aurora, July 9, 2010, p.1.

8 ibid.

fig A.12 aurora 2C secondary plan: greenlands and trails

takes advantage of its proximity to the 404 highway, and will increase the ratio of residential to employment lands from 87.9% : 12.1% to a level that is closer York Region's average ratio of 81.7% : 18.3%.[9]

In addition to land use policy, the plan presents urban design and amenity policies that conform to the principles of economic, social, and environmental health. These policies include design guidelines and provisions that focus on the design of the public realm, the design of the private sector, and environmental initiatives for the community, as well as policies for accessibility and public art. The provisions for public space address the character of roads and lanes, guidelines for views and focal points, and the relationship between buildings, roads, and open space. They focus on enhancing the quality of the pedestrian realm by providing well-designed streetscapes and visual connections to the greenlands system. Policies for the private sector provide guidelines for the development of building lots, buildings, and the pedestrian environment. These policies conform to the notion of prioritizing the pedestrian realm over the automobile realm. Guidelines for "building a greener community" are also included in the plan. They include policies for green building and design, alternative and renewable energy, waste management, soil pollution and erosion mitigation, and noise and air pollution mitigation.[10] Accessibility policies ensure that the community's built environment is accessible to all residents and visitors.[11] Public art policies are also included in the plan which encourage the enhancement of the public realm.

9 *Appendix 1: Terms of Reference, Northeast Aurora Secondary Plan "2C Planning Area"*. Town of Aurora, April 7, 2009, p.11.

10 *2C Secondary Plan Area - Draft 1*. Town of Aurora, July 9, 2010, p.353-58.

11 ibid, p.58.

fig A.13 aurora 2C secondary plan: road network

Another section of the plan focuses on the conservation of cultural heritage resources and archaeology. It includes policies that focus on preserving and restoring buildings or sites of historic, archaeological, architectural, or cultural significance.

Provisions for sustainable infrastructure is a key component of the 2C Secondary Plan. This includes road and networks, public transportation systems, and sewer, water, and stormwater utilities. Some of the objectives include: the promotion of alternate modes of transportation, such as walking, cycling, and transit to reduce automobile dependency; the integration of an efficient transit system; and the development of effective and sustainable stormwater management facilities which also serve as public amenity spaces.[12] The final section of the plan provides guidelines for the interpretation and implementation of the plan, including provisions for site plan control, by-laws, land securement, and phasing.

The 2C Secondary Plan is a progressive plan that works in accordance with many of the local, regional, and provincial policies that prioritize ecological health and sustainable urban design. The principles, objectives, and policies in the plan improve upon conventional suburban planning. The plan demonstrates an understanding of the environmental, social, and economic value of maintaining natural heritage features, and how these features can be integrated into the built realm.

12 ibid, p.67.

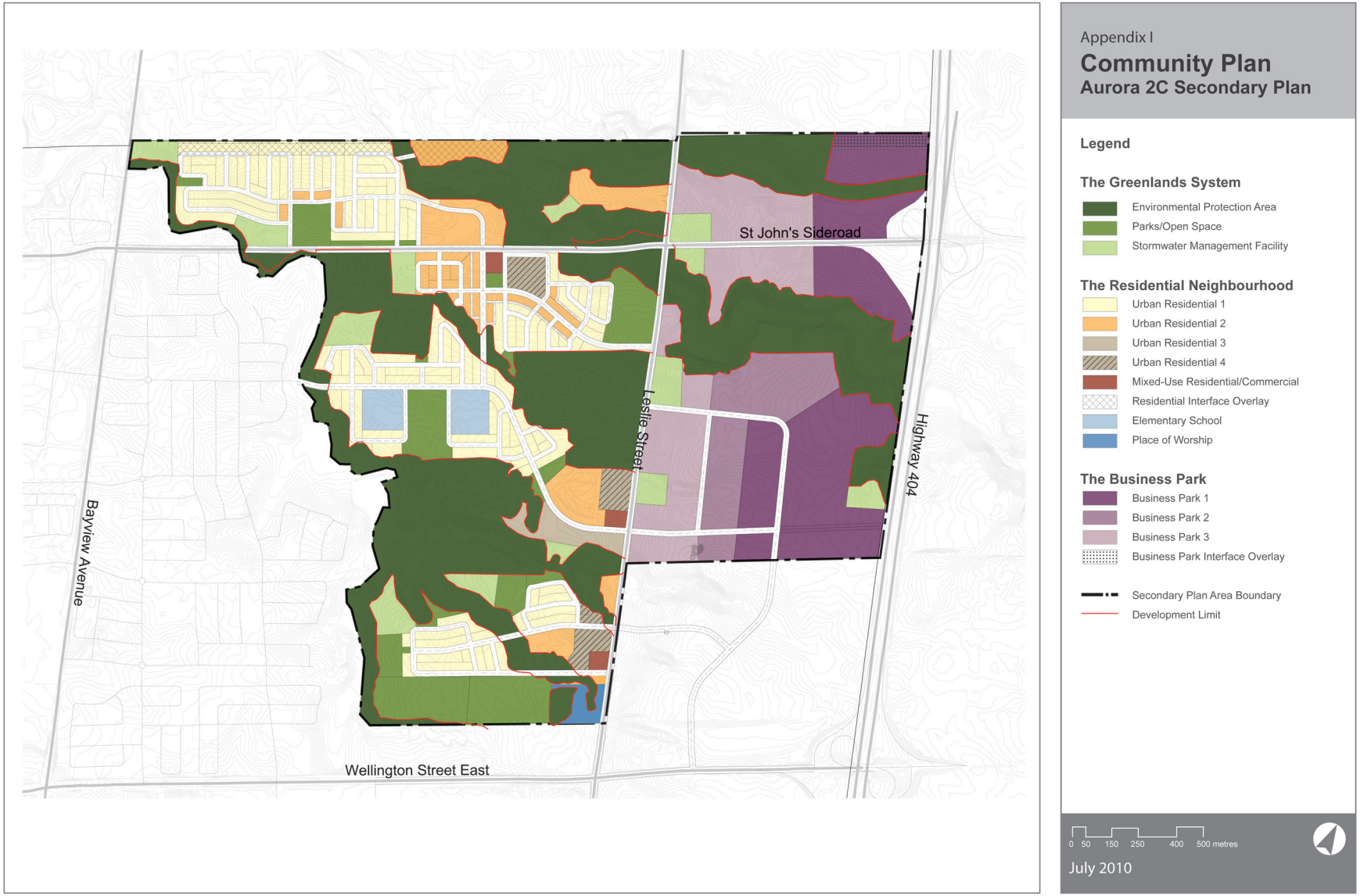

fig A.14 aurora 2C secondary plan: community plan

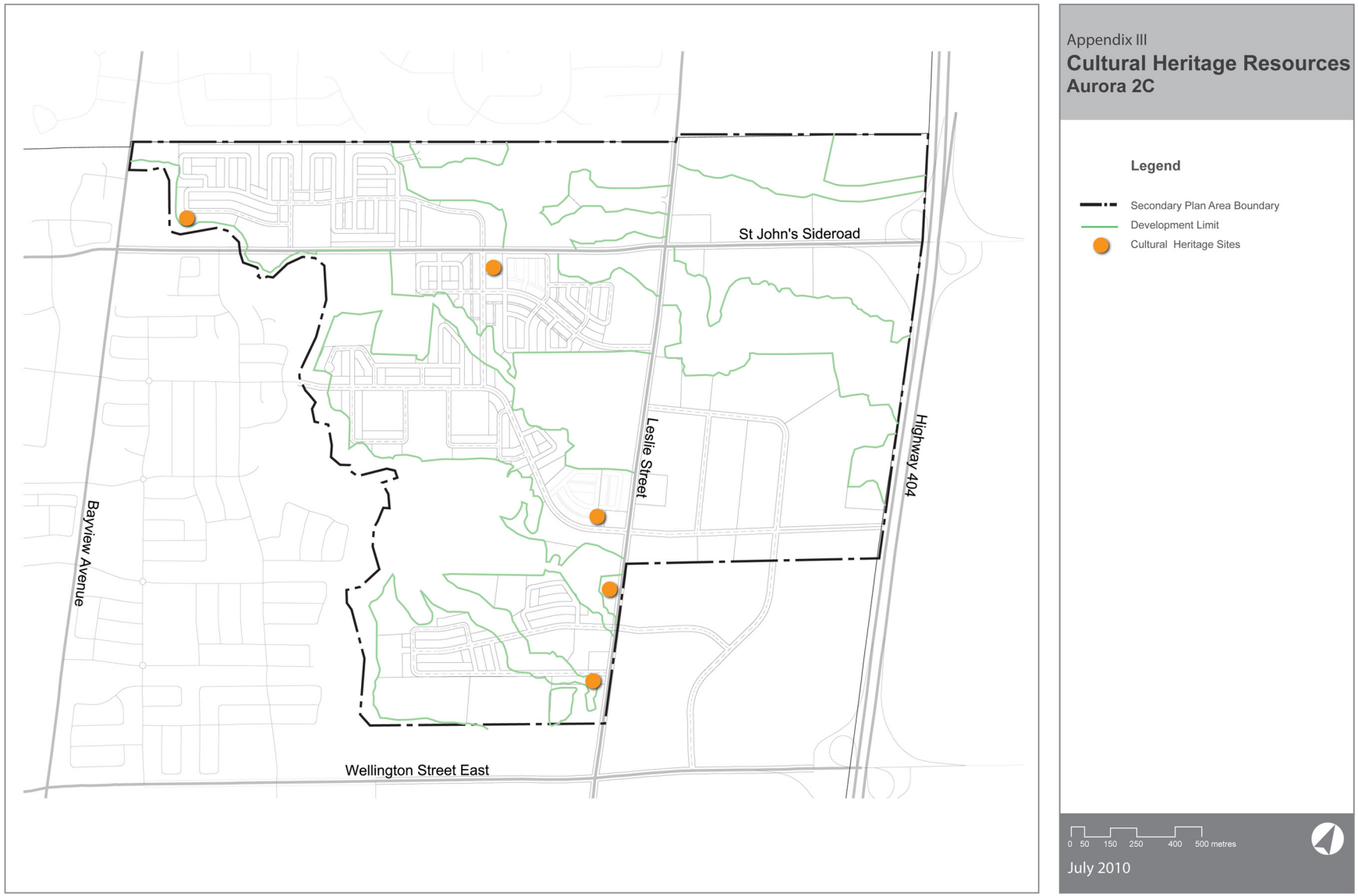

fig A.15 aurora 2C secondary plan: cultural heritage resources

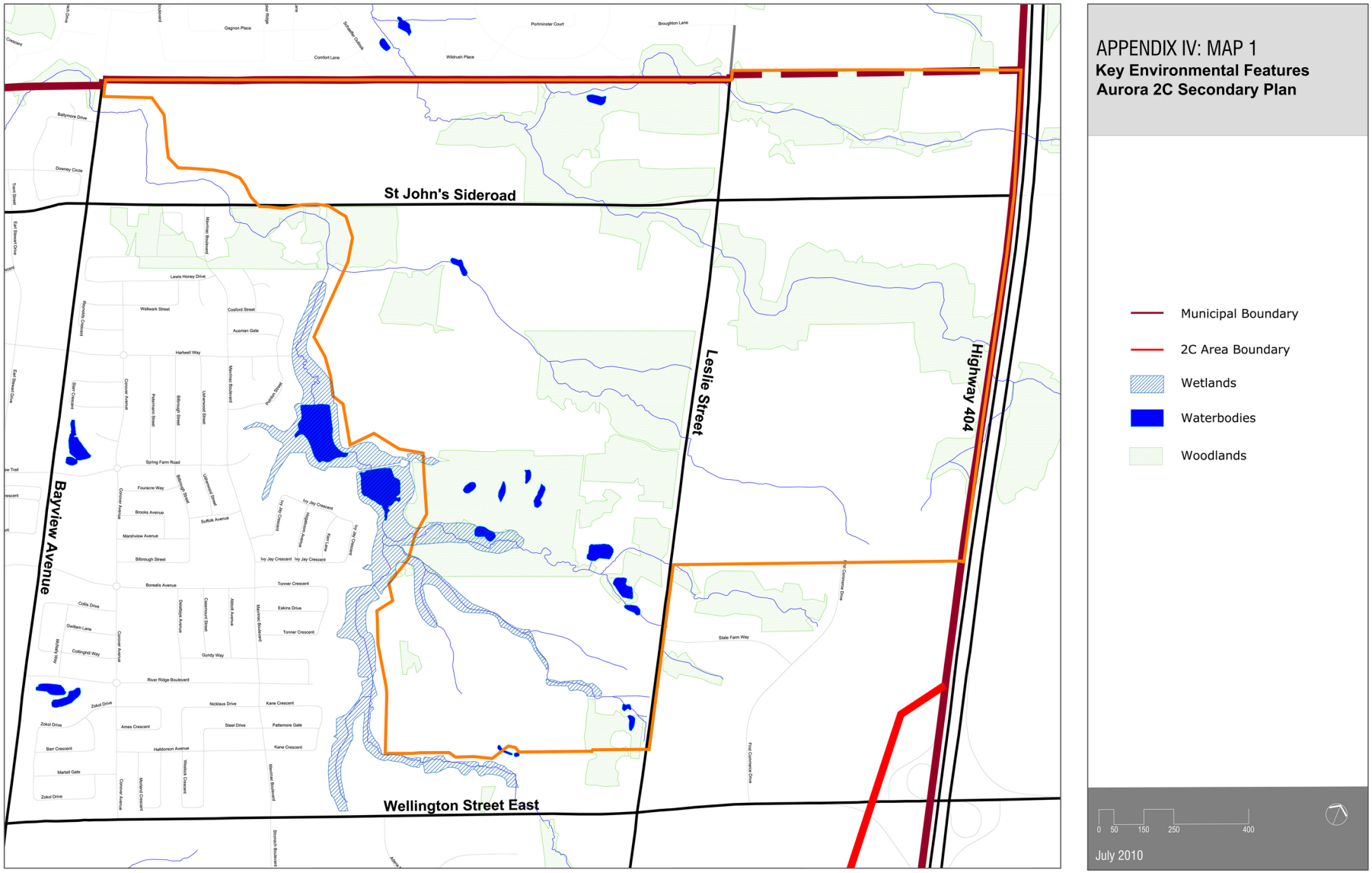

fig A.16 aurora 2C secondary plan: key environmental features

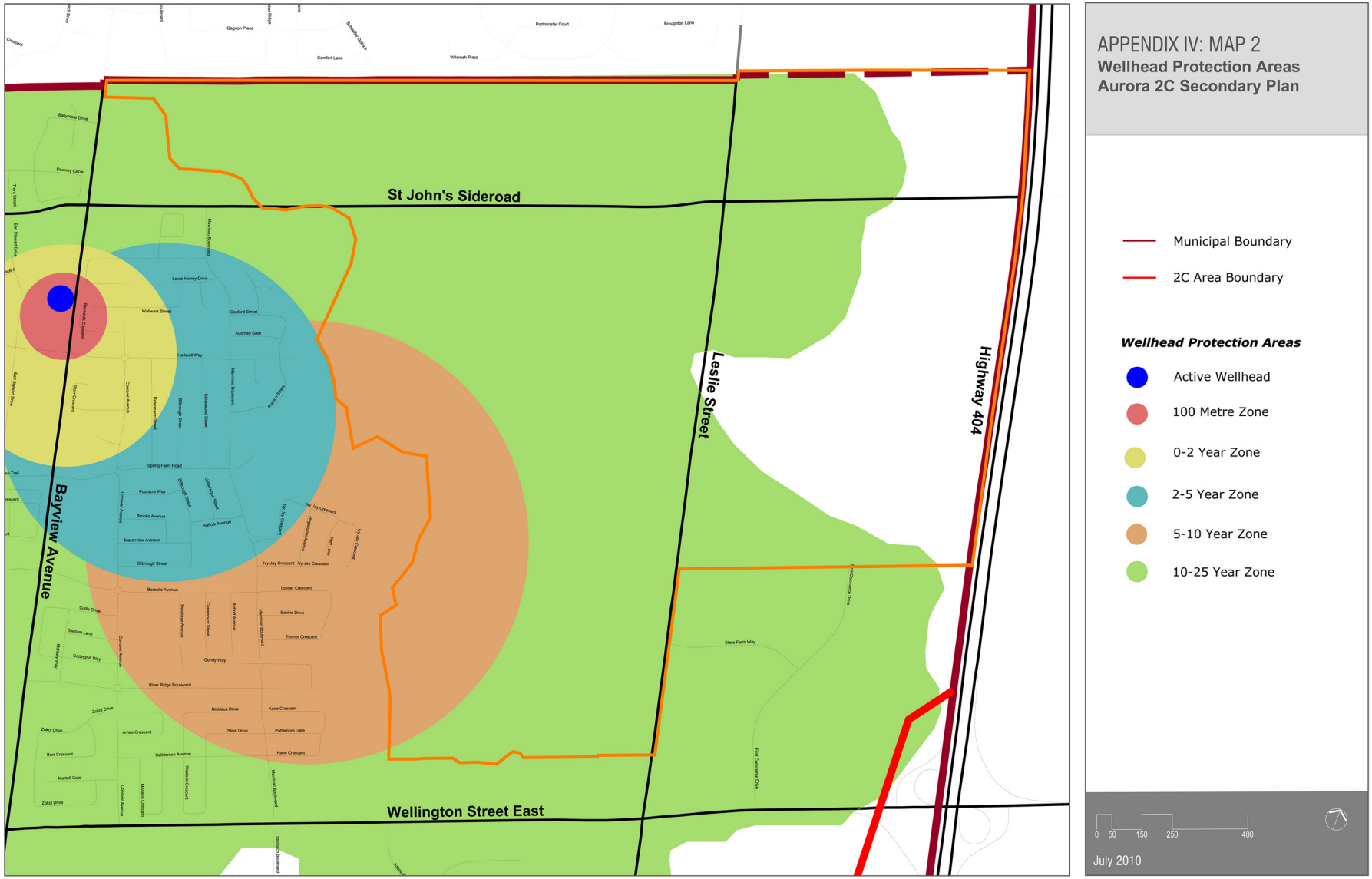

fig A.17 aurora 2C secondary plan: wellhead protection areas