



Leveraging the Benefits of Green Space for Environmental and Public Health Benefits

A Casebook of Ontario Initiatives

FEBRUARY 2017

Karen Morrison, Ph.D.
YORK UNIVERSITY



Acknowledgements

The development of this Ontario casebook has been a collaborative effort involving reviewers from across the Province. The author would like to particularly thank Ecohealth Ontario Research Group members, particularly Suzanne Barrett (EcoHealth Ontario), Asim Qasim (York Region Public Health), Mike Puddister (Credit Valley Conservation), Marina Whelan (Simcoe Muskoka District Health Unit) and Dr. Donald Cole (Dalla Lana School of Public Health, University of Toronto) for their contribution to the overall text. The author is also extremely grateful to the contributors to, and reviewers of, the individual cases: Eva Schacherl and Matthew Bromwich (Children's Hospital for Eastern Ontario), Ronald

Macfarlane, Sheila Boudreau and Susanne Burkhardt (City of Toronto), Louise Aubin (Peel Region), Paul Ronan and Stefan Szczepanski (Ontario Parks and Recreation Association), Tom Bowers and Kathy Macpherson (Friends of the Greenbelt Foundation), Rob Keen and Al Corlett (Forests Ontario), Jo-Anne Rzadki and Jane Lewington (Conservation Ontario) and Cam Collyer (Evergreen Foundation) for improving the quality of the casebook based on their expertise and experience. Ecohealth Ontario is grateful to the Ontario Trillium Foundation, Forests Ontario and our Steering Committee members for their generous support for our work.

Executive Summary

Green spaces are areas that are predominantly covered by vegetation. Found in cities and the countryside, green spaces typically include natural areas, parks, community gardens, playgrounds, street trees, yards, agricultural areas, wetlands, forests and nature reserves. In addition to providing a wide variety of recreational opportunities and biodiversity, green spaces also deliver important ecological functions such as cooling, improving air and water quality, storing water during droughts, recharging groundwater and many more.

We are increasingly recognizing the important role that green spaces play in improving and protecting the environment and our own well-being. There is a growing library of literature linking biodiversity to human health and revealing how ecological features and forces impact us and shape our lives. Many studies highlight the important functions that green spaces serve in our communities, as well as the need for increased research, capacity building and political attention to the potential co-benefits that can be realized by thinking about green spaces as settings for health and well-being at various scales.

The consequences of climate change are creating a more urgent need for new frameworks and perspectives to give shape and structure to innovative strategies and opportunities that not only support, but also improve our quality of life. Linking green space planning and management explicitly to the protection and enhancement of human health and wellbeing has the potential to help us reduce or mitigate the wide ranging and escalating impacts of climate change to the environment and our own well-being.

Doing nothing is not an option any more. The potentially catastrophic effects of climate change and biodiversity loss on green spaces and health creates a preoccupation with livelihoods and the resilience and adaptability of our social-ecological systems. As well, all levels of government and watershed management agencies will continue to face the escalating costs of climate change impacts to traditional infrastructure, our economy and health care systems.

EcoHealth Ontario recognizes the urgency of the problem and the full range of potential benefits that green spaces can provide. At whatever scale, green spaces help to address these impacts and improve the physical and mental well-being of people. What we need is a more fulsome accounting of the benefits of protecting and enhancing of green spaces in the years to come.

Ecohealth Ontario is made up of a collection of *practical* practitioners, planners, academics, researchers, educators and many more, committed to sharing information, developing the science, exploring the research and kick starting discussion on the important connections between the environment and our own well-being.

This report presents a casebook of Ontario-based initiatives that explore practices and policies that are helping to protect and/or enhance green spaces. It looks at street trees, hospital gardens, school greening, unique hiking initiative, benefits of trails, urban forests, the Greenbelt, watershed management and regional deforestation. While these case studies originate in Ontario, they are not unique to this region. They can be implemented anywhere to address the same conditions which occur worldwide.

The goal of this casebook is twofold: to figure out how to better assess the benefits of green spaces and to encourage us all to connect public health and well-being with our natural environment more effectively.

This collection of ten case examples is designed as a tool to support educational programs, including high school and university seminars and short workshops for professionals. It features cases from a variety of scales and across a range of sectors including planning, environmental science, public health, parks and recreation, law and policy. The case studies are short and user-friendly.

Health is a powerful frame. If we want to support broader changes to socio-ecological systems - which we need to do in the face of serious global threats - then we need to shift the frame of our discourse and connect nature with people much more closely.

Contents

| | |
|---|-----------|
| Acknowledgements | i |
| Executive Summary | ii |
| Introduction | 1 |
| Health and Well-Being | 2 |
| Social Determinants of Health | 2 |
| Ecological Determinants of Health | 3 |
| Social-Ecological Health | 4 |
| Casebook | 5 |
| A) Street Trees | 8 |
| B) Hospital Gardens | 12 |
| C) School Grounds | 16 |
| D) Mood Walks | 20 |
| E) Urban Parks | 23 |
| F) Greenways | 28 |
| G) Urban Forests | 33 |
| H) Greenbelts | 37 |
| I) Watershed Management | 42 |
| J) Regional Forest Restoration | 46 |
| Ecohealth Ontario | 49 |
| References | 50 |

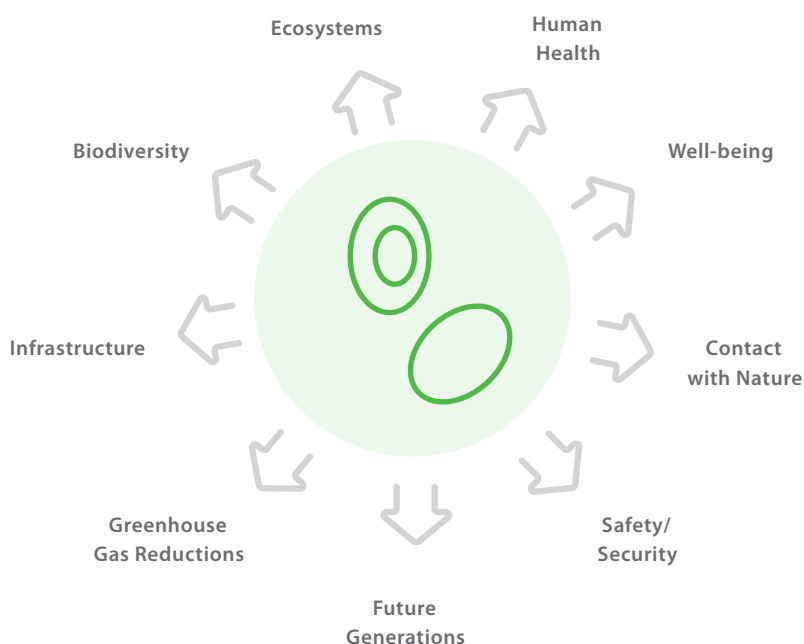
Introduction

Green spaces are areas that are predominantly covered by vegetation. In urban and suburban spaces they include: natural areas, parks, community gardens, playgrounds, street trees and front and back yards. In rural areas, green spaces include agricultural areas, wetlands, forests and nature reserves. In addition, the term blue space is increasingly being used to frame discussions of natural water features (streams, rivers, lakes, etc.). The important role that green and blue space plays in addressing a variety of social and ecological issues in our communities is increasingly recognized (James et al., 2015; Rugel, 2015). Ecohealth Ontario's partners recently released two important studies that reinforce the links between green spaces and health in general (Toronto Public Health, 2015) and the urban heat island effect in particular (Zupancic et al., 2015). There is also an extensive literature linking biodiversity to human health and well-being that draws attention to the less obvious ecological forces that shape our lives (WHO, 2015). These studies highlight the important functions that green spaces serve in our communities, as well as the need for increased research, capacity building and political attention to the potential co-benefits that can be realized by thinking about green spaces as settings for health and well-being at multiple spatial and temporal scales (see also Parkes and Horwitz, 2009 and Morrison et al., 2012).

The multi-scale dimension of green spaces is important as it demonstrates not only the different aspects of human health and well-being that are shaped by green spaces at different scales, but also reminds us of the need to think creatively about issues of connectivity and equity when we consider where and how these places exist and who is (and should be) able to access them. Indeed, realizing the health benefits of green spaces in a changing world was the topic of a 2015 Ecohealth Ontario workshop. The workshop identified a number of areas where work is needed and recommended that Ecohealth Ontario "compile examples of a suite of current activities that seek to enhance the links between ecosystems and public health in order to better communicate the range of activities and themes that are available to the ecohealth community to affect change and to highlight the work already underway" (p. 14). This document is a response to that call.

FIGURE 1

Potential co-benefits of designing green spaces as settings for health and well-being



The literature on green spaces highlights the importance of being explicit about the potential co-benefits of designing such spaces as settings for health and well-being (Figure 1). While the benefits are enormous and multi-faceted, they will only be fully realized if they are accounted for. In the past, only readily quantifiable benefits made it into cost-accounting systems. But this is changing, and structuring our perception of the myriad of potential co-benefits that can be leveraged from investments in green spaces – particularly those that positively influence human health and well-being – is one way to begin to change the dialogue about the role and importance of green space for Ontario communities and to inspire additional investment in, and support for, these essential programs.

HEALTH AND WELL-BEING

Health can be defined in a number of ways. The World Health Organization (1948) defines health as “a *state* of complete physical, mental and social well-being and not merely the absence of disease or infirmity”. This definition focuses on the state of a person’s health and well-being at a given time. The WHO’s definition was refined by WHO Europe in the 1978 Alma Ata Declaration, which emphasized instead the need to build *processes and capacities* to support individual and collective health. Health was thus defined as “the extent to which an individual or group is able, on the one hand, to realize aspirations and satisfy needs; and, on the other hand, to change or cope with the environment”. Both definitions of health can be applied to the examples in this casebook. Several of the cases emphasize physical, mental and social well-being as per the WHO’s 1946 definition of health, while others place emphasis on the social and environmental determinants of health highlighted in the 1978 Alma Ata Declaration definition. Physical, mental and social well-being are themselves only three of several possible categories of health and well-being (Table 1). They are utilized in this casebook for ease of reading. Other categories (e.g. spiritual well-being) are also relevant to the cases in this volume.

| Category | Definition |
|------------------|---|
| Physical | Proper physiological functioning of body parts. Linked to physical activity, hygiene, diet and nutrition, sleep, etc. |
| Mental | Psychological well-being. Linked to ability to enjoy a balanced life and be resilient. |
| Social | How we interact with people in the areas around us. Linked to socialization, social capital and social support systems. |
| Spiritual | Sense of connection or empowerment from a connection with a higher power, all life, nature, the universe ... |

Table 1
Brief Definitions of
Common Categories
of Human Health
and Well-being

SOCIAL DETERMINANTS OF HEALTH

Several of the cases refer to the social and/or ecological determinants of health. The social determinants of health are:

- the conditions in which people are born, grow up, live, work and age. These conditions influence a person’s opportunity to be healthy, his/her risk of illness, and life expectancy. Social inequalities in health – the unfair and avoidable differences in health status across groups in society – are those that result from the uneven distribution of social determinants. [They] are amenable to change through policy and governance interventions (WHO Europe, 2016).

These conditions were the subject of a large international synthesis by the Commission on the Social Determinants of Health (CSDH) that focused specifically on socially determined health inequalities (CSDH, 2008). The social determinants focus attention on, among other factors, poverty, education, social exclusion, poor housing and poor health systems as critical drivers of ill health. These internationally defined determinants are slightly different from those defined by the Public Health Agency of Canada, primarily due to differences between domestic conditions and priorities and those of the wider international community. The Public Health Agency of Canada (2013) considers the following twelve social determinants of health to be particularly relevant to shaping the health status of Canadians:

- Income and Social Status
- Social Support Networks
- Education and Literacy
- Employment/Working Conditions
- Social Environments
- Physical Environment
- Personal Health and Practices and Coping Skills
- Healthy Child Development
- Biology and Genetic Endowment
- Health Services
- Gender
- Culture

Additional information about the Canadian social determinants of health is widely available (Mikkonen and Raphael, 2010; Public Health Agency of Canada, 2016).

ECOLOGICAL DETERMINANTS OF HEALTH

The ecological determinants of health are less widely discussed, but as with the social determinants they focus on the “causes of the causes” of population health inequity. The language of ‘upstream’ and ‘downstream’ determinants of health has gained some traction as a way of characterizing the determinants to the public, although it is rarely linked to ecological settings (Gehlert et al., 2008; National Collaborating Centre for the Determinants of Health, 2014; Bharmal et al., 2015 – an exception is Maller et al., 2006). This language is very appropriate to ecohealth, and to thinking about the ecological determinants of health as ‘upstream’, difficult to isolate, factors influencing health.

The ecological determinants are multi-faceted and are sometimes categorized as proximal and distal: the proximal determinants are those where the exposures are closely related in space and time to the ill effects they produce. Examples include:

- local air pollutants (chemical and particulate), and
- biological agents, such as zoonoses¹ (e.g. bacteria, parasites, viruses, fungi).

The latter are a particular focus of the One Health movement.

Distal determinants are exposures far apart in time and place from the witnessed ill-effects and encompass most forms of environmental degradation. They include, for example:

- transboundary contamination (mercury, persistent organic pollutants),
- ozone depletion,
- greenhouse gas emissions,
- biodiversity loss,
- soil loss and degradation,
- pollution of freshwater resources and oceans (e.g. plastics, garbage, nutrients), etc.

Several cases provide some baseline information about ecological systems in order to create a more balanced understanding of the interaction between ecological structure and function and human health and well-being. In order to understand both, and to leverage their potential co-benefits (and minimize maladaptive responses) we need to foster increased inter-sectoral and interdisciplinary dialogue and cooperation that values the knowledge and experience of many different contributors. This grounding of public health in ecology and environmental science is a particular strength of ecohealth.

¹ A zoonosis is a disease that can be transmitted to humans from animals

SOCIAL-ECOLOGICAL HEALTH

A full appreciation of the value of green space for health requires a worldview or mindset that sees human communities as one part of a larger social-ecological system that extends from where we “live, work, and play”² to encompass the entire biosphere. As indicated in Figure 2, this worldview clearly links human health and well-being to larger regional and global processes, such as climate change and biodiversity loss. It requires multi-level and multi-sectoral action for health promotion in its fullest sense. This view of health is fundamental to tackling the critical issues of our time, particularly climate change.

McDermott

of the World Health Organization (WHO) refers to greenhouse gas emission reductions as ‘zero-level public health prevention’ (i.e. public health prevention measures that underpin the existing system of primary, secondary and tertiary care) that is ultimately fundamental to support our health care systems. Tredinnick (2003) expresses similar ideas as follows:

I sense that human beings live best when they remember that they live inside a natural order, that the land includes us and all our schemes and creations, and that when we begin to imagine our lines of kinship and our bonds of responsibility extending out, beyond ourselves and our human families and our nations to the many forms of life and intelligence that comprise our home place, then it is that we will learn how to behave well, not only at home, not only in human society, but as inhabitants of the earth. (p. 27)

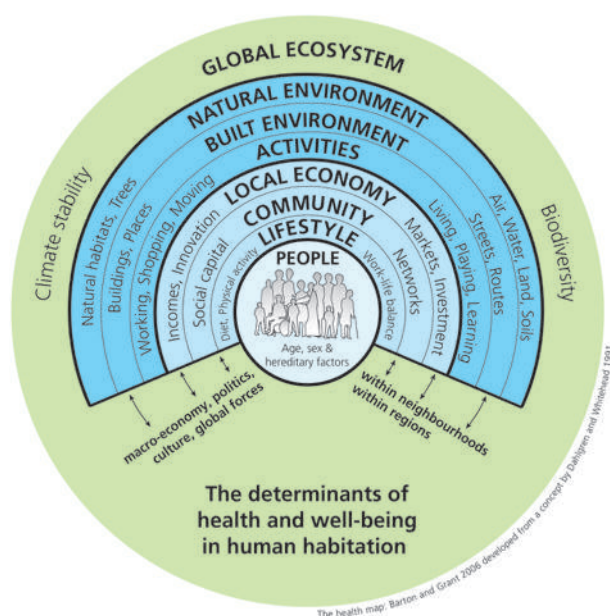


FIGURE 2

A Health Map for the local human habitat: Determinants of health and well-being in our neighbourhoods

(Source: Barton and Grant, 2006; developed from a concept by Dahlgren and Whitehead, 1991)

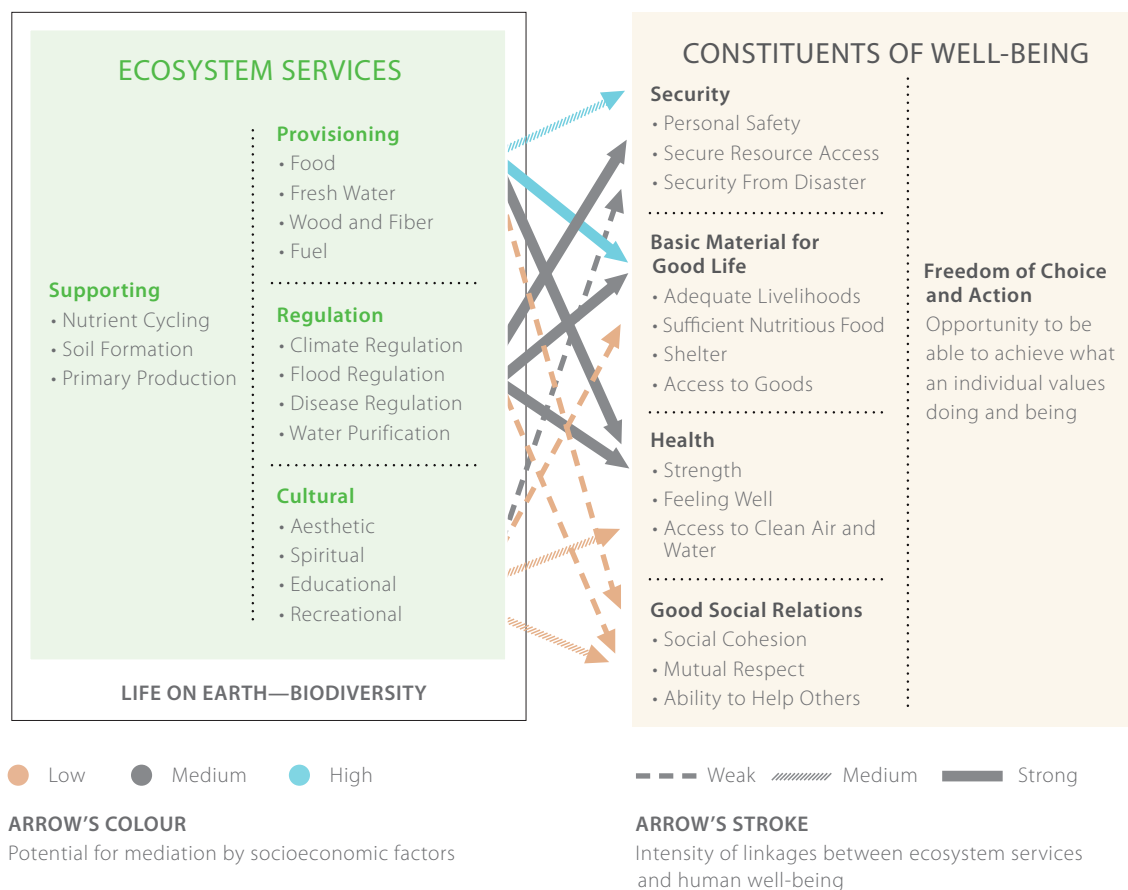
² This phrase is from the Ottawa Charter for Health Promotion and is widely used to support a healthy settings approach to health promotion. This casebook extends the concept to natural settings, such as watersheds.

Two landmark initiatives – the Health Synthesis of the Millennium Ecosystem Assessment (MEA, 2005) and the various reports of the Intergovernmental Panel on Climate Change (IPCC) – have pulled together the latest thinking around global change, ecological services and their impact on human health and well-being. The MEA, in particular, created a common reference point and language for many different sectors and disciplines interested in the connections between ecological change and human health (Figure 3). The IPCC (2014) reports are unambiguous when stating the concerns:

FIGURE 3

Millennium Ecosystem Assessment Framework linking Ecosystem Services to Well-Being

(MEA, 2006)



Climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development. Increasing magnitudes of warming increase the likelihood of severe, pervasive and irreversible impacts for people, species and ecosystems. Continued high emissions would lead to mostly negative impacts for biodiversity, ecosystem services and economic development and amplify risks for livelihoods and for food and human security (p. 64).

These, and many other initiatives, have inspired new efforts to link concerns about environmental change at the local, regional, domestic and international scales to the health of Canadians. For example, the Canadian Public Health Association (2015) recently released a discussion paper on addressing the ecological determinants of health as part of a wider effort to push the public health community forward in this area. Thinking about the ecological determinants of health and their influence on human health and well-being is a critical aspect of this casebook.

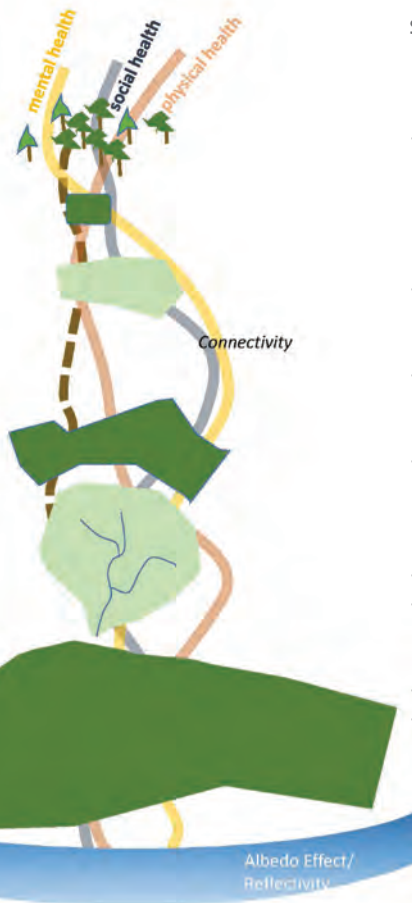
Casebook

Health is a powerful frame. The goal of this casebook is twofold: to empower our community to discuss with confidence the contributions that the initiatives outlined here can make to our collective physical, social, mental, spiritual, emotional and cultural health, and to inspire us all to incorporate the language and science of public health and wellbeing into our discussions about these valuable resources. This shift in how we frame our public discourse is vital to support broader investments in social-ecological systems in the face of serious global threats, such as biodiversity loss and climate change. Through these cases, we seek to initiate conversation and debate around what it means to be healthy in the 21st Century, and the roles that ecological systems play in supporting population health in the province.

This collection of case examples is designed as a tool to support educational programs, including high school and university seminars and short workshops for professionals. It features cases from a variety of spatial scales (Figure 4). It is relevant to discussions within and among a wide range of sectors, including planning, environmental science and studies, public health, parks and recreation, and law and policy. The casebook is based on the following definition of a public health case:

SPATIAL SCALE OF GREEN SPACE

| | |
|------------------------------------|-----|
| Street Trees | 1 |
| School Ground/ Community Garden | 2 3 |
| Urban Park | 4 5 |
| Regional Trail | 6 |
| Protected Area | 7 8 |
| Watershed | 9 |
| Large Biome (e.g. forest) | 10 |



SELECTED BENEFITS

- Shade
- Air Quality
- Aesthetics
- Social Capital
- Recreation
- Active
- Transportation
- Food Security
- Flood Attenuation
- Air Quality
- Water and Soil Management
- Flood Protection
- Biodiversity
- Carbon Sink
- Soil and Water Conservation

FIGURE 4

Multi-Scale Connectivity of Green Spaces and Benefits for Human Health and Well-being

A real-world situation that promotes independent thinking as well as group discussion which ultimately allows the learner an opportunity to explore complex public health issues and apply theory to practice by analysing, integrating and synthesizing knowledge (Speechley and Terry, 2015, p.5).

Our intent is to encourage the analysis, integration and synthesis of information from across a wide array of sectors and disciplines. The casebook explicitly seeks to link the emerging body of research and theory to local actions. To do this, specific thematic lenses (Table 2, below) are applied to each case in order to provide the reader with an introduction to broader themes currently being investigated in the green space and health literature. The cases do not begin to cover all of the relevant potential programs and activities taking place in the province. They were selected based on the following criteria:

- Illustrate programs and activities that link green spaces with concerns about human health and well-being;
- Include a range of green space types;
- Draw on a range of spatial and temporal scales;
- Are easily communicated, and
- Have the potential to be replicated in other jurisdictions.

The cases are short (no more than 4 pages) and include questions for discussion and debate. Links and key references are provided to encourage additional exploration of the case. The intent of the casebook is not to provide a comprehensive review of each case and the surrounding literature of the links between health and green spaces. Rather it is designed to focus attention on a particular set of environment-health relationships while inspiring additional interest and research on the topic of green spaces and their connection to human health and well-being at a variety of spatial and temporal scales.

The cases focus on programs and activities that, individually and collectively, frame our interest in green spaces as settings for public health and well-being. Many of the programs are not unique to Ontario, but build on the work of others. The focus on Ontario is meant to inspire and engage stakeholders across the province, and in other provinces, to think broadly and creatively about how green spaces can be best leveraged to provide a wide-range of co-benefits that support the health and well-being of current and future generations of Canadians. The potentially extreme consequences of climate change require new frameworks and perspectives to give shape and structure to innovative new strategies and opportunities that not only support but also improve our quality of life in the decades to come. Linking green space planning and management explicitly to the protection and enhancement of human health and wellbeing has the potential to help us move the bar forward in these areas.

In addition to a spatial focus, the cases also provide some insight into the way in which our understanding of the relationship between green space and health has evolved over time. The cases range from the mid-1800s to the present, and demonstrate how our concerns have evolved from regional socio-economic and livelihood concerns, to specific concerns over physical health, including mortality and morbidity, to the influence of green space on mental health, includes socialization and creativity. More recently, the potentially catastrophic effects of climate change and biodiversity loss on green spaces and health have led us back to a preoccupation with livelihoods and the resilience and adaptability of our social-ecological systems. As many of our green space planning and development practices have shifted from having a single focus to supporting multiple objectives, so too has our understanding of the impact of green space on health expanded to embrace a broad spectrum of health concerns and determinants of health. These powerful transitions have the potential to lead to a more fulsome accounting of the benefits of protecting and enhancing green spaces in the years to come.

TABLE 2
Brief Summary
of Casebook
Examples

| Example | Key Themes |
|---|--|
| 1. Street Trees: A 'Canary in the Coal Mine' for Urban Climate Change Adaptation in Toronto | Multiple Co-Benefits |
| 2. Hospital Gardens: Drawing on nature for respite and recovery | Therapeutic value of exposure to nature |
| 3. School Grounds: Greening and System Change | Complexity, Gender, Creativity |
| 4. Mood Walks: A socio-ecological prescription for health? | Mental and social health benefits of walking in nature |
| 5. Urban Parks: Bringing Ecosystems back into Public Spaces | Urban ecology and healthy communities |
| 6. Greenways: The Lake Ontario Waterfront Trail: Green and Blue Spaces and Places | Greenway, Green and Blue Landscapes |
| 7. Urban Forests: Priority tree planting, social justice and the urban green space paradox | Values, Valuation, Social Justice, Social Cohesion |
| 8. Greenbelts: Connecting to place and the ecological determinants of health | Connection to Place, Determinants of Health |
| 9. Watershed Management: Confronting loss of life and property due to flooding | Flooding, Watershed Governance |
| 10. Regional Forest Restoration: Environmental Degradation, Unsustainable Livelihoods and Population Health in Southern Ontario | Deforestation, Livelihoods |

A. STREET TREES

A 'Canary in the Coal Mine' for Urban Climate Change Adaptation in Toronto

Summary

Urban street trees convey a number of significant environmental services to the communities of people, and of other species, who live among them. They have much to teach us about the challenges of climate change in urban ecosystems and the opportunities to adapt to it. Compared to other urban trees, street trees appear to be disproportionately valuable to the protection and maintenance of human health and well-being. Ultimately, the benefits of street trees will only be realized and the costs only reduced by a collective understanding of their value, good communication and coordinated planning and design, involving a wide range of stakeholders, as well as the general public. The City of Toronto has made significant investments in street trees, given they play an important role in protecting and enhancing human health and well-being, and in helping realize the City's climate change adaptation and mitigation goals.

Introduction/Background

Urban street trees convey a number of significant ecosystem services (see Box A-1) to the communities of people, and of other species, who live among them. They produce oxygen, clean the soil, attenuate noise, retain water, slow stormwater runoff, act as carbon sinks, clean the air, provide shade, cool the air, reduce the urban heat island effect, act as windbreaks, fight soil erosion, increase property values and sales, reduce water treatment costs, provide food, provide habitat, act as a refuge for migrating species. They also protect asphalt from the sun, extending its useful life and reducing maintenance and replacement costs, and help reduce energy costs through their contributions to heating and cooling the air. They beautify the urban environment and add to the connectivity of parks and the public realm. Street trees also provide a wide range of direct and indirect health benefits to people (e.g. spiritual, and improved psychological well-being). The sum total of these services positively impact both human health and well-being and community safety and resilience. The concept of a ‘working tree’ (trees intentionally established to achieve specific functions) is useful to help showcase the myriad of contributions that such trees make to our communities (USDA, 1996).

Box A-1. Ecosystem Services

Ecosystem services are the tangible and intangible goods and services provided by biotic and abiotic systems, including street trees. These services can be more, or less, valuable to supporting human health and well-being. Robust, vibrant ecosystems tend to provide more ecosystem services to human communities. Degraded and polluted ecosystems tend to provide us with fewer services, but support other species (such as toxic algae) very well. Ecosystem services are often categorized as: provisioning, regulating, habitat or supporting and cultural services. The term is used in a wide range of disciplines.

Street trees are in many ways, ‘canaries in the coal mine’ that have much to teach us about climate change impacts in urban ecosystems. In their review of street trees as an adaptation mechanism for climate change, the Clean Air Partnership (2012) found that they represent “an interesting paradox where street trees are both a mechanism for addressing climate impacts, and are themselves more vulnerable due to climate change” (p.1). As Toronto’s climate becomes hotter, with concurrent changes to precipitation patterns and an increased frequency of extreme weather events, the benefits that street trees provide in terms of shading, cooling and storm water uptake will become even more valuable (Johnston, 2004).

Roads or streets are taxing environments for trees. Barriers to healthy growth include poor soil quality and limited soil volumes, road de-icing salt, infrastructure replacement and air pollution. Extreme weather conditions (e.g. heat, drought, intense rainfall and winds, ice storms) also affect the health of street trees (Clean Air Partnership, 2012). The lives of street trees are finite, and proactive planning is required if our current streetscapes are to be maintained (see Figure A-1). Due to the difficult growing conditions they endure, street trees rarely live to maturity. This limited lifespan reduces the trees’ ability to provide their full spectrum of environmental benefits to society (Clean Air Partnership, 2012) and places them in the ‘meso’ level between annual plants and large mature urban trees, many of which were planted in the mid-1900s in very different conditions to modern cities. The slow growth and short life span of the average street tree increases the cost of maintaining the urban canopy and decreases the potential social and ecological benefits they provide. Nonetheless, this turnover also allows for new planting techniques and species to be planted to respond to emerging knowledge and changing climatic conditions. Thus, a closer examination of street trees has the potential to advance the work of a number of disciplines and to provide insight into the effectiveness of street trees as key to a climate change adaptation program.

**FIGURE A-1****Evolution of Palmerston Boulevard tree plantings from 1908 to 2002**

Trees are reaching the end of their lifespans in many of Toronto's older neighbourhoods. Timely replacement is critical to maintaining forest cover in these areas.

(Source: City of Toronto, 2013, p.17)

Health and Well-being

Street trees appear to be valuable to the protection and maintenance of human health and well-being given that they are more likely than trees in parks and backyards to affect people through regular contact (visual or through their physical presence), and they play an important role in reducing airborne particulate matter through dry deposition (Karden et al., 2015) and attenuating traffic noise. They directly reduce exposure to UV radiation along streets and sidewalks by providing shade. This enhances and promotes neighbourhood walkability. As part of the urban forest (see Case 7), street trees also contribute to the quality of urban life by improving air quality (e.g. through the absorption of gaseous pollutants such as ozone and nitrogen dioxide, and by producing oxygen); reducing carbon dioxide (directly by carbon sequestration, and indirectly through reduced heating and cooling costs); reducing the urban heat island effect; improving water quality (by filtering out contaminants, nutrients and metals) and reducing the volume of stormwater runoff (United States' Environmental Protection Agency, 2013). Karden et al. (2015) focused their study of green space and health specifically on street trees and found that:

- "Having 10 more trees in a city block, on average, improves health perception in ways comparable to an increase in annual personal income of \$10,000 and moving to a neighbourhood with a \$10,000 higher median income or being 7 years younger. We also find that having 11 or more trees in a city block, on average, decreases [adverse] cardiometabolic conditions in ways comparable to an increase in annual personal income of \$20,000 and moving to a neighbourhood with \$20,000 higher median income or being 1.4 years younger."(p. 1).

Street trees also contribute to human health and well-being by reducing traffic speed and collisions, as well as reducing solar glare for drivers.

Concerns have also been raised about potential adverse impacts of street trees. These include damage to infrastructure and building foundations, unwanted debris (or litter collecting in planting beds), creating street canyons (concentrating pollutants in roadways and adjacent sidewalks) and tree allergies. Proper planning and management, including a careful selection of species and careful consideration of sightlines and existing utilities can reduce the impact of these features. Indeed, the science of street tree placement is well-known (Burden, 2006).

Actions

In Toronto, tree canopy covers almost 28% of the City. The City has a canopy goal of 40% within 50 years (City of Toronto, 2013). The 600,000 city managed street trees represent 6% of the total tree population (Weiditz and Penny, 2007; City of Toronto, 2010). Only half of Toronto's street trees are considered to be in good to excellent health, compared to 81% of the City's overall

tree population (Clean Air Partnership, 2012). Establishing and maintaining a diverse community of street trees is essential to increase the trees' resilience to established and emerging threats from invasive species, such as the Asian long horned beetle, Dutch elm disease and the Emerald ash borer. The more trees and the longer that trees survive, the more benefits they provide, including the amount of carbon sequestered by the trees as they grow (Rosenzweig et al, 2006). Using the software iTree, which uses existing tree inventory data to estimate the value of municipal street trees, Nowak et al. (2013) estimated that trees and shrubs in Toronto "remove approximately 1,950 metric tons of air pollution each year, with a societal value of 16.9 million CAD/year" (p. 22).

Given their numerous benefits, the City of Toronto has embraced street trees as one component of its climate change adaptation and mitigation strategy. Key actions include: "introducing a new standard to support healthy tree growth by use of continuous soil trench systems in commercial areas; increased street tree planting and, increased enforcement of tree protection and planning requirements for private lands during development review" (Clean Air Partnership, 2012, p.10). The Toronto Streetscape Manual notes that street trees must be "recognized as part of the city's infrastructure (such as street lights, litter bins, and utilities) and considered integral to a complete street" (Clean Air Partnership, 2012, p. 11).

Discussion

The full benefits that street trees can provide to urban residents are currently under-realized. As a climate change adaptation and mitigation measure, they have the potential to provide multiple direct and indirect benefits to urban communities.

The value of street trees is well-known and the links between street trees, and public health and well-being is receiving increased attention from researchers. Placing these studies into a larger narrative of social benefit and change can serve as a reminder that the influence of green spaces, including street trees, extends well-beyond the scope of any one study or set of studies to our overall well-being. There is a need for implementation and policy research at the municipal scale that looks at the effectiveness of new tree planting approaches, monitoring programs, incentive schemes and urban forest governance, all of which will be needed to proactively adapt to the demands of a changing climate (Clean Air Partnership, 2012; Hotte et al., 2015).

Unfortunately, the many benefits of street trees are not necessarily well-known or well-regarded by citizens. Tree protection by-laws are increasingly needed to protect trees from being cut down to facilitate new development. The challenges to maintaining a healthy street tree community are related to: funding over the lifecycle of the trees, political support, other infrastructure, and policy (Clean Air Partnership, 2012). Ultimately, the benefits of street trees will only be realized and the costs only reduced by good communication and planning among a wide range of stakeholders, including residents.

Ensuring that street trees are able to flourish under the challenging climatic conditions that are anticipated is a significant multisectoral and multidisciplinary challenge. Success in this area may prove to be a good indicator of how well we can self-organize to respond to the multitude of urban climate change challenges that confront us.

Discussion Questions

- A-1.** Would a full accounting of the multiple co-benefits of street trees help to change public perception of their value? Why or why not?
- A-2.** Street trees are most often managed by municipal parks departments. Is there a case to be made for them to instead be part of the responsibility of the department responsible for street construction and maintenance? What would be the implications of such a shift?
- A-3.** Trees need water to survive, and currently stormwater is diverted from the sidewalks and streets to the storm drain system. Increasing drought and stormwater impacts from both infrequent and more intense rain events with climate change are also anticipated. How can tree planting designs be reimaged for passive irrigation from stormwater runoff?

For More Information about the Case, See:

City of Toronto. 2013. Sustaining and Expanding the Urban Forest: Toronto's Strategic Forest Management Plan. Toronto: Parks, Forestry and Recreation Department.

Weiditz, I., & Penney, J. 2007. *Climate Change Adaptation Options for Toronto's Urban Forests*. (online) Available at: http://www.cleanairpartnership.org/reports_climate_change_adaptation [Accessed: March 19, 2011]

B. HOSPITAL GARDENS

Drawing on nature for respite and recovery

Summary

There are many different manifestations of community gardens, including those supported by public institutions such as hospitals, long-term care facilities and prisons. The latter are also known as institutional gardens and are associated with an expanded range of social benefits, including rehabilitation, restoration and skills training. Hospital gardens represent a particular type of institutional garden – they are also referred to as healing gardens. The gardens of the Children's Hospital of Eastern Ontario are supported by a network of community groups that help maximize the value of these green spaces. It is noteworthy that active participation in hospital green spaces is not required in order to receive benefits from natural landscapes – activities in healthcare outdoor spaces ranges from very active to completely passive, and health-promoting benefits can be gained wherever people are on this gradient. This creates an interesting opportunity for convergence between the ecological, medical and arts communities that appears to be underutilized and could be further explored by the ecohealth community.

Introduction/Background

The physical, mental and spiritual values of gardens have long been recognized (Kingsley, 2009; Perrins-Margalis et al., 2000). Community gardens are increasingly valued as a critical element of community development and green infrastructure programs in cities around the world (Quayle, 2007; Draper and Freedman, 2010). There are many different manifestations of community gardens, including those supported by public institutions such as hospitals, long-term care facilities and prisons (Knezevic et al., 2016). The latter are also known as institutional gardens and are associated with an expanded range of social benefits, including rehabilitation, restoration and skills training (Dwyer et al., 2016). Such gardens may be part of a hospital's sustainability plan (Boone, 2012; Schroeder, 2012). Hospital gardens represent a particular type of institutional garden – they are also referred to as healing gardens. Hospital gardens are increasingly common, although some of them amount to little more than “two chaise lounges and potted plants on a rooftop” (Cooper-Marcus, 2016, p.172). Others, however, are more thoughtful. They include gardens designed specifically for rehabilitation and physical therapy (Davis, 2011), intensive care (Minton and Batten, 2015), children's recovery (Whitehouse et al., 2001) and dementia (Pollock and Marshall, 2012). Some hospitals are also investing in nature assisted therapy programs. These include horticultural therapy programs and food gardens (Annerstedt and Warborg, 2011; Mount and Knezevic, 2015; Knezevic et al., 2016).

In the 1860s, Florence Nightingale recognized the need to pay particular attention to the healing environment of patients, for example, quietness, light, fresh air, cleanliness and warmth (See also Box B-1). She was also an early advocate for beauty, arguing that it had positive benefits not only on the mind, but also the body. Early hospital design in Europe recognized the value of the environment for healing, and featured balconies, cloistered gardens and views of the outside world (Cooper-Marcus and Barnes, 1995; Ulrich, 2002). Ironically, only cleanliness seems to have survived the transition to ‘modern’ hospital environments in the mid- to late-1900s, with their sealed windows, constant noise and artificial light (Grinde and Patil, 2009; Hamilton and Shepley, 2010). In recognition of Florence Nightingale's work, sunlit atriums in hospitals are still referred to as ‘Nightingale wings’.

The Children's Hospital of Eastern Ontario (CHEO) in Ottawa features two distinct therapeutic gardens. The Butterfly Garden has been a part of the hospital landscape since 2002. In 2014, the hospital undertook a major renovation of its gardens, and opened a new Healing Earth Garden. The Butterfly Garden provides a metaphor for transformation that is very relevant to the hospital community. It is designed to be a “place for respite and quiet contemplation for patients and their families, providing hope and inspiration in a natural setting” (CHEO, 2016). The newly opened Healing Earth Garden is designed for long-term patients and children with chronic disorders. The gardens, and the programs associated with them, have the potential to positively impact the hospital community in a number of ways.

Box B-1. Nature-Based Interventions for Intensive-Care Unit Patients

- Regular assessment of the impact of environmental factors (noise, light, views, day/night patterns);
- Position long-stay patients (+4 days) close to windows;
- Position patient beds and head positions to view the outside world;
- Maximize exposure to early morning light to set the circadian rhythm;
- Use nature-based soundtracks and assess patients' responses;
- Encourage families to provide photos of the outside world that the patient would enjoy;
- When patients are physiologically stable, take them outside to a hospital garden/courtyard;
- Hang or project picture of nature on the wall and ceiling in the patients' bed space.

Source: Minton and Batten (2015)

Health and Well-Being

After a period of budget conscious, sterile hospital design, the pendulum is shifting back to something closer to Nightingale's vision as the evidence in favour of incorporating environmental features, such as green walls, gardens, fountains and courtyards into hospital settings gains traction (Franklin, 2012). Ulrich's (1984) seminal work focused on recovery times for patients with and without 'green' landscape views. Following from this study, a wide range of benefits of exposure to nature have been recognized. They include a mix of one or more of the following three processes: i) relief from physical symptoms, illness or trauma (e.g. a recovering postoperative patient); ii) stress reduction and increased levels of comfort for individuals dealing with emotionally and/or physically tiring experiences (this includes patients and hospital staff); and iii) an improvement in the overall sense of well-being (Cooper-Marcus and Barnes, 1995). CHEO's Healing Earth Garden identifies the following three benefits: healing interaction between children and nature improves the quality of the patient experience and opens new opportunities for rehabilitation; health and the environment are inextricably linked and we need to care for both as responsible stewards; and, programming stimulates the senses and educates the patient during recovery and rehabilitation and connects the hospital to the community in new ways (CHEO, 2013).

Actions

The CHEO gardens are supported by a network of community groups that help maximize the value of these green spaces. Volunteer gardeners maintain all of the plants and structures on the grounds, and other local organizations schedule repairs and cleanups. The Butterfly Garden is supported by The Compassionate Friends, an organization that provides peer support for parents and families experiencing the death of a child. The Healing Earth Garden is designed to "promote health and wellness, develop new skills, restore self esteem and provide a sense of community. It supports nutrition, education, rehabilitation and other programming (for example, Healthy Active Living and Obesity, Youth Net and Psychiatry) developed by the hospital's departments. Both gardens are designed to meet the physical, psychological and social needs of patients, their families and the staff who care for them. The Healing Earth Garden features an "activity area, a sensory and exploration area and a quiet area to retreat and renew energy". Horticultural therapy programs are run for in-patients. The plants are specially selected to appeal to the senses (sight, smell, taste, touch and sound). The gardens are fully accessible to all mobilities. The design principles for the garden were to have it be: accessible, permaculture and organic, local, educational and safe. As relatively new gardens, CHEO is able to provide some up-to-date budget information. The budget to create for the new Healing Earth Garden was 30K, with an annual operating budget of 1K (CHEO, 2016). The gardens fit into CHEO's strategic priority areas of: connected care, responsible stewards, and exceptional patient experience (CHEO, 2013).

Discussion

Many authors refer to E.O. Wilson's (1984) biophilia hypothesis to explain why people are attracted to green spaces and places. The hypothesis states that humans are genetically drawn to other living things. The literature for therapeutic and healing gardens supports this contention. This connection is particularly important for children's health. In a comprehensive review of the literature, Faber Taylor et al. (2006) note that "current evidence suggests that ... contact with nature is supportive of healthy child development in several domains – cognitive, social and emotional" (p. 136). The benefits are similar to those of school ground greening programs (Case 3), and perhaps even more powerful given the vulnerable situation of children in hospitals.

Box B-2. Therapeutic Value of Nature Art

The power of visual mediums such as art were highlighted by Aiken (1998) who make a scientific and philosophical argument in support of the emotional impact of art and its importance to our survival as a species.

Nature-based images are consistently found to be particularly supportive of patients' recovery – this includes 2D and 3D images, as well as virtual reality and digital art interventions (see Hathorn and Nanda, 2008). Ulrich and Gilpin (2003) find that nature art (and/or art with views or representations of nature) promote restoration if "it contains the following features: calm or slowly moving water, verdant foliage, flowers, foreground spatial openness, park-like or Savannah-like properties (scattered trees, grassy undershot), and birds or other unthreatening wildlife." (p.123). This ties into the savannah hypothesis of preferred human landscapes put forward by G.H. Orians (Thompson, 2000).

A number of design features have been identified that help create therapeutic gardens that fulfil their design function for both hospital patients and staff. Some of these are fairly straightforward, such as creating opportunities for physical movement and exercise as well as opportunities to make choices, seek privacy and experience a sense of autonomy or control (Ulrich, 1999). Others are less so: for example, the need to create familiar environments drawing on readily recognizable plants, and to only include unambiguously positive art in these places (emotional congruence theory finds that complex and/or abstract art can exacerbate negative feelings in stressed or anxious people) (Bower, 1981; Cooper-Marcus, 2007). Attention needs to be paid to whether or not the garden is functioning as well as it could. In a study of a children's healing garden in the United States, Whitehouse (2001) found that, while a number of benefits were identified, the garden was not being used "as often or as effectively as intended" and "the majority of family members surveyed throughout the hospital did not know about the garden" (p.301). This study draws attention to the need to fully integrate hospital gardens into the health care setting.

Fortunately, active participation in hospital green spaces is not required in order to receive benefits from natural landscapes – activities in healthcare outdoor space range from very active to completely passive (Cooper-Marcus, 2007). As mentioned in Case 1 (Street Trees), benefits can be obtained by noticing and observing nature, including artificial, visual (e.g. photographs, videos, screen savers), and auditory stimuli (e.g. sound of running water, rain, etc.) (see also Box B-2) (Velarde et al, 2007; Ulrich and Gilpin, 2003). This suggests that there are opportunities for an interesting convergence between the ecological, medical and arts communities that appears to be underutilized and could be further explored by the ecohealth community.

Discussion Questions

- B-1. Should institutional gardens be required for all new public care facilities (including hospitals, hospices, retirement residences, prisons) in the province? Why or why not?
- B-2. Given the power of nature-based art to affect patients' health-related experiences and outcomes, how can it be better incorporated into the day-to-day setting of a hospital?

For More Information about the Case, See:

Children's Hospital of Eastern Ontario. 2016. CHEO's Healing Garden. [Accessed 16 August 2016]
<http://www.cheo.on.ca/en/healing-garden>

C. SCHOOL GROUNDS

Greening & System Change

Summary

Social values are converging that link equitable and accessible opportunities for children's active play with the individual and social benefits of green spaces. This shift is represented by the gradual expansion of school greening programs. Creating a green school ground is not as easy as pulling up the asphalt and planting some trees and shrubs, however. It requires system-wide changes not only to playground design and maintenance, but also to the larger socio-political context in which the school is embedded. While local champions are vital to the success of school greening and often lead the initial stages of projects, in the end professional design and implementation as well as supportive school policies are required to support student engagement with green spaces over the long term. The struggle to transform all schools into 'green' schools, and to realize the myriad of social, environmental and health benefits associated with such a transformation, mirrors the larger social dynamics at play.

FIGURE C-1
Asphalt Daycare
Playground
in Toronto



Introduction/Background

Social values are converging that link equitable and accessible opportunities for children's active play with the individual and social benefits of green spaces. This shift is represented by the gradual expansion of school greening programs and increased concern over the lack of attention being paid to children's landscapes, particularly in urban and suburban areas. These programs link diversity in school ground design and vegetation with both pedagogy and improvements in children's social, mental and physical health ((Toronto District School Board (TDSB), 2004; Dymont, 2005; Evergreen, 2016a). Greening programs include naturalization, habitat restoration, tree planting and/or food gardening. They may focus on a single feature (e.g. greening a school yard; creating theme, sensory and/or food gardens; enhancing canopy cover; creating spaces for outdoor learning) or the structure and function of the entire school (e.g. ecoschools, forest kindergartens).

Physical health concerns related to our 'sedentary society' have motivated an increased interest in children's environments, including school facilities and schoolyards. The right to play is recognized as a basic entitlement for all children (United Nations, 1989). This right to play has additional benefits in a 'green' setting, particularly since children spend "the majority of their waking hours in the school setting" and have limited access and opportunities for active play in areas other than playgrounds during school breaks (Kreimler et al., 2011, p.27). As urban densities increase, many children (particularly those in apartment buildings) have limited opportunities for unscheduled active play in green spaces outside of school hours. Indeed, a 2012 study by Active Healthy Kids Canada (AHKC) found that only 14% of children regularly spend their after-school leisure time playing outside. Their 2014 study reinforced this message by finding that only 7% of 5-7-year-old Canadian children - and 4% of 12-17 year olds - meet physical activity guidelines (AHKC, 2014).

Creating a green school ground is not as easy as pulling up the asphalt and planting some trees and shrubs. It requires system-wide changes not only to playground design and maintenance, but also to the larger socio-political context in which the school is embedded. In recognition of the many challenges inherent in school ground greening programs, as well as the benefits that school greening programs can offer, the non-profit charity, Evergreen is one of several organizations in Ontario (including conservation authorities and the Ontario EcoSchools Program) that supports a wide range of initiatives to encourage and expand this work. Evergreen takes a multi-level, systems-based approach to the issue of school greening in order to create the conditions necessary for green school spaces to flourish.

Health and Well-being

The benefits of green school grounds, over and above physical exercise, include the provision of shade to reduce ultraviolet ray exposure, more diverse opportunities for motor development as well as social and mental health improvements (Fjortoft, 2004; Maller and Townsend, 2005; Dymont and Bell, 2007). Research has also found that play opportunities in traditional asphalt playgrounds (also the low-cost option, see Figure C-1) are strongly gendered. They are associated with a kind of vigorous, rule-bound and competitive play that fosters and rewards a relatively narrow range of social skills (e.g. a hierarchical social dynamic of exclusion and dominance; see Evans, 2001; Gagen, 2000; Martensson et al, 2014) that encourage stereotypical play choices (Paechter and Clark, 2007). In this recreational paradigm, girls and younger children tend to be 'pushed' toward more social and sedentary activities in the fringes of the play space (Paechter and Clark, 2007; Dymont et al, 2009; Baines and Blatchford, 2011; Martensson et al., 2014). Dymont and Bell (2007) note that school yards can thus be considered 'moral geographies' (from Fielding, 2000, p. 230) where a myriad of community values are manifest.

As opposed to asphalt lots and grass sportsfields, green school yards encourage more non-competitive, open-ended, creative and imaginative play and reduce bullying and boredom (Figure C-2; Dymont and Bell, 2007). Trees, shrubs, sand, rocks, paths and logs create a multitude of opportunities for children to interact with the environment using the natural materials at hand. Jumping, climbing, running, hiding, socializing and role-playing are all encouraged. This diversity of the physical space welcomes and engages children of all shapes, sizes, interests and abilities (Bell and Dymont, 2006; Dymont and Bell, 2007). Green school grounds are investments in holistic education (social, mental, physical, emotional, spiritual) that have particularly strong benefits for early child development.

In 2005, the term 'nature deficit disorder' was coined by Richard Louv to describe the impact of human alienation from nature, particularly on children. Similarly, Pyle's (1993) 'extinction of experience' hypothesis draws attention to the idea that as populations of people have less direct contact with nature, this creates a "cycle of disaffection" towards nature (Soga and Gaston, 2016, p. 94) that has implications for not only human health and well-being but also future investments in preserving natural spaces and vital ecosystem services. Thus, concerns over children and nature are both immediate and intergenerational.

Actions

In Canada, the major champion of school ground greening is the non-governmental organization, Evergreen. Evergreen recognizes that successful school greening programs are embedded in a larger systemic shift toward programs, policies and practices that recognize the value of vibrant ecological setting in support children's social, emotional and physical development. School greening is both a response to, and a symptom of, the shrinking domain of children's spaces that is occurring worldwide (Loebach and Gilliland, 2016).

Evergreen has invested significant resources in building Canadian capacity to design, maintain and use green school grounds (Evergreen, 2016a). Given their size, these spaces are disproportionately challenging to create. They require sophisticated designs to be resilient enough to survive the rigour of year-round use, and hardy enough to survive the love and interest of hundreds of small hands and feet. While local champions are vital to the success of school greening and often lead the initial stages of the project, in the end professional design and implementation as well as supportive school policies are required to create green school grounds that are sustainable over the long term. Evergreen has created a vibrant domestic and international network of design professionals trained green school ground design. They publish design manuals (Evergreen, 2004) and were founding members of the International Schoolground Alliance. Evergreen creates partnership with school boards and have helped draft school board policies related to school greening, landscapes and child development. They work

FIGURE C-2

**School Greening
Project at École
élémentaire publique
Marie-Curie in Ottawa**

(Evergreen, 2016b).



extensively to provide practical and motivating teacher training related to the effective use of outdoor spaces for learning. Evergreen also provides grants to assist motivated school communities to create new green school grounds. Remarkably, there is currently no institutional funding for school greening, despite its many benefits for children. Funding for this work is one-off and idiosyncratic.

Discussion

Embracing school greening has the potential to inspire positive changes in social values. They require a commitment to community engagement, planning, investment and programming in order to realize their full benefits. Even modest investments in school greening are associated with a variety of positive outcomes and they are increasingly supported by government and non-governmental agencies and programs. Holmes and Collyer (2006) recommend that communities “start small and do it well” (p.i). The struggle to transform all schools into ‘green’ schools, and to realize the myriad of social, environmental and health benefits associated with such a transformation, mirrors the larger social dynamics at play.

Box C-1. Imagination

In her book, *Tackling Wicked Problems through the Transboundary Imagination*, Dr. Valerie Brown highlights the critical role of imagination in working through complex issues that defy complete definition and for which there can be no final ‘solution’*. The majority of critical social-environmental issues are such ‘wicked problems’.

Brown et al. (2010) point out that “imagination is associated with creativity, insight, vision and originality; and is also related to memory, perception and invention. All of these are necessary in addressing the uncertainty association with wicked problems in a world of continual change” (p.5). Creating spaces and opportunities to foster the imagination is thus critical to efforts to address environment and health issues.

* See the seminal paper by Rittel and Weber, 1973, for a definition of ‘wicked problems’.

As Canadian politicians and leaders lament the lack of a culture of innovation in our society, they may be well-advised to look beyond universities and business start-ups to the design of early childhood, primary and secondary school structures and curriculums. School greening programs encourage creativity, imagination, role-playing, open-ended play and collaborative play

while connecting students to the mental and physical health benefits of natural systems. They unleash the imagination (see Box C-1) and thus invest in our collective capacity to tackle challenging issues. Investments in school greening may help close the loop in this innovation cycle, while also creating the conditions for a healthier, more resilient and just society.

Discussion Questions

- C-1. What is system-level change and why is it important for school greening programs?
- C-2. Do you agree that the engagement with traditional playgrounds is strongly gendered? Why or why not?
- C-3. Do you think that open-ended, imaginative and/or collaborative play at schools may lead to more innovative thinking later on?
- C-4. What are your favorite memories of play as a child? How were those activities linked to the physical spaces that you were playing in?

For More Information about the Case, See:

Evergreen. 2016. Greening School Grounds. <https://www.evergreen.ca/our-impact/children/greening-school-grounds/>

D. MOOD WALKS

A socio-ecological prescription for health?

Summary

The evidence supporting a positive relationship between exposure to natural environments and human health and well-being is growing exponentially. Programs like Mood Walks are taking advantage of the convergence between exercise, mood and exposure to nature to create programs targeting a variety of vulnerable populations. The programs are allowing mental health professionals to explore new avenues for intervention with a variety of vulnerable populations. It remains to be seen, however, how well the evidence behind this innovative program will be integrated into the wider health system.

Introduction/Background

People have been advocating for the salutogenic (e.g. health affirming) benefits of exposure to nature for millennia (Burford, 1969; Antonovsky, 1987). Recently these messages of enhanced health and well-being have been translated into specific program initiatives in Ontario. New partnerships between Conservation Authorities, Hikes Ontario and the Canadian Mental Health Association (CMHA) and other provincial and local agencies are leading to public health interventions focused specifically on leveraging the ability of natural landscapes to enhance the physical, social and mental health of program participants. They formalize and expand on innovative local programs, such as partnerships between the Homewood Health Centre and the Guelph Hiking Trail Club, and the Waypoint Centre and the Ganaraska Hiking Trail Association (Friesen, 2016).

Due to the active and social nature of group nature walks, it can be difficult to separate out the benefits of being in the forest from those provided by the social interaction and the physical exercise; all are important to enhancing health and well-being (Wilson et al, 2010). A variety of studies have compared walking programs in natural settings to those in urban or indoor environments. Where effects are documented, the majority tend to favor natural (e.g. 'green' and 'blue' environments – forested and water landscapes, respectively) as having more beneficial effects (Berman et al., 2008; Hartig et al., 2003; Peacock et al, 2007; Coon et al., 2011). These studies support the contention that the natural surroundings are key to realizing the full benefits of guided walking programs.

In their evaluation of Irish 'Woodland for Health' mood walks program, Iwata et al., (2016:22) found that "the elements of quietness and fewer people are particularly important to people who are experiencing mental ill-health, because they are more self-conscious and sometimes not comfortable surrounded by other people. In the forest settings, the participants were more relaxed and willing to interact with each other". In addition, "the sense of escaping from everyday life, the beauty of nature, and having something interesting to look at in the forest environments were important elements for improving their mood, encouraging communication and motivating regular participation" (p.16). These features – the quiet, un-crowded, beautiful and interesting forest; the walk as a different activity from everyday life; and the social support – have been highlighted by a variety of other researchers as well (Kaplan et al., 2012; Berman et al., 2012; Gonzales et al, 2010; Cruwys et al., 2014; Korpela et al, 2016).

Health and Well-being

Mood walks and other similar programs are, at their core, walking groups facilitated by trained professionals. The guided walks last anywhere from 30-120 minutes, and are usually held once a week, although they may also be more frequent. They target a wide variety of vulnerable groups, including the elderly, youth-at-risk and those with a range of mental health concerns, including depression, anxiety, substance disorders, bi-polar, schizophrenia and other psychotic disorders (Barton et al, 2012; Sahlin et al., 2015; Iwata et al., 2016). Nature walks have been shown to enhance attentional, emotional and physiological processes related to stress reduction, vitality, cognition and creativity. The 'route of exposure' in ever-changing landscapes can be visual, tactile, olfactory and auditory, making exposure to nature very difficult to quantify (Frumpkin and Jackson, 2014).

Many studies have explored the relevance of Attention Restoration Theory (Kaplan, 1995) to understanding the positive mental health and well-being effects we receive from nature (Jung, 2016; Lee et al., 2015). The theory centres on the restorative benefits of natural landscapes that allow us to recover from 'directed attention fatigue' and regain our ability to concentrate. Directed attention fatigue occurs during the performance of cognitive tasks that require long periods of directed attention (Bowler et al., 2010). According to Kaplan, the following four properties are needed for a natural environment to provide this restorative effect: i) extent (the scope to feel immersed in the environment); ii) being away (providing an escape from habitual activities); iii) soft fascination (aspects of the environment that capture attention effortlessly – e.g. leaves in a forest; sunlight glinting off water); and iv) compatibility (individuals must want to be exposed to, and appreciate the environment). Fascination appears to play a critical role, with the other three properties enhancing and sustaining it (Kaplan, 1995). A recent systematic review of the theory provided some support for the theory, but noted that the diversity of study designs, sample size and types of evidence make it difficult to isolate the attributes that may be affected (Ohly et al., 2016). The concept of restorative environments is strongly grounded in Attention Restoration Theory (von Lindern et al., 2017; Collado et al., 2017).

Actions

In Ontario, the Mood Walks program is targeting a variety of vulnerable groups, including youth in transition (for youth at risk of, or experiencing, mental health issues), and older adults. Based on their experience to date, some best practices for mood walk programming in Ontario include: engaging mental health agency staff who already have an outdoor orientation; building in-house capacity to lead mood walk by training staff and clients to become Certified Hike Leaders and Safe Hiker Instructors; leveraging win-win partnerships with local hiking clubs and trail associations to cross-promote the programs; ensuring participants have access to appropriate clothing and footwear; designing 'loop' hikes to allow participants to opt out, as necessary and gradually increasing the time, length and speed of the hikes; and, pre-hiking the planned route in groups of three. Where possible, organizers may choose to pre-hike with interested participants who are wary of structured group events (Friesen, 2016).

Preliminary results from the evaluation of the 2014 Mood Walks pilot program targeting seniors found that 22 new walking groups were created and 64% of these groups walked for at least 10 weeks. An average of 6.4 participants walked for, on average, 70 minutes. Safe Hiker training was provided to 257 people, and 21 new Safe Hiker Instructors and 51 Certified Hike Leaders received training. 92% of the participants described the new partnerships as 'successful' and 73% 'definitely' expected to continue the program. Participants particularly enjoyed connecting with nature, the social aspect of the walks and learning and gaining new skills. They demonstrated significant positive changes in happiness, anxiety and energy levels from pre- to post-walk and both organizers and participants increased their awareness of nature's influence on mental health (Mitchell, 2015).

In New Brunswick and British Columbia, a new program is promoting the use of prescription pads that doctors can use to 'prescribe' outdoor walking to their patients (Owens, 2014). Were it to be expanded to Ontario, this program could be further strengthened through referrals, by doctors, to specific, targeted and organized programs such as Mood Walks.

Discussion

Mood walks are creating new partnerships in Ontario that can be seen as part of a systemic change in how we collectively respond to the challenge of mental ill-health in our communities. The engagement of non-traditional groups in designing and implementing programs for vulnerable populations suffering from mental illness helps de-stigmatize these issues.

Given that the Mood Walks program in Ontario is quite new, it is not clear how much potential it has to be integrated into the larger health system. A study of the national British program, Walking for Health, found that only 6% of participants had been referred to the program by their doctors. This suggests the potential for much greater outreach if physicians and nurses

Figure D-1**New Brunswick Medical Society's
exercise prescription pad**

R_x for Health
pour la santé

Date: _____

Name/Nom: _____

I recommend/Je recommande :

☐ Walking/la marche ☐ Other/Autre : _____

_____ minutes a day/Minutes chaque jour

_____ days per week/Jours par semaine

On a scale of 1 to 10, regarding the patient's confidence that they can achieve the above activity goal, the patient answered/Sur une échelle de 1 à 10, en ce qui a trait à la confiance du patient à l'égard de l'atteinte de l'objectif ci-dessus en matière d'activité physique, le patient a répondu : _____

* Health Canada suggests moderate activity of 30 minutes per day 1.5 days a week / Santé Canada suggère des activités modérées d'environ 30 minutes par jour 1.5 fois par semaine

For recommendations tailored to your age, Google "Canadian Physical Activity Guidelines." / Pour obtenir des recommandations adaptées à votre âge, utilisez Google pour trouver les Directives canadiennes en matière d'activité physique.

Physician signature/Signature du médecin: _____

can be engaged in promoting this non-pharmacological approach as part of a comprehensive treatment plan for a wide range of health conditions (Marselle et al., 2014). Some of the pieces of the puzzle are in place. For example, the Ontario College of Family Physicians (OCFP) has a continuing medical accreditation program focused on advocating for lifestyle changes. Titled "Environmental Impacts on Health: Reducing Common Comorbid Conditions by Encouraging Lifestyle Changes", the three-hour course promotes "a systems medicine, integrative approach to help ... patients make and maintain informed health-promoting lifestyle changes and enhance self-management" (OCFP, 2016, p.15). The course currently focuses on elderly patients (over 65), but it opens the door to additional training focused on other vulnerable populations and opportunities for action. The 'prescriptions' for exercise and exposure to nature being advocated by some Canadian public and medical health agencies is another encouraging step. Thus, there are a variety of opportunities to leverage existing programs across the medical, public and mental health communities to better support and promote participation in programs that reap the benefits of natural settings. Changing physicians' mindsets and practices to reflect our current knowledge of the benefits of green space and health is a significant challenge.

Discussion Questions

- D-1.** Compare and contrast the pathogenic (disease) model of health to the salutogenic model. Which is more relevant to ecohealth?
- D-2.** What other vulnerable populations do you think could benefit from Mood Walk programming in Ontario?
- D-3.** How is the Mood Walk program different than prescriptions for physical exercise?
- D-4.** Do you think clinicians in Ontario would welcome the opportunity to prescribe Mood Walks? Why or why not?
- D-5.** What are some of the barriers to people continuing walking in nature outside of the Mood Walks program, or after it is over?

For More Information about the Case, See:

Mood Walks. 2016. www.moodwalks.ca

E. URBAN PARKS

Bringing Ecosystems back into Public Spaces

Summary

Urban parks are increasingly being designed to contribute to not only the socio-economic and health well-being of nearby residents, but also to the ecological functioning of these social-ecological systems. O'Connor Park in Mississauga is an example of a newly created multi-functional park space that provides community uses while prioritizing the protection of a natural heritage feature, in this case a wetland and cultural meadow. The park is a demonstration site looking at the implementation and effectiveness of a variety of Low Impact Development technologies. The long-term resilience of the engineered wetland and meadow system is dependant both on the integrity of its design and on the connectivity of the park with the wider ecological system. The design of the park met multiple goals. Multiple goals are a hallmark of the modern urban park system.

Introduction/Background

Protecting and sustaining resilient ecosystem services in urban areas is a challenging task. It requires innovative and adaptive resource management processes that both protect and enhance local resources while engaging and reflecting local community and stakeholder values (Commission for Biological Diversity, 2012). A key challenge for planners is to ensure that the provision of green space meets the local and regional demand for recreation (e.g. how much, where, what kind?). For public health, the challenge is to attract people out of their homes and into these areas so that they will be more physically and socially active (Corkery, 2015). For ecologists, the challenge is to protect, preserve and enhance urban and regional ecosystem services under unrelenting pressure from human populations, invasive species and global climatic change.

Urban parks are “seen to provide the most ready access to nature for many individuals” (Maller et al., 2006, p. 46). The challenges of maintaining ecological integrity of these parks are multiplied by the overall trend toward habitat loss and fragmentation in the built environment. This trend was illustrated in the newly created O'Connor Park in Mississauga, where the neighbourhood-level shift from abandoned agricultural lands to suburban development was well-documented during the design and construction phases of urban development (Figures E-1, E-2).

Figure E-1.

O'Connor Park Neighbourhood in 2000

(Source: Ronan and Szczepanski, 2016)

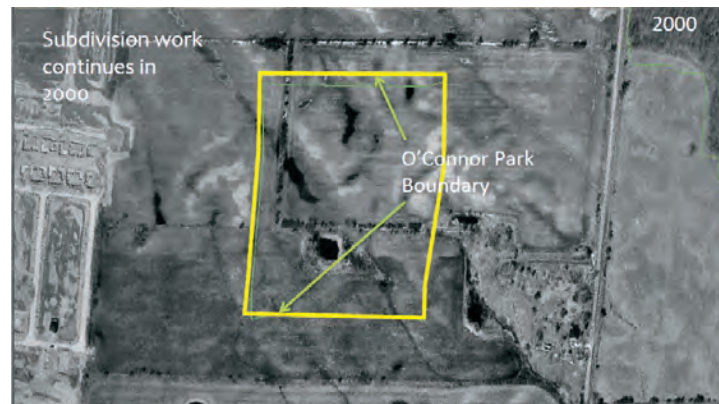
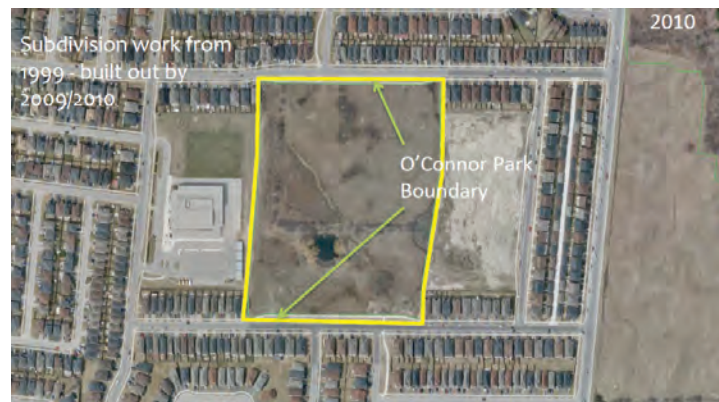


Figure E-2.

O'Connor Park Neighbourhood in 2010

(Source: Ronan and Szczepanski, 2016)



McKinney (2002) points out that “the most effective (and cheapest in the long term) strategy is to preserve as much remnant natural habitat as possible” (p. 886). In urban areas, rare species and remnant natural habitats are most common in city parks, cemeteries, railroad trackways, vegetated areas under transmission lines and other public rights-of-way that are protected from development (McKinney, 2002). These ecosystem fragments have been found to be “far more important than their limited size and disturbed state might suggest” (Rudd et al., 2002, p.368). Dearborn and Kark (2009) put forward a range of possible motivations for urban biodiversity, ranging from those primarily benefitting nature, to those primarily benefitting humans. They suggest that a clear articulation of the goals of this work will help both communicate the rationale to the public and interested stakeholders, and allow them to assess progress in achieving the goals. The seven motivations are: preserving local biodiversity, creating stepping stones to non-urban habitat, understanding and facilitating responses to environmental change, conducting environmental education, providing ecosystem services, fulfilling ethical responsibilities, and improving human well-being (Dearborn and Kark, 2009, p.3).

Health and Well-being

Public health interest in the link between ‘contact with nature’ and health and well-being is growing exponentially. Nonetheless, public health strategies have yet to maximize the benefits of nature, such as the benefits of nature contact as a health promotion intervention for populations (Maller et al., 2006). A number of green space features have been found to positively impact health including: high neighbourhood green space density; green space in close proximity to residences; diversity of plants; perceived cleanliness; perceived safety; play structures; grass and large trees; water features; community gardens; and, accessibility to a range of ages and mobility levels” (Zupancic et al., 2015, p. 20). Increasingly, the psychological and psycho-social benefits generated by the protection, enhancement and preservation of urban biodiversity are receiving attention (Fuller et al., 2007).



Figure E-3.

**Design of O'Connor Park,
Mississauga**

(Source: CVC, 2014)

Illustrated rendering of
O'Connor Park (Drawing
prepared by PMA
Landscape Architects for
the City of Mississauga)

What are considered desirable park attributes varies, depending on the populations being served. For example, seniors may value access and perceived safety; children and youth may value recreational amenities and un-structured opportunities to explore; and adults may value peacefulness, walking trails and opportunities for socializing. Desirable park attributes also depend on the characteristics of particular sub-populations, for example, the mobility challenged, dog walkers, cricket players, mountain bikers or hikers.

Actions

O'Connor Park in Mississauga is an example of a newly created multi-functional park space that has prioritized the protection of a natural heritage feature, in this case a wetland and meadow (Figure E-3). It was built on former agricultural land that included six small orphaned wetland ecosystems supporting bird and reptile populations as well as other wildlife. These 'natural area remnants' (see Discussion, below) were subject to statutory protection by the Ministry of Natural Resources and Forestry and Credit Valley Conservation. The site is completely surrounded by new subdivisions and is a significant greenspace within the Churchill Meadows Community residential neighbourhood. The property is part of the Sawmill Creek subwatershed, which drains into the Credit River and then in to Lake Ontario. After extensive consultation, the final design for the park recommended consolidating the existing wetlands into one larger 'enhanced natural area'.

In an effort to maintain ecological systems to the extent possible, 39% of the new park is a restored wetland and meadow system. While the desire to protect, expand and/or create new habitat to enhance and preserve biodiversity in urban areas is a laudable, such areas are in danger of becoming population or habitat 'sinks' that are unable to support self-sustaining populations of the native species they were designed to protect (Taylor et al., 1993). This is due to their relative isolation in a sea of development, as well as the threats posed by non-native species, including predators such as dogs, cats and raccoons. Thus, it is important to consider urban and sub-urban parks in terms of both their individual resilience and that of the larger ecosystems of which they are a part.

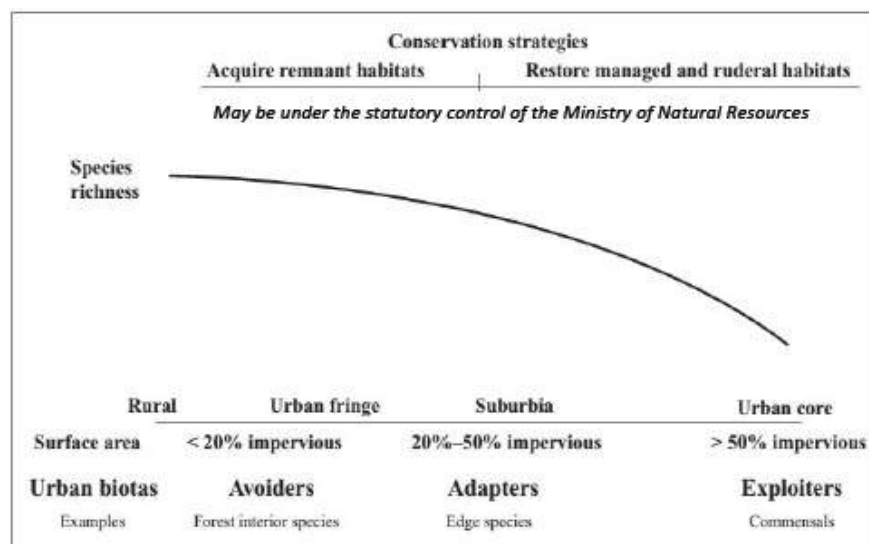
The park is a demonstration site looking at the implementation and effectiveness of a variety of Low Impact Development (LID) technologies for storm water management, including surface water collection, groundwater recharge areas, engineered subsurface water capture and drainage and permeable pavements and bioswales. Maintaining the water balance for the wetland ecosystem is a key element of the design (CVC, 2014). The wetland includes an island specifically for the local wildlife (particularly the midland painted turtle) to have an undisturbed (by humans) site for laying their eggs, building nests, etc. The park includes an elevated viewing area for people to observe the wetland, as well as themed and natural play zones, trails and sports fields. The site has won a number of local design awards and is put forward as an example of the City of Mississauga and Credit Valley Conservation working "in partnership to balance environmental conservation and recreation needs for residents" (p. 2).

Discussion

Urban parks are increasingly being designed to contribute to not only the socio-economic and health well-being of nearby residents, but also to the ecological functioning of these social-ecological systems. The resulting designs are, by necessity, place-based and highly contextual and reflect not only the aspirations and needs of the communities, but also the environmental legacy that is bequeathed in the land. This legacy may be negative (i.e. brownfields that require extensive remediation) or positive (i.e. containing swaths of relatively undisturbed native ecosystems). More likely, the land is in the mid-way zone. According to the habitat-loss gradient theory (Whitney, 1985; McKinney, 2002, Figure E-4) through the process of urbanization, an area's original habitat becomes increasingly fragmented and is gradually replaced by the following four types of altered habitat:

- i) built habitat (buildings and sealed surfaces, such as roads);
- ii) managed vegetation (residential, commercial and other regularly maintained green spaces),
- iii) ruderal vegetation (empty lots, abandoned farmland and other green space that is cleared but not managed); and,
- iv) natural remnant vegetation (remaining islands of original vegetation, usually subject to substantial non-native plant invasion).

The abandoned farmland purchased for O'Connor Park was a combination of types iii and iv. The long-term resilience of the engineered wetland and meadow system is dependant both on the integrity of its design and on the connectivity of the park with the wider ecological system. Different species have different needs. Large and mobile species, such as pollinators and predators, operate at larger scales than the individual park (Goddard et al., 2009). The need for connectivity is thus species-specific and depends on the scale at which organisms are able to use a landscape (Hostetler, 2001).

**FIGURE E-4.**

Urban-rural biodiversity gradient and selected conservation strategies

(Source: McKinney, 2002, p. 885)

Goals of the O'Connor Park project included: protection of natural heritage features (preserving local biodiversity), testing the lifecycle performance of low impact development processes (understanding and facilitating responses to environmental change), conducting environmental education (through signage and look-out points in the park), and improving human well-being (through creating an accessible socio-ecological place for the community to use in a variety of ways). These multiple goals are a hallmark of the modern urban park system. They are quite different from the "static, generic models and standardized people-parkland ratios" which guided much park design in the past (Ibes, 2016, p. 123).

Discussion Questions

- E-1.** How are discussions related to urban biodiversity different than those about biodiversity in less disturbed areas?
- E-2.** Given the challenges associated with preserving viable ecosystems in urban areas, are ecological restoration initiatives worthwhile? Why or why not?
- E-3.** Why is it important to articulate the goals of a park project?

For More Information about the Case, See:

Credit Valley Conservation (CVC). 2014. O'Connor Park. Public Lands Case Study. Mississauga: CVC Water Resources Management and Restoration. <http://www.creditvalleyca.ca/wp-content/uploads/2014/04/OConnor-Park-Case-Study-Revised6.pdf>

For more information related to the Credit Valley Conservation monitoring program refer to the Credit Valley Conservation factsheet:

http://www.creditvalleyca.ca/wp-content/uploads/2016/06/Factsheet_OConnor_Park_Final.pdf

F. GREENWAYS

The Lake Ontario Waterfront Trail: Green and Blue Spaces and Places

Summary

Greenways are important for connecting communities and places. Engaging the public and promoting physical activity is a major benefit of greenways. In addition to exercise, greenways serve as ecological corridors that connect people, neighbourhoods, communities and towns. As a green space itself, the Lake Ontario Waterfront Trail also leverages the health and well-being benefits of blue spaces: a key goal is to route the trail as close to the water's edge as environmentally feasible. Issues around equity and access are important, particularly with regard to maintaining a freely accessible trail and to supporting and maintaining public access to waterfronts and water resources. The trail is part of the new generation of multi-objective greenways that are contributing to the revitalization, restoration and regeneration of the Great Lakes waterfront and the province.

Introduction/Background

Greenways are important for connecting communities and places. Searns (1995) identified three distinct phases of greenway development: from boulevards and parkways, to trail-oriented recreational pathways, to multi-objective greenways. Little (1990) defined them as "linear open space established either along a natural corridor, such as a riverfront, stream valley or ridgeline, or overland along a railroad right-of-way that has been converted to recreational use, a canal, a scenic road, or other route". The development of multi-use greenways surged in the 1980s, with increasing interest in the multiple benefits of these routes for economic, social, cultural and ecological reasons (Fabos and Ryan, 2006). They were originally linear spaces, but are now more aptly referred to as greenway networks that create a 'green matrix' (Kullman, 2013). Greenways are primarily used for recreation, although in some cities and town they also act as key transportation corridors. Greenways provide opportunities for active living that produces fitness and health benefits, create alternate transportation routes, support the conservation of habitats and biodiversity, protect and conserve historical sites, foster economic development, and provide aesthetic, visual, and psychological amenities (Lindsey et al., 2004).

The Waterfront Regeneration Trust was established in 1992 to implement the recommendations of the Royal Commission on the Future of the Toronto Waterfront. Its vision is a regenerated Great Lakes waterfront. The Lake Ontario Waterfront Trail system (Figure F-1) is part of the Greenway Strategy and is one of the key initiatives supporting that vision. As stated on the Waterfront Trail website (2016), the trail is critical to "connect people to their Great Lakes waterfront. In doing so, ... [people are] inspired to become advocates for a healthy, vibrant waterfront ... we envision a Great Lakes Waterfront Trail that is 'complete and connected,' an integral part of each ecosystem it passes through, enhancing the environment, economy, society and history of every community that participates in the development and use of the Trail". The Trail now runs over 1600km in Ontario and on into Quebec, and is set to expand to Northern Ontario along the north channel of Lake Huron from Sault Sainte Marie to Sudbury. As part of its commitment to contributing to a broader trail network, it is part of the Trans Canada Trail as well as the St. Lawrence bikeway and the Niagara River Recreational Trail. As of 2013, the trail connected:

- 2 Great Lakes; 3 bi-national rivers; 3 UNESCO Biospheres; 68 communities; 19 Provincial Parks; 3 National Parks, including Canada's first National Urban Park; 15 National Historical Sites; 325 municipal parks; 58 conservation areas; 90 beaches, including 8 Blue Flag awarded beaches; 3 major wine regions; 25 historical village main streets; 10 Bicycle Friendly Communities; 16 Ontario by Bike (formerly Welcome Cyclists) Network Regions; 427 businesses designated as bike-friendly; 8 international border crossings, and over 40 major connecting trails (Waterfront Regeneration Trust, 2013, p.3).

It is a world-renowned tourist attraction, as well as a recreation, fitness and green transportation amenity that is connected to the Ontario Greenbelt Trail network in Cobourg and potentially through the new expansion of the Greenbelt into the ravine system in and around Toronto (see Case 8). Work is currently underway to connect the trail to the Metrolinx system, connecting commuters and recreational Trail users to GO stations across the region. The result of the Greenbelt to Great Lake connections will be a regional watershed network of trails, paths and public transit systems.

**FIGURE F-1.****Lake Ontario Waterfront Trail**

(Source: Waterfront Trail, 2013)

Health and Well-being

Ecological health imperatives are the enduring impetus behind the Trail, however, public health has become a compelling incentive for community and public participation in the initiative. Promoting physical activity is a major public health benefit of greenways. Public health movements such as Active Living by Design and Healthy People 2020 focus attention on the need for a structural environment (sidewalks, bike lines, trails, etc.) that supports active lifestyle choices for people across all life stages and ages. Most trails are free to use, making them well-suited to advance equity goals and to support the health of the general public. In addition to bicycling and walking, trails can be used for jogging, rollerblading, horse riding, cross-country skiing and are suitable for wheelchair uses, parents with children in strollers and other groups. Maintaining and promoting public ownership and access to the waterfront is an important asset in an age of increasingly privatized space.

Proximity to a trailhead is important, particularly for older adults (Dorwart, 2015). A relatively large on-site survey in Chicago “showed that trail location relative to home strongly influenced how a greenway trail was used, who used it, how often it was used, and other factors” (Gobster, 1995, p. 401). The study advocated an emphasis on local trails to enhance access, which then connect to regional and provincial/state trail systems. Renalds et al. (2010) found that more walkable neighbourhoods are associated with increased physical activity, increased social capital, lower levels of obesity and depression, and less alcohol use. They also can help unite communities and neighbourhoods that are otherwise segregated by race or class (Coutts and Miles, 2011). Greenways also connect urban and rural landscapes.

The overarching purpose of the Waterfront Regeneration Trust is to reconnect people and communities to the Great Lakes – the largest group of freshwater lakes in the world. The trail leverages the power of this ‘blue’ space (Box F-1) as a therapeutic landscape (Gesler, 1992) that enhances human health and well-being (Finlay et al., 2015; Volker and Kistemann, 2011, 2013; White et al., 2010). Indeed, a key focus of the Waterfront Trail is to move the trail closer to the water’s edge (Waterfront Trail, 2013).

Box F-1. Blue Space

The power of water to influence human attitudes and affects is of increasing interest to researchers in a variety of disciplines, including cultural and health geography and environmental psychology.

Foley and Kistemann (2015) define healthy blue space as “health-enabling places and spaces, where water is at the centre of a range of environments with identifiable potential for the promotion of human wellbeing”. It is closely associated with the literature on green spaces, but is also distinct from it. The authors state that “A re-discovery of water within wider public health is evident in the promotion of coasts, rivers and lakes as spaces of leisure, exercise and recovery” (p.158).

Actions

The Lake Ontario Waterfront Trail aims to be part of a clean, green, connected, accessible, affordable, open, useable, diverse and attractive greenway. These are known as the nine waterfront principles. It has been credited with helping regenerate the waterfront, by increasing public attention to the waterfront landscape and amenities through access and interpretive signs. By setting the trail in a larger greenway, the Lake Ontario Waterfront Trail becomes “more than a walking or cycling facility”. It is an essential part of a new relationship to the waterfront and a catalyst for ecological and community renewal including: revitalizing brownfields, green space enhancements and habitat restoration ... improving the trail and making connections” (Waterfront Regeneration Trust, 2013, p.6).

In 2014, the Waterfront Regeneration Trust concluded a partner-wide strategic planning process that resulted in expanding the vision for the Trail to include all of the Canadian Great Lakes and the St. Lawrence River. The goal is to establish the safest route available, nearest to the waterfront, using existing infrastructure. Priorities are identified for improvements and enhancements. Together, the communities, who own and maintain the Trail, and the Waterfront Regeneration Trust work to make improvements and enhancements. An example of moving the Trail closer to the water's edge is the Trust's work with the Province (PanAm Legacy Fund) and the Central Lake Ontario Conservation Authority to move the Waterfront Trail off the busy Bayly/Victoria Rd in west Whitby. The realignment addressed important safety issues and connected the Trail to two provincially significant wetlands. The result is a continuous, off-road trail from Highland Creek in Toronto to Oshawa's Lakeview Park. Closing the gap has increased the utility and popularity of the Trail in Durham.

Tourism is a key driver for communities connecting to regional trail systems, particularly in rural areas. It represents a low-carbon tourist strategy that helps achieve climate change adaptation goals (Mundet and Coenders, 2010) while contributing to the local economy of towns and villages linked to the Trail. The Waterfront Regeneration Trust launched a fully supported annual cycling holiday in 2008 as way to engage and inform the public of the Trail. For the majority of participants, the event introduced them to parts of the Province and waterfront they had never known. In the 2013 survey, 91% saw the Trail as an important part of regenerating the waterfront; 70% would be likely to take a more active interest in issues affecting the Great Lakes. (GWTA 2013 Participant Survey Results).

The Lake Ontario Trail website provides an interactive map, as well as connections to the local tourist destinations and associations along the route. These include a wide range of parks, beaches and green spaces. Maintaining, improving and expanding the trail system requires continual engagement in urban and rural planning processes at a variety of spatial scales. The Waterfront Regeneration Trust surveyed planners along the Lake Ontario section of the Trail in 2013 and learned that 82% of communities had a waterfront vision in their planning documents; 89% have a vision for public access at the waterfront. These planning documents are the policy framework protecting the legacy of the Trail and its vision for regeneration.

The Lake Ontario Waterfront Trail, like many other provincial and national trail systems, relies heavily on rural roads in some areas, which means that motorized and non-motorized transportation are not entirely separate. In rural areas, roads commonly serve as the only active transportation infrastructure for residents. The Trail is comprised of paths (21%), neighbourhood streets (21%) and rural roads (58%). The type of trail has implications for the safety of different user groups, particularly vulnerable populations (seniors, mobility challenged, etc.). A survey of 2013 Great Waterfront Trail Adventure participants found that over 95% would like to have more paved shoulders on the trail route and 59% would like to see the trail move off-road (Waterfront Regeneration Trust, 2013).

Connecting the users of the greenway to natural heritage sites, while maintaining the ecological integrity of these sites, has been a priority since the inception of the Trail project. Rattray Marsh in Mississauga is one example. The trail is connected to the wetland to promote public access, but designed so that biking is not permitted on the boardwalk and trails running through the sensitive ecological system (Ontario Trails, 2016). Finding a balance between public access to well-functioning ecological places and their protection and restoration is critical to the success of a greenway trail.

The idea of the Lake Ontario Waterfront Trail came from hundreds of people who participated in public hearings held in 1988. It will take generations to achieve the goal of dedicated path at the water's edge. One of the biggest threats to the accomplishments of the past 21 years is complacency on the part of municipal staff, and disenchantment from the public. A continuous, signed Trail serves as a living progress report, giving people first-hand experience of accomplishments, challenges and imperatives to achieving ecological health.

Discussion

Multi-objective greenways recognize that these greenways can be designed to go beyond recreation and beautification to address other needs and values, such as wildlife habitat, flood protection, water quality improvement, outdoor education and natural and cultural heritage. These multiple benefits require additional thought, planning and design in order to be realized for a given trail system. Manton et al. (2016) define the key features of greenways as: exclusive to non-motorized travel (other than mobility devices, such as scooters, etc.); accessible to those of all abilities, separated from motorized traffic and, ecological benefits. These features are challenging to realize for large trail systems and, indeed, large sections of the Lake Ontario Trail are not exclusive to non-motorized travel.

The Lake Ontario Waterfront Trail is strongly focused on connecting the blue and green spaces that enhance public life. “The legacy goal for the Trail is to become a dedicated off-road path as close to the water’s edge as environmentally feasible” (p.3). The trail has inspired the regeneration and restoration of brownfields and otherwise degraded landscapes along the waterfront, and is increasingly shaping the public perception and experience of lands further upstream. It has inspired new parks, protected wetlands and habitat restoration initiatives that “will bring animals, birds, plants and people back to the Great Lakes waterfront” (Waterfront Regeneration Trust, 2013, p.7). The Waterfront Trail creates a strong link between local green spaces and cultural centres and the Great Lake system that they are part of. They connect people not only to their local places, but also to that larger system and makes changes to the Lake system (e.g. water quality, water quantity, biodiversity) relevant to greenway trail users across the province. Fostering this sense of connection to the larger landscape is vital to gaining public support for greenway protection and enhancement. Promoting the therapeutic value of exposure to blue and green landscapes, in addition to the physical health benefits of trail use, is an additional benefit provided by the Lake Ontario Waterfront Trail to trail users. Revitalizing and restoring the valuable waterfront land, including natural and cultural heritage sites, and ensuring public access and connection to the Great Lakes ecosystem, has a myriad of positive implications for the region.

Discussion Questions

- F-1. How does connection to landscapes influence people’s attitudes and behaviour toward these spaces and places?
- F-2. What are the social benefits that can be obtained from trail systems in greenways? Are there opportunities to enhance the Lake Ontario Waterfront Trail to increase its value for human health and wellbeing? What would be required to realize these benefits?

For More Information about the Case, See:

Waterfront Trail. 2016. www.waterfronttrail.org

G. URBAN FORESTS

Priority tree planting, social justice and the urban green space paradox

Summary

Given the significant natural capital invested in urban forests and their well-recognized benefits, research related to urban forests is more overtly economic than in many other green-space and health domains. Other values are beginning to shape the debate, however; including social cohesion, social equity and environmental justice. “Priority Tree Planting Areas to Grow Peel’s Urban Forest” is the first program of its kind in Canada. It was developed “to support strategic and cost effective tree planting, and optimize the benefits accrued to the community from tree planting”. This combination of social, economic and environmental factors interpreted spatially (at multiple scales) through a focus on tree planting is a demonstration of how these critical yet diverse themes interact on the landscape. While addressing the inequalities in the distribution of the urban forest is a key issue, it may prove that the real challenge is in maintaining the benefits of urban forestry for disadvantaged and low-income communities as the forest matures.

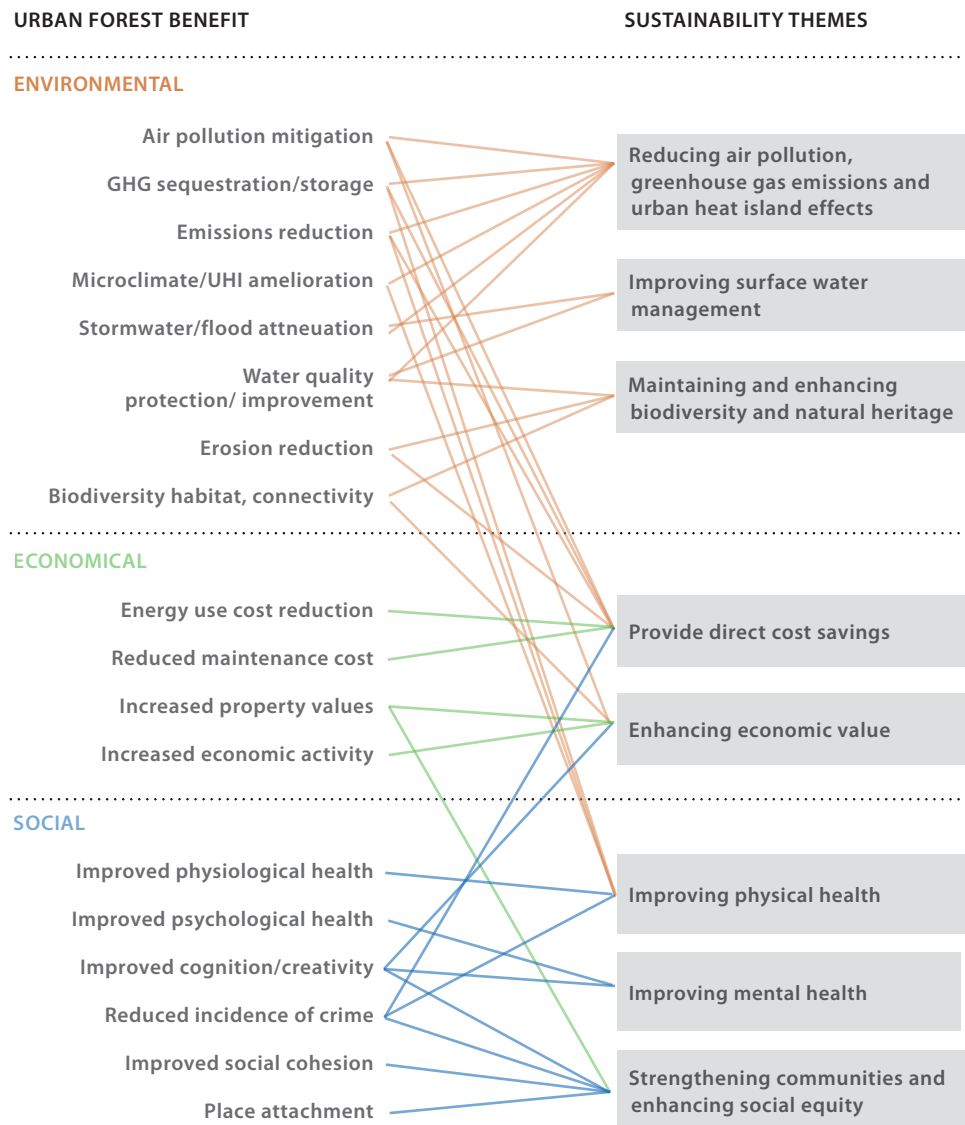
Introduction/Background

Given the significant natural capital invested in urban forests and their well-recognized benefits, research related to urban forests is more overtly economic than in many other green-space and health domains. Indeed, the Toronto Dominion (TD) Bank commissioned two recent economic valuation studies, one focused on the value of urban forests in cities across Canada (Alexander and DePratto, 2014) and another specifically on the value of trees in the City of Toronto (Alexander and McDonald, 2014). The TD and other similar studies focus attention on the economic value of a limited suite of ecosystem services provided by the urban forest, such as, for example, improved air quality, reduced flooding and reduced urban temperatures. These benefits, however, represent only one set of a wide range of relevant socio-ecological values (Hotte et al., 2015; Figure G-1).

FIGURE G-1.

**Relationship
between urban
forest benefits
and a draft list
of sustainability
themes for Peel
Region**

(Wong, 2014)



Another key set of socio-ecological values relates to environmental justice and social equity. The justice and equity lenses are powerful, and are currently being used in a number of jurisdictions to help guide decision-making related to urban forestry. Peel Region's Tree Planting Prioritization Program builds on the principles of ecosystem services, environmental justice and social equity to inspire change in social-ecological system dynamics in neighbourhoods and communities across the municipality. The eight overall benefits of tree planting recognized by the Region of Peel (2015) include: "mitigating air pollution; mitigating urban heat island effects; contributing to the management of surface water quantity and quality; maintaining and enhancing

natural heritage; enhancing economic value; providing direct cost savings; supporting improved physical health and emotional well-being; and, strengthening communities and enhancing social equity" (Beacon Environmental, 2015, p. iii). These benefits structure a geographic information system (GIS) that can identify opportunity zones in the region that should be considered for new planting.

Health and Well-being

In their comprehensive review of urban forestry in Canada, Hotte et al. (2015) highlight the four mechanisms most frequently mentioned in the literature pertaining to urban forestry and public health. These include trees' role in i) filtering air; ii) increasing physical activity; iii) reducing stress, and iv) increasing social cohesion within a community. The first three mechanisms have been addressed in other case examples in this book (see Cases 1, 2, 4 and 7). The final mechanism, increasing social cohesion within a community, is the focus of this case example. A Region of Peel discussion paper defines social cohesion as "a process and outcome of social solidarity based on shared values, common norms and common bonds within a national community or population" (Galabuzi and Teelucksingh, 2010, p.2).

The focus on social cohesion is important. In their article in the American Journal of Public Health, Shanahan et al. (2015) note that disadvantaged neighbourhoods tend to contain "less overall vegetation cover, less public parkland, fewer street trees, and lower plant species richness and vegetation abundance" (p. 475). The authors state that "[g]iven the health outcomes that nature can deliver, inequalities in access and use could exacerbate social disadvantage" (p. 475). They also note that, while addressing the inequalities in the distribution of the urban forest is a key issue, it may prove that the real challenge is in maintaining the benefits of urban forestry for disadvantaged and low-income communities as the forest matures. As discussed further below, established trees raise local property values and can displace vulnerable and low income residents over time.

Actions

The Region of Peel's Tree Planting Prioritization Tool focuses on eight key overall benefits: i) mitigating air pollution; ii) mitigating urban heat island effects; iii) contributing to management of surface water quantity and quality; iv) maintaining and enhancing natural heritage; v) enhancing economic value; vi) providing direct cost savings; vii) supporting improved physical health and emotional well-being, and viii) strengthening communities and enhancing social equity. The issue of social justice is being highlighted in this short case (recognizing that the other themes are equally relevant and important for health and well-being). In the Tree Planting Prioritization Tool analysis all of the overall benefits are given equal weight.

The overall benefit of 'Strengthening communities and enhancing social equity' defines two target benefits: strengthening communities through better canopy cover, and enhancing lower income neighbourhoods through better canopy cover. The opportunity zones for tree planning were defined as residential areas with below average canopy cover in their jurisdiction, and areas with relatively high proportions of low income households, respectively.

The Tree Planting Prioritization Tool is the first program of its kind in Canada. It was developed "to support strategic and cost effective tree planting, and optimize the benefits accrued to the community from tree planting" (p.v). The system provides information about where planting should be undertaken (based on the parameters of the target benefits), and also where it could be undertaken (based on the planting space within the opportunity zone) (Beacon Environmental Limited, 2015). This powerful combination of social, economic and environmental factors interpreted spatially (at multiple scales) through a focus on tree planting is a fulsome demonstration of how these critical yet diverse themes interact on the landscape (Figure G-2). It is important in highlighting the multitude of social, environmental and health benefits that can be obtained through regional support for urban forests.



Figure G-2.
Example of Priority Planting
Areas in the Region of Peel

Discussion

Recent work on urban forestry in Canada highlights the important role that values play in shaping the questions, the analysis and the recommendations that emerge from applied research. The TD Bank analysis focuses attention on one select set of ecosystem services – those that lend themselves to econometric analysis and quantification. Peel Region's work focuses attention on the multiple values and the environmental characteristics that influence tree planting decisions, and the public benefit that can be gained from strategic investment in this area.

The social equity lens adds a challenging new layer of complexity to urban forestry decisions. It is a key feature of the 'urban green space paradox' (Wolch et al., 2014). Critical to understanding this paradox is respecting the power of urban forests and other green spaces to enhance property values. This means that investments in this area often disproportionately benefit higher income households. They can gentrify neighbourhoods, increasing housing costs and real estate values and thus price out the low income populations they were meant to benefit. Tree planting strategies inspired by social equity seek to create a level playing field across all jurisdictions, where all neighbourhoods have a baseline of equal access to the benefits of urban forests. Anguelovski (2015) goes so far as to state that locally unwanted land uses "can be reconceptualised from contamination sources to green amenities because of the displacement they seem to trigger or accelerate" (p. 1). This backlash against community greening in low income neighbourhoods is thus - ironically - grounded in a strong commitment to social justice.

From their study of environmental improvements leading to neighbourhood gentrification in Brooklyn, New York, Curren and Hamilton (2012) introduced the idea of 'just green enough'. This concept draws attention to the gentrification and displacement that often follows urban greening initiatives. The authors note that promoting social justice through being 'just green enough' often requires an organized fight against both market forces and environmental advocates. It raises challenging issues related to environmental justice as socio-economic conditions change over time – i.e. when green space improvements subvert the rationale for the initial investment (to enhance green spaces for the benefit of low-income communities). Other authors use the language of green and ecological gentrification to make this point (Checker, 2011; Wolch et al., 2014).

As the full value of urban forests gains recognition, the challenges of levelling the playing field and enhancing the benefits that can be gained for all citizens become increasingly apparent. Tools like the Priority Planting Tool are extremely valuable. Their recommendations, however, need to be weighed against the potential pitfalls of greening for social equity, highlighted by the concepts of green gentrification, the urban green space paradox and 'just green enough'.

Discussion Questions

- G-1. How much (and what quality of) scientific evidence is needed to support policy development in areas linking environment and human health?
- G-2. Does looking at neighbourhoods and municipalities as social-ecological systems defined at different scales change the conversation about what changes or investments are needed at each scale?
- G-3. Is 'just green enough' a factor in Peel Region? Why or why not?

For More Information about the Case, See:

Beacon Environmental Limited. 2015. Priority tree planting areas to grow Peel's urban forest. Report prepared for the Region of Peel: Beacon Environmental Limited. Accessed June 13 2016

<https://www.peelregion.ca/planning/climatechange/reports/pdf/ExecSum-TPPT-2015-Aug07.pdf>

H. GREENBELTS

Connecting to Place & the Ecological Determinants of Health

Summary

Greenbelts are used by cities around the world to protect swaths of natural features and agricultural land surrounding cities and towns from urban development. The Ontario Greenbelt was established in 2005 to protect the land that surrounds the Golden Horseshoe region. It built upon previous conservation initiatives established in the Oak Ridges Moraine Conservation Plan and Niagara Escarpment Plan. The scope and scale of the greenbelt fosters additional reflection on both the population health level benefits that are received from the connection to place being fostered by the Greenbelt within the region and the positive impact that this landscape has on the well-being of society. There is strong interest from a number of stakeholders in expanding the Greenbelt to include additional critical sensitive water resources in the region that are under threat from development and vulnerable to the effects of climate change. This interest in a so-called Bluebelt reinforces the connections that are being made through the Greenbelt to various determinants of health and the need to take proactive measures to sustain environmental systems for the benefit of current and future generations of Ontarians.

Introduction/Background

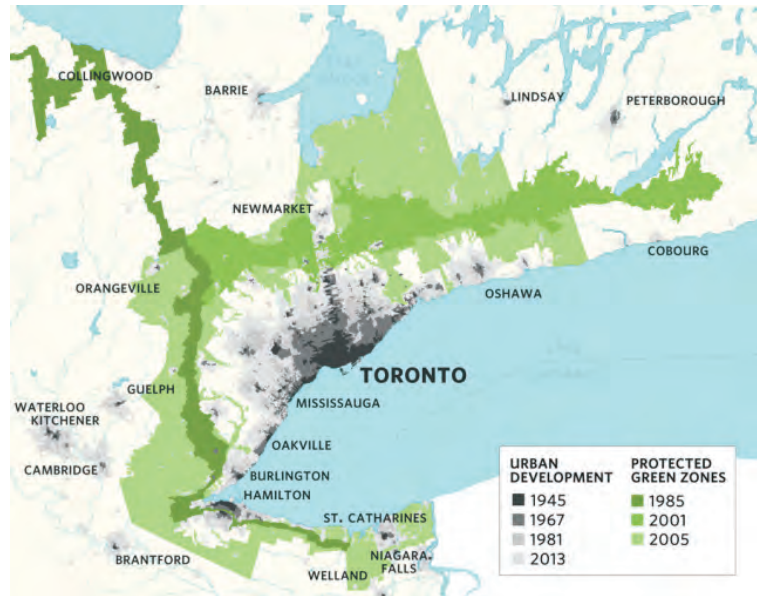
Greenbelts are "swaths of natural or open land surrounding cities or towns. They often contain a mix of public land and privately held land on which development restrictions are placed" (Erickson, 2004, p. 202). They are used by cities around the world to "help achieve local food security, protect ecological integrity, conserve biodiversity, protect local water quality and quantity, and provide natural recreation areas for nearby urban centres" (Carter-Whitney and Esakin, 2010, p.1). Greenbelts also act as carbon sinks. Protected vegetation absorbs and stores greenhouse gases, reducing a region's overall emissions. The Ontario Greenbelt is estimated to store 102 million tonnes of carbon (David Suzuki Foundation, 2008, p.3). This is important in Ontario as the province moves toward the establishment of "net-zero communities" as part of its climate change strategy (Ministry of the Environment and Climate Change, 2016).

The Ontario Greenbelt was established in 2005 to protect the land that surrounds the Golden Horseshoe region. It includes 430,000 ha of some of the most productive agricultural land in Canada. The Greenbelt emerged from the work of the Royal Commission on the Future of the Toronto Waterfront (see also Case 6). The Commission focussed attention on the entire Greater Toronto Bioregion – bounded by Lake Ontario to the South, the Niagara Escarpment to the West and the Oak Ridges Moraine to the north and east (Figure H-1). The Greenbelt is a "systems-based approach to natural heritage planning at a landscape scale" (Ontario Nature, 2014, p.8) covering 7,200 km². The Greenbelt Plan articulates five goals:

- agricultural protection
- environmental protection
- support for culture, recreation and tourism
- support for strong rural economy
- support for Infrastructure

FIGURE H-1.
Greenbelt and
Urban Development
Change over Time
(1945 – 2013)

(Source: Greenbelt.ca)



The interest of the emerging Bluebelt advocates (for example, the Grow our Greenbelt group) is to expand the greenbelt in such a way as to extend protection to “threatened headwaters, moraines, groundwater recharge and discharge areas, wetlands, rivers and streams” (Grow our Greenbelt, 2016). Such an interest recognizes that water and land management are inextricably linked – one of the key rationales for a watershed/aquifer based approach (Case 9).

Health and Well-being

The benefits of the Greenbelt for human health and well-being include, for those who live in and travel to the region, many of the individual level physical and psycho-social benefits associated with green space. These include physical health benefits related to outdoor recreation and tourism, good local outdoor air quality and reduced stress; mental health benefits related to relaxation, attention restoration and mood enhancement, and social benefits of sharing interests and concerns with an extended peer community, including the local food movement.

In this case, we are particularly interested in the concept of connection to place. Having a strong connection to place is seen as critical to help people make choices that help protect and conserve our natural environment (Halpenny, 2010). It is a psychological construct referring to the meanings, feelings and a sense of relationship that people attribute to particular places (Kyle and Chick, 2007; Lynch et al., 2012). It can be more difficult to foster in urban areas where people no longer experience the natural world as part of their daily life (Kellert, 2002; Schultz, 2002; Kyle et al., 2004). The Greenbelt draws on both natural and socio-cultural (Indigenous and post-Colonial) history and current programming (local food markets, trails, etc.) to help foster this connection in the region. This is demonstrated through consistent high levels of support for the Greenbelt, growing it to protect critical water resources and ensuring the boundaries are protected in perpetuity.³ As the Greenbelt connects more directly to cities along Lake Ontario through urban river valleys, this sense of connection to the surrounding landscape will be further strengthened.

The scope and scale of the Greenbelt fosters additional reflection on the population health level benefits that are received from the essential services supporting human life and the positive impact that this landscape has on the “well-being of society” (Forge, 2000, p.1). Because the Greenbelt influences both the social and ecological determinants of health in the region, this multifunctionality⁴ is critical to appreciating the Greenbelt. In terms of the social determinants, the greenbelt contributes to sustainable regional economic development. This includes enhanced food security through expanded local food systems, some resource development (e.g. aggregate), tourism and recreation (related to agriculture, natural heritage sites, recreational paths, scenic routes, etc.), as well as the provision of vital built and green infrastructure. This green infrastructure provides services such as flood control which protects human health and property in the event of extreme weather events.

³ Ontario Greenbelt Environics Polling 2015; http://www.greenbelt.ca/ontario_greenbelt_environics_polling_2015

⁴ “An activity is said to be multifunctional when it plays a number of roles that may contribute to the well-being of society. In economic terms, impacts other than the primary objective of an activity are called ‘externalities’” (Forge, 2000, p.1). The term is most commonly associated with agricultural policies in Europe and Japan. The ecosystem services provided by area or feature functionality are often overlooked or undervalued using traditional approaches, but can be highlighted by an emphasis on multifunctionality and the social and environmental determinants of health.

The Greenbelt influences the proximal environmental determinants of the health by placing controls on development practices that harm the integrity of the landscape. By limiting urban sprawl and the air, land and water quality degradation that accompanies them, the Greenbelt preserves vital air, water and land resources and reduces pollution. In addition, it helps address the myriad of other issues associated with urban sprawl, such as obesity, coronary heart disease, greenhouse gas emissions, road injuries and fatalities, and social and mental health (Griffin et al., 2013; Ewing et al., 2014; Barrington-Leigh and Millard-Ball, 2015). The distal ecological determinants of health, such as climate change, biodiversity loss, contaminants, etc., are also positively influenced by the Greenbelt. While the benefit of each individual action taken on the landscape (for example, a best management or low impact development practice) may be difficult to link to a population health outcome in a reductionist sense, they are nonetheless recognized as preventive health measures at the regional scale, for example by the World Health Organization (2011, 2016) and the Intergovernmental Panel on Climate Change (2014).

Actions

The Greenbelt has strong connections to other land use plans in the region. The Province of Ontario recently undertook a land use planning review that focused on the Growth Plan for the Greater Golden Horseshoe, the Greenbelt Plan, the Oak Ridges Moraine Conservation Plan and the Niagara Escarpment Plan. Together these four provincial land use plans are intended to manage growth, curb sprawl and protect the region's natural environment and agricultural lands. The review, and the Plan amendments proposed by the Province in response, call for stronger measures to build complete communities, support agriculture viability, protect natural heritage and water, grow the Greenbelt, address climate change, and integrate infrastructure with development. Taken together, these measures will increase human health and wellbeing in the Greater Golden Horseshoe, including the Greenbelt.

A key innovation in the current renewal of the Greenbelt Plan was the creation of a new land use designation in the province: urban river valleys. This change is allowing the Province to expand the Greenbelt directly into the urban communities it supports, through a network of 21 urban river valleys and 7 costal wetlands (Figure H-2). This expansion will contribute to the protection of the headwaters of the rivers running from the Greenbelt to Lake Ontario. It will also make a significant contribution to raising the public's awareness of both the green space and recreational resources provided by urban ravines and their connection to the larger Greenbelt system. As mentioned above, creating connections to place is vital to the creating social and political will to fully realize the benefits of the Greenbelt and related land use policies in the region.

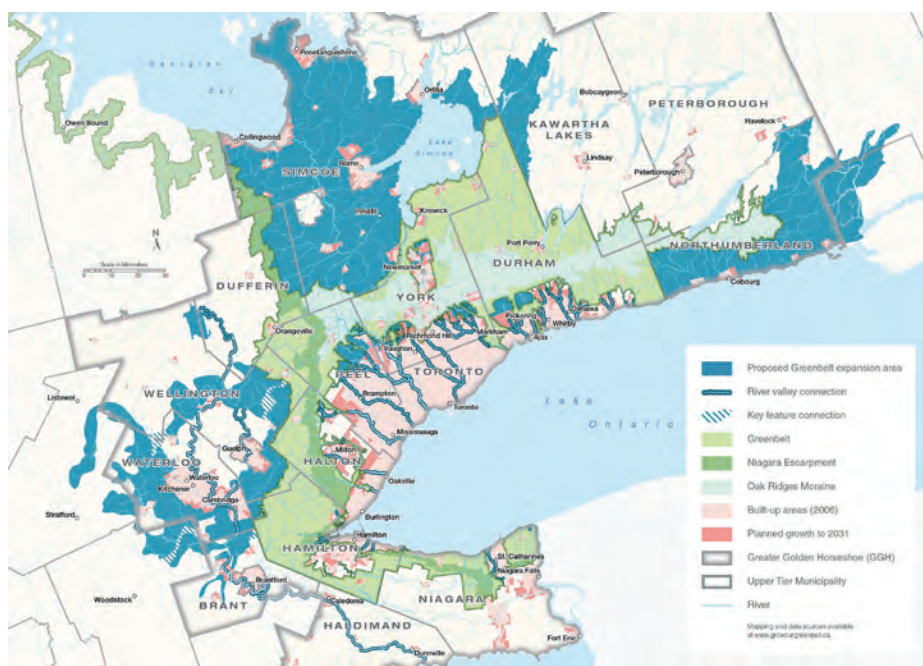


Figure H-2.
Proposed Greenbelt
Expansion with Rivers
and Headwaters

(Source: Grow our
Greenbelt, 2016)

The interest in incorporating additional water resource systems has the potential to revitalize ecosystems throughout the region. It supports existing densification programs for urban areas to create livable communities that make best use of expensive urban infrastructure and to protect the already contested water resources that support municipal, industrial, agricultural and ecological water uses in the region.

Discussion

The proposed amendments include establishing an ongoing commitment to explore new opportunities to grow the Greenbelt. Public calls to include lands referred to as the 'bluebelt' could improve the social and ecological determinants of health in the region by supported enhanced economic development activities and improving ambient environmental quality. By protecting vital water resources for generations to come, the proposed expansion will help ensure that future generations of Ontarians benefit from these vital resources. The Catskill Mountains in New York State that serve to provide New York City with potable water (Appleton, 2002; Postel and Thompson, 2005) starkly illustrate the financial argument to be made for resource preservation, as the cost of cleaning up degraded water resources for large populations is extremely expensive and difficult and forgoes the co-benefits that are received from inherent multifunctionality of these vital areas.⁵ By creating a new construct to label and identify Southern Ontario's valuable agricultural land (Figure H-3), the Greenbelt has assisted in creating a meaningful place for the region's predominantly urban residents to relate to and draw meaning from. The expansion of the Greenbelt into the urban river valleys of the Greater Horseshoe Region has the potential to raise public awareness of the interconnectedness among social, ecological and economic systems in the region. The ravines serve multiple functions, particularly as a recreation resource, wildlife corridor and the destination for precipitation and urban runoff from the surrounding watersheds. They are increasingly being framed as a focal point for Toronto's emerging green identity (Murray, 2000; City of Toronto, 2015).

Figure H-3.
Greenbelt Logo –
Creating a Sense
of Place



Discussion Questions

- H-1.** Which of the social determinants of health relate to this case example? Ecological determinants of health?
- H-2.** The services provided by the Greenbelt will only become more valuable over time in light of climate change and increasing urbanization. How can permanent protection be maintained in the face of pressure from land speculation by developers and urban boundary expansion?

For More Information about the Case, See:

Friends of the Greenbelt Foundation. 2016. www.greenbelt.ca

Grow Our Greenbelt. 2016. Growing the green, protecting the blue. www.growourgreenbelt.ca

⁵ The website ecosystemmarketplace.com briefly summarizes this well-known example as follows: "A filtration plant large enough to clean New York City's water supply would cost between \$8-\$10 billion in today's dollars, approximately \$6 billion to build and another \$250 million annually to maintain. Preserving the watershed, conversely, was estimated at \$1.5 billion, just over a dime invested on ecological preservation for every dollar that would have been spent on a filtration plant. The City spent or committed between \$1.4 – \$1.5 billion in watershed protection projects so far, averaging \$167 million in expenditures per year".

I. WATERSHED MANAGEMENT

Confronting loss of life and property due to flooding

Summary

Extensive deforestation and uncontrolled development in the late 1800s and early 1900s left Southern Ontario's social-ecological systems in a precarious state. In addition to the shift to semi-arid desert conditions across much of the province, there was a concurrent increase in severe flooding. Erosion and flooding caused extensive damage to property and proved fatal on a number of occasions. As public awareness and concern over this issue increased, there were calls for a political response. Water engineers were well aware that hydrological issues, such as flooding, needed to be confronted systemically on a watershed basis and that there were tensions between upstream activities and downstream flood events. In 1946, the Conservation Authorities Act was passed. As flood warning, flood zoning and flood forecasting techniques have improved, reductions in flood-related mortality are providing public health agencies with the space to focus on the wide range of other health impacts from flooding, such as mental health. On the water management side, there has been a shift from 'hard' to 'soft' paths for water, in particular green infrastructure.

Introduction/Background

The impacts of extensive deforestation and uncontrolled development in the late 1800s and early 1900s were not only detrimental to agricultural land and rural communities (see Case 1), but they also contributed to severe flood events that affected urban and rural communities downstream. The need for a more integrated approach to land and water management was recognized by a wide range of stakeholders, and the natural boundary of the watershed was recognized as the most effective one for this task. The political response to concerns over flooding was the creation of a watershed governance framework which led to the establishment of Conservation Authorities. Although watershed governance is critical to effective water and land management, Ontario is one of the few jurisdictions in Canada with an established province-wide mechanism for watershed governance (Robins, 2007).

The 1937 Thames River Flood (Figure I-1) was "the critical event that propelled the birth of the Conservation Authorities" (Bacher, 2011, p. 179). Five deaths were attributed to the flood and approximately 1,100 homes were destroyed. At 6.6 metres above mean summer flow, the flood crest was the highest ever recorded for the Thames River (Upper Thames River Conservation Authority, 2015).



Figure I-1.
Flooded Neighbourhoods from
the 1937 Thames River Flood

(Source: Upper Thames River
Conservation Authority, 2015)

The Conservation Authorities Act of 1946 provided a place-based mechanism for enhanced cooperation between municipalities and the Province at a watershed scale. It relied on local engagement and interest for the impetus to create a Conservation Authority. Such interest was more widespread in areas that were hard hit by deforestation, erosion and flooding, and where municipalities were being directly affected by upstream actions. Three fundamental concepts were embedded in the Act: i) local initiative, ii) cost-sharing and, iii) watershed jurisdiction (Conservation Ontario, 2016a). There are currently 36 Conservation Authorities in the province (Figure I-2).

Figure I-2.
Boundaries of Conservation
Authorities of Ontario.

Source: Conservation Ontario,
2016b



Health and Well-being

In the mid-1900s, concern over flooding centred on mortality (loss of life) and property damage. In 1954, for example, 81 people lost their lives from the Hurricane Hazel flood which was focused on the Humber River west of Toronto. The storm left over 1800 families homeless, caused more than \$25 million (1954 dollars, equal to almost 229 million in 2016!) in property damage and destroyed more than 20 bridges. Since that time, a broad array of adverse health impacts from flooding have been documented (Table I-1). Public health agencies are recognizing the link between climate change and increased severe weather events, including flooding, and the need to take proactive measures to identify and engage with vulnerable populations in flood-prone areas (Meene and Murray, 2012; Berry et al., 2014). There remains a need to focus on flood mitigation and warning systems to reduce threats to physical health. At the same time, the mental health impacts of major flood events are increasingly understood to be one of the major adverse health outcomes associated with these events (Stanke et al., 2012; Lowe et al., 2013; Goldman and Galea, 2014).

Table I-1.
Health impacts, climate-related causes and potential health effects related to extreme precipitation and flooding

(Source: Adapted from Morrison, 2015)

| Category | Climate-Related Causes | Projected/Possible Health Effects |
|---|---|---|
| Extreme weather events | <ul style="list-style-type: none"> • More frequent and violent thunderstorms, more severe hurricanes and other types of severe weather • Heavy rains causing landslides and floods • Canal breaching • Rising sea levels and coastal instability • Severe ice storms • Extreme snowfall events • Social and economic changes | <ul style="list-style-type: none"> • Death, injury and illness from violent storms, floods, heavy snow, landslides, ice, etc. • Injury caused by debris • Accidents caused by extreme precipitation and damage to transportation infrastructure • Carbon monoxide poisoning from generators • Electrocution from downed power lines and damaged household and electrical equipment • Psychological health effects, including mental health (e.g. depression, anxiety, post-traumatic stress) and stress-related illnesses from loss of loved ones, property, livelihoods and financial concerns • Health impacts from food or water shortages • Hypothermia and frostbite from disruption of power and heating systems • Effects of displacement of populations and crowding in emergency shelters • Indirect impacts from ecological changes, infrastructure damage and interruptions to health services |
| Contamination of food, water and buildings | <ul style="list-style-type: none"> • Contamination of drinking and recreational water by run-off from heavy rainfall and rapid snowmelt • Cross-contamination of water mains by sewage • Changes in marine and freshwater environments, including run-off patterns and turbidity, that result in algal blooms and higher levels of toxins in drinking and irrigation water, fish and shellfish | <ul style="list-style-type: none"> • Illnesses related to drinking water contamination (both pathogens and chemicals) • Outbreaks of strains of micro-organisms, such as E. coli, Cryptosporidium, Giardia, S. typhi, amoebas and other water borne pathogens • Food-borne illnesses • Intoxication from the ingestion, dermal exposure and/or inhalation of mould and algal toxins (several of which are also suspected carcinogens) • Other diarrheal and intestinal diseases |

Actions

Since the 1930s, significant investments have been made in flood protection using what are now known as ‘hard path’ approaches to water management (see Brooks, 2005; Box I-1). These include the construction of dams, dikes and diversions. Unfortunately, these solutions are “expensive to construct, have perpetual long term management costs and have the potential to fail resulting in catastrophic loss” (Conservation Ontario, 2013, p.8). Over the last decade, the focus has shifted

to a more comprehensive model, focused on five pillars of Emergency Planning and Management: prevention, mitigation, preparedness, response and recovery (Conservation Ontario, 2013). An approach that has been proven successful in protecting life and property when compared to other jurisdictions (Brown et al., 1997). Conservation authorities support their watershed communities by establishing policies to restrict or prohibit development (such as habitable structures) in flood hazardous areas. This is essentially a public health approach: saving lives and protecting property are the focus of this work. This environmental work is paralleled by that of the health hazards and disaster preparedness units of local public health units. They act on the information provided by the Conservation Authorities' flood warning systems to identify vulnerable populations prepare the community for public health emergencies and disasters.

Box I-1. Hard and Soft Paths for Water Management

Hard path approaches include traditional supply management activities, such as constructing higher dams, expanding pipe diameters and pipelines and drilling deeper wells to exploit new water reserves (Brooks, 2005). It can be contrasted to a more modern approach that encourages so-called soft path investments (Gleick, 2002). These include investments in water conservation and demand management, as well as an emphasis on green infrastructure, such as wetland protection and restoration, bioswales and permeable pavements. Green infrastructure is particularly important as a buffer against extreme precipitation and drought.

In addition to their work in emergency preparedness, the Conservation Authorities are increasingly targeting investments in 'soft path' techniques (Gleick, 2002), including green infrastructure, stormwater management and watershed stewardship to help mitigate the impact of severe weather and flooding. Not only do these techniques help reduce future flooding, they also provide a variety of green spaces that contribute a range of health benefits. Conservation Authorities are engaging more often with local public health units in discussions about not only flood protection, but also Source Water Protection (drinking water) and other areas of common interest (green space, canopy cover, recreation, etc.). These conversations are identifying additional opportunities to leverage the co-benefits of inter-sectoral watershed governance to enhance public health and well-being (Parkes et al., 2010; Bunch et al., 2014).

Discussion

The best indicator of future climate conditions is to consider an extreme version of current conditions (Kundzewicz, 2013). Thus, in areas with a history of flooding, more frequent and severe flooding can be expected. In areas suffering from drought, longer, more severe frequent and severe droughts can be expected. Thus, climate change adaptation measures need to be grounded in local conditions. It is difficult, and frequently prohibitively expensive, to build hard path solutions to all potential future climate threats. The degree of uncertainty and the additional costs are such that alternatives are needed. This is where soft paths for water, green infrastructure and watershed governance converge as critical mechanisms for climate change adaptation. Ontario's Conservation Authorities are well-positioned to help lead this work but they need supportive and engaged populations who understand the rationale behind land- and water management decisions and their links to human health and well-being in a changing climate.

Discussion Questions

- I-1. How will climate change impact the relationship between watershed governance and human health and well-being?
- I-2. What is the current role of public health in watershed governance? Is it sufficient?
- I-3. What are the co-benefits associated with increased investments in 'green infrastructure' at the watershed scale?

- I-4. Is there a parallel between the shift from hard to soft water paths and between concern over the physical to the mental health impacts of flooding? Why or why not?
- I-5. How effective are Conservation Authorities in protecting human health and well-being from the threat of flooding? Which health impacts are they most focused on?

For More Information about the Case, See:

Conservation Ontario. 2016. www.conservationontario.ca

I. REGIONAL FOREST RESTORATION

Environmental Degradation, Unsustainable Livelihoods and Population Health in Southern Ontario

Summary

Many Ontarians are unaware that, in the mid to late 1800s, human activities turned large swaths of Southern Ontario into semi-arid desert. This ecosystem shift was largely due to rampant and uncontrolled deforestation. It had the effect of devastating rural communities and livelihoods across the region. The 'cure' for this socio-economic and ecological disaster was an extensive and on-going investment in reforestation. Reforestation programs helped restore the viability of agriculture and rural communities through their impact on soil and water resources.

Introduction/Background

By 1850 the forests in Southern Ontario had been largely cleared through processes of unrestricted logging and fire. Governments of the time put a priority on settlement and agricultural development, both objectives to be accomplished through deforestation and conversion of the land to a farming economy. These activities, however, left the lands susceptible to extensive wind erosion often stripping away the fertile soils, leaving only sands with no fertility. In Southern Ontario, this practice had serious implications for the livelihoods of the predominantly rural, agricultural communities. In the mid- to late 1800s and early 1900s, the scope and scale of the environmental degradation caused by clearing land by fire and unsustainable logging practices were such that many formerly fertile areas had become semi-arid deserts, that were "irredeemable for agriculture" (Kelly, 1975, p. 69; Figure J-1). These problems re-emerged in Southern Ontario during the Great Depression (1929-1939) when forest regulations and programming were weakened.



FIGURE J-1.

Soil eroded from underneath the roots of white pine after deforestation (1905)

Source:

<https://springwaterparkcitizenscoalition.wordpress.com/tag/dr-john-bacher/>

FIGURE J-2.

Springwater Park, Simcoe County, after clear cut and before replanting in 1922. Photo taken in 1926 by Edmund Zavitz

<https://springwaterparkcitizenscoalition.wordpress.com/tag/dr-john-bacher/>



Soil erosion and blow sand were serious issues, and the loss of soil fertility reduced yields and diminished the ability of the land to sustain livestock and crops (Niewojt, 2007). Without trees to buffer the wind, heavy snowdrifts blocked roadways and made winter driving even more treacherous, while unimpeded gusts of wind also dispersed topsoil and leaf litter, preventing seeds from germinating. In some places, farmhouses, fence rows and even roads were partially buried by sand and dark clouds of airborne sand could be seen on the horizon (Figure J-2). The degraded landscape contributed to serious downstream flooding, particularly in the spring. Groundwater retention was affected, causing a loss of soil moisture and reduced stream baseflows and summer droughts. For example, in the 1908 *Report on Reforestation of Wastelands in Southern Ontario*, Francis Squair warned that streams flowing from the Oak Ridges moraine had “almost ceased to exist, except for a short time during spring freshets” (Bacher, 2011, p.80). Shallow wells were contaminated by erosion and runoff and ghost towns were created across the region. Farmers began to notice changes in the local climate – for example, the fruit tree industry was “on the verge of collapse” as farmers found it more difficult to grow fruit in a harsher local climate with strong winds sweeping along unimpeded by forests. In other areas, such as Prince Edward County, orchards were being “entombed” by blowing sand dunes (Bacher, 2011, p. 97). Indeed, the Ontario Fruit Growers Association, formed in 1892, was one of the early advocates of reforestation.

Health and Well-being

Health issues related to a lack of forests included threats to physical well-being from flooding, infrastructure damage, a harsher climate (e.g. wind and sunburn, hypothermia, frostbite) and degraded drinking water quality and quantity. Threats to social and family health came from population dislocation as well as food and livelihood insecurity. Mental health challenges were linked to the loss of livelihoods and (for some) the loss of contact with nature and the aesthetic values of forests.

Actions

In response to concern over the degradation of the landscape in the late 1800s and early 1900s, extensive reforestation measures were undertaken by the provincial government. They included new regulations, by-laws and policies, tree planting and soil cover (e.g. sweet clover) programs, investments in forest husbandry and nurseries as well as water towers, investments in fencing to prevent the spread of sand dunes, demonstration sites and the creation of extensive forest reserves. Trees help purify polluted runoff and wellhead plantings were encouraged to protect sources of drinking water from contamination. These programs were implemented differently in each county, and some regions lagged behind others. Due to on-going settlement and land clearing for agriculture, and despite decades of concerted effort, the percentage of forest cover in Southern Ontario in 1943 was the lowest ever recorded (9.7%). As the benefits of reforestation became more apparent, however, the situation improved, and in 1963, the forests covered 25.2% of the region (Bacher, 2011, p. 199). The current percentage remains around 25%, although in some predominately agricultural counties, such as Essex, the percentage remains extremely low at 5 - 7% (See also Box J-1).

Box J-1. Environmental Canada Forest Threshold Recommendations

Environment Canada recommends a minimum threshold of 30% forest cover in a watershed, although this is a 'high-risk' approach that should be considered a lower limit (Ontario Nature, 2004).

The department points out that the "target 30% forest cover at the watershed scale is the minimum forest cover threshold. This equates to a high-risk approach that may only support less than one half of the potential species richness, and marginally healthy aquatic systems; 40% forest cover at the watershed scale equates to a medium-risk approach that is likely to support more than one half of the potential species richness, and moderately healthy aquatic systems; 50% forest cover or more at the watershed scale equates to a low-risk approach that is likely to support most of the potential species, and healthy aquatic systems". Thus, a minimum 50% cover is needed to ensure healthy natural landscapes.

Environment Canada, 2004, internet pagination

In the 1960s, as the immediate threats to livelihoods and health in the region diminished and public awareness of ecological issues increased, attention was directed more to enhancing the ecological integrity of these restored forest landscapes and to connecting them to local communities through, for example, the establishment of recreational trails. The region's county forests and reforested private lands were recognized as prime habitat for a wide range of species, and the main source of the remaining Carolinian forest. Work continues on enhancing the economic, social and biodiversity-related benefits that can be obtained from these large tracts of forest. Their contributions to the stabilization of soils and to the protection of surface and groundwater resources are well-recognized (although perhaps still undervalued). The forests contribute to provincial carbon sequestration efforts and reduce albedo, thus helping mitigate global climate change.

Discussion

The magnitude of the damage done to the Southern Ontario landscape by uncontrolled deforestation is difficult to imagine today, thanks to the heroic actions of legions of foresters and forestry advocates, such as Edmund Zavitz (1875-1969), Trees Ontario (now Forests Ontario), the Ontario Conservation Authorities, community forest managers, the Ministry of Natural Resources and Forests, many producer groups (such as the Ontario Fruit Growers Association) and individual landowners. This case illustrates the power of the link between the Southern Ontario ecosystem and human health and well-being. Where the ecosystem is severely degraded, the resulting semi-arid landscape is a difficult one for human populations to thrive in. Where the forest ecosystem is sustainably managed, water resources, soil quality and functioning rural settlements can eventually be restored.

There are many parallels between Ontario's past experience of deforestation, and our current concern over global climate change. The need for proactive measures to sustain functioning ecosystems, as well as remedial efforts to restore degraded ones, are complicated by uncertainty over the scope and scale of climate change and its impacts on social and ecological systems. Ontario has direct experience dealing with some of the major socio-ecological challenges currently plaguing many developing countries (for example, desertification, population migration linked to ecosystem degradation). Nonetheless, we rarely think of these as issues of provincial concern, thanks to the decades of action taken to restore our own severely degraded landscapes. We are also increasingly aware of the protection our large tracts of forest continue to provide, in terms of carbon sequestration, albedo and biodiversity protection.

In 2015, the Ontario legislature unanimously approved a motion to support a new Green Legacy Program which aims to celebrate Ontario's entry into Confederation (with Nova Scotia, New Brunswick and Quebec) in 1867 by planting 150 million trees (one for each year of Confederation) beginning in 2017. This initiative highlights the continuing need to invest in the sustainable management and restoration of our forests, in order to protect the health and well-being of current and future generations of Ontarians.

Discussion Questions

- Is deforestation really a 'health' issue? Would it have been perceived as one in the late 1800s? Now?
- What other benefits can be realized from the protection and restoration of large forests, in addition to reducing flooding and drought and protecting biodiversity?
- What are the social determinants of health and how are they linked to this case study?
- What would Southern Ontario look like now if the reforestation initiatives of the early 1900s had not been undertaken?
- Given what the agency itself has written, is Environment Canada's 30% minimum target for forest cover in a watershed adequate to protect the health and well-being of current and future generations of Ontarians? Is 50% forest cover feasible throughout the province? How could it be achieved?
- What parallels can be drawn between regional deforestation in the 1800s and climate change today?

For More Information about the Case, See:

- Bacher, J. 2011. Two Billion Trees and Counting: The Legacy of Edmund Zavitz. Toronto: Dunburn.

ECOHEALTH ONTARIO

EcoHealth Ontario (EHO) is a collaborative of professionals in the fields of public health, medicine, education, planning and the environment. We are working together to increase our understanding of the relationships between environment and health with the aim of finding ways to increase the quality and diversity of the urban and rural spaces in which we live.

Please send us your comments and feedback regarding the casebook, through our website at:

<http://www.ecohealth-ontario.ca/>

References

- Introduction

- Barton, H. and M. Grant. 2006. A health map for the local human habitat. *The Journal for the Royal Society for the Promotion of Health*. 126(6):252-253.
- Bharmal, N., K.P. Derose, M. Felician and M.M. Weden. 2015. Understanding the upstream social determinants of health. Working Paper. Washington, D.C.: RAND Social Determinants of Health Working Group.
- Canadian Public Health Association (CPHA). 2015. Global change and public health: Addressing the ecological determinants of health. Ottawa: CPHA.
- Commission on the Social Determinants of Health. 2008. Closing the gap in a generation. Geneva: WHO. http://www.who.int/social_determinants/thecommission/finalreport/en/
- Dahlgren G, Whitehead M (1991). "The main determinants of health" model, version accessible in: Dahlgren G, and Whitehead M. (2007) European strategies for tackling social inequities in health: Levelling up Part 2. Copenhagen: WHO Regional Office for Europe.
- Ecohealth Ontario. 2015. Realizing the health benefits of green space in a changing world: Workshop Report. Toronto: Ecohealth Ontario.
- Gehlert, S. et al. 2008. Targeting health disparities: A model linking upstream determinants to downstream interventions. *Health Affairs*. 27(2):339-349.
- Intergovernmental Panel on Climate Change. 2015. Climate Change 2014 Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the IPCC. Geneva: IPCC.
- James, P., R.F. Banay, J.E. Hart and F. Laden. 2015. A review of the health benefits of greenness. *Current Epidemiology Reports*. 2:131-142.
- Maller, C., M. Townsend, A. Pryor, P. Brown and L. St. Leger. 2006. Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations. *Health Promotion International*. 21(1):45-54.
- Mikkonen, J. and D. Raphael. 2010. Social Determinants of Health: The Canadian Facts. Toronto: York University School of Health Policy and Management.
- Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being Synthesis. Washington, D.C.: Island Press. Morrison, K. E., Parkes, M. W., Hallstrom, L. H., Neudoerffer, C. V., Bunch, M. J., & Venema, H. D. 2012. Ecohealth and watersheds: Watersheds as settings for health and well-being in Canada. Network for Ecosystem Sustainability and Health (Publication Series No. 3) and the International Institute for Sustainable Development, Winnipeg, MB.
- National Collaborating Centre for the Determinants of Health (NCCDH). 2014. Let's talk: Moving upstream. Antigonish: NCCDH.
- Parkes MW, Horwitz P. 2009. Water, ecology and health: Exploring ecosystems as a 'settings' for promoting health and sustainability. *Health Promotion International*, 24, 94 -102.
- Public Health Agency of Canada. 2013. What determines health. [Accessed 25 October 2016] <http://www.phac-aspc.gc.ca/ph-sp/determinants/index-eng.php>
- Public Health Agency of Canada. 2016. Social Determinants of Health. [Accessed 16 August 2016]. <http://cbpp-pcpe.phac-aspc.gc.ca/public-health-topics/social-determinants-of-health/>
- Raphael, D. (ed.). 2016. Social determinants of health: Canadian perspectives. 3rd Edition. Toronto: Canadian Scholar's Press, Inc.
- Rugel, E. 2015. Green space and mental health: Pathways, impacts and gaps. Vancouver: National Collaborating Centre for Environmental Health.....

- Speechley, T. and A. Terry (eds.). 2015. *Western Public Health Casebook: Cases from the Schulich Interfaculty Program in Public Health*. London: Western University Public Health Casebook Publishing.
- Toronto Public Health. 2015. *Green City: Why nature matters to health – An Evidence Review*. Toronto, Ontario.
- Tredinnick, M. 2003. *Belonging to here: An introduction*. In: Tredinnick, M. (ed.). *A place on Earth – An anthology of nature writing from Australia and North America*. Sydney, Australia: University of New South Wales Press. pp. 27-45.
- World Health Organization (WHO). 1948. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19-22 June; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948.
- WHO. 2015. *Connecting Global Priorities: Biodiversity and Human Health: A State of Knowledge Review*. Convention on Biological Diversity. Retrieved from <https://www.cbd.int/health/SOK-biodiversity-en.pdf>
- WHO Europe. 1978. Alma Ata Declaration. International Conference on Primary Health Care. 6-12 September. http://www.euro.who.int/__data/assets/pdf_file/0009/113877/E93944.pdf
- WHO Europe. 2016. Social Determinants. [Accessed 16 August 2016] <http://www.euro.who.int/en/health-topics/health-determinants/social-determinants/social-determinants>
- Zupancic, T., C. Westmacott and M. Bulhuis. 2015. *The impact of green space on heat and air pollution in urban communities: A meta-narrative systematic review*. Toronto: David Suzuki Foundation.

– Case 1 Street Trees

- Burden, D. 2006. *Urban Street Trees: 22 Benefits, Specific Applications*. Walkable Communities, Inc.
- City of Toronto. 2010. *Every Tree Counts: A portfolio of Toronto's Urban Forest*. Toronto: Parks, Forestry and Recreation Department.
- City of Toronto. 2013. *Sustaining and Expanding the Urban Forest: Toronto's Strategic Forest Management Plan*. Toronto: Parks, Forestry and Recreation Department.
- Clean Air Partnership. 2012. *A street tree survival strategy in Toronto*. Toronto: Clean Air Partnership.
- Hotte, N., S. Barron, Z.C. Cheng, L. Nesbitt and J. Cowan. 2015. *The social and economic values of Canada's urban forests: A national synthesis*. Vancouver: Canadian Forest Service and University of British Columbia.
- Johnston, M. 2004. Impacts and adaptation for climate change in urban forests. *Proceedings of the 6th Canadian Urban Forest Conference*, Kelowna, BC.
- Karden, O., et al. 2015. Neighbourhood greenspace and health in a large urban center. *Scientific Reports*. 5, 11610; doi: 10.1038/srep11610
- Nowak et al., 2013. *Assessing urban forest effects and values: Toronto's urban forest*. Delaware, USA: United States Department of Agriculture Forest Service. Resource Bulletin NRS-79.
- United States Department of Agriculture (USDA). 1996. *Agroforestry for farms and ranches*. Agroforestry Technical Note No. 1. Washington, D.C.: Natural Resources Conservation Service.
- United States Environmental Protection Agency. 2013. *Stormwater to Street Trees: Engineering urban forests for stormwater management*. Washington, D.C.: Office of Wetlands, Oceans and Watersheds.
- Weiditz, I., & Penney, J. 2007. *Climate Change Adaptation Options for Toronto's Urban Forests*. (online) Available at: http://www.cleanairpartnership.org/reports_climate_change_adaptation [Accessed: March 19, 2011]

– Case 2 – Hospital Gardens

- Annerstedt, M. and P. Wahrborg. 2011. Nature-assisted therapy: Systematic review of controlled and observational studies. *Public, Environmental and Occupational Health*. 39(4):371-388.
- Boone, T. 2012. *Creating a culture of sustainability: Leadership, coordination and performance measurement decisions in healthcare*. Chicago: University of Illinois.

- Bower, G. H. 1981. Mood and Memory. *American Psychology*. 36(2): 129-148.
- Children's Hospital of Eastern Ontario. 2013. Healing Earth Garden. Powerpoint Presentation prepared by the CHEO Sustainability Committee Executive. Ottawa: CHEO.
- Children's Hospital of Eastern Ontario. 2016. CHEO's Healing Garden. [Accessed 16 August 2016] <http://www.cheo.on.ca/en/healing-garden>
- Cooper-Marcus, C. and M. Barnes. 1995. Gardens in healthcare facilities: Uses, therapeutic benefits and design recommendations. Concord, USA: Centre for Health Design.
- Cooper-Marcus, C. 2007. Healing gardens in hospitals. *Interdisciplinary Design and Research e-journal*. 1(1): on-line pagination. <http://www.idrp.wsu.edu>
- Cooper-Marcus, C. 2016. The future of healing gardens. *Health Environments Research and Design Journal*. 9(2):172-174.
- Davis, B.E. 2011. Rooftop hospital gardens for physical therapy: A post-occupancy evaluation. *Health Environments Research and Design Journal*. 4(2):14-43.
- Draper, C. and D. Freedman. 2010. Review and analysis of the benefits, purposes and motivations associated with community gardening in the United States. *Journal of Community Practice*. 18(4):458-492.
- Dwyer, K., M-C. Flores-Pajot, J. Lawlor, J. McGivern and E. Pagotto. 2016. Harvesting health: Investigating the therapeutic effects of gardens. Thesis submitted to the Faculty of Graduate and Post-Doctoral Affairs. Ottawa: Carleton University.
- Faber Taylor, A. and F. Kuo. 2006. Is contact with nature important for healthy child development? State of the evidence. In: Spencer, C. and M. Blades (eds.). *Children and their environments: Learning, using and designing spaces*. Cambridge, UK: Cambridge University Press. 124-140.
- Franklin, D. 2012. How hospital gardens help patients heal. *Scientific American*. <http://www.scientificamerican.com/article/nature-that-nurtures/>
- Grinde, B. and G. Patil. 2009. Biophilia: Does visual contact with nature impact on health and well-being? *International Journal of Environmental Research and Public Health*. 6:2332-2343.
- Hamilton, D and M. Shepley. 2010. *Design for critical care: An evidence-based approach*. Oxford: Elsevier.
- Kingsley, J.Y., M. Townsend and C. Henderson-Wilson. 2009. Cultivating health and wellbeing: Members' perception of the health benefits of a Port Melbourne community garden. *Leisure Studies*. 28(2):207-209.
- Knezevic, I., P. Mount and C. Clement. 2016. Shared opportunities on institutional lands: On-site food production, its benefits, barriers, and opportunities. *Health Environments Research and Design Journal*. 1-11.
- Minton, C. and L. Batten. 2015. Rethinking the intensive care environment: Considering nature in nursing practice. *Journal of Clinical Nursing*. 25:269-277.
- Mount, P. and Knezevic, I. 2015. Ontario public institutions and on-site food production: Current capacities and constraints. Guelph, Ontario: Ontario Ministry of Agriculture, Food and Rural Affairs. Available at <http://projectsoil.ca/project-reports/>
- Nightingale, F. 1860. *Notes on nursing: What it is, and what it is not*. London: Harrison and Sons.
- Perrins-Margalis et al. 2000. The immediate effects of a group-based horticulture experience on the quality of life of persons with chronic mental illness. *Occupational Therapy in Mental Health*. 16(1):15-32.
- Pollock, A. and M. Marshall (eds.). 2012. *Designing outdoor environments for people with dementia*. New York: HammondCare Press.
- Quayle, H. 2007. *The true value of community farms and gardens: Social, environmental, health and economic*. Bristol, UK: Federation of City Farms and Community Gardens.
- Schroeder, H. 2012. *Getting sustainability right in Canadian health care: an art and science approach*. Ottawa: Canadian Coalition for Green Health Care.
- Thompson, I. 2000. *Ecology, community and delight: An inquiry into values in landscape architecture*. London: Spon Press.
- Ulrich, R. 1984. View through a window may influence recovery from surgery. *Science*. 22(4):224-225.

- Ulrich, R. 1999. Effects of gardens on health outcomes: theory and research. In: Cooper-Marcus, C., M. Barnes (eds.). *Healing gardens: Therapeutic benefits and design recommendations*. New York: Wiley. pp. 27-86.
- Ulrich, R. 2002. Health benefits of gardens in hospitals. Paper for Conference: Plants for People International Exhibition Floriade. Accessed 8 August 2016 from: [www. http://plantsolutions.com/documents/HealthSettingsUlrich.pdf](http://plantsolutions.com/documents/HealthSettingsUlrich.pdf)
- Ulrich, R. S., & Gilpin, L. 2003. Healing arts: Nutrition for the soul. In: S. B. Frampton, L. Gilpin, & P. A. Charmel (eds.), *Putting patients first: Designing and practicing patient-centered care* (pp. 117–146). San Francisco, USA: John Wiley & Sons.
- Velarde, M.D., G. Fry and M. Tveit. 2007. Health effects of viewing landscapes – Landscape types in environmental psychology. *Urban Forestry & Urban Greening*. 6:199-212.
- Wilson, E.O. 1984. *Biophilia*. Boston, USA: Harvard University Press.
- Whitehouse, S. et al. 2001. Evaluating a children's hospital garden environment: utilization and consumer satisfaction. *Journal of Environmental Psychology*. 21(3):301-314.

– Case 3 School Greening

- Active Healthy Kids Canada. 2012. *Is Active Play Extinct? The Active Healthy Kids Canada 2012 Report Card on Physical Activity for Children and Youth*. Toronto: Active Healthy Kids Canada.
- Active Healthy Kids Canada. 2014. *Is Canada in the Running? How Canada Stacks Up Against 14 Other Countries on Physical Activity for Children and Youth*. Toronto: Active Healthy Kids Canada.
- Baines, E., Blatchford, P., 2011. Children's games and playground activities in school and their role in development. In: Pellegrini, A.D. (Ed.). *The Oxford Handbook of the Development of Play*. Oxford University Press, New York, pp. 261–283.
- Bell, A.C. and Dymont, J.E. 2006. *Grounds for Action: Promoting Physical Activity through School Ground Greening in Canada*, Toronto, Ontario: Evergreen. Available at <http://www.evergreen.ca/en/lg/lg-resources.html>
- Brown, V., J.A. Harris and J.Y. Russell. 2010. *Tackling wicked problems through the transdisciplinary imagination*. Washington, D.C.: Earthscan.
- Dymont, J.E. 2005. *Gaining ground: The power and potential of green school grounds in the Toronto District School Board*. Toronto, Ontario: Evergreen. Available at [http:// www.evergreen.ca/en/lg/lg-resources.html](http://www.evergreen.ca/en/lg/lg-resources.html).
- Dymont, J.E. and A.C. Bell. 2007. Active by design: Promoting physical activity through school ground greening. *Children's Geographies*. 5(4):463-477.
- Dymont, J.E., Bell, A.C., Lucas, A.J., 2009. The relationship between school ground design and intensity of physical activity. *Children's Geographies* 7 (3), 261–276.
- Evans, J. 2001. In search of peaceful playgrounds, *Education Research and Perspectives*, 28(1), 45–56.
- Evergreen. 2003. *The Learning Grounds: Guide for Schools*. Toronto: Evergreen.
- Evergreen. 2016a. *Greening School Grounds*. <http://www.evergreen.ca/our-impact/children/greening-school-grounds/>
- Evergreen. 2016b. *Asphalt to apple trees: École Marie-Curie in Ottawa transforms their school grounds*. Accessed 7 July 2016: <https://www.evergreen.ca/blog/entry/asphalt-apple-trees-ecole-marie-curie-ottawa-transforms-school-grounds/>
- Fielding, S. 2000. Walk on the left!: Children's geographies and the primary school. In: S.L. Holloway and G. Valentine (eds.) *Children's Geographies: Playing, Living, Learning*, New York: Routledge, 230–244.
- Fjortoft, I. 2004. Landscape as playscape: The effects of natural environments on children's play and motor development, *Children, Youth and Environments*, 14(2), 21–44.
- Gagen, E.A. 2000. Playing the part: Performing gender in America's playgrounds, in: S.L. Holloway and G. Valentine (eds.) *Children's Geographies: Playing, Living, Learning*, New York: Routledge, 213–229.
- Holmes, R. and C. Collyer. 2006. *All hands in the dirt: A guide to designing and creating natural school grounds*. Evergreen: Toronto. [<https://www.evergreen.ca/downloads/html/all-hands/index.html>]

- Kriemler, S., Meyer, U., Martin, E., van Sluijs, E. M., Andersen, L. B., & Martin, B. W. 2011. Effect of school-based interventions on physical activity and fitness in children and adolescents: a review of reviews and systematic update. *British Journal of Sports Medicine*, 45(11), 923–930. doi:10.1136/bjsports-2011-090186
- Loebach, J. and J. Gilliland. 2016. Neighbourhood play on the endangered list: examining patterns in children's local activity and mobility using GPS monitoring and qualitative GIS. *Children's Geographies*. <http://dx.doi.org/10.1080/14733285.2016.1140126>
- Louv, R. 2005. Last child in the woods: Saving our children from nature-deficit disorder. Chapel Hill, USA: Algonquin Books of Chapel Hill.
- Maller, C. and Townsend, M. 2005. Children's mental health and wellbeing and hands-on contact with nature. *The International Journal of Learning*, 12, 1447–9540.
- Martensson, F., M. Jansson, M. Johansson, A. Raustorp, M. Kylin and C. Boldemann. 2014. The role of greenery for physical play at school grounds. *Urban Forestry and Urban Greening*. 13:103-113.
- Pyle, R.M. 1993. The thunder tree: lessons from an urban wildland. Boston, USA: Houghton Mifflin.
- Rittle, H.W.J. and M. M. Weber. 1973. Dilemmas in a general theory of planning. *Policy Sciences*. 4:155-169.
- Soga, M. and K.J. Gaston. 2016. Extinction of experience: the loss of human-nature interactions. *Frontiers in Ecology and the Environment*. 14(2):94-101.
- Toronto District School Board. 2004. *Ecoschools: School Ground Greening Designing for Shade and Energy Conservation*. Toronto, Ontario: Toronto District School Board.
- United Nations. 1989. *Convention on the Rights of the Child*. High Commissioner for Human Rights: Geneva, Switzerland.

– Case 4 – Mood Walks

- Antonovsky, A. 1979. *Health, Stress and Coping*. San Francisco: Jossey-Bass Press.
- Barton, J., M. Griffen and J. Pretty. 2012. Exercise-, nature- and socially interactive-based initiatives improve mood and self-esteem in the clinical population. *Perspectives in Public Health*. 132:89-96.
- Berman, M., J. Jonides and S. Kaplan. 2008. The cognitive benefits of interacting with nature. *Psychological Science*. 19:1207-1212.
- Berman, M. et al., 2012. Interacting with nature improves cognition for individuals with depression. *Journal of Affective Disorders*. 140:300-305.
- Bowler, D.E., L. Buyung-Ali, T.M. Knight and A.S. Pullin. 2010. A systematic review of the evidence for the added benefits to health of exposure to natural environment. *BMC Public Health*. 10:456-466.
- Burford, A. 1969. *The Greek temple builders at Epidauros*. Toronto: University of Toronto Press.
- Collado, S., H. Staats, J.A. Corraliza and T. Hartig. 2017. Restorative environments and health. In: *Handbook of environmental psychology and quality of life research*. New York: Springer International Publishing. pp. 127-148.
- Coon, J.T. et al. Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental wellbeing than physical activity indoors? A systematic review. *Environmental Science and Technology*. 2011. doi: 10.1021/es102947t
- Cruwys, T. et al. 2014. Feeling connected again: Interventions that increase social identification reduce depression symptoms in community and clinical settings. *Journal of Affective Disorders*. 159:139-146.
- Friesen, F. Best Practices for Success with Mood Walks Groups: A Hike Ontario Perspective. Presentation to the Mood Walks Summit. YMCA Elm Centre: Toronto. 31 March 2016. [Accessed 30 May 2016] <http://www.moodwalks.ca/wordpress/wp-content/uploads/2015/04/Best-Practices-for-Success-with-Mood-Walks-Groups.pdf>
- Frumppkin, H. and R.J. Jackson. 2014. Ecopsychology and public health. *Ecopsychology*. 6(3):131-133.

- Gonzalez, M., T. Hartig, G.G. Patil, E.W. Martinsen and M. Kirkevold. 2010. Therapeutic horticulture in clinical depression: A prospective study of active components. *Journal of Advanced Nursing*. 66:2002-2013.
- Hartig, T., G.W. Evans, L.D. Jamner, D.S. Davis and T. Garling. 2003. Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology*. 23:109-123.
- Iwata, Y., A.N. Dhubhain, J. Brophy, D. Roddy, C. Burke and B. Murphy. 2016. Benefits of group walking in forests for people with significant mental ill-health. *Ecopsychology*. 8(1):16-26.
- Jung, M., J. Jonides, L. Northouse, M.G. Berman, T.M. Koelling and S.J. Pressler. 2016. Randomized crossover study of the natural restorative environment intervention to improve attention and mood in heart failure. *Journal of Cardiovascular Nursing*. Oct 14. [Epub ahead of print] <https://www.ncbi.nlm.nih.gov/pubmed/27755225>
- Kaplan, R. and S. Kaplan. 1989. *The experience of nature: A psychological perspective*. Cambridge, UK: Cambridge University Press.
- Kaplan, S. 1995. The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology*. 15(3):169-182.
- Korpela, K.M., E. Stengard and P. Jussila. 2016. Nature walks as part of therapeutic intervention for depression. *Ecopsychology*. 8(1):9-15.
- Lee, K.E. et al. 2015. 40-second green room view sustain attention: The role of micro-breaks in attention restoration. *Journal of Environmental Psychology*. 42:182-189.
- Marselle, M. R., K.N. Irvine and S.L. Warber. 2014. Examining group walks in nature and multiple aspects of well-being: A large-scale study. *Ecopsychology*. 6(3):134-147.
- Morgan, W. P. (2001). Prescription of physical activity: a paradigm shift. *Quest*, 53(3), 366-382.
- Mitchell, S. Mood Walks. Presentation to the Healthy Parks, Healthy People Conference. University of Waterloo, Ontario. May 6-7, 2015. [Accessed 30 May 2016] <http://www.moodwalks.ca/wordpress/wp-content/uploads/2015/07/Mood-Walks-CASIOPA-20150507-web.pdf>
- Ohly, H., et al. 2016. Attention restoration theory: A systematic review of the attention restoration potential of exposure to natural environments. *Journal of Toxicology and Environmental Health, Part B*. <http://dx.doi.org/10.1080/10937404.2016.1196155>
- Ontario College of Family Physicians. 2016. Continuing Professional Development MAIN PRO-C Workshop Listing. Toronto: OCFP. pp 1-27.
- Owens, B. 2014. Exercise prescriptions endorsed. *Canadian Medical Association Journal*. 186(13):E478.
- Peacock, J., R. Hine and J. Pretty. 2007. *Got the blues, then find some greenspace: The mental health benefits of green exercise activities and green care*. Colchester, UK.: Centre for Environment and Society, University of Essex.
- Sahlin, E, G. Ahlborg, A. Tenenbaum and P. Grahn. 2015. Using nature-based rehabilitation to restart a stalled process of rehabilitation in individuals with stress-related mental illness. *International Journal of Environmental Research and Public Health*. 12:1928-1951.
- Von Lindern, E., F. Lymeus and T. Hartig. 2017. The restorative environment: A complementary concept for salutogenesis studies. In: *The Handbook of Salutogenesis*. New York: Springer International Publishing. Pp. 181-195.
- Wilson, N et al. 2010. Green shoots of recovery: The impact of a mental health ecotherapy programme. *Mental Health Review*. 15:4-14.

– Case 5 – Urban Parks

- Corkery, L. 2015. Beyond the park. In: H. Barton, S. Thompson, S. Burgess and M. Grant (eds.). *Handbook of planning for health and well-being*. New York: Routledge. Chapter 17.
- Secretariat of the Convention on Biological Diversity. 2012. *Cities and biodiversity outlook: Action and policy*. Montreal: Secretariat of the Convention on Biological Diversity.

- Credit Valley Conservation (CVC). 2014. O'Connor Park. Public Lands Case Study. Mississauga: CVC Water Resources Management and Restoration.
- Dearborn, D.C. and S. Kark. 2009. Motivations for conserving urban biodiversity. *Conservation Biology*.
- Fuller, R. A., Irvine, K. N., Devine-Wright, P., Warren, P. H., & Gaston, K. J. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology letters*, 3(4), 390-394.
- Goddard, M.A., A. J. Dougill and T.G. Benton. 2009. Scaling up from gardens: biodiversity conservation in urban environments. *Trends in Ecology and Evolution*.
- Hostetler, M. (2001). The importance of multi-scale analyses in avian habitat selection studies in urban environments. In J.M. Marzluff, R. Bowman & R. Donnelly (Eds.), *Avian ecology and conservation in an urbanizing world* (chap. 7). Boston: Kluwer Academic Publishers.
- Ibes, D.C. 2015. A multi-dimensional classification and equity analysis of an urban park system: A novel methodology and case-study application. *Landscape and Urban Planning*. 137:122-137.
- Maller, C., M. Townsend, A. Pryor, P. Brown and L. St. Leger. 2006. Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations. *Health Promotion International*. 21(1):45-54.
- McKinney, M.L. 2002. Urbanization, biodiversity and conservation. *BioScience*. 52(10):883-890.
- Ronan, P. and S. Szczepanski. 2016. Designing parks for health and wellbeing. Presentation to the Parks and Recreation Ontario Educational Forum and Trade Show. 7 April.
- Rudd, H., J. Vala and V. Schaefer. 2002. Importance of backyard habitat in a comprehensive biodiversity conservation strategy: A connectivity analysis of urban green spaces. *Restoration Ecology*. 10(2):369-375.
- Taylor, P.D., L. Fahrig, K. Henein and G. Merriam. 1993. Connectivity is a vital element of landscape structure. *Oikos*. 68(3):571-573.
- Whitney, G.G. 1995. A quantitative analysis of the flora and plant communities of a representative Midwestern U.S. town. *Urban Ecology*. 9:143-160.
- Zupancic, T., C. Westmacott and M. Bulhuis. 2015. The impact of green space on heat and air pollution in urban communities: A meta-narrative systematic review. Toronto: David Suzuki Foundation.

– Case 7. Urban Forests

- Alexander, C. and B. DePratto. 2014. Special Report Urban Forests: The Value of Urban Forests in Cities Across Canada. Accessed 10 June 2016
<https://www.td.com/document/PDF/economics/special/UrbanForestsInCanadianCities.pdf>
- Alexander, C. and C. McDonald. 2014. Special Report Urban Forests: The Value of Trees in the City of Toronto. Accessed 10 June 2016
<http://www.td.com/document/PDF/economics/special/UrbanForests.pdf>
- Anguelovski, I. 2015. From toxic sites to parks as (green) LULUs? New challenges of inequity, privilege, gentrification, and exclusion for urban environmental justice. *Journal of Planning Literature*. 1-14.
- Beacon Environmental Limited. 2015. Priority tree planting areas to grow Peel's urban forest. Report prepared for the Region of Peel. Markham: Beacon Environmental Limited. Accessed June 13 2016 <https://www.peelregion.ca/planning/climatechange/reports/pdf/ExecSum-TPPT-2015-Aug07.pdf>
- Checker, Melissa. 2011. "Wiped out by the "Greenwave": Environmental Gentrification and the Paradoxical Politics of Urban Sustainability." *City & Society* 23 (2): 210–29. doi:10.1111/j.1548- 744X.2011.01063.x.
- Curran, W. and T. Hamilton. 2012. Just green enough: Contenting environmental gentrification in Greenpoint, Brooklyn. *Local Environment*. 17:1027-1042.
- Dooling, Sarah. 2009. "Ecological Gentrification: A Research Agenda Exploring Justice in the City." *International Journal of Urban and Regional Research* 33 (3): 621–39.

Galabuzi, G-E. and C. Teelucksingh. 2010. Social cohesion, social exclusion, social capital. Immigration Discussion Paper. Regional of Peel.

Hotte, N., S. Barron, Z.C. Cheng, L. Nesbitt and J. Cowan. 2015. The social and economic values of Canada's urban forests: A national synthesis. Vancouver: Canadian Forest Service and University of British Columbia.

Shanahan, D.F. et al, 2015. Toward improved public health outcomes from urban nature. *American Journal of Public Health*. 105(3):470-477.

Wolch, J.R., J. Byrne and J.P. Newell. 2014. Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough'. *Landscape and Urban Planning*. 125:125-244.

Wong, J. 2014. Priority planting areas to grow Peel's urban forest. Presentation prepared for the A.D. Latonnell Conservation Symposium. Alliston, Ontario, 18 November.

– Case 7. Greenway

Coutts, C. and J. Miles. 2011. Greenways as green magnets: The relationship between the race of greenway users and race in their proximal neighbourhoods. *Journal of Leisure Research*. 43(3):317-333.

Dorwart, C.E. 2015. Views from the path: Evaluating physical activity use patterns and design preferences of older adults on the Bolin Creek greenway trail. *Journal of Aging and Physical Activity*. 23:513-523.

Fábos, J. G., & Ryan, R. L. 2006. An introduction to greenway planning around the world. *Landscape and Urban Planning*, 76(1), 1–6.

Finlay, J., T. Franke, H. McKay and J. Sim-Gould. 2015. Therapeutic landscapes and wellbeing in later life: Impacts of blue and green spaces on older adults. *Health & Place*. 34:97-106.

Foley, R. and T. Kistemann. 2015. Blue space geographies: Enabling health in place. *Health & Place*. 35:157-165.

Gesler, W. 1992. Therapeutic landscapes: medical issues in light of the new cultural geography. *Social Science and Medicine*. 34:735-746.

Gobster, P.H. 1995. Perception and use of a metropolitan greenway system for recreation. *Landscape and Urban Planning*. 33:401-413.

Kullmann, K. 2013. Green-networks: integrating alternative circulation systems into post-industrial cities. *Journal of Urban Design*, 18(1), 36–58

Little, C. E. 1990. *Greenways for America*. London: Johns Hopkins University Press.

Lindsey, G., J. Man, S. Payton and K. Dickson. 2004. Property values, recreation values and urban greenways. *Journal of Park and Recreation Administration*. 22(3):69-90.

Manton, R., S. Hynes and E. Clifford. 2016. Greenways as a tourism resource: A study of user spending and value. *Tourism Planning and Development*. Doi:10.1080/21568316.2015.1136835

Mundet, L., & Coenders, G. 2010. Greenways: a sustainable leisure experience concept for both communities and tourists. *Journal of Sustainable Tourism*, 18(5), 657–674.

Ontario Trails. 2016. Rattray Marsh Trail. [Accessed 15 August 2016] <http://www.ontariotrails.on.ca/trails/view/mississauga-parks-and-recreation---rattray-marsh-trail>

Renalds, A., T.H. Smith and P.J. Hale. 2010. A systematic review of built environment and health. *Family and Community Health*. 33(1):68-78.

Searns, R.M. 1995. The evolution of greenways as an adaptive urban landscape form. *Landscape and Urban Planning*. 33:65-80.

Volker, S., Kistemann, T. 2011. The impact of blue space on human health and well-being Salutogenetic health effects of inland surface waters: a review. *International Journal of Hygiene and Environmental Health*. 214(6):449 -460.

Volker, S., Kistemann, T. 2013. 'I'm always entirely happy when I'm here!' Urban blue enhancing human health and well-being in Cologne and Dusseldorf, Germany. *Social Science and Medicine*. 78: 113–124.

Waterfront Regeneration Trust (WRT). 2013. State of the Waterfront Trail 2013: Leading the movement for waterfront regeneration on Ontario's Great Lakes. Toronto: WRT.

Waterfront Trail. 2016. State of the Trail. [Accessed 11 July 2016] <http://www.waterfronttrail.org/partner-resource-center/state-of-the-trail>

White, M., Smith, A., Humphries, K., Pahl, S., Snelling, D., Depledge, M., 2010. Blue space: the importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology*. 30(4):482-493.

– Case 8. Greenbelt

Appleton, A.F. 2002. How New York City used an ecosystem services strategy carried out through an urban-rural to preserve the pristine quality of its drinking water and save billions of dollars and what lessons it teaches about using ecosystem services. Presentation given to the Katoomba Conference Tokyo. November.

Barrington-Leigh, C. and A. Millard-Ball. 2015. A century of sprawl in the United States. *PNAS*. 112(27):8244-8249.

Carter-Whitney, M. and T.C. Esakin. 2010. Ontario's greenbelt in an international context. Toronto: Canadian Institute for Environmental Law and Policy.

City of Toronto. 2015. Toronto Ravine Strategy: Draft Principles and Actions. Toronto: City of Toronto.

David Suzuki Foundation. 2008. Ontario's wealth Canada's future: Appreciating the value of the Greenbelt's Eco-services. Vancouver: David Suzuki Foundation.

Ewing, R., G. Meakins, S. Hamidi and A.C. Nelson. 2014. Relationship between urban sprawl and physical activity, obesity and morbidity – Update and refinement. *Health and Place*. 26:118-126.

Forge, F. 2000. The multifunctionality of agriculture: Summary of the Canadian Federation of Agriculture Conference. Ottawa: Government of Canada, Parliamentary Research Branch. [Accessed 20 July 2016] <http://publications.gc.ca/Collection/R/LoPBdP/BP/prb0014-e.htm>

Griffin, B.A. et al. 2013. The relationship between urban sprawl and coronary heart disease in women. *Health and Place*. 20:51-61.

Grow our Greenbelt. 2016. Growing the Green, Protecting the Blue. Primer. Grow our Greenbelt. http://www.growourgreenbelt.ca/bluebelt_resources

Intergovernmental Panel on Climate Change. 2015. Climate Change 2014 Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the IPCC. Geneva: IPCC.

Kellert, S.R. 2002. Experiencing nature: Affective, cognitive and evaluative development in children. In: P.H. Hahn, Jr. and S. R. Kellert (eds.). *Children and nature: Psychological, sociocultural and evolutionary investigations*. Cambridge, USA: MIT Press. pp. 117-151.

Kyle, G.T., A. J. Mowen and M. Tarrant. 2004. Linking place preferences with place meaning: An examination of the relationships between place motivation and place attachment. *Journal of Environmental Psychology*. 24:439-454.

Kyle, G. and G. Chick. 2005. The social construction of a sense of place. *Leisure Sciences*. 29:209-225.

Lynch, T., C. Glotfelty and K. Armbruster (eds.). 2012. *The bioregional imagination: literature, ecology and place*. Athens, USA: University of Georgia Press.

Ministry of the Environment and Climate Change. 2016. Ontario's Climate Change Strategy. Toronto: Queen's Printer for Ontario.

Murray, S. 2000. *Toronto's Ravines: Walking the Hidden Country*. Erin: Boston Mills Press.

Ontario Nature. 2015. Best practices guide to natural heritage systems. Toronto: Ontario Nature.

Postel, S.L. and B. H. Thompson, Jr. 2005. Watershed protection: Capturing the benefits of nature's water supply services. *Natural Resources Forum*. 29:98-108.

Schulz, P.W. 2002. Inclusion with nature: the psychology of human-nature relations. In: P.C. Stern, and W.P. Schultz (eds.). *Psychology of sustainable development*. Norwell, USA: Kluwer Academic.

World Health Organization. 2011. Health co-benefits of climate change mitigation – Transport sector. Health in the green economy series. Geneva: WHO.

World Health Organization. 2016. Preventing disease through healthy environments: A global assessment of the burden of disease from environmental risks. Geneva: WHO.

– Case 9. Watershed

Bacher, J. 2011. Two Billion Trees and Counting: The Legacy of Edmund Zavitz. Toronto: Dunburn.

Berry, P., K-L. Clarke, M.D. Fleury and S. Parker. 2014. Human health. In: Warren, F.J. and D.S. Lemmen (eds.) Canada in a changing climate: Sector perspectives on impacts and adaptation. Ottawa: Government of Canada. pp. 191-232.

Berry, P., K-L. Clarke, M.D. Fleury and S. Parker. 2014. Human health. In: Warren, F.J. and D.S. Lemmen (eds.) Canada in a changing climate: Sector perspectives on impacts and adaptation. Ottawa: Government of Canada. pp. 191-232.

Brooks, D.B. 2005. Beyond Greater Efficiency: The Concept of Soft Water Paths. Canadian Water Resources Journal. 30(1):83-92.

Brown, D. W, Syed M.A. Moin & Michelle L. Nicolson (1997) A comparison of flooding in Michigan and Ontario: 'Soft' data to support 'soft' water management approaches. Canadian Water Resources Journal / Revue canadienne des ressources hydriques, 22(2):125-139.

Bunch, M., M. Parkes, K. Zubrycki, H. Venema, L. Hallstrom, C. Neudoerffer, M. Berbes-Blazquez and K. Morrison. 2014. Watershed Management and Public Health: An exploration of the intersection of two fields as reported in the literature from 2000-2010. *Environmental Management*. 54: 240-254.

Conservation Ontario. 2013. Conservation Ontario's Business Case for Strategic Reinvestment in Ontario's Flood Management Programs, Services and Structures. Toronto: Conservation Ontario.

Conservation Ontario. 2013. Dodging the 'Perfect Storm': Conservation Ontario's Business Case for Strategic Reinvestment in Ontario's Flood Management Programs, Services and Structures. Newmarket: Conservation Ontario. Accessed 20 December 2016 http://conservationontario.ca/documents/CO%202013%20Flood%20Business%20Case__Oct.pdf

Conservation Ontario. 2016a. History of Conservation Authorities. [Accessed 17 August 2016] <http://conservationontario.ca/about-us/conservation-authorities/history>

Conservation Ontario. 2016b. Map of Conservation Authorities. [Accessed 17 August 2016] <http://conservationontario.ca/library?view=document&id=302:map-of-conservation-authorities&catid=65:corporate-documents>

Environment Canada. Flooding Events in Canada – Ontario. Accessed 3 May 2015 <https://www.ec.gc.ca/eau-water/default.asp?lang=En&n=B85B942F-1>.

Gleick, P. 2002. Soft water paths. *Nature*. 418:373.

Goldman, E. and S. Galea. 2014. Mental health consequences of disasters. *Annual Review of Public Health*. 35:169-183.

Kundzewicz, Z.W. et al. 2013. Flood risk and climate change: global and regional perspectives. *Hydrological Sciences Journal*. 59(1):1-28.

Lowe, D., K.L. Ebi and B. Forsberg. 2013. Factors increasing vulnerability to health effects before, during and after Floods. *International Journal of Environmental Research and Public Health*. 10:7015-7067.

Meene, B. and V. Murray (eds.). 2012. Floods in the WHO European Region: health effects and their prevention. Copenhagen: WHO Regional Office for Europe and Public Health England.

Morrison, K. 2015. Application of Multiple Exposures, Multiple Effects Model to four flood events in Canada: Lessons learned for public health adaptation to climate change in the context of extreme precipitation and flooding. Peterborough: Peterborough County-City Health Unit.

Parkes, M.W., K. Morrison, Bunch, M.J., Hallstrom, L.K., Neudoerffer, R.C., Venema H.C. and Waltner-Toews, D. 2010. Towards integrated governance for water, health and social-ecological systems: the watershed governance prism. *Global Environmental Change*. 20:693-704.

Robins, L., 2007. Nation-wide decentralized governance arrangements and capacities for integrated watershed management: Issues and insights from Canada. *Environments*, 35(2):1-47.

Stanke, C., V. Murray, R. Amlot, J. Nurse and R. Williams. 2012. The effects of flooding on mental health: Outcomes and recommendations from the literature. *PLoS Currents Disasters*. May 30. Edition 1. doi: 10.1371/4f9f1fa9c3cae

Upper Thames River Conservation Authorities. 2015. The Flood of April 1937. [Accessed 6 May 2015] <http://thamesriver.on.ca/water-management/flooding-on-the-thames-river/1937-flood-photos/>

– Case 10. Regional Deforestation

Bacher, J. 2011. *Two Billion Trees and Counting: The Legacy of Edmund Zavitz*. Toronto: Dunburn.

Environment Canada. 2004. *How much habitat is enough?* Third Edition. Toronto: Environment Canada.

Kelly, K. 1975. The impact of nineteenth century agricultural settlement on the land. In: Wood, J.D. (ed). *Perspectives on landscape and settlement in nineteenth century Ontario*. Toronto: McClelland and Stewart.

Niewojt, L. From waste land to Canada's tobacco production heartland: Landscape change in Norfolk County, Ontario. *Landscape Research*. 32(3):354-377.