

Carbon in the Bank

ONTARIO'S GREENBELT AND ITS ROLE IN
MITIGATING CLIMATE CHANGE



David
Suzuki
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SOLUTIONS ARE IN OUR NATURE

CARBON IN THE BANK: ONTARIO'S GREENBELT AND ITS ROLE IN MITIGATING CLIMATE CHANGE

August 2012

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For the David Suzuki Foundation

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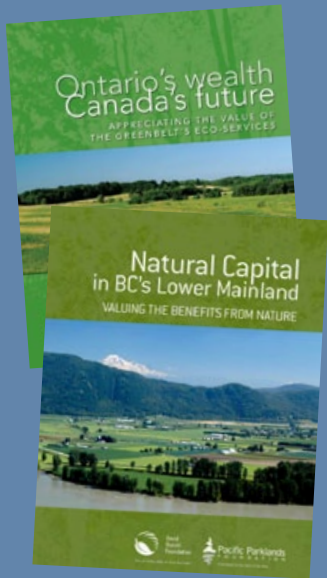
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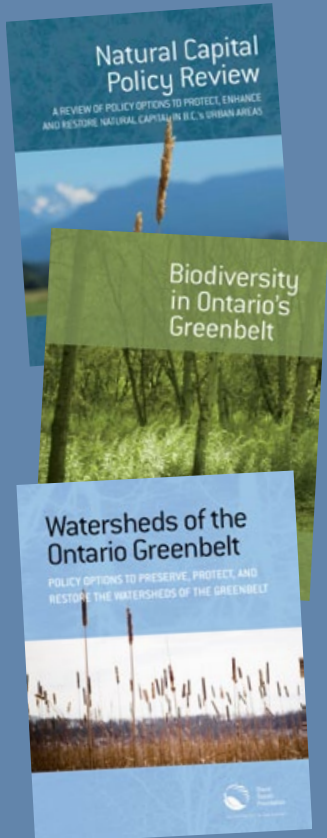
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Introduction and Context

ONTARIO'S GREENBELT WAS ESTABLISHED IN 2005 as a large band of permanently protected countryside to serve both as a limit to unsustainable urban sprawl and as a means of preventing the further loss of valuable agricultural lands and natural features in the Greater Golden Horseshoe region. By providing this protection, the Greenbelt has the potential to act as a long-term safeguard for the valuable stock of natural capital within the Greenbelt, whose ecosystems offer a broad set of benefits including the provision of clean drinking water, improved air quality, and vital natural habitat. In a time of growing urgency to address the causes of climate change, one of the most important—but often overlooked—ecosystem functions of the Greenbelt is its potential to reduce greenhouse gases. The Greenbelt's forests, wetlands, and agricultural soils capture and store considerable amounts of carbon and, as such, can play a role in mitigating climate change. A principle goal of this report is to bring the importance of the Greenbelt as an instrument of climate change mitigation into relief by quantifying the amount of carbon captured and stored by its ecosystems and translating these services into economic values. The report examines a number of threats to the long-term ability of the Greenbelt to serve this climate regulation function and argues that the province's climate change policy framework should be revised to strengthen its ability to protect essential functions and even enhance the Greenbelt's natural capacities as a carbon sink.

The watersheds of the Greater Golden Horseshoe provide a range of vital services to the residents of the region, but to maintain these services, we must monitor and adjust our impact on the resources providing them.

Development in the Greater Golden Horseshoe

Home to about nine million people, more than two-thirds of Ontarians, and almost one-quarter of all Canadians, the Greater Golden Horseshoe (GGH) makes up a vast region surrounding the western end of Lake Ontario. Robust and sustained growth since Second World War has seen this region transform from discrete urban centres surrounded by rural countryside to what is now large swaths of unbroken urban and suburban development laced together by major highways, a “megapolis.” While this growth has been driven by the economic prosperity of southern Ontario, it has placed increasing pressures on existing infrastructure and the remaining ecological systems; traffic congestion, commute times, and smog have increased while the quantity and quality of agricultural lands, wetlands, forests and other ecosystems have generally declined.¹ Increasingly, the challenges of maintaining a livable urban and suburban environment are converging with the challenges of ensuring healthy agricultural and natural ecosystems.

¹ Jack Donnan. 2008. *Economic Implications and Consequences of Population Growth, Land Use Trends, and Urban Sprawl in Southern Ontario*. Report to the Environmental Commissioner of Ontario. www.eco.on.ca/uploads/Reports%20-%20Background,%20Discussion,%20Roundtable/2008%20sprawl%20appendix.pdf.



Over the next 20 years, the population is expected to grow by 2.5 million and reach 11.5 million by 2031. This would make the GGH one of the fastest growing regions in North America.

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This is not a situation that will solve itself. Effervescent growth in the GGH is expected to continue unabated; over the next 20 years, the population is expected to grow by 2.5 million and reach 11.5 million by 2031. This would make the GGH one of the fastest growing regions in North America. A 2002 report by the Neptis Foundation estimated that if the anticipated growth was accommodated through “business as usual” patterns of development, an additional 107,000 hectares of rural land would be urbanized by 2031, an area that is almost double the size of the City of Toronto. Approximately 92 per cent of the land in the path of development is classified as prime agricultural land.²

As is often the case with rapid growth, development in the GGH brings both benefits and challenges. Many of its residents have been lured to the suburbs by the dream of a more affordable, quieter, safer neighbourhood that is both near to the attractions of the city and the open beauty of the countryside. Yet as millions of households pursue the same dream, suburban development sprawls further from the urban centres, consuming more and more of the countryside with car-dependent subdivisions. The Toronto region already features some of the worst traffic congestion in North America and the Neptis study cited above projects that work-week traffic delays will increase 300 per cent by 2031. The costs of suburban sprawl are not only felt in terms of the wasted time getting into and around the city, but in the higher costs of service delivery as the capacity to manage already aging infrastructure is outstripped by new demands. The Neptis report projected that \$33 billion in new investments would be needed in water and wastewater treatment infrastructure under the business as usual scenario to 2031, and a further \$43.8 billion for transportation infrastructure, mostly roads and highways. It has become increasingly evident that “business as usual” development patterns will produce not only a diminishing and fragmented countryside but cities that are unsustainable and unaffordable.

As the Greater Golden Horseshoe continues to expand and develop, its environmental footprint grows. One of the most worrisome trends is the increase in greenhouse gas (GHG) emissions associated with increased travel and congestion across the growing region. With over 13 million automobile trips happening each day across the GGH,³ emissions from transportation represent a substantial portion of the region's carbon footprint. In 2008, 33 per cent of Ontario's greenhouse gas emissions (60.3 Mt CO₂e) were from transportation.⁴ While some sources of emissions in the province have seen their rates of growth slow or decline (such as industry, electricity generation, and agriculture), emissions from road transportation have shown a 35 per cent rise between 1990 and 2008, more than any other sector.⁵

2 Neptis Foundation. (2002). *Toronto-Related Region Futures Study: Modelling Growth in the Toronto-Related Urban Region to 2031*. Prepared by the IBI Group. Toronto: Neptis Foundation.

3 Transportation for Tomorrow Data Management Group. 2006. “Travel Summary for Transportation Tomorrow Survey Area.” www.dmg.utoronto.ca/pdf/tts/2006/regional_travel_summaries/TTS_area.pdf.

4 Ontario Ministry of the Environment. 2010. *Climate progress: Ontario's Plan for a Cleaner, More Sustainable Future. Annual Report 2009-2010*. www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_085413.pdf.

5 Ibid.

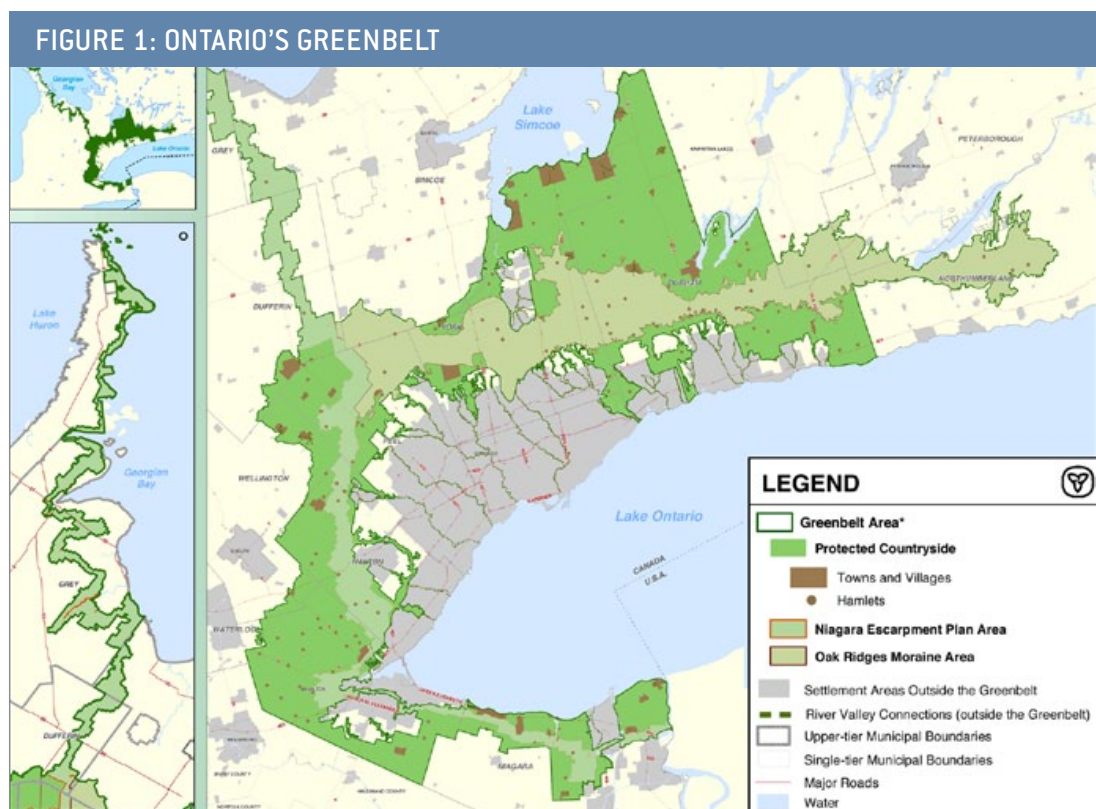
Ontario's Greenbelt

Faced with the compounding challenges in the GGH of a rapidly growing population, advancing urban sprawl, widespread environmental degradation, and a loss of valuable agricultural and recreational lands, the Government of Ontario took decisive action in 2005 and established one of the world's largest greenbelts.⁶ The Greenbelt is a broad band of permanently protected land that is designed to contain urban sprawl, prevent the further loss and fragmentation of valuable countryside, and promote much more sustainable use of land and resources (see Figure 1).

Covering close to 750,000 hectares (1.8 million acres) and extending 325 kilometres from Rice Lake in Northumberland County to the Niagara River, the Greenbelt is a continuous permanently protected band of land in southern Ontario. The Greenbelt features a highly diverse range of agriculture as well as important natural heritage and hydrological features, wildlife habitat, recreational sites, and local communities. Agriculture is the predominant land use in the Greenbelt and with more than 7,000 farms, the majority of the land is privately owned. The Greenbelt contains many important natural heritage and hydrological features, such as forests and wetlands, which provide essential ecosystem services, such as natural air and fresh water filtration, as well as habitat for a wide range of species, including those threatened or endangered. The Greenbelt is also home to many small communities as well as a range of economic activities besides agriculture, including tourism and recreation and renewable (e.g., forestry) and non-renewable (e.g., aggregate extraction) natural resource development.

Ontario's Greenbelt Plan lays out the government's vision for long-term protection of this priceless natural and working landscape.⁷ The Greenbelt Plan is a robust strategy that provides protection for agricultural and

The Greenbelt features a highly diverse range of agriculture as well as important natural heritage and hydrological features, wildlife habitat, recreational sites, and local communities.



Source: greenbelt.ca

6 Maureen Carter-Whitney. 2010. *Ontario's Greenbelt in an International Context*. Friends of the Greenbelt Foundation Occasional Paper Series, No. 11. <http://cielap.org/pdf/GreenbeltInternationalContext2010.pdf>.

7 Ontario Ministry of Municipal Affairs and Housing. 2005. *Greenbelt Plan 2005*. Approved by the Lieutenant Governor in Council. Order in Council 208/2005. www.mah.gov.on.ca/Asset1277.aspx.



Because the Greenbelt is an integrated band of mostly green countryside, it allows for more complete ecosystem habitats and continuous migration routes than do isolated parks.

KEY GREENBELT FACTS

- Close to 750,000 hectares (1.8 million acres) of countryside, the largest greenbelt in the world.
- Extends 325 kilometres from Rice Lake in Northumberland County to the Niagara River.
- The Greenbelt incorporates 325,000 hectares (800,000 acres) of land that were already under protection through the Niagara Escarpment Plan (1973) and the Oak Ridges Moraine Conservation Plan (2001).
- The Greenbelt has about 217,000 hectares (535,000 acres) of lakes, wetlands, river valleys and forests, providing habitat for over one third of Ontario's species at risk, including red-shouldered hawk, cucumber magnolia, Jefferson salamander, American ginseng, southern flying squirrel and monarch butterfly.⁸
- Because the Greenbelt is an integrated band of mostly green countryside, it allows for more complete ecosystem habitats and continuous migration routes than do isolated parks.
- The Greenbelt preserves space for locally accessible tourism, recreation, and outdoor activities.
- With over 7,000 farms, agriculture is the predominant land use in the Greenbelt, generating over \$1.5 billion in total gross farm receipts annually.⁹
- Almost half of Ontario's fruit farms and one fifth of Ontario's vegetable farms are located in the Greenbelt. The Greenbelt produces over 15 per cent of Ontario's apples; 82 per cent of its peaches; 50 per cent of its sour cherries; over 85 per cent of its grapes; and 16 per cent of its raspberries.¹⁰
- The Greenbelt's natural capital produces \$2.6 billion a year in critical ecosystem services (e.g., water storage and filtration, pollination etc.); an average value of \$3,487 per hectare.¹¹

8 Biodiversity in Ontario's Greenbelt. 2011. Ontario Nature and the David Suzuki Foundation. www.davidsuzuki.org/publications/downloads/2011/REPORT-GB_Habitat-Dec2011.pdf.

9 V. Di Poce, E. Goarley and B. Mausberg. 2009. "Greenbelt grown: a profile of agriculture grown in the Greenbelt." Friends of the Greenbelt Foundation Occasional Papers.

10 Ibid.

11 S. J. Wilson. 2008. "Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services." Prepared for the David Suzuki Foundation. www.davidsuzuki.org/publications/reports/2008/ontarios-wealth-canadas-future-appreciating-the-value-of-the-greenbelts-eco-serv/.

natural ecosystems within the Greenbelt, identifying where urbanization should not occur. The Plan adds 400,000 hectares (one million acres) of new “Protected Countryside” areas to the already protected areas of the Niagara Escarpment Plan and the Oak Ridges Moraine Conservation Plan. The Protected Countryside consists of an Agricultural System and a Natural System, together with towns, villages, and hamlets. The Agricultural System is comprised of specialty crop, prime agricultural, and rural areas. The Natural System supports natural heritage features and the protection of watersheds.

The Greenbelt Plan is an integral part of a larger planning framework for the Greater Golden Horseshoe. It includes the Growth Plan for the Greater Golden Horseshoe (GGH Plan), that was passed by the Government of Ontario in 2006.¹² While the Greenbelt Plan defines where new urban development is *prohibited*, the Growth Plan shows where and how growth will be *accommodated*. It allots population and job growth projections to all of the upper-tier and single-tier municipalities in the GGH and provides directions on how the expected growth is to be managed. In particular, the Growth Plan requires that much (40 per cent) of the coming population and job growth be accommodated through intensification, i.e., be absorbed within each municipality’s existing built-up area. The Growth Plan also identifies certain growth centres within built-up areas where development is to be focused, while the remaining growth outside the existing urban boundary must achieve certain minimum densities (50 people or jobs per hectare). Thus, the Growth Plan limits the amount of land that can be designated for urban development. The Greenbelt and Growth Plans, along with the other elements of the province’s policy framework, are widely considered a highly ambitious attempt to create more sustainable growth patterns in the GGH.¹³

In the context of the present report, however, it is important to note that this planning framework does not guarantee the integrity of the Greenbelt’s natural capital and ecosystems. Most importantly, the Greenbelt Plan allows for activities that may threaten the carbon storage capacity of the Greenbelt’s forests, wetlands and other ecosystems in the long-term. The conflict between long-term protection and exploitation of the Greenbelt can be seen in the vision statement that is at the heart of the Greenbelt Plan:¹⁴

- Protect against the loss and fragmentation of the agricultural land base and support agriculture as the predominant land use.
- Give permanent protection to the natural heritage and water resource systems that sustain ecological and human health and that form the environmental framework around which major urbanization in south central Ontario will be organized.
- Provide for a diverse range of economic and social activities associated with rural communities, agriculture, tourism, recreation and resource uses.

This vision statement reflects the desire of the Plan’s drafters to balance sustainability and conservation objectives with economic development goals, a balance that is inherently challenging. For example, the Plan allows for Greenbelt lands to be used for the construction of local, regional, provincial, and national infrastructure. Mining for aggregates — the sands, gravel and crushed stone used in common construction — is also permitted within some areas of the Greenbelt. There are requirements in the Plan that these types of potentially damaging activities minimize environmental impacts, but the fact that they are permitted within the Greenbelt means that there will be ongoing trade-offs between the need for ecosystem and agricultural preservation and economic development. These issues will be discussed at greater length in Section 5 of this report.

“The Greenbelt is a cornerstone of Ontario’s proposed Greater Golden Horseshoe Growth Plan, which is an overarching strategy that will provide clarity and certainty about urban structure, where and how future growth should be accommodated, and what must be protected for current and future generations.”
— The Greenbelt Plan, 2005

12 Ministry of Infrastructure. Growth Plan for the Greater Golden Horseshoe, 2006. www.placestogrow.ca/content/ggh/plan-cons-english-all-web.pdf.

13 The Growth Plan won the American Planning Association’s prestigious Daniel Burnham Award for a Comprehensive Plan in 2007. See: www.planning.org/awards/2007/.

14 Ontario Ministry of Municipal Affairs and Housing, 2005. *Greenbelt Plan 2005*. Toronto: The Queen’s Printer for Ontario.

Climate Change and its Impacts

Overview of Global Climate Change

Despite what “climate change deniers” say, the science behind climate change is well established and is the subject of a very wide consensus among scientists not associated with the fossil fuel industry.

GENERATIONS OF MODERN INDUSTRIAL PROGRESS have transformed the way we live; relentless economic growth and technological innovation have brought about changes in each generation that would boggle the imagination of the last. The essential catalyst for this explosive progression has been the unleashing of the energy in the world’s store of fossil fuels. We have taken seemingly endless supplies of oil, gas, and coal from deep within the Earth, extracted enormous amounts of stored energy, and in the process released vast quantities of gaseous carbon into our atmosphere. We now rely heavily on this mode of production and there are few human activities that are not dependent on fossil fuel energy and, indirectly, on the carbon emissions associated with its use. Every Canadian is responsible for an average of 20.3 tonnes of greenhouse gases per year, one of the highest per capita emission rates in the world.¹⁵ This amount is equivalent to burning almost 10,000 litres of gasoline annually per person in Canada, or almost 25,000 litres for the average household.

Despite what “climate change deniers” say, the science behind climate change is well established and is the subject of a very wide consensus among scientists not associated with the fossil fuel industry. This does not mean that there are not debates as to exactly how greenhouse gas (GHG) concentrations in the atmosphere will increase over time, how this will affect global and regional climates, and what the impacts of these changes will be on the human and natural ecosystems. However, there is now a broad international consensus among scientists and policy makers that GHG emissions and climate change are major threats that require serious action.¹⁶

The evidence on GHG concentrations in the atmosphere and the likely impacts in terms of climate change is continuously assessed and re-assessed by the International Panel on Climate Change (IPCC), composed of the world’s leading climate scientists. The Panel reports that atmospheric concentration of carbon dioxide (CO₂), one of the main GHG, has increased globally by about 36 per cent over the last 250 years, from about

15 Environment Canada. 2012. *National Inventory Report 1990-2010: Greenhouse Gas Sources and Sinks in Canada. Executive Summary*. www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=8BAF9C6D-1.

16 Naomi Oreskes. 2004. “The Scientific Consensus on Climate Change.” *Science*, 306(5702), page 1686. www.sciencemag.org/content/306/5702/1686.full.

280 parts per million (ppm) in the pre-industrial era (AD 1000–1750) to 379 ppm in 2005.¹⁷ Moreover, global emissions of CO₂ have been accelerating: the growth rate increased from 1.3 per cent per year in the 1990s to 3.3 per cent per year between 2000 and 2006.¹⁸ The current rate of increase is faster than the IPCC's worst-case scenario, which suggests an average rise in global temperature of 6.4°C by the end of this century.¹⁹ An average global temperature increase of more than 2°C has been recognized as the point at which socio-economically dangerous climate change would begin.²⁰ World leaders reaffirmed the goal of limiting climate change below this point in Copenhagen in 2009.²¹ Regrettably, lasting agreements and strong coordinated action to implement this target have as yet eluded the world's political and economic leaders.

Observed Changes in Southern Ontario's Climate

Although the melting of glaciers in the Canadian Arctic presents some of the most evident effects of climate change, more subtle changes are underway in every region of the country. In Ontario, average annual temperatures have increased by as much as 1.3°C over the last 60 years, between 1948 and 2006. This warming has been more pronounced in the western part of the province and has occurred mostly during the winter months. Observations suggest this warming is already beginning a trend of increasing extreme climatic events, such as heat waves, flooding, droughts, and warmer winters. Increasing occurrence of heat waves, combined with poor air quality, is already a serious health risk. The rise in temperature that has occurred to date is also linked to water shortages, forest fires, decline in agricultural production, and lower Great Lake water levels.²²

Annual precipitation in southern Canada has increased by about five to 35 per cent since 1900,²³ while high-intensity rain storms have increased in variability and occurrence in some parts of Ontario since the late 1950s.²⁴ In the Great Lakes region, warmer temperatures have resulted in later seasonal freezing and earlier break-up of ice. The season of ice cover has been reduced by one to two months over the last 100 to 150 years.²⁵ As the lakes have warmed, there has been a shift from cold- and cool-water fish species to more warm-water species²⁶ and there have been major ecosystem impacts, including substantial algae blooms and the spread of invasive species such as zebra mussels.²⁷

Observations suggest warming is already beginning a trend of increasing extreme climatic events, such as heat waves, flooding, droughts, and warmer winters. Increasing occurrence of heat waves, combined with poor air quality, is already a serious health risk.

17 S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.). 2007. *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press: Cambridge, UK. www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html.

18 J.G. Canadell, C. Le Quéré, M.R. Raupach, C.B. Field, E.T. Buitenhuis, P. Ciais, T.J. Conway, N.P. Gillett, R.A. Houghton, and G. Marland. 2007. "Contributions to accelerating atmospheric CO₂ growth from economic activity, carbon intensity, and efficiency of natural sinks." *Proceedings of the National Academy of Sciences*, 104(47), pages 18866-18870.

19 IPCC. 2007. *Fourth Assessment Report: Climate Change 2007*. www.ipcc.ch/publications_and_data/ar4/wg1/en/ch10s10-es-1-mean-temperature.html.

20 J. S. Schellnhuber, W. Cramer, N. Nakicenovic, T. M. L. Wigley and G. Yohe, Eds. 2006. *Avoiding Dangerous Climate Change*. Cambridge, Cambridge University Press.

21 The Copenhagen Accord, 18 December 2009. http://unfccc.int/files/meetings/cop_15/application/pdf/cop15_cph_auv.pdf.

22 Q. Chiotti and B. Lavender. 2008. "Ontario," in *From Impacts to Adaptation: Canada in a Changing Climate 2007*, edited by D.S. Lemmen, F.J. Warren, J. Lacroix and E. Bush; Government of Canada, Ottawa, ON, pp. 227-274.

23 X. Zhang, L.A. Vincent, W.D. Hogg, and A. Nitsoo. 2000. "Temperature and precipitation trends in Canada during the 20th century." *Atmosphere-Ocean*, 38(3): 395-429.

24 É. Mekis and W.D. Hogg. 1999. "Rehabilitation and analysis of Canadian daily precipitation time series." *Atmosphere-Ocean*, 37(1), pages 53-85.

25 G.W. Kling, K. Hayhoe, L.B. Johnson, J.J. Magnuson, S. Polasky, S.K. Robinson, B.J. Shuter, M.M. Wander, D.J. Wuebbles, D.R. Zak, R.L. Lindroth, S.C. Moser, and M.L. Wilson. 2003. *Confronting climate change in the Great Lakes region: impacts on our communities and ecosystems*. Union of Concerned Scientists, Cambridge, Massachusetts, and Ecological Society of America, Washington, DC.

26 D.W. Schindler. 2001. The cumulative effects of climate warming and other human stresses on Canadian freshwaters in the new millennium. *Canadian Journal of Fisheries and Aquatic Science*, 58(1), pages 18-29.

27 H.J. MacIsaac, J.V.M. Borbely, J.R. Muirhead, and P.A. Graniero. 2004. "Backcasting and forecasting biological invasions of inland lakes." *Ecological Applications*, 14(3), pages 773-783.

While some of these changes have been gradual and subtle, others have been more obvious. Together, they present clear evidence that our climate is being fundamentally altered. These changes represent the beginning of a long transition away from the climate to which we, and all other life forms, are adapted and foreshadow a turbulent transition to a new climate regime with results that are as variegated as they are uncertain.

Expected Changes in Southern Ontario's Climate and Potential Impacts in the Greenbelt Region

Over the next decades, the impacts of climate change are expected to become increasingly pronounced as the delayed effects of growing atmospheric greenhouse gases begin to more substantially alter global and regional climate systems. As a basis for discussion in this report, we rely on projections for Ontario's future climate made by Environment Canada in association with the Canadian Climate Change Scenarios Network. This work provides a set of climate projections for mid-century (2040-2070) Ontario that were derived by combining models developed by 24 international climate modelling centres. This is known as an "ensemble approach" and is believed to provide more reliable projections of seasonal temperature and precipitation than any single climate model.²⁸ The following are some of the key projected climate change impacts for southern Ontario, including areas covered by the Greenbelt, within the coming decades (by 2050).

TEMPERATURE

Projections show that the average annual temperature will increase by 2.5 to 4°C by 2050 depending on the rate of GHG emissions over the coming years. Maximum warming will occur in the winter and will be less pronounced in the summer, though the number of extreme heat days (those exceeding 30°C) is projected to more than double by 2050 and possibly triple by 2080. In general, higher temperatures will result in more moisture in the air and lead to an increase in extreme weather events, including rain, snow, drought, heat waves, wind, and ice storms.

PRECIPITATION AND WATER

Winter months are projected to have increased precipitation, though warmer winters will mean that much of this increase will be in the form of rain and freezing rain. Summer precipitation is not expected to change significantly, though a rise in intense rainfall events is projected. Higher average temperatures will increase rates of evaporation, leading to lower water levels in rivers, lakes, and wetlands. These lower water levels will result in water shortages, including decreased groundwater recharge. Seasonal ice cover on lakes will become increasingly reduced or may become eliminated completely.

ECOSYSTEMS

Higher water temperatures in lakes is projected to result in an increasing rate of invasive species and the continued shift towards warm-water species, displacing existing species such as lake trout in Lakes Ontario and Erie. Lower water levels will have a particular impact on sensitive wetland ecosystems, resulting in a loss of habitat and breeding sites for fish and waterfowl. As local climates change, terrestrial habitats will be altered and species will need to adapt in response. Some species will adapt through migration while others may be at risk for sudden declines in populations.

28 N. Comer [editor]. 2009. *Ensemble Scenarios for Canada, 2009*. Produced for the Canadian Climate Change Scenarios Network. Adaptation and Impacts Research Division, Environment Canada.

"The impacts of climate change are already evident in every region of Canada."
— The Government of Canada, 2007.
From *Impacts to Adaptation: Canada in a Changing Climate*.

"Climate change is not simply a future problem, rather it is happening here and now."
— Expert Panel on Climate Change Adaptation, 2009.
Adapting to Climate Change in Ontario.

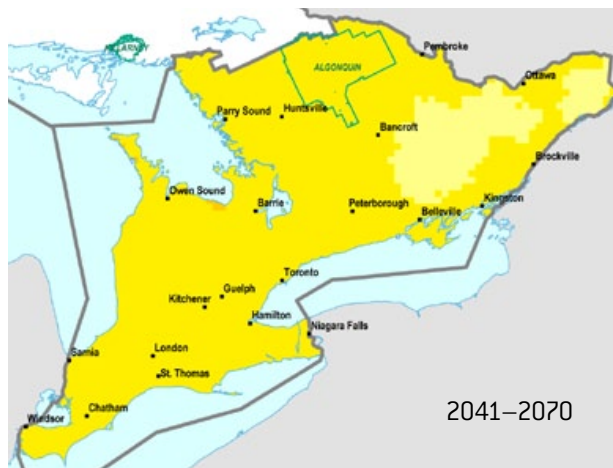
AGRICULTURE

Climate change is projected to have mixed effects on agriculture in southern Ontario. With rising temperatures, there will likely be some short-term benefits in terms of extended growing seasons and a northward expansion of crop production. These benefits will be balanced against increased variability and severity of precipitation events as well as a declining availability of water. Higher temperatures are projected to present an increased potential for pest invasion and disease, while invasive weeds are likely to increase with warmer weather and increased atmospheric CO₂. Warmer winter temperatures and reduced snow cover are also likely to harm ice wine production.

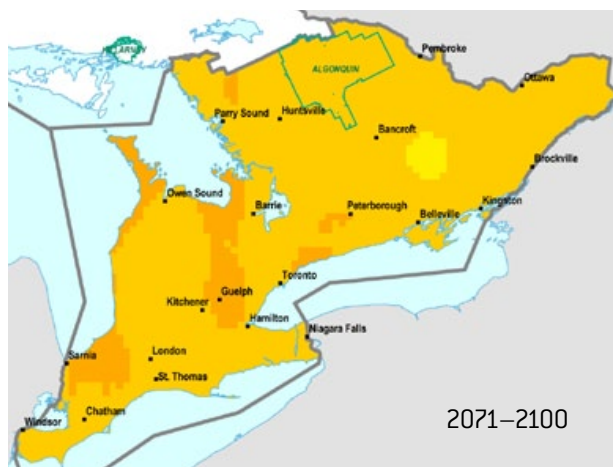
Some significant efforts are being made towards reducing GHG emissions in Ontario. As we will discuss in Section 6 of this report, the provincial government has set ambitious targets and implemented a broad list of programs to achieve these goals. While these measures are welcome, it is important to note that current policy tools focus almost exclusively on cutting emission sources and generally neglect the role of natural ecosystems in capturing and storing existing GHG in order to reduce atmospheric concentrations. Human industrial activity has upset the natural balance of the carbon cycle through the rapid conversion of enormous stores of fossil fuel carbon into GHG over the last century and a half, but the earth's ecosystems function to naturally reduce the amount of CO₂ in the atmosphere. Ontario's rich and diverse natural capital, including those ecosystems found within the Greenbelt, offer the potential to capture and store substantial amounts of carbon and serve the province's efforts towards mitigating climate change, while generating a wide range of additional benefits associated with vibrant, healthy ecosystems.

With rising temperatures, there will likely be some short-term benefits in terms of extended growing seasons and a northward expansion of crop production.

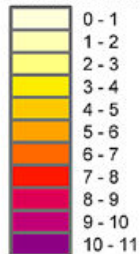
FIGURE 2: PROJECTED CHANGE IN WINTER TEMPERATURES IN SOUTHERN ONTARIO



By mid-century average winter temperatures in most of southern Ontario could increase by 3 to 4°C. By 2071, winter temperatures will increase by 4 to 5°C in most of southern Ontario and in some parts of the region (e.g., the Bruce Peninsula, Collingwood, Sarnia, and Toronto) by as much as 5 to 6°C. As a result, in 2071–2100, people living in Barrie, Brockville, and Parry Sound will have winters like those currently found in Niagara and Windsor.



Difference in Temperature (°C)



Source: S.J. Colombo, D.W. McKenney, K.M. Lawrence and P.A. Gray. 2007. Climate Change Projections for Ontario: Practical Information for Policymakers and Planners. Ontario Ministry of Natural Resources, Applied Research and Development Branch. Climate Change Research Report CCRR-05. Sault Ste. Marie, ON

Valuing the Role of Natural Ecosystems in Climate Change Mitigation

The lack of attention afforded the climate change mitigation potential of natural ecosystems is part of a larger blind spot in our understanding of the value of nature.

AS THE IMPERATIVE TO TAKE SERIOUS ACTION to reduce greenhouse gas concentrations in the atmosphere becomes increasingly clear, policymakers are in need of the widest range of possible options. To date, the major focus of the policy debate has been on cutting emissions through reductions in fossil fuel use through measures such as increased equipment efficiency, conservation, and wider use of renewable energy sources. Another set of policy options, which has received less attention, is offered by the potential of ecosystems to remove existing and future greenhouse gases from the atmosphere by absorbing them into vegetation and soils through the processes of carbon sequestration and storage.

The lack of attention afforded the climate change mitigation potential of natural ecosystems is part of a larger blind spot in our understanding of the value of nature. The benefits that ecosystems provide to humans are regularly ignored or taken for granted by the traditional economic measures used to evaluate the costs and benefits associated with alternate ways of solving a problem. This selective evaluation has greatly distorted the way individuals, businesses, and governments view the world. Our economic, policy, and personal decisions rarely take into account the benefits provided by ecosystems and how they contribute immensely to our well-being, from the air we breathe to the food we eat and the landscapes we enjoy. One rarely stops to think about how the fresh air we breathe is from the same pool of gases into which our car tailpipe is pouring toxic exhaust, and that thankfully this air has been diffused, filtered and purified by a complex web of natural cycles and ecosystems. We know the economic value of the fishing industry because we put a price on the fish that are caught and sold, but we take for granted the ecosystem services such as water purification and habitat creation that make the fishery possible. Clearly, if we do not accurately account for the vast range of benefits provided by the natural world, we cannot begin to make decisions that will allow us to address the environmental challenges before us.

Fortunately, the situation is beginning to change. The last 15 years has seen a growing focus on the concepts of natural capital and ecosystem services as governments, researchers, and businesses begin to take into account the costs and benefits associated with the natural world.²⁹ By estimating the economic

29 R. Costanza, R. d'Arge, et al. 1997. "The Value of the World's Ecosystem Services and Natural Capital." *Nature*, 387: 253-260.

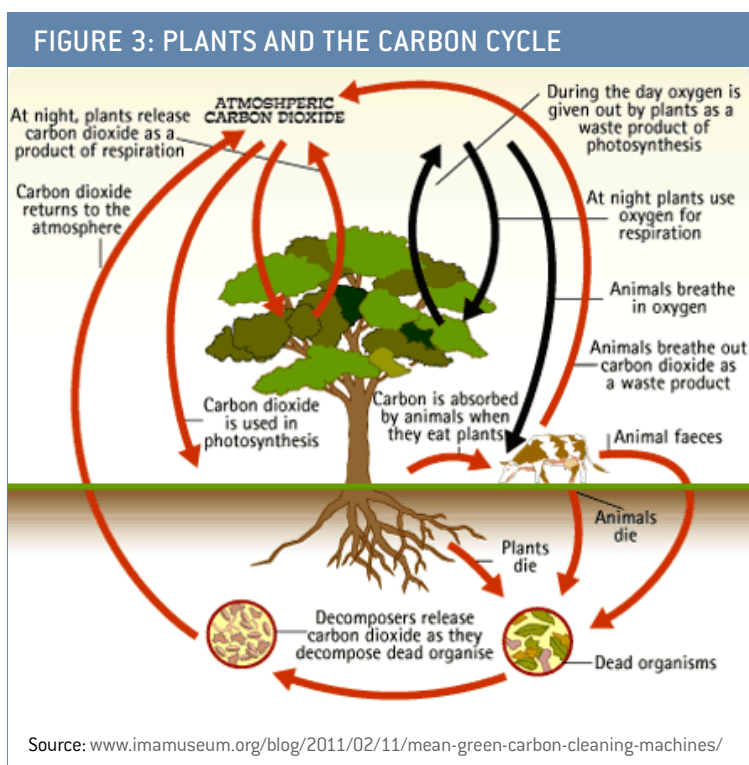
value of ecosystem services, social costs or benefits that otherwise would remain hidden can be accounted for in the regulatory decision making process, allowing for tradeoffs to be weighed in land use decisions. By attaching economic values to nature's services, we can begin to include environmental concerns in standard decision-making.³⁰

The 2003 Millennium Ecosystem Assessment places ecosystem services into four categories: provisioning (e.g. food, fresh water, fuel, genetic resources); regulating (e.g. climate, disease and flood regulation); cultural (e.g. recreation, aesthetics, and education); and supporting (services necessary for production of other ecosystem services, e.g. soil formation, waste treatment, and nutrient cycling).³¹ Climate regulation is, of course, the ecosystem service that interests us most in the context of the present report.

Plant ecosystems contribute to climate regulation through their impact on the global carbon cycle. Plants sequester carbon through the process of photosynthesis, whereby CO₂ is absorbed from the atmosphere to produce energy and then stored in plant biomass (i.e., leaves, trunks, roots, etc.). Some of the carbon absorbed is released back into the atmosphere through respiration as plants use the energy produced through photosynthesis. Carbon is also returned to the atmosphere when plants are burned. A significant amount of carbon is stored in the biomass of dead plants and, under natural conditions, is transferred to soil where it is released slowly as the biomass decomposes. Plant ecosystems therefore continuously sequester CO₂ from the atmosphere and store it in biomass and soils.

The capacity of plant ecosystems to help regulate climate change is increasingly being recognized by policy makers. The United Nations' Reducing Emissions from Deforestation and Forest Degradation (REDD) program, for example, has recognized that the GHG emissions from deforestation and forest degradation have contributed almost 20 per cent of the world's emissions over the last 20 years.³² Intact, healthy forests naturally capture carbon through photosynthesis and store it for generations but development that alters or destroys these ecosystems, such as the clear-cutting of old growth forests to create agricultural lands, results in enormous losses in natural carbon storage capacity. To address this problem the UN's REDD program provides financial incentives to maintain forests, particularly in the global south, where there is added pressure to clear forests for agriculture and other development.

In the next section, we will turn out attention to estimating the economic value of the Greenbelt's carbon storage and sequestration functions.



30 Austin Troy and Ken Bagstad. 2009. *Estimating Ecosystem Services in Southern Ontario*. Prepared for the Ontario Ministry of Natural Resources. www.ontla.on.ca/library/repository/mon/23011/296833.pdf.

31 Millennium Ecosystem Assessment. 2003. *Ecosystems and Human Well-Being: A Framework for Assessment*. Washington DC, Island Press. www.millenniumassessment.org/en/Framework.aspx.

32 C. Parker, A. Mitchell, M. Trivedi, N. Mardas, K. Sosis. 2009. *The Little REDD+ Book*. Prepared for the Global Canopy Program. www.thereddesk.org/sites/default/files/lrb_en.pdf.

Estimating the Economic Value of the Greenbelt's Role in Climate Change Mitigation

Estimating the value of benefits provided by the natural capital in the Greenbelt can be useful in the context of policy making, investment choices, and other types of decision making that affect the Greenbelt and surrounding areas.

PHOTO COURTESY
PHRAWR/FICKR

THE GREENBELT PROVIDES A NUMBER OF IMPORTANT BENEFITS, including the long-term protection of valuable agricultural lands, ecosystems and habitat, the cleaning of air and water, as well as the provision of areas for recreation and leisure. However, the key benefit of interest in the context of the present report is the Greenbelt's significant capacity for greenhouse gas sequestration and storage. The Greenbelt is made up of a mix of agricultural lands, forests, and wetlands, all of which have considerable natural capital value in terms of climate change mitigation. Fully assessing the economic value of this climate change mitigation capacity is a challenging undertaking. However, a recent study conducted for the David Suzuki Foundation goes a long way in this direction. *Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services*,³³ estimates the economic value of a broad range of benefits provided by the natural capital present in the Greenbelt. Such a valuation exercise can be useful in the context of policy making, investment choices, and other types of decision making that affect the Greenbelt and surrounding areas. The following analysis is based on the findings of this report.

Carbon Storage and Sequestration in the Greenbelt's Forests

Forests make up 24 per cent (182,657 hectares) of the protected area within the Greenbelt,³⁴ and are a highly valuable part of Ontario's overall natural capital. As dynamic ecosystems, forests and their trees, plants and soils clean water and air, reduce pollution, provide habitat for wildlife, and capture and store CO₂ while continuously providing oxygen (O₂). Here we estimate the economic value of forest ecosystems in the Greenbelt with respect to their capacity to sequester and store carbon.

33 Sara J. Wilson. 2008. "Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services. Prepared for the David Suzuki Foundation." www.davidsuzuki.org/publications/reports/2008/ontarios-wealth-canadas-future-appreciating-the-value-of-the-greenbelts-eco-serv/.

34 Wilson draws information on land cover within the Greenbelt from the 2000-2002 Southern Ontario Land Resource Information System.

CARBON STORAGE BY THE GREENBELT'S FORESTS

More than half of the earth's terrestrial carbon is contained in the world's forest ecosystems and forests account for approximately 80 per cent of the carbon exchange that occurs between terrestrial ecosystems and the atmosphere.³⁵ When forest ecosystems are healthy and intact, this carbon is contained, making forest ecosystems an effective carbon bank. It is for this reason that deforestation and forest degradation are seen as such serious threats to global climate regulation and why protecting forest ecosystems is essential to climate change mitigation.

To calculate the value of the carbon stored in the Greenbelt's forests, we need to know how many tonnes of carbon is stored in its forested areas (the storage capacity) and the monetary value of each tonne stored.

The capacity of a forest to store carbon depends in part on the eco-climatic zone where the forest is located. The forests of southern Ontario, including those found within the Greenbelt, are predominantly within the Cool Temperate (CT) zone, with some portions within the Moderate Temperate (MT) zone. On average, forests within the CT and MT zones store 220 and 340 tonnes of carbon per hectare, respectively.³⁶ Because most of the Greenbelt lies within the CT zone, an average of 220 tonnes per hectare is used to approximate the total carbon stored by the Greenbelt's forest ecosystems. With 182,657 hectares of forested land, this means that the Greenbelt's forests store over 40 million tonnes of carbon, equal to 147 million tonnes of carbon dioxide equivalent (CO₂e). To put this quantity of carbon in perspective, this amounts to more than twice the total CO₂e released each year in Ontario from transportation, the province's largest source of emissions.³⁷ The Greenbelt ensures that this carbon is stored in protected forests for the long-term.

Carbon is stored in a forest as a result of natural processes, i.e., without the need for human inputs. Without priced inputs, we cannot calculate the monetary value of each tonne of stored carbon directly. However, we can do this in an indirect way: we can either estimate what the economic cost of storing this carbon through human means would be or we can assess the economic harm that would result if this carbon were to be released into the atmosphere.

In some cases, it is possible to find a good comparison of the cost of human provision of the ecological service (e.g., the value of natural systems in terms of water filtration can be compared to the cost of building and operating human-made purification systems).

FIGURE 4: TREE COVER IN THE GREENBELT



Source: Sara J. Wilson. 2008. *Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services*. Prepared for the David Suzuki Foundation.

35 Food and Agriculture Organization. 2011. *State Of The World's Forests 2001*. www.fao.org/docrep/003/y0900e/y0900e06.htm#TopOfPage.

36 W.A. Kurz and M.J. Apps. 1999. "A 70-Year Retrospective of Carbon Fluxes in the Canadian Forest Sector." *Ecological Applications*. 9, pages 526-547.

37 Emissions from transportation in Ontario were 63.5 Mt CO₂e in 2007 [Source: *Climate Change Action Plan Annual Report 2008-09*].

Increasing the amount of forest cover throughout the Greenbelt, such as planting new forests, or managing existing forests to maximize carbon sequestration rates would significantly increase the quantity of annual carbon uptake.

However, in many cases, finding a direct comparison between an ecosystem service and a human alternative is relatively difficult (e.g., habitat provision). Thus, many natural capital assessments consider the avoided costs provided by natural ecosystems as these costs are relatively clear. In the case of carbon storage by forests, the easiest way to determine its economic value is to estimate the monetary value of the harm associated with losing that storage capacity. The harm involved may include the cost of society for health and mortality impacts of extreme weather events and the cost of climate change adaptations.

Estimates of the economic cost of damages from climate change, and thus GHG, vary considerably depending on the models and assumptions used and the social and economic damages included in the calculation. One 2005 review of over 100 estimates showed that most fell within a range from -US\$10/tC (i.e., CO₂ release seen as a net benefit) to +US\$350/tC (i.e., a net cost).³⁸ When considering only peer-reviewed estimates, the average cost of global damages due to the level of CO₂ in the atmosphere was US\$43 per tonne of carbon (or \$52/tC in 2005 Canadian dollars). This figure was accepted by the International Panel on Climate Change (IPCC) in its 2007 Assessment Report.³⁹ Using this figure, we can estimate that the carbon stored in the Greenbelt's forest ecosystems has a value of \$2.09 billion (in 2005 C\$). To give this an annual value, we can think of the carbon stored by the Greenbelt's forests as an annuity investment over 20 years, which places the total annual value of carbon stored by the Greenbelt's forests at \$167.9 million, or \$919 per hectare.

ANNUAL CARBON SEQUESTRATION BY THE GREENBELT'S FOREST

Not only do forest ecosystems store immense amounts of carbon, they draw additional carbon from the atmosphere each year as they grow. To estimate the net carbon sequestration of the Greenbelt's forest ecosystems, the CITYgreen Geographic Information System (GIS) software was used.⁴⁰ This software uses satellite imagery of the Greenbelt to analyze tree canopy and calculate the annual carbon removal by trees.

Trees capture varying amounts of carbon depending on their age; young forests experience the greatest carbon uptake and this rate slows as forests age, eventually stabilizing to no net uptake. To reflect this, three Age Distribution Types were assigned to forests across the Greenbelt (based on typical trunk diameters) with each type given a multiplier reflecting the annual carbon uptake per hectare of that type. Type 1 represents a distribution of young trees, Type 2 represents older trees, and Type 3 represents a mixed distribution of tree ages. This method allows for an effective estimation of annual carbon sequestration for a large area like the Greenbelt.

Using this method, we can estimate that the forest ecosystems of the Greenbelt sequester 137,000 tonnes of carbon annually, or an average of 0.75 tonnes of carbon per hectare per year.⁴¹ Based on the economic cost of carbon discussed above (C\$52/tC), the value of the Greenbelt's forest carbon sequestration is \$7.1 million annually, or \$39 per hectare per year. Increasing the amount of forest cover throughout the Greenbelt, such as planting new forests, or managing existing forests to maximize carbon sequestration rates would significantly increase the quantity of annual carbon uptake.

38 R.S.J. Tol. 2005. "The marginal damage costs of carbon dioxide emissions: an assessment of the uncertainties." *Energy Policy*, 33, pages 2064-2074. www.fnu.zmaw.de/fileadmin/fnu-files/publication/tol/enpolmargcost.pdf.

39 IPCC. 2007: Summary for Policymakers. In M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (editors), *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, pages 7-22.

40 American Forests. CITYgreen software ArcGIS 8.x.

41 This is the value for the point in time when the assessment was made, i.e., 2008. The value will change as the forest composition changes.

Carbon Storage and Sequestration in the Greenbelt's Wetlands

Wetlands comprise roughly 12 per cent of the total area of the Greenbelt and, like forests, offer a broad range of benefits, from fresh water filtration to habitat and recreation. They also have an enhanced ability to store carbon due to their high biological productivity; indeed, wetlands are among the most productive ecosystems in the world. Additionally, wetlands are often anaerobic (without O_2) and therefore have much lower levels of decomposition compared to dry-land ecosystems. Low levels of decomposition mean that less of the carbon stored in wetland biomass is released into the atmosphere. Taken together, the high productivity and low decomposition levels in wetlands mean that wetlands are generally a net carbon sink.⁴² It is only when wetlands are drained for agriculture or other development that the O_2 in the atmosphere decomposes the carbon banks to release CO_2 . Regrettably, 70 percent of southern Ontario's wetlands have already been lost to agricultural expansion, a trend that has resulted in a substantial transfer of carbon stores into the atmosphere over the centuries of European settlement.⁴³

CARBON STORAGE BY THE GREENBELT'S WETLANDS

Canada's Soil Organic Carbon Database was used to quantify the amount of carbon stored in the Greenbelt's wetlands. This database identifies carbon storage levels according to various types of land cover. Based on these figures, it is estimated that the Greenbelt's 94,014 hectares of wetlands store an estimated 6.7 million tonnes of carbon in their soils, peat, and other biomass. Using the method applied to forests above, we can assess the value of this carbon storage by estimating the climate change costs that would be associated with its loss as a carbon bank, (i.e., \$52/tC). This gives a result of \$348.4 million. When converted to an annuity, the value is \$41.8 million per year over 20 years. This value equates to \$429 to \$1,360 per hectare of wetland, depending on the type considered (open water, bog, marsh, swamp or fen).

FIGURE 5: WETLAND COVER IN THE GREENBELT



Source: Sara J. Wilson. 2008. *Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services*. Prepared for the David Suzuki Foundation.

42 Ducks Unlimited, "Carbon sequestration and greenhouse gas emissions in wetlands." www.ducks.ca/conserve/research/projects/climate/carbon.html.

43 Ducks Unlimited, "Impacts on wetlands." www.ducks.ca/conserve/research/projects/climate/wetlands.html.

ANNUAL CARBON SEQUESTRATION BY THE GREENBELT'S WETLANDS

Like forests, wetlands can also be valued for their ability to sequester carbon on an on-going basis. An in-depth study has yet to be conducted specifically on the wetlands of southern Ontario to determine the exact amount of carbon sequestered per year. Nonetheless, an estimate can be made using the global average of sequestration rates for wetlands.⁴⁴ The annual rates of wetland carbon sequestration range from 0.2 to 0.3 tonnes of carbon per hectare. Using an average of 0.25 tonnes per hectare we can estimate that the Greenbelt's wetlands capture 23,500 tonnes of carbon per year, valued at \$1.22 million per year, or \$13 per hectare. This carbon sequestration figure represents a highly conservative estimate as other studies have suggested higher rates of capture.⁴⁵

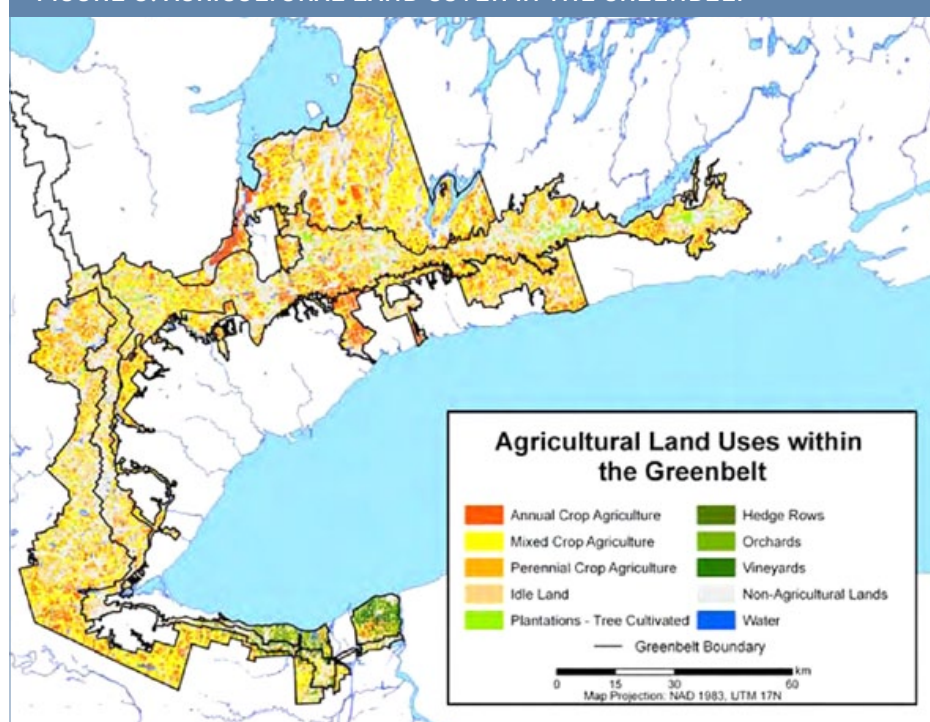
Carbon Storage and Sequestration in the Greenbelt's Agricultural Soils

As the predominant land use within the Greenbelt, agriculture is the cornerstone of the Greenbelt, ensuring the ongoing provision of locally grown produce and the economically productive use of this protected land.

More than half of Canada's best farmland (class 1 agricultural lands) is found in Ontario and an important motivation for creating the Greenbelt was to stem the loss of farmland to urban sprawl. Agricultural lands cover approximately 475,500 hectares, or 63 per cent of the Greenbelt and are home to more than 7,100 farms.⁴⁶ The Greenbelt's farmlands also play an important role in climate change mitigation by storing vast amounts of carbon in its soils.⁴⁷

Like other soils, agricultural soils are made up of a complex mix of decomposed organic material, such as plants, animal tissues, and microbes. As crops grow, they absorb CO₂ from the atmosphere and through photosynthesis convert it into biomass. After harvesting, much of this carbon may eventually be released back

FIGURE 6: AGRICULTURAL LAND COVER IN THE GREENBELT



Source: Sara J. Wilson. 2008. *Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services*. Prepared for the David Suzuki Foundation.

44 The Carbon Balance of Peatlands. www.aswm.org/science/carbon/quebec/sym43.html.

45 Fluxnet Canada. "Peatland Carbon Study. Mer Bleu Eastern Peatland." www.trentu.ca/academic/bluelab/research_merbleue.html.

46 A. Bell, B. Cundiff, and B. Mausberg. 2007. *Greenbelt Agriculture: An In-depth Look at Agriculture in the Greenbelt*. Friends of the Greenbelt Foundation. Toronto, Ontario.

47 Although not included in the present analysis, it is worth noting that by providing a local source of food, the Greenbelt's farms serve climate change mitigation by reducing the need for imported produce. Such produce may travel thousands of kilometres by truck, ship, and plane to reach supermarkets in the Greater Golden Horseshoe.



Agricultural practices can play a determining role as to whether farmland soils are a net carbon source or sink.

PHOTO COURTESY
DENIS GILES/Flickr

into the atmosphere, but some can be retained within the soil. As with forests and wetlands, this carbon can be stored for extended periods of time, but can also be quickly released if conditions change. Agricultural practices can play a determining role as to whether farmland soils are a net carbon source or sink. For example, heavy tillage exposes crop residues to the soil's surface and transfers greater amounts of CO₂ back into the atmosphere. In contrast, practices such as reduced or no-till farming minimize this disruption and decrease the amount of carbon that is released during seasonal crop cycles. Effective crop rotation also helps to maximize the amount of carbon stored in soils as it more closely matches the diversity of natural ecosystems compared to intensive monocropping agriculture.

CARBON STORAGE BY THE GREENBELT'S AGRICULTURAL SOILS

An estimate of the total amount of organic carbon stored in the Greenbelt's agricultural soils was made using the Canadian Soil Organic Database.⁴⁸ The amount of carbon stored in agricultural soil varies depending on the quality and organic content of the soil and ranges from 71 to 90 tonnes of carbon per hectare. Using an average figure of 80 tonnes per hectare, it is estimated that the Greenbelt's agricultural soils store 39.9 million tonnes of carbon, with a value of \$2.08 billion (based on the average cost of carbon emissions of C\$52/tC). As an annuity this is valued at \$157 million per year, or \$330 per hectare.

ANNUAL CARBON SEQUESTRATION BY THE GREENBELT'S AGRICULTURAL SOILS

The high degree of variance in agricultural practices across the Greenbelt and the absence of a thorough study into agricultural carbon sequestration in southern Ontario make it difficult to accurately assess the economic value of carbon sequestration by the Greenbelt's farmland. For example, agriculture that entails more permanent plant cover, such as orchards, provide carbon sequestration rates closer to those found in forests, whereas the continuous monocropping of perennial crops such as corn and soybean may provide little to no net annual carbon sequestration.

Land in permanent cover sequesters more carbon than tilled land because of lower decomposition rates and a higher input of plant residue back into the soil. Although the rate of sequestration depends on the type

⁴⁸ C. Tarnocai and B. Lacelle. 1996. *Soil Organic Carbon Database of Canada*. Eastern Cereal and Oilseed Research Centre, Research Branch, Agriculture and Agri-Food Canada, Ottawa, Canada.

Of course, the Greenbelt's ecosystems provide a variety of other services, such as water regulation, water filtration, flood control, waste treatment, recreation, and wildlife habitat, but the carbon storage and sequestration function holds the greatest value.

SUMMARY OF CARBON STORAGE AND SEQUESTRATION BENEFITS

CARBON STORAGE

- Forests: 40 million tonnes of carbon (147 million tCO₂e).
Value: \$2.09 billion or \$167.9 million per year over 20 years.
- Wetlands: 6.7 million tonnes of carbon (24.6 million tCO₂e).
Value: \$348.4 million or \$41.8 million annually over 20 years.
- Agricultural soils: 39.9 million tonnes of carbon (147 million tCO₂e).
Value: \$2.08 billion or \$157 per year over 20 years.

TOTAL: 86.6 million tonnes of carbon (318.6 million tCO₂e).

TOTAL VALUE: \$4.5 billion or over \$366.7 million per year over 20 years.

CARBON SEQUESTRATION

- Forests: 137,000 tonnes of carbon annually (502,242 tCO₂e). Value: \$7.1 million per year.
- Wetlands: 23,500 tonnes of carbon annually (84,318 tCO₂e). Value: \$1.2 million per year.
- Agricultural soils: 45,565 tonnes of carbon annually (601,349 tCO₂e). Value: \$2.4 million/year.

TOTAL: 206,065 tonnes sequestered annually (759,864 tCO₂e).

VALUE: \$10.7 million/year.

of cover, the change from conventional crop tillage to permanent cover is estimated to increase sequestered carbon by 0.5 tC per hectare per year compared with conventional crop cover.⁴⁹ Currently, agricultural lands within the Greenbelt include 78,889 hectares of covered idle land, 5,202 hectares of orchards, and 7,039 hectares of hedge rows. These lands sequester 45,565 tonnes of carbon annually, which has a total value of \$2.4 million based on an average cost of carbon emissions of C\$52/tC, or \$26 per hectare.

THE ABOVE ANALYSIS HAS DEMONSTRATED how the forests, wetlands, and agricultural lands within the Greenbelt, through their carbon sequestration and storage, play a substantial role in mitigating climate change in southern Ontario. This is done in two direct ways: through the enormous stores of carbon contained in the Greenbelt's forests, wetlands, and agricultural soils and through the additional carbon sequestered each year by these ecosystems. In total, the Greenbelt's forests, wetlands, and agricultural soils store an estimated 86.7 million tonnes of carbon (318.6 million tCO₂e), with an estimated economic value of \$4.518 billion or over \$366.7 million per year over 20 years. The total amount of carbon sequestered each year by the Greenbelt's forests, wetlands, and agricultural soils is approximately 206,065 tonnes (759,864 tCO₂e), with an estimated economic value of \$10.7 million per year over 20 years. Of course, the Greenbelt's ecosystems provide a variety of other services, such as water regulation, water filtration, flood control, waste treatment, recreation, and wildlife habitat, but the carbon storage and sequestration function holds the greatest value.⁵⁰

49 W.N. Smith et al. 2001. "Estimated changes in soil carbon associated with agricultural practices in Canada." *Canadian Journal of Soil Science*, 81:221-227. (Used in Olewiler, N. 2004. *The Value of Natural Capital in Settled Areas of Canada*. Ducks Unlimited and Nature Conservancy of Canada.)

50 S.J. Wilson. 2008. "Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services. Prepared for the David Suzuki Foundation." www.davidsuzuki.org/publications/reports/2008/ontarios-wealth-canadas-future-appreciating-the-value-of-the-greenbelts-eco-serv/.

Land Use Changes in the Greenbelt

IN THE PREVIOUS SECTION, we reviewed the direct role that the Greenbelt plays in climate change mitigation through its carbon storage and annual sequestration functions. It is important to recognize, however, that the preservation of these functions in the Greenbelt is not guaranteed by the current policy framework, neither by the legislation and plans governing the Greenbelt nor the province's climate change policies. In fact, land use changes occurring within the Greenbelt that are permitted and supported by the Greenbelt Plan have the potential to greatly reduce the carbon capture and storage capacity of the Greenbelt's ecosystems. The policy framework allows for a considerable range of non-agricultural land uses, including renewable and non-renewable natural resource extraction, local, regional, and inter-regional infrastructure construction, and recreation and tourism development. These activities may threaten the environmental protection goals of the Greenbelt and present serious risks in terms of the greenhouse gas mitigation function of the Greenbelt's natural and managed ecosystems.

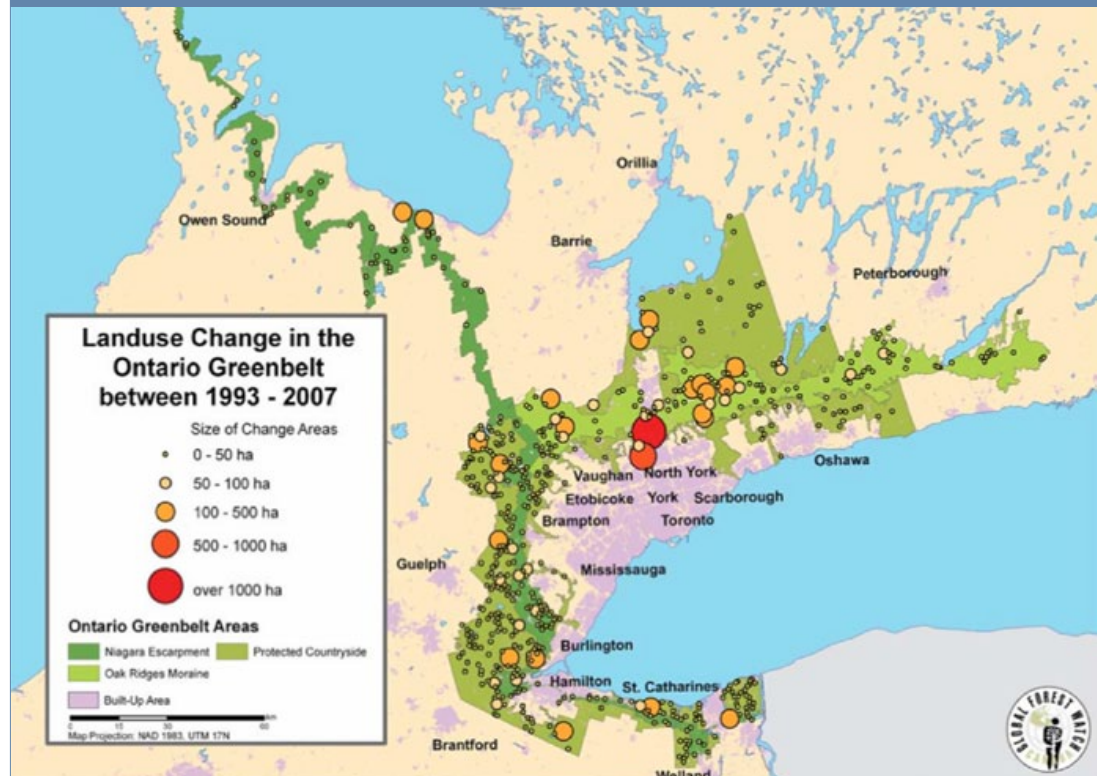
There is already considerable pressure for development within the Greenbelt. A study by Global Forest Watch Canada on major land use changes within the Greenbelt found that between 1993 and 2007, over 11,000 hectares of land were converted to other uses, including residential and commercial developments, golf courses, and aggregate pits and quarries.⁵¹ The leading reasons for land conversion were for the construction of urban and built-up areas, conversion to golf courses, and aggregate operations. Of the land use conversions that took place in these years, 51 percent occurred on Class 1 soils, the most productive agricultural lands. While most of these changes took place prior to the creation of the current legal and planning framework governing the Greenbelt, this study demonstrates the degree to which development pressure exist in Greenbelt lands and underline the need to better manage these threats to the Greenbelt's carbon storage and sequestration functions in the coming years.

The massive carbon storage capacity of the Greenbelt is a double-edged sword. As long as the carbon remains locked up in the Greenbelts vegetation and soils, the area continues to provide an important service in terms of climate regulation. However, if land use conversions were permitted on a wide-enough scale, there is a risk

Between 1993 and 2007, over 11,000 hectares of land were converted to other uses, including residential and commercial developments, golf courses, and aggregate pits and quarries.

51. R. Cheng and P. Lee. 2008. *Urban Sprawl and Other Major Land Use Conversions in Ontario's Greenbelt From 1993 to 2007: A Change Analysis Project Using Satellite Imagery*. Report to the David Suzuki Foundation and the Greenbelt Foundation. Edmonton, Alberta: Global Forest Watch Canada.

FIGURE 7: LAND USE CHANGES IN THE ONTARIO GREENBELT BETWEEN 1993 AND 2007



Source: R. Cheng and P. Lee. 2008

that the Greenbelt could become a significant source of GHG emissions. Every time forest cover is reduced, wetlands are drained, or agricultural soils are disturbed, carbon is released and the Greenbelt's sequestration capacity is degraded. Thus, it is important that proper measures are in place to ensure the climate change mitigation capacity of the Greenbelt is maintained and that activities that reduce this capacity are closely regulated. Improper management and an inadequate policy framework could tip the Greenbelt from a carbon sink to a net source of GHG emissions.

In this section, we explore three key land use conversions that are permitted within the Greenbelt under the current policy framework: aggregate mining, infrastructure development, and recreation and tourism. These non-agricultural land uses involve varying degrees of impacts but, taken together, they could pose a substantial threat to the health of the Greenbelt's ecosystems and the natural services it provides if not properly managed.

Aggregate Mining in the Greenbelt

The land use that is permitted in the Greenbelt and that is of greatest concern from a carbon-storage and sequestration point of view is aggregate mining. This activity entails a dramatic ecological footprint and the release of substantial amounts of stored carbon from the affected areas. Aggregates are an essential part of the modern built environment and include the sand, gravel, and stone used in all forms of construction. Aggregate minerals are the primary inputs needed to make public infrastructure such as roads, sidewalks, concrete bridges, underground tunnels, and sewer systems. They are also a major component in the construction of most buildings, including residential, commercial and institutional structures. Clearly, these minerals play an essential role in building and maintaining our towns and cities.



Given their important role in our society, it is not surprising that the demand for aggregates is very large: in 2009, a total of 154 million tonnes of aggregate was mined in Ontario, which equates to an average of more than 13.7 tonnes per resident of the province.⁵² Of this annual production, it is estimated that more than 50 per cent is sold to public authorities for the construction and maintenance of public infrastructure.⁵³ Most of the rest is purchased by private construction firms as inputs into the building stock. Thus, both the public and private sectors have an interest in securing reliable and inexpensive supplies of aggregate materials on an enormous scale.

Economically, the key attributes of aggregate materials are their enormous weight and the high cost of transport. This means that transporting aggregates over long distances is not feasible without raising the cost of the delivered material and possibly hampering economic development in the growing region.⁵⁴ Thus, the central preoccupation of aggregate resource policy in Ontario is to ensure that extraction occurs “close to market”, i.e., as near as possible to the location where the resource will be used. In the case of the rapidly growing core of the Greater Golden Horseshoe, comprised of the Greater Toronto Area and Hamilton, many close-to-market aggregate sources are found in the Greenbelt.

There were 260 licensed operations in the Greenbelt and vicinity in 2009, with these operations disturbing a total area of over 12,000 hectares.⁵⁵ Most of the high-quality deposits are in the Niagara Escarpment and the Oak Ridges Moraine.⁵⁶ In fact, the Milton Quarry, Ontario’s largest aggregate mining operation, is in the Niagara Escarpment, an ecologically rich natural feature within the Greenbelt recognized by the United Nations as a World Biosphere Reserve.

As virtually all aggregates are extracted from open pits or quarries, they entail impacts to surface features. When starting a new aggregate extraction site, or when expanding an existing site, operators begin

GREENBELT PLAN GOAL:

“To enhance our urban and rural areas and overall quality of life by promoting the following matters within the Protected Countryside:

...Provision for the availability and sustainable use of those resources critical to the region’s social, environmental, and economic growth needs.”

— The Greenbelt Plan, 2005, pages 5-6.

PHOTO COURTESY
ALEJANDRA PERDERMO

52 The Ontario Aggregate Resource Corporation, 2009. *Mineral Aggregates in Ontario: Statistical Update 2009*. www.toarc.com/pdf/Stats_2009.pdf.

53 Ibid.

54 Extracting aggregate resources close to where they are being utilized can also be considered a GHG mitigation approach as trucking resources long distances increases GHG emissions.

55 The Ontario Aggregate Resources Corporation, 2010, op cit.

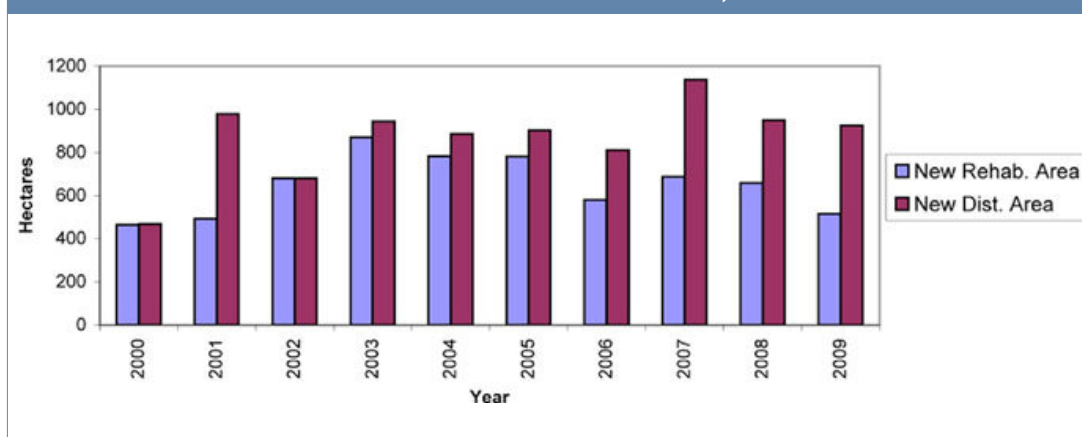
56 Mark Winfield and Amy Taylor. 2005. *Rebalancing the load: The need for an aggregates conservation strategy for Ontario*. Toronto: The Pembina Institute. <http://pubs.pembina.org/reports/Aggregatesfinal-web2.pdf>.

by removing the vegetation, topsoil, and subsoil over the deposit. In this process, the majority of the carbon stored in the previous vegetative cover is released as GHG emissions. Not only do these mining operations, therefore, release carbon emissions through the disruption and destruction of forest, soil, and wetland ecosystems, but by eliminating these features they further reduce the carbon sequestration capacity of the Greenbelt. Further GHG emissions result from the infrastructure, machinery, transportation, and operational demands of these mines.

The mining of aggregate resources in the Greenbelt is regulated thorough several layers of provincial policy. The Aggregate Resources Act (ARA) lays down the conditions for obtaining a licence or permit to extract aggregates. The ARA dictates how the entire lifecycle of an aggregate extraction site is to be planned, including how it is to be rehabilitated when extraction has ceased. The Provincial Policy Statement (PPS), which guides municipal planning decisions, provides direction as to how the needs of the aggregate industry — including extraction sites, accessory uses, storage and processing — should be considered in land use planning processes. The Greenbelt Plan provides further direction, beyond that which is in the PPS, as to how aggregate uses should be planned within the Greenbelt area. The Niagara Escarpment Protection Plan (NEP) and Oak Ridges Moraine Plan (ORMCP), two provincial plans that apply in very large areas within the Greenbelt, indicate where and under what conditions aggregate resources can be extracted within the Niagara Escarpment and Oak Ridges Moraine planning areas respectively.

This policy framework works to ensure a steady supply of aggregate from the Greenbelt. The ARA and the PPS prioritize the activities of producers, protect the resources from incompatible uses, and place limits on the ability of municipalities (and other interveners) to constrain aggregate operations. The Greenbelt Plan as well as the NEP and ORMCP explicitly allow aggregate operations in all but the most sensitive and valuable agricultural and natural areas. For example, the Greenbelt Plan prohibits the development of new mineral aggregate mining operations only in those areas designated as significant wetland, significant habitat of endangered or threatened species, or significant woodlands. The ORMCP allows new sites as well as expansions of existing sites in areas designated as Countryside and Natural Linkage Areas. Only Natural Core Areas, making up 38 per cent of the land covered by the Plan, are off-limits to aggregate extraction. The NEP allows new and expanded aggregate operations in Rural Areas covered by the Plan. All three plans set conditions for new and expanded operations that are designed to reduce disruption of natural features on the affected sites. None of the plans, however, make any mention of the need to minimize impacts on the GHG storage functions of the Greenbelt.

FIGURE 8: NEWLY DISTURBED AND REHABILITATED LAND, 2000–2009



Source: The Ontario Aggregate Resources Corporation. 2010. Statistical Update 2009. Burlington, ON: The Ontario Aggregate Resources Corporation. www.toarc.com/pdf/Stats_2009.pdf.

Although the policy framework contains provisions designed to minimize the collateral damage that the aggregate industry does to the environment, there are a number of weaknesses that undermine its effectiveness in protecting the carbon storage capacity of the Greenbelt's natural and managed ecosystems. This includes:⁵⁷

- Operations are approved on a site-by-site basis and cumulative impacts (e.g., on ground water, landscape, or carbon storage) of aggregate extraction operations clustered in a particular area are not considered.
- The protection of close-to-market aggregate resources typically trumps other key considerations during the planning of aggregate extraction sites, namely the protection of natural heritage and of water resources.
- The provincial monitoring and enforcement of operator adherence to site plans and licence conditions is generally considered to be deficient.

The rehabilitation of mined-out sites could reduce the threat of the aggregate industry to the carbon storage functions of the Greenbelt by restoring vegetation and soil. Indeed, the Aggregate Resources Act requires progressive and total rehabilitation of active pits and quarries and the Greenbelt Plan requires that the rehabilitated area be maximized and the disturbed area be minimized on an on-going basis over the life-cycle of the pit or quarry. In practice, however, rehabilitation has been lagging behind policies for years. There is clear evidence that over the last decade, land has been disturbed by aggregate extraction at a significantly faster rate than it has been rehabilitated after extraction (see Figure 8). The same was true in the previous decade — less than half of the land disturbed for aggregate production between 1992 and 2001 had been rehabilitated by 2005.⁵⁸ The Environmental Commissioner of Ontario has repeatedly addressed the lag in the rehabilitation of aggregate extraction sites. In his 2003–2004 annual report to the Ontario Legislature Assembly, the Commissioner ascribed the problem to a lack of enforcement by MNR and to the fact that the ARA rules on rehabilitation do not apply to sites that were established prior to the coming into effect of the legislation.⁵⁹

Although the policy framework governing aggregate mining in the Greenbelt does include certain limits on aggregate operations, these constraints may not adequately ensure the protection of the Greenbelt environment nor do they address in any way the climate change implications of these activities. The importance of aggregate materials in the growth and maintenance of our built environment and the predominant role of provincial and municipal governments in these activities mean that aggregate mining operations will continue to be necessary in and around the Greater Golden Horseshoe. The considerable ecological impacts of these operations, the associated carbon footprint, and the destruction of lands within the Greenbelt, however, are things that need to be more adequately addressed through stronger provincial policy provisions and enforcement mechanisms. The scale of aggregate mining operations and the environmental footprint they create poses a real threat to the long-term protection of the Greenbelt and the cumulative impacts of these activities have substantial climate change implications for southern Ontario.

57 Matt Binstock and Maureen Carter-Whitney. 2011. *Aggregate Extraction in Ontario: A Strategy for the Future*. Prepared for the Canadian Institute for Environmental Law and Policy (CIELAP). <http://cielap.org/pdf/AggregatesStrategyOntario.pdf>.

58 Op Cit: M.S. Winfield and A. Taylor. 2005.

59 Environmental Commissioner of Ontario. 2004. *Choosing our Legacy – Annual Report 2003-2004*. Report to the Legislative Assembly of Ontario. www.eco.on.ca/eng/uploads/eng_pdfs/ar2003.pdf. According to the Ontario Ministry of Natural Resources (Pers. Comm), the ARA rules on rehabilitation can apply to older sites that predate the Act if the pit/quarry operator continues to operate under the authority of a license. In addition, some older sites may be eligible for rehabilitation under the province's Management of Abandoned Aggregate Properties Program, www.toarc.com/maap-1/about-maap.html.

GREENBELT PLAN GOAL:

“To enhance our urban and rural areas and overall quality of life by promoting the following matters within the Protected Countryside:

- Support for infrastructure which achieves the social and economic aims of the Greenbelt and the proposed Growth Plan while seeking to minimize environmental impacts.”

— The Greenbelt Plan, 2005, pages 5-6.

Major Infrastructure in the Greenbelt

The policy framework governing the Greenbelt allows for the construction of infrastructure within the Greenbelt, including both local infrastructure as well as major infrastructure serving national, provincial and inter-regional needs. The Greenbelt Plan acknowledges that new infrastructure will be needed to serve existing and permitted land uses in the Greenbelt and that expansions of existing major infrastructure and new major infrastructure will be needed to serve the substantial growth projected for Southern Ontario. No part of the Greenbelt is out of bounds to infrastructure projects, including prized natural heritage features. However, the Greenbelt Plan requires that infrastructure be built so as to minimize its footprint in the Protected Countryside, to avoid impacts on natural heritage features if reasonable alternatives exist, and to mitigate impacts if avoidance is deemed impossible. Similar provisions are found in the NEP and the ORMCP. No mention is made in any of the plans, however, of the need to minimize the GHG mitigation impacts of infrastructure development.

The most significant infrastructure threat to the carbon storage capacity of the Greenbelt comes from highways. Already, some of the most travelled highways in Canada pass through the Greenbelt, including the 400, 401, 404, and 407. Given the projections for substantial growth around the Greater Golden Horseshoe, it is expected that these major routes will be widened over the coming years. However, the larger threat to the Greenbelt is the new highways being planned and constructed across its lands.

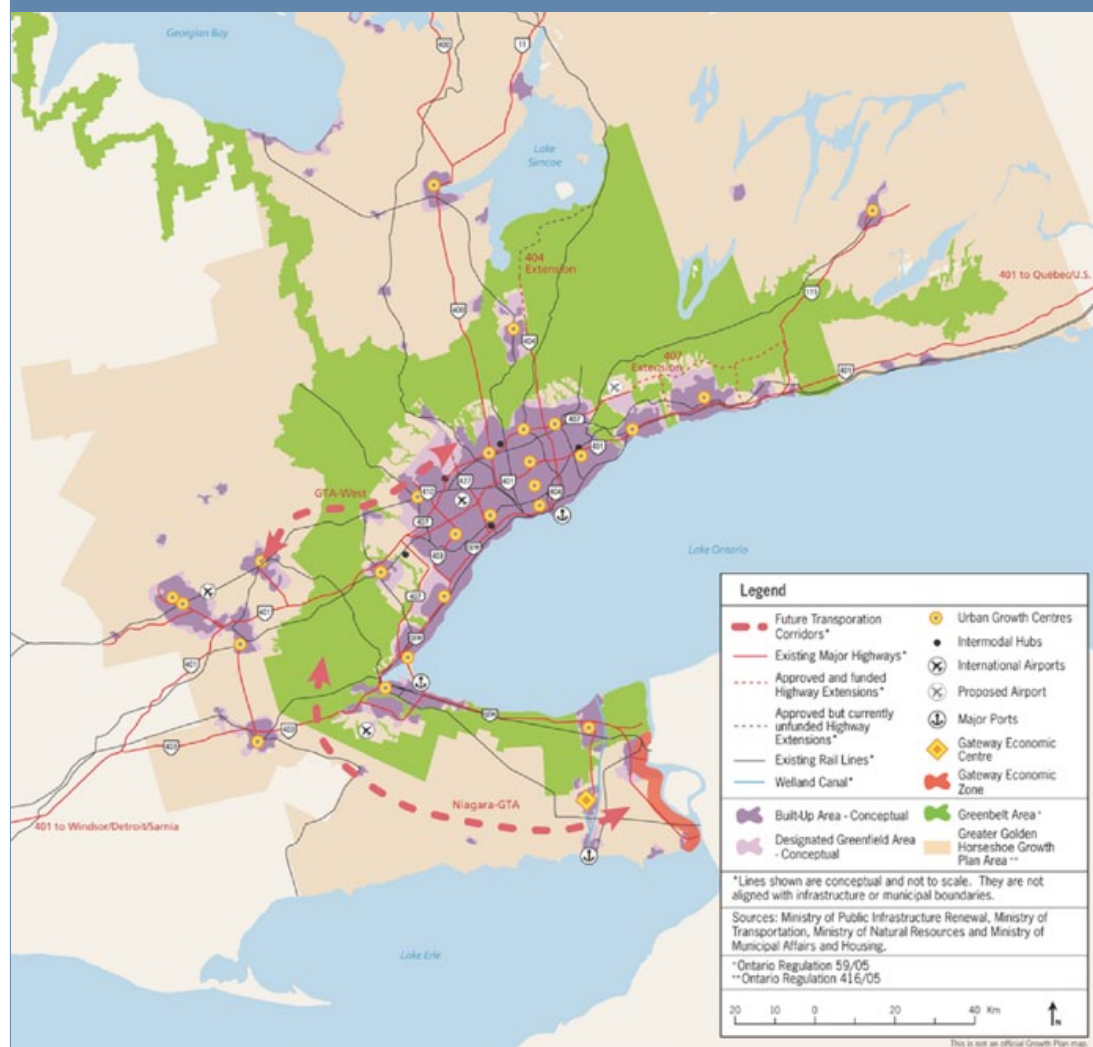


The most significant infrastructure threat to the carbon storage capacity of the Greenbelt comes from highways. Already, some of the most travelled highways in Canada pass through the Greenbelt.

PHOTO COURTESY
MARTIN CATHRAE/FLICKR

Source: As the Crow
Flies cARTography,
adapted from Schedule
6 of the Growth Plan.

FIGURE 9: PLANNED HIGHWAY PROJECTS



The Growth Plan for the Greater Golden Horseshoe lays out the province's plan for highway development to 2031. The plan identifies four highway projects that will have direct impacts on the Greenbelt: extensions to the existing Highways 404 and 407 and two new highway corridors, known as the GTA-West and Niagara-GTA corridors. These four projects are shown in Figure 9. The highway extensions have already undergone environmental assessments and are currently under construction. The two new highways are still being planned and are currently undergoing environmental assessment processes.

Highway projects in the Greenbelt can have very significant direct impacts on agricultural and natural areas.⁶⁰ This type of infrastructure construction results in the direct loss of climate change mitigating natural landscape within the Greenbelt, including the permanent destruction of forests and wetlands. Moreover, the disturbance of soils during construction releases much of the stored CO₂. In terms of land lost, for a 100 metre-wide highway, at least 10 hectares of land would be directly affected for every kilometre of highway built. The linear corridors required for roads and highways are particularly harmful to ecosystem health as they eliminate linkages, restrict movement, and effectively transform the Greenbelt's protected lands into divided and isolated parcels. Furthermore, the construction and long-term usage of major highways results in further GHG emissions. Modelling studies by Metrolinx show that new highway capacity in the GTA-West and Niagara-GTA corridors combined would entail an increase in GHG emissions of roughly 10 per cent.⁶¹

There are promising signs that the province is taking action to limit the adverse impacts of new highways on the Greenbelt. Although the Highway 407 extension is proceeding as planned, the length of the Highway 404 extension has been scaled back, at least for now, compared to its EA-approved plan. Of the two new corridors, the GTA-West corridor is being planned to avoid the creation of a new ROW through the Greenbelt; the project will most likely rely instead on a widening of the existing Highway 401. In the Niagara-GTA corridor, the QEW may be widened through the Niagara Escarpment in order to avoid the need to for a new section of highway crossing the landform, which is a World Biosphere Reserve. These measures are welcome and will serve to moderate the direct impact of these highway projects on natural and managed ecosystems in the Greenbelt. However, the improvements cannot mask the fact that the planned highway projects will involve significant disruption to the Greenbelt's ecosystems and its carbon storage capacity.

Moreover, these mitigation measures will have little effect on the *indirect* impacts of highway building in the Greenbelt. This refers to the well-known tendency for highway development to stimulate land development in its path.⁶² Although the highway projects are justified by the government on the basis of their potential to smooth the transport of cargo through the region, new highways inevitably become clogged with commuters from adjacent communities. New highways that service communities within the Greenbelt could increase pressures for development to encroach into areas under Greenbelt protection. Highways extending to communities outside the Greenbelt could encourage leapfrog development and further sprawl just beyond the Greenbelt.⁶³ Sprawling development outside the perimeter of the Greenbelt could limit opportunities for expanding the Greenbelt in the future and lead to a further loss of natural and managed ecosystems along with their carbon storage capacity.

Toronto has the longest commute times in Canada⁶⁴ and one of the longest (next to New York) among major North American cities.⁶⁵ However, we cannot build ourselves out of this situation by expanding highway

“The Greenbelt Plan also fails to challenge status quo approaches to transportation – as demonstrated through Plan policies permitting highways and aggregate extraction operations in most of the Protected Countryside, thereby compromising the Plan's expressed goal of offering protection to natural heritage, water resource systems, and agricultural lands. The ECO believes this fundamental weakness of the Plan could lead to transportation corridors that generate additional growth pressures that would threaten the [protected countryside] and beyond.”

— The Environmental Commissioner of Ontario (ECO).

Source: The Environmental Commissioner of Ontario. 2005. *The Greenbelt Act, 2005, and the Greenbelt Plan. Planning our Landscape*. ECO Annual Report, 2004-05. Toronto: The Queen's Printer for Ontario, page 54

60 R.T. Forman and L.E. Alexander. 1998. “Roads and Their Major Ecological Effects.” *Annual Review of Ecology and Systematics*, 29, pages 207-231. www.annualreviews.org/doi/pdf/10.1146/annurev.ecolsys.29.1.207.

61 Metrolinx. 2008. *White Paper #2: Preliminary Directions and Concepts*. Toronto: Metrolinx. www.metrolinx.com/Docs/WhitePapers/WhitePaper2.pdf.

62 B. Heavner. 2000. *Paving the Way: How Highway Construction has Contributed to Sprawl in Maryland*. Baltimore, MD: Maryland Public Interest Research Group Foundation. www.policyarchive.org/handle/10207/bitstreams/5488.pdf.

63 Ray Tomalty and Bartek Komorowski. 2011. *Inside and Out: Sustaining Ontario's Greenbelt*. Prepared for the Friends of the Greenbelt Foundation. http://greenbelt.ca/sites/default/files/inside_and_out_sustaining_ontario039s_greenbelt_.pdf.

64 Martin Turcotte. 2010. “Commuting to work: Results of the 2010 General Social Survey.” Prepared for Statistics Canada. www.statcan.gc.ca/pub/11-008-x/2011002/article/11531-eng.pdf.

65 Toronto Board of Trade. 2012. *Toronto as a Global City: Scorecard on Prosperity - 2012*. www.bot.com/Content/NavigationMenu/Policy/Scorecard/Scorecard2012/Scorecard2012.pdf.

GREENBELT PLAN GOAL:

“To enhance our urban and rural areas and overall quality of life by promoting the following matters within the Protected Countryside:

- Provision of a wide range of publicly accessible built and natural settings for recreation including facilities, parklands, open space areas, trails and water-based/shoreline uses that support hiking, angling and other recreational activities.
- Enabling continued opportunities for sustainable tourism development.”

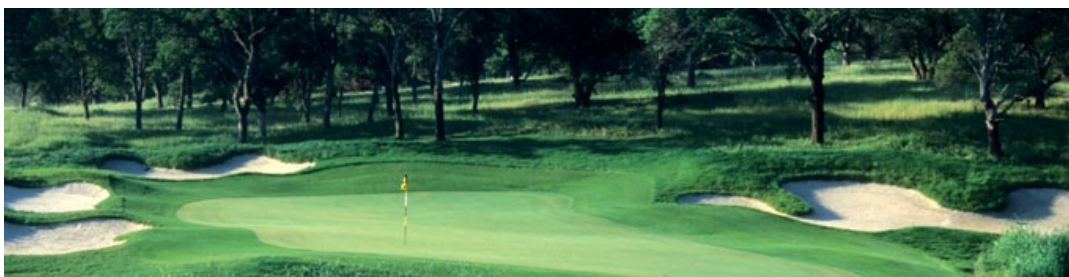
— The Greenbelt Plan, 2005, pages 5-6.

capacity. Further investment in highway and road systems encourages sprawl and car commuting while contributing to what is already the province's largest source of GHG emissions, those from the transportation sector. If the Greenbelt is, in fact, meant to serve as a tool for preserving natural and managed ecosystems, limiting urban sprawl and promoting smart growth, major transportation infrastructure should be discouraged within the Greenbelt, with the funding better directed towards expanding public transit systems.

Recreation and Tourism in the Greenbelt

The Greenbelt Plan permits and supports the ongoing development of recreational and tourism-related facilities such as trails, parks, golf courses, bed and breakfasts, tourist accommodation, playing fields, camp grounds, and ski hills and resorts within the designated lands. While these types of development are important to the economic diversity of the Greenbelt and the Greenbelt's contribution to the quality of life in the region,⁶⁶ it is crucial that they be carefully balanced with conservation goals. The rapidly growing population in the Greater Golden Horseshoe will undoubtedly increase the demand for accessible recreation and tourism facilities within the Greenbelt. Apart from a prohibition on recreation and tourism development in prime agricultural and specialty crop areas within the Greenbelt, there are few policy restrictions to the growth of these sectors. There are no limits on the cumulative amount of recreational facilities permitted in the Greenbelt, and the policy framework makes no mention of the need to limit the climate change mitigation impacts of recreational development.

Some recreational facilities involve considerable land use transformation, including the degradation of ecosystem health and loss of habitat. Although the Greenbelt Plan requires major new or expanded recreational facilities to maintain the amount of vegetation on the site, some loss of ecosystem function may be inevitable for some types of development. In particular, converting forests and wetlands to golf courses results in a loss of ecosystem carbon storage capacity.⁶⁷ Furthermore, although golf courses provide some carbon capture and storage through vegetative land cover, the ongoing maintenance operations, including regular cutting and application of fertilizer and pesticide, generally entail considerable net GHG emissions.⁶⁸ Golf courses also consume heavy amounts of fresh water, often drawing this resource directly from rivers, streams or groundwater, and this water usage puts substantial strain on the Greenbelt's hydrologic systems. The Oak Ridges Moraine system, which serves as an essential groundwater discharge and recharge area for millions of Ontarians and a direct drinking water source for over 250,000 residents, already has 41 golf courses.⁶⁹ Without explicit limits to the amount of land available for recreation and tourism purposes, there is a risk of significant further land use changes within the Greenbelt and consequential natural and hydrologic degradation.



66 The report by Sara Wilson, 2008 op cit, estimated the economic value of the recreational services provided by the Greenbelt's forests, wetlands, and water at \$95 million per year or \$335 per hectare per year.

67 Chen, 2008, op cit, found that after urbanization, the main reason for land conversion within the Greenbelt was golf courses.

68 S. Asumu. 2010. "Measuring the Lifecycle Carbon Footprint of a Golf Course and Greening the Golf Industry in Japan." Paper presented at conference entitled "Transition to Sustainability 30 November-3 December, 2010 , Auckland, NZ. www.thesustainabilitysociety.org.nz/conference/2010/presentations/Saito.pdf.

69 Ecojustice/Earthroots, 2008. *Ontario's Water Hazard: The Cumulative Impact of Golf Courses on Water Resources*.



The Greenbelt and Climate Change Policy

Ontario's Climate Change Policy Framework

A recent report by the David Suzuki Foundation compared provincial climate change plans and performance. The authors found that in terms of total emissions, Ontario ranks second only to Alberta in its relative contribution to Canada's total annual greenhouse gas emissions. On a per capita basis, however, Ontario has one of the lowest per capita levels of emissions in the country. Moreover, total emissions have been steadily decreasing over the past few years. In 2009, overall emissions were 18 percent lower than 2005 and seven percent below 1990 levels. Although the report recognized that decreased emissions are partly a consequence of the slow-down in the Ontario economy with the 2008 recession, the author concluded that the Ontario government was making significant efforts and awarded a "very good" score to the province's climate change policy framework.⁷⁰

The keystone of this policy framework is the province's Climate Change Action Plan, introduced in 2007.⁷¹ Although somewhat lacking in details, the plan was ambitious in its objectives and, if fully implemented, would have far-reaching impacts on almost all aspects of Ontario's economy and society. The plan introduced one of the most ambitious set of emission targets of any jurisdiction in Canada: six per cent below 1990 levels by 2014, 15 per cent below 1990 levels by 2020, and 80 per cent below 1990 levels by 2050. The key measures identified in the plan to achieve the short and medium term goals included heavy investment in public transit, stimulating the green economy, phasing out coal and growing green power, and improving tree cover.

The province's plan is a "living document" and has been updated a number of times since being released in 2007. According to the most recent update, in 2010, the initiatives launched to that point would take the province more than 85 per cent of the way towards the 2014 target. In its 2011 review of the province's climate change policy, however, the Environmental Commissioner of Ontario argued that the government must find additional GHG reduction options for its climate change policy toolkit in order to reach its short- and medium-term targets. "At this time," the Environmental Commissioner of Ontario warns, "there is no plan, mechanism or tools in place which would allow the 2020 target to be met."⁷²

In its 2011 review of the province's climate change policy, however, the Environmental Commissioner of Ontario argued that the government must find additional GHG reduction options for its climate change policy toolkit in order to reach its short- and medium-term targets.

PHOTO COURTESY
JESSICA LOVEGROVE

⁷⁰ Miranda Holmes. 2012. *All Over the Map 2012: A comparison of provincial climate change plans*. Prepared for the David Suzuki Foundation. www.davidsuzuki.org/publications/downloads/2012/All%20over%20the%20Map%202012.pdf.

⁷¹ Government of Ontario. 2007. *Ontario's Climate Change Action Plan 2007*. Toronto: The Queen's Printer for Ontario. www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079169.pdf.

⁷² Environmental Commissioner of Ontario, 2010. *Meeting Responsibilities: Creating Opportunities: Annual Greenhouse Gas Progress Report 2011*. Toronto: The Queen's Printer for Ontario. Page 6. www.eco.on.ca/uploads/Reports-GHG/2011/Climate-Change-Report-2011-endnotes.pdf.

The Diminishing Role of Natural Carbon Sinks in the Province's Climate Change Policy Framework

The role of carbon storage — and the Greenbelt in particular — in the unfolding of the province's climate change policy framework has been somewhat uneven and even contradictory. In the 2007 Climate Change Plan, the sequestration capacity of the province's forests — and the Greenbelt in particular — was highlighted as one of four major policy planks to achieve the government's climate change goals. The Greenbelt Plan was cited throughout the report as an important part of the province's mitigation strategy and as a complement to the GHG reduction strategy. For example, the report noted:

We know that not only must we reduce greenhouse emissions; we also need to protect our forests and farmland. These are precious resources that help to capture and store climate-altering carbon dioxide, and filter emissions of air pollutants. That's why the McGuinty government has gone farther than any government in Ontario's history to protect Ontario's green space and ensure more sustainable urban communities. The Greenbelt Act, 2005 and the Greenbelt Plan protect approximately 1.8 million acres of environmentally sensitive and agricultural land... from urban development and sprawl.⁷³

While the plan did not adopt formal sectoral targets, it did present a figure that showed where the emission reductions were projected to come from (see Figure 10). The figure highlights the importance the government was placing on the Greenbelt; it is cited as the main example of “additional current policies,” which were expected to achieve 13 per cent of the plan's reduction goal by 2014.

In the first annual report and update to the plan,⁷⁴ the role to be played by the Greenbelt was still significant although mentioned less often in the plan. The sequestration role of the Greenbelt was confirmed in the plan and a new pie chart once again included the Greenbelt as a key policy initiative (see Figure 11).

By the second update (2008–09),⁷⁵ the Greenbelt had clearly been demoted. The Greenbelt itself was mentioned only once in the report and that was in an appendix, where it was presented with the Growth Plan for the Greater Golden Horseshoe as a way to manage growth. There was no mention of the role of the Greenbelt in storing carbon. A summary of the expected GHG emissions reductions by major project appeared in the report,⁷⁶ but the role of the Greenbelt was not mentioned. Interestingly, however, the summary presented an estimate for the reduction impact of afforestation programs, in southern Ontario, specifically a program to plant 50 million trees in southern Ontario by 2020 and a program to plant 100,000 trees in cities and urban areas by 2010. These programs were projected to reduce the province's GHG emissions by .5 Mt CO₂e by 2020. Of 14 other major initiatives, only five were projected to have a bigger impact than the afforestation program. Afforestation would have a 50 per cent larger impact than the reductions flowing from the Places to Grow Plan for the Greater Golden Horseshoe while the multi-billion investment in public transit (the so-called “Big Move” program) would produce savings only 50 per cent larger than the afforestation programs.

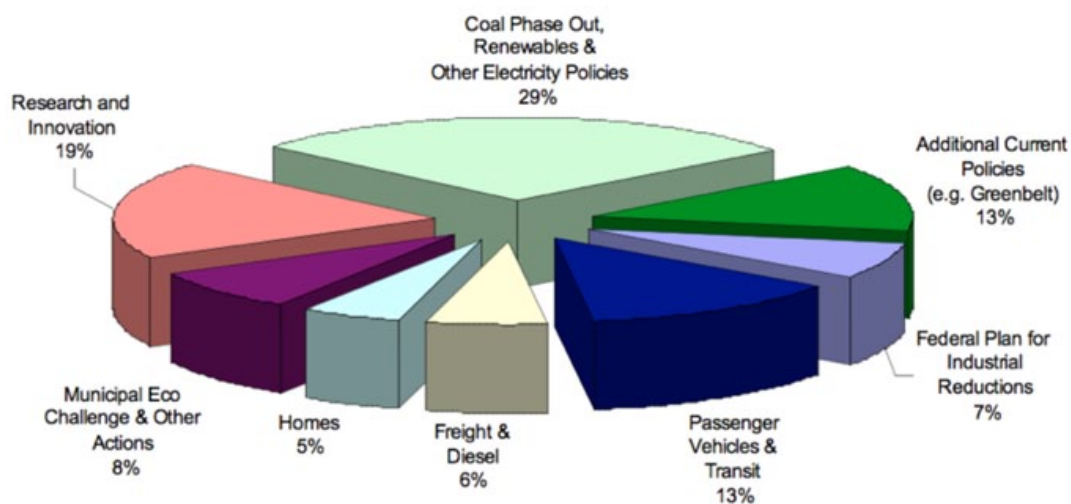
⁷³ Government of Ontario. 2007. *Go Green: Ontario's Action Plan on Climate Change*. Page 42. www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079169.pdf.

⁷⁴ Government of Ontario. 2008. *Ontario's Climate Change Action Plan: Creating Our Sustainable Future. Annual Report 2007-2008*. Toronto: The Queen's Printer for Ontario. www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079196.pdf.

⁷⁵ Government of Ontario. 2009. *Annual Report 2008-09: Climate Change Action Plan*. Toronto: The Queen's Printer for Ontario. www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079210.pdf.

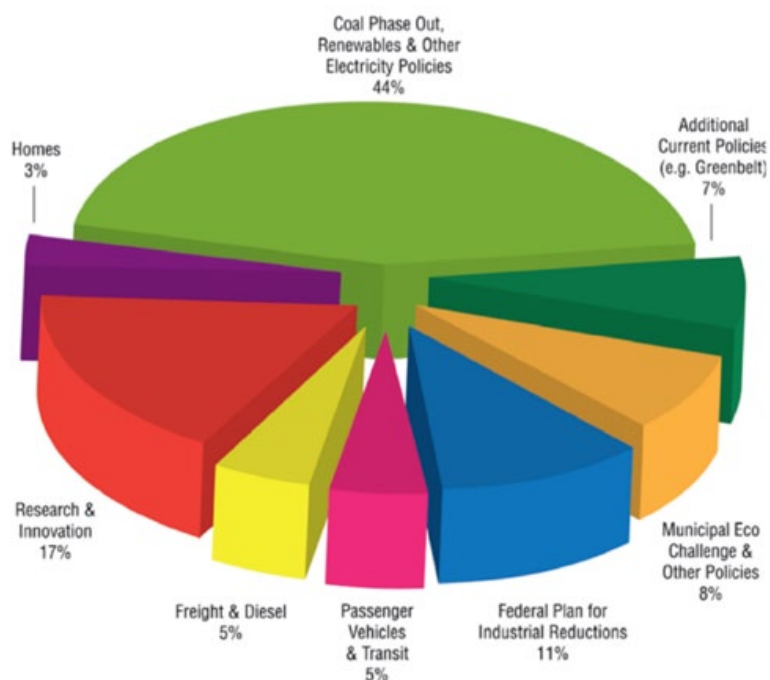
⁷⁶ Ibid, pages 63-65.

FIGURE 10: EMISSION REDUCTIONS BY SECTOR, CCAP



Source: Government of Ontario. 2008. Ontario's Climate Change Action Plan: Creating Our Sustainable Future. Annual Report 2007-2008.

FIGURE 11: EMISSION REDUCTIONS BY SECTOR, 2007–2008 UPDATE TO THE CCAP



Source: Ontario's Climate Change Action Plan 2007

The third update (2009–10)⁷⁷ was almost totally mute on the Greenbelt and its role as a carbon storage facility. Forest stewardship was highlighted as a climate change adaption strategy (trees moderate the local climate by providing shade, reducing the effects of storms, and increasing soil and water retention); their important role in carbon storage was barely mentioned in this report. The report included a roll-up of

⁷⁷ Government of Ontario. 2010. *Climate Progress: Ontario's Plan for a Cleaner, More Sustainable Future. Annual Report 2009-10*. Toronto: The Queen's Printer for Ontario. www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_085413.pdf.

The province had dramatically changed its perspective on the importance of the GHG mitigation potential of the province's natural and managed ecosystems in general and the Greenbelt in particular over the three years between the first publication of the climate change plan and its most recent update to that plan.

emission reduction projections by sector⁷⁸ and, like the previous update, the carbon storage potential of the Greenbelt went unmentioned. Unlike the previous report, however, this update did not include any carbon storage initiative related to natural or managed ecosystems in its sectoral projections. Clearly, the province had dramatically changed its perspective on the importance of the GHG mitigation potential of the province's natural and managed ecosystems in general and the Greenbelt in particular over the three years between the first publication of the climate change plan and its most recent update to that plan.

In its 2011 review of Ontario's climate change policy framework, the Environmental Commissioner of Ontario noted this lack of attention to carbon storage as a GHG mitigation strategy. As mentioned above, the ECO concluded from its 2011 review that additional measures, not yet identified by the government, would be required in order to meet the GHG emission reduction goals that are at the centre of the province's climate policy framework. One of only four recommendations made in the ECO's 2011 review relates to the carbon storage potential of natural and managed ecosystems in Ontario. The ECO recommended that "the Ontario government investigate and publicly report on the potential for soil carbon sequestration as a GHG mitigation strategy."

The commissioner elaborated later in its report:

*The significant near-term opportunities related to... the longer-term management of agricultural soils for carbon sequestration must become key components of the government's climate change mitigation plan. These opportunities are nowhere to be seen in the government's most recent CCAP Annual Report or in any other ministry documents or research of which the ECO is aware. This is distressing when their significant near-term climate mitigation benefits...are so promising.*⁷⁹

One possible explanation for the diminishing attention to the storage capacity of the Greenbelt and other natural or managed ecosystems in Ontario in subsequent iterations of the province's climate action plan may lie in the fact that the province does not in fact include emissions or sequestrations from land use changes and forestry in its GHG emissions inventory. The province created the Climate Change Secretariat within the Cabinet Office in 2008 and one of the secretariat's primary roles is to track and monitor progress on climate change. One of the key elements of any monitoring program is, of course, what is measured. As explained in the 2008-2009 update document, for its monitoring work, the Secretariat has adopted the definition of GHG emissions that are used to prepare Environment Canada's National Inventory Report on Greenhouse Gases and Sinks in Canada. An important difference, however, is that — unlike the national inventory — the Secretariat does not include Land Use, Land Use Change and Forestry (LULUCF) as part of its monitoring system. In other words, changes from increased forestation, better land management practices, improved agricultural practices, or wetland restoration in the Greenbelt (or anywhere else in Ontario) are not counted towards the province's GHG balance sheet.⁸⁰ Nor are losses to these capacities that result from loss or disruption of vegetative cover due to aggregate mining, infrastructure development, or new recreational facilities in the Greenbelt.

In a sense then, the third update report, which plays down the carbon storage function of the Greenbelt and other natural or managed ecosystems in Ontario and does not include this function in its roll-up of sectoral contributions to achieving the province's emissions reductions goal, is more consistent with the Secretariat's monitoring program than the previous reports. The earlier reports, in other words, were contradictory: on the one hand they included carbon storage in natural and managed ecosystems in the programs the government claimed were contributing to achieving the Action Plan's goals, while on the other hand this function was not actually included in the monitoring and carbon accounting system used to track progress and shape policy

⁷⁸ Ibid, page 51.

⁷⁹ Environmental Commissioner of Ontario, 2010. *Meeting Responsibilities: Creating Opportunities: Annual Greenhouse Gas Progress Report 2011*. Toronto: The Queen's Printer for Ontario. Page 13. www.eco.on.ca/uploads/Reports-GHG/2011/Climate-Change-Report-2011-endnotes.pdf.

⁸⁰ Interestingly, however, the gains from the GGH Places to Grow Plan are included in the balance sheet through impacts on energy used for transportation and household heating.

choices. While consistency in this regard is welcome, the Secretariat has moved in the wrong direction: instead of incorporating carbon storage into the monitoring system, it has chosen to virtually eliminate carbon storage from the discussion of emission-reduction programs.

Perhaps one reason the Secretariat chose to go this route is the lack of institutional capacity within the province for tracking the carbon storage capacity of existing natural and managed ecosystems or for modelling (projecting) the different policy options for improving that capacity. This constitutes another weakness of the province's climate change policy framework. To return to the ECO's discussion of agricultural soils, the Commissioner draws on international research to estimate that improved agricultural practices could sequester 8.8 Mt of carbon annually by 2020. This would fill 30 percent of the currently estimated 30 Mt policy gap at 2020, i.e., the difference between the government's 2020 GHG reduction goal and the ability of current and planned programs to meet that goal. However, the Commissioner notes that the province does not currently have the capacity to account for and model the various management practices and policy options related to increasing soil carbon, and calls on "the Ontario government ... to develop its own protocols, based on both soil-sequestration modelling and local data."⁸¹

The government's capacity to measure and model carbon storage from other natural and managed ecosystems in the province (including the Greenbelt) are similarly weak. The Forest Resources Inventory has not been updated for 35 years and is totally unsuitable for carbon storage monitoring and modelling. MNR's Southern Ontario Land Resource Information System (SOLRIS) provides very fine categorization of land cover type in southern Ontario, including the Greenbelt. Unfortunately SOLRIS does not have structural and compositional information such as tree type, size and age, or soil composition, all of which are essential to accurate carbon storage measurement and modelling. SOLRIS has been used as a basis for more intensive data collection efforts in parts of southern Ontario, including small sections of the Niagara Escarpment.⁸² The potential for this data to be used in carbon storage and sequestration measurement and modelling has been demonstrated, but to date no systematic program that would cover the whole of the Greenbelt is being planned.⁸³

The lack of attention to the carbon storage capacity of natural and managed ecosystems in the government's thinking is reflected in the lack of integration of this issue into the nuts and bolts of programs related to these ecosystems. For example, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMFRA) runs the Environmental Farm Plan program, which provides guidance and funding to farmers who wish to identify environmental risks in their operations and develop action plans to address those risks. Although it covers a broad range of areas and includes many practical guidelines for improving the environmental impacts of farming, there are no linkages to climate change mitigation through carbon storage. Practices relating to soil management are focused on preventing erosion and improving quality without necessarily encouraging those practices that would enhance the carbon storage capacity of agricultural soils.

There is no doubt, however, that Ontario's eventual entry into carbon trading initiatives will provide a strong stimulus for the government to improve its tracking of carbon sinks in the province's natural and managed ecosystems. In 2008, Ontario joined the Western Climate Initiative and committed to joining other states and provinces in implementing a regional cap-and-trade system for GHGs. Despite passing enabling legislation, the Ontario government later opted out of the January 2012 launch of the program, citing the need for more time to secure emissions data from large industrial facilities. This appears to be in the nature of a delay than a cancelling of the program; the Ministry of the Environment's web site indicates that the province is still committed to the program.⁸⁴

Ontario's eventual entry into carbon trading initiatives will provide a strong stimulus for the government to improve its tracking of carbon sinks in the province's natural and managed ecosystems.

81 "Province delays cap and trade plan." *Better Farming*. April 13, 2011. www.betterfarming.com/online-news/province-delays-cap-and-trade-plan-4108.

82 Vegetation Sampling Protocol (VSP): a quantitative, integrative and adaptable method of vegetation and habitat sampling. www.forestry.utoronto.ca/imsa/VSP/.

83 Dr. Danijela Puric-Mladenovic, Faculty of Forestry, University of Toronto, personal communication, July 17, 2012.

84 Ontario Ministry of the Environment. Undated website. www.ene.gov.on.ca/environment/en/category/climate_change/STDPROD_078899.html.

The PPS, Greenbelt Plan and the GGH Places to Grow Plan are all being or will soon be coming up for review, which will provide an opportunity to strengthen the land-use planning framework in this regard and better integrate the province's climate change goals into the system.

In preparation for entry into the cap-and-trade program, the government began consultation in 2008 on the design of a GHG emissions trading system for Ontario that would help meet the province's climate change reduction goals.⁸⁵ One of the key findings of the consultation was that there is strong support for Ontario to move forward with establishing an offsets program within the context of a cap-and-trade system. In particular, industry wants offsets available as a compliance alternative under the cap and trade system and offset providers want to have their offsets eligible for use in the compliance market. Two of the main sources of offsets in Ontario are expected to be the agriculture and forestry sectors.

Implementing an offset system will require that the government increase its capacity to track carbon sinks in natural and managed ecosystems. Indeed, the government has already taken some initial steps in this direction. Ontario Agriculture conducted a Pilot Project to Test Carbon Offset Protocols to test the feasibility of tillage system management and nitrogen fertilizer reduction actions as potential carbon offset resources. The results will inform the design of the carbon offset trading component of the future cap-and-trade system. The project tested the data collection and management requirements as well as the verification component of the two draft protocols.⁸⁶ In terms of the forestry sector, the Ministry of Natural Resources is undertaking to improve and update Ontario's Forest Resource Inventory. This will allow the province to better assess the climate impacts and carbon storage potential of the province's managed and protected forests.⁸⁷

A final observation on the province's climate change policy framework is that it is currently incomplete with respect to land-use planning in the Greenbelt. Although the land use regulation system in Ontario generally supports the aims of the CCAP, there is currently no requirement that planning take place in such a way as to reduce GHG emissions and to preserve carbon storage capacity. Take, for example, the Provincial Policy Statement (PPS), which provides direction to municipalities on matters of provincial interest related to land use planning and development. The *Planning Act* requires that all decisions affecting land use planning matters "shall be consistent with" the PPS. It includes policies on key issues such as the efficient use and management of land and infrastructure, protection of the environment and resources, and ensuring appropriate opportunities for employment and residential development, including support for intensification and a mix of uses. It does not, however, mention climate change, planning to minimize GHG emissions or the need to maintain carbon storage capacity in the province's natural and managed ecosystems. The same can be said of the GGH Places to Grow Plan, and the Greenbelt Plan.

Fortunately, the PPS, Greenbelt Plan and the GGH Places to Grow Plan are all being or will soon be coming up for review, which will provide an opportunity to strengthen the land-use planning framework in this regard and better integrate the province's climate change goals into the system. A model for action in Canada comes from British Columbia, where the provincial government passed legislation in 2008 (Bill 27) requiring local governments to include GHG emission reduction targets, policies and actions in regional growth strategies and official community plans. Each local government will set GHG emission reduction targets that are appropriate for their community. In order to assist local governments with this exercise, the province prepared a Community Energy Emissions Inventory, which provides all local governments in BC with baseline community-wide energy and emissions information.⁸⁸

85 Government of Ontario. 2008. *Moving Forward: A Greenhouse Gas Cap-and-Trade System for Ontario*. Toronto: The Queen's Printer for Ontario. www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079549.pdf.

86 Government of Ontario. 2009. *Annual Report 2008-09: Climate Change Action Plan*. Toronto: The Queen's Printer for Ontario. www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079210.pdf.

87 Ontario Ministry of Natural Resources. Undated website. "Forest Resource Inventory." www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/199556.html.

88 BC Ministry of Community Development. 2008. *Frequently Asked Questions Local Government (Green Communities) Statutes Amendment Act, [Bill 27] 2008*.

Policy Recommendations



PROTECTING AND ENHANCING THE GREENBELT'S capacity to mitigate climate change requires policies that recognize the important role that the Greenbelt can play in helping Ontario meet its ambitious greenhouse gas emission reduction targets as a carbon sink. Efforts must also be made to limit GHG emissions associated with the degradation of carbon-rich ecosystems from land use practices within the Greenbelt itself. The following are recommendations for incorporating the Greenbelt into the province's set of climate change policies.

Efforts must be made to limit GHG emissions associated with the degradation of carbon-rich ecosystems from land use practices within the Greenbelt.

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DARREL BIRKETT

A. INCORPORATE THE GREENBELT'S STORAGE CAPACITY INTO PROVINCIAL POLICIES

1. INCORPORATE THE GREENBELT INTO THE PROVINCE'S CLIMATE CHANGE ACTION PLAN: Given the substantial climate change mitigating capacity of the Greenbelt, it should be explicitly incorporated into provincial climate change action plan as a key policy goal, both to serve Ontario's climate change goals and to establish additional incentives to maintain the Greenbelt's carbon-rich farmland and natural ecosystems. In order to operationalize this recommendation, the province will need to improve its capacity to track carbon storage in the Greenbelt.⁸⁹ The province should immediately move forward with an inventory and monitoring program that will allow detailed measurement of the carbon storage capacity of the Greenbelt's agricultural lands, forests, and wetlands along with changes in that capacity at regular intervals over time.

2. IDENTIFY THE NATURAL CAPITAL WITHIN THE GREENBELT AS A SOURCE OF CARBON OFFSETS: Working towards the province's goal of participating in an interjurisdictional cap-and-trade system, the Greenbelt should be identified as a source of carbon offsets, which will effectively provide increased value and incentives to Greenbelt landowners to adopt mitigation enhancing practices. In order to meet "additionality" requirements that characterize most cap-and-trade systems, measures that would qualify for offsets will be limited to those that are above and beyond existing management measures.

⁸⁹ Office of the Environmental Commissioner of Ontario. 2008. *Progress in a Climate of Change: A Review of Ontario's Climate Change Action Plan Annual Report 2007-2008*. A Special Report to the Legislative Assembly of Ontario. www.eco.on.ca/uploads/Reports%20-%20GHG/2007_2008/GHG%202008.pdf.

3. INCORPORATE THE PROVINCE'S CLIMATE CHANGE GOALS INTO THE LAND USE AND TRANSPORTATION PLANNING FRAMEWORK THAT GOVERNS THE GREENBELT:

As noted above in this report, the planning policy framework that governs development in the Greenbelt and the Greater Golden Horseshoe does not directly address climate change mitigation. To address this situation, the province should integrate climate change mitigation into provincial policies that govern provincial and municipal planning processes, including the PPS, the Growth Plan, and the Greenbelt Plan. These policy documents should be amended to require the province and municipalities to assess the GHG emission implications of major land use and transportation planning decisions. The revised policy documents should also require municipalities to include appropriate climate change mitigation targets and measures in their Official Plans. As in B.C., a provincial inventory of GHG emissions should be prepared to assist municipalities in the Greenbelt with this function. The province should amend its environmental assessment process to require that the cost-benefit analysis done for major transportation projects incorporates consideration of the loss of carbon storage capacity. The province's transportation plan for the Greater Golden Horseshoe should be amended to favour transport solutions that reduce disruption to the carbon storage capacity of the Greenbelt, such as new transit facilities along existing rights of way.

B. INCREASING THE GREENBELT'S CARBON STORAGE CAPACITY

The revised Greenbelt Plan should establish a goal of increasing forest cover in the Greenbelt from its existing 24 per cent to 35 per cent by 2025, working with landowners and municipalities.

1. INCREASE NATURAL CAPITAL WITHIN THE GREENBELT: The upcoming 2015 mandatory review of the Greenbelt Plan provides an opportunity to strengthen the role of the Greenbelt in meeting the province's climate change goals. The revised plan should establish a goal of increasing forest cover in the Greenbelt from its existing 24 per cent to 35 per cent by 2025, working with landowners and municipalities. In order to help meet this goal, the province should expand its tree planting program in the Greenbelt and provide further incentives for private landowners to preserve and expand vegetative cover. Carbon offset credits could be used for this purpose once the province has entered into an interjurisdictional cap-and-trade system.

2. ENCOURAGE SUSTAINABLE AGRICULTURE: As the predominant form of land use within the Greenbelt, it is crucial that agriculture practices be improved so as to enhance the role of the Greenbelt as a carbon sink. Toward this end, more aggressive provincial programs are needed in order to guide farming practices and incentivize improvements on a wide-scale basis. The adoption of better farming practices that reduce soil erosion, better manage crop residues, improve cropland soil organic matter levels, and increase tree cover will not only increase the productivity and long-term health of southern Ontario's farms, but will also go a long way towards enhancing the carbon capture and storage capacity of agricultural soils.⁹⁰ To this end, Ontario's Environmental Farm Plan program should be expanded and carbon storage should be included as a policy goal. Once a cap-and-trade system is in place, carbon offset credits should be used to encourage farmers to reduce emissions and increase carbon capture. These incentives would provide an economic boost to Greenbelt farmers, serve provincial GHG targets, and enhance long-term productivity and sustainability.

3. PROMOTE AGGREGATE SITE RESTORATION: To improve rehabilitation at active sites, the Aggregate Resources Act (ARA) should be modified to make its rehabilitation rules apply to operations that predate it and have heretofore been exempted from its rules.⁹¹ The ARA could also be modified to make the disturbance of new

90 Ontario Ministry of Agriculture, Food and Rural Affairs. 2000. "Carbon Sequestration and Ontario Agriculture." www.ontla.on.ca/library/repository/mon/2000/10298422.pdf.

91 According to the Ontario Ministry of Natural Resources (Pers. Comm), the ARA rules on rehabilitation can apply to older sites that predate the Act if the pit/quarry operator continues to operate under the authority of a license. In addition, some older sites may be eligible for rehabilitation under the province's Management of Abandoned Aggregate Properties Program, www.toarc.com/maap-1/about-maap.html.

land within licensed sites contingent on the rehabilitation of previously disturbed lands, forcing operators to perform rehabilitation on a continuous basis. To ensure that rehabilitation is proceeding at the desired rate and that the quality is adequate, MNR will need to increase its field resources to improve monitoring and enforcement. A security deposit system for new licences and permits should be instated to discourage abandonment of aggregate sites and to ensure that there is sufficient funding available for complete rehabilitation in case of abandonment or licence revocation. Once a cap-and-trade system is in place, carbon offset credits could be provided to those operators whose rehabilitation efforts improve the carbon storage capacity of the land beyond its original capacity, i.e., prior to operations.

C. MINIMIZE THE LOSS OF CARBON STORAGE CAPACITY IN THE GREENBELT DUE TO LAND USE CONVERSION

1. LIMIT AGGREGATE MINING IN THE GREENBELT: The vigorous growth that is projected for the Greater Golden Horseshoe will increase demand for aggregates “close to market” and greater pressure for mining within the Greenbelt. To moderate demand, efforts to reduce the use of aggregate-intensive materials and to increase the use of recycled aggregates and aggregate substitutes are required.⁹² An outright ban on new or expanded aggregate extraction operations in the Greenbelt is politically unrealistic, but clear limits should be established through a comprehensive plan for aggregate mining in the Greater Golden Horseshoe. The Greenbelt Plan should be amended to give the preservation of natural heritage clear priority over aggregate mining. The pressure for aggregate extraction in the Greenbelt could be mitigated by facilitating the entry of aggregate materials into the Greater Golden Horseshoe market from further afield. In order to neutralize the GHG contributions that longer transportation routes would entail in this case, the province should undertake a study of the feasibility of low-carbon transport options, such as water and rail. For proposals for new and expanded operations within the Greenbelt, the Aggregate Resources Act should be updated to require consideration of cumulative impacts upfront so that projects with excessive impacts can be screened out at an early stage. Provincial enforcement of regulatory requirements should be improved to minimize the loss of natural capital. Mine operators should be encouraged to adopt strict sustainability standards, such as the Socially and Environmentally Responsible Aggregate (SERA) standards, a voluntary certification program designed in consultation with industry, environmental, and other stakeholder representatives.⁹³

The pressure for aggregate extraction in the Greenbelt could be mitigated by facilitating the entry of aggregate materials into the Greater Golden Horseshoe market from further afield.

2. LIMIT THE NEED FOR AND IMPACT OF MAJOR INFRASTRUCTURE IN THE GREENBELT: While the province is taking measures to limit the direct impacts of the planned highway projects on the Greenbelt, a better approach would be to reassess the need for additional highway infrastructure in light of the availability of feasible alternatives, including optimizing the use of existing roads and highways and shifting travel demand to public transit. Optimization of existing roads and highways can be accomplished through increasing the capacity of existing arterial roads through signalling improvements or by converting two-lane undivided highways to controlled access highways by grade separating all junctions with other roads, but without twinning. A third possibility is to convert existing lanes on the QEW and 400-series highways to high-occupancy vehicle (HOV) lanes. The province should aggressively support employer transportation demand management (TDM) programs to encourage carpooling and vanpooling and to maximize the use of the HOV lanes.⁹⁴ Another strategy that has

92 M.S. Winfield and A. Taylor. 2005. *Rebalancing the load: The need for an aggregates conservation strategy for Ontario*. Toronto: The Pembina Institute. <http://pubs.pembina.org/reports/Aggregatesfinal-web2.pdf>.

93 See www.seracanada.ca/.

94 C. Burda, A. Baillie, and G. Haines. 2010. *Driving Down Carbon: Reducing Greenhouse Gas Emissions from the Personal Transportation Sector in Ontario*. Drayton Valley: The Pembina Institute. <http://pubs.pembina.org/reports/driving-down-carbon-report.pdf>.

been endorsed by the Greenbelt Council is the wider use of road pricing.⁹⁵ By shifting trips to other modes, road pricing could help free up highway capacity for commercial vehicles and diminish the justification for new highway projects. Shifting travel demand from highways to transit is another strategy to reduce the need for highway improvements. Bus rapid transit and rail projects beyond those projected in the GGH Places to Grow Plan could be accommodated on the existing road network or on existing rail rights of ways and would not entail a significant loss of vegetation along their routes. Funds for these projects could be obtained from the redirection of money earmarked for highway expansion projects.⁹⁶ Finally, the Greenbelt Plan should be amended to stipulate that any highway development that cannot be avoided through managing demand or shifting to other modes should result in no net increase in emissions from the loss of natural capital, i.e., the development of new major infrastructure should be offset by ecosystem enhancements elsewhere.

3. ENSURE THAT RECREATION AND TOURISM IN THE GREENBELT IS SUSTAINABLE: With the potential for substantial land use changes, recreational development should also be required to result in no net emissions from loss of natural capital. As the main form of recreational land use conversion, golf courses present the clearest risk. Golf courses within the Greenbelt should develop a voluntary sustainable framework for best practices aimed at reducing emissions, enhancing carbon sinks, and conserving water.

95 Greenbelt Council, 2009. "Advice regarding Environmental Assessments for the Niagara-GTA and GTA West Transportation Corridors." Letter to the Minister of Municipal Affairs and Housing. www.mah.gov.on.ca/Page7067.aspx.

96 C. Burda, op cit.

Conclusion

BY PROTECTING SOME OF OUR MOST VALUABLE NATURAL SYSTEMS, the Greenbelt has the potential to ensure healthy and vibrant ecosystems, provide fresh air and drinking water, locally sourced and high quality agriculture, and access to beautiful natural recreation sites. In addition to these benefits, the Greenbelt's forests, wetlands, and agricultural soils offer valuable climate change mitigation services through the capture and storage of carbon. As we embark on the gradual yet increasingly urgent shift towards a low carbon future, the Greenbelt can play an important role in offsetting emissions from other sources while at the same time enhancing the other benefits it delivers.

The new planning framework for the Greater Golden Horseshoe put in place by the Ontario government since 2005 offers great promise for forging a pattern of sustainable development in southern Ontario. The Greenbelt is an integral part of this ambitious planning framework; it not only protects valuable natural capital but also serves as a natural barrier to urban sprawl, aiding in the shift towards greater urban sustainability by encouraging growth patterns that reduce commute times, enhance urban centres, and provide for healthy and dynamic lifestyles. This focus on sustainable growth outside the Greenbelt that will serve the pressing need to address climate change by reducing GHG emissions below the "business as usual" level, while protecting ecosystems within the Greenbelt that will naturally help counteract the GHG from other sources. The Greenbelt is, however, on the front line of urban sprawl and is inevitably bound to face mounting pressure for resource extraction, infrastructure and other development as cities and towns in the Greater Golden Horseshoe continue to grow and flourish. It is only through bold commitment in the decisions we make today that we can ensure that the Greenbelt establishes a legacy of sustainability to be passed on to future generations.

As we embark on the gradual yet increasingly urgent shift towards a low carbon future, the Greenbelt can play an important role in offsetting emissions from other sources while at the same time enhancing the other benefits it delivers.

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SHERRY PRENEVOST



This report is the sixth in a series that studies natural capital and ecosystem services in Canada's major urban centres. It highlights the important role that the Ontario Greenbelt's forests, wetlands, and agricultural soils play in capturing and storing vast amounts of carbon. A principle goal of the report is to bring the importance of the Greenbelt as an instrument of climate change mitigation into relief by translating these essential ecosystem services into economic values. The report also examines a number of threats to the long-term ability of the Greenbelt to serve this climate regulation function and argues that Ontario's climate change policy framework should be revised to strengthen its ability to protect essential functions and even enhance the Greenbelt's natural capacities as a carbon sink.



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