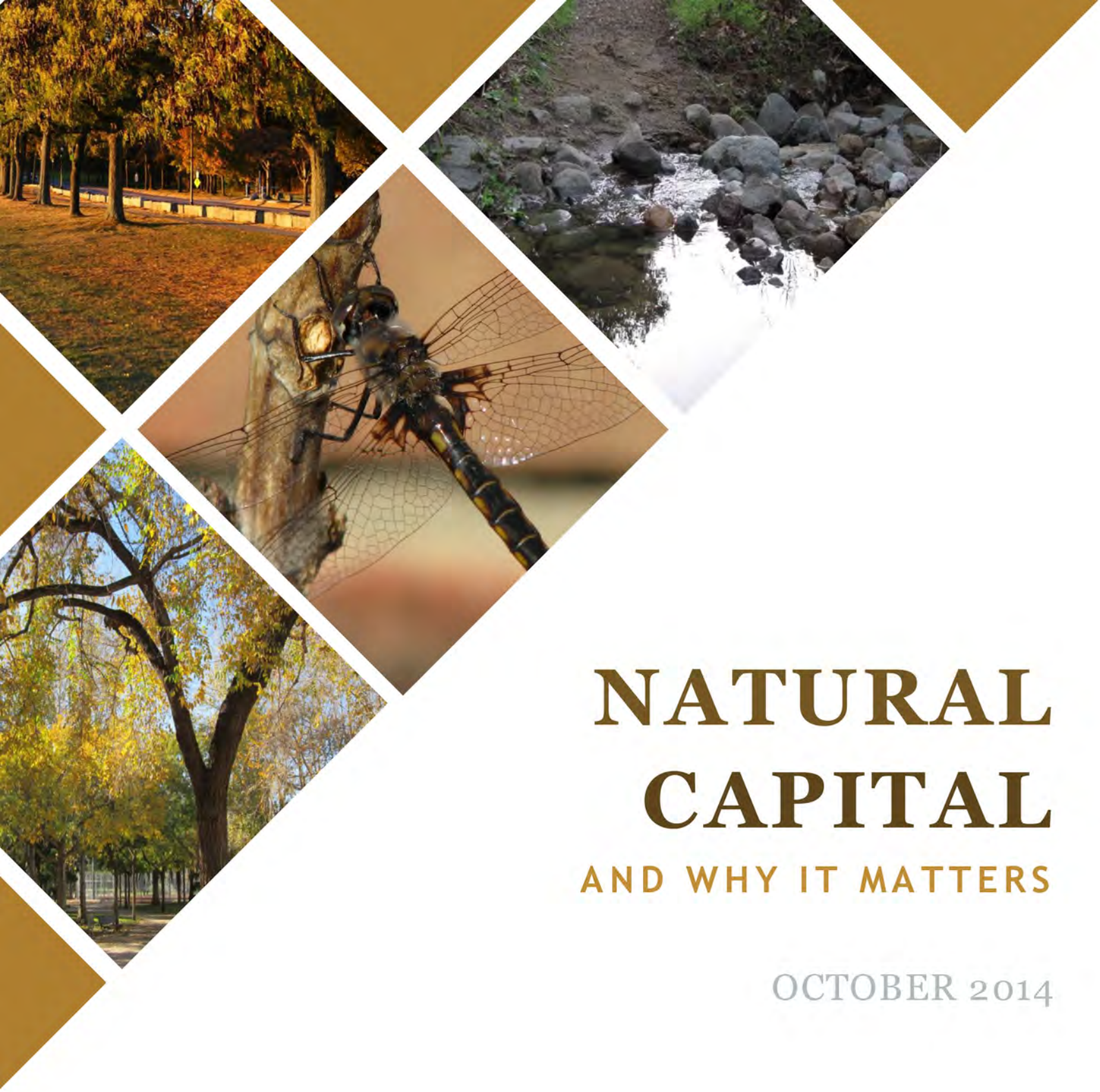

NATURAL CAPITAL

AND WHY IT MATTERS

OCTOBER 2014

Clean Air Partnership

CLEAN AIR COUNCIL

ACKNOWLEDGMENTS

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ABOUT THE CLEAN AIR PARTNERSHIP

Clean Air Partnership (CAP) is a registered charity that works in partnership to promote and coordinate actions to improve local air quality and reduce greenhouse gases for healthy communities. Our applied research on municipal policies strives to broaden and improve access to public policy debate on air pollution and climate change issues. Our social marketing programs focus on energy conservation activities that motivate individuals, government, schools, utilities, businesses and communities to take action.

Clean Air Partnership's mission is to transform cities into more sustainable, resilient, and vibrant communities where resources are used efficiently, the air is clean to breathe and greenhouse gas emissions are minimized.

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EXECUTIVE SUMMARY

Healthy ecosystems provide fertile soil, clean water and air, as well as natural resources such as timber and food. They help protect us from floods and the spread of disease and also help moderate complex climate and hydrological systems. These and other "ecosystem services" are fundamental to our survival.

This report highlights recent work to develop an economic value for the services provided to society by our ecosystems. It provides background on the limitations of neo-classical economics and the rationale for placing an economic value on natural capital and services. Neo-classical economics assumes that nature has a near infinite capacity to supply raw materials and absorb waste. Ecological Economics recognizes that there are limits to carrying capacity and that ecological services have an economic value that needs to be factored into policy decisions and business cases.

Gross Domestic Product (GDP) is the most widely-used indicator of a country's economic strength and prosperity, and the neo-classical economics metric of choice. It is calculated either by combining total production (sales of all goods and services) or total income and dividing it by the population. While this tool is widely used, it is also imperfect and its imperfections have significant ramifications for our overall economic, environmental and social wealth. GDP does not differentiate between exchanges that contribute to or take away from overall well-being, nor does it account for unpaid services that are essential to societal functioning and well-being. If a good or service is not purchased or sold on the market, it is not valued and excluded from GDP calculations. This report describes the inherent weaknesses in the GDP and offers alternative tools and frameworks that would enable us to more accurately measure not only our manufactured and financial capital gains and losses, but also factor in our natural, human and social capital assets and shortfalls.

This report also recognizes the contributions of key champions and reports in the movement towards the development of an economic system that factors in the carrying capacity and the value of natural capital. The reports highlights contributions, expertise and resources developed by the Economics of Ecosystems and Biodiversity (TEEB) initiative that has overseen the development of a System of Economic Environmental Accounting (SEEA) that helps guide the valuation of untraded ecosystem products and services.

Perhaps most importantly, this report highlights and describes efforts to put natural capital valuation into practice by calculating the value of ecosystem resources and services. In this way, we can begin to build the case to correct for gaps and perversities in market forces and better incorporate natural capital values into our decision making processes and thereby increase opportunities to ensure our longer-term economic, environmental and societal growth and prosperity.

As far as the GDP is concerned, the only way something has value is if it is bought or sold.

A healthy person who walks to work, eats at home, and saves their money does not contribute to the economy as much as a person who smokes, drives to work, and borrows to consume, increasing their personal debt. What economists call "growth" is not always what people would consider "good".

PART 1: WHAT IS MISSING IN TRADITIONAL ECONOMICS?

"The gross national product[1] does not allow for the health of our children, the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wisdom nor our learning, neither our compassion nor our devotion to our country; it measures everything in short, except that which makes life worthwhile".

– ROBERT KENNEDY, MARCH 18, 1968

What we measure reflects what we value and what captures our attention. Virtually every nation tells its story of economic progress using gross domestic product (GDP): the monetary value of all the goods and services bought and sold in the formal economy. As far as the GDP is concerned, the only way something has value is if it is bought or sold. Politicians and economists frequently lead us to believe that the more the GDP grows, the better off we are. However a growing group of economists have begun to challenge this paradigm.

Accordingly, there are seven major weaknesses embodied in the GDP:

1. The GDP regards every expenditure as an addition to well-being, regardless of the purpose of the expenditure and its implications. Thereby, a healthy person who walks to work, eats at home and saves their money does not contribute to the economy as much as a person who smokes, drives to work, and borrows to consume, increasing their personal debt. *What economists call "growth" is not always what people would consider "good".*

2. The GDP ignores the crucial economic functions that lie outside the realm of monetary exchange. *The GDP excludes the value of unpaid housework, home childcare, communities, open spaces, watersheds, rivers, oceans and the atmosphere.* Such things contribute to human well-being much more than what we buy from the market. Yet the GDP regards these life sustaining functions as worthless – until the economy destroys them and we have to buy substitutes from the market or from government, then the GDP says that the economy has "grown".

3. The GDP does not account for natural resources that are required to sustain current and future economic development – implying that the

[1] Both the GDP (Gross Domestic Product) and GNP (Gross National Product) measure the size and strength of an economy but are calculated in different ways. GDP = consumption + investment + (government spending) + (exports – imports) and accounts for the total value of products & services produced within the territorial boundary of a country. GNP = GDP + NR (Net income inflow from assets abroad or Net Income Receipts) - NP (Net payment outflow to foreign assets) and accounts for total value of goods and services produced by all nationals of a country (whether within or outside the country). Source: diffen.com

Source: US EPA September, 2010 Source: Flicker

The GDP calculates the costs of a clean up from an oil spill as an economic gain, at the same time it takes no financial accounting for the loss of animal life, habitat, or water quality.

future has no value. The GDP excludes natural resources capital and functions, human resources and research and development. For example the *GDP counts the depletion of natural resources as current income rather than depletion or liquidation of an asset*.

4. The *GDP ignores entirely the distribution of income, and the social costs of inequality and poverty*. A growing economy primarily benefits those with the least financial need, which often results in material accretion rather than true economic advance.

5. *The GDP contains expenditures that do not contribute to economic welfare*. It simply assumes that any financial transaction contributes to economic growth even if that transaction involves such things as cleaning up an oil spill or nuclear accident. Meanwhile, unpaid volunteers and family care are not considered as adding any value.

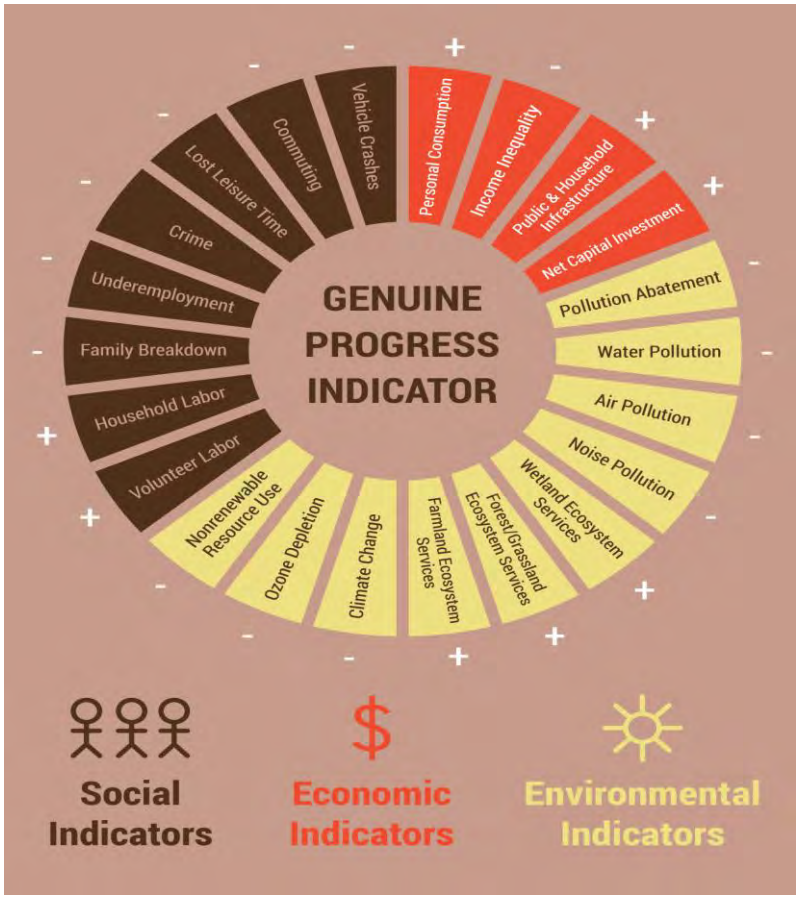
6. The GDP minimizes the value of expenditures on education, environmental protection and health care prevention. Preventing future problems and illness does not adequately contribute to the economy as far as the GDP is concerned since the *GDP does not calculate the investment present education and prevention costs play in avoiding future expenditures*.

7. *The GDP does not directly measure investment in social capital*. Social capital includes investments in the health and wellness of communities, social institutions, and democratic processes.

GENUINE PROGRESS INDICATOR – HOW IT IMPROVES UPON THE GROSS DOMESTIC PRODUCT

The Genuine Progress Indicator (GPI) was developed in 1995 by Cliff Cobb, an economist with Redefining Progress, as an alternate measure of economic well-being and progress to the GDP. The GPI was designed to correct for some of the main weaknesses in our calculation of the GDP and thereby create a metric that more accurately indicates genuine progress in people's quality of life and overall economic, social and environmental well-being.

In order to try and address a number of the above mentioned weaknesses in the GDP, the GPI takes into account more than twenty aspects of our economic lives that the GDP ignores. It starts with the same personal consumption data the GDP is based on, but then it adjusts for certain factors (such as income distribution); adds certain others (such as the value of household work and volunteer work); yet subtracts others (such as the costs of crime and pollution); and differentiates between economic transactions that add to well-being and those which diminish it.



While the GDP is the accounting tool that most countries use to measure progress, it makes sense to try and improve upon the weaknesses and gather more accurate and comprehensive information and measurements in order to holistically gauge the state of our economies, as well as societal and individual well-being.

The GPI has been calculated for a number of countries including the United States (as well as many US States) and for the province of Alberta. It has shown that while GDP has been steadily increasing, the GPI has been steadily declining since the 1970's in the study countries.[2]

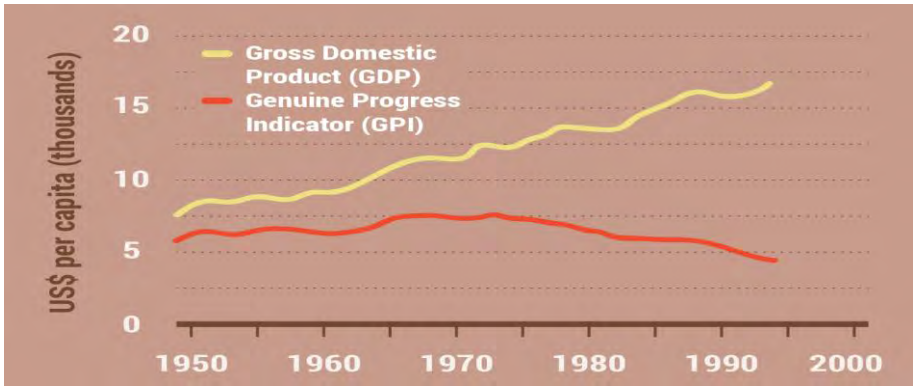


FIGURE 1: Source: Peter Victor, Nature 468,370–371 (18 November 2010)

[2] The Economics of Happiness, Mark Anielski, New Society Publishers, 2007 p. 30-43.

PART 2: TYPES OF CAPITAL

Natural Capital

Human Capital

Social Capital

Manufactured Capital

Financial Capital

There are five types of capital from which we derive the goods and services we need to improve the quality of our lives.

1. **Natural Capital** is any stock or flow of energy and material that produces goods and services. It includes: resources (renewable and non-renewable materials), sinks (that absorb, neutralize or recycle wastes) and services/processes - such as watershed management or climate regulation.

2. **Human Capital** consists of people's health, knowledge, skills and motivation. All these things are needed for productive work. Enhancing human capital through education and training is central to a flourishing economy.

3. **Social Capital** concerns the institutions that help us maintain and develop human capital in partnership with others; e.g. families, communities, businesses, trade unions, schools, and voluntary organizations.

4. **Manufactured Capital** comprises of material goods or fixed assets which contribute to the production process rather than being the output itself; e.g. tools, machines and buildings.

5. **Financial Capital** plays an important role in our economy, enabling the other types of capital to be owned and traded. But unlike the other types, it has no real value itself but is representative of natural, human, social or manufactured capital; e.g. shares, bonds or banknotes.

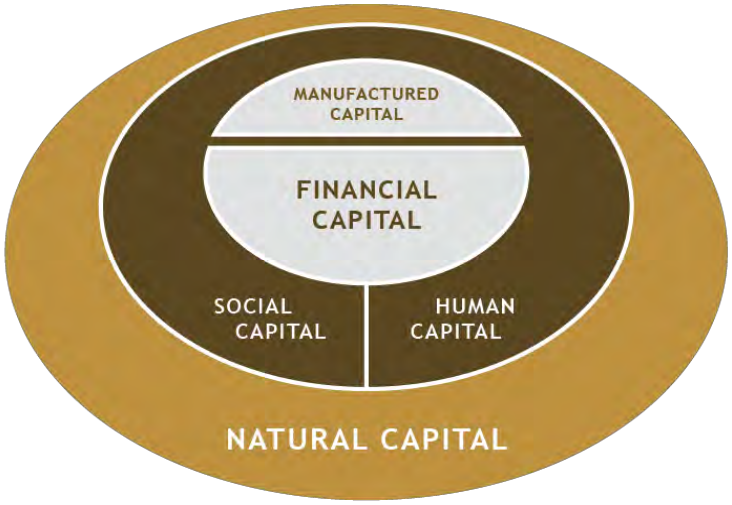


FIGURE 2: Source: The 5 Types Of Sustainable Capital. Source The Five Capitals. Forum For The Future

What gets measured; gets managed.

Peter Drucker

Not everything that can be counted counts; and not everything that counts can be counted.

Albert Einstein

The GDP only calculates manufactured and financial capital. It does not provide recognition or place value on the remaining three forms of capital (natural, human and social). Despite the capacity of the GPI to go behind the standard GDP calculation and capture the other three forms of capital, there is still the need for us to continue to enhance our capacity to factor in our missing natural, human and social capitals.

The main reason why companies and governments are so lackadaisical with ecosystem services is that the values of those services do not readily appear on the balance sheet. Not only do these services provide a real and substantial value, but for most of these ecological services there is no known substitutes at any price and humans cannot exist without them.

Natural Capitalism as proposed by Amory Lovins, Hunter Lovins and Paul Hawken puts forward a new approach towards the evolution of capitalism that would not only protect the biosphere but also improve profits and competitiveness by ensuring that natural capital is properly valued. The journey towards natural capitalism would involve the following four major interlinked shifts in business practices:

Dramatically increase the productivity of natural resources. Reducing the wasteful and destructive flow of resources from depletion to pollution represents a major business opportunity. Through fundamental changes in both production design and technology, farsighted companies are developing ways to make natural resources – energy, minerals, water, forests – stretch 5, 10, even 100 times further than they do today. These major resource savings often yield higher profits than small resource savings do – or even saving no resources at all would – and not only pay for themselves over time but in many cases reduce initial capital investments.

Shift to biologically inspired production models. Natural capitalism seeks not merely to reduce waste but to eliminate the very concept of waste. In closed-loop production systems, modeled on nature's designs, every output either is returned harmlessly to the ecosystem as a nutrient, like compost, or becomes an input for manufacturing another product. Such systems can often be designed to eliminate the use of toxic materials, which can hamper nature's ability to reprocess materials.

Move to a solutions-based business model. The business model of traditional manufacturing rests on the sale of goods. In the new model, value is instead delivered as a flow of services – providing illumination, for example, rather than selling light-bulbs. This model entails a new perception of value, a move from the acquisition of goods as a measure of affluence to one where well-being is measured by the continuous satisfaction of changing expectations for quality, utility, and performance. The new relationship aligns the interests of providers and customers in ways that reward them for implementing the first two innovations of natural capitalism —resource productivity and closed-loop manufacturing.

What is Natural Capitalism?

Ultimately, governments, business and society must restore, sustain, and expand the planet's ecosystems so that they can produce their vital services and biological resources even more abundantly.

Reinvest in natural capital. Ultimately, governments, business and society must restore, sustain, and expand the planet's ecosystems so that they can produce their vital services and biological resources even more abundantly. Pressures to do so are mounting as human needs expand, the costs engendered by deteriorating ecosystems rise, and the environmental awareness of consumers increases. Fortunately, these pressures all create business value.

PART 3: WHAT IS NATURAL CAPITAL AND WHY DOES IT MATTER?

Natural capital is the land, air, water, living organisms and all formations of the Earth's biosphere that provide us with ecosystem goods and services imperative for human survival and well-being.

This part of the Report provides a rationale and examples for how natural capital can and is being factored into cost-benefit analyses and decision making. Since land only has recognized value when it is developed and turned over to commercial, industrial or residential uses, it is not surprising that this is often the outcome. Sustainability considerations can only be factored into cost-benefit analyses when a more holistic, longer-term view of natural value implications is assessed.

Natural capital is the land, air, water, living organisms and all formations of the Earth's biosphere that provide us with ecosystem goods and services imperative for human survival and well-being. Furthermore, it is the basis for all human economic activity. Natural capital is the spectrum of physical assets within the natural environment that deliver economic value through ecosystem services. Like a savings account, natural capital can pay interest or be liquidated. If a tree is chopped down for firewood, the capital has been spent. However, if the tree is retained and preserved, it can deliver (perhaps much higher) value through the ecosystem services of shade, air filtration, carbon sequestration and erosion control. Many forms of natural capital provide multiple benefits. Wetlands, for example, provide water treatment and purification services; prevent floods by retaining surface runoff; and provide wildlife with habitat. It is important to note that recreating natural capital services through human design and technology is often prohibitively expensive.[3]

Like a savings account, natural capital can pay interest or be liquidated.

Photo Source: Brian Hoffman, DSC_0033, October 2008

The concept of natural capital involves the expansion of our traditional economic system and extending its valuation mechanisms to include the ecosystem and the flow of its services. Ecosystem services are not widely evaluated as an economic factor resulting in a valuation of zero when conducting cost-benefit analyses on development decisions. Through the consideration of the ecosystem in land assessments, decision-making will take the full worth of ecosystems into consideration, enhancing the environmental sustainability of land-use planning and decision-making.

Humans have been provided with an endowment of natural capital and while the sustainable way to access that capital would be to live off the interest and ensure that capital remains for future generations, there is a general consensus that we are drawing down on our natural capital at a significant rate and undermining our generations' and future generations' long term endowment. For example, since European settlement in Canada, our Carolinian forest has been depleted by 90%. The scale of this depletion is especially dramatic when compared against the Amazon rainforest, which although vastly larger, was

[3] The replication of natural services was attempted and failed in a $200 million experiment in which 8 humans were unable to survive more than 2 years inside Biosphere 2 (1991-3), Arizona.

"At the species level, it's been estimated that insect-based pollination, bees pollinating fruit and so on, is worth something like $190 billion. That's something like 8 percent of the total agricultural output globally. … But when did a bee actually ever give you an invoice?

Pavan Sukhdev, Former Lead of UNEP's TEEB & The Green Economy

depleted by 18% in the same time period. Factoring our natural endowment into our cost-benefit business analyses and policy decisions is one mechanism that would better enable us to ensure its protection.

3.1 THE TEEB APPROACH TOWARDS ESTIMATING THE VALUE OF NATURAL CAPITAL

In 2007, environmental ministers from the G8+5 countries agreed to begin analyzing the global economic benefits that derive from ecosystems and biodiversity, and to compare the costs of failure to protect these resources with the costs of conserving them. The resulting initiative TEEB (The Economics of Ecosystems and Biodiversity) was launched and is hosted by the United Nations Environment Program. The purpose of this initiative is to develop a global study on the economics of biodiversity loss and guide policy makers regarding the impacts of the ongoing loss of biodiversity and natural capital, an impending concern to development and economics.

By demonstrating how non-valuation of natural capital and biodiversity leads to financial loss, degeneration of soil, air, water and other resources and how this adversely affects public health, food production, consumer behaviour and business opportunities and growth, TEEB makes the business case for policy makers to capture the value of ecosystems and biodiversity and incorporate them in the decision-making for better management and high returns.

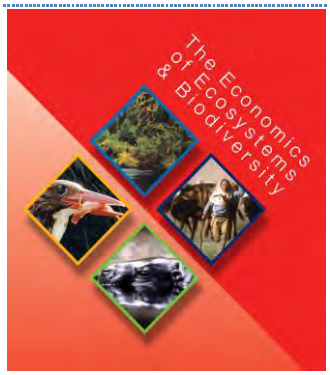
The challenges involved with the TEEB approach involve understanding natural capital values, their place in the decision-making process and the response to this information, where efficiency and fairness are key. Although economic valuation may neglect to accurately reflect all the factors that are important to human survival, it is desirable to include priority data for the purpose of building an equitable financial comparison. TEEB emphasizes that economic valuation is one part of the holistic decision-making process.

TEEB's findings detail the strong correlation between poverty and loss of natural capital and provide global examples of how the valuation of biodiversity leads to policy changes, and how investment in natural capital and conservation can produce greater returns over man-made alternatives.

TEEB identifies 4 economic and scientific priorities in their report summary:

1. To halt deforestation and forest degradation
2. To protect tropical coral reefs
3. To save and restore global fisheries
4. To recognize the deep link between ecosystem degradation and the persistence of rural poverty

Some of their solutions for wide-scale application towards stewardship of natural capital include:



The TEEB Manual for Cities provides a six step approach for including ecosystem services into municipal decision making and policy development.

1. Rewarding benefits through payments and markets
2. Reforming environmentally harmful subsidies
3. Addressing losses through regulation and pricing
4. Adding value through protected areas
5. Investing in ecological infrastructure

TEEB urges the creation of a global framework through the establishment of a standardized system of ecosystem measurement. Without this framework, the value of ecological services goes unnoticed through standard accounting principles or Standard National Accounts (SNA), which do not account for 'wear and tear' of ecological assets. This is the essential idea behind informing policy makers about the need for transparency of effects through valuation. According to TEEB, the System of Economic Environmental Accounting (SEEA) fiscally and physically values land, water, environmental investments and social issues, although it requires an update as it neglects to evaluate progress on indicators and include ecosystem services in national accounts.

The TEEB report supports a change from the use of GDP as a universal indicator of progress, as it does not measure sustainability and overall community health. As part of a long-term solution, the TEEB report recommends adopting quantitative measurement systems of biodiversity and ecosystem services to measure impacts and serve as indicators of ecosystem health.

The TEEB report for policymakers also emphasizes the use of ecosystem valuation in traditional cost-benefit analysis for conservation and restoration of natural resources, as this framework quantifies the potentially very high returns through the investment. TEEB highlights the two most valuable methods to mitigate some environmental externalities:

The Polluter Pays Approach – This method involves the application of fees, fines, taxes and standards where the effects of private decision-making on natural resources are reflected within their strategy through public regulatory tools.

Full Cost Recovery Principle – This method suggests a discontinuation of subsidies and incentives which inaccurately reflect the complete consumption cost of the products or services used. Exceptions apply where certain groups cannot afford to pay the full cost of essential products and services. In these cases, TEEB suggests payment exceptions and concessions for the poor.

The TEEB Manual for Cities provides a six step approach for including ecosystem services into municipal decision making and policy development. The manual provides guidance to cities for how they can integrate natural capital valuation and how it is connected to municipal costs, local economic development, opportunities to enhance green and grey infrastructure synergies and how to recognize opportunities and trade-offs between various policy options, planning proposals or infrastructure choices.

For a 20 minute TED Talk on TEEB and the need to recognize the value of natural capital visit Pavan Sukhdev's Environmental Economist for TEEB: Put a value on nature! TED Talk

Many municipalities are beginning to recognize biodiversity as a key foundation of a healthy, livable and sustainable City and are developing Biodiversity Strategies that outline policies and practices that aim to preserve, protect and enhance their long-term biodiversity.

3.2 THE GBIF-ICLEI BEST PRACTICE GUIDE FOR BIODIVERSITY DATA PUBLISHING BY LOCAL GOVERNMENTS

The GBIF-ICLEI Guide supports local governments in the acquisition of data for use when developing estimates of natural capital. Local Governments hold an essential role as decision-makers for land use and development and purveyors of primary biodiversity data. Global Biodiversity Information Facility (GBIF) is an international organization that manages a registry of publicly accessible biodiversity datasets to assist local governments and other stakeholders in managing and publishing biodiversity data for policy and decision-making.

Effective biodiversity management secures human well-being and a sustainable economy since biodiversity, in its most limited role, is essentially the drive behind health and finance. Its existence improves the quality of life of its surroundings and through its natural capital and flow of services, shapes the nature of the economy through employment, development and agriculture opportunities it provides and its capacity to mitigate the effects of climate change.

The GBIF-ICLEI Best Practice Guide suggests that incomplete knowledge of biodiversity, limited information on species occurrences, as well as gaps in monitoring systems can be linked to the absence of comparable data on the issues behind comprehensive environmental decision-making. Often, the data generated by local governments is created in a number of formats, and this results in multiple versions of the same datasets.

The guide affirms that by publishing primary biodiversity data using GBIF tools[4], local government will benefit through enhanced decision-making processes, greater transparency and increased confidence in development-related decisions, thereby helping to build a positive reputation for local authorities. The guide also states that published primary data is freely and continuously available in the public domain for future use.

The methodology principles for publishing primary data are (1) accuracy, (2) precision regarding the level of detail of the data, (3) quality indicating the suitability of data for intended use, (4) effectiveness of the data achieving the intended goal and (5) the transparency of information describing the dataset.

[4] GBIF tools available through the network include standardized templates for data collection, metadata or supporting information used to authenticate data and determine their quality.

Source: Huffington Post Urban forests and green spaces are part of the natural capital of urban areas and provide valuable ecosystem as well as human services.

RECOMMENDATIONS FOR LOCAL GOVERNMENTS

- Include GBIF-ICLEI best practice guidelines for data publishing within Terms of Reference for assessments and biodiversity reports for relevant processes.
- Recommend to consultants that they make use of the GBIF network to source appropriate data when embarking on a new study.
- Include data publishing in Local Biodiversity Strategy and Action Plan.
- Join GBIF network to benefit from the free exchange of datasets and support in decision-making though comprehensive cost-benefit analysis
- Contact the Canadian Biodiversity Information Facility (BIF) or the GBIF Node Manager.

PART 4: NATURAL CAPITAL VALUATION IN PRACTICE

In 1990's the City of New York paid landowners just over $1 billion to change their farm management practices, and saved themselves $ 6-8 billion by avoiding having to build a new water filtration plant.

Building natural capital valuation into policy, while challenging and an emerging field, has already resulted in changes in policies that have recognized and acted on the need to protect natural capital resources. For example:

- Payments to preserve ecosystem services date to at least the early 1980s when the United States implemented wetland and stream credit banking.[5] In the 1990's, the City of New York paid landowners in its watershed more than $1 billion to change their farm management practices to prevent animal waste and fertilizer from washing into the waterways. In doing so, the City avoided spending $6-8 billion on a new water filtration plant and $300-500 million annually to run it.[6]

- In 1996 Costa Rica began paying landowners $42 per hectare per year to preserve forest. At the time, Cost Rica had the highest deforestation rate in the world, now it is among the lowest.[7]

- Norway is paying Indonesia $1 billion to preserve rainforest for carbon storage and sequestration to limit the impacts of climate change.

- In Vietnam, an investment of $1.1 million in mangroves that protect coastal regions from flooding, saved the country $7.3 million annually in dike maintenance.

- In the Philippines, the economic and ecological benefits of intact mangroves was found to outweigh the returns to aquaculture and after presenting those results to the press and local governments aquaculture ponds were shut down in order to conserve the threatened ecosystem.[8]

Below is a summary of reports that have allocated natural capital valuation at a global, regional, sub-regional, watershed, and municipal scale.

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[5] EPA. Wetlands Fact Sheet: Mitigation Banking Factsheet [website]. Washington, DC:U.S. Environmental Protection Agency (updated 12 Jan 2009). Available: Source: epa.gov

[6] TEEB. The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers. Geneva, Switzerland: The Economics of Ecosystems and Biodiversity Study, United Nations Environment Programme (2010). Available: Source: teebweb.org

[7] Sánchez-Azofeifa GA, et al. Costa Rica's Payment for Environmental Services Program: intention, implementation, and impact. Conserv Biol. 2007; 21(5):1165–1173. Source: dx.doi.org

[8] Environ Manage. 2010 Jan; 45(1):39-51. doi: 10.1007/s00267-009-9379-4. Epub 2009 Oct 15.

In 1997, Robert Costanza and his colleagues made headlines around the world when they published a paper in the journal Nature that estimated the annual net worth of the biosphere at what they considered a conservative average amount of $ 33 trillion, a figure greater than the annual gross national products (GNP) of all the world's economies combined.

4.1 GLOBAL APPLICATION: THE VALUE OF THE WORLD'S ECOSYSTEM SERVICES AND NATURAL CAPITAL

Robert Costanza is the Director and Founder of the Gund Institute for Ecological Economics at the University of Vermont and the co-founder of the International Society for Ecological Economics. In 1997, Robert Costanza and his colleagues made headlines around the world when they published a paper in the journal Nature that estimated the annual net worth of the biosphere at what they considered a conservative average amount of $ 33 trillion, a figure greater than the annual gross national products (GNP) of all the world's economies combined. In 2002 Robert and his colleagues released another paper in the journal Science that stated that investing in the preservation of intact ecosystems yields returns of 100 to 1. Costanza and his colleagues believe that putting a price on the services ecosystems provide (such as stabilizing the climate, providing biodiversity, and pollinating crops) alerts us to the true costs of the destruction of the biosphere. If these costs were accounted for in standard measures of economic well-being, like GDP, policymakers and society would be less inclined to allow corporations to exploit natural resources. The report can be accessed here.

4.2 REGIONAL APPLICATION: ESTIMATING ECOSYSTEM AND NATURAL CAPITAL VALUATION IN SOUTHERN ONTARIO

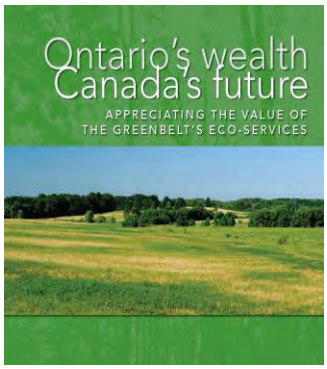
The primary purpose of this study by the Spatial Informatics Group for the Ontario Ministry of Natural Resources is to provide some understanding of southern Ontario's[9] natural capital through an economic valuation of the existing data and also to discover how this information will assist in policy and decision-making. This study, like many other ecological economics reports, use the "value transfer" method as a time-efficient and cost-effective method of deriving estimates for the natural services and occurrence of natural capital.

The total ecosystem service estimates (2008 CAD $/year) for the region was over $84 billion). Examples of values allocated by land cover types by hectare are:

- open water in urban/suburban river valued at $236,392 by hectare/year

[9] The study area includes Ecoregions 7E and 6E in southern Ontario and the near shore portions of the Great Lakes bordering those regions, to the country border.

- wetlands in urban/suburban area were valued at $161,420 by hectare/year.



Ontario's Wealth, Canada's Future: Appreciating the Value of the Greenbelt's Eco-Services, David Suzuki Foundation, 2008

The employment contribution of Ontario's Greenbelt are significantly higher than that of the provincial fish, forestry, mining, quarrying and oil and gas extraction level; Ontario's utility sector; and it is nearly as large as the Toronto Economic Region's public administration.

Additional total ecosystem service value for other land value types is available in Table 4 & 5 of the report. The report also emphasizes that these amounts represent a lower bound estimate of value due to the lack of empirical economic value studies. The natural capital and ecosystem services, including recreation and water supply in urban/suburban areas are highly valued as compared to the rural areas, given the large number of beneficiaries and the scarcity of natural capital in developed areas. This report provides southern Ontario municipalities with validated ecosystem values of various land covers based on $/ha that can be used to undertake municipal natural capital assessments. The report can be accessed here.

4.3 REGIONAL APPLICATION: APPRECIATING THE VALUE OF THE GREENBELT'S ECOSYSTEM SERVICES

Ontario's Greenbelt spans over 1.8 million acres and is geared to shelter fundamental ecosystem services, fertile lands, air and water quality, food production, biodiversity and quality of life from urbanization. Located in the most densely populated area in Canada with over 8 million residents in the Greater Golden Horseshoe, the Greenbelt comprises wetlands, farmlands, forests, communities and watersheds. More than half of the Greenbelt is used for agriculture due to its ideal farming conditions, high quality soil, temperate climate and easy access to water.

This study quantifies the economic contributions[10] of the Greenbelt on the provincial economy and local areas dependent on its resource base. This study used a combination of macroeconomic theories, location theory and economic models developed by Economic Research Limited (ERL) designed to capture and quantify financial impacts on income, output, employment and tax revenue by sector based on data released from Statistics Canada. The impacts are assessed in terms of GDP, gross output, employment expenditures, and taxes through five tax categories and imports.

Employment from sales in the province ($21.4 billion) totals 161,495 full-time person years or 75,000 Ontarians. This employment level is significantly higher than that of the provincial fish, forestry, mining, quarrying and oil and gas extraction level (42,300 Ontarians), the utility sector (46,300 Ontarians) and it is nearly as large as the Toronto Economic Region's public administration (93,100 Ontarians). The Greenbelt area provides significant national benefits and tax revenue estimated at over $2.8 billion; of which federal government's share is over $1.5 billion, the provincial government share is $1.0 billion and local

[10] For the purpose of this study, *economically dependent* activities are defined as agriculture, fishing, trapping, forestry, tourism and recreation. Not all activities that are dependent on the Greenbelt are considered within this study.

governments collectively received $307 million. The report can be accessed here.

The most valuable ecosystem service in the study is disturbance regulation which is the natural response to environmental fluctuations, for example vegetation structure providing storm protection and flood control.

4.4 SUB-REGIONAL APPLICATION: FLAMBOROUGH-BURLINGTON NATURAL CAPITAL

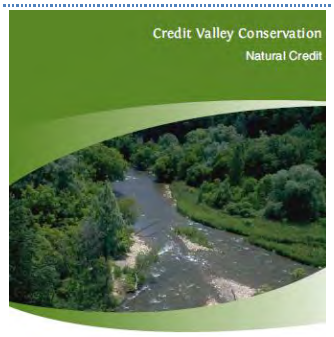
Flamborough-Burlington's natural capital and flow of ecosystems services are especially valuable due to the area's proximity to residents and its high quality features. Stop Escarpment Highway Coalition (SEHC) commissioned Green Metrics in 2011 to analyze and study the economic valuation of the natural area of the Flamborough-Burlington escarpment. This study was designed to develop a cost-benefit analysis with greater accuracy for land-use decisions, specifically the proposed Escarpment Highway, by assessing the financial value of the natural capital and the effect on ecosystem services throughout the region. The study resulted in an assessed value of $912 million/year. This created awareness about the significance of natural capital, ecosystem services and the importance of comprehensive accounting, while encouraging dialogue among stakeholders. The report drew some high level observations with striking similarities between the Flamborough-Burlington area and 4 studies of comparable natural capital from the Ministry of Natural Resources report[11] (MNR). The report can be accessed here.

The most valuable ecosystem service in the study is disturbance regulation which is the natural response to environmental fluctuations, for example vegetation structure providing storm protection and flood control. This ecosystem service is valued at $314 million/year and represents over 30% of the total estimated value; water supply is also greatly valued at $160 million/year. The Niagara Escarpment and the natural capital's proximity to the residents make the area suitable for quality recreation such as hiking and bird watching to name a few, setting the associated value at $150 million/year. Wetlands (valued at $658 million/year) serve an essential role to residents by performing such services as reducing flood risks, purifying the water and assimilating waste. Both wetlands and forest cover account for 87% of the total flow of benefits.

4.5 WATERSHED LEVEL APPLICATION: ESTIMATING THE VALUE OF NATURAL CAPITAL IN THE CREDIT RIVER WATERSHED

This report by the Pembina Institute was commissioned in 2009 by the Credit Valley Conservation (CVC) for the purpose of quantifying the value of the

[11] Troy, A. And K. Bagstad. Estimating Ecosystem Services in Southern Ontario. Ontario Ministry of Natural Resources, 2009. Toronto. Ontario. http://www.worldometers.info/world-population/



Human development has an impact on the ecosystem services benefitting residents; however these impacts are often ignored in land-use planning and policy development.

natural capital and flow of ecosystem services in the Credit River Watershed region which falls within the Credit Valley Conservation Authority compass.

The Credit River Watershed is located within one of the most densely populated areas in Canada, housing 750,000 residents and experiencing continuous population growth. While ecological services contribute directly to well-being for residents from Orangeville to Southern Mississauga, the region's lower property costs and proximity to the highly urban Greater Toronto Area has prompted continuous encroachment by commercial and residential development.

An increase in urban development for residential and commercial use has a series of adverse implications for vital ecosystem services, such as wastewater disposal, storm water run-off, sediment erosion, degradation of habitats, increased water temperature, and decreased groundwater discharge. These effects have a large economic impact on ecosystem services benefitting residents, though these impacts are often ignored in land-use planning and policy development.

The total value of the watershed was estimated at $371 million per year or $490/year/resident (2007 dollars). The ecosystem services that provided the highest valued services included:

- water treatment ($137.1 million/year)
- water supply($100.1 million)
- climate regulation ($41 million)
- bundled riparian services ($35 million)
- disturbance avoidance ($16.1 million)
- recreation ($13.6 million)
- amenity and cultural($9.3 million)
- habitat($8.6 million)
- gas regulation ($5.9 million)
- pollination ($4 million).

The value of natural capital by land cover type comprised of:

- wetland ($186.8 million)
- upland forest ($70.9 million/year)
- riparian forest ($51 million)
- agriculture ($21 million)
- urban forest (18.7 million)
- water ($14.5 million)
- meadows ($7.8 million)

Pembina Institute applied the commonly used benefit transfer method to assess the value of ecosystem services in the Credit River watershed. The report provides a valid argument concerning the time constraint of the

assessment provided; as natural capital becomes increasingly scarce, its value rises significantly. Accordingly, the valuation of the watershed should only be utilized for the next 10 years and the area must be periodically monitored and assessed.

Should the Credit River Conservation Authority consider a reforestation plan, incurring a cost of approximately $8 million over 10 years, the valuation of the region would increase by $13.2 million/year. The report can be accessed here.

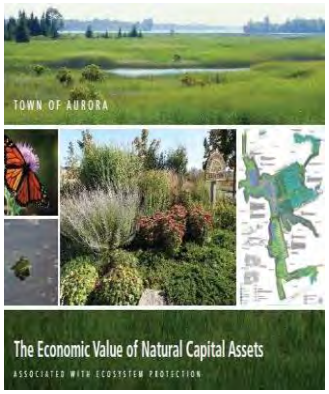
The above report is but one of a number of natural capital valuation initiatives that have been undertaken by Credit Valley Conservation. They are also undertaking efforts to better understand the linkages between ecosystem health and human well-being; the perceived importance of ecosystem elements to residents' well-being; and recommendations for indicators to monitor changes in well-being over time. Credit Valley Conservation is also working with their municipal partners to determine methods for integrating natural capital in the development application process. More information on their natural capital valuation efforts can be accessed here.

4.6 LOCATION SPECIFIC APPLICATION: WEALTH OF NATURAL CAPITAL IN ROUGE NATIONAL PARK

The David Suzuki Foundation estimated the value of the existing Rouge National Park, its three surrounding watersheds and (at the time the proposed) the new Rouge National Park using land cover data from Southern Ontario Land Resource Information System (SOLRIS), and methodology developed by TEEB. The Rouge National Park and their surrounding watersheds were also mapped by their ecosystem service values according to the land cover type.

The ecosystem consists of a diverse level of natural cover areas, agricultural and urban lands, as well as parking lots including the Toronto Zoo. This study uncovered the immense amount of non-market economic benefits the area provides to the Greater Toronto Area (GTA) residents at $115.6 million/annually. Ecosystem services with the greatest valuation include; pollination services worth $28.2 million/year, stored carbon at $17.8 million/year and wetland habitat at another $17.1 million/year. To provide context, in 2009 the Ontario Ministry of Natural Resources study estimated the combined value of ecosystem services in southern Ontario to be worth $63 billion (2011). The report can be accessed here.

Furthering their research in this area, the David Suzuki Foundation is partnering with Google Earth Outreach to launch an online map in which users select a region and are provided with a listing of economic services and the estimate the current natural capital value.



The Town of Aurora estimated the value of their natural capital at approximately $7.4 million annually.

They are now incorporating the valuing of natural capital into their development application process.

4.7 MUNICIPAL SPECIFIC APPLICATION: TOWN OF AURORA ECONOMIC VALUE OF NATURAL CAPITAL ASSETS ASSOCIATED WITH ECOSYSTEM PROTECTION

The Town of Aurora mapped the Town's natural assets via their GIS system, created separate layers for numerous natural features (ex. wetlands, woodlands, agriculture, grasslands, park) and estimated the value of Aurora's natural capital at approximately $7.4 million annually (this amount does not include the value of street and urban trees). This value is attributed to protection of environmental features, reduction in greenhouse gas emissions and other ecological benefits.

The GIS system will allow Aurora to update their valuation on an ongoing basis and incorporate natural capital into land use planning decisions. Aurora is in the process of preparing Official Plan policies to require development applicants to prepare detailed natural asset economic valuation of pre- and post- development scenarios with any new planning applications that involve natural assets. The report can be accessed here.

PART 5: CONCLUSION

Humans have been so fortunate with the natural capital endowed to us that it is understandable that we have traditionally pursued growth with the idea that nature's ability is limitless. Although this mindset has historically led to substantial improvements in quality of life and wealth, with human population expected to grow to 9 billion by 2040[i], and projected consumption patterns being in any way close to what are expected, it is unlikely that this mindset will serve us well in the future.

Our natural capital is limited. Accordingly, we need to better understand actions and decisions that undermine nature's ability to provide us with the ecological services we need and depend on. We need to understand where and when it makes sense to make withdrawals from our natural capital and how and where it makes financial, social and environmental sense to save and build this capital.

Removing green infrastructure and replacing it with grey infrastructure can have significant positive results including economic stimulation and the provision of homes and places of business. However, there can be negative environmental consequences. One such example is where inadequate absorption by green infrastructure and increased runoff over grey infrastructure can result in increased flooding during heavy rainfall events. This has been evident across Ontario, in Peterborough (2002, 2004), Toronto (2005, 2013), Hamilton (2009, 2013), Thunder Bay (2012) and London (2000, 2008) and many other Ontario communities. If natural capital had been better factored into development decisions, the impact of these floods would have been less severe, and would not have caused such significant damage to our grey infrastructure.

There are numerous comparisons that could be made between the 2008 financial crisis and the likelihood of an upcoming natural capital crisis if we continue on with our 'business as usual and nature has no limits' mindset. The financial crisis resulted from the bundling and dilution of risk. Following from the decline in the US housing market in 2006, sub-prime mortgages continued to be bundled, overvalued and traded as securities. The real value of these 'bundles' was considerably lower than what was being traded. When this realization finally came to light, financial institutions had inadequate capital to back the securities on their books and the collapse ensued. Risk and value was not being appropriately accounted for, and as such, was not factored in when those risks and values were transferred to others.

Under our current systems of economic analyses, we place little to no value on natural capital, therefore we do not adequately account for the environmental and corresponding financial and human risk associated with developing it. We are not accounting for the full suite of costs and risks in our development decisions. The inherent weaknesses in this system are becoming apparent. Flooding and other environmental ramifications are becoming more common. When natural capital is not factored into decision making, the resulting costs are borne by the masses. Taxpayers and insurance rate payers all shoulder the costs of flooding. Only a few benefit from these occurrences, while almost everyone else pays. The risks of withdrawals from our natural capital are transferred to society and to future generations.

As Canadians we have been especially endowed with a wealth of natural capital. We have an abundance of natural resources, fresh water and land for development. We have a certain margin for error because of our natural capital advantages. Our privileged position would allows us the luxury to build our capacity to learn how we can better and more accurately account for the costs, risks, and benefits resulting from using and/or protecting our natural capital. Developing and sharing these lessons learned will allow for others, especially less affluent countries, to better manage their natural capital.

Such considerations are not anti-growth; rather they are akin to smart development. While it may very well be true that human nature leads us to value short term gain over longer term risk or loss, it is also in our nature to protect and defend our assets from those seeking to take them from us and use them for their benefit alone.

However, in order to protect and defend our natural capital assets we need to better understand and value it. . Taking steps toward accounting for natural capital and incorporating its value into decision making would lead us closer to shifting this paradigm.

APPENDIX A: GENUINE PROGRESS INDICATOR FACTORS

The calculation formula of Genuine Progress Indicator presented in the simplified form is the following:

GPI = A + B - C - D + I

A is income weighted private consumption

B is value of non-market services generating welfare

C is private defensive cost of natural deterioration

D is cost of deterioration of nature and natural resources

I is increase in capital stock and balance of international trade

Individual components that increase (+) or decrease (-) the value of the GPI are the following:

- + Personal consumption weighted by income distribution index
- + Value of household work and parenting
- + Value of higher education
- + Value of volunteer work
- + Services of consumer durables
- + Services of highways and streets
- - Cost of crime
- - Loss of leisure time
- - Cost of unemployment
- - Cost of consumer durables
- - Cost of commuting
- - Cost of household pollution abatement
- - Cost of automobile accidents
- - Cost of water pollution
- - Cost of air pollution
- - Cost of noise pollution
- - Loss of wetlands
- - Loss of farmland
- -/+ Loss of forest area and damage from logging roads
- - Depletion of nonrenewable energy resources
- - Carbon dioxide emissions damage
- - Cost of ozone depletion
- +/- Net capital investment
- +/- Net foreign borrowing

= Genuine Progress Indicator

APPENDIX B: SOME MORE KEY ECOLOGICAL ECONOMICS PLAYERS

HERMAN DALY

Herman Daly is often called the forefather of ecological economics. From 1988 to 1994, Daly was the World Bank's senior environmental economist. During his six year tenure he succeeded in getting the World Bank to at least consider the environment in its policies and programs, but had significant challenges changing the economic landscape in the organization towards a view of the economy living squarely inside the global ecosystem rather than the other way around. He is presently a professor at the University of Maryland in its School of Public Policy. In 2003, Herman Daly and Joshua Farley published the economic text book Ecological Economics: Principles and Applications that has been included in many university economic degree curriculums.

PAUL HAWKEN

Paul Hawken is a renowned American environmentalist and author of The Ecology of Commerce (1993); and Natural Capitalism, co-authored with Amory Lovins and Hunter Lovins (1999). Natural Capitalism highlights how industry and often governments look only at earth's ecosystem as a source of limitless raw resources. Water, land, and air are used without consideration for the larger services those systems provide and the costs of destroying those ecosystems only becomes apparent when the services start to break down and those break downs are more often than not paid for by society rather than industry.

THE PRESIDENT'S COUNCIL OF ADVISOR'S ON SCIENCE AND TECHNOLOGY (PCAST)

Report to the President. Sustaining Environmental Capital: Protecting Society and the Economy

Natural Capital (NatCap) Project
NatCap has created software called InVEST (Integrated Valuation of Environmental Services and Tradeoffs) to model tradeoffs among environmental, economic and social benefits so that decision makers can explore the implications of alternative land-use scenarios.

International Payments for Ecosystem Services United Nations Environment Program

Economics and Sustainable Development: Values and Valuation International Institute for Sustainable Development

Green Accounting and **Payments for Environmental Services** World Bank Environmental Economics

APPENDIX C: REFERENCES

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