PUBLIC AGENDA
SASKATOON ENVIRONMENTAL ADVISORY COMMITTEE

Thursday, September 10, 2015, 11:30 a.m.
Committee Room A, Second Floor, City Hall
Committee Members:

Dr. M. Hill, Chair
Ms. K. Aikens, Vice-Chair
Councillor M. Loewen
Ms. A. Bugg
Dr. D. McGrane
Mr. B. Latimer
Mr. S. Homenick
Ms. A. Garg
Ms. N. Kochar
Dr. S. Moshiri
Mr. B. Sawatzky

Pages

1. CALL TO ORDER

2. CONFIRMATION OF AGENDA

Recommendation

That the agenda be confirmed as presented.

3. ADOPTION OF MINUTES

Recommendation

That the minutes of Regular Meeting of the Saskatoon Environmental Advisory Committee held on June 11, 2015 be adopted.

4. UNFINISHED BUSINESS

5. REPORT OF THE CHAIR

Verbal Update - M. Hill

Recommendation

That the information be received.

6. COMMUNICATIONS

6.1 Net Metering Program for Saskatoon Light & Power (File No. CK. 2000-1) 4 - 11

Attached is a report of the General Manager, Transportation & Utilities Department, dated June 2, 2015, which was considered at the Regular Business Meeting of City Council held June 22, 2015; it was resolved that the report be forwarded to SEAC for its information.

Recommendation

That the information be received.

6.2 Publications (File No. CK. 175-9)

Planning and Design Newsletter, Spring/Summer 2015 edition.

Saskatoon Tree Tour Booklets, SOS Elms Coalition.

The Committee Assistant will distribute copies of the above noted publications at the meeting.

Recommendation

That the information be received.

7. REPORTS FROM ADMINISTRATION

7.1 Growth Plan (Growing Forward) - Update (File No. CK. 4110-2) 12 - 14

Verbal Update - A. Wallace and L. Anderson, Planning & Development Division

A PowerPoint presentation will be provided.

Attached for the Committee's information is a memo in regards to the above-noted matter.

Recommendation

That the direction of the Committee issue.

7.2 Energy Codes in Saskatchewan - Update (File No. CK. 540-1)

Verbal Update - K. Fagnou, Building Standards Division

Recommendation

That the information be received.

7.3 Biodiversity Conservation: Recommendations for the City of Saskatoon 15 - 64

(File No. CK. 175-9)

Verbal Update

Attached for the Committee's information is a report prepared by Kelly Richardson, MSEM Candidate, School of Environment and Sustainability on the above-noted matter.

Recommendation

That the information be received.

7.4 Environmental and Corporate Initiatives Update (File No. CK. 7550-1) 65 - 70

Verbal Update - B. Wallace

Attached is a memo from the Environmental & Corporate Initiatives Division providing an update on various Policies and Reports relating to the Committee's 2015 Goals and Objectives along with information on Soil Handling Strategy.

Recommendation

That the information be received.

8. CHANGES IN ENERGY INTENSITY IN CANADA (File CK. 175-9) 71 - 86

Verbal Update - S. Moshiri

Attached for the Committee's information is a report on the above-noted matter.

Recommendation

That the information be received.

9. STATEMENT OF EXPENDITURES 87 - 87

Attached is a current Statement of Expenditures.

Recommendation

That the information be received.

10. ADJOURNMENT

Net Metering Program for Saskatoon Light & Power

Recommendation
That the Standing Policy Committee on Environment, Utilities and Corporate Services recommend to City Council:

1. That Saskatoon Light & Power revise the Power Producer's Policy to add a Net Metering Program to align with SaskPower's Net Metering Program;
2. That the Power Producer's Policy be revised to only accept technologies that demonstrate significant GHG emission reductions over conventional sources, and environmentally-preferred technologies including solar and combined-heat & power; and
3. That the City Solicitor be requested to prepare the necessary revisions to Bylaw No. 2685 regulating the sale of electric light and power, to reflect the change to a Net Metering Program.

Topic and Purpose

The purpose of this report is to recommend that City Council approve a Net Metering Program for Saskatoon Light & Power (SL&P) customers. Net Metering allows customers to generate their own electricity from approved environmentally-preferred technologies, and to be credited for the unused portion at the same rate as electricity is purchased from the utility.

Report Highlights

1. A Net Metering program offers a greater financial incentive for more customers than the current Power Producer's Policy administered by SL&P.
2. A Net Metering program is expected to help reduce community greenhouse gas (GHG) emissions in the SL&P Service Area, tied to energy use.
3. SL&P has thirty-three (33) customers currently interconnected to the electricity grid with their own solar panels.

Strategic Goal

This report supports the four-year priority to continue implementation of the Energy and Greenhouse Gas Management Plan, under the Strategic Goal of Environmental Leadership. The Energy and Greenhouse Gas Management Plan lays out a number of actions related to the development of renewable energy in Saskatoon for both civic operations and the community as a whole, and proposes investigating a net metering program similar to SaskPower's for green power generators.

Background

At its meeting on October 9, 2007, City Council adopted the Power Producer's Policy. This policy offers SL&P customers an opportunity to generate electricity at their home or business. Any electricity generated by the customer offsets electricity purchased from SL&P for their home or business, reducing their monthly electricity bill. Any excess

power generated is sold to SL&P and flows onto the electricity grid. The current program is equivalent to the Small Power Producer Program offered by SaskPower.

Report

Net Metering Program

SaskPower offers a Small Power Producer's Program and the Net Metering Program, for its customers to produce their own power. SL&P currently offers a program that is equivalent to SaskPower's Small Power Producer's Program, but does not offer an equivalent Net Metering Program. A description of the two SaskPower programs, as well as SL&P's current program is provided in Attachment 1.

Net metering allows customers to generate their own electricity with approved environmentally-preferred technologies, and to be credited for the unused portion at the same rate as electricity is purchased from the utility. For small systems, a Net Metering Program is more financially beneficial to the customer than the Small Power Producer's Program, creating more incentive to self-generate electricity.

A typical residential or small commercial system will produce approximately 60% of the electricity used during the year. However, most of the electricity generated occurs during the daytime when the electricity consumption is at its lowest. A Net Metering Program allows the customer to 'bank' excess electricity on the grid, and to 'withdraw' the banked electricity when it is needed. Under SL&Ps current Power Producer's Policy, customers receive an annual year-end payment at a lesser rate for any unused power that comes onto the electricity grid.

Reducing Community GHG Emissions

The Net Metering Program would be open to approved environmentally-preferred technologies that demonstrate significant GHG emission reductions over conventional energy sources. Under the Net Metering Program, the City would receive all environmental credits associated with each system.

Thirty-three Customers Currently Interconnected

SL&P has 25 residential and 8 commercial customers currently interconnected to the electricity grid with their own solar power systems. Currently, all of SL&P's customer self-generation is done with solar, but there has been interest in Combined-Heat & Power in commercial applications. In 2014, the cost of the current program to the City was:

Lost Electricity Sales:	$10,700
Electricity Purchased at Premium:	$ 3,900
Total:	$14,600

In 2014, the cost would have been $16,500, or an increase of $1,900, if a Net Metering Program was in place.

Options to the Recommendation

To further incentivize adoption of environmentally-preferred generation, the City could create a temporary Feed-In-Tariff (FIT) Program. A FIT pays a premium for electricity sold to the Utility from customer owned generation source. The municipality of Banff has recently created the first municipal FIT in the country. SL&P is not in a position to offer this program to all Saskatoon residents and businesses (only to SL&P's service area), and the financial impact to the Utility would be larger. Therefore, this option is not recommended.

Alternatively, the City could continue to offer only the current program. This is not recommended by Administration as the current program offered by SL&P is one of the lowest incentive programs offered by any electric utility in Canada.

Public and/or Stakeholder Involvement

SL&P has been approached by several of the existing program customers who have expressed concern with a lack of a Net Metering Program or Feed-In-Tariff. Administration believes the recommendations set forth reflect the wishes expressed by these citizens.

Communication Plan

If the SL&P Power Producer's Policy is revised to add a Net Metering Program, this information will be made available to the public via the City's website and via a direct mail-out to the SL&P customers currently interconnected to the electricity grid with their own solar panels. Wider communications to identified stakeholders and special interest groups may be considered.

Policy Implications

SL&P's Power Producers Policy will be revised accordingly.

Financial Implications

The program will be funded through SL&P's operating program. This is the same funding source for the currently offered program.

A Net Metering Program is estimated to cost $24,000 in 2015 if approved, which would be an estimated $2,800 increase over the existing program, and the current program is more than doubling in size every two years.

	2012	2013	2014	2015 (est.)	2016 (est.)
# of Customers	14	18	33	47	61
Generation Capacity	97 kW	130 kW	218 kW	306 kW	413 kW
Est. Net Metering Equivalent Cost	$6,500	$13,300	$16,500	$24,000	$35,700
Current Program Cost	$5,100	$11,800	$14,600	$21,200	$31,300
Increased Cost to City	$1,400	$1,500	$1,900	$2,800	$4,400
GHG Credits (tonnes Co2eq)	50	98	116	163	228

Environmental Implications

The net metering program provides the opportunity for customers to reduce their reliance on energy derived from fossil fuels, and therefore, reduce GHG emissions tied to energy generation. In 2014, the program reduced GHG emissions by 116 tonnes CO2e, which is equivalent to removing 24 cars from the road.

Other Considerations/Implications

There are no privacy, or CPTED implications or considerations.

Due Date for Follow-up and/or Project Completion

If the recommendations are approved, a revised Bylaw No. 2685 regulating the sale of electric light and power, reflecting the change to a Net Metering Program will be presented to City Council.

Public Notice

Public Notice pursuant to Section 3 of Policy No. C01-021, Public Notice Policy, is not required.

Attachment

1. Saskatoon Light & Power Customer Generation Program

Report Approval

Written by:	Nathan Ziegler, Sustainable Electricity Engineer
Reviewed by:	Brendan Lemke, Acting Director of Saskatoon Light & Power
Approved by:	Jeff Jorgenson, General Manager, Transportation & Utilities Department

EUCS NZ - Net Metering Program for Saskatoon Light & Power

Saskatoon Light & Power Customer Generation Program

Program Outline

Saskatoon Light & Power's (SL&P) Power Producer's Policy offers our customers an opportunity to generate electricity at their home or business. Any electricity generated by the customer offsets electricity purchased from SL&P for their home or business, reducing their monthly electricity bill. Any excess power generated is sold to SL&P and flows to the electrical grid.

A bi-directional meter keeps track of the electricity to and from the grid for billing purposes. Power put back onto the grid is accumulated throughout the year. At the end of each year, payment is made for all customer generated electricity sold to SL&P.

There are some program restrictions in the downtown area.

Credits and rates

Purchase rates are based on kilowatt-hours (kWh). Payment is made once a year for the total accumulated power that flowed back onto the electrical grid. In 2014, the customer generated electricity was purchased at 10.198 ¢/kWh. Rates escalate by 2% per year. Residential customers purchased electricity from SL&P at 13.12 ¢/kWh.

Program Cost to Customer

Saskatoon Light & Power (SL&P) Customer Generation Program customer cost:

- $100 + GST to SL&P for witnessing operation of protection equipment
- Other customer costs: Electrical permit fee, installation, commissioning, and electrical inspection.

1

SaskPower offers both a Small Power Producer's Program and a Net-Metering Program to its customers. The SL&P Power Producer's Policy is equivalent to SaskPower's Small Power Producers Program.

SaskPower Net-Metering Program

(The following information was extracted from the SaskPower Net Metering Program Website)

Program Outline

Residents, farms and businesses with approved environmentally preferred technologies of up to 100 kW of generating capacity can deliver their excess electricity to SaskPower's electrical grid.

A bi-directional meter keeps track of the electricity to and from the grid for billing purposes. Electricity sent to the grid is banked and applied to the customer's current month electricity consumption. Any excess electricity is carried over to the following month and applied against that month's consumption. A credit appears on the customer's monthly bill showing the net amount of electricity that has been banked. Excess power needs to be used within the year; if not, any credits will reset to zero.

Credits and rates

SaskPower credits their customer's excess power at the same rate that they purchase power. Power billing is based on kilowatt-hours (kWh). As an example, the 2014 electrical rate was 13.12 ¢/kWh, and then excess power will be credited at that amount.

Program Cost to Customer

SaskPower Net Metering Program costs customers the following:

- $315 including taxes for a Preliminary interconnection study
- $475 + GST for a Bi-directional meter and interconnection
- Other costs: Electrical permit fee, Installation, commission, and electrical inspection.

SaskPower Small Power Producers Program

(The following information was extracted from the SaskPower Small Power Producers Program Website)

Program Outline

The Small Power Producers Program accommodates customers who wish to generate up to 100 kilowatts (kW) of electricity for the purpose of offsetting power that would otherwise be purchased from SaskPower or for selling all of the power generated to SaskPower.

Credits and rates

The 2012 program price that we will pay for electricity is 9.802¢/kWh *(assumed to be 10.198 ¢/kWh in 2014)*. This 2012 price will escalate at two per cent per year thereafter. Purchase rates do not differ between eligible generation technologies. All contracts will be honoured in accordance with the pricing regime in the signed contract, even if the program is discontinued.

Program Cost to Customer

The small power producer is responsible for the cost of connection, commissioning and the meter installation. A quote for these costs will be provided as part of the Interconnection Study.

Rebates

Saskatchewan has a rebate program for environmental preferred technologies including solar. The program is being administered through SaskPower and is available to SaskPower, Saskatoon Light & Power and City of Swift Current electricity customers until November 30, 2016. The program is a one-time rebate, equivalent to 20 per cent of eligible costs to a maximum payment of $20,000, for an approved and grid interconnected net metering projects.

Rebates are available for both the Small Power Producer's Program and the Net-Metering Program. Saskatoon Light & Power (SL&P) customers apply for this rebate directly through SaskPower.

Community Services Department

To: Saskatoon Environmental Advisory Cttee
Date: September 1, 2015

From: Lesley Anderson, Project Manager
Growing Forward! Shaping Saskatoon
Phone: 306-975-2650
Our File: PL 4110-12-7
Your File:

Re: Growth Plan to Half a Million Update

Development of the Growth Plan began in 2013 with the award of the Transit Plan; Rapid Transit Business Case; Core Area Bridge Strategy; and the Nodes, Corridors, and Infill Plan to Urban Systems Ltd. Other projects are being completed alongside this work that will be incorporated into the Growth Plan, including:

a) an Active Transportation Plan;
b) an Employment Areas Study;
c) a Financing Growth Study; and
d) a Water and Sewer Plan.

Three major rounds of public engagement have occurred to date. The latest round of Growth Plan public engagement took place from February 25 to March 18, 2015. The intent of this engagement was to:

a) present the preferred long-term options (recommendations) for the Growth Plan's core initiatives of Corridor Growth, Transit, and Core Bridges; and
b) introduce and seek input on implementation possibilities and priorities for Corridor Growth, Transit and Core Bridges for the 0- to 5-year, 5- to 10-year and 10- to 20-year planning horizons.

The Engagement Summary Report #4 (see www.growingfwd.ca> Get Involved > Downloads) documents the communications and engagement activities that took place during the Phase 4 engagement, including the input received from the open public survey, stakeholders, and a representative survey of 800 Saskatoon residents.

The long-term possibilities and proposed implementation priorities for the Growth Plan's core initiatives presented during the last round of engagement, include:

Corridor Growth

Redevelopment along certain areas of 22nd Street, Idylwyld Drive, College Drive, Preston Avenue and 8th Street have been identified as the highest potential locations to support growth. Redevelopment of these high priority corridors could accommodate up to 15% of the city's growth over the next 30 years:

- These corridor locations would be prioritized for the development of Secondary Plans, which would be necessary to consider and facilitate changes that are sensitive to the community character and integrate with transit planning;
- Secondary Plans would enable the integration of land use and transit planning to occur, including consideration for Complete Streets, and active transportation infrastructure; and
- Transit Oriented Development guidelines are also being prepared to outline the development forms and considerations to apply in these areas during redevelopment.

Transit

The Long Term Transit Plan lays out a series of changes that will allow residents to choose from a broader range of services to meet their various needs. Residents will be able to choose various ways to use transit; by walking to their nearest bus stop, walking or cycling further to access a more frequent service, driving or cycling to a park-and-ride close to the rapid transit corridor to access a more frequent, direct service, or in areas of low demand, potentially using a dial-a-ride or on-demand service.

Rapid transit will serve as the spine to the transit network, providing a facility that will be used by many transit routes to improve travel time and reliability. Rapid transit corridors and stations will be planned to support and connect higher density, mixed use areas of the city in order to enhance mobility for residents and visitors. The facility along the corridor will include transit priority measures, such as dedicated lanes, and transit priority signals which will facilitate reliable service, while various routes accessing the corridor will provide frequency along the spine. Stations along the corridors will be designed for passenger comfort, safety, and access.

The addition of new types of services, transitioning the current local routes over time, and adding a variety of facilities are suggested as ways to better meet the needs of residents. Some of these changes include:

- add buses and service hours to provide more frequency along routes that show high transit demand and a concentration of destinations,
- add service to growing areas of the city with new models of transit, such as a community shuttle service,
- implement dedicated lanes and transit priority features on an incremental basis in order to build facilities as transit ridership grows,
- establish park and ride facilities to allow residents to drive to the nearest park and ride to access frequent or rapid transit service,
- In the longer term (10 to 15 years), conventional local routes would be gradually transitioned to become an east-west, north-south grid system which would establish frequent transit corridors and link more destinations in a more direct manner.

Core Area Bridges

Based on the technical evaluation and public input, a 33rd Street crossing in conjunction with Bus Rapid Transit lanes on the University Bridge is recommended as a long-term option to support core area travel demands, as well as the growth in the strategic infill areas of the Downtown, North Downtown and the University.

Timing for Implementation

Plans for Corridor Growth and Transit, including BRT, may be implemented incrementally with high priority changes identified for the next 0-10 years, while a new bridge would not likely be considered until sometime after ten years.

Reporting on Long-term Possibilities

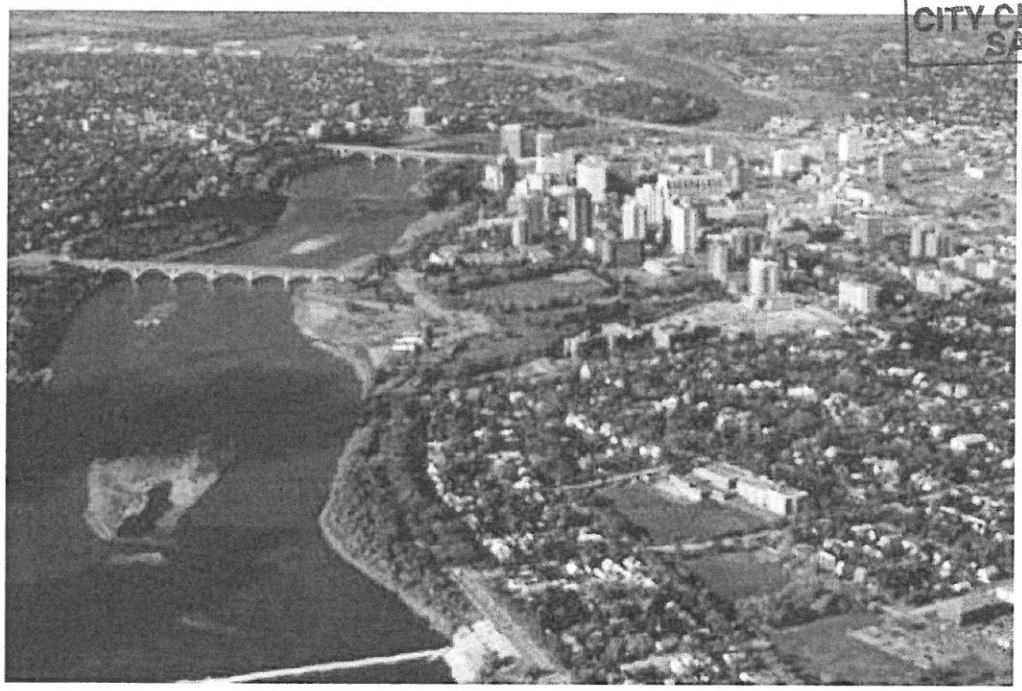
The Growth Plan Summary Report #2: Long-Term Possibilities (available online at www.growingfwd.ca > Get Involved > Downloads), provides a detailed assessment of the recommended options for corridor growth, transit, and core bridges, as well as an overview of the process undertaken. It lays out the material that was presented and discussed during the last round of engagement in February/March 2015, and will help inform members of the public and stakeholders that may or may not have been following this process.

Following the final round of public engagement this fall, the draft plan will be finalized and will go to City Council for consideration and approval in principle. This is scheduled for March 2016. Public engagement would continue during implementation of each initiative.

LA:la

cc: **Alan Wallace, Director, Planning and Development**

175-9



Aerial Shot of Saskatoon`s City Centre, 2009, Photo Credit: Amanda Deitz

Biodiversity Conservation: Recommendations for the City of Saskatoon

Kelly Richardson, MSEM Candidate, School of Environment and Sustainability

II

A Project Submitted to the College of
Graduate Studies and Research
in Partial Fulfillment of the Requirements for the
Degree of Master of Sustainable Environmental Management
in the School of Environment and Sustainability
University of SaskatchewanSaskatoon, SK, Canada

by

Kelly Richardson MSEM Candidate
Partner Organization: The City of Saskatoon, Environmental Corporate Initiatives

Disclaimer: The purpose of this report is educational and does not substitute for professional services in any areas, including for example architectural, civil, legal, mechanical or health related design. This work was completed on a voluntary basis for the organization cited above. The work served the experiential learning component of a course entitled ENVS 992, offered in the School of Environment and Sustainability's Masters of Sustainable Environmental Management program. No obligations or liabilities are implied.

Permission to Use: Permission to use this report is hereby given to the School of Environment and Sustainability (SENS) and The City of Saskatoon.

Executive Summary

Biodiversity is the diversity of all living things found on our planet. It is important to conserve biodiversity as it provides ecosystem services that cost far more to replicate than to preserve. Ecosystem services include an array of things from the regulation of water to providing habitat for native species.

ICLEI is an international association of local governments and organizations that have committed to sustainable development. Within ICLEI is a global biodiversity programme that uses an action-oriented approach customised for urban areas and cities, with the goal of improved biodiversity management at the local level.

For this report, information from the City of Edmonton was examined in detail as Edmonton shares similar geographic and climatic features to Saskatoon. Edmonton began its conservation journey by joining the Local Action for Biodiversity and through the process of acquiring evidence through scientific research and creating its values through public consultation. As well, Edmontoncreated an Integrated Conservation Plan that was implemented through the Biodiversity Action Plan. Edmonton also created a policy solely dedicated to biodiversity conservation called the Natural Areas Policy and over the years has created a conservation toolbox that comprises of a variety of tools to assess, acquire, design, and manage biodiversity.

Although Saskatoon does have policies that protect and potentially enhance the environment, the word biodiversity is not specifically included in any of these policies. In addition, the responsibility and management of these policies are limited to only a few divisions within the city government. It is important that biodiversity principles and concepts be integrated across all existing and future policies to consistently align with Saskatoon's Strategic Goal to "improve access to ecological systems, both natural and naturalized". Current developments have included biodiversity in their concept plans and certain measures have been taken to conserve and enhance the natural environment. It is now prudent for the City of Saskatoon to project a coherent and consistent message around the importance of biodiversity in all its policies and plans.

The following recommendations address biodiversity conservation in Saskatoon:

1. **Incorporate Biodiversity into Saskatoon's Policies/Plans**
   Currently the term biodiversity does not exist in any policies or plans in Saskatoon. Although there are aspects of different policies and plans that include measures to protect and potentially enhance the natural environment, the word biodiversity does not appear. Include a clear and consistent definition of biodiversity in all policies and plans such as the one in this report.

2. **Adopt a Specific Policy on Biodiversity/Natural Areas**
   A policy dedicated solely to the conservation of natural areas with responsibility distributed across multiple departments. Departments will identify areas of responsibility in which biodiversity can be measured, how to measure biodiversity and means of reporting progress toward enhancing biodiversity annually to City Council.

3. **Join the Local Action for Biodiversity**
   Joining the Local Action for Biodiversitywould open the door to a valuable array of resources and the opportunity to join a growing network of cities committed to biodiversity conservation. Along with this, the Local Action for Biodiversity provides its members with the tools to create and implement a biodiversity action plan.

4. **Develop a Conservation Plan**
   Saskatoon is at a critical time in its growth evolution to develop a conservation plan. With scientific research and public involvement through consultation, conservation goals can be created that align both city and community values. The Conservation Plan will include policies to guide action, monitoring and plan evaluation

5. **Create biodiversity education campaign(s) for city departments and the public**
   Biodiversity is not a common term within city literature. The concept has not been openly, or evenly, shared with the general public. An education campaign would allow for the opportunity to introduce city departments and the public to the concept of biodiversity. Similar campaigns have occurred with success for water conservation and, emergency preparedness.

6. **Create a Biodiversity Conservation Checklist**
   A biodiversity conservation checklist provides the opportunity for developments to be more sustainable. The purpose of the biodiversity checklist is to identify and record the presence of protected habitats and species within or in close proximity to, a development application site This information will contribute to more timely and informed decision making by Council as well as assist in developing a city-wide data base on biodiversity.

7. **Create an Office of Biodiversity**
   A multi-disciplinary team that is dedicated to coordinating biodiversity protection would provide a great opportunity to ensure all departments are working together to protect, restore, and manage Saskatoon's natural areas along with providing the community opportunities to become stewards of the natural environment.

8. **Secure resources**
   Secure human, financial, and any other resources required to implement the above recommendations. This includes creating a position(s) to develop and coordinate the first steps towards biodiversity conservation in Saskatoon.

Acknowledgements

I would like to thank the City of Saskatoon's Shannon Dyck, Amber Jones and Brenda Wallace for the wonderful opportunity to work on this research topic and for their invaluable guidance and support along the way. I would also like to thank my academic supervisor Dr. Robert Patrick for his academic advice on planning, research and writing. Gary Pedersen with the Department of Park's Naturalised Areas Division for an inspiring tour of our city's naturalised parks and for his advice. I am grateful to Grant Pearsell from Edmonton's Office of Biodiversity for all of his help and inspiration.

Table of Contents

Introduction

Saskatoon is the largest city in a province that is in the midst of high levels of economic growth. With this economic growth comes population growth as labourers, professionals and those seeking other means of opportunity migrate to Saskatoon to take advantage of the abundance of opportunity. The City of Saskatoon is currently attempting to accommodate the increasing population through residential and commercial development. These developments have potential to impact the natural environment. This natural environment is mainly composed of grasslands and wetlands (see Figure 1) that are home to a wide variety of native plants, mammals, birds and insects. It is important that this habitat be conserved for future generations as our city expands, as it will enable citizens to retain a relationship with the native environment that has been a part of the area for longer than we have inhabited it.

This report looks at biodiversity from a number of perspectives and asks why biodiversity is important generally, examines how biodiversity is addressed in another Canadian city, Edmonton, and identifies the current place of biodiversity in Saskatoon. Through the analysis of these three topics, along with the analysis of ways to measure biodiversity, a critical analysis of current developments in Saskatoon is provided. In addition, a list of recommendations is provided in this report.

Figure 1: Prairie Landscape by the Saskatchewan River - Photo Credit: Branimir Ghetjav

Context

What is Biodiversity?

The term "biodiversity" refers to the diversity of all-biological life or the immense richness and variation of the living world. The word is derived from 'bio' meaning life and 'diversity' meaning different or varied (Groom & Orians, 2006). We can consider biodiversity at many levels, from the genetic variability within a species, to the biota of some selected region of the globe, to the diversity of ecosystems on Earth (Groom & Orians, 2006). Most of us are truly unaware of the entire spectrum of biodiversity as our own experience involves looking at what we can see, the native species of our area we are familiar with and the "star" species that attract so much attention in the popular media around the world. If we are to understand the importance of biodiversity we must appreciate the richness in its entirety all the way from genes to biomes.

The many levels of biodiversity can best be understood from a categorised perspective, from genes, through populations and species, communities, ecosystems and landscapes. This can be further elaborated upon in terms of variations in composition, structure and function (Groom & Orians, 2006). Within these levels also lie structural and functional attributes that contribute to its complexity. Genetic compositions of certain populations that lie in areas under intense selection pressures may be more important for the long term survival of a species in an area of extreme environmental conditions, such as urban environments, that are subject to intense habitat degradation and sudden changes in food sources (Noss, 1990). It is a general rule with biodiversity that the greater an ecosystem's diversity is, the greater the ability to adapt to change. Reduced biodiversity results in an ecosystem that is unhealthy and vulnerable. Species become extinct and productivity is minimised. Urban biodiversity is especially confronted with challenges of habitat loss and disturbances to air, water and soil (Noss. 1990).

Urban Biodiversity

Often when we think of biodiversity the first thing that comes to our mind is images of remote natural beauty– not an empty car park around the corner or a vacant lot beside your home. Wildlife, we frequently believe, should be found in wild places, or confined to sanctuaries and national parks but cities can in fact support biodiversity too. Urban biodiversity includes not only the pigeons and rats we often encounter and the trees in our parks but also the small things such as plants in the sidewalk cracks, insects feeding on those plants, and microbes on the surfaces of everything. There are many parts of a city that are not so heavily built-up, such as the parks and greenways, the low-density neighbourhoods, or the outskirts of the city are often greener and biologically busier. When you consider this whole range – the variety of kinds of organisms and kinds of places in the urban matrix – it's not hard to image that urban biodiversity can be quite rich.

Why is Biodiversity Important?

Biodiversity is especially important in cities as they house the majority of the human population and many of our cities are constructed upon areas of high ecological diversity/productivity. Unfortunately, urban areas provide many threats towards biodiversity, mostly in the form of habitat loss, degradation and fragmentation. Fragmentation is caused by barriers of habitat that are unsuitable and prevent the mobility of organisms among patches of habitat, which is vital for population persistence.

Our planet is now in the midst of its sixth mass extinction of plants and animals — the sixth wave of extinctions in the past half-billion years. Currently we are experiencing the worst series of species die-offs since the eradication of the dinosaurs 65 million years ago. Extinction is a natural phenomenon, it occurs at a natural "background" rate of about one to five species per year. Scientists estimate we're currently losing species at 1,000 to 10,000 times greater than the background rate (Chivian & Bernstein, 2008), with dozens of species going extinct every day and as many as 30 to 50 per cent of all species possibly heading toward extinction by mid-century (Ibid et. al, 2004). Unlike past mass extinctions caused by events such as asteroid strikes,

volcanic eruptions, and natural climate shifts, the current crisis is almost entirely caused by human activity. Ninety-nine per cent of threatened species are at risk from human activities such as those that cause habitat loss, introduction of exotic species, and global warming (Encyclopedia Britannica, 2009). As the rate of change in our biosphere increases the numbers of extinctions are likely to accumulate in the coming years. It is important that we conserve these species before extinction versus dealing with the effects of their loss.

Urban environments are dynamic centres of activity, draining large amounts of natural resources, producing vast amounts of waste, interacting with bioregions and dramatically altering ecosystems both near and far. Cities are home to more than half the global population and play host to population growth, development pressures and climate change, which are some of the greatest challenges to the protection of biodiversity and human well-being. In cities, well-being and quality of life of its citizens is directly connected with the ecosystems and the services they provide in both the urban environment and the natural environment outside city boundaries (ICLEI, 2010). As the urban population grows, so do the pressures on the natural environment and biodiversity. Urban areas often lie on areas of ecological significance and have the unique opportunity to play a pivotal role in preserving our planet's biodiversity. Unfortunately, urban areas provide many threats towards biodiversity, mostly in the form of habitat loss, degradation and fragmentation. Fragmentation of habitat results in barriers that are unsuitable and prevent the mobility of organisms among patches of habitat, which is vital for population persistence and for a species to live out its full life cycle.

Examples of Ecosystem Services

- *Air Filtering* – Reduction in pollution is mainly caused by vegetation. The more vegetation a city has, the cleaner the air.
- *Food Supply* - Urban gardens, rooftop gardens and urban agriculture fields are a source of food production and can help solve food insecurity issues.
- *Recreation* – The hectic lifestyle of an urban inhabitant can be stressful at times. Urban green spaces provide recreational benefits and can help enhance human health and well-being.

Benefits

Biodiversity sustains natural systems and provides humanity with ecosystem services essential for survival and well-being. Ecosystems themselves are extremely dynamic and complex in nature, having richly interconnected relationships between the living and non-living environment. When

aspects of an ecosystem are compromised, other components of the ecosystem are more susceptible to disease, starvation and predation. The maintenance of ecosystem strength increases nature's resilience and decreases its vulnerability (Groom & Orians, 2006). Healthy and diverse ecosystems provide those living within it with a large amount of ecosystem services that are essentially free and provide the basics of life such as clean air, clean water and soils healthy enough to produce food. Biodiversity is essential to the lives and welfare of an urban area's population. Natural environments, and the flora, fauna and micro-organisms that live within them, moderate temperatures, purify the air and water, provide soil for food growth, pollinate fruits and vegetables, reduce storm water runoff and mitigate flooding risks, and capture carbon from the atmosphere to help reduce greenhouse gas emissions and mitigate the effects of climate change (Pickett et. al, 2011). The amount it would cost to replace, replicate, or restore these ecosystem services far outweighs the cost of maintaining these functions today.

ICLEI – Local Governments for Sustainability

ICLEI - Local Governments for Sustainability is the world leader of cities and local governments that are devoted to sustainable development. ICLEI consists of 12 mega-cities, 100 super-cities and urban regions, 450 large cities as well as 450 small and medium-sized cities and towns in 84 countries. Promoting local action for global sustainability ICLEI supports cities to become sustainable, resilient, bio diverse, low-carbon, resource-efficient urban centres; and to construct intelligent, sustainable infrastructure; and to grow a comprehensive, green economy. The definitive goal is to attain happy and healthy communities that are both environmentally and socially friendly. ICLEI has developed stable, long-term initiatives to support local-level sustainability and maintain the development of pioneering new programs that respond to international areas of concern. The organisation was founded in 1990 as the 'International Council for Local Environmental Initiatives' and was established when over 200 local governments from 43 countries assembled at ICLEI's initial conference, the World Congress of Local Governments for a Sustainable Future, at the United Nations in New York (ICLEI, 2008)

"To build and serve a worldwide movement of local governments to achieve tangible improvements in global sustainability with special focus on environmental conditions through cumulative local actions." – ICLEI's Mission (ICLEI, 2014)

ICLEI's Biodiversity initiative began in 2006, when city governments recognised their relevance in the role of conserving urban biodiversity.

Local Action for Biodiversity

Local Action for Biodiversity (LAB) is a global biodiversity programme organized by ICLEI and IUCN (International Union for Conservation of Nature). It is a proactive and customised approach for local and regional authorities and their partners around the globe, with an overall goal of enhanced and efficient biodiversity management at the local level. LAB is a vital element of, and contributor to, the Global Partnership on Cities and Biodiversity, chaired by the Secretariat for the Convention on Biological Diversity. The program began in 2006 with 21 pioneer cities and local governments who are global leaders in biodiversity management at the local level. A group of biodiversity experts runs LAB, who provide support to all participants in the form of technical assistance, guidance of networking and profiling opportunities and, along with partners, enabling a platform for advocacy on the global level (CBD, 2009).

LAB's 5-Step Process (CBD, 2009)

1. **Biodiversity Assessment** – local government along with current biodiversity management structures, communication, education, public awareness, and any relevant activities acquires the current status quo of biodivers-ity and ecosystem services. This builds a profile and is a useful source of biodiversity.
2. **Political Commitment** - The Mayor signs *The Durban Commitment: Local Governments for Biodiversity*, an international commitment to reduce biodiversity loss and improve local biodiversity management.
3. **Biodiversity Planning** - A Local Biodiversity Strategies and Action Plan (LBSAP) is created. This plan outlines the overall biodiversity strategies and provides information on specific actions that will achieve these strategies.
4. **Political Approval** – The LBSAP goes through the official process to gain council approval.
5. **Biodiversity Implementation – Three** projects, as outlined in the LBSAP, are implemented on the ground.

From 2006 to 2009, 21 local governments took part in the pilot phase of the LAB program. The 21 Original LAB Pioneers are international leaders in biodiversity management and have played a significant role in LAB's current success. LAB

continues to take new local governments through the 5-step process to improve and enhance the management of their biodiversity.

The Current State of Biodiversity in Saskatoon

Saskatoon is situated on the South Saskatchewan River in the heart of the Canadian Great Plains. The city is located in the Northern Mixed Grasslands Eco region, a transition zone between the Tall Grasslands to the east, Short Grasslands to the south and Aspen Parklands to the north (Savage, 2000) This region is now listed as critically endangered as a result of conversion of grassland to agricultural fields. Only fragmented areas of native prairie remain in their natural state (see Figure 2).

Figure 2: Naturalized prairie along the Saskatoon's Southern Riverside at Gabriel Dumont Park – Photo Credit: Kelly Richardson

Urban and agricultural development in and around Saskatoon has resulted in very little native plant life within city limits. While much of the urban forest is indeed native to other areas of Saskatchewan, a large amount of the flora associated with this specific region has been lost. Some notable conservation areas in Saskatoon are the Northeast and Small Swale natural areas, and Petturson's Ravine, Crocus Prairie, and Saskatoon Natural Grasslands. These areas are some of the last remaining native fescue and grassland communities in the area. Despite their ecological value, these

conservation areas are under increased pressure from residential developments such as Aspen Ridge and Brighton. Because of this trend, it is becoming increasingly important for the City to create a vision and strategy for conserving biodiversity in these areas during all stages of development to preserve their ecological integrity.

Meewasin Valley Authority

Saskatoon is also home to a unique conservation authority that provides protection to the South Saskatchewan River Valley's cultural and natural resources. Created in 1979 by a Provincial Act, the Meewasin Valley Authority is managed by three parties: the City of Saskatoon; the Province of Saskatchewan; and the University of Saskatchewan. The Meewasin was created with the hopes that the three partners collaborating in a single agency could accomplish more than they could individually. Meewasin applies the following four principles in planning the Valley (Meewasin, 2013).

- Recreation and development balanced with resource conservation
- Opportunity for diverse activities for a multitude of interests
- Natural and heritage resource preservation
- Public Ownership in decision making

Project Goal and Objectives

The goal of this project is to identify ways in which the concept of biodiversity may be supported within the Corporation of the City of Saskatoon. This project goal will be achieved through the following four objectives.

1. To define what biodiversity is and why it is important in an urban context.
2. To identify existing biodiversity policies, programs and strategies from a comparable Canadian city.
3. To describe what the City of Saskatoon is doing to support the concept of biodiversity through policies, programs and strategies.
4. To make recommendations to the City of Saskatoon to support the concept of biodiversity through policies, programs and strategies.

Methodology

In order to find out what biodiversity is and why it is important, a literature review was conducted. A review of ICLEI's website and associated documents was also conducted to establish knowledge of ICLEI as well as the LAB programme. Background information on Saskatoon's current state of biodiversity and the Meewasin Valley Authority was obtained through a literature review of Candace Savage's book *Prairie: A Natural History* and a review of Meewasin's website and associated documents

Edmonton was chosen as a case study to give insight into how the concept of biodiversity may be approached in a city with a similar biogeography, population demographic and governance attributes. To find out more about Edmonton's conservation of biodiversity an extensive review of that city's website, along with relevant documents, was conducted. This led to the formulation of a conceptual model of Edmonton's Conservation Toolbox. To find out which policies, programs and bylaws exist in Saskatoon that include conservation of biodiversity a document review was conducted of the city's website. To further enhance this research an informal email was also sent out to Directors and Managers of each city division. Finding out ways that a city may be able to measure biodiversity included a thorough review of the Singapore Index website and related documents. Finally, in order to gauge how well Saskatoon's most current developments are conserving biodiversity a document analysis was conducted of both Brighton and Evergreen's concept plans.

Results

Edmonton's Conservation Plan

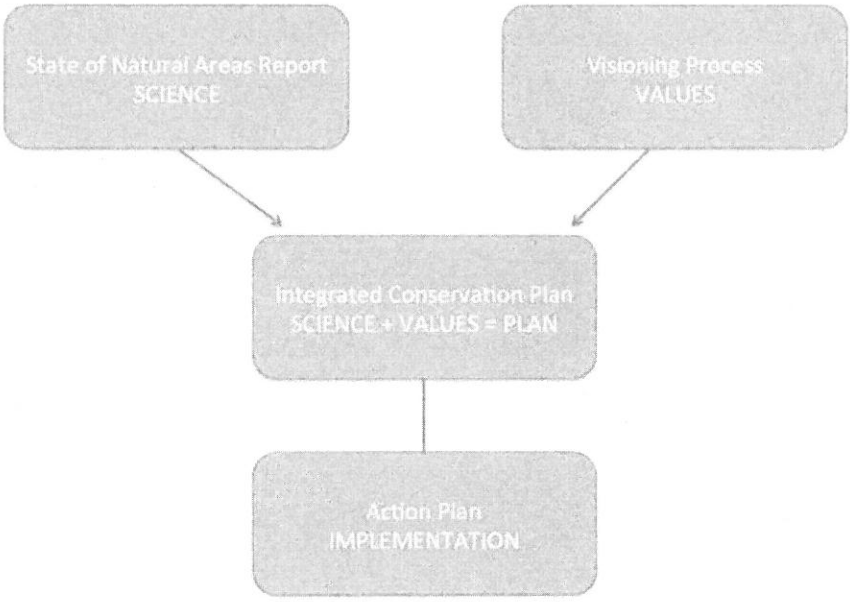
Founded as a city in 1904, Edmonton's conservation planning has long been an integral part of that city's development efforts. The City's conservation policy actually began in 1915 with the objective to protect part of the North Saskatchewan River Valley for the enjoyment for future generations. The result of this large-scale conservation effort in the City's early history is the City's famous River Valley, otherwise known as the "ribbon of green", what has become a rather distinguishing feature of Edmonton's cityscape. This cross-city ecological corridor now serves as the basis of their "ecological network approach" to biodiversity planning and is the largest, most continuous municipally owned parkland in Canada (City of Edmonton, 2009a). Edmonton joined LAB in 2007, and as part of the program has developed a conservation plan. To develop these plans, a local committee was set up to guide the development process, to ensure it aligned with community goals and objectives and that local stakeholders are involved in the process (See Figure 1).

Summer 2006: State of Natural Areas Report - Spencer Environmental was hired to create the report, which is essentially an inventory update, an integration of Natural Areas, and a definition of an ecological network that connects the city to the region.

Fall 2006: Conservation Vision – This vision was the public engagement process conducted by the City and included members of the public, internal/external stakeholders and the City. From the process came the Vision statement, guidingF principles, broad conservation goals and objectives.

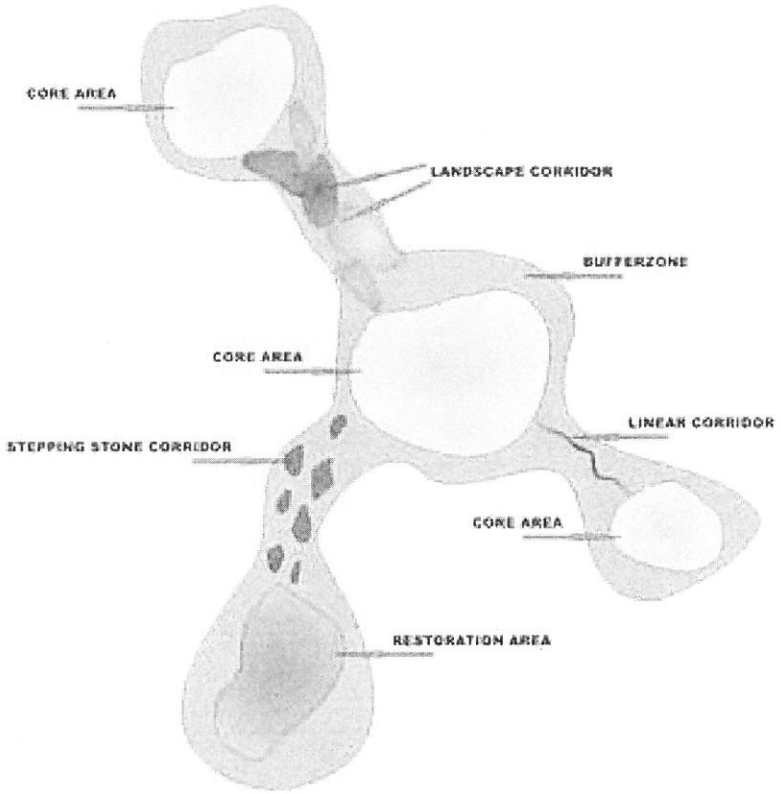
2007: Implementation Plan – The implementation plan consists of detailed implementation strategies, allocation of responsibility for conservation and management activities and monitoring framework (see Figure 3 below).

Figure 3: Edmonton's Conservation Plan Process, 2009.



In 2007, the City of Edmonton also created a new Natural Area Systems Policy (C-531) and a strategic plan, Natural Connections. Together, these two documents accentuate a new direction for the planning, protection and conservation of Edmonton's natural heritage through an ecological network approach. This ecological network approach involves identifying and conserving connected ecological networks, rather than considering natural sites in isolation. This innovative approach requires a new practice of ecological assessment, taking the City beyond previously used assessments. Refer to Figure 4 for an example of an ecological network and a detailed picture of Edmonton's Ecological Network can be found in Appendix 1.

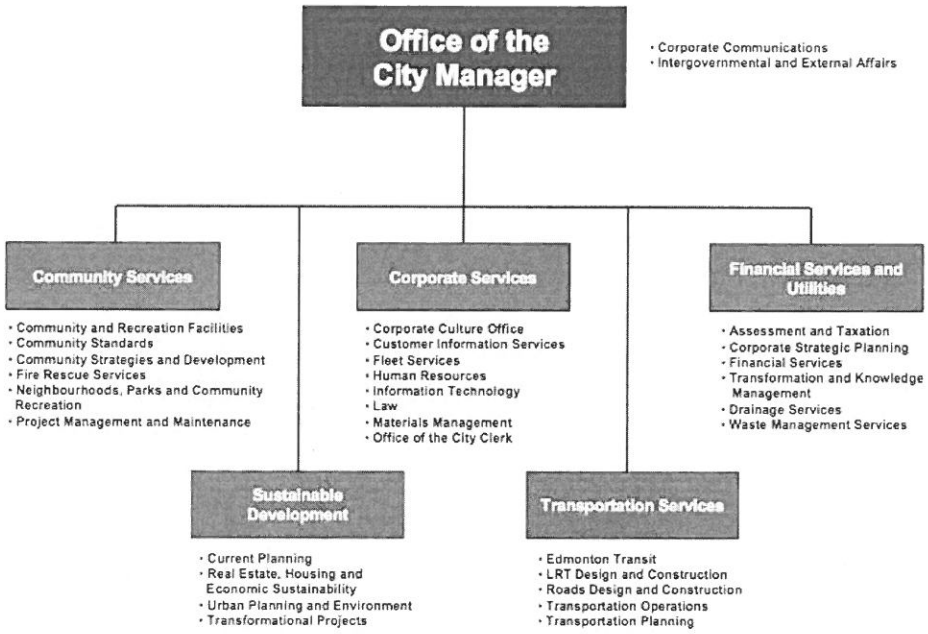
Figure 4: An example of an Ecological Network, 2009 – Photo Credit: Croatian State Institute for National Ecological Network.



The Office of Biodiversity

The Office of Biodiversity is a multi-disciplinary team that coordinates biodiversity protection for the City. It collaborates with other departments to ensure that natural areas are protected, restored and managed, and opportunities exist for community members to become engaged in the stewardship of natural areas (City of Edmonton, 2014). The Office of Biodiversity lies within the Sustainable Development department under Urban Planning and the Environment in the City's Corporate Structure (see Figure 5).

Figure 5: Edmonton's Corporate Structure, 2014 – Photo Credit: City of Edmonton



Edmonton's Conservation Toolbox

Edmonton has developed a toolbox to achieve these goals that consists of tools that assist in assessing, securing, designing and managing the natural environment and ensure sustainable development.

1. Assessment Tools

- **Ecological Network Reports**

  Edmonton's ecological network approach was created with the intention of protecting the city's natural areas as a single, integrated natural system, recognising the importance of ecological connections between natural areas, and understanding how these areas exist in the context of surrounding lands. More specifically, an ecological network approach involves conserving plant and wildlife species and ecological functions by protecting a system of core natural areas that are connected by natural and semi-natural linkages and, to the extent possible, surrounded by compatible land uses. The network integrates publicly- and privately-owned natural areas (Office of Natural Areas, 2008).

When a new development occurs an Ecological Network Report must be created. Ecological Network Reports are divided into two phases (Phase I and Phase II). Phase I is intended for the Area Structure Plan (ASP) and Phase II is designed for the Neighbourhood Structure Plan (NSP). The purpose of the Phase I Report is to: (Office of Natural Areas, 2008)

- Identify and assess the structure, function and integrity of the ecological network existing within the plan area;
- Consider the ecological network within the broader landscape, including ecological linkages to natural systems outside the plan area;
- Identify key components of the ecological network that the City should secure;
- Ensure that development is tailored to the ecological network; and
- Outline a set of recommendations that will help the City to develop an ASP that maximizes the protection of the identified ecological network, including the identification of mitigation measures and management issues.

The purpose of the Phase II Report is to: (Office of Natural Areas, 2014)

- Build further upon the Phase I ENR by description and assessments of the structure, function and integrity of the existing ecological network within the plan area.
- Collect information specific to the site so that the ecological features and requirements can be incorporated into the planning process in a sustainable manner, and maintained functionally.
- Describe recommended arrangements of the ecological network in the plan area, and the conservation tool(s) that will be used.
- Identify projected ecological impacts of the proposed development and suggest mitigation measures.
- Examine the long-term habitat connectivity of the area and improve ecological linkages.
- Describe the measures necessary to ensure the network remains sustainable post-development that stays within the context of the Development Concept approved at the ASP stage.

For further information on Ecological Network Reports, Area Structure Plans and Neighbourhood Structure Plans please refer to the terms of reference included in the references for this report.

- **Environmental Site Assessments (ESAs)**

All applications for land development that are brought forward to Council and the Subdivision Authority are done so in the form of a land development application (LDA). Part of the LDA process is to consider the natural environment and to determine if the site is suitable for the full range of allowable uses. Environmental Site Assessments can determine site suitability. An LDA may potentially require Phase I, Phase II and Phase III ESAs (City of Edmonton, 2009).

Phase I involves a historical and current review of the subject site
Phase II involves groundwater and soil tests
Phase III involves remediation and/or mitigation of risk to the site

For further information on ESAs in Edmonton please refer to the ESA Guidebook included in the references.

2. Securement Tools

- **Borrowing Initiative**

  In order to protect as many natural areas as possible from being converted into development, the City borrowed $20 million to do so. In order to make payments on this loan leverage was placed on an existing fund (Pearsell, 2014).

- **Edmonton & Area Land Trust**

  From 2004 to 2006, the City adopted the idea to create a local land trust, comprising of six partners (the Edmonton Community Foundation, Edmonton Nature Club, Legacy Lands Conservation Society, Land Stewardship Centre of Canada, Urban Development Institute and the City) coming together in 2006 to form the Edmonton and Area Land Trust. That year, the City provided an operational grant of $2.5 million to the young organization (Pearsell, 2014).

- **Conservation Easements**

  A conservation easement is a land agreement voluntarily placed on the deed of property by landowner to protect natural features. Landowners may sell or donate an interest in the land to an eligible conservation agency for the purpose of preserving a portion of the land for the enhancement of natural ecosystems. The benefit to the landowner can come through tax deductions for the easement and/or payments by the conservation agency (The Nature Conservancy, 2013).

3. Design Tools

- **Wildlife Passage Engineering Design Guidelines**

  Wildlife Passage Engineering Design Guidelines promote the preservation or improvement of urban biodiversity by guaranteeing wildlife populations are able to move about the City. This will ensure that wildlife has the ability to access spaces in order to fulfil their life cycles, and will prevent fragmentation or isolation of populations. The guidelines will also help ease concerns of safety with regards to wildlife-vehicle interactions (City of Edmonton, 2010d).

- **Environmental Reserve Guidelines**

These guidelines were developed for determining an appropriate buffer zone for wetlands and other water bodies with respect to lands to be dedicated as Environmental Reserve (ER). They are based on several sources of information including a literature review and guidelines from other jurisdictions (City of Edmonton, 2009a).

- **Terms of Reference**

The Terms of Reference provides the background, objectives and purpose of the various conservation tools used in Edmonton.

- **Area Structure Plans (ASPs) and Neighbourhood Structure Plans (NSPs)**

The ASP provides an intermediate link between the City of Edmonton's Municipal Development Plan (MDP) and Neighbourhood Structure Plans. Area Structure Plans provide guidelines on the way MDP policies are to be understood and set out fundamental environmental requirements to ensure an efficient development of a plan area. These requirements include the establishment of essential services and facilities, land uses, transportation systems, population size/densities, and the sequence of development. With a combination of MDP policies and guidelines for a large planning area, ASPs are able to provide a broad framework of policy for future NSP development. Sizes of ASPs can range anywhere from 200 ha (500 ac.) to 2000 ha (5000 ac.) (City of Edmonton, 2010a).

The NSP provides a framework for the future development of lands identified within an ASP. It provides a link between the ASP and future plans of subdivision by policy and objective implementation defined by the presiding ASP. Residential NSPs form an area within an ASP with a population of usually around 4,000 to 7,000 and support a variety of housing, services and amenities and are deemed a planning unit by either natural or man-made boundaries. The NSP offers clear recommendations and environmental requirements to ensure the sustainable development of a plan area with regard to the provision of essential services and land uses, transportation systems, population sizes/densities, and the sequence of development. Sizes of NSPs can range anywhere from 60ha (148 ac.) to 400 ha (988ac.) (City of Edmonton, 2014b).

4. Management Tools

- **Urban Forest Management Plan**

Edmonton's Urban Forest Management Plan (UFMP) is a 10-year strategy for sustainably managing and enhancing its diverse urban forest so that it will continue to serve this community for generations to come. The plan provides strategic direction for Edmonton's entire urban forest. This includes all trees within city limits – whether planted, naturally occurring or accidentally seeded. Trees found in parks, natural areas, the river valley, ravines, roadways,

roof top gardens, commercial, residential and private lands are all part of the urban forest, and within the scope of this plan. This Urban Forest Management Plan was developed collaboratively, with input from affected stakeholders and the public through focus group meetings and an online questionnaire, as well as informal consultations. The Plan is guided by three objectives (City of Edmonton, 2012):

- Effective management, monitoring, sustainment and ensuring the health and growth of Edmonton's urban forest.
- The general public, city agencies, communities and internal/external partners are informed of how important the urban forest is, the benefits it provides, forestry issues and best management practices.
- Protect native forest and tree stands in collaboration with the Office of Biodiversity

These objectives are hoped to be achieved through a variety of strategies, which can all can be found in the Urban Forest Management Plan located in this report's references.

- **Natural Area Management Plans**

  For every natural area the City obtains, they create a Natural Area Management Plan. This purpose of this plan is to set priorities for management of the area, as well as specific tasks to be performed by City staff, developers and volunteers (City of Edmonton, 2010b).

- **Master Naturalist Program**

  The City offers a "learn and serve" program for citizens who would like to learn more about ecology along with becoming involved in the stewardship of Edmonton's natural areas. Master Naturalists must attend 35 hours of training and field trips, along with undertaking 35 hours of volunteering in activities that support natural areas management, protection, and education. This program is an excellent use of the citizen science tool to build community capacity, knowledge and enthusiasm for ongoing conservation of local natural areas. Master Naturalists have 14 months to complete their volunteer service (City of Edmonton, 2014). A brochure that provides more details on t he program can be found in Appendix 2.

Saskatoon's Regulation/Policies, Programs and Plans

Saskatoon has conveyed the importance of the preservation of the natural environment through its Strategic Plan (2013). In this plan, under Environmental Leadership, there is a strategic goal dedicated to "improving access to ecological systems, both natural and naturalized". Although there is no policy dedicated solely to conserving biodiversity in Saskatoon there are a few policies, programs and plans from both the municipal government and the Meewasin Valley Authority that include aspects within that have potential for biodiversity conservation and enhancement through such measures as habitat protection and creation; allocation of green space; conservation of important habitats such as wetlands and the inclusion of green space in developments. Policies, programs and plans that include aspects with the potential for conserving biodiversity unfortunately only appear to be under the management of a few divisions: Planning, Utility Services, Parks & Development and Meewasin. Below is a list of the different current policies, programs and plans in Saskatoon (see Table 1).

Table 1: A list of current policies, programs and plans in Saskatoon that have potential to conserve biodiversity

Name	Type	Purpose	Division
Trees on City Property	Policy	Conservation of Urban Forest	Public Works
Wetland Policy	Policy	Wetlands Conservation & Management	Planning & Development
Park Development Guidelines	Policy	Natural Habitat Conservation & Creation; Environmental Reserves	Planning & Development
Environmental Policy (City of Saskatoon, 2006)	Policy	Maintaining Capacity of Environment for Species	Environmental & Corporate Initiatives
2012 Parks Standards – Naturalized Areas	Program	Natural Area Management; Establishment of Native Habitat; Exotic Species Management & Removal; Native Species Management	Parks & Recreation

Name	Type	Purpose	Division
Development Review	Policy	Ensure Development Takes Account of Natural Heritage and Resources	Meewasin
River Edge Industrial Location	Policy	Natural Area Protection	Meewasin
Meewasin Valley Authority Act	Regulation	Conservation of Natural Habitat	Meewasin
Community Gardens on Park Land	Program	Promotion of Plants to Attract Pollinators; Creation of Habitat for Insects	Community Development
Official Community Plan	Plan	Riverbank, Wetlands, Conservation, Allocation of land for green space	Planning & Development

Saskatoon's Naturalized Parks Program

Intended both to preserve significant natural elements outside of the jurisdiction of the Meewasin Valley Authority and serve both local and city wide needs.
Serves passive users allowing for jogging, walking and cycling along with nature appreciation, interpretation, and education (Figure 5).

- Serve to enhance the urban biodiversity as well as help preserve the natural heritage of Saskatoon through the extensive use of native plant material and land management strategies.
- New Canadians locating to Saskatoon will most likely be introduced to the area's natural heritage through visiting these parks.

Figure 6: Naturalized and recreational space existing together in Donna Birkmaer Park – Photo Credit: Kelly Richardson

Ways of Measuring Biodiversity

Currently there is only one way to officially measure urban biodiversity. The City Biodiversity Index (CBI), also known as the Singapore Index, is a self-assessment tool that is valuable for monitoring and evaluating biodiversity in cities and is the only biodiversity index specifically designed for urban areas. It was developed and is currently managed by experts from around the world who specialise in biodiversity and ecosystem services in an urban context (Convention on Biological Diversity, 2009).

The overall aim of the CBI is to

(a) Serve as a self-assessment tool
(b) Assist national governments and local authorities in benchmarking biodiversity conservation efforts in the urban context at the city level
(c) Help evaluate progress in reducing the rate of biodiversity loss in urban ecosystems
(d) Help measure the ecological footprint of cities
(e) Serve as a platform through which cities can share solutions for biodiversity conservation
(Convention on Biological Diversity, 2010):

Features

The Singapore Index has a total of 25 indicators that look at three main components: native biodiversity, ecosystem services, and governance and management of biodiversity.

Native biodiversity consists of 11 indicators including natural and semi-natural areas, the diversity of ecosystems, fragmentation and five different native species, among others. Plants, birds and butterflies are set categories among the five different native species, leaving individual cities to identify another two native species most applicable to them (Chan et al, 2010).

Ecosystem Services has a total of five indicators: freshwater services, carbon storage, recreation and education services, area of parks and activities against population, and number of educational visits to parks or nature reserves per year (Chan et al, 2010).

Governance and Management refers to the policies and plans made with regards to biodiversity. There are a total of 9 indicators under governance including outreach programmes, budget set aside for biodiversity projects, education and collaboration with companies and charities (Chan et al, 2010).

The index is intended as a positive indication of the biodiversity conservation efforts of cities and aims to highlight areas in which these efforts can be improved. Cities are not ranked based on the results of the index. These indicators can be a useful tool in painting a picture of a city's current state of biodiversity and also to measure improvements or to highlight gaps as strategies are implemented.

Neither Edmonton nor Saskatoon has adopted the Singapore Index but each city uses certain indicators to measure elements of biodiversity. Edmonton uses quantitative spatial metrics such as "percent area protected" to assess progress and guide its efforts. Edmonton's goal is to secure and protect 10% of the city as natural areas and double the urban forest canopy in the next 10 years (City of Edmonton, 2009a). Edmonton also maps land lost annually and compares it with its securement rate. By comparing the two measurements Edmonton is able to project where the end state is. Edmonton views quantifiable conservation goals for biodiversity as both useful to gain support from sources at the local, provincial and federal levels and for conveying progress to internal and external stakeholders and hopes to create more metrics to measure biodiversity in the future. Currently, Saskatoon has quantitative indicators included in their *2014 Our Environment Report* that measure certain aspects of biodiversity in the city. These indicators include: Wildlife Habitat in the Meewasin Valley; Protected Land; Species Inventories in the Northeast Swale and Natural Grasslands; Trees Planted; and a Public Tree Inventory (City of Saskatoon, 2014). Meewasin and a variety of students from University of Saskatchewan are currently developing a more comprehensive inventory that will be included in future reports.

Brighton's Low Impact Development Techniques (Grant & Parks, 2014)

- Reducing road widths (enables additional green space and trees)
- Reducing building footprints by allowing taller buildings to achieve desired floor space (preserves more natural vegetation)
- Reducing the amount of space dedicated to parking (reduces impervious area)
- Limiting the amount of surface parking and replacing it with underground parking (allows more preservation of natural area and parkades can have green roofs)
- Building compact communities (preserves natural areas)
- Preserving significant natural features
- Potential for biodiversity conservation if native species and natural heritage designs are used whenever possible.

Current Developments in Saskatoon

Brighton

Brighton is a proposed residential neighbourhood, comprising of 826 acres. It is the first to be developed in the Holmwood Suburban Development Area and has been designed to be pedestrian friendly with amenities, transit and open recreational open space located nearby residences. Brighton's elements will include constructed wetlands, a linear park system and a variety of housing, including one-unit and semi-detached dwellings, low-density townhouses, medium density multiple-unit dwellings, and mixed use development combining residential with retail, office, and service uses. When completed, the neighbourhood will house approximately 15,259 residents (Gutman, 2014a).

There are two opportunities within Brighton to conserve biodiversity: The constructed wetlands and through Low Impact Development techniques. The constructed wetlands will offer the community the opportunity to conserve vital ecosystems. The primary use of these wetlands will be passive in nature and will help Brighton achieve one of

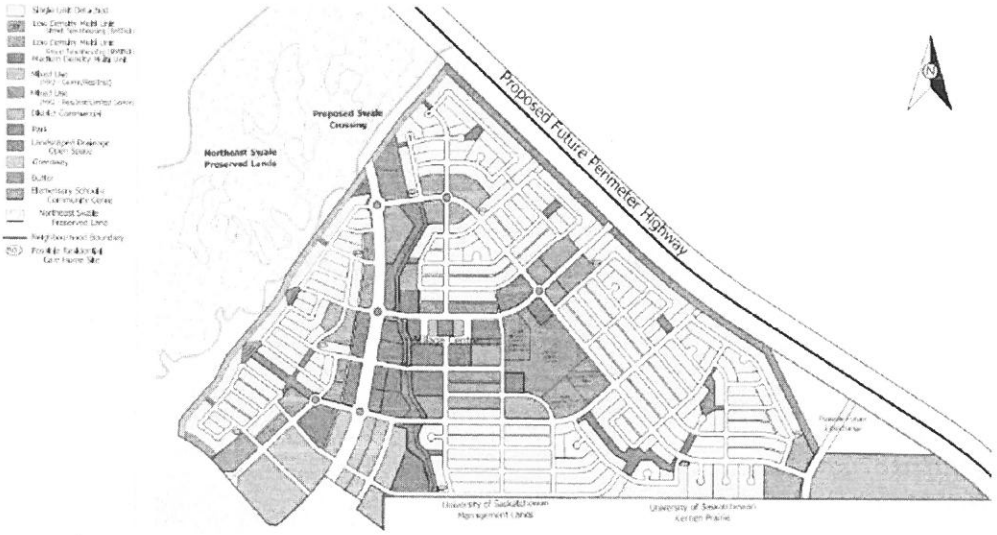
its important development goals: "to bring people closer to nature and engage the public in the various functions that wetlands can provide". The constructed wetlands will also include a dry land/non-irrigated grass area. The establishment of these areas is being implemented more and more by the City of Saskatoon. The dry land grass areas and naturalised tree and shrub planting would complement the natural or

naturalised pond and wetland areas, ecologically by increasing biodiversity (Grant & Parks, 2014). Brighton's plan includes 10% of its land space to be dedicated to green space as a Municipal Reserve; according to the plan the purpose of the proposed parkland is to provide healthier lifestyles through increased safe recreation opportunities (Grant & Parks, 2014). When combined with the constructed wetlands it also provides educational and interpretive opportunities for patrons. While these parks do increase the amount of green space in the city along with providing an increase in the urban forest and public education on native ecosystems the main focal point is on recreation and environmental preservation is not mentioned; if native species are not used there is high potential to have a negative impact on biodiversity through the possible introduction of invasive/alien species.

Aspen Ridge

Aspen Ridge is the next neighbourhood to be developed in the University Heights Area. The neighbourhood is located on 638.71 acres in Saskatoon's northeast and has been designed to be an attractive pedestrian friendly neighbourhood with a variety of housing styles with easy access to schools, services, recreation, and transit. When Aspen Ridge was designed, consideration was given to the neighbourhood's integration with the North East Swale (see Figure 6) (Guttman, 2014b).

Figure 7: Aspen Ridge Land Use Plan – Photo Credit: Saskatoon Land, 2014



The Northeast Swale

The Northeast Swale is the result of an ancient river path from a glacial period ten to fifteen thousand years ago. This glacial activity brought a broad sheet of melt water to the north, and is now the largest fragment of native prairie in Saskatoon's city limits. The swale sits lower than the surrounding prairie elevation and serves as part of an important drainage system. This area also acts as a wildlife corridor and habitat for many species of mammals and birds (UMA Group, 1985).

The Greenway

The Greenway is a transitional zone between the development bordering the Swale and the Swale itself, meant to help ensure neighbouring development is able to preserve the Swale. The main purpose of this feature is protecting the Swale and accommodating drainage. Both the Ecological Buffer Zone and the Transition Zone of the Greenway will be seeded with species native to the Swale (Saskatoon Land, 2014). Information about the Greenway, the Swale, and the native species existing in both, will be provided to all those who purchase lots that back onto the Swale. This will include information on the Swale's value, the Greenway's function, and its relation to adjacent development. It will also identify the differences between a naturalized area like the Greenway and standard linear and pocket parks that will exist throughout Aspen Ridge (Saskatoon Land, 2014). This will provide residents with the information they need to understand the neighbourhood's natural heritage and possible tools to make informed decisions about conservation.

Park System

According to Aspen Ridge's concept plan, the design of park space is consistent with passive and active use. The Ownership Group recognizes the City's advocacy for the development of naturalized parks and the associated management plans and sees the need for environmentally green spaces as avenues to conserve biodiversity and contribute towards Saskatoon's natural heritage. If the City of Saskatoon proposes naturalized spaces in Aspen Ridge the development group has expressed in its concept plan that it is open towards including them (Saskatoon Land, 2014)

Both Aspen Ridge and Brighton are examples of a neighbourhood that is built with sustainability in mind and has the potential to be a shining example of an area that can promote biodiversity. However, the lack of policy and planning tools that conserve biodiversity in the City of Saskatoon prevents a lot of opportunity and it is then left up to the developer to make the decision as to when to promote biodiversity conservation.

Discussion

Although there is a concrete definition for biodiversity, which is "the diversity of life", it is still difficult for one to understand the immensity that encompasses biodiversity. It consists of every living organism on our planet, from the tiniest cell all the way up to the magnificent biome that is the prairie grasslands we currently live on. There is much to be observed and conserved and this diversity provides many important benefits to through the form of ecosystem services. These ecosystem services are of vital importance to cities as they provide sustenance, protection, regulation and enjoyment for both its citizens and the other species inhabiting the area.

Edmonton is one of the leading cities in Canada when it comes to urban biodiversity conservation. From 2006 to 2007 Edmonton followed a conservation plan process that consisted of a SCIENCE + VALUES = PLAN formula. To further expand on this formula, the Scientific data gathered during the State of Natural Areas Report combined with the Values derived from the public consultation process came together to form the Integrated Conservation Plan and the Biodiversity Action Plan was the Implementation of the Conservation Plan. Despite Edmonton's success story, the timing of this research report did not allow to see the monitoring and evaluation results of the Biodiversity Action Plan over ten years and since Edmonton has not yet implemented the Singapore Diversity Index Indicators there are very few ways to measure how successful the conservation plan is at preserving/enhancing biodiversity. Further studies of other cities outside of Canada would provide the opportunity to compare/contrast what is being done in other countries to Canadian cities such as Edmonton.

Overall, Saskatoon has very few policies, programs, and plans that enhance biodiversity conservation. The policies that do exist do not specifically include the word biodiversity, although this could be attributed to the word not being included in any high-level policies or programs. Also, existing policies tend to be limited to only a small portion of overall divisions. This puts the majority of the responsibility for biodiversity conservation on a small fraction of the City government, despite the fact ecological conservation is included in one of the strategic goals. Biodiversity is being included in current developments in Saskatoon, with the word appearing in both Brighton and Aspen Ridge's Concept Plans, along with measures being taken to conserve the Northeast Swale and also potentially build Naturalized Parks in the future if the City requests to do so.

Saskatoon has the unique opportunity to be ahead of the game in comparison to many other cities in Canada if it begins now to take measures to protect and enhance its biodiversity. A healthy amount of biodiversity will provide many benefits to the City and help increase its resilience against such perturbations as climate change through the services that healthy ecosystems are able to provide such as: stormwater management, groundwater conservation and filtering, carbon sequestration, air filtering, urban heat effect cooling, species habitat, and food/water services. Along with the environmental benefits, Saskatoon will see increased social benefits through added and improved green spaces that can be used by its citizens for recreation and education. This will lower health risks both physically and mentally along with providing a greener city that citizens will find more enjoyable to live in. Economically, the services that a healthy ecosystem will provide are far more costly to replace with structures than to conserve and mitigation that biodiversity provides for climate change can result in avoiding costly measures in the long term. A city rich in biodiversity also has the potential to bring in more tourism and improve their national and international reputation. Through something as simple as biodiversity conservation, Saskatoon has the exciting opportunity to become a shining example of sustainability in Canada.

Recommendations

9. **Incorporate Biodiversity into Saskatoon's Policies/Plans**
   Currently the term 'biodiversity' does not exist in any policies or plans in Saskatoon. Although there are aspects of different policies and plans that include measures to protect and potentially enhance the natural environment, the word biodiversity does not appear. Include a clear and consistent definition of biodiversity in all policies and plans such as the one in this report.

10. **Adopt a Specific Policy on Biodiversity/Natural Areas**
    A policy dedicated solely to the conservation of natural areas with responsibility distributed across multiple departments. Departments will identify areas of responsibility in which biodiversity can be measured, how to measure biodiversity and means of reporting progress toward enhancing biodiversity annually to City Council.

11. **Join the Local Action for Biodiversity**
    Joining the Local Action for Biodiversity would open the door to a valuable array of resources and the opportunity to join a growing network of cities committed to biodiversity conservation. Along with this, the Local Action for Biodiversity provides its members with the tools to create and implement a biodiversity action plan.

12. **Develop a Conservation Plan**
    Saskatoon is at a critical time in its growth evolution to develop a conservation plan. With scientific research and public involvement through consultation, conservation goals can be created that align both city and community values. The Conservation Plan will include policies to guide action, monitoring and plan evaluation.

13. **Create biodiversity education campaign(s) for city departments and the public**
    Biodiversity is not a common term within city literature. The concept has not been openly, or evenly, shared with the general public. An education campaign would allow for the opportunity to introduce city departments and the public to the concept of biodiversity. Similar campaigns have occurred with success for water conservation and, emergency preparedness.

14. Create a Biodiversity Conservation Checklist

A biodiversity conservation checklist provides the opportunity for developments to be more sustainable. The purpose of the biodiversity checklist is to identify and record the presence of protected habitats and species within, or in close proximity to, a development application site. This information will contribute to more timely and informed decision-making by Council as well as assist in developing a citywide database on biodiversity.

15. Create an Office of Biodiversity

A multi-disciplinary team that is dedicated to coordinating biodiversity protection would provide a great opportunity to ensure all departments are working together to protect, restore, and manage Saskatoon's natural areas along with providing the community opportunities to become stewards of the natural environment.

16. Secure resources

Secure human, financial, and any other resources required to implement the above recommendations. This includes creating a position(s) to develop and coordinate the first steps towards biodiversity conservation in Saskatoon.

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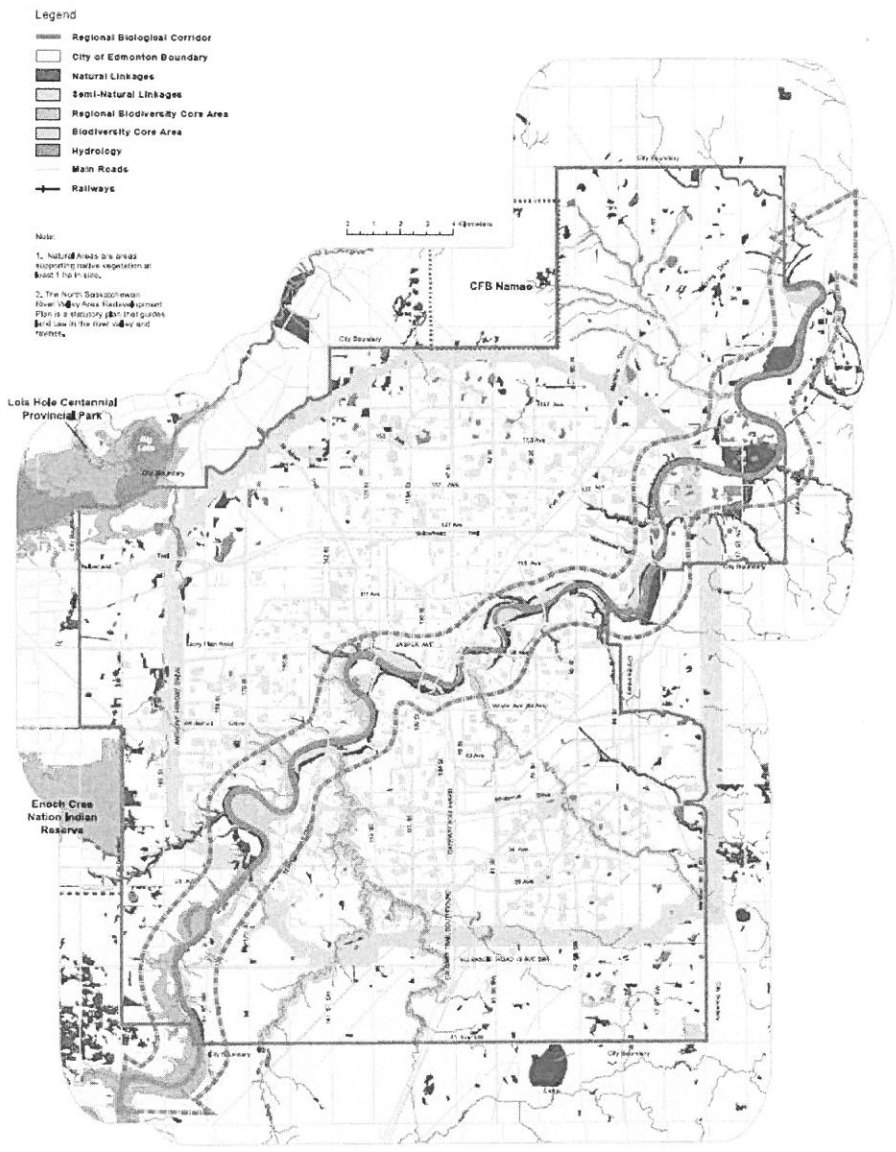
Appendices

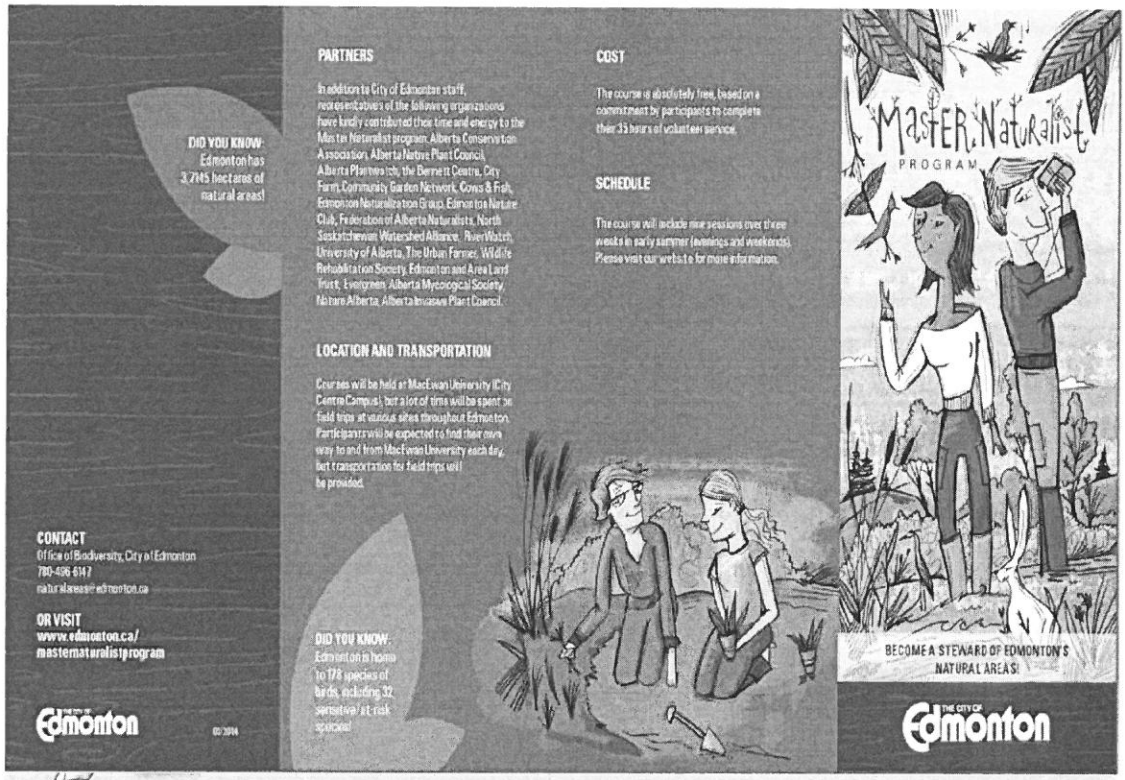
Appendix 1: Edmonton's Ecological Network

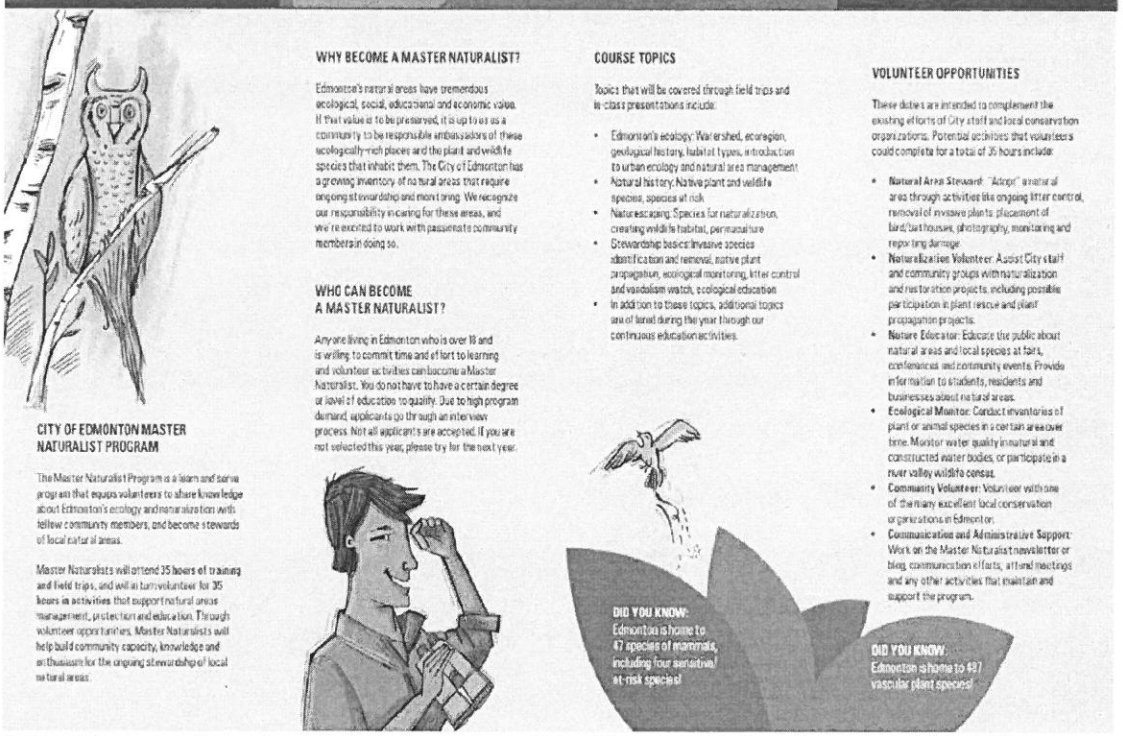
Edmonton's Ecological Network



(http://www.edmonton.ca/city_government/documents/Ecological_Network_Map.pdf)

Appendix 2: Brochure for Edmonton's Master Naturalist Program





(http://www.edmonton.ca/programs_services/documents/mn_brochure2014_V7_(1).pdf)

Appendix 3: Example of Biodiversity Checklist from the United Kingdom

Biodiversity Checklist for Full Applications

Planning ref: (for office use)

Site address:

There are numerous legally protected sites of nature conservation interest across Hampshire. Hampshire also supports a wide range of legally protected species and non-statutory important sites. Developments can adversely affect these and in many cases Local Planning Authorities (LPAs) are **legally required** to address potential impacts to these. LPAs are required by the Government to consider the conservation of biodiversity when determining a planning application. Government planning policies for biodiversity are set out in the National Planning Policy Framework (NPPF), while the Local Authority's local plan / core strategy will set out how they address these requirements in local policy terms. In order to meet these requirements, LPAs need to be able to understand what the potential impacts of the development might be and if there are impacts on biodiversity, how these will be avoided or mitigated.

This Checklist has been designed to help you work out if your proposal is likely to affect biodiversity, and if so, help you understand what additional information you will need to provide to support your application and how to get that information.

Guidance for applicants

If your answers to the questions in **Sections 1, 2** and / or **3** identify that your project may potentially have an adverse impact on designated sites, priority or other notable habitats or legally protected or notable species you will need to submit a Biodiversity Statement or other suitable report which demonstrates the following:

- Information about the sites, species, habitats or features that could be affected (such as location, size, abundance, importance)
- Likely impacts of your development on habitats, sites or species identified in this Checklist
- How alternative designs and locations have been considered
- How adverse impacts will be avoided
- How any unavoidable impacts will be mitigated or reduced (*see note 4*)
- How impacts that cannot be avoided or mitigated will be compensated (*see note 4*)

- Any proposals for enhancements of biodiversity

Where more targeted and specific reports are necessary (for example bat surveys), these must:

- Be undertaken by an appropriately qualified and experienced person
- Be of appropriate scope and detail (i.e. be carried out to established standards)
- Be conducted at an appropriate time of year, in suitable weather conditions and using recognised methodologies.

Reports may not be required where applicants are able to provide pre-application correspondence from Natural England, the Local Authority or their ecological adviser that confirms that they are satisfied that the proposal will not have an adverse impact on any features identified in Sections 1, 2 or 3.

The application may not be validated if any of the information submitted proves to be inadequate. If validated and the information is subsequently found not to fully address any potential impacts then further information may be required during the course of any planning application, for instance if any of the information you have provided needs clarification, or if other potential impacts are identified. If sufficient information on ecological issues is not provided by the time the application needs to be determined, the application may be refused.

It is strongly advised that you consider biodiversity at the **earliest** possible stage in your project as there are seasonal constraints to much of the survey work that may be needed to support your application.

For further advice on competent ecologists that can undertake specialist survey work, please see the Chartered Institute of Ecological and Environmental Management http://www.cieem.net in the first instance.

SECTION 1 – Legally protected sites for nature conservation

PROPOSAL DETAILS Please answer ALL questions **Yes** or **No** by marking the appropriate box against each question	**YES**	**NO**	If you have answered **'YES'** to any of these, is it likely that the development would have an impact on the identified site? (*see note 2*) Please explain why / why not, or state if further information is provided
1.1 Is the application for any of the following: • >0.5ha in area			

	• >10 units/dwellings • power station • sewage treatment works • fish farm • industrial/agricultural development next to or discharging pollutants into a water course • a new road scheme AND within 2km of a **SAC**, **SPA** or **Ramsar** site? (*see note 1*)			
1.2	Is the application for any of the following: • power station • sewage treatment works • fish farm • industrial/agricultural development next to or discharging pollutants into a water course • a new road or rail scheme • any new housing units • any new industrial units • other infrastructure and services • industrial estate • service station • golf course • leisure centre/stadium • car park • industrial or agricultural unit with large powder or liquid discharges AND within 500m of a **SSSI**? (*see note 1*)			

Continued

SECTION 2 – Habitats

PROPOSAL DETAILS Please answer ALL questions **Yes** or **No** by marking the appropriate box against each question ***NB:*** *If Yes, there may be a* ***SINC****,* ***Priority Habitat**** *or other important feature within or adjacent to the application site – please see note 3 for further information on identifying these.*	**YES**	**NO**	Is it likely that the development would have an impact (*see note 2*) on this? Please explain why / why not, or state if further information is provided
2.1 Are any of the following present on or within 100m of the application site?			
a) *Broad-leaved woodland*			
b) *Veteran (particularly old / large) trees*			
c) *Water courses (rivers or streams)*			
d) *Lakes or ponds*			
e) *Wetlands or marshes*			
f) *Flower-rich meadow / grassland*			
g) *Water meadow*			
h) *Heathland*			
i) *Mature hedgerow*			

* SINC – Site of Importance for Nature Conservation. These are not legally protected, but are identified in planning policy as being of importance for biodiversity and are considered during the planning process – see http://www3.hants.gov.uk/biodiversity/hampshire/sincs.htm

** Priority Habitat – natural or semi-natural habitats that have been identified as being at risk (in that they are rare or in decline) or that are important for certain key species of plant or animal -

http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/prioritylist.aspx

SECTION 3 – Legally Protected Species

PROPOSAL DETAILS Please answer ALL questions **Yes** or **No** by marking the appropriate box against each question	**YES**	**NO**	If you have ticked **'YES'** to any of these, you will need to consider potential impacts to the following:	**Survey attached?**
3.1 Will the proposal affect any of the following features / structures? (*see note 2*)				
a) *buildings with hanging tiles (see note 5), timber cladding or weatherboarding where the building is within 200m of woodland or water*			▪ Bats and bat roosts	
b) *pre-1960 buildings or structures within 200m of woodland and/or water*				
c) *pre-1914 buildings or structures within 400m of woodland and/or water*				
d) *pre-1914 buildings with gable ends, peg tile / traditional clay tile roofs or slate roofs, hanging tiles or weatherboarding regardless of location*				
e) *underground structures (e.g cellars, caves or mines)*				
f) *bridges or similar structures*				
g) *structures where there is known current or historic bat use*				

PROPOSAL DETAILS Please answer ALL questions **Yes** or **No** by marking the appropriate box against each question	**YES**	**NO**	If you have ticked **'YES'** to any of these, you will need to consider potential impacts to the following:	**Survey attached?**
3.2 agricultural buildings particularly of traditional brick, timber or stone construction and/or with exposed timber beams greater than 20cm thick			▪ Bats and bat roosts ▪ Barn owl ▪ Nesting birds	
3.3 other large agricultural buildings			▪ Barn owls	
3.4 Will the proposal affect trees with any of the following features? (*see note 2*)				
a) *old and veteran trees*			▪ Bats and bat roosts ▪ Nesting birds	
b) *trees with obvious holes, cracks, cavities or heavy vegetation*				
c) *trees with a circumference greater than 1m at chest height*				

Continued→

Section 3 continued

PROPOSAL DETAILS Please answer ALL questions **Yes** or **No** by marking the appropriate box against each question	**YES**	**NO**	If you have ticked **'YES'** to any of these, you will need to consider potential impacts to the following:	Survey attached?
3.5 Are there streams, rivers or lakes on or within 25m of the application site that would be affected (including their banks and adjacent habitat) by the development?			▪ Bat foraging habitat ▪ Otters ▪ Water vole ▪ White-clawed crayfish	
3.6 Will the proposals affect (see *note 2*) any of the following features?				
a) *deciduous (i.e. not mainly conifer) woodland?*			▪ Bat foraging habitat (see note 1a) ▪ Dormice ▪ Breeding birds ▪ Badger	
b) *field hedgerows over 1m tall and over 0.5m thick?*				
c) *areas of scrub well-connected to woodland or hedgerows?*				
3.7 Is the proposal either: - a major application (>0.5ha, >10 dwellings or >1000m² floor space for non-residential) within 500m of a pond, - or any other application within 200m of a pond where water in the pond(s) at its highest level (excluding flood events), is 225m² (c.15m x 15m)?			▪ Amphibians (particularly with respect to great crested newts)	
3.8 Will the proposal affect mature/overgrown gardens over 0.25ha, or any rough			▪ Reptiles ▪ Breeding	

	grassland, derelict/brownfield land, railway land or allotments? (*see note 2*).			birds	
3.9	Will the proposal affect flower-rich meadows or grassland on or directly adjacent to the site? (*see note 2*).			▪ Breeding birds	

Notes

- ***Note 1***

You can find out if your application site is on or near any of these sites from www.natureonthemap.org.uk, www.magic.gov.uk or the LPA's Local Plan Proposals Map.

SSSI = Site of Special Scientific Interest (designated and protected under UK law); SAC = Special Area of Conservation; SPA = Special Protection Area (these are designated and protected under EU law and are also SSSIs); Ramsar site = internationally important wetland, designated under the Ramsar Convention – these will also be SPAs / SACs and SSSIs. See http://www.naturalengland.org.uk/ourwork/conservation/designatedareas/default.aspx for more information.

- ***Note 2***

Effects could be DIRECT, such as destruction, removal or modification, or INDIRECT through disturbance such as run-off, noise, dust, lighting or increased recreational use.

- ***Note 3***

Areas of designated Ancient Woodland and some Priority Habitats can be found on www.magic.gov.uk. The LPA's Local Plan Proposals Map may identify the location of any SINCs. Ordnance survey maps may also help.

- ***Note 4***

Avoidance = measures taken to avoid impacts – should be the first considerations; Mitigation = measures which make unavoidable impacts less severe; Compensation = measures which counterbalance remaining impacts, resulting in an overall no net loss of biodiversity. (NB 'Mitigation' as a general term, or a 'mitigation strategy' is often used to cover all these processes).

- ***Note 5 – a note on hanging tiles.***

This checklist, where relating to potential impacts on **bats**, is adapted from the Bat Conservation Trust's guidelines (see http://www.bats.org.uk/pages/guidanceforprofessionals.html) on where bats might reasonably be likely to be found. However bats can be found in other

locations, types or areas of buildings. It is particularly important to note that where a building has **hanging tiles** but is not within 200m of woodland or water, there is still potentially a reasonable likelihood of bats being present and a survey may be required in situations other than those specifically identified in this checklist.

Important: this checklist can not include *all* protected species and *all* circumstances where they may be affected. Legislation relating to protected species applies in all circumstances and it is the responsibility of the developer to ensure that protected species and habitats are not impacted as a result of development. If protected species are found during the course of development, work should be halted and advice sought from Natural England or a qualified ecologist.

For office use:

1	Have **ALL** questions on **ALL** sections been completed?	**Y / N**	If YES, go to 2	If NO, application should not be validated
2	Have any questions been answered 'Yes'?	**Y / N**	If YES, go to 3	If NO, application can be validated
3	Does the applicant identify likely impacts **and** address potential issues in any comments made on the checklist?	**Y / N**	If YES, application can be validated	If NO, go to 4
4	Has a separate statement, report or other supporting information been submitted to address potential impacts?	**Y / N**	If YES, application can be validated	If NO, application should not be validated

If you are unsure about any of these, please call the Hampshire County Council Development and Biodiversity team (part of the Strategic Environmental

City of Saskatoon

Corporate Performance Department

Environmental and Corporate Initiatives

To: Members of Saskatoon Environmental Advisory Committee

Date: August 26, 2015

From: Brenda Wallace, Director
Environmental and Corporate Initiatives

Phone: 306-975-2973

File: 0175-001

Re: 2015 Goals and Objectives – Policies and Reports

I understand that the Committee continues to have an interest in the ongoing development of a number of policy and report matters. With this memo I wish to confirm the list of items the Committee wishes to receive an update on. I currently understand the list to include:

- *Dark Sky Lighting Policy Development* – Updates will continue to be provided by the Planning and Development Division
- *Wetlands Policy Implementation* – A verbal update on the Storm Water Master Plan will be provided by Environmental and Corporate Initiatives in September and additional updates on tools for implementing the Wetlands Policy under a Natural Areas Master Plan will be provided by Planning and Development later this year, including a new Pre-Development Protocol now in force
- *LEED Building Standards* – An update on the development of a Civic Building Sustainability Policy will come forward from Environmental and Corporate Initiatives later this year
- *Water Conservation* – An update will come forward from Environmental and Corporate Initiatives in November
- *Air Quality* – A verbal update can be provided later this year; timing for a formal update awaits release of the results of the Regional Air Quality Study that recently completed the air monitoring phase
- *Contaminated Soils and Sites* – An update on activities under the Soils Handling Strategy is provided with this memo

If there are other items the Committee has a specific interest in (beyond those listed in the 2015 Goals and Objectives for the Committee as previously provided to me), please let me know.

Sincerely,

Brenda Wallace

Brenda Wallace
Enclosure

cc: Catherine Gryba, General Manager, Corporate Performance
Twyla Yobb, Manager, Land and Water Quality Protection

Soil Handling Strategy
Saskatoon Environmental Advisory Committee
September 10, 2015

1.0 Introduction

The Soil Handling Strategy is a corporate-wide framework for the management of excess construction soils, both clean and contaminated, from City directed projects, The strategy also supports the management of other materials from civic operations such as cover for the landfill, street sweepings, water treatment residuals, spill clean-up sand, and material from riverbank slumping.

1.1 Objectives

The Strategy is fundamentally intended to promote compliance with environmental regulation regarding the management of impacted sites and contaminated soil. This is accomplished by providing a suite of tools and services that facilitate compliance and reduce financial impacts by applying the concept of beneficial re-use of soil.

2.0 Background

Capital Project 2052 – *Contaminated Soil Handling Strategy* was established in 2013 based on the City's successful work in 2011 and 2012 with the responsible and cost-effective management of contaminated soil for the Circle Drive South project. The soil and water management plan for this project allowed contaminated soils from other COS brownfields projects to be encapsulated beneath the roadway. This saved the City an estimated $2 million in hauling and tipping fees related to soil disposal.

Extension of this successful soil management approach from a single project to a corporate-wide strategy was driven primarily by the need to develop a consistent approach to compliance with changing environmental regulation.

2.1 Environmental Regulation

Regulation of contaminated soils is a provincial responsibility. The Saskatchewan *Environmental Management and Protection Act, 2010* protects the province's air, land, and water by regulating potential harmful substances and activities.

The *Saskatchewan Environmental Code* (Code), effective June 1, 2015, contains specific regulations pertaining to contaminated soil management (*Division B: Land Management and Protection*).

The Code encourages **risk management** for impacted sites and contaminated soil. Choosing the appropriate action relies on an understanding of the type and amount of contaminant present in the soil. Depending on the nature of an impacted site, a risk management plan and/or a safe work procedure may be all that is required; there may be no need for a costly cleanup.

Compliance with environmental regulation represents a **minimum level of service** that a municipality is legally required to adhere to for the protection of public, worker, and environmental health.

2.2 Other Project Drivers

Contaminated soil is located throughout Saskatoon wherever chemical substances or hazardous materials have spilled or leaked in the past. Historic practices of filling in natural contours along the riverbank have deposited garbage and some contaminants in these areas. In other cases, spills have migrated from private property onto City property.

Recent growth of the City has accelerated redevelopment of previously contaminated sites. Historic practices of depositing contaminated material locally, and without a formal risk management framework, must now be addressed in order to protect public and environmental health.

The COS Landfill is regulated by a *Permit to Operate* that requires processes for acceptance and tracking of contaminated materials. The strategy links the requirements of the *Permit to Operate* and the requirements of the new *Environmental Code*.

Project managers that encounter contaminated soil are situated in different city work groups and have a variety of educational backgrounds. The strategy provides these managers with centralized in-house expertise that supplements and reviews the work of external environmental consultants. This ensures that compliance efforts are coordinated and reasonable at the corporate level.

3.0 Beneficial Reuse

The Soil Handling Strategy is based upon the principle of beneficial re-use. The “dig and dump” approach to soil management considers excess and impacted soil to be waste. The Strategy views soils and other materials to be a valuable resource to be re-used wherever possible instead of discarded as waste. This reduces the need to pay tipping fees for soil disposal. As the city grows and the cost of acquiring clean fill rises, there will be additional cost benefits to re-using impacted soil as much as possible.

4.0 Elements of the Strategy

In order to implement the principle of beneficial re-use, the strategy is used to classify contaminated materials into different streams for re-use or disposal considering:

- The source of the contamination;
- The nature of the contaminated material (chemical composition and concentration);
- Requirements for regulatory compliance;

- Risks at the proposed storage/re-use/disposal site; and
- Risk-management options and costs.

The Soil Handling Strategy consists of a suite of tools and services that act as a framework for regulatory compliance and that also takes advantage of opportunities for beneficial reuse as often as possible. Access to these tools and services are limited to civic projects only.

4.1 Landfill Soil Acceptance Procedures

The first element of the strategy to be developed was procedures for acceptance of soil as either waste or as daily/intermediate cover material at the landfill. Development of procedures and training staff to implement them has allowed diversion of lightly impacted soil from disposal as waste to use as cover material. This has reduced the total volume of soil disposed at the landfill by reducing the need for clean fill from other sources.

A list of other disposal sites in proximity to Saskatoon that accept contaminated materials for disposal was also developed. Conditions and costs of disposal are included and updated periodically.

4.2 Advisory and Review Services

In the past, Environmental & Corporate Initiatives (formerly Environmental Services) employed a Soil Engineer who was seconded to a limited number of larger city projects to directly manage environmental consultants and to ensure that regulatory compliance was achieved. The salary for the Soil Engineer was recovered through cross charges to these capital projects.

Under the Strategy, this practice was altered to provide advisory and review services to all workgroups involved with soil in the corporation; these activities range from major construction works to park irrigation and utility infrastructure repairs. This important refocussing made expertise and support accessible to as many staff as possible, thereby increasing capacity to support regulatory compliance corporate wide. This also gave the Soil Engineer access to more information about soil handling practices across the corporation, providing an opportunity to improve management and compliance activities corporate-wide.

Advisory and review services have been provided in the following areas:

- Management of liability with respect to sale or purchase of land;
- Planning and project delivery for regulatory compliance;
- Options for soil management;
- Regulatory liaison for permits and approvals;
- Review of documents prepared by external consultants, advice on implications;
- Materials management (street sweepings, snow dump sites, spill sand).

The Soil Engineer also administers the city account for the Ministry of Environment web portal. Projects are able make digital submissions to the Ministry via this portal.

4.3 Training and Education

The most effective way to control costs and schedule for contaminated soil management within a project is to align the project management framework with compliance requirements. As such, education of project managers across the corporation is a priority within the Strategy.

Several sessions have been developed to promote an understanding of appropriate contaminated soil management. These sessions are provided annually, or on an as-requested basis:

- Environmental Code: Environmental Site Assessment Process
- Environmental Code: Discharge and Discovery Reporting
- Landfill Operations: Soil Acceptance Criteria and Procedures

4.4 Management Tools

The following management tools have been developed to help city project managers prepare for contaminated site management:

Safe Work Procedures: a process to assist with the safe disturbance and removal of soil and water where contamination is known to exist. These procedures have been developed for the River Valley and for right-of-ways where contamination may have migrated from private to public property. These procedures can be modified for inclusion in the front end of contract documents for specific projects to ensure that bidders are aware of potential risks and expectations for managing risks.

Soil sharing website: an online site where project managers can post information about excess soils generated by a project, whether contaminated or clean, or post a requirement for soil needed by a project. The intent is to facilitate the pairing of soil sources and sinks as quickly as possible and to promote the use of integrated Corrective Action Plans for all projects. The site will also facilitate data collection for corporate-level tracking of clean and contaminated soils, which will benefit future project audits.

Impacted Sites Map: a digital compilation of known sites where activities have taken place in the past that may have impacted soil quality. Information for the map was compiled from the:

- Hazardous Material Storage database on the Sask Spills website;
- Henderson directory from the years between 1955 and 1985;
- Fire Department list of known underground storage tank locations (2002);

- External and internal report submissions that are on file with E&CI.

These sites were cross referenced with the building permits on the corporate mapping site (Geocortex) as of July 2015.

Environmental Protection Plan (EPP): a tool that targets smaller projects and works in conjunction with the impacted sites map. The map identifies potential areas of concern within the city before any ground disturbance takes place, and the EPP outlines compliance-based procedures for mitigating risk when contamination is encountered. The EPP will act as a pre-approved process by the Ministry of Environment; projects dealing with small volumes of soil with typical contaminants will not have to go through a lengthy compliance process.

4.5 Hub Site

Ideally, contaminated or clean soil will be transferred directly from a source site to a re-use or disposal site. This is the least costly approach to soil management and is a best practice that is typically used for all construction projects. However, unexpectedly encountering impacted soils on a construction site can stop or considerably delay a project, especially if there is no appropriate location to stockpile contaminated soil at the project site itself.

A hub site is a temporary storage location for impacted soils until they can be properly characterized and a final re-use or disposal location can be determined. A pilot hub site will be established near the landfill, with capacity to temporarily store small volumes of contaminated material. The site is intended to be a backstop for projects that need to manage contaminated soil, but are unable to do so within the project schedule or physical boundaries.

The site will also serve as a storage location for clean fill to be used as cover for the landfill. Currently, because of the limited space at the landfill, any clean fill delivered to the site is promptly used and spread in order to avoid on-site congestion. This practice means that cover layers can sometimes be thicker than needed. Alternately, when clean fill is less available, cover layers can be thinner than needed. The ability to stockpile clean fill at the hub site will greatly improve the landfill’s ability to use daily cover with consistent thickness.

Executive Summary

Changes in Energy Intensity in Canada

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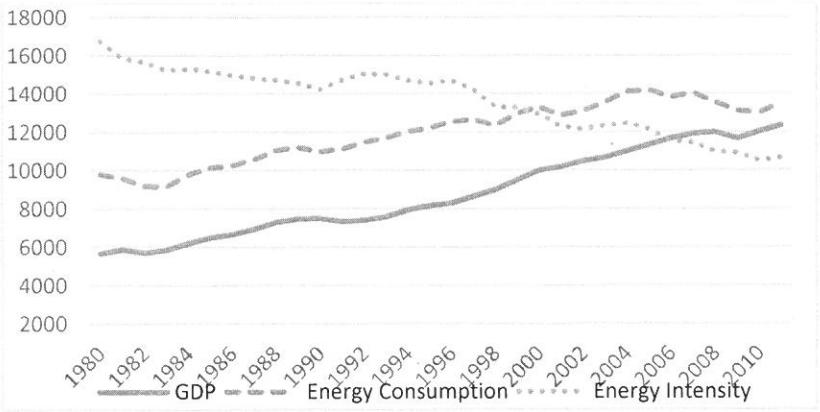
Abstract

Canada is one of the top ranked energy intensive and CO2 emitters among the OECD countries. However, energy intensity has been declining on average by about 1.1 percent since 1980. In this paper, we use the Fisher Ideal Index to determine the contributions of changes in economic activity and efficiency to a decline in energy intensity in Canada at national, provincial, and industry levels. We also apply panel data estimation methods to further investigate the factors driving energy intensity, efficiency and activity indexes for the period 1980-2008. We control for factors such as climate, policy, and energy endowment. The national and provincial decomposition results suggest that most of the reduction in energy intensity have occurred mainly due to improvements in energy efficiency as compared to shifts in economic activities. Within the industry, while manufacturing experienced a significant decline in energy intensity mostly due to an improvement in efficiency, energy intensity has remained stable in transportation, utilities, and construction, and increased significantly in mining. The provincial panel regression results indicate that energy intensity is higher in provinces with higher income, faster population growth, colder climate, and higher capital-labour ratio, and lower in provinces with higher energy prices and higher investment. The industry panel regression results show that investment has contributed to energy efficiency in utilities and mining and to moving away from energy intensive activities in manufacturing and transportation industries. Technological advances have been most effective in increasing energy efficiency in construction and utilities and in moving to less energy intensive activities in manufacturing industries. The results indicate that although efficiency contributes to a reduction in energy intensity in Canada, increasing activities in energy intensive industries, such as oil and mining, partially offsets the efficiency gains in other industries.

Introduction

Canada is one of the top ranked energy users in the world with its total energy use growing on average by 1.1 percent since 1980. The energy intensity, energy consumed per unit of output and measured by the ratio of energy consumption to GDP, in Canada is 1.3 and 2.4 times greater than that in United States and Germany, respectively. Canadian energy intensity has been declining recently, but Canada is still one of the top ranked energy intensive and CO2 emitters among the OECD countries (Figures 1 and 2). As emission control has become one of the key global issues in addressing environmental problems and sustainability of economic growth, and more than 80 percent of Canada's greenhouse gas emissions are generated from energy production and consumption, Canada may need to develop more aggressive policies to curb its energy consumption[1]. Therefore, understanding the factors driving the changes in energy intensity is vital to any policy designs addressing high energy consumption.

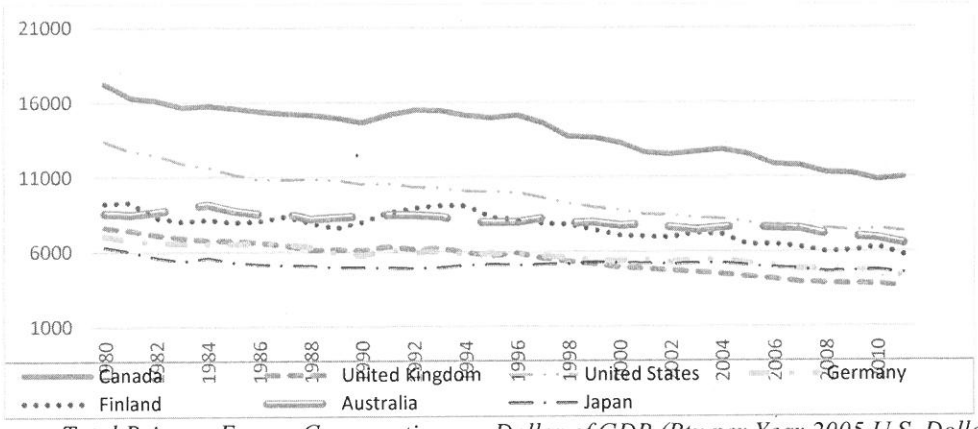
Figure 1: Energy Intensity, Energy consumption. and GDP in Canada (1980-2011)



Energy intensity is Total Primary Energy Consumption per Dollar of GDP (Btu per Year 2005 U.S. Dollars (Purchasing Power Parities)). GDP is Constant 2005 US$ (×100,000,000). Energy is Total Primary Energy Consumption (Trillion BTU). Data Source: EIA and WDI.

[1] Canada signed the Copenhagen Accord, the first international agreement to include all major emitting countries, in 2009, thereby committing to reducing its greenhouse gas emissions 17% below 2005 levels by 2020 (Environment Canada, 2010).

Figure 2: Energy Intensity in Selected OECD Countries (1980-2011)



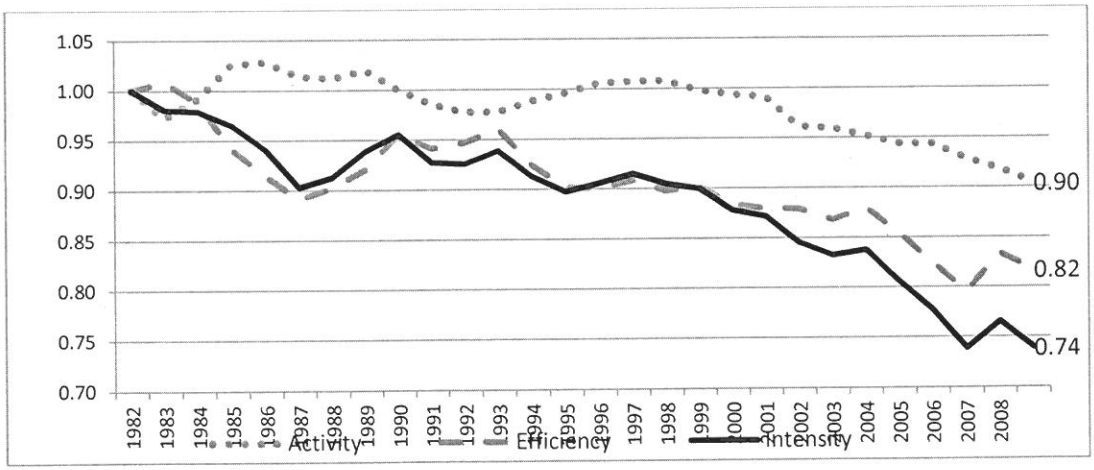
Total Primary Energy Consumption per Dollar of GDP (Btu per Year 2005 U.S. Dollars (Purchasing Power Parities)). Data Source: EIA

It is important to note that a fall in energy intensity does not necessary mean total energy consumption is falling. The ratio of energy per GDP can still fall even if total energy use is rising because the percentage increase in GDP can be greater than the percentage increase in total energy consumption. This has been the case in Canada for the past 30 years as total energy consumption has risen on average by 1.1 percent annually, whereas GDP has been growing at an average of 2.5 percent. Changes in energy intensity also reflect changes in either technology or economic activities. For instance, lower energy intensity in Canada may have been caused by either an improvement in technology or moving away from energy intensive sectors. Decomposition methods can be used to identify technical (efficiency) changes from the changes in economic activities. Furthermore, regression methods can be employed to estimated the effects of socio-economic factors on changes in energy intensity. This paper investigates the underlying factors driving energy intensity changes in Canada at national, provincial, and industry levels using decomposition and regression methods.

Decomposition Analysis

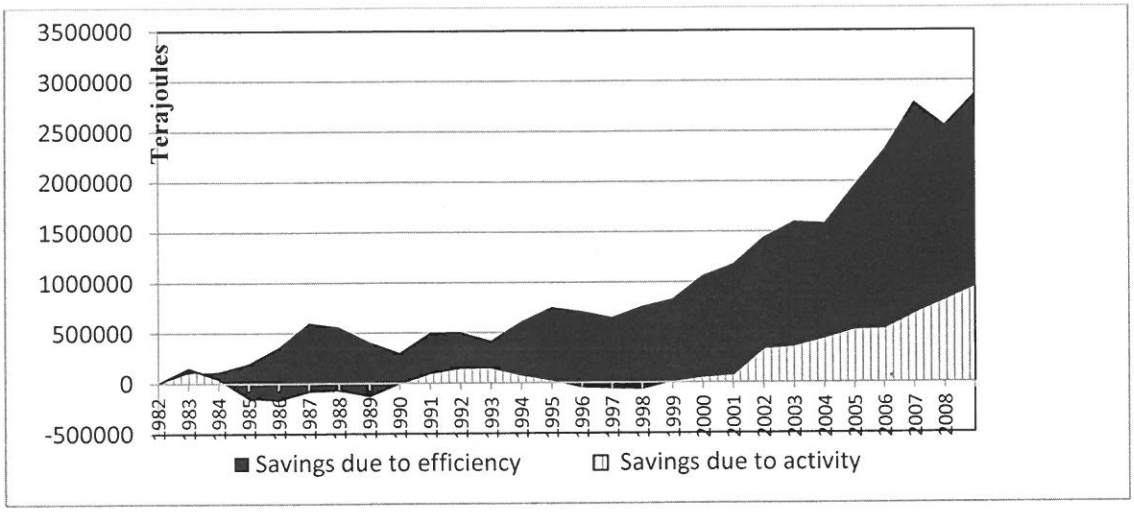
We conduct the decomposition analysis using the Fischer Ideal Index at the two-digit NAICS (North American Industry Classification System) using 17 industry groups for the 1981-2008 period and taking 1981 as the base year. As Figure 3 shows, total energy intensity has declined by 26% between 1981 and 2008, that is, 1.1% annual decline on overage. Moreover, activity index and efficiency index were 90% and 82% of their 1981 levels, respectively. That is, had energy efficiency remained unchanged at its 1981 level for all sectors, energy intensity would have declined by 10%. Likewise, had composition of the economic activity remained constant between 1981 and 2008, energy intensity would have declined by 18%.

Figure 3. Energy Intensity Indexes in Canada (Two-digit Industry Level)



The decline in energy intensity from 1981 to 2008 implies that a total of 27.8 x 10^6 tera joules of energy or 13 percent of total energy use has been saved due to the decline in energy intensity. Improvement in efficiency accounted for 83% of the energy saved while changes in economic activity accounted for 17% (Figure 4).

Figure 4. Energy Savings Due to a Declining Energy Intensity in Canada (1981-2008)



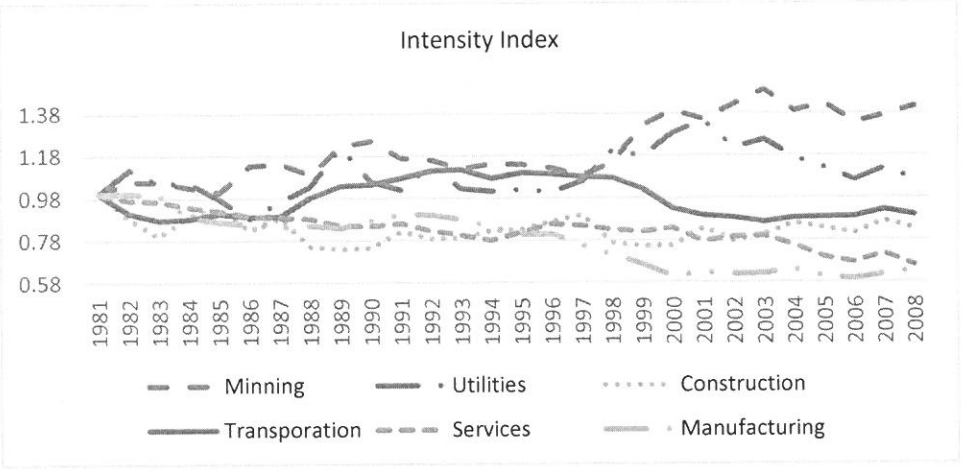
Industry Level Analysis

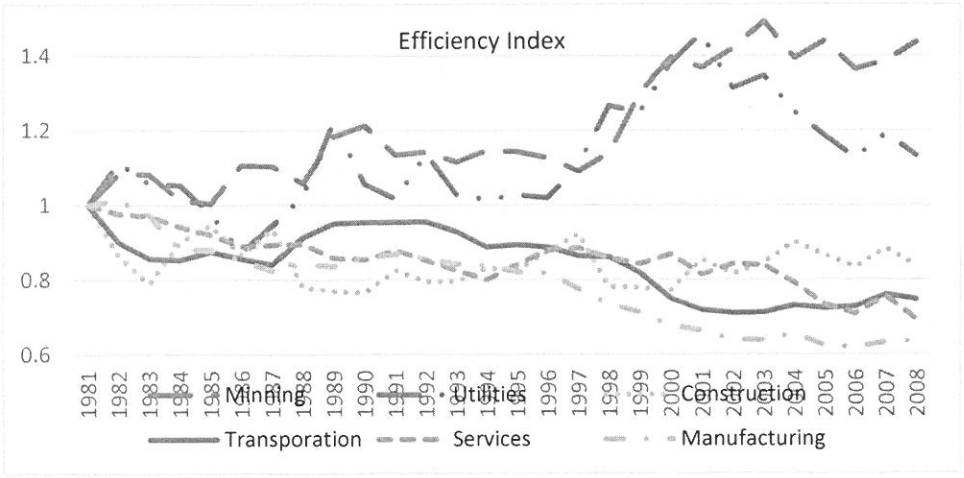
The more detailed analysis at the industry level indicate that energy intensity in the manufacturing industry declined in the 1980s before increasing between 1988 and 1992 (Figure 5). It further declined sharply from 1993-2000 and stabilized after 2000. On average, energy intensity in the manufacturing industries has declined at an annual rate of 2% for the period 1981-2008, and in 2008 is 63% of its level in 1981. Improvement in efficiency has played a dominant role in this downward trend. Specifically, if energy efficiency had not changed in 2008, changes in economic activity would have reduced energy intensity to just 99.8% of its 1981 level. The activity index depicts that economic activity shifted to more energy intensive sectors between 1983 and 1994; however, this drift reversed from 1994 to 2008.

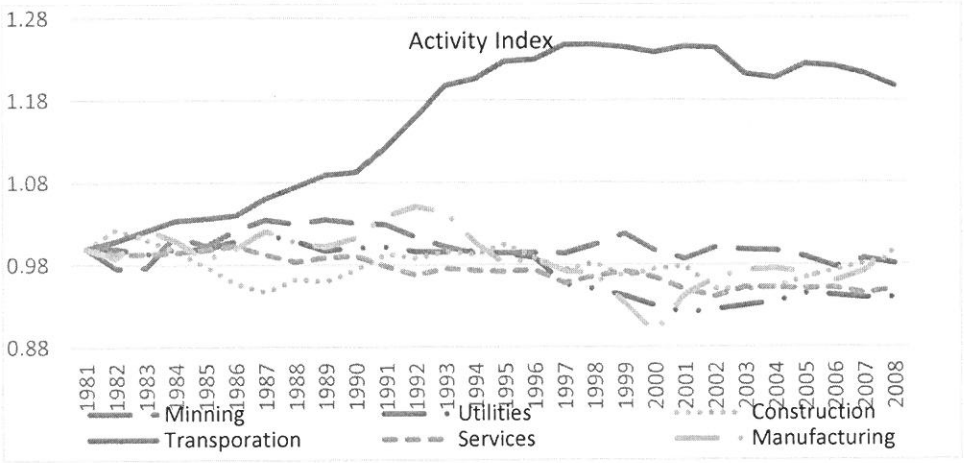
Energy intensity was stable in the transportation industry in the early 1980s, before increasing in the late 1980s and reaching its peak in 1993. Although there has been a steady improvement in efficiency, economic activity has shifted to the energy intensive sectors. Thus, aggregate energy intensity in the industry decreased at a very slow rate.

Mining is the only industry that has a relatively consistent upward trend in energy intensity for most periods. Energy Intensity increased sharply after the late 1990s, reaching its peak in 2003 and stabilizing afterward. Changes in economic activity in the mining industry have been moderately constant mainly because the industry includes only two homogenous energy intensive activities (oil and mining). The upward trend in energy intensity within this industry was driven by the decline in energy efficiency. With efficiency worsening at average annual rate of 1.22%, energy intensity also increased at average annual rate of 1.26%. Energy intensity in the utility industry has been stable until the mid-1990s, after which it started to increase reaching its peak in 2001 when intensity was 134% of its 1981 level. The decline in energy intensity in the 2000s has been mostly due to efficiency improvement, which brought the energy intensity back to its 1981 level in 2008. Energy Intensity in the construction industry declined in the early 1980s and remained rather stable throughout the remaining period. On average, energy intensity in the industry has been declining on annual rate of 0.002%. In 2008, energy intensity was 83% of its 1981 level. Efficiency improvement has been the main source of declining energy intensity in the industry.

Figure 5: Energy Intensity Decomposition results at three-digit Industry level





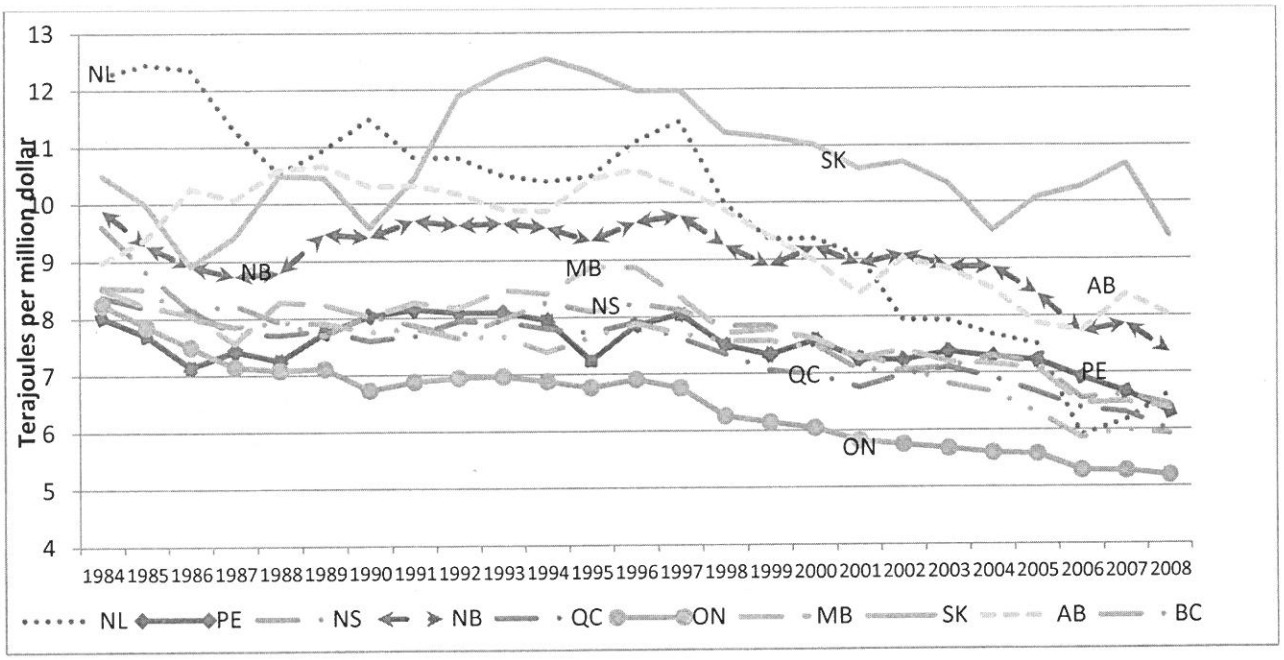


Provincial Level Analysis

The decomposition analysis also carried out at provincial level including seven sectors: (1) Agriculture (2) Mining and Oil and gas extraction (3) Construction (4) Manufacturing (5) Transportation (6) Public administration (7) Other sectors.[2]

[2] Other sectors include Wholesale and Retail Trade, Utilities, Information and Cultural Industries, Education services, Health care and social assistance and any other services not listed. We excluded utility industry from this group, but the results did not alter.

Figure 6: Energy Intensity by Canadian Provinces (1984-2008)



As the results in Figure 6 show, all ten provinces have a downward trend in energy intensity with most of it happening in the late 1990s and 2000s. Newfoundland and Labrador (NL) with an average annual decline rate of 2.3%, experienced the most declines in energy intensity followed by Ontario with average annual decline rate of 1.9%. Saskatchewan and Alberta have the lowest average annual decline rates of 0.3% and 0.4%, respectively. In general, Saskatchewan is the most energy intensive province while Ontario has the lowest energy intensity. The gap between energy intensity in Saskatchewan and Ontario has been widening since the 1984. Energy intensity in Saskatchewan was 27% and 81% higher than Ontario's in 1984 and 2008, respectively.

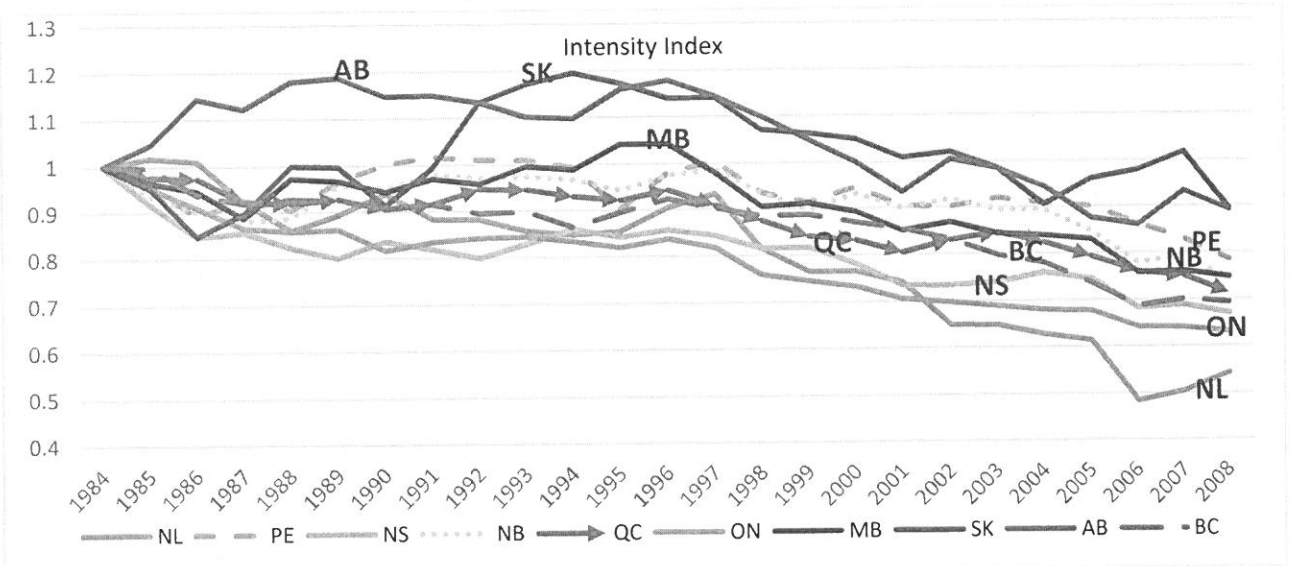
Table 1- Provincial Energy Intensity and Decomposition Results (1984-2008)

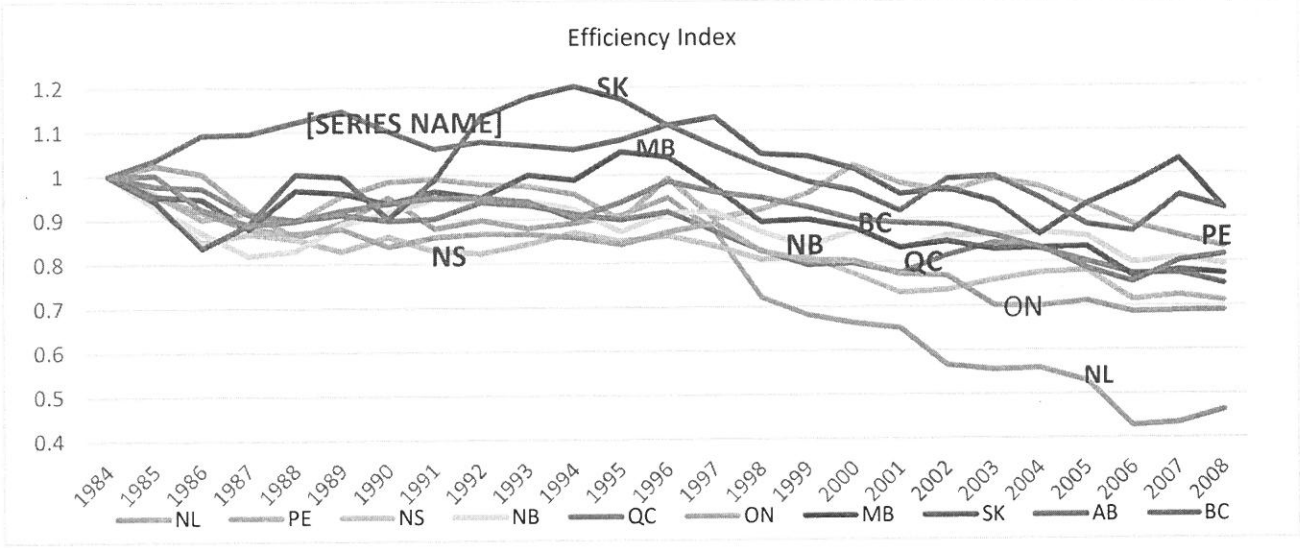
Province	Energy Intensity (1984)	Energy Intensity (2008)	Intensity Index (2008)	Activity Index (2008)	Efficiency Index (2008)
Newfoundland	12.24	6.64	0.54	1.17	0.46
Prince Edward Island	8.02	6.30	0.79	0.94	0.83
Nova Scotia	9.61	6.44	0.67	0.94	0.71
New Brunswick	9.91	7.34	0.74	0.93	0.80
Quebec	8.38	5.98	0.71	0.95	0.75
Ontario	8.24	5.20	0.63	0.92	0.69
Manitoba	8.52	6.37	0.75	0.97	0.77
Saskatchewan	10.50	9.40	0.90	0.97	0.92
Alberta	8.98	8.01	0.89	0.97	0.92
British Columbia	8.54	5.92	0.69	0.85	0.82

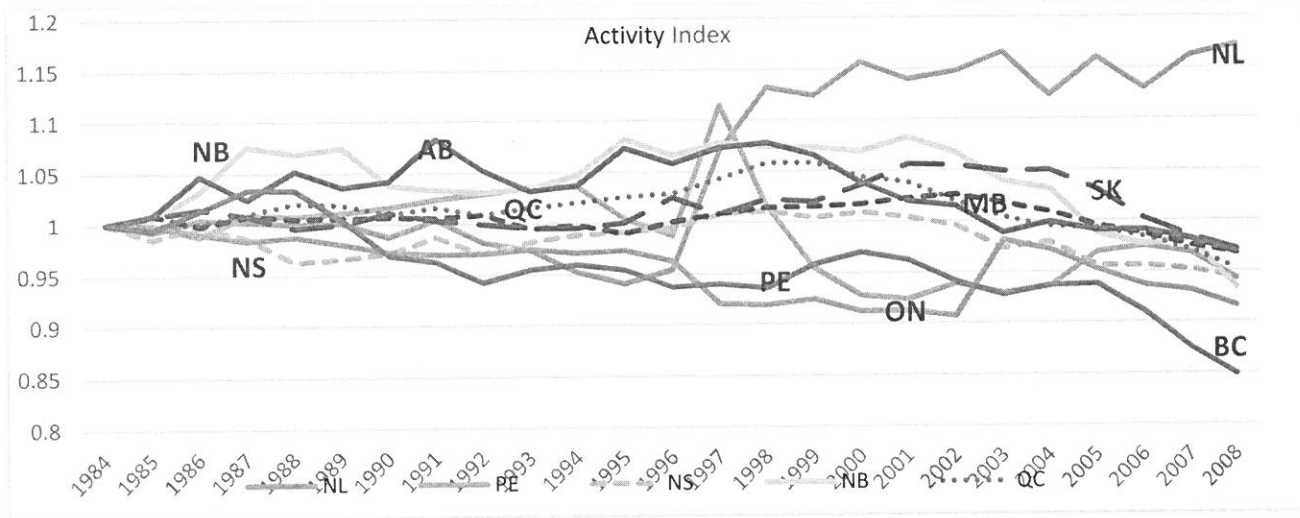
Note: Energy intensity is measured in terajoules per 1,000,000 dollars. Source: CANSIM and authors' calculation. Intensity index is the ratio of energy intensity in 2008 to the energy intensity in 1984.

Table 1 shows the decomposition results for Canadian provinces in 2008. The intensity index generally measures the change in energy intensity over years. Newfoundland and Labrador has the lowest Intensity Index (0.54) followed by Ontario (0.63) and Saskatchewan has the highest intensity index (0.90) followed by Alberta (0.89). The trends for changes in intensity, activity and efficiency indexes are displayed for each province over time in Figure7.

Figure 7: Decomposition Results for Canadian Provinces (1984-2008)







In general, for most provinces, energy intensity was stable in the 1980's, but has been fast declining after the mid 1990's. There are also variations in energy intensity across provinces, with these variations increasing over time. While energy intensity in New Brunswick and Prince Edward Island has generally remained stable, Saskatchewan and Alberta have experienced more increases in energy intensity than other provinces. In Newfoundland and Labrador, Ontario, Quebec, Nova Scotia, British Columbia and Manitoba, energy intensity has been declining for most periods. Both changes in the economic activity and energy efficiency improvement have played a role in reducing energy intensity in provinces, but the impact of the latter has been much stronger than the former. NL is an outlier showing a greater than one

activity index and less than 0.5 efficiency index. High activity index in NL perhaps reflects the structural change from fishing to oil and gas industry in the mid-1990s.

Table 2- Energy Savings Relative to 1984 Intensity (terajoules)

		Energy Saved due to Changes in	
	Energy Saved	Activity	Efficiency
Newfoundland	927299	-212514	1139814
Prince Edward Island	41877	8902	32975
Nova Scotia	1076650	85439	991210
New Brunswick	404991	-149363	554355
Quebec	5402804	-468094	5870898
Ontario	17963398	3262355	14701043
Manitoba	628499	-17497	645996
Saskatchewan	15270	-222325	237595
Alberta	-780827	-715326	-65502
British Columbia	3662433	1161317	2501117

Source: CANSIM and authors' calculation

Table 2 shows the total amount of energy saved throughout the 1985- 2008 period. Due to decline in energy intensity, all provinces, with the exception of Alberta, experienced a reduction in energy consumption (saved energy). Efficiency improvement was a major contributor to the reduction in energy use, whereas changes in economic activity increased energy use in six provinces. Alberta was the only province in which both changes in economic activity and decline in energy efficiency increased energy consumption. This is mainly because of huge investments in the Alberta oil sands, which is a high energy and capital intensive industry.

Socio-economic Drivers of the Changes in the Energy Intensity Indexes

Provincial Analysis

We use a panel data model to estimate the energy intensity index across Canadian provinces for the period 1984-2008. The explanatory variables include energy prices, real income, temperature (cooling/heading degree days), population growth, investment, capital-labour ratio, and a proxy for policy changes. The results show that the price has a negative and income a positive impact on energy intensity. The heating degree day shows a positive and highly significant effect, implying that colder provinces

have higher energy intensity. A standard deviation increase in the heating degree days is associated with a 2.6 percentage point increase in energy intensity. The investment effect on energy intensity is negative but not statistically significant. The population growth coefficient shows that faster growing provinces have higher energy intensity. This could be due to the fact that faster growing provinces suffer from congestion or attract energy intensive infrastructure. The policy coefficients (the number of years each party has been in power) has no effect.

The regression results above assumes energy intensity responds immediately to change in economic variables. Realistically, economic variables are likely to affect energy intensity with some lag because of timely capital and structural adjustments. All the results are the same, except that he reign of NDP and the liberal party is associated with a fall in energy intensity as compared to the conservative party. The coefficient of the investment ratio has also become larger and significant. A 1% rise in investment ratio is associated with a 0.05 percentage point decrease in energy intensity.

The effects of the socio-economic variables on energy intensity are also analyzed for efficiency index and economic activity index. The results show that the negative effect of price is fully explained by changes in economic activity, but positive effect of income mostly by efficiency index. The positive effect of capital-labour ratio on energy intensity is due to changes in efficiency and economic activity, indicating that Canada has been employing higher energy intensive capital. The positive effect of population growth on energy intensity index is fully explained by the efficiency index, implying that higher population growth has put more pressure on energy intensive infrastructures. The effect of heating degree days can mostly be explained by efficiency index. Similarly, the results for policy effects show that both NDP and liberals, relative to conservatives, have contributed to increasing energy efficiency and, at the same time, to encouraging more energy intensive activities in provinces. The positive coefficients for the activity index might be surprising, particularly for NDP, which is known as a pro-regulation and pro-environment party. However, NDP is also a big supporter of unions, which have a strong presence in the energy-intensive industries such as manufacturing and mining.

The estimation results from the regression analysis are used to obtain price and income ealsticities of energy demand[3]. The results are reported in Table 10.

Table 10 – Price and Income Elasticities of Energy Demand in Canada

	Intensity		Efficiency		Activity	
	SR	**LR**	**SR**	**LR**	**SR**	**LR**
All Provinces						
Price	-0.03	-0.05	0.02	0.04	-0.02	-0.07
Income	0.44***	1.01***	0.45***	-0.09	1.05***	1.21***
Energy-endowed Provinces						
Price	0.14	0.213	0.22**	0.42*	-0.04	-0.13
Income	0.34***	0.06	0.48***	0.01	1.02***	1.06***
Less Energy-endowed Provinces						
Price	-0.101***	-0.16***	-0.08**	-0.12**	-0.01	-0.01
Income	0.53***	0.25***	0.49***	0.22**	0.92***	0.81***
All provinces						
Electricity Price	0.003	0.005	0.0007	0.001	0.003	0.007
Natural gas price	-0.002***	-0.003***	-0.002***	-0.004***	-0.0003	-0.0008
Income	0.49***	0.04	0.45***	-0.07	1.02***	1.06***
Provinces with Low Electricity Prices						
Electricity Price	0.005	0.009	0.02***	0.04***	-0.009**	-0.033**
Natural Gas Price	-0.001**	-0.001**	-0.001**	-0.002**	-0.0006	-0.0002
Income	0.58***	0.28***	0.63***	0.16***	1.05***	1.17***
Provinces with High Electricity Prices						
Electricity Price	0.008***	0.14**	0.008**	0.02**	-0.001	-0.001
Natural Gas Price	-0.0008***	-0.001**	-0.001**	-0.002**	-0.000	-0.000
Income	0.59***	0.30***	0.63***	0.20***	1.05***	1.19***

, ** and * indicate statistical significance at 10%, 5%, and 1%, respectively. SR: short-run, LR: long-run.*

The price elasticities are negative for intensity index and activity index and positive for efficiency index, but none is significant. The income elasticities are all positive and significant (except for efficiency

[3] Price (income) elasticity measures the percentage changes in demand for energy in response to a one percent change in price (income).

in the long-run), meaning that higher income will lead to higher energy demand. However, the greater than one income elasticities for the activity index indicate that higher energy demand will mostly come from the energy-intensive activities, such as oil and mining extraction.

The price elasticities are positive and significant for efficiency index in energy-endowed provinces (AB, SK, and NL), but negative and significant for intensity and efficiency in less energy-endowed provinces. The income elasticities are positive and significant in both groups and they are greater for activity index, particularly in energy-endowed provinces. Finally, the bottom part of the Table 10 shows the price elasticities for electricity and natural gas obtained from the regression which included individual energy prices. The electricity price elasticities of demand for energy are not significant, but the natural gas price elasticities are significant in the energy intensity and efficiency index regressions. As previous results, the income elasticities are significant and greater than one in activity index regression. The finding that Canadian provinces do not respond to electricity price changes but react to natural gas price changes may be explained by the fact that electricity is produced locally and most provinces do have excess capacity, but natural gas is imported by most central and eastern provinces and its provision is subject to transportation and weather condition constraints. Further investigation shows that a rise in electricity prices will increase energy demand due to lower efficiency and decrease energy demand due to changes in activities in energy-endowed provinces. However, electricity price elasticities are not significant in less energy-endowed provinces, most of which generate electricity using hydro or nuclear plants and have significant excess capacity.

Conclusion

This paper provides a comprehensive understanding of the forces driving changes in energy intensity in Canada since 1980. The Fisher Ideal Index method is used to decompose energy intensity into efficiency and activity indices at the national, provincial, and industry, and ab econometric model is applied to identify underlying factors driving the changes in energy intensity in Canada.

The decomposition results, both at the national and provincial levels, suggest that most of the reduction in energy intensity have occurred mainly due to improvements in energy efficiency as compared to shifts from energy intensive to less energy intensive economic activities. Energy efficiency improvement accounted for more than 82% of the decline in energy intensity. Energy intensity was mostly stable in the 1980's but has been fast declining after the mid 1990's. Additionally, variation in energy intensity across provinces has been increasing over time. Within the industry, while energy intensity increased significantly in mining, it experienced a significant decline in manufacturing mostly due to an improvement in efficiency. The energy intensity has remained rather stable in other industries.

The panel data regression results also indicate that on average higher energy prices have led Canadian economic structure to move away from energy intensive activities, while rising income has been the most significant factor in increasing energy intensity. Even though population growth is relatively low in Canada, it has positive and significant effect on energy intensity. Energy intensity is higher in provinces with colder climate, but the effect of warmer climate on energy intensity is relatively limited. The provincial and industry level study show that capital and energy are complementary on average across provinces and industries. Investment ratio, which captures the turnover of capital stock, has also contributed to the declining in energy intensity in provinces. The industry regression results confirm that the investment has contributed to energy efficiency in utilities and mining and to changes to less energy intensive activities in manufacturing and transportation industries. Technological advances have been most effective in increasing energy efficiency in construction and utilities industries and in switching to less energy intensive activities in manufacturing industries.

The regression analysis for the two energy-endowed and less energy-endowed provinces reveals heterogeneous responses of energy intensity indexes to explanatory variables. Specifically, energy prices and income have stronger negative and positive effects in less energy-endowed provinces, respectively. Also, policy effects are different in the two groups with liberals having to increase energy intensity in energy-endowed provinces and to decrease it in less energy-endowed provinces. The energy demand elasticities results indicate that energy is price inelastic and changes in energy prices will reduce energy

demand only in less energy-endowed provinces. However, breaking down the energy prices into electricity and natural gas prices in the regression reveals that while all provinces respond significantly to changes in natural gas prices, the electricity price elasticity is only significant in the less energy-endowed provinces. Furthermore, a rise in income will increase energy demand mostly due to a rise in high energy intensive activities particularly in energy-endowed provinces.

This study shows that Canada is slowly reducing its high energy intensity with a focus on increasing energy efficiency through economic forces such as investment and technological advances. However, increasing activities in energy intensive sectors, such as oil and mining, will partially offset the efficiency effects gained in other industries. This is particularly true as about 50 percent of the greenhouse gas emission produced in Canada is concentrated in oil and gas and transportation industries and in two oil producing provinces: Saskatchewan and Alberta. Thus, the pace of energy intensity reduction will increase rapidly, should efficiency improve significantly in the energy intensive industries, or they move to less energy intensive activities. Since the latter is not a realistic option for Canada as a major oil-exporting country, the government policy to encourage R&D in those energy intensive industries will help meet the CO2 reduction targets in due course.

01-5536-103 LEG CM/ADVY BD-S'TOON ENVIR ADVY COUNCIL - Budget - $6,800									
JCN	Type	Date	Doc#	Trx Ctrl#	Description	Debit	Credit	Balance	Budget Remaining
					Beginning Balance			0	$6,800
JCN216870	AP	2015/03/31	AP1894603	AP1894603	APB90205 R547604 LA PREP - Lunch for Performance Target Facilitation/Stakeholder Consultation Meeting - March 30, 2015	431.55	20.55	411	
JCN217087	AP	2015/03/31	AP1896650	AP1896650	APB90317 APV355714 LAINE, MELANIE - Reimbursement for March 30, 2015 Consultation meeting Refreshments	47.17	0.6	46.57	
					March Total	**478.72**	**21.15**	**457.57**	**$6,342**
					Ending Balance, July/2015			**457.57**	**$6,342**

2015 Budget: $6,800

Publications/Reports: $100	$100
Public Education, Information Gathering	$6,000
Conferences/Workshops: $500	$500
Membership Fees	$200
Total	**$6,800**