Regional Watershed Alliance Meeting #4/19 was held at Toronto and Region Conservation Authority Head Office, 101 Exchange Avenue, Vaughan, on Wednesday, November 13, 2019. The Acting Chair, Jennifer Drake, called the meeting to order at 6:35 p.m.

PRESENT

Drake, Jennifer	Acting Chair
Bream, Margaret	Member
Burnett, Neil	Member
Calvin, Elizabeth	Member
Gomez, Orlando	Member
Groves, Annette	Member
Iacobelli, Tony	Member
Laing, David	Member
Lockridge, Karen	Member
Mallet, Lisette	Member
Mattos, Mike	Member
McCullough, Sean	Member
McDowell, Madeleine	Member
Miller, Learie	Member
Pickles, David	Member
Schulte, Deb	Member
Wickens, Andy	Acting Vice-Chair
Wright, Doug	Member

REGRETS

Barrett, Suzanne	Member
Bowers, Thomas	Member
Broadbent, Heather	Member
Dasko, Stephen	Member
Dies, Joanne	Member
Dyce, David	Member
Felix, Rui	Member
Heath, Jack	Member
Innis, Jennifer	Member
Keenan, Rosemary	Member
Kelly, Jill	Member
Malowany, Mick	Member
McGlynn, Chris	Member
Ngan, Amory	Member
Nonnekes, Joanne	Member

O'Connor, Kevin	Member
Olivieri, Sara	Member
Presutti, Michael	Member
Scotchmer, Carolyn	Member
Vrana, Andrew	Member

The Acting Chair recited the Acknowledgement of Indigenous Territory.

RES.#R21/19 - MINUTES

Moved by: Madeleine McDowell
Seconded by: Andy Wickens

THAT the Minutes of Meeting #3/19, held on September 11, 2019, be approved.

CARRIED

Items for the Action of the Regional Watershed Alliance

RES.#R22/19 - **2020 REGIONAL WATERSHED ALLIANCE MEETING SCHEDULE**
To provide a schedule of meeting dates for the Regional Watershed Alliance (RWA) for 2020.

Moved by: Margaret Bream
Seconded by: David Laing

THAT 2020 RWA meeting schedule be approved, as described below:

#1/20 Wednesday, March 4, 2020

#2/20 Wednesday, May 20, 2020

#3/20 Wednesday, September 16, 2020

#4/20 Wednesday, November 18, 2020;

THAT some RWA meetings be held in the afternoon to accommodate various members schedules, at the discretion of TRCA staff;

AND FURTHER THAT the meetings be held at 101 Exchange Avenue, Vaughan, ON, unless otherwise noted.

CARRIED

RATIONALE
A schedule of meetings is proposed to assist the RWA members with 2020 planning. TRCA staff undertook an examination of the dates of regional and local municipal council meetings as well as other important dates in the larger community to avoid scheduling conflicts when setting the proposed meeting dates noted above.

As per current schedule, meetings take place at 6:30 pm. Staff recommends that in order to accommodate some members' schedules, RWA members consider holding some of the meetings in the afternoon.

TRCA will provide meeting space for the RWA to meet on a regular basis at 101 Exchange Avenue, Vaughan, ON. This location is central to all the watersheds and easily accessible.

Report prepared by: Jessica MacDonald, Ext 5903
Email: jessica.macdonald@trca.ca
For Information contact: Jessica MacDonald
Email: jessica.macdonald@trca.ca, Ext 5903
Date: November 8, 2019

RES.#23/19 - **YOUTH COUNCIL EXECUTIVE MEMBERSHIP**
To update the RWA on the first term (2018-2019) of Youth Council accomplishments and seek approval of Youth Council Executive membership for second one-year term beginning in November 2019.

Moved by: Deb Schulte
Seconded by: Elizabeth Calvin

WHEREAS TRCA's Youth Council completed a successful one-year term in the Fall of 2019 and a new cohort of youth for Council Executive has been selected through a selection process in November 2019;

THEREFORE LET IT BE RECOMMENDED THAT the Regional Watershed Alliance receive the appended report summarizing the work completed and evaluation of the Youth Council's first term activities and outcomes;

THAT the outgoing members be thanked for their contributions to the work of TRCA;

THAT the terms of four returning Youth Council Executive members, as indicated in the report, extend their terms for an additional year to November 30th 2020;

AND FURTHER THAT the membership list for the new Youth Council Executive, as appended, be approved.

CARRIED

BACKGROUND
Youth Councils are being deployed around the world as a means to engage and inspire youth. TRCA's 2017 Community Engagement Strategy recommended the development of a youth council. The program framework of the Youth Council was developed by TRCA staff and Regional Watershed Alliance members. The ultimate goal of the Youth Council is to build healthy communities. This will be achieved through four program objectives:

a) Build capacity and engage youth by providing youth across the Toronto region with learning opportunities;

b) Build a youth network/strengthen existing networks through creation of a broad network of youth in the region that is interested in environmental and sustainability issues;

c) Identify youth perspectives by developing an understanding of youth opinion around current environmental issues and how these might be incorporated in the work of TRCA and its partners; and

d) Create fun opportunities for youth through entertaining and engaging learning opportunities.

The framework for the Youth Council was approved by the RWA in February 2018 (RES.#R11/17). Recruitment for the first year of the Youth Council began during the fall of 2018.

Participants could sign up as a general member or apply to be on the Youth Council Executive. Executive members serve as the guiding body for the Council for a one-year term and are responsible for the development of program activities and priorities that fit within the objects defined in the program framework.

RATIONALE

Key Outcomes from the 2018/2019 Youth Council Executive

Overall the 2018/19 Youth Council Executive made progress towards achieving program objectives through the delivery of multiple initiatives:

- A comprehensive survey on youth perspectives
- Developing a newsletter and engagement through yoursay.ca
- A guided walk (9 Executive members and 10 general Youth Council members participating)
- An Earth Day Clean-up (9 participants and 271 pounds of litter collected)
- A free documentary movie night (Over 140 participants)
- Direction on building youth capacity in the environmental sector

Overall, the Youth Council Executive built strong partnerships with Evergreen Brickworks, Patagonia and Swim Drink Fish, and continue to engage the general membership through a series of newsletters. Recommendations to improve program delivery next year include: extending the term for up to four executives to ensure program continuity; booking meetings further in advance; defining clear roles for executives; expanding work with the general membership; and exploring how to leverage the Youth Council network to promote key messaged and actions related to TRCA work. A more detailed evaluation of Youth Council activities is in the attached report (Attachment 1).

Youth Council Executive Membership Process

Four Executive Members were asked if they would be interested in extending their term by an additional year. A year term was initially selected because youth in the age 16-30 cohort are more likely to be in transitional years between the professional world and school, and less likely to commit to a term longer than one year. It is, however, vital to have some continuity in leadership across years to maintain the relationships and continue to build momentum in youth engagement. For this reason, it has been recommended that four spaces (out of ten) should be made available to executive members interested in continuing their term. Recruitment for new executives launched on October 10th, 2019 and remained open until October 31st, 2019. Applicants were evaluated by TRCA staff and the RWA Youth Council working group. Six new members (see Attachment 2) were selected based on experience and their responses to questions, bearing in mind age differences. Furthermore, an attempt was made to select a diverse group in terms of interests, age, and representation of TRCA's entire jurisdiction.

Relationship to Building the Living City, the TRCA 2013-2022 Strategic Plan

This report supports the following strategies set forth in the TRCA 2013-2022 Strategic Plan:
Strategy 5 – Foster sustainable citizenship
Strategy 8 – Gather and share the best sustainability knowledge

FINANCIAL DETAILS

Funds are available in TRCA Community Engagement & Outreach program accounts for watershed engagement and community projects to support the recruitment, convening and ongoing activities of the Youth Council. Staff will work with the Regional Watershed Alliance Youth Council working group and with the Youth Council itself to ensure that the scope of work reflects available budget and staff support

DETAILS OF WORK TO BE DONE

- A meet-up for all Youth Council Members is to be set up for the month of November, likely in the format of a voluntary guided walk at Evergreen Brickworks, or a movie night at Patagonia. Staff and the Youth Council Working Group will work with the Youth Council Executive to plan that event.
- A retreat for Youth Council Executive member will take place in early 2020 to begin detailed work planning.

Report prepared by: Kate Goodale, Ext 5280
Emails: Kate.Goodale@trca.on.ca
For Information contact: Kate Goodale, Ext 5280
Emails: Kate.Goodale@trca.on.ca
Date: October 25, 2019
Attachments: 2

Attachment 1: **TRCA Youth Council 2018/2019 Report**
Attachment 2: **Youth Council Executive 2020 Membership**

Toronto and Region Conservation Authority

TRCA Youth Council 2018/19 Report

Prepared by Kate Goodale

October, 2019

Summary

Youth Councils are being deployed around the world as a means to engage and inspire youth. Following suit in this growing trend, TRCA's 2017 Community Engagement Strategy recommended the development of a youth council. The program framework of the Youth Council was developed by TRCA staff and Regional Watershed Alliance members. The ultimate goal of the Youth Council is to build healthy communities. This will be achieved through four program objectives:

a) Build capacity and engage youth by providing youth across the Toronto region with learning opportunities;

b) Build a youth network/strengthen existing networks through creation of a broad network of youth in the region that is interested in environmental and sustainability issues;

c) Identify youth perspectives by developing an understanding of youth opinion around current environmental issues and how these might be incorporated in the work of TRCA and its partners; and

d) Create fun opportunities for youth through entertaining and engaging learning opportunities.

Recruitment for the Youth Council began during the fall of 2018. Participants could sign up as a general member or apply to be on the Youth Council Executive. Executive members serve as the guiding body for the Council for a one year term, and are responsible for the development of program activities and priorities that fit within the objects defined in the program framework. All new members are required to complete a survey that asked them to identify which environmental/sustainability topics were most important to them out of a list of 25 (an open-ended option was also included). The 2018/19 Executives also carried out a survey of members to determine engagement preferences. This information, in combination with the entrance survey helped to determine the selection of activities and topics.

Overall the Youth Council was able to make progress towards achieving program objectives through the delivery of three events: a guided walk, an Earth Day Clean-up, and a Free Documentary Movie night. They built strong partnerships with Evergreen, Patagonia and Swim Drink Fish, and continue to engage the general membership through a series of newsletters. The first term of the Executive has now drawn to a close. Recommendations to improve program delivery next year include: extending the term for up to four executives to ensure program continuity, booking meetings further in advance, defining clear roles for executives, and expanding work with the general membership.

Table of Contents

INTRODUCTION

Around the world, youth councils have been created by governments, community groups, and non-profit organizations as a means of providing local youth with an opportunity to gain important skills, build capacity and network, while providing the sponsoring agencies with important input and perspectives from youth stakeholders. The long-term success of efforts to advance environmental protection and sustainability in the Toronto region depend on the support of the region's youth, both now and into the future. TRCA's Community Engagement Strategy (2017) recommends more focused engagement of youth to enhance the reach of TRCA programs and activities and prepare the next generation of conservation leaders (Actions 6.1 and 6.2). Activities of the Youth Council build on existing engagement programs while deploying tools and strategies to develop a strong network of youth driven to take active ownership of their local environment.

The Youth Council reports directly to the Regional Watershed Alliance. The mission, mandate and goals, along with the Terms of Reference for the Youth Council, were developed by TRCA and the Regional Watershed Alliance (RWA) in consultation with relevant stakeholders. At Regional Watershed Alliance Meeting #1/2017, held on November 15th, 2017, Resolution #R002/17 was approved, in part, as follows:

> WHEREAS THE Terms of Reference of the Regional Watershed Alliance proposes the establishment of Watershed/Working Groups, Youth Council, and Indigenous Liaison Committee;
>
> THEREFORE LET IT BE RESOLVED THAT the following members of the Alliance [the RWA Working Group] work with staff to lead the establishment of Youth Council including development of Terms of Reference:
>
> a) Lisette Mallet; b) Amory Ngan; c) Rui Felix; d) Mick Malowany; and e) Karen Lockridge.

This report provides a summary of program development, Terms of Reference, work planning, and an evaluation of the first year of the Youth Council's operation.

PROGRAM FRAMEWORK

Youth councils, and similar youth engagement groups, are being utilized around the world as a means of engaging and empowering youth. Examples such as the City of Toronto's Youth Cabinet and others were used in the development of TRCA's Youth Council. Consultations with Ontario Nature's Youth Council Program Coordinator also took place during the fall of 2018. A common factor in the development of these different councils was the provision of opportunities for youth to have active leadership in the development of the program. For a Youth Council to be effective, the participants must be actively engaged and empowered through mentorship.

The Youth Council framework was developed using a program development and evaluation approach, which outlines clear connections between program goals, objectives, activities, outputs and deliverables, and ultimate program outcomes. By breaking down large-scale goals into defined objectives, activities can be identified that directly address those objectives, creating a clear pathway between goals and outcomes. Figure 1 illustrates the Youth Council's logic model. The framework for the Youth Council has the goals and objectives of the TRCA Community Engagement Strategy at its foundation (identified by the blue boxes). More specific goals and objectives were identified and agreed upon by staff and the Youth Council RWA working group (identified by the orange boxes).

The primary goal of the Youth Council is to "**Build healthy communities through improved connection to greenspace and nature**." The most meaningful type of connection to nature and greenspace may differ from one community or individual to the next; however, the RWA Youth working group and staff agree that enhancing that connection through diverse and appropriate initiatives will improve community health and wellbeing. A healthy community will inspire empowered and engaged youth, which is the second program goal, laying the groundwork for youth to have an integral role in the discussion of environmental and sustainability issues. On the TRCA Youth Council, this engagement began with the planning and shaping stages of the Council itself.

There are four objectives that guide program activities for the Youth Council:

a) Build capacity and engage youth by providing youth across the Toronto region with learning opportunities;

b) Build a youth network/strengthen existing networks through creation of a broad network of youth in the region that is interested in environmental and sustainability issues;

c) Identify youth perspectives by developing an understanding of youth opinion around current environmental issues and how these might be incorporated in the work of TRCA and its partners; and

d) Create fun opportunities for youth through entertaining and engaging learning opportunities.

A preliminary set of activities for the TRCA Youth Council was also outlined in the framework, including the following:

- Convening an annual event (an action item identified in the TRCA Community Engagement Strategy);
- Holding regular council meetings;
- Advocating for key environmental and sustainability issues;
- Providing feedback on key TRCA projects and initiatives; and
- Creating a framework for youth network interaction.

The above framework of goals, objectives and activities notwithstanding, the Youth Council was provided the opportunity to identify their *own* priorities, and the activities to address those priorities. In other words, the highest-level goals and outcomes were determined prior to convening the Youth Council, but the Youth Council was provided with the opportunity to determine the pathways (i.e., Activities, Outputs, and Immediate Outcomes) to achieve those goals.

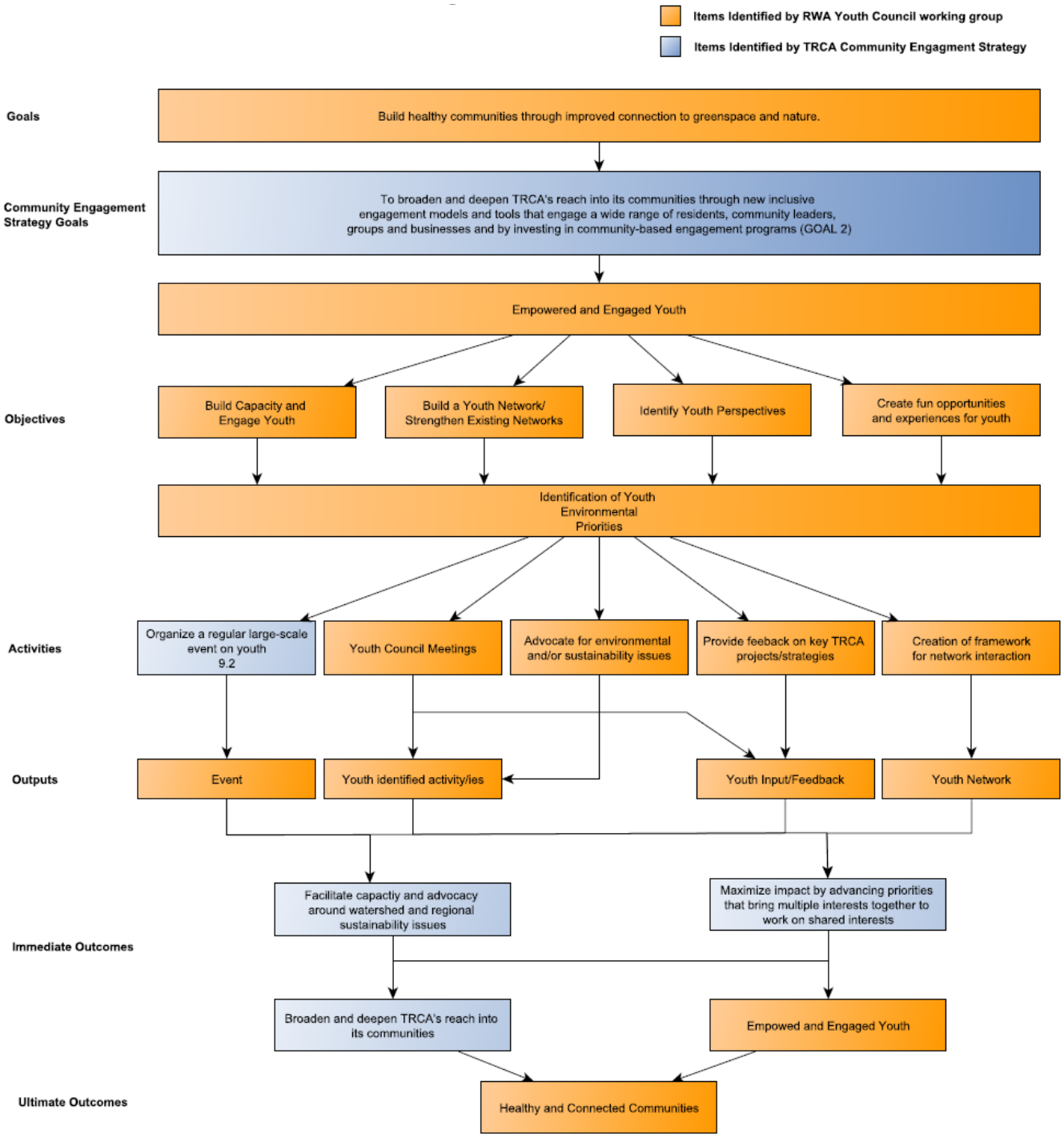


Figure 1 Youth Council Logic Model

DEFINITION OF YOUTH

The definition of "Youth" is not consistent across disciplines. The definition of youth was investigated in other examples of youth councils, consultations with project managers from other organizations, academic literature, and through discussion with RWA steering group members. Based on that investigation, youth was defined as 16-24 (the

same as the City of Toronto's Youth Council). That category was later revisited when recruitment seemed to be skewed towards more female participation and was subsequently changed to 16-30 years old at the recommendation of the RWA and Education and Training Staff. The rationale for this change was that older male youth are more likely to engage than younger males. It remains to be seen if this is indeed the case.

RECRUITMENT

There are two participation streams for the Youth Council. Executive members are an application-based year-long term position responsible for the development of a workplan and attending monthly meetings. General members, by contrast, have no application and recruitment is open year-round. General members are provided opportunities to participate in activities selected by the executive, but their participation is completely voluntary.

Recruitment materials were developed by the RWA Youth Council Working Group in consultation with staff. The final list of questions to be included in all applications can be seen in Appendix 1. In addition to those questions, applicants for the executive membership were also asked to answer two out of the four following questions:

1) Why are you interested in joining the Executive Council?
2) What would you like to accomplish as part of the Youth Council?
3) What would make you a good candidate for the Youth Council Executive?
4) What do you think is the biggest challenge faced by your neighbourhood or region right now? What would you do to help people understand and address that challenge?

Executive applicants were also invited to attach a resume, though this step was optional. Recruitment for both tiers of the Youth Council began online in mid-September 2018, and applications for executive membership closed on October 15, 2018. Advertisement for the recruitment was published on Instagram and YouTube, and was circulated and communicated through relevant TRCA networks (e.g., Education and Training's Conservation Youth Corps, and University Mailing lists).

In total, 19 applications for executive membership were received. These applications were evaluated by the Youth Council Working Group and TRCA staff. Considerations for the selection of executive members included: representation from across the jurisdiction, demographic factors, and merit based on the quality of application. It was decided not to hold interviews, as the role is volunteer based, and it would be difficult and time consuming to schedule. Age was also factored into the assessment of their experience and writing level, as applicants ranged from high school to graduate level students. Generally, most applicants were either nearing the end of undergraduate/college degrees or had recently graduated.

Ten individuals were selected. Of those ten, one declined the position and their spot was then offered to the next runner up. One individual never returned any of the emails offering them the role. After multiple attempts it was decided to simply keep the group at nine rather than ten.

FIRST MEETING AND GUIDED WALK

Executive members were invited to an initial meet and greet event at Evergreen Brickworks in November 2018. At this meeting they were introduced to TRCA staff and RWA working group members, and were provided with a brief introduction of TRCA and the goals and objectives of the Youth Council. After this meeting, a guided walk took place

around Evergreen Brickworks. General members were also invited to this walk as an opportunity to meet their Executive Council members. Nine executive members attended this event, and 10 general members.

Figure 2 Mick Mallowany (RWA Member) provides a guided tour to youth council executive and general members at evergreen brickworks

RETREAT – ALBION HILLS FIELD CENTRE

A retreat for executive members was held on a Saturday in January 2019 at the Albion Hills Field Centre. The date was chosen in an effort to avoid exam time for university students, as well as the holidays. This retreat was facilitated by TRCA staff (led by Raysha Carmichael from Education and Training and Daphne Paszterko from PAIE). A copy of their presentation/agenda can be found in Appendix 2. The goal of this retreat was to a) agree on a Terms of Reference, b) start a workplan, and c) provide an opportunity for the executive members to get to know each other. The morning was spent undertaking team building activities outdoors (facilitated by Albion Hills Field Centre Staff) and introducing the group to a draft Terms of Reference and workplan template. Lunch was provided by the Field Centre, and in the afternoon the executives were given time to begin drafting their own work plan based on the Terms of Reference they had drafted that morning. The Terms of Reference is attached in Appendix 3 and workplan is attached in Appendix 4.

Figure 3 Executive members undertake team building activities at Albion Hills Field Centre

Figure 4 Executives attempt marshmallow team challenge at Albion Hills Field Centre

MONTHLY MEETINGS

Monthly in-person meetings were held at different locations at the convenience of executive members. If a member was unable to attend in person, they were invited to participate online through Google Hangouts (provided the location had access to Wi-Fi). Meeting agendas were drafted a few days prior to the meeting and were circulated online via Google Docs. Executive members adopted a rotating Chair system, where members would volunteer to chair each meeting. Minutes and action items were recorded during the meeting via a Google Doc spread sheet. If warranted, a follow-up online meeting was scheduled two weeks after the in-person meeting. This meeting would take place via Google Hangouts.

GOALS AND OBJECTIVES

The 2018/19 workplan for the Youth Council was designed to achieve the goals and objectives set out in the program framework. The following section provides a summary of each of those objectives, and what work was carried out to address them.

Build youth capacity and learning opportunities

The creation of the Youth Council itself arguably contributes to building youth capacity among members. Executives were provided with the opportunity to create their own workplans, engage in their own networking, and help to organize their own events and programs. These activities were all carried out with support and mentorship from TRCA.

Build youth network

One of the primary goals of TRCA's Youth Council is to build and strengthen the youth environmental network across TRCA's jurisdiction and beyond. To achieve this goal, Youth Council Executives were encouraged to network with other environmental and sustainability groups. To facilitate the communication between executives and general members, the executives drafted a quarterly newsletter. This newsletter provided links to volunteer opportunities both with TRCA and with external agencies. By the end of their 2018/19 term, the Youth Council had broadened their network through:

- Delivering a presentation at the Regional Watershed Alliance
- Partnerships with Brickworks (hosting inaugural meet and greet)
- Partnerships with Swim Drink Fish and Patagonia (year-end movie night and volunteer opportunities)
- Shared communication with the Youth Biodiversity Network (volunteer opportunities)
- Shared communication with Youth Challenge International Innovate MY Future Program (volunteer opportunities)

Learn about what is important to Youth

Youth Perspectives have been measured in two ways: via a survey of all Youth Council Members and via a survey to the general public (where youth were invited to join the Council, but were given the option to complete the survey without joining). This information will be used to tailor activities targeting youth for both TRCA and for the Youth Council.

Survey Methods

A list of 25 topics was created through consultation and discussion with the Regional Watershed Alliance working group and TRCA staff. Topics were intentionally chosen to reflect a diversity of topics including environmental, social, and sustainability issues (Table 1). The list of topics was then placed into a random order to prevent selection bias on the part of the respondent. Some topics, such as "Climate Change," could be placed in more than one, or even all, of the categories described in Table 1.

Table 1 Topics Listed on Survey

Environmental	Sustainability	Social	Planning
Climate change	Greening the Economy	Education	Farmland protection
Biodiversity	Renewable energy	Accessibility	Sustainable development
Urban forest	Green Buildings/Architecture	Food Security	City-building
Air quality	Carbon pricing	Immigration	Waste management
Wildlife and Habitat Conservation		Indigenous Reconciliation	Land-use planning
Water quality and source water protection		Recreational activities	Flood risk and stormwater management
		Access to Green space, parks and natural areas	
		Heritage	
		Urban agriculture	
		Arts and culture	

Individuals who elected to join the Youth Council as a general member, or as an executive member, were asked to select the top five issues from the list of 25 that were most important to them. An open-ended question followed for respondents to add any issues they felt were missing.

To measure perception of environmental health, respondents were also asked to indicate how healthy they considered their local natural environment on a scale of five from “very unhealthy” to “healthy”. Finally, respondents were asked to fill out demographic information, including: age, gender, postal code, and first language.

Results

Demographics

Out of 116 responses, 78 indicated they identified as female (67%), and 20 indicated they identified as male (17%), the remainder opted to leave the question blank or selected or “prefer not to say”. A “not identified here” option, including an open-ended space for respondents to add their preferred gender identify, was offered but no respondents selected this option.

The average age of respondents was 20.6 years old, but some difference in average age were noted across gender and geographic area (Table 2). Blank responses were omitted from analysis.

Table 2 Age of Respondents by Municipality

Category	Average Age	Min	Max
All Responses (n=113)	20.7	16	25
Durham (n=2)	18.5	16	21
Peel (n=18)	19.2	16	23
Toronto (n=63)	21.3	16	25
York (n=26)	20	16	24
Female (n=75)	20.4	16	25
Male (n=20)	20.3	17	23

Respondents were divided into their resident municipality based on postal code. Most respondents reside in Toronto (n=66), followed by York (n=26), Peel (n=18), and Durham (n=2). Three respondents listed postal codes outside of TRCA's jurisdiction; this is likely because Youth Council members must be either residents or attend school in TRCA's jurisdiction (Table 3).

Table 3 Respondent Municipalities

Region/Community	Number of Respondents	% of total responses
Durham	**2**	**2%**
Oshawa	1	1%
Pickering	1	1%
Outside TRCA Jurisdiction	**3**	**3%**
Milton	2	2%
Oakville	1	1%
Peel	**18**	**16%**
Brampton	12	10%
Caledon	1	1%
Mississauga	5	4%
Toronto	**66**	**57%**
Etobicoke	3	3%
North York	12	10%
Scarborough	11	9%
Toronto	40	34%
York	**26**	**22%**
Maple	2	2%
Markham	8	7%
Stouffville	2	2%
Thornhill	2	2%
Vaughan	5	4%
Woodbridge	7	6%
Grand Total	115	99%

First language was used as an indicator that the respondent is either new to Ontario, or part of a family who immigrated to Ontario within the last generation. It is an imperfect measure but does provide some insight into the difference between multi-generational Canadians and recent immigrants. Most respondents (81%) indicated that their first language was English (Table 4).

Table 4 Reported First Language

Language	Number of Respondents	Proportion of Non-English Speakers
Chinese (Mandarin or Cantonese)	6	32%
Russian	2	11%
Arabic	2	11%
French	2	11%
Portuguese	1	5%
Korean	1	5%
Urdu	1	5%
Tagalog	1	5%
Marathi	1	5%
Finnish	1	5%
Filipino	1	5%

Topics of Interest

The most frequently selected topic was "Climate Change" with 59% of respondents. Figure 6 summarizes the distribution of topics selected by all respondents (n=116).

There are some differences in the reported most important issues between English and Non-English speakers (Figure 8). Most notably, 27% more English than Non-English speakers selected "Education", 18% selected "Water Quality", and 16% selected "City-building" as well as "Indigenous Reconciliation". Likewise, 14% more Non-English than English speakers selected "Climate Change", 11% selected "Arts and Culture", 9% selected "Renewable Energy" and 9% selected "Air Quality".

There are notable differences in reported important issues between residents of different municipalities (Figure 9). The majority of all respondents selected "Climate Change", but a larger proportion of York residents (73%) and Peel residents (78%) selected this option compared to Toronto (50%). "Wildlife and Habitat Conservation" was also selected more frequently among York (69%) and Peel (67%) residents, compared to Toronto (36%). "Access to Green Space, Parks, and Natural Areas" was selected more frequently by Toronto (42%) and Peel (44%) residents, compared to York (15%). Interestingly, "Biodiversity" was selected by the majority of Peel residents (61%) but was selected by a much small proportion of Toronto (23%) and York (31%) residents. Due to the small number of respondents, those responses from outside of TRCA's jurisdiction and from Durham Region were omitted from further analysis.

Perception of Environmental Health

Respondents were asked to identify what they considered to be the best description of the health of the natural environment in their neighbourhood on a scale from poor to excellent. Most respondents selected "Good", but some regional differences were noted. 6% of Toronto respondents selected "poor", and no respondents from any other

region selected this option. Most Toronto and York respondents selected “Good”, and most Peel respondents selected “fair”. The same analysis was carried out looking at English and non-English speakers, but little difference between the groups was noted and thus the results have been omitted from this report.

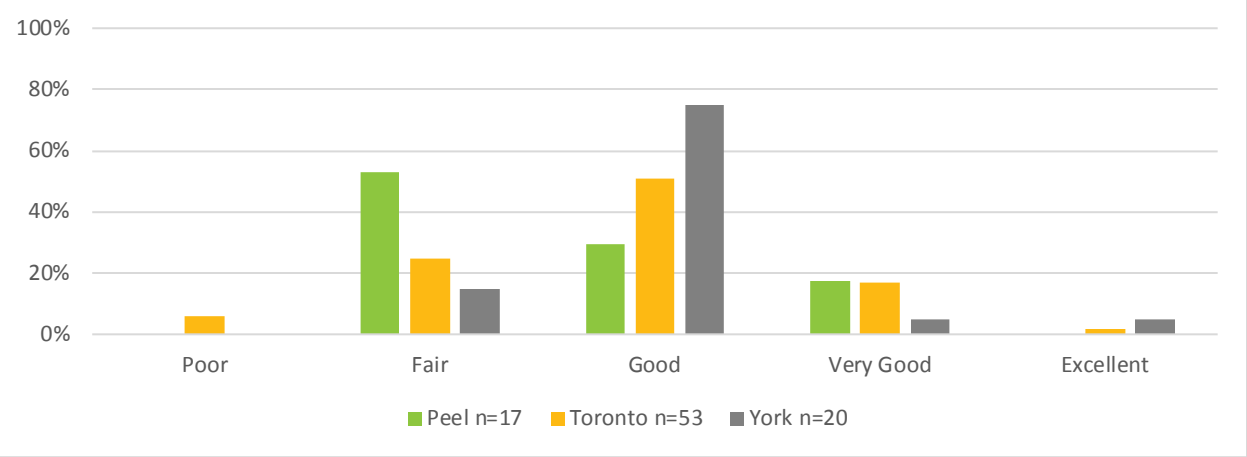


Figure 5 Reported Perception of Environmental Health by Municipality

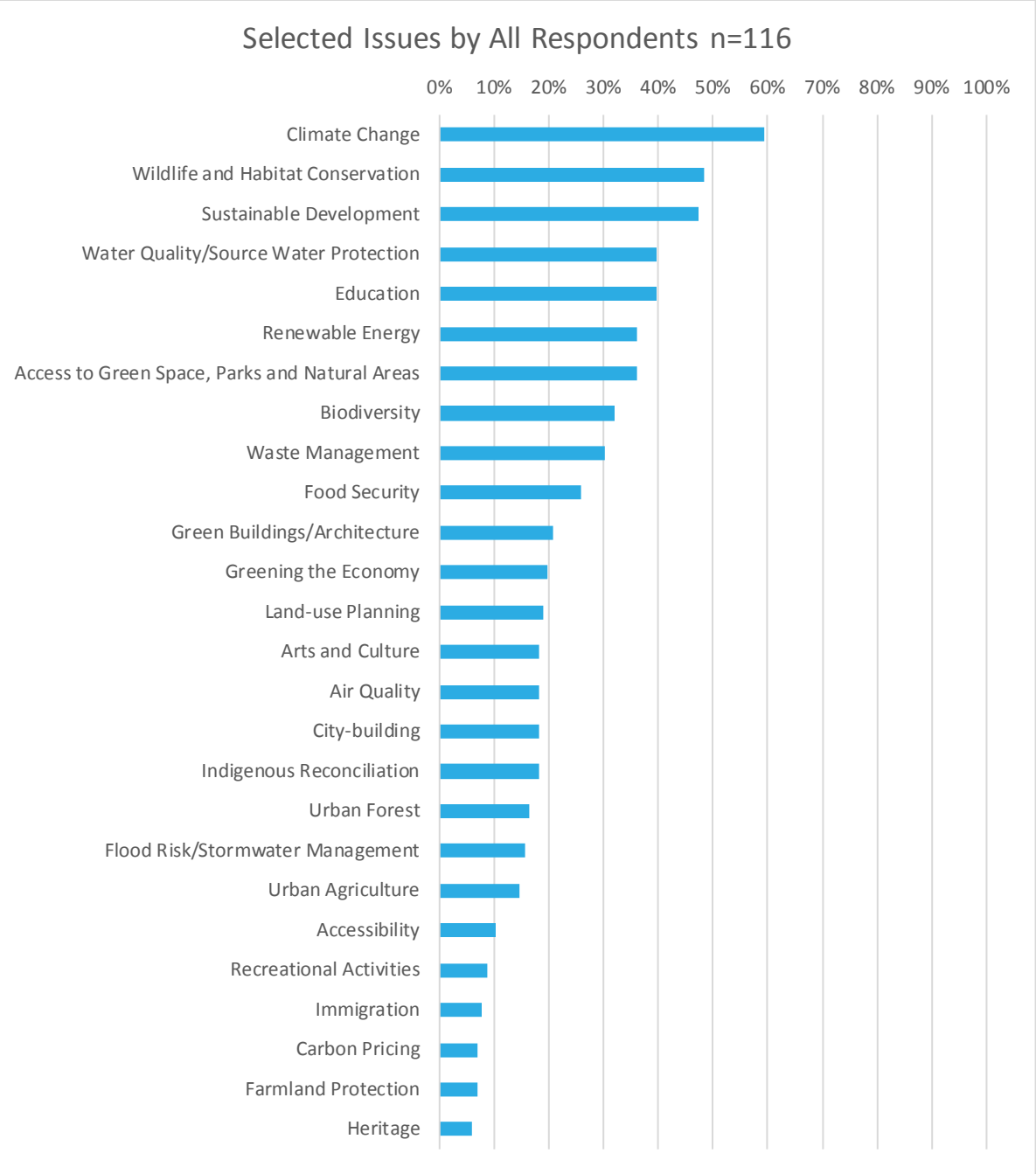


Figure 6 Issues Selected

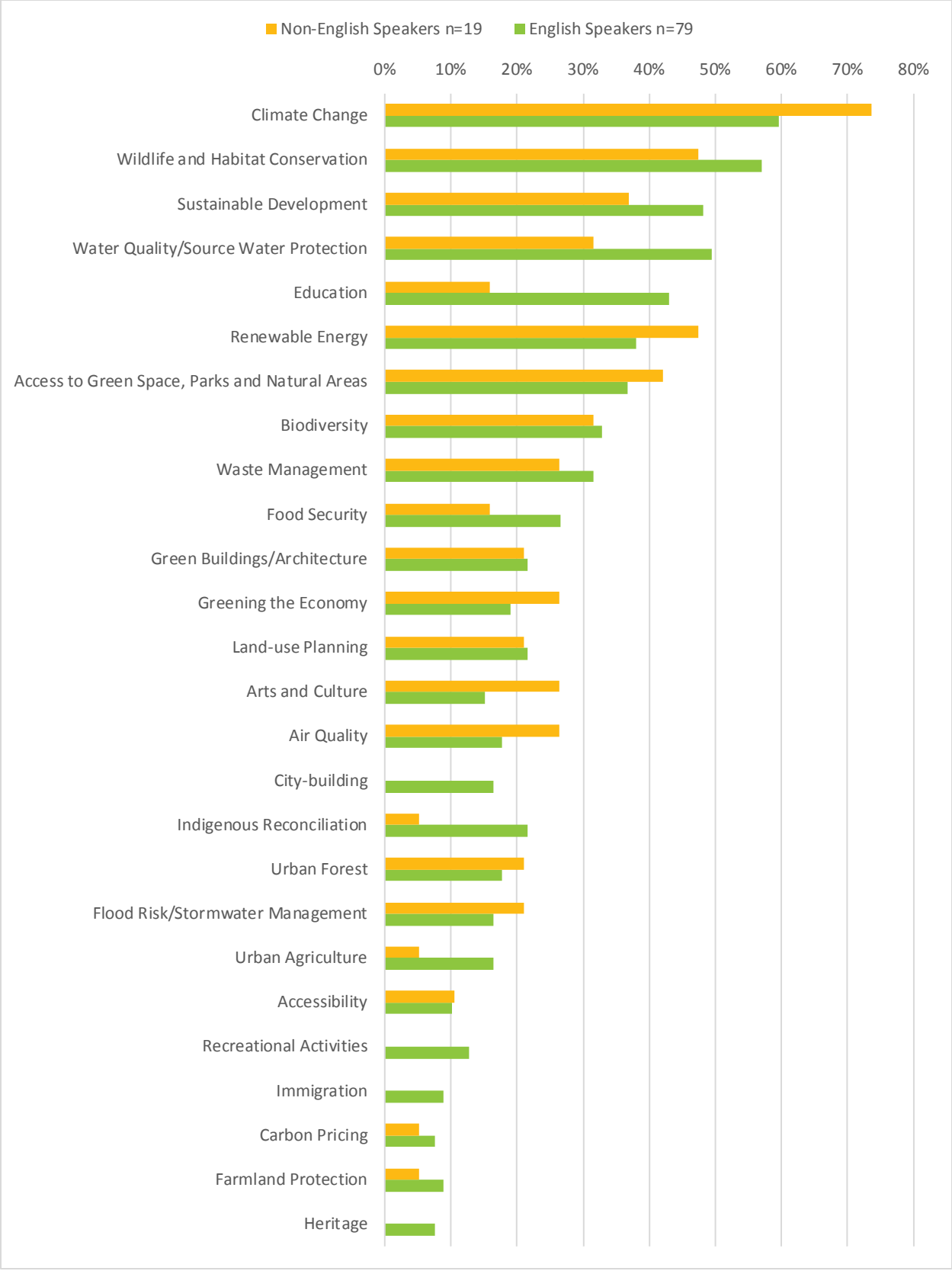


Figure 7 Topics Selected by English and Non-English Speakers

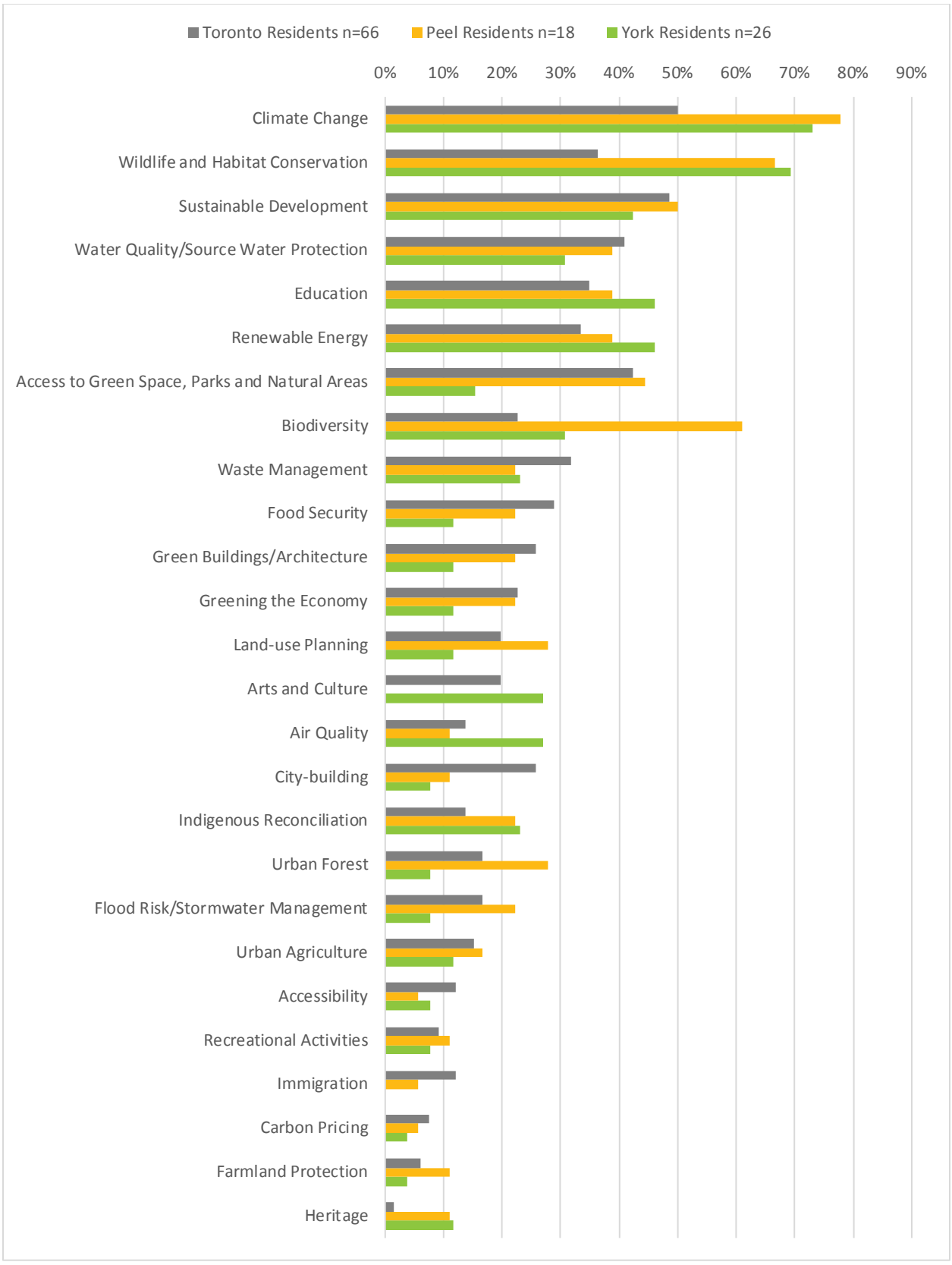


Figure 8 Topics Selected by Municipality

Online Email Campaign

To engage current members, recruit new members, and encourage individuals to complete the survey, an email campaign was developed by TRCA's Marketing and Communications team. Ten emails were drafted, each with a different theme. The themes were chosen based on the results of the survey of youth interests. Individuals could sign up for the series and would receive each e-mail ten days apart. Each email also encouraged participants to visit the Youth Council YourSay page and to complete the survey.

The series was advertised on Gmail. with a $100 budget the Youth Council gained 18 new subscribers. The ad received 6,006 impressions and 1,076 clicks. A click is simply when someone expands the ad within Gmail and is when a cost-per-click charge is applied. On average, the cost per click (to expand the ad in Gmail) was $0.10. From this, there were 18 clicks to the landing page with the same number of new subscribers to the email series. This means that each new subscriber acquisition cost about $5.55. This cost is considered quite good, as there is considerably more value in having someone join your email list rather than simply gaining web page views. Furthermore, the Youth Council will be able to continually engage these new subscribers through email and continue to build relationships with them.

Create Fun Opportunities

Youth Council Executive investigated the engagement preferences of the general membership. They wanted to determine if members were interested in being actively engaged (e.g., hand on tree planting event) or more passively engaged (e.g., webinar). These results would help to determine the kinds of activities that would be most appealing to the general membership.

A short survey of engagement preferences was sent to general members and 18 responses (15% response rate) was received. This is a low response rate but is considered to be within the acceptable range for a one-time survey link. Generally, respondents were more interested in active engagement opportunities. A summary of the responses can be found in Figure 9; for analysis the scale of "completely disagree" to "completely agree" was transferred to numerical values from -2 to 2. The mean for each response was calculated to provide an indication of how strongly respondents agreed (positive score closer to 2), or disagreed (negative score closer to -2) with a series of statements:

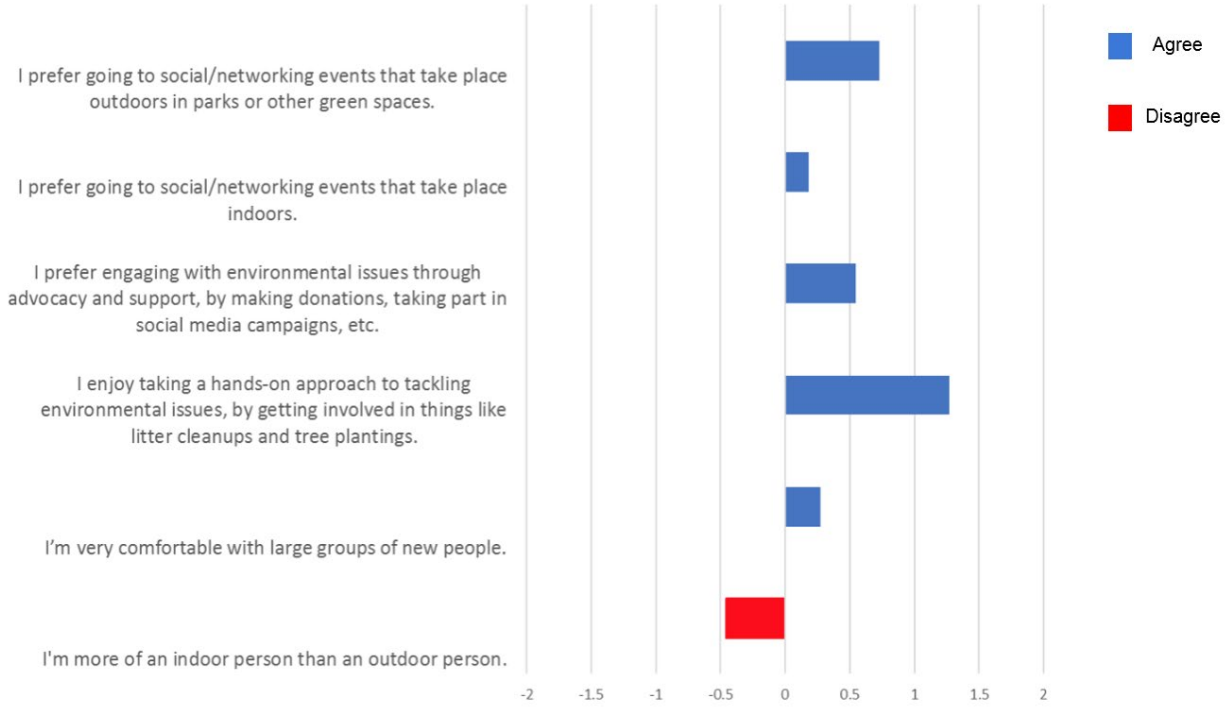


Figure 9 Engagement Preference of Members

The Youth Council Executive expressed interest in The Meadoway project. Corey Wells, Project Manager, TRCA Project Management Office was invited to a Youth Council meeting to present on behalf of the TRCA Meadoway team. Through discussion with TRCA staff, it was determined that one of the best opportunities for a volunteer event would be a litter clean up around Earth Day. This work would help contribute to restoration work in the Meadoway, as litter clean-ups must be carried out prior to any seeding or mowing. The Youth Council Executive held a clean-up event on April 28th 2019. They advertised via the spring newsletter and through a posting to TRCA's social media account. There were fewer participants than anticipated (nine in attendance). This low attendance was attributed to having a selected a location that is not easily accessible by transit, having many competing Earth Day events that weekend, and by not pushing sufficient advertising through social media (which is thought to be the best way to reach youth). That said, participants were able to collect an impressive 271 lbs of litter.

Figure 10 Earth Day litter clean up in The Meadoway

Youth Council Executives looked to broaden the scope of "fun opportunities" and decided to include a book review in the newsletter. Books selected would fit into the category of environmental/sustainability but contained both fiction and non-fiction.

A year-end culmination event was also organized. This event was a documentary screening of three films: Swim Drink Fish, Fix and Release, and Hidden Rivers. The movie night was free and was held at Patagonia Toronto in partnership with Swim Drink Fish and Patagonia. There were over 140 participants at the event.

Figure 11 Youth Council Movie Night at Patagonia

PROGRAM EVALUATION

At the end of the one-year term, Youth Council executives were asked to reflect on the work they carried out over the course of their term. They were asked to consider the following questions first as individuals, and then brought their answers to a subsequent discussion:

1. What was your favourite part of the Youth Council?
2. What was your least favourite part of the Youth Council?
3. Do you think we accomplished our goals? Were the goals reasonable/attainable? (goals: build network, fun opportunities, understand youth perspectives)
4. What about procedures? Meetings (location and times), Executive structure (e.g., role of the chair etc), TRCA staff support, communication (whats app, email, text, FB)?
5. Do you think you benefited from your experience?
6. What would you do differently next time?
7. Do you have any suggestions to get more people out to our events/workshops/etc?

Structure

By and large, the executive members enjoyed their experience, especially being given the freedom to present their own ideas and determine the pathway to achieve those ideas. They found the networking experiences with external partners, RWA members and TRCA staff, as well as learning about the diversity of environmental themes from their peers, from partners and from TRCA, to be beneficial. They also enjoyed networking on a more personal level with other executive and general members.

Monthly meetings were agreed to be necessary. They agreed that booking meetings in the summer was challenging, and there was a noticeable drop in participation among executive members. This was in part due to summer jobs, vacation and summer jobs abroad. As a result, one suggestion is to consider having monthly meetings (including locations) booked well in advance so that they can be made a priority for members, in contrast to finding times that worked for a majority.

In the Terms of Reference, executive members had agreed to a rotating Chair structure, whereby the Chair could change from meeting to meeting. Members acknowledged that this was positive in that multiple people had a chance to chair meetings, but in practice it proved to be too onerous. Few executives volunteered, and it made it challenging to create consistent agendas and minutes. Therefore, it is recommended that positions such as Chair, Vice Chair, and Secretary be term-length positions. Likewise, to help boost participation, roles and responsibilities for executives must be more clearly defined. One suggestion to achieve this is to assign roles to executive members; in this way two people would be responsible for events, two for newsletters, two for building networks etc.

Goals and Objectives

Generally, executives agreed that the Youth Council was able to make progress towards achieving program goals but agreed that more work should be done.

Build youth capacity and learning opportunities

The Youth Council itself is a mechanism to build youth capacity. This was achieved for executive members through their own identification of activities and programs. That said, the level of participation among executive members was varied—some members were actively engaged, while others participated infrequently. This was a source of frustration among members who were actively participating. Since the positions are voluntary it is difficult to enforce participation, but to mitigate this problem, greater care in the selection of executive could be taken. Interviews may provide more insight into whether prospective executives would be committed to actively participating.

At this early stage of the Youth Council, there has been limited interaction with the general membership. This interaction must be increased in subsequent years so that general members feel that they are being heard and have the means to provide input into Youth Council activities.

Build youth network

Creating a network is a long-term and ongoing process that will take longer than one year to achieve. That said, work towards establishing that network was carried out and has laid the groundwork to continue the development of a strong network. The newsletter serves as a means to connect the Youth Council Executive to the general membership, and also provides a platform to share upcoming volunteer opportunities with TRCA or with other groups identified and approached by the Executive.

Executive members agreed that some work had been carried out but felt that they could have done more to build that network utilizing their own personal networks. They also cited that having the opportunity to present at the RWA meeting provided them with important networking opportunities.

Measures:

5 Networking Opportunities (Evergreen Brickworks, Swim Drink Fish, Patagonia, Youth Biodiversity Network, Youth Challenge International)

2 Newsletters sent to all members

3 Events (guided walk, Meadoway clean-up, Movie Night)

1 YourSay Engagement Website

Learn about what is important to youth

A survey of members has provided some insight into youth perspectives and has been able to illuminate some regional and demographic differences in opinion. This is valuable information that will be used to guide future development of Youth Council activities and can be used by TRCA to guide education and community engagement activities.

Executive members pointed out that surveys are one means of collecting data regarding youth perspectives and suggest that more should be done to reach out to general members on a personal level.

Measures:

1 Entrance Survey delivered to all participants (n=116, 100% response rate)

1 Engagement Preference Survey to members (n=18, 15% response rate)

1 YourSay Engagement Website

Create fun opportunities for youth

The Youth Council was able to organize two events: an Earth Day litter clean-up and a free documentary movie night. While few people attended the litter clean up, the movie night was very well attended. The success of the movie night can be attributed to utilizing networks to advertise and to provide free fun opportunities for youth. Patagonia (contacted by Youth Council executives) hosted the event, and through their own network was able to secure donated refreshments. Swim Drink Fish (also contacted by Youth Council Executives) also attended and provided screening rights for their film and advertised the event through their networks. In sum, the event was both a fun opportunity for youth and a capacity-building opportunity for the executives.

Executive members would like to have been able to hold more events, but also said that as this was the inaugural year of the Youth Council, they were satisfied with what they were able to accomplish. They also agreed that it was a learning experience in the kind of work required to put together fun networking opportunities and engaging events.

Measures:

3 Events (guided walk, Meadoway clean-up, Movie Night)

1 YourSay Engagement Website

RECOMMENDATIONS

1. Keep four spaces on the Executive open for returning Executive members. This will help facilitate knowledge transfer and provide continuity to the program.
2. Consider holding interviews for new Executive members
3. Consider breaking over the summer (unless Executive is committed to continuing)
4. Book meetings well in advance at an agreed-upon location
5. Stream-line communication between executives and TRCA utilizing one method (to be agreed upon by Executive)
6. Encourage executives to reach out to their own networks
7. Create more specific roles, beyond Chair and Vice-Chair, for executive members (e.g., events, network, newsletter)
8. Prioritize connecting Executive to general membership and increasing communication between both groups.

CONCLUSION

Overall the first year of the Youth Council was successful. While not all goals were achieved in their entirety, significant strides toward achievement were made. The Youth Council will open recruitment for new executives in October 2019. By implementing the recommendations provided by RWA working group members, former Youth Council Executive members and TRCA staff, the program will be able to make considerable progress toward goal achievement.

Appendix 1: Recruitment Questionnaire

What issues are the most important to you? Please select your top five from the following list

- Biodiversity
- Greening the Economy
- Education
- Farmland
- Protection
- Accessibility
- Sustainable Development
- Food Security
- Immigration
- Climate Change
- Indigenous Reconciliation
- City-building
- Recreational
- Activities
- Access to Green Space, Parks and Natural Areas
- Waste Management
- Renewable Energy
- Heritage
- Urban Forest
- Land-use Planning
- Air Quality
- Green Buildings/Architecture
- Flood Risk/Stormwater Management
- Urban Agriculture
- Wildlife and Habitat Conservation
- Carbon Pricing
- Water Quality/Source Water Protection
- Arts and Culture

Is there anything we missed?

How would you describe the natural environment in your neighbourhood?
Poor Fair Good Very Good Excellent I don't know

Did you grow up in the Toronto region? Yes/No
If no, where?

What year were you born?

What is your first language? English/French/Other please identify

Do you identify as First Nation, Métis, and/or Inuit? Yes/No/Prefer not to answer

What is your gender? Male/Female/Not Listed Here/Prefer not to say

What is your Postal Code?

Name?

Email?

Yes! Send me news and information by email.
By clicking the checkbox above, you provide consent to Toronto and Region Conservation Authority (TRCA) to send newsletters and other emails to the email address provided. You may unsubscribe at any time by using the link at the bottom of every email, or by contacting TRCA at info@trca.on.ca, 416.661.6600, or mailing 5 Shoreham Drive, Toronto, ON M3N 1S4.
TRCA is committed to respecting your personal privacy and will never share your private information with a third party. For more information, please see our Privacy Policy

Appendix 2: Youth Council Executive Retreat Presentation

Youth Council Executive Retreat

Albion Hills Field Centre

Presented by:
Kate Goodale, Project Manager Humber Watershed
Raysha Carmichael, Coordinator, Peel EcoSchools
Daphne Paszterko, Coordinator, Newcomer Youth Program

January 12, 2019

Toronto and Region Conservation Authority

Agenda

9:00 AM -12:30 PM

- Breakfast, Intro and Icebreakers
- Low Ropes
- Marshmallow Challenge
- Framework and Terms of Reference

LUNCH 12:30 -1:30 PM

1:30 – 5:15 PM

- Data Presentation, Develop Objectives
- GPS Activity
- Develop Workplan

DINNER 5:15- 6:15 PM

CAMPFIRE 6:15 -7:15 PM

Introductions – Famous Duos

- Pick a card from the hat
- Once everyone has their label, place yours on your chest
- Walk around the room to find your other half

Learn more about your partner:

1. What is your name?
2. What do you think the biggest environmental challenge your community faces is?
3. What is one thing you hope to achieve through the Youth Council
4. If you were an animal what would you be and why?

Introduce your partner to the group

Ice Breaker – The Story of Your Name

Explain to your partner what your name means (if anything) and where it comes from.

You can also discuss the following questions.

1. Who gave you your name? Why?
2. What is the origin of your name?
3. What are your nicknames, if any?
4. Do you like your name? Why or Why not?
5. What do you prefer to be called?

Take some notes if you like – we will be asking you to share information about your partners' name at the end of the discussion period.

Low Ropes Activity

Get ready to go outside to try out Albion's Low Ropes Course!

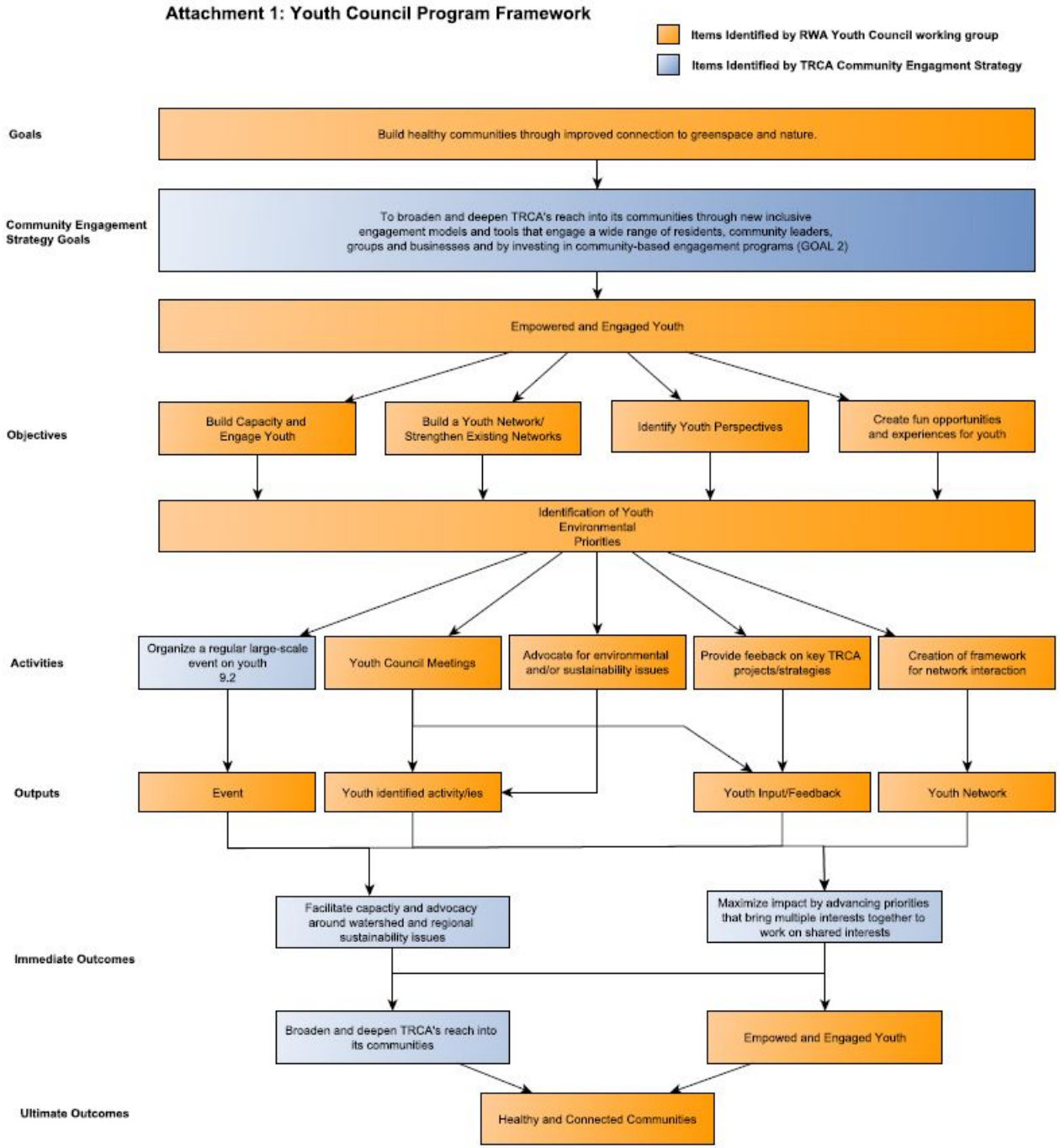
The Marshmallow Challenge

Aim: Construct a spaghetti tower that has a marshmallow on the top. The tallest tower standing unassisted wins!

Rules:

- Only use materials provided: yard of masking tape, 25 sticks spaghetti, marshmallow
- Time limit: 20 minutes
  - Marshmallow must be on the top
  - Tower must be standing unassisted.
- Measurement is a vertical measurement from the table top up
- You may stick masking table tape to the table top
- Spaghetti may be broken into smaller pieces
- Once broken, pieces may not be replaced

Review Youth Council Framework



Review Youth Council Terms of Reference

- Review existing TOR
  - Decide on the STRUCTURE of the Youth Council
  - Decide on MEETING schedule
  - Other revisions
- Brainstorm during this exercise on objectives
- Compile questions for RWA Youth Council Committee for feedback (if needed)

Data Presentation

Learn more about Youth Council Network:

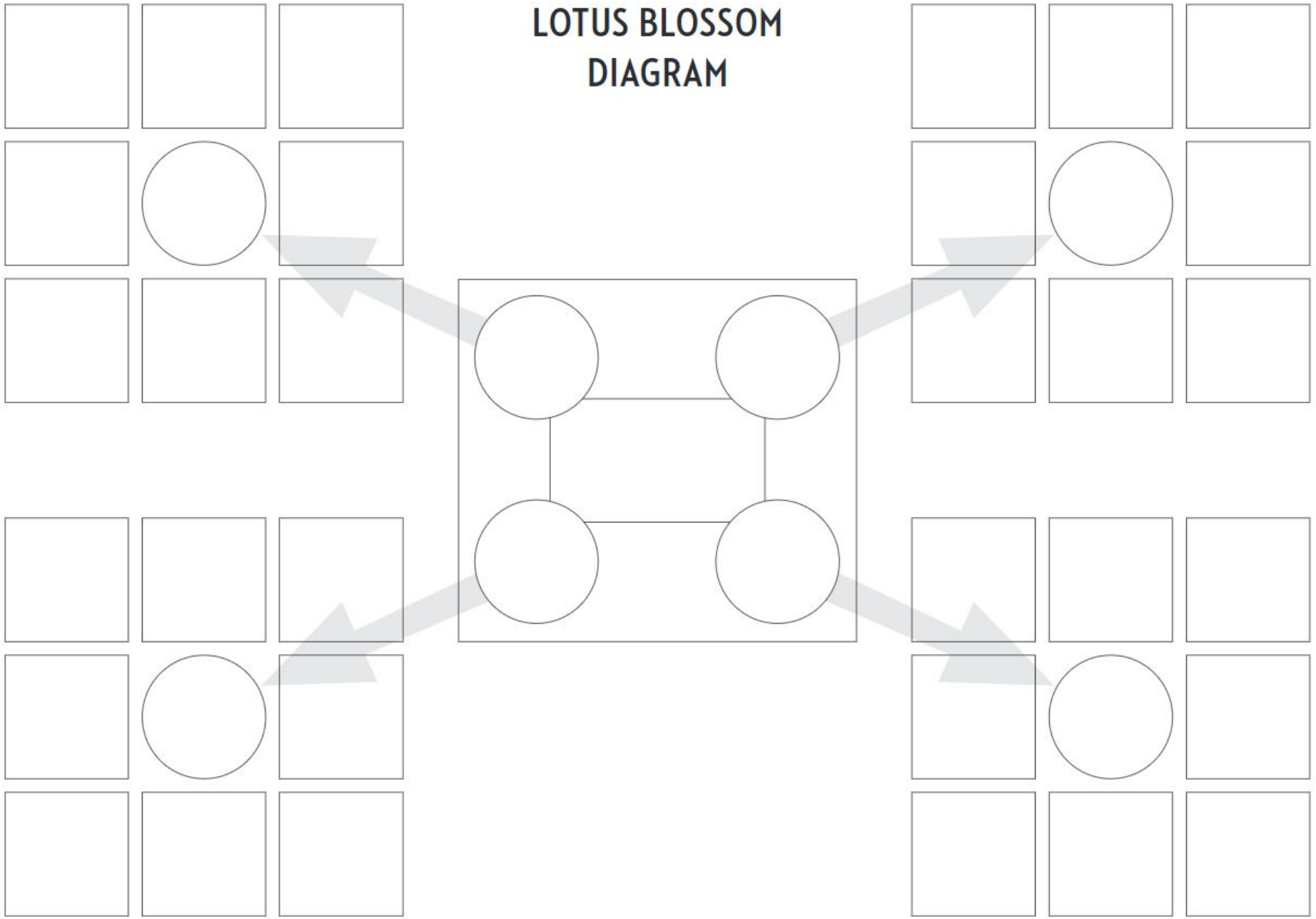
- Demographics
- Priorities

Consider how these could influence:

- Objectives
- Workplan

Developing Objectives

LOTUS BLOSSOM DIAGRAM



Developing a Workplan

	A	B	C	D	E
1	**Workplan - Template**				
2					
3	**Milestone**	**Step**	**Activity**	**Start Date**	**End Date**
4		1. Format Project Plan	Meeting with Mentor, October 8, 2018		
5			Clarify expectations for deliverables re: length, layout and format of report, final deliverable format		
6			Clarify expectations for communication with mentor (eg main team member responsible to be liaison with mentor, best method for reaching mentor (phone, email, text?)		
7			Obtain examples of similar deliverables from organization and discuss what aspects should be retained		
8			Clarify expectations for success with mentor		
9					
10	Technical Report	2. Researching Report	Determine sections of report and divide amongst team members	October 9, 2018	October 11, 2018
11			Background research on Section I		
12			Background research on Section II		
13					
14					
15		3. Writing Report	Introduction		
16			Section 1 - Use of hot water return systems in Unionville		
17			Section 2		
18	Technical Report		Recommendations		
19	Technical Report	4. Editing and Formatting Report	Read report for grammar/spelling/inconsistencies		
20			Format report, insert graphics etc.		
21					

Appendix 3: Terms of Reference

Youth Council Terms of Reference

1.0 BACKGROUND

Since the 1980s, Toronto and Region Conservation Authority's (TRCA) watershed and waterfront committees and task forces have been instrumental in supporting the development and implementation of TRCA's watershed management activities. The Rouge Comprehensive Basin Management Strategy (1988), was TRCA's first initiative supported by a citizen based "public committee." The 1989 Greenspace Strategy committed to a program of watershed strategy development for each of TRCA's watersheds in cooperation with a public advisory committee for each watershed. Over the past two decades, the Duffins-Carruthers Watershed Resource Group, Rouge Park Alliance, Don Watershed Regeneration Council, Humber Watershed Alliance and Etobicoke-Mimico Watersheds Coalition have played a significant role in building community stewardship capacity to help TRCA deliver on priorities of watersheds and waterfront. Watershed and waterfront residents and stakeholders are also engaged through Conservation Lands stewardship committees and integrated/multi-objective or sector-based programs such as Sustainable Neighbourhood Retrofit Action Plans (SNAP) and Partners in Project Green: A Pearson Eco-Business Zone (PPG).

TRCA's 2013-2022 Strategic Plan highlights regional sustainability challenges of increasing scope and scale - such as preparing for the impacts of climate change, transitioning to a low carbon economy, managing urbanization and growth pressures. The Plan also calls for regional engagement of a broad cross-section of the population at both local and regional scales within TRCA's jurisdiction. As such, in 2015, upon the completion of the existing terms for the Don, Humber and Etobicoke-Mimico watershed committees, the Authority directed staff to update TRCA's community-focused engagement model in light of new trends and opportunities in civic engagement and to facilitate the implementation of the Strategic Plan.

On June 23, 2017, at Authority Meeting #8/17, The Community Engagement Strategy along with a new citizen governance model was adopted. The new citizen governance model includes the Regional Watershed Alliance (RWA), and its subcommittees; Youth Council, Watershed/Waterfront Working Groups. An Indigenous Liaison Committee to the Authority has also been approved as part of the proposed governance model (Figure 1). The RWA is a formal citizen advisory board of TRCA which will report to the Authority on regular basis.

The Youth Council will be comprised of community youth champions, existing youth group representatives and new recruits. The Youth Council will report to the Regional Watershed Alliance.

The mission, mandate and goals, along with the Terms of Reference for the working groups, and Youth Council will be developed by TRCA and the Regional Watershed Alliance in consultation with relevant stakeholders.

Authority Direction

Resolution #A178/17 from Authority Meeting #8/17, held on October 27, 2017.

2.0 YOUTH COUNCIL MISSION AND MANDATE

Mission: Build healthy communities through improved connection to greenspace and nature.

Mandate: Reporting to the Regional Watershed Alliance (Figure 1) and working closely with TRCA and the RWA, the Youth Council will be established as a subcommittee to the RWA with the purpose of:

Build Capacity and Engage Youth	provide youth across the Toronto region with learning opportunities;
Build a Youth Network/Strengthen Existing Networks	create/enhance a broad network of youth in the region who are interested in environmental and sustainability issues;
Identify Youth Perspectives	develop an understanding of youth opinion around current environmental issues and understand/investigate how these might be incorporated in the work of TRCA and its partners; and
Create fun opportunities for youth	provide entertaining and engaging learning opportunities.

3.0 ROLES AND RESPONSIBILITIES

The Youth Council shall:

1) Through events and on-line engagement, provide a forum for communication by maintaining and enhancing contacts within the wider youth community. Mobilize and empower networks of that community to build capacity and influence people's behavior;
2) Adhere to the basic principles of sound ecosystem management and sustainability that recognizes the interrelationships between cultural heritage, physical characteristics, biological conditions and economic needs, and the integration of conservation, restoration, social and economic activities necessary for the health of the watersheds;
3) Work with staff in setting regional and local priorities that help advance TRCA's and its municipal partners' objectives of sustainable communities, recommendations of TRCA's 2017 Community Engagement Strategy, watershed plans, watershed report cards and The Living City Report Card;
4) Advocate on regional and local environmental policy issues through discussion papers, briefs and comments etc. and providing advice and comments to staff and the Authority on relevant programs and policies impacting TRCA watersheds and communities. Examples include: TRCA's Terrestrial Natural Heritage System Strategy; Sustainable Near-urban Agriculture Policy; watershed plans; TRCA Trails Strategy; and TRCA Greenspace Strategy;
5) Act as a resource to TRCA, TRCA's municipal partners and The Toronto and Region Conservation Foundation by providing advice on matters of community interest;
6) Work with TRCA and Toronto and Region Conservation Foundation to identify priorities, seek new partnerships, public sector investment and other sources of funding;
7) Where appropriate, and when requested, serve as a spokesperson for media and government relations on behalf of staff;
8) Seek political support at all levels of government;
9) Collaborate with other conservation authorities, municipalities, environmental non-government organizations (ENGO) and groups on opportunities that transcend TRCA jurisdictional boundaries;

10) Maximize the collective impact of TRCA and other environmental and sustainability champions in the region through resource and data sharing, measuring, and reporting on regional priorities; and

11) Report to the Regional Watershed Alliance on a regular basis.

4.0 STRUCTURE

Supported by TRCA staff, the Youth Council Executive will have a rotating Chair, rotating Vice Chair, and will be comprised of approximately 10 voting members.

4.1.1 Voting Members

The Youth Council Executive members will be recruited based on a diverse skill set, sector and community specific expertise, network connections, demonstrated leadership, experience, and knowledge of the watersheds within TRCA's jurisdiction.

4.1.2 Non-Voting General Members

Youth Council membership will be open to all youth (aged 16-24) who reside in or attend school within TRCA's jurisdiction. Members will be invited to attend Youth Council events, and provide input to Youth Council Executives, but will not have voting privileges.

4.1.3 Guests

The Youth Council meetings are open to the public. Municipal or other agency staff may be invited as guests to offer presentations or participate in discussions on relevant issues. Guests will not have voting privileges nor be eligible for travel expenses to and from meetings.

4.1.4 Chair or Vice Chair

The Chair and Vice Chair of the Youth Council will be selected on a monthly rotating basis from amongst its executive members for the term.

The Youth Council Chair and Vice Chair will provide leadership in building a shared vision and commitment for moving forward with the Regional Watershed Alliance's mission, mandate and responsibilities.

The Chair will have the following additional responsibilities:

- Presiding over Youth Council meetings, setting the agenda and generally ensuring the effectiveness of meetings

In the absence of the Chair, the Vice Chair will perform the above functions.

The Vice Chair will have the following additional responsibilities:

- Taking notes, and circulating meeting minutes.

4.2 Executive Membership Appointment Process

Watershed Residents and Students of Schools within Watersheds

Applications from watershed residents and students attending school within TRCA's jurisdiction will be solicited through direct recruitment, announcements in newsletters, local newspapers, web sites, volunteer networks, and through various social media platforms. A committee of TRCA staff and RWA members will select the Youth Council Executive members through the application process using a set of criteria to ensure suitability and eligibility.

4.3 Term of Appointment

Youth Council Executive members will be established with a revolving term of one year. Members will be appointed for a one-year term with a possible extension of up to two years. This will allow for a staggered replacement process maintaining a balance between new and experienced members. The membership will be reviewed on an annual basis. Members unable to fulfill their commitments may be replaced as per TRCA's Roles of Conduct.

Notice of resignations and recommendations for new members will be presented to TRCA for approval on an 'as required' basis.

4.4 Meetings

Executive Members are required to attend monthly evening meetings. Meetings are expected to be approximately three hours in length, at the discretion of the Youth Council. An agenda will be circulated one week in advance of meetings.

The Executive will have the discretion to call additional meetings, if required. Additional meetings may be required to deal with specific issues from time to time. Some meetings may be held during regular work hours depending on the preference and availability of members and staff or via conference call or online meetings.

Light meals and refreshments will be provided at evening meetings.

4.5 Reporting

The Youth Council is considered an Advisory Body of the Regional Watershed Alliance. The Youth Council will report to the RWA on projects and progress through their meeting minutes or seek RWA approval as necessary on specific initiatives.

The Youth Council is not a formal commenting body regarding review and approval of planning applications or permits.

4.6 Quorum and Governance

A quorum will consist of voting members in numbers greater than or equal to one-third of the total number of voting members on the Youth Council Executive.

Consensus-based decision making will be the preferred procedure. Formal decisions will be based on a simple majority vote. In the event of a tie, the vote fails.

4.7 Rules of Conduct

The Regional Watershed Alliance will adhere to TRCA's Rules of Conduct as adopted by Resolution #A34 at Authority Meeting #2/86, held on March 21, 1986, and as amended periodically or superseded by any bylaws enacted as per the Conservation Authorities Act. Other policies and legislation may be applicable in regard to code of conduct, conflict of interest and Volunteer Policy.

4.8 TRCA Staff Support

The Youth Council will be supported by a team of staff from the Community Engagement and Outreach, and the Education and Training Divisions including:

- Director, CE and O;
- Government and Community Relation Specialists;
- project managers;
- coordinators;
- administrative support staff.

Staff will provide the following support functions:

- Coordination of Youth Council meetings;
- Administrative and financial support;
- Strategic guidance on alignment of Youth Council work plan priorities with other strategic opportunities;
- Coordination of work with The Toronto and Region Conservation Foundation;
- The Toronto and Region Conservation Foundation support for management of any funds collectively raised by the Youth Council or any of its subcommittees that support the implementation of their work plans; and
- TRCA technical expertise on projects and initiatives of the Youth Council and its subcommittees.

4.9 Funding

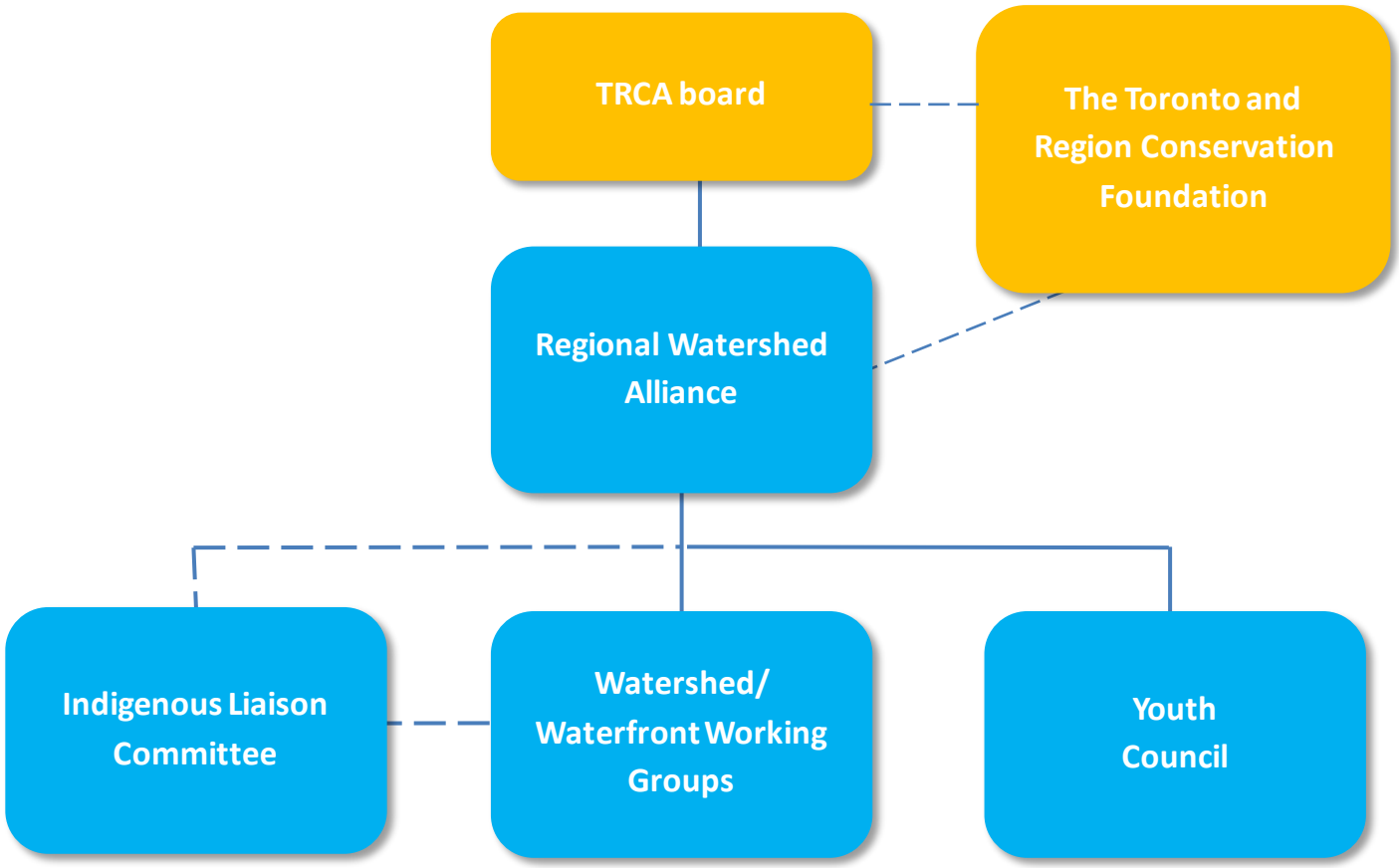
Funding will be available for projects and activities of the Youth Council based on approved work plans and available TRCA budget. Members are encouraged to assist in securing other resources and partnerships for Youth Council projects and activities, whenever possible through collective public investment opportunities. In-kind or other support for the projects and activities of the council are welcome from businesses, industries, government agencies, private foundations, educational institutions and others in accordance with TRCA policies. In-kind or other support will be coordinated with the assistance of The Toronto and Region Conservation Foundation, where appropriate.

5.0 COMPENSATION FOR YOUTH COUNCIL MEMBERS

At regular Youth Council meetings executive members will be eligible for travel expenses and any other expenses approved in advance by TRCA's Director, CE and O, according to TRCA policy, where these are not covered by their agency or other source. The TRCA policy on volunteers is also applicable and can be accessed at: *http://trca.on.ca/get-involved/volunteer/volunteers-and-interns.dot*. Members shall not receive a per diem or honorarium for attendance at meetings and functions. General members are not eligible for

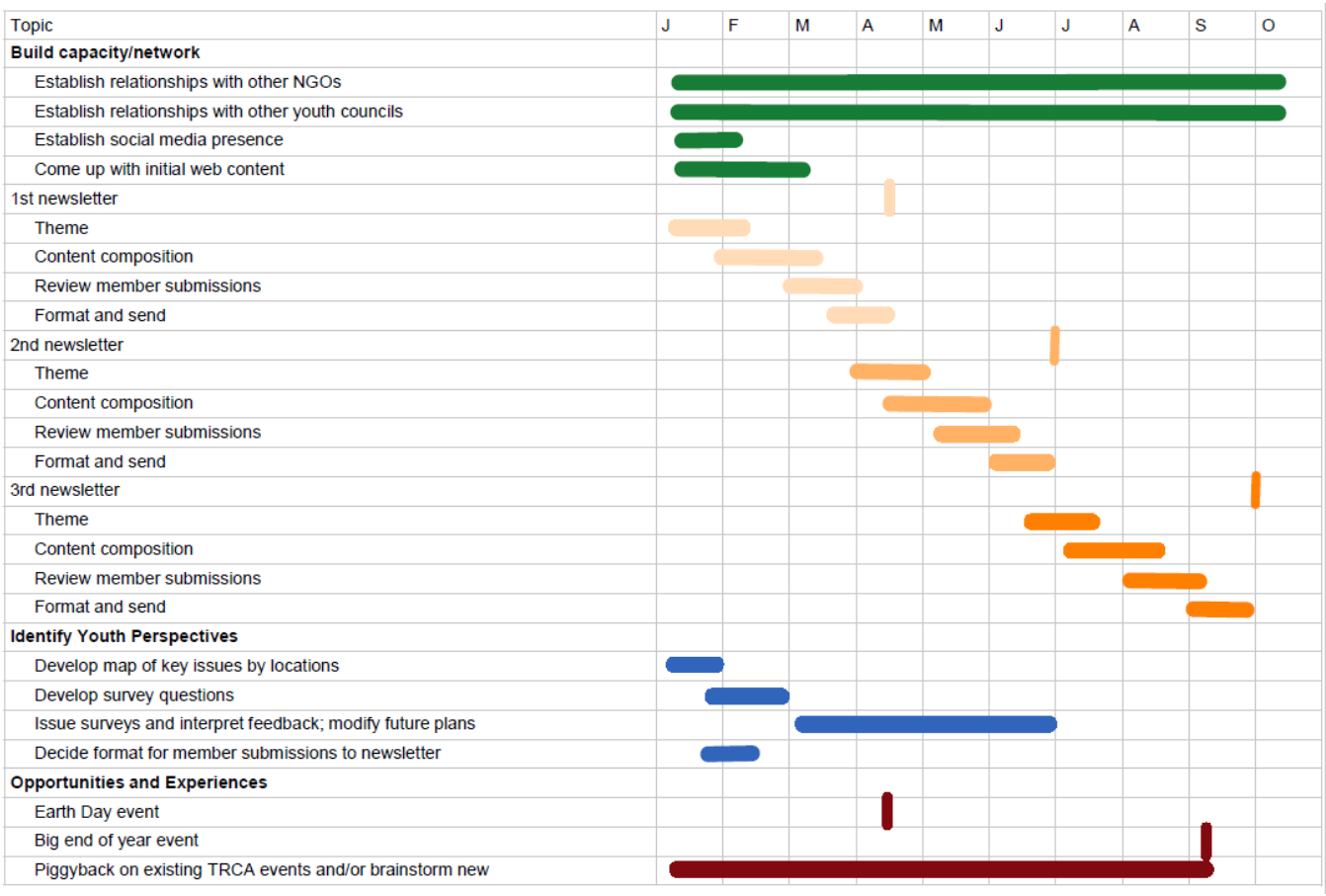
reimbursement of expenses (including travel expenses).

Figure 1: TRCA Citizen Governance Model



Appendix 4: Workplan

Gantt Chart Developed by Youth Council Executive at Retreat



Formal Workplan:

Youth Council – Work Plan 2019

PROJECT NAME	TRCA Staff Lead
Regional Watershed Alliance (Working Group)	Kate Goodale, Project Manager, CE & O, TRCA

ACTION	TASK	STATUS	NOTES
Objective #1 : *Build capacity among youth and build/strengthen youth network*			
Establish relationships with other NGOs/Youth Councils	- Share opportunities with the YC network - identify synergies with potential partner organizations	On going	External volunteering/networking opportunities: - Swim Drink Fish - Youth Challenge International, Climate Action Catalyst - Evergreen
Create social media presence	Use hashtag #TRCAYouth in lieu of social media accounts	On going	Working with marketing to develop materials
Create Web Content	- Your Say website - TRCA landing site	On going	Working with marketing to develop materials https://yoursay.ca/youth-perspectives
Create three newsletters	e-blasts to go out in April, July, September	On going	Working with marketing to develop materials
Objective #2: *Identify Youth Perspectives*			
Develop a map of key issues by locations	Google map of primary interests of members based on postal code	Complete	
Develop survey for wider public to better understand youth priorities across jurisdiction	- Develop survey - Push survey through network and TRCA social media - Analyze data	In progress	- Survey has been developed and deployed
Present at Latornell	- Create Abstract - Create Presentation	In Progress	Abstract has been submitted
Objective #3: *Create fun opportunities and experiences for youth*			
Earth Day event	Clean Up in the Meadoway	Complete	Event held April 28th 2019
Create big year end event	Free Movie Night with Patagonia and Swim Drink Fish	Complete	Survey to YC members to determine interests, will inform the development of this event

www.trca.ca

Toronto and Region Conservation Authority

Attachment 2 – Youth Council Executive Membership for 2019/2020

Confirmed:
Wai Ying Lam
Adeena Afridi
Tua Hytonen
Alessia Molé

Pending Confirmation:
Issa Ashtarieh
Matthew Zuniga
Maya Adachi
Rebecca Formosa
Shannon Petrie
Luca Villeneff

RES.#24/19 - **TRAIL STRATEGY FOR THE GREATER TORONTO REGION**
Update on the final endorsement of TRCA's Trail Strategy for the Greater Toronto Region (TRCA Trail Strategy) and next steps.

Moved by: Elizabeth Calvin
Seconded by: Lisette Mallet

WHEREAS the TRCA Trail Strategy received final endorsement from the TRCA Board of Directors at Meeting #8/19, held on September 27, 2019;

THEREFORE, LET IT BE RESOLVED THAT the TRCA Trail Strategy and staff report be received;

THAT TRCA Trail Strategy priorities be integrated into the work plans of working groups of the Regional Watershed Alliance, where appropriate;

AND FURTHER THAT the Regional Watershed Alliance members help to advance the objectives of the TRCA Trail Strategy through advocacy and identifying grant, funding or program opportunities that can be brought forward for TRCA consideration.

CARRIED

BACKGROUND
Toronto and Region Conservation Authority (TRCA) drafted the Trail Strategy for the Greater Toronto Region (the Trail Strategy) in 2018. The Trail Strategy sets out the direction for TRCA to work towards achieving its vision of "a complete regional trail network in greenspace and along the Lake Ontario shoreline that connects our growing communities to nature, to culture, and to each other, contributing to active living and enhancing our conservation legacy." It outlines TRCA's plan to complete, expand, manage and celebrate the Greater Toronto Region trail network and serves as a framework to protect potential trail alignments. It acts as a guide for the planning, development and management of these trails, and creates the opportunity for partnership with our member municipalities, provincial and federal agencies, and trail focused groups.

The Draft TRCA Trail Strategy for the Greater Toronto Region was endorsed by the Regional Watershed Alliance at Meeting #3/18, held on September 19, 2018 by Resolution #R5/18, as amended, and was adopted by the Board of Directors at Meeting #9/18, on November 30, 2018, with Resolution #A183/18.

At Board of Directors Meeting #8/19, held on September 27, 2019, Resolution #A157/19 was approved as follows:

> *WHEREAS it was resolved by the TRCA Board at Meeting #9/18 on November 30, 2018 that the Draft Trail Strategy for the Greater Toronto Region, dated November 2018, be endorsed in principle for the purposes of engaging with external partners to obtain input prior to finalizing the Strategy and Workbook and for informing staff reviews of projects and plans and preliminary budget submissions (RES.#A183/18);*
>
> *WHEREAS it was resolved by the TRCA Board at Meeting #9/18 on November 30, 2018 that staff were requested to report back to the Board of Directors in Q3 2019 for final approval of the Strategy;*

THEREFORE, LET IT BE RESOLVED THAT the TRCA Trail Strategy for the Greater Toronto Region be approved;

AND THAT TRCA staff be directed to meet with partner municipalities to discuss priority projects, service level agreements, and funding agreements in support of the expansion and management of the regional trail network;

THAT TRCA request the Province recognize and build components of the TRCA Trail Strategy for the Greater Toronto Region into the Province's transit and transportation strategies, projects, and provincial land use plans including the Metrolinx Regional Transportation Plan, the Growth Plan for the Greater Golden Horseshoe and official plan update and conformity processes;

AND FURTHER THAT TRCA'S trail partners and the Regional Watershed Alliance be so advised.

RATIONALE

When endorsing the Draft Trail Strategy in 2018, the TRCA Board of Directors directed staff to engage with external partners to obtain input prior to finalizing the Strategy. Staff proceeded to consult with external partners, stakeholders and the public from December 3, 2018 to January 18, 2019. Engagement occurred in the form of meetings, workshops, presentations, social media marketing campaigns, online commenting forms and public open houses. The extensive and constructive input provided by governments, community stakeholders and the public greatly improved the Trail Strategy.

Staff incorporated the feedback received from the additional engagement in late 2018 and early 2019 into the final Trail Strategy document. The overall framework of the Trail Strategy is maintained, including the concept and guiding principles.

See the approved Trail Strategy for the Greater Toronto Region here.

Updates to the Trail Strategy

The following highlights some of the changes made to the Trail Strategy as staff prepared it for final endorsement.

Purpose, Vision Statement and Strategic Objectives

The purpose of the Trail Strategy was updated to emphasize the importance of capitalizing on the development process to protect land in support of trail development. The updated purpose of the Trail Strategy is "to outline a plan to protect potential trail alignments, and to guide the planning, development and management of a network regional trails".

The vision of the Strategy was updated to include the Lake Ontario shoreline as it serves as an integral feature of the regional trail network in the Greater Toronto Area. The updated vision for the Trail Strategy is "a complete regional trail network in greenspace and along the Lake Ontario shoreline that connects our growing communities to nature, culture, and to each other, contributing to active living and enhancing our conservation legacy".

The strategic objectives now consist of seven strategies that set out how TRCA will work to achieve the vision of the Trail Strategy. The eighth strategic objective (Organize Effective Trail Leadership) was removed as a strategic objective and its content was included as part of the

Making It Happen: Organizing for Success section of the document. The rationale for this change is that this strategic objective was better suited as a short-term operational objective rather than a longer-term goal.

The remaining seven strategic objectives are as follows:

1. Prioritize trail and destination area capital projects
2. Promote greater trail use and awareness
3. Build a sound knowledge base
4. Integrate community enjoyment and protection of our heritage
5. Promote meaningful community engagement
6. Support complete communities
7. Secure adequate and sustainable investment

Trail Concept

Staff received important feedback from both our government partners and the public. Comments and suggestions were used to update conceptual trail alignments and provided TRCA staff with a greater understanding of how people use trails and where improvements could be made. Existing and conceptual trail alignments were refined to include updated, project-level detailed trail alignments and recommendations from municipalities, stakeholders and the public. The concept now better aligns with municipal initiatives.

The Greater Toronto Region Trail Network presented in the trail concept includes 1,000 kilometres of trails. This includes 520 kilometres of trails that are already in place and 480 kilometres of new trails yet to be built. The trail concept will continue to be updated to reflect current conditions opportunities and priorities, and TRCA will be making this spatial dataset available through TRCA's Open Data Portal so that it can easily be incorporated into the strategies and plans of others.

Context

The Cultural Heritage context section of the Trail Strategy was expanded to elaborate on key terms and concepts. This complements the section on Natural Heritage and demonstrates TRCA's interest in cultural heritage protection and celebration.

Making it Happen

The Trail Strategy positions trails as a key component of complete communities and as a mechanism to conserve the natural and cultural heritage features of our watershed. The development industry plays a significant role in the development of our communities. Therefore, more emphasis was put on the development process and its importance towards building the regional trail network.

The proposed external Trail Leaders Round Table was removed from the document and replaced with targeted meetings with government partners involved in trail planning, implementation and operations. These meetings will build on existing relationships with TRCA's municipal partners, other government agencies, and trail leaders.

The Workbook is no longer included as a separate document. Financial information previously included as part of the Workbook was moved to the Trail Strategy document. Other information contained in the Workbook such as the trail and destination capital project candidate lists and implementation plans will be included as part of future online mapping initiatives and will be maintained to reflect current conditions including opportunities and completed works.

Priority trail projects will include those that will close gaps in existing major trail systems, quick win projects, and partnerships with government partners and other trail partners to plan, design and build trails.

Role of the Regional Watershed Alliance
The Regional Watershed Alliance is identified as a trail and community leader with whom TRCA will be collaborating in order to deliver the vision of the Trail Strategy. Therefore, Trail Strategy priorities will continue to be integrated into the work plans of working groups of the Regional Watershed Alliance where appropriate. This work will focus on the following:

1. **Advancing Strategic Objectives:** TRCA will continue to rely on the members of the Regional Watershed Alliance to advance the objectives of the Trail Strategy through known grant or program opportunities, their respective networks, and municipalities.
2. **Creating Opportunities:** The Regional Watershed Alliance will work collaboratively with the TRCA Trails Working Group, as well as the other trail and community leaders, to create opportunities for all groups, particularly Indigenous communities.
3. **Coordinated Engagement:** Coordinating public consultation efforts through a geographically representative body such as the Regional Watershed Alliance will support consensus-building and ensure trail-based decisions with regional impact are made equitably.

Relationship to Building the Living City, the TRCA 2013-2022 Strategic Plan
This report supports the following strategies set forth in the TRCA 2013-2022 Strategic Plan:
Strategy 3: Rethink greenspace to maximize its value
Strategy 4: Create complete communities that integrate nature and the built environment
Strategy 5: Foster sustainable citizenship
Strategy 6: Tell the story of the Toronto region
Strategy 7: Build partnerships and new business models

FINANCIAL DETAILS
Financial resilience will require a range of eligible funding sources as well as leveraging the revenue-generating potential of trails and related facilities. TRCA will use the Trail Strategy to collaborate with municipal, provincial and federal colleagues, non-governmental organizations, trail and community leaders, and the development industry to acquire, protect and enhance the Greater Toronto Regional Trail Network. A financial plan to obtain funding to deliver the projects will be developed and the Trail Strategy initiatives and actions will be incorporated into work plans and into business and budget planning processes in a manner that maximizes budgets, time, and resources. This will include all traditional funding sources and support, including the levy process, service agreements, mutually beneficial partnerships with municipalities, federal, provincial and municipal funding programs, Toronto and Region Conservation Foundation donations and funding campaigns, the development process, and development and management agreements, as well as other partnership projects with trail and community organizations.

The total cost to increase TRCA's trail program budget to meet the directions provided in the Trail Strategy and its action plan will be identified as unfunded priorities within TRCA's budget planning process in 2020 and beyond. If funding support for the administration of the Trail Strategy is secured for 2020, it would include consideration of all proposed amendments or updates from trail partners, advancement of three actions identified in the action plan per year, and monitoring and reporting on the performance of the Trail Strategy at a cost of $500,000.00

(2020 dollars). Staff will continue to explore a variety of additional funding sources to contribute to the financial implementation of projects outlined in the Trail Strategy in conjunction with budget planning process for the unfunded priorities.

DETAILS OF WORK TO BE DONE

TRCA is focused on:

- Securing more greenspace to provide trails, grow our natural system and accommodate growth (Initiative 1.1).
- Developing a business plan to deliver trail and destination area capital projects in partnership with our government partners (Initiative 1.2).
- Implementing a wayfinding plan for the Greater Toronto Region Trail Network (Initiative 2.1).
- Implementing a communications campaign for the Greater Toronto Region Trail Network (Initiative 2.2).

In order to achieve these initiatives, TRCA will:

- Continue to pursue and obtain funding to administer the Trail Strategy and deliver priority trail and destination capital projects through TRCA's budget planning process, the TRCA grants centre and with trail partners, with the assistance of Regional Watershed Alliance members.
- Use the TRCA Trails Working Group to guide the phased implementation of the Trail Strategy, to prioritize trail capital projects, and to ensure that trail-related activities are coordinated within TRCA and with our municipal partners and partner agencies.
- Formalize municipal partner working group meetings to discuss existing and future trail projects, coordinate implementation plans, seek opportunities for partnership, secure land and easements, and address trail ownership and management.
- Incorporate the Trail Strategy initiatives and actions into work plans and into business and budget planning processes, including those of the Regional Watershed Alliance.
- Track and report on the performance of the Trail Strategy.

Members of the Regional Watershed Alliance will be valuable in helping TRCA to:

- Identify capital funding or program opportunities to deliver trail projects in partnership with government partners that can be brought forward for TRCA staff review via the Strategic Business Planning and Performance business unit.
- Explore new forms of technology to improve natural and cultural interpretation on trails.
- Implement a communications campaign for the Greater Toronto Region Trail Network that builds on existing trail promotion efforts by TRCA and partners.
- Partner with municipalities, tourism agencies, and private businesses to promote destinations within the Greater Toronto Region Trail Network.

Report prepared by: Deanna Cheriton, Ext 5204
Emails: deanna.cheriton@trca.ca
For Information contact: Deanna Cheriton, Ext 5204, Ralph Toninger, Ext 5366
Emails: deanna.cheriton@trca.ca, ralph.toninger@trca.ca
Date: October 18, 2019

Items for the Information of the Regional Watershed Alliance

RES.#R25/19 - VALUATION OF ECOSYSTEM SERVICES PROVIDED BY THE CITY OF TORONTO RAVINE SYSTEM

To inform the Regional Watershed Alliance regarding the results of an ecosystem service valuation of the Toronto ravine system and discuss potential application and advancement of this approach in other parts of TRCA's jurisdiction as appropriate.

Moved by: Madeleine McDowell
Seconded by: David Laing

WHEREAS the Toronto Ravine Strategy, approved in 2017 by Toronto City Council, outlines several actions for supporting a natural, connected, and accessible ravine system for the health and well-being of the city;

AND WHEREAS completing an analysis of the ecosystem services provided by Toronto's ravine system is one such action specified in the Ravine Strategy;

AND WHEREAS the Toronto and Region Conservation Authority (TRCA), in support of the implementation of this strategy, partnered with the City of Toronto to undertake an ecosystem service valuation study in 2018;

THEREFORE, LET IT BE RESOLVED THAT the Regional Watershed Alliance receive the staff report on the ecosystem service valuation study;

AND FURTHER THAT staff continue to engage the Regional Watershed Alliance in the current science and application of ecosystem service valuation approaches, as well as engagement opportunities, in order to advance TRCA programs and support municipal partners.

CARRIED

BACKGROUND

In 2017 the City of Toronto developed its first Ravine Strategy. The Strategy recognizes the critical role ravines play in the health and well-being of the city, as well as the continued pressures that population growth, new development, and climate change place on the ravine system. The vision of the Strategy is:

> *A ravine system that is a natural, connected sanctuary essential for the health and well-being of the city, where use and enjoyment support protection, education and stewardship.*

The Strategy outlines five guiding principles and twenty actions for Toronto's ravines, as developed through extensive consultation with the public, interest groups, staff and key stakeholders. One such action is to undertake an analysis of the ecosystem services provided by the ravine system. Specifically, the Strategy directs focus to the *market* and *non-market value* of ecosystem services, such as air pollution removal, erosion control, and recreation.

The intended goal of this action is to raise awareness about the essential role that the ravine system plays in the health and wellbeing of human and non-human residents. Although the

application of economic models to complex ecological systems is understood by staff to be a challenging and contentious undertaking, such studies can provide useful information to support consensus-building and outreach efforts.

In 2018, the City of Toronto and the Toronto and Region Conservation Authority partnered to undertake the ecosystem service analysis as outlined in the Ravine Strategy. Green Analytics, a consulting firm specializing in the valuation of ecosystem services, was retained to undertake the technical assessment. The study was completed in the summer of 2018 (Attachment 1).

RATIONALE

Toronto's ravine system provides many benefits to the people of Canada's most populated city, including improved air quality from the filtering effects of trees, recreation and active transportation opportunities, aesthetic benefits from natural landscapes, and cultural and spiritual benefits. These benefits are termed *ecosystem services*. By framing these benefits in this manner, staff are better able to conceptualize, plan and manage natural systems as essential *green infrastructure* requiring dedicated investment.

In order to more fully understand the value of the ravine system, Green Analytics completed an economic evaluation that considered thirteen distinct ecosystem services (Attachment 2, Table 1). A monetized value was estimated for eight of the thirteen services. The remaining services identified were not evaluated for several reasons, including a lack of necessary data and unsuitability of existing economic methods.

Several different techniques are available for assigning monetary values to ecosystem services. The two main approaches used for this study are:

a) An expenditure approach, which calculates money spent to access the ecosystem services provided by the ravines;
b) An avoided costs approach, which calculates the reduced economic costs (to health-care for example) as a result of the services provided by the ravines.

The study utilized locally derived data to the greatest extent possible. However, where local data was not available, values derived in other communities were used. Table 2 (Attachment 2) outlines the ecosystem services quantified in the study and the metric applied to the calculation of associated benefits.

Based on the monetized benefits, the total annual value of the ecosystem services provided by Toronto's ravines is an estimated $822 million. Table 3 (Attachment 1) outlines the physical and monetary flow accounts for the ecosystem services assessed.

Study Limitations

There are several limitations that must be considered when applying and communicating the results of ecosystem service valuation studies. Such assessments tend to include only a subset of the ecosystem services generated by a target land area. For example, the Toronto ravine study did not assess several important services, including flood mitigation. In many instances, the monitoring data required to assign value may be incomplete or absent altogether. The complexity and interconnectedness of ecosystems presents significant challenges for economic models that rely on discrete, monetizable parts. Furthermore, the value derived from a landscape may be highly subjective and strongly influenced by the unique worldview and lived-experience of an individual. Thus, it is difficult to aggregate all the nuanced preferences of individuals together to reflect larger group values. It follows that the values presented in this study should be considered conservative estimates and care should be taken to communicate

and apply the values appropriately.

Relationship to Building the Living City, the TRCA 2013-2022 Strategic Plan
This report supports the following strategies set forth in the TRCA 2013-2022 Strategic Plan:
Strategy 3 – Rethink greenspace to maximize its value
Strategy 4 – Create complete communities that integrate nature and the built environment
Strategy 9 – Measure performance

FINANCIAL DETAILS
The funds required for this project were provided by the City of Toronto.

DETAILS OF WORK TO BE DONE
Staff will seek RWA input on potential application of this approach to increase public awareness.

TRCA will continue to support our municipal partners in the advancement of the science and application of ecosystem service valuations. We will work the City of Toronto to utilize these study results for public communications and other purposes, as requested.

Finally, staff will continue to monitor and engage with researchers and practitioners engaged in the discipline of ecological economics in order to apply existing and emerging methods for valuation accurately and responsibly.

Report prepared by: Meaghan Eastwood, Ext 5734, Noah Gaetz, Ext 5348
Emails: meaghan.eastwood@trca.ca, noah.gaetz@trca.on.ca
For Information contact: Meaghan Eastwood, Ext 5734, Noah Gaetz, Ext 5348
Emails: meaghan.eastwood@trca.ca, noah.gaetz@trca.ca
Date: October 22, 2019
Attachments: 2

Attachment 1: Ecosystem Service Values of the City of Toronto Ravine System
Attachment 2: Supporting Tables for City of Toronto Ravine Ecosystem Services

GREEN ANALYTICS

ECOSYSTEM SERVICE VALUES OF THE CITY OF TORONTO RAVINE SYSTEM

Prepared for the City of Toronto and Toronto and Region Conservation Authority

FINAL REPORT

July 25, 2018

Submitted by:	Guelph Office	Head Office (Edmonton)
Green Analytics	Jeff Wilson (Primary Contact)	Unit 348, 2057 111 Street
www.greenanalytics.ca	Chief Executive Officer	Edmonton, AB T6J 4V9
	41 Verney Street	P. 887.353.6835
	Guelph, ON N1H 1N5	contact@greenanalytics.ca
	P. 226.820.0233	
	jeff.wilson@greenanalytics.ca	

Table of Contents

Executive Summary

Toronto's ravine system provides many benefits to the people of the Canada's most populated city, including improved air quality from the filtering effects of trees, recreation and active transportation opportunities, aesthetic benefits from natural landscapes, and cultural and spiritual benefits. To support informed decision-making about the management and use of the city's ravine system, the value of these *ecosystem services* can be measured, monitored and wisely managed along with other services provided by more traditional assets (e.g. financial and infrastructure assets).

Green Analytics was commissioned by the City of Toronto and Toronto and Region Conservation Authority (TRCA) to provide an assessment of ecosystem service values provided by the natural capital within the ravine system. Natural capital can be defined as the stock of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people. These benefits are termed ecosystem services.

This analysis follows from direction outlined in the Toronto Ravine Strategy, which provides guidance for ravine management, use, enhancement and protection. The study area for the assessment is the City of Toronto's Ravine and Natural Feature Protection Bylaw area, referred to as Toronto's ravine system. The assessment relied on the most current economic and ecological condition data, as well as the most up-to-date valuation approaches. Thirteen ecosystem services provided by natural capital in the ravine system were considered, and monetized benefit estimates were derived for eight of the thirteen services. Ecosystem services for which monetized estimates were derived include:

- Recreation
- Physical health
- Mental health
- Gas regulation (e.g. air quality)
- Carbon sequestration
- Food provision
- Aesthetic appreciation
- Habitat and refugia

For each ecosystem service noted above, a description of the service is provided, along with details on how the values were estimated. Depending on the service, the valuation approach varied. Services that were considered, but not assigned a monetary value, include:

- Disturbance regulation (e.g. flood mitigation)
- Temperature regulation
- Noise regulation
- Active transport
- Education and research benefits

Based on the monetized benefits, the total annual value of the ravine system's ecosystem services is estimated to be $822 million. Table 1 provides a summary of the values by ecosystem service. The values

presented here should be considered conservative as we only included benefits with an existing body of supporting evidence.

Table ES-1: Ecosystem service physical flows and monetary benefits for the City of Toronto ravine system

Ecosystem service physical flows and monetary benefits for the City of Toronto ravine system							
Ecosystem Service	**Indicator**	**Unit**	**Physical flow 2017**		**Indicator**	**Unit**	**Monetary flow benefit 2017 ($ Millions)**
Recreation	Users of ravines for cycling and biking	# of users	398,240		Value of welfare benefit received by biking in ravines	$ per year	**$111**
	Users of ravines for walking and hiking	# of users	924,486		Value of welfare benefit received by walking and biking in ravines	$ per year	**$473**
Physical health	Population meeting physiscal health guidelines by accessing greenspace	# of people	753,812		Value of physical activity supported (avoided health care costs of dealing with ill health due to inactivity)	$ per year	**$217**
Mental health	Reduced number of people experiencing depression	# of people	5,297		Value of improved mental health, avoided foregone GDP due to depression	$ per year	**$5**
Gas regulation (air quality)	Air pollution removed (CO, NO_x, O_3, PM_{10}, SO_2)	metric tonnes	CO=3.2; NOx=94.3; O3=374.4; PM10=113.0; SO2=19.8		Value of cleaner air (avoided health care costs of visits to hospital for respiratory and other related health issues)	$ per year	**$7**
Carbon sequestration	CO2e sequestered	metric tonnes	14,542		Value of carbon sequestered (avoided social damages that are anticipated to result from climate change)	$ per year	**$2**
Food provision, urban agriculture	Fruit and vegetable production occuring in ravine area	metric tonnes	34.7		Value of food from urban agriculture sites in ravines (replacement cost of equivalent produce)	$ per year	**$0.04**
Aesthetic appreciation	Area of natural cover	hectares	6,000		Value people place on the aesthetic enjoyment of the area	$ per year	**$2.67**
Habitat and refugia	Area of natural cover	hectares	6,000		Value people place on knowing natural areas exist	$ per year	**$2.47**
							$822

The values presented above can inform the potential implications of land use change and resource management policy decisions in Toronto. As with all critical assets that support health and wellbeing, the natural assets of the ravine system should be protected or enhanced to ensure the flow of ecosystem services can be sustained for current and future residents of the watershed.

1 Introduction

Toronto's ravine system provides many benefits to the people of the Canada's most populated city, including improved air quality from the filtering effects of trees, recreation and active transportation opportunities, aesthetic benefits from natural landscapes, and cultural and spiritual benefits. These *ecosystem services* provided by the natural capital of the ravine are significant contributors to the health and wellbeing of the residents of Toronto and its surrounding regions. Thus, it is imperative that they be taken into consideration when making land-use and resource development decisions. To support informed decision-making about the management and use of the city's ravine system, the value of these *ecosystem services* can be measured, monitored and wisely managed along with other services provided by more traditional assets (e.g. financial and infrastructure assets). Thus, Green Analytics was commissioned by the City of Toronto and Toronto and Region Conservation Authority (TRCA) to provide an assessment of ecosystem service values provided by the natural capital resources within the ravine system, a recommended action included in the 2017 Toronto Ravine Strategy. The assessment relied on the most current economic and ecological conditions as well as the most up-to-date data and valuation approaches.

The results of the ecosystem service assessment of the City of Toronto ravine system are contained in this report, which is structured as follows:

- Section 2 contains background information on the ravine system, natural capital and ecosystem services.
- Section 3 presents values for each of the ecosystem services provided by the ravine system.
- Section 4 summarizes the ecosystem service values for the ravine system.
- Section 5 presents recommendations and concludes the report.
- Appendix A provides an overview of the state of ecosystem service science in an urban context.
- A reference list is provided at the end of the report.

2 Background

The importance of healthy, functioning ecosystems and the ecosystem services that they provide is increasingly being recognized within Canada and around the world. The result is a growing trend towards the assessment and valuation of such services. Decision-makers at various levels of government (municipal, regional, provincial, federal) are pursuing the assessment and valuation of ecosystem services to:

1. Better communicate the importance of green space to residents,
2. Inform policy decisions related to natural resource consumption, management and conservation,
3. Measure and track progress towards policy goals and objectives, and
4. Complement and incorporate ecosystem service estimates into measures of wellbeing, which tend to focus on traditional economic-oriented indicators (such as gross domestic product).

Commensurate with the increased interest in recognizing the value of ecosystem services, is the trend towards improved analytical approaches for identifying, quantifying, assessing and valuing such services. This section of the report defines natural capital and ecosystem services.

2.1 Natural Capital and Ecosystem Services Defined

Natural capital refers to the stock of natural "assets" in a region. It is typically characterized by common ecosystem land cover types such as water, forests, wetlands, and grasslands, but also includes air, soil, and the assemblage of flora and fauna that make up these ecosystems. Similar to other forms of capital, these stocks produce a flow of valuable goods and services over time. For instance, a wetland (the stock) can absorb flood water, providing flood protection (the flow) to people and property downstream. These flows are referred to as ecosystem services. Ecosystem services are typically defined as the benefits people obtain from nature. They are measurable and result in improvements to human wellbeing. In the case of flood protection, for example, the benefit that can be measured is avoided flood damages. Figure 1 illustrates the pathway from ecosystem structure to economic value.[1]

[1] For an alternative, and more detailed representation of this pathway please see the ecosystem services cascade model used by the Common International Classification for Ecosystem Services: https://cices.eu/supporting-functions/

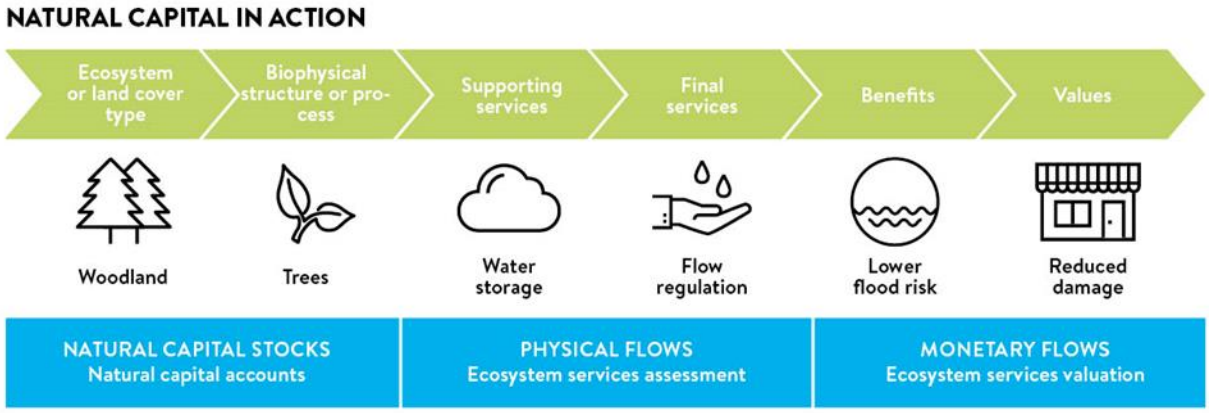


Figure 1. The pathway from ecosystem structure to economic value[2]

On the left side of Figure 1, the stock of natural capital is defined by biophysical structure, function and processes, usually organized by land cover classifications. When biophysical structures, processes and functions occur in proximity to human populations, they can provide a physical flow of ecosystem services (e.g. water storage and flow regulations), which in turn produce measurable benefits (e.g. lower flood risk) that can be translated into measures of economic value (e.g. the value of avoided flood damages).

Because the concept of natural capital is focused on the benefits nature provides to humans, the value we place on it is dependent on who benefits, and where beneficiaries are located relative to the spatial distribution of ecosystem service flows. As a result, natural areas near large populations tend to have high associated values. For instance, a wetland or forest on an urban fringe can provide quick, easy access for recreation, and if urban development is downstream, those same features can provide flood protection benefits. An ecologically identical wetland or forest located 100 kilometers downstream of the nearest human habitation is not likely to be providing the same level of direct benefits to people.

Since 2008, there has been an evolution in how ecosystem services are defined and categorized. The Economics of Ecosystems and Biodiversity (TEEB) reports propose the following framework for categorizing ecosystem services (TEEB 2010):

- Provisioning services – the material outputs from ecosystems (e.g. wild foods, crops, fresh water and plant-derived medicines)
- Regulating services – services ecosystems provide by acting as regulators (e.g. filtration of pollutants by wetlands, climate regulation through carbon storage, water cycling, pollination and protection from disasters)
- Cultural services – the non-material benefits people obtain from contact with ecosystems (e.g. recreation, spiritual and aesthetic values, and education)
- Supporting services – refer to specific ecological characteristics that in one way or another underpin the output of a 'final' ecosystem service (e.g. soil formation, photosynthesis and nutrient cycling).

[2] Source of Figure: https://www.raconteur.net/sponsored/success-water-industry-much-financial-capital

2.2 Why is Natural Capital Important?

The concept of natural capital recognizes that the natural environment is a fundamental asset on which our social and economic systems depend. By conceptualizing nature as an asset, we can codify, measure, and track the ways in which we depend on and impact the environment. Business and economic activity depends on natural capital assets to provide important inputs, such as clean water, minerals, and timber. Natural capital also provides better air quality, water quality, flood protection, and climate stability, which are well established as important determinants of social wellbeing. In addition, natural capital provides other important indirect functions that support human health. Urban greenspaces, parks, wetlands and protected areas, for example, provide important recreation spaces and buffer the effect of extreme heat in urban settings, thereby reducing the prevalence of respiratory infections and heat related illnesses. While the physical health benefits of nature contact are well documented, recent scientific research highlights the mental health benefits (Hartig et al., 2014; Keniger et al., 2013; Bratman et al., 2012). Maller, a leading authority on the health benefits of nature, contends that increasing access and exposure to greenspace and natural areas may be the most effective population wide strategy for promoting mental health (Maller et al., 2006). However, if we do not manage our natural assets responsibly, their value will depreciate and their ability to provide benefits diminish. Like any asset, natural assets need to be carefully managed to ensure a sustainable supply of services. Figure 2 depicts the roles of governance and institutions in the decision-making process, as well as the functions of built, human and social capital in transforming ecosystem services into goods and benefits for people.

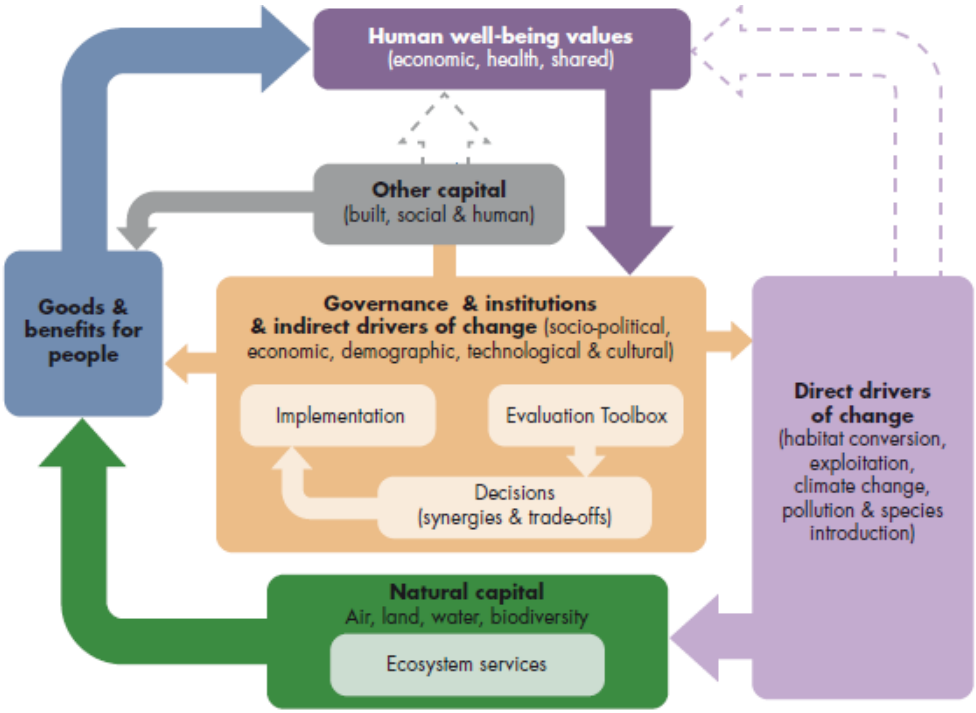


Figure 2. The UK NEAFO Ecosystem Services Conceptual Framework [3]

[3] Source of Figure: UK National Ecosystem Assessment Follow-on. 2014. The UK National Ecosystem Assessment Follow-on: Synthesis of the Key Findings. UNEP-WCMC, LWEC, UK.

When natural capital is destroyed, or its ability to provide an ecosystem service is impaired or lost, the service must be replaced for people to continue to derive the benefits that were provided by the natural system. Engineering the replacement of a service nature provides often requires expensive new infrastructure with significant operational and maintenance costs. In the long run, the protection of natural capital and the services it provides is often the most cost-effective option. This realization is now being incorporated into many municipal initiatives that consider natural capital assets as "green infrastructure." The Green Infrastructure Ontario Coalition defines green infrastructure as the natural vegetative systems and green technologies that collectively provide society with a multitude of economic, environmental and social benefits.[4] While the emphasis has been on preserving existing natural capital assets, increasingly municipalities and agencies are looking to restore and enhance natural capital assets as well.

[4] This includes: urban forests and woodlots; bioswales, engineered wetlands and stormwater ponds; wetlands, ravines, waterways and riparian zones; meadows and agricultural lands; green roofs and green walls; urban agriculture; parks, gardens, turf, and landscaped areas. See Green Infrastructure Ontario Coalition, greeninfrastructureontario.org.

3 The Value of Natural Capital in Toronto's Ravine System

This section of the report describes the study area and contains the results of the ecosystem service assessment. The assessment considered thirteen ecosystem services provided by natural capital in the ravine system. A monetized benefit was estimated for eight of the thirteen services. Table 1 identifies the ecosystem services that were considered in this assessment. Services assigned a monetized value are highlighted in green.

Table 1: Ecosystem service provided by the Toronto ravine system

Ecosystem Services	
Monetized value	**Non-monetized value**
Recreation Physical health Mental health Gas regulation (e.g. air quality) Carbon sequestration Food provision Aesthetic appreciation Habitat and refugia	Disturbance regulation (e.g. flood mitigation) Temperature regulation Noise regulation Active transport corridors Education and research benefits

For the services that were provided a monetized value estimate, Table 2 summarizes the measurable benefits that were valued.

Table 2. Key ecosystem services and associated measurable benefits

Ecosystem Service	**Measurable Benefit to Human Wellbeing**
Recreation	Value of recreational activity
Physical health	Value of health benefits associated with living in proximity to nature and avoided health care costs of dealing with ill health due to inactivity
Mental health	Avoided health care costs and forgone GDP due to depression
Gas regulation (air quality)	Value of human health care costs avoided from reduced air pollution
Carbon sequestration	Avoided social costs of climate change[5]
Food provision	Value of food from community gardens, fruit trees, and urban agriculture
Aesthetic appreciation	Value people place on the aesthetic enjoyment of the area
Habitat and refugia	Value people place on knowing natural areas exist

The study area for the assessment is the City of Toronto's Ravine and Natural Feature Protection Bylaw area, referred to as Toronto's ravine system. Figure 3 shows the geographic boundaries of the ravine bylaw area (shaded in green).

[5] The social costs of climate change refer to damages anticipated to occur over the coming decades, such as increased damages from more frequent and more severe extreme weather events.

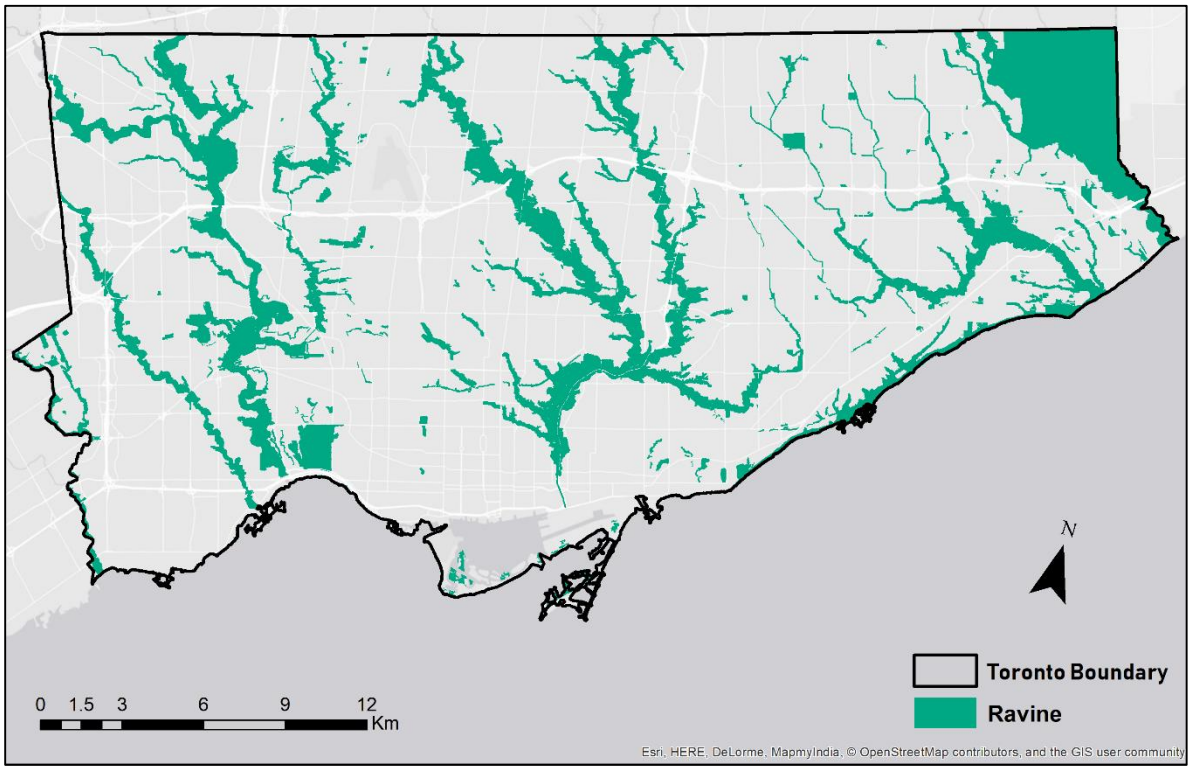


Figure 3. Map of the Toronto Ravine and Nature Feature Protection Bylaw Area.

Land cover data for Toronto's ravine system was used to estimate the monetary value of the services provided. Table 3 provides a breakdown of the natural land cover categories within the study area.

Table 3. Land cover types in the Toronto Ravine System

Natural Cover Types	Area (ha)
Beach / Bluff	83
Forest	4431
Meadow	748
Successional	526
Wetland	209
Open Water	3
Total Natural Area of Ravine*	6000
Other**	5,009
Total Area of the Ravine By-law	11,009

* Based on Natural Cover 2013 dataset from TRCA open data

** Other covers include a range of developed or modified surfaces such roads, buildings, and cemeteries.

In the sections that follow, for each ecosystem service under consideration, a description of the service is provided, along with details on how the values were estimated. Depending on the service, the valuation approach varied. All values are presented in 2017 Canadian dollars (unless otherwise stated).

3.1 Recreation

Nature recreation is one of the most tangible ways in which people derive benefit from natural capital. Toronto's system of ravines represents the city's most significant concentration of natural areas and urban

greenspace. It is heavily used for recreational activity. Recreation activities that take place within the ravine system include walking/hiking, biking, picnicking and birding. For the purpose of this study, we focused on two recreational categories, walking/hiking and biking for pleasure (not as a form of active transportation). For each recreational category, we estimate the value of wellbeing derived from the activity.

Calculation

To estimate the welfare value of walking/hiking and biking using an expenditure approach based on reported spending on "nature-based recreation" in Ontario as per the 2012 Canadian Nature Survey (2014) (adjusted to 2017 dollars), the following steps were undertaken:

1. Estimate the number of users by activity (walking/hiking and biking)
2. Estimate the value per user/trip
3. Estimate the total value by multiplying the number of users by activity by the value per user.

Recreation benefit

The total annual value derived from recreational activities in the ravine system is $584 million. Table 4 provides a summary of the value by recreational activity type.

Table 4. Recreation annual values

	# of users	Average # of days per year	$ per person/ per day	Estimated value ($ Millions)
Walking/hiking	924,486	66	$7.75	$472.9
Biking	398,240	36	$7.75	$111.1
Total				**$584.0**

3.2 Physical Health

Access to nature and greenspace contributes to positive physical health outcomes. Studies have found that increased greenspace is associated with lower blood pressure and reduced rates of cardiovascular disease, asthma, and respiratory illness (Donovan et al, 2013; Lovasi et al, 2008). Karden et al (2015) in a study of Toronto found that people who live in neighbourhoods with a higher density of trees on their streets report significantly higher health perception and significantly less cardiometabolic conditions. Studies also document the physical benefits of stress reduction attributed to nature contact, such as reduced headaches and increased energy levels (Hansmann 2007). Numerous studies have also shown that greenspace and park access increases physical activity in a population (Astell et al. 2014, Lee et al. 2013, McCormack et al. 2010, Hartig et al. 2003). Table 5 lists physical wellbeing benefits resulting from interacting with nature.

Table 5: Examples, physical wellbeing experience and associated benefits of interacting with nature

Experience	Benefit
Lower blood pressure	Reduced rates of cardiovascular disease and death
Ability to breath more clearly	Reduced asthma attacks and lower rates of asthma and respiratory illness
Faster healing and recovery times	Reduced impact of illness and injury
Increased sense of perceived health	Reduced occurrence of illness and improved overall health

For this assessment, we estimate the physical health benefits derived from exercising in the ravine system. While only counting the physical activity benefits underestimates the value of physical health benefits, we are cautious to avoid double counting benefits captured by other benefit categories, for example, improved air quality, aesthetic appreciation and recreation.

Access to greenspace is associated with increased levels of physical activity resulting in avoided costs of ill health due to inactivity. We estimate avoided ill health costs due to inactivity based on the number of ravine users that meet weekly recommended physical health requirements (150 minutes of moderate to vigorous activity per week, or portion thereof) multiplied by the direct and indirect costs of inactivity. This approach is proposed in the United Kingdom, Urban Natural Capital Accounts framework and applied in the Corporate Natural Capital Accounting (CNCA) framework (eftec 2017, Jon Sheaff and Associates 2017).

The direct and indirect health care costs of physical inactivity in Canadian adults is estimated to be $6,757,000,000 or $253 per adult (in 2009 CDN) or $288.29 per adult in 2017 (Janssen 2012). A challenge, however, is determining the number of users meeting the weekly exercise standard in the ravines. To establish this number, we estimate the number of ravine users engaged in physical activity based on park use. The percent of park users engaged in moderate to vigorous activity is estimated to range from a high of 53% in three urban Ontario parks to a low of 13% in a study of five US cities (Hamilton et al. 2017, Holliday et al. 2017). A study focused on urban parks in Los Angeles found that 34% of users engaged in moderate to vigorous activity (Cohen et al. 2007).

The Urban Natural Capital Accounts framework was applied in the London Borough of Barnett. For that study, instead of estimating number of park users, the authors assumed that half of those who meet the weekly exercise standard in the Borough did so using greenspaces, although the study does not defend the assumption with any supporting data. Using this approach, we would assume half of the Toronto adult population that were at least moderately active or higher (46.4% in 2014)[6] were physically active in a ravine space.

Calculation

The following steps were taken:

1. Estimate the number of people meeting recommended physical health activity requirements of 150 minutes of moderate to vigorous exercise per week who are physically active in the ravines. We determined the number of users meeting their weekly exercise standard in the ravines using two different set of assumptions:
    a. Approach A establishes the number of ravine users and multiples that by the percentage that were at least moderately active or higher based on the park use study of three Ontario urban parks (noted above).
    b. Approach B assumes half of adults that were at least moderately active or higher were physically active in the ravine based on the approach used in London Borough of Barnett study.

[6] Toronto Public Health. 2017. Health Surveillance Indicator: Physical Activity.

2. Multiply the number of people meeting recommended physical health activity requirements using the ravine (results of approach A and B above) by $288.29 (the direct and indirect costs of inactivity per adult).

Physical health value of physical activity

The annual value of physical activity occurring in the ravine ranges from $140 million (Table 7) to $217 million (Table 6).

Table 6: Health value of physical activity

Population meeting physical health activity requirement using ravines	Direct and indirect health care costs of physical inactivity per adult	Value of increased physical activity annually ($ Millions)
Approach A: 753,812	$288.29	$217.3
Approach B: 478,218	$288.29	$137.9

We recommend the use of assumption A as it is based on assumptions derived from research on Ontario urban parks.

3.3 Mental Health

Maller, a leading authority on the health benefits of nature, contends that increasing access and exposure to greenspace and natural areas may be the most effective population wide strategy for promoting mental health (Maller et al. 2006). Maller's recommendation reflects over 30 years of research demonstrating that contact with nature reduces stress and increases sense of personal wellbeing (Shanahan et al. 2016, Hartig et al. 2014). Empirical studies have shown that being in nature reduces cortisol levels and blood pressure (Van de Berg and Custers 2011, Hartig et al. 2003). While explanatory pathways are not well understood, studies consistently find that people feel better in nature. Contact with nature is positively associated with increased self-esteem, higher life satisfaction, cognitive function and better job performance (White et al. 2013, Bratman et al. 2012, Bowler et al. 2010, Kaplan and Kaplan 1989). Table 7 provides examples of mental health benefits of interacting with nature.

Table 7: Examples, mental wellbeing experience and associated benefits of interacting with nature

Experience	**Benefit**
Lower stress/ faster recovery from stress	Reduced rates of stress and anxiety related illness
Increased self-esteem and sense of well being	Reduced rates of depression
Lower aggression, anger, frustration	Reduced rates of crime and destructive behaviour
Improved cognitive function	Improved educational outcomes and job performance
Increased productivity	Improved job performance

To estimate the mental health benefits derived from Toronto's ravine system, we adopt a cautious approach and only estimate a monetary benefit associated with reduced rates of depression. A study by Shanahan and colleagues found that 30 minutes per week in greenspace reduces the population prevalence of depression by 7% (Shanahan et al. 2016). The direct health care costs and forgone gross domestic product (GDP) due to lost productivity resulting from depression are estimated to be $1.5 billion ($2009) and 32.3 billion ($2012), respectively (Smetanin et al. 2011, Conference Board of Canada 2016). Using Statistics Canada population estimates[7], the average costs per person are estimated to be $50.82 ($2017) and $982.90 ($2017), respectively.

Calculation

To calculate the mental health value associated with reduced rates of depression, the following steps were taken:

1. Estimate the number of people spending on average 30 minutes or more per week in the ravines
2. Establish the prevalence rate of depression
3. Estimate the reduced prevalence rate of depression resulting from spending time in the ravines (item 2, corrected for item 1)
4. Multiply the reduced rate of depression by the direct health care costs and forgone GDP due to lost productivity resulting from depression per person

Mental health value of spending time in Toronto's ravine system

The total mental health value associated with reduced rates of depression resulting from spending time in the ravine system is $5.5 million (Table 8).

[7] Statistics Canada. *Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual (persons unless otherwise noted),* CANSIM (database). Accessed April 2018.

Table 8: Mental health benefit value

Reduced prevalence of depression (# of people)	Mental health benefit per person (2017)	Mental health benefit value ($ Millions)
5,297	$1,033.72	$5.5

3.4 Gas Regulation (Air Quality)

Forested areas and trees can regulate atmospheric gases and maintain air quality by removing airborne pollutants. This results from the collection of particulate matter on the surface area of leaves and by the absorption of gaseous pollutants into leaves. Improved air quality can result in significant benefits to the surrounding population, who are likely to experience fewer visits to the hospital for respiratory and other illnesses (Nowak et al. 2015). The City of Toronto has already conducted a robust research project on understanding the value of urban forests (Nowak et al. 2013). Across the City of Toronto, it was estimated that trees and shrubs remove 1,430 metric tonnes of air pollution (CO, NO_2, O_3, PM10, SO_2).

Calculation

To estimate the value of clean air provided by Toronto's ravines system, we weighted the results of the city-wide estimates by the ratio of canopy cover in the ravine area to the total Toronto canopy cover. In other words, about 36% of Toronto's canopy cover occurs within the ravine area and this number was used to estimate the portion of the city-wide benefits attributable to the ravine system.

Improved air quality value provided by the ravine area

Based on the research conducted in 2009 for the City of Toronto, the avoided health care costs provided by the ravine area is approximately $7.4 million per year (Table 9).

Table 9. Summary of air quality improvement and avoided annual health care costs

Variable	Toronto-Wide Estimate ($M)	Ravine Area Estimate ($M)
Pollutant removal rate (tonnes per year)		
- Carbon monoxide (CO)	10	4
- Nitrogen oxides (NOx)	297	107
- Ozone (O_3)	1180	427
- Particulate matter (PM)	357	129
- Sulphur dioxide (SO_2)	62	22
Total removal rate (tonnes per year)	1906	689
Avoided health care costs (dollars per year)	**$20.4 M**	**$7.4 M**

The valuation approach employed in the city-wide study accounts for health-care expenses (i.e. cost of illness and willingness to pay to avoid illness), productivity losses associated with specific adverse health events, and the value of a statistical life in the case of mortality.

3.5 Carbon Sequestration

Forests, woodlands, wetlands, grasslands, and non-intensive agriculture play an important role in mitigating climate change through the sequestration and storage of carbon dioxide and other greenhouse gases. The mitigation of climate change is likely to have a wide range of benefits to humans in the form of

avoided severe weather events. Here, only sequestration is valued, as it represents the annual service flow.[8]

Calculation

The first step in estimating the value of carbon sequestration is to establish the rate of sequestration. Two approaches were used in this analysis:

1. Like the approach used to estimate gas regulation, the total carbon sequestration rate for forests across Toronto was adjusted to reflect only the forests located within the ravine area.
2. For grasslands, non-intensive agriculture and wetlands, estimates were obtained for the rate of sequestration for each of the ecosystem types (i.e. tonnes of carbon sequestered per ha per year of ecosystem type) present in the ravine system.

Once the average rate of sequestration was determined, a price per tonne of carbon was applied to the sequestration estimates. For this purpose, Environment Canada's recommended social cost of carbon was used, which is currently $44.67 per tonne of CO_2e (i.e. CO_2 equivalents).[9] The social cost of carbon quantifies the marginal value of avoided social damages that are anticipated to result from climate change. In other words, it is a measure of the incremental avoided damages from a decrease in CO_2 emissions. Note that this price per tonne is different than the price used by Nowak et al. (2013).

Since the social cost of carbon is measured in tonnes of CO_2e, and sequestration is measured in tonnes of carbon, it was necessary to convert the values to comparable units. The conversion was based on the relative atomic weights. That is, 1 tonne of carbon sequestered translates into 3.667 tonnes of CO_2 removed from the atmosphere.

Existing research on Toronto's urban forest has calculated the gross carbon sequestration by trees in Toronto to be 46,700 metric tonnes of carbon per year and net carbon sequestration to be 36,500 metric tonnes (Nowak et al. 2013). Based on the fact that 36% of Toronto's tree canopy occurs in the ravine area, carbon sequestration for this area is assumed to be 13,194 tonnes per year. The social cost of carbon was then applied to the sequestration for the trees within the study area to calculate the value of carbon sequestration from the forested area in Toronto's ravine system.

Drawing on recent literature examining the role of wetlands in sequestering carbon, a series of sequestration rates were identified for different wetlands. A weighted average sequestration rate for different wetland types was calculated and then applied to the area of wetlands within the study area. Data for carbon sequestration rates were drawn from Mitsch et al. (2013) and Bernal and Mitsch (2012). The weighted average for wetlands was estimated at 3.4 tonnes per hectare per year. The social cost of carbon was then applied to the sequestration for the wetlands within the study area to calculate the value of carbon sequestration from wetlands in Toronto's ravine system.

[8] The carbon storage can also be valued. However, it represents the accumulated stock of carbon that has been sequestered in all previous years. As a result, it is not included as the annual service value.
[9] http://www.ec.gc.ca/cc/default.asp?lang=En&n=BE705779-1

Similarly, existing literature was used to establish sequestration rates for grasslands. Unfortunately, limited research was found related to grasslands, particularly in an Ontario context. Previous valuation reports for areas in southern Ontario drew on a study that estimated an average of 0.5 tonnes of carbon per ha per year (Smith et al. 2001). More recent research suggests that temperate grasslands can sequester anywhere from 0 to 8 tonnes of carbon per ha per year (Jones and Donnelly 2004). In western Canada, sequestration by grasslands averages about 0.19 tonnes of carbon per ha per year (Wang et al. 2014). Given the uncertainty in the rate of sequestration and lack of data for Southern Ontario systems, for this report, 0.5 tonnes per ha per year is assumed.

Carbon sequestration value provided by the ravine area

The total carbon sequestration value provided by the ravine area is $2.4 million per year. Carbon sequestration values by land cover type are summarized in Table 10.

Table 10. Carbon sequestration, annual values by land cover type

Land cover type	Area (ha)	Carbon sequestration Rate (tonnes)	CO2e (tonnes)	Social value ($ per tonne)	Estimated Value ($ Millions)
Forest	4,431	13,194	48,382	$44.67	$2.16
Wetlands	209	711	2,606	$44.67	$0.12
Meadow	748	374	1,371	$44.67	$0.06
Successional	526	263	964	$44.67	$0.04
Total	**5,914**	**14,542**	**53,324**	**$44.67**	**$2.38**

3.6 Food Provision

Urban agriculture and community gardens provide benefits to participants. Studies show that gardening and participating in a community garden provide mental and physical health benefits, contribute to an increased sense of community belonging and are an important source of nutritional food (Toronto Public Health 2015). Case studies examining the relationship between community gardens, including urban agriculture and health have found that people who use community gardens report (Castro et al 2013, Comstock et al. 2010, Wakefield et al. 2007, Zick et al. 2013):

- Improved access to food
- Better nutrition
- Increased physical activity
- Improved mental health
- Enhanced social health and community cohesion

Growing your own food also leads to avoided food transport costs and lower food waste.

To avoid double counting, for this analysis we only consider the value of benefits derived from avoided food purchases based on the market value of produce derived from established urban agriculture sites within the ravine system. Currently, there is one site, Black Creek Community Farm.

Calculation

To calculate the value of food grown in the ravine area, the following steps were undertaken:

1. Estimate the hectares of growing space in the ravine area
2. Multiply the area of growing space by estimated food production per hectare
3. Multiply the food production per hectare by the market value of food grown

Metric tonnes of food production were estimated based on a yield figure of 10.7 metric tonnes per hectare.[10] Market value of urban agriculture food production per tonne in the Toronto region is estimated to be $1,033.72 based on the market value equivalent of a similar basket of locally grown food.[11]

Food provision value

The total food provision value of urban agriculture in the ravine area is $36,000, annually (Table 11).

Table 11. Value of food provision

Hectares of growing space	Food production (metric tonnes)	Market value of food per tonne (2017)	Value of food provision
3.24	34.70	$1,033.72	$35,837

3.7 Aesthetic Appreciation

Aesthetic appreciation is the benefit people obtain from the beauty of natural vistas. Many aesthetic benefits result from recreational activities and some such value would be accounted for in the recreational estimates above. However, the aesthetic values experienced by those simply viewing the ravine, from a road way or sidewalk, or from a nearby house or balcony overlooking the ravine have not been captured in the recreation estimates. Numerous studies show that properties adjacent to, or near natural areas, such as an urban ravine, command higher selling or rental prices (Brander and Koetse 2011). The value of aesthetic appreciation is location-specific depending not only on the aesthetic quality of an area, but also on the local real estate market. However, it is not possible to clearly determine if this market differential captures only aesthetic appreciation values. In fact, it likely also captures other values associated with attributes such as ease of access to the ravine or social status symbol.

Calculation

As a first step toward calculating this value, a meta-analysis was utilized to transfer existing values to the City of Toronto (Brander and Koetse 2011). The meta-analysis was based on 20 studies providing 73 value estimates associated with key services provided by urban greenspace. The approach systematically holds constant three services provided by urban greenspace: recreation, preservation, and aesthetic appreciation. By holding these variables constant, and focusing on aesthetic appreciation values, the risk

[10] Garnett, T. ND. City Harvest: The Feasibility of Growing More Food in London. Sustain: The Alliance for Better Food and Farming. Available online: http://www.fcrn.org.uk/sites/default/files/CityHarvest/.

[11] Dihr, S. 2018. Personal communication. Senior Project Manager, Humber Watershed Services and Urban Agriculture Program. June 2018.

of double counting recreation is avoided. By parameterizing this equation to the City of Toronto, the aesthetic value of the ravine system was estimated to be $445 per ha per year.

Aesthetic value

The total aesthetic value provided by the ravine area is $2.7 million per year (Table 12).

Table 12. Aesthetic value

Area of natural cover within the ravine area	Aesthetic value per hectare (2017)	Aesthetic value ($ Millions)
6,000 hectares	$445	$2.7

3.8 Habitat and Refugia

The value of habitat and refugia (referred to as existence and bequest values, or preservation values) is derived from the knowledge that the diversity of individual species of flora and fauna – as well as their assemblage into connected ecosystems and habitats – is protected for current and future generations.

Not surprisingly, the majority (87%) of Toronto's environmentally significant areas (ESA) are found in the ravine system (City of Toronto, 2017). Within Toronto's ESA's there are 369 significant plant species, 175 species of birds and 16 species of reptiles and amphibians (City of Toronto, 2017).

It is important to note that biodiversity itself is not an ecosystem service. However, existence and bequest values implicitly account for biodiversity and these values can be held for a wide range of environmental features (Green Analytics 2016). For instance, there is a considerable volume of research that examines the value of endangered species (Richardson and Loomis 2009), while others examine the value of protected areas (Adamowicz et al. 1998). There is also considerable debate on whether valuation techniques can adequately capture the different levels of disaggregation resulting from how individuals perceive such values. An entire body of literature exists that examines the sensitivity of these values to the scope of the environmental good being studied.[12] To avoid these complex issues and uncertainties, a meta-analysis function was used to transfer the preservation value (i.e. the value residents place on knowing an area is protected or preserved) of urban habitat to Toronto (Brander and Koetse 2011).

Calculation

By parameterizing the meta-analysis function to the City of Toronto, the existence value of the ravine system was estimated to be $412 per ha per year.

The total existence value of the ravine system is $2.5 million per year (Table 13).

Table 13. Habitat and refugia value

Natural area within ravine area	Existence value per hectare	Existence Value ($ Millions)
6,000 hectares	$412	$2.5

[12] For example, see: Boyle et al. (1994)

3.9 Ecosystem Services Not Accounted For

This section notes and provides brief descriptions of other benefits that are relevant to the ravine system but have not been accounted for above due to a lack of data, allocation challenges related to assigning a benefit to the ravine system, or lack of scientific knowledge.

3.9.1 Disturbance Regulation

Wetlands and other natural areas can play an important role in protecting human property by regulating flood waters and erosion. Ideally, these values would be determined by carefully assessing the hydrology of relevant subwatersheds and quantifying the level of anticipated flooding with and without flood regulating land covers. Such flood and erosion profiles can be correlated with the number of properties and other built infrastructure located within flood zones downstream of regulated land covers. For example, Moudrak et al. (2017) modelled flooding and the impact wetlands have on flooding in two southern Ontario pilot sites: one urban and one rural. At the urban site, if wetlands were maintained relative to being replaced by agriculture, flood damages were estimated to be $51.1 million (or 38%) lower. This modelled scenario examined the loss of 540 ha of wetlands in Laurel Creek watershed for an average of roughly $94,600 per ha in avoided damages. At the rural site, flood damages were estimated to be $3.5 million (or 29%) lower. This modelled scenario examined the loss of 72.9 ha of wetlands in the Credit River Watershed, for an average of roughly $48,000 per ha in avoided damages. Nowak et al (2012) investigated the effects and values of Toronto's urban forests, including the impact of urban forests on stormwater run-off. Simulations conducted as part of that study indicate that a doubling of the tree canopy in the Don watershed would decrease overall water flow by 2.5% (Nowak et al. 2012).

While the hydrologic modelling required to estimate the value of disturbance regulation for Toronto's ravine system was not within the scope of this study, the above examples illustrate the potential impact that wetlands and forest cover can have in regulating water flows in Southern Ontario. The Toronto Region Conservation Authority is currently in the process of conducting a flood risk assessment. The results of this research may provide some insight to the value of disturbance regulation provided by the ravines.

3.9.2 Temperature Regulation

Toronto's urban forest is estimated to reduce energy use from heating and cooling of residential buildings by 41,200 MWH ($9.7million/year). Trees also provide an additional $483,000 in value per year by reducing the amount of carbon released by fossil-fuel based power plants, representing a reduction of 17,000 metric tonnes of carbon emissions (City of Toronto Urban Forestry, 2017).

A pro-rated approach similar to that used for carbon sequestration could be used to quantify the value of street trees in the ravine. However, in the case of temperature regulation, the value also depends on the position of street trees relative to residential buildings. Therefore, any pro-rated approach should ideally consider the number of trees in the right spatial configuration relative to a residential building to provide the energy savings. The effort required to do this was outside the scope of this project. As a result, this value is left this unaccounted. In future urban forest modelling work, exploring a way to tag the specific trees that are providing this value could make this assessment a simple matter of extracting the correct information from the urban forest database.

3.9.3 Noise Regulation

The United Kingdom has developed urban natural capital accounts that include benefits derived from noise regulation (eftec 2017). Lower noise levels contribute to improved health outcomes and greater productivity in the workplace.

In their approach, patches of tree cover greater than a threshold area of 200 m^2 are assumed to provide a noise mitigation service. To estimate the noise reduction benefit resulting from natural capital, the number of buildings located within patches of trees that meet the 200 m^2 threshold is quantified along with the amount of road noise and the reduction in noise due to the presence of trees. A benefit is assigned based on number of buildings where road noise levels are mitigated by 2 dB (decibels).

The UK natural capital accounts were used to derive a monetary benefit value for noise mitigation for Greater Manchester. The analysis found that 429,000 buildings receive some noise mitigation by urban trees. In total, noise mitigation from natural capital is estimated at £59m per year. For comparison purposes, the study estimates the value of CO_2e sequestered by Greater Manchester's urban woodland at £2m per year and avoided direct and indirect health costs of inactivity of nearly £40 m per year.

3.9.4 Active Transportation

Ravine trails and pathways are well used to travel by active transportation to work. In addition to physical health benefits, active transport replaces commuting by car or public transit reducing CO_2 emissions. In Toronto, 6.9% of the working population commute to their usual place of work by active transport (5.2% cycling, 1.4% walking).[13] Depending on the neighbourhood, commuting to work by bike or walking are as high as 34% in Cabbagetown and 33% in Bloor-Spadina.

The benefits derived from an active commute to work include physical and mental health benefits (see Sections 3.2 and 3.3) as well as environmental benefits. The main environmental benefit is avoided CO_2 emissions. Avoided emissions can be estimated by subtracting the emissions associated with kilometers travelled by active transportation from emissions that would have occurred if those trips had been made by car or bus. Avoided life cycle emissions, including caloric intake, are estimated at 250 g CO_2 /km for travel by car and 80 g CO_2 /km for travel by bus.[14]

3.9.5 Information, Science, Education, and Research Benefits

Natural areas can provide significant cultural benefits in the form of provision of information, and opportunities to conduct science, education and research. Quantifying such benefits is difficult due to data limitations. To derive an estimate for such benefits would first require an understanding of who is deriving value from the ravine system for these purposes. This could be determined through a survey of primary, secondary, and post-secondary education institutions and research centres. The second step would be to establish a price for these activities. This is much more difficult. Few approaches exist to quantify these values (Phillips et al. 2008). One approach that has been used relies on the social value of research. One estimate measures this proxy value as $12,000 per article per year,[15] measured by achievement of knowledge that leads to additional economic growth (Loomis and Richardson 2000). To

[13] Statistics Canada. 2016. Census of Population.

[14] CO2 emissions per kilometer traveled per passenger: cycling 21g/km; bus 101 g/km; car 271 g/km

[15] Note this value is reported in USD currency for the year 2000.

use this approach, an estimate of the annual number of scientific studies published from research done within the ravine system would be needed.

4 Summary of City of Toronto Ravine System Values

Table 14 summarizes the physical and monetary flow accounts for key ecosystem service values for the City of Toronto ravine system. This study makes use of many advances in concepts, data, and valuation techniques to provide the most up-to-date values possible. For each ecosystem service, the measurable benefit that was used to determine the value is described. This is provided to clearly demonstrate what has been measured and what has not. Data gaps limit the ability to provide estimates for all final services. As noted in section 3, several benefits were not accounted for in this study, including disturbance regulation, temperature regulation, noise regulation, active transportation corridors, and information, science, education and research benefits. Based on the monetized benefits, the total annual value of the ravine system's ecosystem services is estimated to be $822 million. The values presented here should be considered conservative estimates of the values provided by the ravine system.

Table 14: Ecosystem service physical flows and monetary benefits for the City of Toronto ravine system

Ecosystem service physical flows and monetary benefits for the City of Toronto ravine system						
Ecosystem Service	**Indicator**	**Unit**	**Physical flow 2017**	**Indicator**	**Unit**	**Monetary flow benefit 2017 ($ Millions)**
Recreation	Users of ravines for cycling and biking	# of users	398,240	Value of welfare benefit received by biking in ravines	$ per year	**$111**
	Users of ravines for walking and hiking	# of users	924,486	Value of welfare benefit received by walking and biking in ravines	$ per year	**$473**
Physical health	Population meeting physiscal health guidelines by accessing greenspace	# of people	753,812	Value of physical activity supported (avoided health care costs of dealing with ill health due to inactivity)	$ per year	**$217**
Mental health	Reduced number of people experiencing depression	# of people	5,297	Value of improved mental health, avoided foregone GDP due to depression	$ per year	**$5**
Gas regulation (air quality)	Air pollution removed (CO, NO_x, O_3, PM_{10}, SO_2)	metric tonnes	CO=3.2; NOx=94.3; O3=374.4; PM10=113.0; SO2=19.8	Value of cleaner air (avoided health care costs of visits to hospital for respiratory and other related health issues)	$ per year	**$7**
Carbon sequestration	CO2e sequestered	metric tonnes	14,542	Value of carbon sequestered (avoided social damages that are anticipated to result from climate change)	$ per year	**$2**
Food provision, urban agriculture	Fruit and vegetable production occuring in ravine area	metric tonnes	34.7	Value of food from urban agriculture sites in ravines (replacement cost of equivalent produce)	$ per year	**$0.04**
Aesthetic appreciation	Area of natural cover	hectares	6,000	Value people place on the aesthetic enjoyment of the area	$ per year	**$2.67**
Habitat and refugia	Area of natural cover	hectares	6,000	Value people place on knowing natural areas exist	$ per year	**$2.47**
						$822

5 Recommendations and Conclusions

This report presents the results of an assessment of ecosystem service values derived from the City of Toronto ravine system. The values can inform the potential implications of land use and resource management policy decisions in the region. Tracking and measuring the ways in which local populations benefit from natural capital is essential to their long-term management. As with all assets, the natural assets of the ravine system should be protected and conserved to ensure the flow of ecosystem services can be sustained for current and future residents of the watershed.

This assessment of natural capital in the City of Toronto ravine system represents the next step in advancing towards standardized accounting and valuation of the many benefits provided by the watershed. Towards that end, a number of key actions can be taken:

1. Formally establish the ravine system as an asset, similar to other built assets in Toronto, and incorporate it the municipal asset management process. Key next steps toward this recommendation would include:
    a. Build an asset inventory of the ravine system and organize it in an asset registry.
    b. Conduct a condition assessment of the ravine asset. This could largely draw on and build off the existing data and ecological assessments done by the City of Toronto and TRCA.
2. Establish sampling protocols and use trail counters to gain a more accurate understanding of the actual public use of the ravine system.
3. Continue to update and advance the urban forestry program and modelling. The existing work provides excellent input into the carbon sequestration and air quality services. For future modelling work, consider making a distinction between trees in the ravine versus other areas of Toronto. This would better facilitate the use of that information as an input in monitoring the ravine as an asset. Consider distinguishing in the model key subcomponents of the urban forest:
    a. Street trees / canopy
    b. Ravine trees / canopy
    c. Trees / canopy in other parks and open spaces
4. Coordinate with TRCA water resources staff to explore how current hydrologic modelling could be incorporated into this assessment to fill the gap associated with the role the ravine system plays in flood and erosion control (i.e. disturbance regulation).

Appendix A – The State of Ecosystem Service Science in an Urban Context

This appendix summarizes the state of ecosystem service science in an urban context. The review targets the most current economic and ecological studies as well as the most up-to-date data and valuation approaches. Specifically, this appendix presents:

1. A review of frameworks and accounting processes
2. Examples of ecosystem services modelling and assessment tools
3. Application considerations in an urban setting
4. Urban case studies

Ecosystem Service Accounting and Classification Frameworks

This section briefly describes leading frameworks and guidance documents for classifying ecosystem services and establishing natural capital accounts with an emphasis on urban and local scale frameworks. The following frameworks are discussed in this section:

- The United Nations System of Environmental-Economic Accounting, National
- The Common International Classification of Ecosystem Services, National
- National Ecosystem Services Classification System, National (United States)
- Principles of Natural Capital Accounting, National (United Kingdom)
- Urban Natural Capital Accounts, City (United Kingdom)
- Corporate Natural Capital Account Framework, Local (United Kingdom)
- Mapping and Assessment of Ecosystem Services Urban Pilot, City (European Union)

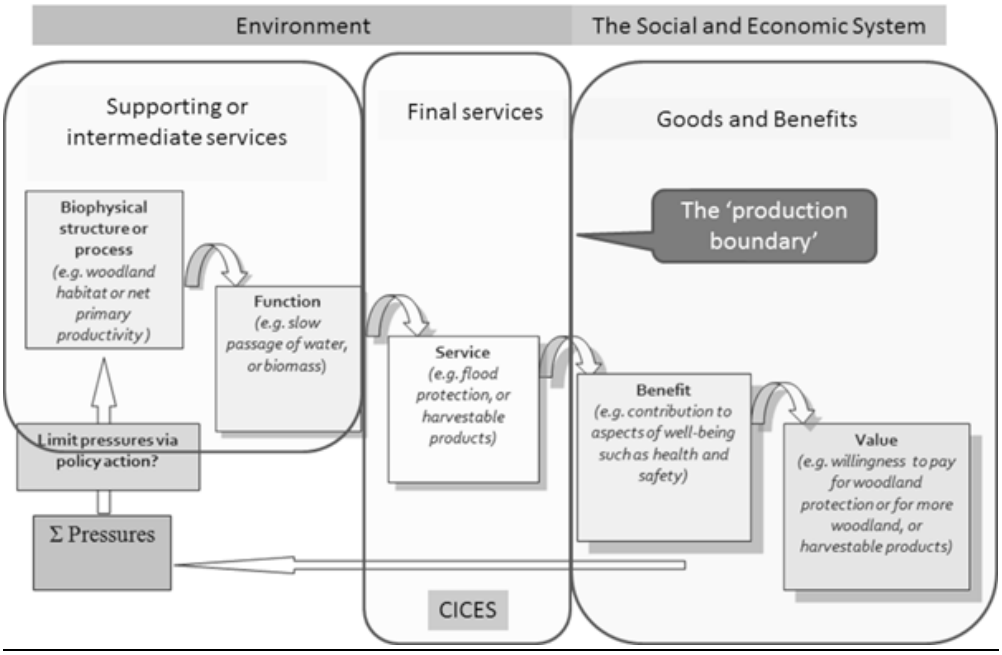
The United Nations System of Environmental-Economic Accounting

There has been substantial international effort to develop standardized frameworks for classifying ecosystem services and establishing natural capital accounts. The United Nations (UN) System of Environmental-Economic Accounting (SEEA) is a key source of technical guidance for integrating environmental accounting into national accounting frameworks. In 2014, the UN released the SEEA Experimental Ecosystem Accounting framework for organizing biophysical data, measuring ecosystem services, and tracking changes in ecosystem assets. The SEEA Experimental Ecosystem Accounting framework provides a structure to integrate ecosystem services and ecosystem conditions in both physical and monetary terms into national accounting frameworks (2014). The guidance document supports countries looking to integrate natural capital and ecosystem services into national accounting systems.

The Common International Classification of Ecosystem Services

The Common International Classification of Ecosystem Services (CICES) was developed by the European Environment Agency as part of their contribution to SEEA. CICES is a classification system designed to help measure, account for, and assess ecosystem services. The system builds on earlier classification typologies introduced in the Millennium Ecosystem Assessment (MA, 2005) and The Economics of Ecosystems and Biodiversity (TEEB, 2010). Version 5.1 was released in January 2018 (Haines-Young & Potschin, 2018). CICES seeks to classify final ecosystem services which are defined as the contributions that ecosystems make to human wellbeing (p.3). The classification scheme is grouped at the highest level

into provisioning services, regulation and maintenance services and cultural services which are respectively subcategorized into detailed divisions, groups and classes. The cascade model (figure below) provides the conceptual framework underlying CICES (Haines-Young & Potschin, 2018 from Potschin & Haines-Young, 2016).



Cascade Model, Potschin and Haines-Young, 2016

In addition to being used at the national level, CICES is the basis of the mapping, assessment and accounting work advanced in support of Action 5 of the EU Biodiversity Strategy to 2020 under the Mapping and Assessment of Ecosystem Services (MAES) initiative (urban framework discussed below).

National Ecosystem Services Classification System, United States

The National Ecosystem Services Classification System (NESCS) developed by the United States Environmental Protection Agency (2015) is designed to support comprehensive and systematic accounting of changes in ecosystem services. NESCS focuses on flows of final ecosystem services (FFES), which it defines as the direct contributions made by nature to human production processes or to human wellbeing. FFES are identified by linking the ecological systems that supply final ecosystem services with the human systems that demand them. To uniquely identify and classify FFES, the NESCS structure consists of four classification groups:

1. Environmental classes, which are spatial units, with similar biophysical characteristics, that are located on or near the Earth's surface and that contain or produce "end-products" (e.g., aquatic, terrestrial, atmospheric).
2. Classes of ecological end-products, which are the biophysical components of nature directly used or appreciated by humans.
3. Classes of direct human uses (extractive or in situ) or non-use appreciation of end-products.

4. Classes of direct human users of end-products (EPA, 2015).

A defining characteristic of NESCS when compared to other classification nomenclatures is the emphasis on final ecosystem services which occurs at the point of hand-off between natural systems (ecosystems) and human systems (producers and households) (EPA, 2015).

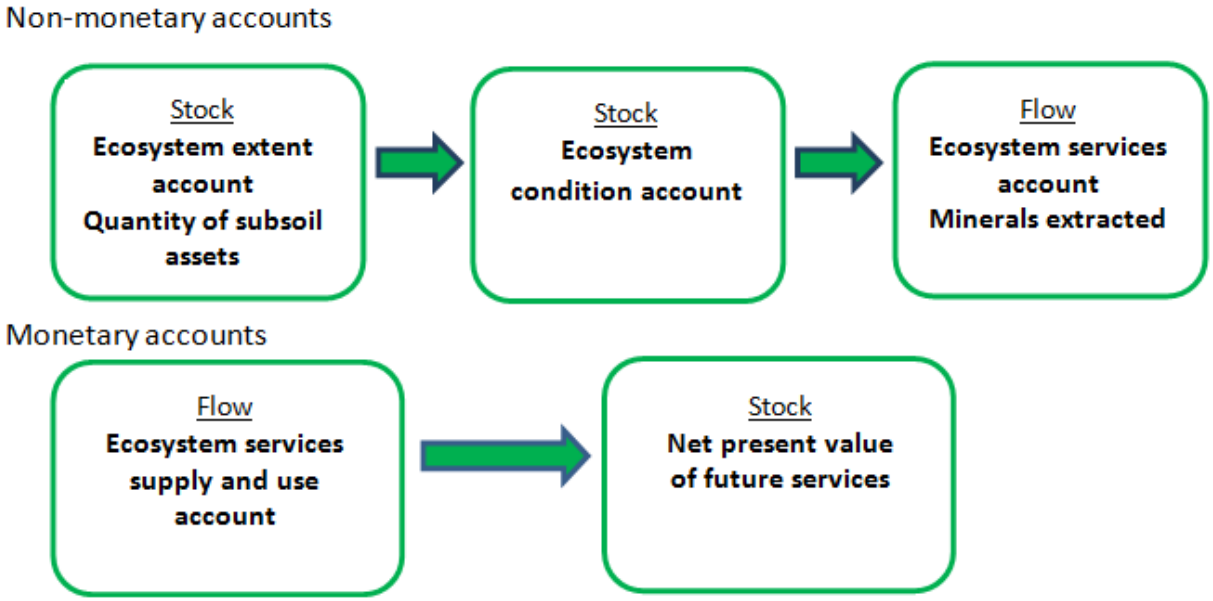
Principles of Natural Capital Accounting, United Kingdom

In the United Kingdom (UK), the Department for Environment, Food and Rural Affairs (DEFRA) and the Office of National Statistics (ONS) have coordinated efforts to formalize natural capital accounts into the UK Environmental Accounts by the year 2020 including the development of natural capital accounting principles and a natural capital accounting framework schedule (DEFRA/ONS, 2017).

The framework proposes five principle accounts (figure below):

1. Physical account of natural capital extent (stock account)
2. Physical account of natural capital condition (stock account)
3. Physical account of ecosystem service provision and use (flow account)
4. Monetary account of annual provision of ecosystem service (flow account)
5. Monetary account of future provision of ecosystem service (stock account)

Tracking the proposed accounts over time allows for the assessments of changes in the extent and condition of natural assets, in addition to changes in the provision of ecosystem services. An account would report the opening and closing value of a stock of natural capital assets as well as the reconciliation of these stocks by recording intervening (net) changes to assets over the accounting period (DEFRA/ONS, 2017).



DEFRA/ONS framework of national natural capital accounting

Urban Natural Capital Accounts, United Kingdom

Based on the cumulative work advancing natural capital accounting led by DEFRA/ONS, Eftec (2017) was consulted to test how urban natural capital accounts might be developed in the UK. The scoping study provided initial monetary value estimates for the following ecosystem services: physical health, local climate regulation, noise regulation, air quality regulation, food provision, and global climate regulation. Other ecosystem services were excluded on the basis of low/no provision or lack of data/methods for analysis. Consistent with other studies, Eftec (2017) noted methodological challenges around converting physical flows into monetary benefits and lack of data limiting more robust analysis. The study also highlighted other challenges for consideration in the urban context such as how to report on the condition of the natural capital stocks, how to quantify benefits of climate regulation and treatment of transboundary effects. Treatment of transboundary effects refer to how to consider the influence on residents of natural capital assets on the edge of urban areas which fall outside the urban boundaries excluding them from analysis (Eftec, 2017). The scoping study provides a useful example of process, linking natural capital extent and condition to ecosystem services, and connecting physical flows to monetary flows.

Scope of UK Urban Natural Capital Account (Eftec 2017, p. 23)

Natural capital benefits	**Physical flow account**	**Monetary flow account**
Food	✓	✓
Freshwater	X	x
Air quality regulation	✓	✓
Noise regulation	✓	✓
Climate regulation - local	✓	✓
Climate regulation – global (carbon)	✓	✓
Natural hazard regulation (incl. flood)	X	x
Water quality regulation	x	x
Pollination	x	x
Cultural heritage	x	x
Aesthetic value	n/a	◊
Recreation and tourism	◊	◊
Property values	n/a	◊
Physical health from outdoor recreation	✓	✓
Key benefits included in original account: ✓: high priority ✓: low priority ◊: existing figures/under development x: not included		

Corporate Natural Capital Account Framework, London Borough of Barnett

The UK national efforts have been adapted to a local level. The Corporate Natural Capital Account (CNCA) framework developed to capture the value of green infrastructure in the London Borough of Barnett (LB Barnett) is a leading demonstration of natural capital assets accounting at a municipal scale (Jon Sheaff and Associates, 2017). The CNCA framework provides a balance sheet that shows the benefits provided by natural capital against the cost of maintaining it and is designed to accompany physical infrastructure asset management plans. The framework puts forward a structure for accounting and valuing natural capital assets starting with the development of an asset inventory. The inventory is used to derive a

physical flow account. In the case of LB Barnett, they included four benefit categories: recreation, physical health benefits, property value uplift, and carbon sequestration. Benefits chosen were expected to be amongst the most significant and were categories for which data were available. The physical flow account informs a monetary flow account by assigning economic value to benefits from natural capital that accrue to the organisation that manages the assets (private benefits) and those that accrue to others (external benefits). To develop the natural capital balance sheet, the monetary benefits are compared against the cost of maintaining the natural capital. The final output, or natural capital balance sheet, reports the benefits of natural capital as 'Assets' and the maintenance costs as 'Liabilities' in present value (PV) terms (Jon Sheaff and Associates, 2017).

An ongoing challenge of natural capital accounting is assigning monetary values to the benefit categories with confidence. The methodologies need to be robust and transparent. In the case of LB Barnett, the asset values were estimated where possible using third party established valuation methodologies and local datasets. The recreation benefit value was estimated using the Outdoor Recreation Valuation Tool (ORVal) developed by the University of Exeter for Defra. The physical health benefit was the avoided costs of dealing with ill health due to inactivity based on locally collected physical health data and visits to greenspace data. The property value uplift was determined through analysis of case studies. The carbon regulation benefit was determined by multiplying the UK carbon sequestration rate by habitat type by the DECC non-traded carbon value (Jon Sheaff and Associates, 2017).

Mapping and Assessment of Ecosystem Services Urban Pilot, European Union

The Mapping and Assessment of Ecosystem Services (MAES) Urban Pilot is a collaboration between the European Commission, the European Environment Agency, volunteering Member States and cities, and stakeholders. The fourth MAES report proposed a framework for urban ecosystem services piloted in ten communities. The framework provides a standardized template to assess the condition and contribution of ecosystem services across Europe (European Commission, 2016). The framework includes a set of key indicators that can be used for mapping and assessment at regional, metropolitan and urban scales based on CICES ecosystem services relevant to cities. Indicators are organized by CICES section: provisioning services, regulating and maintenance services, and cultural services (see tables below). Each indicator is marked as a capacity indicator or demand indicator and by relevant spatial extent: Regional (R), Metropolitan (M), Urban (U) (European Commission).

Indicators frame for provisioning, regulating, maintenance and cultural services (European Commission, 2016)

CICES Division - Group					
Nutrition - Biomass					
Class	**Class type (urban ecosystem service)**	**Indicator (unit)**	**Relevant spatial extent**		
			R	**M**	**U**
Cultivated crops	Vegetables produced by urban allotments and in and the commuting zone	● Production of food (ton ha^{-1} $year^{-1}$)	●	●	
		● Surface of community gardens /small plots for self-consumption (ha)		●	●
Nutrition - Water					
Surface/ground water for drinking		● Drinking water provision (m^3 $ha^{-1}year^{-1}$)	●	●	
		● Drinking water consumption (m^3 $year^{-1}$)	●	●	●
Materials - Water					
Surface/ground water for non-drinking		● Water provision (m^3 $ha^{-1}year^{-1}$)	●	●	
		● Water consumption per sector (m^3 $year^{-1}$)	●	●	●

CICES Division - Group					
Mediation of waste, toxics and other nuisances - Mediation by ecosystems					
Class	**Class type (urban ecosystem service)**	**Indicator (unit)**	**Relevant spatial extent**		
			R	**M**	**U**
Filtration/ sequestration/storage/ accumulation by ecosystems	Regulation of air quality by urban trees and forests	● Pollutants removed by vegetation (in leaves, stems and roots) (kg ha^{-1} year-1)		●	●
		● Dry deposition velocity (mm s^{-1})		●	●
		● Population exposed to high concentrations of pollutants (% on surface area)		●	●
Mediation of smell/noise/visual	Noise mitigated by urban vegetation	● Leaf Area Index + distance to roads (m)		●	●
		● Noise reduction rates applied to UGI within a defined road buffer dB(A) m^{-2} vegetation unit (Derkzen et al. 2015)		●	●
Mediation flows-Liquid flows					
Hydrological cycle and water flow maintenance	Water flow regulation and run off mitigation	● Soil water storage capacity (mm)	●	●	●
		● Soil water infiltration capacity (cm)	●	●	●
		● Water retention capacity by vegetation and soil (ton km^{-2})	●	●	●
		● Intercepted rainfall (m^3 $year^{-1}$)	●	●	●
		● Surface runoff (mm)	●	●	●
Flood protection	Flood protection by appropriate land coverage	● Share of green areas in zones in danger of floods (%)		●	●
		● Population exposed to flood risk (% per unit area)		●	●
		● Areas exposed to flooding (ha)		●	●
Maintenance of physical chemical biological conditions - Lifecycle maintenance, habitat and gene pool protection					
Pollination and seed dispersal	Insect pollination	● Capacity of ecosystems to sustain insect pollinators activity (dimensionless) (Zulian et al. 2013)	●	●	
		● Relative abundance (number over area or over a length)	●	●	
Maintenance of physical, chemical, biological conditions - Atmospheric composition and climate regulation					
Global climate regulation by reduction of greenhouse gas concentrations	Climate regulation by reduction of CO_2	● Carbon storage in soil (ton C ha^{-1})	●	●	
		● Carbon sequestration (ton ha^{-1} $year^{-1}$)	●	●	

Micro and regional climate regulation	Urban temperature regulation	• Leaf Area Index		•	•
		• Temperature decrease by tree cover ($^{\circ}C\ m^{-2}$)		•	•
		• Cooling capacity of UGI (Zardo et al.)		•	•
		• Cooling capacity of UGI (Derkzen et al. 2015)		•	•
		• Cooling capacity of UGI (Grêt-Regamey et al. 2014)		•	•
		• Population exposed to high temperatures (% per unit area)		•	•

CICES Division - Group					
Physical and intellectual interactions with ecosystems and land-/seascapes [environmental settings] – Physical and experiential interactions					
Class	**Class type (urban ecosystem service)**	**Indicator (unit)**	**Relevant spatial extent**		
			R	**M**	**U**
Physical use of land-/seascapes in different environmental settings	Nature-based recreation	● Accessibility[15] to public parks, gardens and play-grounds (more than 50 ha) - (inhabitants within 10 km from a park)	●	●	●
		● Accessibility to public parks gardens and play-grounds (between 10 ha and 50 ha) - (inhabitants within 1 km from a park)	●	●	●
		● Accessibility to public parks gardens and play-grounds (between 2.5 ha and 10 ha) - (inhabitants within 500 m from a park)		●	●
		● Accessibility to public parks gardens and play-ground (between 0.75 ha and 2.5 ha or smaller but important green spaces) - (inhabitants within 250 m from a park).			●
		● Weighted recreation opportunities provided by Urban Green Infrastructure (Derkzen et al. 2015)			●
		● Nature based recreation opportunities (includes Natura 2000; includes bathing water quality) (dimensionless) (Zulian et al. 2013)	●	●	
		● Proximity of green infrastructure to green travel routes (km)	●	●	●
		● Green related social service provided to population (dimensionless) (Secco and Zulian 2008)			●
		● Regression models on georeferenced data (i.e. pictures or geo tagged locations) (Tenerelli et al. 2016)	●		
Physical and intellectual interactions with ecosystems and land-/seascapes [environmental settings] – Intellectual and representative interactions					
Educational Scientific	Nature-based education	● Accessibility of parks from schools (number of public parks and gardens within a defined distance from a school)		●	●
Heritage, cultural		● Cultural and natural heritage sites[16] (e.g., UNESCO world heritage sites) (number per unit area, % per unit area)	●	●	●

Ecosystem Service Modelling and Assessment Tools

Numerous tools and models have been developed to identify, assess, model, and place a monetary value on ecosystem services with little consistency and standardization across approaches. This section provides a high level overview state of ecosystem services assessment.

The assessment and quantification of ecosystem services typically involves 4 steps:

(1) Identify/inventory the location of ecosystems (i.e. natural capital) providing the service.
(2) Identify the human demand for the service, which can be either:
    a. Rival, where use of a service leaves less of it available for other users (e.g., consumptive water use), or
    b. Nonrival, where its use does not prevent others from enjoying it (e.g., recreational water use or scenic views).
(3) Identify spatial flow paths for the service (e.g., hydrologic flows, lines of sight, or transportation networks).
(4) Assess the biophysical and anthropogenic landscape features that deplete or alter that spatial flow (Bagstad et al., 2014).

While the general steps are similar, how assessments have been carried differ especially in regards to economic valuation techniques employed, the spatial and temporal representation of services, the effects of management practices and trade-offs, the incorporation of existing biophysical models, and the sensitivity analysis (Grêt-Regamey et al., 2017; Bagstad et al., 2013; de Groot et al., 2010). Bagstad and colleagues (2013) reviewed 17 modelling tools designed to measure and quantify ecosystem services and assessed them based on 8 criteria. The authors found that most tools seek to quantify services and their trade-offs at a landscape scale in order to support scenario analysis using simplified underlying biophysical models. However, they differ in their modelling approaches, level of complexity, generalizability, and proprietary nature (p.g.28).

An important conclusion from the Bagstad and colleagues (2013) review is that that there is still no standard modelling approach or tool. Grêt-Regamey and colleagues (2017) similarly conclude that despite the vast increase in ES studies in recent years, ES assessment approaches need to be further developed to improve standardization, site specific relevance, and use in decision making contexts. The authors found some sector specific tools, such as for agriculture or forestry to be more advanced and better suited to support the integration of nature's benefits into policy and planning processes.

An important consideration in ecosystem services assessment is determining the right degree of model complexity. Assessments based on proxy information such as land cover have been shown to sacrifice accuracy and limit site specific policy recommendations (Grêt-Regamey et al., 2017). Highly complex models, however, may restrict wider use and do not necessarily add value to decision making (Seppelt et al., 2011). Context and purpose of the ecosystem service assessment clearly matter. Another important consideration is the underlying value dimensions and world views. Grêt-Regamey and colleagues (2017) conducted a literature review of 68 tools for integrating ecosystem services into decision making; they noted substantial differences in study outcomes depending on the value systems that were applied.

Based on the conclusions from recent research, the best path forward may be to focus less on developing a singular standardized tool, and more on a system of data sharing (especially for spatial data), ecological studies to parameterize models, and economic valuation techniques (Bagstad et al., 2013). Clear assumptions and transparency in motivations and world view are also critical to understand where and in what context model replicability is suitable.

Application Considerations in an Urban Context

Natural areas in urban contexts have unique ecosystem service considerations given their small size, unbalanced composition and fragmentation. Within urban areas, ecosystems services can vary greatly depending on the surrounding environmental and socio-economic characteristics. Bolund and Hunhammar (1999) proposed the first classifications of ecosystem services for an urban context arguing the focus should be on direct and locally generated services. They identified seven urban ecosystem types: street trees, lawns/parks, urban forests, cultivated land, wetlands, lakes/sea, and streams. For the respective ecosystem types, Bolund and Hunhammar assessed ecosystem service values of air filtration, micro climate regulation, noise reduction, rainwater drainage, sewage treatment, and recreation and cultural value. Building on Bolund and Hunmammar's pioneering work, Gómez-Baggethun and Barton (2013) developed an expanded list of ecosystem service categories for inclusion in urban ecosystem valuation assessments, which is the current standard. They suggested: food supply, water flow regulation and runoff mitigation, temperature regulation, noise reduction, air purification, moderation of environmental extremes, waste treatment, climate regulation, pollination and seed dispersal, recreation and cognitive development, and animal sighting.

When assessing urban ecosystem services, identifying the most appropriate study boundaries is not a simple task. From a budgetary and authority perspective, municipal boundaries make the most sense. Cities, however, derive substantial ecosystem services from outside jurisdictional boundaries. Depietri and colleagues (2013) suggest using watersheds as boundaries, recognizing the link between urban life and healthy watershed ecosystems.

Numerous studies have attempted to assign a monetary value to urban ecosystem services. Elmqvist and colleagues (2015) reviewed 25 peer reviewed studies in the literature focusing on five ecosystem services: local pollution removal, carbon sequestration and storage, regulating water flows, climate regulation/cooling effects, and aesthetics, recreation and other amenities. The authors conclude that the monetary benefits are substantial. Based on the studies analyzed, benefits range from US$ 3,212 to $17,772 in constant dollars per ha per year, justifying, the authors contend, the need for ecosystem restoration and green infrastructure investment. Elmqvist and colleagues (2015) single out the contribution of urban green infrastructure to enhancing the capacity of cities to respond and adapt to a changing climate, 'insurance value', as a neglected variable in most analyzes.

In respect to specific urban ecosystem types, substantial research has looked specifically at the ecosystem service values provided by urban forests (Nesbitt et al., 2017; Willis & Petrokofsky, 2017; Livesley et al., 2016; Haavardsholm, 2015). The US Forest Service developed the i-Tree suite of tools, which have been widely applied at a municipal level across Canada with several examples in Southern Ontario including Toronto, Brampton, Mississauga, Waterloo, Oakville, and Hamilton (Steenberg, 2017). The i-Tree Eco tool, for example, estimates urban forest canopy cover and benefits associated with carbon storage, carbon

sequestration, air pollutants removal, and energy conservation (Novak et al., 2013). While the focus of assessments is usually on benefits, Escobedo and colleagues (2011) introduced the concept of ecosystem disservices in the context of urban forests. Examples of disservices associated with the urban forest include: tree growth that block views; wind pollinated plants dispersing allergens, and damage to infrastructure from root growth. The concept has been extended more broadly to other ecosystem services as well (Gómez-Baggethun & Gren, 2013).

Assessing urban ecosystem services has brought attention to the importance of management practices. Livesley and colleagues (2016) show that urban forest management practices can improve energy conservation, carbon storage, reduce storm-water runoff, improve air quality, and enhance human health and wellbeing. Tratalos and colleagues (2009) in a study of biodiversity potential and ecosystem services in five UK cities found there is substantial scope for improving ecological performance based on management of urban form. Using spatial analysis, Holt and colleagues (2015) identify hotspots of production potential in cities where multi-functionality of greenspace can be increased. What emerges from their respective research is that we clearly need to manage urban greenspaces to maximize multiple ecosystem services.

The concept of ecosystem services is increasingly part of urban planning discourse. The cities of Stockholm New York, Seattle and Berlin in particular, have widely integrated the concept into urban planning policy and strategy documents largely in respect to promoting cultural services and habitat provision (Hansen et al., 2015). Seeing natural capital as a vital part of the urban landscape will help increase the resiliency of our cities to environmental impacts and improve health, and quality of life of residents (Gomez-Baggethun and Gren, 2013).

Best Practice, Urban Biodiversity and Ecosystem Services Research Project

The Urban Biodiversity and Ecosystem Services (URBES) project, which concluded in 2015, assessed urban ecosystem services and biodiversity in seven cities in Europe and the United States. The project aimed to bridge the knowledge gaps related to the contribution of urban biodiversity and ecosystem services to human wellbeing. The effort resulted in over 50 published papers. Based on the collective experience, researchers and practitioners identified key insights to guide future urban ecosystem services research. The insights summarized below are discussed in more detail in Kremer et al. (2016).

1. Using existing land-cover and land-use based indicators to estimate ES benefits in urban areas is problematic as conversion factors are often based on non-urban empirical data. The ecosystem performance and functionality between urban and non-urban areas will differ substantially. Even extended conversion factors between cities is problematic given different conditions.

2. Understanding urban ES supply and demand dynamics requires cross-scale and cross-boundary considerations. Administrative boundaries are often not sufficient to delimit an area of analysis because ES supply and demand dynamics do not align with administrative boundaries. The authors suggest conducting analysis at three scales, the core city within administrative boundaries, the hinterland, and the combined core city and hinterland.

3. Ecosystem services and benefits derived from them depend on non-ecological elements, including physical infrastructure, technology, social practices, and the cultural contexts in which people experience human-environment relations. Studies must consider these factors when estimating the human benefits of ecosystem services or advising on management of services.

4. Cultural ecosystem services are difficult to quantify and value, however, they are among the most important services in urban areas because people hold spiritual, educational, aesthetic, place-based, and other nonmaterial values toward the urban environment that contribute substantially to human wellbeing. These values will differ based on culture, experience, social norms, and economic status.

5. Links between biodiversity and ecosystem services in an urban setting remain unclear. Understanding and managing for that relationship could potentially enhance biodiversity and ecosystem services simultaneously.

6. Implementing ES concepts in planning and policies requires addressing the "science-policy gap", developing methods and tools that planners can use to assess ES, and communicating concepts in language that economists, architects and engineers grasp.

Examples of Greater Toronto Area focused research

There are few examples of published attempts to identify, measure and value the benefits of ecosystem services specific to Toronto. Existing studies have been primarily in the realm of public health and not necessarily framed around ecosystem benefits. For example, looking at the increased health benefits of active transportation or more walkable cities (Toronto Public Health, 2012) which reference trails and parks or the relationship between increased physical activity and public green spaces (Koohsari et al., 2015).

Healthy Toronto by Design Series

The Healthy Toronto by Design series includes two literature review studies on the benefits of greenspace. The studies focus on the impact of greenspaces on heat island mitigation and reducing air pollution (Zupancic et al., 2015), and on physical health, mental health and wellbeing (Toronto Public Health, 2015). The respective studies do not explicitly link greenspaces in Toronto to specific benefit values, however, they do document evidence of the ecosystem service benefits provided by greenspaces in an urban context and offer important information to carry out more detailed analysis. What is clear from the respective studies is that the benefits provided by greenspaces are large and positively impact the liveability of cities.

Urban Forest

The study, *Every Tree Counts, A Portrait of Toronto's Urban Forest* provides a detailed analysis of trees in Toronto (City of Toronto, 2013). The assessment used the iTree suite of tools to estimate that Toronto has about 10.2 million trees with a canopy cover of approximately 26.6 percent of the city. The summary of ecosystem services provided by the urban forest canopy includes:

- Storage of approximately 1.1 million tonnes of carbon valued at CAD$25.0 million.
- Sequestration of about 46,700 tonnes of carbon per year (CAD$1.1 million per year)
- Removal of about 1,905 tonnes of air pollution per year (CAD$16.9 million per year).
- Reduce annual residential energy costs by CAD$9.7 million per year.

The information on the structure and functions of the urban forest, as measured in this type of study, can be used to improve support for urban forest management programs. If updated on a regular basis, the results can be used to track progress toward urban forest management goals and well as broader city-wide goals to improve environmental quality.

Taking a different approach, Karden et al. (2015) conducted a statistical analysis correlating the presence of urban forest and greenspace with self-reports of general health, cardio-metabolic conditions and mental illnesses. Controlling for socio-economic and demographic factors, their results suggest that people who live in neighborhoods with a higher density of trees report significantly higher health perception and significantly less cardio-metabolic conditions. Statistically, the results suggest having 10 more trees in a city block improves health perception that is comparable to an increase in annual personal income of $10,000. Similarly, having 11 more trees on a city block decreases cardio-metabolic conditions that is comparable to an increase in annual personal income of $20,000. Urban trees have also been linked to improved educational outcomes. A recent study examining potential effects of tree cover, diversity, and species composition on academic performance of grade three and six students in the Toronto District School Board found that proportion of tree cover was a significant positive predictor of student performance (Sivarajah et al., 2018).

Wellbeing and Your Watershed, Credit River Ecosystem Services WebMap

Bunch (2016) created a web based mapping tool that tracks and measures ecosystem services benefiting the residents, community and stakeholders of the Credit River watershed, and informs them about these benefits. The tool communicates the wellbeing benefits associated with ecosystem services documented in the literature; it does not attempt to specifically quantify or value the ecosystem services benefits associated with the Credit River Watershed.

Urban Case Studies

Ultimately, what is measured, and the approach used to measure it, depends on the intended use of the results. Types of uses at a municipal or regional level include:

Education and Building Awareness

Ecosystem service valuation is frequently used to increase citizen and corporate understanding and awareness of the value provided by nature. By estimating the monetary value of nature's contribution to wellbeing, people have a greater appreciation for the importance of nature and are able to asses that value on equal footing with other monetized goods and services.

Case Study Example: At nearly 2 million acres, Ontario's Greenbelt stretches from Niagara to Northumberland protecting vital agricultural land and greenspace in the Greater Golden Horseshoe. Implemented in 2005, the Greenbelt Plan protects this natural capital by preventing new urban development in greenfield areas within its boundaries. Green Analytics and Sustainable Prosperity were

commissioned by the Friends of the Greenbelt to provide an updated estimate of the value of natural capital in Ontario's Greenbelt, building on an assessment that was first carried out in 2008. The assessment used the National Ecosystem Services Classification methodology to identify a series of ecosystem service accounts that directly benefit residents (e.g. recreation, flood protection, and clean air to breath). This study determined that the Greenbelt accounts were valued at $3.2 Billion per year.

Tracking, Monitoring, and Managing Natural Assets

There is a growing trend towards the use of ecosystem service assessment and valuation by municipalities to track, monitory and manage the natural assets within their boundaries.

Case Study Example: In July 2014, the Town of Gibsons, British Columbia, became the first municipality in North America to pass a municipal asset management policy that explicitly defines and recognizes natural assets as an asset class and creates specific obligations to operate, maintain and replace natural assets alongside traditional capital assets, including the development of natural asset management strategies. The Town recognized that if natural assets are degraded or destroyed, the services previously provided for free have to be replaced. From an economic perspective, maintaining healthy ecosystems ensures continuity of essential services at a fraction of replacement and maintenance costs of engineered alternatives. The municipal asset management policy means that in addition to reporting physical assets like roads and storm sewers, Town planners will track natural assets such as forests, aquifers, creeks, wetlands and foreshores that provide essential services, such as flood prevention, provision of drinking water and rain water management. Currently the only natural capital asset tracked is the Town aquifer. [16]

According to the Town's eco-asset plan, natural asset management plans require:

- assessing the asset conditions from a biophysical perspective to determine their properties, and the civil services they provide;
- determining the asset worth and substitution or replacement cost so that the municipality understands the risk and exposure in the event that the asset deteriorates and needs to be replaced with an engineered alternative;
- determining the impact of increased demands on the asset;
- determining objectives for the asset which could range from maintaining it at the lowest possible cost to being protected in perpetuity;
- developing an operations and maintenance plan; and,
- developing a financial management plan (Municipal Natural Asset Initiative, 2017).

Changing how we track and value natural assets brings attention to the important ecological services that ecosystems provide and the incredible economic and social value that previously went unaccounted.

Land Use Planning

Ecosystem service assessment and valuation can also play an important role in supporting land use planning within municipal settings. Natural capital can be spatially allocated, and the implications of alternative land use decisions modelled and mapped to identify areas well suited to development and regions for ecological protection. Trade-offs resulting from different land uses can also be informed by ecosystem service assessment and valuation.

[16] Town of Gibsons, *Towards and Eco-Asset Strategy for the Town of Gibsons*, Gibsons, BC: Town of Gibsons.

Case Study Example: The University of Michigan developed the Green Infrastructure Spatial Planning Model (GISP) for identifying priority areas (census tracts) for green infrastructure development in Detroit. As a post-industrial city –there is extensive vacant land for urban transformation. Detroit has ambitious policies to develop green infrastructure to enhance sustainability and resiliency. GISP tool was design to help planners best site future green infrastructure to maximize different ecosystem benefits and to distribute these benefits fairly across neighborhoods. The tool provide a rational approach to justify green development locations. Newell one of developers argued that current siting decisions are largely political and focus predominately on storm water management neglecting other ecosystem service benefits.

The tool is made up of six GIS layers corresponding to six green infrastructure or ecosystem service benefits: stormwater management, social vulnerability, access to green space, air quality, the urban heat island effect, and landscape connectivity. To compare priority sites versus current sites, tool developers used multi criteria analysis to weigh different ecosystem service benefits based on expert engagement. The tool includes social vulnerability recognizing that critical ecosystem service benefits of green infrastructure investment are largely localized.

Case Study Example: In United Kingdom, Bateman and colleagues (2013) show that making land use decisions based solely on the market value of agricultural production can contribute to significant economic losses. The authors use spatially explicit models in conjunction with valuation methods to estimate comparable economic values of land use decisions that consider a wide range of ecosystem services. Ecosystem services considered in the analysis include: agricultural production, greenhouse gas sequestration, recreation, urban greenspace amenity, and wild bird species diversity. Looking out to 2060, they demonstrate that making land use decision based on a comprehensive suite of ecosystem service values can generate 19.6 billion of £s per annum (£2010) (equivalent to 35.6 billion $CAN) compared to 892 million of £s per annum (£2010) (equivalent to 1.6 billion $CAN) when considering market prices for agricultural production alone.

Monitoring Progress Towards Policy Goals/Objectives

Municipal governments can use ecosystem service assessment and valuation to measure progress towards policy objectives and goals. This could be in relation to protecting a specified percent of land, or achieving an objective such as no net loss or biodiversity targets.

Case Study Example: The City of Birmingham estimated the stock of natural capital assets and flow of ecosystem services at a city-wide level as basis to establish targets for increasing greenspace as part of the City's Green Living Spaces Plan and to inform a 25-year Natural Capital Plan. The Green Living Spaces Plan assessment includes indicative monetary values in annual terms and asset values (over 100 years) based on value transfer. The city also adopted the Natural Capital Planning Tool (NCPT) to inform planning and policy for sustainable land use. The NCPT is qualitative based on 'expert opinion' translating indicators into impact scores, without any quantification or monetisation of physical impacts. Ecosystem services measured by the City's Green Living Spaces Plan include: harvested products, biodiversity, aesthetic values, recreation, water quality regulation, flood risk regulation, air quality regulation, local and global climate regulation and soil contamination (Eftec, 2017). The City of Birmingham is at the forefront of natural capital accounting and exploring opportunities to ensure

natural capital is integrated into land use and planning decisions as exemplified by the City's Natural Capital Plan, Natural Capital Planning Tool, and becoming a designated biophilic city.

Case Study Example: Halifax Regional Municipality (HRM) has implemented a progressive Urban Forest Master Plan that includes forest management plans for 111 unique urban forest neighbourhoods. Adopting a Neighbourhood level management approach increases citizen participation in urban forest stewardship fostering a sense of local ownership and social cohesion. The Master Plan promotes location-specific forest health to maximize the ecosystem service benefits across the municipality. The city used the i-Tree method to determine canopy coverage and estimate ecosystem value benefits provided by the urban forest. HRM estimated benefits of carbon sequestration, shading, and reduction in air pollutants by forest neighbourhood. For the municipality as a whole, the urban forest sequesters over 18,500 tonnes of carbon annually and directly reduces energy demand through heating and cooling by 1.7 million dollars. In addition, the trees remove over 550,000 kg of pollutants from the air annually.

References

Adamowicz, W., Boxall, P., Williams, M., & Louviere, J. (1998). Stated preference approaches for measuring passive use values: choice experiments and contingent valuation. *American journal of agricultural economics*, *80*(1), 64-75.

Astell-Burt, T., Feng, X., & Kolt, G. 2014. Is neighborhood green space associated with a lower risk of type 2 diabetes? Evidence from 267,072 Australians. *Diabetes Care.* 37: 197-201.

Bagstad, K., Semmens, D., Waage, S., Winthrop, R. 2013. A comparative assessment of decision-support tools for ecosystem services quantification and valuation. *Ecosystem Services, 5*, 27-39.

Bagstad, K., Villa, F., Batker, D., Harrison-Cox, J., Voigt, B., & Johnson, G. 2014. From theoretical to actual ecosystem services: mapping beneficiaries and spatial flows in ecosystem service assessments. *Ecology and Society, 19* (2), 64.

Bateman, I. J., Harwood, A. R., Mace, G. M., Watson, R. T., Abson, D. J., Andrews, B., & et al. 2013. Bringing ecosystem services into economic decision-making: land use in the United Kingdom. *Science*, *341*(6141), 45-50.

Bernal, B., & Mitsch, W. J. (2012). Comparing carbon sequestration in temperate freshwater wetland communities. *Global Change Biology*, *18*(5), 1636-1647.

Bolund, P., & Hunhammar, S. 1999. Ecosystem services in urban areas. *Ecological Economics, 29*, 293–301.

Bowler, D., Buyung-Ali, L., Knight,T., & Pullin, A. 2010. A systematic review of evidence for the added benefits to health of exposure to natural environments. *BMC Public Health*. 10:456.

Boyle, K. J., Desvousges, W. H., Johnson, F. R., Dunford, R. W., & Hudson, S. P. (1994). An investigation of part-whole biases in contingent-valuation studies. *Journal of Environmental Economics and Management*, *27*(1), 64-83; or Carson, R. T., & Mitchell, R. C. (1995). Sequencing and nesting in contingent valuation surveys. *Journal of environmental economics and Management*,*28*(2), 155-173

Brander, L. M., & Koetse, M. J. (2011). The value of urban open space: Meta-analyses of contingent valuation and hedonic pricing results. Journal of environmental management, 92(10), 2763-2773.

Bratman G., Hamilton J., & Daily, G. 2012. The impacts of nature experience on human cognitive function and mental health. *Annals of the New York Academy of Sciences, 1249*(1), 118–36.

Bunch, M. 2016. Human wellbeing, ecosystem services and watershed management in the Credit River Valley. York University and Credit Valley Conservation.

Castro, D. C., Samuels, M., & Harman, A. E. 2013. Growing Healthy Kids: A Community Garden-Based Obesity Prevention Program. American Journal of Preventative Medicine, 44(3).

City of Toronto Urban Forestry. 2017. Every Tree Counts, A Portrait of Toronto's Urban Forest.

Cohen, D., McKenzie, T., Sehgal, A., Williamson, S., Golinelli, D., Lurie, N. 2007. Contribution of Public Parks to Physical Activity. *Am J Public Health*, 3, 509–514, doi: 10.2105/AJPH.2005.072447.

Comstock, N., Dickinson, M., Marshall, J. A., Soobader, M., Turbin, M. S., Buchenau, M., & Litt, J. S. 2010. Neighborhood attachment and its correlates: Exploring neighborhood conditions, collective efficacy and gardening. Journal of Environmental Psychology, 30(4), 435–442.

Conference Board of Canada. 2016. Healthy Brains at Work: Estimating the Impact of Workplace Mental Health Benefits and Programs.

Department for Environment, Food and Rural Affairs/ Office of National Statistics. 2017. Principles of Natural Capital Accounting/ Available Online: www.ons.gov.uk/economy/environmentalaccounts/methodologies/principlesofnaturalcapitalaccounting/.

Depietri, Y., Guadagno, L., & Breil, M. 2013. Urban Watershed Services for Improved Ecosystem Management and Risk Reduction, Assessment Methods and Policy Instruments. FEEM Working Paper.

Donovan, G., Butry, D., Michael, Y., Prestemon, J., Liebhold, M., Gatziolis, D., & Mao, M. 2013. The Relationship between Trees and Human Health: Evidence from the Spread of the Emerald Ash Borer. *American Journal of Preventive Medicine*. 44(2): 139-145.

Economics for the Environment Consultancy Ltd (eftec). 2017. Scoping and Developing UK Urban Natural Capital Accounts, June 2017. Prepared for the Department for Environment, Food and Rural Affairs.

Elmqvist. T., Seta, H., Handel, S., van der Ploeg, S., Aronson, J., Blignaut, J., Gomez-Baggethun, E., Nowak, D., Kronenberg, J., & de Groot, R. 2015. Benefits of restoring ecosystem services in urban areas. *Current Opinion in Environmental Sustainability*, *14*, 101–108.

Escobedo, F., Kroeger, T., & Wagner, J. 2011. Urban forests and pollution mitigation: Analyzing ecosystem services and disservices. *Environmental Pollution*, *159*, 2078-2087.

European Commission. 2016. Mapping and assessment of urban ecosystems and their services; Urban Ecosystems 4th report. Technical Report - 2016 – 102.

Federal, Provincial, and Territorial Governments of Canada. 2014. 2012 Canadian Nature Survey: Awareness, participation, and expenditures in nature-based recreation, conservation, and subsistence activities. Ottawa, ON: Canadian Councils of Resource Ministers.

Gómez-Baggethun, E., & Barton, D. 2013. Classifying and valuing ecosystem services for urban planning. Ecological Economics, 8*6*, 235–245.

Gómez-Baggethun, E., & Gren, A. 2013. Urban ecosystem services. Chapter 11 in T. Elmqvist et al. (eds.), Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment, DOI 10.1007/978-94-007-7088-1_11.

Green Analytics (2016). Ontario's Good Fortune: Appreciating the Greenbelt's Natural Capital. Prepared for the Friends of the Greenbelt Foundation.

Grêt-Regamey, A., Sirén, E., Hanna Brunner, S., & Weibel, B. 2017. Review of decision support tools to operationalize the ecosystem services concept. *Ecosystem Services*, *26* B, 306-315.

Haavardsholm, O. 2015. Valuing urban ecosystem services, a contingent valuation study on trees in Oslo. University of Oslo, October 2015.

Haines-Young, R. & Potschin, M-B. 2018. Common International Classification of Ecosystem Services (CICES) V5.1 and Guidance on the Application of the Revised Structure.

Hamilton, K., Kaczynski, A., Fair, M., Lévesque, L. 2017. Examining the Relationship between Park Neighborhoods, Features, Cleanliness, and Condition with Observed Weekday Park Usage and Physical Activity: A Case Study. *J Environ Public Health*, 7582402. doi: 10.1155/2017/7582402.

Hansen, R., Frantzeskak, N., McPhearson, T., Rall, E., Kabisch, N., Kaczorowska, A., Kain, J-H., Artmann, M., & Pauleit, S. 2015. The uptake of the ecosystem services concept in planning discourses of European and American cities. *Ecosystem Services*, *12*, 228-246.

Hansmann, R., Hug, S., & Seeland, K. 2007. Restoration and stress relief through physical activities in forests and parks. *Urban Forestry Urban Greening*. 6: 213–225.

Hartig, T., Evans, G., Jammer. L., Davis, D., & Garling, T. 2003. Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology*. 23:109–123.

Hartig, T., Mitchell, R., de Vries, S. & Frumkin, H. 2014. Nature and Health. *Annual Review of Public Health, 35*, 207–228.

Holliday, K., Howard, A., Emch, M., Rodríguez, D., Rosamond, W., Evenson, K. 2017. Where Are Adults Active? An Examination of Physical Activity Locations Using GPS in Five US Cities. *J Urban Health*. 2017 Aug; 94(4): 459–469. doi: 10.1007/s11524-017-0164-z.

Holt, A., Mears, M., Maltby, L., & Warren, P. 2015. Understanding spatial patterns in the production of multiple urban ecosystem services. *Ecosystem Services*, 16, 33–46.

Janssen, I. 2012. Health care costs of physical inactivity in Canadian adults. Applied Physiology, Nutrition, and Metabolism, 37(4), 803-806.

Jon Sheaff and Associates. 2017. London Borough of Barnet Corporate Natural Capital Account. Prepared for the London Borough of Barnet.

Jones, M. B., & Donnelly, A. (2004). Carbon sequestration in temperate grassland ecosystems and the influence of management, climate and elevated CO2. *New Phytologist*, *164*(3), 423-439.

Kaplan, R. & Kaplan, S. 1989. The Experience of Nature: A Psychological Perspective. University of Nevada, Reno. Cambridge University Press. Cambridge.

Kardan, O., Gozdyra, P., Misic, B., Moola, F., Palmer, L. J., Paus, T., & Berman, M. 2015. Neighborhood greenspace and health in a large urban center. *Scientific Reports*, *5*, 11610.

Keniger, L., Gaston, K., Irvine, K., & Fuller, R. 2013. What are the Benefits of Interacting with Nature? *International Journal of Environmental Research and Public Health, 10*, 913-935.

Koohsari, M., Mavoa, S., Villanueva, K., Sugiyama, T., Badland, H., Kaczynski, A.T., Owen, N., & Giles-Corti, B. 2015. Public open space, physical activity, urban design and public health: concepts, methods and research agenda. *Health and Place*, *33*, 75-82.

Kremer et al. 2016. Key insights for the future of urban ecosystems services research. *Ecology and Society*, 21 (2).

Lee, C., Ory, M., Yoon, J., & Forjuoh, S. 2013. Neighborhood walking among overweight and obese adults: Age variations in barriers and motivators. *Journal of Community Health*. 38: 12-22.

Livesley, S., McPherson E., & Calfapietra, C. 2016. The Urban Forest and Ecosystem Services: Impacts on Urban Water, Heat, and Pollution Cycles at the Tree, Street and City Scale. *Journal of Environmental Quality*, 45.

Loomis, J. & Richardson, R. (2000). Economic Values of Protecting Roadless Areas in the United States. Washington, DC: The Wilderness Society and Heritage Forests Campaign.

Lovasi, G., Quinn, J., Neckerman, K., Perzanowski, M., & Rundle, A. 2008. Children living in areas with more street trees have lower prevalence of asthma. *Journal of Epidemiology and Community Health*. 62(7):647–649.

MA, Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Current State and Trends. Island Press, Washington, DC.

Maller, C., Townsend, N., Pryor, A., Brown, P., & Legern, L. 2006. Healthy nature healthy people: 'Contact with nature' as an upstream health promotion intervention for populations. *Health Promotion International*, *21*, 45–54.

Mitsch, W. J., et al. (2013). Wetlands, carbon, and climate change. *Landscape Ecology*, *28*(4), 583-597.

McCormack, G., Rock, M., Toohey, A., & Hignell, D. 2010. Characteristics of urban parks associated with park use and physical activity: a review of qualitative research. *Health Place.* 16:712–26.

Moudrak, N., Hutter, A.M., & Feltmate, B. 2017. *When the Big Storms Hit: The Role of Wetlands to Limit Urban and Rural Flood Damage.* Prepared for Ontario's Ministry of Natural Resources and Forestry. Intact Centre on Climate Adaptation, University of Waterloo.

Municipal Natural Asset Initiative. 2017. *Municipal Natural Asset Initiative (MNAI) Call for Expressions of Interest*, MNAI.

Nesbitt et al. 2017. The social and economic value of cultural ecosystem services provided by urban forests in North America: A review and suggestions for future research. *Urban Forestry & Urban Greening*, *25*, 103-111.

Nowak et al., 2012. Assessing Urban Forest Effects and Values: Toronto's Urban Forest, United States Department of Agriculture, Forest Service, Northern Research Station, Resource Bulletin NRS-79.

Nowak, et al., 2013. "Assessing the Urban Forest Effects of Toronto's Urban Forest." USDA Northern Research Station, Resource Bulletin NRS-79.

Nowak, D.J., Hirabayashi, S., Bodine, A., & Greenfield, E. 2015. Tree and forest effects on air quality and human health in the United States. *Environmental Pollution,* 193 (119-129).

Phillips, S., Silverman, R., & Gore, A. (2008). Greater than zero: toward the total economic value of Alaska's National Forest Wildlands. The Wilderness Society, Washington.

Potschin, M. & Haines-Young, R. 2016. Defining and measuring ecosystem services. In: Potschin, M., Haines-Young, R., Fish, R. &Turner, R.K. (eds) Routledge Handbook of Ecosystem Services. Routledge, London and New York, pp 25-44.

Richardson, L., & Loomis, J. (2009). The total economic value of threatened, endangered and rare species: an updated meta-analysis. *Ecological Economics*, *68*(5), 1535-1548.

Richardson, L., Loomis, J., Kroeger, T., & Casey, F. 2015. The role of benefit transfer in ecosystem service valuation. *Ecological Economics*, *115*, 51-58.

Seppelt, R., Dormann, C.F., Eppink, F.V., Lautenbach, S., & Schmidt, S. 2011. A quantitative review of ecosystem services studies: approaches, shortcomings, and the road ahead. *Journal of Applied Ecology*, 48,630–636.

Shanahan, D., Bush, R., Gaston, K., Lin, B., Dean, J., Barber, E., & Fuller, R. 2016. Health benefits from nature experiences depend on dose. *Scientific Reports*. 6: art. 28551.

Sivarajah, S., Smith, S., & Thomas, S. 2018. Tree cover and species composition effects on academic performance of primary school students. PLoS ONE 13(2): e0193254.

Smetanin, P., Stiff, D., Briante, C., Adair, C.E., Ahmad, S. and Khan, M. 2011. The Life and Economic Impact of Major Mental Illnesses in Canada: 2011 to 2041. RiskAnalytica, on behalf of the Mental Health Commission of Canada.

Smith, W. N., Desjardins, R. L., & Grant, B. (2001). Estimated changes in soil carbon associated with agricultural practices in Canada. *Canadian Journal of Soil Science*, 81(2): 221-227.

Steenberg, J. 2018. Personal Communication re. i-Tree applications in Canada. February 2018.

Statistics Canada. *Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual (persons unless otherwise noted),* CANSIM (database). (Accessed: April 2018.)

Statistics Canada. Consumer Price Indexes For Canada, monthly, V41690973 series.

TEEB, The Economics of Ecosystems and Biodiversity. 2010. Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB. Earthscan, London-Washington.

Toronto Public Health. 2012. The Walkable City: Neighbourhood Design and Preferences, Travel Choices and Health.

Toronto Public Health. 2015. Green City: Why nature matters to health – an evidence review. Toronto, Ontario.

Tratalos, J., Fuller, R., Warren, P., Davies, R., & Gaston, K. 2007. Urban form, biodiversity potential and ecosystem services. *Landscape and Urban Planning*, *83*, 308-317.

United States Environmental Protection Agency. 2015. National Ecosystem Services Classification System (NESCS): Framework Design and Policy Application. EPA-800-R-15-002. United States Environmental Protection Agency, Washington, DC.

United Nations Statistical Division (UNSD). 2014. The System of Environmental-Economic Accounting 2012—Experimental Ecosystem Accounting (SEEA Experimental Ecosystem Accounting).

Van den Berg, A., & Custers, M. 2011. Gardening promotes neuroendocrine and affective restoration from stress. *Journal of Health Psychology*. 16: 3–11.

Wakefield, S., Yeudall, F., Taron, C., Reynolds, J., & Skinner, A. 2007. Growing urban health: Community gardening in South-East Toronto. Health Promotion International, 22(2), 92–101.

Wang, X., VandenBygaart, A. J., & McConkey, B. C. (2014). Land management history of Canadian grasslands and the impact on soil carbon storage. *Rangeland Ecology and Management*, *67*(4), 333-343.

White, M., Alcock, I., Wheeler, B., & Depledge, M. 2013. Would you be happier living in a greener urban area? A fixed-effects analysis of panel data. *Psychological Science*. 24(6):920–8.

Willis, K., & Petrokofsky, G. 2017. The natural capital of city trees. *Science*, 3*56*, 6336.

Zick, C. D., Smith, K. R., Kowaleski-Jones, L., Uno, C., & Merrill, B. J. 2013. Harvesting more than vegetables: the potential weight control benefits of community gardening. American Journal of Public Health, 103(6), 1110–5.

Zupancic, T., Westmacott, C., & Bulthuis, M. 2015. The impact of green space on heat and air pollution in urban communities: A meta-narrative systematic review. Toronto, ON: David Suzuki Foundation.

Attachment 2 – Supporting Tables for City of Toronto Ravine Ecosystem Services

Table 1: Ecosystem service provided by the Toronto ravine system

Ecosystem Services	
Monetized value	**Non-monetized value**
Recreation Physical health Mental health Gas regulation (e.g. air quality) Carbon sequestration Food provision Aesthetic appreciation Habitat and refugia	Disturbance regulation (e.g. flood mitigation) Temperature regulation Noise regulation Active transport corridors Education and research benefits

Table 2. Key ecosystem services and associated measurable benefits

Ecosystem Service	**Measurable Benefit to Human Wellbeing**
Recreation	Value of recreational activity
Physical health	Value of health benefits associated with living in proximity to nature and avoided health care costs of dealing with ill health due to inactivity
Mental health	Avoided health care costs and forgone GDP due to depression
Gas regulation (air quality)	Value of human health care costs avoided from reduced air pollution
Carbon sequestration	Avoided social costs of climate change[1]
Food provision	Value of food from community gardens, fruit trees, and urban agriculture
Aesthetic appreciation	Value people place on the aesthetic enjoyment of the area
Habitat and refugia	Value people place on knowing natural areas exist

[1] The social costs of climate change refer to damages anticipated to occur over the coming decades, such as increased damages from more frequent and more severe extreme weather events.

Table 3. Ecosystem service physical flows and monetary benefits for the City of Toronto ravine system

Ecosystem service physical flows and monetary benefits for the City of Toronto ravine system							
Ecosystem Service	**Indicator**	**Unit**	**Physical flow 2017**		**Indicator**	**Unit**	**Monetary flow benefit 2017 ($ Millions)**
Recreation	Users of ravines for cycling and biking	# of users	398,240		Value of welfare benefit received by biking in ravines	$ per year	**$111**
	Users of ravines for walking and hiking	# of users	924,486		Value of welfare benefit received by walking and biking in ravines	$ per year	**$473**
Physical health	Population meeting physisical health guidelines by accessing greenspace	# of people	753,812		Value of physical activity supported (avoided health care costs of dealing with ill health due to inactivity)	$ per year	**$217**
Mental health	Reduced number of people experiencing depression	# of people	5,297		Value of improved mental health, avoided foregone GDP due to depression	$ per year	**$5**
Gas regulation (air quality)	Air pollution removed (CO, NO_x, O_3, PM_{10}, SO_2)	metric tonnes	CO=3.2; NOx=94.3; O3=374.4; PM10=113.0; SO2=19.8		Value of cleaner air (avoided health care costs of visits to hospital for respiratory and other related health issues)	$ per year	**$7**
Carbon sequestration	CO2e sequestered	metric tonnes	14,542		Value of carbon sequestered (avoided social damages that are anticipated to result from climate change)	$ per year	**$2**
Food provision, urban agriculture	Fruit and vegetable production occuring in ravine area	metric tonnes	34.7		Value of food from urban agriculture sites in ravines (replacement cost of equivalent produce)	$ per year	**$0.04**
Aesthetic appreciation	Area of natural cover	hectares	6,000		Value people place on the aesthetic enjoyment of the area	$ per year	**$2.67**
Habitat and refugia	Area of natural cover	hectares	6,000		Value people place on knowing natural areas exist	$ per year	**$2.47**
							$822

ADJOURNMENT

ON MOTION from Margaret Bream, the meeting adjourned at 8:25 p.m., on Wednesday, November 13th, 2019.