MAKING THE CASE FOR GREEN INFRASTRUCTURE

WITH VISUALIZATION AND ECONOMIC ANALYSIS

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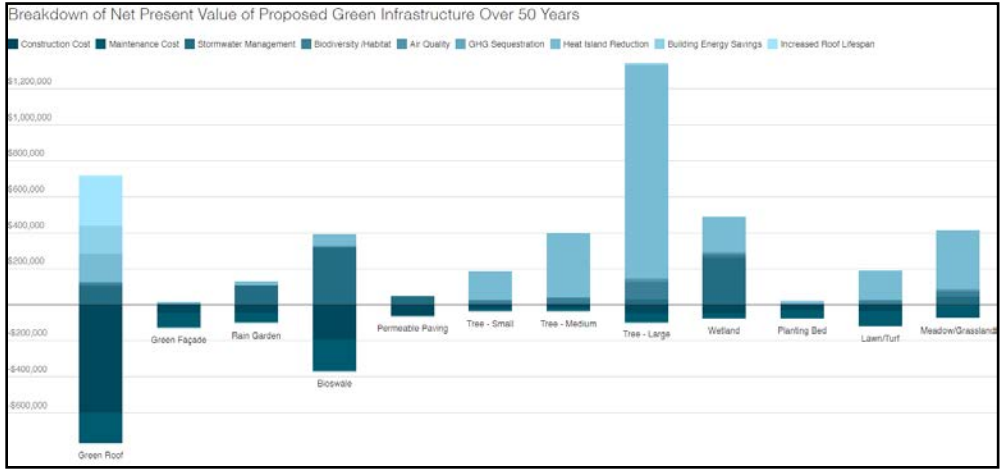
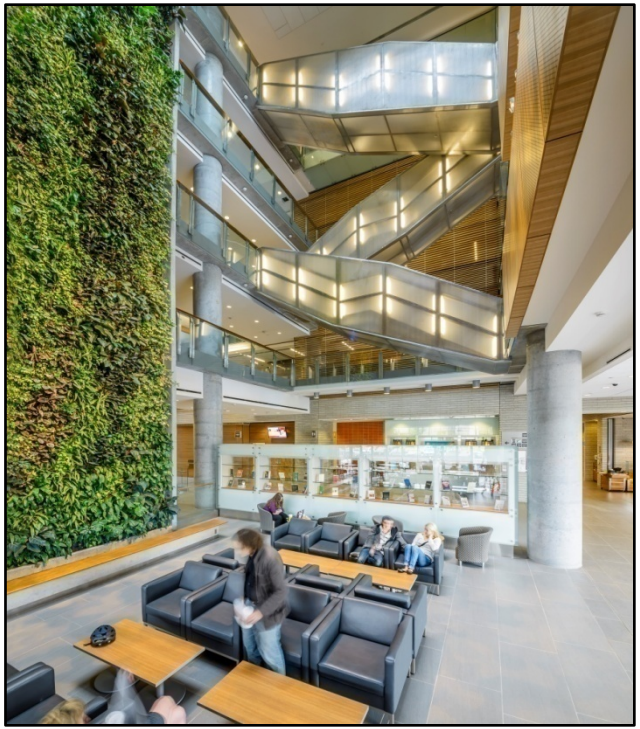


ABOUT THE GREEN INFRASTRUCTURE FOUNDATION



Charitable organization affiliated with Green Roofs for Healthy Cities

Mission

GIF partners with communities to shape healthy, resilient and sustainable places through living green infrastructure.

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SUPPORTED BY

FCM FEDERATION OF CANADIAN MUNICIPALITIES FÉDÉRATION CANADIENNE DES MUNICIPALITÉS

Ontario Trillium Foundation Fondation Trillium de l'Ontario

IN PARTNERSHIP WITH

ONTARIO PARKS ASSOCIATION

Protecting Tomorrow Today

CONTEXT FOR GREEN INFRASTRUCTURE

- Our communities are paved over and impervious surfaces are increasing with development
- As rain falls on roads, parking lots, and roofs, it picks up trash, oils, heavy metals, and bacteria which are discharged into water bodies

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CONTEXT FOR GREEN INFRASTRUCTURE

- Climate change is increasing the severity of extreme weather, like storms and extreme heat
- Climate change is also exposing vulnerabilities in our natural systems

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WHAT IS GREEN INFRASTRUCTURE

- Green infrastructure means natural and human-made elements that provide ecological and hydrological functions and processes. Green infrastructure can include components such as natural heritage features and systems, parklands, stormwater management systems, street trees, urban forests, natural channels, permeable surfaces, and green roofs.

BUT

Our focus has typically been on neighbourhood and site-scale systems

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WHY GREEN INFRASTRUCTURE?

- Green infrastructure complements and extends the lifespan of grey infrastructure
- Communities are facing huge infrastructural challenges
- …and are investing large amounts in green infrastructure
  - New York City - $2.5 billion (20 years)
  - Philadelphia - $1.7 billion (25 years)

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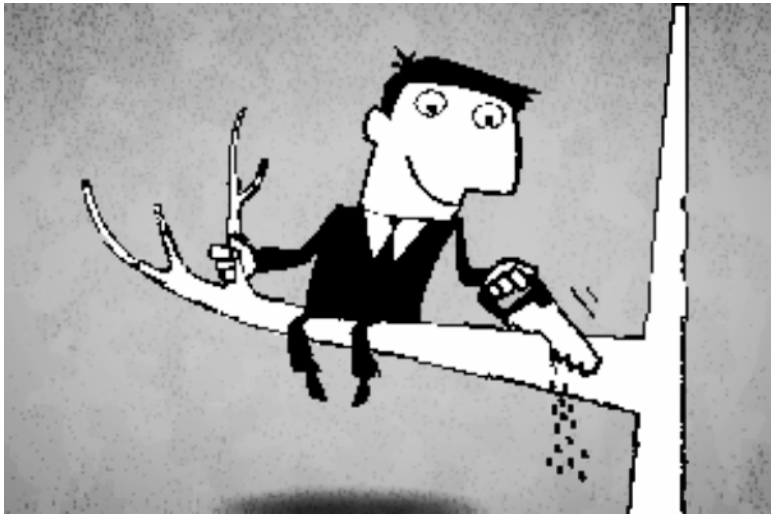
WHY VALUE GREEN INFRASTRUCTURE?

- Benefits are now widely known and accepted – but not often applied to decision making
- Leads to missed opportunities – misallocation of resources



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WHY VALUE GREEN INFRASTRUCTURE?

- Considerations when making important decisions that have far reaching implications about our communities

"The pollutant is in timed-release capsules so that cleanup costs are passed to future generations."

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WHAT DOES A BILLION DOLLARS BUY YOU?

32 km of Highway (407 East Extension)

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WHAT DOES A BILLION DOLLARS BUY YOU?

Two F-35 Fighter Jets

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WHAT DOES A BILLION DOLLARS BUY YOU?

Security at the 2010 G20 Summit in Toronto

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WHAT IF WE INVESTED THAT KIND OF MONEY IN GREEN INFRASTRUCTURE?

Before & After: Artist's rendering of a Philadelphia neighbourhood revitalization using green infrastructure intervention. Philadelphia, PA.

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CHALLENGES

This is a difficult question to answer – and it raises even more questions

- How would it transform our communities?
- How many jobs would get created?
- What would the costs and benefits be?
- What's the return on investment?
- How do we answer these questions with limited resources?

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OBJECTIVES

- To create a compelling green infrastructure
- To understand the potential costs and benefits
- To engage community members and policy makers and excite them
- To leverage outside expertise and combine it with local knowledge
- To move towards detailed study and eventual implementation of green infrastructure

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SOLUTION: THREE PROJECT COMPONENTS

- Green Infrastructure Training
- Cost-Benefit Matrix
- Design Charrette

Before & After: Artist's rendering of a Toronto neighbourhood with green infrastructure. Toronto, ON.

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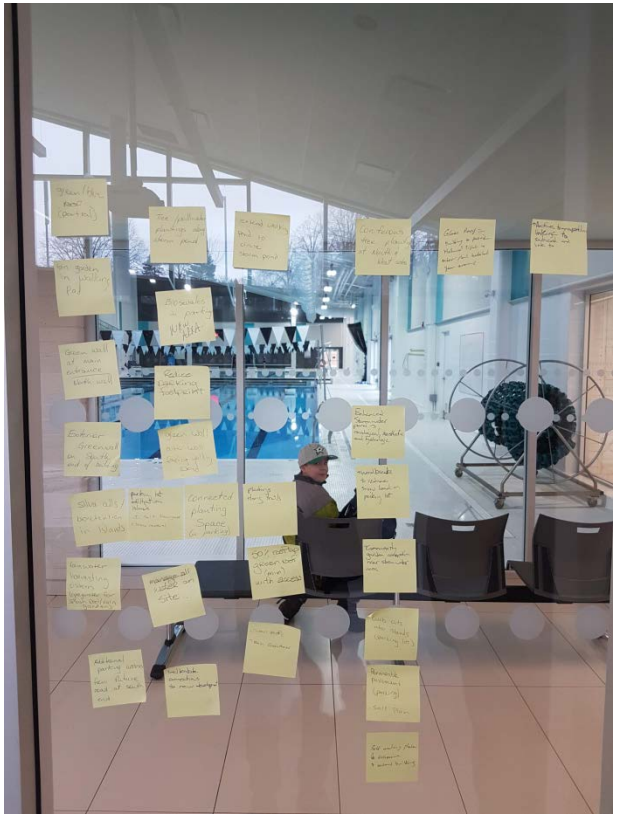
GREEN INFRASTRUCTURE TRAINING

- Two training courses:
  - Introduction to Green Infrastructure: Principles, Applications, and Policies
  - Valuing the Benefits of Green Infrastructure: Principles and Methods

Available at **livingarchitectureacademy.com**



COST-BENEFIT MATRIX

- Based on a detailed **literature review**, as well as a **market survey** and **peer review**
- A tool that provides an **aggregate** cost-benefit analysis
- **10 benefits** and **2 costs** valued for **10 green infrastructure technologies** all on a **per sq metre** basis

Corus Quay interior living wall. Toronto, ON.

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5 STEP VALUATION METHOD

Type Definition

What are the different types of green infrastructure?

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GREEN ROOFS

- Extensive: Growing medium of 15 cm or less
- Intensive: Growing medium of 15 cm +

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GREEN WALLS

- Green Facades: Climbing plants rooted in the ground or in planter boxes
- Living Walls: Plants rooted on a vertical surface

RAIN GARDEN (BIORETENTION)

- Depression designed to receive runoff

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BIOSWALE

- Similar to rain gardens but are typically linear and also convey runoff

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PERMEABLE SURFACES

- Porous or permeable surfaces used in place of conventional paving

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TURF/LAWN

- Grassed areas for human use – sports fields, lawns, etc

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MEADOW/GRASSLANDS

- Biodiverse areas of herbaceous vegetation

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TREES

- Small – less than 10m tall
- Medium – 10m-15m tall
- Large – more than 15m tall

- Huge variation in benefits depending on type of tree, context, age, tree health, etc.

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WETLAND

- Bogs, fens, swamps, marshes, and shallow waters
- Can be natural or constructed

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PLANTING BED

- Can be raised or in-ground, aesthetic or functional

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5 STEP VALUATION METHOD

Type Definition

What are the different types of green infrastructure?

Benefit Identification

What are the different benefits of green infrastructure?

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COSTS AND BENEFITS

- We selected a few that we'd be able to quantify and monetize
- Based on current research
- We quantified them on a general basis within a range
- Customizable based on local factors

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COSTS AND BENEFITS

- Construction Cost
- Maintenance Cost
- Biodiversity
- Stormwater Management
- Increase in Air Quality
- Green House Gas Sequestration
- Urban Heat Island Reduction
- Reduction in Building Energy
- Construction Job Creation
- Maintenance Job Creation
- Property Value/ Taxation Revenue
- Food Production
- Increase in Roof Lifespan

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COST AND BENEFIT LIMITATIONS

Many benefits have not been monetized, including:

- Improved human health
- Improved productivity and reduced absenteeism
- Noise reduction and improved acoustics
- Reduced crime
- Improved access to recreational space
- Increased lifespan of grey infrastructure
- Improved aesthetics

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5 STEP VALUATION METHOD

Type Definition

Benefit Identification

Benefit Valuation

What are the different types of green infrastructure?

What are the different benefits of green infrastructure?

How much is a unit of benefit worth?

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BENEFIT VALUATION

What is the right unit to measure benefits on?

- Litre of stormwater managed
- kWh of Electricity saved
- KG of SO_x, NO_x, PM
- Ton of Carbon

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BENEFIT VALUATION

How much is each unit worth?

Use market and non-market methods devised by ecological economists

- Avoided cost
- Damage cost avoided, replacement cost, substitution cost
- Contingent valuation
- Benefits transfer

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BENEFIT VALUATION

Our approach

- Literature review
- Seek multiple values/ a range of values for each unit
- Normalize values for time and currency
- Weigh them to arrive at an average value

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5 STEP VALUATION METHOD

Type Definition	What are the different types of green infrastructure?
Benefit Identification	What are the different benefits of green infrastructure?
Benefit Valuation	How much is a unit of benefit worth?
Performance Evaluation	How many units of benefit do each type of green infrastructure provide?

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PERFORMANCE EVALUATION

Determining how each type of green infrastructure performs on a variety of metrics, including:

- Litres of stormwater captured and infiltrated
- kWh of energy saved
- Tons of Carbon sequestered
- Kg of pollutants captured

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PERFORMANCE EVALUATION

How can we determine this?

- Literature reviews
- Modeling tools

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5 STEP VALUATION METHOD

Type Definition	What are the different types of green infrastructure?
Benefit Identification	What are the different benefits of green infrastructure?
Benefit Valuation	How much is a unit of benefit worth?
Performance Evaluation	How many units of benefit do each type of green infrastructure provide?
Final Valuation	Benefit Valuation x Performance Evaluation

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FINAL VALUATION

- Gives us a dollar figure for each type of green infrastructure for each benefit, **per square metre**
- These dollar figures can be input into different decision-making models or frameworks
- Using assumptions that fit your circumstances
- Could be applied to asset management

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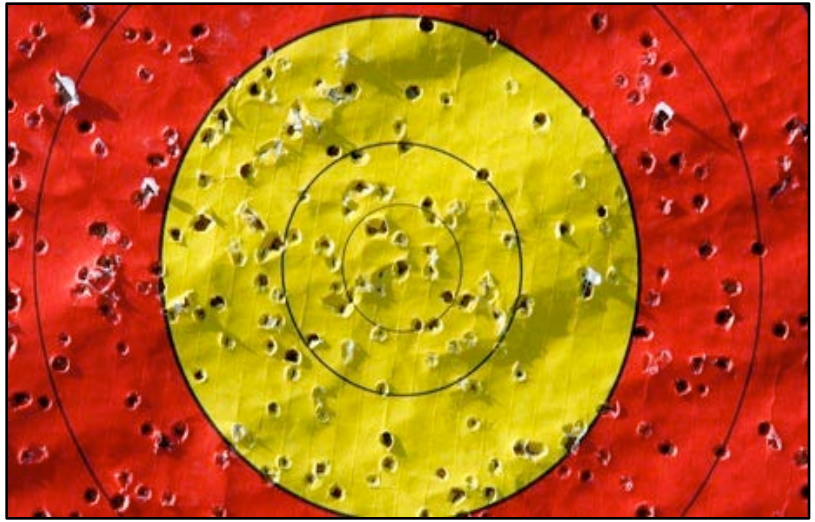
LIMITATIONS

We’re not trying to score a bullseye with this tool

We’re looking to hit the dartboard and start the conversation about the costs and benefits of green infrastructure!



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CHARRETTE

- One-day event with a goal of using green infrastructure to leverage site opportunities and solve problems

Streetscape revitalization concept using green infrastructure intervention. Hamilton, ON

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CHARRETTE

- Attendees are divided into 2-3 multidisciplinary working groups
- Site information is made available to participants
- Opportunities, constraints, goals, objectives

Streetscape revitalization concept using green infrastructure intervention. Windsor, ON.

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CHARRETTE OUTPUTS

- Visuals – site plan, sketches
- Narrative – goals and objectives
- Measurement of each type of green infrastructure

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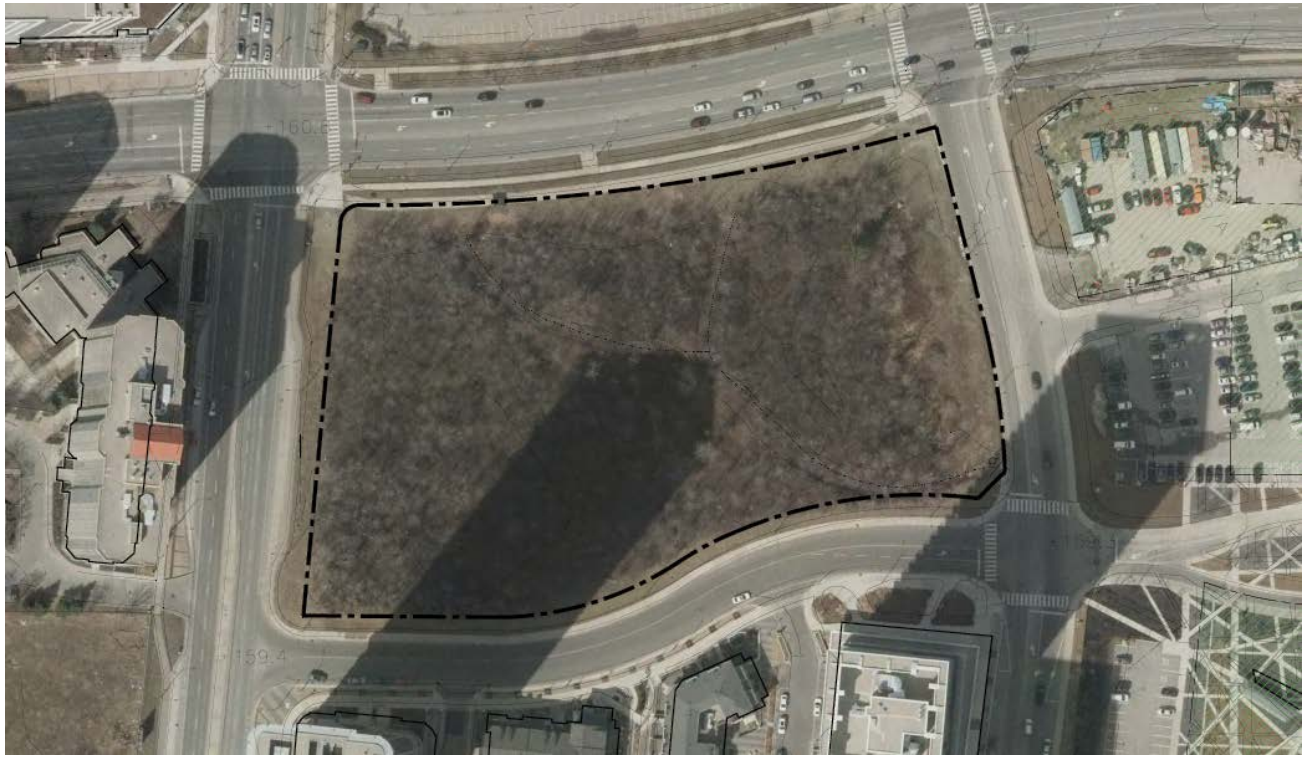
EXAMPLE - MISSISSAUGA



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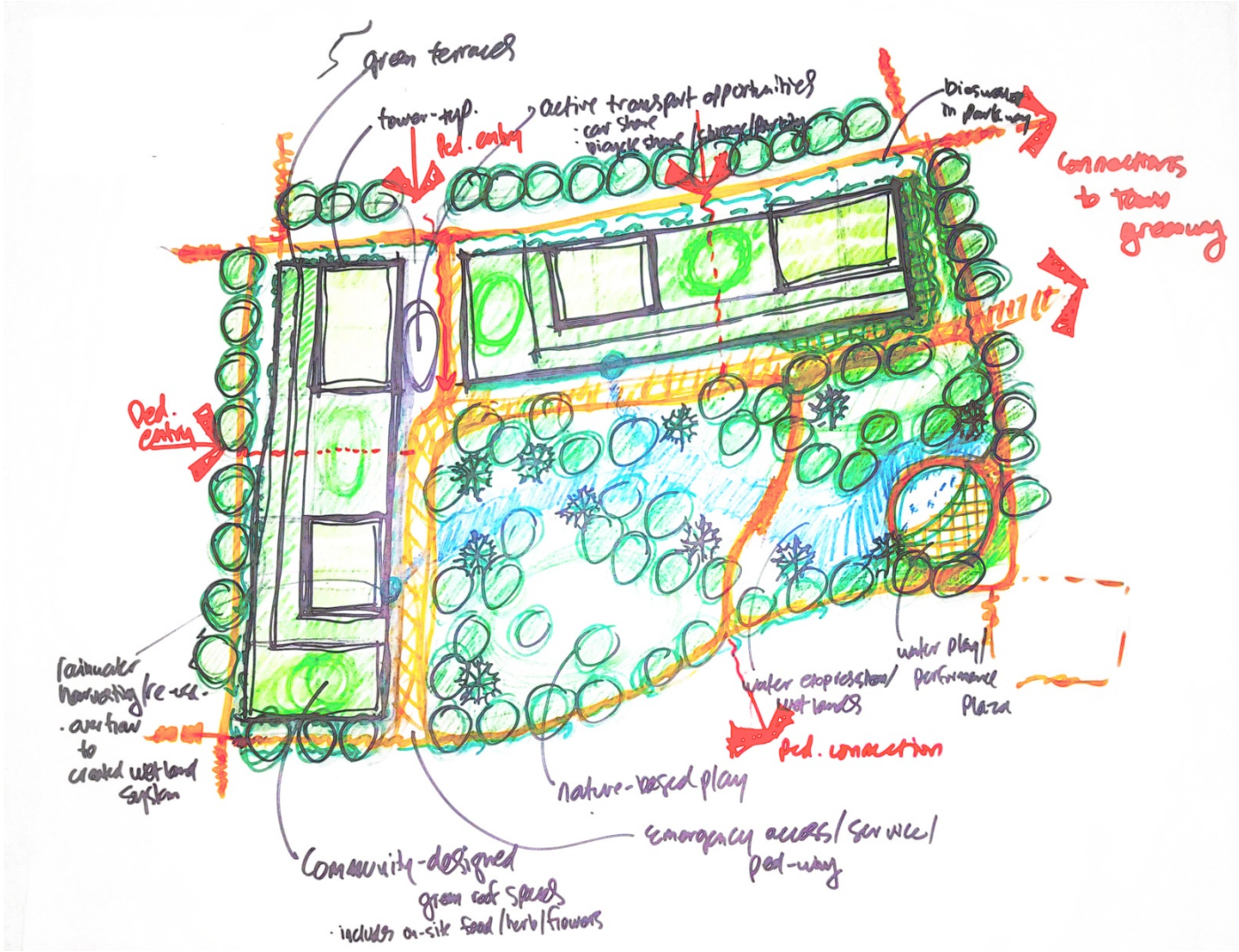

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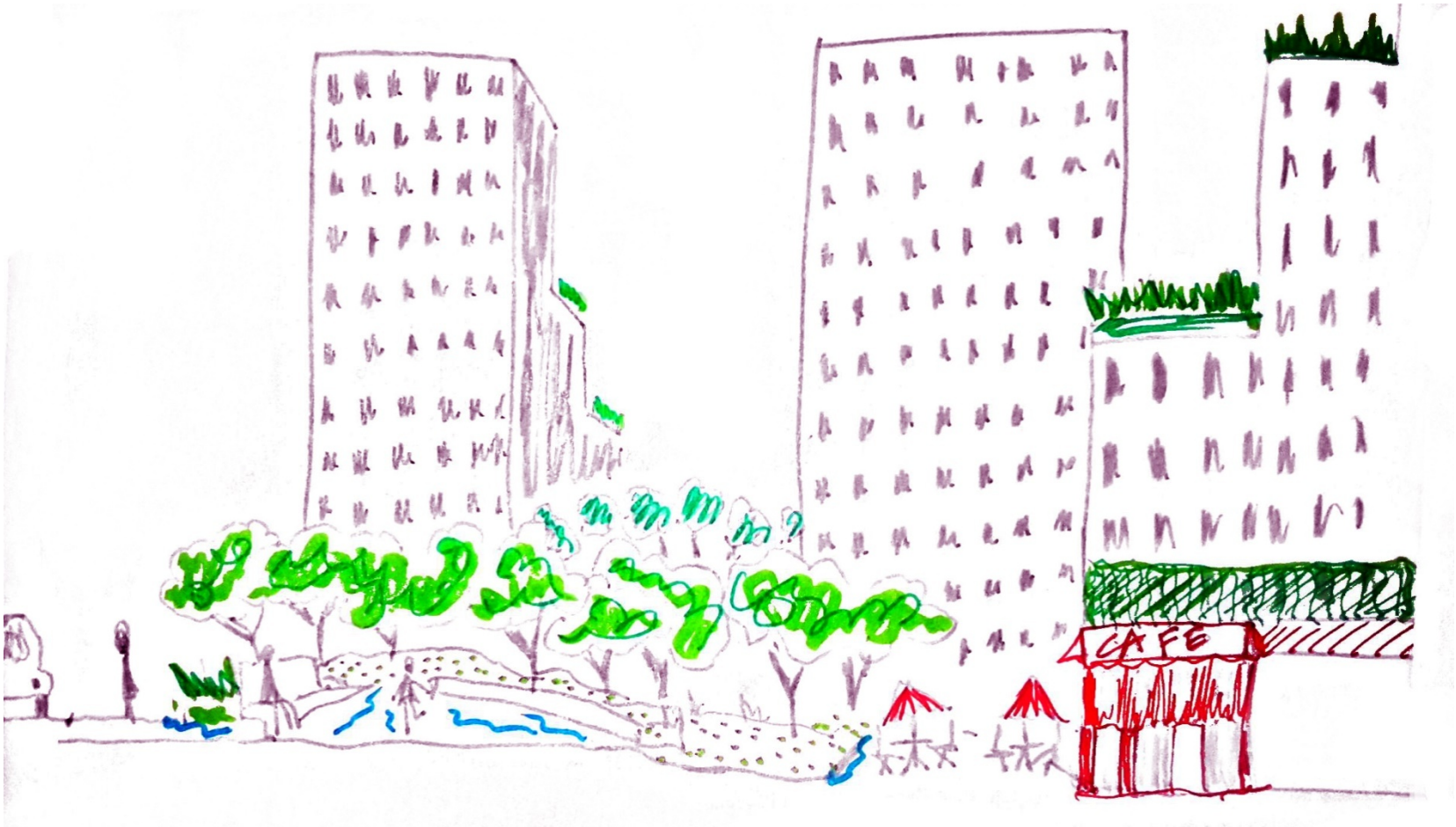

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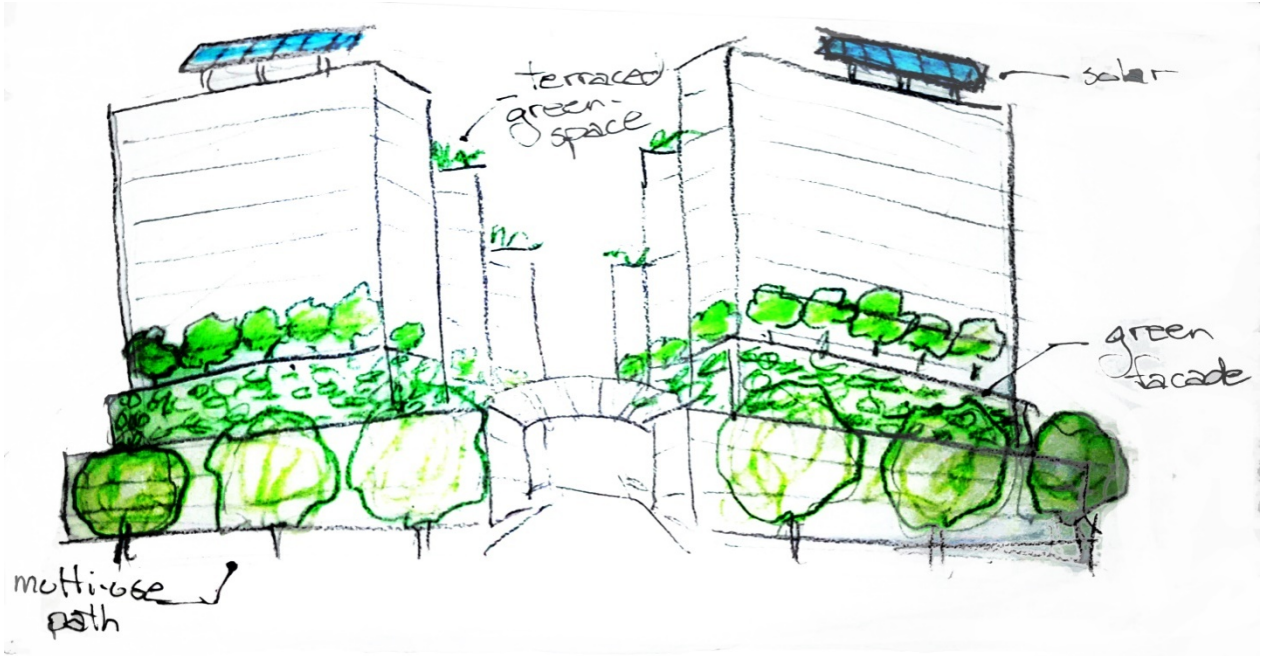
EXAMPLE - MISSISSAUGA



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EXAMPLE – VAUGHAN, ON

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EXAMPLE – WATERLOO, ON

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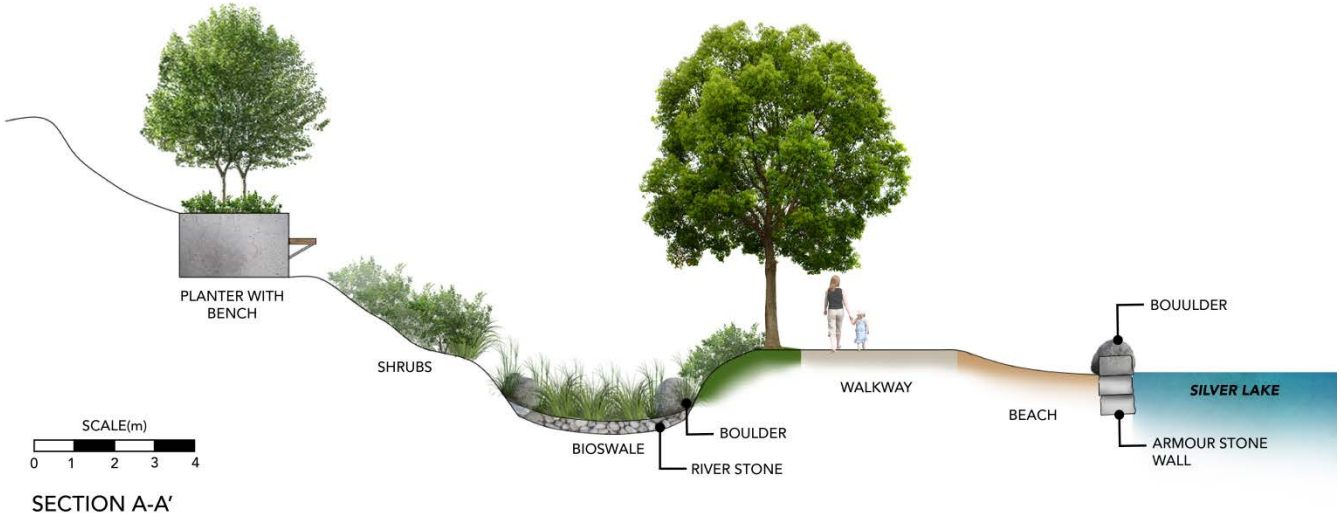
EXAMPLE – WATERLOO, ON



SECTION A-A'

EXAMPLE – BARRIE, ON

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EXAMPLE – SEATTLE, WA

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EXAMPLE – SEATTLE, WA

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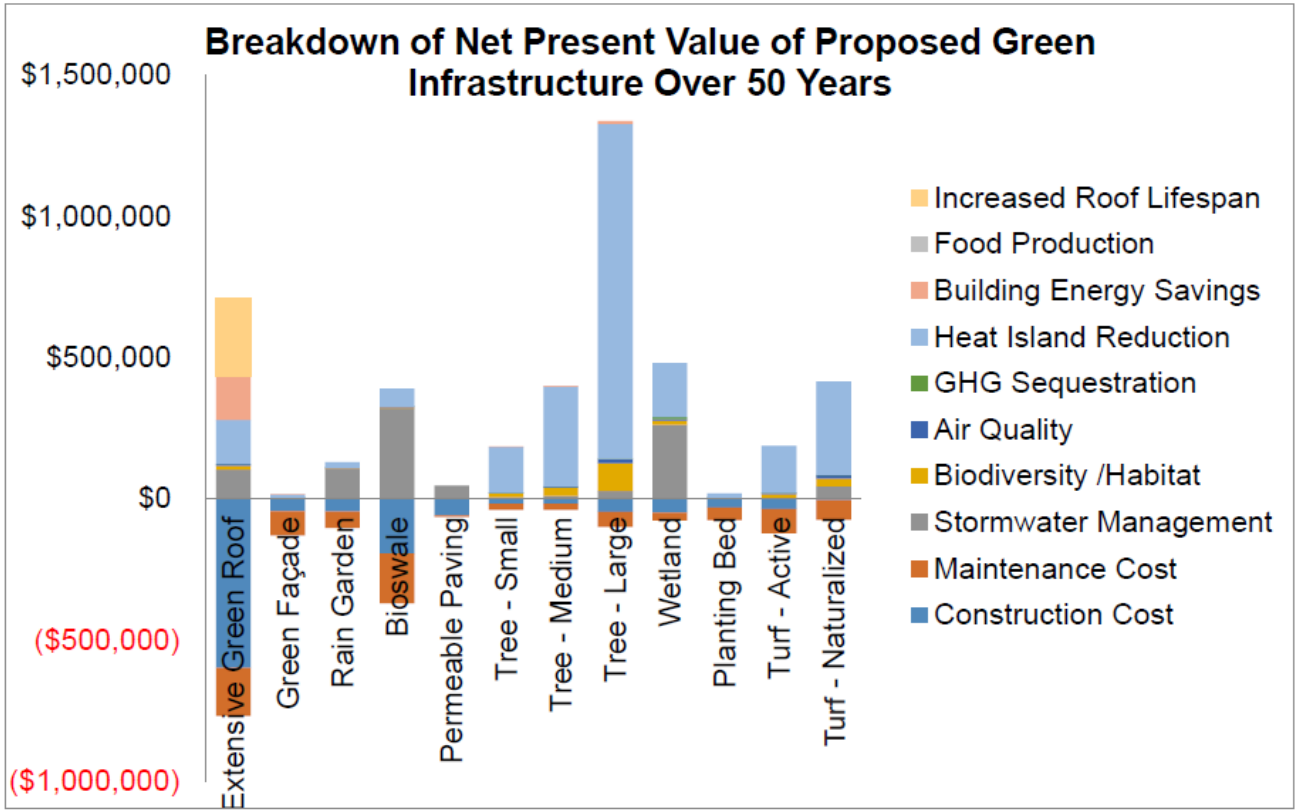
COST-BENEFIT ANALYSIS



COST-BENEFIT ANALYSIS

Net Present Value and Jobs of Green Infrastructure on Site (over 50 years)						
Type of Green Infrastructure	**Area**	**NPV of Costs**	**NPV of Benefits**	**NPV**	**Job-years (Construction)**	**Job-years (Maintenance)**
Extensive Green Roof	3,000	($770,174)	$709,731	($60,443)	10.59	3.00
Green Façade	300	($130,087)	$14,763	($115,324)	0.79	1.50
Rain Garden	400	($104,293)	$128,720	$24,427	0.81	1.04
Bioswale	1,205	($371,252)	$388,735	$17,483	3.43	3.12
Permeable Paving	800	($65,499)	$45,607	($19,892)	1.06	0.09
Tree - Small	3,097	($39,101)	$182,826	$143,725	0.32	0.37
Tree - Medium	6,784	($39,142)	$398,602	$359,460	0.32	0.37
Tree - Large	22,713	($99,459)	$1,337,116	$1,237,657	0.85	0.91
Wetland	3,660	($78,060)	$479,165	$401,105	0.88	0.49
Planting Bed	300	($76,282)	$18,668	($57,614)	0.57	0.78
Active Turf	3,173	($122,713)	$186,118	$63,405	0.66	1.51
Naturalized Turf	6,346	($75,526)	$414,194	$338,669	0.09	1.24
TOTAL	**51,777**	**($1,971,587)**	**$4,304,243**	**$2,332,656**	**20.37**	**14.42**

COST-BENEFIT ANALYSIS

- Construction cost: **$1.2 million**
- Annual maintenance cost: **$28,100**
- Annual benefits: **$140,000**
- Total job years over 50 years: **34.7**
- Net Present Value (25 years): **$1.9 million**
- Net Present Value (50 years): **$2.3 million**
- Payback Period: **9.2 years**

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CONCLUSION

- A picture is worth a thousand words – but when combined with a cost-benefit analysis, its power for change is multiplied
- A charrette is empowering and educational, and helps provide a vision of green for a community
- Helps bring stakeholders to the table
- Provides planners and other advocates for green infrastructure with a strong argument to make to decision-makers and funders

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THANK YOU

Read the charrette reports including cost-benefit analyses and visuals:
greeninfrastructurefoundation.org/charrette

Contact

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