MANITOBA CLIMATE
RESILIENCE TRAINING

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Supported by Natural Resources Canada's Building Regional Adaptation Capacity and Expertise (BRACE) Program

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RESILIENCE TRAINING

The Dollars and 'Sense' of Climate Change

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February 10, 2022

We acknowledge that we are gathered here today in Treaty 1 Territory, within the traditional territories of the Anishinaabe (Ojibwe), Ininew (Cree), Oji-Cree and Dakota peoples, and in the homeland of the Métis Nation

Overview of content

1. Introduction
2. The cost of climate change
3. Assessing risk
4. Ecosystem services
5. Natural assset management
6. Implementing adaptation measures
7. Tools & resources
8. References

Learning objectives

Participants will leave today's workshop with:

- **An understanding of the costs incurred through inaction on climate change**
- **A working knowledge of the skills to make the case for protecting existing natural assets by incorporating ecologic system in design practice(s)**
- **The ability to identify methodologies, tools, and approaches that improve resilience**

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What we've learned

Climate Change 101 (November 4th) provided an overview of climate science reinterating one critical point: our climate is changing

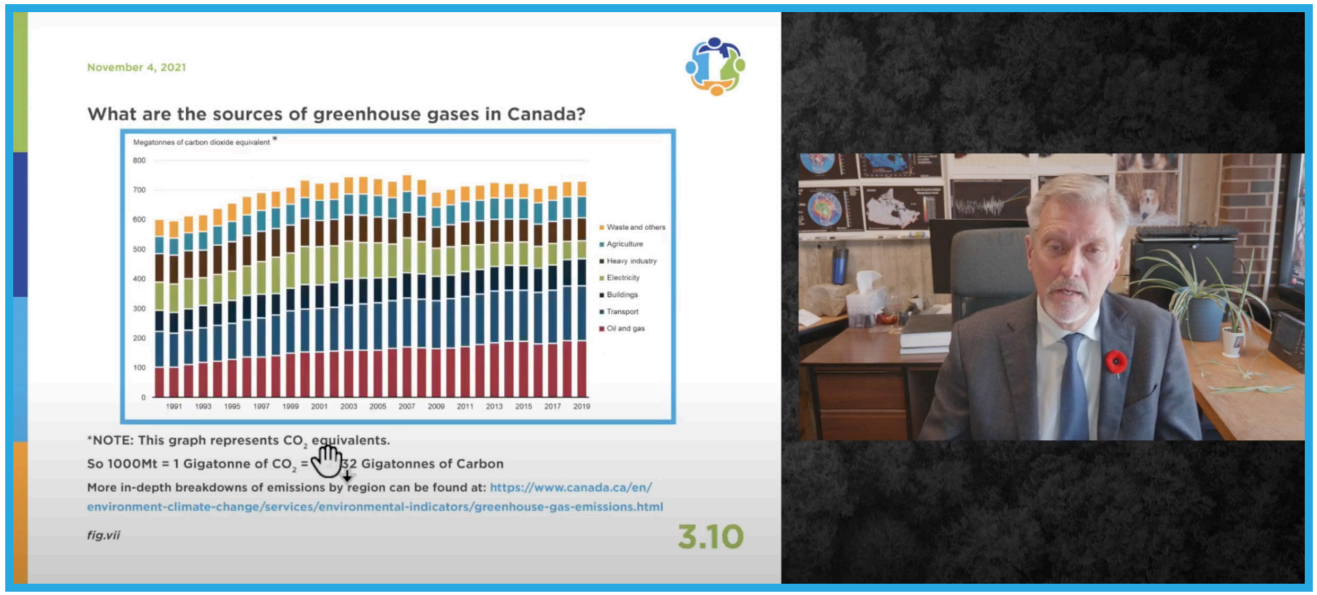

fig.i *https://www.youtube.com/watch?v=O_rGTI7ptVo*

What we've learned

Manitoba's Changing Climate (December 2nd) reviewed the four main trends projected for Manitoba: hotter, drier, wetter, *weirder*

Climate change will present in two ways:

1. **Slow onset events**
2. **Extreme weather events**

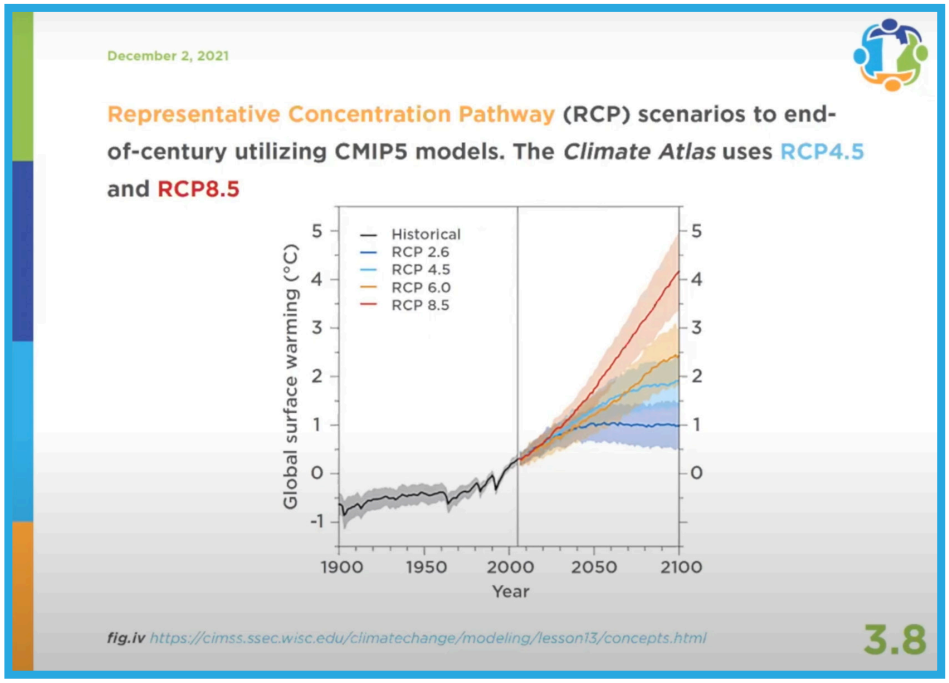

fig.ii *https://www.youtube.com/watch?v=8fndPi28sJI*

What we've learned

A Path Forward (January 13th) discussed the professional obligations of practitioners and how adaptation responses can be integrated with Manitoba's planning hierarchy

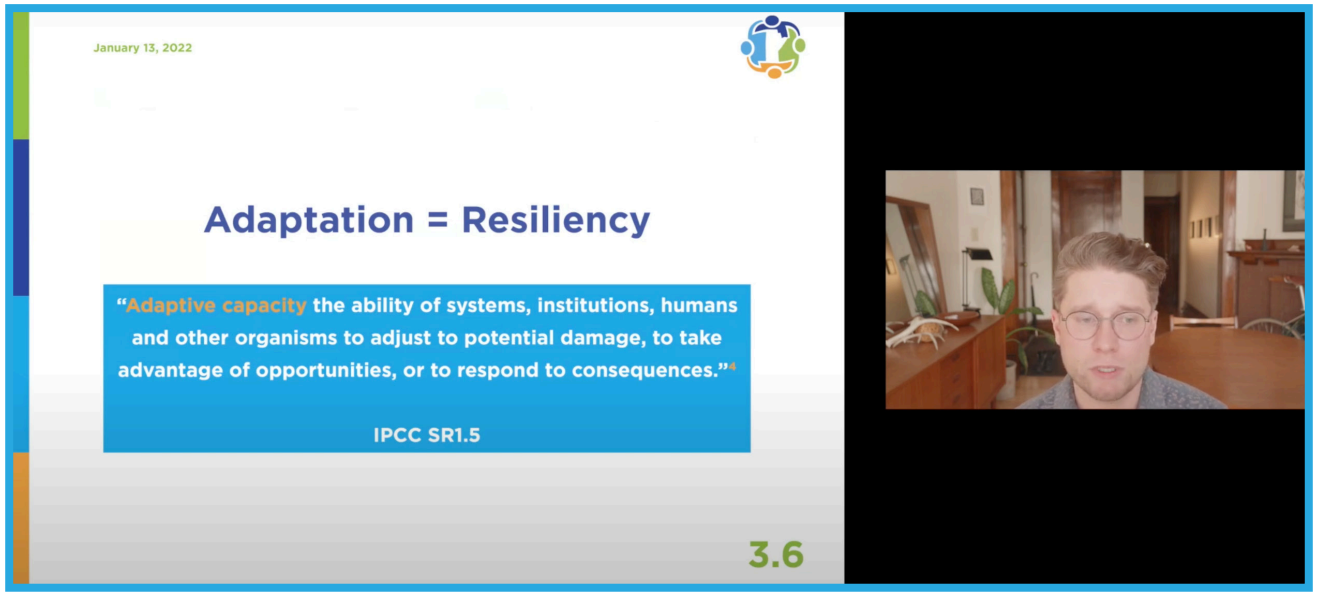

fig.iii *https://www.youtube.com/watch?v=WwTIt50E6jk*

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The cost of climate change

What have major natural disasters cost in the past?

What will the cost of not acting on climate change be in the future?

2.1

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2014 Assiniboine River flood estimated total cost:

$1,164,679,000

fig.iv *https://www.brandonsun.com/multimedia/pov/265947731.html*

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2011 Assiniboine, Roseau & Red River floods estimated total cost:

$699,884,000

fig.v *https://wordpress.org/openverse/image/9ebed9b8-d658-46ab-a3fd-df177bec8de5*

1999 to 2014 drought estimated total cost:

between $4-7 billion

fig.vi *https://www.gov.mb.ca/water/pubs/water/drought/drought_management_strategy.pdf*

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2019 October ice storm estimated total cost:

$10,000,000

fig.vii *https://globalnews.ca/news/7369068/manitoba-2019-thanksgiving-storm-one-year-later/*

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City of Winnipeg's 2022 Preliminary Operating Budget forecasts similar shortfalls

Roadway Snow Removal and Ice Control

Service Detail Sub-services (in millions of $)		2020 Actual	2020 Budget	2021 Budget	2022 Preliminary Budget	2023 Projection
Regl Streets Snow/Ice Removal	Revenue	0.047	0.042	0.042	-	-
	Operating expenses	17.337	12.596	12.589	12.422	12.474
	Transfer to Capital	-	-	-	-	-
		17.290	12.555	12.547	12.422	12.474
Local Streets Snow/Ice Removal	Revenue	0.048	0.048	0.048	0.006	0.006
	Operating expenses	18.058	15.758	15.768	15.642	15.721
	Transfer to Capital	-	-	-	-	-
		18.010	15.710	15.719	15.637	15.716
Sidewalk Snow/Ice Removal	Revenue	0.008	0.012	0.012	0.006	0.006
	Operating expenses	4.067	4.774	4.781	4.748	4.761
	Transfer to Capital	-	-	-	-	-
		4.059	4.762	4.769	4.742	4.756
Parks,Facility Snow,Ice Remove	Revenue	0.010	0.009	0.009	-	-
	Operating expenses	0.928	1.170	1.178	1.177	1.194
	Transfer to Capital	-	-	-	-	-
		0.917	1.161	1.169	1.177	1.194
Snow Disposal Sites	Revenue	0.002	0.002	0.002	-	-
	Operating expenses	2.083	0.720	0.722	0.718	0.720
	Transfer to Capital	-	-	-	-	-
		2.081	0.718	0.720	0.718	0.720
Mill Rate Support/(Contribution)		42.357	34.906	34.924	34.696	34.860

Capital Budget	2022 Preliminary Budget	2023-2027 Forecast	6 Year Total
(In millions of $)	-	0.478	0.478

Roadway Snow Removal and Ice Control

Includes:

- *Regional Streets Snow and Ice Removal*
- *Local Streets Snow and Ice Removal*
- *Sidewalk Snow and Ice Removal*
- *Park and Facility Snow and Ice Removal*
- *Snow Disposal Sites*

Description

Undertake effective roadway snow and ice control services in order to provide safe and accessible conditions on city streets and sidewalks during the winter season.

OurWinnipeg 2045: Good Health & Well-being

Key Goals

1. Provide safe and accessible transportation infrastructure in winter by delivering efficient and effective snow and ice control services.
2. Comply with Environment Canada's Code of Practice for Road Salt Management by implementing best management practices for the municipal use of road salt for snow and ice control in winter months.

Service Level Statistics

Description	2017	2018	2019	2020
Annual snowfall (cm)	93	95	136	140
Days of snowfall (3 cm or more)	11	6	14	13
Regional streets - Priority 1 truck plows (Department budgets for 3 events)	4	5	6	7
Regional streets - Priority 1 grader plows (Department budgets for 3 events)	1	1	3	2
Bus routes and truck routes - Priority 2 truck plows (Department budgets for 3 events)	4	5	7	5
Bus routes and truck routes - Priority 2 grader plows (Department budgets for 2 events)	2	1	4	2
Residential streets - Priority 3 grader plows (Department budgets 2 events)	0	1	2	1
Alleys (Department budgets for 2 events)	1	3	3	5
Salt applied (tonnes)	27,000	20,622	18,687	24,173
Sand applied (tonnes)	58,000	49,979	55,309	53,559
Snow removed / hauled (m3) [A]	1,700,000	689,717	471,465	344,224
Sidewalks plowed (km) [B]	45,627	48,261	24,549	42,349

[A] More than half of the total snowfall for 2020 occurred within the milder months (March, April, October, November), where due to mild temperatures and the use of ice control (salt), the snow melted before there was a need to haul

[B] Due to the increased pedestrian activity on sidewalks as a result of the COVID-19 pandemic, sidewalk plowing increased in 2020 to keep up with demand

fig.viii,ix *https://winnipeg.ca/finance/files/2022-Preliminary-Operating-and-Capital-Budget-Volume-2.pdf*

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The cost of climate change

Extreme weather events are becoming more frequent *and* more costly

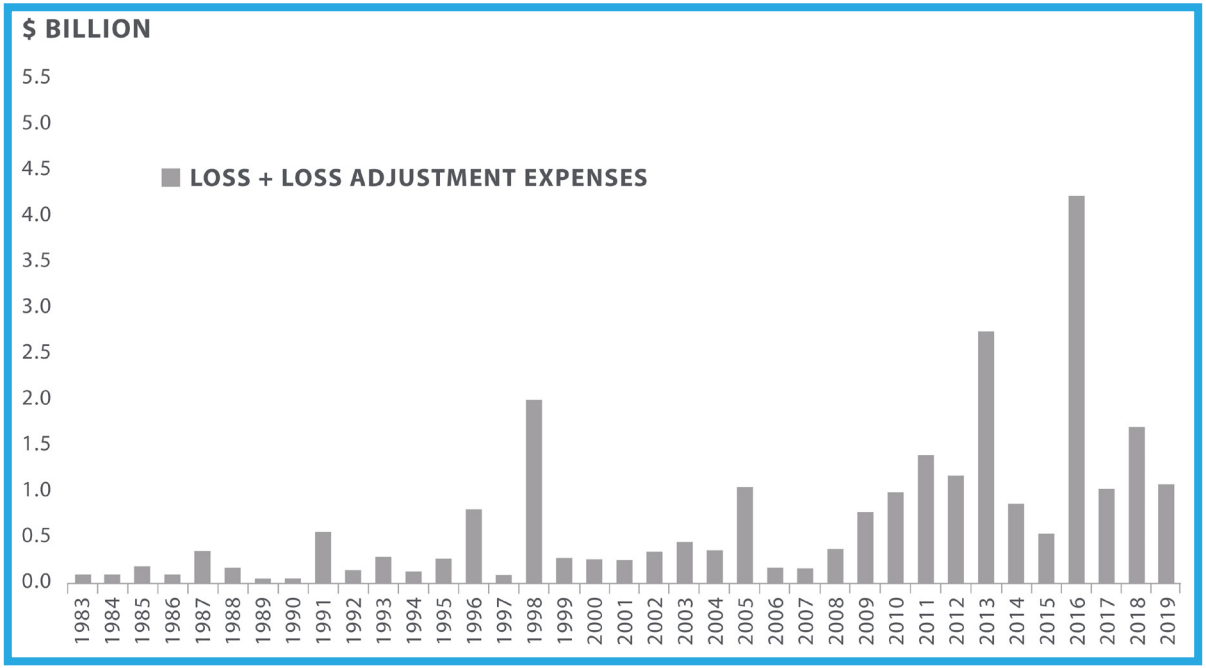

fig.x *http://assets.ibc.ca/Documents/Disaster/The-Cost-of-Climate-Adaptation-Report-EN.pdf*

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The cost of climate change

National Issues Report

Being able to convey the true costs of climate change remains a major impediment for practitioners and muncipal decision-makers alike

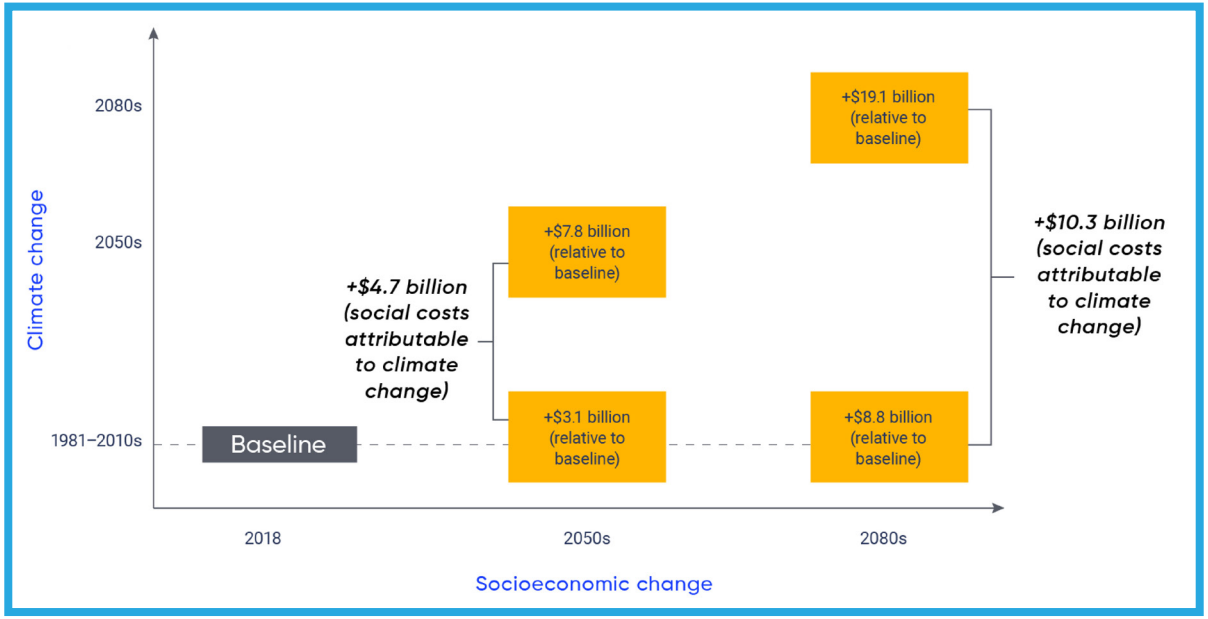

fig.xi *https://www.nrcan.gc.ca/sites/nrcan/files/pdf/National_Issues_Report_Final_EN.pdf*

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The cost of climate change

National Issues Report

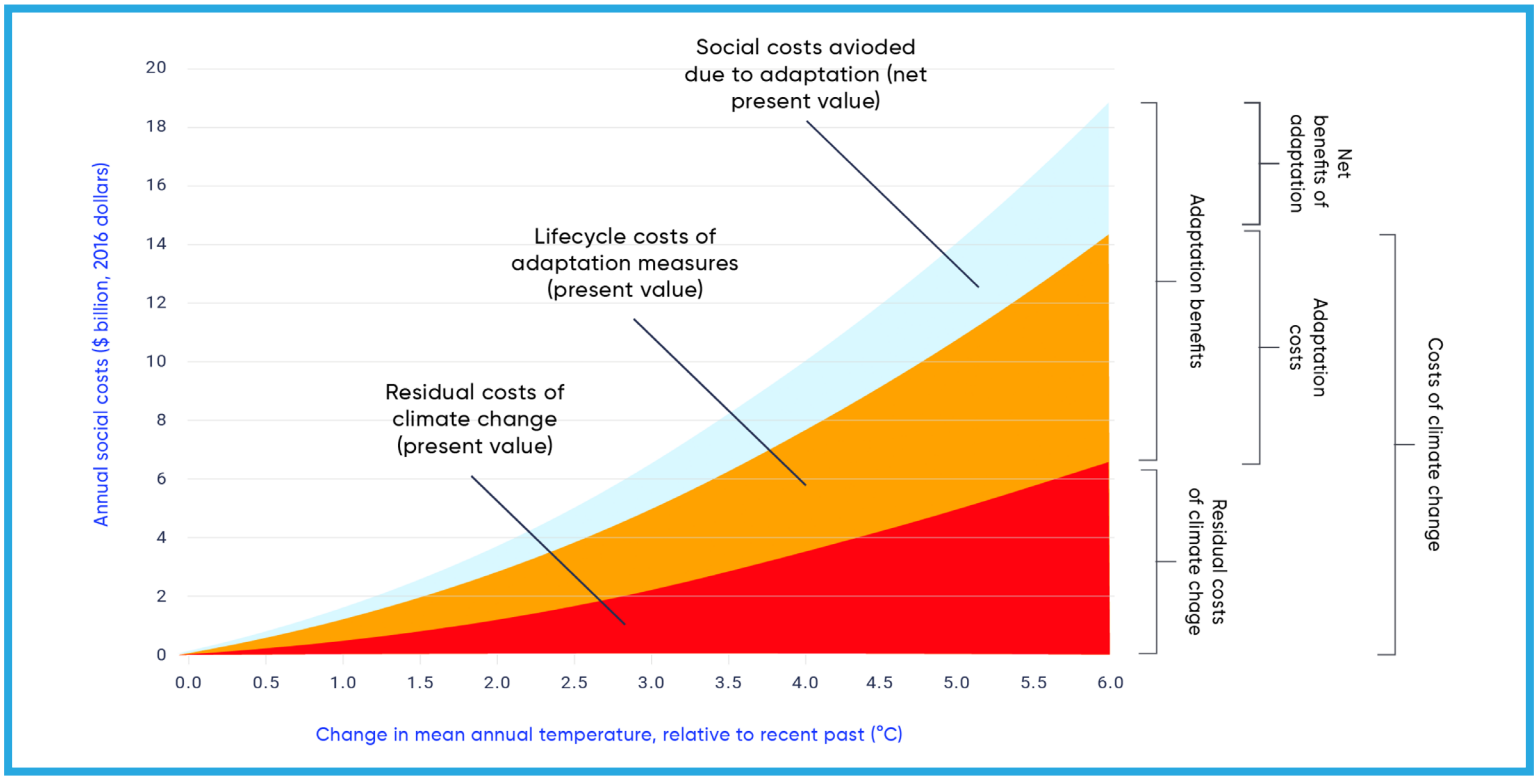

fig.xii *https://www.nrcan.gc.ca/sites/nrcan/files/pdf/National_Issues_Report_Final_EN.pdf*

Implications

- Increasing cost of natural disasters will have major implications for government finances and local economies in the future
- Planners and Landscape Architects can help prepare communities
- There is a cost to inaction

"The benefits of strong and early action far outweigh the economic costs of not acting." - The Stern Review[1]

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The New Triple Bottom Line

Graphic attributed to Sustainable Management, University of Wisconsin

fig.xiii *https://sustain.wisconsin.edu/sustainability/triple-bottom-line/*

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Assessing risk

How can vulnerability and risk assessments inform how planning/ design decisions are approached?

What are the basic steps involved in a VRA?

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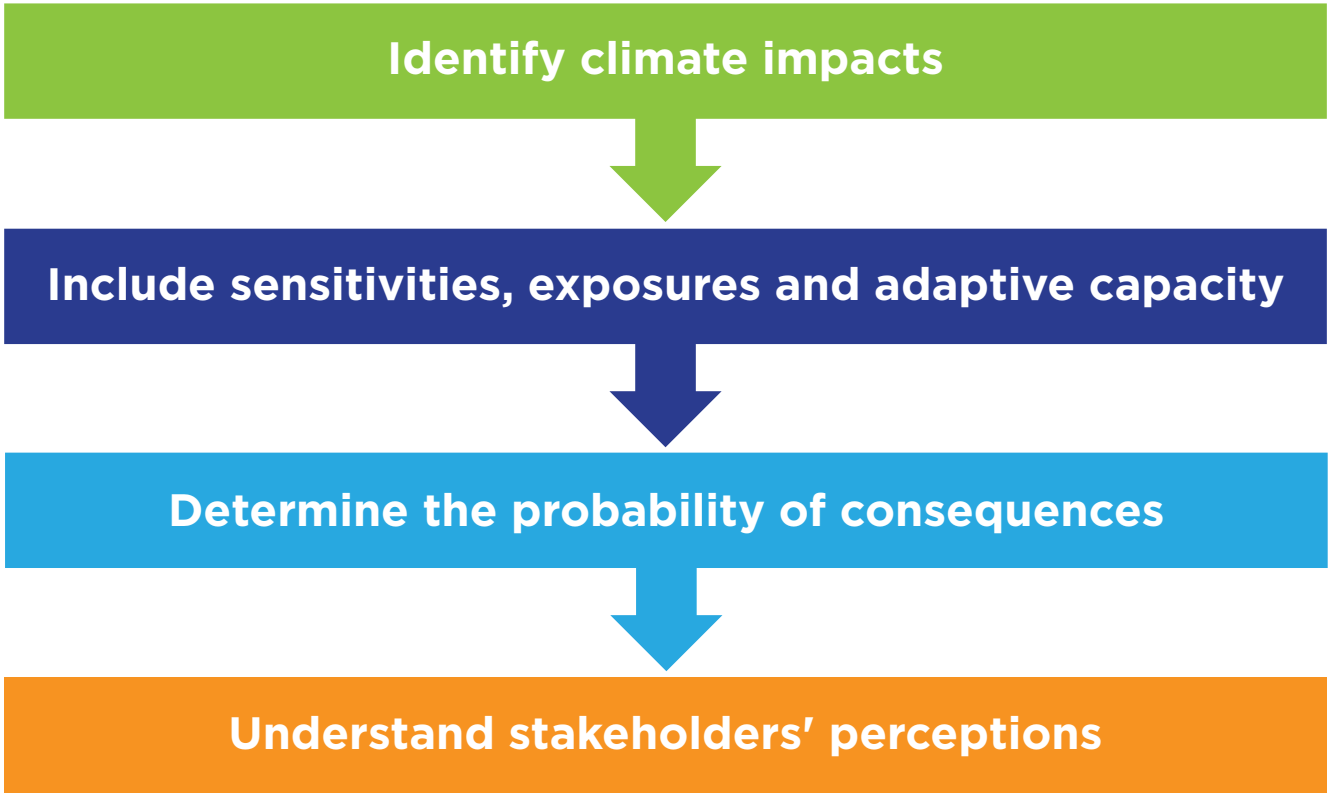
Vulnerability and risk assessment

fig.xiv *https://youtu.be/IYAf8B648EQ*

Vulnerability and risk assessment



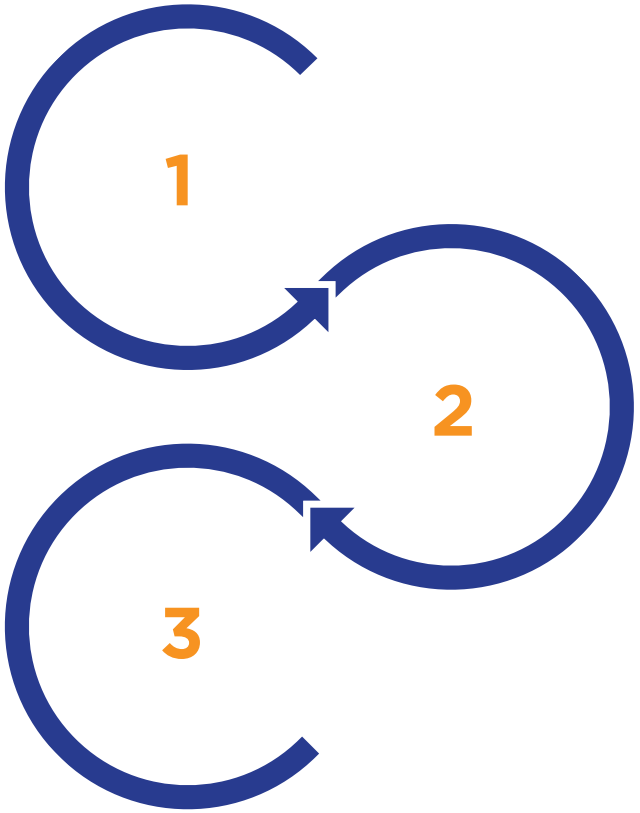
Vulnerability and risk assessment

VRA should also:

1. Incorporate Indigenous Knowledges

2. Add documentation for replicability

3. Include robust monitoring and reviewing components



Vulnerability and risk assessment

City of Selkirk

Adaptation Strategy

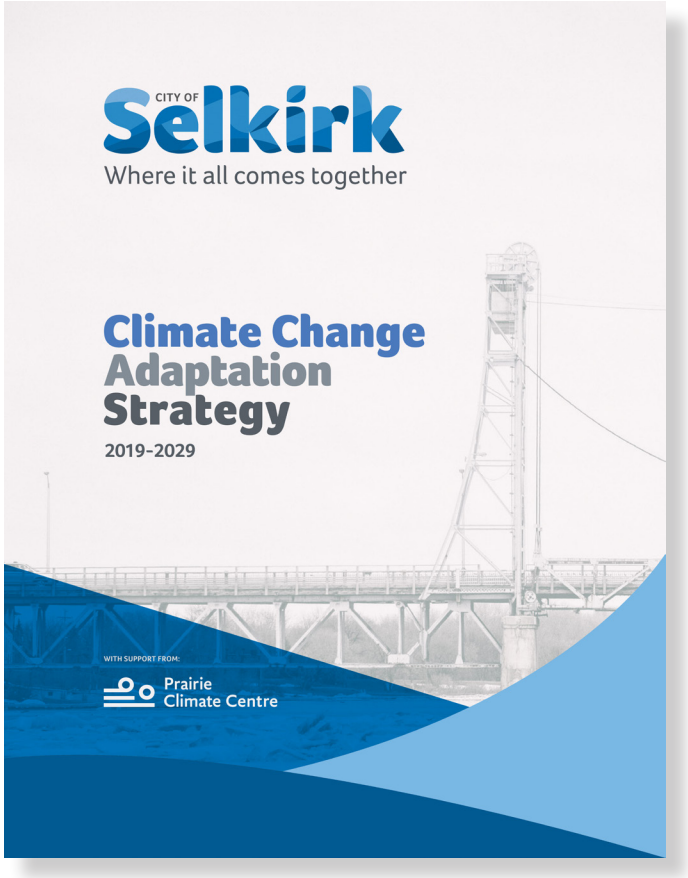
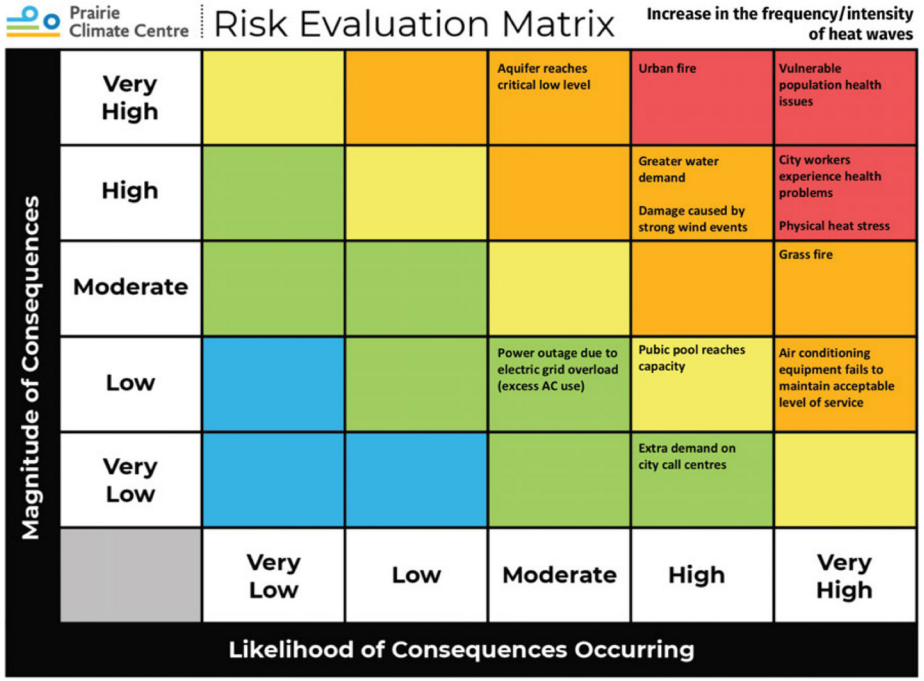


fig.xv *https://www.myselkirk.ca/wp-content/uploads/2019/07/Climate-Change-Adaptation-Strategy-Final-May2019.pdf*

Vulnerability and risk assessment

City of Selkirk Adaptation Strategy

Risk matrices were used to score and assess potential impacts with inputs from all municipal departments and key community stakeholders



Graphic attributed to City of Selkirk

fig.xvi *https://www.myselkirk.ca/wp-content/uploads/2019/07/Climate-Change-Adaptation-Strategy-Final-May2019.pdf*

Vulnerability and risk assessment

City of Selkirk Adaptation Strategy

Hierarchies of actions were informed by grading each impact based on seven evaluation criteria (e.g. effectiveness, equitability) and decision-making factors (e.g. implementation investment)

Criteria	Score 1	Score 2	Score 3	Score 4
Effectiveness	Minor Contribution to effective management of risk			Vital to effective management of risk and achievement of objectives
Affordability	Requires significant additional budget for implementation			Can be completed within planned budgets
Feasibility	Lack of human, legal knowledge, technical, or administrative capacity to implement			Sufficient human, legal, knowledge, technical and administrative capacity to implement
Acceptability	Significant pushback likely from specific stakeholders, elected officials			Supported by majority of stakeholders, elected officials
Equitability	Has unintended or undesirable distributional effects			Costs and benefit equally shared across community
Flexibility	Difficult to reverse, inflexible			Easy to scale up or down, flexible, no regret

Criteria	Score 1	Score 2	Score 3	Score 4
Investment Cost (Implementation)	$ (<$25,000)	$$ ($25,000-$74,999)	$$$ ($75,000 - $199,999)	$$$$ (> $200,000)
Annual Cost (Recurring)	$ (<$5,000)	$$ ($5,000 - $19,999)	$$$ ($20,000 - $49,999)	$$$$ (> $50,000)
Timeframe (to have action implemented by)	Short Term (< 3 Years)	Medium Term (3-6 Years)	Long Term (> 6 Years)	On Going

Graphic attributed to City of Selkirk

fig.xvii,xviii *https://www.myselkirk.ca/wp-content/uploads/2019/07/Climate-Change-Adaptation-Strategy-Final-May2019.pdf*

Vulnerability and risk assessment

2021 Budget Highlights

CITY OF Selkirk

5. Environmental stewardship

Project Title	2020 Budget
Lot Grade Plan Policy *	$0
New Waste Water Treatment Plant (WWTP) Construction *	$2,605,339
New Waste Water Treatment Plant (WWTP) Engineering Services *	$34,820
Purchase two electric cars for corporate travel use *	$82,500
Selkirk Park Lift Station *	$436,585
Develop a By-Law/Policy to Take Over Private Fire Hydrants *	$0
Bio-Solids Pad Construction *	$180,000
Install Collection Net at Rosser Outfalls	$15,000
Hire a Community Energy Advocate	$51,393
Amend Asset Management Risk Policy to Give Greater Priority to Wastewater Renewal Projects that Includes Storm Sewer Separation	$0
Planting an Urban Canopy	$500,000

Graphic attributed to City of Selkirk

fig.xix *https://www.myselkirk.ca/wp-content/uploads/2021/02/2021-Budget-Highlights.pdf*

Courses/certifications:

Climate Risk Institute - Infrastructure Resilience Professional (IRP)

- Climate Change and Infrastructure Risk Assessment - PIEVC Protocol
- Asset Management and Climate Resiliency

Asset Management Saskatchewan - The Learning Path to Asset Management Readiness

Royal Roads University - Natural Asset Management

Other BRACE recordings:

- Climate Change Risk Assessment Core Principles

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Ecosystem services

What are the various types of ecosystem services?

How does Canada rank globally in protected wildlife areas?

4.1

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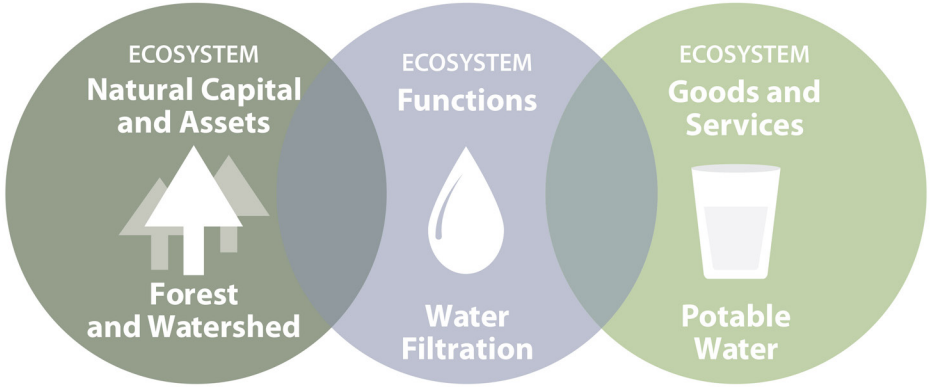
Ecosystem services

Ecosystem services are the direct and indirect contributions that natural systems provide for human wellbeing



Graphic attributed to Municipal Natural Asset Initiative

fig.xx *https://mnai.ca/media/2018/02/finaldesignedsept18mnai.pdf*

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Ecosystem services

1. Provisions services are the extracting resources that ecosystems provide (e.g. timber, fresh water)

fig.xxi *https://steinbachonline.com/local/a-free-gift-of-timber-comes-at-a-cost-for-local-rms*

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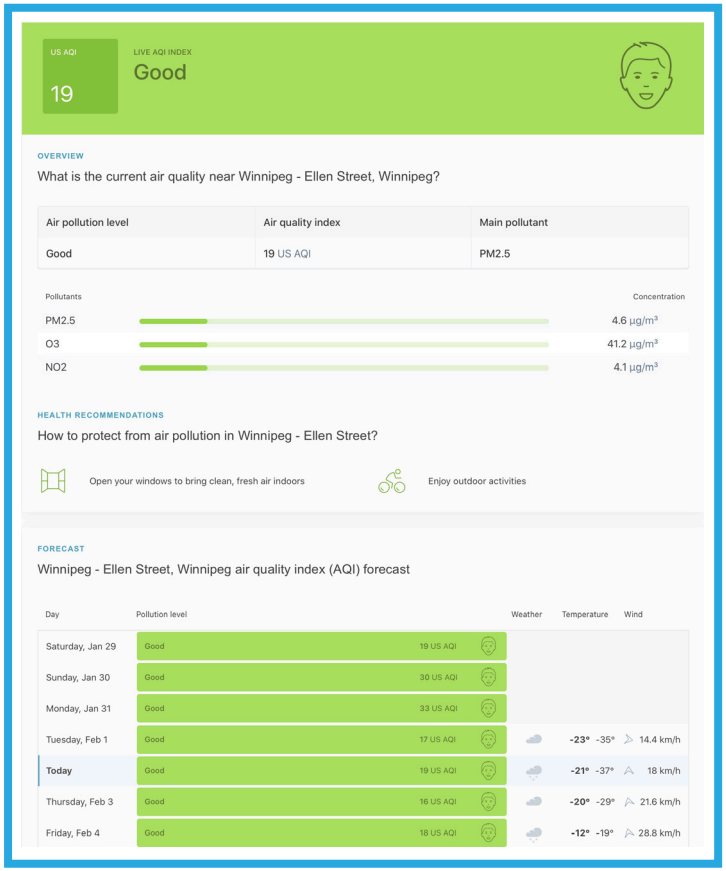
Ecosystem services

2. Regulations services are ecosystems functions that regulate and sustain critical biotic inputs



Graphic attributed to iQ Air

fig.xxii *https://www.iqair.com/ca/canada/manitoba/winnipeg*

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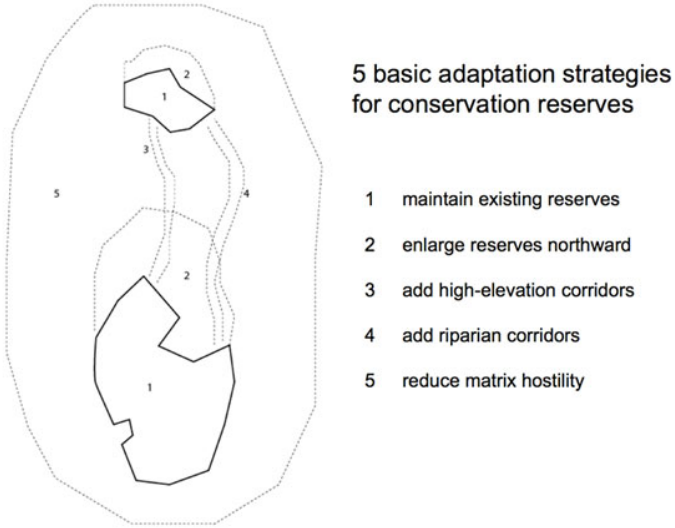
Ecosystem services

3. Habitat/support services are the living spaces and resources required to support non-human residents and migratory species (e.g. flowering meadows for pollinators)



Graphic attributed to Kristina Hill

fig.xxiii *https://www.asla.org/ContentDetail.aspx?id=28548*

Ecosystem services

4. Cultural services are the non-material benefits people obtain from ecosystems (e.g. aesthetic experiences, spiritual enrichment)

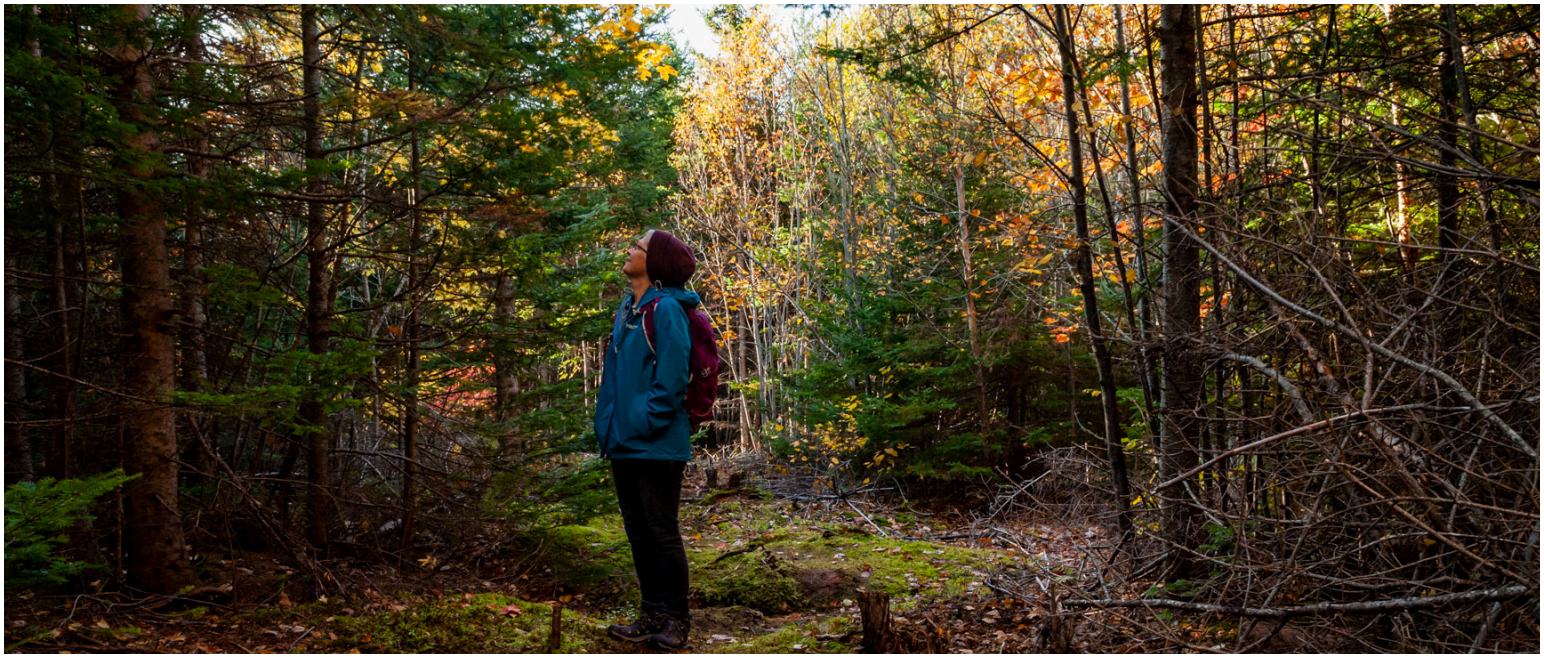
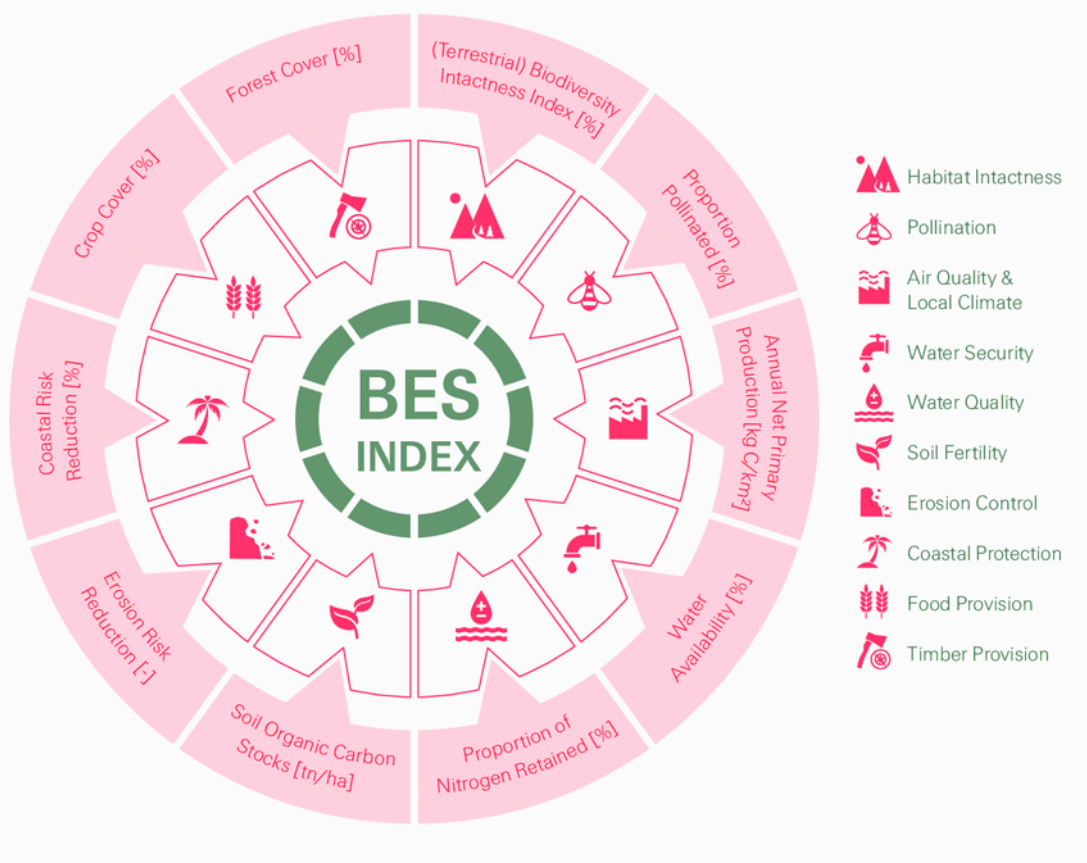


fig.xxiv *https://treetophaven.ca/activities/forest-bathing/*

Ecosystem services

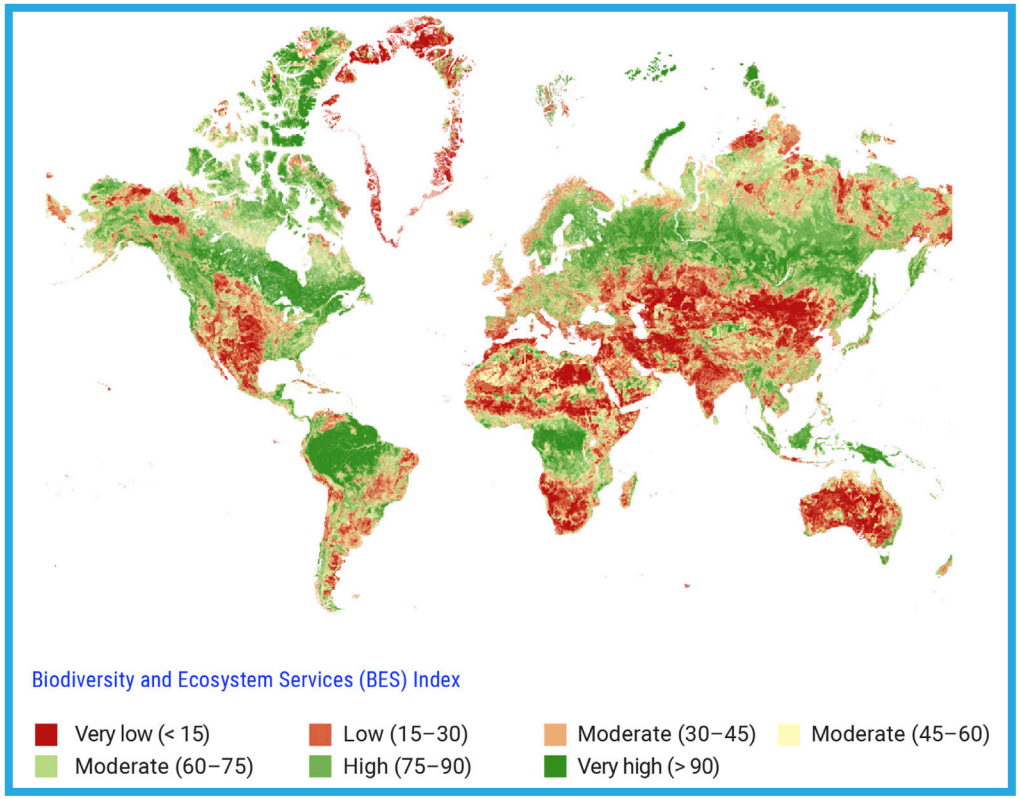


Graphic attributed to Swiss Re Institute

fig.xxv *https://www.researchgate.net/figure/Ecosystem-services-included-in-the-SRI-BES-Index_fig4_348729525*

Ecosystem services

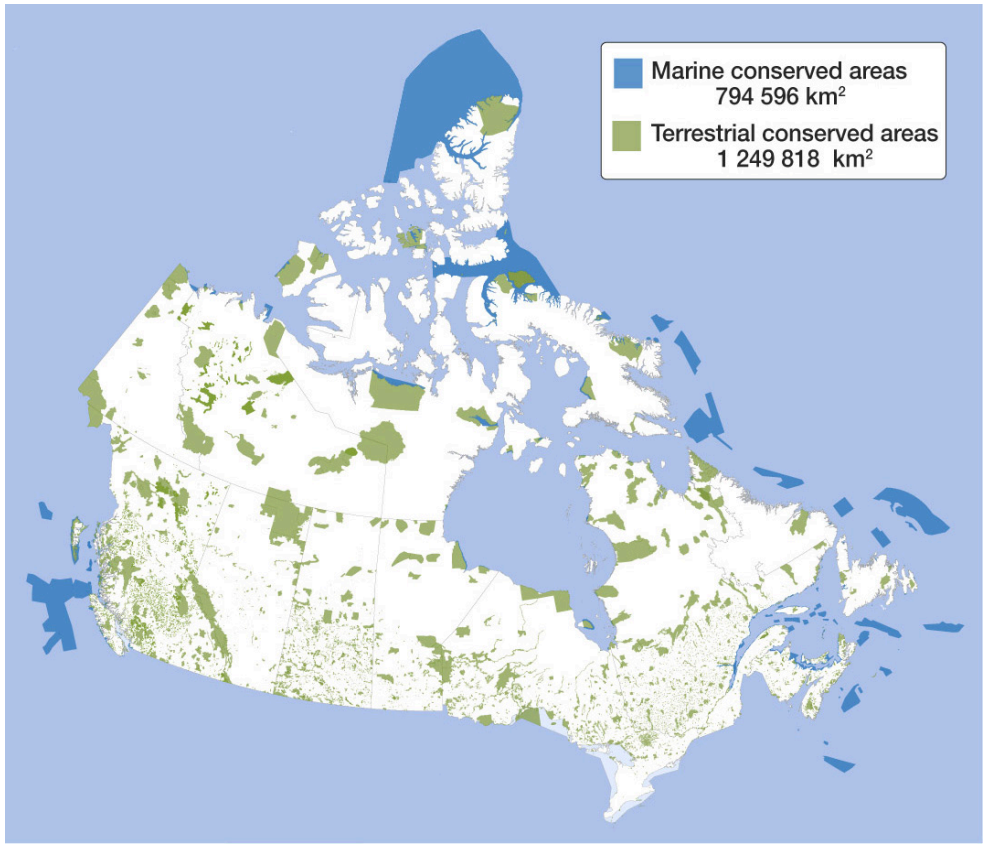
25% of Canada's GDP is highly dependent on BES with coastal protection, air quality and habitats for pollinators being the most at risk indexes



Graphic attributed to Swiss Re Institute

fig.xxvi *https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-biodiversity-and-ecosystems-services.html#/*

Protected and conserved areas



Graphic attributed to Government of Canada

fig.xxvii *https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/conserved-areas.html*

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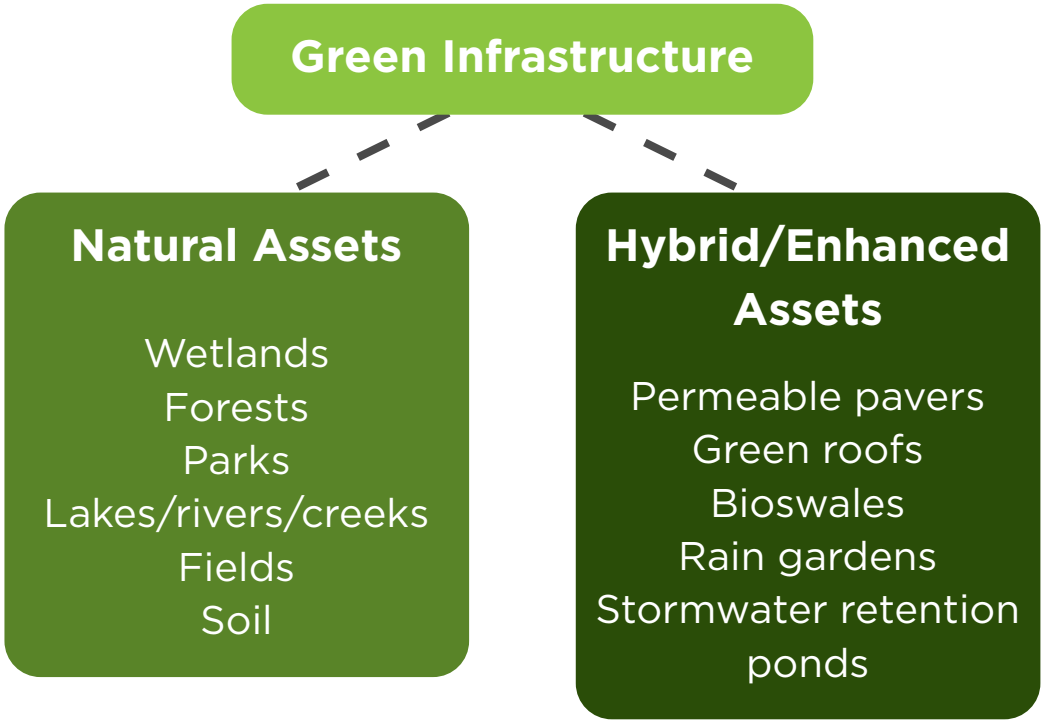
Natural asset management

What are natural assets?

What are practitioners' roles in forwarding municipal natural asset initiatives?

5.1

Natural assets



Graphic reproduced from Municipal Natural Asset Initiative (MNAI)

fig.xxviii *https://mnai.ca/media/2019/07/SP_MNAI_Report-1-_June2019-2.pdf*

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Municipal natural assets

The MNAI defines municipal natural assets (NAs) as the natural resources and ecosystems that contribute to the provision of one or more services required for a community and its residents

fig.xxix *https://rmofmorris.ca/*

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MNAI example

Buttertubs Marsh Conservation Area - Nanaimo, BC

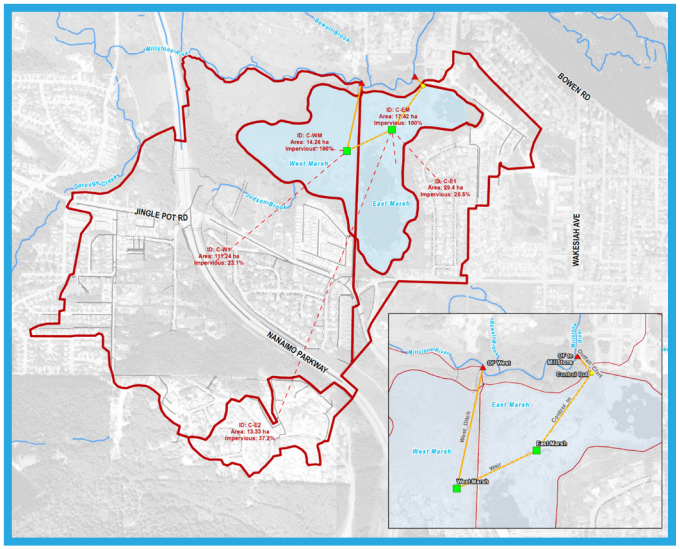

fig.xxx *https://waterbucket.ca/gi/2018/04/29/the-buttertubs-marsh-pilot-study*
fig.xxxi *https://davidsuzuki.org/wp-content/uploads/2018/07/municipal-natural-assets-initiative-nanaimo-b-c.pdf*

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MNAI example

Buttertubs Marsh Conservation Area - Nanaimo, BC

A valuation study of the water storage capacity of both marshes for a 1-in-100 year rainfall event under RCP8.5 yielded $6.56 million in equivalent grey infrastructural investment

	West Marsh					East Marsh				
Scenarios	Surface Area at Max Level (m^2)	Starting Water Level (m)	Max Water Level (m^2)	Storage Volume (m^3)	Cost at $150 per m^3	Surface Area at Max Level (m^2)	Starting Water Level (m)	Max Water Level (m^2)	Storage Volume (m^3)	Cost at $150 per m^3
Historic 100 year	85,560	56.79	57.01	18,230	$2,734,540	145,167	57.16	57.25	13,065	$1,959,755
Climate Change (median)	85,560	56.79	57.09	24,859	$3,728,919	145,167	57.16	57.29	18,872	$2,830,757
Climate Change (90th)	85,560	56.79	57.17	31,489	$4,723,297	145,167	57.16	57.32	23,227	$3,484,008

fig.xxxii *https://davidsuzuki.org/wp-content/uploads/2018/07/municipal-natural-assets-initiative-nanaimo-b-c.pdf*

Valuation comparisons

IISD literature review

Lifetime, undiscounted costs and value comparisons using the SAVi assessment tool highlight the need for more valuations and an understanding of risk

SAVi assessment	Type of infrastructure	Total cost (thousand USD)		Value generated (thousand USD)	
		NBI	Grey	NBI	Grey
Pelly's Lake	Water reservoir	783	38,260	93,596	93,596
Stephenfield Reservoir	Water reservoir	6,511	4,716	481,244	480,172
Lake Dal	Water treatment	229,914	211,716	5,107,480	3,221,043
Saloum Delta	Wetland	0	674,920	2,374,135	87,166
S'Ena Arrubia Wetland	Wetland	17,354	29,996	96,516	85,232
Corru S'Ittiri Wetland	Wetland	17,354	77,782	261,215	231,171
Stormwater in Johannesburg	Water treatment	3,050	5,772	9,491	0.679
Indonesia Forest Restoration	Tree planting and water retention wells	9,600	N/A	113,930	N/A
Addis Ababa Tree Planting	Tree planting	58,163	457,178	472,015	625,214
Rainbow Junction Tswhane	Green roofs and tree planting	185	N/A	223,655	N/A

Graphic attributed to IISD

fig.xxxiii *https://nbi.iisd.org/wp-content/uploads/2021/10/investment-in-nature-close-infrastructure-gap.pdf*

Natural assets

MNAI interviewed professional planners in Ontario to identify critical barriers for practitioners

Barriers:

- **Natural assets are more complex than engineered assets**
- **Natural systems are generally not conceptualized/included on plans**

Opportunities:

- **Capital assets provide a foundation for cross-jurisdictional collaboration (e.g. regional planning)**
- **Proper documentation and inclusion of NAs in planning documents means future revisions have to acknowledge them**

Mapping resources

Canadian Wetland Inventory - Ducks Unlimited

Detailed wetland inventories for southeastern and western Manitoba categorized by bog, fen, marsh, swamp and shallow open water

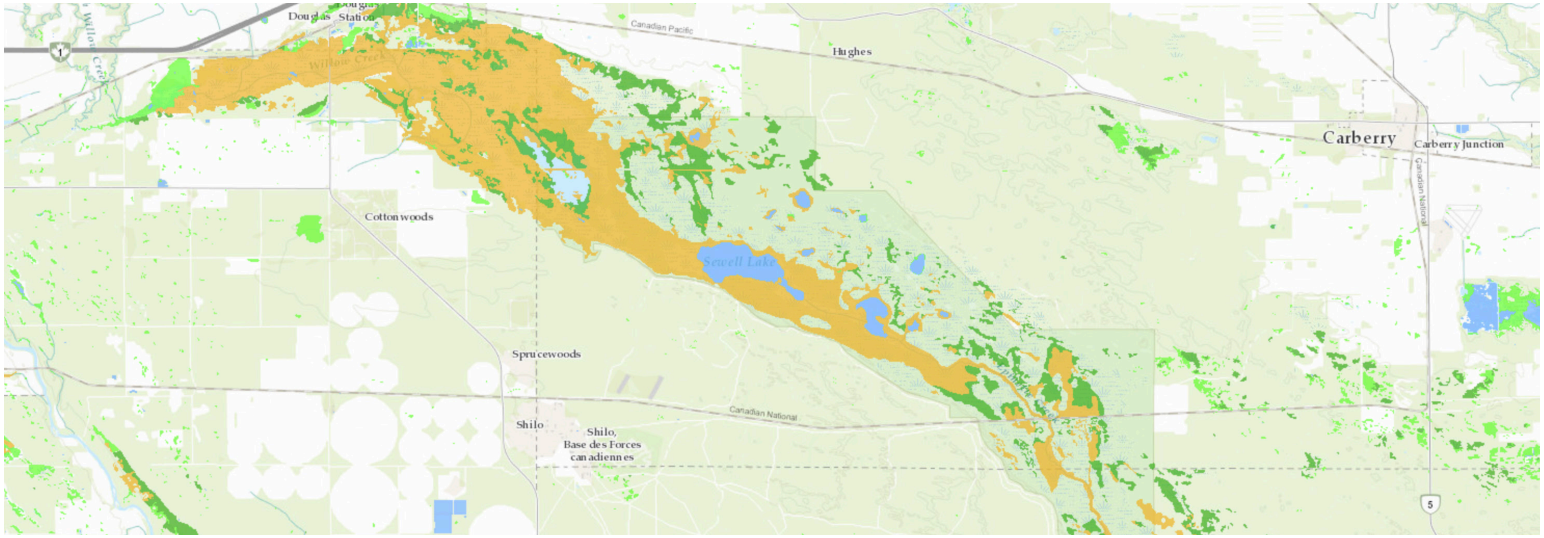

fig.xxxiv *http://maps.ducks.ca/cwi/*

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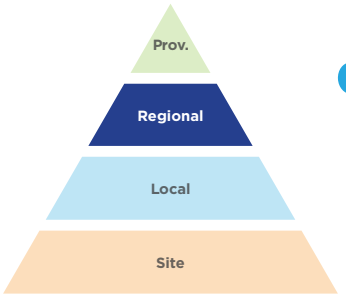

Manitoban successes

Winnipeg Metropolitan Region: Plan 20-50 (2022)

MNAI is working for the WMR to "develop a GIS-based inventory" of all natural assets within the Capital Region and Treaty 1 Territory which will include additional layers that identify "species at risk and critical habitats"[2]

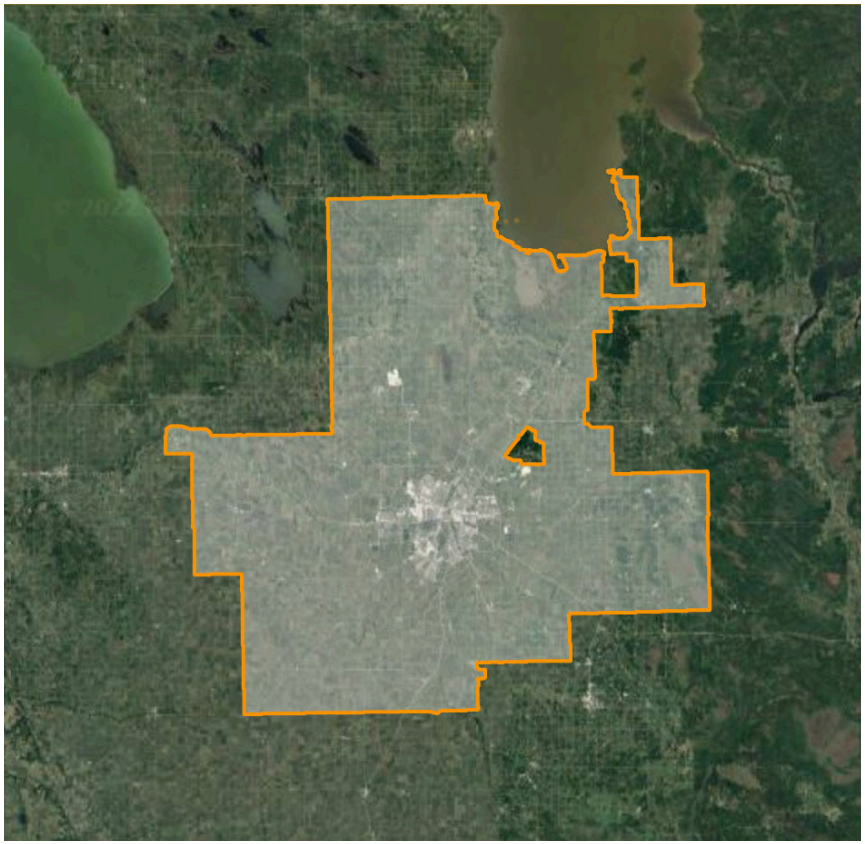

fig.xxxv *https://www.google.ca/maps/@50.0369068,-97.7631303,134588m/data=!3m1!1e3*

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Implementing adaptation measures

What adaptation measures can landscape architects promote that make "dollars and sense" for communities?

What regulatory and financial instruments can communities use to encourage development that incorporates these adaptation measures?

Four approaches to adaptation

1. Fortify/defend
2. Accommodate/ adapt
3. Retreat/relocate
4. Clean-up

fig.xxxvi *https://www.turenscape.com/en/project/detail/4629.html*

Accommodation responses account for future climate projections by promoting infrastructures that maintain service delivery even in adverse conditions (i.e. floodable, liminal areas in park designs)

Pros: already in practice, expertise is readily available

Cons: legislative hurdles, scaling beyond the neighbourhood requires extensive stakeholder engagement

fig.xxxvii *http://www.winnipegarchitecture.ca/assiniboine-riverwalk/*

Clean-up responses contend with a community/client's adaptive capacity to return to pre-incident condition. Largely informed by budgetary constraints, available personnel, skills and community assets (e.g. maintenance equipment)

Pros: leverages existing systems, minimal additional costs if incorporated early in the planning stages

Cons: limited to new developments/ revitalization projects

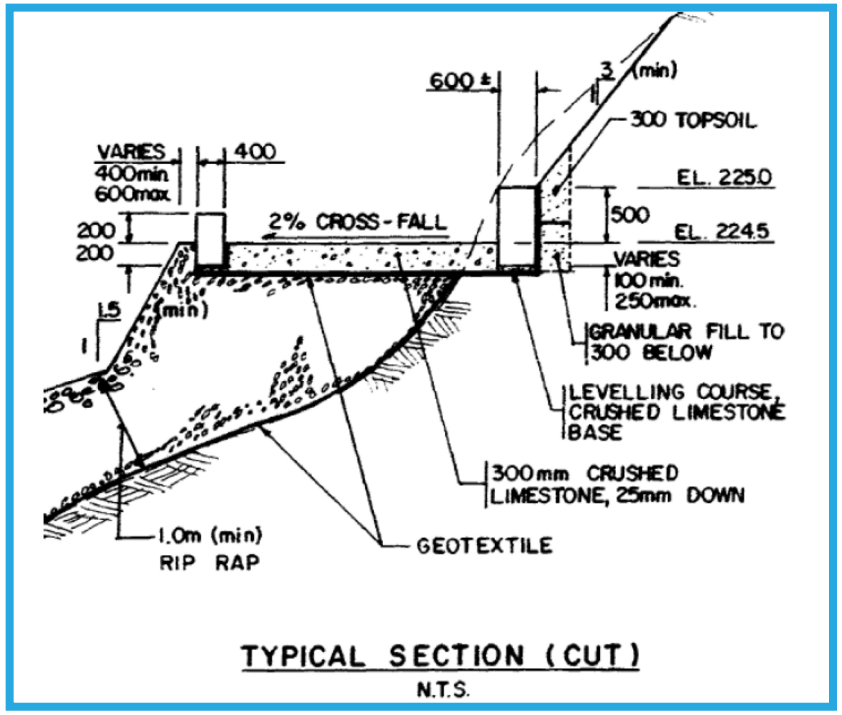

fig.xxxviii *https://buyandsell.gc.ca/cds/public/2020/03/23/9fcfe56dcd567d5d911bc1ce49d5be8a/19-0472_statement_of_work.pdf*

Low-impact developments (LIDs)

Stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to it's source as possible

To accomplish this, it uses practices that help to preserve or to restore predevelopment hydrological and ecological functions

Preservation: using site design strategies to minimize runoff and protect natural drainage patterns

Restoration: using distributed structural practices that filter, detain, retain, infiltrate, evapotranspire, and harvest stormwater

Low-impact developments (LIDs)

Bioswales

Wetlands

Rain gardens

Engineered products

fig.xxxix, xli, xlii *HTFC Planning & Design*
fig.xl *https://www.nativeplantsolutions.ca/our-work/royalwood/*

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LIDs: Constructed wetlands

OurWinnipeg's Sustainable Water and Waste Strategy 06-4b encourages the use of constructed wetlands

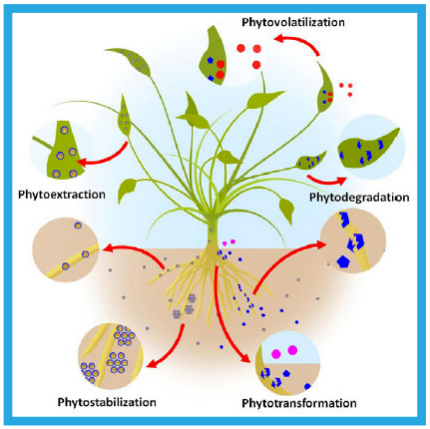

fig.xliii *http://opensciencepublications.com/*
fig.xliv *https://www.ladco.mb.ca/royalwood*

LIDs: Bioswales

Bioswales are designed to function like a ditch but filter out contaminants thus lowering turbidity at their outlet

fig.xlv *https://www.asla.org/awards/2007/07winners/506_nna.html*
fig.xlvi *https://water.phila.gov/pool/files/gsi-planning-and-design-manual.pdf*

LIDs: Rain gardens

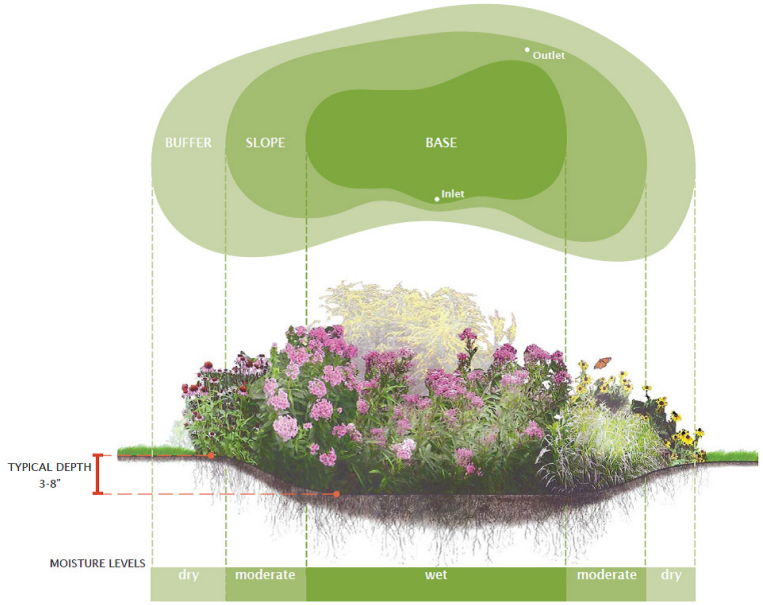

fig.xlvii *https://thewatershed.org/green-infrastructure-rain-gardens/*
fig.xlviii *HTFC Planning & Design*

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LIDs: Engineered retention products

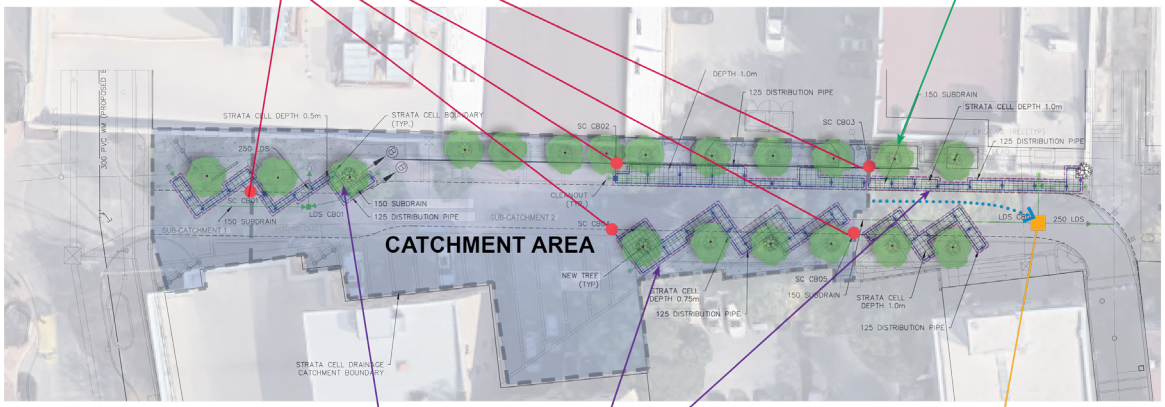
Engineering advancements have focused on improving soil capacity/infiltration rates

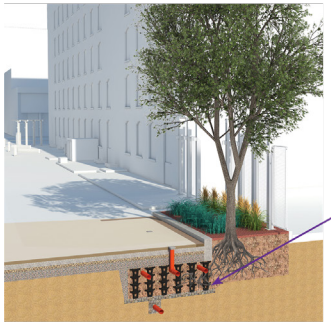
fig.xlix *https://www.greenmax.eu/en/silvacell/*
fig.l *https://greenblue.com/gb/product-category/stormwater-management/*

Case study: John Hirsch Place

Surface stormwater runoff flows into 5 catch basins and is dispersed by perforated pipes into soil cells

Water is absorbed by the tree roots and moves through the tree to the air by evapotranspiration





Soil cells hold and filter water, removing pathogens, sediments and other particles from the stormwater runoff. Microbes in the soil break down and absorb organic forms of nutrients and make them available to the trees

Stormwater runoff is now filtered and its volume is reduced before it enters the combined sewer system

fig.li *HTFC Planning & Design, WSP*

Case study: John Hirsch Place

LIDs: Green roofs

Green roofs emulate natural strata creating environments suitable for plant growth and improving insulation/stormwater retention

fig.lvi *https://www.nativeplantsolutions.ca/our-work/canadian-museum-for-human-rights/*
fig.lvii *HTFC Planning & Design*

LIDs: other strategies

Other LID strategies that contend with excessive runoff may include: rainwater harvesting and permeable pavers

fig.lviii *https://www.watercache.com/portfolio/galvanized-metal-cisterns*
fig.lix *https://www.barkmanconcrete.com/products/hardscapes/pavers/product/colonial-eco*

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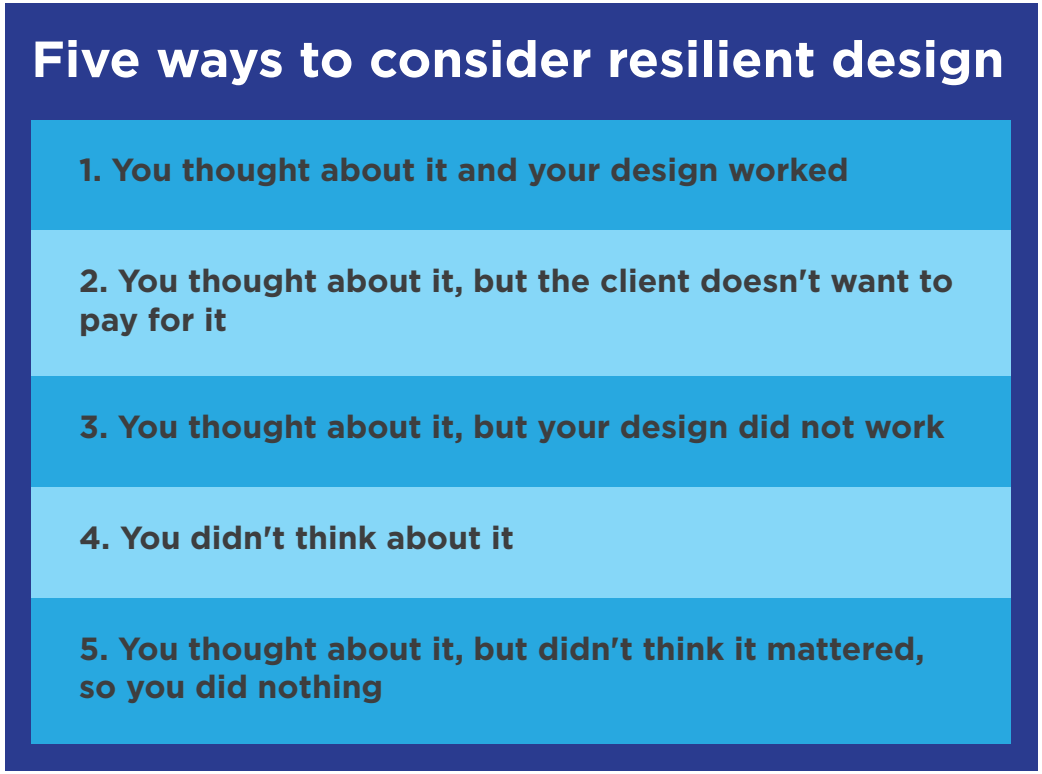
Risk aversion



Graphic reproduced from Design and the Evolving Standard of Care (AXA XL Insurance)

fig.lx *https://axaxl.com/fast-fast-forward/articles/changing-climate_changing-standard-of-care*

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HOW CAN COMMUNITIES ENCOURAGE LOW-IMPACT DEVELOPMENT AND THE PRESERVATION OF NATURAL ASSETS?

fig.lxi *https://coastalreview.org/2020/06/low-impact-development-virtual-workshop-set/*

Regulatory and financial instruments

- Zoning and permitting
- Development agreements
- Taxation, user fees, incentives
- Conservation agreements

fig.lxii *http://flaticon.com/free-icons/cityscape*

Zoning and permitting processes

Incorporating adaptation and mitigation standards into zoning and permitting processes will:

- **Result in direct adaptive benefits, and;**
- **Foster adaptation skills and perspectives among developers and other commercial entities**

Zoning and permitting processes

Inland Port Special Planning Area

Sustainable Development Measures Checklist

Development proposals shall achieve a minimum of five points in total, from any combination of the following sustainable development measures before a Development Permit will be issued. No partial points will be accepted. Applicants are encouraged to incorporate as many sustainable development measures as possible into their developments. Documentation shall be submitted to the Senior Planner, at **inlandportspa@gov.mb.ca** for review and approval.

	Measure/Description	Point(s)	Minimum Performance Measure(s)	Materials Required for Verification
ENERGY AND ENVIRONMENT	**Energy Efficient Building** The **Manitoba Energy Code for Buildings**, **ANSI**, and **ASHRAE** systems establish minimum standards for energy use in new or renovated (50 per cent plus) buildings.	2	New Construction +10 per cent over Manitoba Energy Code baseline OR Major Renovation +5 per cent over ANSI / ASHRAE / ES Std. 90.1-2013.	Letter of Certification from qualified professional indicating that the building(s) will achieve proposed improvements.
	Energy Performance (Benchmarking and Disclosure) Manager facilitates data monitoring, rating, and optimization of building energy use through an online portal.	2	Enrolment in Canadian ENERGY STAR Portfolio Manager.	Copy of Enrolment Certificate.
	Green Building Designing, constructing, and operating environmentally sustainable facilities to reduce environmental impacts.	2	Includes Canada Green Building Council (ex: "LEED v4"), Green Globes or Living Building Challenge green building certification frameworks. Green Building points cannot be duplicated for any comparable performance measures in this list.	Identification of building certification framework and points sought and construction plans or Letter(s) of Certification demonstrating measure(s).
	Green Roof Vegetated building surfaces reduce on-site drainage needs and can support reduced interior heating and cooling needs.	3	At least 50 per cent of all on-site roof and/or sidewall surfacing to be vegetated.	Construction, drainage and planting plans demonstrating minimum 50 per cent vegetated cover.
	Green Industries Facility operations demonstrating a strong commitment to sales of green products and services. Green industries include: a) Sellers of green energy technology; b) Sellers of toxic free alternatives to ozone depleting substances, such as freons, halons and chlorofluorocarbons, in the areas of refrigeration, plastic foams, halons, solvents, fumigants and aerosol; or c) Recycling services	3	Qualified green product sales and services comprise at least 75 per cent of revenue.	Product and/or service specifications to be submitted indicating percentage of gross revenues captured through green product sales and services.
		5	Qualified green product sales and services comprise at least 95 per cent of revenue.	
	Heat Island Reduction Reducing ambient heat gain improves pedestrian comfort, ecological resiliency, and passively reduces interior heating and cooling needs.	3	At least 35 per cent of on-site hardscaping (ex: parking, sidewalks, driveways, courtyards) covered by: a) 15-year maturity shade trees canopy; b) solar reflective paving; or c) roofing with a solar reflectance index (SRI) of >29	Construction plans demonstrating at least 35 per cent of surfacing meets requirements.

Manitoba

fig.lxiii *https://www.gov.mb.ca/mr/centreport/index.html*

Development agreements: Land dedication

City of Winnipeg Development Agreement parameters:

(a) The Developer shall dedicate a minimum of 8% of the net area for public park purposes and pay the remaining 2% in cash

(b) If land is not dedicated for public purposes, the Developer shall provide a cash payment representing 10% of the appraised value of the Development Application, as determined by the City and prior to the release of subdivision mylars by the City

User fees & incentives

Benefits:

- Can raise capital for infrastructure adaptation in stable, equitable manner
- Can create incentives for property owners to reduce usage of that service
- Can fund adaptive infrastructure responsive to projected climate risks, including increased precipitation and flooding

Limitations:

- Fees may have greater impacts on lower-income property owners
- Challenging to implement
- May be seen as a new and unnecessary tax or fee

Stormwater user fees

- Can be based on an impervious area measurement (representing the likely amount of water runoff) for each property
- Incentivizes property-level actions to reduce impervious areas
- Stormwater credit programs can provide further rebates for rain gardens, rain barrels, and other green infrastructure

fig.lxiv *https://www.barkmanconcrete.com/products/hardscapes/pavers/product/turfstone-eco/*

Conservation agreements

fig.lxv *https://www.mhhc.mb.ca/our-programs/mapping-and-assessment/*

Tools & resources

What are some of the available online tools that can be used to calculate project valuations?

How can valuations be used to inform design?

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The Sustainable SITES Initiative

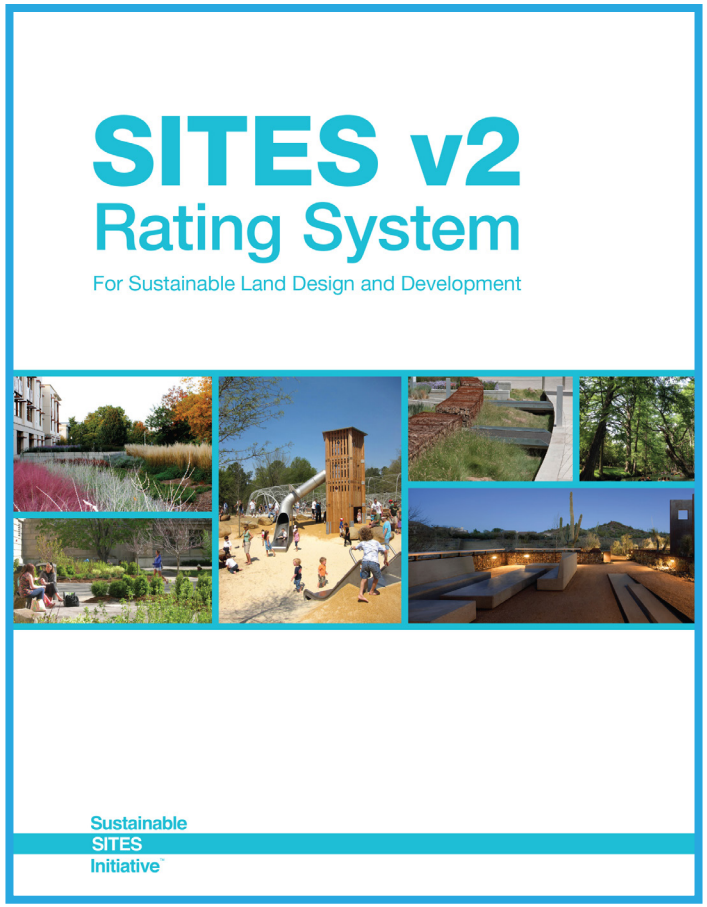

fig.lxvi *https://sustainablesites.org/*

February 10, 2022

The Sustainable SITES Initiative

Project Name: _____ Project ID#:_____ Date: _____

SITES v2 Scorecard Summary

YES	?	NO			
0	0	0	**1: SITE CONTEXT**	**Possible Points:**	**13**
Y			**CONTEXT P1.1**	Limit development on farmland	
Y			**CONTEXT P1.2**	Protect floodplain functions	
Y			**CONTEXT P1.3**	Conserve aquatic ecosystems	
Y			**CONTEXT P1.4**	Conserve habitats for threatened and endangered species	
			CONTEXT C1.5	Redevelop degraded sites	3 to 6
			CONTEXT C1.6	Locate projects within existing developed areas	4
			CONTEXT C1.7	Connect to multi-modal transit networks	2 to 3
0	0	0	**2: PRE-DESIGN ASSESSMENT + PLANNING**	**Possible Points:**	**3**
Y			**PRE-DESIGN P2.1**	Use an integrative design process	
Y			**PRE-DESIGN P2.2**	Conduct a pre-design site assessment	
Y			**PRE-DESIGN P2.3**	Designate and communicate VSPZs	
			PRE-DESIGN C2.4	Engage users and stakeholders	3
0	0	0	**3: SITE DESIGN - WATER**	**Possible Points:**	**23**
Y			**WATER P3.1**	Manage precipitation on site	
Y			**WATER P3.2**	Reduce water use for landscape irrigation	
			WATER C3.3	Manage precipitation beyond baseline	4 to 6
			WATER C3.4	Reduce outdoor water use	4 to 6
			WATER C3.5	Design functional stormwater features as amenities	4 to 5
			WATER C3.6	Restore aquatic ecosystems	4 to 6
0	0	0	**4: SITE DESIGN - SOIL + VEGETATION**	**Possible Points:**	**40**
Y			**SOIL+VEG P4.1**	Create and communicate a soil management plan	
Y			**SOIL+VEG P4.2**	Control and manage invasive plants	
Y			**SOIL+VEG P4.3**	Use appropriate plants	
			SOIL+VEG C4.4	Conserve healthy soils and appropriate vegetation	4 to 6
			SOIL+VEG C4.5	Conserve special status vegetation	4
			SOIL+VEG C4.6	Conserve and use native plants	3 to 6
			SOIL+VEG C4.7	Conserve and restore native plant communities	4 to 6
			SOIL+VEG C4.8	Optimize biomass	1 to 6
			SOIL+VEG C4.9	Reduce urban heat island effects	4
			SOIL+VEG C4.10	Use vegetation to minimize building energy use	1 to 4
			SOIL+VEG C4.11	Reduce the risk of catastrophic wildfire	4
0	0	0	**5: SITE DESIGN - MATERIALS SELECTION**	**Possible Points:**	**41**
Y			**MATERIALS P5.1**	Eliminate the use of wood from threatened tree species	
			MATERIALS C5.2	Maintain on-site structures and paving	2 to 4
			MATERIALS C5.3	Design for adaptability and disassembly	3 to 4
			MATERIALS C5.4	Use salvaged materials and plants	3 to 4
			MATERIALS C5.5	Use recycled content materials	3 to 4
			MATERIALS C5.6	Use regional materials	3 to 5
			MATERIALS C5.7	Support responsible extraction of raw materials	1 to 5
			MATERIALS C5.8	Support transparency and safer chemistry	1 to 5
			MATERIALS C5.9	Support sustainability in materials manufacturing	5
			MATERIALS C5.10	Support sustainability in plant production	1 to 5

YES	?	NO			
0	0	0	**6: SITE DESIGN - HUMAN HEALTH + WELL-BEING**	**Possible Points:**	**30**
			HHWB C6.1	Protect and maintain cultural and historic places	2 to 3
			HHWB C6.2	Provide optimum site accessibility, safety, and wayfinding	2
			HHWB C6.3	Promote equitable site use	2
			HHWB C6.4	Support mental restoration	2
			HHWB C6.5	Support physical activity	2
			HHWB C6.6	Support social connection	2
			HHWB C6.7	Provide on-site food production	3 to 4
			HHWB C6.8	Reduce light pollution	4
			HHWB C6.9	Encourage fuel efficient and multi-modal transportation	4
			HHWB C6.10	Minimize exposure to environmental tobacco smoke	1 to 2
			HHWB C6.11	Support local economy	3
0	0	0	**7: CONSTRUCTION**	**Possible Points:**	**17**
Y			**CONSTRUCTION P7.1**	Communicate and verify sustainable construction practices	
Y			**CONSTRUCTION P7.2**	Control and retain construction pollutants	
Y			**CONSTRUCTION P7.3**	Restore soils disturbed during construction	
			CONSTRUCTION C7.4	Restore soils disturbed by previous development	3 to 5
			CONSTRUCTION C7.5	Divert construction and demolition materials from disposal	3 to 4
			CONSTRUCTION C7.6	Divert reusable vegetation, rocks, and soil from disposal	3 to 4
			CONSTRUCTION C7.7	Protect air quality during construction	2 to 4
0	0	0	**8. OPERATIONS + MAINTENANCE**	**Possible Points:**	**22**
Y			**O+M P8.1**	Plan for sustainable site maintenance	
Y			**O+M P8.2**	Provide for storage and collection of recyclables	
			O+M C8.3	Recycle organic matter	3 to 5
			O+M C8.4	Minimize pesticide and fertilizer use	4 to 5
			O+M C8.5	Reduce outdoor energy consumption	2 to 4
			O+M C8.6	Use renewable sources for landscape electricity needs	3 to 4
			O+M C8.7	Protect air quality during landscape maintenance	2 to 4
0	0	0	**9. EDUCATION + PERFORMANCE MONITORING**	**Possible Points:**	**11**
			EDUCATION C9.1	Promote sustainability awareness and education	3 to 4
			EDUCATION C9.2	Develop and communicate a case study	3
			EDUCATION C9.3	Plan to monitor and report site performance	4
0	0	0	**10. INNOVATION OR EXEMPLARY PERFORMANCE**	**Bonus Points:**	**9**
			INNOVATION C10.1	Innovation or exemplary performance	3 to 9

YES	?	NO		
0	0	0	**TOTAL ESTIMATED POINTS**	**Total Possible Points: 200**

KEY		SITES Certification levels	Points
YES	Project confident points are achievable	CERTIFIED	70
?	Project striving to achieve points, not 100% confident	SILVER	85
NO	Project is unable to achieve these credit points	GOLD	100
		PLATINUM	135

1/3/2017

Page 1 of 6

fig.lxvii *https://asic.org/wp-content/uploads/2017/01/SITESv2_Scorecard.pdf*

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Pathfinder

Designed by Climate Positive Design and CMG Landscape Architecture

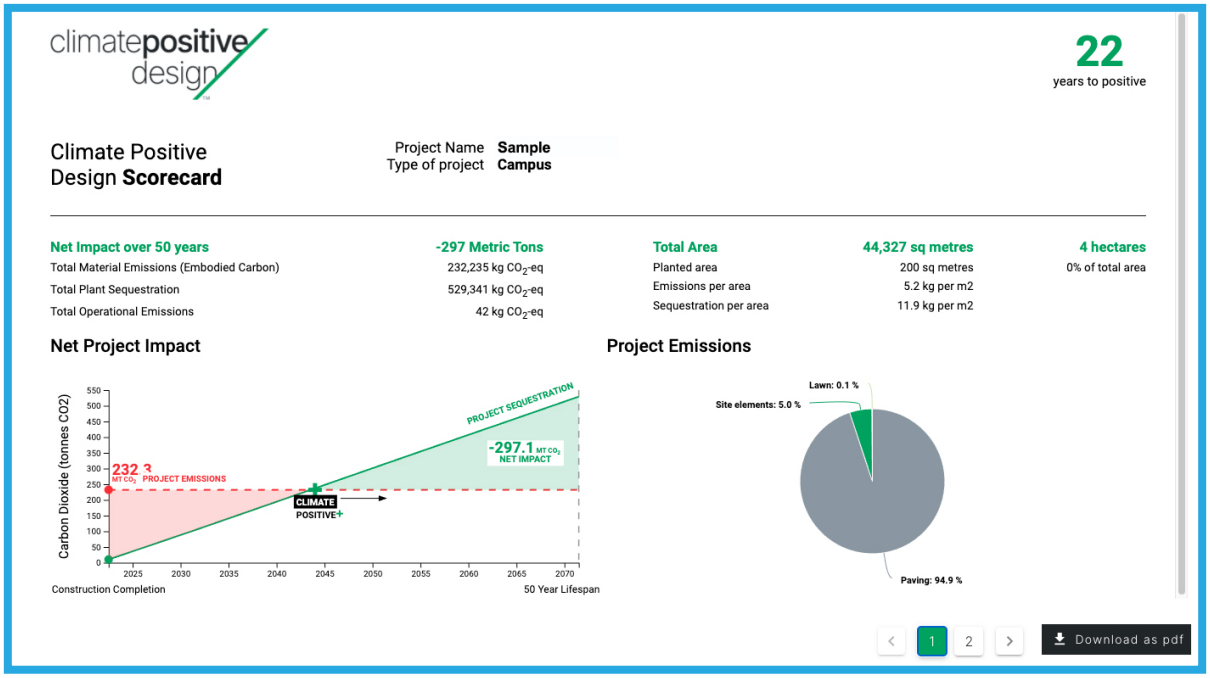

fig.lxviii *https://climatepositivedesign.com/pathfinder/*

Pathfinder

Climate Positive Design **Scorecard**

Project Name **Sample**
Type of project **Campus**

Materials

Element	Total impact
Loose Aggregate Paving	4,694.7 kg
Loose Aggregate Paving	3,253.9 kg
Loose Aggregate Paving	989.7 kg
Loose Aggregate Paving	718.2 kg
Loose Aggregate Paving	2,750.3 kg
Loose Aggregate Paving	1,598.5 kg
Loose Aggregate Paving	1,656.3 kg
Loose Aggregate Paving	1,659.8 kg
Loose Aggregate Paving	131.4 kg
Concrete - Pedestrian	198,801.2 kg
Wood Decking	1,798.4 kg
Wood Decking	1,435.7 kg
Wood Decking	68 kg
Wood Decking	755.6 kg
Wood Decking	377.8 kg
Steel Trellis/Built in Feature	5,627.9 kg
Steel Trellis/Built in Feature	4,783.7 kg
Steel Trellis/Built in Feature	253.3 kg
Wood Trellis/Built in Feature	880.6 kg
Subtotal	**232,235 kg**

Plants

Element	Total impact
No-mow lawn	3,970 kg
Moderate management lawn	247.4 kg
Deciduous Large trees	5,621 kg
Deciduous Medium trees	4,190 kg
Evergreen Medium trees	2,688 kg
Wetlands	500,902.7 kg
Wetlands	12,217.1 kg
Subtotal	**529,342 kg**

Operations

Element	Total impact
Existing Trees Impact - Deciduous Large	0 kg
Subtotal	0 kg

Net Impact over 50 Years 297,107 kg CO2-eq

fig.lxix *https://climatepositivedesign.com/pathfinder/*

i-Tree Tools: i-Tree Design

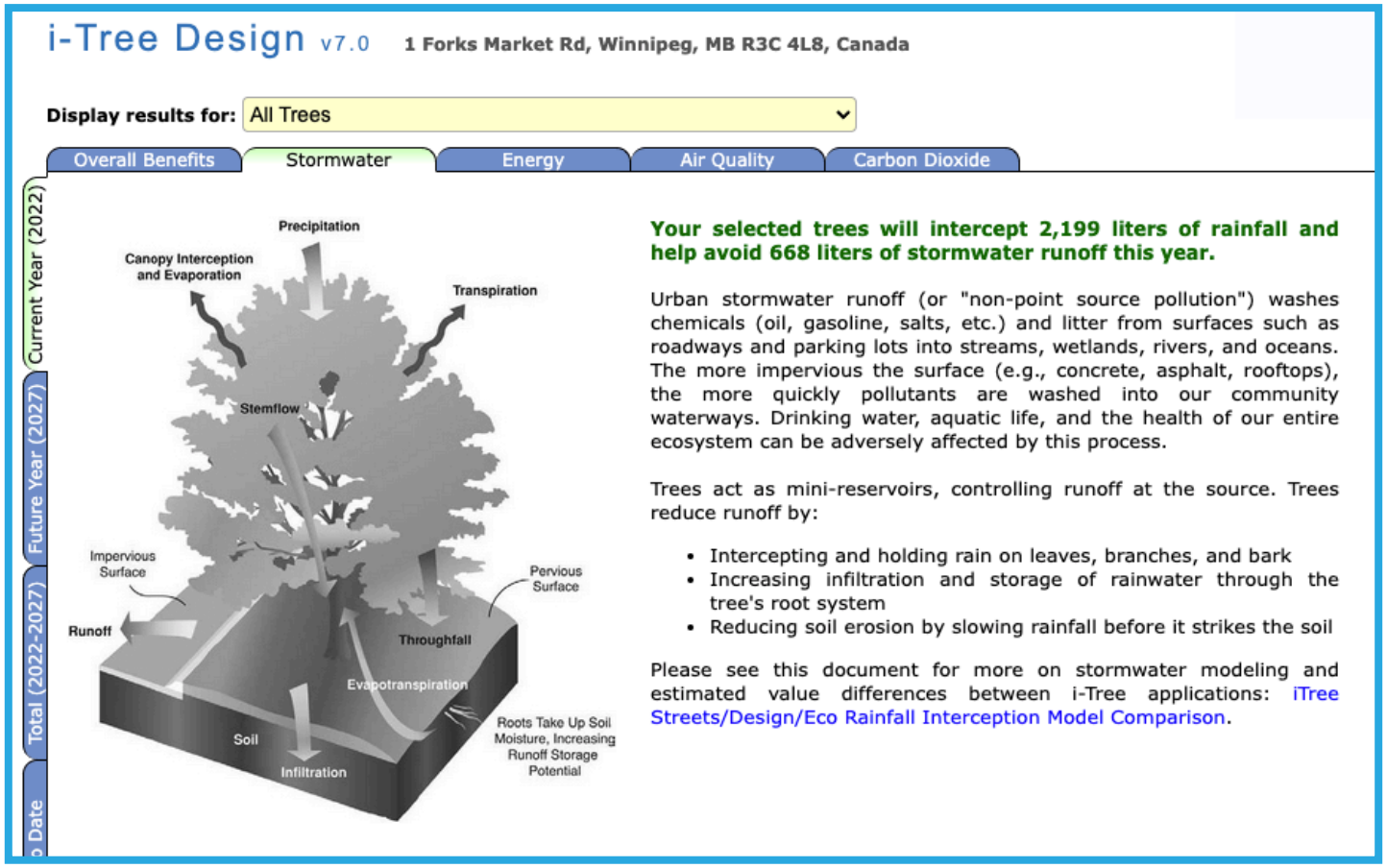

fig.lxx *https://design.itreetools.org/*

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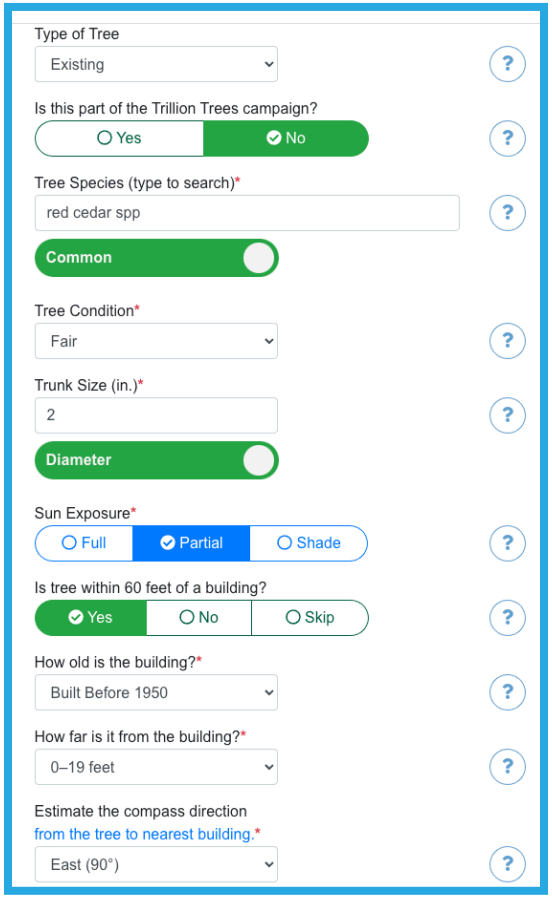
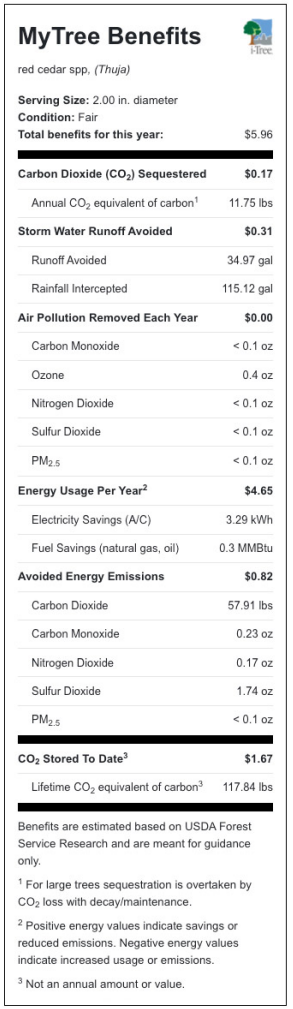
i-Tree Tools: MyTree





MyTree Benefits

red cedar spp, *(Thuja)*

Serving Size: 2.00 in. diameter
Condition: Fair
Total benefits for this year: $5.96

Carbon Dioxide (CO_2) Sequestered	**$0.17**
Annual CO_2 equivalent of carbon[1]	11.75 lbs
Storm Water Runoff Avoided	**$0.31**
Runoff Avoided	34.97 gal
Rainfall Intercepted	115.12 gal
Air Pollution Removed Each Year	**$0.00**
Carbon Monoxide	< 0.1 oz
Ozone	0.4 oz
Nitrogen Dioxide	< 0.1 oz
Sulfur Dioxide	< 0.1 oz
$PM_{2.5}$	< 0.1 oz
Energy Usage Per Year[2]	**$4.65**
Electricity Savings (A/C)	3.29 kWh
Fuel Savings (natural gas, oil)	0.3 MMBtu
Avoided Energy Emissions	**$0.82**
Carbon Dioxide	57.91 lbs
Carbon Monoxide	0.23 oz
Nitrogen Dioxide	0.17 oz
Sulfur Dioxide	1.74 oz
$PM_{2.5}$	< 0.1 oz
CO_2 Stored To Date[3]	**$1.67**
Lifetime CO_2 equivalent of carbon[3]	117.84 lbs

Benefits are estimated based on USDA Forest Service Research and are meant for guidance only.

[1] For large trees sequestration is overtaken by CO_2 loss with decay/maintenance.

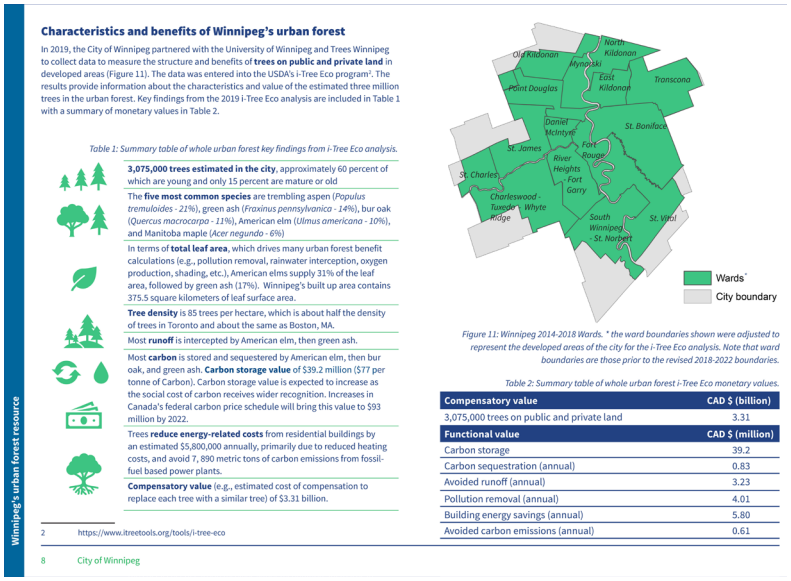
[2] Positive energy values indicate savings or reduced emissions. Negative energy values indicate increased usage or emissions.

[3] Not an annual amount or value.

fig.lxxi,lxxii *https://mytree.itreetools.org/#/*

February 10, 2022

Case study: Winnipeg's Urban Forest Strategy



Winnipeg's urban forest resource

Characteristics and benefits of Winnipeg's urban forest

In 2019, the City of Winnipeg partnered with the University of Winnipeg and Trees Winnipeg to collect data to measure the structure and benefits of **trees on public and private land** in developed areas (Figure 11). The data was entered into the USDA's i-Tree Eco program[2]. The results provide information about the characteristics and value of the estimated three million trees in the urban forest. Key findings from the 2019 i-Tree Eco analysis are included in Table 1 with a summary of monetary values in Table 2.

Table 1: Summary table of whole urban forest key findings from i-Tree Eco analysis.

3,075,000 trees estimated in the city, approximately 60 percent of which are young and only 15 percent are mature or old

The **five most common species** are trembling aspen (*Populus tremuloides - 21%*), green ash (*Fraxinus pennsylvanica - 14%*), bur oak (*Quercus macrocarpa - 11%*), American elm (*Ulmus americana - 10%*), and Manitoba maple (*Acer negundo - 6%*)

In terms of **total leaf area**, which drives many urban forest benefit calculations (e.g., pollution removal, rainwater interception, oxygen production, shading, etc.), American elms supply 31% of the leaf area, followed by green ash (17%). Winnipeg's built up area contains 375.5 square kilometers of leaf surface area.

Tree density is 85 trees per hectare, which is about half the density of trees in Toronto and about the same as Boston, MA.

Most **runoff** is intercepted by American elm, then green ash.

Most **carbon** is stored and sequestered by American elm, then bur oak, and green ash. **Carbon storage value** of $39.2 million ($77 per tonne of Carbon). Carbon storage value is expected to increase as the social cost of carbon receives wider recognition. Increases in Canada's federal carbon price schedule will bring this value to $93 million by 2022.

Trees **reduce energy-related costs** from residential buildings by an estimated $5,800,000 annually, primarily due to reduced heating costs, and avoid 7, 890 metric tons of carbon emissions from fossil-fuel based power plants.

Compensatory value (e.g., estimated cost of compensation to replace each tree with a similar tree) of $3.31 billion.

2 https://www.itreetools.org/tools/i-tree-eco

8 City of Winnipeg

*Figure 11: Winnipeg 2014-2018 Wards. * the ward boundaries shown were adjusted to represent the developed areas of the city for the i-Tree Eco analysis. Note that ward boundaries are those prior to the revised 2018-2022 boundaries.*

Table 2: Summary table of whole urban forest i-Tree Eco monetary values.

Compensatory value	CAD $ (billion)
3,075,000 trees on public and private land	3.31
Functional value	**CAD $ (million)**
Carbon storage	39.2
Carbon sequestration (annual)	0.83
Avoided runoff (annual)	3.23
Pollution removal (annual)	4.01
Building energy savings (annual)	5.80
Avoided carbon emissions (annual)	0.61

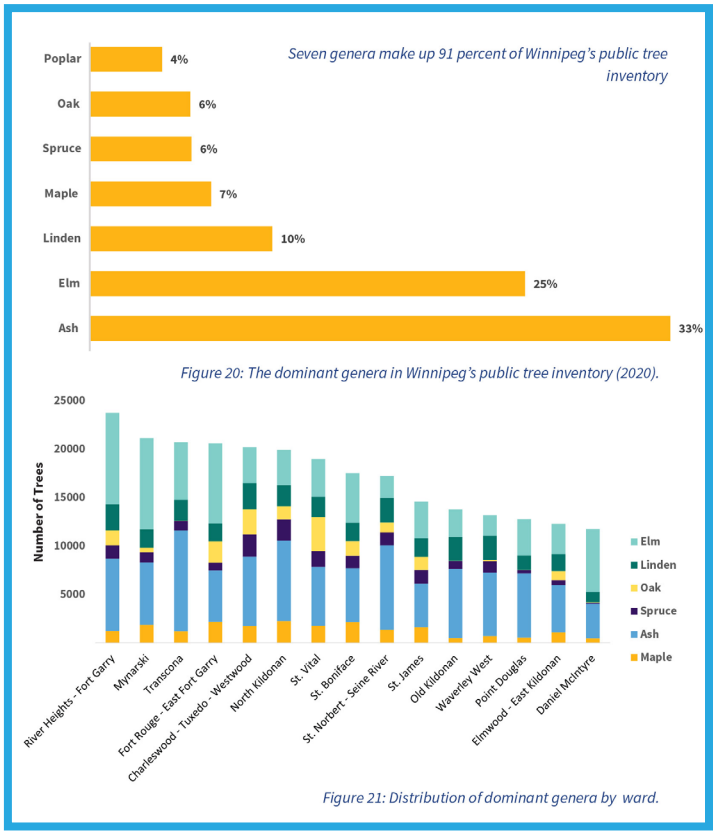


Figure 20: The dominant genera in Winnipeg's public tree inventory (2020).

Figure 21: Distribution of dominant genera by ward.

fig.lxxiii,lxxiv *https://engage.winnipeg.ca/urbanforest/widgets/67282/documents*

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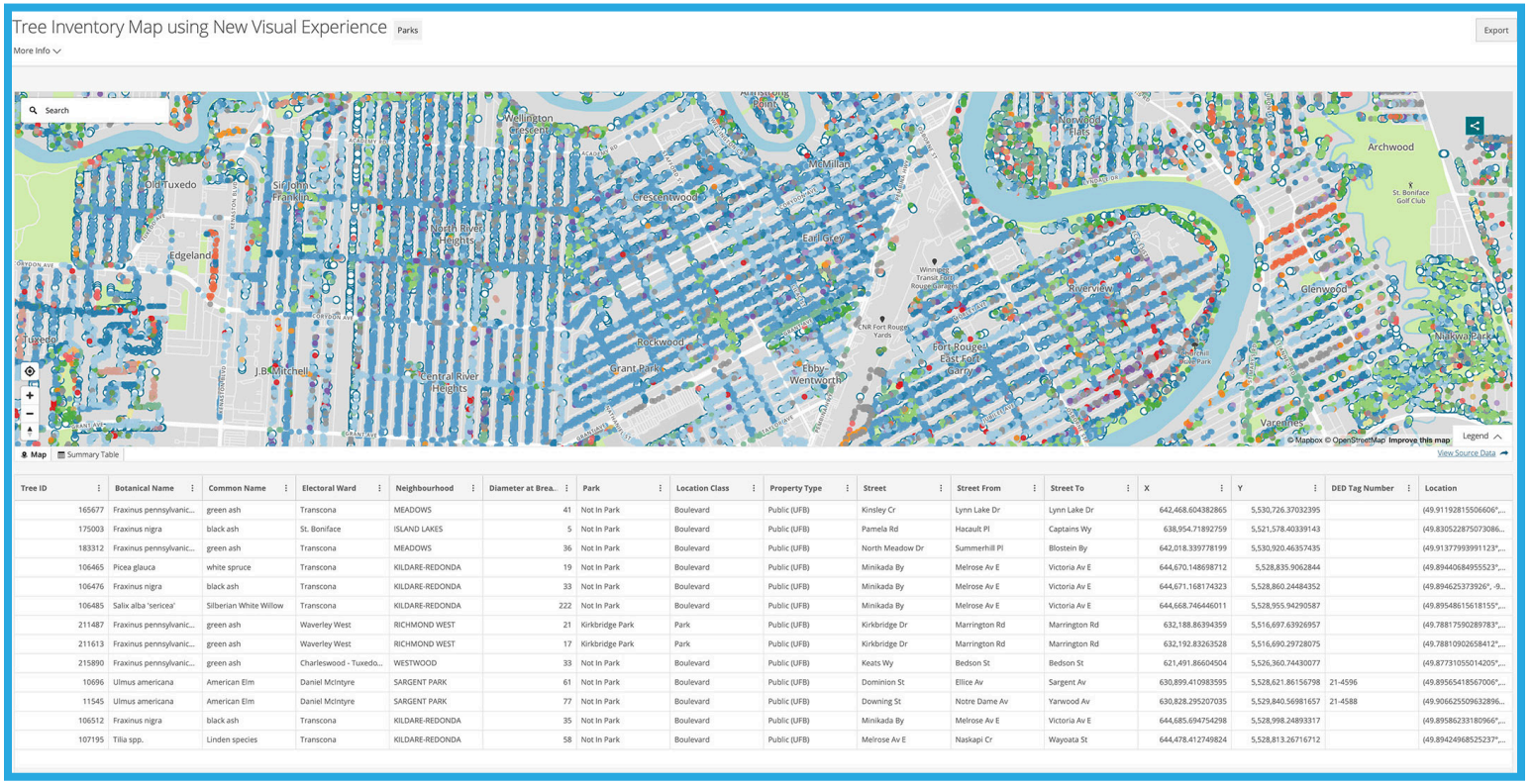

Tree ID	Botanical Name	Common Name	Electoral Ward	Neighbourhood	Diameter at Brea..	Park	Location Class	Property Type	Street	Street From	Street To	X	Y	DED Tag Number	Location
165677	Fraxinus pennsylvanic...	green ash	Transcona	MEADOWS	41	Not In Park	Boulevard	Public (UFB)	Kinsley Cr	Lynn Lake Dr	Lynn Lake Dr	642,468.604382865	5,530,726.37032395		(49.91192815506606°,...
175003	Fraxinus nigra	black ash	St. Boniface	ISLAND LAKES	5	Not In Park	Boulevard	Public (UFB)	Pamela Rd	Hacault Pl	Captains Wy	638,954.71892759	5,521,578.40339143		(49.83052287507308 6...
183312	Fraxinus pennsylvanic...	green ash	Transcona	MEADOWS	36	Not In Park	Boulevard	Public (UFB)	North Meadow Dr	Summerhill Pl	Blostein By	642,018.339778199	5,530,920.46357435		(49.91377993991123°,...
106465	Picea glauca	white spruce	Transcona	KILDARE-REDONDA	19	Not In Park	Boulevard	Public (UFB)	Minikada By	Melrose Av E	Victoria Av E	644,670.148698712	5,528,835.9062844		(49.89440684955523°,...
106476	Fraxinus nigra	black ash	Transcona	KILDARE-REDONDA	33	Not In Park	Boulevard	Public (UFB)	Minikada By	Melrose Av E	Victoria Av E	644,671.168174323	5,528,860.24484352		(49.894625373926°, -9...
106485	Salix alba 'sericea'	Silberian White Willow	Transcona	KILDARE-REDONDA	222	Not In Park	Boulevard	Public (UFB)	Minikada By	Melrose Av E	Victoria Av E	644,668.746446011	5,528,955.94290587		(49.89548615618155°,...
211487	Fraxinus pennsylvanic...	green ash	Waverley West	RICHMOND WEST	21	Kirkbridge Park	Park	Public (UFB)	Kirkbridge Dr	Marrington Rd	Marrington Rd	632,188.86394359	5,516,697.63926957		(49.78817590289783°,...
211613	Fraxinus pennsylvanic...	green ash	Waverley West	RICHMOND WEST	17	Kirkbridge Park	Park	Public (UFB)	Kirkbridge Dr	Marrington Rd	Marrington Rd	632,192.83263528	5,516,690.29728075		(49.78810902658412°,...
215890	Fraxinus pennsylvanic...	green ash	Charleswood - Tuxedo...	WESTWOOD	33	Not In Park	Boulevard	Public (UFB)	Keats Wy	Bedson St	Bedson St	621,491.86604504	5,526,360.74430077		(49.87731055014205°,...
10696	Ulmus americana	American Elm	Daniel McIntyre	SARGENT PARK	61	Not In Park	Boulevard	Public (UFB)	Dominion St	Ellice Av	Sargent Av	630,899.410983595	5,528,621.86156798	21-4596	(49.89565418567006°,...
11545	Ulmus americana	American Elm	Daniel McIntyre	SARGENT PARK	77	Not In Park	Boulevard	Public (UFB)	Downing St	Notre Dame Av	Yarwood Av	630,828.295207035	5,529,840.56981657	21-4588	(49.90662550963289 6...
106512	Fraxinus nigra	black ash	Transcona	KILDARE-REDONDA	35	Not In Park	Boulevard	Public (UFB)	Minikada By	Melrose Av E	Victoria Av E	644,685.694754298	5,528,998.24893317		(49.89586233180966°,...
107195	Tilia spp.	Linden species	Transcona	KILDARE-REDONDA	58	Not In Park	Boulevard	Public (UFB)	Melrose Av E	Naskapi Cr	Wayoata St	644,478.412749824	5,528,813.26716712		(49.89424968525237°,...

fig.lxxv *https://data.winnipeg.ca/Parks/Tree-Inventory-Map-using-New-Visual-Experience/n7eq-raej*

Other resources and tools

The Landscape Architecture Foundation's Landscape Performance Series features an exhaustive list of additional resources

LANDSCAPE PERFORMANCE SERIES by the Landscape Architecture Foundation

InVEST integrated valuation of ecosystem services and tradeoffs

Carbon Conscience BETA SASAKI

fig.lxxvi - lxxix *https://www.landscapeperformance.org/*

Conclusion

Planners and designers have a role in forwarding the collective understanding of how important natural assets are in rapidly responding to climate change as we continue to contend with greater variability and storm events that will test existing infrastructures

THANK YOU

References

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