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NATURE AT WORK

Economic value of natural assets in a changing prairie climate

Final report

City of Saskatoon

MARCH 2026

About Habitat

Habitat is an environmental consulting firm whose mission is to accelerate the ecological transition by turning environmental ambitions into concrete, sustainable, and tailored actions.

Habitat supports a wide range of organizations and stakeholders in integrating environmental issues at the core of their strategic decision-making. Our work aims to promote the adoption of practices that strengthen the resilience of territories and organizations in the face of climate change, while also contributing positively to biodiversity.

Behind each of our projects lies unique expertise in modeling, biodiversity monitoring, ecosystem services assessment, spatial ecosystem management, and sustainable land-use planning.

We design and implement innovative, science-based solutions that are tailored to today's and tomorrow's challenges.

Project Team

This report was prepared by the Habitat team.
For any questions or communications regarding this report, please contact info@habitat-nature.com.

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Note: The monetary values presented in this report are expressed in Canadian dollars, based on their 2025 value.

EXECUTIVE SUMMARY

This study builds on previous City of Saskatoon and Meewasin assessments by conducting a detailed cost-benefit analysis comparing a conserved natural asset (the Northeast Swale) with a constructed park (Briarwood Park). It models current and future ecosystem services—carbon sequestration and storage, urban heat mitigation, and access to nature—using site-specific data and official maintenance costs, providing a replicable framework for valuing other natural assets across the city.

The report first presents the results of the ecosystem-services assessment, followed by a detailed cost-benefit analysis to support the City of Saskatoon in its decision-making regarding green spaces.

Here follows the main results of the study.

For the Northeast Swale:

- Provides high carbon storage and sequestration capacity due to the predominance of natural environments.
- Demonstrates stronger heat mitigation performance than Briarwood Park, although the difference remains moderate.
- Offers satisfactory access to nature, with expected improvements in the coming years due to population increase.
- Delivers strong ecological and social value relative to the level of investment required.
- Benefits are expected to increase as nearby populations grow and the social cost of carbon continues to rise.

For Briarwood Park :

- Generates limited benefits in carbon storage, sequestration, and heat mitigation.
- Nonetheless provides meaningful heat relief for nearby residents.
- Contributes to local access to nature, despite its more modest environmental impact.
- Although it delivers notable health and carbon benefits per hectare, the park faces high maintenance costs that outweigh its overall site-level benefits.

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INTRODUCTION

Defining ecosystem services

Ecosystem services are the direct and indirect benefits that natural systems provide to humans, supporting environmental health, economic activities, and overall quality of life. These services are typically categorized into provisioning services (e.g. clean water, raw materials, and food), regulating services (e.g. climate regulation, water filtration, and flood mitigation), cultural services (e.g. recreation, aesthetic value, and cultural identity), and supporting services (e.g. soil formation and nutrient cycling) that underpin all other ecological functions. Heat mitigation, stormwater retention and management, carbon storage as well as recreational uses are all examples of ecosystem services that can be found in cities.

Understanding and evaluating ecosystem services is essential for well-informed land-use planning, conservation efforts, and sustainable resource management. Furthermore, incorporating ecosystem services into urban planning helps ensure that ecological functions are preserved or enhanced. It reduces environmental risks by supporting a healthier and more resilient urban environment.

Scope of the project

In 2019, the City of Saskatoon worked with Meewasin to complete a preliminary inventory of natural areas to assess the existing Green Network of the urban area (Meewasin Valley Authority, 2019). This Green Network includes both Natural Assets (e.g.water bodies, forests & shrublands, and grasslands) and Enhanced Assets (e.g. green spaces and agricultural land). The preliminary inventory report aims to support the City of Saskatoon's Green Infrastructure Strategy by providing baseline data regarding Saskatoon's Natural and Enhanced Assets.

In 2020, the City of Saskatoon completed a pilot project to economically valuate ecosystem services of two of its natural areas, the Small Swale and the Richard St. Barbe Baker Afforestation Area (City of Saskatoon, 2020). The results provide a point-in-time assessment of Saskatoon's natural assets but lack comprehensive site-specific information since economic values were obtained through benefit transfer method (using an existing economic value from a comparable ecosystem in another location).

The aim of this project is to build on these previous studies and conduct cost-benefit analysis to compare a conserved natural asset, the Northeast Swale, and a constructed park, Briarwood Park (Table 1).

This study models the current (2025) and future (2050) provisioning of four ecosystem services of the Northeast Swale and Briarwood Park. The ecosystem services studied include carbon sequestration, carbon storage, urban heat mitigation (the cooling capacity of natural environments in an urban context), and access to urban nature. Maintenance costs of the two study areas were based on official documentation transmitted by the City and Meewasin. The methodology and values of ecosystem services calculated for these two sites can be applied to the valuation of other natural assets in the City of Saskatoon.

Table 1. Objectives of the analyses.

Scenario	Carbon storage	Carbon sequestration	Urban heat mitigation	Access to urban nature	Maintenance costs
Northeast Swale, in 2025	How much carbon dioxide (CO_2) is stored in the soil and the biomass (vegetation)	How much carbon dioxide (CO_2) is removed annually from the atmosphere by the vegetation	How much natural infrastructure contributes to reducing the urban heat island effect	How many people have satisfactory acces s to urban nature in proximity to their residence (Use of projected growth to estimate population in 2050)	What are the annual maintenance costs of green infrastructure?
Briarwood Park, in 2025					
Northeast Swale, in 2050					
Briarwood Park, in 2050					

This innovative approach can be used for the entire Green Network of Saskatoon and in other Canadian cities. It is an opportunity to establish Canadian leadership in Natural Asset Valuation. The approach also improves recognition of ecosystem value, particularly in urban areas. It supports more comprehensive consideration of natural environments in decision-making processes. The approach allows local governments to improve their understanding of ecosystem services and, ultimately, build more resilient and healthier communities.

Various stakeholders participated throughout the project including City Departments such as Sustainability, Parks, Planning and Development, Corporate Asset Management, and Recreation and Community Development; and external groups such as Meewasin. Their role was to validate the methodology proposed by Habitat and ensure that the analyses aligned with the needs of the City of Saskatoon. This participatory approach proved highly relevant, as it enabled the refinement of results and the enhancement of the final reports. This process could be replicated in future projects.

VALUATION FRAMEWORK

To complete the cost–benefit analysis for the Northeast Swale and Briarwood Park study areas, a three-step approach was implemented:

1. Site characterization and data collection:

Key physical, ecological, and demographic characteristics of each site were documented, including land use land cover and current (2025) and future (2050) population density.

2. Biophysical modelling of ecosystem services:

Ecosystem service delivery was estimated under current (2025) and future (2050) conditions based on site characteristics, using modeling software and a literature review. The modelling approaches deliver biophysical results, such as tonnes of carbon, air temperature, and number of people with satisfactory access to urban nature.

3. Economic valuation of ecosystem services and maintenance costs:

Biophysical outputs of the model were translated into monetary values using established valuation approaches. Annual maintenance expenditures were compiled from City and Meewasin operational budgets. Benefits and costs were then compared both in total and on a per-hectare basis to account for differences in site surface areas.

Sites characterization and data collection

The current project focuses on two study areas, the Northeast Swale and Briarwood Park. These sites are briefly described below, followed by a section explaining how data were collected to characterize the sites.

The Northeast Swale

The Northeast Swale is an ancient river channel adjacent to the South Saskatchewan River (Figure 1). It covers approximately 366 hectares within the City of Saskatoon's limits. The Northeast Swale is predominantly composed of natural grassland ecosystems (58% of the area) (Table 2), representing one of the few remaining examples of natural grasslands in the region, less than 5% of which is estimated to persist today (CPAWS, 2022). The area supports a rich diversity of bird and plant species and plays a critical role in maintaining the ecological integrity and biodiversity of Saskatoon. In addition, the presence of wetlands, specifically marshes, further enhances the Swale's ecological functions and habitat complexity.

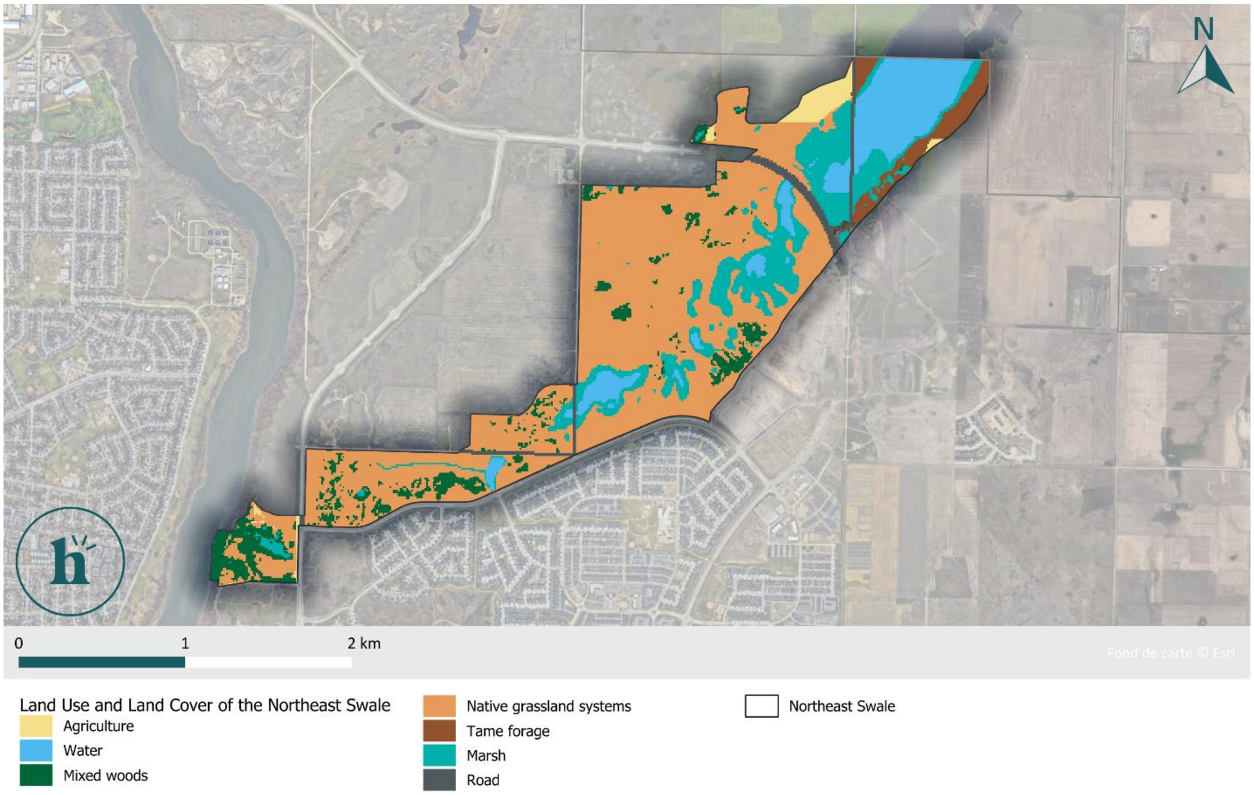

Figure 1. Land use and land cover of the Northeast Swale (within the city limits)

Table 2. Land use in Northeast Swale within the city limits.

Land use type	Area (in ha)	Area (in km^2)	% of the area
Native grassland	211.04	2.11	58%
Wetland (Riparian zone)	54.47	0.54	15%
Wetland (open water)	41.54	0.42	11%
Tree vegetation	29.74	0.30	8%
Tame forage	11.95	0.08	3%
Agriculture	8.33	0.54	2%
Road	8.46	0.01	2%
TOTAL	**366.68**	**3.67**	**100%**

Briarwood Park

Briarwood Park is a constructed urban green space situated within a well-established residential area (Figure 2). The park features a constructed stormwater pond, known as Briarwood Lake, which serves both functional and aesthetic purposes. Briarwood Park includes a range of recreational amenities designed to support community use, such as pathways and sporting facilities. The landscape is primarily composed of turf (58% of the park) with a few isolated trees (7%). The pond itself represents 30% of the park (Table 3).

Figure 2. Land use and land cover of Briarwood Park.

Table 3. Land use in Briarwood Park.

Land use type	Area (in ha)	Area (in km^2)	% of the area
Turf/grass	8.20	0.08	58%
Constructed pond	4.23	0.04	30%
Tree vegetation	1.03	0.01	7%
Bare soil	0.22	0.00	2%
Road	0.22	0.00	2%
Building footprint	0.05	0.00	0%
TOTAL	**13.95**	**0.14**	**100%**

Study areas data collection

Study area delineation and characteristics were provided by the City of Saskatoon.

Current (2025) population density was taken from 2021 census (Statistics Canada, 2021). For future (2050) population projections, we used the City's expertise (Michael Kowalchuk, email exchange, Nov. 26, 2025).

A 10-meter resolution raster layer representing the Land Use/Land Cover (LULC) of the Northeast Swale and Briarwood Park was created by Habitat. LULC refers to the combination of physical surface characteristics and the human activities associated with specific areas of land. Land cover describes the observable features on the Earth's surface, such as vegetation, water bodies, built-up areas, or bare soil, while land use captures how these areas are used, including residential, agricultural, industrial, recreational, or conservation purposes. LULC information provides an essential basis for environmental monitoring, urban planning, resource management, and spatial analysis. It helps identify patterns; measures change over time and supports informed decision-making in land management.

The LULC raster layer was developed primarily using information collected during a previous project for the David Suzuki Foundation (Habitat, 2025). This LULC raster layer is a combination of several datasets (Table 4). We further refined the LULC layer based on information provided by local stakeholders. This allowed us to ensure that the LULC files reflected up-to-date and accurate information.

Table 4. Dataset used to create a LULC raster layer representing the study areas.

Layer	Use	Source/URL
Saskatchewan Digital Landcover 2020[1]	Base layer to create current raster layer	Open source from the Government of Saskatchewan. URL: https://geohub.saskatchewan.ca/datasets/a287612147ab4f0a9863148f76170f00/about
Meewasin Valley Authority, Natural Areas Inventory for the City of Saskatoon 2019	Accurate delineation of any type of natural asset within the City of Saskatoon	Provided by the City of Saskatoon. More info: https://meewasin.com/wp-content/uploads/2019/12/Natural-Areas-Inventory-for-the-City-of-Saskatoon-2019-Final-Report-November-25-2019.pdf
ROADSEG	Roads network delineation	Open source from the Government of Saskatchewan. URL: https://geohub.saskatchewan.ca/datasets/e2477059552f4c7e9b1370a9e94778e7/about
The Open Database of Buildings	Building footprint	Open source from Statistics Canada. URL: https://www150.statcan.gc.ca/n1/en/catalogue/34260001
Saskatoon Zoning	Used to assess building footprints and surrounding urban area zoning (i.e. commercial, residential, etc.).	Provided by the City of Saskatoon. More info: https://www.saskatoon.ca/business-development/building-development-construction/zoning https://www.saskatoon.ca/sites/default/files/documents/city-clerk/bylaws/9990.pdf
Canopy	Used to add individual trees and canopy cover when it overlaps with other LULC classes.	Created by Habitat (2025). More info and URL: https://habitatanalyste.shinyapps.io/FDS_CarteInt_SASK/

[1] The first row of the table (Saskatchewan Digital Landcover 2020) corresponds to the dataset used as a base layer, while the last row (Canopy) corresponds to the dataset used on a top of the others.

Biophysical modelling of ecosystem services

Ecosystem services were quantified through a combination of literature review and spatially explicit modelling (Table 5).

In the cases of carbon storage and sequestration, a review of scientific literature was conducted to assign carbon density and sequestration factors to each natural LULC category (e.g., forests, wetlands, native grasslands, and irrigated turf). These coefficients represent the amount of carbon stored in biomass and soils, as well as the annual rate of carbon uptake through vegetation growth.

The LULC layer developed for the project was then used to determine the area occupied by each natural asset category for each study site. By multiplying these areas by the carbon factors, we generated estimates of:

- Current carbon stock (total stored carbon)
- Annual carbon uptake (sequestration in 2025 and 2050)

Whenever possible, data originating from Saskatchewan were prioritized, followed by studies conducted in the Canadian Prairies. This approach ensures that the study reflects the specific context and conditions of the city of Saskatoon and its surrounding areas.

Concerning urban heat mitigation and access to urban nature, InVEST® models (Nature Capital Project, 2025) were used to estimate both services. InVEST® modeling relies primarily on LULC dataset. InVEST® is a collection of free, open-source modeling tools created by Stanford University. They are designed to quantify and map ecosystem goods and services that support and enhance human well-being.

The Urban Cooling model evaluates temperature moderation benefits derived mainly from vegetation cover and evapotranspiration. It estimates spatial variation in temperature under current (2025) and future (2050) conditions. The model allowed us to identify which areas are more vulnerable to heat.

The Urban Nature Access model quantifies how many residents are within walking distance to urban green spaces. It links ecological features to social benefits and enables projections based on expected demographic change.

Table 5. Ecosystem services modelling methodology.

Ecosystem services	Description	Scale of analysis	Modelling method
Carbon storage	Quantity of carbon stored by vegetation (biomass) and soil.	Value per natural asset (grasslands, wetlands, forests)	Literature review to assess value by natural asset
Carbon sequestration	Quantity of carbon sequestered annually by vegetation (biomass)		
Urban heat mitigation	Temperature reduction in each area		Urban Cooling, InVEST® model
Access to urban nature	Number of residents with access to a park according to walking distance	Value for the Northeast Swale / Briarwood Park	Urban Nature Access, InVEST® model

Economic valuation of ecosystem services and maintenance costs

Economic benefits were calculated according to different methods (Table 6). Calculations were based on biophysical values (i.e. tonnes of carbon, air temperature, number of residents with satisfactory access to a park). Valuation approaches come from Canadian governmental guidelines or Canadian scientific literature.

Carbon storage and sequestration economic values are derived from the social cost of carbon, as established in federal guidelines. This metric represents the estimated incremental economic damages resulting from a marginal increase in greenhouse gas emissions[1].

Heat mitigation has not been economically evaluated since no proper value applicable to Canadian context was found after a literature review. Further research would be necessary.

Access to urban nature was economically valued based on avoided cost on physical and mental health. Avoided cost refers to money that will not be spent within the healthcare system due to factors such as increased physical activity or the positive effects of nature on mental health. Avoided cost values of physical and mental health come from Wilson & Xiao (2023) Canadian's study.

Costs related to park maintenance come from City operational budgets provided by the City of Saskatoon and Meewasin.

Economic benefits and costs were then compared both in total and on a per-hectare basis to account for differences in site surface area and infrastructure requirements. Unless clearly mentioned, all economic valuations are expressed in 2025 Canadian dollars (CAD).

Table 6. Economic valuation methodology.

Ecosystem services	Description	Economic valuation
Carbon storage	Quantity of carbon stored by vegetation (biomass) and soil	Social cost of carbon
Carbon sequestration	Quantity of carbon sequestered annually by vegetation (biomass)	
Urban heat mitigation	Temperature reduction in each area	No economic valuation
Access to urban nature	Number of people who can access a park according to walking distance	Avoided cost on physical and mental health

[1] https://www.canada.ca/en/environment-climate-change/services/climate-change/science-research-data/social-cost-ghg.html

ECOSYSTEM SERVICES VALUATION RESULTS

The following sections present the valuation results for the four ecosystem services assessed in this study: carbon storage, carbon sequestration, urban heat mitigation, and access to urban nature. Each subsection is structured consistently to allow comparison across services.

For each ecosystem service, we begin with a brief conceptual description of the service. This is followed by the methodological approach, detailing the biophysical modelling techniques, data sources, and key assumptions used to quantify service delivery under current (2025) and future (2050) conditions. A dedicated section outlines model parameters and methodological limitations, highlighting uncertainties and boundary conditions that influence the interpretation of results.

When applicable, an economic valuation section explains how modeled biophysical outputs were translated into monetary terms. Finally, each subsection concludes with the presentation of results.

This structured approach ensures that both biophysical and socio-economic contributions of natural assets are assessed consistently and comprehensively across the two study areas.

1. CARBON STORAGE AND SEQUESTRATION

Description of the ecosystem services

Carbon storage and carbon sequestration are key climate regulation services provided by natural ecosystems. Carbon storage refers to the long-term retention of carbon in vegetation and soils, effectively storing carbon and preventing it from contributing to climate change. Carbon sequestration represents the annual uptake of carbon dioxide through plant photosynthesis and growth, continually increasing the amount of carbon stored over time.

Forests, wetlands, and other vegetated natural areas are particularly effective at capturing and storing atmospheric carbon, making them critical components of municipal climate strategies. In an urban context, these services help offset greenhouse gas emissions, support climate-neutrality goals, and strengthen the city’s resilience to climate change. Evaluating both the existing carbon stocks and the future sequestration potential of natural assets provides valuable insight into how protected and restored ecosystems contribute to long-term carbon mitigation efforts.

Methodology

Parameter estimation for each natural asset

An extensive literature review was conducted to gather information on carbon dynamics in natural environments characteristic of Western Canada, and more specifically, the Saskatoon region. The objective was to develop the most realistic and accurate estimates for carbon sequestration and storage values in the Northeast Swale and Briarwood Park.

Carbon storage values for main ecosystems (mixed forests/tree vegetation, native grasslands, marshes, turf, constructed pond) were collected in various scientific articles conducted in the Canadian Prairies region, such as Gill & Jackson, 2000; Pinno & Wilson, 2011; Badiou and al., 2011; Wang and al., 2014; and Bork & Badiou, 2017.The value for the carbon storage capacity of constructed ponds is an exception: the value comes from the work of Taylor and al. (2019) and was conducted in the United Kingdom. Carbon storage values include above and belowground biomass plus carbon stored in the soil at various depth, depending on the study.

Carbon storage is the amount of carbon retained within the vegetation, soils and biomass of natural areas over time.

Depending on the availability of studies and the feasibility of linking them to the Saskatoon LULC, values are either derived from a single article or obtained from multiple articles when several relevant studies were identified. When values were sourced from multiple articles, an average was calculated. In the scientific literature, carbon storage values are expressed in metric tonnes of carbon per hectare. However, to facilitate data interpretation we are providing values in tonnes equivalent CO_2 (tCO_2e). Equivalent CO_2 is a standard unit for measuring carbon footprints, and it helps to understand the impact of different greenhouse gases in terms of the amount of CO_2 that would create the same amount of warming. To convert carbon (C) to equivalent CO_2 (eq. CO_2), a conversion factor of 3.67 (or 44/12) is used. 1 metric tonne of carbon is then equal to 3.67 tonnes of equivalent CO_2.

Carbon sequestration values for the main ecosystems were also collected through scientific studies conducted in the Canadian Prairies region, when available. Lynch and al., 2005; Townsend-Small and Czimzcik, 2010; Wang and al., 2014; Chizen and al., 2024; and Mistry et al., 2025 all contributed to the analyses. Carbon sequestration values represent above and belowground annual uptake of carbon through plant growth. Carbon sequestration is also expressed in metric tonne per hectare in the scientific literature, but has been converted into tCO_2e.

Carbon sequestration is the gradual process by which natural areas capture atmospheric carbon dioxide through plant growth, soil formation and other ecological processes.

The values associated for both carbon storage and sequestration associated with different agricultural LULC categories are drawn from the work of Hutchinson and al. (2007) (agriculture), Tremblay and Ouimet (2013) (hay crops) and Amichev and al. (2017) (tame forage). The values related to urbanized environments are primarily derived from the studies of Raciti, Hutyra, and Finzi (2012), as well as Pouyat and al. (2002). The values were compiled according to the land-use categories defined by the City of Saskatoon.

Approach limitations

Natural environments are subject to a wide range of natural and human-induced disturbances, both of which can significantly affect long-term carbon stocks and sequestration rates (Euliss and al., 2006; Wang and al., 2014).

Carbon sequestration and storage values represent average estimates because no information was available regarding vegetation or natural asset age. It is important to note, for example, that young trees typically exhibit higher annual sequestration rates than mature ones, as they grow faster and accumulate biomass more rapidly. Sequestration is therefore a gradual process that varies over time and is incrementally added to long-term carbon storage.

Economic valuation

There are several ways to assess the economic value associated with carbon stocks in natural environments, such as market-based valuation or the social cost of carbon. The latter was used in this project, as it provides an overarching view of the potential social damages associated with increasing greenhouse gas concentrations in the atmosphere, whereas the market-based approach relies solely on supply-and-demand dynamics.

> Social cost of carbon refers to the estimated monetary value of economic and social damages caused by emitting one tonne of CO^2.

In Canada, the social cost of carbon is used by the federal government to evaluate the costs and benefits of policies that affect greenhouse gas emissions. It evolves from year to year. Projected values fixed by the Government of Canada[2] are $535 / t$CO_2$e in 2025, and $616 / t$CO_2$e for 2050. These values were used to estimate the economic value of carbon storage and sequestration in both study sites. The use of these values is relevant because it captures the overall impacts of increasing greenhouse gas emissions on economic and social systems. It therefore provides an effective overview of the broader effects of climate change on communities.

[2] For more information on the social cost of carbon, please refer to https://www.canada.ca/en/environment-climate-change/services/climate-change/science-research-data/social-cost-ghg.html

Carbon storage results

Table 7 presents the mean carbon storage in tonnes of CO_2 equivalent per hectare (tCO_2e/ha) for the main natural assets in the Northeast Swale and Briarwood Park. Total storage values (tCO_2e) were calculated by multiplying the mean rate by the area occupied by each natural asset type within each study area. Only natural assets for which sufficiently robust storage data were included. Assets such as bare soil and open water were excluded due to the lack of reliable or representative sequestration values in the literature.

The key finding is that the Northeast Swale stores nearly three times more carbon per hectare than Briarwood Park. This difference is largely explained by the Swale's natural character and the type of native ecosystem it supports.

Table 7. Carbon stored by principal natural assets composing the Northeast Swale and Briardwood Park.

Study area	Natural asset type	Total area (ha)	Mean carbon stored per hectare (tCO_2e/ha)[3]	Total carbon stored (tCO_2e)
Northeast Swale	Tree vegetation	29.74	663.43	19,730.29
	Native grassland	211.04	296.17	62,503.72
	Wetland	54.47	642.62	35,003.35
		295.25	**397.08**	**117,237.64**
Briarwood Park	Tree vegetation	1.03	663.43	683.33
	Turf/grass	8.20	44.04	361.13
	Constructed pond	4.23	153.41	648.91
		13.46	**125.81**	**1,693.36**

Table values are rounded for readability; calculations use full-precision values.

[3] The values per hectare are a weighted average.

Table 8 presents the economic value of carbon storage provided by the main natural assets in the Northeast Swale and Briarwood Park for the years 2025 and 2050. Economic values were derived by applying the social cost of carbon price associated with each year to the mean storage per hectare for each natural asset type. Total annual values were then calculated based on the area occupied by each ecosystem type in each study area.

The average economic value per hectare of the Northeast Swale in terms of carbon storage is nearly three times higher than that of Briarwood Park. In 2025, the carbon stored in the Northeast Swale represents an economic value of approximately $200,000 per hectare, compared to about $67,000 per hectare for Briarwood Park. The total economic value of the Northeast Swale is estimated at more than $62 million in 2025 and $72 million in 2050. In comparison, the value of Briarwood Park is approximately $905,000 in 2025 and $1,043,000 in 2050. Because these figures reflect the current carbon stocks, they do not consider natural or human-driven fluctuations in carbon storage over time.

Table 8. Economic value of carbon stored by principal natural assets composing the Northeast Swale and Briarwood Park.

Study area	Natural asset type	Total area (ha)	Economic value per hectare in 2025 ($/ha)[4]	Economic value per hectare in 2050 ($/ha)	Total economic value in 2025 ($)	Total economic value in 2050 ($)
Northeast Swale	Tree vegetation	29.74	$354,932.86	$408,670.35	$10,555,703.15	$12,153 856.34
	Native grassland	211.04	$158,450.42	$182,440.10	$33,439,375.58	$38,502,159.55
	Wetland	54.47	$343,800.10	$395,852.07	$18,726,791.17	$21,562 062.36
		295.25	**$212,436.48**	**$244,599.76**	**$62,721,869.91**	**$72,218,078.25**
Briarwood Park	Tree vegetation	1.03	$354,932.86	$408,670.35	$365,580.84	$420,930.47
	Turf/grass	8.20	$23,61.40	$27,128.64	$193,203.48	$222,454.85
	Constructed pond	4.23	$82,072.21	$94,498.10	$347,165.45	$399,726.95
		13.46	**$67,306.82**	**$77,497.20**	**$905,949.77**	**$1,043,112.26**

Table values are rounded for readability; calculations use full-precision values.

[4] The values per hectare are a weighted average.

The type of natural environment greatly influences its capacity to store carbon. For example, the Northeast Swale is primarily composed of natural grasslands, wetlands, and a few mixed shrub groves. These characteristics allow for a greater carbon storage capacity (Figure 3).

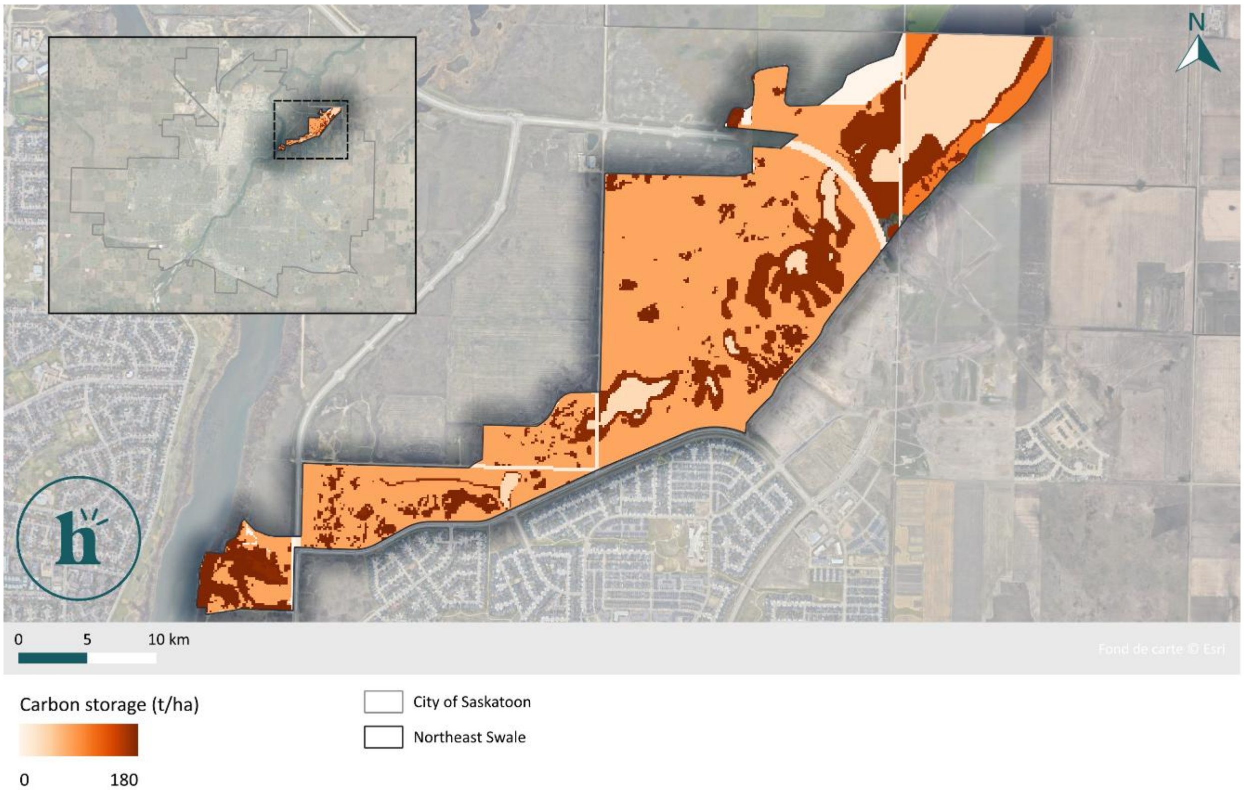

Figure 3. Carbon stored in Northeast Swale in tC/ha.

For example, wetlands store carbon because their water-saturated soils slow the decomposition of organic matter, allowing carbon to accumulate over time. They also support dense plant growth that captures CO_2, which is then retained in the anaerobic soil environment. By maintaining saturated, low-oxygen conditions, riparian plants help slow decomposition and promote long-term carbon storage. They also act as buffers that filter sediments and nutrients, preventing processes that would release stored carbon. Overall, riparian zones significantly strengthen both carbon sequestration rates and the stability of carbon stocks in wetland ecosystems.

Natural grasslands also store carbon effectively due to several ecological and biological mechanisms. First, these ecosystems develop extensive and deep root systems that continuously accumulate organic matter belowground. Because most of the plant biomass is in the roots rather than above the surface, carbon is stored directly in the soil, where it is less vulnerable to disturbances such as fire or grazing.

In comparison, infrastructures like Briarwood Park are not very effective in terms of carbon storage (Figure 4). This is mostly because their vegetation has low biomass, shallow root systems, and undergoes frequent maintenance that removes organic material before it can be incorporated into the soil. The soils in these settings are often compacted or engineered, further reducing their capacity to retain carbon. Artificial ponds contribute minimally due to shallow sediments and management practices that prevent organic accumulation. Overall, their design and maintenance practices inherently limit their ability to store meaningful amounts of carbon. The natural components that store the most carbon are trees, which accumulate increasing amounts of carbon as they grow.

Figure 4. Carbon stored in Briarwood Park in tC/ha

Carbon sequestration results

Table 9 presents the mean annual carbon sequestration rates in tonnes of CO_2 equivalent per hectare per year ($tCO_2e/ha/yr$) for the main natural assets in the Northeast Swale and Briarwood. Total annual sequestration values (tCO_2e/yr) were calculated by multiplying the mean rate by the area occupied by each natural asset type within each study area. Only natural assets for which sufficiently robust sequestration data were included. Assets such as bare soil and open water were excluded due to the lack of reliable or representative sequestration values in the literature.

The key finding is that the Northeast Swale sequester nearly four times more carbon per hectare per year than Briarwood Park. This difference is largely explained by the Swale's natural character and the type of native ecosystem it supports, especially native grasslands.

Table 9. Carbon sequestered by principal natural assets composing the Northeast Swale and Briarwood Park.

Study area	Natural asset type	Total area (ha)	Mean carbon sequestrated per hectare per year ($tCO_2e/ha/yr$)[5]	Total carbon sequestrated per year (tCO_2e/yr)
Northeast Swale	Tree vegetation	29.74	9.17	272.86
	Native grassland	211.04	20.70	4,368.27
	Wetland	54.47	2.42	131.94
		295.25	**16.17**	**4,773.08**
Briarwood Park	Tree vegetation	1.03	9.17	9.45
	Turf/grass	8.20	5.14	42.13
	Constructed pond	4.23	0.31	1.30
		13.46	**3.93**	**52.89**

Table values are rounded for readability; calculations use full-precision values.

Table 10 presents the economic value of annual carbon sequestration provided by the main natural assets in the Northeast Swale and Briarwood Park for the years 2025 and 2050. Economic values were derived by applying the social cost of carbon price associated with each year to the mean

[5] The values per hectare are a weighted average.

sequestration rates for each natural asset type. Total annual values were then calculated based on the area occupied by each ecosystem type in each study area.

The results show a pronounced scale difference between the two sites: the Northeast Swale generates approximately $2.55 million per year in 2025 versus $28.2 thousand at Briarwood Park, and $2.94 million versus $32.0 thousand in 2050. Per hectare, the economic value of carbon sequestration in the Northeast Swale is approximately four times higher than Briarwood Park in 2025. The difference is mostly explainable by its natural characteristics, native grasslands being its most important contributor, with trees and wetlands contributing smaller shares.

Table 10. Economic value of the carbon sequestered by principal natural assets of the Northeast Swale and Briarwood park in 2025 and 2050.

Study area	Natural asset type	Total area (ha)	Economic value per hectare per year in 2025 ($/ha/yr)	Economic value per hectare per year in 2050 ($/ha/yr)	Total economic value per year in 2025 ($/yr)	Total economic value per year in 2050 ($/yr)
Northeast Swale	Tree vegetation	29.74	$4,908.63	$5,651.80	$145,982.51	$168,084.53
	Native grassland	211.04	$11,073.86	$12,75.20	$2,337,162.48	$2,691,013.25
	Wetland	54.47	$1,295.88	$1,492.08	$70,586.42	$81,273.34
		295.25	**$8,648.93**[6]	**$9,958.39**	**$2,553,595.92**	**$2,940,215.12**
Briarwood Park	Tree vegetation	1.03	$4,908.63	$5,651.80	$5,055.88	$5,821.35
	Turf/grass	8.20	$2,748.83	$3,165.01	$22,540.41	$25,953.07
	Constructed pond	4.23	$164.93	$189.90	$697.65	$803.28
		13.46	**$2,102.08**	**$2,420.33**	**$28,293.94**	**$32,577.70**

Table values are rounded for readability; calculations use full-precision values.

[6] The values per hectare are a weighted average.

The following maps illustrate the average carbon sequestration by natural asset type per year, based on the LULC dataset for the Northeast Swale (Figure 5) and Briarwood Park (Figure 6). These values represent an approximation derived from published literature.

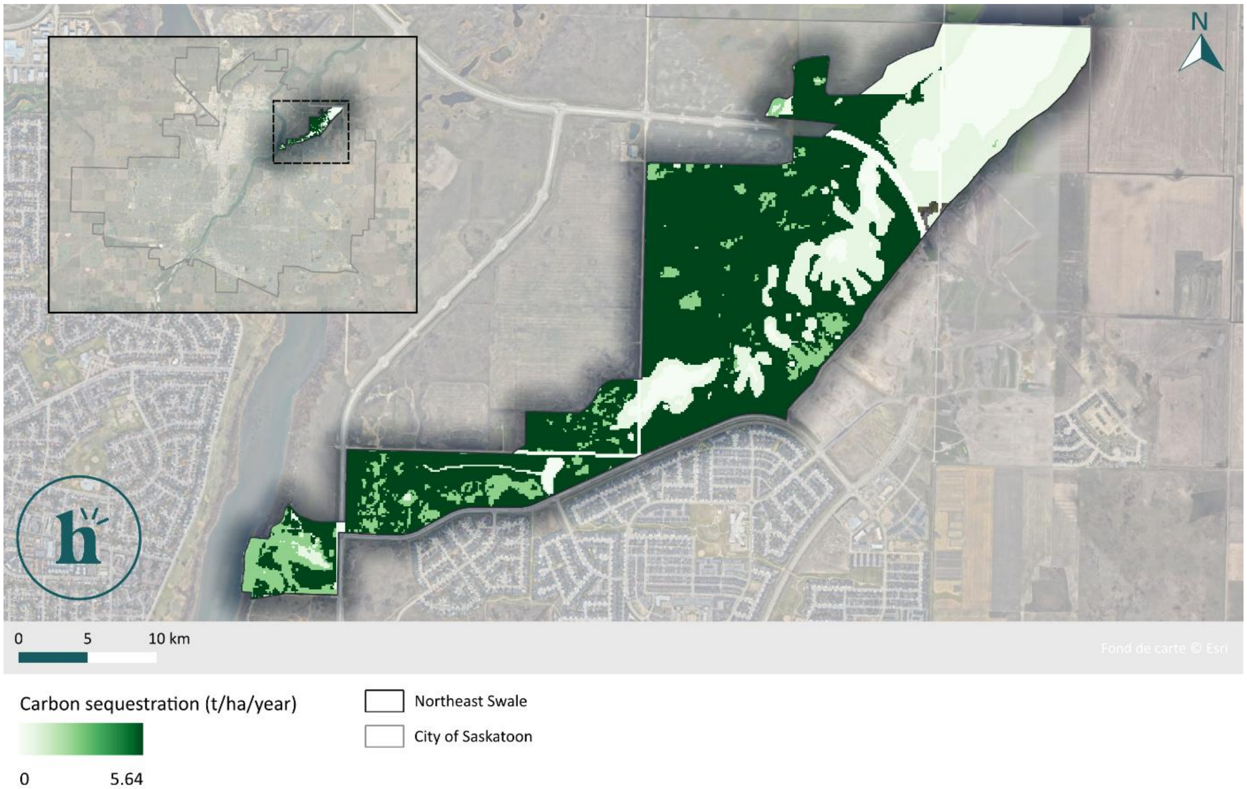

Figure 5. Carbon sequestered in the Northeast Swale (in tC/ha/yr)

Wetlands are massive long-term carbon reservoirs, but the annual sequestration rate is low because peat accumulates slowly and plant growth is limited by climate and nutrient availability.

Natural grasslands sequester large amounts of carbon because their deep, dense root systems capture and transfer carbon into the soil. These ecosystems continuously capture atmospheric carbon dioxide (CO_2) through photosynthesis, converting it quickly into plant biomass. During active growth, grasses allocate a substantial portion of their photosynthesized carbon to roots. Even during aboveground dieback (late summer or fall), roots continue to accumulate and maintain carbon. However, they store relatively little carbon aboveground: grasses have low biomass compared to forests, and frequent natural disturbances (e.g. drought) prevent the long-term accumulation of plant material.

Parks dominated by turf grass are generally poor at sequestering carbon because turf grasses have shallow root systems and low overall biomass, which limits the amount of carbon they can capture and store. In addition, they have low vegetation diversity, and they require frequent mowing and intensive maintenance, practices that reduce plant growth. In this environment, trees remain the primary contributors to carbon sequestration, which can be observed in Figure 6. As they grow, they accumulate increasing amounts of carbon, making them highly effective long-term carbon sinks.

Figure 6. Carbon sequestered in Briarwood Park (in tC/ha/yr)

KEY FINDINGS

- The Northeast Swale stores far more carbon than Briarwood Park due to its native grasslands, wetlands, and tree vegetation, which collectively hold over 100,000 tCO_2e. The Northeast Swale sequesters nearly 4,800 tCO_2e annually.
- Its economic value is significantly higher, with carbon storage worth more than $62 million in 2025 (and projected to reach $72 million in 2050), compared with approximately $1 million for Briarwood Park.
- Built park environments inherently store little carbon because of shallow-rooted turfgrass, compacted or engineered soils, minimal vegetation diversity, and maintenance practices that remove organic material—while natural ecosystems maintain deep root systems and soil conditions conducive to long-term carbon retention.

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2. URBAN HEAT MITIGATION

Description of the ecosystem services

In the context of climate change, rising temperatures and urban heat islands are a major concern for many municipalities, including the City of Saskatoon. Natural areas can play a significant role in reducing temperatures. Urban cooling models are used by urban planners to analyze cooling mechanisms, document effective mitigation strategies, and provide evidence-based policy initiatives.

The Heat Mitigation Index refers to the cooling capacity of different surfaces, depending on land use.

Methodology

Model parameterisation

The Urban Cooling model from the InVEST® suite was applied in this project. The model estimates the cooling capacity of natural infrastructure based on data on climate and land use. The Heat Mitigation Index (HMI) quantifies the relative capacity of an urban landscape's natural elements (green and blue infrastructures) to reduce the Urban Heat Island (UHI) effect. This unitless index, typically ranging from 0 to 1, is a spatially explicit metric derived from key biophysical parameters including surface albedo, shade provided by the canopy cover, evapotranspiration rates, and proximity to large cooling islands such as parks or water bodies. A higher HMI value indicates greater local heat mitigation potential. The index serves to identify heat hotspots and prioritize the strategic deployment of nature-based solutions to enhance resilience.

In this context, the Heat Mitigation Index provides an overall indication of the cooling capacity of the Northeast Swale and Briarwood Park. It enables a comparison of the respective abilities of a natural environment and a constructed park to mitigate heat for both visitors and nearby residents. The analyses were conducted for current (2025) and future values (2050), using available data.

The analyses were conducted using the 90th-percentile value of the average summer daytime temperatures (June, July, August), in a moderate scenario, based on a 30-year average from 1981 to 2010 (Climate Atlas of Canada, 2025). The reference value for 2025 is 19 °C based on the 30-year average. For 2050, the value used is 21.8 °C. Land use data for 2025 and 2050 within and surrounding the two study sites remain unchanged.

Nighttime temperatures have a significant influence on the urban heat island phenomenon. Since heat islands retain heat, nighttime temperatures do not decrease as much as in non-urban areas. Minimum temperatures should not be overlooked, as they play an essential role in supporting informed decision-making regarding heat islands. For this reason, the mean value was used. As 90th percentile refers to temperature extremes, the data should therefore be interpreted as the highest summer averages over the 30-year period, including both nighttime and daytime temperatures.

Model and parametrisation limitations

The model focuses specifically on green spaces and incorporates values for shade, albedo, and evapotranspiration. It is therefore possible that the results are influenced by the model's inherent characteristics. For example, water bodies have low albedo and provide no shade, which may affect how this type of ecosystem is represented—even though they can help mitigate heat-island effects. This represents one of the model's limitations, and the data should be interpreted with caution.

Economic valuation

A review of the scientific and technical literature was conducted to identify potential approaches for economically valuing heat mitigation benefits. However, no robust or transferable monetary values could be applied to the modelling framework used in this study. The Urban Cooling Model can generate an economic valuation based on energy savings in buildings, relying on established relationships between ambient temperature and building energy demand. Since no buildings are located within the Northeast Swale or Briarwood Park study areas, the model's energy-based valuation pathway could not be applied. As a result, heat mitigation benefits are presented solely in biophysical terms, without an associated economic assessment. It is important to note that there is a large body of literature which associates exposure to high temperatures to increased illness, hospitalisation and mortality (Baccini and al., 2008; Basu, 2008; Gasparrini and al., 2015) having an overall economic cost. Events such as heat waves can lead to peaks in heat-related mortality over the space of a few days, for example the European heat wave of 2003 was associated with thousands of excess deaths (Robine and al., 2008). City populations are especially at risk due to the additional higher temperature associated with the urban heat mitigation effect during heat waves, which can exacerbate health impacts from heat.

Urban heat mitigation results

Table 11 presents the heat mitigation index for the main natural assets in the two study sites. As noted above, the closer the value is to 1, the greater the cooling capacity of the natural environment type. For example, trees typically exhibit very high cooling capacity compared to turf.

Table 11. Heat mitigation index (HMI) of principal natural assets of the Northeast Swale and Briarwood Park.

Study area	Natural asset type	Heat mitigation index (HMI)
Northeast Swale	Tree vegetation	0.90
	Native grassland	0.43
	Wetland	0.55
	MEAN	**0.63**
Briarwood Park	Tree vegetation	0.90
	Turf/grass	0.18
	Constructed pond	0.12
	MEAN	**0.40**

Table 12 compares the average summer air temperature between the Northeast Swale and Briarwood Park, for 2025 and 2050.

Table 12. Comparison of the mean summer air temperature (in °C) of the Northeast Swale and Briarwood Park in 2025 and 2050.

Study area	Mean summer air temperature (in °C)	
	2025	2050
Northeast Swale	19.64	23.87
Briarwood Park	19.79	24.36

The differences between the two environments are not substantial due to their characteristics. Since the model focuses on shade, evapotranspiration and albedo, this influences the model's interpretation.

Natural grasslands provide moderate heat-mitigation benefits primarily through evapotranspiration, which cools the air but declines during dry periods. Their limited shading offers only minor protection from direct solar radiation and prevents them from matching the cooling potential of tree-dominated ecosystems. Their relatively high albedo helps reflect sunlight, though this effect varies with moisture and seasonal vegetation changes.

Built parks with maintained lawns, few trees, and artificial ponds like Briarwood Park provide limited heat-mitigation benefits according to the model. Turfgrass offers only modest evapotranspiration, with cooling dependent on irrigation. Their minimal tree cover results in very little shade and limited protection from direct solar radiation. Albedo effects are moderate, as lawns reflect some sunlight, but their cooling contribution varies with mowing, vegetation color, and moisture levels. Overall, these parks provide some cooling benefits, but their design and management practices limit their ability to mitigate heat compared with more vegetated or structurally diverse natural environments.

However, each of these environments do procure a heat mitigating effect that should not be overlooked.

The following map presents the heat mitigation index for the main natural assets of the Northeast Swale (Figure 7) and Briarwood Park (Figure 8) based on the LULC dataset. The index values range from 0 to 1 and provide insight into the areas' cooling capacity. Darker colors indicate lower cooling capacity and higher temperatures.

The heat mitigation potential is greater in the Northeast Swale than in Briarwood Park, mainly due to the natural environments that compose it. However, in both cases, trees are the element that provides the greatest relief according to the modelling used.

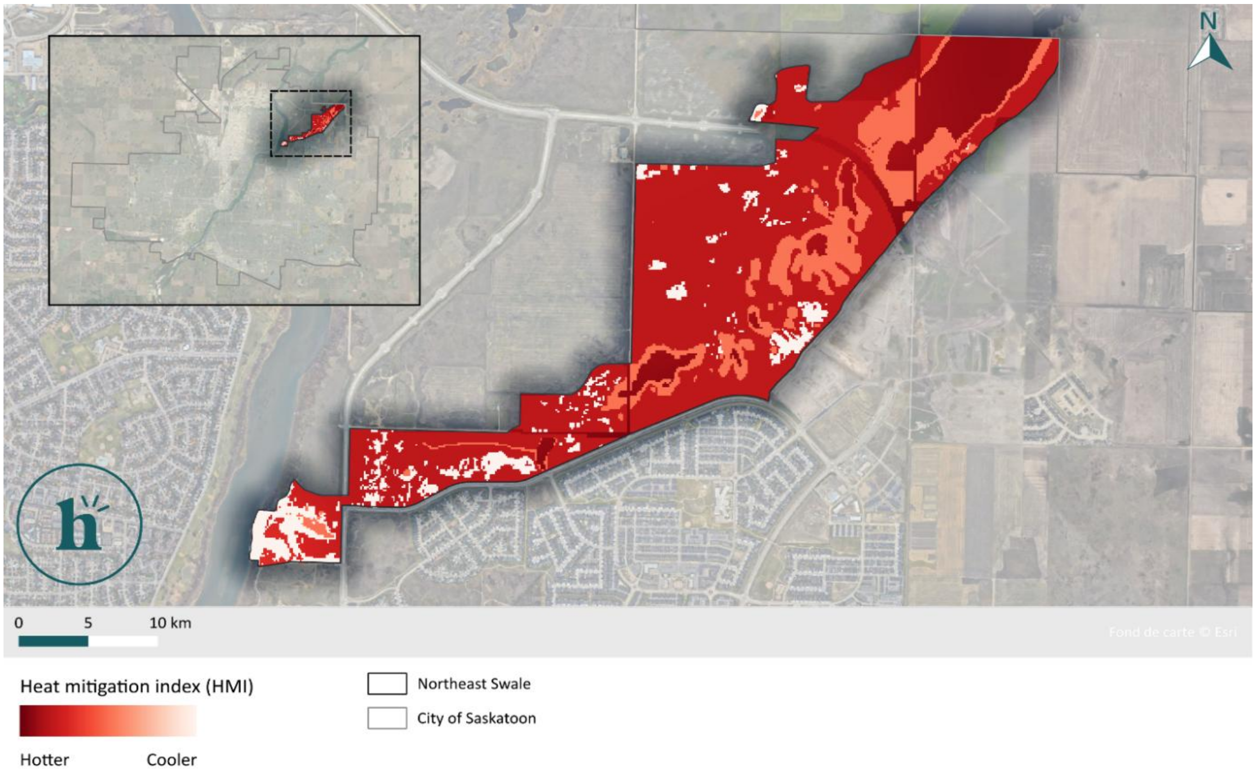

Figure 7. Heat mitigation index in the Northeast Swale.

Figure 8. Heat mitigation index in Briarwood Park.

The maps below illustrate the spatial variation in average summer temperature across the different zones of the Northeast Swale (Figure 9) and Briarwood Park (Figure 10) as well as the potential change between 2025 and 2050.

Overall, the land composition and surrounding environment of the study sites have a significant influence on heat perception and mitigation. In the southwest corner of the Northeast Swale, the area is dominated by tree vegetation, which helps reduce air temperatures. Moreover, proximity to the South Saskatchewan River contributes to cooling in this area. The northern portion of the swale, which is mostly undeveloped, results in cooler temperatures, in contrast to the southern portion, where land is urbanized or under development and air temperatures are highest. In the future, temperature patterns are expected to remain consistent, as land use land cover data used are unchanged from 2025 in our analysis.

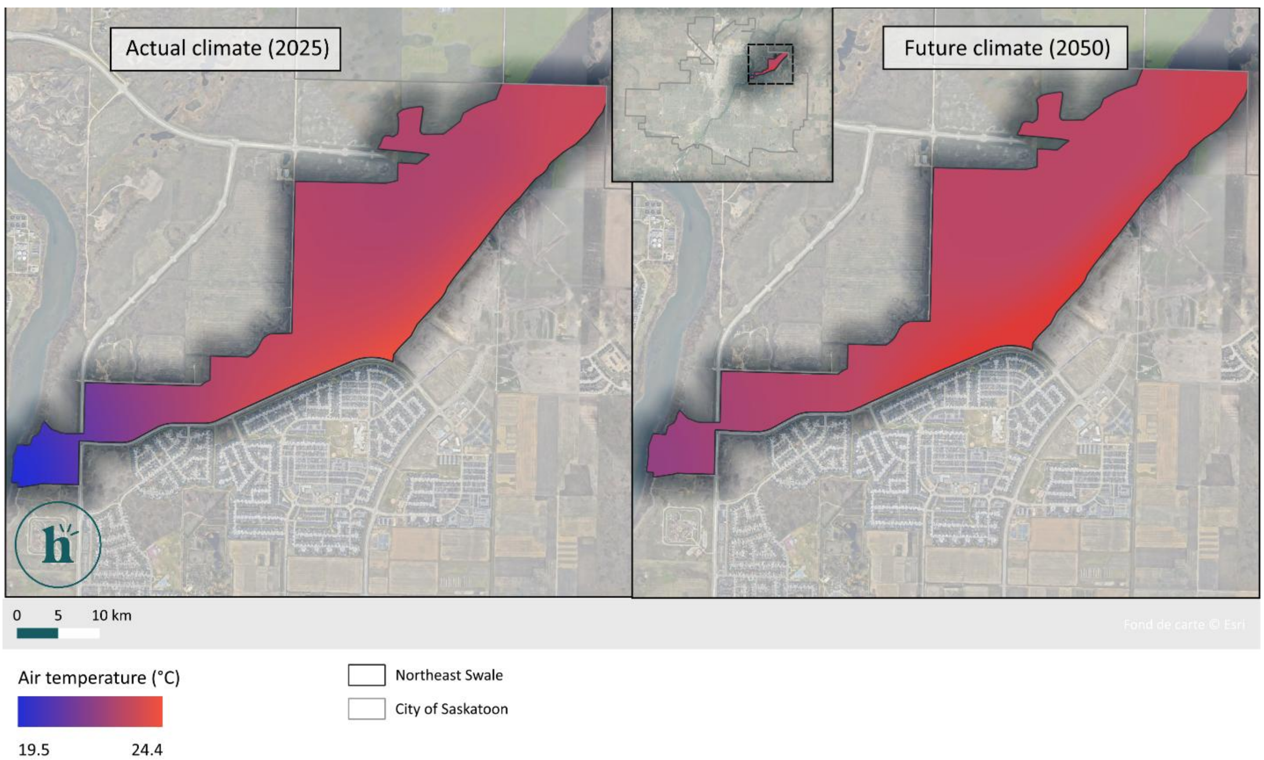

Figure 9. Mean summer air temperature variation between 2025 and 2050 in the Northeast Swale.

The significant presence of urbanized areas near Briarwood Park, along with its composition, results in limited heat mitigation, particularly over the long term (Figure 10). However, the benefit for residents living nearby is nonetheless substantial.

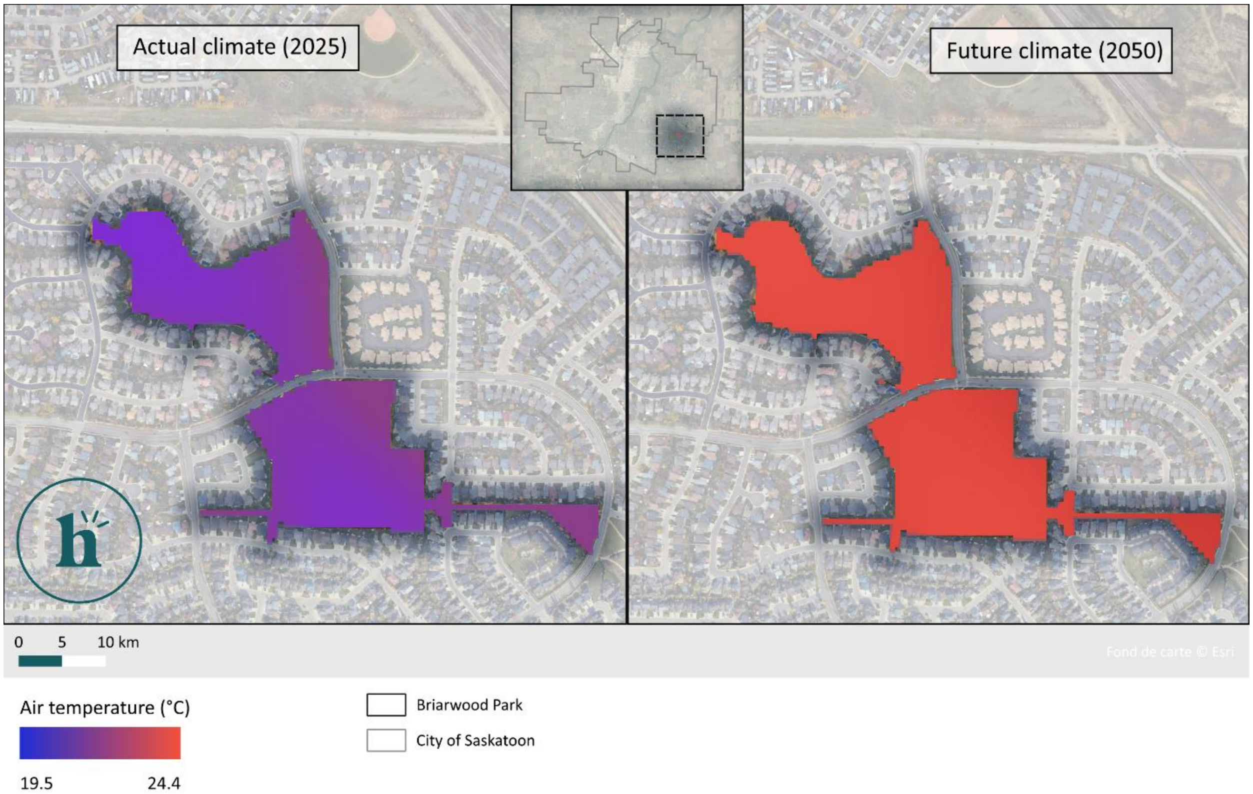

Figure 10. Mean summer air temperature variation between 2025 and 2050 in Briarwood Park.

KEY FINDINGS

- The Northeast Swale demonstrates stronger heat-mitigation capacity than Briarwood Park due to its natural grasslands, wetlands, and tree vegetation. Trees in both study areas provide the highest cooling effect (HMI 0.90), while turfgrass and constructed ponds offer minimal mitigation.
- Both sites show similar mean summer temperatures in 2025 and 2050, with slightly cooler conditions in the Northeast Swale. Differences remain modest because the model emphasizes shade, evapotranspiration, and albedo—factors that vary more across vegetation types than between the two sites overall.
- Natural ecosystems mitigate heat through evapotranspiration, shading, and reflective surfaces, while built parks remain limited by shallow-rooted vegetation, low tree cover, and managed lawns. A study limitation is that future developments around the Swale were not included, which may influence future temperature projections.

3. ACCESS TO URBAN NATURE

Description of the ecosystem services

The presence of accessible public open spaces in urban areas plays a significant role in improving the health of residents (Lee & Maheswaran, 2011). Walking in urban parks and woodlands reduces stress and depression (Bratman and al., 2019; Jiang and al., 2014). Accessibility to parks also helps promoting physical exercise and thus contributes to greater mental and physical health (Morris, 2003).

Access to urban nature refers to the degree to which city residents can benefit from a satisfying access to natural spaces within urban environments.

Methodology

Model parameterisation

The Urban Nature Access model (version 3.16.2) (Natural Capital Project, 2025) was used to estimate the supply/demand balance for public open spaces in urban areas, following the methodology described in Liu & al. (2022). The model estimates the number of residents with a good/poor access to public open spaces in the city based on travel-distance and the space requirement per inhabitant. The results do not illustrate the number of people going to Briarwood Park or the Northeast Swale, but rather the number of people with satisfactory access to urban nature. The model incorporates the following factors:

- The location of public open spaces, i.e. the Northeast Swale and Briarwood Park.
- Demand in square meters for accessible public open spaces in the city of Saskatoon. This has been determined according to the City's recommendation[7], which suggests 40 m^2 of accessible public open spaces per inhabitant.
- The distance inhabitants are willing to walk to access the park. We used an 800 meters radius, based on Wilson & Xiao (2023), which is also the source used to economically value this ecosystem service. Note that for the Northeast Swale, inhabitants living west of the South Saskatchewan River were not taken in account.
- The population density within 800 meters radius to the Northeast Swale and Briarwood Park. Current population density was collected from 2021 census at the dissemination area level (Statistics Canada, 2021). Dissemination areas represent the smallest geographic region for which all census data are disseminated by Statistics Canada. For 2050 population projection, we used the City's expertise (Jessie Best, Michael Kowalchuk, email exchange, Nov. 26, 25). In the case of the Northeast Swale area, the number of people living within an 800 meters radius will

[7] "A ratio of four hectares of public open space to every 1,000 persons will be considered adequate. Public open spaces may include Municipal Reserves and other publicly owned areas dedicated to public enjoyment and recreation." (City of Saskatoon, Official Community Plan).

increase by 203%, due to the development of neighbourhoods that do not exist today. In the case of Briarwood Park, population in 2050 will remain stable since the area is fully built up.

Model and parametrisation limitations

The Urban Nature Access model has several parameters to choose from.

First, the model was configured without considering socio-demographic characteristics that could affect the results. The model was used with a maximum travel distance of 800 meters for the entire population. However, travel distances may vary depending on age group and physical condition. For example, elderly people, pregnant women and young children will not always travel 800 metres to reach a park.

Second, the model does not consider physical barriers (e.g. railway tracks, highways, etc.). The distance of 800 meters is a straight-line distance, meaning that a resident whose home is located 800 meters from a park can be considered to have good access to nature, even if a physical barrier requires to travel more than 800 meters to reach that park. To account for this limitation, the Northeast Swale inhabitants living west of the South Saskatchewan River were not taken in account.

Third, it is important to emphasize that the present analysis focuses only on the specific park modeled in each study area and does not account for the presence of other parks or natural spaces that residents may also access. As a result, the values for "satisfactory access to urban nature" are likely underestimated, while "unsatisfactory access" are likely overestimated in both study areas.

Finally, the model was configured considering an equal level of naturalness for Briarwood Park and the Northeast Swale, which doesn't truly reflect reality, Briarwood Park being a constructed park whereas the Northeast Swale is a conserved natural asset.

Economic valuation

Economic valuation was calculated based on Wilson & Xiao (2023) methodology. The authors developed an economic valuation framework to quantify and estimate the potential annual avoided cost of health benefit (i.e. mental and physical health improvements) related to parks presence in the city of Peterborough (Ontario, Canada).

As a reminder, "avoided cost" refers to money that will not be spent within the healthcare system due to factors such as increased physical activity or the positive effects of nature on mental health.

According to Wilson & Xiao (2023) study, the economic burden of mental illness in Canada was $1,950 per person in 2019[8] and residents living close to a park get a 2% improvement in mental health condition.

To estimate mental improvements, we then used the formula below:

Annual avoided cost on mental health

=

Number of people with satisfactory access to a park (Briarwood Park or the Northeast Swale)

*

Mental health improvement attributed to presence of a park (2%)

*

Annual avoided economic burden of mental illness ($2,359.70 in 2025)

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[8] For the present study, value was adjusted for inflation. $1,950 CAD in 2019 is $2,359.70 CAD in 2025.

In the case of physical improvement, according to Wilson & Xiao (2023) study, the avoidance of direct health care costs of physical inactivity in Canada was $323.69 per person in 2019[9]. Furthermore, 16.4% of residents living in an 800 meters range of a park engage weekly in 150 minutes or more of moderate to vigorous physical activity, which is the Canadian average rate as reported in the 2017 Canadian Health Measures Survey (Statistics Canada n.d.).

To estimate physical improvements, we used the formula below:

Annual avoided cost on physical health
=
Number of people with satisfactory access to a park (Briarwood Park or the Northeast Swale)
*
Change in the number of physically active people with satisfactory access to a park (16.4%)
*
Avoided annual health care costs of physical inactivity per individual ($391.70 CAD in 2025).

Access to urban nature results

Table 13 summarizes the number of people living in an 800 meters radius from the study area having an un/satisfactory access to urban nature.

Table 13. Numbers of persons living in an 800 meters radius from the study area having an un/satisfying access to urban nature.

Study area	Number of persons living in an 800 meters radius from the park		Number of persons with satisfactory access to urban nature		Number of persons with unsatisfactory access to urban nature	
	2025	2050	2025	2050	2025	2050
Northeast Swale	7,700	15,774	6,422	11,783	1,278	3,991
Briarwood Park	4,505	4,505	972	972	3,533	3,533

[9] For the present study, value was adjusted for inflation. $323.69 CAD in 2019 is $391.70 CAD in 2025.

Table 14 estimates the annual avoided costs on physical and mental health due to satisfactory access to urban nature.

Table 14. Annual avoided costs on physical and mental health due to sufficient access to urban nature.

Study area	Number of people with satisfactory access to urban nature		Annual avoided cost related to physical health		Annual avoided cost related to mental health		Total economic value	
	2025	2050	2025	2050	2025	2050	2025	2050
Northeast Swale	6,422	11,783	412,541.57	756,925.78	303,079.87	556,086.90	715,621.44	1,313,012.68
Briarwood Park	972	972	62,440.11	62,440.11	45,872.57	45,872.57	108,312.68	108,312.68

KEY FINDINGS

- The Northeast Swale contributes more substantially to avoided health costs and accessible urban nature primarily because of the larger surrounding population and wider extent of satisfactory access, while Briarwood Park maintains stable but lower values across both years.
- Annual avoided costs related to physical and mental health are higher for the Northeast Swale due to the greater number of residents with satisfactory access. Briarwood Park generates comparatively lower avoided costs, reflecting its smaller service population.

COST-BENEFITS ANALYSIS

This section evaluates the balance between the benefits generated by ecosystem services and the maintenance costs for Northeast Swale and Briarwood Park. The analysis covers three ecosystem services: carbon sequestration, urban heat mitigation and access to urban nature. These benefits represent quantifiable environmental and health-related gains directly linked to the ecological assets found in each study area. Carbon storage has been excluded from the analysis because it represents a stock rather than an annual flow.

1. Maintenance costs for the Northeast Swale and Briarwood Park

Annual maintenance costs were compiled by City of Saskatoon and Meewasin staff (Jessie Best, email exchange, Nov. 18, 25) for all relevant asset types in the Northeast Swale and Briarwood Park. These include activities such as vegetation management (i.e. tree pruning and removal, irrigation, weed control, mowing) and maintenance (i.e. sediment and debris removal, inlet/outlet pipe maintenance). The following sections summarize the annual maintenance costs for each site, establishing the economic foundation upon which the cost–benefit comparison was completed.

Northeast Swale maintenance costs

Maintenance costs in the Northeast Swale are primarily concentrated within the Recreational Zone (46.74 ha), located in the southwest portion of the area, where the network of trails requires frequent upkeep. These maintenance activities are overseen by Meewasin, which is responsible for maintaining safe and accessible recreational infrastructures. Certain natural assets, including wetland areas, also receive regular attention, particularly vegetation management on the islands within the wetlands. However, this estimate does not include expenditures related to ecological monitoring, management planning or reporting activities. Annual maintenance costs are presented in Table 15.

Table 15. Annual maintenance costs for the recreational zone in the Northeast Swale.

Asset type	Maintenance activity	Total annual costs ($)
Forest	Vegetation maintenance (tree pruning and removal)	150.00
Grassland	Broadcast seeding	Unknown
	Prescribed burning	10,000.00
	Conservation grazing	11,300.00
	Integrated weed management	12,187.50
	Mowing	4,000.00
Wetland	Operation, technical, and maintenance support	5,000.00
	Inlet / outlet pipe maintenance	200.00
	TOTAL	**42,837.50**

Current funding and program capacity are a significant limit to the maintenance of the site (e.g. concerning the invasive species mitigation strategies).

The Northeast Swale includes a variety of natural asset types, including forests, grasslands and wetlands. Each asset requires different maintenance activities to sustain ecological function and public accessibility. The annual maintenance cost for the Northeast Swale is $42,837.50.

- Forest assets incur relatively low recurring costs ($150) related to tree pruning and removal.
- Grassland management represents the largest share of expenses, driven by labour intensive and technique-intensive activities such as prescribed burning ($10,000), conservation grazing ($11,300), integrated weed management ($12,187.50) and periodic mowing ($4,000).
- Wetland assets add a modest cost burden through operational support ($5,000) and inlet/outlet pipe maintenance ($200).

Overall, the Northeast Swale demonstrates a moderate maintenance profile but its due to funding limitation. Many of these activities, such as prescribed burning and conservation grazing, support long-term ecosystem resilience and biodiversity conservation.

Briarwood Park maintenance costs

In contrast, Briarwood Park is characterized by highly managed urban green spaces requiring intensive and frequent maintenance, resulting in significantly higher annual costs of $180,223, more than four times the Northeast Swale total. Annual maintenance costs are presented in Table 16.

Table 16. Annual maintenance costs for Briarwood Park.Annual maintenance costs for Briarwood Park.

Asset type	Maintenance activity	Total annual costs ($)
Individual trees	Tree inspections, maintenance, pruning, removals, and replanting.	3,070.00
Shrub beds	Shrub bed maintenance	16,216.20
Turf/grass - Irrigated	Turf maintenance	74,205.00
	Irrigation maintenance	7,507.80
	Irrigation connection servicing	2,400.00
	Irrigation utilities	76,824.00
Constructed pond		Unknown
Riparian	Herbicide/weed control	Unknown
	TOTAL	**180,223.00**

- Individual tree maintenance, including inspections, pruning, removals, and replanting represents a modest share ($3,070).
- Shrub bed maintenance contributes $16,216.20, reflecting the upkeep of designed ornamental landscapes.
- Maintaining turf and irrigated grass areas is the greatest expense. Turf maintenance alone accounts for $74,205, while irrigation-related expenses (maintenance, servicing, and utilities) add another $86,731.80.
- Additional natural assets, including the constructed pond and riparian areas, have unknown costs, suggesting that total maintenance costs are even higher than reported.

Briarwood Park maintenance cost structure reflects a landscape dominated by water-intensive, labour-intensive, and highly engineered assets, which require ongoing inputs to maintain appearance, function, and user safety. This management-intensive profile drives substantially higher recurrent costs relative to the Northeast Swale.

2. Economic ecosystem benefits related to the Northeast Swale and Briarwood Park

Northeast Swale annual economic ecosystem benefits

In the Northeast Swale study area, the annual ecosystem service benefits outweigh maintenance costs in both 2025 and 2050 (Table 17). Total annual benefits increase from 3.23 million in 2025 to 4.21 million in 2050, while maintenance costs remain constant at $42,837.50 per year. This produces a strong positive value, primarily driven by carbon sequestration and a rising share of health-related benefits as the number of residents with satisfactory access to urban nature increases through time.

Table 17. Total annual economic ecosystem benefits and maintenance cost for the Northeast Swale.

Northeast Swale total annual benefits and costs ($/yr)	2025	2050
Annual carbon sequestration	2,553,595.92	2,940,215.12
Annual avoided cost related to physical health	412,541.57	756,925.78
Annual avoided cost related to mental health	303,079.87	556,086.90
Total annual benefits	3,269,209.18	4,253,218.38
Annual maintenance costs[10]	42,837.50	42,837.50
Net benefits	**3,226,379.86**	**4,210,390.30**

[10] This value only reflects maintenance cost in the recreational zone (46.74 ha), whereas the Northeast Swale area is 366.68 ha

When normalized by area to account for the Northeast Swale large footprint (366.68 ha), the site still demonstrates a consistently positive economic performance (Table 18). The net cost–benefit value per hectare rises from $9,684/ha/year in 2025 to $12,622/ha/year in 2050, showing that the Northeast Swale not only continues to provide high ecological value but becomes increasingly beneficial over time as demand for access to nature and social cost of carbon grow.

Table 18. Per hectare annual economic ecosystem benefits and maintenance cost for the Northeast Swale.

Northeast Swale benefits and costs ($/ha/yr)	2025	2050
Annual carbon sequestration	8,648.93	9,958.39
Annual avoided cost related to physical health	1,125.07	2,064.27
Annual avoided cost related to mental health	826.55	1,516.55
Total annual benefits	10,600.52	13,539.17
Annual maintenance costs[11]	916.51	916.51
Net benefits	**9,684.05**	**12,622.70**

Northeast Swale natural assets contribute significantly to carbon capture and mental and physical health benefits, while maintaining relatively low annual costs. These results reinforce that maintaining natural ecosystem, without much intervention, yields durable returns for the City of Saskatoon.

Briarwood Park annual economic ecosystem benefits

In Briarwood Park, annual ecosystem service benefits amount to $136,603 per year in 2025, rising slightly to $140,887 in 2050 as social cost of carbon increases. However, total annual ecosystem service benefits do not offset maintenance costs (Table 19). Annual maintenance expenditures are high ($180,223 per year), while benefits only reach $136,603 per year in 2025 and $140,887 in 2050, resulting in negative net values (−$43,616 per year in 2025 and −$39,332 per year in 2050). The inclusion of additional ecosystem services, such as stormwater management, which was not considered in this analysis, could improve the overall cost–benefit balance and potentially offset maintenance costs.

[11] This value only reflects maintenance cost in the recreational zone (46.74 ha), whereas the Northeast Swale area is 366.68 ha

Table 19. Total annual economic ecosystem benefits and maintenance cost for Briarwood Park.

Briarwood Park total annual benefits and costs ($/yr)	2025	2050
Annual carbon sequestration	28,293.94	32,577.70
Annual avoided cost related to physical health	62,440.11	62,440.11
Annual avoided cost related to mental health	45,872.57	45,872.57
Total annual benefits	136,603.87	140,887.21
Annual maintenance costs	180,223.00	180,223.00
Net benefits	**-43,616.38**	**-39,332.62**

When expressed per hectare to reflect Briarwood Park's smaller size (13.95 ha), the results are more nuanced (Table 20). Benefits per hectare reach levels comparable to the Northeast Swale, between 9,866 and $10,184/ha/yr in total benefits, depending on the year. However, maintenance costs per hectare are high, $12,919/ha/yr, more than 14 times higher than in the Northeast Swale. This leads to a negative return per hectare, −$3,052/ha/yr in 2025 and −$2,734/ha/yr in 2050. These findings highlight that Briarwood Park does provide meaningful ecosystem services, but these benefits are overshadowed by a costly maintenance model focused on water- and labour-intensive landscaping.

Table 20. Per hectare annual economic ecosystem benefits and maintenance cost for Briarwood Park.

Briarwood Park benefits and costs ($/ha/yr)	2025	2050
Annual carbon sequestration	2,102.08	2,420.33
Annual avoided cost related to physical health	4,475.99	4,475.99
Annual avoided cost related to mental health	3,288.36	3,288.36
Total annual benefits	9,866.22	10,184.45
Annual maintenance costs	12,919.21	12,919.21
Net benefits	-3,052.79	-2,734.53

KEY FINDINGS

- Northeast Swale delivers strong positive net benefits, with ecosystem services (carbon sequestration and health-related benefits) far exceeding its low annual maintenance costs ($42,800/year), both in 2025 and 2050.
- Briarwood Park incurs high maintenance expenditures ($180,200/year) driven by water- and labour-intensive landscaping, resulting in negative net benefits despite providing meaningful ecosystem services.
- Per-hectare benefits are comparable between both sites, but Briarwood Park's maintenance costs per hectare are over 14 times higher, leading to persistent negative returns.
- Natural, low-intervention ecosystems in the Northeast Swale show durable economic performance, becoming increasingly beneficial over time as population density and the social cost of carbon rise.

CONCLUSION

This final report was developed to support a comparative cost–benefit analysis (CBA) between two study areas: the Northeast Swale, representing a largely pristine natural asset, and Briarwood Park, a constructed urban park. The primary objective was not only to quantify ecosystem service benefits and maintenance costs, but also to establish a robust and transferable methodological framework capable of comparing sites with fundamentally different origins, sizes, and ecological characteristics.

The analytical approach followed a structured, three-step methodology consisting of site characterization, biophysical modelling of ecosystem services, and economic valuation. Particular attention was given to ensuring methodological consistency between the two study areas, as this was essential to enable a meaningful comparison within a cost–benefit framework. The use of standardized land-use/land-cover (LULC) data and harmonized natural asset classifications allowed ecosystem services to be assessed using comparable assumptions despite major differences in site history and spatial extent.

Biophysical modelling constituted a central component of the analysis. Carbon storage and sequestration were estimated using literature-derived average values associated with specific natural asset types. Urban heat mitigation and access to urban nature were modelled using InVEST tools, which rely primarily on LULC data and spatial relationships rather than site-specific field measurements.

Economic valuation translated selected biophysical outputs into monetary terms using established valuation approaches. The analysis focused on annual, flow-based ecosystem services to ensure consistency within the cost–benefit framework. As such, carbon storage, which represents a stock rather than an annual benefit, was intentionally excluded from annual benefit–cost comparisons, although its total economic value was quantified separately to reflect long-term climate mitigation potential. Similarly, urban heat mitigation was not monetized due to methodological constraints, as the energy-saving valuation pathway embedded in the Urban Cooling Model requires the presence of buildings within the study areas. These choices reflect a conservative and transparent valuation strategy that avoids overstating benefits.

By normalizing costs and benefits on a per-hectare basis, the methodology enables comparison between the Northeast Swale and Briarwood Park despite their substantial difference in size and degree of anthropogenic intervention. This normalization is a key methodological contribution of the report, as it allows planners and decision-makers to evaluate the relative performance of pristine versus designed green spaces within a common analytical framework.

Overall, this report demonstrates how a cost–benefit analysis can be applied to contrasted urban natural assets using a consistent methodology. While data limitations and modelling assumptions remain, the approach provides a solid technical foundation for integrating ecosystem services into urban planning, investment prioritization, and long-term climate and resilience strategies. Future applications could further refine the analysis by incorporating dynamic vegetation data, additional ecosystem services, and improved economic valuation methods as data availability and modelling tools evolve.

RECOMMENDATIONS

- Preserve the natural environments of the Northeast Swale and reduce human disturbances both within and around the area. Limiting human access outside designated recreational zones could help prevent carbon loss, particularly by avoiding disturbance of the upper soil layers. Minimizing soil disruption should be a priority.
    - It is not recommended to expand the recreational area over a larger portion of the Northeast Swale, as this could negatively affect the carbon stocks currently present on the site.
- Reducing park maintenance costs by naturalizing a portion of parks such as Briarwood Park or planting lower-maintenance species (e.g., clover) would generate significant savings and therefore increase the financial benefits of maintaining green spaces in the city.
- Enhance the heat-mitigation ecosystem service by reducing the intensity of maintenance practices in urban parks (Francoeur and al., 2022). This includes allowing vegetation to grow slightly higher— even letting lawns grow a few centimeters can make a difference in temperature regulation and reduce evaporation.
    - Plant native, heat- and drought-resistant species in urban parks instead of turfgrass. Native species often have higher evapotranspiration rates and can improve heat mitigation (Francoeur and al., 2022).
- Increase the number of green and blue infrastructures, which can improve both heat mitigation and stormwater management. These features should be integrated into city planning and new residential developments.
    - Continue afforestation efforts while ensuring functional diversity in urban parks and on municipally owned lands in Saskatoon. In parks such as Briarwood, increase tree density and diversify species composition. However, this should not be done at the cost of native habitats such as the natural grasslands of the Northeast Swale.
- Continue efforts to collect detailed ecological characterization data for Saskatoon's natural areas, and, when possible, make these data publicly accessible to support community engagement and raise awareness of the importance of natural environments.
- Conducting follow-up studies focused on different services, such as stormwater management, would provide a more comprehensive understanding of the various ecosystem services offered by natural areas.
- Limiting urban development near natural environments like the Northeast Swale could help reduce disturbances to these ecosystems, which may otherwise increase due to higher visitor pressure in recreational zones.
- Integrating green spaces into the planning of new neighbourhoods would enhance residents' access to nature and improve overall well-being.

LESSONS LEARNED

- It is complex to compare two completely different environments such as Briarwood and the Northeast Swale. In future studies, selecting sites that are more similar in configuration would allow for much stronger comparisons.
- The lack of available data hindered several analyses, both on the City of Saskatoon's side and within the existing literature. Systematically consolidating information within the City of Saskatoon would improve efficiency in the years ahead.
- Holding a workshop with the various stakeholders proved highly valuable, as it provided additional relevant information and helped clarify areas of uncertainty. This methodology should be repeated for similar projects, as the participatory approach greatly enhances the overall process.

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