DAVID SUZUKI FOUNDATION
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Implementation of Nature-Based Solutions in Canada

State of Play Report

MARCH 2023 | CONTACT Clarissa Samson: csamson@davidsuzuki.org

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SUMMARY

Introduction

Nature-based solutions are "actions to protect, conserve, restore, sustainably use and manage natural or modified ecosystems to address social, economic and environmental challenges effectively and adaptively, simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits (UNEA 2022)." Type 1 NbS projects aim to protect natural ecosystems from unsustainable practices and degradation, enhancing the potential to derive benefits from the ecosystem services that flow from nature. Type 2 projects seek to improve how we manage working landscapes and waterscapes to foster the sustainability and multifunctionality of managed ecosystems. Type 3 projects refer to those that either restore previously degraded ecosystems or create new ones.

Interest in NbS is increasing in Canada, as is the drive to ensure that NbS implementation maximizes economic, social and environmental benefits and reduces risks of being labelled "false solutions" to the climate and biodiversity crises. In June 2022, the David Suzuki Foundation engaged Environmental and Social Systems Analysts Technologies Ltd. to develop a baseline inventory of NbS projects implemented in Canada, with a focus on municipal action, and analyze the set of projects to understand:

- What types of NbS are being used?
- What ecosystem services are NbS projects addressing?
- How inclusive are decision-making processes surrounding NbS implementation?
- How effective are NbS projects?
- What factors enable and hinder NbS implementation and effectiveness?

A companion report contains four case studies and elaborates on enablers of effective NbS implementation and barriers to it.

Methods

The study involved three main steps, making all decisions on methods collaboratively with the DSF.

1. Literature reviews to define a typology for NbS projects;
2. Web-based searches to identify, screen and characterize NbS projects and
3. A qualitative assessment of NbS implementation success using the International

Union for Conservation of Nature Global Standard for nature-based solutions (IUCN 2020) and based on publicly available information on NbS projects. The report takes stock of NbS implementation across Canada through analysis of an illustrative sample of 38 NbS projects implemented between 1992 and 2022.

Characteristics of the NbS Inventory

The inventory contains NbS projects for three streams: 26 municipal projects in the largest cities, five Indigenous-led projects and seven projects that were regional in scale or exhibited unique attributes. Municipal projects are smaller in area than Indigenous-led projects, which is unsurprising given the different interests of these groups: satisfying demand for local services versus sustaining landscape-scale outcomes such as the supply of species.

Types of NbS Projects

Given the focus on municipalities, just over half of NbS projects in the inventory are Type 3 projects (restore or create ecosystems), reflecting the preponderance of restoration and naturalization efforts at this scale. Type 1 (protect) and Type 3 projects are represented throughout the inventory period (1992-2022), whereas the few Type 2 (manage) projects (six in total) in the set are from 2014 onward. Table 0 1 summarizes shared and differentiated attributes across projects in the inventory.

Table 0-1: Common features of NbS projects in the inventory.

TYPE 1 (PROTECT): MORE LIKELY TO RECEIVE FINANCIAL SUPPORT FROM ENGOS		
Approaches	**# of projects**	**Commonalities**
Parks, protected areas and urban greenways	9	Commonly part of land-use planning strategies and commitments
Natural infrastructure for water solutions	3	Tend to be targets for investment and engagement by environmental non-governmental organizations
TYPE 2 (MANAGE): MORE LIKELY TO BE INDIGENOUS-LED AND/OR INVOLVE INTERSECTORAL OR INTERGOVERNMENTAL COLLABORATION		
Approaches	**# of projects**	**Commonalities**
Diverse implementation actions (e.g., land-use planning, improved grassland and forest management)	6	Shared decision-making enables their implementation
TYPE 3 (RESTORE/CREATE): MORE LIKELY TO RELY ON COST-SHARED FUNDING ACROSS LEVELS OF GOVERNMENT; MOST CAPITAL INTENSIVE		
Approaches	**# of projects**	**Commonalities**
Low-impact development or redevelopment	9	Costliest NbS projects of the inventory
Natural infrastructure for water solutions	7	Tend to address municipal stormwater management and wastewater treatment; commonly link to municipal plans or strategies
Wetland and watershed restoration	4	Driven by environmental objectives; tend to respond to federal or provincial priorities

Ecosystem Services Potentially Generated through NbS Projects

Inventoried projects have the potential to contribute to the generation of a range of supporting, regulating, provisioning and cultural services, with the most frequently recorded ecosystem services being habitat provision and carbon sequestration and storage, and the least frequently recorded ecosystem services being soil formation and retention, and raw materials for energy.

Municipal NbS projects are most associated with carbon sequestration and storage, flood mitigation, stormwater management, moderation of extreme events and enjoyment of nature and outdoor education. The apparent focus on regulating services and some cultural services links to municipalities' authorities, accountabilities and budgets (e.g., stormwater management, parks and recreation), with carbon sequestration and storage likely regarded as a co-benefit. Indigenous-led NbS projects are associated with a more even distribution of service categories compared to the municipal case and a greater emphasis on cultural and provisioning services.

Inclusiveness in Decision-Making Process for NbS implementation

Public and community engagement in NbS project planning is currently the biggest opportunity to enhance inclusiveness of NbS decision-making processes. Public and community engagement is a condition for success in about one in five of projects in the inventory. Engagement at the outset, such as that undertaken by municipalities, leads to early identification of resistance and informs strategies to address it. Community members can also provide local governments with feedback on NbS projects as they are implemented, but this approach was only documented for one project. The existence and use of public and community engagement mechanisms in local governance are necessary but insufficient to support inclusive decision-making for NbS implementation. Consideration of intersectional impacts, risks and opportunities for diverse social groups is essential to support equitable outcomes and is only starting to permeate local government action.

Inclusive governance is part of IUCN's Global Standard for NbS and is essential for Canada's context as NbS at scale is unachievable without upholding Indigenous rights and respecting Indigenous governance and knowledge systems. Only six of 38 projects met all the indicators associated with inclusive governance; these projects were either Indigenous-led or implemented in British Columbia. Though not all projects may trigger provisions for the free, prior and informed consent of Indigenous Peoples or require a feedback and grievance resolution mechanism for their implementation, it's evident that future NbS projects can improve their inclusivity to enhance transparency, empowerment and long-term implementation success.

Effectiveness of NbS Projects

Canadian NbS projects are moderately effective, based on the application of the IUCN Global Standard assessment framework to the project inventory using

qualitative methods. Further corroboration using monitoring data to measure changes in environmental, social and economic outcomes attributable to the NbS intervention is an important task. The findings here are preliminary.

In general, projects are strongest in meeting criteria on societal challenges, matching the scale to the problem and generating biodiversity benefits. Projects are weakest in meeting criteria on adaptive management, local capacity development and economic feasibility.

Projects scoring 20 points or above (out of 29) tend to involve conserving a large regional area or are ambitious, high-profile projects occurring within Canada's largest municipalities. These projects commonly have large budgets, involve multiple stakeholders and rights holders, are designed to generate multiple co-benefits and are associated with an integrative plan or strategy for management and protection of nature, climate resilience and or sustainable development (either through municipal, provincial or federal plans). In other words, funding, participatory planning and NbS mainstreaming within broader plans and strategies are factors that enhanced these projects' performance against the IUCN Global Standard.

Projects scoring under 12 points (out of 29) tend to involve opportunistic initiatives to conserve or protect areas within a municipality, spurred by a stakeholder other than the municipality or the result of a one-time funding opportunity. Other commonalities are that these projects tend to be small in geographic scope, are less likely to employ ongoing monitoring and are less likely to engage beyond consulting the direct stakeholders involved.

Evidence in this study suggests that Indigenous-led projects may be more effective at meeting the IUCN Global Standard than other project streams. Indigenous-led projects are, on average, younger than municipal and regional/other projects and, therefore, may have benefitted from more and better sources of guidance. Indigenous-led projects tend to be more holistic (e.g., environmental and socio-cultural drivers), integrative (e.g., greater range of ecosystem services associated with them) and inclusive in their planning and implementation compared to other project streams.

Factors Enabling and Hindering NbS Implementation and Effectiveness

Common barriers and enablers to NbS implementation in Canada include political (e.g., policy integration), cultural (e.g., social acceptance), financial and practical (e.g., access to physical space) factors (Table 0 2). Identifying these factors paves the way for concerted efforts to remove barriers and support enabling conditions. Building on interview research, the companion case study report expands on the factors revealed through analysis of the inventory of 38 NbS projects.

Table 0-2: Summary of barriers and enablers to NbS implementation described in the 38 projects in the inventory.

BARRIERS	ENABLERS
Political and cultural: lack of political will, resistance to change, uncertainty about legal protections for Type 1 projects.	**Political and cultural:** effective collaboration (across disciplines, inter-sectoral, coalition-building), public and community engagement during planning and/or implementation, integration of NbS into broader strategies/plans/policies.
Financial: reliance on external funding, insufficient funding to cover all phases, procurement delays.	**Financial:** cost-sharing (crowdsourcing, subsidies).
Practical: access to physical space in urban environments, uncertainty in financial and performance outcomes compared to conventional alternatives.	**Practical:** knowledge management and learning by doing.

Future Directions on Gaps and Recommendations

The report ends by identifying knowledge gaps, including uncertainties in the evidence-based impact of NbS projects and on the limits of NbS, and adverse and unintended consequences of NbS implementation. As well, the section draws attention to knowledge gaps on the long-term performance of NbS in a changing climate, and on the importance of developing spatially explicit tools to optimize the identification of potential project locales that work together to meet ecological and socio-economic goals.

Consistent with the DSF's strategic goal of supporting integration of nature in decision-making via municipal leadership, the analysis in this report mainly relies on our review of municipal NbS projects. Nevertheless, opportunities for DSF and partners to contribute to scaling Type 1, Type 2 and Type 3 NbS involves broadening this focus. Eight recommendations are provided for DSF's consideration.

1 INTRODUCTION

Nature-based solutions are "actions to protect, conserve, restore, sustainably use, and manage natural or modified ecosystems to address social, economic, and environmental challenges effectively and adaptively, simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits (UNEA 2022)." Examples of NbS applications include urban forests, riparian planting, living shorelines and salt marsh restoration (CCME 2021). Although the term itself dates to 2002, NbS have gained popularity in the past five years as an integrated approach to address the twin global crises of climate change and biodiversity loss[1], in tandem with local concerns such as air quality and renewal of municipal infrastructure services (Griscom et al. 2017; Chausson et al. 2020; Somarakis et al. 2019). In Canada, discourse on NbS in academic and policy circles has focused on using NbS to meet three core challenges:

- **Resilience of municipal infrastructure services:** With growing interest among local governments in using NbS to meet current and emerging infrastructure challenges, one track of discourse has focused on natural and naturalized ecosystems to meet targeted infrastructure outcomes (e.g., managing flood and drought risk) under current and future climates, and provide co-benefits (CCME 2021). Since one of local government's primary functions is planning and regulating land use, municipalities provide ideal test beds to pilot with and scale land-based NbS. The Municipal Natural Assets Initiative (MNAI), the Natural Infrastructure for Water Solutions (NIWS) and the federal Natural Infrastructure Fund are examples of interventions supporting this NbS track, which increasingly expands engagement beyond municipalities to local and regional institutions, including watershed organizations and Indigenous communities.
- **Action on climate change:** A second track focuses on the potential for NbS to meet climate change challenges, drawing particular attention to their carbon sequestration and storage contributions to meeting the climate mitigation goal of stabilizing global average temperature rise (Griscom et al. 2017, Drever et al. 2021). The Government of Canada's Natural Climate Solutions programs illustrate the focus of this track. Indicators to measure program performance centre on land areas covered and on greenhouse gas (GHG) emissions reductions[2]. NbS in support of adaptation and disaster risk reduction are also gaining momentum in Canada (Molnar et al. 2021), although targeted funding programs to achieve these outcomes outside of the federal Disaster Mitigation and Adaptation Fund are largely lacking.
- **Indigenous environmental governance and reconciliation:** A third track pursues alignment between Indigenous-led conservation and nature-based

climate action as a way to strengthen Indigenous environmental governance (Townsend et al. 2020). Indigenous Nations hold unextinguished rights and title to the lands currently governed as Canada. As such, this track acknowledges the important role of Indigenous people in exerting climate leadership, stewardship and maintenance of ecosystem services (Molnar et al. 2021); it addresses three agendas: climate change, biodiversity and Indigenous reconciliation, with the Indigenous Conservation Initiative and the Conservation through Reconciliation Partnership as prominent national platforms exploring the risks and opportunities of Indigenous-led NbS. Enhanced opportunities to fund Indigenous-led conservation include using the proceeds of carbon offsets from NbS projects to support the establishment and maintenance of Indigenous protected and conserved areas, as well as community-based monitoring programs.

The upshot is that nature-based solutions hold promise in addressing multiple challenges cost-effectively (Molnar et al. 2021), but they remain underutilized (CCME 2021). Gaps in awareness of NbS, collaboration, finance, enabling policy and inclusiveness, as well as uncertainties in NbS performance, are among the barriers to adoption raised globally and in Canada (Sarabi et al. 2020, Townsend et al. 2020, Dorst et al. 2022). Efforts are underway to reduce barriers to NbS uptake and implementation. For example, the U.S. government recently issued a road map for accelerating the deployment of NbS in that country, with strategies focused on policy, finance, government leading by example, workforce readiness and research (White House Council on Environmental Quality 2022). In Canada, the National Adaptation Strategy includes a similar objective for NbS as its U.S. counterpart but lacks the detail on pathways to achieve it (see Government of Canada 2022).

At the same time, the push for NbS is not without risks. Re-labelling business-as-usual infrastructure and development planning as NbS to perpetuate the status quo has the potential to taint NbS as "false solutions," limit new projects and deter building on existing ones (Melanidis and Hagerman 2022, CCME 2021). Additionally, the potential exists for use of nature-based climate solutions in Canadian climate policy to pose barriers to Indigenous self-determination (Reed et al. 2022). A minimum standard for development of NbS is that they are developed with the full prior and informed consent of Indigenous Peoples, as outlined in the UN Declaration on the Rights of Indigenous Peoples. Taking this further, a key guiding principle for effective NbS is that interventions empower Indigenous Peoples through ownership and co-governance of projects (Seddon et al. 2021).

To maximize the economic, social and environmental benefits from NbS and reduce implementation risks, identifying projects that qualify as effective NbS is important. In June 2022, the David Suzuki Foundation engaged ESSA Technologies Ltd. to develop a baseline inventory of NbS projects implemented in Canada, with a specific focus on municipal[3] action, given this order of government's unique role in land-use decisions and delivery of infrastructure services essential to the daily lives of people living in Canada. This report summarizes the results of our analysis of the project inventory. The report takes stock of NbS implementation across

Canada through analysis of an illustrative sample of NbS projects implemented between 1992 and 2022. With a focus on NbS implementation by local institutions, this report specifically addresses these five questions.

1. What types of NbS are being used?
2. What ecosystem services are NbS projects addressing?
3. How effective are NbS projects?
4. How inclusive are decision-making processes surrounding NbS implementation?
5. What factors enable and hinder NbS implementation and effectiveness?

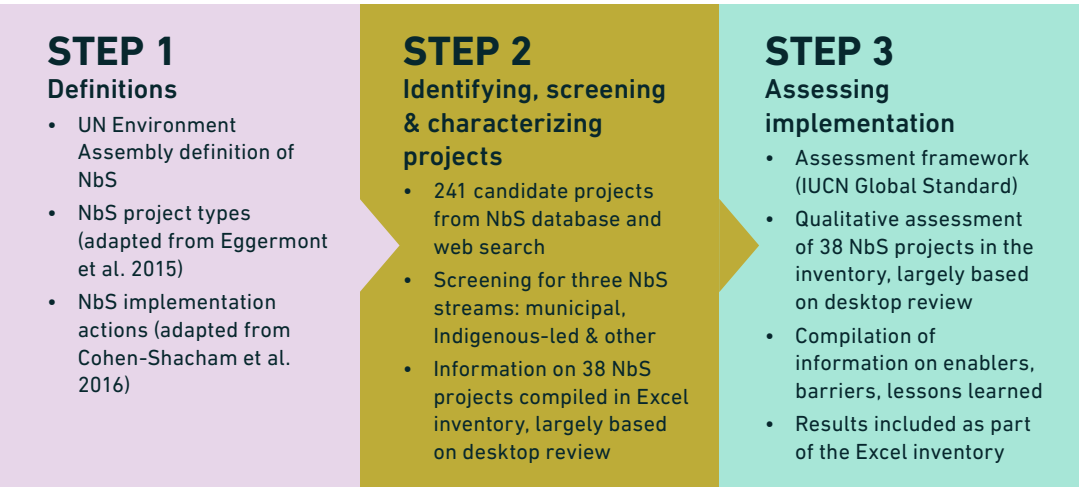
Ultimately, this report provides insights on strategies to support integration of effective NbS as part of community and regional operations and planning. A companion report to this one contains four detailed case studies illustrating attributes of effective and successful NbS projects.

The report structure is as follows. It starts by outlining our methods in Section 2, including limitations of our analysis. Next is a section describing the inventory of NbS projects (Section 3), followed by key findings on the status of NbS implementation, as gleaned from our inventory of NbS projects (Section 4). Finally, Section 5 provides conclusions on the state of play of nature-based solutions in Canada and discusses future directions with the potential to accelerate NbS implementation throughout the country.

2 METHODS

The methods used to describe the state of play of NbS implementation in Canada included three main steps (Figure 2 1): 1) literature reviews to define a typology for NbS projects; 2) web-based searches to identify, screen and characterize NbS projects and 3) the assessment of NbS implementation success using the IUCN Global Standard for Nature-Based Solutions (IUCN 2020) and based on publicly available information on NbS projects. We made all decisions on methods in collaboration with DSF. Box 2 2 outlines the main limitations of our methods.

Figure 2 1: Summary of the methods used to describe the state of play of NbS implementation in Canada.



2.1 DEFINING A TYPOLOGY FOR NBS PROJECTS

Box 2 1: Definition of nature-based solutions (NbS) used in this report (Source: UNEA 2022)

"Actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits."

"Nature-based solutions" is an umbrella concept that can refer to a range of intervention approaches, such as ecosystem-based adaptation and natural or green infrastructure. NbS is a concept that encompasses diverse actions aimed at addressing societal challenges by working with nature (Veerkamp et al. 2021). Underpinning this concept is also the understanding that functioning ecosystems

supply services to people and so NbS, in addition to addressing societal challenges, must benefit biodiversity and support the delivery of ecosystem services (EC n.d.). Because of the diverse forms and functions of NbS, agreeing on a definition and an organizing typology for NbS projects was an important first step in our process.

This report uses the definition of NbS provided by the United Nations Environmental Assembly in 2022 (Box 2 1). ESSA and DSF chose this definition from among others because it is the most inclusive, recent and multilaterally agreed-upon definition of NbS.

Several typologies seeking to organize thinking about NbS exist (Eggermont et al. 2015; Cohen-Shacham et al. 2016; EC 2015; Gomez Martin et al. 2020; Castellar et al. 2021; FEMA 2021; Anderson and Gough 2022). These typologies tend to focus on characteristics like 1) scale of implementation, 2) the degree of engineering, technology and management required, 3) the ability to deliver focal ecosystem services and co-benefits and 4) the number and kind of societal challenges addressed. Typologies or categories of NbS also tend to combine descriptive elements, such as ecosystem protection through area-based management, and aspirational elements, such as ecosystem-based adaptation to climate change. In this report we adopt a two-tier typology to classify each NbS project according to:

- **Desired ecosystem outcomes of the NbS project:** based on Eggermont et al. (2015) and Nature4Climate (2022), this classification scheme divides projects into Type 1, Type 2 and Type 3 projects. Type 1 projects refer to those that protect natural ecosystems from unsustainable practices and degradation, enhancing the potential to derive benefits from the ecosystem services that flow from nature. Type 2 projects refer to those that seek to improve how we manage working landscapes and waterscapes, to foster the sustainability and multifunctionality of managed ecosystems. Type 3 projects refer to those that either restore previously degraded ecosystems or create new ones.
- **Implementation actions of the NbS project:** based on Cohen-Shacham et al. (2016), this classification scheme tags NbS projects according to the actions they implemented. Table 2-1 shows the categories we used to tag projects and examples of implementation actions per category.

Table 2-1: Types of NbS implementation actions

IMPLEMENTATION CATEGORY	EXAMPLES OF IMPLEMENTATION ACTIONS
Ecosystem restoration	**Ecological restoration:** the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed (Society for Ecological Restoration 2004).
	Ecological engineering: the design of sustainable ecosystems that integrate human society with its natural environment for the benefit of both (Mitsch 2012).
	Landscape restoration: the process of regaining ecological functionality and enhancing human well-being across deforested or degraded landscapes (Maginnis et al. 2014).
Issue-specific approaches	**Ecosystem-based adaptation:** the sustainable use of biodiversity and ecosystem services into an overall adaptation strategy to help people adapt to the effects of climate change, generate social, economic and cultural co-benefits, and contribute to biodiversity conservation (CBD 2009).
	Ecosystem-based mitigation: the conservation, sustainable use and restoration of ecosystems and biodiversity to reduce greenhouse gas emissions or enhance carbon sinks (CBD 2010).
	Ecosystem-based disaster risk reduction: the conservation, sustainable use and restoration of ecosystems and biodiversity to provide services that reduce disaster risk by mitigating (rapid onset) climate and non-climate hazards and by increasing livelihood resilience (PEDRR 2010).
IMPLEMENTATION CATEGORY	EXAMPLES OF IMPLEMENTATION ACTIONS
Infrastructure-related approaches	**Natural infrastructure:** the use of preserved, restored or enhanced elements or combinations of vegetation and associated biology, land, water and naturally occurring ecological processes to meet targeted infrastructure outcomes (CCME 2018).
	Green infrastructure: the use of natural vegetative systems, engineered and built features and green technologies that collectively provide society with a multitude of economic, environmental and social outcomes (GIO 2020, Stanley et al. 2019).
Ecosystem-based management	Integrated, science-based approach to the management of natural resources that considers all major activities and their cumulative impacts affecting ecosystem goods and services that are provided by natural ecosystems (Burt et al. 2017). This category includes integrated coastal zone management, integrated water resource management, and integrated land management.
Ecosystem-based protection	**Area-based conservation:** management of an area of conservation that maintains watershed functionality, while preserving species and their habitats for present and future generations by reducing stressors from human activity (Anderson and Gough 2022).
	Protected area management: management of a clearly defined geographical space, recognized through legal or other means, to achieve the long-term conservation of nature with associated ecosystem services (Dudley 2008).

Several implementation actions may be required to achieve a single type of NbS project (i.e., Type 1, 2 or 3). However, we can expect some implementation categories to be more prevalent in certain project types than others. For example, the implementation of infrastructure-related approaches is more likely in Type 3 "create" NbS projects. As well, implementation of ecosystem-based protection is a clear way to achieve the outcomes of a Type 1 "protect" NbS project.

2.2 IDENTIFYING, SCREENING AND CHARACTERIZING NBS PROJECTS

A baseline inventory of NbS projects implemented in Canada, with a specific focus on municipal action, was a key output of the work feeding into this report. Therefore, identifying projects to include in this inventory was a core step in our approach. Our target was to identify NbS projects for three streams: 26 municipal projects implemented in the largest cities within each province and territory

(Municipal NbS), five Indigenous-led projects (Indigenous-led NbS) and seven additional projects that were regional in scale or exhibited unique attributes (e.g., first local application of a specific implementation action) (Regional/Other NbS). We proceeded to identify and screen NbS projects for inclusion in the baseline inventory in three steps:

- We searched through NbS databases, municipal websites, funding initiatives and summary reports to identify Canadian NbS case studies or references to Canadian NbS projects. Appendix 7.1 contains the list of sources we consulted. Considerations in identifying candidate projects were 1) fit with our definition of NbS, 2) implementation status (i.e., projects needed to have at least "broken ground") and 3) designation as municipal, Indigenous-led or other. We considered projects implemented within the past 31 years (i.e., 1992-2022). As a result of this search, we identified 241 candidate projects. This includes 102 municipal projects, 101 NGO or volunteer projects, 18 Indigenous projects, 13 projects that are private sector–led or led by a combination of private sector and other stakeholders (e.g., provincial, and federal government, NGOs), four federally led projects and three provincially led projects. Regionally, Ontario contained the highest number of NbS projects identified (n=53), followed by New Brunswick (n=41) and British Columbia (n=31).
- We screened the 241 candidate projects based on general considerations and those specific to streams. General considerations were: 1) likely availability of public information on the project; 2) diversity of NbS types and implementation actions; 3) confirmed implementation status and, by implication, the potential for tangible outcomes; and 4) the potential for a project to be a high-quality intervention. Table 2 2 summarizes specific considerations per project stream and the locations of the selected projects. Significant interaction between ESSA and DSF took place to finalize the list of projects to include in the baseline inventory.

Table 2 2: Screening considerations applicable to our three target streams of NbS projects

STREAM	SCREENING CONSIDERATIONS	LOCATIONS OF PROJECTS SELECTED FOR THE INVENTORY
Municipal NbS	• The aim was to showcase NbS projects and/or initiatives implemented within and (ideally) led by Canadian municipalities. • The target was to select two interventions in cities/regions (e.g., Greater Toronto Area) per province and territory, for a total of 26 NbS projects.	**26 projects/initiatives** Vancouver (2) & Surrey (British Columbia); Whitehorse (Yukon); Calgary (2) & Edmonton (Alberta); Saskatoon & Regina (Saskatchewan); Winnipeg & Brandon (Manitoba); Nunavut communities (Nunavut); Greater Toronto Area (2) & Ottawa (Ontario); Montreal (2) & Quebec City (Quebec); Fredericton & Moncton (New Brunswick); Charlottetown (2) (Prince Edward Island); Halifax (2) (Nova Scotia); St. John's, Halifax (2) (Newfoundland and Labrador)
Indigenous-led NbS	• The aim was to showcase NbS projects and/or initiatives implemented by Indigenous communities, nations or organizations, either alone or as partnerships, with Indigenous leadership and self-determination exemplified. • The target was to select five diverse projects or initiatives across different regions in Canada.	**Five projects/initiatives** The Great Bear Rainforest (British Columbia); Peel Watershed (Yukon); Dehcho First Nations (Northwest Territories); Ka'a'gee Tu First Nation (Northwest Territories); Seal River Watershed (Manitoba)
Regional/Other NbS	• The aim was to showcase outcomes from NbS projects that go beyond municipal boundaries. • The target was to select five diverse projects or initiatives across different regions in Canada that exhibit sound NbS principles and demonstrate inspirational qualities. • At least three of the five projects needed to be regional and represent collaborative ventures. • This stream helped fill in some gaps from municipal NbS, such as the inclusion of coastal and watershed-scale projects.	**Seven projects/initiatives** Southern Clayoquot Sound (British Columbia); Grand Forks (British Columbia); Southern Foothills of the Rocky Mountain (Alberta); Buffalo Pond Lake (Saskatchewan); Utopia (Ontario); Forillon National Park, Gaspé (Quebec); and Riverside-Albert (New Brunswick).

- We then compiled information on the following rubrics for each of the 38 NbS projects in an Excel workbook (available under separate cover). We logged this information based on a desktop review of project documentation and references. In only two instances did we contact project leads for an interview to complete the characterization of their NbS project.
    - Descriptive information: province/territory; city/location; year initiated; project lead; project description; funding initiative (if applicable); funding source; budget (capital cost); cost-sharing/collaboration (if applicable); key stakeholders involved; whether the project was part of an integrative plan or strategy for management and protection of nature, climate resilience or sustainable development; area covered; land ownership; status (active or finished); and data source(s).
    - NbS typology: NbS project type and implementation actions.NbS applications: tagging each project for its use of one or more of up to 17 site-level applications: bioswales/

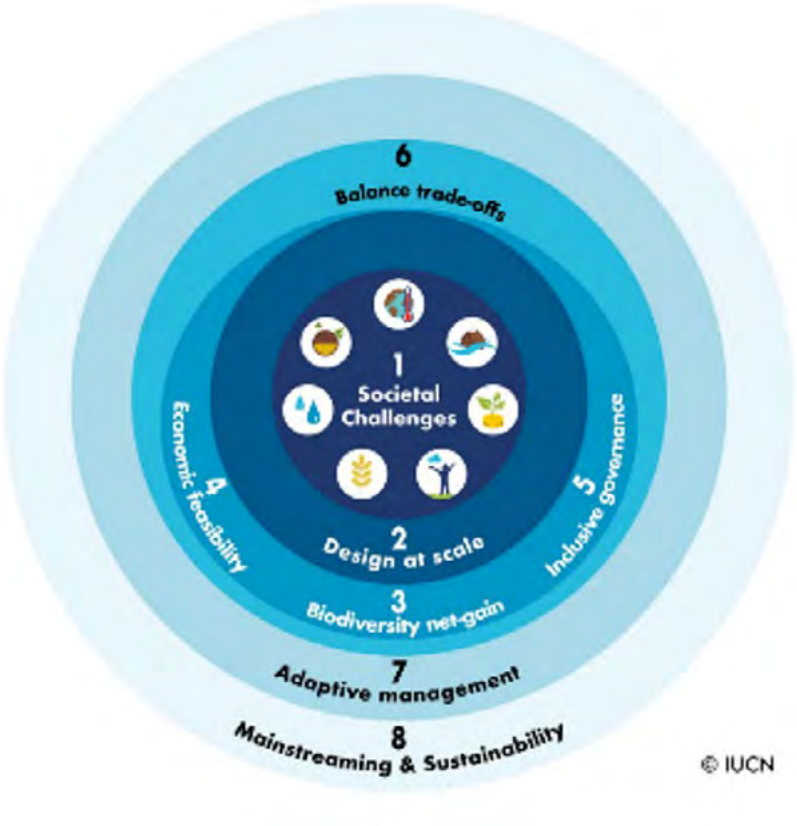
bioretention, stormwater infrastructure, coastal resilience/flood mitigation, riparian buffers, coastal wetlands, engineered wetlands, inland wetlands, forests and vegetation systems, grasslands, green roofs, green walls, growing roofs, rain gardens, community gardens, vertical gardens/greening systems, street trees and tree-based intercropping systems.

- Ecosystem services generated: tagging the number and type of ecosystem services the project generated or could have generated, from a list of five provisioning services, 15 regulation and maintenance services, five supporting services and 10 cultural ecosystem services. This included tagging ecosystem services explicitly noted in project documentation as well as ecosystem services we inferred could be improved based on the intervention type.
- Ecosystem disservices generated: tagging the number and type of intended or unintended ecosystem disservices (i.e., unwanted, adverse impacts) that can arise during project implementation (Schaubroeck 2018) from a list of seven disservices (e.g., restrictions to livelihoods).
- Local challenges addressed: tagging the number and type of challenges NbS projects addressed, from a list of 16. Challenges relate to changes in physical conditions (drought, longer dry season, wildfire, wind, mudslides/landslides, glacial retreat and decreased snow cover, storm surge); water and coastal conditions (increased stormwater runoff, reduced water availability, reduced water quality, freshwater flooding, coastal saltwater intrusion, coastal inundation and coastal erosion; soil conditions (soil erosion, reduced soil quality, desertification and waterlogging of soil), ecological conditions (biomass cover loss, change in phenology, increased incidence/changing distribution of disease, spread of invasives and biodiversity loss), and socio-economic conditions (urban heat island exposure, loss of food production, Indigenous food insecurity and loss of timber production).

2.3 ASSESSING NBS PROJECT IMPLEMENTATION

Aside from characterizing NbS projects in the inventory, our goal with this report was to assess the effectiveness of NbS projects, the inclusiveness of NbS development and implementation, and enablers and barriers to effectiveness. Over 20 frameworks exist to support the design and assessment of NbS interventions (see Appendix 1 in the James Hutton Institute n.d.). We selected the IUCN Global Standard for Nature-Based Solutions (IUCN 2020) as it is comprehensive, backed by an internationally reputable body, with potential widespread use, thereby facilitating future comparisons across jurisdictions. The IUCN Global Standard is a self-assessment tool consisting of eight criteria and 28 associated indicators (Figure 2 2). A gap in the IUCN Standards regarding the goals of this report was in the consideration of local capacity to support NbS operations and maintenance, which is critically important to future NbS implementation in Canada. Therefore, we added one criterion (and related indicator) focused on local capacity to the assessment framework, which we sourced from the Green Communities Canada living cities framework (Tozer et al. 2022).

Figure 2-2: Framework used to evaluate the 38 projects in the NbS inventory. The framework is the IUCN Global Standard for Nature-Based Solutions (IUCN 2020), with eight criteria and 28 indicators. Because of the focus of this report on local action, the final framework included an indicator on local capacity.



Criterion 1. NbS must respond to goals and challenges faced by society (3 indicators)

Criterion 2: NbS design matches (ecological and social) scale of the issue (3 indicators)

Criterion 3: NbS generates net biodiversity and ecosystem gains (4 indicators)

Criterion 4: NbS is cost-effective and economically viable (4 indicators)

Criterion 5: NbS governance is inclusive, transparent and empowering (5 indicators)

Criterion 6: NbS balances and manages trade-offs (3 indicators)

Criterion 7: NbS implementation provides for adaptive management (3 indicators)

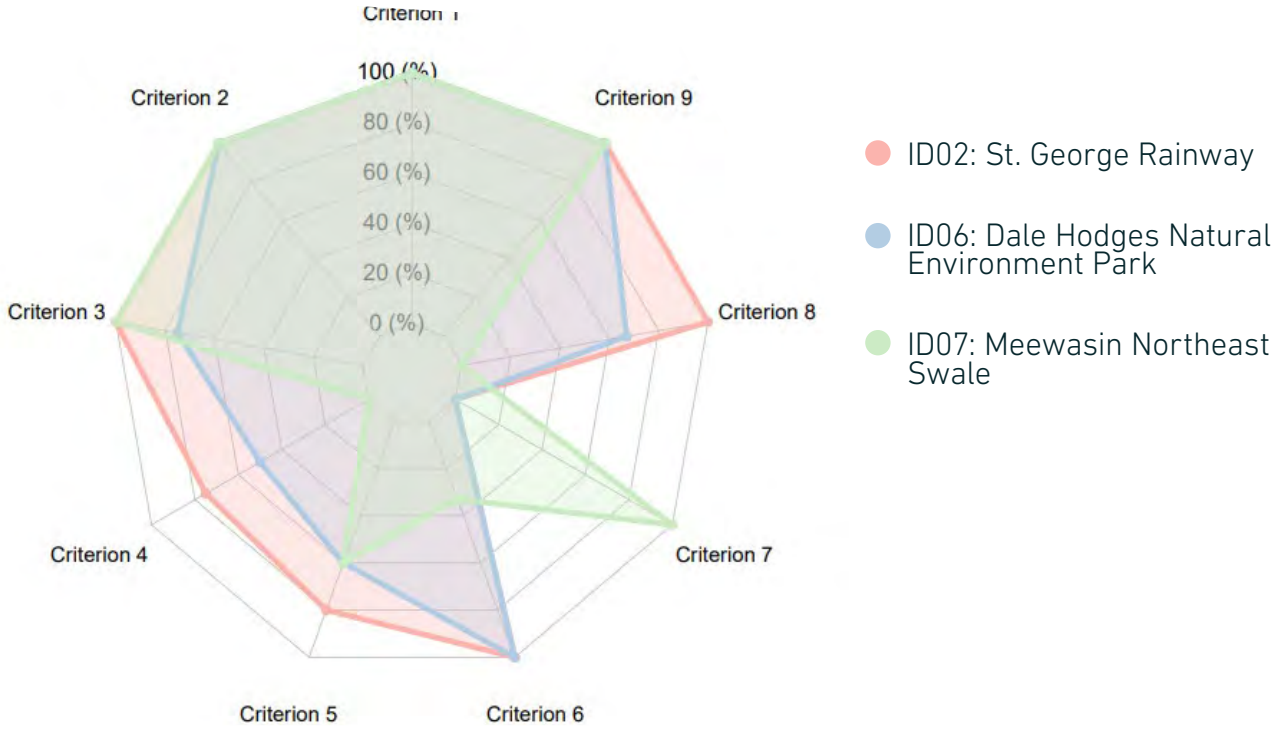
Criterion 8: NbS is mainstreamed and aligned (3 indicators)

Plus 1 indicator added by ESSA focused on whether NbS supports building knowledge and technical capacity locally. We refer to this is **"Criterion 9"** on capacity.

We relied on publicly available information to qualitatively assess each NbS project in the inventory against the criteria and indicators in our assessment framework. For each project, we assigned one point per indicator for which information was available to conclude that the attribute was present in that project. We assigned a score of zero where information was not available to inform the indicator, or we found information claiming that the indicator was not fulfilled at all. Each project could garner a total score out of 29 points. We did not attempt to assess how well each project performed against each indicator, as primary research would have been required to do this. We did not attach weights to assessment criteria, but this is something DSF or other readers may wish to do to enhance alignment with their values. With the structure adopted, we can roll up scores across criteria or per

criterion (as in Figure 2 3) or simply show scores per indicator, thus providing several ways to compare across NbS projects in the inventory.

Figure 2-3: Example of scoring structure for three NbS projects in the inventory. A score of one or zero was given for each of the indicators across the nine criteria. The number of indicators varied for each criterion, ranging from one to five. This radar diagram shows that all three projects assessed best meet criteria 1 (societal challenges), 2 (scale) and 9 (capacity), with significant differences among projects for the rest of the criteria.



Finally, in reviewing project documentation to support the qualitative scoring process, we also kept track of information on enablers and barriers for NbS planning and implementation, as well as lessons learned. We compiled key insights on barriers, enablers and lessons learned in the Excel workbook. The appendix includes a list of strategies, plans and policies that we encountered during our document review, most of which either directly support or have the potential to support local NbS implementation.

Box 2 2: Limitations of our approach to identify, screen, characterize and assess NbS projects.

Establishing a baseline on the state of implementation of NbS in Canada, relying on publicly available information, is not without challenges. Here we summarize the main limitations of our approach and the implications on our report findings.

- Representativeness. A systematic review of NbS projects was beyond the scope of the assignment. Instead, we identified a target number of projects and then turned to databases and documented case studies to identify candidate projects for inclusion in our inventory and then screened them. Therefore, our inventory may be picking up self-reporting biases present in our sources (e.g., a preponderance of projects from certain NGOs with strong marketing functions or repeated mentions of notable municipal projects). As well, meeting our municipal targets for NbS projects (one project from the two largest municipalities in each province and territory) was not possible for the territories, with only two projects added to the NbS inventory and four additional projects from Canada's largest municipalities (Vancouver, Calgary, Toronto and Montreal) were added in their place. Relative to other provinces, NbS projects were difficult to find for municipalities in Saskatchewan and Manitoba, although this may be related to differences in terminology used to refer to projects that fit the NbS definition. The significant exchange between ESSA and DSF in selecting projects for inclusion in the inventory helped mitigate the potential for bias but did not entirely remove it. Any extrapolation of key patterns drawn from our inventory of NbS projects requires caution.

- Information availability. Developing an inventory of NbS projects via review and analysis of publicly available information is efficient but has its downsides. For example, documentation for older projects (pre-2005) is sparser than that for more recent projects. As well, we were not always able to find project information to populate all the fields in our inventory. Despite our best efforts to locate it, our inventory lacks budget information for 16 of 38 projects and land area information for seven of 38 projects. Aside from information unavailable to characterize NbS projects, gaps in publicly available information also influenced our ability to apply our assessment framework. Project information like objectives, findings and implementation activities is easy to find, but key information on stakeholder engagement, feedback mechanisms and subsequent results of monitoring after project completion less so. The implications of information gaps are more significant for NbS assessment than for simple characterizations, since it can result in some projects not meeting a certain indicator solely due to the information not being readily available. We encourage readers to focus on broad patterns across the suite of projects and not dwell on assessment results for individual projects, since validation of these results was beyond the scope of the assignment.

- Ex-post application of the NbS assessment framework. Our inventory of implemented NbS projects spans from 1992 to 2022 and includes projects that predate discussions on "nature-based solutions" and related performance attributes. For this assignment we applied an assessment framework retroactively, meaning that project proponents would not have had NbS standards (the IUCN Global Standard) in mind when designing and implementing their projects. This has implications beyond the availability of public information but could highlight weaknesses in implemented projects relative to a standard that they were never designed to meet. For example, some projects were not of a scope for all indicators to be relevant. Reforestation projects in Charlottetown and naturalization projects in St. John's or Halifax are relatively small compared to other projects examined, and are funded inconsistently and without provisions for long-term monitoring or assessment. Therefore, these projects ended up scoring lower than those with dedicated funding, that are more comprehensive or are higher in profile. This emphasizes the importance of focusing on broad patterns revealed through our analysis instead of specific scores for projects. Nevertheless, applying this global NbS standard is an opportunity to learn about its applicability to Canadian projects.

3 THE INVENTORY OF NBS PROJECTS

This section of the report describes the set of NbS projects included in the inventory. The full inventory is available under separate cover, as an Excel workbook. The 38 NbS projects in the inventory are diverse: distributed across Canada and reflecting a variety of NbS types and implementation actions (Figure 3 1). Table 3 1 and Table 3 2 contain summary information on the set of NbS projects. What follows are highlights. See Appendix 7.3 for additional figures and tables.

By design, the inventory of NbS projects is pan-Canadian, with projects in all provinces and territories. Half of NbS projects in the inventory are in the four most populous jurisdictions in Canada — Ontario, Quebec, British Columbia and Alberta — although there is an overrepresentation of B.C. projects. The oldest projects are in Saskatchewan (1992) and British Columbia (1994), with more recent projects from a greater number of jurisdictions. For 2022, the inventory contains 10 projects from seven jurisdictions.

Figure 3-1: Geographic distribution and type of the 38 NbS projects in our Excel-based inventory. Municipal, Indigenous-led and Regional/Other projects are denoted by triangles, squares and circles, respectively. NbS project types are denoted by colour, with red, yellow, blue and green as Type 1 (protect), Type 2 (manage) and Type 3 (create and restore), respectively.

The number of NbS projects implemented has increased over time, with two projects initiated between 1992 and 2001, eight projects initiated between 2002 and 2011 and 28 from 2012 onward. Although the visibility of and support for NbS are undoubtedly recent, the apparent upward trend in NbS implementation reflected in our inventory is likely a combination of increased implementation and, importantly, increased attention to and ease of reporting.

Just over half of NbS projects in our inventory are Type 3 projects (restore or create ecosystems), which is unsurprising given the focus on municipal NbS and the preponderance of restoration and naturalization efforts at this scale. Type 1 (protect) and Type 3 projects are represented throughout the inventory period (1992-2022), whereas the few Type 2 (manage) projects (six in total) in the set are from 2014 onward. All categories of implementation actions are reflected in the set of NbS projects, with the top three most frequently used actions being ecosystem restoration, infrastructure-related approaches and ecosystem-based protection (e.g., area-based conservation). This too is consistent with the focus on municipal action, and, to a lesser extent, Indigenous-led projects.

Implementation status was part of our project selection criteria; only projects past the planning stage were included. Most projects in our inventory —about 60 per cent — are completed, with the rest under active implementation.

The NbS projects in our inventory represent an investment of over $800 million (2020$), with project budgets ranging from $33,000 to $335 million (i.e., differing by four orders of magnitude) and about 50 per cent of project budgets under $10 million. Budget information was available for 22 of 38 projects. Although not always clear from source documents, we assume that budget information is for initial costs only and not operations and maintenance. Using the median project budget as a proxy for the information missing for 16 projects would bring the total investment in NbS projects to $880 million. To put this sum into perspective, the federal Natural Infrastructure Fund announced in Budget 2021 is providing $200 million in grant funding and contribution agreements and the federal Natural Climate Solutions Fund is a 10-year fund disbursing $631 million for projects that conserve, restore and enhance wetlands, peatlands and grasslands to store and capture carbon. These funds target a range of project sizes, coming close to the range of budgets reflected in our inventory.

In total, NbS projects cover a land area of 19.6 million hectares, with project areas ranging from 0.1 ha (ID16) to 6.7 million ha (ID30), and over 50 per cent of projects covering 500 ha or less. As was the case with budget information, finding information on land area covered was not always possible. Indeed, information on the area of implementation was available for 31 of 38 projects. Noteworthy is that four Indigenous-led projects amounted to 99.7 per cent of the total land area covered by all projects; these are two Type 1 (protect) and two Type 2 (manage) projects. Overall, municipal projects are smaller in area than Indigenous-led projects, which is unsurprising as Indigenous-led projects are more often than

not located in remote areas and municipal projects are located where land is at a premium (e.g., in populous areas facing development pressures). Also, municipal projects centre on the provision of focal services that municipalities are legally bound to supply at a local scale. Indigenous-led projects might be more oriented to landscape-scale outcomes; e.g., maintenance of supply of a species for food, social and ceremonial purposes.

Although early on we hypothesized that a relationship existed between project budget and land area (i.e., more funding resulting in larger projects by area), the NbS projects in the inventory did not support this. Projects covering a very small area can be expensive relative to larger projects, with factors such as land value and the degree of restoration and capital works needed likely being more influential. Project costs per hectare covered differ markedly among Type 1, 2 and 3 projects, with the cost of restoration and creation of ecosystems higher than the cost of protection and enhanced management per unit area.

Access to multiple funding sources to finance projects is a success factor for NbS (Veerkamp et al. 2021). Projects in our inventory received funding from a range of sources, including federal contributions, self-financing by municipalities, intergovernmental cost-sharing (e.g., federal, provincial and municipal), NGO and private funding. More often than not (15 out of the 22 with budget information), NbS projects received funding from more than one source. Federal funding seems to influence the land area covered by NbS projects, as projects in our inventory supported federally are over one million ha, which is much bigger than the median land area of projects. This relates to the policy issues of federal interest (e.g., biodiversity conservation, Indigenous reconciliation), compared to those of municipal governments, which have a localized focus.

NbS projects have the potential to contribute to the generation of several ecosystem services, with the most frequent number of services amounting to 11. The number of ecosystem services potentially generated by NbS projects is indicative of the capacity for service supply and the multi-solving ability of NbS. The minimum number of ecosystem services associated with NbS projects in our inventory is five (ID10) and the maximum number is twenty (ID11, ID27, ID28) (see Figure 7 3 in the appendix). The number of ecosystem services is not the same as effectiveness of NbS, which the next section of the report addresses.

Table 3-1: Summary characteristics of the Excel-based inventory of NbS projects. All dollar values are in 2020$.

REF	SUMMARY INDICATORS	DEFINITION	UNIT	NBS PROJECTS
0	**Sample sizes**	# of municipal projects in the inventory	#	26
		# of Indigenous-led projects in the inventory		5
		# of regional/other projects in the inventory		7
1	**Project type**	% of projects by type, as defined by desired ecosystem outcomes		
	Type1 (Protect)		%	32%
	Type 2 (Manage)		%	16%
	Type 3 (Restore or Create)		%	53%
2	**Implementation actions a**	% of projects that use a given action in the implementation of NbS		
	Ecosystem restoration		%	29%
	Issue-specific (e.g., adaptation, mitigation)		%	10%
	Infrastructure-related		%	29%
	Ecosystem-based management		%	12%
	Ecosystem-based protection		%	21%
3	**Implementation status**	% of projects being implemented		39%
		% of completed projects		61%
4	**Project budget (initial costs)**	Descriptive statistics of project budget information available for 22 projects		
4a	Sum of project budgets	Descriptive statistics of project budget information available for 22 projects	2020$	809,535,818
4b	Average project budget		2020$	36,797,083
4c	Median project budget		2020$	4,456,598
4d	Minimum project budget		2020$	33,965
4e	Maximum project budget		2020$	335,250,000
5	**Project budget categories (initial costs)**	Magnitude of projects' initial costs, based on budget information available for 22 projects		
	Under 1 M		%	36%
	1-10 M		%	23%
	21-30 M		%	14%
	41-50 M		%	9%
	51-60 M		%	9%
	Over 6 M ha			9%
6	**Land area covered**	Descriptive statistics of land covered by NbS projects, based on information available for 31 projects		
6a	Sum of projects' area		ha	19,619,777
6b	Average project area		ha	632,896
6c	Median project area		ha	156
6d	Minimum project area		ha	0.1
6e	Maximum project area		ha	6,743,100

REF	SUMMARY INDICATORS	DEFINITION	UNIT	NBS PROJECTS
7	**Land area categories**	Project size, based on area information available for 31 projects		
	Under 10 ha		%	19%
	10-500 ha		%	39%
	500-1 M ha		%	29%
	1-2 M ha		%	3%
	2-6 M ha		%	3%
	Over 6 M ha		%	6%
8	**Cost per hectare**	Descriptive statistics of the unit cost of NbS implementation per hectare, based on information available for 20 projects		
8a	Average		2020$	3,301,299
8b	Median		2020$	159,199
8c	Minimum		2020$	1
8d	Maximum		2020$	46,217,600
8e	Type 1 – average		2020$	1,461 (n=4)
8f	Type 2 – average		2020$	14,709 (n=2)
8g	Type 3 – average		2020$	4,713,623 (n=14)
9	**Ecosystem services generated**	Descriptive statistics on the sum of ecosystem services (supporting, regulating, provisioning and cultural) generated by NbS projects		
9a	Mode across 4 ecosystem service types		#	11
9b	Minimum		#	5
9c	Maximum		#	20

[a] See definitions of implementation actions in Table 2 1

Table 3-2: Brief descriptions of the 38 NbS projects in the Excel-based inventory. ID numbers in this table correspond to those in the inventory.

PROJECT		DESCRIPTION
ID01: New Brighton Park Shoreline Habitat Restoration Project **Project location:** Vancouver, B.C. **Subgroup:** Municipal **NbS project type:** Create (Type		Project by the Vancouver Park Board and Vancouver Fraser Port Authority to create a salt marsh on the east side of New Brighton Park in Vancouver, B.C. The project's goal was to restore coastal wetland habitat on the south shore of Burrard Inlet. The coastal wetland habitat will deliver critical habitat for fish, which feed along the shoreline of Burrard Inlet. The project was completed in 2017. COPYRIGHT: THE PORT OF VANCOUVER
ID02: St. George Rainway project **Project location:** Vancouver, B.C. **Subgroup:** Municipal **NbS project type:** Create (Type 3)		A rainwater-management project located on St. George Street in Vancouver. The project's goal is to develop the rainway as part of a blue-green system that manages rainwater using check dams, inlets, gravel and rock, soils, plants and trees, while providing safe and active transportation routes; enhancing greenery and public space; increasing biodiversity; building on community activation and celebrating water and nature. The rainway will deliver core utility services of rainwater management in the neighbourhood. The project is currently in construction and to be completed in early 2023. COPYRIGHT: CITY OF VANCOUVER

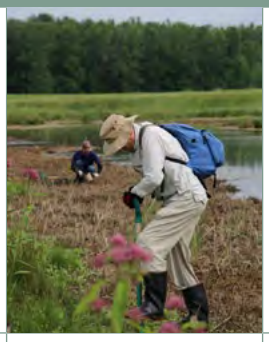
PROJECT		DESCRIPTION
ID 03: The Green Infrastructure Network (GIN) **Project location:** Surrey, B.C. **Subgroup:** Municipal **NbS project type:** Protect (Type 1)		Project to establish a 3,900-hectare interconnected network of protected open space and natural areas in Surrey British Columbia. The GIN is the backbone of the city's Biodiversity Conservation Strategy, which has the goal to preserve, protect and enhance Surrey's biodiversity. The GIN will preserve habitat, ensure connectivity between habitat areas and provide a diversity of habitat features. Approximately 2,700 hectares of the GIN is already secured, and a remaining 1,216 hectares are anticipated to be protected or acquired. COPYRIGHT: CITY OF SURREY
ID04: Blatchford Community Development Project **Project location:** Edmonton, AB **Sub-group:** Municipal **NbS project type:** Create (Type 3)		Blatchford is a 212-hectare urban community development in the heart of Edmonton. The goal of the development is to build an efficient, medium-density neighbourhood that helps Edmonton grow sustainably. The project will deliver a carbon-neutral neighbourhood powered entirely by renewable energy that also incorporates green infrastructure, by integrating low-impact design, urban agriculture, tree-lined streets and naturalized spaces that consider biodiversity. The city development is expected to finish in 2038 and support 30,000 residents. COPYRIGHT: CITY OF EDMONTON
ID05: The Shepard Wetland **Project location:** Calgary, AB **Sub-group**: Municipal **NbS project type:** Create (Type 3)		The Shepard Wetland at Ralph Klein Park was constructed 2009 as part of the stormwater quality retrofit program in the east side of Calgary. The goal was to build a stormwater storage facility and treatment wetland that naturally filters stormwater, improving the quality of stormwater before it is discharged south to the Bow River, while also having the capacity to handle a one-in-100-year flood. At 230 hectares, it is the largest constructed stormwater treatment wetland in Canada. COPYRIGHT: PAUL SAULNIER
ID06: Dale Hodges Natural Environment Park **Project location:** Calgary, AB **Sub-group:** Municipal **NbS project type:** Create (Type 3)		This project transformed a gravel quarry along the Bow River into a 40-hectare park and stormwater treatment facility that addresses runoff from over 1,700 hectares of the surrounding area. A collaboration between art, engineering and landscape architecture, the project features a nautilus pond, stormwater wetlands and a multi-use trail system that delivers water quality and carbon sequestration benefits. It is also an aesthetically pleasing and inviting park that provides the public an opportunity to observe naturalized stormwater treatment. The project was completed in 2019. COPYRIGHT: O2 DESIGN
ID07: The Meewasin Northeast Swale **Project location:** Saskatoon, SK **Sub-group:** Municipal **NbS project type**: Protect (Type 1)		Ancient river channel that carves a 26-km path adjacent to the South Saskatchewan River. The Northeast Swale contains native prairie grasslands and offers high-quality biodiversity, proximity to urban areas, economic benefits for recreation and education and a natural filter for air and water. The swale also contains vibrant wetlands to mitigate flooding to the surrounding community. Although not legally protected, Meewasin and the City have expressed interest in protecting the Swale and are actively managing the site. COPYRIGHT: SASKATCHEWAN BMP
ID08: McKell Wascana Conservation Park **Project location:** Regina, SK **Sub-group:** Municipal **NbS project type:** Protect (Type 1)		A 171-acre park in the city of Regina dedicated to conserving and restoring native prairie and wetland habitat, providing key habitat for local wildlife, including nesting birds, while also providing an important outlet for recreation for the city. The park is the Regina Wetland Centre of Excellence, serving as an outdoor classroom for science students at Dr. Martin LeBoldus Catholic High School, in collaboration with Ducks Unlimited Canada. The park was established in 2005. COPYRIGHT: ANNE GEORG

PROJECT		DESCRIPTION
ID009: Naturalized Stormwater Retention Ponds **Project location:** Winnipeg, MB **Sub-group:** Municipal **NbS project type:** Create (Type 3)		Since 2002, Native Plant Solutions, a consulting branch of Ducks Unlimited Canada, has naturalized more than 50 stormwater basins in Winnipeg, representing 90 per cent of new stormwater basins. Naturalized stormwater retention basins create attractive and inviting places that support biodiversity while also delivering key stormwater services. They enhance the living space of communities, connecting residents with nature. One example is Sage Creek (pictured), a six-phase housing development on 365 hectares in southeast Winnipeg. COPYRIGHT: NATIVE PLANT SOLUTIONS
ID10: Urban Ecological Preserve **Project location:** Brandon, MB **Sub-group:** Municipal **NbS project type:** Protect (Type 1)		A project by the Nature Conservancy of Canada in collaboration with the city of Brandon, landowners and Stoneridge Equities Inc. to preserve 20 hectares of small white lady-slipper (endangered in MB) and mixed grass prairie habitat from any future development. Ongoing stewardship and monitoring, in addition to significant community awareness, outreach and educational programming, are also taking place at the preserve. The preserve was established in October 2020. COPYRIGHT: MELISSA GRANTHAM
ID11: Jim Tovey Lakeview Conservation Area **Project location:** Greater Toronto Area, ON **Sub-group:** Municipal **NbS project type:** Create (Type 3)		A collaborative venture among the Credit Valley Conservation Authority, the Region of Peel and Toronto and Region Conservation Authority. The goal of the project is to create a 26-hectare natural waterfront park that will establish ecological habitat and public linkages on the eastern Mississauga waterfront. When complete, the project will include several large coastal wetlands, meadows, beachfront and forested habitats, as well as an enhanced shoreline for residents and wildlife. The project is anticipated to finish in 2025. COPYRIGHT: CREDIT VALLEY CONSERVATION AUTHORITY
ID12: Tree Canopy and Waterfront Shoreline Project **Project location:** Toronto, ON **Sub-group:** Municipal **NbS project type:** Restore (Type 3)		A collaboration between the City of Toronto and the Toronto and Region Conservation Authority to improve the city's ability to adapt to increasing and intensifying weather events by repairing and enhancing resiliency to shoreline erosion control infrastructure on Toronto's shorelines. It includes expanding the city's tree-planting program and increasing tree maintenance and natural area restoration, increasing the number of healthy trees that provide this stormwater management services to the shorelines. Expected completion in 2022. COPYRIGHT: BRAD ROSS/TWITTER
ID13: Black Rapids Wetland Enhancement **Project location:** Ottawa, ON **Sub-group:** Municipal **NbS project type:** Restore (Type 3)		A collaboration between the National Capital Commission and the Rideau Valley Conservation Authority to enhance a wetland in the headwaters of Black Rapids Creek. The project doubled the size of the wetland from 3,444 m2 to almost 7,000 m2. The project delivered an enhanced wetland that improved water quality, enhanced rare wetland habitat along the Black Rapids Creek system and increased biodiversity. The project was completed in September 2016. COPYRIGHT: RIDEAU VALLEY CONSERVATION AUTHORITY
ID14: Revitalization of Papineau Avenue **Project location:** Montréal, QC **Sub-group:** Municipal **NbS project type:** Create (Type 3)		A project to reconstruct a two-km stretch of Papineau Avenue with green infrastructure to relieve pressure on the existing sewer system. Over 1.2 km of bioretention basins and vegetated basins were developed and help deliver improved stormwater management services and habitat for wildlife. In total, nearly 40,000 plants were added to the site, diverting nearly 100,000 m3 of water from the sewer system, enabling treatment of approximately 10,000 m3 of stormwater each year, and the removal of 80 per cent of suspended solids from treated water. This was completed in 2017. COPYRIGHT: CITY OF MONTREAL

PROJECT		DESCRIPTION
ID15: Parc Frédéric-Back **Project location:** Montréal, QC **Sub-group:** Municipal **NbS project type:** Create (Type 3)		A multi-decade project to transform a former limestone quarry and landfill into a 153-hectare green space and recreational park. The park will deliver several cultural, educational, and recreational opportunities for citizens, while also delivering green space for wildlife and energy from biogas wells dispersed throughout the landscape. The biogas wells aggregate toxic bacterial anaerobic fumes from the decomposing leachate underneath the park. Frédéric-Back Park is set to become one of the largest urban parks in the city by 2026. COPYRIGHT: CITY OF MONTREAL
ID16: Regreening and Demineralization Projects **Project location:** Québec City, QC **Sub-group:** Municipal **NbS project type:** Create (Type 3)		Quebec City has initiated a series of greening and demineralization projects to remove existing streets and replace them with green areas. By 2023, the city wants to carry out 10 greening and demineralization projects in neighbourhoods where the canopy indices are the lowest. The goal of this project is to reduce urban heat islands in densely built urban environments in the city. One project is complete (Rue Bouffard) with a second project completed in 2022. COPYRIGHT: VILLE DE QUÉBEC
ID17: Campbell Creek Restoration Project **Project location:** Fredericton, NB **Sub-group:** Municipal **NbS project type:** Restore (Type 3)		Led by the Maliseet Conservation Council, in collaboration with the City of Fredericton and others, the project goal is to improve water quality and fish habitat by removing the Campbell Creek dam within the creek and restoring the headpond by planting trees and shrubs to restore the former. The project will deliver improved water quality, increased habitat for native anadromous fish and approximately 2.6 hectares of habitat for terrestrial species. Planting of riparian species will continue beyond 2022 and post-dam removal monitoring for the project will be completed in 2024. COPYRIGHT: NATALIE DESETA, NASHWAAK WATERSHED ASSOCIATION INC.
ID18: Naturalized Storm Retention Ponds and Guidelines **Project location:** Moncton, NB **Sub-group:** Municipal **NbS project type:** Create (Type 3)		The city of Moncton began naturalizing its stormwater ponds in 2016 and has thus far naturalized three in the city. Additionally, the municipality has developed Moncton Naturalized Stormwater Management Guidelines. Naturalized stormwater retention basins support biodiversity, while also delivering key stormwater services, enhancing the living space of communities, and connecting residents with nature. Currently the three naturalized stormwater retention basins were pilots, but the city anticipates establishing more naturalized stormwater ponds in the future. COPYRIGHT: MICHELLE MCALOON, CITY OF MONCTON
ID19: Charlottetown Reforestation Projects **Project location:** Charlottetown, PEI **Sub-group:** Municipal **NbS project type:** Manage (Type 2)		A series of three urban forest reforestation projects with goal of enhancing the city's urban forest by increasing habitat and natural area cover, making woodlands safer, creating beautiful places to walk, improving water quality by reducing storm water runoff and erosion, increasing the number of pollutants that are removed from air and water and creating a woodland management plan for the areas. The three reforestation projects were completed from 2006 to 2012. COPYRIGHT: CITY OF CHARLOTTETOWN
ID20: Kelly's Pond Watershed Restoration **Project location:** Strafford (Charlottetown), PEI **Sub-group:** Municipal **NbS project type:** Restore (Type 3)		A project involving the Town of Strafford, the province of P.E.I. and the Government of Canada, with the goal of restoring the integrity of the Kelly's Pond–Moore's Pond watershed, which is currently compromised by undersized water-control structures, sediment infilling, degraded wetlands and inadequate buffer zones. By restoring this system, the project will improve the ponds' ability to mitigate the effects of extreme weather events and climate change, in addition to providing a healthy habitat for local wildlife. The project is expected to be completed in 2023. COPYRIGHT: TONY DAVIS/CBC

PROJECT		DESCRIPTION
ID21: Naturalization Projects **Project location:** Halifax, NS **Sub-group:** Municipal **NbS project Type:** Create (Type 3)		These projects apply an ecologically based approach to landscaping, with the goal of enhancing biodiversity and ecological resilience in the urban landscape by planting native or non-invasive-adapted plant species. The city has completed three pilot naturalization projects under its naturalization strategy. These naturalization projects were shown to provide several ecological, environmental, educational and recreational benefits. In September 2022, the city expanded the naturalization pilot to a municipal-wide program. COPYRIGHT: HALIFAX REGIONAL MUNICIPALITY
ID22: Urban Park Designation — Blue Mountain — Birch Cove Lakes Wilderness Area **Project location:** Halifax, NS **Sub-group:** Municipal **NbS project type:** Protect (Type 1)		A 1,767-hectare wilderness at the edge of urban Halifax. Made up of native Acadian forests, wetlands and an interconnected system of headwater lakes, this park has been designated as a protected wilderness area since 2015 by the province and is considered a valuable natural asset for the municipality. The area delivers several environmental, recreational and education services. The municipality, together with partners, is undertaking a planning project to consider an enlarged park area to classify it as a national urban park by Parks Canada. COPYRIGHT: IRWIN BARRETT/ECOLOGY ACTION CENTRE
ID23: Naturalization of Parks **Project location:** St. John's, NL **Subgroup:** Municipal **NbS project type:** Create (Type 3)		The Naturalization of Parks is an initiative lead by the City of St. John's through a federal and provincial cost-shared funding model to address climate change and its impacts in the city. The goal of a naturalization program is to enhance ecosystems of the natural environment within the city. This program will create 11.4 hectares of additional natural zones within municipally owned land. Three of seven sites have been initiated. COPYRIGHT: CITY OF ST. JOHN'S
ID24: Urban Wetland, Lundrigan's Marsh **Project location:** St. John's, NL **Sub-group:** Municipal **NbS project type:** Protect (Type 1)		A project that was initiated by the Conservancy of Canada and Ducks Unlimited Canada to protect and preserve the productive wetland within St. John's city limits. The wetland is now managed by the City of St. John's and currently designated as an "environmentally valuable area" and protected area in the City of St. John's municipal plan. The wetland provides key habitat for many waterfowl and marsh bird species while also providing vital flood control for the city. The marsh has been protected since 2004. COPYRIGHT: ROBERT LEEMAN
ID25: Regional Parks **Project location:** Whitehorse, YK **Subgroup:** Municipal **NbS project type:** Protect (Type 1)		In 2015, the City of Whitehorse established five regional parks within city limits that cover more than 12,000 hectares and over 30 per cent of the total municipal area. The goal of establishing these parks was to preserve areas in Whitehorse for all future residents, providing recreational activities while also preserving environmentally sensitive areas. In 2014, city council adopted the Regional Parks Plan to set a 10-year vision and planning framework for the park system. COPYRIGHT: CANADIAN PARKS AND WILDERNESS SOCIETY, YUKON CHAPTER
ID26: Tundra Wetland Treatment Areas — Nunavut Sewage Lagoons **Project location:** Across Nunavut **Subgroup:** Municipal **NbS project type:** Create (Type 3)		Sixteen out of 25 of the hamlets in Nunavut treat municipal wastewater with a wastewater stabilization pond in combination with a tundra wetland treatment area. The goals of the WTAs are to filter wastewater leaving the stabilization ponds before returning to the marine environment. The wetlands provide water-treatment services, sequester carbon and enhance biomass cover. COPYRIGHT: GUIDELINES FOR THE DESIGN AND ASSESSMENT OF TUNDRA WETLAND TREATMENT AREAS IN NUNAVUT (2016)

PROJECT		DESCRIPTION
ID27: Edéhzhíe National Wildlife Area and Dehcho Protected Area **Project location:** Dehcho First Nations, NWT **Subgroup:** Indigenous-led **NbS project type:** Protect (Type 1)		A 14,218-km2 area of wetlands and boreal forest located in the southwest of the Northwest Territories. The diverse landscape supports a high diversity of species and contains several headwater lakes that supply freshwater to much of the Dehcho region, mature spruce forests and vibrant wetlands. In 2018, the Dehcho First Nations and the Government of Canada signed the Edéhzhíe agreement, establishing the area as Canada's first Indigenous protected area under its Canada Nature Fund. In 2022, over 14,000 km2 of wetland and boreal forest in Edéhzhíe became a National Wildlife Area. COPYRIGHT: REBECCA WARREN
ID28: Seal River Watershed Initiative **Project location:** Seal River Watershed, MB **Subgroup:** Indigenous led **NbS project type:** Protect (Type 1)		Sayisi Dene First Nation is leading an initiative to designate the entirety of the Seal River watershed as an Indigenous protected area in partnership with its Cree, Dene and Inuit neighbours. The goal is to protect the watershed from industrial development. The watershed is 99.97 per cent intact and is home to abundant wildlife, including several endangered and charismatic species. The watershed is also a significant carbon sink with vibrant wetland, peatlands and carbon-rich boreal soils. Efforts are still ongoing to protect this area for future generations. COPYRIGHT: SEAL RIVER WATERSHED INDIGENOUS PROTECTED AREA INITIATIVE
ID29: Great Bear Forest Carbon Project **Project location:** Great Bear Rainforest, north and central coast of B.C. **Subgroup:** Indigenous-led **NbS project type:** Manage (Type 2)		A 6.4-million-hectare rainforest in British Columbia, managed through an agreement that conserves 85 per cent of the forest and 70 per cent of the old growth forest, while leaving 15 per cent of the forest available for logging to support local jobs and strengthen the region's communities. The agreement delivers initiatives that fulfil cultural, social and economic objectives of First Nations and other communities, while also preserving long-term economic and environmental benefits. COPYRIGHT: KATHRYN BURRINGTON
ID30: The Peel Watershed Regional Land Use Plan **Project location:** Peel River Watershed, YK **Subgroup:** Indigenous-led **NbS project Type:** Manage (Type 2)		An area of 67,431 km2 in northern Yukon containing valuable natural resources including diverse plant, fish and wildlife populations, as well as rich gas, oil and mineral deposits. The Peel Watershed Land Use Plan is a project led by the Peel Watershed Planning Commission; it established a special management Area (55%), wilderness area (25%), wilderness area for boreal caribou (3%) and an integrated management area (17%). COPYRIGHT: JURI PEEPRE
ID31: Northern Agriculture Futures **Project location:** Ka'a'gee Tu First Nation, NWT **Subgroup:** Indigenous-led **NbS project type:** Manage (Type 2)		A collaboration among several communities across the South Slave and Dehcho regions in the Northwest Territories and researchers from Wilfred Laurier University. The goal is to identify areas for present and future agricultural development in the region and use pilot-scale food-growing projects to build local capacity and develop agricultural best management practices specific to a community's soil types. The project delivers options for community-grown food to be developed while also contributing to policy development and knowledge-sharing with other communities in the Northwest Territories. The project is ongoing COPYRIGHT: ANDREW SPRING
ID32: Conservation of Buffalo Pound Lake **Project location:** Buffalo Pond Lake, SK **Subgroup:** Regional/ other **NbS project type:** Protect (Type 1)		In 2020, the Nature Conservancy of Canada announced the purchase of Buffalo Pound Lake, which consists of 866 hectares of native grasslands and seven kilometres of shoreline along the north shore of Buffalo Pound Lake. These grasslands help filter water entering the lake, which is used as drinking water for approximately one-quarter of the province's population, including Regina, Moose Jaw and several surrounding communities COPYRIGHT: JASON BANTLE / NATURE CONSERVANCY OF CANADA

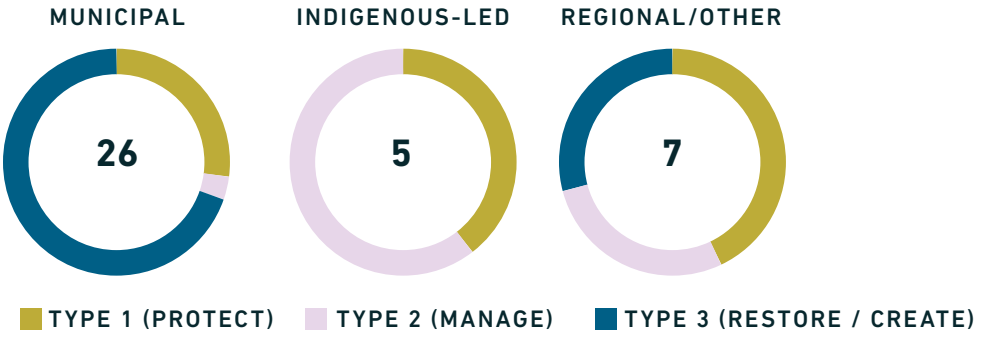
PROJECT		DESCRIPTION
ID33: Take a Load Off Project **Project location:** Utopia, ON **Subgroup:** Regional/ other **NbS project type:** Restore (Type 2)		The Nottawasaga Valley Conservation Authority leads a project to engage landowners, farmers and volunteers to "Take a Load Off" of the Nottawasaga Valley watershed north of Toronto by improving the 3,700-km2 watershed's resiliency to climate impacts, urban growth and other threats. The project aims to reduce flooding in the watershed by increasing infiltration rate, creating floodplain capacity and protecting and increasing wetlands. Activities include wetland, river, forest and native grassland habitat restoration, and farm practices to create carbon-rich healthy soils. The project began in 2019 and is ongoing. COPYRIGHT: NOTTAWASAGA VALLEY CONSERVATION AUTHORITY, EMILY VANDERMEER / WWF-CANADA
ID34: City of Grand Forks Flood Mitigation Projects **Project location:** Grand Forks, B.C. **Subgroup:** Regional/ other **NbS project type:** Create (Type 3)		The City of Grand Forks is implementing several flood-mitigation projects in response to a 2018 flood that devastated the municipality. This project involves reinforcing approximately 1,300 metres of riverbank along the Johnson Flats channel, re-establishing a natural flood plain in North Ruckle and building new retention ponds in South Ruckle. The City of Grand Forks estimates that once complete, the project will increase the flood resilience of over 800 residents during spring thaws and other extreme weather events. Projects are ongoing. COPYRIGHT: CC BY-NC-ND 2.0
ID35: Coastal Restoration of the Beach at Cap-des-Rosiers, Forillon National Park **Project location:** Gaspé, QC **Subgroup:** Regional/ other **NbS project type:** Restore (Type 3)		A project led by Parks Canada in response to more frequent extreme storm events and significant coastal erosion in Forillon National Park. The goal of the project was to restore a 1.7-km section of a beach to restore the natural dynamics of the coastal ecosystem and spawning sites of prey fish. Following its completion, the project delivered improved capelin spawning sites and enhanced beach stabilization that is more resilient to storm events. The project was completed in 2016. COPYRIGHT: OLEKSANDR DZUIBA
ID36: The Nature Conservancy Easement — Waldron **Project location:** Southern Foothills of the Rocky Mountain Front Conservation Region, AB **Subgroup:** Regional/ other **NbS project type:** Manage (Type 2)		A collaborative project between the Nature Conservancy of Canada and the Waldron Ranch Co-operative. The arrangement ensures that the 12,357-hectare Waldron grasslands will be preserved from subdivision and cultivation, while protecting the headwaters consisting of critical streams and rivers for the entire Canadian Prairies, which provide water for millions of Canadians and countless wildlife species. While protected, the Waldron's 65 rancher shareholders will retain grazing rights to the land. The conservation easement was completed in 2014. COPYRIGHT: KYLEFOTO.COM
ID37: Kennedy Watershed Restoration Project **Project location:** Southern Clayoquot Sound, Vancouver Island, B.C. **Subgroup:** Regional/ other **NbS project type:** Restore (Type 3)		Initiated in 1994 under the Canadian Salmon Enhancement and Restoration Fund, the project restored creeks destroyed and degraded by logging as well as the bordering riparian forests, to improve Pacific salmon runs and population health. Since 1994, approximately 70 km of stream habitat have been fully restored in the Kennedy Watershed. In addition, 62 hectares of riparian forest have been restored, 48 hectares of slide area have been bioengineered and 247 km of logging road have been deactivated. The project was able to deliver improved stream conditions, health of the riparian forests and ecosystem integrity. The project was completed in 2008. COPYRIGHT: JEREMY KORESKI
ID38: Rare Forest in Albert County **Project location:** Riverside-Albert, NB **Subgroup:** Regional/ other **NbS project type:** Protect (Type 1)		The conservation of an Acadian forest to preserve a community's water supply was a collaboration between the village of Riverside-Albert and the Nature Conservancy of Canada. This project conserves a 130-hectare area of Acadian forest that was up for lease, to protect the old growth forest and the Riverside-Albert village water supply. The project is able to deliver protection of old growth forest as well as preserve the community's water supply indefinitely. The forest was designated as protected in 2019. COPYRIGHT: THE CANADIAN PRESS/HO, MIKE DEMBECK, NATURE CONSERVANCY OF CANADA

4 KEY FINDINGS ON THE CURRENT STATUS OF NBS IMPLEMENTATION

KEY FINDING 1: NBS TYPES

- Nature-based solutions in Canada have mainly comprised projects to protect natural areas and flows of ecosystem services from development (i.e., Type 1) and to retrofit cities by restoring existing ecosystems and creating new ones, all while improving city services such as stormwater management and urban heat island mitigation (i.e., Type 3).
- Projects seeking to manage working landscapes (i.e., Type 2) are not widely implemented by Canadian municipalities (Figure 4 1).

Figure 4-1: Representation of NbS project types in our inventory



The following section provides an overview of patterns across projects under each NbS project type, with Table 4 1 summarizing shared and differentiated attributes, and highlighting corresponding projects.

Table 4 1: Common features of projects in our inventory by NbS project type

TYPE 1 (PROTECT): MORE LIKELY TO RECEIVE FINANCIAL SUPPORT FROM ENGOS		
Approaches	**Project ID**	**Commonalities**
Parks, protected areas and urban greenways	ID03, ID07, ID08, ID10, ID22, ID25, ID27, ID28 & ID35	Commonly part of land-use planning strategies and commitments
Natural infrastructure for water solutions	ID24, ID32 & ID38	Tend to be targets for investment and engagement by environmental non-governmental organizations
TYPE 2 (MANAGE): MORE LIKELY TO BE INDIGENOUS-LED AND/OR INVOLVE INTERSECTORAL OR INTERGOVERNMENTAL COLLABORATION		
Approaches	**Project ID**	**Commonalities**
Diverse implementation actions (e.g., land-use planning, improved grassland and forest management)	ID19, ID29, ID30, ID31, ID33 & ID36	Shared decision-making enables their implementation

TYPE 3 (RESTORE/CREATE): MORE LIKELY TO RELY ON COST-SHARED FUNDING ACROSS LEVELS OF GOVERNMENT, MOST CAPITAL INTENSIVE		
Approaches	**Project ID**	**Commonalities**
Low impact development or redevelopment	ID01, ID04, ID11, ID12, ID14, ID15, ID16, ID21 & ID23	Costliest NbS projects of the inventory
Natural infrastructure for water solutions	ID02, ID05, ID06, ID09, ID18, ID26 & ID34	Tend to address municipal stormwater management and wastewater treatment; commonly link to municipal plans or strategies
Wetland and watershed restoration	ID13, ID17, ID20 & ID37	Driven by environmental objectives; tend to respond to federal or provincial priorities

Type 1 (Protect)

Canada is the fastest-growing country in the G7, with nearly 75 per cent of inhabitants living in one of 41 urban centres (Statistics Canada 2022); yet, unlike many country peers that lack physical space (O'Donnell et al. 2017), Canada has abundant opportunities to proactively protect natural areas within and beyond municipalities in the form of NbS projects. This is apparent in our baseline inventory, in which 12 of 38 projects are Type 1 (Protect). These 12 projects are diverse in implementation actions (area-based protection, ecosystem-based management and integrated watershed management) and area (from 22 to five million hectares). Relative to other NbS types, these projects are more likely to receive financial support from environmental non-governmental organizations. In general, these projects are of two kinds: i) parks, protected areas and urban greenways (ID03, ID07, ID08, ID10, ID22, ID25, ID27, ID28 and ID35), ii) natural infrastructure for water solutions (ID24, ID32 and ID38).

Most projects to establish or enhance parks, protected areas and urban greenways are part of broader land-use planning strategies and conservation commitments. For example, the Blue Mountain Cove Lakes Park (ID22) is part of Halifax's Green Network Plan; the Green Infrastructure Network (ID03) is part of Surrey's Biodiversity Conservation Strategy; the Meewasin Northeast Swale (ID07) is part of Saskatoon's Green Infrastructure Strategy; and regional parks of Whitehorse (ID25) comprise a network of parks covering 30 per cent of the municipality. On the conservation front, the Edéhzhíe Dehcho National Wildlife Area (ID27) and Seal River Watershed Initiative (ID28) are both Indigenous-led and help deliver on a national commitment to protect 30 per cent of lands and inland waters by 2030. In contrast to these examples, two municipal NbS, Regina's McKell Wascana Conservation Park (ID08) and Brandon's Urban Ecological Preserve (ID10), are not linked to municipal or regional planning but are rather smaller areas — under 70 hectares — setting aside existing natural ecosystems to protect them from development.

Projects focused on protecting ecosystems to sustain flows of water-related ecosystem services are distinct for being targets for investment and engagement by environmental non-governmental organizations. Three projects in our inventory received funding and organizational support from the Nature Conservancy of Canada and Ducks Unlimited, among others. Ecosystems and services protected

by these projects are urban marshes and flood protection (St. John's Lundrigan's Marsh - ID24), native grasslands and drinking water provision (Buffalo Pond Lake in Saskatchewan - ID32), and old growth forests and drinking water provision (Riverside-Albert in New Brunswick -ID38). The spatial coverage of these projects ranges from 22 to 866 hectares, with the smallest area associated with the project facing most development pressure.

Type 2 (Manage)

Globally, implementation of Type 2 NbS (i.e., natural or semi-natural ecosystem management interventions other than restoration or protection, such as ecological forest management) appears to occur more frequently than Type 1 NbS, but this is not the case in our baseline inventory. In a global study mapping the effectiveness of NbS for climate change adaptation, Chausson et al. (2020) illustrate the relative frequency of implementation across NbS types, suggesting a descending order of Type 3, Type 2 and Type 1. This pattern is not apparent in our inventory, as six of 38 projects are Type 2 (ID19, ID29, ID30, ID31, ID33 and ID36) and five of these projects are either Indigenous-led or regional/other. It is possible that by targeting municipalities and local NbS action we have understated the extent of implementation of NbS Type 2 projects. In any case, projects of this kind are diverse in their implementation actions, and include urban afforestation and reforestation, Indigenous-led land-use planning and ecosystem-based management (+ 6 M hectares), small (30 hectares) and larger (+12,000 hectares) initiatives to enhance the multifunctionality of grasslands, wetlands and boreal forest. Type 2 projects are noteworthy for the power-sharing/shared decision-making needed to make them work (see Table 3-2).

Type 3 (Restore/Create)

Urbanization, land-use pressures and the need to ensure communities and cities are vibrant and livable create incentives for strategic land-use and urban redevelopment. This is reflected in our baseline inventory, in which 19 of 38 projects are Type 3 (create/restore). These 19 projects mainly use implementation actions that are infrastructure-related, in addition to ecosystem restoration. Relative to other NbS types, these projects are more likely to rely on cost-shared funding across levels of government and are the most capital-intensive. Eight of the 10 costliest NbS projects in our inventory are Type 3. In general, projects are of three kinds: i) low-impact development or redevelopment (ID01, ID04, ID11, ID12, ID14, ID15, ID16, ID21 and ID23); ii) natural infrastructure for water solutions (ID02, ID05, ID06, ID09, ID18, ID26 and ID34 and iii) wetland and watershed restoration (ID13, ID17, ID20 and ID37).

Municipal low-impact or redevelopment projects include sustainable neighbourhood development, softer approaches to waterfront and shoreline development, brownfield redevelopment, street removal and greening and naturalization of parks and rights-of-way. These projects feature hybrid grey-green solutions, engineered and restored wetlands and transformation of degraded

land into conservation areas and green spaces. They represent the costliest NbS projects catalogued. Major natural infrastructure projects such as the New Brighton Park Shoreline Habitat Restoration Project in Vancouver (ID01), the Jim Tovey Conservation Area in Mississauga (ID11), the Parc Frédéric-Back in Montreal (ID15) and a series of regreening projects in neighbourhoods with low canopy indices in Quebec City (ID16) have among the highest unit costs ($/ha) of the NbS project inventory but also among the highest number of ecosystem services generated. Smaller cities, Halifax (ID21) and St. John's (ID23), feature projects linked to city-wide naturalization programs.

A set of natural infrastructure projects addresses water-related services, with the majority focused on managing municipal stormwater but also wastewater treatment and spring flood mitigation. NbS to support stormwater management range from a low-impact development project — the St. George Rainway Project (ID02) — to constructed habitats such as the Shepard Wetland (ID05) and Dale Hodges Environmental Park (ID06), both in Calgary, to the naturalization of stormwater basins and retention ponds in Winnipeg (ID09) and Moncton (ID18), integrating features like bioswales and green roofs. These projects tend to result from municipal planning or environmental strategies to either deal with stormwater (e.g., Vancouver Rain City Strategy) or adaptation to climate change (e.g., Moncton Climate Change Adaptation and Flood Management Strategy). Two other water-related examples illustrate the importance of context in deciding on and designing NbS. One is the Government of Nunavut's tundra Wetland Treatment Areas that passively manage wastewater from communities' sewage lagoons (ID26). Low operating costs and maintenance requirements factored heavily into the decision to use this option (Government of Nunavut 2016). The other project is an intergovernmental investment in flood resilience by reinforcing riverbanks, re-establishing a natural flood plain and building new retention ponds in Grand Forks, British Columbia (ID34). The impetus for this project was a massive flood in 2018 caused by a rapid spring thaw.

In contrast to NbS projects involving infrastructure-related approaches, projects focused on restoration of natural ecosystems are less likely to attract municipal funding or link to municipal planning. Projects focused on wetland and watershed restoration are Black Rapids Wetland Enhancement in Ottawa (ID13), Campbell Creek Restoration in Fredericton (ID17), Kelly's Pond Restoration in the town of Strafford, P.E.I. (ID20) and Kennedy Watershed Restoration on Vancouver Island (ID37). Common across these projects is the primacy of environmental objectives as opposed to human challenges; specifically ecological integrity, water quality and fish habitat quality. Except for the project in Strafford, which is a municipal-funded venture that delivers on municipal plans, the three other projects are or were highly collaborative in their conception and implementation and responded to federal or provincial priorities.

KEY FINDING 2: CHALLENGES ADDRESSED THROUGH NBS APPLICATIONS

- Loss of biodiversity and vegetation cover, reduced water quality, increased stormwater runoff and urban heat islands are the most frequent challenges addressed by the NbS projects in the inventory.
- Extreme weather and climate hazards (drought, wildfires, wind and landslides specifically) and marine coastal challenges (storm surges, coastal inundation and saltwater intrusion), among others, are some of the challenges least addressed by NbS projects in the inventory. Socio-economic challenges (food insecurity, decreased timber) are largely unrepresented.
- A combination of natural assets, naturalized and engineered systems and forests, wetlands and riparian vegetation feature prominently as NbS applications in projects in the inventory.

By definition, NbS address a range of environmental, economic and societal challenges by harnessing natural and naturalized systems, with projects often performing "multi-solving"[4] roles. Most (36 of 38) NbS projects in the inventory exhibit this multi-solving approach, in that their intent is to address at least two challenges (Figure 4-2). The number of challenges addressed by a project ranges from one to seven, with a mode of four and an average of 4.1 challenges addressed across all 38 projects (Table 4-2).

Comparing across municipal, Indigenous-led and regional/other NbS projects suggests that expectations for multi-solving may be higher for municipal and Indigenous-led projects and lower for regional/other projects (Table 4 2). Across all projects, the Tree Canopy and Waterfront Shoreline Project (ID12) and the naturalization projects in Halifax (ID21) and St. John's (ID23) addressed the most challenges with seven, whereas the Wetland Tundra Areas in Nunavut (ID26) and the Grand Forks Flood Mitigation projects (ID34) addressed the least number of challenges with one (Figure 4-2).

Although small in spatial scale, both the Halifax and St. John's naturalization projects claim addressing air quality, urban heat island effects, stormwater management, spread of invasive species, biomass losses and wildlife habitat through their projects (Halifax Regional Council 2022; City of St. John's n.d.) (Figure 4 3). Conversely, the stated goal of the flood-mitigation project in Grand Forks, B.C. (ID34) was to address one specific problem, that of minimizing the impacts of freshwater flooding following a major flood event in 2018. It is worth noting, however, that addressing one specific problem such as flood mitigation can also overcome other community challenges directly (e.g., avoid home losses) or indirectly (e.g., avoid supply chain disruptions).

Table 4-2: Number of challenges addressed by NbS projects in an inventory of 38 projects. Descriptive statistics (average and spread) are shown for all projects in the inventory and by project classification.

METRICS	AVERAGE NUMBER OF CHALLENGES ADDRESSED	STANDARD DEVIATION (SD)	RANGE (1 SD)	
All projects	4.1	1.6	5.7	2.5
Municipal	4.2	1.6	5.8	2.6
Indigenous-led	4.2	1.1	5.3	3.1
Regional/Other	3.6	1.9	5.5	1.7

Figure 4-2: Summary of challenges addressed across NbS projects. This panel is a bar plot displaying the number of challenges addressed per project.

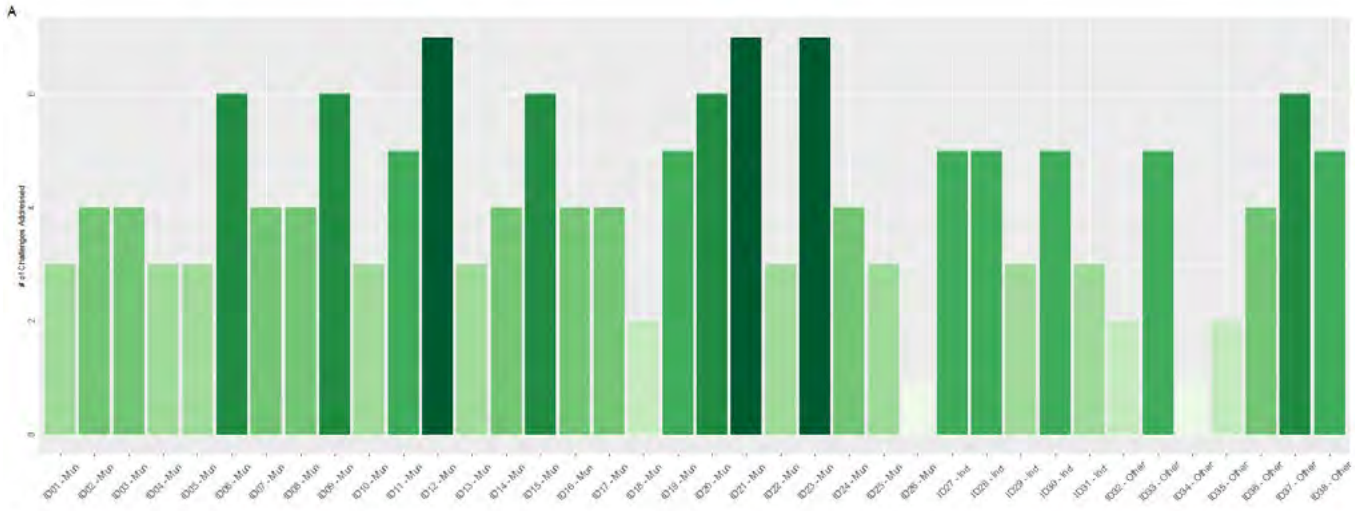
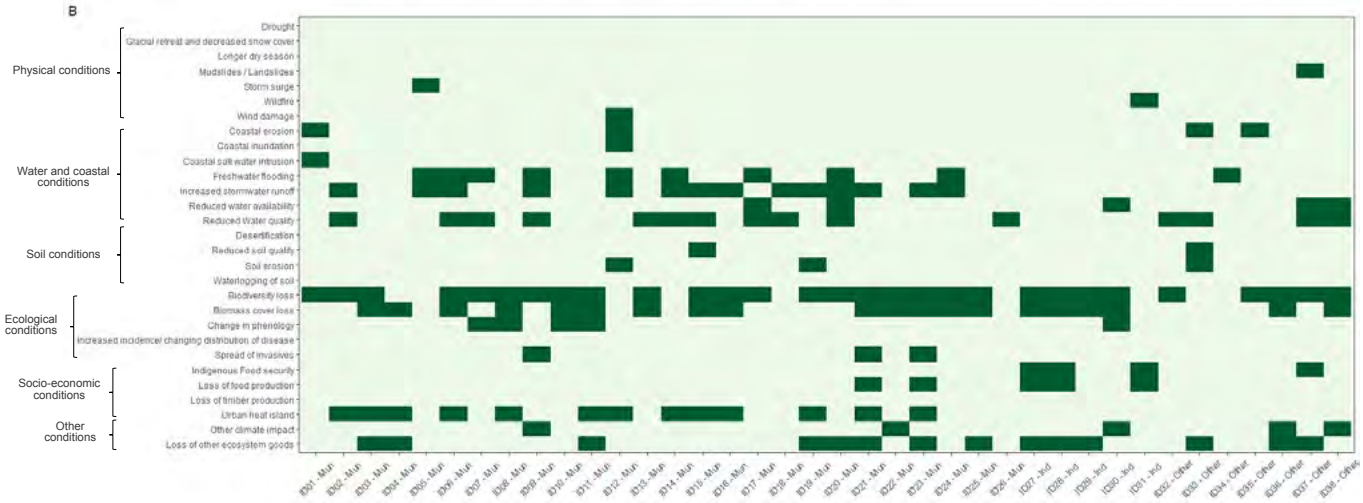


Figure 4 3: Summary of challenges addressed across NbS projects. This panel is a heat map of challenges addressed across all NbS projects.



The top five most frequent challenges addressed through NbS in the inventory are biodiversity loss (76 per cent of the 38 projects), biomass cover loss (53 per cent), reduced water quality (39 per cent), increased stormwater runoff (37 per cent) and urban heat islands (34 per cent) (Figure 4 3). Conversely, coastal marine issues (storm surge, coastal inundation, saltwater intrusion and coastal erosion) and weather and climate extremes (wind damage, landslides, wildfires, drought)

are some of the challenges that are least addressed. The lack of focus on coastal challenges and extremes is also noted in a global study of NbS for climate change adaptation (Chausson et al. 2020). Since biodiversity underpins the supply of ecosystem services such as seed dispersal, pollination and pest and disease control, changes in the quality and quantity of biodiversity presents numerous challenges to human communities (Ash et al. 2010). People also place an intrinsic value in biodiversity and its loss can erode culture and well-being. Loss of biomass cover directly affects the flow of ecosystem services like water regulation and carbon sequestration and storage.

Implementation of a range of NbS applications within projects serves to address the local and regional challenges facing municipalities, Indigenous communities and other project proponents. Considering the set of 38 projects, our desktop review reveals the prominent integration of forests, wetlands and riparian vegetation in NbS projects (Figure 4 4). Proportionately, patterns of NbS applications across Type 1 and Type 2 projects are similar, with some integration of green infrastructure in Type 1 projects and features involving soil management in Type 2 projects. Type 3 projects feature the most extensive range of NbS applications, integrating natural assets, naturalized systems and engineered structures (Figure 4-5)

Figure 4-4: Treemap showing the relative use of NbS applications across all 38 projects in the inventory, with the area of the application denoting the relative frequency of its use. Projects often combine applications in their design and implementation.

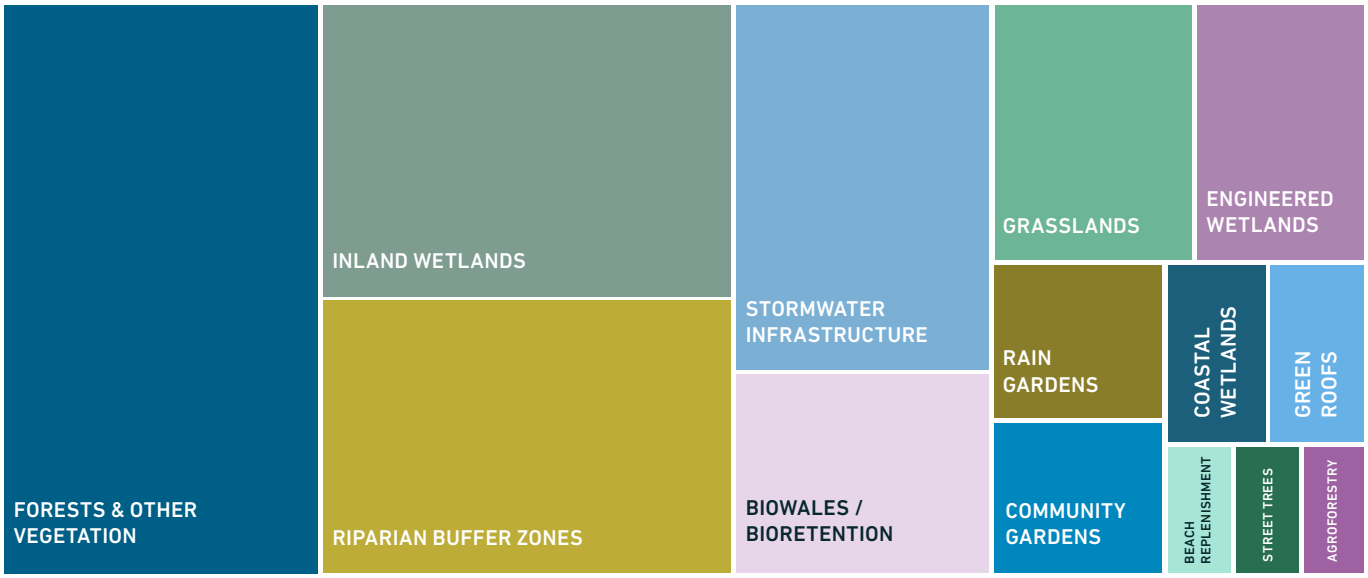
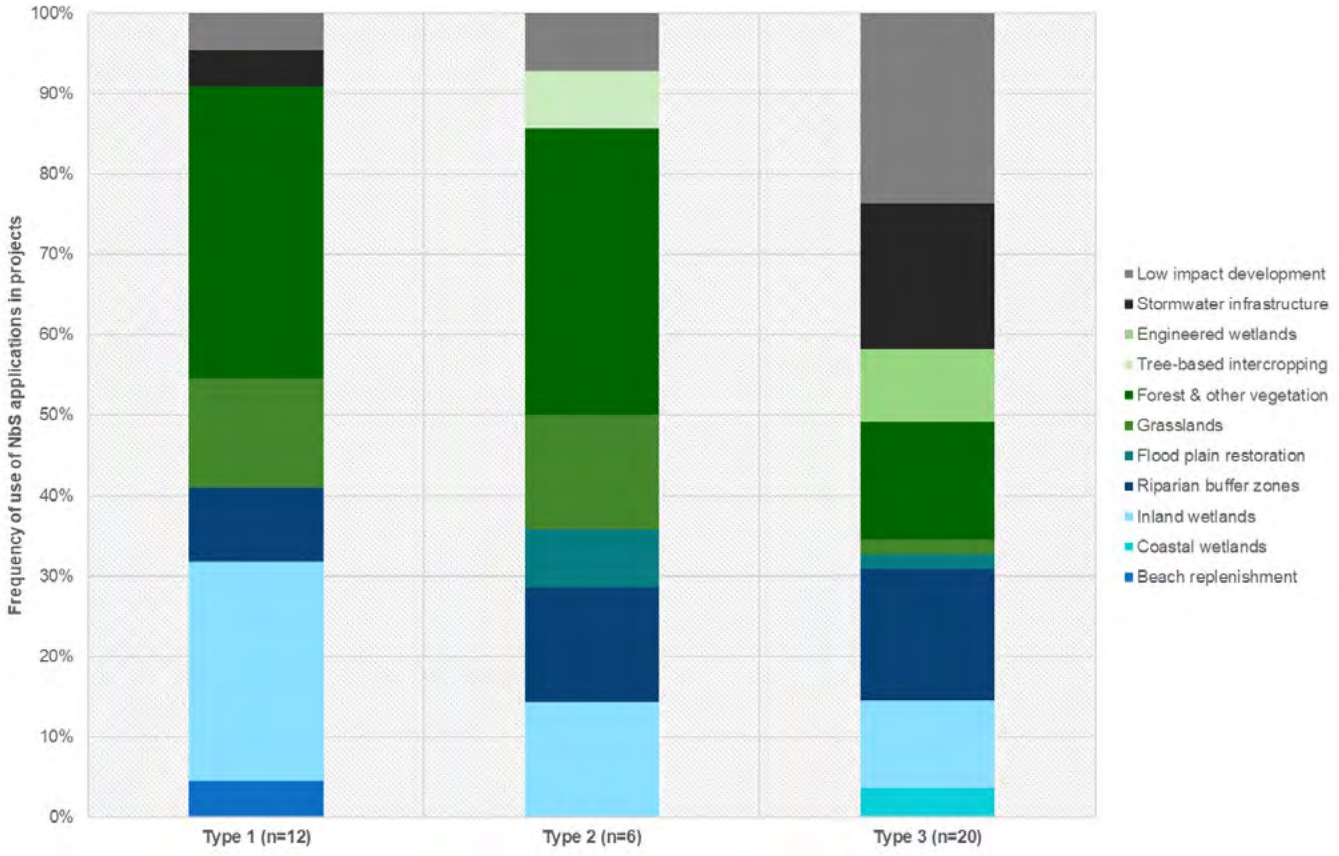


Figure 4-5: Summary of the relative use of site-level NbS applications in our inventory of 38 projects, broken out by NbS project types (Type 1, 2 & 3). Low-impact development includes bioswales/bioretention, green roofs, rain gardens, community gardens and street trees.



KEY FINDING 3: OUTCOMES OF NBS PROJECTS

- The NbS projects in the inventory contributed to the generation of a range of supporting, regulating, provisioning and cultural services.
- The most frequently recorded ecosystem services are habitat provision and carbon sequestration and storage. The least frequently recorded ecosystem services are soil formation and retention, and raw materials for energy.
- When assessing ecosystem service delivery for distinct project classes, we observed a preponderance of regulating and cultural services for municipal projects, with a greater emphasis on provisioning services for Indigenous-led projects in comparison.

In addition to addressing local challenges effectively and adaptively, the intent of NbS is to simultaneously support human well-being, generate biodiversity benefits and enhance flows of ecosystem services. We analyzed the potential for these outcomes by reviewing project profiles and tagging the likely ecosystem services associated with each project. We looked at four ecosystem service categories: supporting, regulating and maintenance (regulating for short), provisioning and cultural. Supporting services include important dimensions of biodiversity, such as habitat provision and primary productivity. These services support the supply of

the other three types of "terminal" services (provisioning, regulating and cultural). An important caution with this analysis is that we did not perform a rigorous verification of the generation of ecosystem services via NbS projects, as that was beyond the scope of our research. In identifying ecosystem services associated with each project we have made inferences in some cases. So, it is possible that the extent and diversity of ecosystem service outcomes is overstated.

All projects assessed generated at least one ecosystem service, with an average of 12.2 (mode: 11, median: 12) ecosystem services generated across all 38 projects, considering the four categories of ecosystem services. The project with the most anticipated ecosystem services generated was the Jim Tovey Conservation Area (ID11) (n=20), whereas the Brandon Urban Ecological Preserve (ID10) was associated with the fewest (n=5). The ecosystem services most frequently recorded across projects were habitat provision and carbon sequestration and storage (89 per cent or 34 out of 38 projects, respectively). The frequency of these potential outcomes aligns with the underlying premise of NbS as a strategy to address the dual crises of climate change and biodiversity loss.

For each ecosystem category, we identified the most frequent and least frequent ecosystem services associated with the set of NbS projects in the inventory (Table 4 3). Supporting and regulating services were most frequently recorded for NbS projects, with the specific services corresponding to the challenges projects addressed and the preponderance of terrestrial ecosystems and other vegetated systems used as site-level applications. The relative prominence of ecosystem service categories and specific services shows a bias toward municipal preferences and priorities since these comprise 26 of the 38 projects in the inventory.

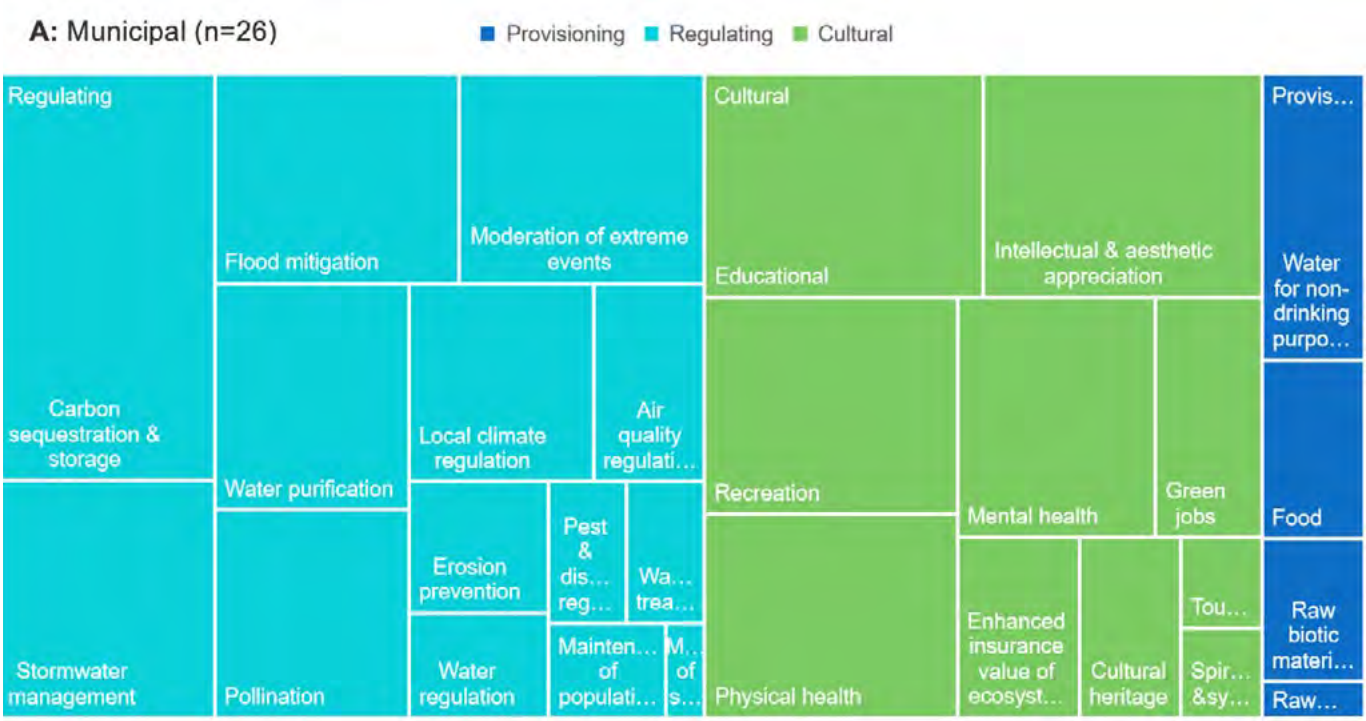
Table 4-3: Ecosystem services most and least frequently recorded for NbS projects in the inventory. Where possible, the top three and bottom three are shown.

ECOSYSTEM SERVICE CATEGORY	MOST FREQUENTLY RECORDED	LEAST FREQUENTLY RECORDED
Supporting (i.e., services that sustain life forms, ecosystems)	Habitat provision (89 per cent)	Soil formation & retention (3 per cent)
	Atmospheric oxygen production (60 per cent)	Nutrient dispersal & cycling (24 per cent
	Biomass production (50 per cent)	Primary production (45 per cent)
Regulating & maintenance (i.e., services that moderate natural processes)	Carbon sequestration & storage (89 per cent)	Pest & disease regulation (8 per cent)
	Flood mitigation (45 per cent)	Water flow regulation (13 per cent)
	Moderation of other extreme events (42 per cent)	Wastewater treatment (13 per cent)
	Water purification (42 per cent)	Maintenance of soil fertility (13 per cent)
Provisioning (i.e., services that provide benefits to people that can be extracted from nature)	Water for non-drinking purposes (37 per cent)	Raw materials for energy (5 per cent)
	Food (24 per cent)	Freshwater for drinking (11 per cent)
	Raw biotic materials (24 per cent)	

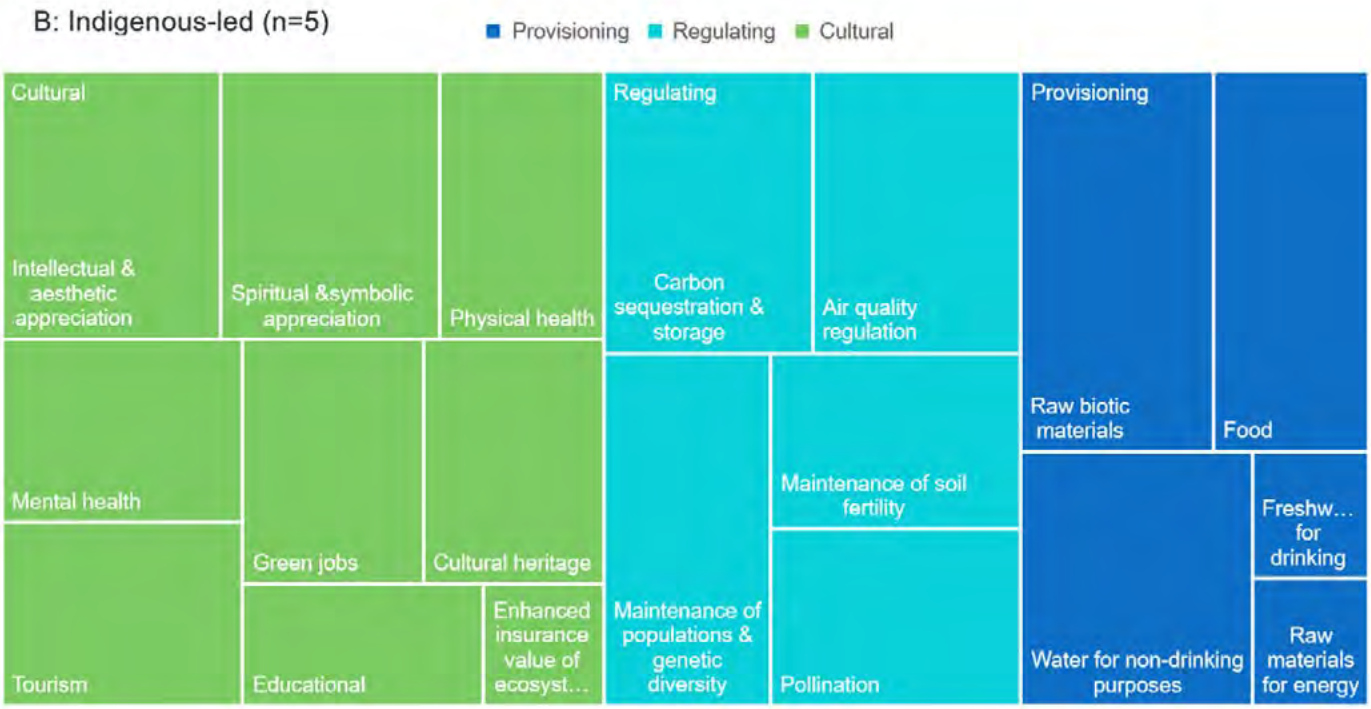
Cultural (i.e., non-material benefits that contribute to human physical and cultural development)	Educational (60 per cent)	Tourism (16 per cent)
	Human physical health (53 per cent)	Spiritual & symbolic appreciation (18 per cent)
	Human mental health (50 per cent)	Cultural heritage (26 per cent)

For municipal NbS projects, we found that the most frequently described ecosystem services were carbon sequestration and storage, flood mitigation, stormwater management and moderation of extreme events (Panel A, Figure 4 6). Cultural services are also prominent, particularly services related to enjoyment of nature and outdoor education. The apparent focus on regulating services and some cultural services is unsurprising given municipalities' authorities, accountabilities and budgets (e.g., stormwater management, parks and recreation). In this context, the frequent mention of carbon sequestration and storage is likely regarded as a co-benefit rather than a focal service tied to project performance.

Figure 4-6: Treemaps of ecosystem services potentially generated from NbS projects in Canada. Larger boxes represent the services most commonly associated with projects, across three types of ecosystem services (provisioning, regulating and cultural). Panel A: Treemap of ecosystem services associated with the municipal projects in the NbS inventory; Panel B: Treemap of ecosystem services associated with Indigenous-led projects in the NbS inventory.



For Indigenous-led NbS projects, we found a more even distribution of service categories compared to the municipal cases and a greater emphasis on cultural and provisioning services (Panel B Figure 4 6). Because of the small number of Indigenous-led projects in our inventory we are cautious about drawing additional observations. However, analysis of the average sum of explicit and implicit ecosystem services per project between 1992 and 2022 suggests that an increase in the supply of provisioning services from NbS projects is associated with Indigenous-led projects.



KEY FINDING 4: EFFECTIVENESS OF NBS PROJECTS

- Canadian NbS projects are moderately effective, based on the application of the IUCN Global Standard assessment framework to the project inventory using qualitative methods.
- Conservation projects involving large tracts of land and ambitious, high-profile projects in Canada's largest municipalities tend to outperform smaller, opportunistic projects.
- Indigenous-led projects outperform municipal and regional/other projects in terms of effectiveness, although this was based on a small sample size.
- Projects are strongest in meeting criteria on societal challenges, matching the scale to the problem, and generating biodiversity benefits.
- Projects are weakest in meeting criteria on adaptive management, local capacity development and economic feasibility.

We explored the effectiveness of NbS projects relative to the IUCN Global Standard for NbS, identifying differences in scores among NbS project types, as well as apparent strengths and weaknesses among projects implemented. Figure 4 7 and Table 4 4 display results of our scoring exercise. Across all 38 projects, only one project, Conservation Finance in the Great Bear Rainforest in British Columbia (ID29), met all 29 indicators under our assessment. The average score across all projects was 17.6/29, with scores ranging from four to 29. Projects scoring 20 points or above tend to involve conserving a large regional area (e.g., ID27, ID29 and ID30) or are ambitious, high-profile projects occurring within Canada's largest municipalities (e.g., ID11 and ID12). These projects commonly have large budgets, involve multiple stakeholders and rights holders, are designed to generate

multiple co-benefits and are associated with an integrative plan or strategy for the management and protection of nature, climate resilience and/or sustainable development (either through municipal, provincial or federal plans). In other words, funding, participatory planning and NbS mainstreaming within broader plans and strategies are factors that enhanced these projects' performance against the IUCN Global Standard.

Projects scoring under 12 points tend to involve opportunistic initiatives to conserve or protect areas within a municipality, spurred by a stakeholder other than the municipality (e.g., ID08, ID10 and ID24), or were the result of a one-time funding opportunity (ID13). Other commonalities are that these projects tend to be small in geographic scope, are less likely to employ ongoing monitoring and are less likely to engage beyond consulting the direct stakeholders involved.

We performed regression analysis to test the relationship between the number of ecosystem services (potentially) generated by projects in our Excel inventory as a function of projects' performance against the IUCN assessment framework. This analysis shows a statistically significant increase in the number of ecosystem services the better performing the project is. There is a moderate correlation between the two variables (correlation coefficient of 0.44), with a regression model that is statistically significant at the 0.05 level (see Figure 7 4 in Appendix 7.3). This is a crude analysis that we include here to stimulate further research ideas.

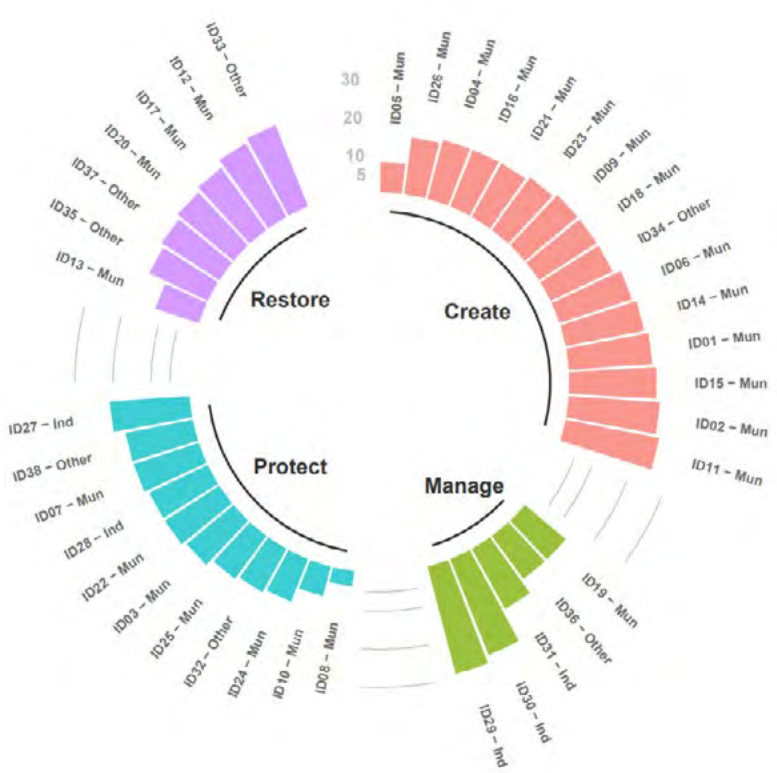
The limited evidence we have suggests Indigenous-led projects may be more effective at meeting the IUCN Global Standard than other project types, according to our assessment framework. Table 4 4 shows average projects scores broken out by project classification (NbS type and sampling category). Indigenous-led projects tend to score higher than municipal or regional/other. The influence of the apparent effectiveness of Indigenous-led projects is also evident in the scores of Type 2 projects, comprising three of the seven projects in that category. A notable feature of Indigenous-led projects in our inventory is their implementation date; Indigenous-led projects are, on average, younger than municipal and regional/other projects and, therefore, may have benefited from more and better sources of guidance. Our contention is that projects from the 1990s and early 2000s are less likely to address criteria such as inclusive governance and mainstreaming, as these policy goals are newer relative to others. However, this temporal gradient is not obvious in our relatively small inventory of projects (Table 4-4). It is also possible that Indigenous-led projects are more holistic, integrative and inclusive in their planning and implementation than other project types, with Indigenous project leads leaning on long histories of sustainable co-existence with their lands and waters (Townsend et al. 2020).

Table 4-4: Average NbS project scores resulting from a desktop assessment against a framework following the IUCN Global Standard for Nature-based Solutions. Project scores (average and spread) are shown for all projects in the inventory and by project classification.

NBS PROJECTS (#)	AVERAGE SCORE	STANDARD DEVIATION (SD)	RANGE (1 SD)	
All projects (38)	17.6	5.1	12.5	22.7
Municipal (26)	16.9	5.1	11.8	22.0
Indigenous-led (5)	22.4	5.4	17.0	27.8
Regional/other (7)	17.3	3.3	14.0	20.5
Type 1 (12)	14.6	4.8	9.8	19.3
Type 2 (7)	20.8	6.5	14.3	27.3
Type 3 (19)	18.4	4.1	14.3	22.5

Our qualitative assessment of the 38 NbS projects in the inventory suggests that they are strongest in meeting criteria on societal challenges, matching the scale to the problem and generating biodiversity benefits (see Table 4-5 for average count frequency per criterion). Examining scores at the indicator level also points the strengths regarding NbS implementation with a clear understanding and rationale of the challenges to be addressed, understanding of the current state of the ecosystems concerned, complementing other types of interventions and clear anticipated benefits. At the surface, these implementation attributes are reasonable for projects involving natural, naturalized and hybrid green-grey systems, since project approval often requires clear, evidence-based rationale.

Figure 4 7: Circle bar plot displaying how projects were scored under the evaluation framework. The projects are grouped by their associated type and arranged from lowest score to highest. The highest possible score for a given project is 29.



Conversely, our assessment suggests that projects are weakest in meeting criteria on adaptive management, local capacity and economic feasibility (Table 4-5). Apparent underperformance when it comes to building local capacity is

unsurprising since concepts like "green jobs" and the "restoration economy" as elements of societal transition have existed for 20 years (Cunningham 2002, ILO 2008) but focused attention on these outcomes is recent. A similar observation applies to adaptive management. Indeed, a review of NbS as an effective umbrella concept highlighted the need for adaptive management as a gap in evolving good practice principles for NbS (Cohen-Shacham et al. 2019). Low scores on economic feasibility, in contrast, are surprising since demonstrating cost-effectiveness is common in project appraisal. An exception here could be projects that merit implementation for non-pecuniary reasons such as would be the case for Type 1 projects. Evidence of effectiveness is another gap noted in a 2019 review of good practice principles for implementing and scaling NbS (Cohen-Shacham et al. 2019), so weaknesses in this practice could be common beyond the NbS projects in our inventory.

Inclusive governance of NbS is one of the nine criteria in the assessment framework (criterion 5) and is an essential one for Canada's context since implementation of NbS at scale is unachievable without upholding Indigenous rights and respecting Indigenous governance and knowledge systems (Townsend et al. 2020, CCA 2022). In total, only six of 38 projects were able to meet all the associated indicators under this criterion (ID01, ID25, ID27, ID29, ID30, ID34), with an average of 2.8 indicators being met across all projects (Table 4 5). Although some of these projects may not have triggered provisions for the free, prior and informed consent of Indigenous Peoples or required a feedback and grievance resolution mechanism for the project to be implemented, the findings do suggest that future NbS projects can improve on their inclusivity surrounding project decision-making to enhance transparency, empowerment and long-term implementation success.

Table 4-5: Summary of NbS project performance against indicators in our assessment framework. Dark green denotes the apparent ability to meet the indicator. Type 1 projects colour-coded with white, Type 2 with black shading and Type 3 with grey shading.

			1. Societal challenges			2. Design at scale			3. Biodiversity net gain				4. Economic feasibility				5. Inclusive governance					6. Balance trade-offs			7. Adaptive management			8. Mainstreaming			9. Cap'ty
ID	P/T	Year	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	3.4	4.1	4.2	4.3	4.4	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	7.1	7.2	7.3	8.1	8.2	8.3	9.1
ID07	SK	1992																													
ID24	NL	2004																													
ID08	YT	2005																													
ID25	YT	2014																													
ID35	QC	2015																													
ID38	NB	2019																													
ID10	MB	2020																													
ID32	SK	2020																													
ID03	BC	2022																													
ID22	NS	2022																													
ID27	NWT	2022																													
ID28	MB	2022																													
ID36	AB	2014																													
ID29	BC	2016																													
ID30	YT	2019																													
ID19	PEI	2021																													
ID31	NWT	2022																													
ID33	ON	2022																													
ID37	BC	1994																													
ID09	MB	2002																													
ID21	NS	2002																													
ID11	ON	2002																													
ID13	ON	2002																													
ID26	NU	2008																													
ID05	AB	2009																													
ID06	AB	2014																													
ID18	NB	2016																													
ID01	BC	2017																													
ID17	NB	2017																													
ID14	QC	2017																													
ID34	BC	2018																													
ID12	ON	2019																													
ID23	NL	2021																													
ID16	QC	2021																													
ID04	AB	2022																													
ID02	BC	2022																													
ID20	PEI	2022																													
ID15	QC	2022																													
Criterion average			82%			71%			65%				55%				57%					59%			41%			64%			45%

1. SOCIETAL CHALLENGES

1.1 The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritized

1.2 The societal challenge(s) addressed are clearly understood and documented

1.3 Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed

2. DESIGN AT SCALE

2.1 The design of the NbS recognizes and responds to interactions between the economy, society and ecosystems

2.2 The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors

2.3 The design of the NbS incorporates risk identification and risk management beyond the intervention site

3. BIODIVERSITY NET GAIN

3.1 The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss

3.2 Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed

3.3 Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS

3.4 Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy

4. ECONOMIC FEASIBILITY

4.1 The direct and indirect benefits and costs associated with the NbS, who pays and who benefits, are identified and documented

4.2 A cost-effectiveness study is provided to support the choice of NbS, including the likely impact of any relevant regulations and subsidies

4.3 The effectiveness of the NbS design is justified against available alternative solutions, taking into account any associated externalities

4.4 NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance

5. INCLUSIVE GOVERNANCE

5.1 A defined and fully agreed-upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated

5.2 Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the rights and title of Indigenous Peoples in Canada to free, prior and informed consent

5.3 Stakeholders who are directly and indirectly affected by the NbS have been identified and involved in all processes of the NbS intervention

5.4 Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders

5.5 Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision-making of the stakeholders in the affected jurisdictions

6. BALANCE TRADE-OFFS

6.1 The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions

6.2 The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected

6.3 The established safeguards are periodically reviewed to ensure that mutually agreed trade-off limits are respected and do not destabilize the entire NbS

7. ADAPTIVE MANAGEMENT

7.1 A NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention

7.2 A monitoring and evaluation plan is developed and implemented throughout the intervention life cycle

7.3 A framework for iterative learning that enables adaptive management is applied throughout the intervention life cycle

8. MAINSTREAMING AND SUSTAINABILITY

8.1 The NbS design, implementation and lessons learned are shared to trigger transformative change

8.2 The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming

8.3 Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples

9. LOCAL CAPACITY

9.1 The NbS builds knowledge and technical capacity within the community and industry

KEY FINDING 5: BARRIERS TO AND ENABLERS OF NBS IMPLEMENTATION

- Common barriers and enablers to NbS implementation in Canada include political (e.g., policy integration), cultural (e.g., social acceptance), financial and practical (e.g., access to physical space) factors.
- Sustained funding and access to physical space stand out as barriers for municipal implementation of NbS. Targeted and sustained funding for NbS is elusive, with only larger, well-funded municipalities integrating a range of NbS within municipal plans or strategies. Access to physical space poses a barrier to land securement, enlarging parks and advancing green infrastructure networks within municipalities.
- Awareness of the value of NbS and some buy-in for their implementation exists, emphasizing the importance of understanding how to scale NbS at a reasonable pace. One pathway to scaling up municipal implementation involves public and community engagement, combined with policy integration, and the ability to demonstrate measurable benefits.

Despite the increasing recognition of the value of NbS in Canada and beyond, several interlinked barriers hinder their widespread uptake and mainstreaming (Kabish et al. 2016, Sarabi et al. 2019, Davies and Lafortezza 2019, Kapos et al. 2019, Sarabi et al. 2020, Veerkamp et al. 2021). At the same time, knowledge is emerging about enabling conditions that address these barriers and further support NbS implementation. Table 4 6 summarizes barriers and enablers in relation to NbS for climate change adaptation and disaster risk management. The factors listed are applicable to other NbS, although projects focused on carbon sequestration tied to carbon markets exhibit additional complications (e.g., measurement, reporting and verification issues, and lack of trust in project developers; Schulte et al. 2022). This section summarizes barriers and enablers evident in the inventory of 38 Canadian NbS projects.

Table 4-6: Barriers to and enablers of nature-based solutions for climate change adaptation and disaster risk management (Source: adapted from Veerkamp et al. 2021)

BARRIERS (LIMITING FACTORS)	ENABLERS (SUCCESS FACTORS)
Political and cultural domain	
Lack of political support	Supporting plans and legislation. Policy mechanisms available to address gaps and encourage uptake
Lack of cooperation and consent across landowners and agencies	Alignment of activities across agencies; use of trusted agents and stakeholder engagement through planning and implementation
Social and cultural constraints due to aesthetic preferences, risk perception, status quo bias, sense of ownership and place	Participatory approaches engaging a range of stakeholders, including awareness-building, giving a voice, co-creation and co-management
Financial domain	
Lack of finance for implementation and maintenance	Availability of finance, multiple sources of finance linked to multiple benefits; early assignment of budgets and accountabilities for maintenance

Difficulties with procurement for NbS (e.g., business case, lack of experienced suppliers, path dependency favouring engineered solutions)	Early cross-departmental engagement with procurement and finance, alternative procurement and delivery mechanisms
Practical domain	
Physical and biological constraints related to the quality and quantity of land available for NbS implementation	Access to healthy ecosystems; ability to improve degraded ones; cooperation across landowners to achieve adequate scale
Incomplete demonstration of own or comparative benefits, unclear cost-effectiveness at the appropriate scale	Demonstration of multiple co-benefits, including ecosystem services and integration with grey infrastructure; demonstration of effectiveness for the purpose of adequate scale
Knowledge gap between private and social costs and benefits; time lags in observing and achieving benefits	Demonstration of both private and social costs and benefits
Context-specific evidence of cost-effectiveness that is not transferable or shared	Research and monitoring with common indicators and demonstration projects

Barriers

NbS projects in the inventory exhibit the same overall barriers as those documented internationally (Table 4 6). Financial constraints are a common barrier for implementing and upscaling NbS (Sarabi et al. 2019, Sarabi et al. 2020, Toxopeus and Polzin 2021, Dorst et al. 2022). This was no different for the projects in the baseline inventory, with over 20 per cent of projects noting this as an implementation challenge within their documentation. Finance-related constraints included reliance on external funding to implement interventions (ID13, ID17, ID32, ID34), insufficient funds to cover all facets of the intervention (ID04, ID37) and procurement affecting implementation timelines (ID35). Financial constraints could be one reason hindering project compliance with the IUCN Global Standard. For example, the Kennedy Watershed Restoration project (ID36), despite its relatively large scale and 12-year duration, required multiple funding sources to complete and was unable to put in place a comprehensive monitoring program to quantify the project's effect (SER 2022). The upshot is that targeted and sustained funding for NbS is elusive, with only larger, well-funded municipalities integrating a diversity of NbS within municipal plans or strategies (e.g., Montreal and its 2020-30 Climate Plan, Toronto and its TransformTO plan and Vancouver and its Rain City strategy). Supplemental funding comes from federal and provincial contributions, amenity contributions from developers as part of the permitting process and participation in NGO initiatives. Supplementary project funding helps initiate NbS but can limit the permanence and mainstreaming of these new approaches.

Political and cultural factors are also barriers to NbS implementation in Canada. Factors such as a lack of political will, supportive policy and legal frameworks for NbS implementation, a lack of knowledge, understanding and awareness of NbS, path-dependence — a concept where past decisions or activities shape future decisions — can all lead to entrenched attitudes or norms and a bias toward the status quo (Kapos et al. 2019, Kabisch et al. 2016, Depietri and McPhearson 2017, Davies and Lafortezza 2019, Sarabi et al. 2019, Sarabi et al. 2020, Dorst et al. 2022). Across all 38 projects, about 30 per cent exhibit barriers of these kinds. Examples of resistance to change are evident in six projects (ID02, ID14, ID27, ID30, ID31 and ID33), with challenges in Indigenous-led projects being most striking.

Indigenous nations and organizations have advocated for decades for their lands to be protected and conserved, which would constitute a type of NbS. For example, multiple coastal First Nations in British Columbia had been advocating since the 1980s for protection of the Great Bear Rainforest from logging (Smith et al. 2007), with the Great Bear Rainforest Agreement concluded as recently as 2016. Outside of the uncertainty about legal protections for four Type 1 projects (ID07, ID22, ID25 and ID28), the lack of policy and legal frameworks to implement NbS was not directly stated as a limiting factor across the inventory of projects. Supportive policy, legal, and planning frameworks enable the transition between NbS as a one-off project and an accepted and resourced option to address local and regional challenges.

Practicalities also hinder NbS implementation, with examples including a lack of suitable space within urban environments to implement solutions, a lack of universal agreement and understanding of terminology and metrics and related difficulties measuring the effectiveness of nature-based interventions (O'Sullivan et al. 2020, Sarabi et al. 2020, Martinez and Christiansen 2018, Toxopeus and Polzin 2021). Across the 38 projects, just over 10 per cent identified a biophysical constraint as a barrier to successful implementation. For instance, Lundrigan's Marsh in St. John's (ID24) is bordered on all sides by commercial and industrial development and was at risk of being developed prior to the Nature Conservancy of Canada and Ducks Unlimited Canada purchasing the site and formalizing the permanence of wetland protections. Access to physical space also poses a barrier to enlarging large parks or green infrastructure networks (e.g., ID03: Surrey Green Infrastructure Network, ID22: Blue Mountain – Birch Cove Lakes Wilderness Area) as development pressure can pose threats to attaining anticipated outcomes.

Uncertainty in the flow of projects benefits seems most limiting for scaling municipal NbS Type 3 projects. In Moncton, the city has developed naturalized stormwater-management guidelines (City of Moncton 2015) and has implemented three naturalized retention ponds and wetlands in what the city is considering a "pilot phase" (ID18). The city faces pressure to ensure these pilot retention ponds are successful as adverse outcomes would limit further implementation in the future (Ducks Unlimited 2016). Indeed, other projects, such as the naturalization project in Halifax (ID20), were initiated as pilot projects prior to expanding to municipal-wide programs with a sustained operating budget (Halifax Regional Municipality 2022). Beyond the inventoried projects, delayed, undemonstrated or uncertain financial and performance outcomes of NbS compared to conventional alternatives come up as adoption barriers in the context of shoreline development and protection (Eyzaguirre et al. 2020), along with other societal challenges.

Enablers

Enabling conditions are often a response to addressing barriers for implementation. Reviews of documentation and interviews with project leads in exceptional cases shed light on enablers of NbS, mainly encompassing political

and cultural, and financial domains. Effective collaboration is an enabling cultural factor as it reduces siloed thinking, chips away at resistance to new solutions and helps use complementary contributions efficiently and effectively (Frantzeskaki et al. 2019, Sarabi et al. 2020, Albert et al. 2021). This is illustrated in the Dale Hodges Environmental Park project (ID06) where the City of Calgary embedded artists (Sans façon) in the infrastructure design team as an innovative approach to interject public art into stormwater management. The park's aesthetically pleasing and inviting nature enhances visitation rates, providing many more people an educational opportunity to observe naturalized stormwater treatment. Other examples highlight effective external collaboration, including collaboration among First Nations communities (ID28); among municipalities, developers and NGOs to implement naturalized stormwater management ponds (ID09) and coalitions involving industry, ENGOs and Indigenous communities for applying ecosystem-based land-use planning within the Great Bear Rainforest (ID29). We recorded collaboration as an enabler for 20 per cent of projects. These projects score marginally higher than projects lacking this attribute or where this information is absent (average score 18.8 compared to 17.3).

Public and community engagement during planning and/or implementation is an enabler for just under 20 per cent of projects in the inventory. Public and community engagement strengthens the flow of information on NbS, improving the knowledge, awareness, understanding of the benefits NbS projects provide (Kabish et al. 2016, Katsou et al. 2020) and surfacing potential unintended consequences of the project or public concerns to address. Coastal Restoration at Cap-des-Rosiers, Forillon National Park project (ID035) is an example of this. It employed a multifaceted communications strategy to successfully engage the local community and increase the project's profile. The strategy included multimedia, publications, public meetings, youth-centred interactive educational games within the park, and citizen science monitoring programs. Other projects where public and community engagement stood out were ID01, ID02, ID07, ID16, ID20, ID21 and ID23, the majority of which are municipal projects.

Integration of NbS into strategies, plans and policies is a type of political enabler prominent in the inventory of NbS projects. Integration of this type creates accountability for NbS, mobilizes resources for NbS and elevates the role of NbS as a viable approach to meet multiple objectives. Across all 38 projects, half are associated with a strategy, plan or policy to further implement NbS or strengthen a municipality's resilience to climate change. These instruments range from municipal development plans (e.g., St. John's Municipal Plan), urban forestry strategies (i.e., Toronto, Montreal, Quebec, Vancouver), biodiversity strategies (i.e., Vancouver Biodiversity Strategy, Surrey Biodiversity Conservation Strategy, Toronto's Biodiversity Strategy), strategies to adapt to and manage floods (i.e., Surrey Coastal Flood Adaptation Strategy, Calgary's Flood Resilience Strategy, Moncton Climate Change Adaptation and Flood Management Strategy), green infrastructure strategies (Vancouver Rain City Strategy, Saskatoon's Green

Infrastructure Strategy), wetland strategies (i.e., Edmonton Wetland Strategy) among others (see Appendix 8.2). NbS projects linked to strategies/plans/policies score marginally higher than projects lacking this or where this information is absent (average score 18.3 compared to 16.8). Indigenous-led projects are not a part of a defined nation strategy or policy as preservation and self-governance of lands and territories are unextinguished rights. Nevertheless, this category of projects is helping to deliver on Canada's Target 1 challenge related to protected and conserved areas across the country.

Cost-sharing is a response to barriers to finance for NbS, a practice referenced across multiple projects in the inventory. Cost-sharing models included crowdsourcing to conserve large tracts of grasslands and forests (ID032, ID036 and ID038), and specifically having a cost-sharing program, as illustrated by the Nottawasaga Valley Conservation Authority Take a Load Off Project (ID033). The NVCA program provides landowners and farmers with financial incentives (i.e., subsidies) to employ riparian buffers and restore natural infrastructure on their properties, effectively reducing the area of their land that can be used as a source of income. This cost-sharing program eases the financial burden for these landowners, supporting further implementation of NbS (S. Stephens, personal communication, November 8, 2022).

Finally, two project examples highlight the importance of learning through implementation as a pre-condition to scaling the application of NbS and building capacity to use these options (ID14 and ID26). With its Revitalization of Papineau Avenue (ID14), the City of Montreal was able to demonstrate the project's effectiveness in filtering rainwater and removing pollutants from the surrounding environment. According to project documentation, the experience with this project will contribute to increasing the city's expertise in managing stormwater runoff by pursuing green infrastructure. In Nunavut, multiple scientific studies have demonstrated that the tundra WTAs improve water quality and even meet southern Wastewater Systems Effluent Regulations, leading the territorial regulator to recognize the technique's treatment potential and instil confidence in its future use (ID26).

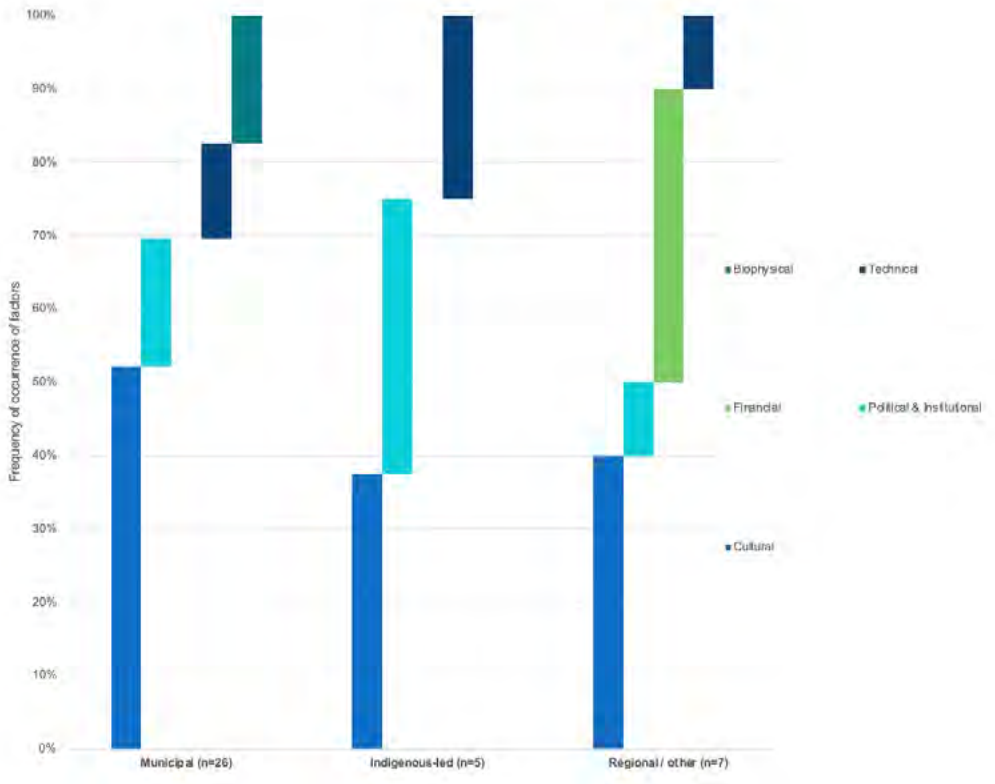
Other studies highlight the importance of bundles of enabling factors as critical to successful implementation of NbS, either working to "open doors" synergistically or sequentially (Schulte et al. 2022). To explore potential pathways, or distinct bundles, we compared the relative frequency of enabling factors catalogued per project, enhancing the resolution of factors to encompass five domains (biophysical, technical, financial, political and institutional, and cultural — see Figure 4-8). These pathways are hypotheses that merit corroboration with additional investigation and analysis, given the small number of non-municipal projects. One overarching insight is the important role of cultural factors in NbS implementation. Issues like public and community engagement, creativity, innovation in communication and fostering collaboration play a role across NbS project categories.

For municipal projects, a possible implementation pathway could resemble the following. Public and community engagement that builds social acceptance of novel approaches also helps create political will. Social acceptance and political will, combined with integration of NbS into broader policy/strategy/plans, increases the odds of earmarking resources to trial NbS. The targeted helps understand requirements of NbS deployment and build capacity for research and monitoring to demonstrate measurable benefits of NbS implementation. In turn, the ability to demonstrate the relative advantages of NbS further enhanced support for their implementation.

For Indigenous-led projects, efforts to exert rights and negotiate agreements (i.e., political and institutional factors), combined with trust-building and partnership development (i.e., cultural factors) are key investments. Implementation (in today's country context) also hinges on having the technical capacity to adapt approaches from elsewhere to Indigenous contexts and demonstrate results that are valued by western colonial structures.

For regional/other projects, which include NbS projects in small municipalities, access to funding and effective collaboration across levels of government and sectors are keys to implementation.

Figure 4-8. Illustrative, hypothesized implementation pathways for nature-based solutions for different categories of projects in the inventory. The length of the bar indicates the importance of each enabling factor in influencing NbS implementation. These are example pathways and not meant to be exhaustive; they are based on analysis of the 38 NbS projects in our inventory.



KEY FINDING 6: INSIGHTS FROM INDIGENOUS-LED PROJECTS

- Compared to municipal framings of NbS as cost-effective approaches to deliver local services to residents, Indigenous-led NbS involve a holistic approach that invokes land rights, self-determination, cultural preservation and a duty to caretake the land, waters and skies. This approach to NbS presents unique challenges and opportunities.
- This is evident for large Type 1 and 2 projects (e.g., establishment of IPCAs) that provide an opportunity for Indigenous groups to protect, manage and in some cases profit (through conservation economies) from the land they reside upon. However, to date, establishing IPCAs has involved protracted negotiations and drawn-out processes, requiring sufficient financing, time and political/social capital to achieve desired outcomes.
- Timing appears important in garnering support for Indigenous land management, including harnessing political momentum, industry transitions (e.g., decline of the pulp and paper industry) and anticipating development and land-use pressure (driven by climate change and otherwise), and to leverage commitments under national and global multilateral agreements.
- The IUCN Global Standard for NbS emphasizes the importance of upholding Indigenous rights and title in Criterion 5 on inclusive governance. However, the cultural value and benefits of Indigenous engagement in NbS could be better reflected in this global tool in support of NbS planning and implementation. This includes acknowledging the diverse values of nature and its benefits, the importance of integrating Indigenous knowledge systems, and of land guardians as part of monitoring and adaptive management.

Indigenous people in Canada have an important leadership role to play in advancing nature-based solutions (Vogel et al. 2022). Not only have Indigenous communities been stewards of lands and waters since time immemorial but Indigenous Peoples have inherent, constitutionally protected rights to self-government and are present in even the most remote locations. With the 2021 federal enactment of the United Nations Declaration on the Rights of Indigenous People and subsequent provincial legal commitments, conservation and protection of these lands has gained momentum in line with reconciliation, and societal and legal recognition of Indigenous sovereignty.

Several Indigenous-led conservation projects are underway across the country, which we recognize here as Type 1 NbS because these projects protect natural ecosystems and generate environmental and human co-benefits such as carbon sequestration, habitat provision and cultural, spiritual and symbolic appreciation. For the most part, these projects involve establishing Indigenous protected and conserved areas. Canada's Target 1 challenge lists 62 Indigenous-led projects across the country, with the potential to result in the establishment of as many IPCAs within 10 years (Environment and Climate Change Canada 2022). At the same

time, Indigenous-led initiatives seeking to weave Indigenous knowledge systems and natural resource management are also underway. These initiatives use holistic management approaches to advance economic, socio-cultural and ecosystem goals concurrently, and thereby have the potential to advance the implementation of Type 2 NbS.

The recent resurgence of and attention on Indigenous-led conservation and land management is an opportunity to shed light on the evolution of policy and programming to advance NbS. This section expands on the five Indigenous-led projects included in the NbS inventory.

The Edéhzhíe National Wildlife Area and Dehcho Protected Area (ID27, Type 1)

FIGURE 4-9: THE EDÉHZHÍE © REBECCA WARREN

The Edéhzhíe is a 14,218 km2 area of wetlands and boreal forest in the southwest of the Northwest Territories. The area is significant to the Dehcho Dene people who rely on it for subsistence and survival. The area contains several headwater lakes that supply freshwater to much of the Dehcho region, mature spruce forests and vibrant wetlands, including Mills Lake, an important wetland for waterfowl (Environment and Climate Change Canada 2022). Thirty-four per cent of Edéhzhíe is made up of water and wetlands, and despite making up 1.5 per cent of the NWT's boreal forest, it contains roughly 2.8 per cent of the territory's wetlands, 2.5 per cent of stored carbon and 1.2 per cent of breeding duck pairs, representing an important carbon sink and habitat refuge in the area (Ducks Unlimited Canada 2018). This dynamic landscape supports a high diversity of species, including 36 mammal species, 197 bird species and 24 species of fish, including several species at risk and bird species recognized as nationally threatened or of special concern (CPAWS 2021). The area also contains 73 vascular plant families (Environment and Climate Change Canada 2022).

After nearly 20 years of working to establish the Edéhzhíe, on October 11, 2018, the Dehcho First Nations and the Government of Canada signed the Edéhzhíe agreement, establishing the area as Canada's first Indigenous Protected Area, synonymous with a modern IPCA. As an IPA, Edéhzhíe will be managed through a consensus-based management board, consisting of five Dehcho First Nations members, one Environment and Climate Change Canada representative and one appointed chair, with implementation support provided by the Dehcho First Nations Indigenous guardians and community coordinators (Edéhzhíe 2022). For every dollar invested in the Dehcho guardians, the program delivers about $2.50 of social, economic, cultural and environmental results (SVA 2016). Since Indigenous people represent most of the membership of the management board and lead operations, the IPA represents a path to follow for Indigenous self-governance.

On June 1, 2022, Edéhzhíe became a designated National Wildlife Area, in addition to its status as a Dehcho Protected Area (Environment and Climate Change Canada 2022). This designation confers Edéhzhíe's lands, waters and biodiversity with permanent protection through the provisions of the Canada Wildlife Act and the Wildlife Area Regulations (Environment and Climate Change Canada 2022). In addition, the Government of the Northwest Territories has protected the Edéhzhíe from any future mineral, oil or gas exploration or development and the Government of Canada has contributed $10 million toward the Edéhzhíe Trust Fund to provide long-term funding to the Dehcho First Nations to continue managing the area (Environment and Climate Change Canada 2022).

Key takeaways

- Indigenous First Nations successfully led and helped secure an area that is culturally important to the Dene people. The area also provides significant co-benefits by securing key habitat for biodiversity and derives several ecosystem services to Dehcho First Nations.
- Significant trade-offs were made in securing the area. Through a multi-stakeholder consultation process, key areas of biodiversity were protected, while other areas that have potential for development were excluded for future economic prosperity.
- The initiative utilizes a co-management structure through a consensus-based management board to outline decisions and manage the area, placing Dehcho needs and priorities at the forefront.

The Seal River Watershed Initiative (ID28, Type 1)

FIGURE 4-10: "HUDSON BAY AERIAL NEAR SEAL RIVER" BY DIDRIK J IS LICENSED UNDER CC BY-NC-SA 2.0

The Seal River Watershed is in northern Manitoba and drains a basin measuring 50,000 km2 through the traditional lands of Sayisi Dene First Nation, Northlands Denesuline First Nation, Barren Lands First Nation, O-Pipon-Na-Piwin Cree Nation and the Inuit of the Kivalliq region into the Hudson Bay. The watershed is intact and considered pristine, as there are no permanent roads, mining activity or hydroelectric development, despite the Seal River being a major river (Puzyreva et al. 2022). The watershed is home to an abundance of wildlife, including several endangered and charismatic species (e.g., barren-ground caribou, belugas, harbour seals) (Puzyreva et al. 2022). The watershed is also a significant carbon sink, with an estimated 1.7 billion tonnes of carbon in boreal soils, wetlands and peatlands, which is equivalent to eight years' worth of greenhouse gas emissions in Canada. (DUC, 2021). The economic value of annual ecosystem goods and services provided by the watershed exceeds $300

billion (the majority being carbon sequestration and storage), which is more than four times the gross domestic product of Manitoba (Puzyreva et al. 2022).

Sayisi Dene First Nation is leading an initiative to protect the entirety of the Seal River watershed from industrial activity in partnership with its Dene, Cree and Inuit neighbours (Seal River Watershed Alliance 2022). Five Indigenous communities with three distinct cultures are working toward the common purpose of conserving the Seal River watershed as an Indigenous Protected Area (IPA). To date, the federal government has provided $3.2 million in funding from Canada's Target 1 Challenge in support of the Seal Watershed Initiative (Environment and Climate Change Canada 2020). Working with the federal and provincial governments, efforts are ongoing to undertake a feasibility assessment of the protected area, guided by the nations' common values and vision of a "pristine watershed where people, animals and fish are healthy, [Indigenous] unique languages and cultures are thriving, and there is hope and abundance for all future generations" (CTV News 2022, https://www.sealriverwatershed.ca/).

Key takeaways

- The Sayisi Dene First Nation is leading an initiative to protect the entirety of the Seal River watershed from industrial activity in partnership with its Dene, Cree and Inuit neighbours. This is an example of successful nation-to-nation collaboration that supports the IUCN principle of designing at scale.
- The initiative is an example of significant return on investment, securing an area that provides annual ecosystem goods and services that exceed $300 billion.
- The Seal River Watershed Initiative supports intergenerational cultural preservation. Loss of culture is not a societal challenge recognized in IUCN guidance on the NbS Global Standard.

Conservation Finance in the Great Bear Rainforest (ID29, Type 2)

FIGURE 4-11: GREAT BEAR RAINFOREST © KATHRYN BURRINGTON

The Great Bear Rainforest is a 64,000 km2 rainforest on the north and central coast of British Columbia, containing one quarter of the global extent of unlogged temperate rainforests. This area is home to some of the largest and oldest trees on Earth, a high degree of ecosystem intactness and exceptional levels of marine, freshwater and terrestrial productivity (DellaSala et al. 2011). The GBR is a significant carbon sink as well, as Pacific Northwest coastal old growth can store more than 1,000 tonnes of carbon in a single hectare of rainforest (Smithwick et al. 2002). The area is also home to 27 unceded territories of First Nations who have inhabited the region for millennia (Price et al. 2009).

In the early 1990s the GBR appeared destined for logging to supply the pulp and paper industry, in line with provincial government and forestry industry interests (Moore and Tjornbo 2012). However, a series of power shifts led to a change in interests, concluding in integrated planning and in creation of the world's first Indigenous-led conservation financing organization. One of these shifts was in First Nations' governance, as a series of court decisions asserted the nations' rights to their traditional territories and clarified that any decisions about management of these lands required the input of First Nations. Consequently, land-use planning in the GBR became jointly led by two governments — provincial and First Nation governments. This change, along with development of industry-environment coalitions (i.e., the Joint Solutions Project) led to development of a land-use framework in 2001, laying the groundwork for government-to-government negotiations, and land use anchored in ecosystem-based management, including creation of a network of protected areas and a new $120 million fund to diversify land-based activities from an extractive focus toward a ''conservation economy'' (Moore and Tjornbo 2012, Price et al. 2009). This funding became Coast Funds, the world's first Project Finance for Permanence initiative. Several years of negotiations concluded in 2016 with the Great Bear Rainforest Land Use Order, containing legally binding objectives to conserve 85 per cent of the forest and 70 per cent of the old growth forest, and set aside 15 per cent of the forest for logging to support regional economies.

Conservation and sustainable land management require financing. The Coast Fund has enabled leveraging of additional dollars to expand guardian programs to monitor 5.6 million hectares annually, undertake over 300 research and habitat restoration projects, invest in over 100 businesses across several sectors, support 1,200 permanent jobs or 13 per cent of the coastal region's Indigenous workforce and attract new investments (Mongabay 2023).

The Great Bear Rainforest Agreement and its PFP is internationally recognized as a landmark agreement and nature-based solution to forest management that would not exist were it not for the leadership of coastal Indigenous nations.

Key takeaways

- Concluding the Great Bear Rainforest Agreement was a drawn-out process that included taking advantage of power shifts due to changes in public sentiment on forestry issues ("war in the woods"), capacity to sustain litigation, application of interest-based negotiations and use of political capital. The decline of the pulp and paper industry in the Pacific Northwest due to changes in comparative advantage relative to other global regions facilitated the transition to conservation.
- This initiative is a model for other Indigenous-led conservation financing and is being promoted internationally as an approach for Indigenous communities to directly access stable funding in pursuit of self-determined priorities.

The Peel Watershed Land Use Plan (ID30, Type 2)

FIGURE 4-12: PEEL WATERSHED © JURI PEEPRE

The Peel Watershed Planning Region (the Peel) is an area of 67,431 km2 in northern Yukon (Peel Watershed Land Use Plan 2019). Within the Peel are the traditional territories of four First Nations governments: the Tetlit Gwich'in, the Na-Cho Nyäk Dun, the Tr'ondëk Hwëch'in and the Vuntut Gwitchin. The region is devoid of permanent human settlements and has limited industrial development (Peel Watershed Planning Commission 2010), although it contains valuable natural resources, including diverse plant, fish and wildlife populations, critical habitat for boreal caribou and rich gas, oil and mineral deposits (Staples et al. 2013, Peel Watershed Regional Land Use Plan 2019). Hunting and trapping, wilderness tourism and mining activities occur in the region at small scales (Peel Watershed Regional Land Use Plan 2019). However, climate change could lead to increased land use, making land-use planning a priority (Staples et al. 2013, Peel Watershed Regional Land Use Plan 2019).

The initiation of land-use planning followed the establishment of the Umbrella Final Agreement in 1993 and negotiations to conclude self-governance agreements with the 14 Yukon First Nations (Staples et al. 2013). The Peel Watershed Land Use Plan is one output of this planning process, which was developed and recommended by the Peel Watershed Planning Commission — a commission composed of six public members nominated by the Yukon government, the First Nations of Na-Cho Nyäk Dun, Tr'ondëk Hwëch'in, Vuntut Gwitchin First Nation and the Gwich'in Tribal Council. Driven by a common vision, this commission jointly developed a collective statement on land use and resource management decisions. Leadership by the First Nations communities represented on the commission was critical to ensure the primacy of conservation goals in the plan.

Following a lengthy negotiation period, including a court battle on the final recommendations, the final plan was agreed to in 2019 (Peel Watershed Regional Land Use Plan 2019). The plan resulted in protection of 83 per cent of the Peel watershed (5.6 out of 6.7 million hectares), three per cent of which are for a boreal caribou wilderness area designated specifically to address Yukon's obligations under the federal Species at Risk Act to protect boreal caribou habitat. In total, the planning region is divided into four areas: a special management area (55 per cent), wilderness area (25 per cent), wilderness area for boreal caribou (three per cent) and an integrated management area (17 per cent) (Peel Watershed Planning Commission, 2019). The plan also makes several specific recommendations about transportation and surface access.

Although the Peel Watershed Land Use Plan took nearly 15 years to come to fruition, it represents an important achievement in Indigenous-led conservation and an example of holistic land use, balancing development with the focal benefits that come from protecting intact ecosystems and endangered species habitat.

Key takeaways

- Although the extent of land protected was reduced from the original recommendations, the Peel Watershed Regional Land Use area and related plan is an opportunity to do land management differently in the absence of short-term development pressures.
- Indigenous-led conservation such as this initiative highlights their importance in meeting government objectives and targets regarding species at risk.

The Northern Agriculture Futures Project (ID31, Type 2)

FIGURE 4-13: SAMBAA K'E FIRST NATION COMMUNITY GREENHOUSE © ANDREW SPRING

The Northern Agriculture Futures Project is a collaboration between the Ka'a'gee Tu First Nation, the Sambaa K'e First Nation in the South Slave and Dehcho regions of Northwest Territories and researchers at Wilfrid Laurier University to use agroecology, firebreak agriculture and community gardens to increase community food security. Climate change is affecting access to and availability of traditional foods essential to community well-being, while at the same time expanding the envelope of suitable agricultural land northward, with longer and warmer growing seasons (Bysouth et al. 2021). Given the possibility of an expanded northern agricultural frontier, communities and the government are exploring the fit of agriculture in northern food systems. In the South Slave and Dehcho regions, several funding barriers exist to local food production. As well, there are cultural and ecological risks in replicating southern models of crop production to northern contexts (Bysouth et al. 2021). For example, converting boreal forests to fallow, cropland or grassland in these regions has the potential to decrease soil carbon stocks by 88 per cent, 34 per cent and 64 per cent, respectively (Price et al. 2022).

The $200,000 project, which is funded by Crown-Indigenous Relations and Northern Affairs Canada's Climate Change Preparedness in the North Program, identifies sites to grow food currently and in the future and, through pilot-scale initiatives, builds local capacity and develops agricultural best management practices adapted to different soil types. The project approach rests on agroecology, "an approach to growing food that works with local ecologies, using agricultural practices that

promote biodiversity, provide for local livelihoods, uphold Traditional Knowledge, defend land rights, and support food sovereignty" (Price et al. 2022). Initiatives include work by SKFN and researchers to develop a community garden and greenhouse for produce that is shared through the community store and cooking circles. As well, KTFN and territorial fire managers are working to establish a firebreak farm that supports the community's food system and adaptation to climate change. Firebreaks are cleared areas of forest that fire managers use to try to stop the progression of a wildfire when it approaches communities or other assets of value. The First Nation is using these firebreaks to protect existing assets, but also to meet the community's food needs by re-establishing lost berry patches (e.g., lowbush cranberry) and making other traditionally gathered food and medicine more accessible to the community. By co-developing firebreak farming practices, the project will help to ensure that firebreaks are in place to protect communities from fire-related loss and damage, while also supporting community food systems. The project is also contributing to policy development and knowledge-sharing with other communities in the Northwest Territories. This modest investment in participatory action research and small-scale "on the ground" interventions is helping to define a bio-culturally-appropriate agri-food system that incorporates crop production alongside traditional practices for food provisioning and environmental stewardship (e.g., hunting, trapping, gathering and fishing) and Indigenous guardianship.

FIGURE 4-14: FRAMEWORK FOR AGROECOLOGY IN NORTHERN CANADA (SOURCE: PRICE ET AL. 2022)

Key takeaways

- Small-scale action research projects focused on land management such as the Northern Agriculture Futures Project are potential vehicles to demonstrate the applicability of Type 2 NbS and at the same time inform food system innovations that are locally appropriate (socially and ecologically).
- This project's multifaceted approach has the potential to inform policy across a range of domains including greenhouse gas mitigation policy, land use, climate change adaptation and disaster risk reduction and food security. Communicating project results in a way that supports action will require tailoring to the different policy and management audiences.

5 CONCLUSIONS, GAPS AND RECOMMENDATIONS

Based on the analysis of a set of 38 projects classified as NbS implemented across the country over the past three decades, we offer the following conclusions:

- Nature-based solutions, or projects classified as NbS, are relevant across the country and are increasingly implemented. Implementation has tended to focus in the most densely populated jurisdictions in Canada, with the research also illustrating that, at the local level, most of the high quality and impactful projects are occurring in Canada's largest municipalities (e.g., Toronto, Calgary, Vancouver).
- NbS projects implemented in Canada address a range of societal and environmental challenges, with the focus of these challenges depending on who is implementing the project. For example, stormwater management and urban heat islands are common challenges addressed by municipal NbS projects, whereas Indigenous-led projects may address landscape-level challenges that threaten the assertion of Indigenous rights or undermine their values. Across the set of projects, biodiversity loss and loss of biomass cover are the two most frequent challenges addressed through NbS projects in the inventory.
- The type of NbS projects pursued (protect – Type 1; manage – Type 2; and restore/create – Type 3) also relates to who is leading the project. Municipalities tend to implement Type 3 projects that integrate enhancements to natural assets like forests, as well as naturalized and engineered systems, and low-impact development (e.g., bioswales/bioretention, green roofs, rain gardens, community gardens and street trees). Indigenous-led projects are mainly associated with Type 1 and Type 2 projects, featuring protection and/or improved management of forests, grasslands, riparian vegetation and inland wetlands, among other interventions. Type 2 projects are underrepresented in the inventory, given the focus on identifying and analyzing municipal projects as opposed to projects by other landowners or land users.
- Implementation experience with NbS lends support to a rule-of-thumb on costs, with protection as the least expensive type of NbS per unit area, and improved management in second place. NbS projects focused on restoring ecosystems or creating new ones are the costliest types of NbS per unit area.
- NbS projects are primarily funded by governments (municipal, federal or provincial), whereas implementation is led or championed by diverse actors including NGOs, local organizations and volunteers.

- Indigenous Peoples add significant value to the quality of NbS projects that are implemented in Canada. When projects are Indigenous-led, they are often of higher quality, include a more holistic approach for managing nature and are catalysts for ensuring NbS projects achieve their desired outcome and address identified societal challenges. Furthermore, Indigenous-led projects can generate unique co-benefits that contribute to economic development and at the same time support Indigenous governance and cultures.

- The IUCN Global Standard for NbS is a suitable framework to assess the effectiveness of NbS projects. Based on our qualitative application, and relying on secondary, published information sources, we were able to efficiently identify patterns across projects, such as strengths in articulating the societal challenges to be addressed and weaknesses in managing NbS adaptively and in ensuring the economic feasibility of NbS. Further, the research revealed a statistically significant, positive correlation between projects' performance against the assessment criteria and the number of ecosystem services potentially generated. However, an important limitation of the approach we used is that it does not actually measure against real environmental, social or economic outcomes — e.g., whether the ecosystem service provision has increased/decreased because of the project or whether service provision is being provided successfully at the same or lower cost than the alternative. The companion case study report elaborates on this limitation. Further, the IUCN standard was conceived of as a self-reporting tool. Compared to our third-party approach, project proponents/implementers would have greater and more accurate information sources and knowledge to draw from, but also face some incentives to overstate their project's performance. Data-driven approaches and greater specificity in metrics and thresholds associated with the standard's criteria may bolster replicability and confidence in results. This top-down approach can fail to recognize local context and values shaping decision-making for and outcomes of NbS, such as what are acceptable trade-offs.

- Municipal planning is a significant catalyst for NbS implementation. By strategically planning, designing and implementing approaches for municipalities to reach their sustainability goals (or climate resilience, climate action, biodiversity), it has given rise to diverse implementation of NbS within jurisdictional boundaries. Municipal planning processes often (if not always) incorporate public and community engagement in project planning, presenting an opportunity to enhance inclusiveness of NbS decision-making.

- Multi-jurisdictional collaboration and development of NbS can enhance outcomes and mobilize lessons learned. Individual municipalities are integrating NbS within their jurisdictions. However, multi-jurisdictional collaboration across shared boundaries supports landscape-level approaches and can yield more robust outcomes for sustainability and conservation. Outside of Indigenous-led projects, multi-jurisdictional collaboration was rare in the set of projects in the inventory.

In this report, we have identified the current state of NbS implementation and how effective these interventions have been at addressing societal challenges and providing ecosystem benefits. We've also identified several barriers and subsequent enablers to NbS implementation. Below we identify **knowledge gaps** that, if filled, could support further upscaling NbS implementation.

- **Uncertainty in NbS performance.** Several projects identified (e.g., ID04, ID05, ID08, ID24, ID25) do not include a robust monitoring program, and in some cases, do not monitor post-implementation (e.g., ID08). A robust monitoring program is a prerequisite for any one project to achieve a comprehensive understanding of effectiveness, including the multiple benefits provided by the NbS. This is not unique to Canadian projects, as it has been found that few projects globally are able to quantify the holistic value of market and non-market benefits NbS projects provide (Viti et al. 2022). By valuing the benefits provided by NbS, comparisons to other common engineering practices and conservation practices can be made, which improve NbS uptake more broadly, and address several current barriers to NbS implementation (Sarabi et al. 2019, Seddon et al. 2020a). At the same time, comprehensive monitoring and understanding of NbS effectiveness helps reveal the limits of NbS, lending support to the approach that seeks complementarity between green and grey solutions (Seddon et al. 2020a).
- **Limited knowledge on the potential negative impacts of NbS implementation.** Although momentum for NbS is growing, there is limited knowledge on the potential negative impacts of NbS implementation on communities in Canada and society at large. The IUCN assessment framework included a criterion of the unintended adverse consequences on nature arising from the NbS, but it did not account for societal impacts that could occur because of the intervention (e.g., spatial injustice, green gentrification). Gentrification is not common in all Canadian municipalities, but it is prominent in Canada's densest cities (Toronto, Vancouver, Montreal), which may be vulnerable to the impacts of green gentrification unless given priority in municipal planning. San Francisco, a city well-known for issues of gentrification, has seen an increase in spatial injustice because of green gentrification as well, where investments in nature led to higher housing prices, displacing its most vulnerable residents, and primarily distributing nature to those who can afford it (Kamerling 2022). More broadly, Anguelovski and Corbera (2023) have identified "nature-enabled dispossession" as a potential outcome of NbS implementation that is embedded in business-as-usual development paths in both urban and rural settings (see Appendix 7.4).
- **Uncertainty in how to set priorities for implementation of NbS on the landscape/seascape.** Although finance for NbS implementation in Canada will almost certainly increase in the coming years, resource constraints are likely to endure, including financial and human resource constraints. Therefore, guiding strategic priorities is important, including identifying the NbS opportunities that will provide the most value for money. Though a complex task to develop, spatially explicit guidance on multi-criteria prioritization or screening of NbS for

project selection would be useful. Indeed, the NSERC-funded initiative ResNet is currently undertaking ecosystem-specific and cross-cutting research to improve monitoring, modelling and management of ecosystem services in working land and seascapes across the country[5]. In principle, knowledge and products stemming from this research and through its links to Statistics Canada have the potential to transform priority-setting for NbS. The timelines for this research are unclear, however.

Adding a spatial analytic dimension to the prioritization process would enable consideration of landscape-scale effectiveness metrics like connectivity and species richness, as well as metrics that are more attuned to capturing socio-ecological co-existence. Ecosystem service mapping at a national level has tended to focus on identifying carbon-rich natural and semi-natural areas, but climate change mitigation is one criterion among many. Additionally, strategically examining the opportunities for NbS in urban ecosystems merits attention so that NbS applications do not end up being isolated green spaces but larger-scale interventions that deliver larger benefits, connect to surrounding ecological processes and functions (LaNotte and Zulian 2021) and consider the potential for spatial injustices. Recent spatial analysis by WWF-Canada overlaying the potential for carbon storage and biodiversity benefits to inform priorities for ecological restoration of converted lands in Canada (Currie et al. 2023) is work to build on.

- **Climate resilience of NbS.** The capacity of ecosystems and natural assets to deliver services, including carbon sequestration and storage and reduced human vulnerability to climate change impacts, is affected by their exposure and sensitivity to climate and ocean changes and the way these systems are managed (Seddon et al. 2020a). Ecological processes in marine, freshwater and terrestrial ecosystems are already undergoing shifts driven by human-caused climate change, with disruptions registered from the gene to the community level (Scheffers et al. 2016). For example, rising temperatures and changing precipitation patterns are altering the growth, survival rates and regeneration of trees, and increasing the risk of wildfires in forests. Similarly, wetlands may experience changes in water availability and quality due to altered rainfall patterns. Therefore, NbS planning and implementation needs to consider the potential impacts of climate change and to continually monitor and adapt these solutions in response to changing conditions. Adaptive management is a tried and tested approach to dealing with uncertainties when it comes to ecosystem management. Effectiveness monitoring and robust assessment support an adaptive management mindset, providing the evidence needed to course correct.

Consistent with the DSF's strategic goal of supporting integration of nature in decision-making via municipal leadership, the analysis in this report mainly relies on our review of municipal NbS projects. Nevertheless, opportunities for DSF and partners to contribute to scaling Type 1, Type 2 and Type 3 NbS involves a

broadening the focus on municipalities. Based on the conclusions and knowledge gaps described here, we offer the following recommendations:

1. Work systemically, integrating strategies to i) create an enabling policy environment that shifts normative frameworks (i.e., laws, policies, plans and public budgets), ii) strengthen organizational mandates, structures and capacities and iii) contribute to behavioural and attitudinal changes that normalize implementation of effective and inclusive NbS, via outreach, use of champions and targeted research. Furthermore, there is a role for DSF and ENGO collaborators to provide or facilitate access to technical assistance for policy and strategy development to increase incentives for NbS implementation and reduce harmful actions, development of NbS project portfolios that optimize outcomes DSF most cares about and robust implementation of NbS projects. See Appendix 7.4 and 7.5 for additional ideas on strategy.

2. Work in collaboration with other ENGOs and interdisciplinary researchers to leverage digital solutions, such as remote sensing and mapping, modelling and forecasting tools to i) identify geographic areas where NbS implementation should be prioritized based on, for example, the match between biodiversity potential, ecosystem service delivery and ecosystem service needs, and ii) assess the impacts of NbS on ecosystems and human communities.

3. Work in collaboration with other ENGOs, social equity-focused organizations and NbS practitioners to develop project screening criteria based on multiple attributes, encouraging the identification and differentiation of focal ecosystem services and co-benefits. There is an opportunity to build norms and standards on what constitutes sustainable or effective NbS, creating confidence and clarity for undecided proponents and funders. In doing so, build on the experience in this assignment on the use of IUCN's Global Standard for NbS.

4. Join and actively participate in the coalition of organizations such as the new Invest in Nature Hub, and contribute to setting a national agenda for scaling nature-based finance, coordinating efforts and aligning resources and guidance. More diverse funding streams, including from the private sector, are needed to increase uptake of nature-based projects. Type 2 and Type 3 projects can more easily attract private investment than Type 1 NbS projects focused on protection and delivering public benefits (see SPI 2021). Nevertheless, there is a need to track the evolution, effectiveness and course correction of innovative financial mechanisms, such as conservation easements, project funding for permanence, green bonds and impact bonds, and to design and test additional ones that focus on rewarding protection and stewardship.

5. In concert with other ENGOs, create opportunities to support and amplify Indigenous-led efforts to scale up Type 1 and Type 2 NbS projects. Support could look like:

    a. advocating for enhanced government funding and proliferation of schemes

like project finance for permanence,

b. developing business cases or road maps for nature-based investments,

c. contributing to research and sharing lessons from implementation of existing Indigenous-led NbS projects,

d. supporting co-development of methods to assess and monitor ecosystem service flows using knowledge from land-based guardians alongside instrumental data,

e. tracking implementation of the nature-related commitments in the National Adaptation Strategy and net-zero plans for contributions to Indigenous land/water governance.

6. To advance Type 3 NbS projects, focus efforts on small and medium municipalities, where capacity and other constraints are greatest and where assistance identifying a project pipeline, project preparation (ecosystem service valuations, etc.), aggregating projects (fundable scale) and enabling collaboration for regional/watershed approaches are needed.

7. Using an "ecosystem" or networked approach, continue advancing municipal Type 3 projects, working to i) raise public awareness of the advantage of NbS for cities and towns compared to traditional approaches or as part of green-blue-grey solutions, ii) advocate for additional dedicated funding and policy to incentivize integration of NbS into municipal decision-making, iii) support the uptake of tools for feasibility assessment, design and monitoring of good NbS projects, iv) deliver knowledge exchange and capacity-strengthening activities aimed at demonstrating NbS effectiveness and generating knowledge on the climate resilience of NbS over time.

8. Continue to work with and support the Natural Assets Initiative, Intact Centre for Adaptation, International Institute for Sustainable Development, Smart Prosperity Institute, Federation of Canadian Municipalities and the constellation of non-government organizations advancing Type 3 NbS across the country to formulate provincial/territorial-specific strategies to scale up NbS, accounting for situational context in each jurisdiction. Place a specific focus on small and medium municipalities and local governments in the north.

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7 APPENDICES

7.1 SOURCES CONSULTED TO IDENTIFY NBS PROJECTS

SOURCE	RESOURCE TYPE	URL
Natural Infrastructure New Brunswick	Database	https://www.naturalinfrastructurenb.ca/case-studies/
Urban Nature Atlas	Database	https://una.city/
Nature Canada - Nature-based Climate Solutions – Map Submissions	Database	https://naturecanada.ca/view/nature-based-climate-solutions-map-submissions/
Nature Based Climate Solutions - Canada's Grassroots Community Based NGOs	PowerPoint	https://www.naturebasedclimatesolutions.ca/s/5-1330-1500-Lindsay-Telfer-NBCSS-From-Canadas-Grassroots-Community-Based-NGOs.pptx
Nature-Based Solutions for Coastal and Riverine Flood and Erosion Risk Management	Report - Case studies	https://www.csagroup.org/wp-content/uploads/CSA-Group-Research-Nature-Based-Solutions-for-Coastal-and-Riverine-Flood-and-Erosion-Risk-Management.pdf
Environmental Damages Fund: Project Map	Database	Environmental Damages Fund: project map - Canada.ca
Catalogue Solutions Nature Quebec	Website	https://naturequebec.org/projets/#Biodiversite
Municipal Natural Assets Initiative	Website	MNAI | Municipal Natural Assets Initiative – Making Nature Count
Benefits of Adopting Natural Infrastructure	Report - Case studies	https://awc-wpac.ca/wp-content/uploads/2019/08/Adopting-Natural_Infrastructure.pdf
Parks Canada - CC and NBS	Website	Climate change and nature-based solutions - Science and conservation (pc.gc.ca)
Building Regional Adaptation Capacity and Expertise Program	Database	Building Regional Adaptation Capacity and Expertise Program (nrcan.gc.ca)
Changing Climate	Database	Case Studies — Canada in a Changing Climate

7.2 STRATEGIES, PLANS, AND POLICIES THAT SUPPORT OR COULD SUPPORT NBS IMPLEMENTATION

Note: this list is non-exhaustive.

MUNICIPALITY	PLAN NAME AND YEAR	URL
Vancouver, British Columbia	Vancouver Climate Emergency Plan, 2020	Vancouver Climate Emergency Plan
	Vancouver Climate Change Adaptation Strategy, 2012	Climate Change Adaptation Strategy
	Greenest City Action Plan 2020, 2011	Greenest City Action Plan
	The Vancouver Plan, 2022	Vancouver Plan
	Vancouver's Urban Forest Strategy, 2012	Vancouver Urban Forestry Strategy
	Vancouver Biodiversity Strategy, 2016	Vancouver Biodiversity Strategy
	Rain City Strategy, 2019	Vancouver Rain City Strategy
	Citywide Integrated Rainwater Management Plan, 2016	Citywide Integrated Rainwater Management Plan

MUNICIPALITY	PLAN NAME AND YEAR	URL
Surrey, British Columbia	Coastal Flood Adaptation Strategy, 2019	Coastal Flood Adaptation Strategy
	Biodiversity Conservation Strategy, 2014	Biodiversity Conservation Strategy
	Natural Areas Management Plan, 2002	Natural Areas Management Plan
	Climate Change Adaptation Strategy, 2013	Climate Adaptation Strategy
	Community Climate Action Strategy, 2013	Community Climate Action Strategy
	Climate Action Now, 2022	Climate Action Plan (In development)
	Shade Tree Management Plan, 2016	Shade Tree Management Plan
	Sustainability Charter 2.0, 2016	Sustainability Charter "2.0"
	Ecosystem Management Study, 2011	Ecosystem Management Study
Edmonton, Alberta	Nature Based Carbon Sequestration Policy Brief, 2019	Nature-based carbon sequestration - City of Edmonton
	Edmonton Wetland Strategy, 2012	Edmonton Wetland Strategy
	Climate Resilient Edmonton: Adaptation Strategy and Action Plan, 2016.	Climate resilient Edmonton adaptation strategy and action plan
	The Way We Green, 2011	The way we green environmental strategic plan
	The Way We Grow, 2008	The way we grow municipal development plan
	Climate Resilient Council Policy, 2021	C627 Climate Resilience Policy
Calgary, Alberta	Our BiodiverCity, 2010	BiodiverCity
	Biodiversity Policy, 2015	Biodiversity Policy
	Calgary's Flood Resilience Plan, 2022	Calgary's Flood Resilience Plan
	Environmental Strategy, 2021	Calgary's Environment Strategy
	Climate Change Strategy, 2022	Calgary Climate Change Strategy
	ImagineCalgary, 2006	imagineCalgary Long Range Urban Sustainability Plan
	Municipal Development Plan, 2009, updated 2020	Municipal Development Plan – Section 2.6 – Greening the City
Saskatoon, Saskatchewan	Green Infrastructure Strategy, 2020	Green Infrastructure Strategy and Implementation Plan
	Pathways for an Integrated Green Network, An Implementation Plan for Saskatoon's Green Infrastructure Strategy, 2022	Pathways for an Integrated Green Network
	Meewasin Valley-Wide Monitoring Framework, 2021	Meewasin Valley-Wide Monitoring Framework
	Urban Forest Management Plan, 2021	Urban Forest Management Plan
	The Low Emissions Community Plan, Saskatoon's Actions for Climate Change Mitigation, 2019	Low Emissions Community Plan
	Climate Action Plan, 2017	Climate Change Action Plan
	Local Actions, Adaptation Strategy, 2018	Local Actions Adaptation Strategy
Regina, Saskatchewan	Energy and Sustainability Framework, 2022	Regina's Energy & sustainability framework
	Renewable Regina, 2022	Renewable Regina

MUNICIPALITY	PLAN NAME AND YEAR	URL
Winnipeg, Manitoba	Ecologically Significant Natural Lands Strategy & Policy, 2007	Ecologically Significant Natural Lands Strategy & Policy
	Climate Action Plan, 2018	Winnipeg's climate action plan
	OurWinnipeg 2045 Development Plan, 2022	OurWinnipeg 2045
	Plan20-50, 2022	20 to 50 (currently in draft)
Brandon, Manitoba	Brandon Climate Change Action Plan, 2022	Brandon Climate Action Plan
	Brandon Brownfield Strategy, 2017	Brandon Brownfield Strategy
	Brandon's Environmental Strategic Plan, 2013	Brandon's Environmental Strategic Plan (2013),
	Brandon Water Conservation Plan, 2013	Brandon Water Conservation Plan (2013)
Toronto, Ontario	Toronto's TransformTO climate action strategy, 2017	TransformTO
	Toronto Resilience Strategy, 2019	Toronto Resilience Strategy
	Strategic Forest Management Plan 2012-2022, 2013	Toronto Strategic Forest Management Plan
	Toronto Ravine Strategy, 2020	Toronto Ravine Strategy
	A Biodiversity Strategy for Toronto, 2019	Toronto Biodiversity Strategy
	Parkland Strategy, 2019	Parkland Strategy
	Climate Resilience Framework, 2019	Climate Resilience Framework
	TransformTO NetZero Strategy, 2021	NetZero 2040
	Wet Weather Flow Master Plan	WWFMP
Ottawa, Ontario	Climate Change Master Plan, 2020	Ottawa Climate Change Master Plan
	Long Term Risk Prevention and Mitigation Plan, 2012	Ottawa's long-term risk prevention and mitigation plan
	A Plan for Sustainability and Resilience in Canada's Capital Region, 2012	A plan for Sustainability & Resilience in Canada's Capital Region
	The Plan for Canada's Capital 2017 (NCC)	The Plan for Canada's Capital (2017-2067)
	Ottawa River Action Plan	Ottawa River Action Plan
	Climate Resiliency Strategy (in development)	Climate Resiliency action plan (in development)
	Water Environment Strategy, 2016	Water Environment Strategy
	Official Plan – Natural Ottawa, 2019	Discussion Paper – Natural Ottawa Official Plan
Montreal, Quebec	Montreal 2030, 2019	Montreal 2030
	Montreal Climate Plan 2019	Montreal Climate Plan 2030
	Nature and Sports Plan, 2019	Montreal Nature and Sports Plan: Integrating nature into the city
	2030 Plan for a Green Economy (Province of Quebec), 2019	2030 Plan for a Green Economy (Provincial)
Quebec City, Quebec	Tree Vision 2015-2025, 2014	Tree vision
	Quebec Rivers Development Plan 2020-2040, 2020	Quebec Rivers Development Plan
Fredericton, New Brunswick	Climate Change Adaptation Plan 2020-2025, 2019	Climate Change Adaptation Plan
	Municipal Plan (adopted in 2020)	Fredericton Municipal Plan

MUNICIPALITY	PLAN NAME AND YEAR	URL
Moncton, New Brunswick	Integrated Sustainability Plan, 2011	City of Moncton Integrated Sustainability Plan
	Climate Change Adaptation and Flood Management Strategy, 2013	Climate Change Adaptation and Flood Management Strategy
	Naturalized Stormwater Management Guidelines, 2015	Naturalized Stormwater Management Guidelines
	Climate Action Report, 2020	Climate Action Report
Charlottetown, PEI	Charlottetown Canopy Cover Assessment,	Canopy Cover assessment
	Climate Change Action Plan for PEI, 2018	PEI Climate Change action Plan
	Integrated Community Sustainability Plan, 2017	Integrated Community Sustainability Plan
St. John's Newfoundland	Resilient St. John's. Community Climate Plan: Adapting to Climate Change, 2022	Resilient St. John's – Adapting to Climate Change
	Envision St. John's Municipal Plan, 2021	City of St. John's municipal plan
	Landscape Development Policy, 2021	St. John's Landscape development policy
	St. John's Urban Forest Management Master Plan, 2006	St. John's Urban Forest Management Master Plan
	Integrated Community Sustainability Plan, 2010	Integrated Community Sustainability Plan
Whitehorse, Yukon	Regional Parks Plan, 2014	Regional Parks Plan
	Official Community Plan, 2010 (currently being updated)	Official Community Plan
Nunavut	Guidelines for the Design and Assessment of Tundra Wetland Treatment Areas in Nunavut, 2016	Guidelines for the Design and Assessment of Tundra Wetland Treatment Areas in Nunavut

7.3 ADDITIONAL FIGURES AND TABLES

Figure 7-1: Time series of the budgets of 22 NbS projects in our Excel-based inventory (2020$) with budget information, categorized by Types 1, 2 and 3.

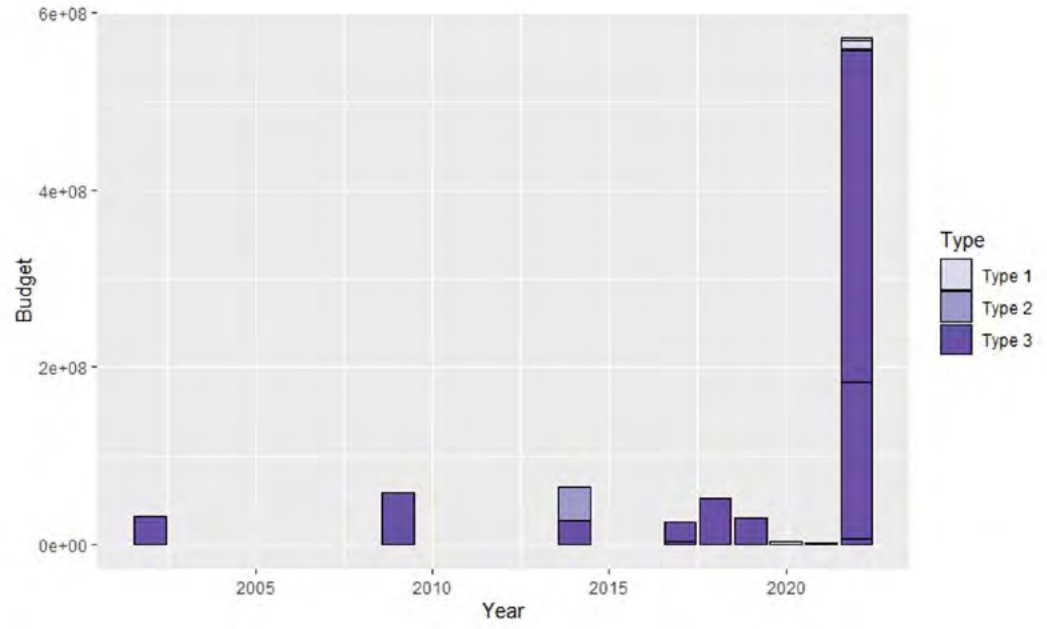


Figure 7-2: Time series of the budgets of 22 NbS projects in our Excel-based inventory (2020$) with budget information, categorized by Types 1, 2 and 3. The budget figures were log transformed (base 10) for ease of comparison.

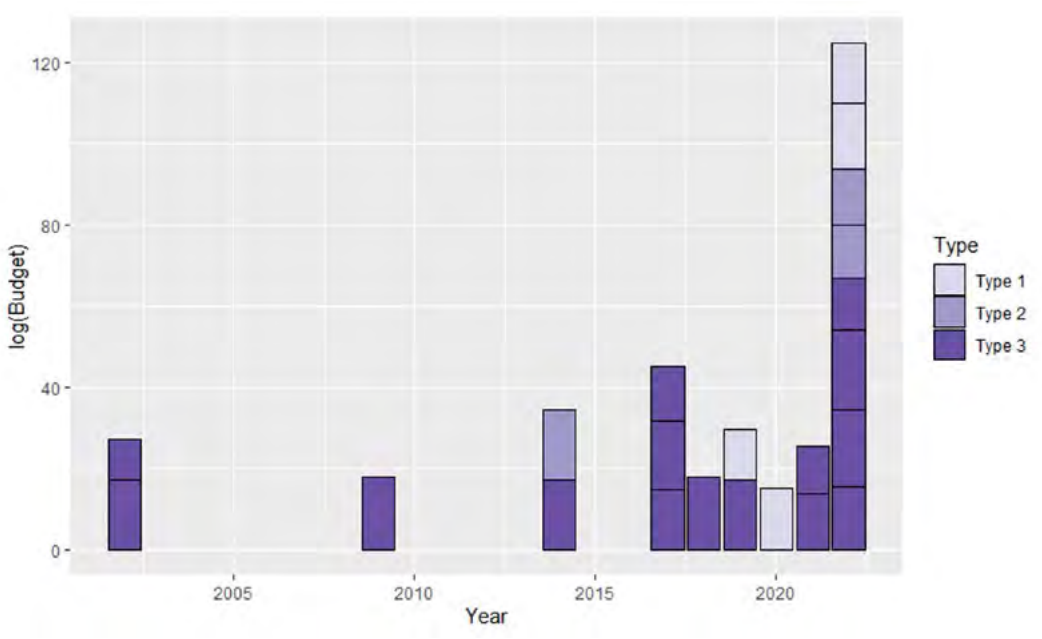


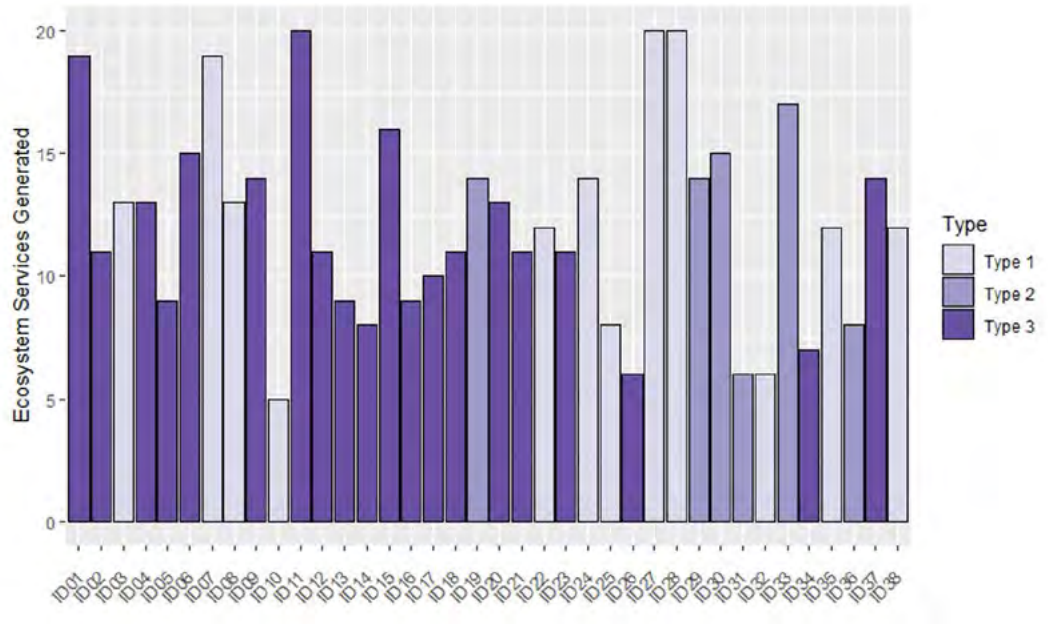
Table 7-1: Distribution of the 22 NbS project in our Excel-based inventory by budget and NbS type.

BUDGETS (2020$) OF NBS PROJECTS IMPLEMENTED	TYPE 1 (PROTECT)		TYPE 2 (MANAGE)		TYPE 3 (RESTORE/ CREATE)	
	COUNT	COLUMN %	COUNT	COLUMN %	COUNT	COLUMN %
under 1 million	1	25%	2	67%	5	33%
1 million-10 million	3	75%		0%	2	13%
11-20 million		0%		0%		0%
21-30 million		0%		0%	3	20%
31-40 million		0%		0%		0%
41-50 million		0%	1	33%	1	7%
51-60 million		0%		0%	2	13%
over 60 million		0%		0%	2	13%
Total	4	100%	3	100%	15	100%

Table 7-2: Time series of NbS projects by type, showing budgets and land area covered per project. Type 1 projects (protect) are shaded in blue, Type 2 projects (manage) are shaded in purple and Type 3 projects (restore/create) are shaded in green.

YEAR	BUDGET (CAPITAL COST $2020)	BUDGET (CAPITAL COST MILLION $2020)	CAPITAL COST ($2020)	AREA COVERED (HA)	LAND AREA (HA)	TYPE
1992				2,800	500-1 million ha	Type 1
2004				23	10-500 ha	Type 1
2005				69	10-500 ha	Type 1
2014				12,655	500-1 million ha	Type 1
2015				170	10-500 ha	Type 1
2019	251,650	0.3	under 1 million	130	10-500 ha	Type 1
2020				22	10-500 ha	Type 1
2020	3,380,000	3.4	1 million - 10 million	866	500-1 million ha	Type 1
2022				3,900	500-1 million ha	Type 1
2022				4,050	500-1 million ha	Type 1
2022	8,940,000	8.9	1 million - 10 million	1,421,800	1-2 million ha	Type 1
2022	2,860,800	2.9	1 million - 10 million	5,000,000	4-5 million ha	Type 1
2014	40,953,750	41.0	41-50 million	12,357	500-1 million ha	Type 2
2016				6,400,000	over 6 million ha	Type 2
2019				6,743,100	over 6 million ha	Type 2
2021						Type 2
2022	475,410	0.5	under 1 million			Type 2
2022	783,144	0.8	under 1 million	30	10-500 ha	Type 2
1994				12,937	500-1 million ha	Type 3
2002						Type 3
2002	41,983,830	42.0	41-50 million	26	10-500 ha	Type 3
2002	33,965	0.03	under 1 million	1	Under 10 ha	Type 3
2002						Type 3
2008						Type 3
2009	69,588,400	69.6	51-60 million	156	10-500 ha	Type 3
2014	29,268,280	29.3	21-30 million	99	10-500 ha	Type 3
2016						Type 3
2017	3,996,195	4.0	1 million - 10 million	1	Under 10 ha	Type 3
2017	23,108,800	23.1	21-30 million	1	Under 10 ha	Type 3
2017	808,808	0.8	under 1 million	3,300	500-1 million ha	Type 3
2018	53,320,800	53.3	51-60 million			Type 3
2019	29,996,680	30.0	21-30 million	900	500-1 million ha	Type 3
2021	955,017	1.0	under 1 million	0	Under 10 ha	Type 3
2021	101,439	0.1	under 1 million	11	10-500 ha	Type 3
2022	4,917,000	4.9	1 million - 10 million	6	Under 10 ha	Type 3
2022	158,238,000	158.2	over 100 million	213	10-500 ha	Type 3
2022	335,250,000	335.3	over 100 million	153	10-500 ha	Type 3
2022	323,852	0.3	under 1 million	1	Under 10 ha	Type 3

Figure 7-3: The number of ecosystems generated or potentially generated by the 38 NbS projects in our Excel-based inventory, by NbS type (Type 1=protect; Type 2=manage; Type 3=restore/create).



To look for correlations between our assessment of projects' performance against the NbS assessment framework and the generation of ecosystem services we used a data analysis tool in Excel — ordinary least squares (OLS) regression analysis. OLS regression helps characterize the relationship between two variables (x and y). The tool draws a line through a scatter plot in a way that minimizes the deviations of single observations (data points) from the line, provides a formula to explain the relationship between variables and information on whether this relationship is statistically significant (i.e., likely not caused by chance). Correlation coefficient (R) is the correlation between predicted values and observed values of y. If the correlation coefficient is less or equal to 0.3, we consider the relationship a weak correlation; if the correlation coefficient is greater than 0.3 but less than 0.7, we consider the relationships a moderate correlation and if the correlation coefficient is greater or equal to 0.7, we consider the relationship a strong correlation. R squared (R2) is another term we use (see below). This is the square of the correlation coefficient and indicates the percentage of variation explained by the regression line out of the total variation.

Figure 7-4: Scatter plot showing the number of ecosystem services generated by the 38 projects in the Excel inventory as a function of project scores against the NbS assessment framework.

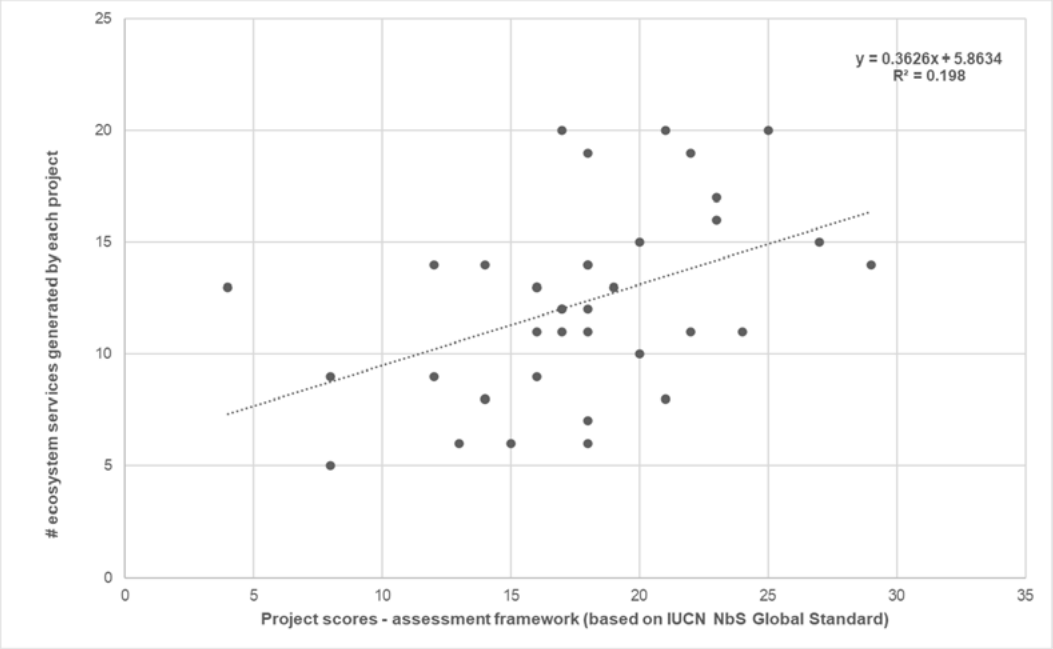


Figure 7-4: Scatter plot showing the number of ecosystem services generated by the 38 projects in the Excel inventory as a function of project scores against the NbS assessment framework. Figure 7 4 plots the number of ecosystem services (potentially) generated by project in our Excel inventory as a function of projects' performance using the IUCN assessment framework. Regression analysis shows a statistically significant increase in the number of ecosystem services the better performing the project is. The information provided below suggests a moderate correlation between the two variables (correlation coefficient of 0.44), with a regression model that are statistically significant at the 0.05 level.

Regression Statistics		
R	0.444961764	Moderate absolute correlation
R Square	0.197990972	
Adjusted R Square	0.175712943	
Standard Error	3.766719113	
Observations	38	

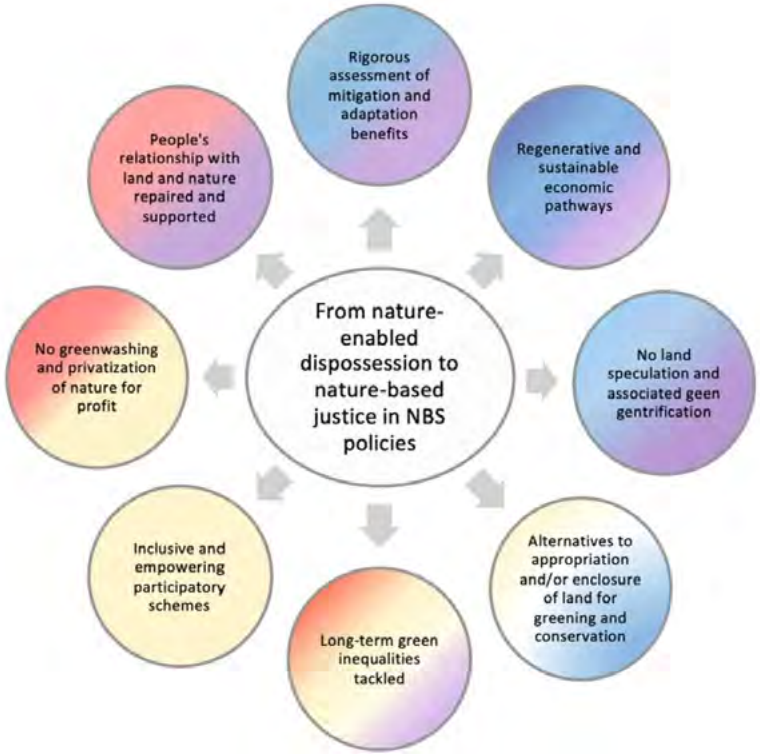
ANOVA

	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	126.0941974	126.0941974	8.887275232	0.005123395	alpha =	0.05	Cannot reject regression model
Residual	36	510.7742236	14.18817288					
Total	37	636.8684211						

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*			
Intercept	5.863436848	2.223507554	2.637021331	0.012269476	1.353954517	10.37291918	1.353954517	10.37291918	alpha =	0.05	Statistically Significant
Overall Score (assessment framework	0.362558982	0.121617019	2.981153339	0.005123395	0.115908235	0.609209728	0.115908235	0.609209728	alpha =	0.05	Statistically Significant

7.4 FRAMEWORK FOR NATURE-BASED JUSTICE IN POLICYMAKING

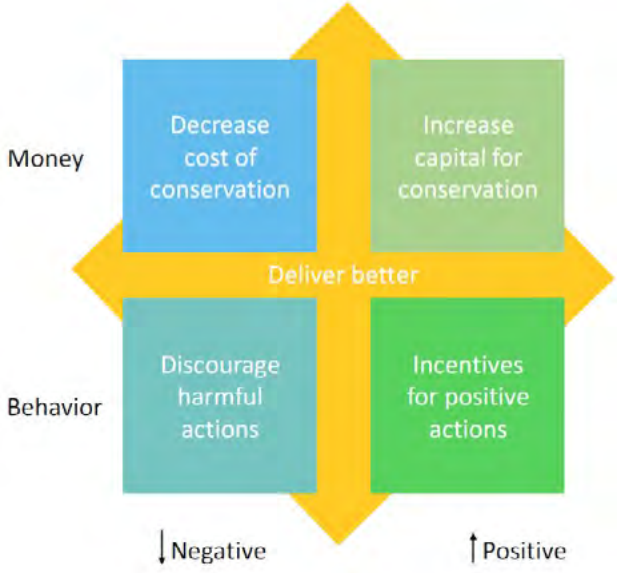
Figure 7-5: Principles for tackling existing environment and climate, social and economic challenges related to NbS, from policy appraisal (blue), decision-making (yellow), implementation (red), to evaluation (purple) (Source: Anguelovski and Corbera 2023).



7.5 FRAMEWORK OUTLINING OUTCOMES OF CONSERVATION FINANCE

Meyers et al. (2020) argue that shifting funding flows toward conservation (by extension "good" NbS) requires a more nuanced approach than quantifying the finance gap and then mobilize to fill it. The approach should integrate strategies and tactics that cover the four quadrants shown in Figure 7-6.

Figure 7 6: Four main outcomes of conservation finance solutions (Source: Meyers et al. 2020).



FOOTNOTES

1 Some global sources also include land degradation as a third crisis (Deutz et al. 2020).

2 https://www.canada.ca/en/campaign/2-billion-trees/natural-climate-solutions-fund-performance-indicators.html

3 "Municipal" is defined broadly and refers to entities that provide services to communities including villages, towns, cities, district municipalities, water improvement districts, regional governments, service commissions, Indigenous communities and nations, conservation authorities (Ontario) and other major title/rights/jurisdiction holders relevant to local government services.

4 Multi-solving involves pooling financial, human resources and political will to solve multiple problems with a single investment of time and money (Sawin 2018).

5 https://www.nsercresnet.ca/about.html