

Nature-based Solutions to Address Flood Risks in Coastal Communities



Summary of Key Processes and Frameworks



“With much of the existing infrastructure in North America exceeding or nearing the end of its service life, there is an opportunity to consider the role of Nature-based Solutions (NBS) in coastal protection.”

Coastal flood risks are projected to intensify across North America due to increasing population densities near the coastline and the effects of climate change. Coastal flood and erosion risk management systems in North America have historically relied upon building hardened structures with constructed material (i.e., concrete, steel, etc.), which in some instances have resulted in unintended socio-economic impacts, catastrophic failures, and the degradation or loss of natural ecosystems.

In 2021, the Commission for Environmental Cooperation (CEC) initiated a project to support the broader uptake of NBS to manage flood risks in coastal communities across Canada, Mexico, and the United States. As part of the project, a comprehensive set of four guidance documents were developed on NBS, covering the topics of co-benefits, retrofitting existing infrastructure, and monitoring efficacy and methodology.

Four Guidance Documents



Co-Benefits



Retrofitting Existing Infrastructure



Monitoring Efficacy



Monitoring Efficacy: Proposed Methodology & Indicators



Canada | Salt Marsh Restoration
Port of Vancouver, 2018



Mexico | Mangrove Restoration
San Crisanto Foundation, Nature4Climate, 2022



United States | Island Restoration
NOAA NCCOS, 2022

Guidance Documents Overview

When developing the set of guidance documents, the general objectives were to:

- Develop a value proposition for NBS
- Summarize key technical and administrative considerations
- Summarize opportunities, constraints, and options
- Develop strategies and practical tools to support decision making
- Provide tangible examples through case studies
- Fill gaps identified by participants at a series of intersectoral workshops, where possible



Co-Benefits

NBS provides primary flood risk management benefits and secondary environmental, social, and economic co-benefits. These four categories of benefits are dynamic and interconnected, with significant overlap between each.

Overview

The specific objectives of the Co-Benefits guidance document were to:

- Provide a comprehensive summary of potential social, environmental, and economic co-benefits.
- Provide practical tools to identify, value, and compare co-benefits.

Co-Benefit Valuation Methods

	Time	Budget	Expertise	
Social				
Conceptual Modeling	🟡	🟡	🟡	↑ Potential Project Impact or Risks
GIS Analysis	🟡	🟡	🟡	
Technical Analysis Using Existing Data	🟡	🟡	🟡	
Expert Opinion	🟡	🟡	🟡	
Canvassing/Polling	🟡	🟡	🟡	
Citizen Science	🟡	🟡	🟡	
Workshops	🟡	🟡	🟡	
Case Study Analysis	🟡	🟡	🟡	
Observational Analysis	🟡	🟡	🟡	
Environmental				
Field Surveys	🟢	🟢	🟢	↑ Potential Project Impact or Risks
Ecosystem Service Modeling	🟢	🟢	🟢	
Remote Sensing Techniques	🟢	🟢	🟢	
Passive Measurement	🟢	🟢	🟢	
Technical Analysis Using Existing Data	🟢	🟢	🟢	
Expert Opinion	🟢	🟢	🟢	
Citizen Science	🟢	🟢	🟢	
Case Studies	🟢	🟢	🟢	
Observational Analysis	🟢	🟢	🟢	
Economic				
Cost-Benefit Analysis	🟢	🟢	🟢	↑ Potential Project Impact or Risks
Life Cycle Costing	🟢	🟢	🟢	
Cost of Living Assessment	🟢	🟢	🟢	
Economic Growth of Industry Sectors	🟢	🟢	🟢	
Technical Analysis Using Existing Data	🟢	🟢	🟢	
Statistical Analysis	🟢	🟢	🟢	
Expert Opinion	🟢	🟢	🟢	
Case Study Analysis	🟢	🟢	🟢	
Observational Analysis	🟢	🟢	🟢	

Analyzing co-benefits helps to:

- ✓ Compare options holistically
- ✓ Improve engagement and public buy-in
- ✓ Improve accountability
- ✓ Anticipate trade-offs and set priorities
- ✓ Comply with project requirements
- ✓ Increase funding opportunities
- ✓ Inform adaptive management
- ✓ Share knowledge

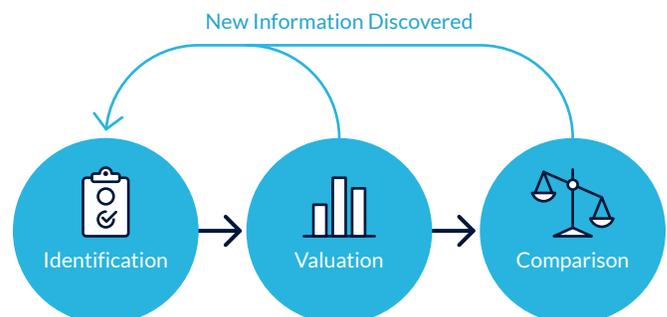
Co-Benefits Assessment Stages

1. Identification: Includes understanding the ‘big picture’ by engaging with stakeholders, government agencies, and Indigenous Peoples, and identifying key experts to identify potential co-benefits.

2. Valuation: Involves determining the potential value or impact of each co-benefit, assigning appropriate valuation methods, selecting performance indicators, setting baselines, and valuing the co-benefits.

3. Comparison: Includes assessing trade-offs, prioritizing co-benefits, and comparing co-benefits associated with different design options. A multi-criteria analysis is recommended to account for intangibles and project-specific objectives.

Each stage includes defined outcomes and is broken up into multiple, tangible steps.





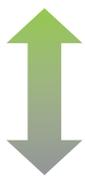
Retrofitting Existing Infrastructure

Retrofitting existing flood risk management systems with NBS involves replacing, modifying, or enhancing existing gray infrastructure with natural or nature-based features and processes.

Overview

The specific objectives of the Retrofitting guidance document were to:

- Demonstrate the value proposition of retrofitting, and outline incentives.
- Provide a comprehensive summary of retrofitting options.
- Provide cost-comparisons.
- Develop strategies to identify and compare retrofitting opportunities and options.



The NBS Spectrum

When discussing retrofitting, it is useful to consider that all coastal protection infrastructure exists on a NBS spectrum, often referred to as the 'Gray to Green' spectrum.

Relative Costs for NBS by Project Development Stage

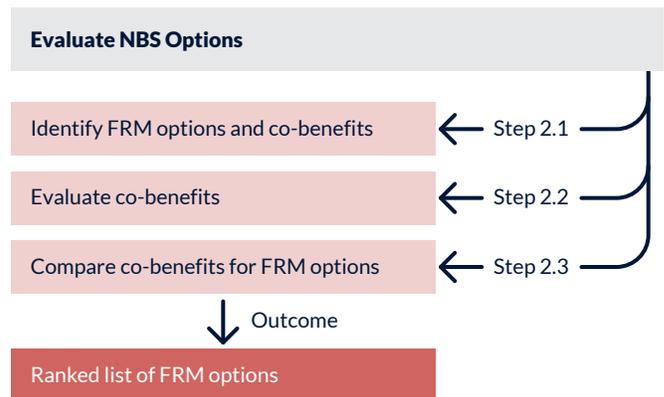
	Planning & Design	Construction	Operations & Maintenance	Overall Cost
Beaches & Dunes	● ● ○	● ● ○	● ● ●	● ● ○
Wetlands & Tidal Flats	● ● ○	● ● ○	● ● ○	● ● ○
Islands	● ● ●	● ● ●	● ● ●	● ● ●
Terrestrial Vegetation	● ○ ○	● ○ ○	● ○ ○	● ○ ○
Submerged Features	● ● ○	● ● ●	● ● ○	● ● ○
Hybrid Features	● ● ●	● ● ●	● ● ○	● ● ●

Low Cost ● ○ ○ Intermediate Cost ● ● ○ High Cost ● ● ●

Retrofitting Stages

1. Identify Opportunities: Involves creating an inventory of existing assets, developing an engagement strategy, evaluating needs, assessing site suitability, and prioritizing identified retrofitting opportunities.

2. Evaluate Options: Involves evaluating and comparing a wide range of retrofitting options (including a 'do-nothing' approach). A multi-criteria analysis is recommended to compare project-specific flood risk management benefits and co-benefits for each option.



Each stage includes defined outcomes and is broken up into multiple, tangible steps.



Monitoring Efficacy

Effective adaptive management and monitoring are key to alleviating uncertainties and challenges associated with NBS, and form the foundation of NBS projects.

Overview

The specific objectives of the Monitoring Efficacy guidance document were to:

- Provide a value proposition for investment in monitoring.
- Summarize key administrative and technical considerations for monitoring, including roles and responsibilities, funding challenges, methods, varying physical environments, and time and spatial scales.

“Adaptive management is built on the principle of addressing and reducing uncertainties in NBS projects in a phased implementation. Monitoring is vital to adaptive management.”



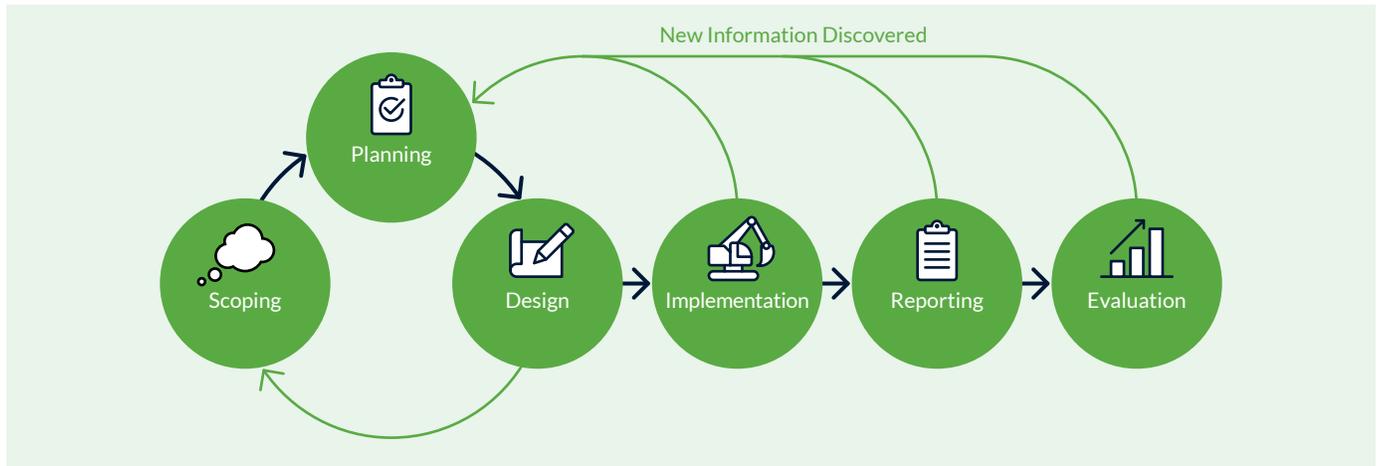
Monitoring Efficacy: Proposed Methodology & Indicators

Overview

The specific objectives of the Monitoring Efficacy: Proposed Methodology & Indicators guidance document were to:

- Summarize guiding principles and goals of monitoring.
- Establish core and additional Performance Indicators.
- Outline non-intensive and intensive monitoring methods/techniques.
- Summarize specific considerations for NBS options and ecosystems.

Monitoring Process



Core and Additional Performance Metrics and Performance Indicators are proposed in Monitoring Efficacy: Proposed Methodology and Indicators. These parameters (and other outlined monitoring plan components) must be refined on a project-specific basis.

Examples of Core and Additional Performance Metrics

	Core	Additional	Not applicable
Performance Metric			
Reduced flood hazard area for a given event			
Reduced flood hazard exposure for a given event			
Reduced wave effects for a target area			
Increased habitat connectivity to adjacent habitats			

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