ADAPTATION TO A CHANGED CLIMATE

INTACT CENTRE
ON CLIMATE ADAPTATION




Navigating Climate Risks Along Canada's Coasts Challenges and Opportunities

Canadian Board of Marine Underwriters Spring Conference

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UNIVERSITY OF WATERLOO

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Agenda

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1. Canada’s Coasts in a Changing Climate
2. The Need for Climate Adaptation (as well as Mitigation)
3. Adaptation Tools and Actions for Marine Infrastructure & Operations
4. Working with Nature
5. Key Takeaways

Intact Centre on Climate Adaptation

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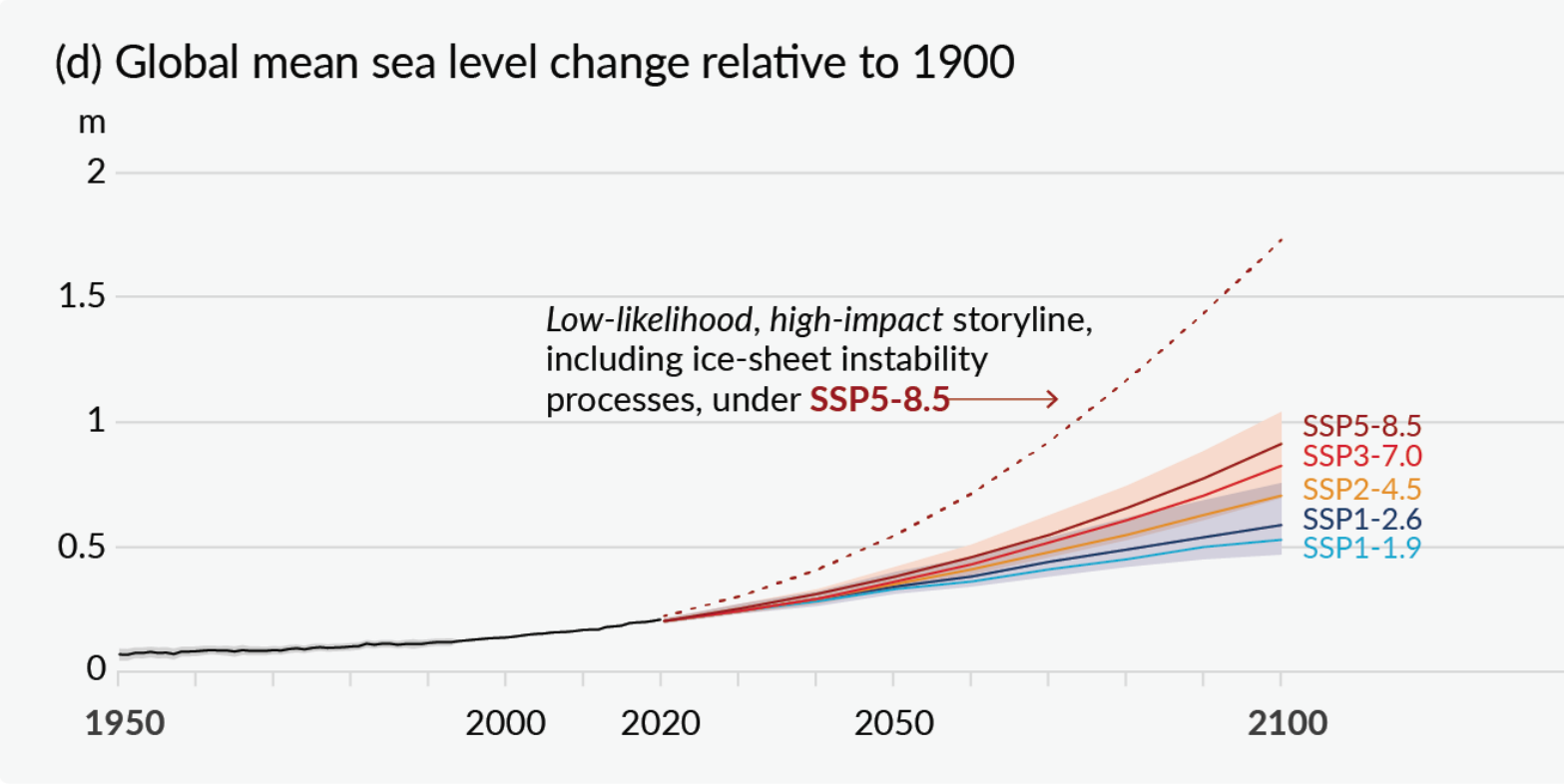
- Applied research centre on Climate Adaptation with a **national focus**
- Bilingual resources

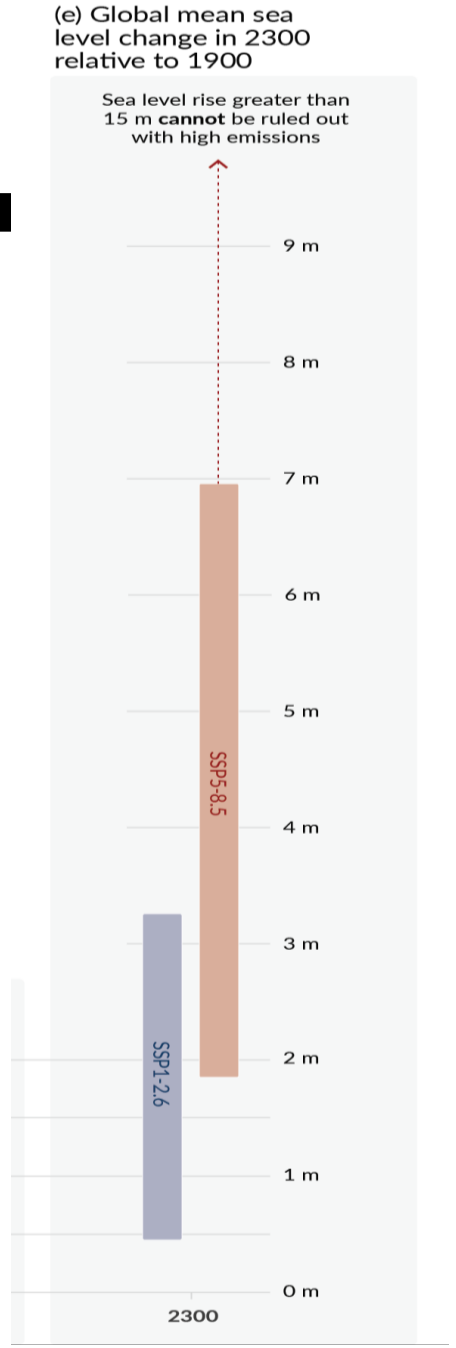
Two main goals:

- To influence the national conversation about climate change to address **climate adaptation**
- To help **residents, communities and businesses** to reduce risks associated with climate change and extreme weather events

IPPC 6th Assessment: Global Mean Sea Level Change

- It is ***virtually certain*** that global mean sea level will continue to rise over the 21st century.
- Sea level is **committed to rise for centuries to millennia** due to continuing deep-ocean warming and ice-sheet melt and will remain elevated for thousands of years (*high confidence*).





Coastal Communities on the Climate Change Frontline

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- Nearly **11% of the global population** (896M) are already living on low-lying coasts directly exposed to coastal hazards

- Population potentially exposed to a 100-year coastal flood is projected to increase by about 20% if global mean sea level rises by 0.15 m relative to 2020 levels; this **exposed population doubles at a 0.75m rise, and triples at 1.4m.**

- **Under all climate and socioeconomic scenarios, low-lying cities and settlements and deltaic communities will face severe disruption, as early as 2050 in many cases**

https://www.ipcc.ch/report/ar6/wg2/downloads/outreach/IPCC_AR6_WGII_FactSheet_CitiesSettlementsBtS.pdf

The Canadian Context

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1. Canada's climate **has warmed and will warm further** in the future, driven by human influence.
2. Both past and future warming is on average **about double** the magnitude of global warming.
3. Warming is **effectively irreversible**.

Climate Impacts

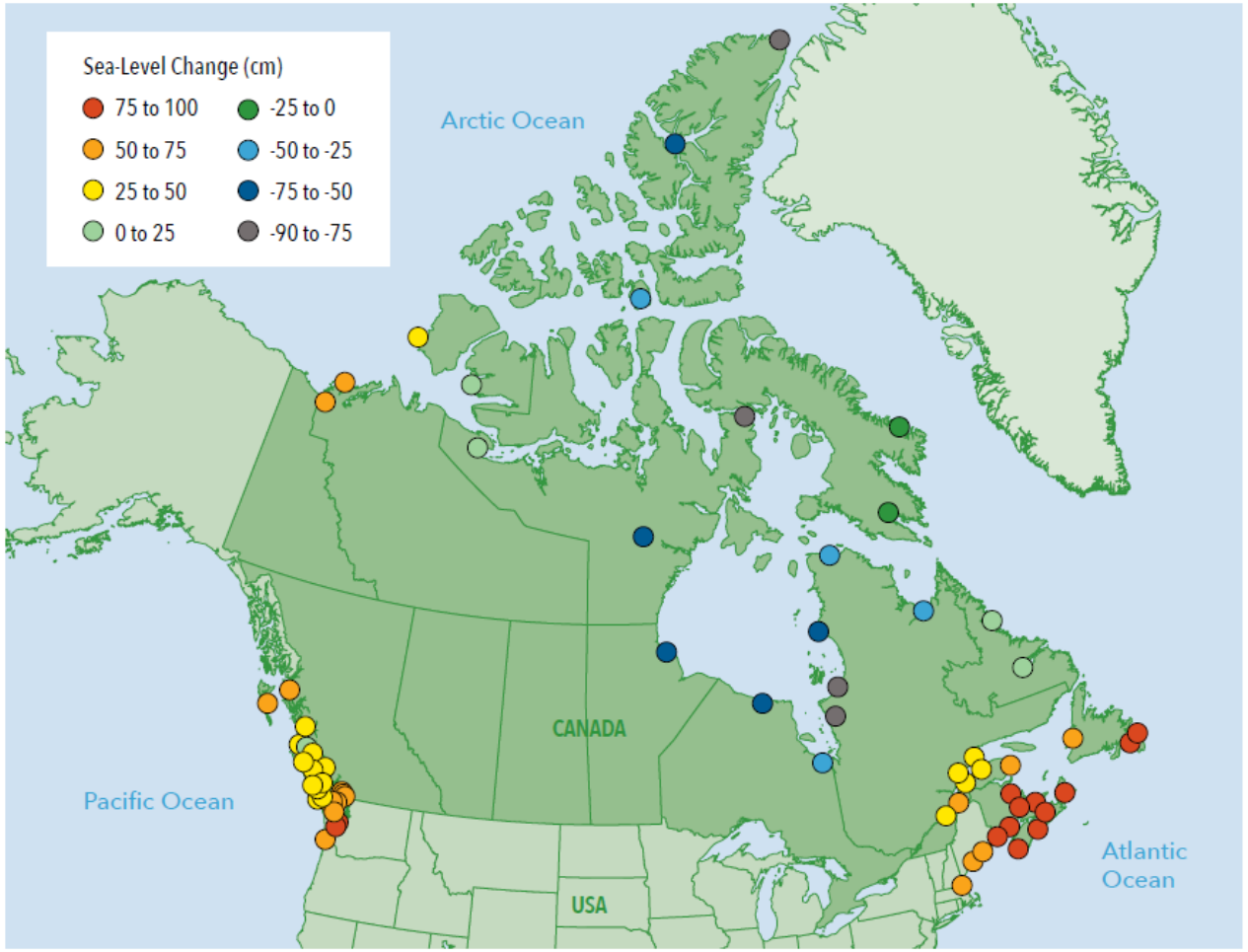
- More extreme heat / less extreme cold
- Shorter seasonal coverage of snow and ice
- Melting of glaciers and permafrost
- Rise in sea level

+ Intensification of extremes:

- Intense rainfall and urban flooding
- Coastal flooding
- Severity of heat waves
- Risk of drought and forest fire

Canada's Marine Coasts

- Relative sea-level change
- Storm surge
- Changing sea ice conditions
- Coastal erosion
  - Dynamics are changing
  - May also be caused by human intervention
- Hurricane intensity (Atlantic)



Projected relative sea-level changes shown at 2100 for the median of a high emission scenario (RCP8.5) at 69 coastal locations in Canada and the northern United States.

Hurriance Fiona – September 24, 2022 (Canada)

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- Category 4 Atlantic hurricane
- **Costliest and most intense tropical or post-tropical cyclone to hit Canada on record.**

- Major flooding in Quebec's Magdalen Islands, southeastern New Brunswick, Prince Edward Island, northeastern Nova Scotia, and southern Newfoundland.

- Over $800M CAD in insured damages
- More than 500,000 customers left without power, including 80% of all Nova Scotia customers and 95% of Prince Edward Island customers

Not « just » an environmental issue….

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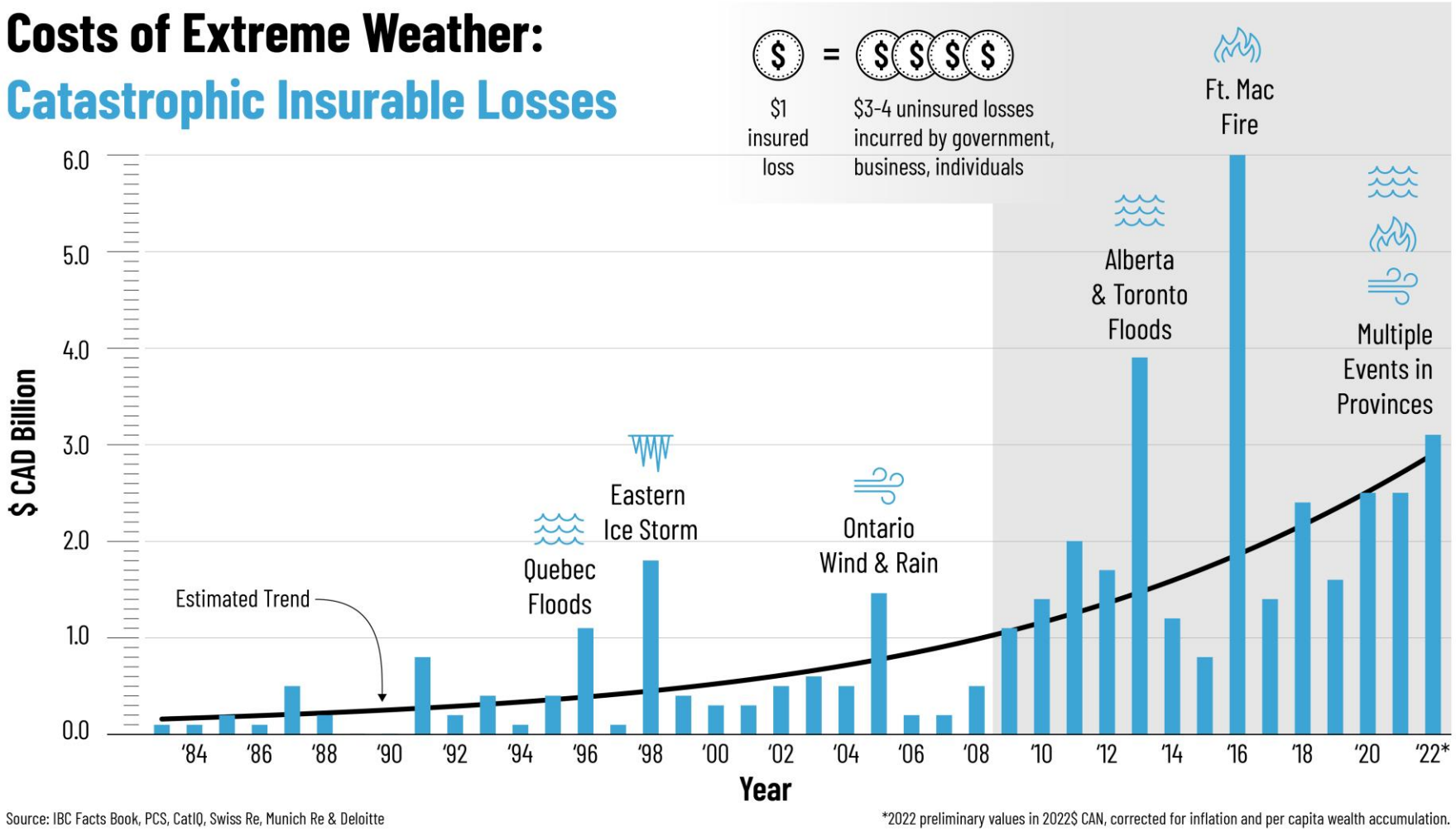

Source: IBC Facts Book, PCS, CatIQ, Swiss Re, Munich Re & Deloitte

*2022 preliminary values in 2022$ CAN, corrected for inflation and per capita wealth accumulation.

- Most recently over $2billion insured losses
- Most losses are not insured.
- Catastrophic losses are not all “financial”, particularly with extreme heat

Climate Adaptation and Climate Mitigation

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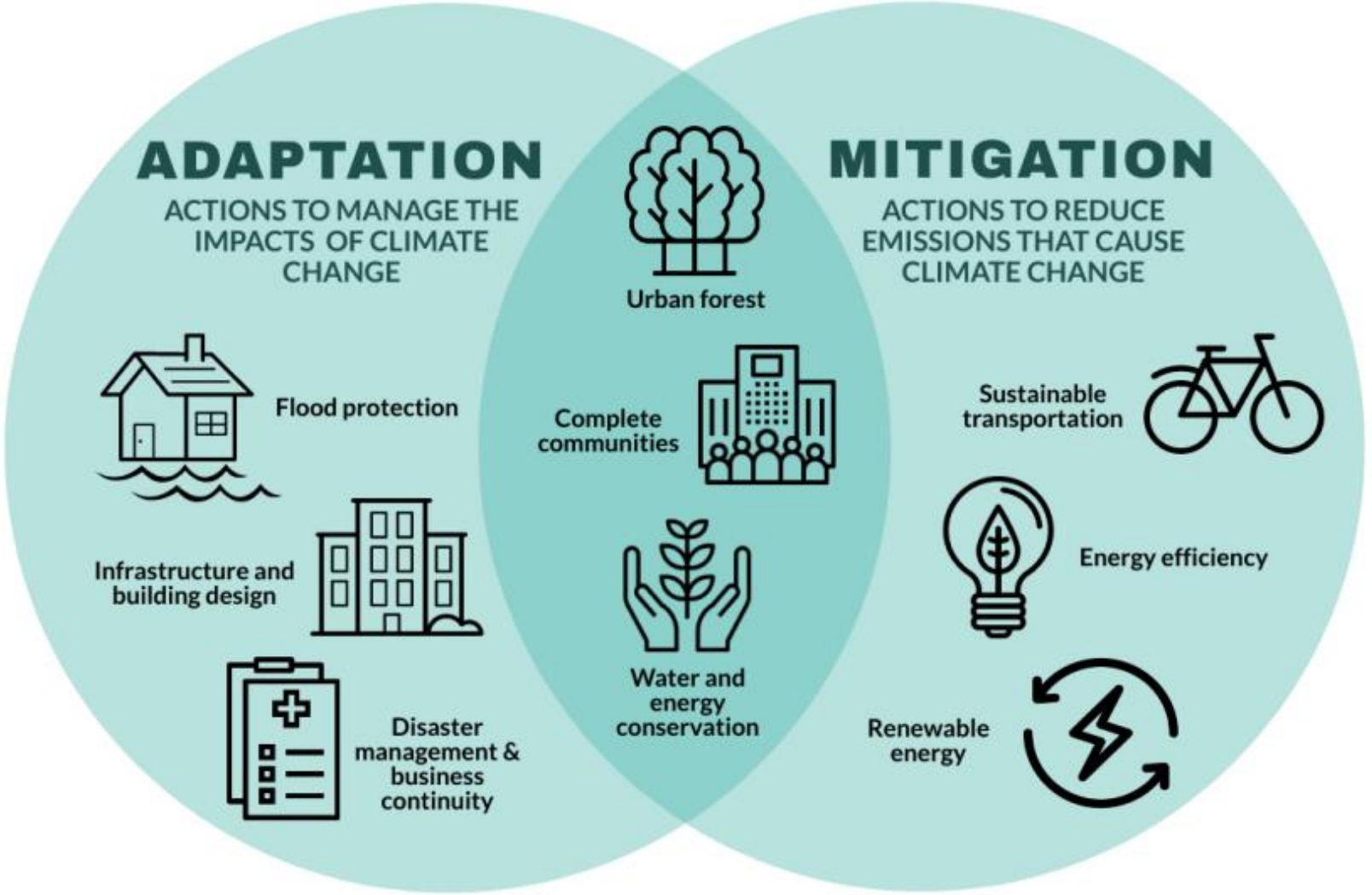
- **Adaptation** is managing the unavoidable
- **Mitigation** is avoiding the unmanageable
- It is not a choice



Climate Adaptation is Risk Management

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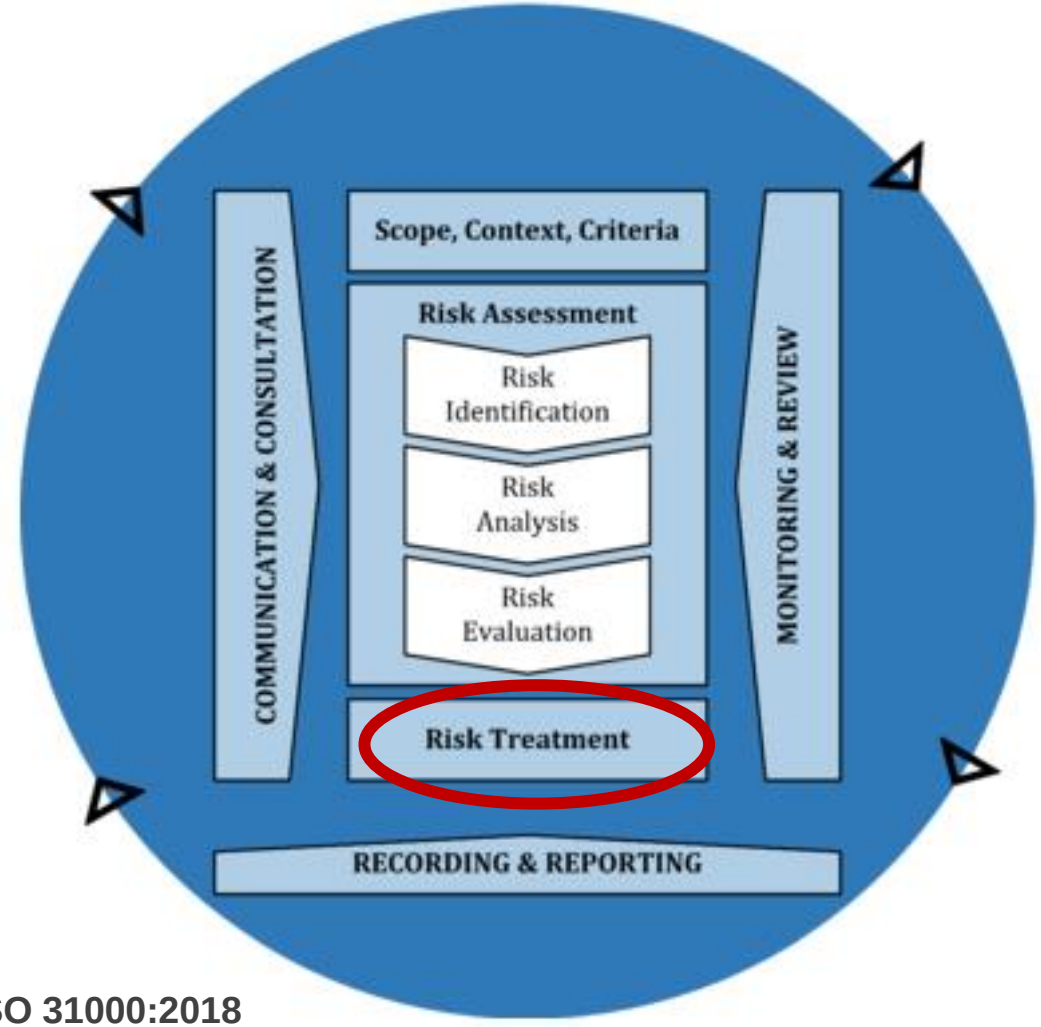

ISO 31000:2018
Risk Management — Guidelines

Insurers have a key role to play:

- understanding changing natural hazards
- understanding climate changes and sea level rise.
- assessing climate risk to buildings, infrastructure, businesses and municipalities they insure
- offering risk transfer solutions
- decreasing the insurance gap
- **incentivising behaviour to reduce risk**

The Necessity and the Potential for Adaptation

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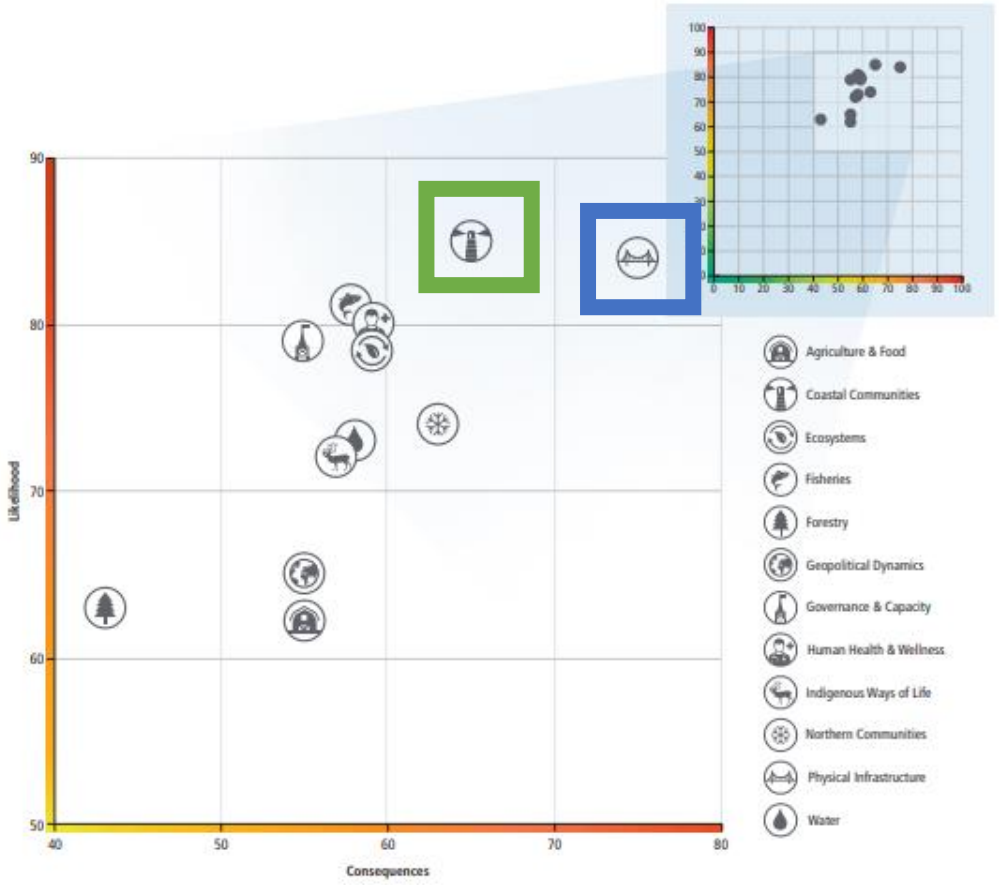
Principal risks (Probability x Consequence)



Potentiel for Adaptation

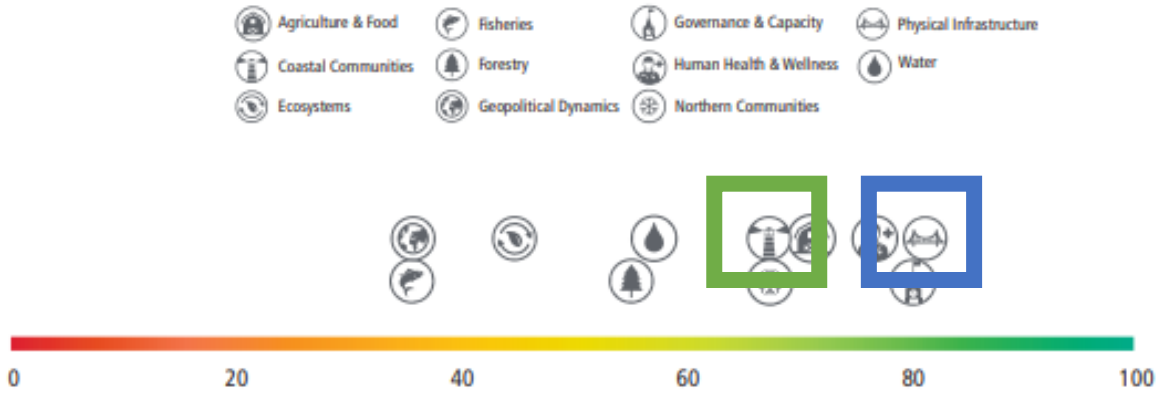


Figure 3.1
Panel Assessment of Adaptation Potential by Risk Area
This graph illustrates the ascribed results of the adaptation potential assessment by risk area. The Panel could not produce a defensible evaluation of the adaptation potential of Indigenous ways of life due to the lack of Indigenous members on the Panel and limited inclusion of Indigenous knowledge in the assessment.

Physical Infrastructure

Coastal Communities

Source: Council of Canadian Academies, 2019

International Coastal Adaptation Responses

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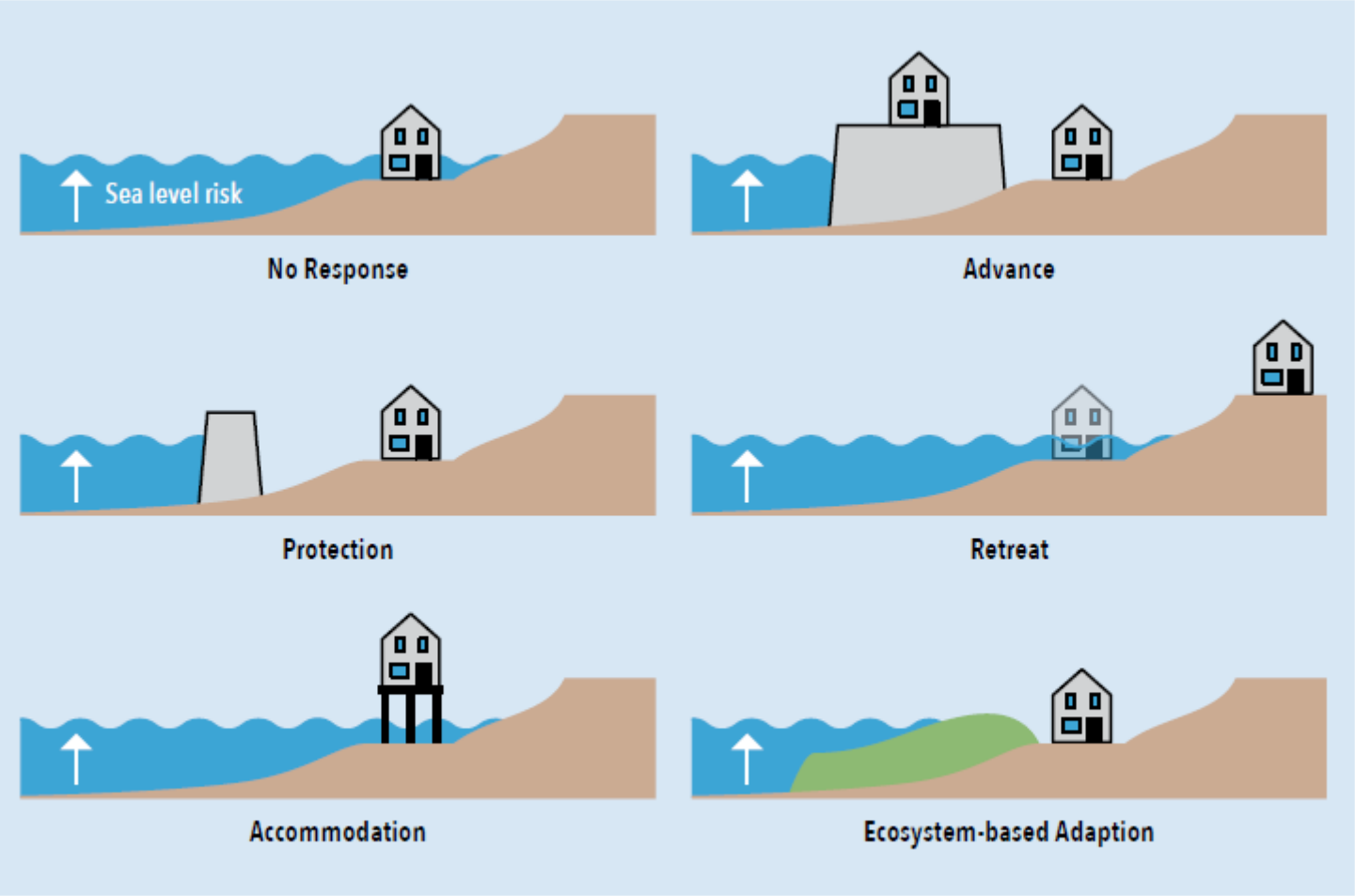

Figure 3 : Different types of responses to coastal risk and sea level rise (Source: Oppenheimer, et al. 2019)[37]

https://www.ipcc.ch/srocc/chapter/chapter-4-sea-level-rise-and-implications-for-low-lying-islands-coasts-and-communities/

Adapt-action is required at different scales

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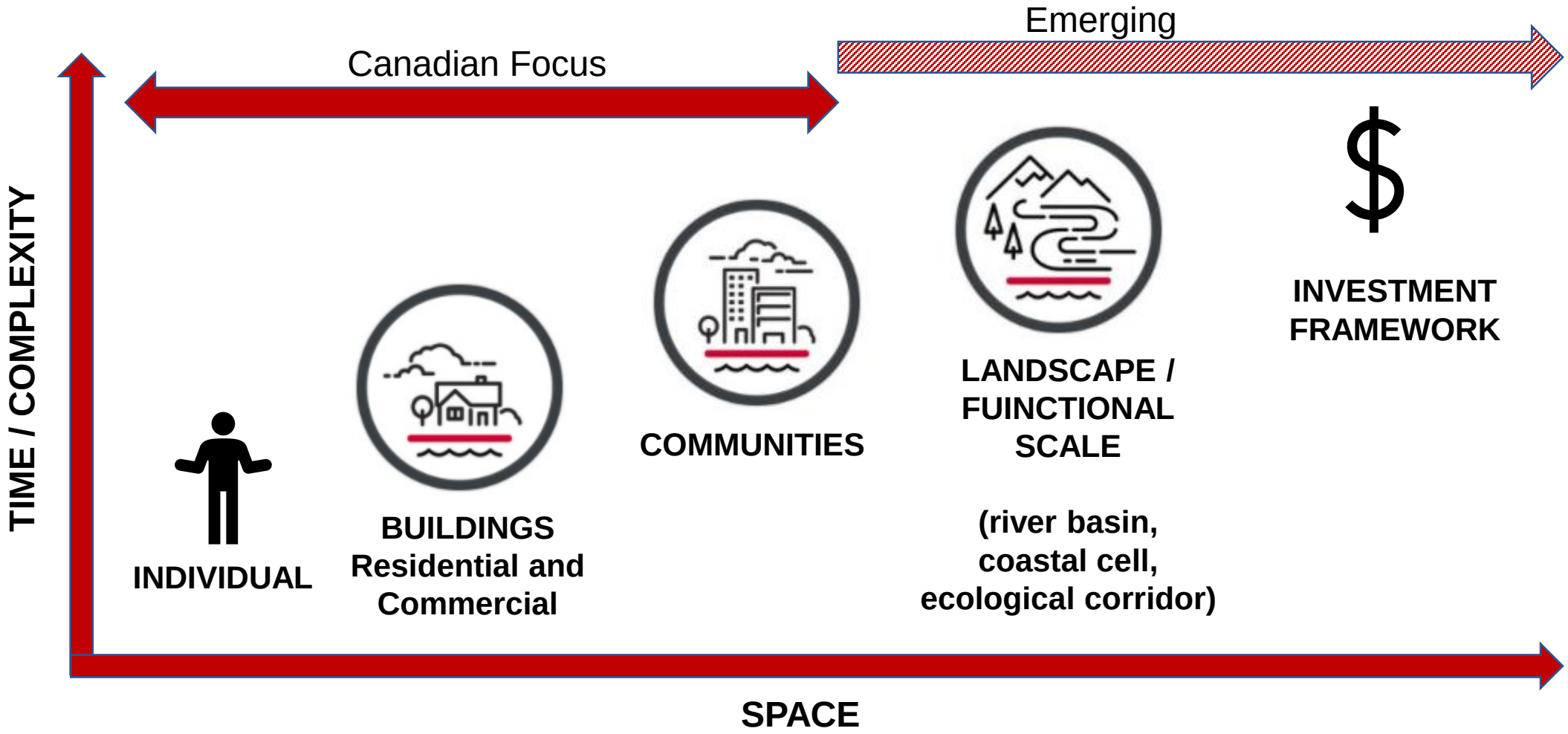

*Icons from "Calgary – Flood Resilience Plan"

Source: https://www.calgary.ca/uep/water/flood-info/mitigation-and-resilience/flood-projects.html

Time-Scales for Adaptation

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SIXTH ASSESSMENT REPORT
Working Group II – Impacts, Adaptation and Vulnerability

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Fact sheet - Responding to Sea Level Rise

Typical timescales of coastal risk management

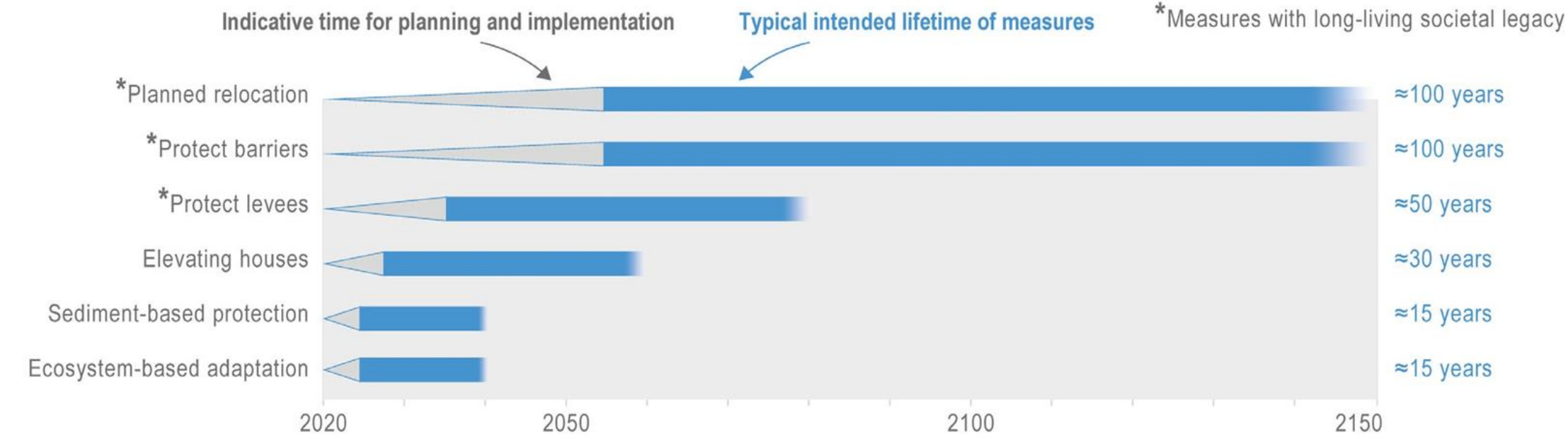

Figure 1: Typical timescales for the planning, implementation (grey triangles) and operational lifetime of current coastal risk-management measures (blue bars). {Figure CCB SLR.1a}

https://www.ipcc.ch/report/ar6/wg2/downloads/outreach/IPCC_AR6_WGII_FactSheet_SLR.pdf

Evolution in Adaptation Approaches

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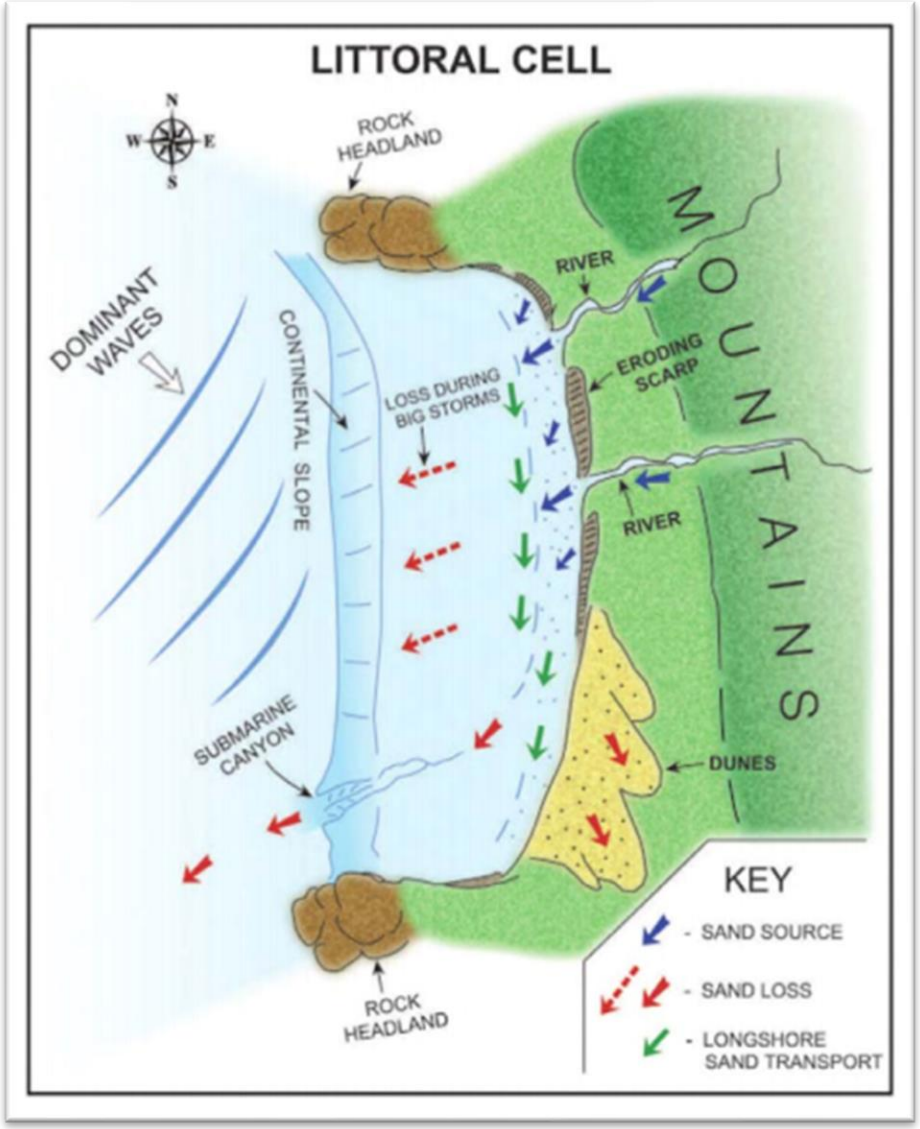
- Recognition of need to consider climate risks in tandem with **people** and **nature**.

- International movement towards solutions that:
  - are strategic and long-term (100yrs)
  - work with natural processes, at the functional scale (littoral cell), rather than fighting them
  - combine structural and non-structural measures (e.g. planning)
  - combine grey and natural infrastructure



This is not the answer….

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- New coastal development in Prince Edward Island is prohibited until a coastal zone policy is developed.
- Environmental protection order prohibits new development in the buffer zone and associated erosion control activities in the watercourse and/or wetland boundary.

https://www.thestar.com/news/canada/2023/02/01/after-controversial-development-pei-suspends-new-shoreline-protection-projects.html

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Impacts on Ports and Marine Transport

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Obvious….

- flooding due to overtopping
- high in-channel river flow velocities or changes in sea state
- low flow or drought
- changes in sediment or debris regime
- bed or bank erosion
- reduced visibility
- change in wind characteristics

….and less obvious impacts.

- extreme cold, ice or icing
- extreme heat
- changes in ocean water acidity
- changes in salinity or saltwater intrusion
- changes in vegetation growth
- changes in species migration or range
- changes in native species survivability or growth rate
- introduction or spread of invasive, non-native species

Source: PIANC REPORT N° 178 (2020) Climate Change Adaptation Planning for Ports and Inland Waterways
https://www.pianc.org/publications/envicom/wg178has

Tools to Assess Climate Risk and Vulnerability

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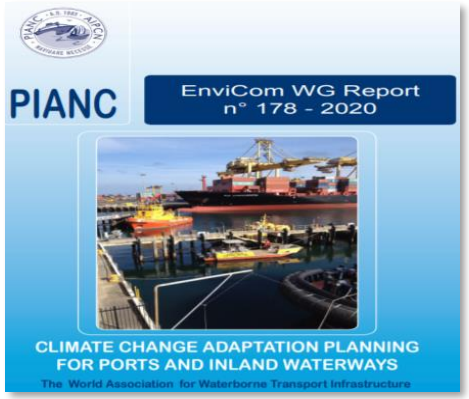
Climate Lens

- Developed by Infrastructure Canada – Mandatory for Funding Streams
- Includes Greenhouse Gas mitigation and Climate Change Resilience assessments

The PIEVC protocol

- Public Infrastructure Engineering Vulnerability Committee's (PIEVC) Engineering Protocol, developed by Engineers Canada
- 5-step process to analyze the engineering vulnerability of each infrastructure component to climate change impacts



Climate Change Adaptation Planning for Ports and Inland Waterways

- Developed by World Association for Waterborne Transport Infrastructure (PIANC)

Climate Risk Management - Canada

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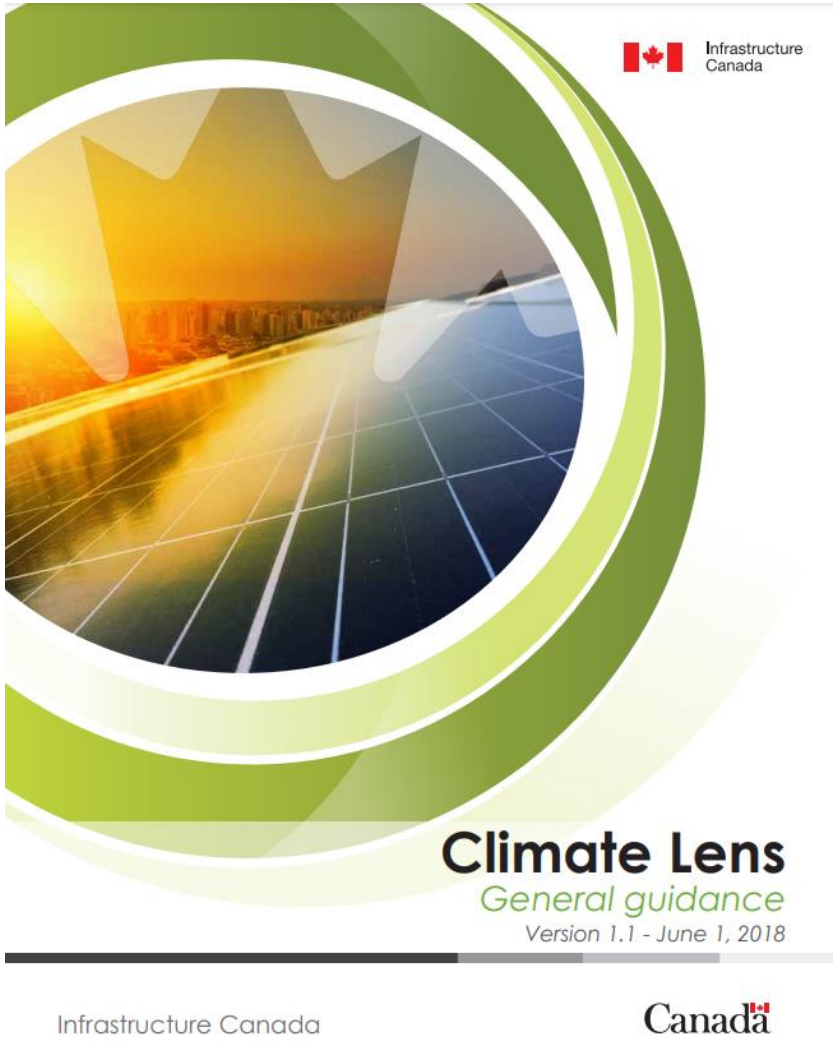
Climate Lens

- Federal guidance
- Required for several funding streams including :
  - Investing in Canada Infrastructure Program
  - Disaster Mitigation and Adaptation Fund
  - Smart Cities
- Required for Federal EIA
- Two components
  - Greenhouse Gas Mitigation Assessment.
  - Climate Change Resilience Assessment.
- Requires qualified professional

https://www.infrastructure.gc.ca/pub/other-autre/cl-occ-eng.html



The PIEVC protocol

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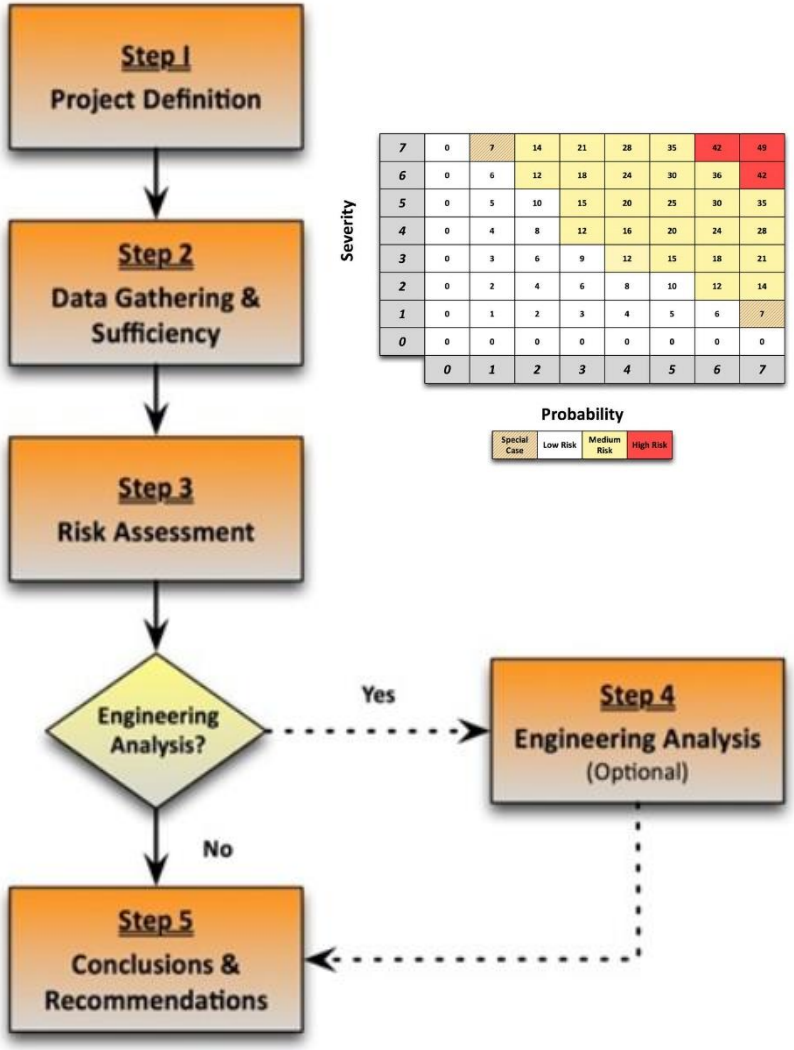
- Approach
  - 5-step systematic approach
  - Assesses engineering vulnerability of each infrastructure component to climate impacts

- Available for use at no financial charge for any public infrastructure assessment project in Canada.

- Contact as of March 2020:
  - Institute for Catastrophic Loss Reduction (ICLR) and the Climate Risk Institute (CRI) in Canada.
  - Email: pievc@iclr.org

- ****NEW** High Level Screening Guide Now Available!**

  https://pievc.ca/pievc-high-level-screening-guide/



Climate Parameters and Port Assets and Operations

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	Navigation zone	Protection infrastructure	Manoeuvre area & berthing	Load / unload area	Port equipment	Storage	Processing	Hinterland connections
IMPACTS	Agitation Water depth Wind patterns Visibility	Coastal floods Overtopping Wave loads Water temp. Salinity/Acidity	Agitation Currents Water depth Visibility Water temp. Salinity/Acidity Heat	Coastal floods Overtopping Agitation Wind patterns Visibility Precipitation Heat	Coastal floods Wind patterns Precipitation Visibility Heat Contamination		Coastal floods Inland floods Wind patterns Precipitation Heat	Coastal floods Inland floods Wind patterns Precipitation Visibility Heat Low water
CLIMATE PARAMETERS	Sea level Storm surge Waves Wind Fog Precipitation	Sea level Storm surge Waves Wind Temperature	Mean sea level Astronomical tide Storm surge Waves Wind Fog Precipitation Temperature				Mean sea level Astronomical tide Storm surge Waves Wind Precipitation Temperature	Mean sea level Astronomical tide Storm surge Waves Wind Fog Precipitation Temperature

Source: PIANC 2020

Climate Adaptation Actions for Ports

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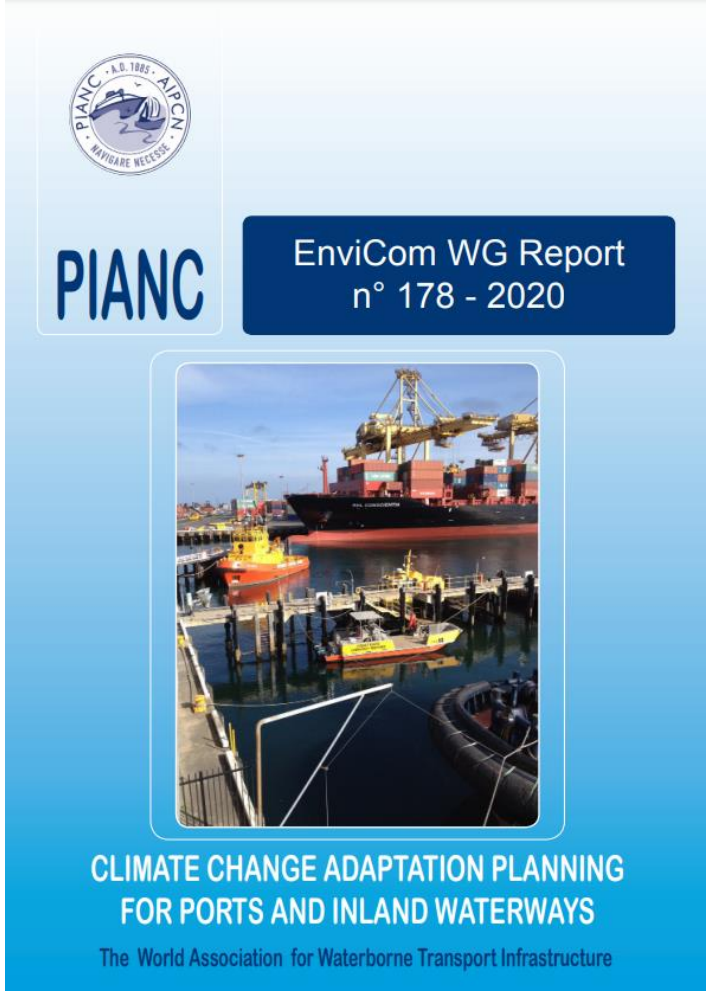
Portfolio of measures identified by PIANC

- Physical, social and institutional measures
- Short-term actions:
  - maintenance to maximise operational resilience
  - extreme weather warning systems
  - contingency planning

- Sustainable planning of new infrastructure (built and natural), may be assisted by Envision.

- Adoption of " **adaptation pathway**" rather than a fixed program to identify decisions to be made when more information is available.



https://www.pianc.org/climate-change-adaptation-portfolio-of-measures

Climate Resilience is Inherent in Sustainable Infrastructure

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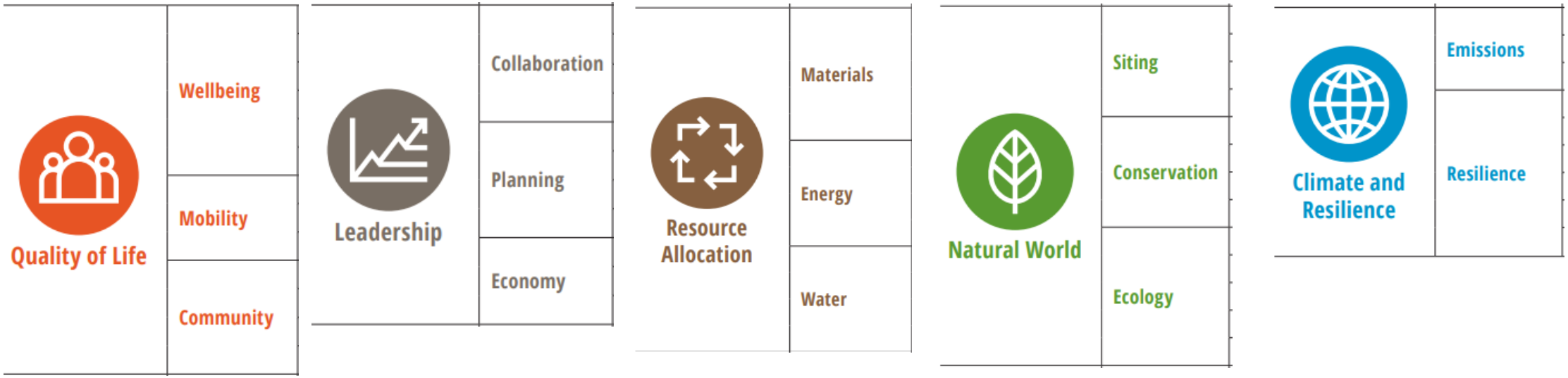

Evolving Accounting and Sustainability Standards

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International Sustainability Standards Board

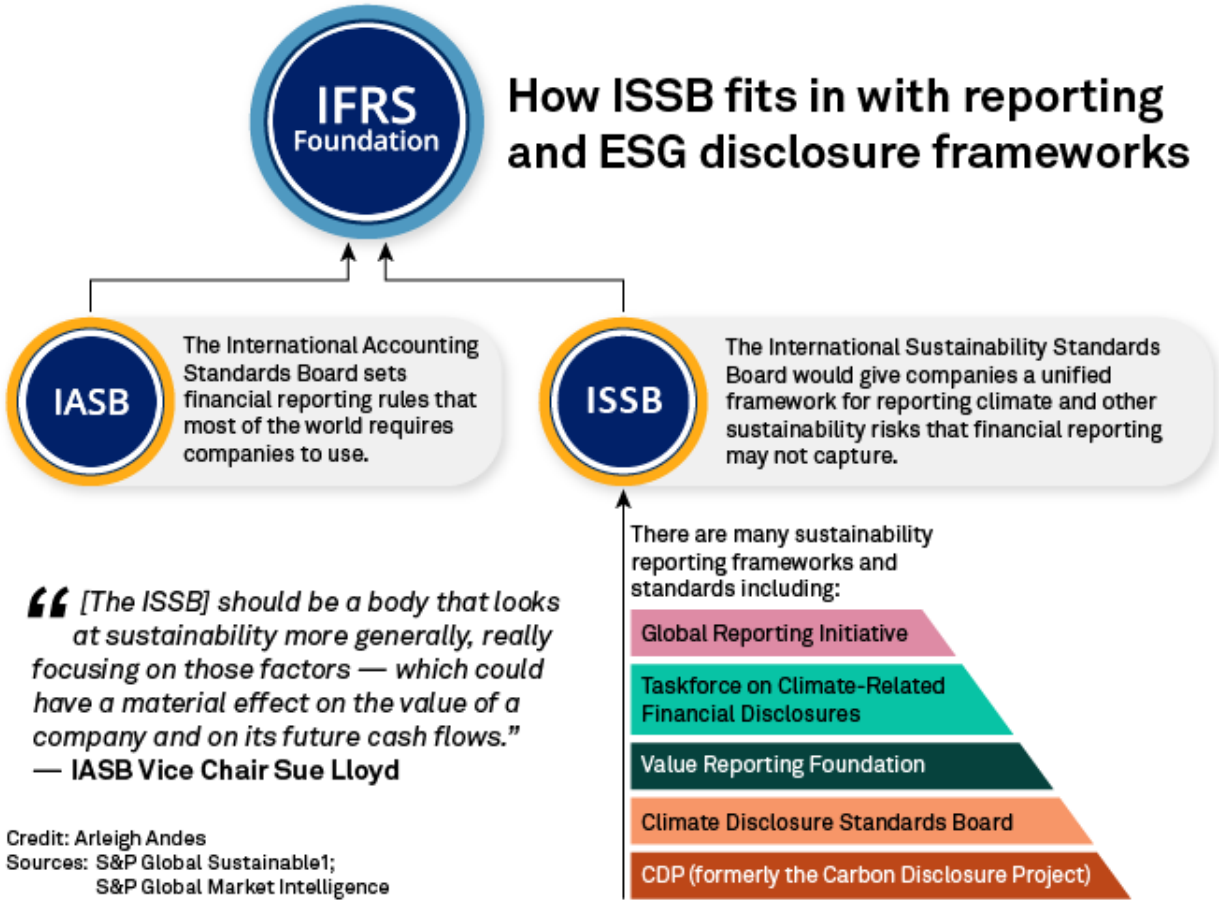
S1 – General disclosure requirements

S2 – Climate disclosure requirements

Consultation on agenda setting open until September – includes biodiversity, human capital

Task-force for Nature-related Financial Disclosures

Natural Assets Inventory Standard



Kunming-Montreal Global Biodiversity Framework

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Key opportunities for multiple wins:

- Nature
- Climate adaptation
- Climate mitigation
- Health
- Equity
- Reconciliation…

TARGET 8

Minimize the impact of climate change and ocean acidification on biodiversity and increase its resilience through mitigation, adaptation, and disaster risk reduction actions, including through nature-based solution and/or ecosystem-based approaches, while minimizing negative and fostering positive impacts of climate action on biodiversity.

TARGET 11

Restore, maintain and enhance nature's contributions to people, including ecosystem functions and services, such as regulation of air, water, and climate,soil health, pollination and reduction of disease risk, as well as protection from natural hazards and disasters, through nature-based solutions and ecosystem-based approaches for the benefit of all people and nature.

Defining Nature-based Solutions

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IUCN

IUCN Global Standard for Nature-based Solutions

*"actions to **protect, sustainably manage, and restore** natural or modified ecosystems, that address **societal challenges** effectively and adaptively, simultaneously providing human well-being and biodiversity benefits."*

NbS for Different Adaptation Approaches

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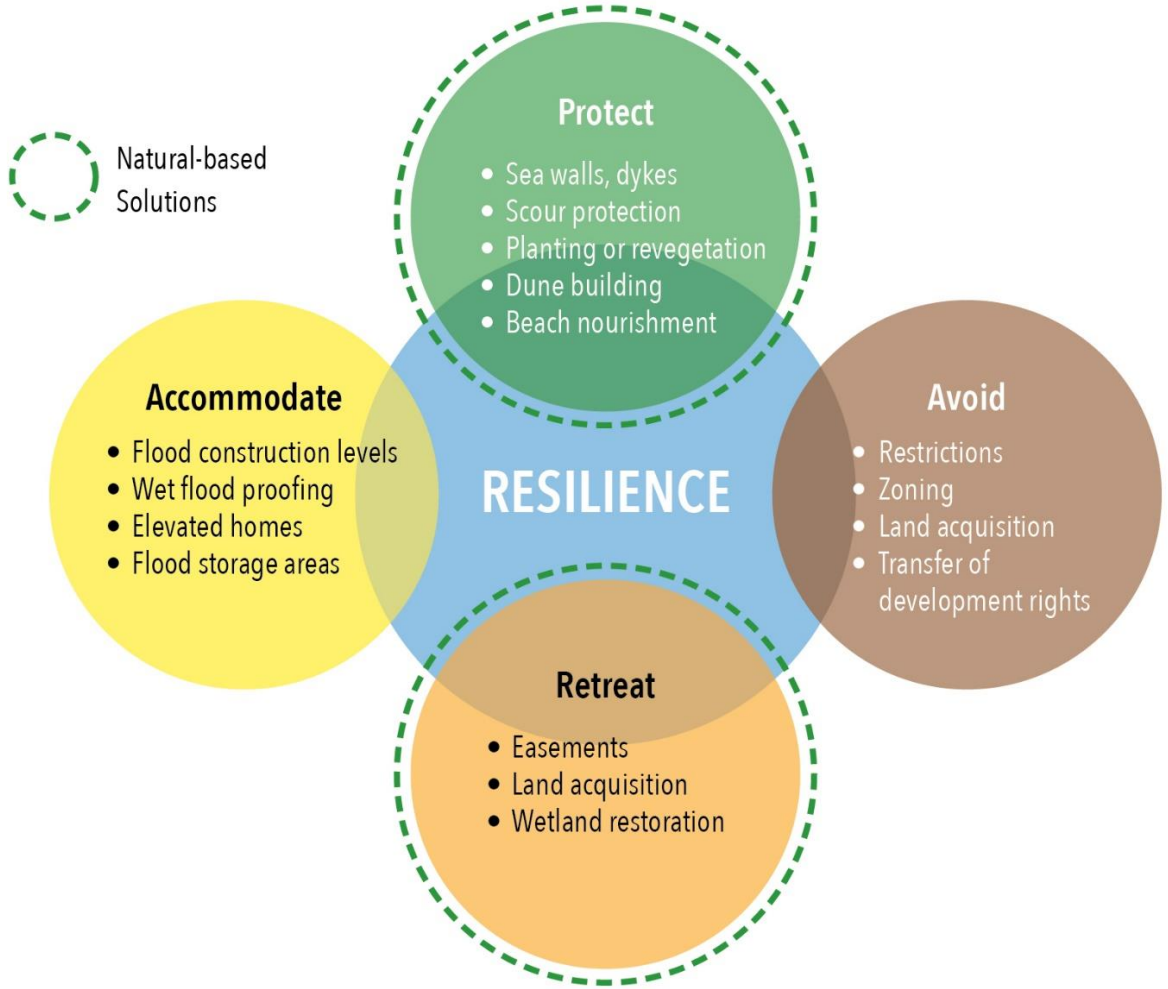

Nature can help “protect” and provided multiple other benefits when people and nature work together…..

Sea2City FALSE CREEK

https://www.intactcentreclimateadaptation.ca/rising-seas-and-shifting-sands-combining-natural-and-grey-infrastructure-to-protect-canadas-eastern-and-western-coastal-communities/

Federal Level: Broadened View of « Infrastructure »

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National Adaptation Strategy, Nov 2022

1. Health and Wellbeing;
2. **Resilient Natural and Built Infrastructure;**
3. Thriving Natural Environment;
4. Strong and Resilient Economy; and,
5. Disaster Resilience and Security.

National Infrastructure Assessment

….covering all sectors of economic, social, sustainable **and natural infrastructure**.

Census of Environment & Canadian SEEA-EA

Statistics Canada / Statistique Canada

Selected progress:

- Human Activity and the Environment
- Urban Greenness
- Ocean and coastal ecosystem extent account

Green or Natural Infrastructure?

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A range of assets from **natural through engineered** which rely on **ecological and hydrological processes** to provide **municipal, ecosystem, and societal services** as well as **resilience benefits**.

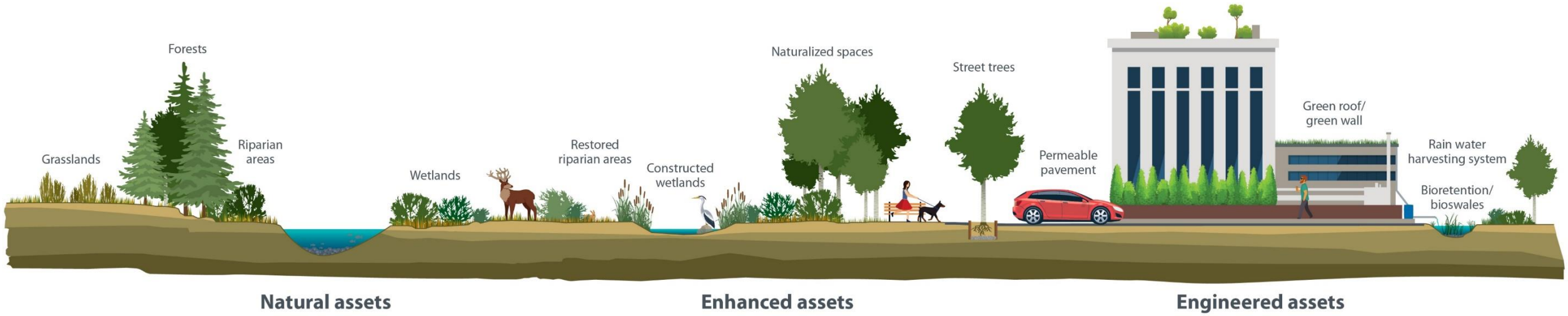

Image courtesy of City of Calgary

Coastal Infrastructure Solutions

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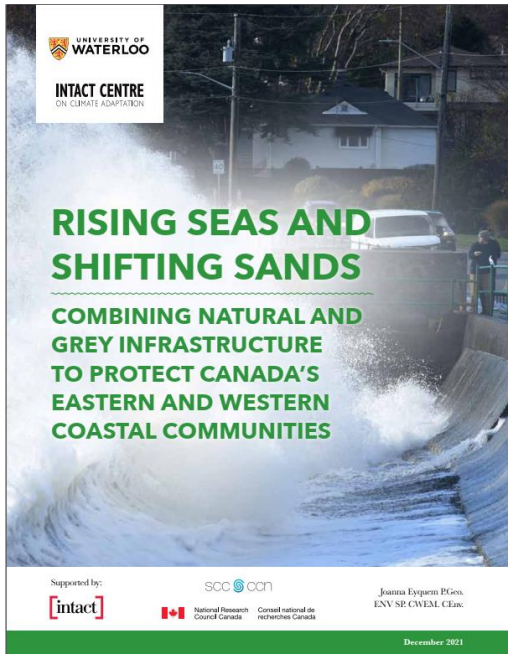

Grey Infrastructure	Underutilized Nature-Based Solutions	
	Predominantly sediment-based	**Predominantly vegetation-based**
		
• Seawalls • Detached / Nearshore Breakwaters • Attached Breakwaters / Headlands • Submerged Breakwaters / Reefs • Permeable Revetments* • Impermeable Revetments* / Retaining Walls • Groynes • Storm Surge Barriers / Tidal Sluices • Sea Dikes / Embankments / Levees	• Dynamic Revetment* / Cobble Berm • Submerged Sills / Perched Beach • Beach Nourishment • Island Restoration or Enhancement	• Dune Restoration or Stabilization • Cliff Stabilization / Revegetation • Salt Marsh and Coastal Wetland Restoration • Submerged Aquatic Vegetation • Bioengineering - Coir Rolls (made of coconut fibre) • Bioengineering - Natural Fibre Blankets

* Revetments are sloped coastal treatments used to protect the coastline.

Guidance: Natural Infrastructure for Adaptation

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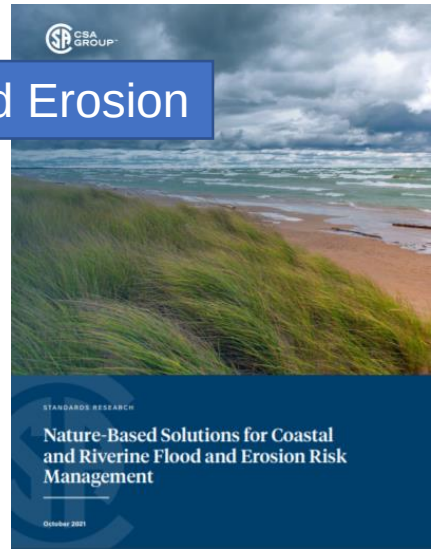
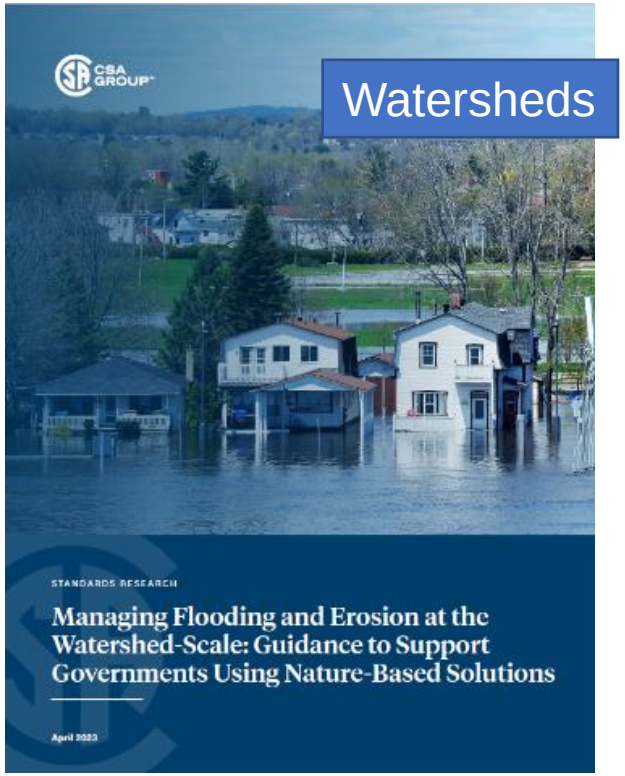
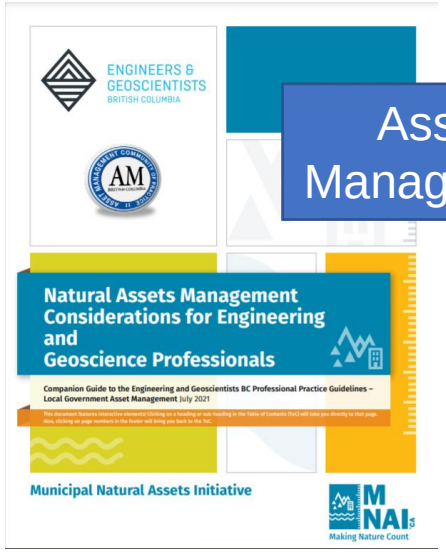
Flood and Erosion



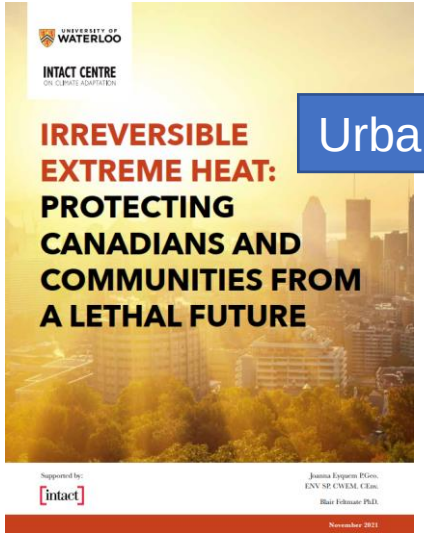
Coasts



Watersheds



Asset Management



Urban Heat

Hot Off the Press!

Focus for standards development

NbS Provide Multiple Co-Benefits!

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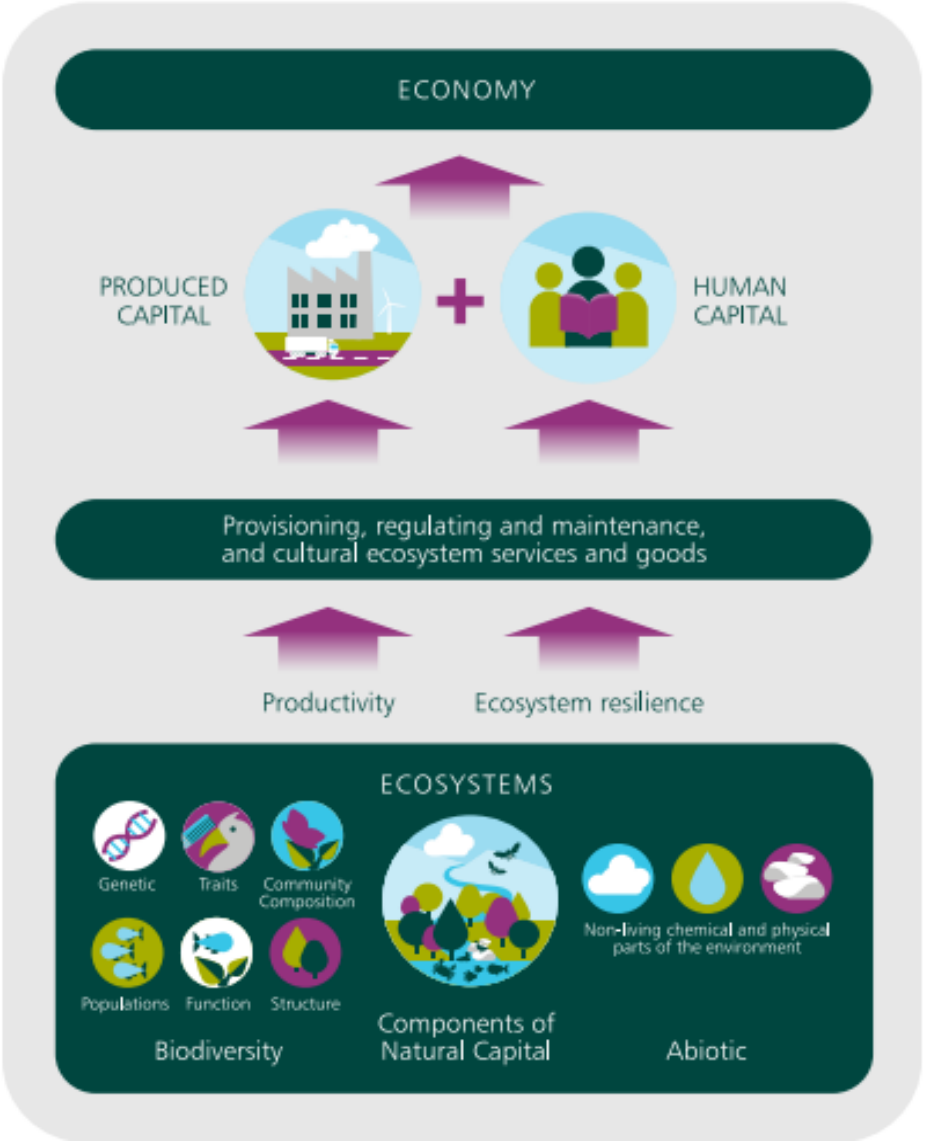
Nature-based Solutions provide

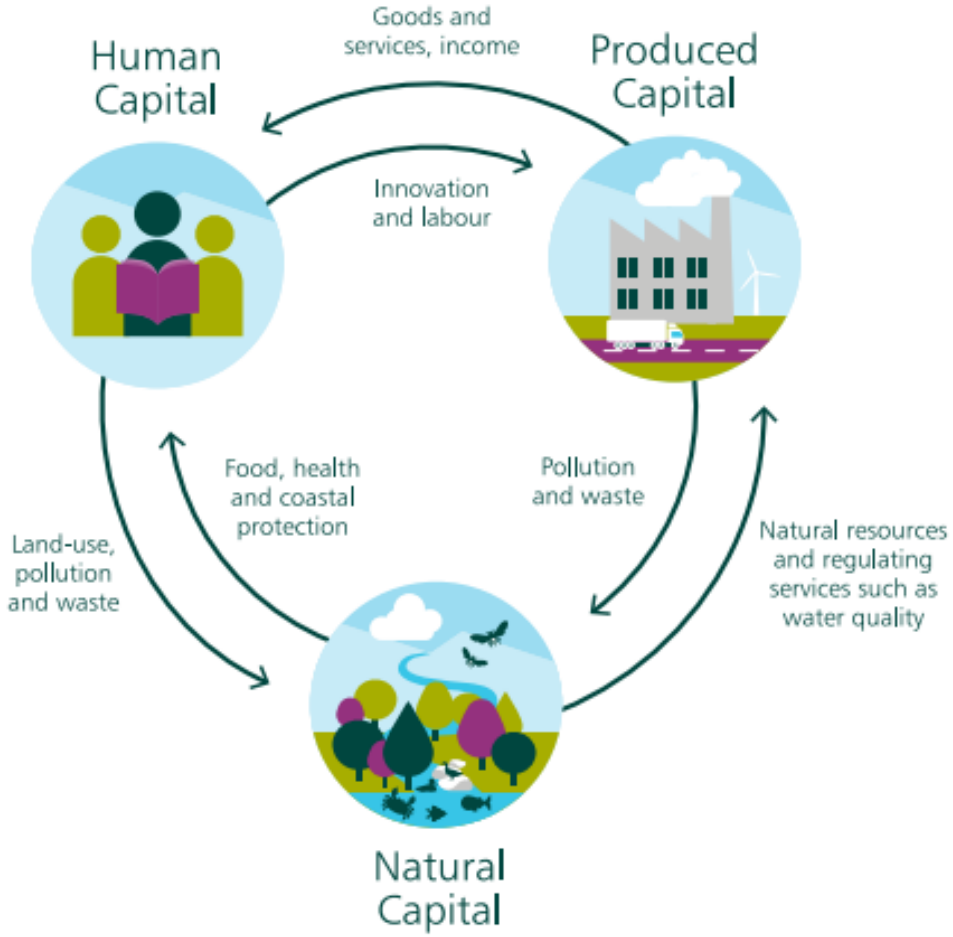
« ecosystem goods and services »

- **Provisioning**
  - Fish and shellfish
- **Regulation and support**
  - Flooding and erosion
  - Temperature control
  - Air and water quality
  - Carbon storage and sequestration
  - Biodiversity and habitats
- **Cultural**
  - Recreation opportunities
  - Aesthetic value

These services are not all offered by « grey » infrastructure

What is an Economical Indicator?





Source: HM Treasury (2021) The Economics of Biodiversity: The Dasgupta Review https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review

Range of « Economic Benefits » Considered in England

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Eligible Flood and Coastal Erosion Management benefits considered in OM1

- Residential properties Commercial properties
- Transport (road, rail, air, ports)
- Utilities (water, gas, electricity, waste)
- Health*
- Temporary accommodation
- Emergency services
- Flood risk asset repair
- Agriculture
- Recreation and leisure facilities
- **Environment****
- Built heritage
- Education
- Tourism
- Recovery, repair and clean-up impacts

* - including social and psychological impacts of flooding and public health - including damage to hospitals and health centres - and fatalities - including distress

** - all natural capital, including wildlife and heritage

Percé, Quebec (Ouranos, 2016)

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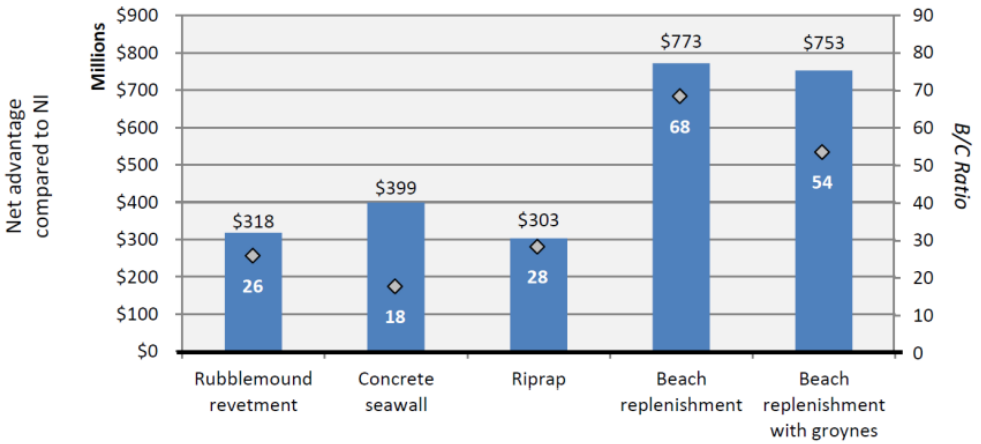
Five alternatives assessed for Anse du Sud (heart of Percé):



CBA compared to non-intervention - Beach nourishment most beneficial option over 50-year period considered.

Benefit-cost ratio: 68:1
Large benefits from tourism industry

Source: Circé, M., et al. 2016, Ouranos
https://www.ouranos.ca/wp-content/uploads/Synthesis-report-ACA-Quebec-final.pdf

Type of Impact	Negative Impacts	Positive Impacts
Related to erosion	• Loss of land • Complete or partial loss of residential or commercial buildings • Loss or damage to public infrastructure	
Related to flooding	• Damages to land • Damages to residential or commercial buildings • Damages to public infrastructure • Emergency evacuation • Debris clean-up • Traffic congestion or detour	
Economic	• Reduced land value • Loss of goods and commercial revenues • Loss of tourism revenues	• Gain in tourism revenues
Environmental	• Loss of natural habitats • Loss of fishing spawning grounds	• Improvement in fish spawning grounds
Social	• Loss of sea view • Loss of sea access • Decline in the coast's recreational use • Reduced quality of life (anxiety, insecurity, etc.) • Deterioration in the landscape • Deterioration in historical and cultural heritage	• Improvement in the coast's recreational use • Improvement in quality of life (security) • Improvement in the landscape

New Brighton Park Shoreline Habitat Restoration

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- Coastal flooding and flooding caused by stormwater/sewer system overflow.
- Much of New Brighton Park built on construction fill in the 1960s.
- Historic loss of natural features (mud flats and saltmarsh) led to increased impacts of wave-related **erosion** (due to increased marine traffic as well as natural erosion)

- Net annualized benefits of about **$0.7 million**
- Benefit-cost ratio of about **2.5.**
- Benefits provided by habitat and cultural services, climate regulation and waste treatment services, nutrient cycling and disturbance regulation services

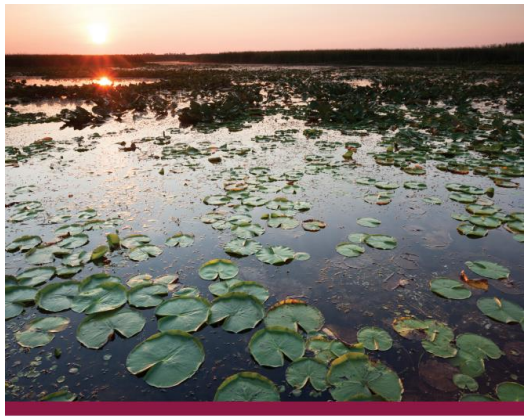
Further information from Vancouver Fraser Port Authority: https://www.portvancouver.com/new-brighton-park-shoreline-habitat-restoration-project/

Managing Natural Assets

Protect what you have

Restore what you've lost

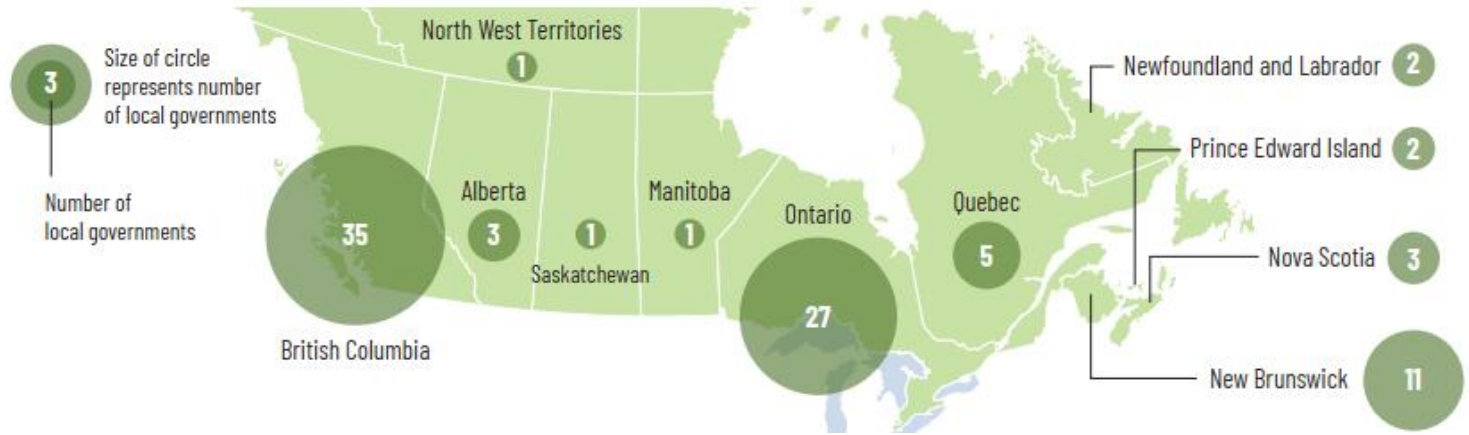
Build what you must

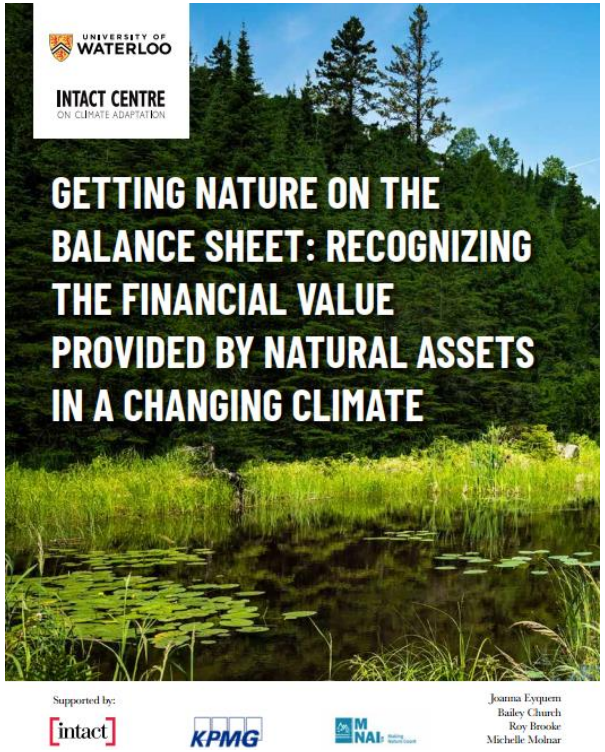


Integrate into Asset Management Planning

Getting Nature on the Balance Sheet

120+ Local governments are already managing and valuing natural assets - our largest cities are on board.





Ports starting to do this work too

https://www.intactcentreclimateadaptation.ca/getting-nature-on-the-balance-sheet/

Accounting systems do not currently allow for reporting of financial value of services provided by nature (but we are working on this!)

Mainstreaming Natural Asset Management

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https://www.theglobeandmail.com/business/article-is-it-time-to-make-natural-capital-an-asset-class/

Media Coverage

- **Globe and Mail (front cover of Report on Business)**, Oct 6 - Accounting body proposes rule changes to put nature on the balance sheet
- **Financial Post (via Globe Newswire),** Oct 5, Nature in the balance: but still not on the balance sheet
- **CBC What on Earth,** Oct 30, Putting a price on nature (25min podcast with partner case studies)
- **La Presse,** Oct 5, *La nature, un « actif financier » pour les villes ?*
- **Canadian Underwriter,** Oct 17 **-** How insurers benefit from a green balance sheet
- **Le Devoir**, Dec 3: La nature, un «actif financier» comme un autre?

Tools Already Available to Reduce Risk

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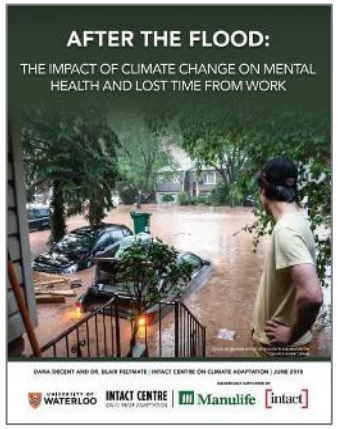
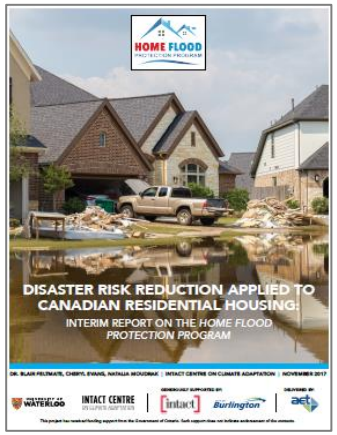
National guidelines and standards developed to reduce climate risk



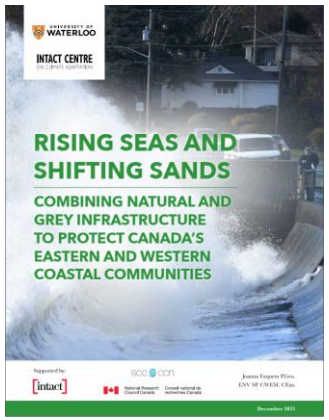
Citizens



Homes

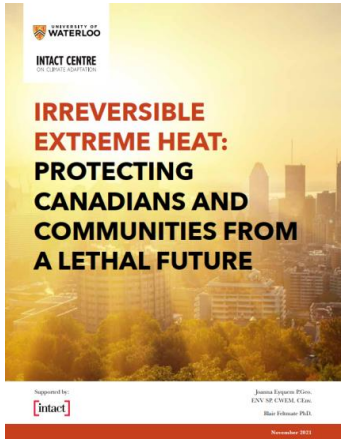
Commerical Real-Estate

Communities

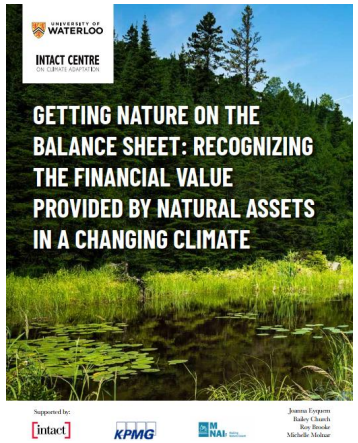


Coastal Protection

Wildfires



Extreme Heat



Role of Natural Infrastructure

Need to be applied to make a difference!

3 Key Takeaways

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1. **Climate adaptation** is at the nexus of climate change, biodiversity loss and sustainability.

2. **Adaptation includes:**
   - Risk management.
   - Opportunities for co-benefits

3. **Marine Insurers can help drive action**
   - Consider built and natural infrastructure when assessing risk
   - Influence client awareness and behaviour