

# Nature-Based Solutions for River Flooding and Erosion Risk Management

## NWT Riverbank Erosion Workshop

December 2-4, 2025

Sean Ferguson • [Sean.Ferguson@nrc-cnrc.gc.ca](mailto:Sean.Ferguson@nrc-cnrc.gc.ca)

Ivana Vouk • [Ivana.Vouk@nrc-cnrc.gc.ca](mailto:Ivana.Vouk@nrc-cnrc.gc.ca)

Saber Ansari • [Saber.Ansari@nrc-cnrc.gc.ca](mailto:Saber.Ansari@nrc-cnrc.gc.ca)

Ali Khan • [Amir.Khan@nrc-cnrc.gc.ca](mailto:Amir.Khan@nrc-cnrc.gc.ca)



National Research  
Council Canada

Conseil national de  
recherches Canada

Canada

# Nature-Based Solutions – Background

## Nature-Based Solutions for Flood and Erosion Risk Management:

*Strategies or measures that depend on, or mimic, natural system processes to provide flood and erosion risk management functions, while delivering environmental and other societal co-benefits (Vouk et al., 2021)*

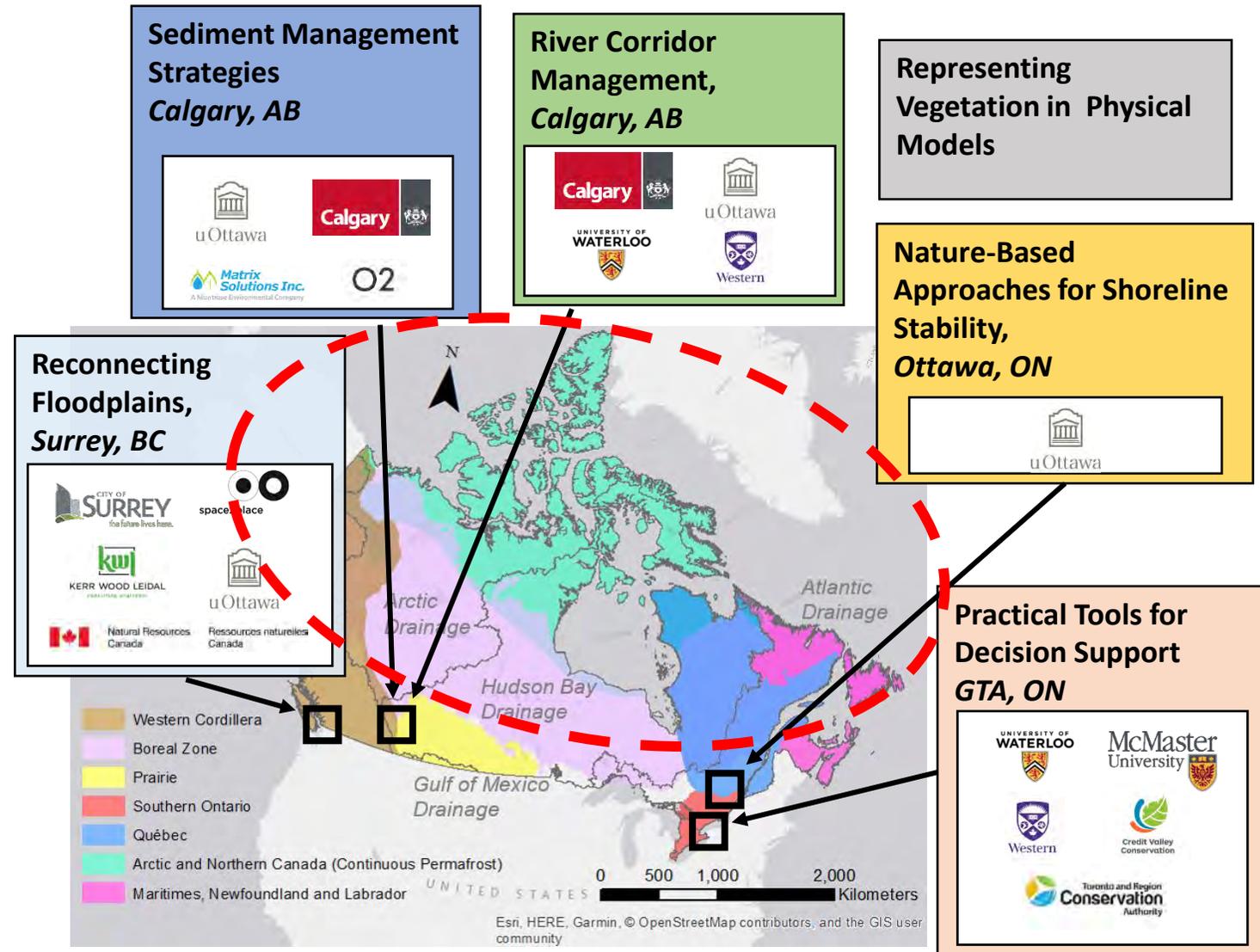
### Potential Benefits



- NbS rely on natural processes and features present in the region of interest (not all NbS include vegetation!)
- Hazard avoidance and preserving natural spaces is considered a nature-based solution (i.e. providing “room for the river”)

# Riverine NbS Project at NRC-OCRE

- Since 2021, NRC-OCRE has been partnering and collaborating with many organizations to support NbS pilot projects in different parts of Canada
- Lessons learned from the pilot projects are being integrated into a new Canadian guideline for NbS design and implementation
- Northern Canada is currently not represented in our collection of NbS pilot projects
- We want to ensure that future editions of the guideline capture the **unique challenges and considerations of working in northern Canada and cold regions**
  - Integrate lessons from existing case studies
  - Collaborate on future projects where natural features/process are being considered



# Riverine NbS Project Example: Bow River Gravel Bar Realignment

## Challenge:

The 2013 flood event deposited a large volume of sediment in the vicinity of the 10<sup>th</sup> Street Bridge. The gravel bars are restricting flow, elevating flood risk.

Conventional engineering approaches (e.g. dredging) can harm riverine habitats and disrupt the natural sediment balance

## Objective

The City is exploring a bar realignment approach with objectives to:

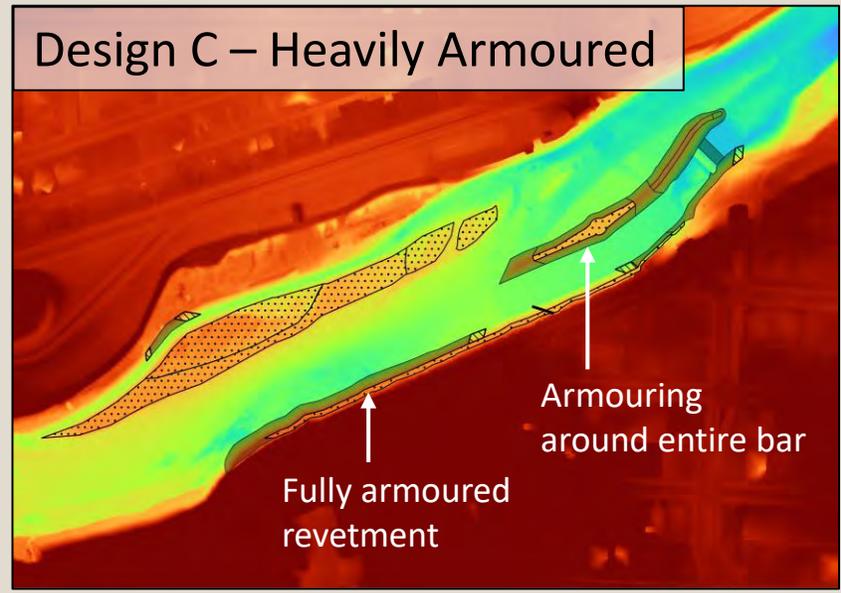
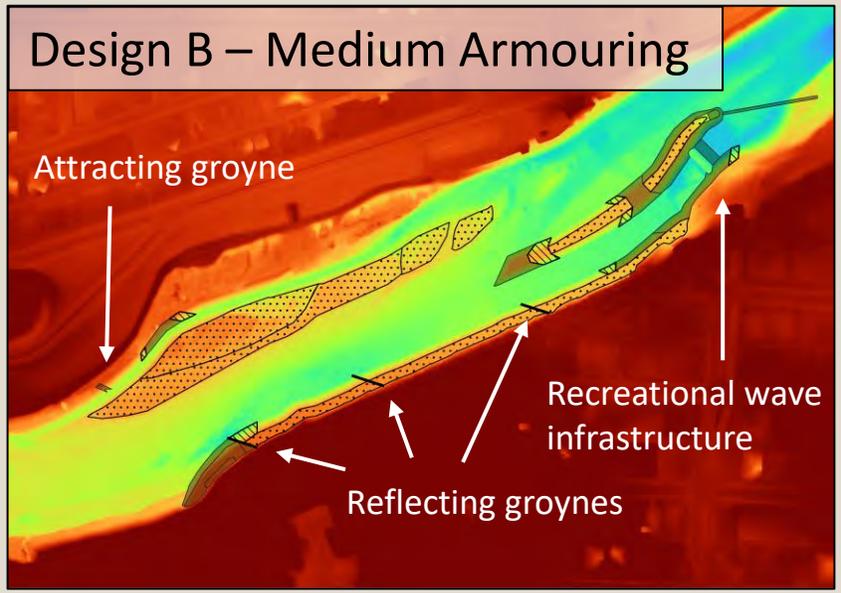
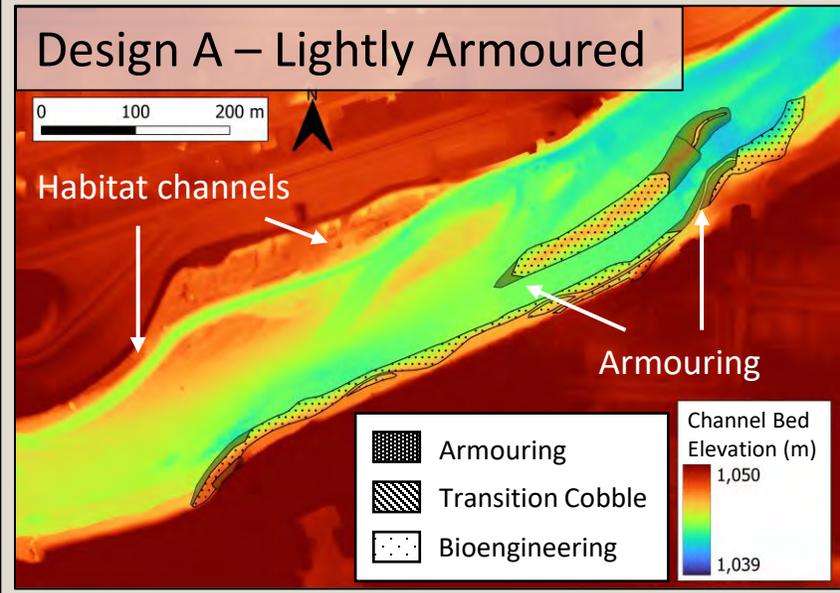
- Reduce the blockage and flood hazard
- Minimize impacts to habitat and geomorphic processes
- Enhance recreation and habitat where possible



# Riverine NbS Project Example: Bow River Gravel Bar Realignment

## Conceptual Designs

- Three conceptual designs were drafted for the City of Calgary by a consultant (Matrix Solutions)
- Each design involves “thinning” the main gravel bar as well as various amounts of rip-rap armouring



# Riverine NbS Project Example: Bow River Gravel Bar Realignment

## Physical Modelling

- NRC-OCRE constructed a physical laboratory model to study the performance of each conceptual design
- The results were shared with the City of Calgary and Matrix Solutions to help them optimize their design
- Key Questions
  - Where can we expect to see sediment erosion/deposition?
  - How will the riverbed change if a small, medium, or large flood were to occur?



Bow River 1:30 scale model

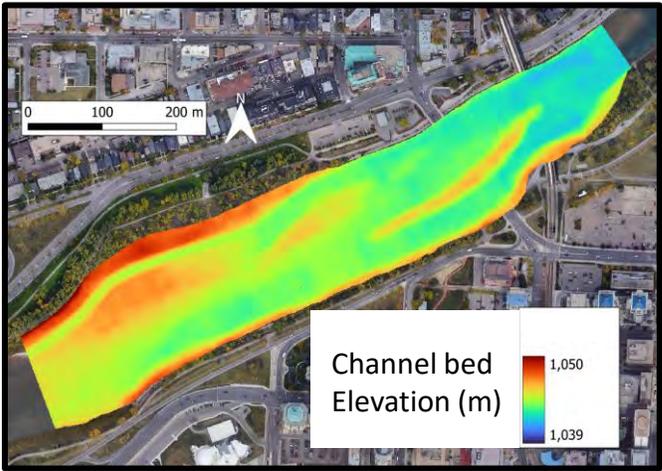
Model Construction  
Photos



# Riverine NbS Project Example: Bow River Gravel Bar Realignment

## Example of Physical Modelling Results for Conceptual Design A

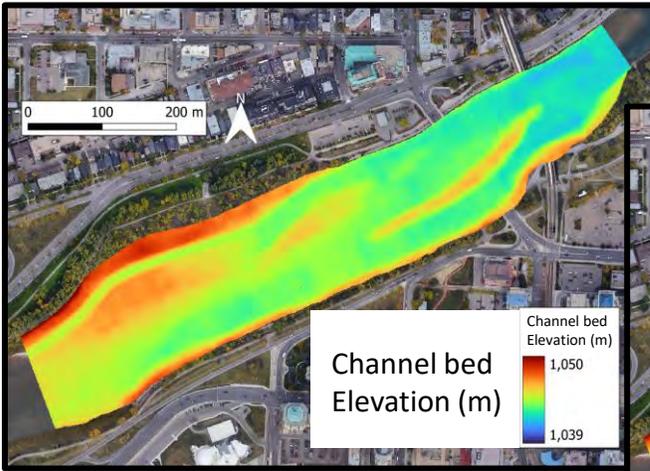
Conceptual Design A



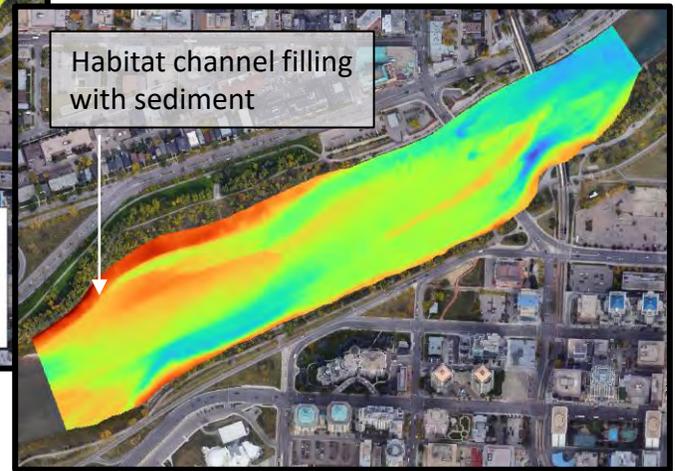
# Riverine NbS Project Example: Bow River Gravel Bar Realignment

## Example of Physical Modelling Results for Conceptual Design A

Conceptual Design A



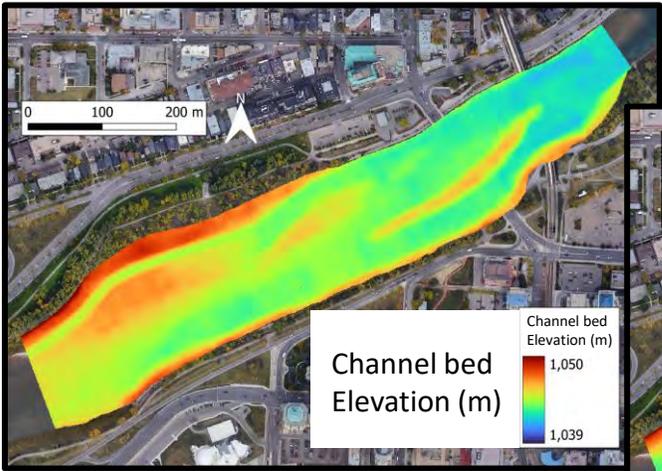
After 10-Year Flood



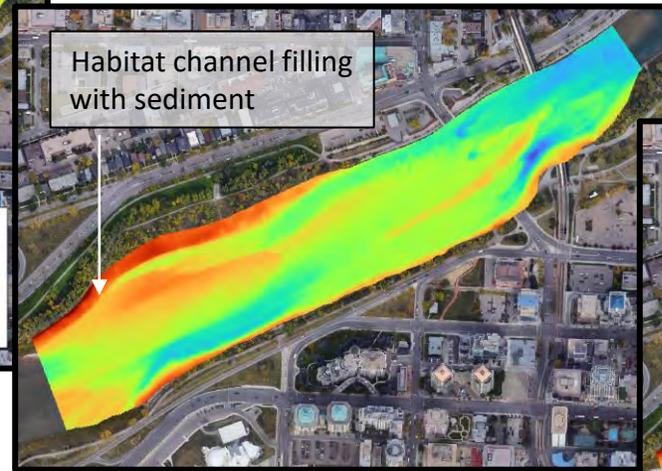
# Riverine NbS Project Example: Bow River Gravel Bar Realignment

## Example of Physical Modelling Results for Conceptual Design A

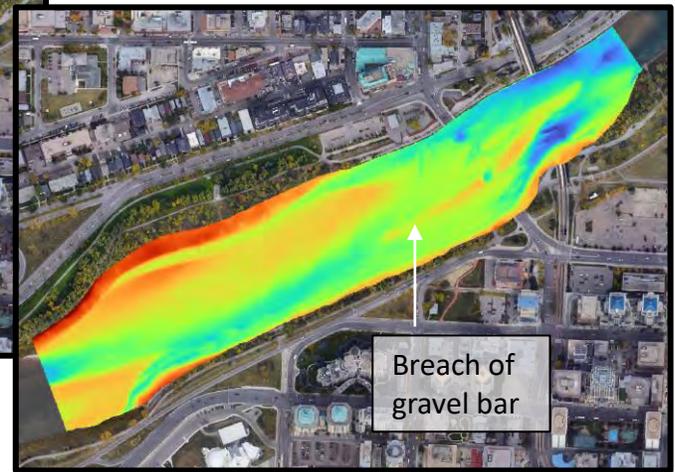
Conceptual Design A



After 10-Year Flood



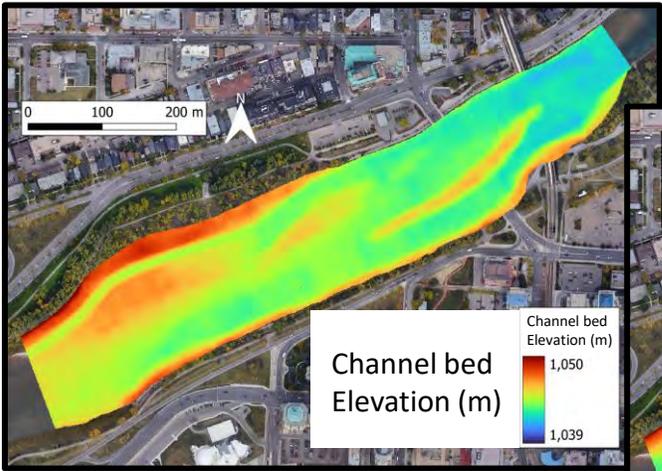
After 10- and 35-Year Flood



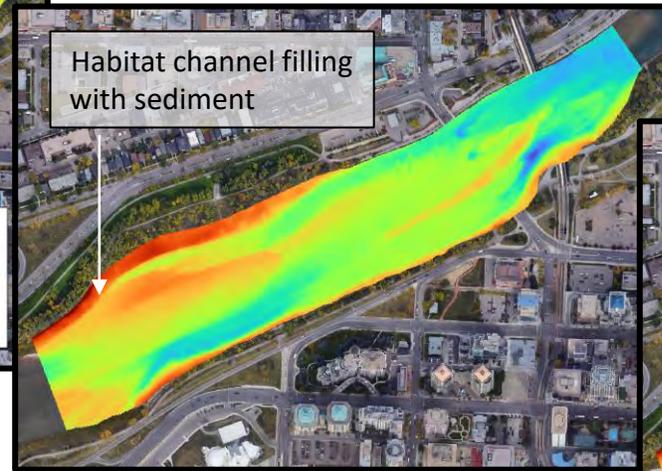
# Riverine NbS Project Example: Bow River Gravel Bar Realignment

## Example of Physical Modelling Results for Conceptual Design A

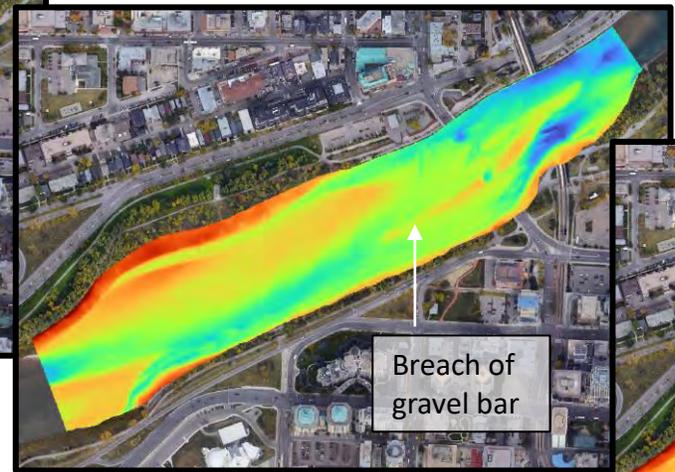
Conceptual Design A



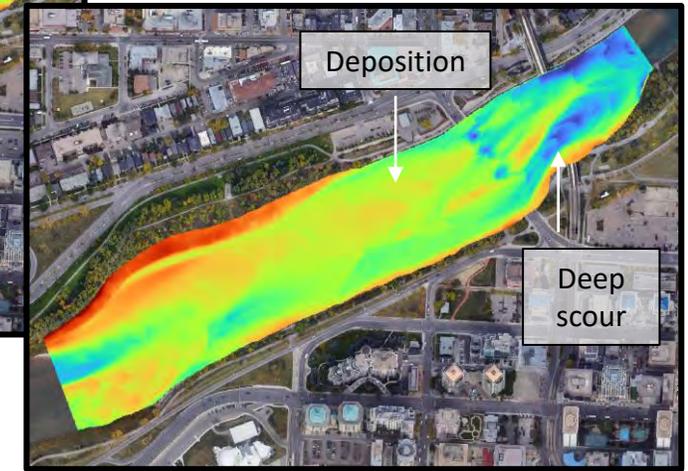
After 10-Year Flood



After 10- and 35-Year Flood



After 10-, 35-, and 100-Year Flood



# Riverine NbS Project Example: Bow River Gravel Bar Realignment

The physical modelling results were provided to the City of Calgary and their consultants to help them assess the performance of their conceptual designs make improvements.

A preliminary site plan has been drafted and construction is anticipated to commence in 2027, pending funding and approvals



# Coastal NbS Project Example: Boundary Bay Living Dyke

## Challenge and Objectives:

- The City of Surrey, City of Delta, and Semiahmoo First Nation are collaborating to investigate coastal NbS to combat climate change and sea level rise
- Exploring a “Living Dyke” approach that includes dyke upgrades and salt marsh planting to attenuate wave energy



City of Surrey (2025)



# Coastal NbS Project Example: Boundary Bay Living Dyke

## Approach:

- Vegetation is a key component of the “living dyke” concept, but vegetation requires suitable time and conditions to grow
- The project team has established a “pilot site” to test different techniques to protect vegetation so that it can grow and become established
- Tested wave protection strategies:
  - Oyster shells in biodegradable bags
  - Brushwood dams
  - Cobble berms
- Prior to field test, some preliminary laboratory testing was conducted at the NRC-OCRE lab

Photos courtesy of Allison Matfin



Oyster shell tests at NRC



Boundary Bay Pilot Site

# Coastal NbS Project Example: Boundary Bay Living Dyke

## Outcomes:

- Lessons from the Boundary Bay pilot site will be used to inform the final design and construction of the Living Dyke in Surrey



City of Surrey (2025)

# Considerations for the NWT Riverbank Erosion Workshop

## Questions to Consider:

- What could a nature based solution look like in your area?
- Are nature-based solutions applicable for your area?
- How do natural features in your area (rock, sediment, vegetation, woody debris, permafrost) influence flow and erosion? How do flow and erosion influence these natural features?

# Nature-Based Solutions for River Flooding and Erosion Risk Management

NWT Riverbank  
Erosion Workshop  
December 2-5, 2025

## Thank You

Sean Ferguson • [Sean.Ferguson@nrc-cnrc.gc.ca](mailto:Sean.Ferguson@nrc-cnrc.gc.ca)  
Ivana Vouk • [Ivana.Vouk@nrc-cnrc.gc.ca](mailto:Ivana.Vouk@nrc-cnrc.gc.ca)  
Saber Ansari • [Saber.Ansari@nrc-cnrc.gc.ca](mailto:Saber.Ansari@nrc-cnrc.gc.ca)  
Ali Khan • [Amir.Khan@nrc-cnrc.gc.ca](mailto:Amir.Khan@nrc-cnrc.gc.ca)

National Research Council Canada  
Ocean, Coastal and River Engineering