

Great Lakes, Greater Insights:

Data and Modelling in Action

A Great Lakes Freshwater Ecosystem Initiative Webinar

The webinar will begin momentarily

September 15, 2026



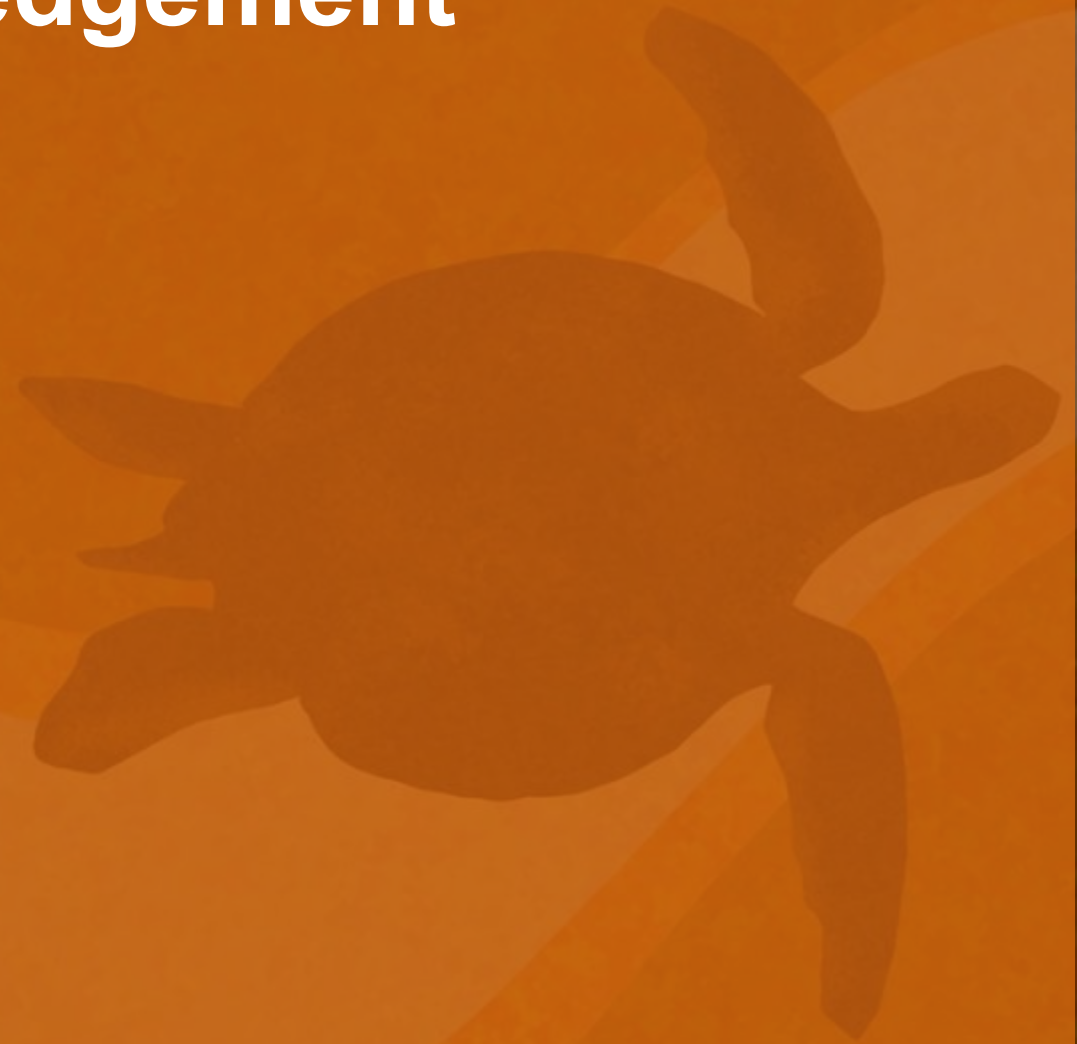
Canada
Water Agency

Agence de l'eau
du Canada

Land Acknowledgement

We respectfully acknowledge the lands we are situated on are Traditional Territories and Treaty Lands of the Mississaugas of the Credit, the Anishinaabeg of the Williams Treaty First Nations, the Huron-Wendat, and the Haudenosaunee, and are now home to many diverse First Nations, Inuit, and Métis peoples.

We appreciate and respect the history and diversity of the land and are grateful to have the opportunity to work and meet in this territory.



Housekeeping



This session is being recorded.
The recording and slides will
be shared via email



Please post questions
using the Q&A



Closed captioning is available
in English



All participants are muted
and video disabled



Please post comments
using the Chat



For technical support, please
message Taylor Kerekes

Restoring and protecting critically important coastal areas

A funding stream under the
Great Lakes Freshwater
Ecosystem Initiative (GLFEI)

- To support and promote local-level action to enhance water quality, ecosystem health, and the resilience of coastal areas experiencing stress due to climate risks and impacts
- Nine projects were awarded multi-year funding in fiscal year 2024/25
- Ten projects were awarded funding in fiscal year 2025/26
- **The next round of applications is anticipated to launch in October 2026**

Webinar Objectives



GAIN technical insights about state-of-the-art tools and cutting-edge research, including coastal process model



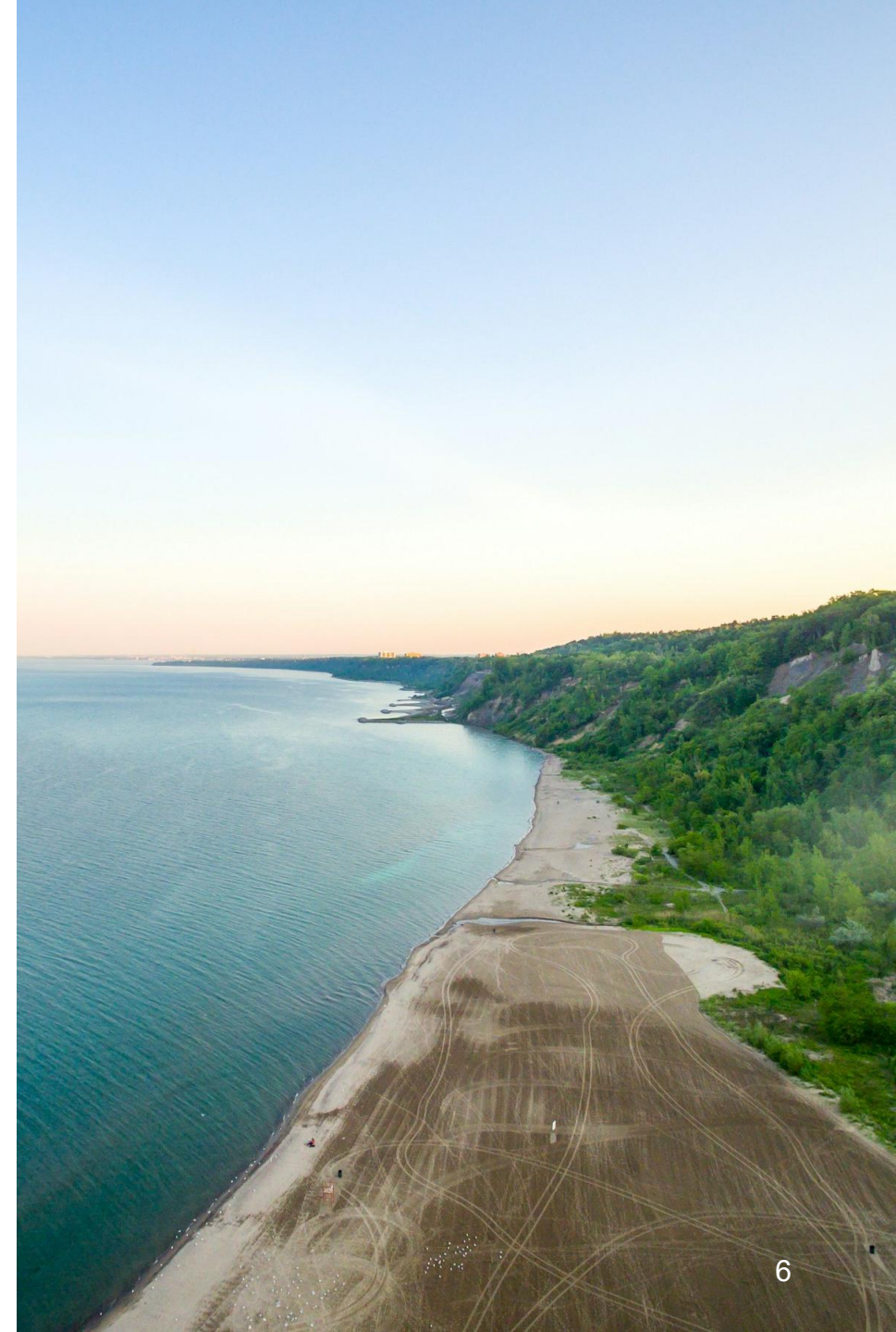
HEAR about how different GLFEI projects are using data and modelling to advance on-the-ground action



MEET and **ENGAGE WITH** other practitioners and researchers who are working to improve Great Lakes water quality and ecosystem health

Session Agenda

- **Overview of the upcoming GLFEI call for applications**
- **Project highlights:**
 1. Validating the Use of a Resilience Index to Classify the Ecological Resilience of Coastal Marshes in Eastern and Northern Georgian Bay
 2. North Shore Resilience Action Plan: Port Glasgow to Long Point
 3. Hillman Marsh Wetland Restoration and Climate Adaptation Plan
 4. Leveraging Big Data to Connect Watershed Plans to Nearshore Lake Health
- **Q&A discussion and upcoming Symposium**



Great Lakes Freshwater Ecosystem Initiative

Upcoming Call for Applications – Fall 2026



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Freshwater Ecosystem Initiatives (FEIs)

Mackenzie River:

Knowledge gaps on water quality and ecosystem health and the effects of **climate change**

Fraser River:

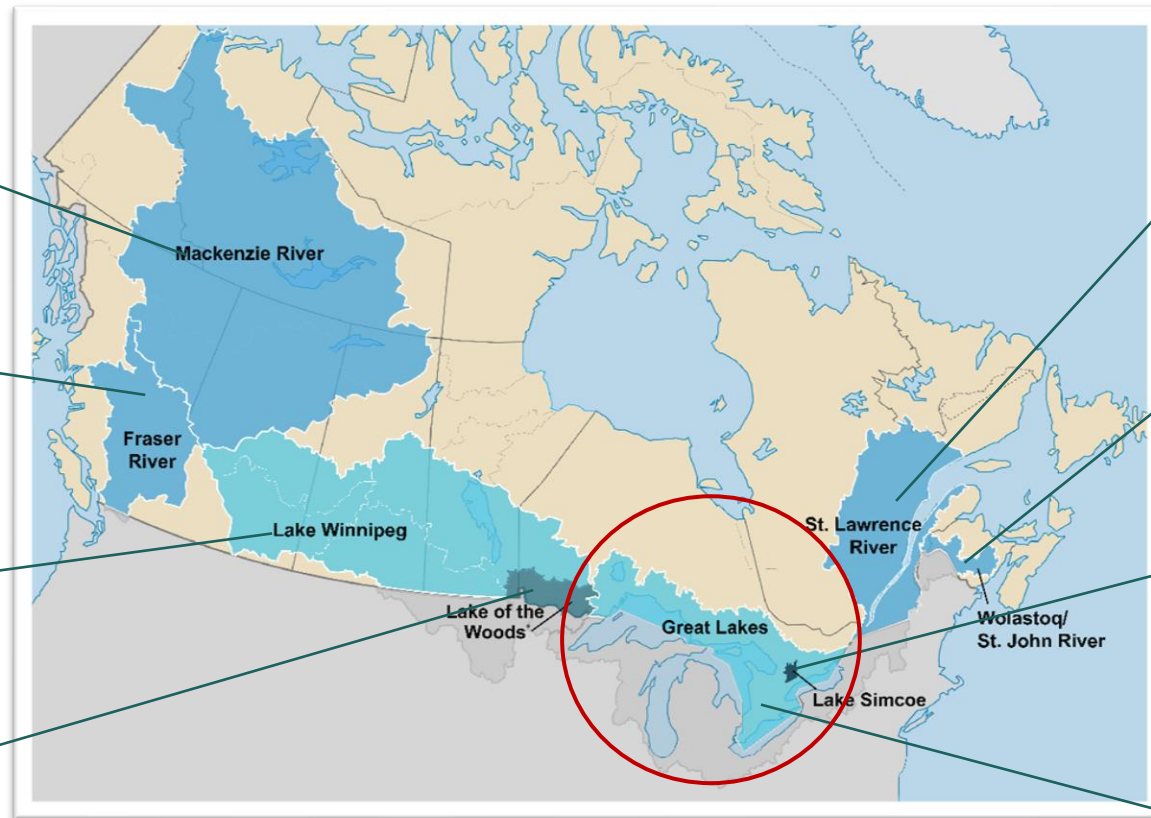
Impacts from toxins, **nutrients**, sediment pollution and habitat loss

Lake Winnipeg:

Toxic and nuisance **algae** caused by **nutrient pollution**; **climate change** impacts

Lake of the Woods:

Nutrient pollution and the impacts of toxic and nuisance **algae**



St. Lawrence River:

Nutrient pollution and the impacts of toxic and nuisance **algae**; biodiversity loss, including loss of coastal wetlands; contaminated sediment and toxic chemicals.

Wolastoq/Saint John River:

Nutrient pollution and the impacts of toxic and nuisance **algae**.

Lake Simcoe:

Nutrient pollution and the impacts of toxic and nuisance **algae**.

Great Lakes:

Toxic and nuisance **algae** caused by **nutrient pollution**; contaminated and degraded Areas of Concern; Great Lakes coastal wetlands and nearshore health is under threat due to the impacts of **climate change**, other stressors including toxic chemicals.

GREAT LAKES FRESHWATER ECOSYSTEM INITIATIVE

PROGRAM PRIORITIES

- 1 Restore water quality and ecosystem health in Great Lakes Areas of Concern (AOCs)
- 2 Prevent toxic & nuisance algae
- 3 Restore & protect critically important coastal areas, including wetlands
- 4 Reduce releases of harmful chemicals
- 5 Support community-based science
- 6 Increase participation of Indigenous Peoples in governance, stewardship, and monitoring
- 7 Advance Great Lakes governance, accountability, and reporting mechanisms





OBJECTIVES – PROTECTING & RESTORING COASTAL AREAS

Great Lakes Nearshore Areas

To support and promote local level ***action*** to enhance water quality and ecosystem health in nearshore areas experiencing high cumulative stress and/or areas with high ecological value under threat from impaired coastal processes

Great Lakes Coastal Wetlands

To ***increase the resilience*** of coastal wetlands to climate-related risks and impacts and other stressors by engaging Canadians in projects that will result in tangible and measurable conservation benefits



COASTAL AREAS FUNDING STREAM – TO DATE

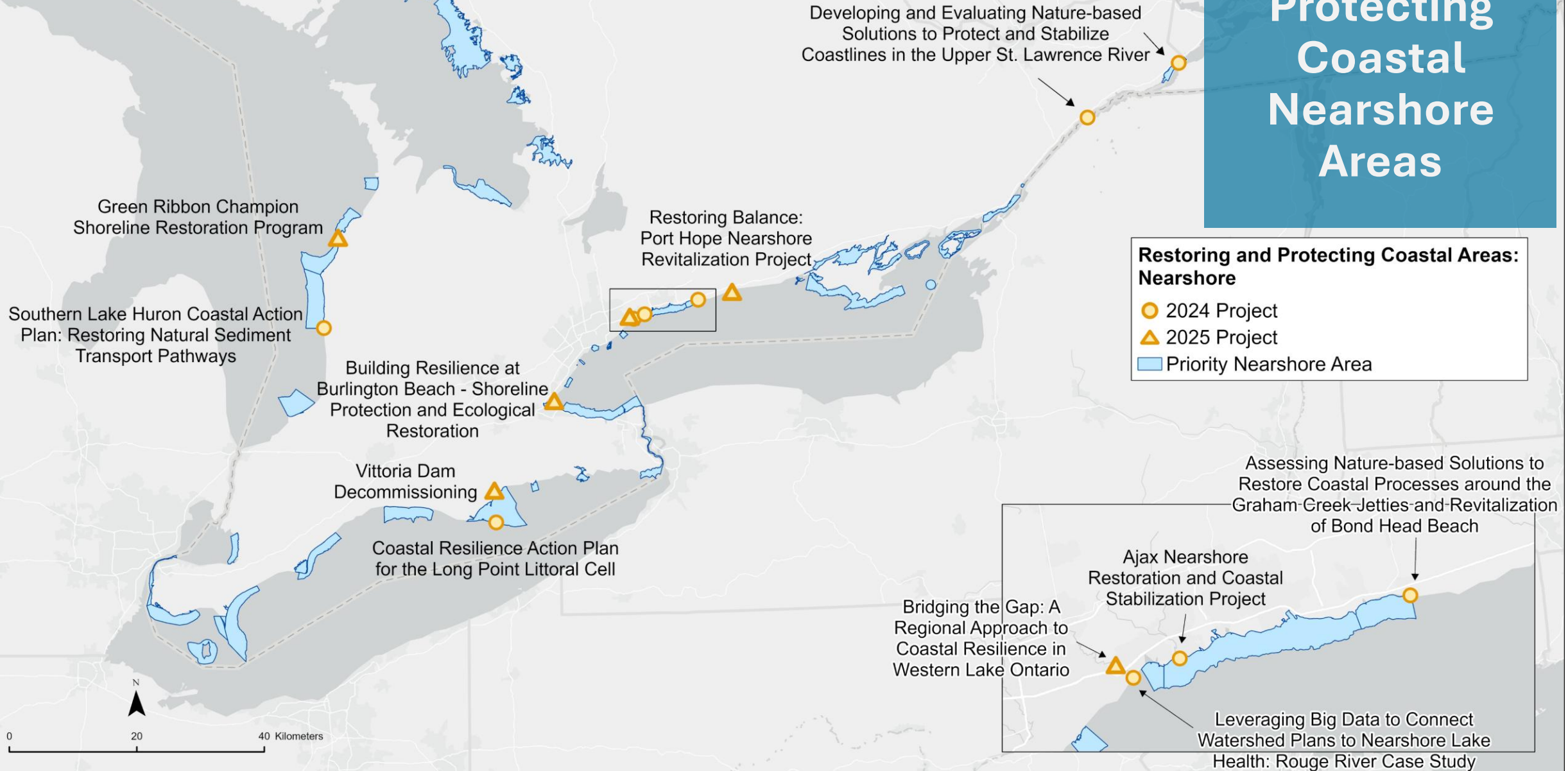
19 projects funded valued at **\$17 million**

- 11 projects under Nearshore
- 8 projects under Coastal Wetlands

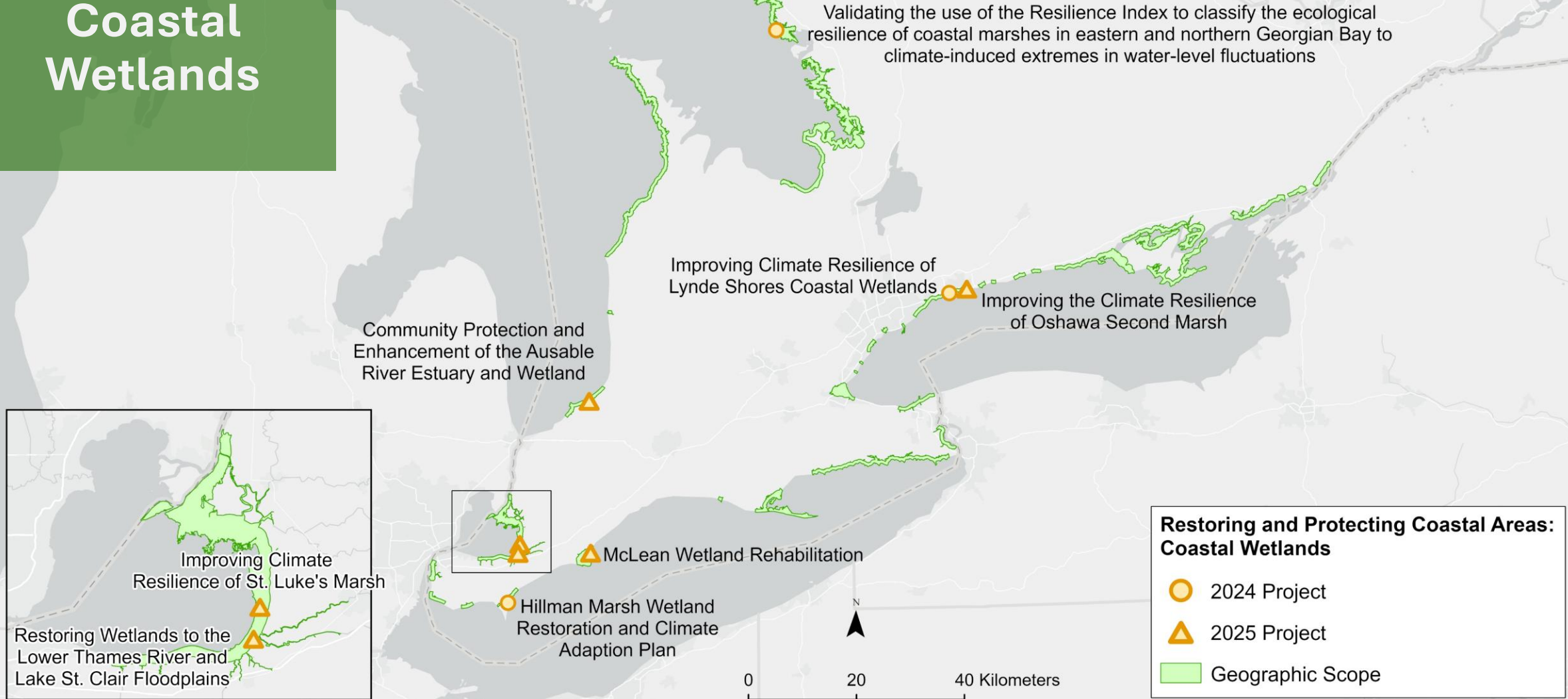
These projects will enhance:

- Water quality
- Ecosystem health
- Coastal resilience

Restoring and Protecting Coastal Nearshore Areas



Restoring and Protecting Coastal Wetlands





FUNDING DETAILS

Project Funding

- Minimum = \$100,000 ; Maximum = approx. \$3 M
- Requested funding should be aligned with the scope and scale of the project
- Support for multi-year projects (minimum 2 years, up to 4 years)

Eligible Applicants

- Conservation Authorities
- Indigenous organizations, governments, individuals, boards, commissions, communities, associations, and authorities
- Canadian municipal and local governments
- Canadian not-for-profit organizations
- Canadian research, academic, and educational institutions
- Canadian local organizations



FUNDING DETAILS

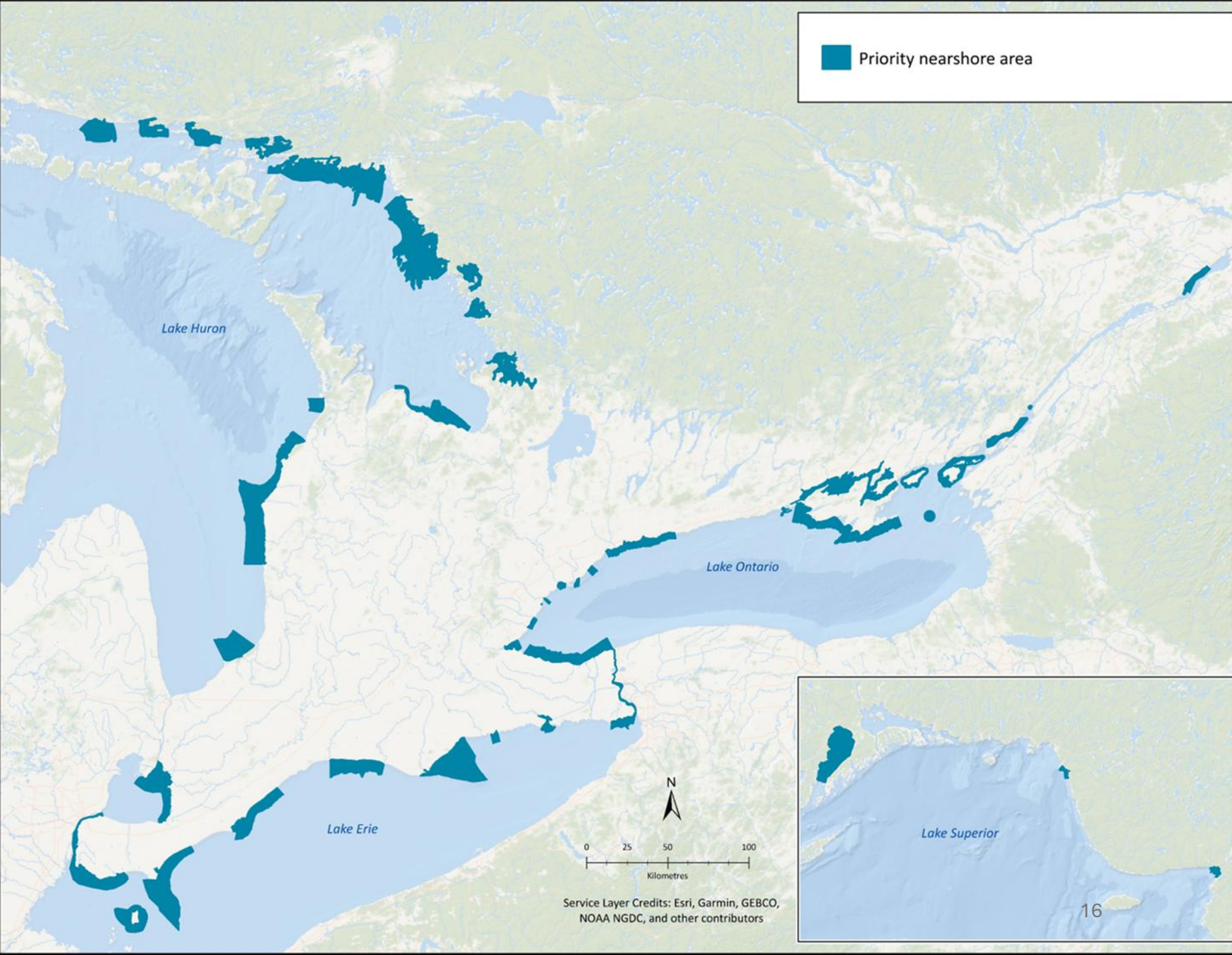
Eligible Project Expenses

- Human resources, including salaries and benefits
- Management and professional services
- Travel
- Material and supplies
- Printing, production and distribution costs
- Rental of equipment and capital assets
- Vehicle rental and operating costs
- Contractors, in support of program activities
- Overhead (reasonable share)
- GST/HST that is not reimbursable by CRA and PST not reimbursable by the provinces

Ineligible Project Expenses

- Land acquisitions
- Purchases of any vehicle or capital assets
- Any expenses for a project required by law, regulation or policy
- Expenses for work that takes place on federal land or in a Provincial Park or conservation reserve

Coastal Nearshore Projects



ACTION: Restore coastal processes to allow unrestricted movement of sediment

Projects may include (but are not limited to):

- Removal or modification of littoral barriers to re-establish or increase sediment transport
- Conducting sand bypass activities to restore coastal processes
- Removal or modification of man-made or engineered structures preventing natural erosion



ACTION: Implement nature-based solutions to remediate altered shorelines and nearshore areas

Projects may include (but are not limited to):

- Softening hardened shorelines
- Installation of submerged breakwaters, reefs or other structures to reduce the impacts of wave energy
- Stabilizing and naturalizing shorelines



ACTION: Restore tributary connectivity between watersheds and the nearshore

Projects may include (but are not limited to):

- Full or partial removal of first barriers/dams
- Activities to establish by-pass channels around dams or other man-made barriers
- Alteration of existing dams to restore fluvial processes, improve water quality or enhance fish passage



SCIENCE: To advance innovative nearshore approaches or technologies

Projects may include (but are not limited to):

- Improve understanding of nearshore sediment dynamics;
- Advance understanding of nearshore water quality and ecosystem health to support future assessments of nearshore waters; and
- Support integration and visualization of stressor data

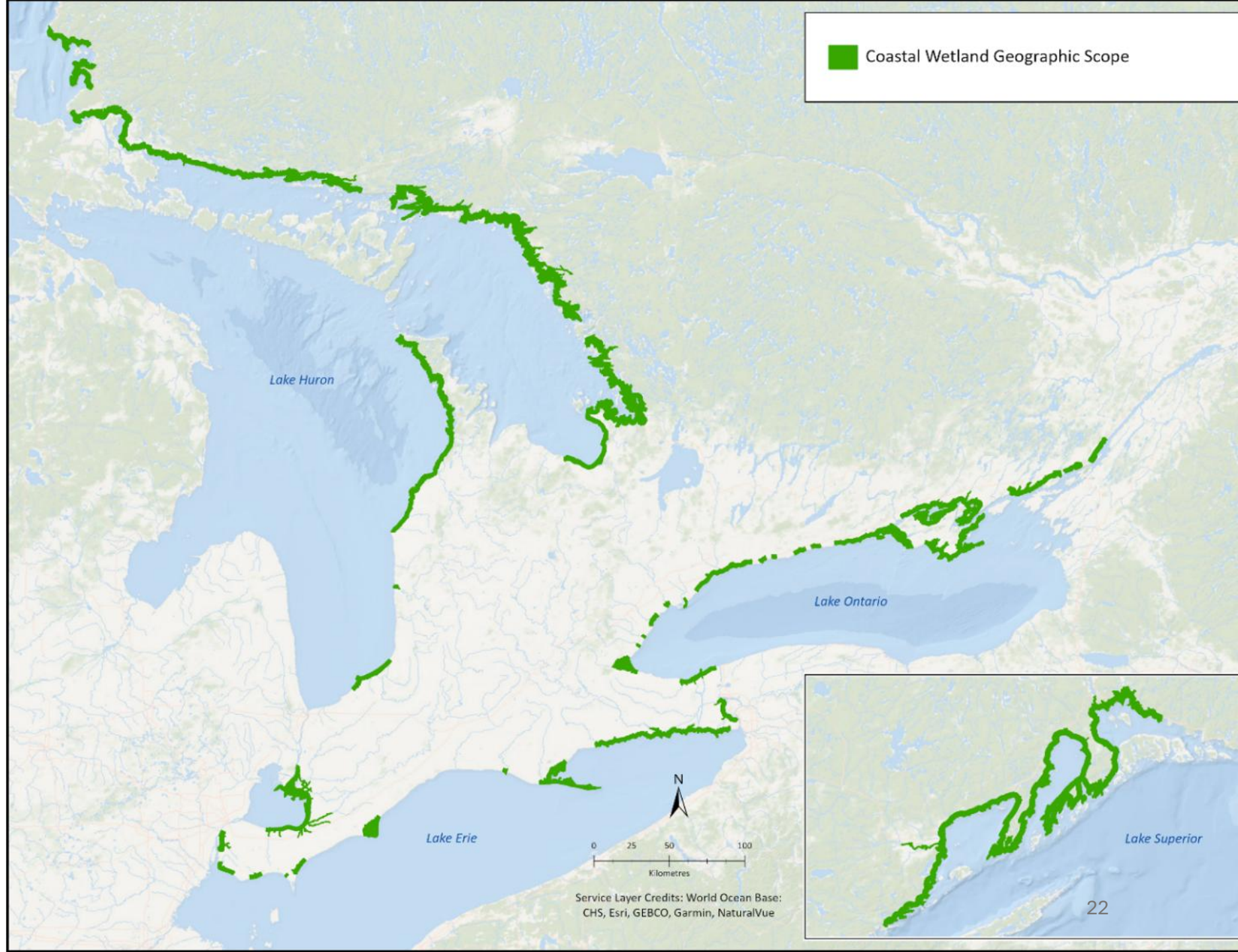


ENGAGEMENT: Improving local community engagement for decision-making on implementation and assessment

Action projects **supported by strategic engagement** with local communities for work planning, implementation, and decision-making toward restoring critically important nearshore areas



Coastal Wetland Projects



Projects that **PROTECT coastal wetlands** from extreme and prolonged lake-level changes, storm events, and thermal changes



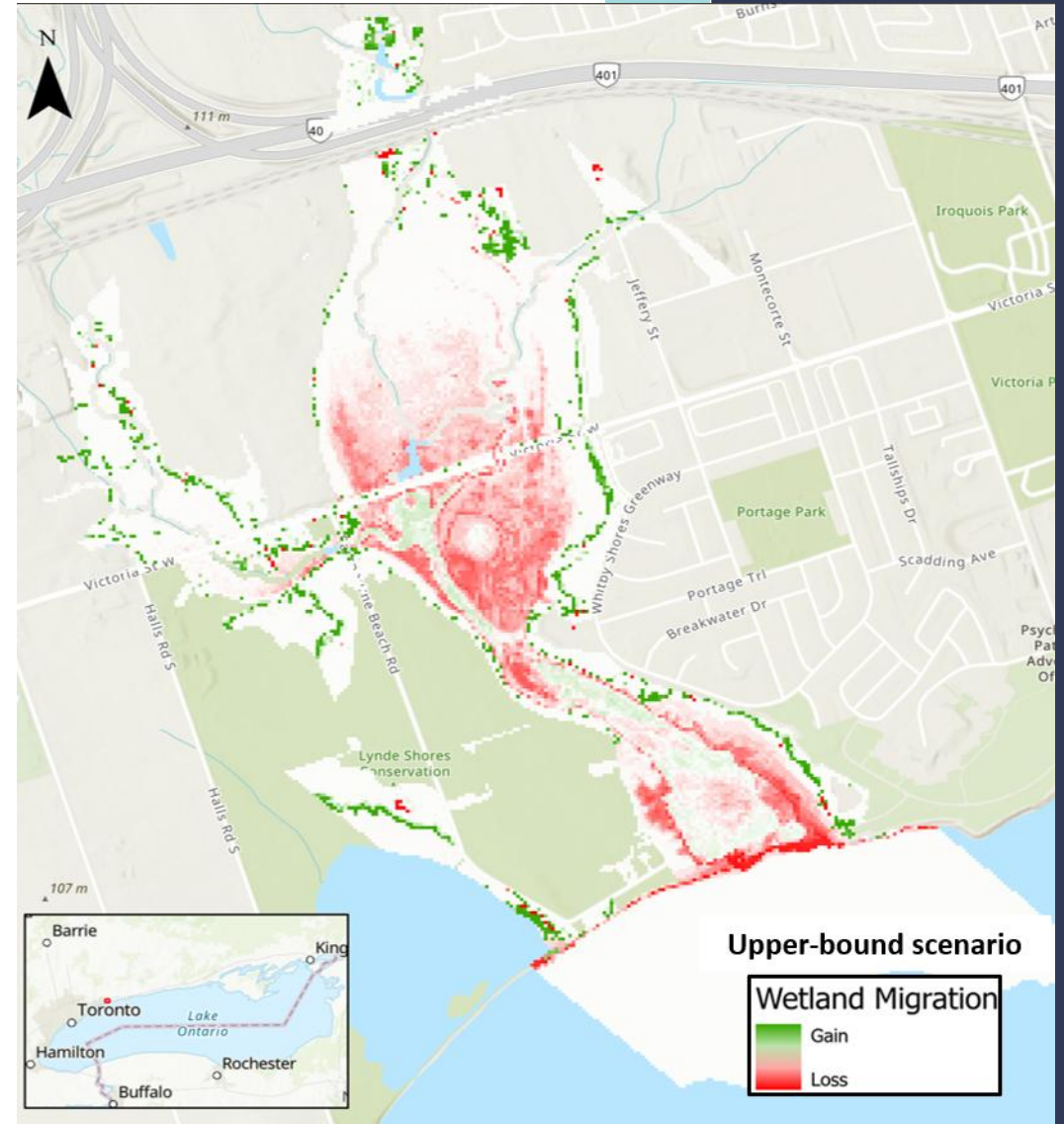
Projects that **REDUCE WETLAND SENSITIVITY** to climate-related impacts by improving various aspects of wetland function, integrity, and diversity of the wetland plant communities and species



Projects that **INCREASE
THE ADAPTIVE CAPACITY**
of a wetland's ability to
adjust, cope, and persist
under changing climatic
conditions



Projects that **ADVANCE** innovative, transferable, and sustainable climate change adaptation and restoration approaches



Evaluation Criteria

Results

Project Feasibility/Likelihood of Success

Additional Benefits

Value of Money



Thank You!



Nearshore Projects:

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Coastal Wetland Projects:

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A serene landscape of a lake with a forested background and a small island with driftwood. The water is calm, reflecting the surrounding greenery and the sky. The text "Project Highlights" is overlaid in white on the left side of the image.

Project Highlights

Validating the use of a Resilience Index to Classify Ecological Resilience of Coastal Marshes in Eastern and Northern Georgian Bay

Pat Chow-Fraser

McMaster University, Dept of Biology

Great Lakes, Greater Insights Webinar:

Data & Modelling in action

September 15, 2026



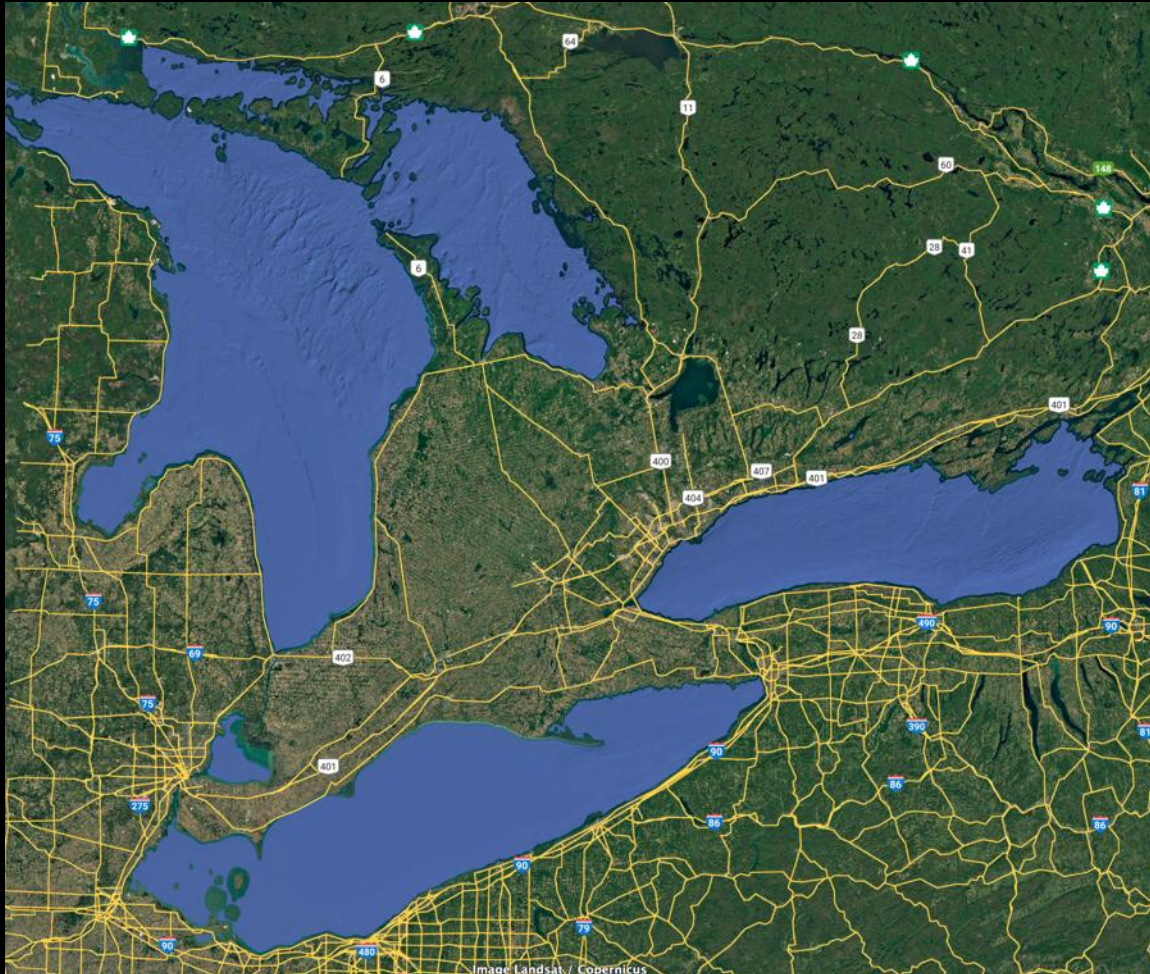
Georgian Bay

- Eastern arm of Lake Huron (15,000 km²), and includes the world's largest freshwater archipelago
- There are thousands of coastal marshes along eastern and northern shoreline
- High biodiversity (Georgian Bay Biosphere):
 - 840 native plant species
 - 170 types of breeding birds
 - 44 mammal species
 - 34 reptiles & amphibians
 - Only self-reproducing GL muskellunge trophy fishery

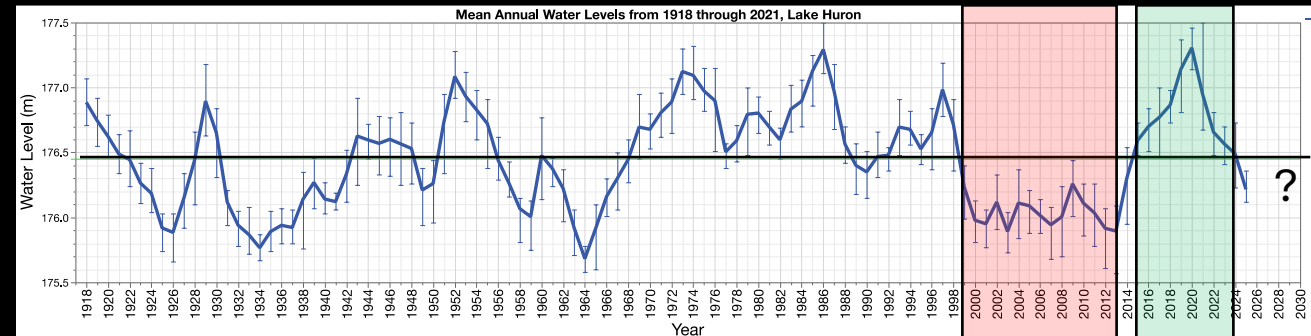


Unlike other Great Lakes coastal marshes:

- Most coastal marshes in Georgian Bay are located on the Canadian Shield and not road accessible, which limits wetland development
- Minimal effect of human activities but highly sensitive to WL fluctuations of Lake Huron



- Pattern of WL fluctuations have varied in response to climate change
- WL varied by >1.0 m during 8-y cycles (1918-1998)
- From 1999 to 2013, WL variation was kept within 50 cm and mean annual WLs were all below the LT mean
- Between 2015 to 2024, mean WL have been above LT mean
- Expect WLs in the next 8 -year cycle to be relatively low



Effect of WL on wetland vegetation:

- From 1999 to 2013 (14 y), low WL allowed terrestrial species to invade former aquatic habitat
- With increased WL in 2014, terrestrial species began to die, but many trees remained standing – forming the novel Dead Tree Zone (DTZ)



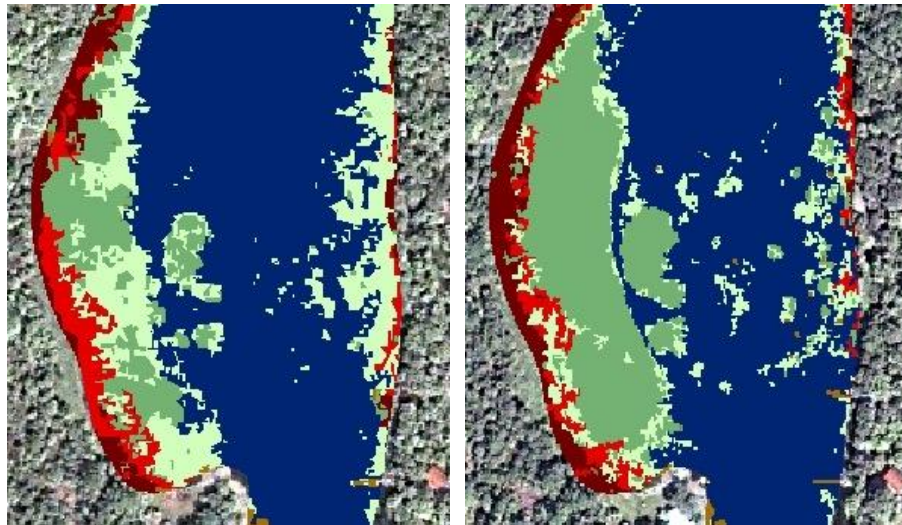
- When WL rose above LT mean (2016-2022), DTZ appeared to block movement of fish into areas occupied by aquatic vegetation (known to be good fish habitat in previous surveys when WL were low)
- **RESEARCH QUESTIONS:**
 1. Is community dynamics of coastal marshes sensitive to WL changes?
 2. Are some wetlands more resilient than others to such WL disturbances?



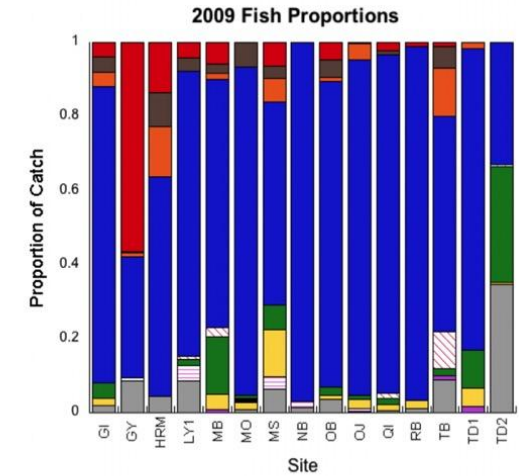
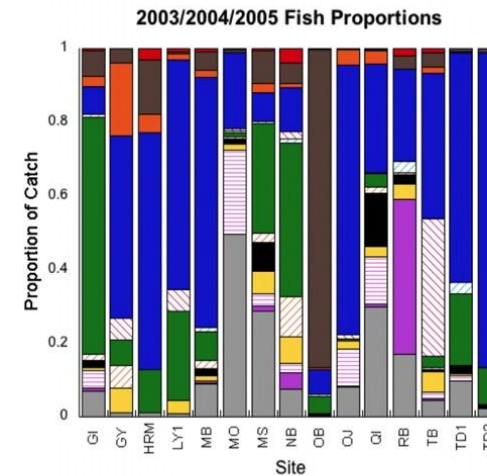
Q1: Is community dynamics of coastal marshes sensitive to WL changes?

Midwood and Chow-Fraser (2012) surveyed the plant and fish communities of 15 coastal wetlands in southeastern GB ~4-6 y following decline in WL and again 9 years following the decline:

- Over that interval, meadow vegetation had increased, dense floating vegetation had expanded, open water had become reduced
- Overall there was less aquatic habitat, especially submersed aquatic vegetation (SAV)
- Modified habitat structure was associated with a less diverse fish community, favouring dominance of pumpkinseeds
- We lost some fish species that require more open-water habitat (Largemouth Bass, Blackchin shiners)



Emergent
HD Floating
Open Water
LD Floating
Meadow
Rock



Q2: Are some wetlands more resilient than others to such WL disturbances?

**Unravelling the
mystery of
disappearing
age-0 muskies
from
southeastern
Georgian Bay**



**John Paul Leblanc,
2010-2014
PhD (McMaster U)**



**Dan Weller, PhD
2014-2018
PhD (McMaster U)**



Young muskies live in coastal marshes during their first few years of life

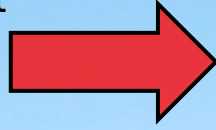
What are the habitat requirements of the YOY muskies?



Exhibit high site fidelity in Georgian Bay



Eggs are broadcast
within emergent
vegetation



YOY are found near
spawning sites

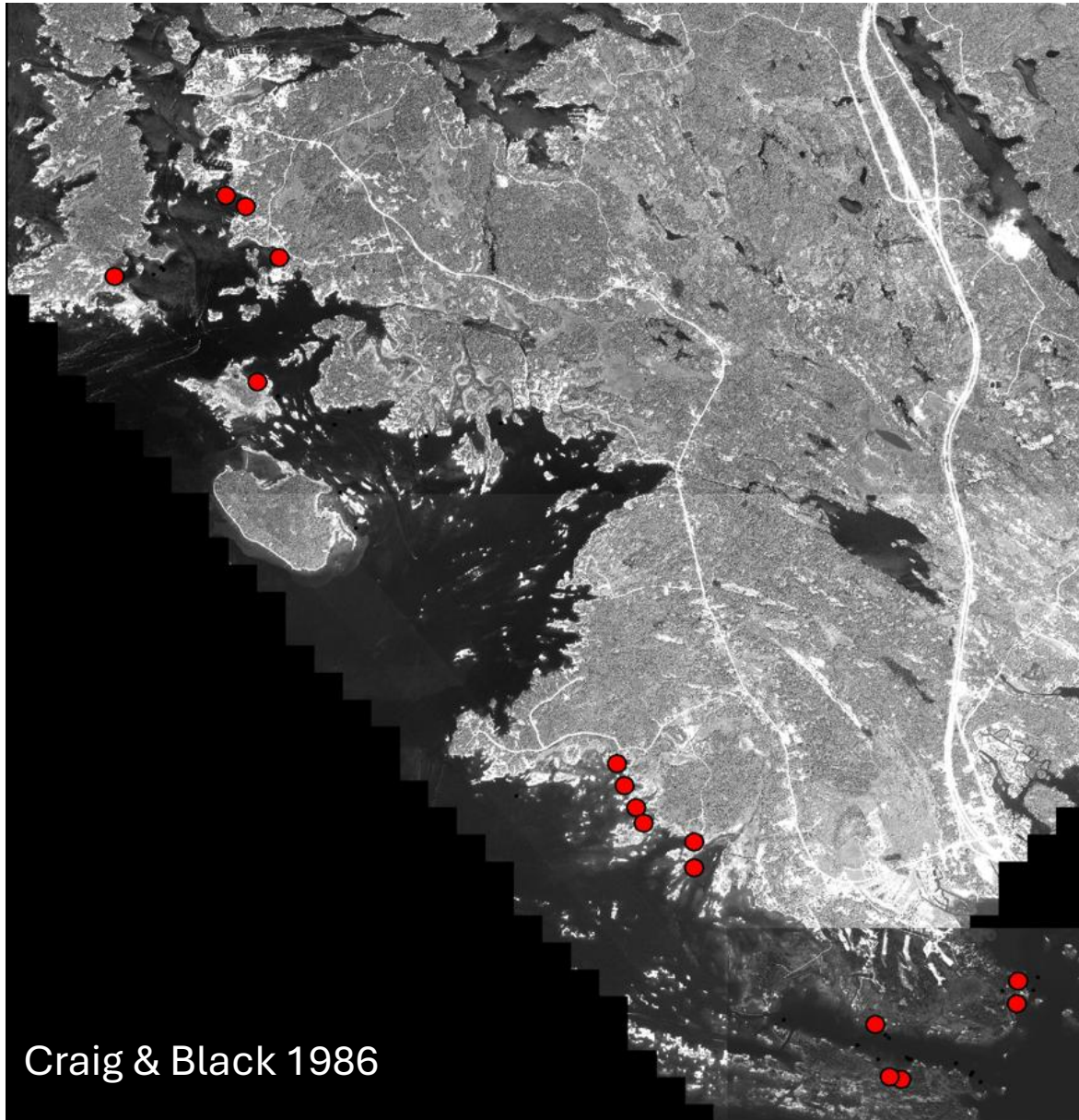
Anecdotal evidence that YOY very sensitive to changes in nursery habitat



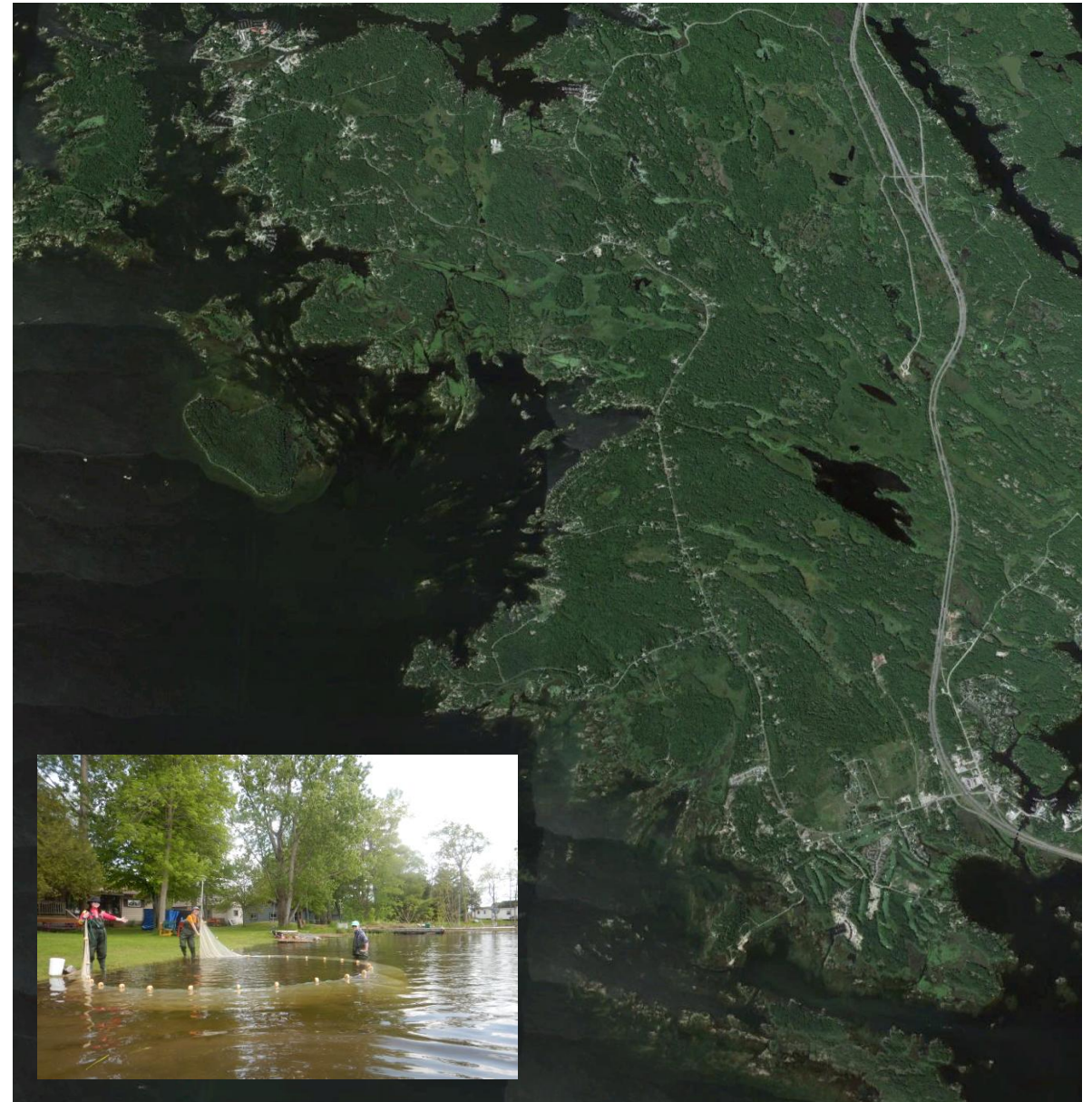
**Literature indicates
they depend on
coastal marshes**

- **They appear to require a structurally diverse habitat**
 - Macrophytes occupying the water column, and open water to move between plants
 - Suitable preferred prey (i.e. fusiform shape fish like minnows and shiners)

1981: OMNR biologists seined 102 sites in Severn Sound and found YOY muskies in only 20 (red dots)

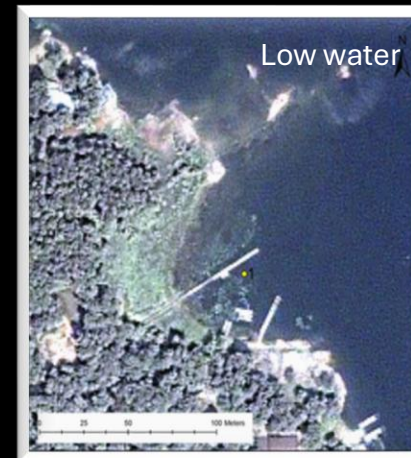
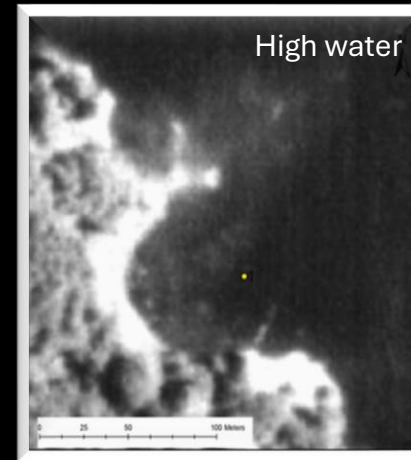
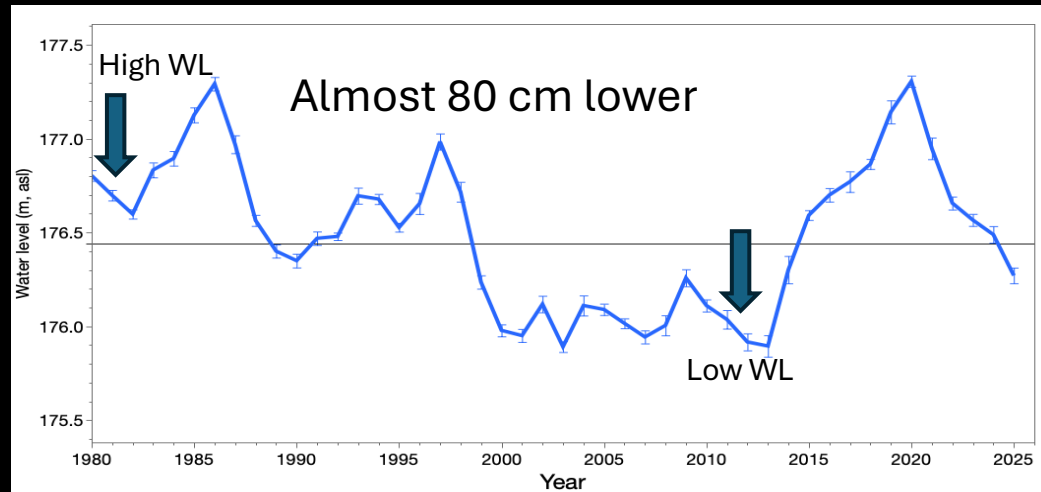


In 2012, 2021 and 2024, the Chow-Fraser lab resurveyed 16 of the 20 sites and found no YOY muskies present

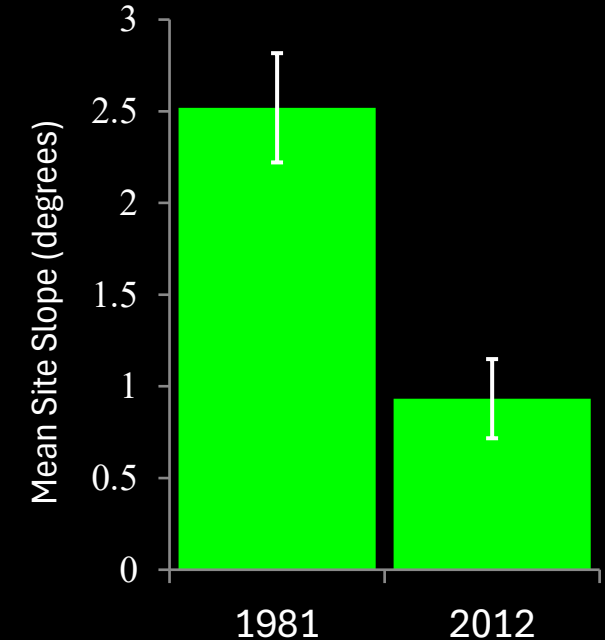
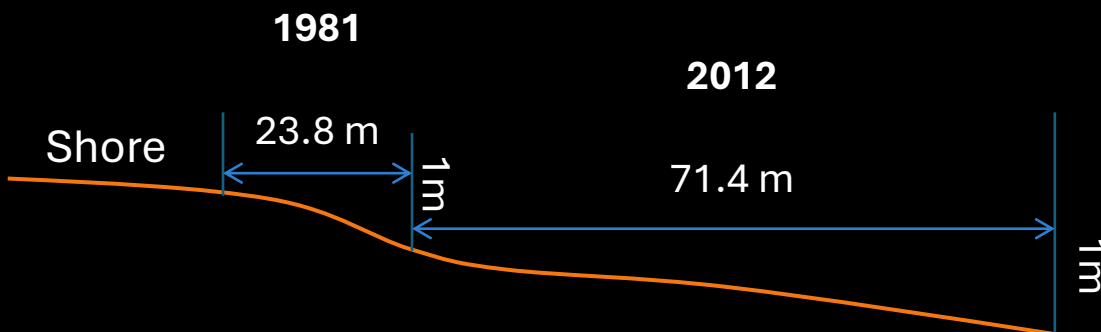


What can explain this disappearance?

Habitat structure of sites in 2012 was different from that in 1981 due to change in WL conditions:



- The slopes in 1981 (high water) were generally steeper than those in 2012
- These conditions supported more suitable vegetation structure for YOY muskies



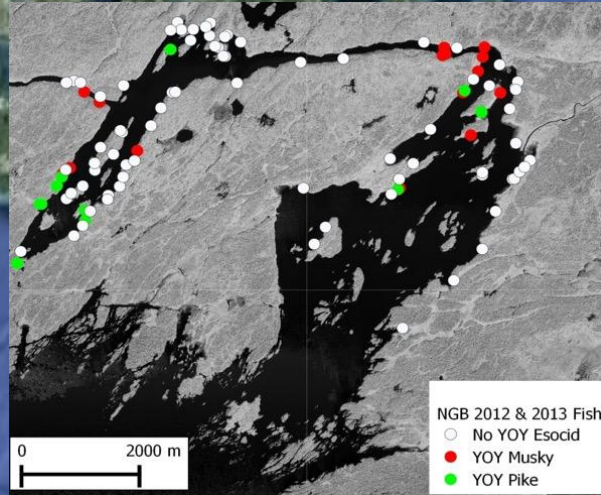
Northern GB



There were musky and pike YOY (congeners)



Muskies were spawning
(Leblanc & Chow-Fraser 2017)



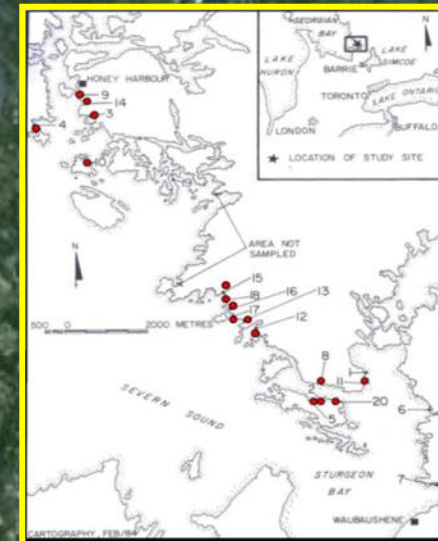
Since both regions were sampled during low water-level regime (2012-2013), there must be regional differences in how coastal marshes respond to WL disturbances

Severn Sound

No YOY muskies

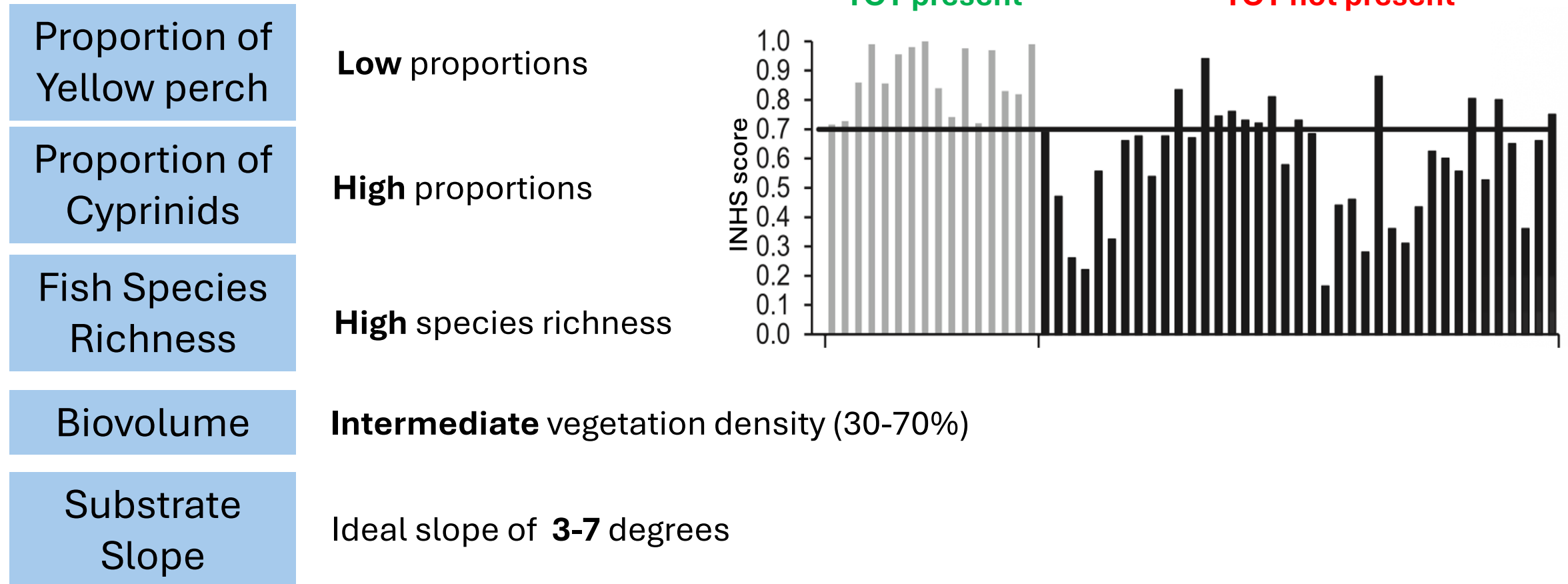
Muskies were spawning
(OMNR Spring Musky Index
Netting surveys)

59 km



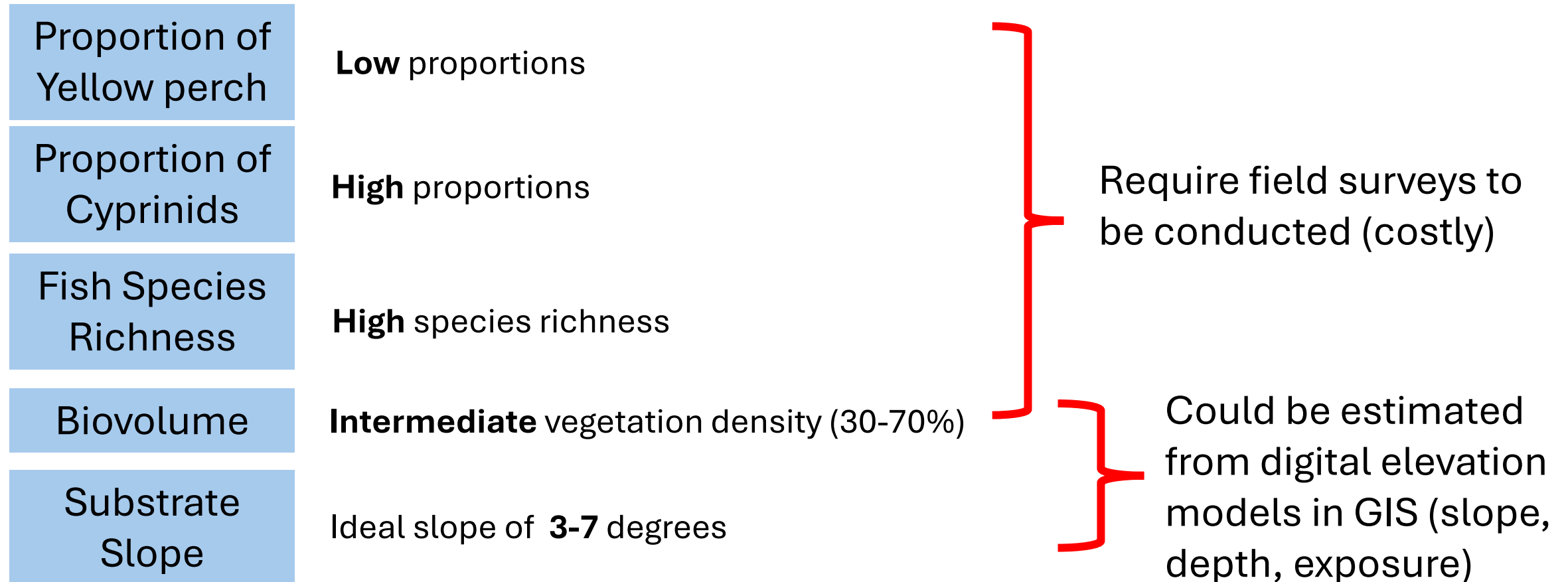
Development of the Index of Nursery Habitat Suitability (INHS)

Leblanc and Chow-Fraser (2017) used observations of site morphometry, fish and plant communities in northern GB during 2012 and 2013 surveys, and those conducted in Severn Sound in 1981.



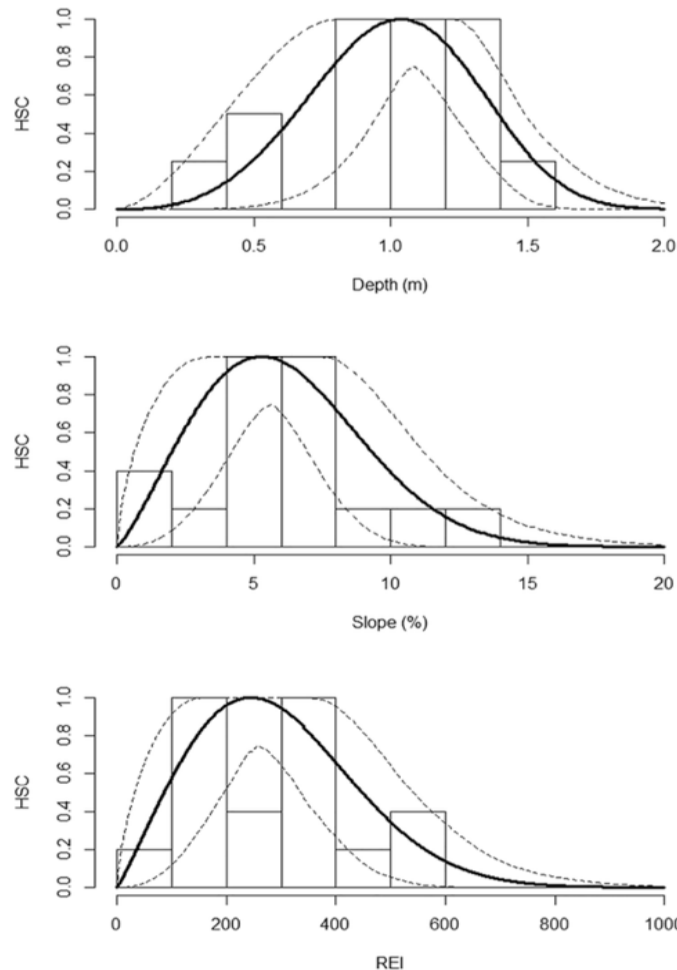
Development of the Index of Nursery Habitat Suitability (INHS)

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Creation of the Resilience Index (RI) (Weller and Chow-Fraser 2019)

J.D. Weller and P. Chow-Fraser



Water depth

% shoreline
slope

Relative
Exposure Index

RI

Fig. 3. Habitat suitability curves (HSCs; solid line) bounded by 95% confidence interval (dashed lines) for hydrogeomorphic variables associated with muskellunge nursery sites. A 2-parameter Weibull probability density functions was fitted to the data from northern Georgian Bay sites under low lake levels ($n = 16$). The HSC is the probability density function rescaled to values of 0–1.

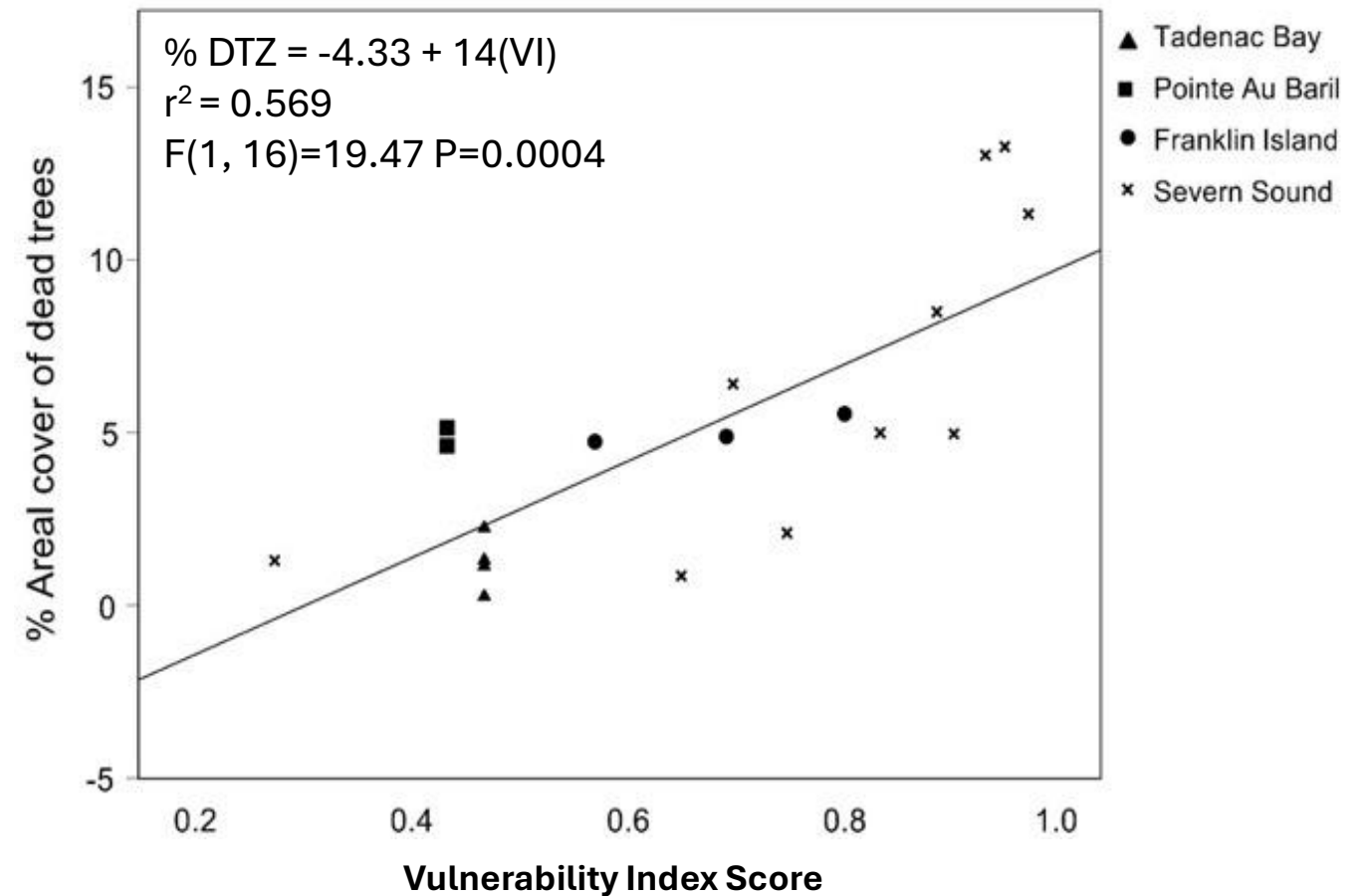
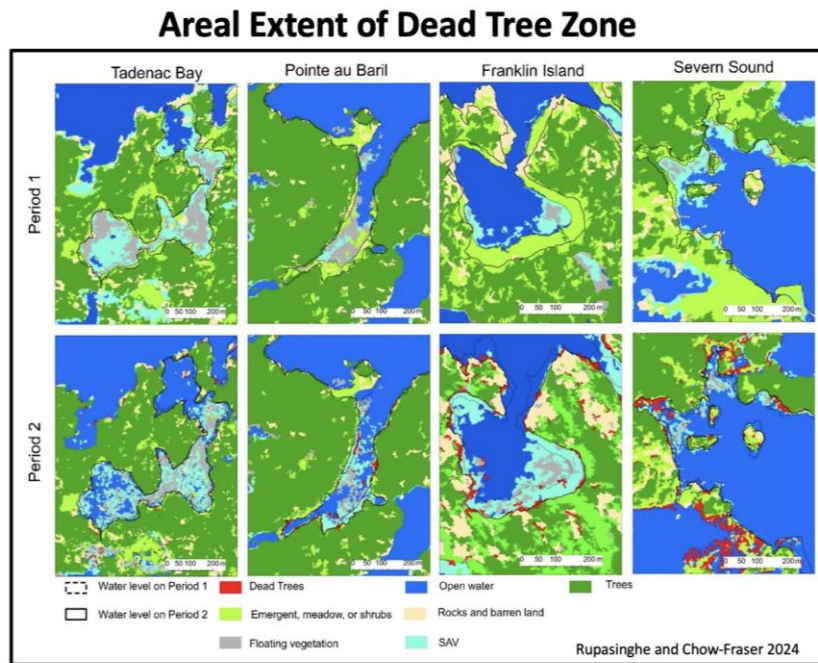
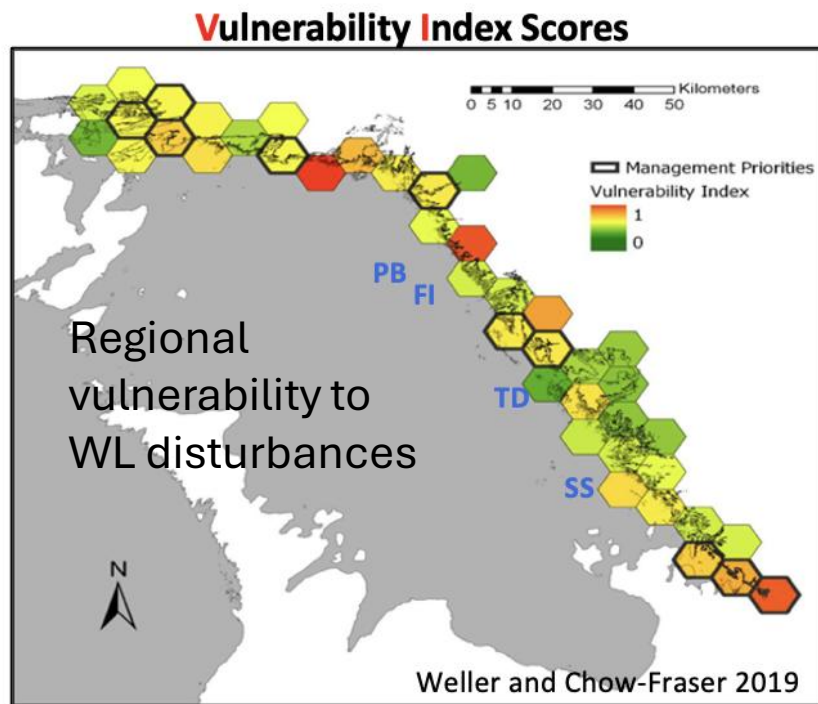
- Using the INHS of Leblanc and Chow-Fraser (2017), Weller and Chow-Fraser created the **Resilience Index (RI)** based only on geomorphic variables
- RI can be used as a screening tool by managers to identify resilient sites that can be targeted for field surveys

Does it work?

- The RI scores for wetlands in northern GB were all significantly higher than those in southern GB

Regional application?

- In addition, we calculated the **Vulnerability Index (VI)**, composite score of a region that confers a measure of regional vulnerability to WL



Across northern and eastern Georgian Bay, the VI (regionally) and the RI (at site level) appear to be useful for estimating degree to which wetland plant communities are affected by changing WL regimes, and by implication, the fish communities.

Resilience Index Scores

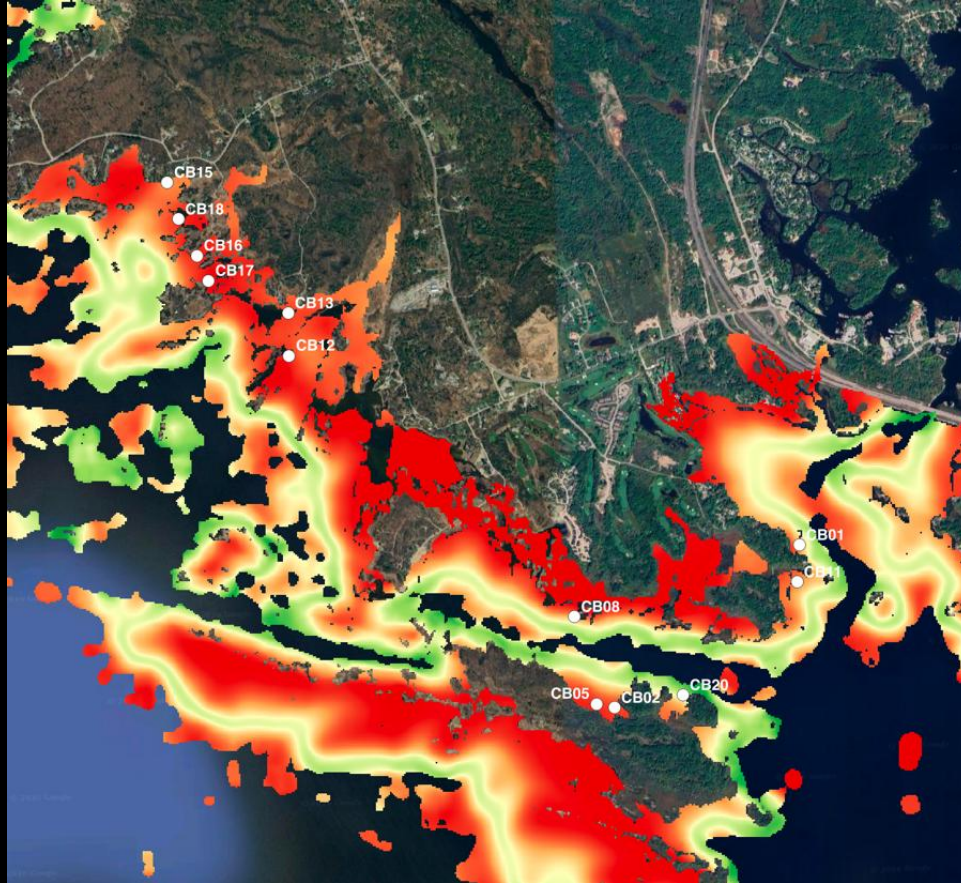
Least resilient

Neither

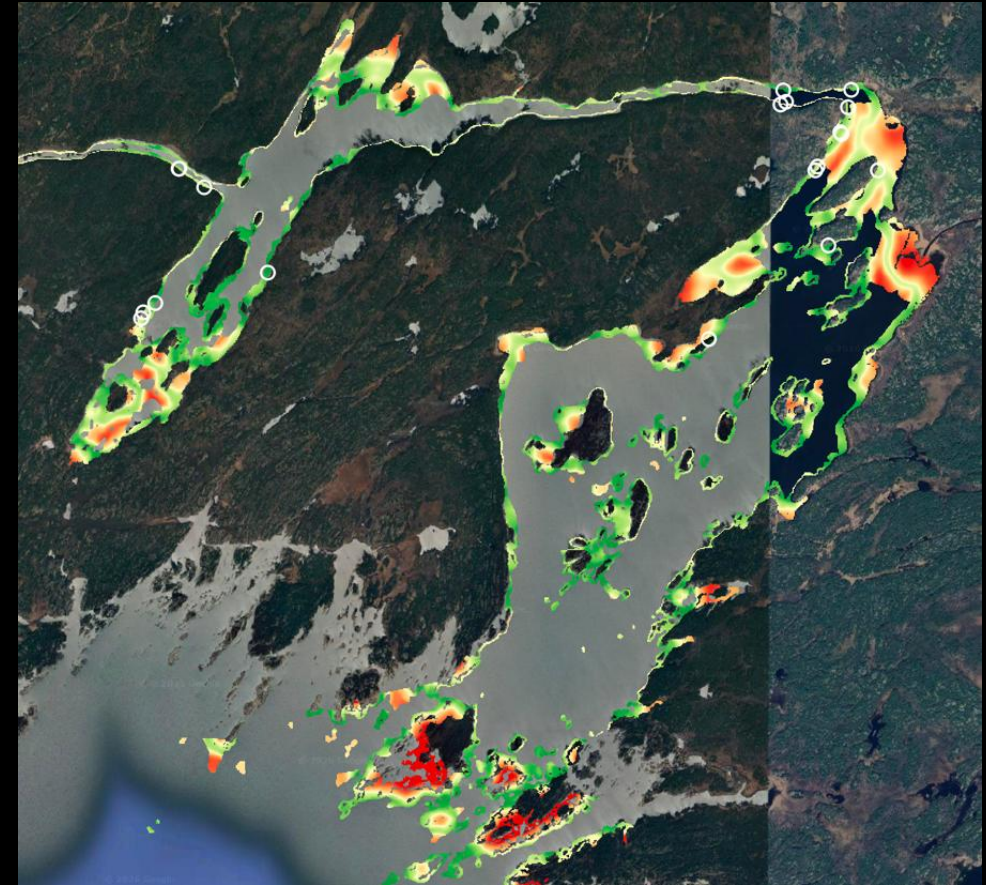
Most resilient

These wetlands are highly vulnerable

These wetlands are not vulnerable



Severn Sound (Craig & Black)



Northern Georgian Bay

Canada Water Agency Great Lakes Freshwater Ecosystem Initiative (2024-2028):

Hypothesis: RI score is significant predictor of wetland resilience to water-level disturbances

- Wetlands with Low RI scores => vulnerable to WL disturbances and will have altered plant and fish communities after perturbation
- Wetlands with High RI scores => not vulnerable to WL disturbances and will not have altered plant and fish communities

Prediction: Degree of similarity of species composition of plant and fish communities before and after perturbation will vary significantly with wetland RI scores

Additional objective: Conduct change-detection using high-resolution satellite/drone images acquired in 2002-2003 (before perturbation) and in 2026 (after perturbation) to reveal the vegetation classes most affected by changing WL regimes

Canada Water Agency Great Lakes Freshwater Ecosystem Initiative (2024-2028):

Method: Survey 30-35 coastal marshes that have been surveyed at least once between 2003 and 2008 (Period 1)

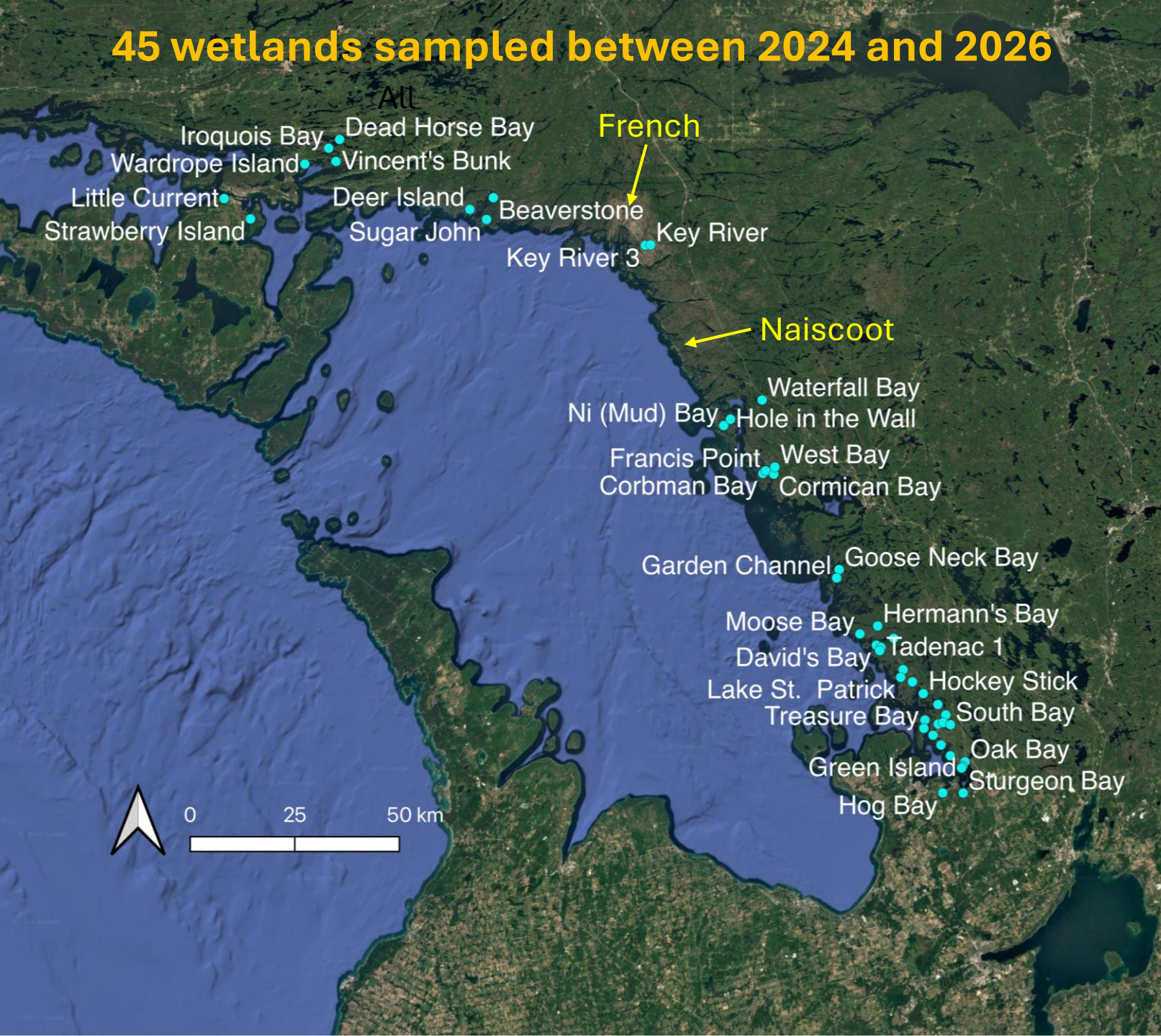
Fieldwork: 2024 to 2027 (Period 2)

- Based on the range of RI scores from Weller and Chow-Fraser, chose up to 40 sites to re-survey fish and plant communities using the same protocols as those in Period 1
- Conduct as many surveys as possible from 2024 to 2026
- Calculate Similarity Index (SI) scores for the fish and plant communities using data collected in Periods 1 and 2
- Regress SI scores against Resilience Index scores

Satellite image acquisition:

- Acquire 2026 satellite images corresponding to surveyed wetlands and conduct change detection

45 wetlands sampled between 2024 and 2026



- Of the 45 wetlands surveyed between 2024 and 2026, 28 are associated with RI scores calculated by Weller and Chow-Fraser (2019)
- RI scores are difficult to calculate without digital elevation model
- Derivation of simplified metrics could increase number of wetlands
- Two regions with RI scores have not been sampled: **French River and Naiscoot River** and may be sampled in 2027 (if necessary)

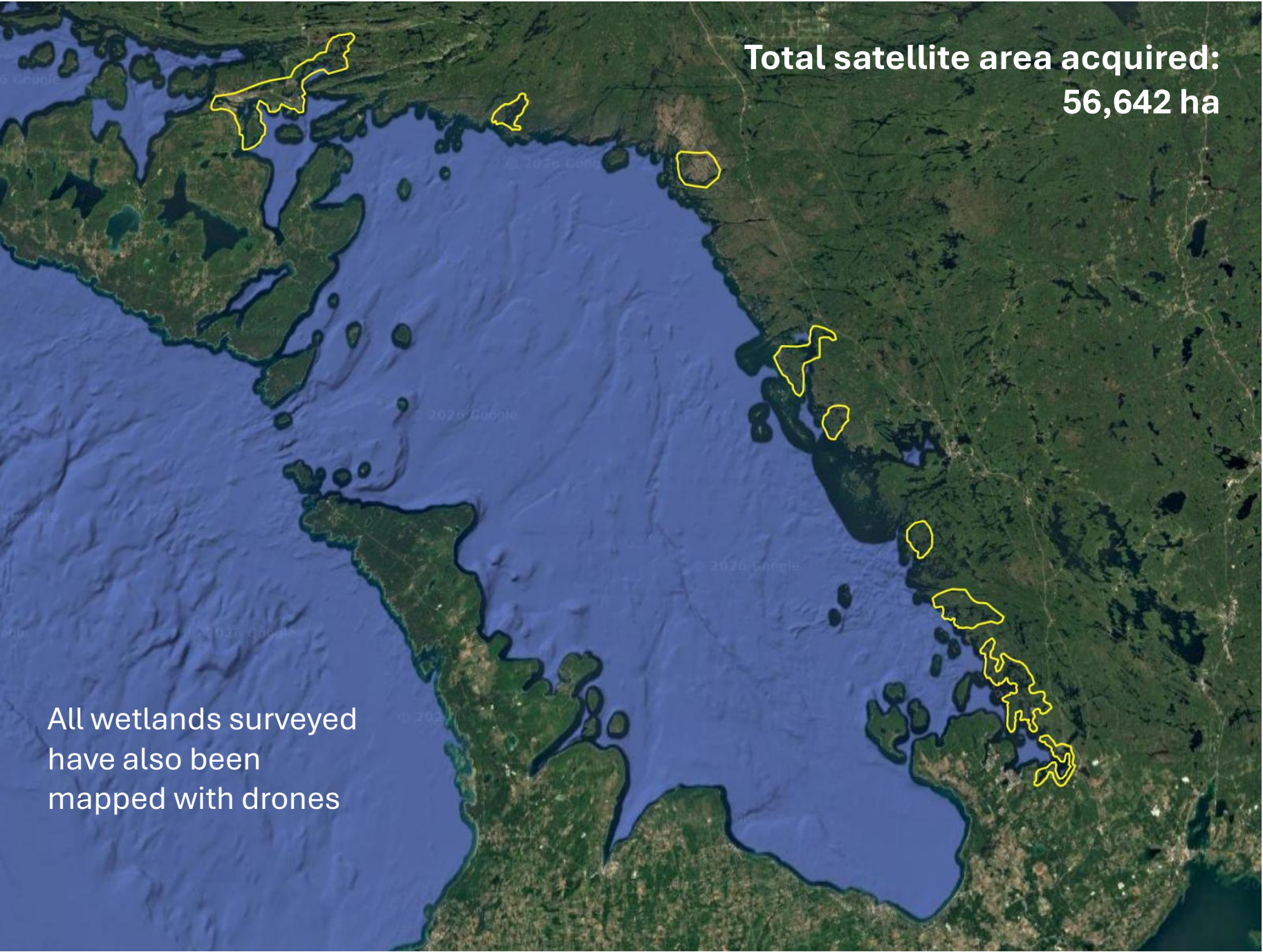
Field work:

All sites monitored for water chemistry and nutrients in open water; plant species presence recorded in 10-12 quadrats/wetland



Presence of all freshwater turtles and fish recorded in each wetland; voucher photos of fish taxa taken and in 2024-25 only, collected underwater videos of fish communities.





McGregor and Strawberry Island:	17,355 ha
Beaverstone:	2,637 ha
Key River:	5,036 ha
Pointe au Baril:	6,347 ha
Franklin Island:	2,503 ha
Sans Souci:	2,768 ha
Wah Wah Taysee & Twelve Mile	6,844 ha
Quarry Island to Go Home Bay:	9,851 ha
Hog to Musky Bay:	3,300 ha

Future work: 2026 – 2028



- Calculate Similarity Index scores for all fish and plant communities in as many wetlands as possible (~30) to test the relationship between SI and RI scores
- Develop simple metrics of wetland vulnerability
- Use drone and satellite images to delineate vegetation communities

- Supervise/conduct change detection of vegetation classes using acquired satellite images
- Determine how DTZ in regions with different VI scores are recovering after WL have returned to near long-term means

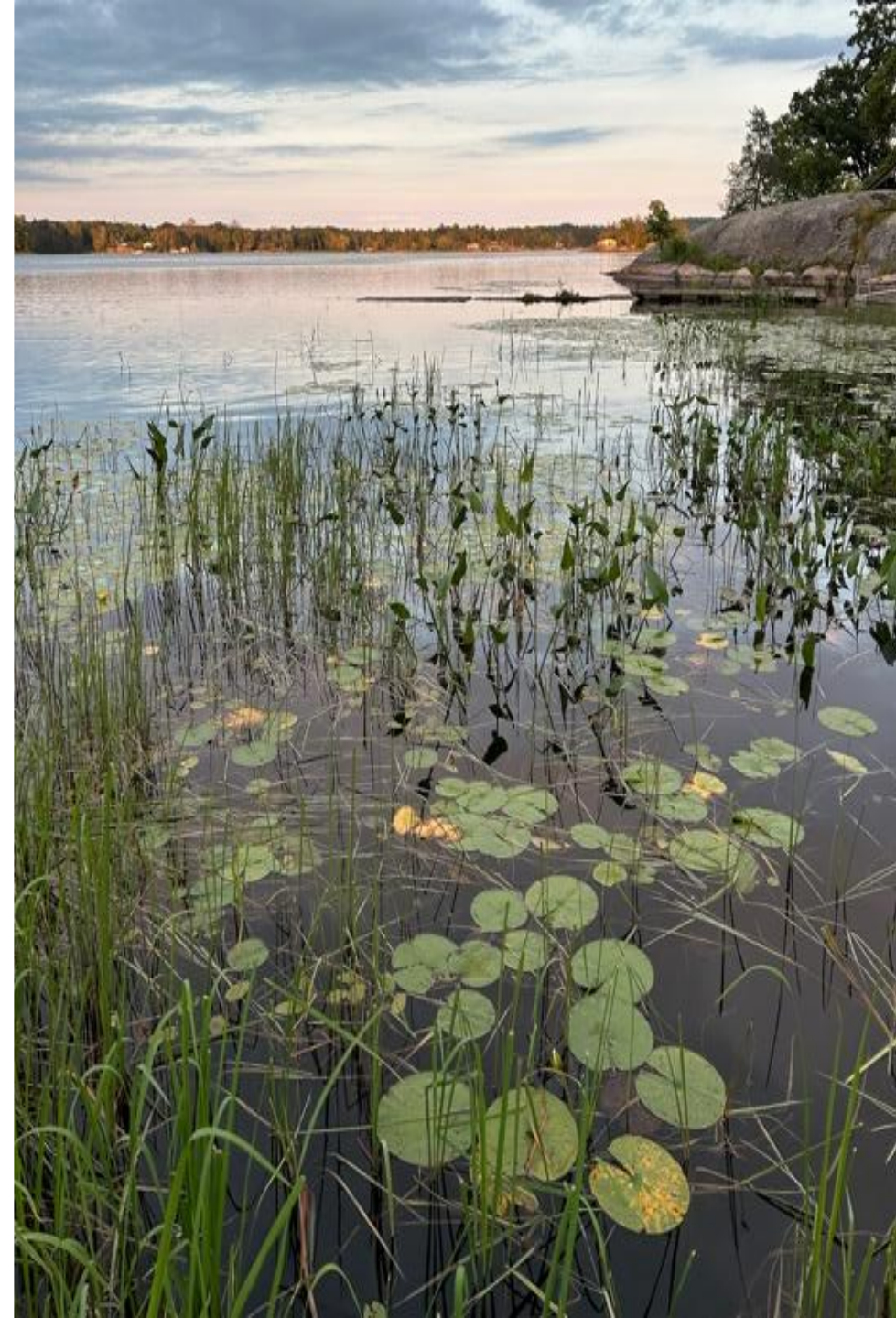


Expected Outcome of Project:

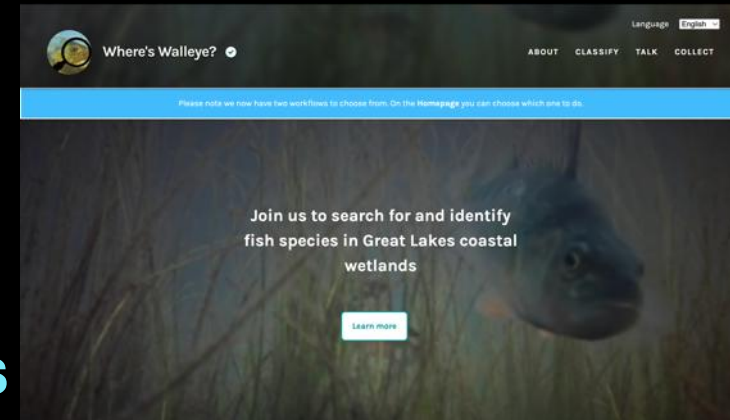
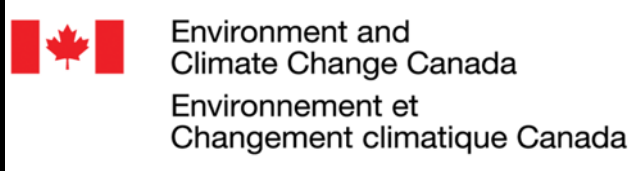
- Validate use of Resilience Index to classify degree of wetland vulnerability to WL disturbances in GB
- Develop simpler metrics to the RI that will not require use of high-resolution DEM
 - Simplified calculation of mean slope and fetch
 - Metrics of human activities (cottages, docks within 500 m of wetlands)
 - Proximity of site to other wetlands (source populations)
- Determine vegetation classes that are most affected by long-term WL disturbances via change detection of satellite images

Benefits to Management:

- Agencies can use simple metrics to screen for high-resilience sites for field surveys and to include as priorities for acquisition or restoration



Cottage associations



Citizen scientists

Funders

- Government programs (COA, LSEGBCUF, GLPI)
- Private foundations
- Mitacs Accelerate grant with GBGLF
- McMaster University
- NSERC Discovery
- Private donations



First Nations

Graduate students

Coastal Resilience Action Plan for the Port Glasgow to Long Point Littoral Cell

September 15, 2026



Pete Zuzek, MES, CFM, P.Geo.
Sarah Bod, B.Sc., M.Sc.



Littoral Cell from Port Glasgow to Long Point

Littoral Cell

A region of coast that defines the supply of sand and pebbles, the direction it moves along the coast, and the area of deposition (accumulation).

Divergent Node

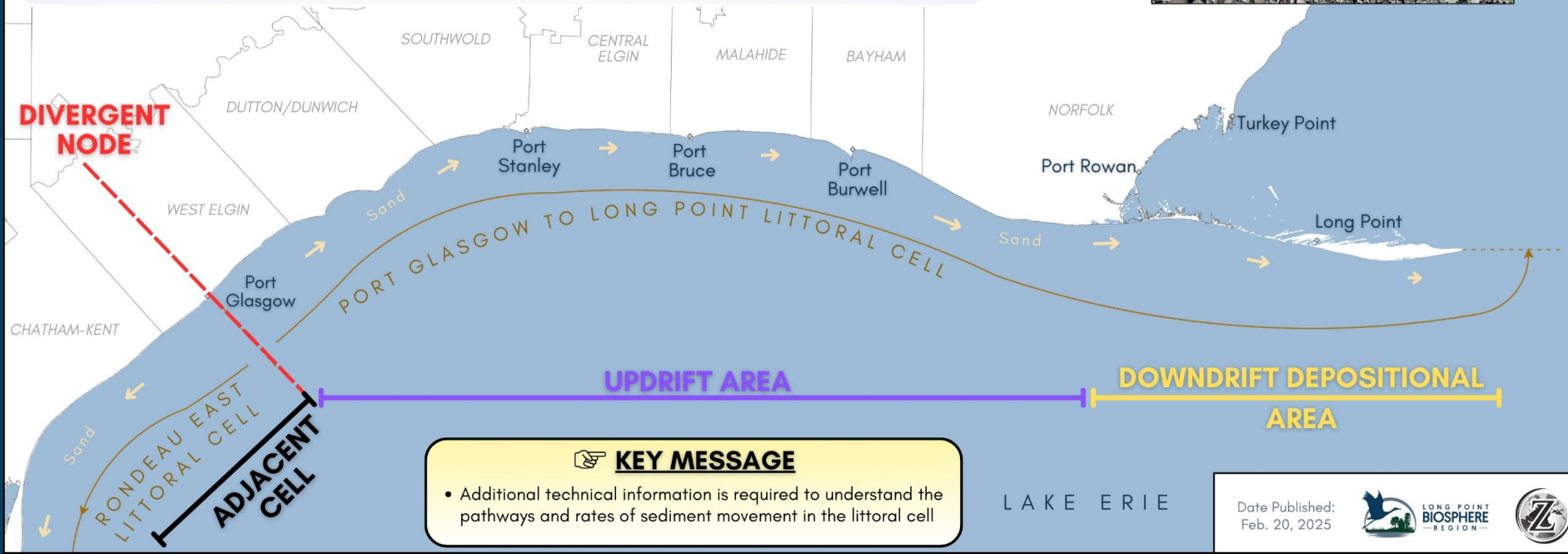
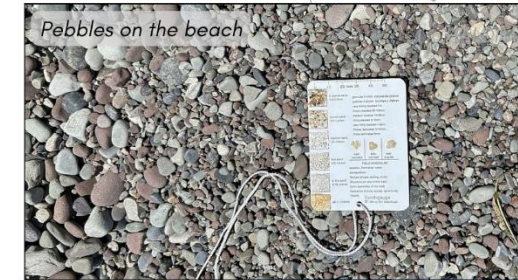
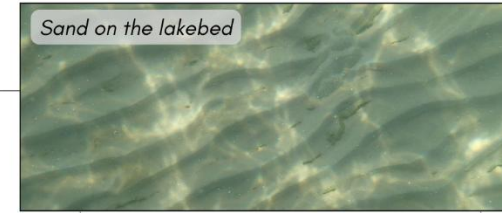
A boundary between two adjacent cells, where sediment moves in opposite directions

Updrift Area

The portion of a littoral cell that features a natural background erosion rate and generates sediment from erosion and river inputs

Downdrift Depositional Area

The stable or accreting area of the cell due to a positive supply of sediment from the updrift area.

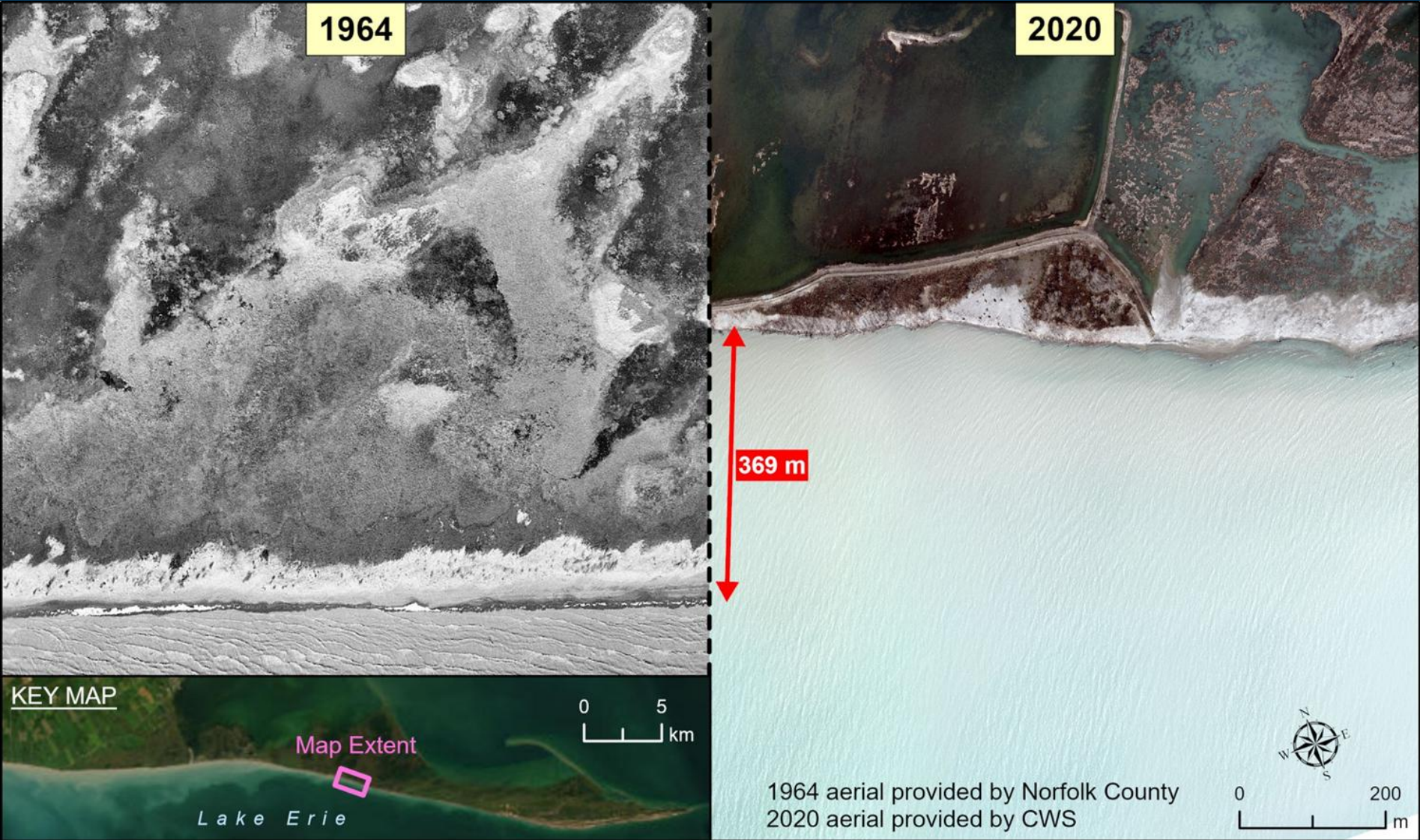


Today, Most of the Spit Is Eroding. Why?



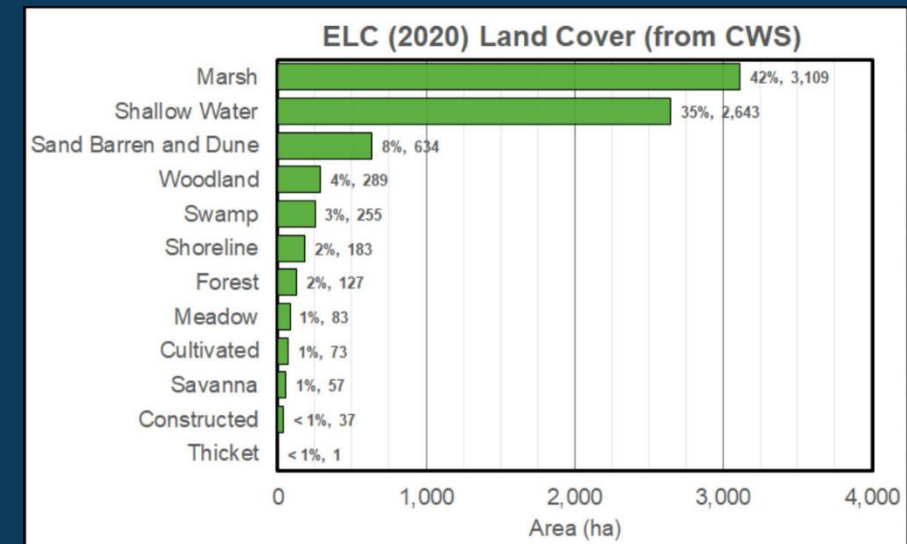
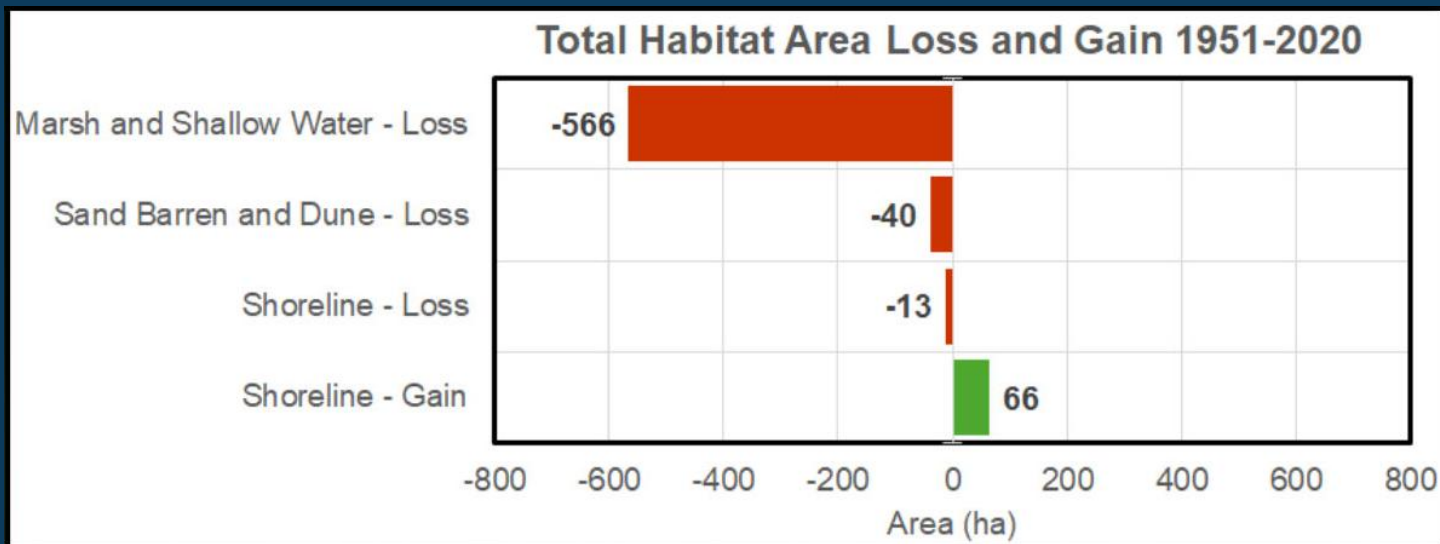
2023/08/10

Long Point Company from 1964 to 2020



Original (simple) Hypothesis

- The sand spit is starved of the sediment it requires to grow due to harbour construction to the west
- Since 1951, Long Point has lost 600 hectares of coastal wetlands, dunes, and beach habitat
- This represents 10% of the spit area



SEDIMENT BUDGET AND NUMERICAL MODELLING TO UNDERSTAND SEDIMENT DYNAMICS

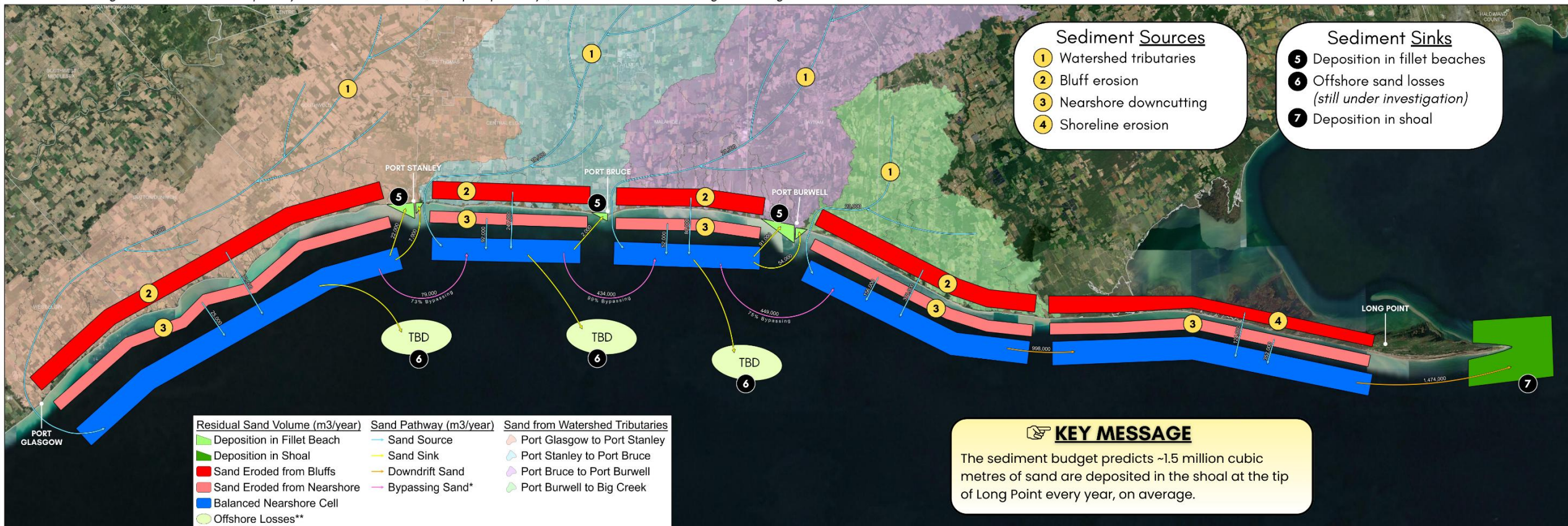


Littoral Cell

Sediment Budget:

The sediment budget quantifies all the sediment sources, transport pathways for sand, and depositional sinks within the boundaries of the Port Glasgow to Long Point littoral cell. When the sediment sources equal the sediment sinks, the budget balances, and there is confidence in the sediment pathways.

The sediment budget calculations below quantify the sediment sources, transport pathways, and sinks for the Port Glasgow to Long Point littoral cell.



Rogers Centre in Toronto has as approximately volume of 1.6 million cubic metres with the roof closed.



Sediment Budget Notes:

*The amount of sand naturally bypassing the harbours is still under investigation with the numerical modelling tools.

**Sediment losses at the harbours due to offshore currents is being investigated with the numerical modelling tools.



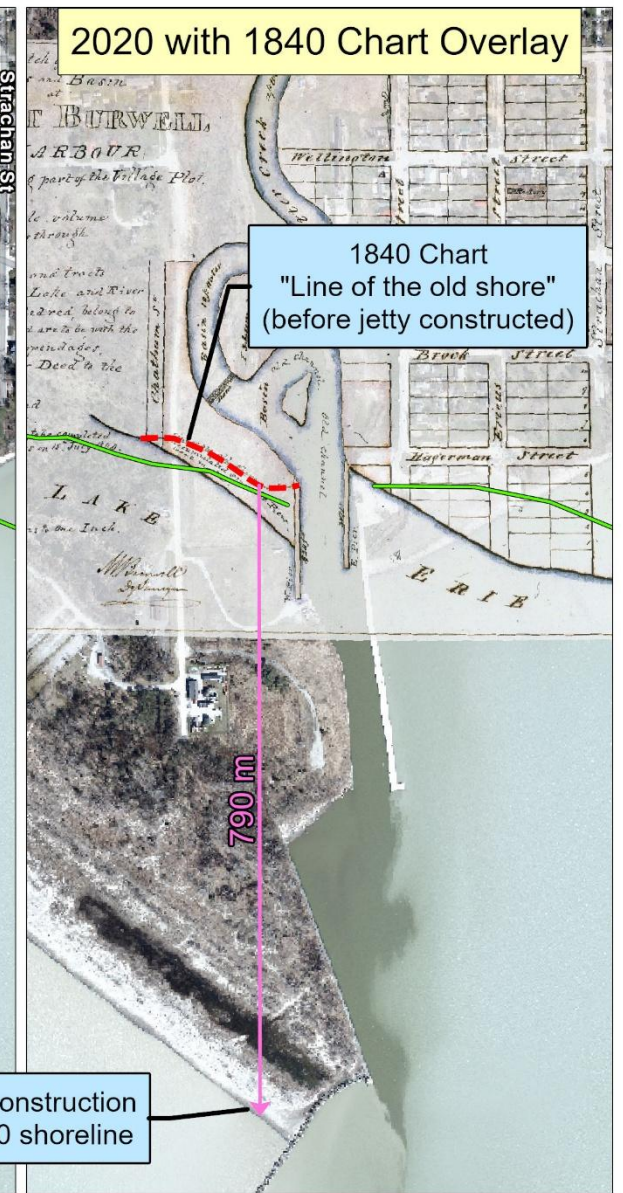
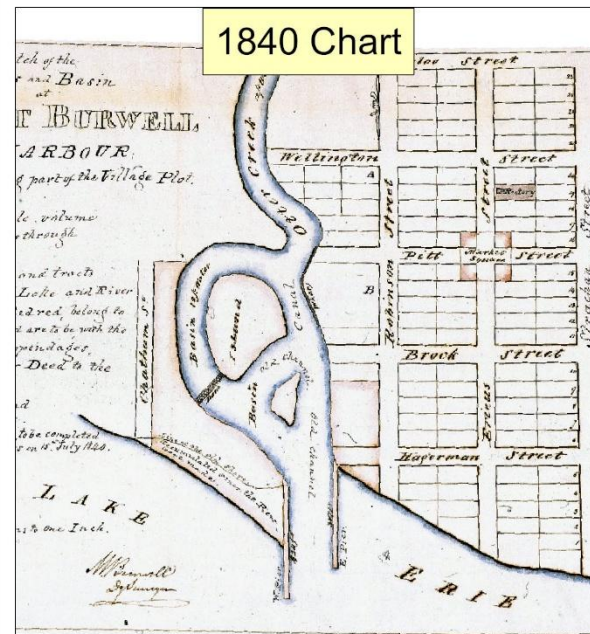
Canada
Water Agency

Agence de l'eau
du Canada

Date Published
March 20, 2026



1840 to 2020 at Port Burwell

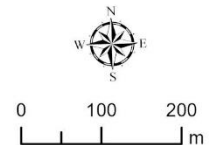


1840 Chart at Port Burwell

--- 1840 Chart Shoreline

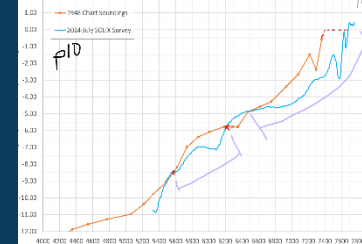
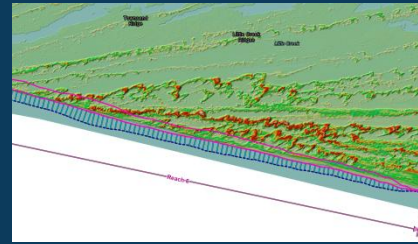
— 1909 Chart shoreline

Notes:
2020 SWOOP imagery from
Elgin County GIS Web Service

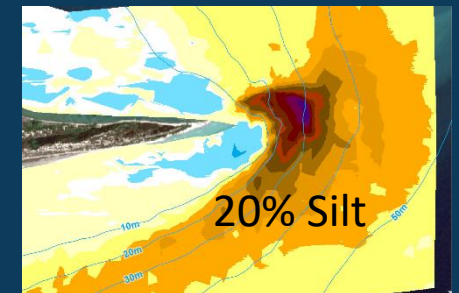
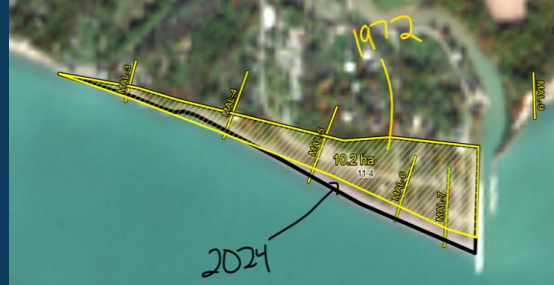


Sand Sources and Sinks in Littoral Cell

- Sources: tributaries, gullies, eroding bluffs and nearshore, Long Point erosion
 - 1,650,000 m³/yr

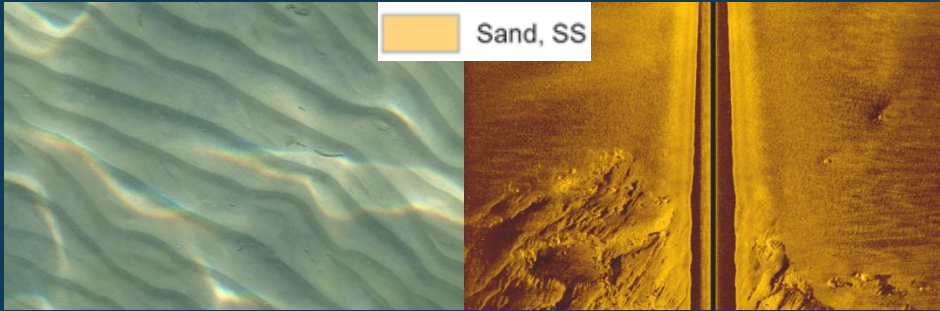


- Sinks: harbour fillet beaches and shoal at the tip of Long Point
 - 1,540,000 m³/yr (does not include modelling of offshore losses)

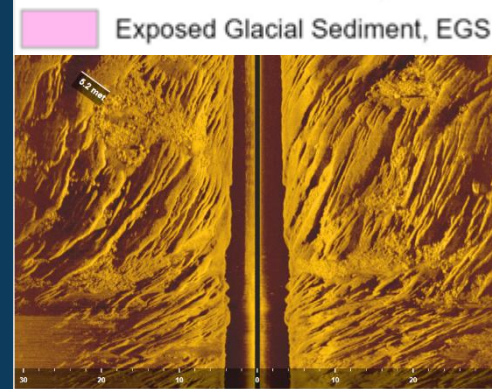


Lake Substrate Mapping For Harbour Bypassing Analysis

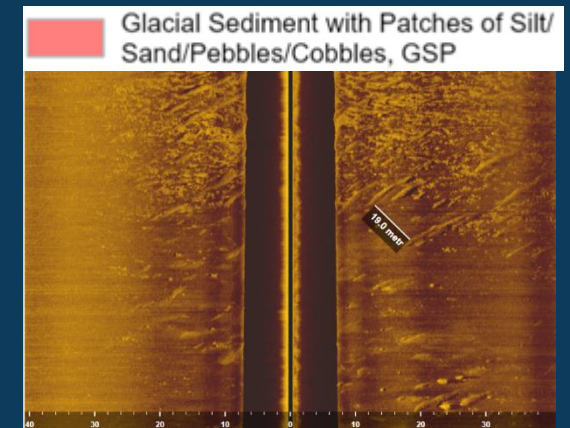
- Sand (SS)



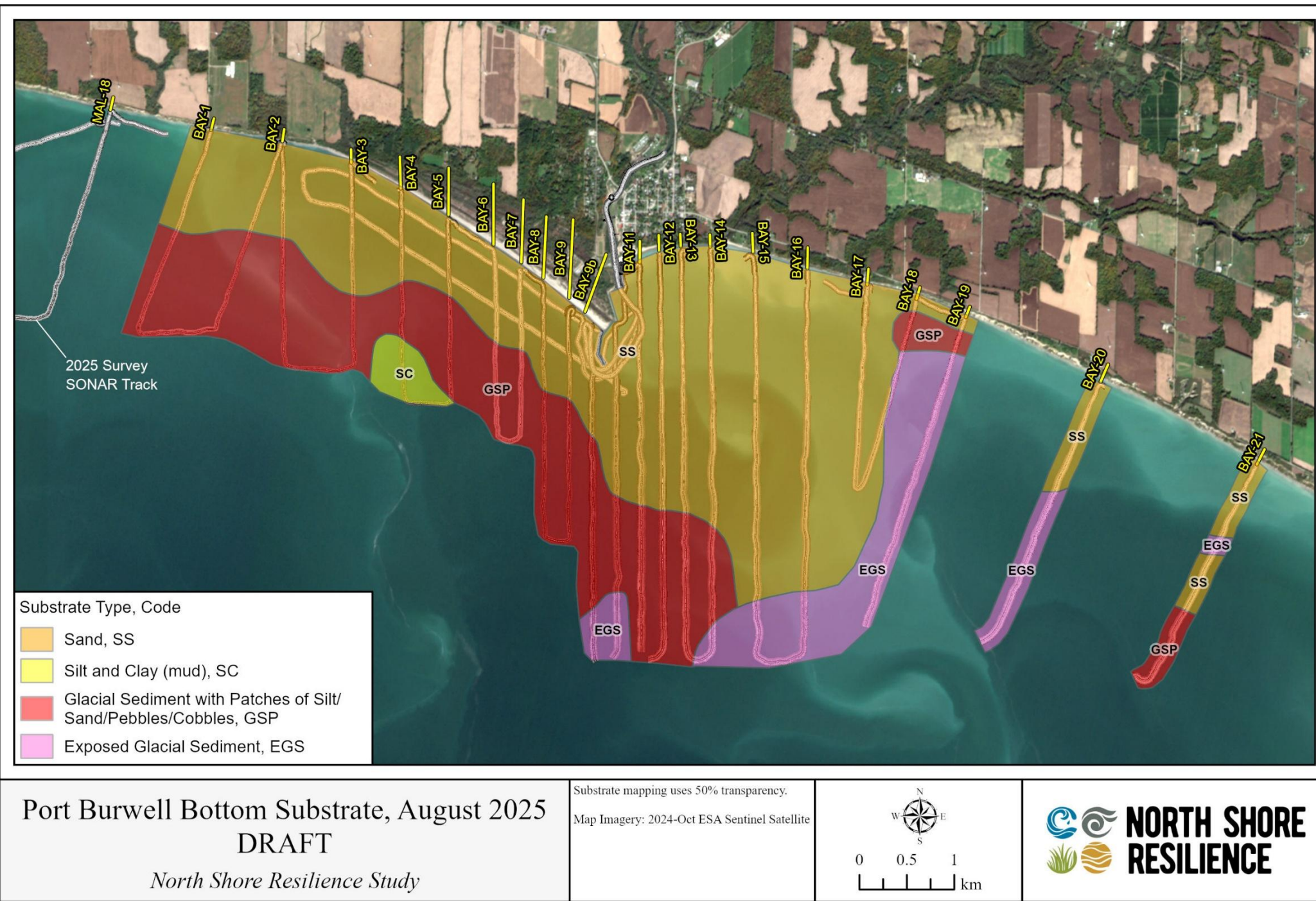
- Exposed Glacial Sediment (EGS)



- Glacial sediment with patches of silt, sand, pebbles, and cobbles (GSP):

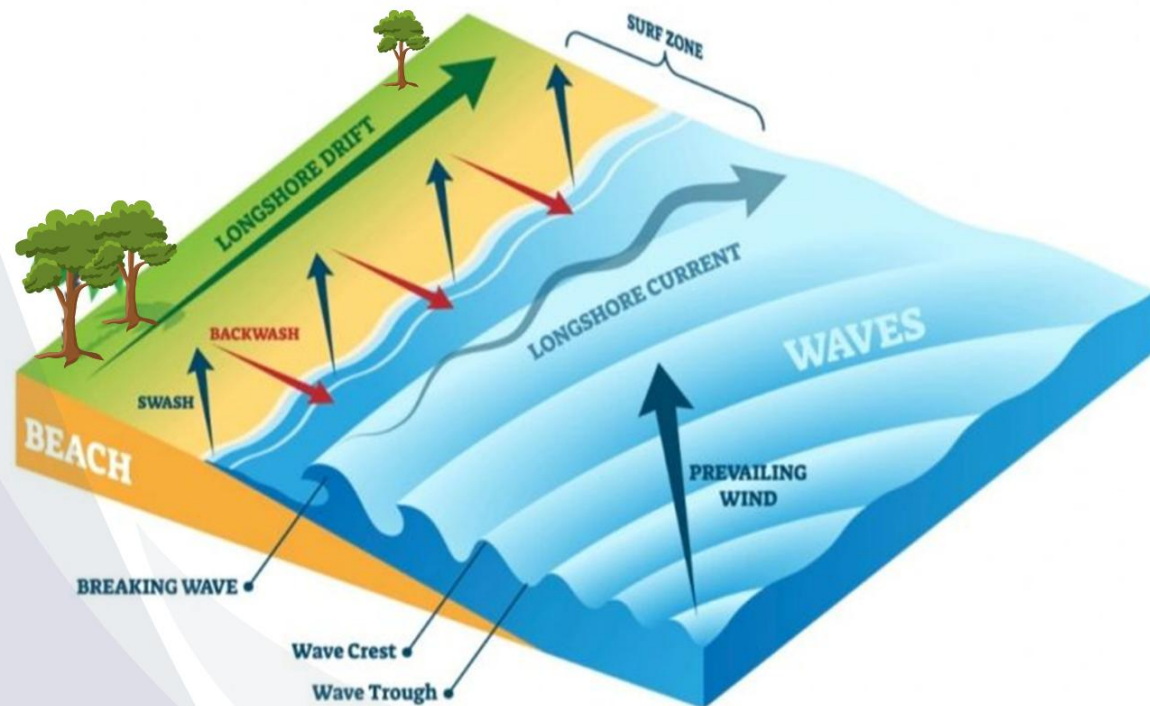


Port Burwell Lake Bottom Type

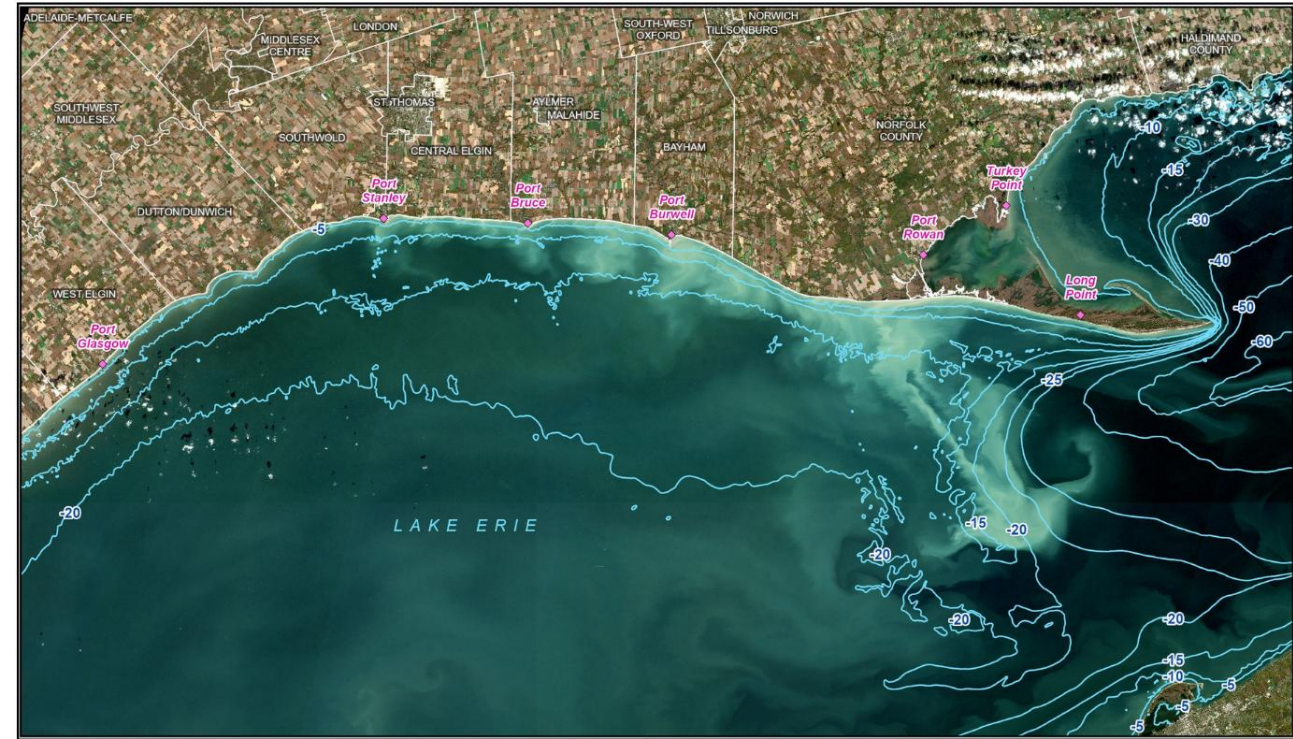


Longshore Sediment Transport Moves Sand to East

Conceptual Diagram of Sand Transport by Waves and Currents

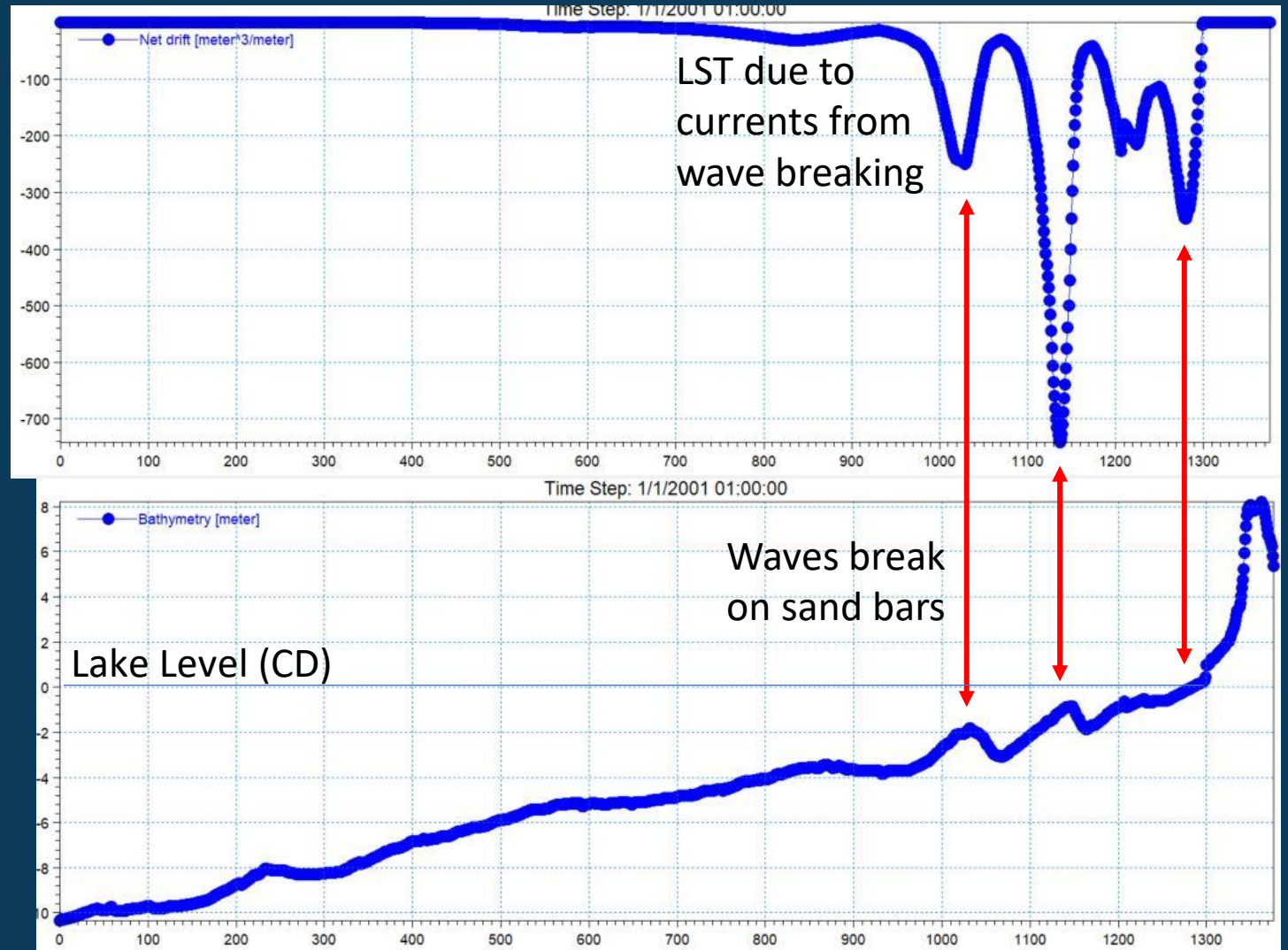


Satellite Image of Sediment Moving Along Coast

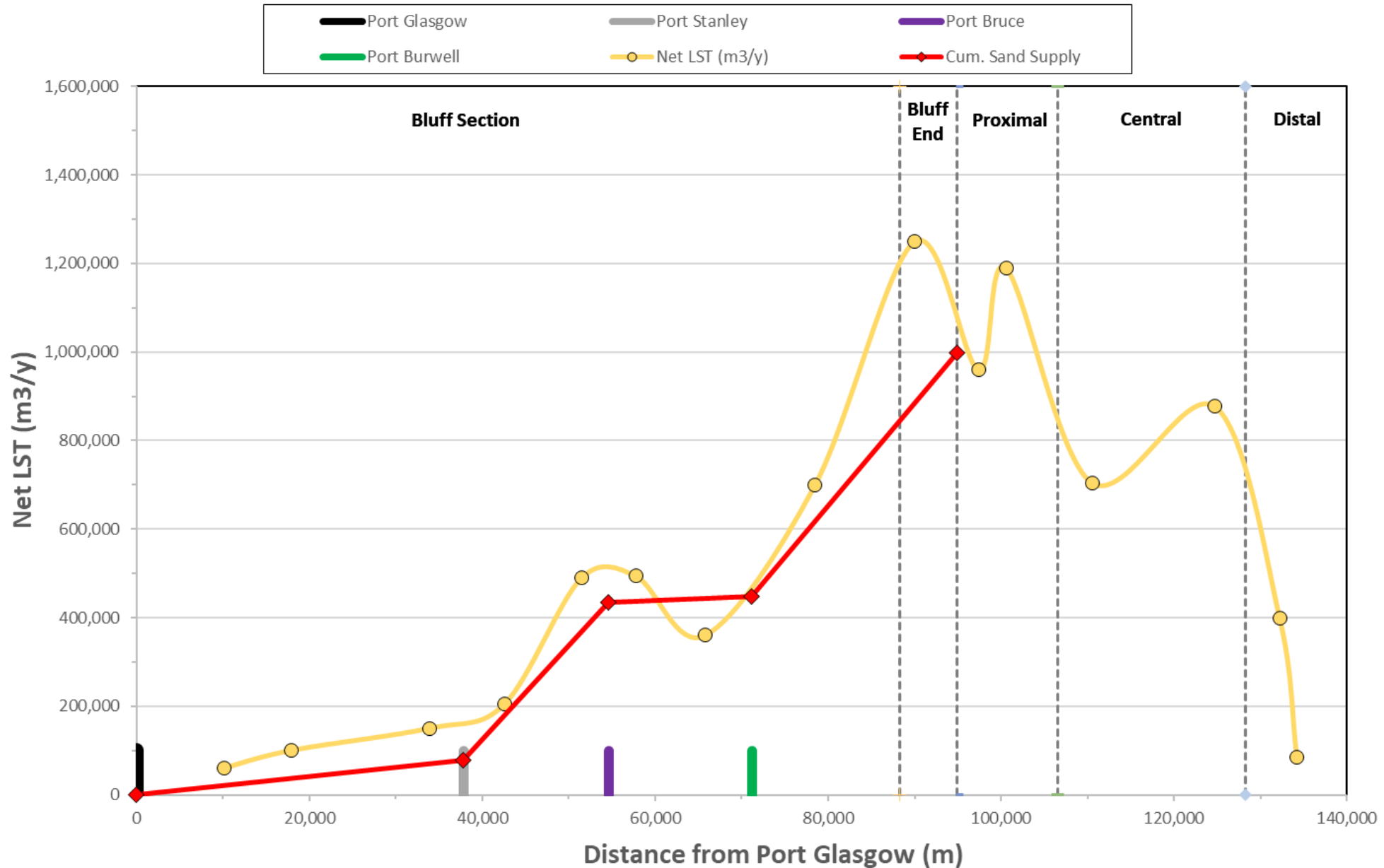


LITPACK Longshore Sediment Transport

- Requires a beach profile to 10 m depth
- Hourly waves and water levels
- Sediment grain size
- East, west, and net longshore sediment transport calculated



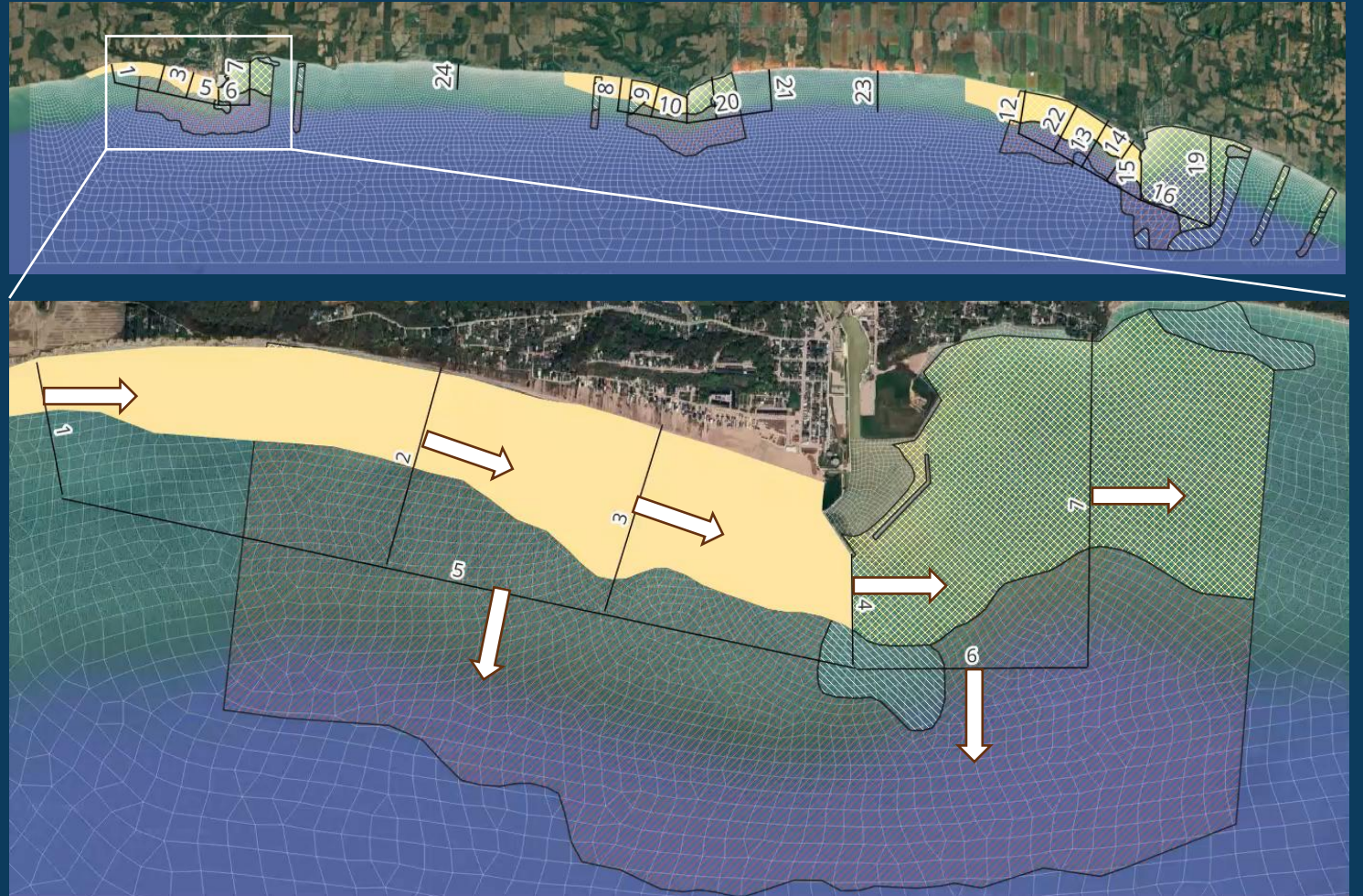
Average Annual Longshore Sediment Transport (m³/y) from Port Glasgow to Long Point

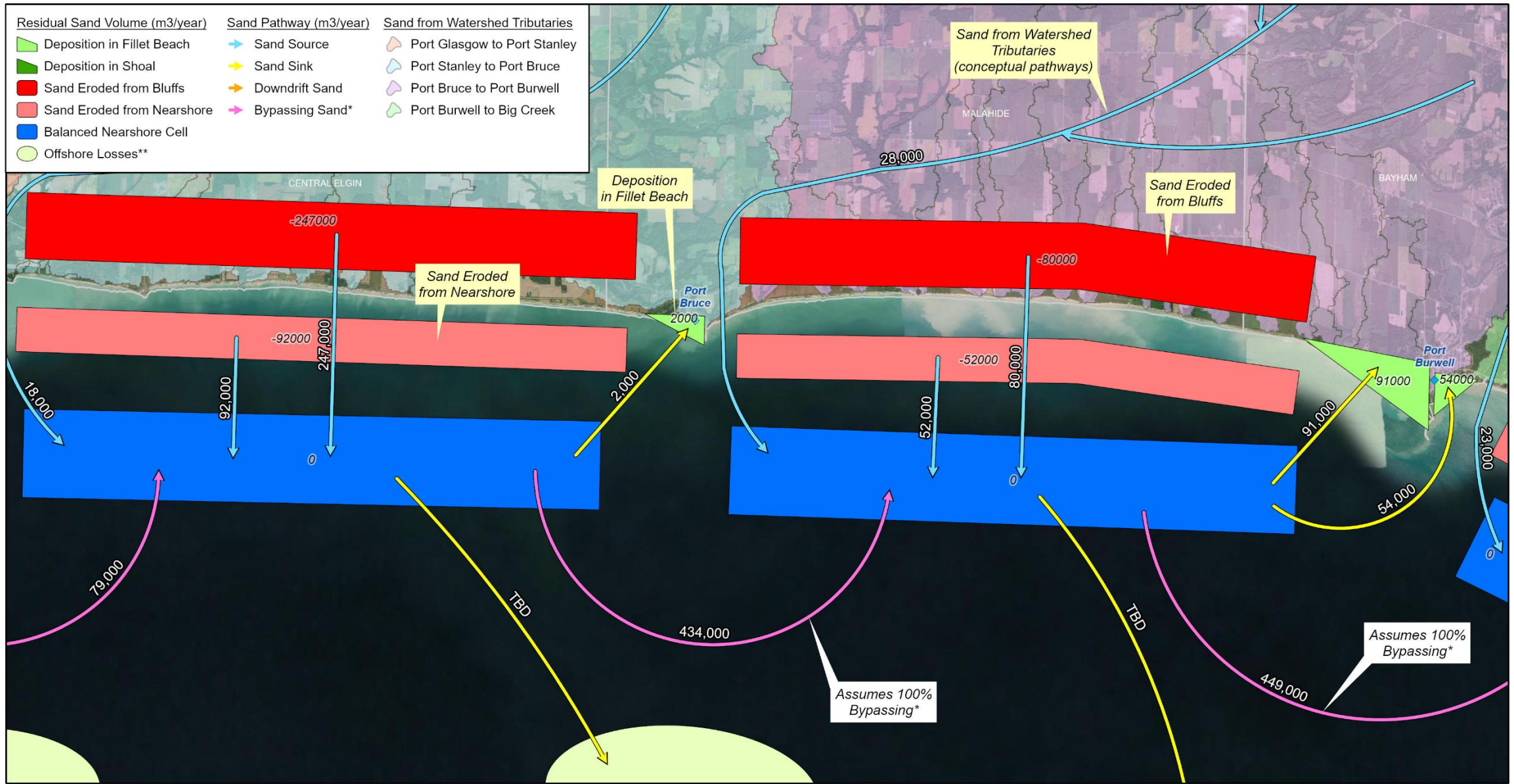


- Sand supply from bluff erosion and tributaries
- Net LST to the east

Harbour Bypassing Model at Port Stanley

- Multi-year simulations
- Rates of transport at each transect compared
- Bypassing estimated for transect 4



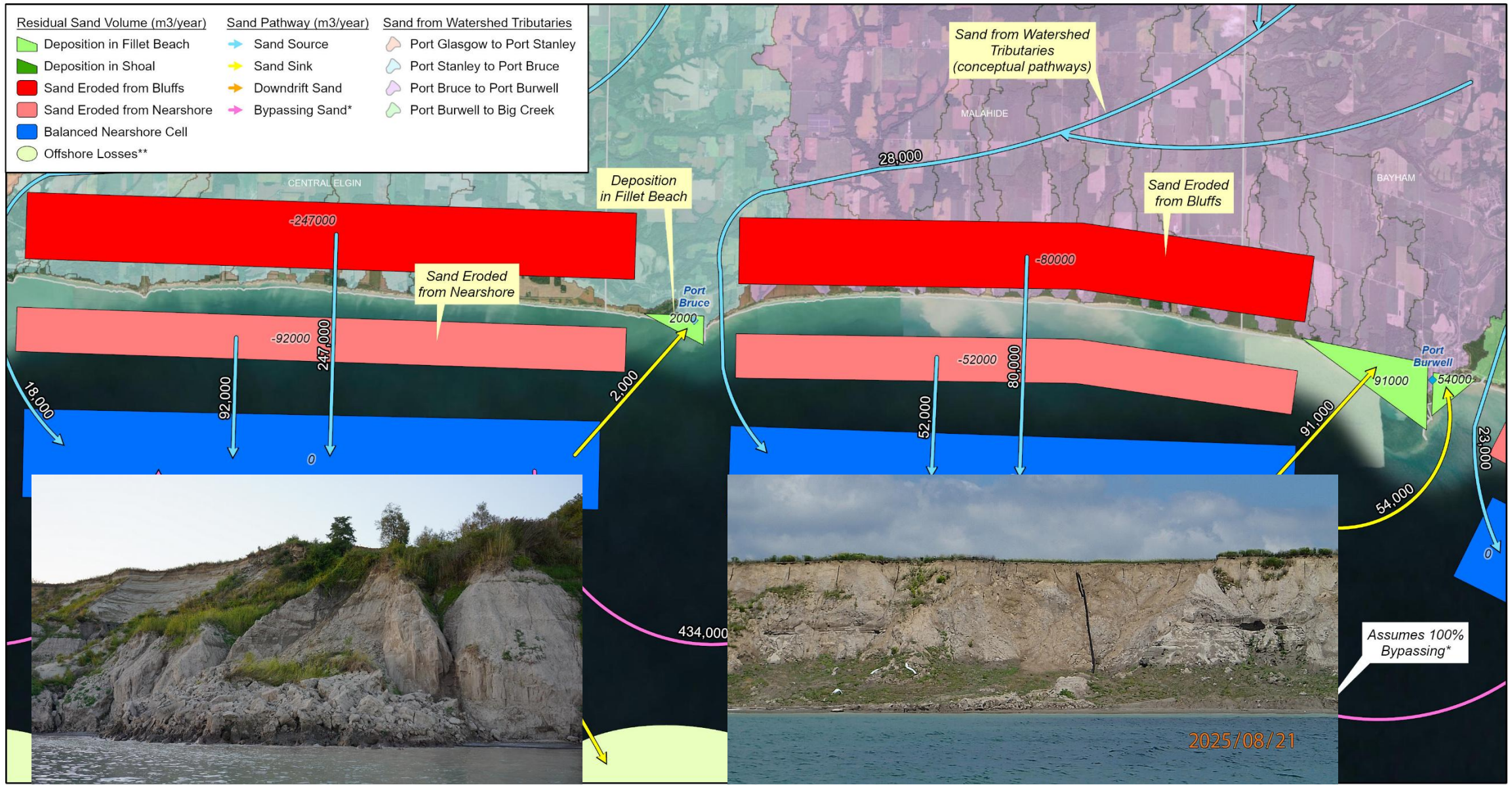


Preliminary Sediment Budget: Port Bruce (Recent Past, Last ~50 Years)

Notes:
 *Draft bypassing volume assumes 100 % bypassing (numerical modelling in-progress). Rate to be refined.
 **Offshore losses to be assessed with numerical modelling (in-progress).
 Background - Esri World Imagery Basemap

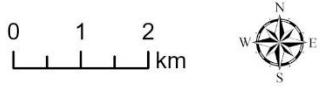
0 1 2 km





Preliminary Sediment Budget: Port Bruce (Recent Past, Last ~50 Years)

Notes:
 *Draft bypassing volume assumes 100 % bypassing (numerical modelling in-progress). Rate to be refined.
 **Offshore losses to be assessed with numerical modelling (in-progress).
 Background - Esri World Imagery Basemap



DRAFT

North Shore Resilience Study



Tributaries
Port Stanley
Port Bruce
Burwell
Creek

Preliminary Sediment Budget: Port Burwell (Recent Past, Last ~50 Years)

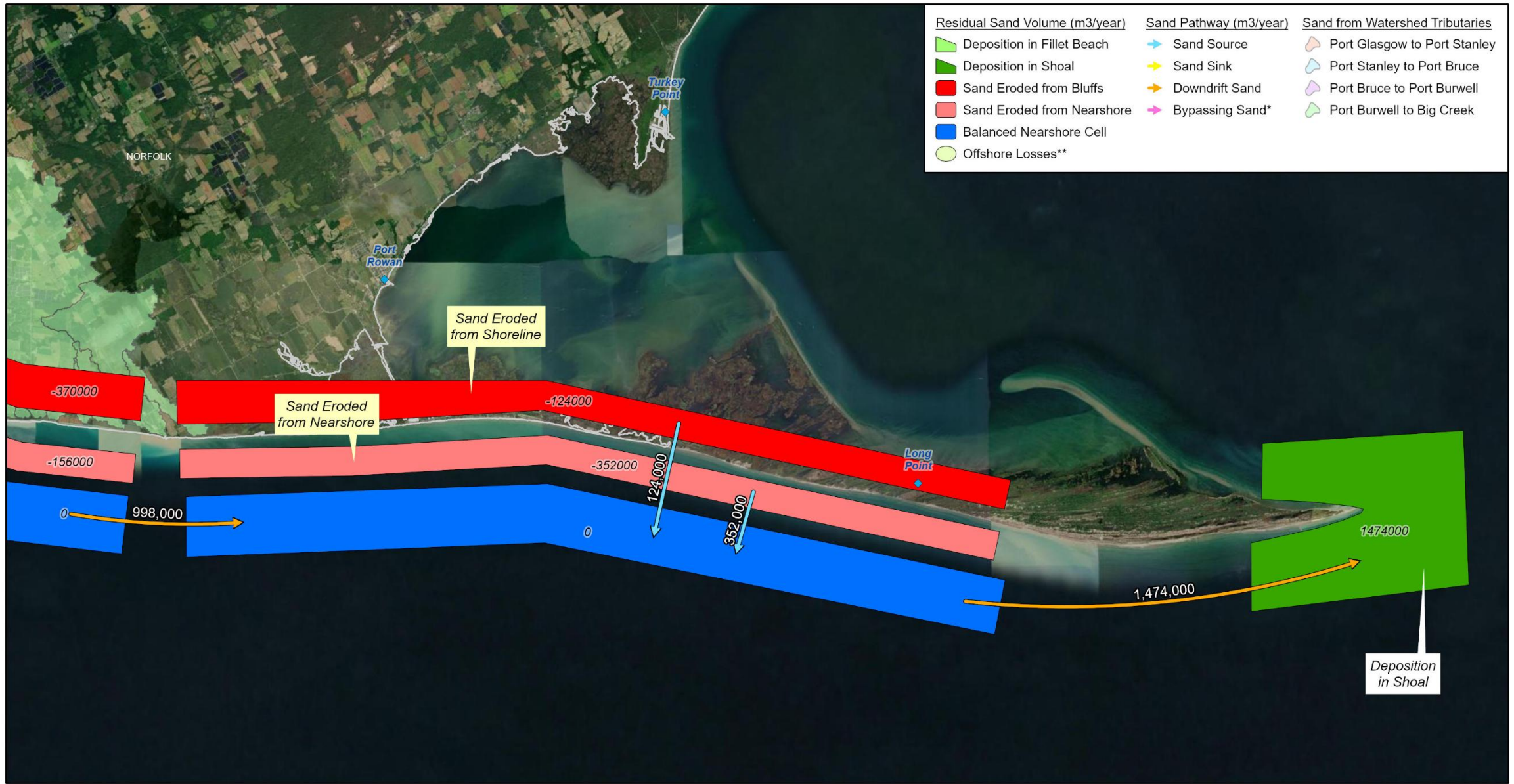
Notes:
*Draft bypassing volume assumes 100 % bypassing (numerical modelling in-progress). Rate to be refined.
**Offshore losses to be assessed with numerical modelling (in-progress).
Background - Esri World Imagery Basemap

0 1 2 km



DRAFT

North Shore Resilience Study



Preliminary Sediment Budget: Long Point (Recent Past, Last ~50 Years)

Notes:
 *Draft bypassing volume assumes 100 % bypassing (numerical modelling in-progress). Rate to be refined.
 **Offshore losses to be assessed with numerical modelling (in-progress).
 Background - Esri World Imagery Basemap

0 1 2 3 km



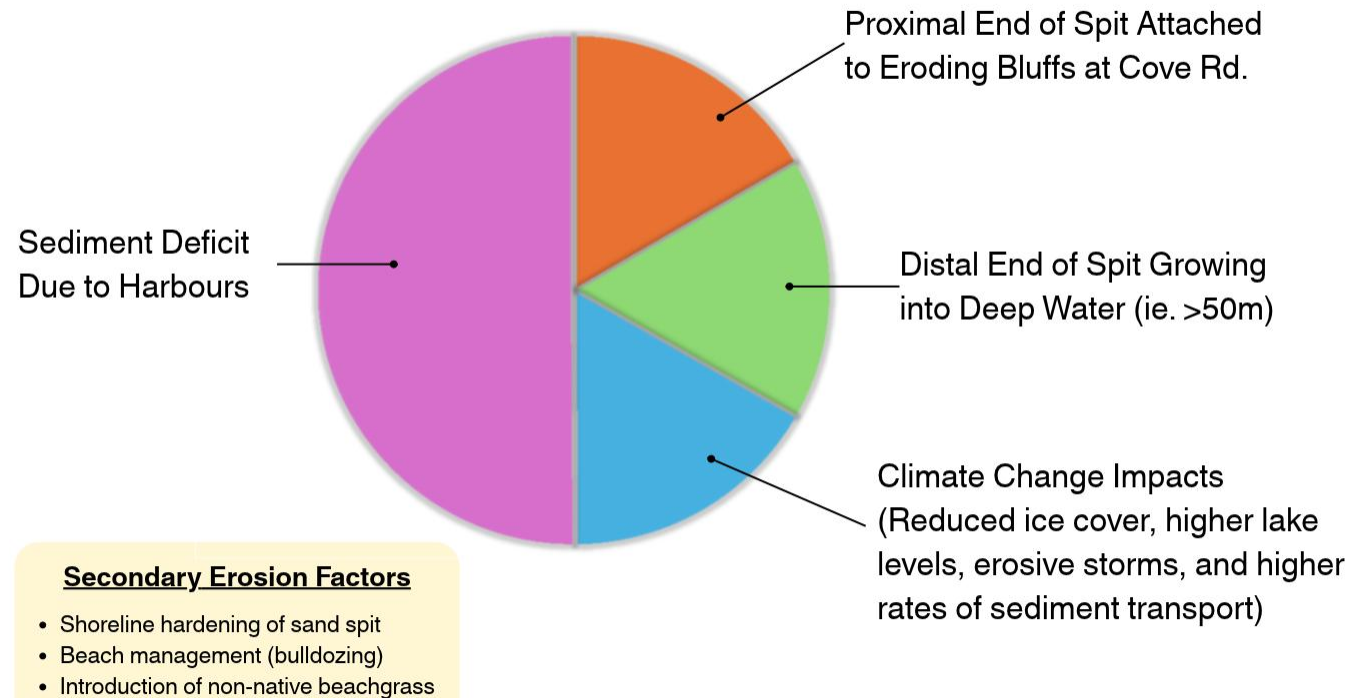
DRAFT

North Shore Resilience Study

Sediment Budget Key Findings

- Sediment budget balances
- Erosion is a natural processes in the bluff region
- Harbours disrupt the natural flow of sand and pebbles along the coast/cell
- ~50% of the erosion at Long Point can be attributed to the sediment deficit created by the updrift harbours

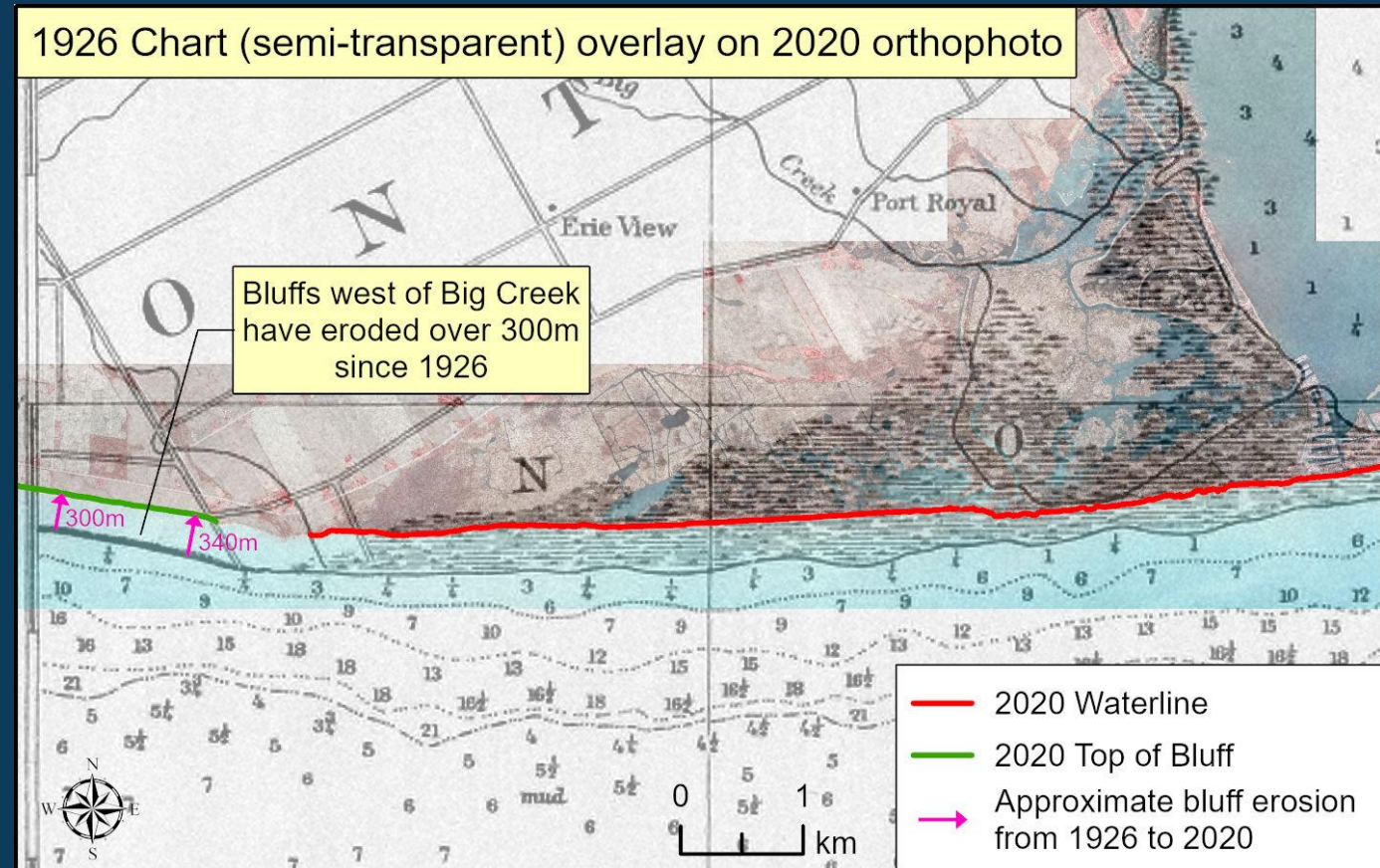
Long Point Sand Spit Erosion Factors



Proximal End of Spit is Attached to Eroding Bluffs



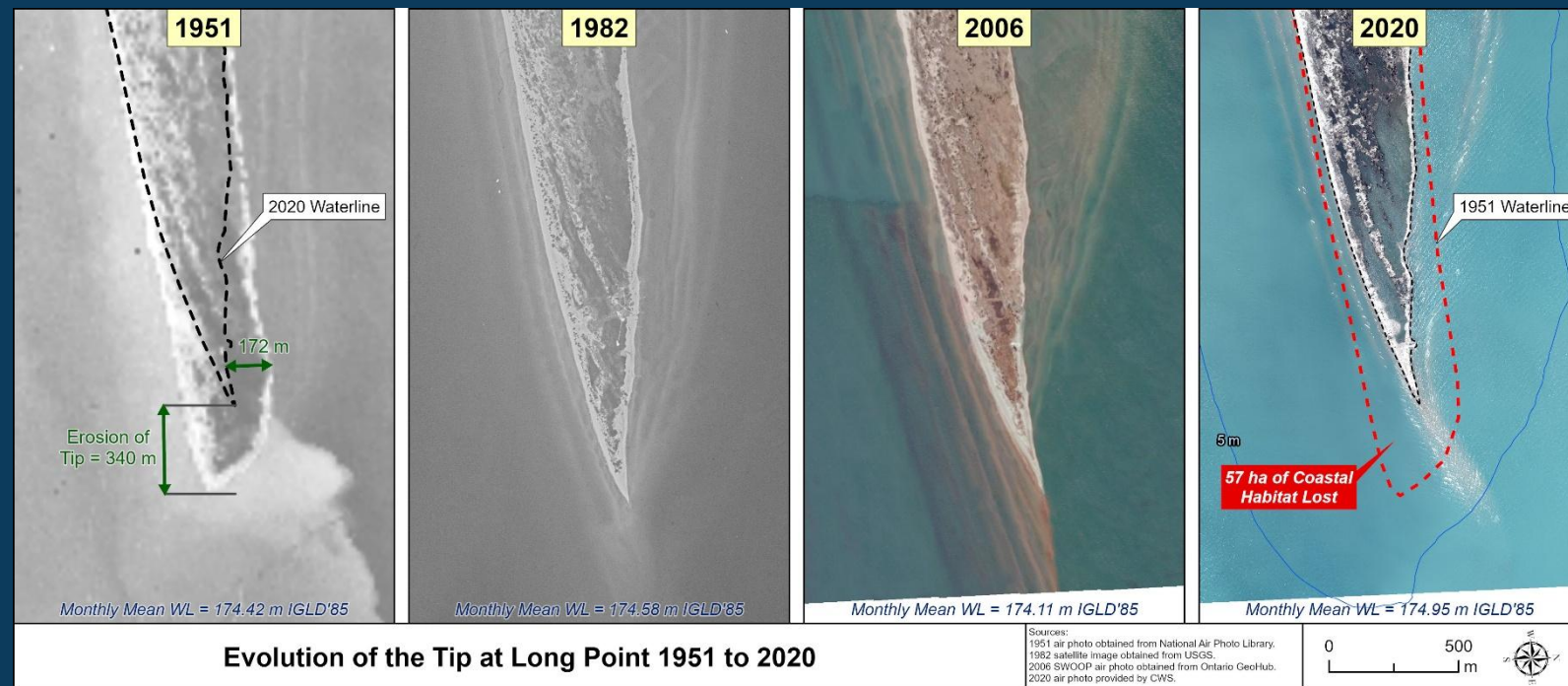
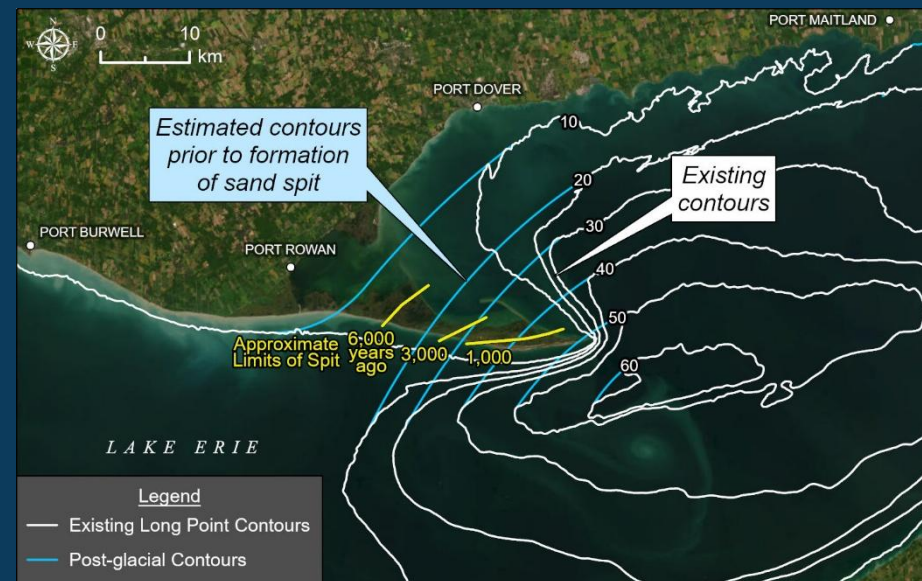
- The eroding bluffs and barrier beaches are an integrated physical system
- As long as the bluffs erode, the spit from Cove Road to the Causeway will erode



Overall Length and Growth into Deep Water



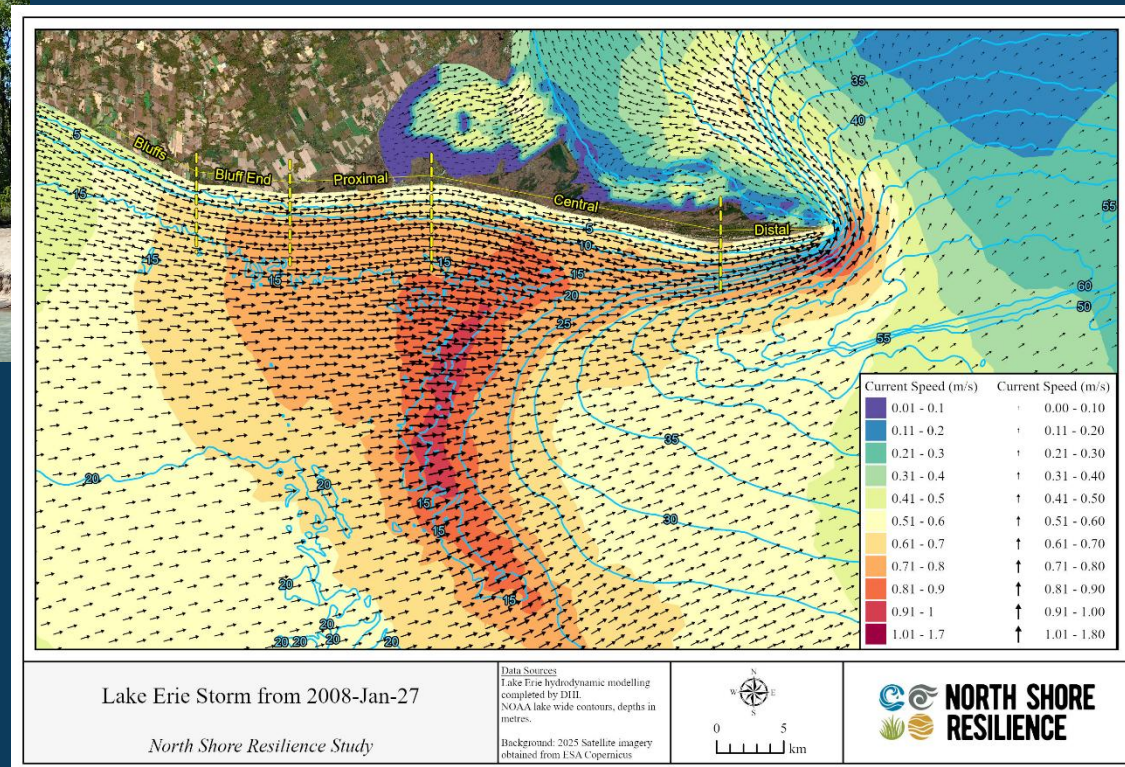
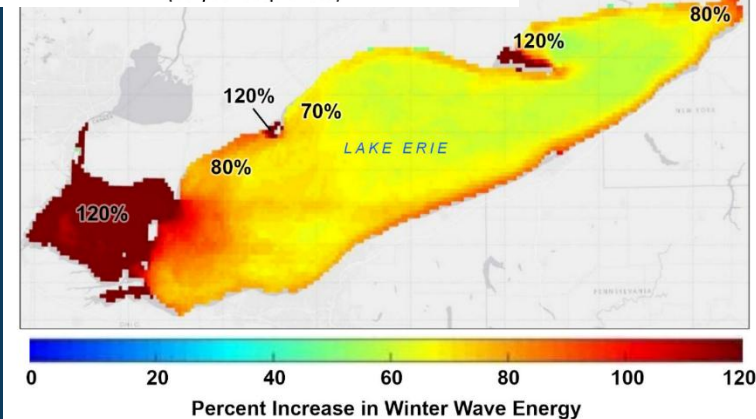
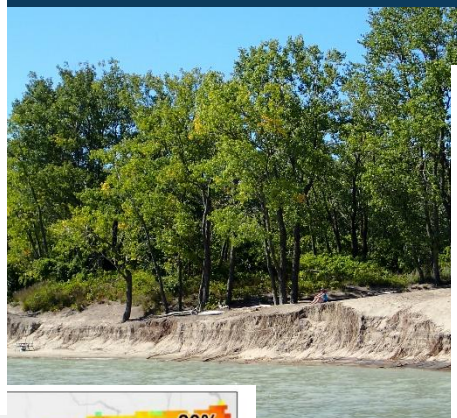
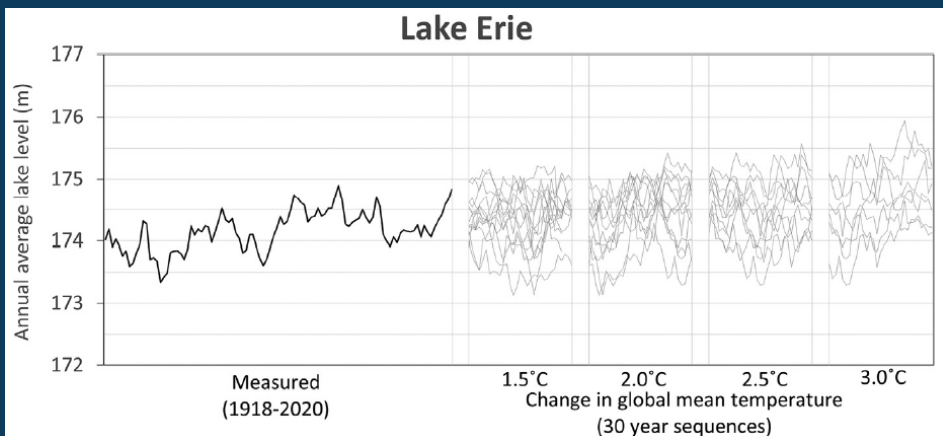
- Sand spit is growing into 60 m of water today
- 6,000 years ago, growing into 15 m of water



Climate Change Impacts



- Higher lake levels leads to more dune erosion and overwash
- Reduction in winter ice cover leads to more storms and higher rates of LST



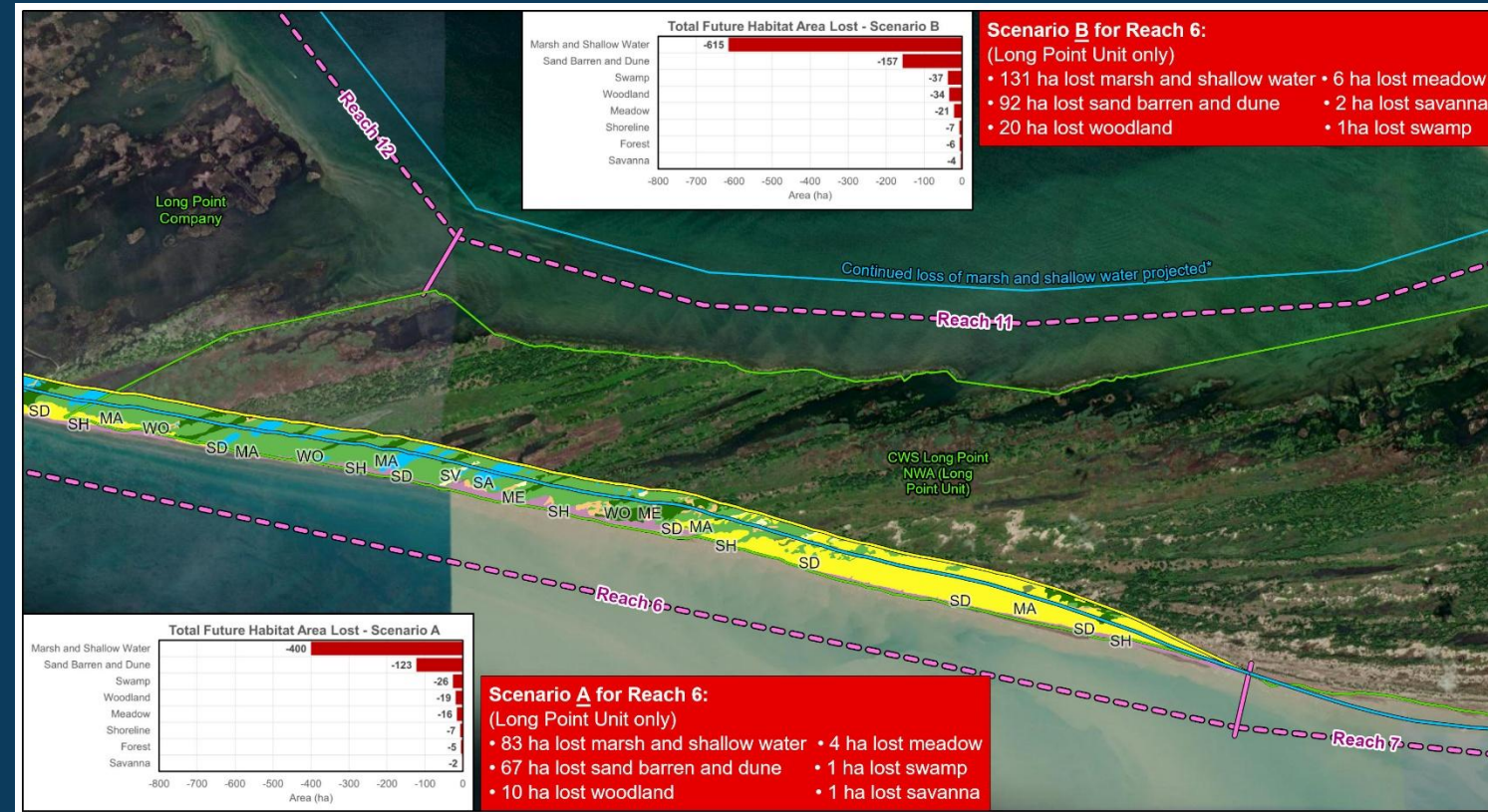
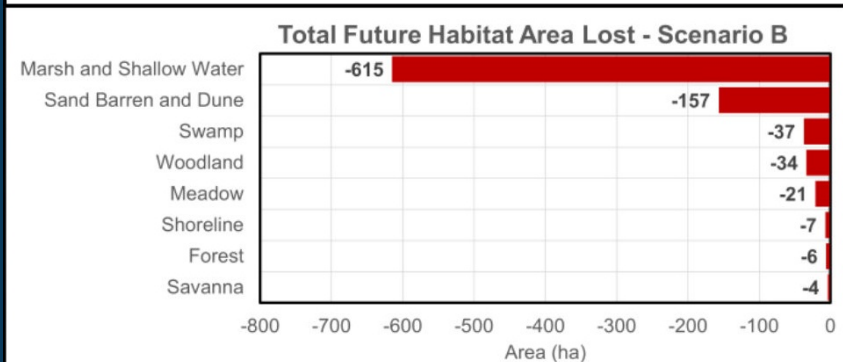
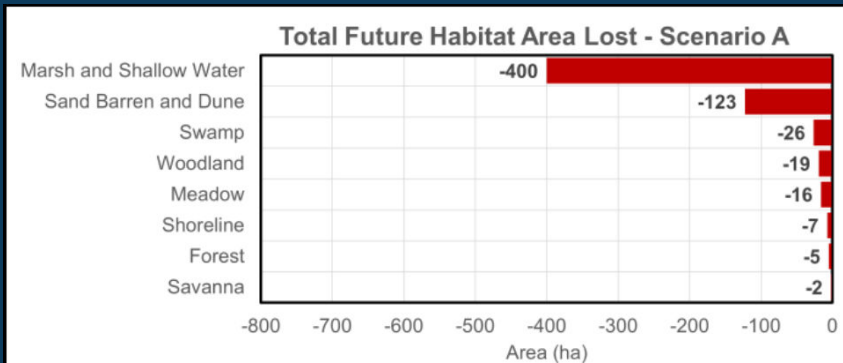
Secondary Factors Contribute to Erosion of the Long Point Spit

- Shoreline hardening
- Bulldozers are part of the beach management strategy
- Introduction of non-native beachgrass, which is not good at building dunes



Significant Habitat Losses Will Continue in the Future for Status Quo

- Recent projections (Zuzek Inc., 2024) suggest another 600 to 900 hectares of Long Point will disappear in the next 100-years

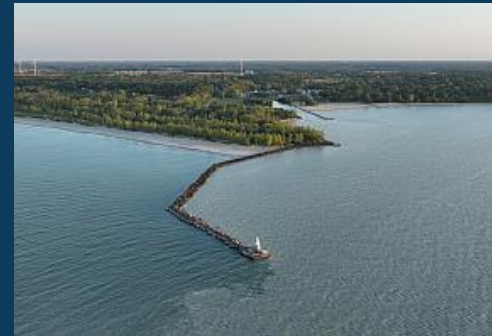
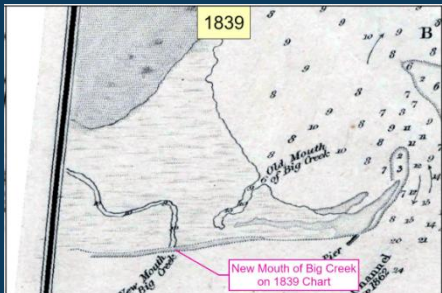
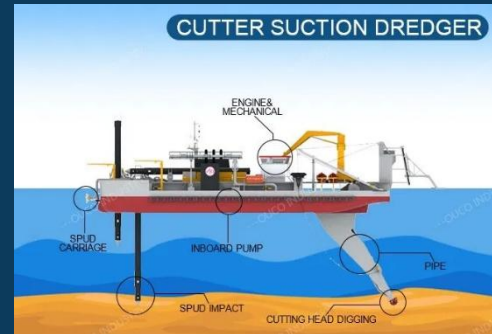


NEXT STEP – IMPLEMENT THE RESILIENCE ACTION PLAN



Actions to Save Long Point

- Fundraising for Phase 2
- Projects include:
 - Continued beach and dune restoration throughout the littoral cell
 - Evaluation of innovative dredging technology and beneficial re-use for beach nourishment projects
 - Sediment bypassing strategy for the harbours
 - Erosion mitigation plan for Cove Road to the Causeway
 - Bay sedimentation and potential re-alignment of Big Creek



Questions and Discussion



Health break

(10 minutes)

Up next:

- Hillman Marsh Wetland Restoration and Climate Adaptation Plan – by Seth Logan, SJL Engineering Inc.
- Leveraging Big Data to Connect Watershed Plans to Nearshore Lake Health – by Krista Chomicki, TRCA
- Q&A discussion and upcoming Symposium



HILLMAN MARSH WETLAND RESTORATION & CLIMATE ADAPTATION PLAN

GREAT LAKES, GREATER INSIGHTS WEBINAR:
DATA & MODELLING IN ACTION

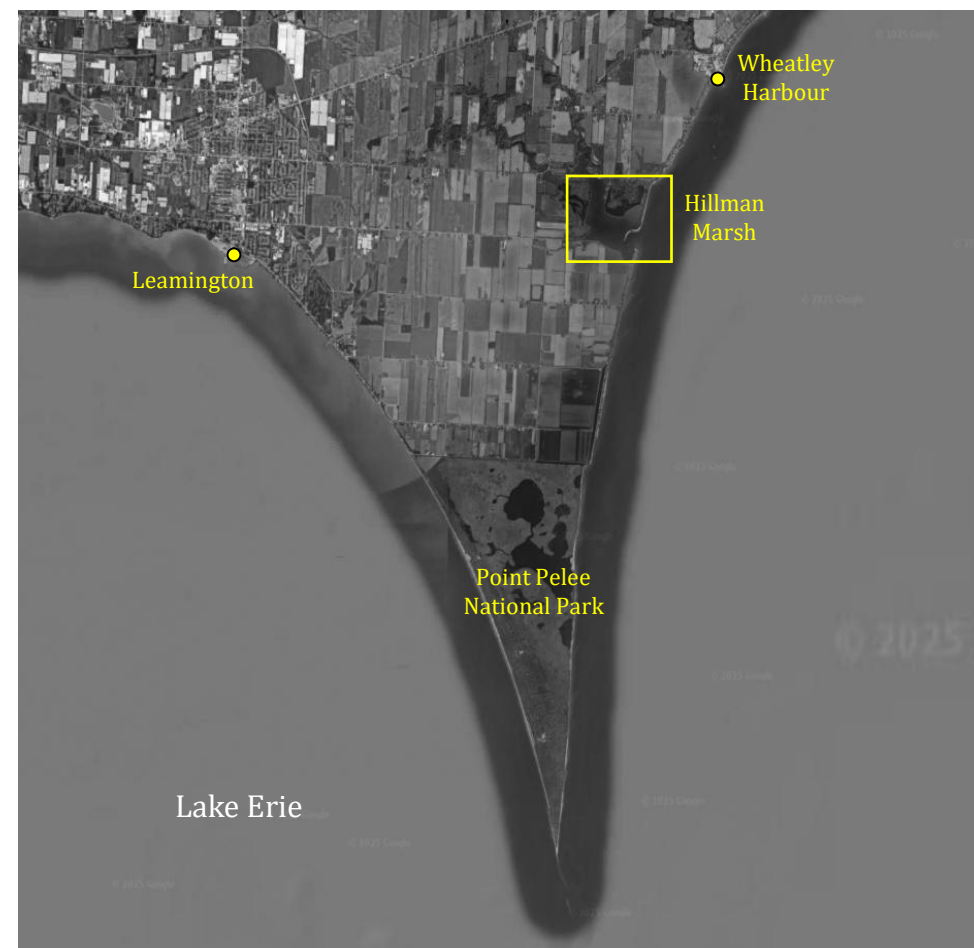
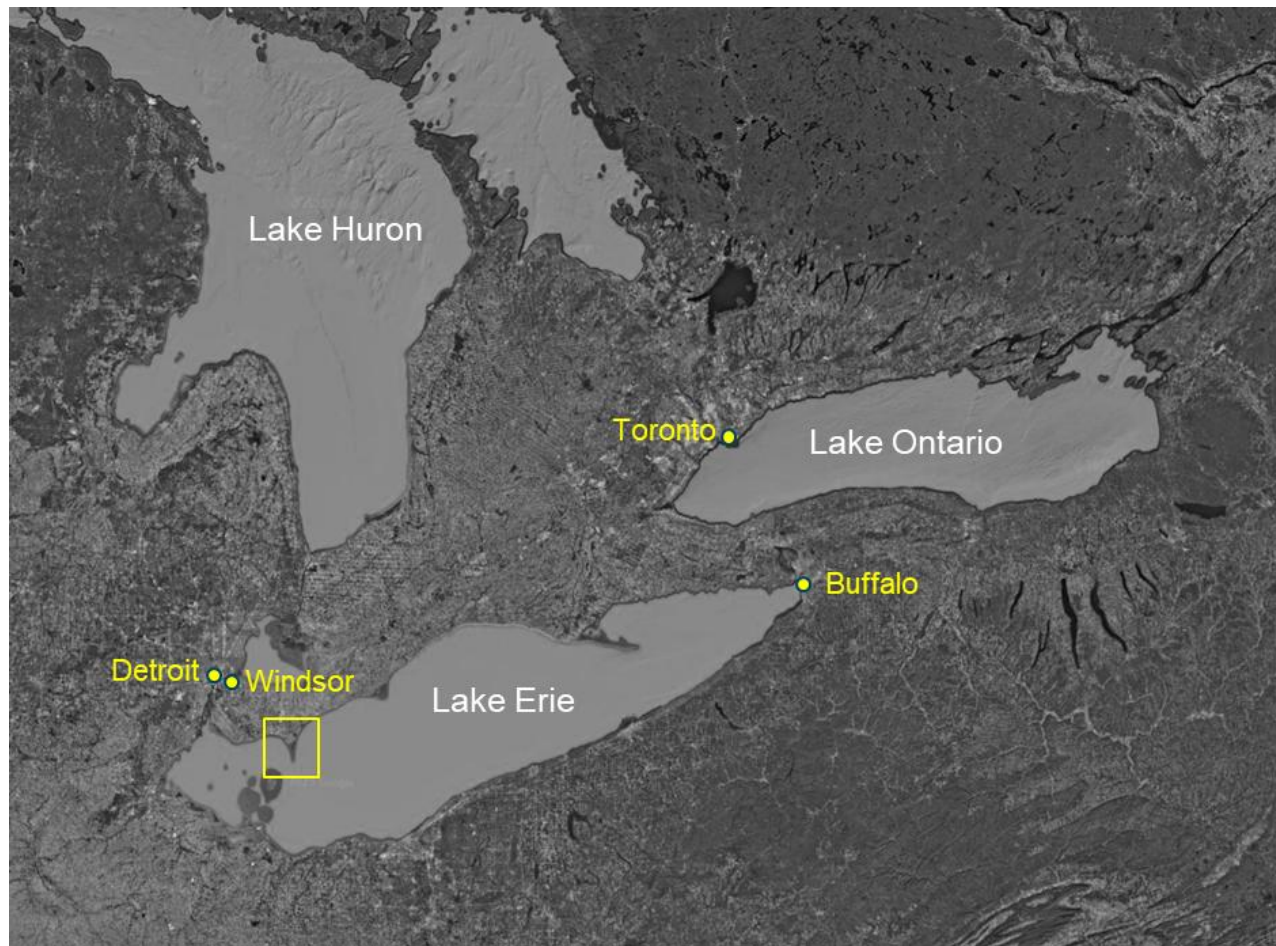
September 21, 2026

Seth Logan, PEng.¹



Canada
Water Agency

Agence de l'eau
du Canada





Hillman Marsh - 1952



Hillman Marsh - 1989

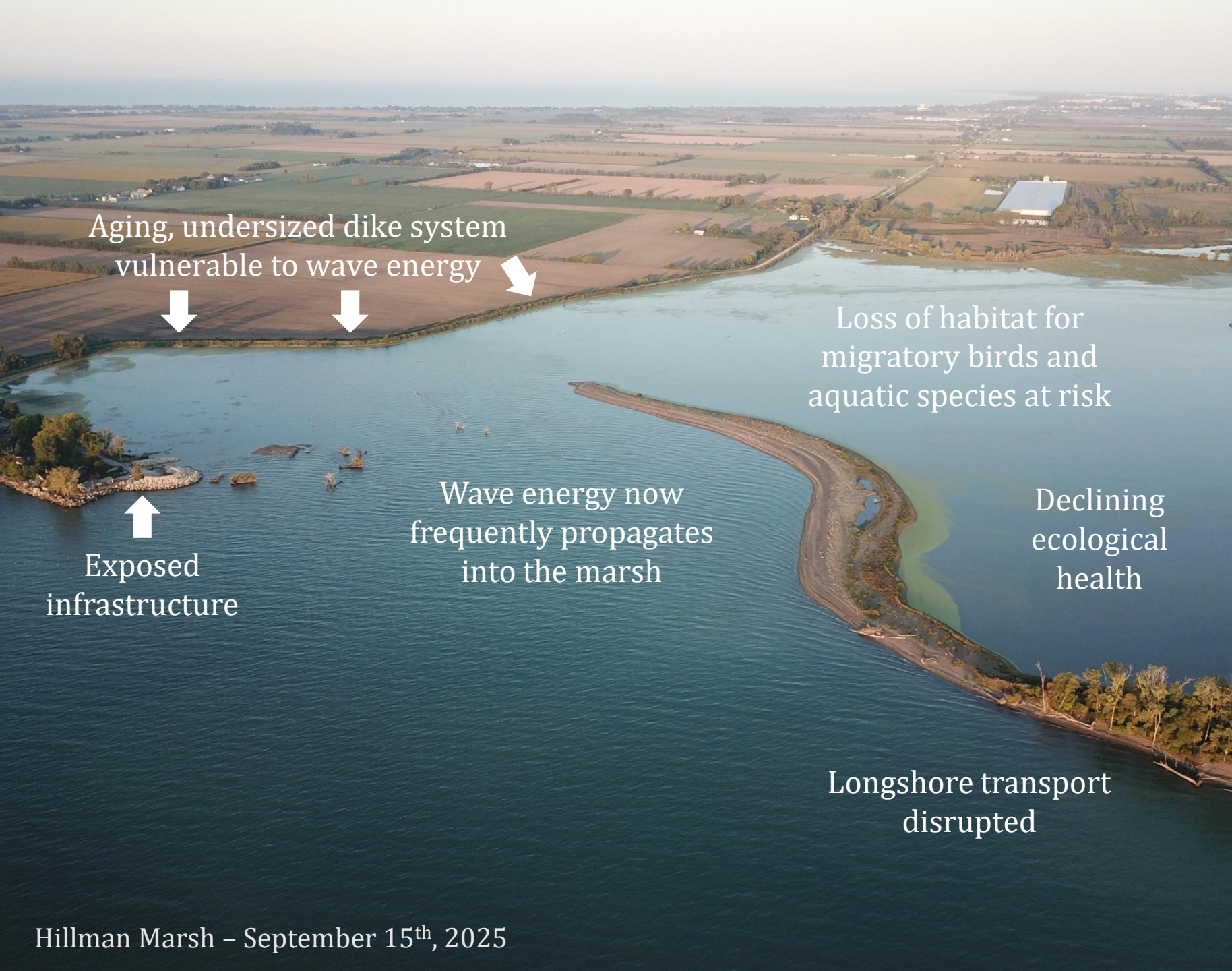
Hillman Marsh - 1952





Hillman Marsh - 2026



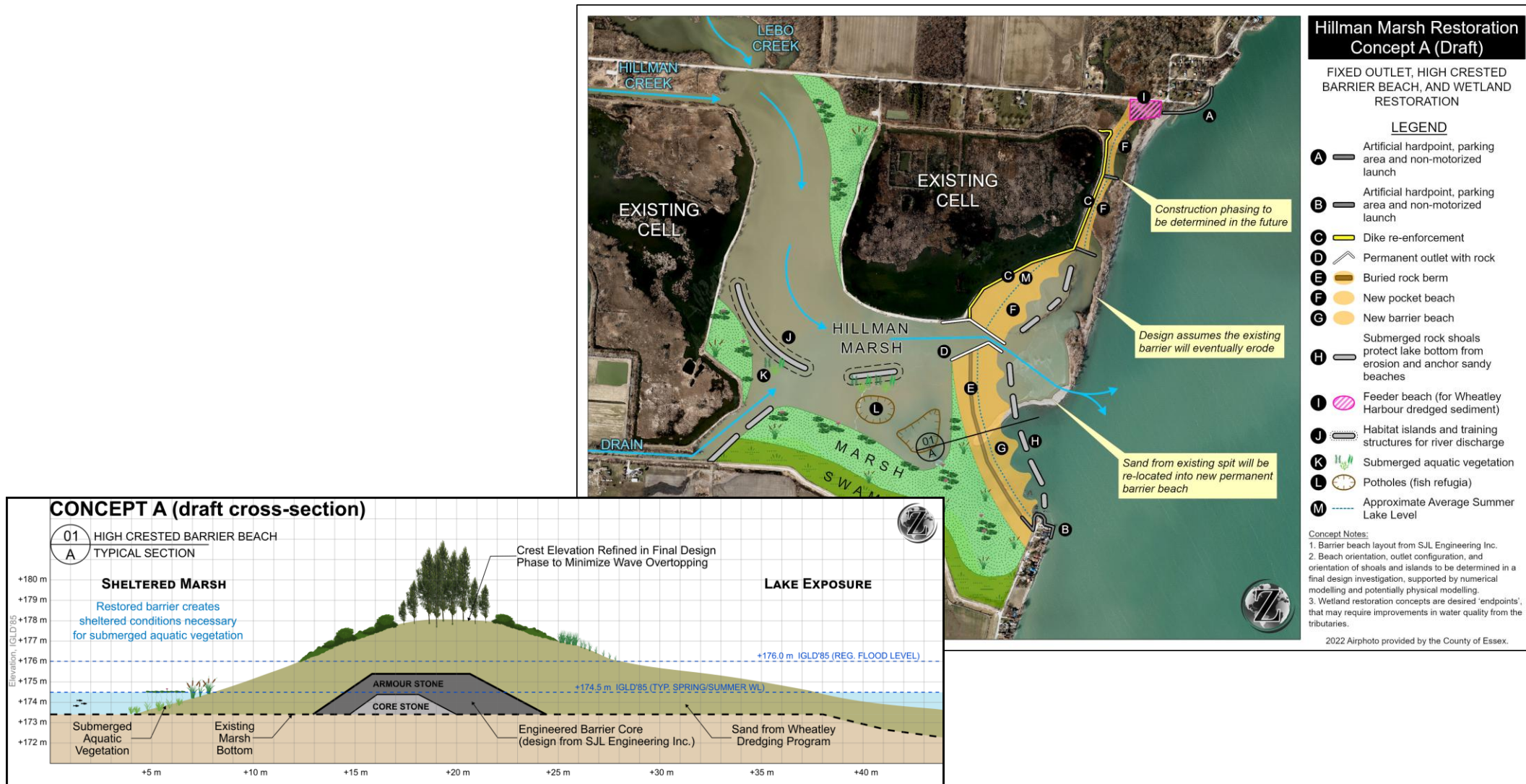


Why Does this Matter?

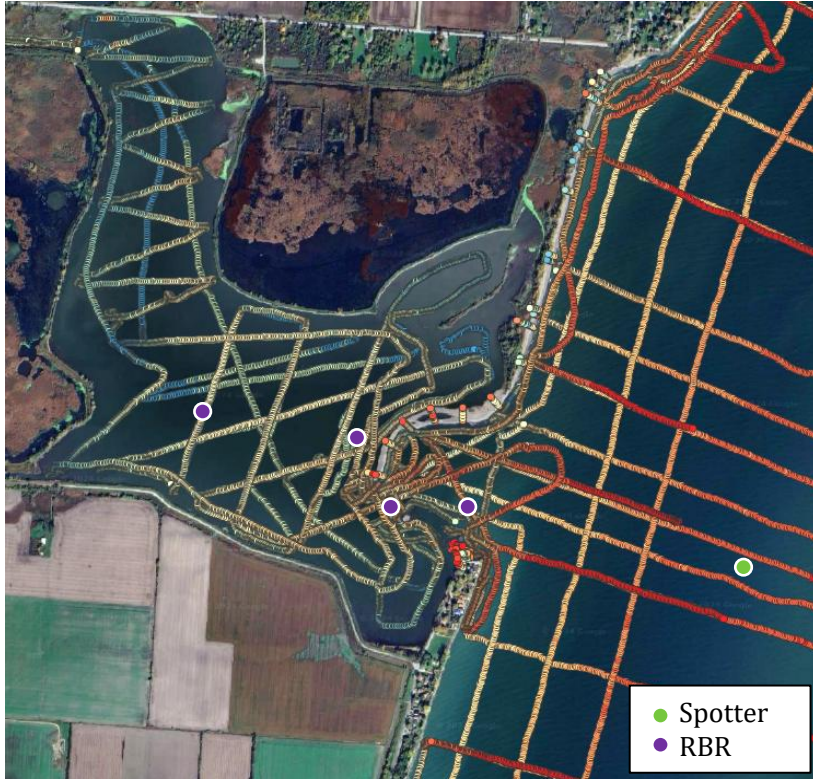
- Reduced protection for communities, infrastructure and high-value farmland
- Declining ecological health and ecosystem services
- Loss of habitat for migratory birds and aquatic species at risk
- Loss of natural coastal resilience and wetland function
- Alteration of natural sediment transport pathways and coastal processes

WHAT CAN WE DO ABOUT IT?

HILLMAN MARSH WETLAND RESTORATION AND CLIMATE ADAPTATION PLAN:



FIELD WORK & DATA COLLECTION



Data Collection (Summer 2024)



Geotechnical field work (courtesy of BGC - Dec 2024)



Spotter Buoy deployment



RBR's (4) and Spotter Buoy after retrieval



Surficial sediment sampling (Dec 2024)

UAV Photography

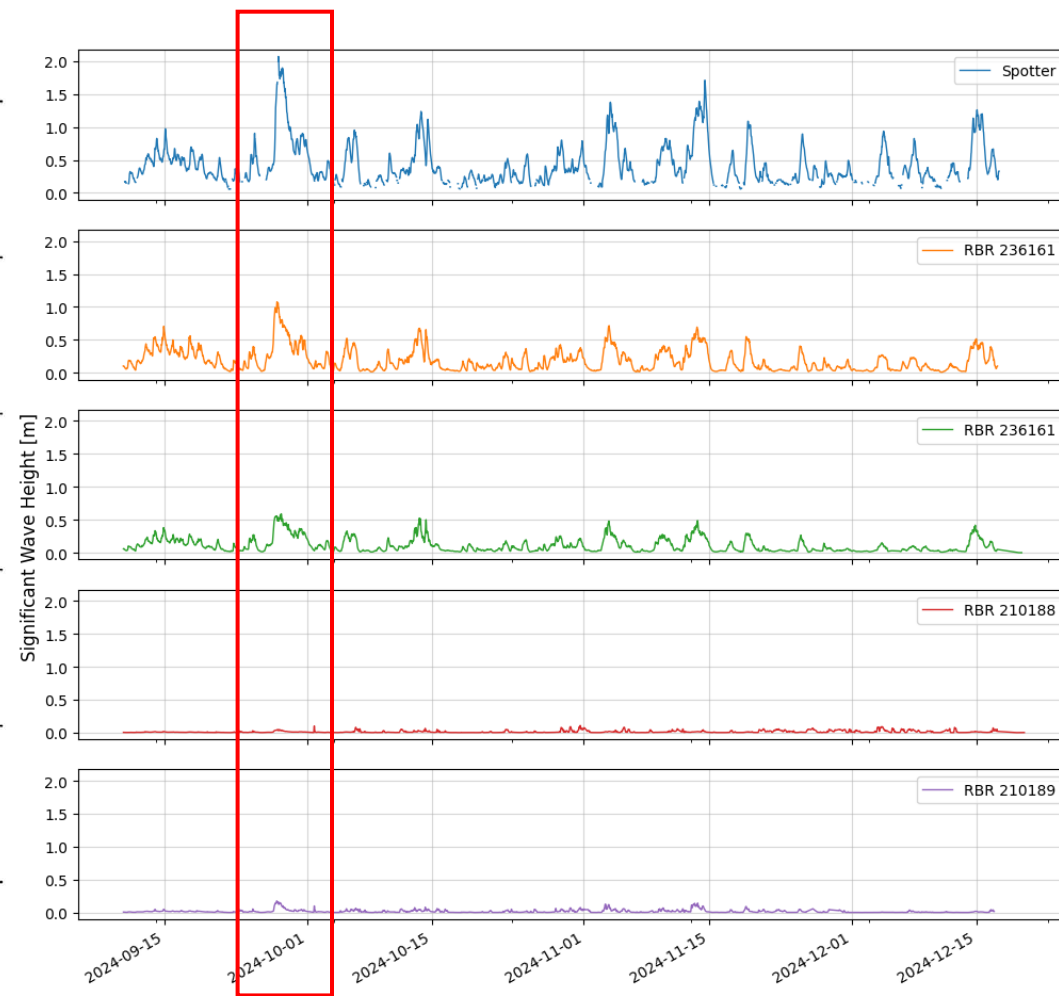
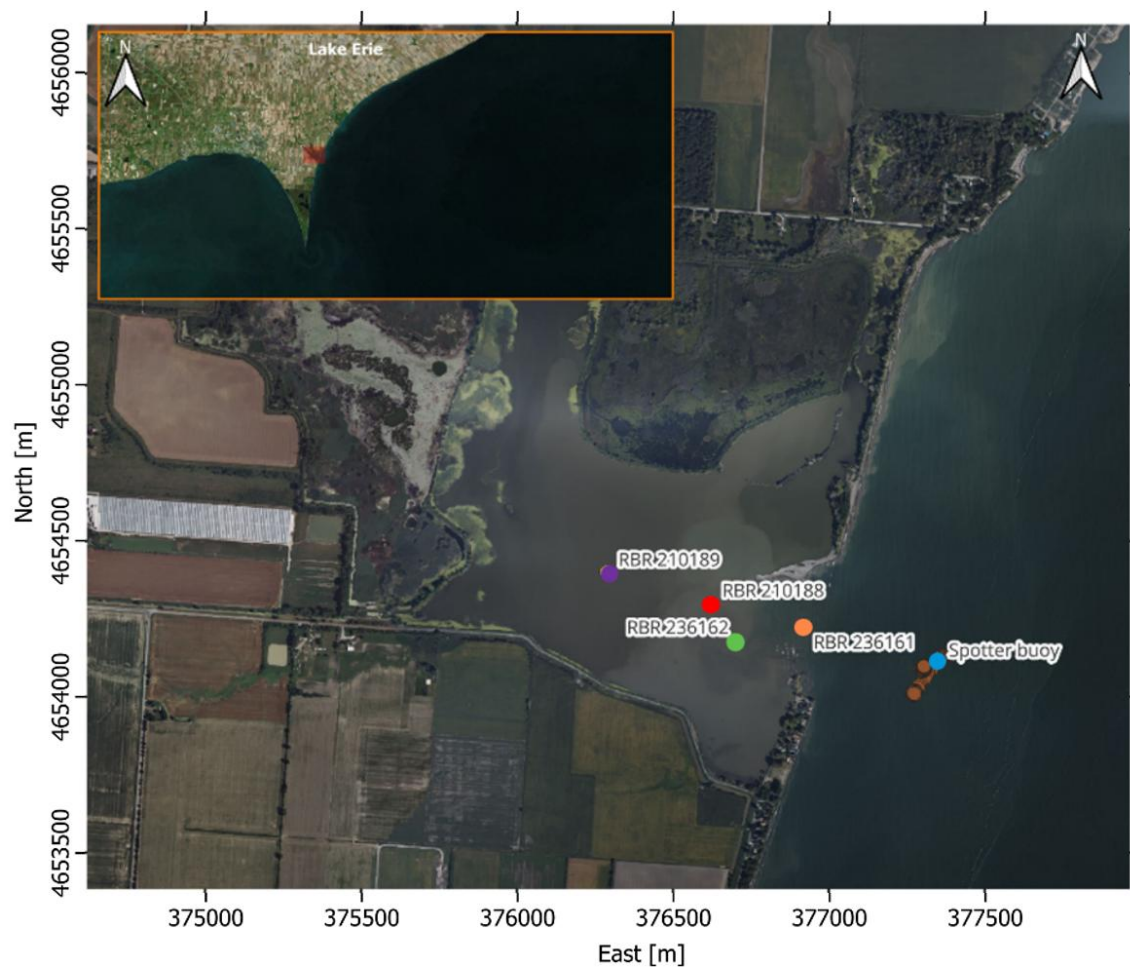


Turbidity sensor deployment (2023)



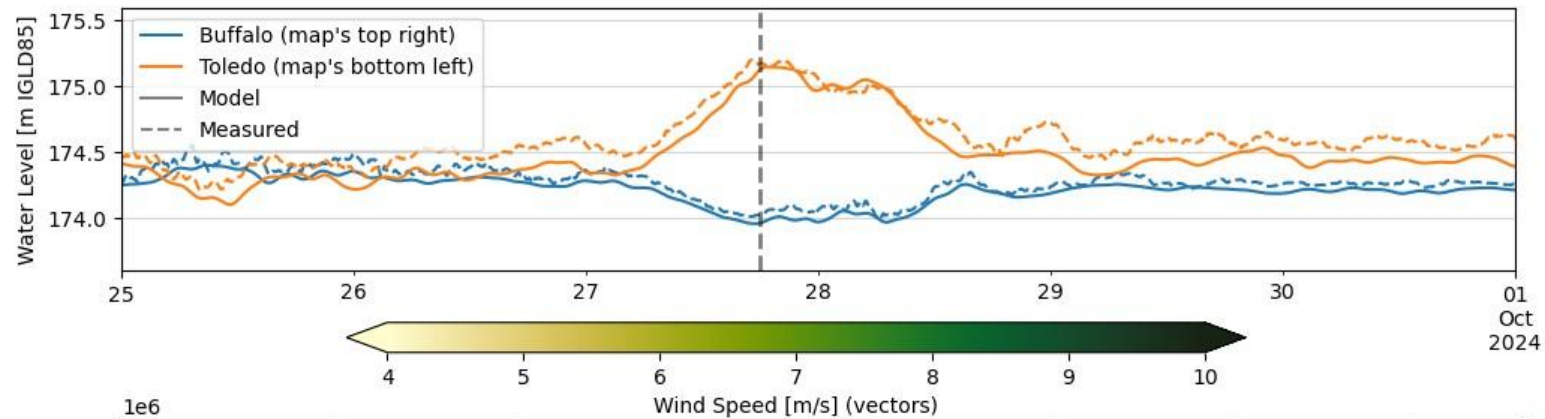
WAVE DATA COLLECTION

SEPTEMBER 1ST – DECEMBER 17TH, 2024

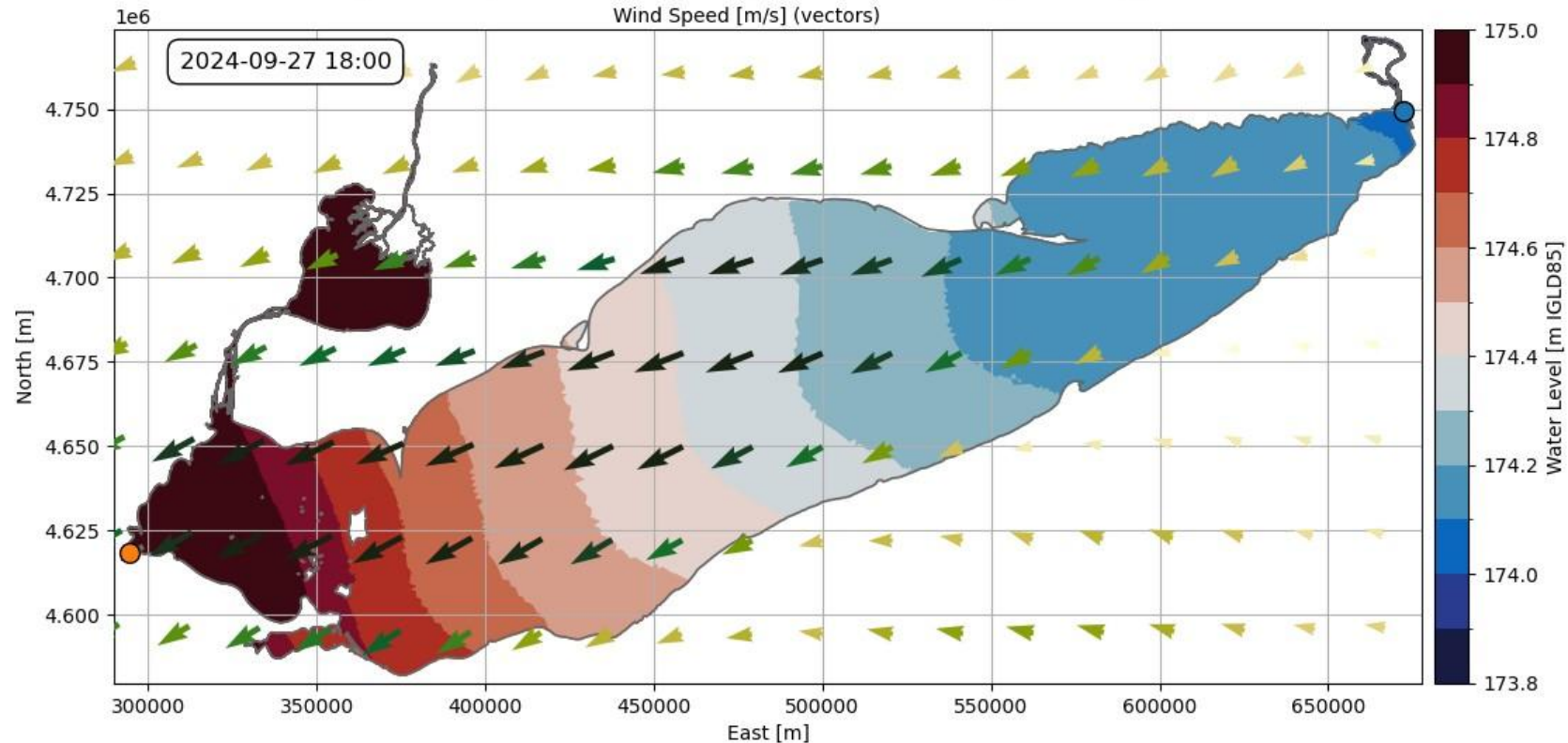


September 28th, 2024
Remnants of Hurricane Helene

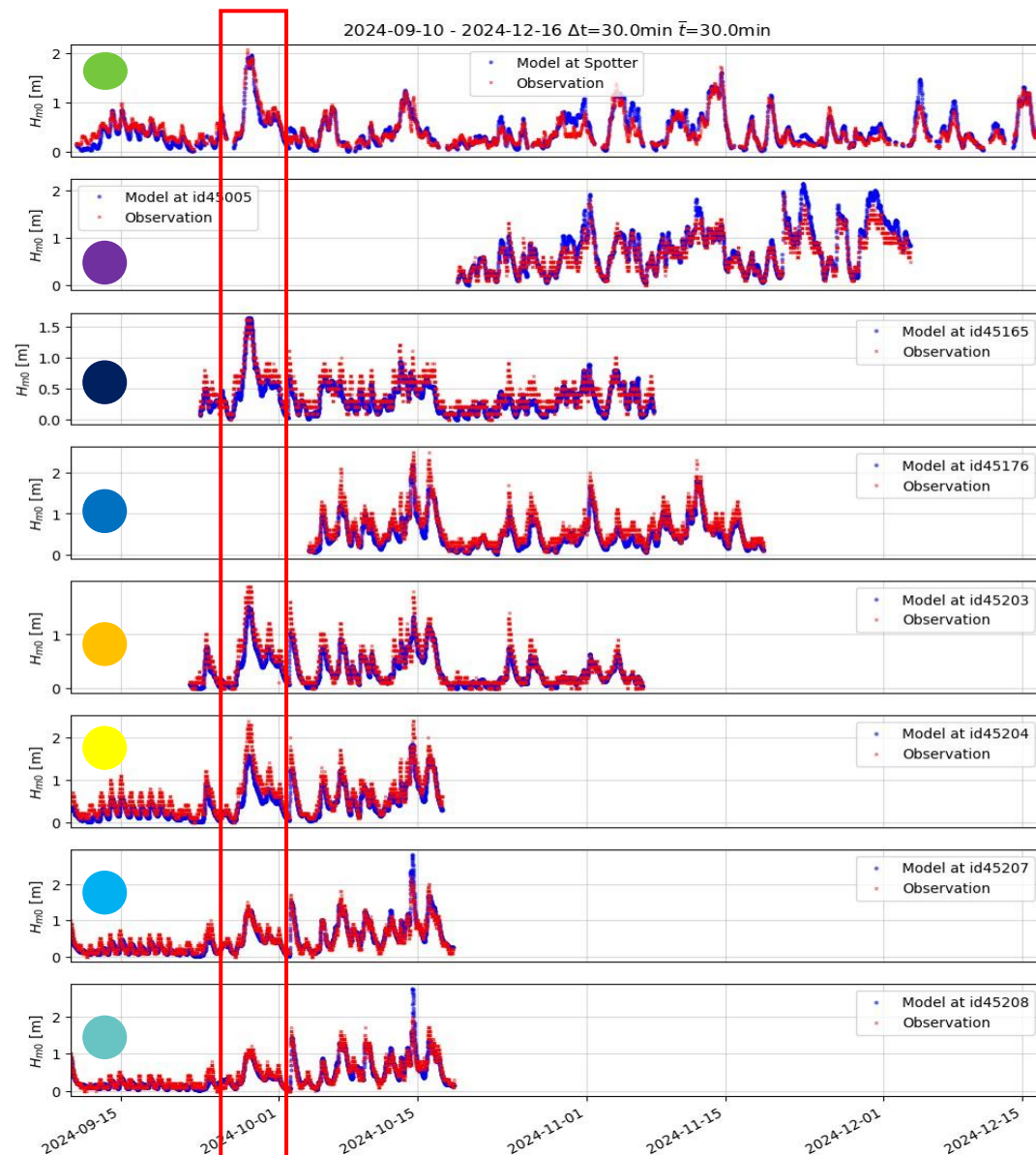
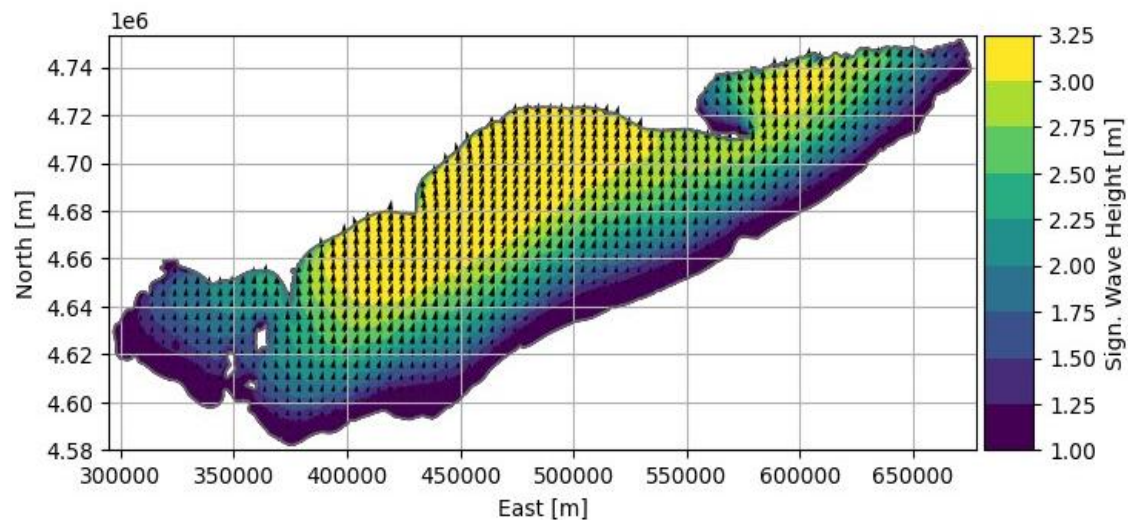
NUMERICAL MODELLING: LAKE-WIDE HYDRODYNAMIC MODEL



*Dozens of other validation events also considered

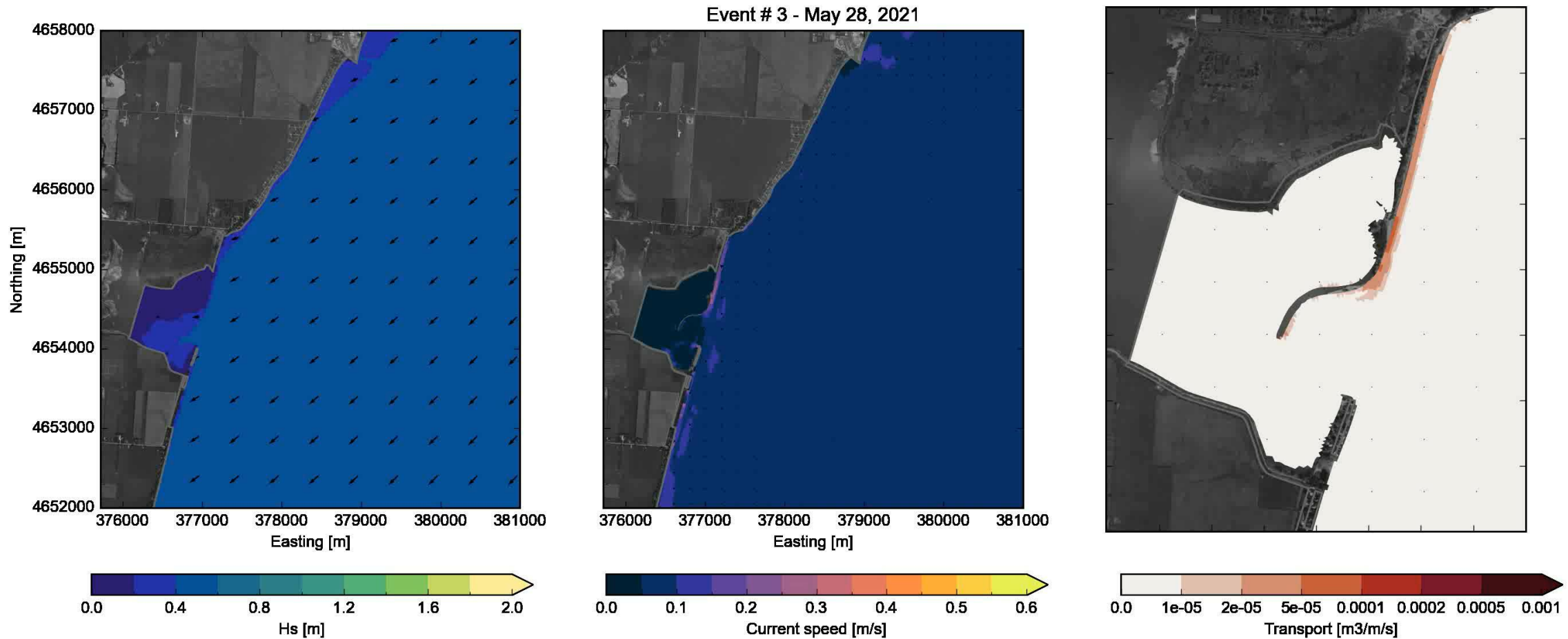


NUMERICAL MODELLING: LAKE-WIDE SPECTRAL WAVE MODEL



September 28th, 2024

NUMERICAL MODELLING: REGIONAL COUPLED WAVE, HYDRODYNAMIC AND SEDIMENT TRANSPORT MODEL



NUMERICAL MODELLING: 3D PHASE-RESOLVING WAVE MODEL

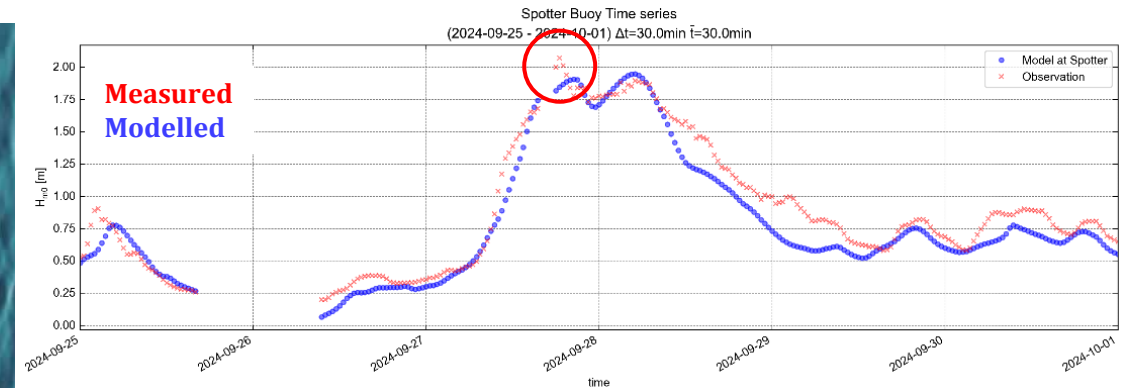
Calibration Event, September 28th, 2024:

MIKE3 WaveFM



WAVES AT SPOTTER BUOY

Hs: ~ 2.1 m
Tp = 7.4 s
MWD = ~90 degrees
WL: ~174.7 m IGLD

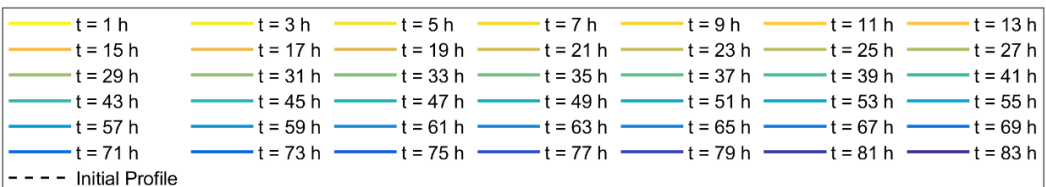
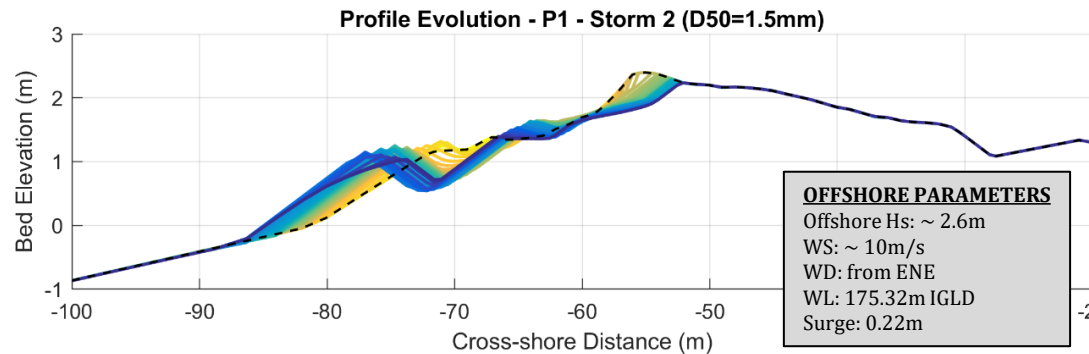
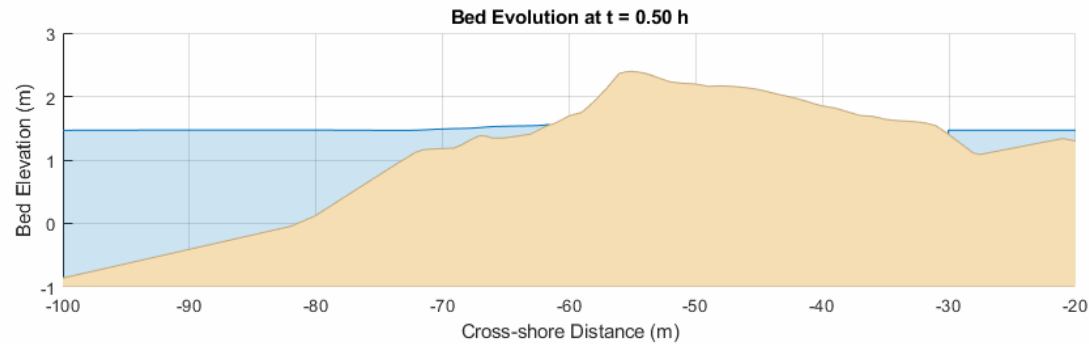


NUMERICAL MODELLING: 1D BEACH EVOLUTION



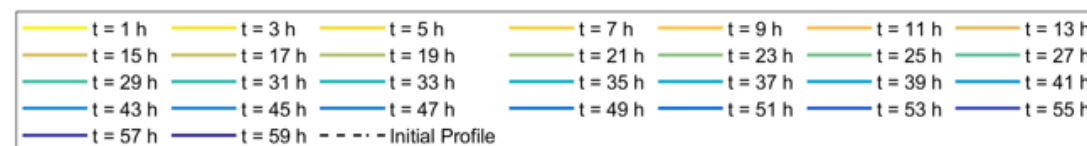
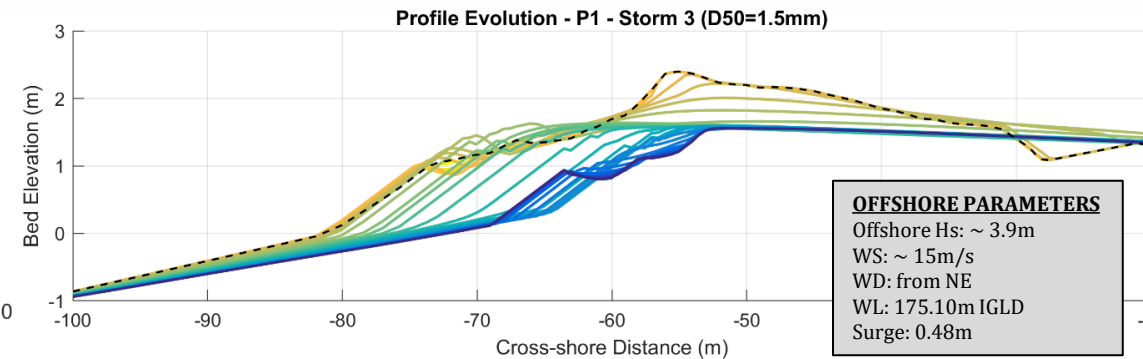
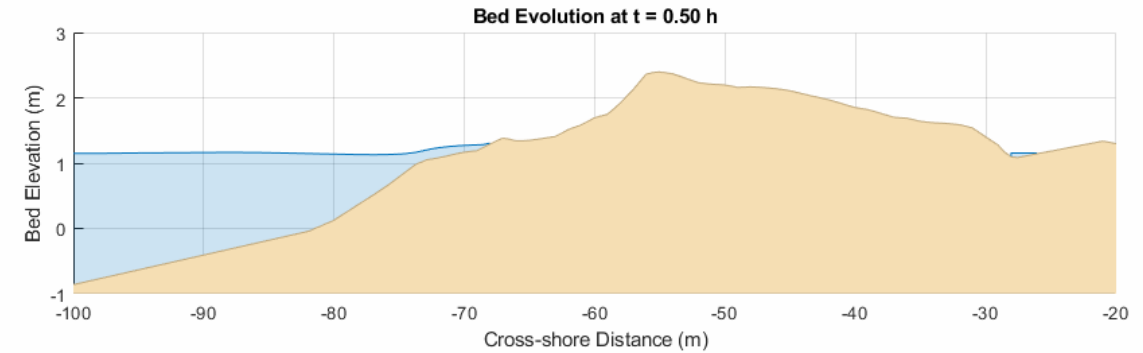
Event # 2 - May 19, 2020

Barrier Bar response for $d_{50}=1.5\text{mm}$



Event # 3 - May 28, 2021

Barrier Bar response for $d_{50}=1.5\text{mm}$



DESIGN DEVELOPMENT

Existing Conditions:



Concept A (original):



Concept B:



Concept C:



Concept D:

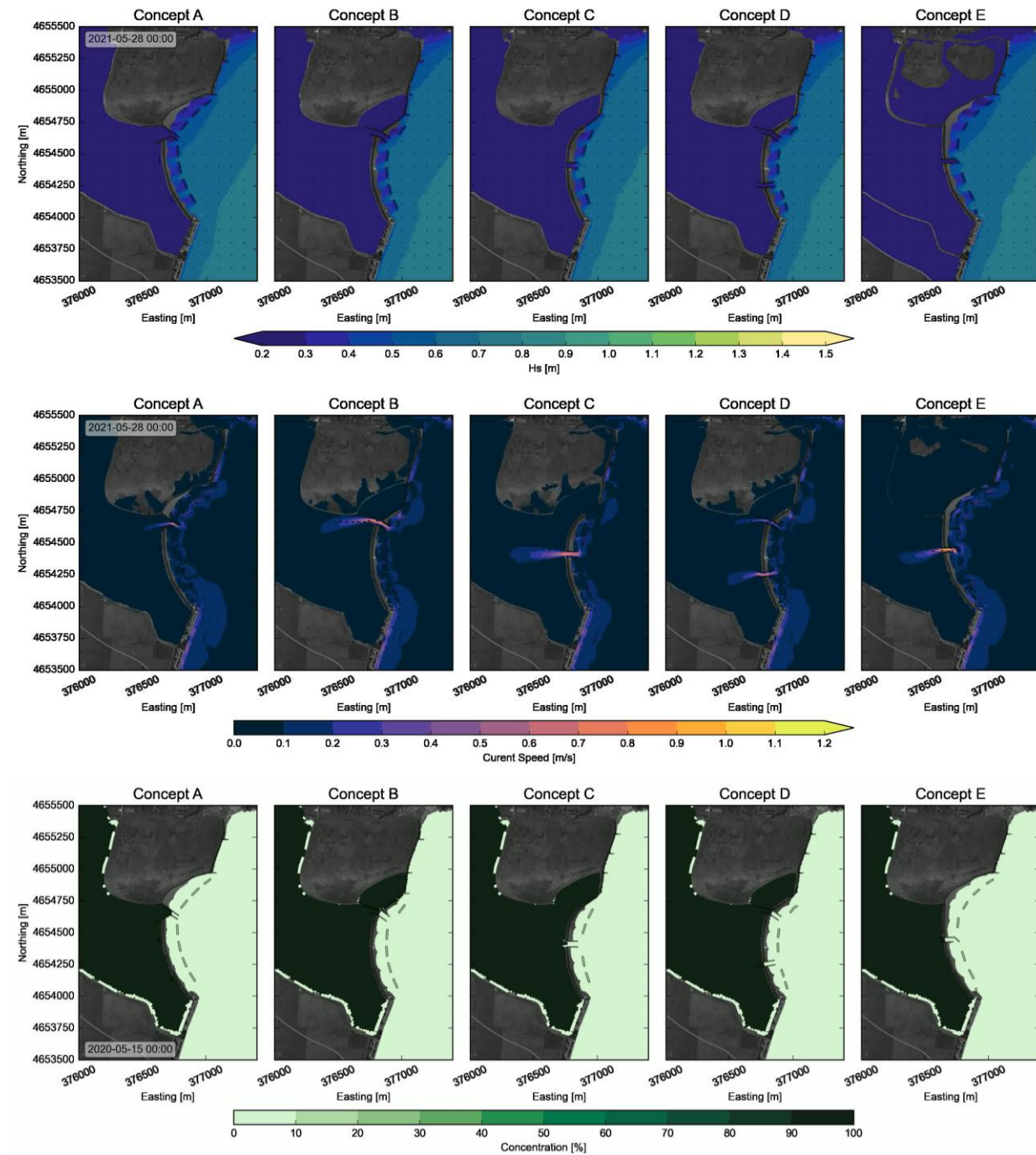


Concept E:



EVALUATE CONCEPTS USING NUMERICAL MODELS BASED ON:

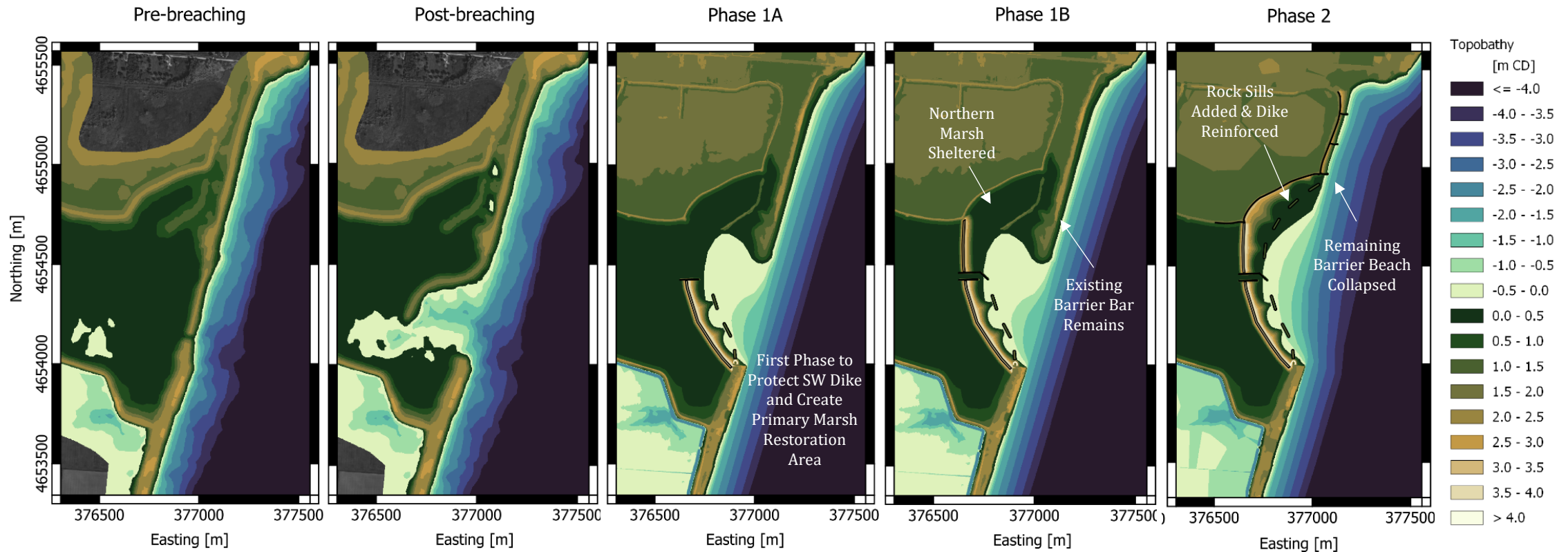
- Wave energy reduction within the marsh
- Bed shear stress and currents around rock structures
- Sediment stability and evolution of beach behind offshore structures
- Wave conditions impacting structures
- Water renewal and circulation within the marsh
- Performance of phased construction under funding constraints
- Sensitivity to a changing climate



PREFERRED CONCEPT:



PREFERRED CONCEPT: FULL TIMELINE



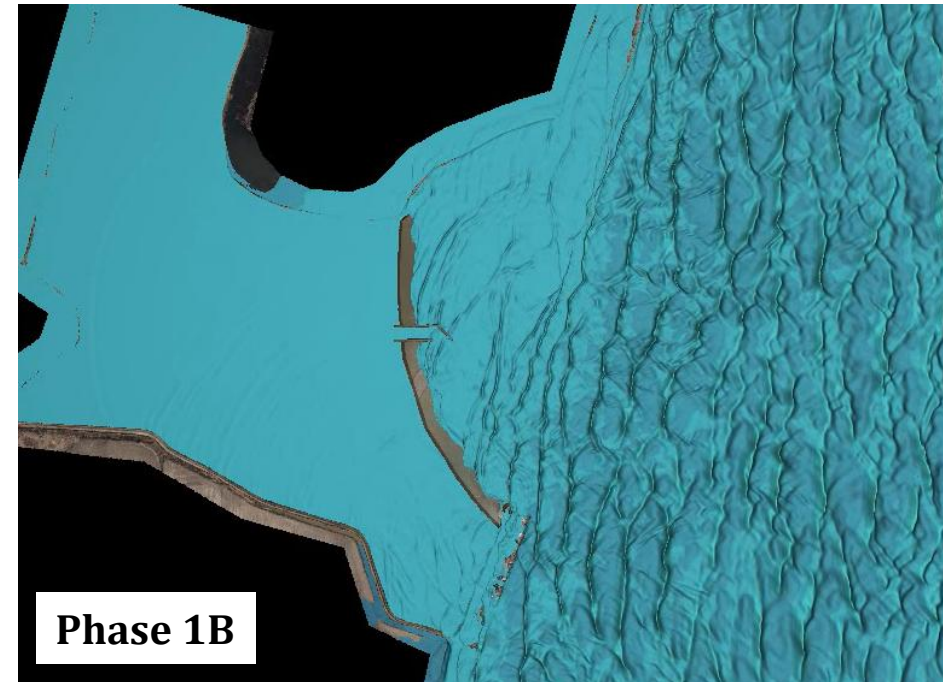
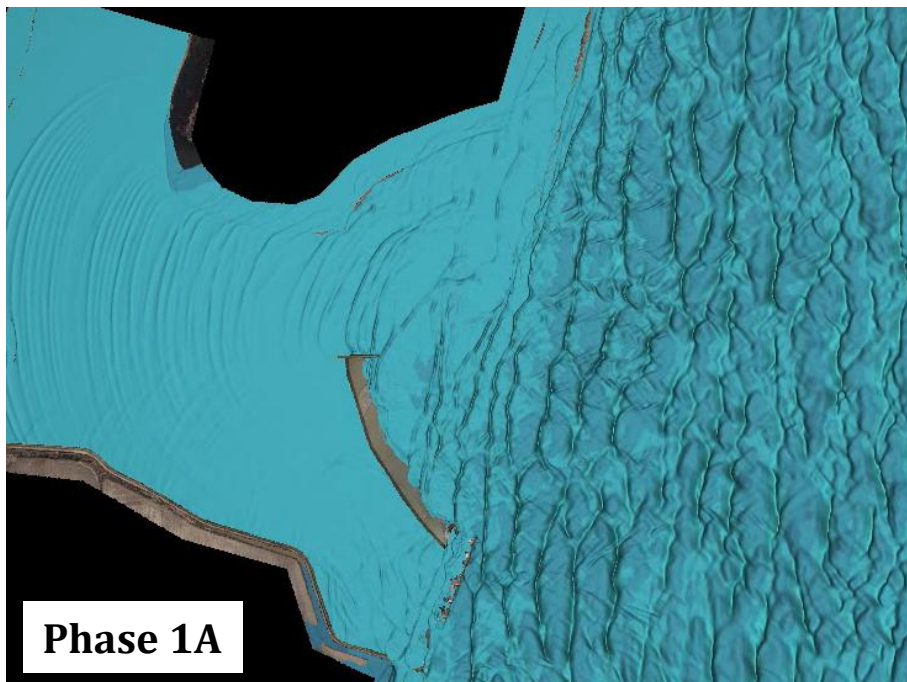
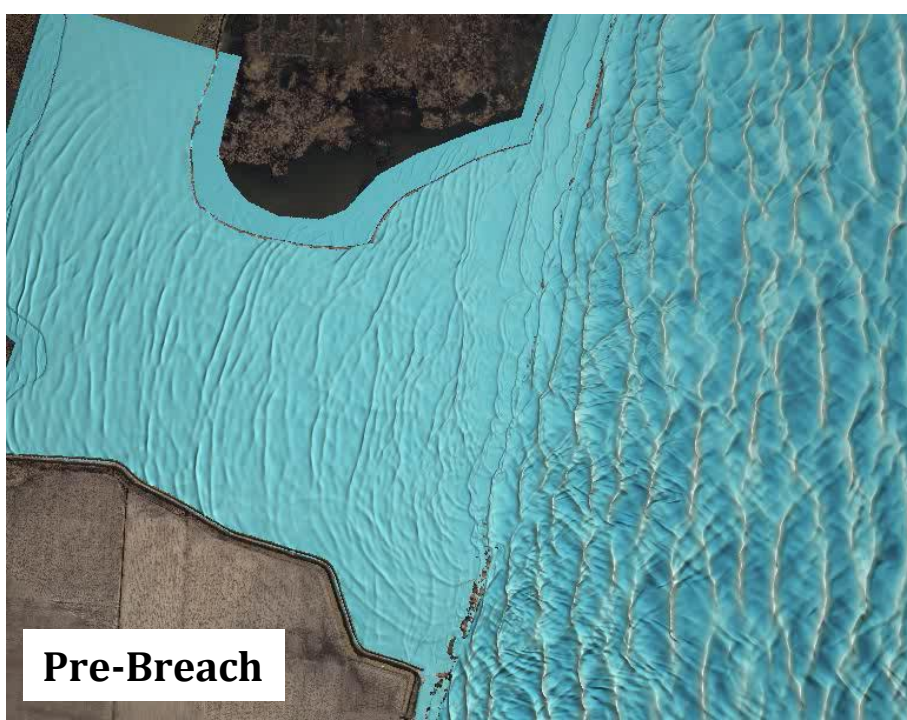
Model waves, currents, sediment transport, water renewal:

- 16 modelling scenarios were completed across Phases using coupled SW+HD modelling.
- Simulations assessed both moderate and extreme storm conditions, including 1-, 5-, and scaled 100-year wave events.
- Water levels ranged from annual high conditions (174.5 mIGLD85) to historical high levels (175.6 mIGLD85) and beyond to including future climate change scenarios.

3D Phase Resolving Wave Model

MIKE3 WaveFM
100-year event

Offshore significant wave height (H_s) of 5.6 m, combined with a historical high-water level of 175.60 m IGLD85.





PHYSICAL MODELLING

DETAILED DESIGN

Detailed Design

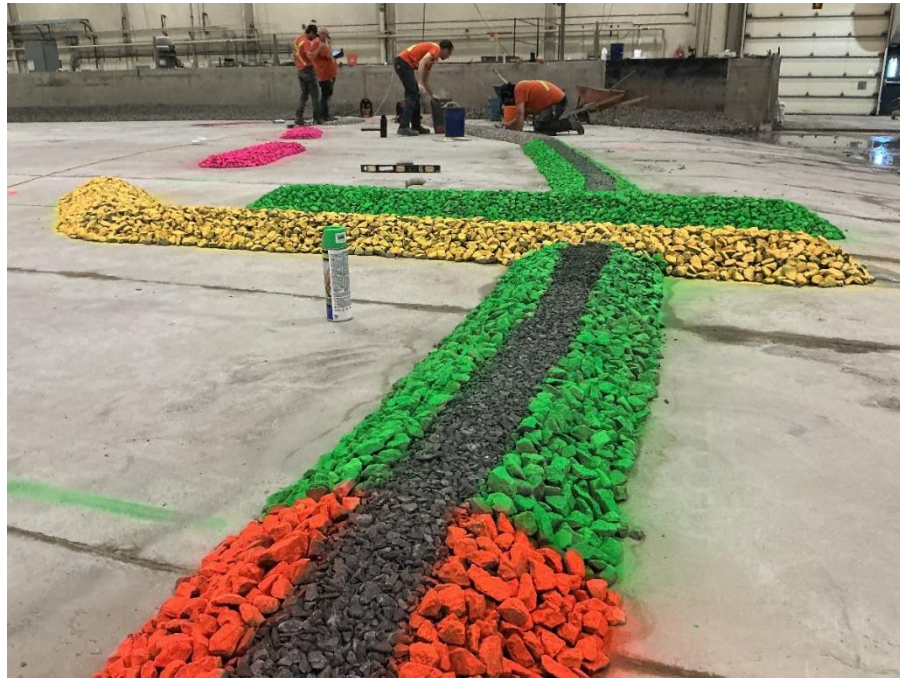
Physical Model Testing
at NRC's Ocean Coastal
and River Engineering
(OCRE) Laboratory,
Ottawa



National Research
Council Canada

Conseil national de
recherches Canada

Initial Construction of
Preferred Concept:



PHYSICAL MODEL

ANNUAL WAVES AT TYPICAL HIGH WL – FULLY EXPOSED STRUCTURES



PHYSICAL MODEL

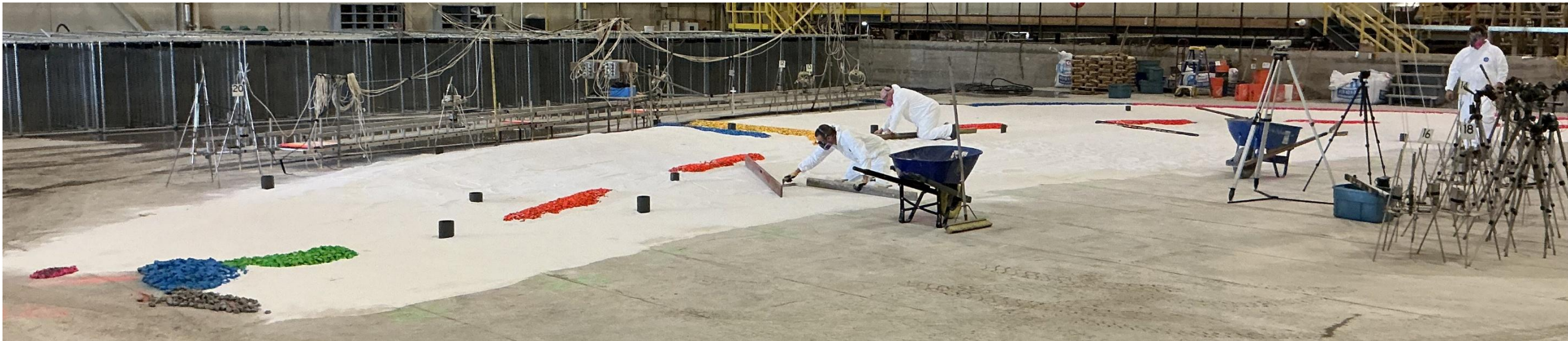
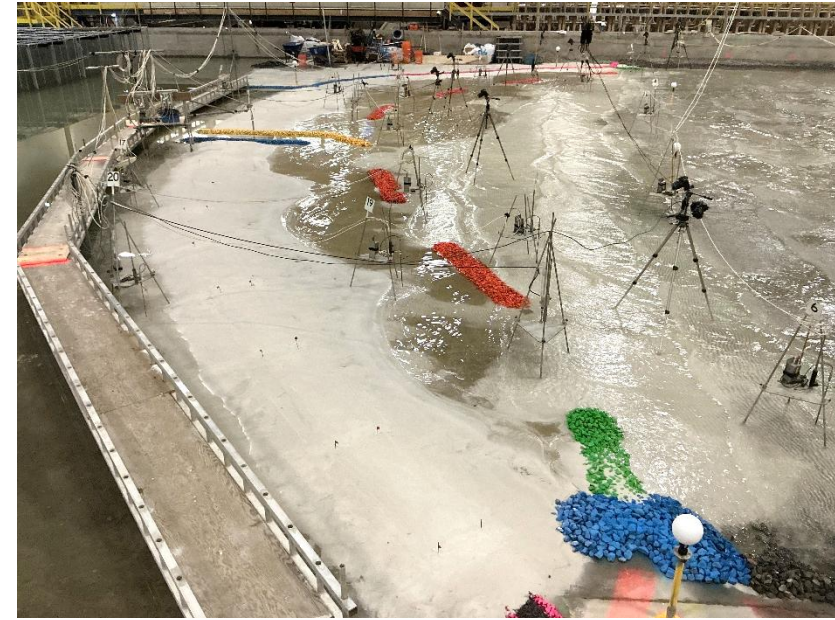
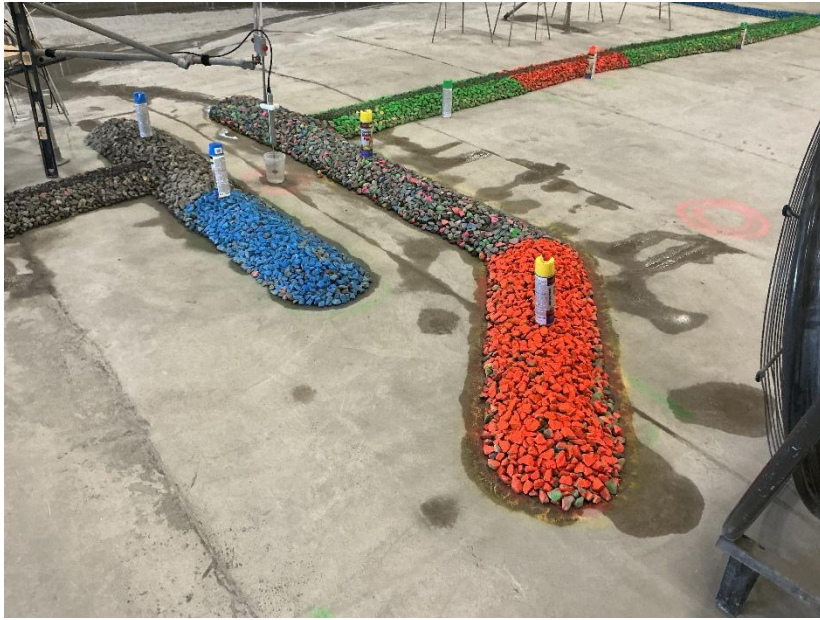
100-YR WAVES AT 100-YR WL – FULLY EXPOSED STRUCTURES



PHYSICAL MODEL: STONE STABILITY

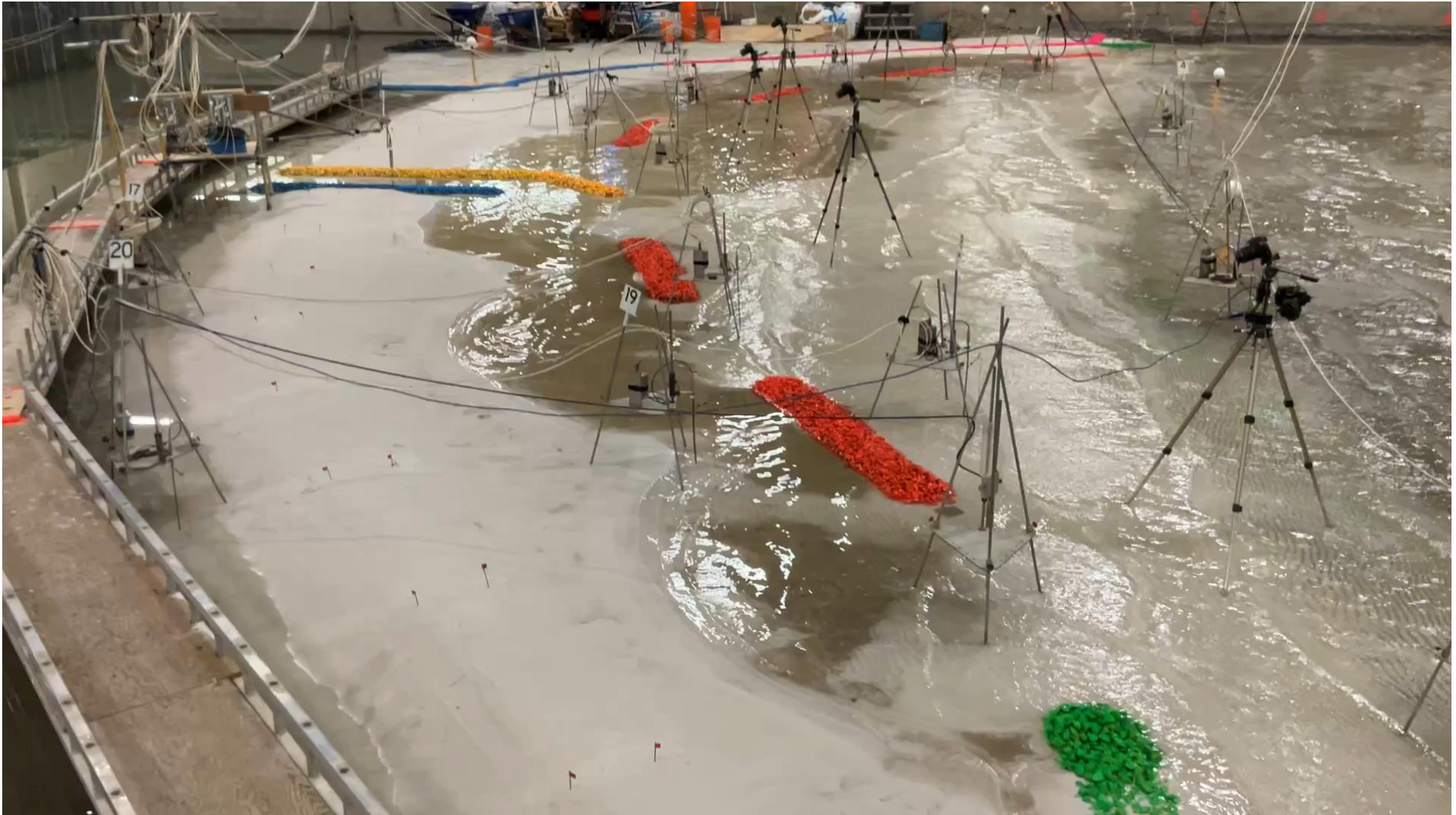


PHYSICAL MODEL: BEACH STABILITY



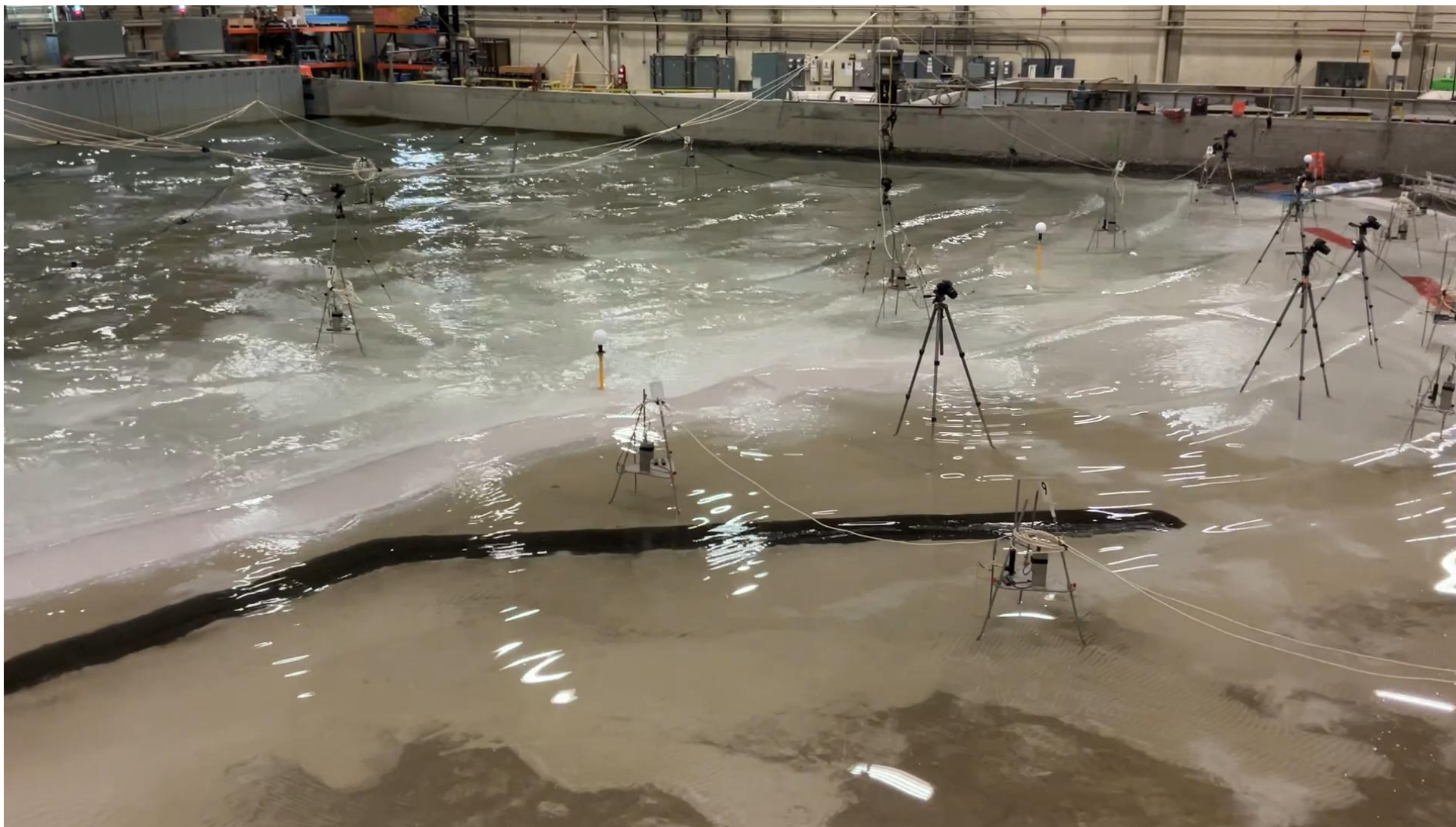
PHYSICAL MODEL

10-YR WAVES AT ANNUAL HIGH WL – PLACED BEACH



PHYSICAL MODEL

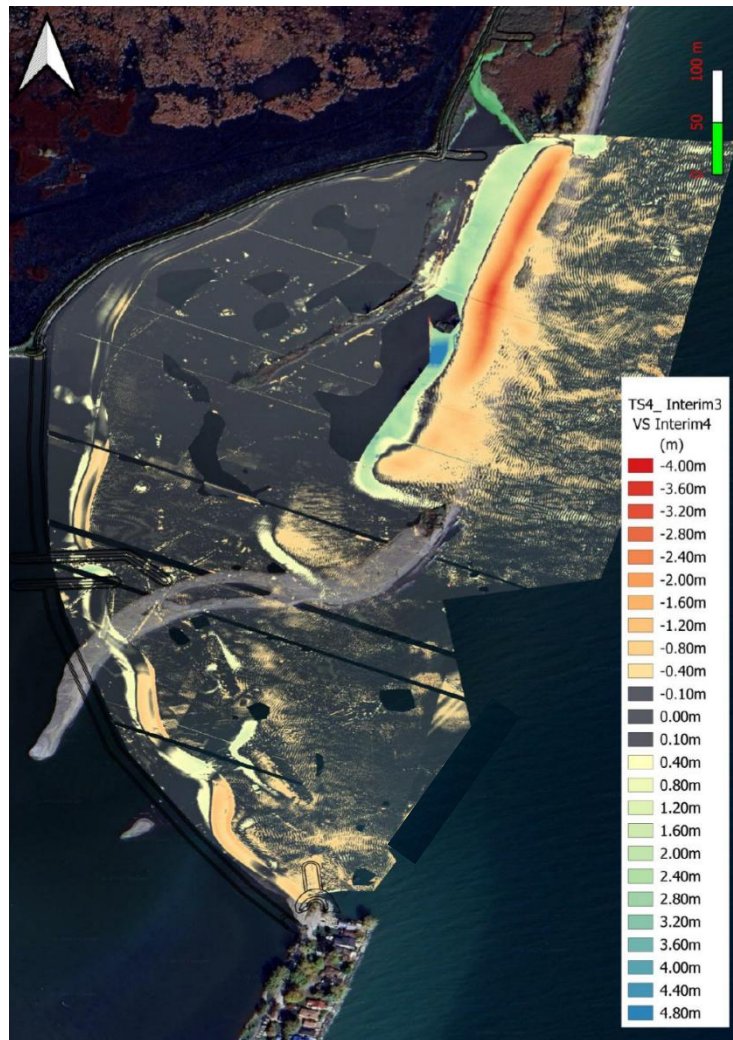
100-YR WAVES AT 100-YR WL – PLACED BEACH AND EXISTING BARRIER



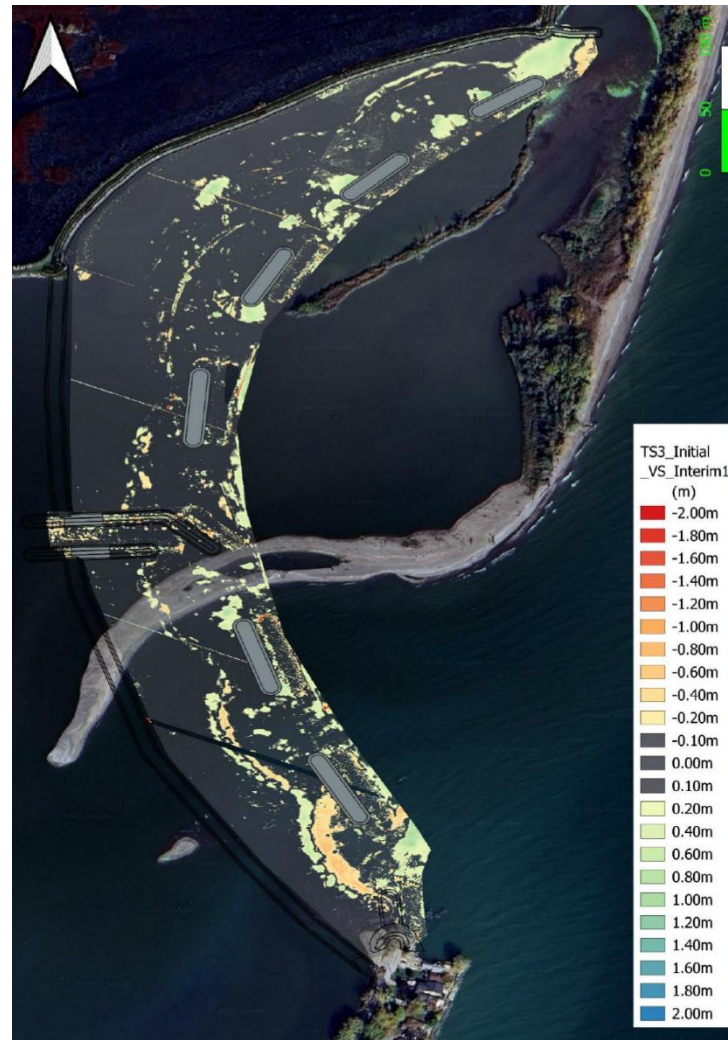
PHYSICAL MODEL

BEACH MORPHOLOGY – 3D SCANS

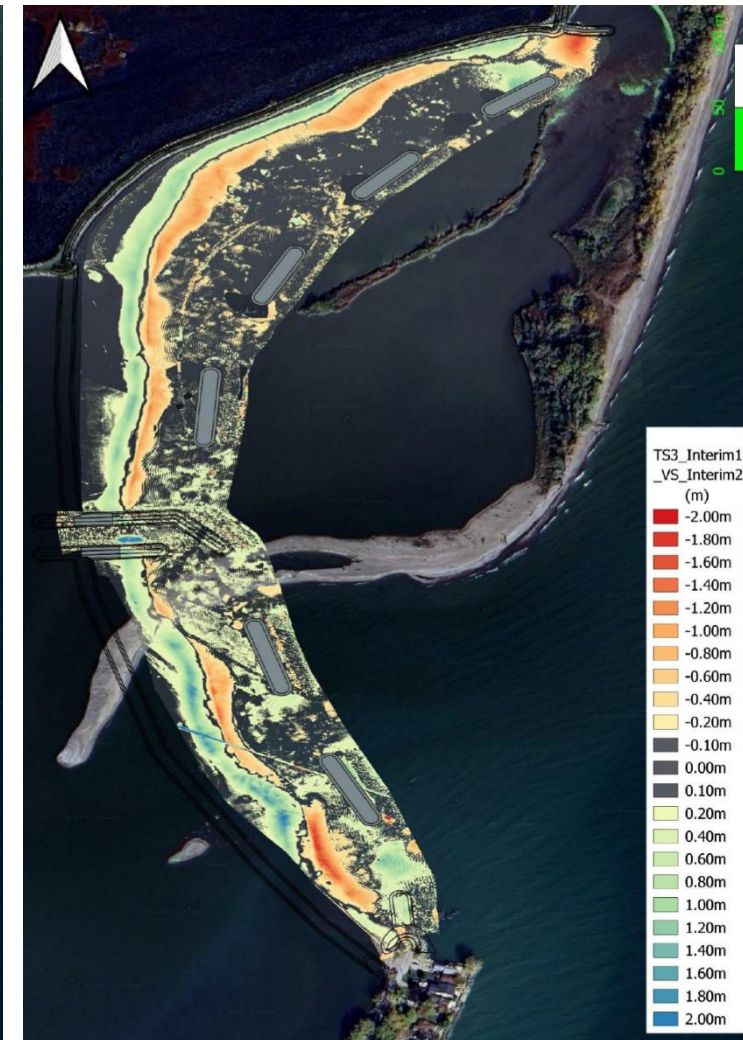
Phase 1 - 100-year event:



Phase 2 – Typ. (annual) event:



Phase 2 – 100-year event:



PHYSICAL MODEL OUTCOMES

- Pre-physical model Class C estimate (all phases) ~ \$16.4M
- Post-physical model Class C estimate (all phases) ~ \$13.3M
- Physical model cost = \$212,000
- Reduction in Class C estimate through physical model optimizations ~ \$3M
- Benefit / Cost ratio of 14

Physical model provides added confidence in structural stability, beach stability and overall performance of design against project objectives

PHASE 1A & 1B



BEFORE... 114

PHASE 1A & 1B



AFTER

PHASE 1A & 1B



BEFORE...



PHASE 1A & 1B



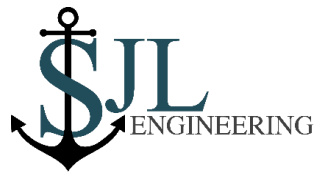
AFTER





THANK YOU!

slogan@sjleng.ca



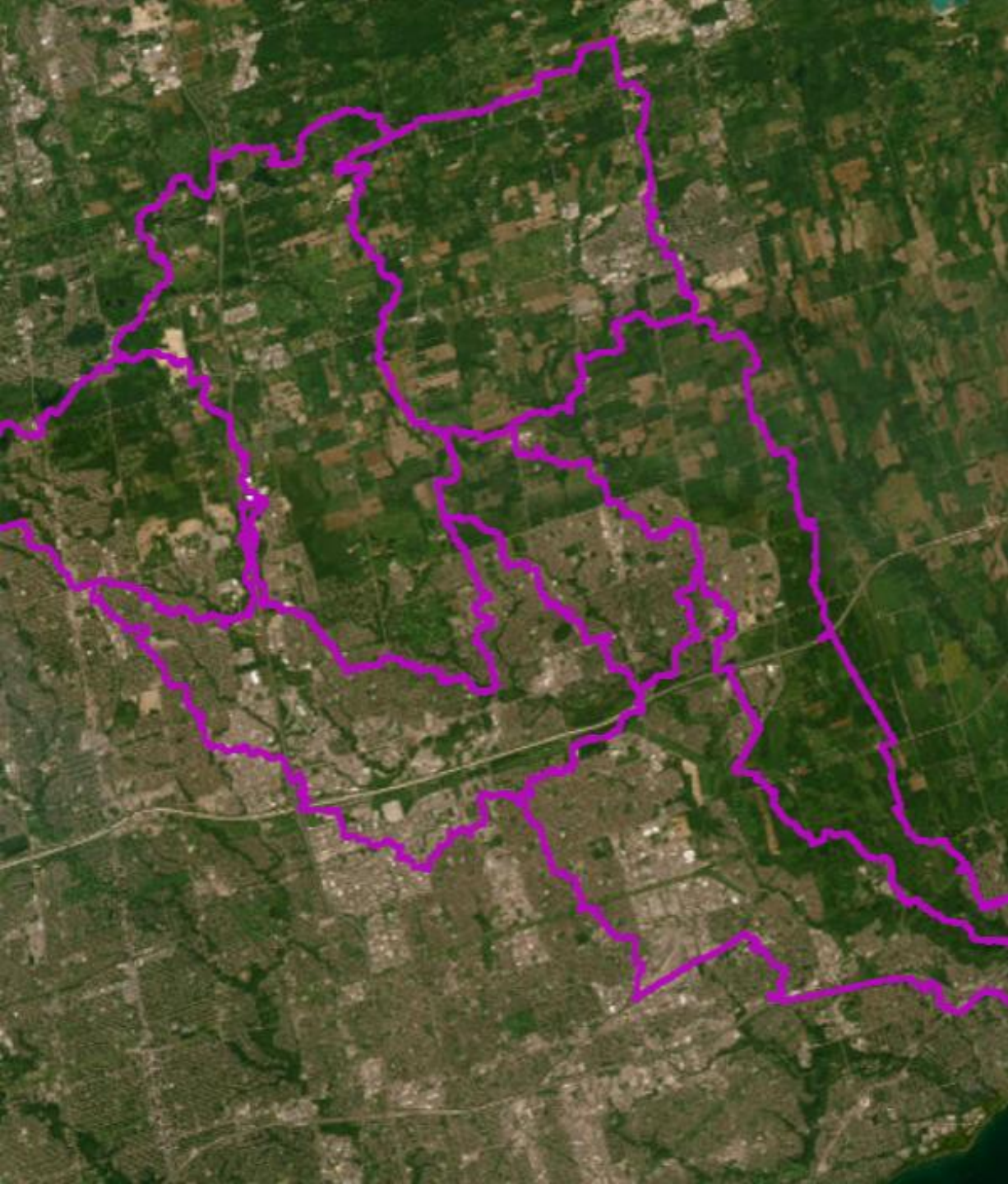
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du Canada

Leveraging Big Data to Connect Watershed Plans to Nearshore Lake Health: Rouge River Case Study

Krista Chomicki, Tyler Harrow-Lyle, Aisha Javed

September 15, 2026



The Goal:

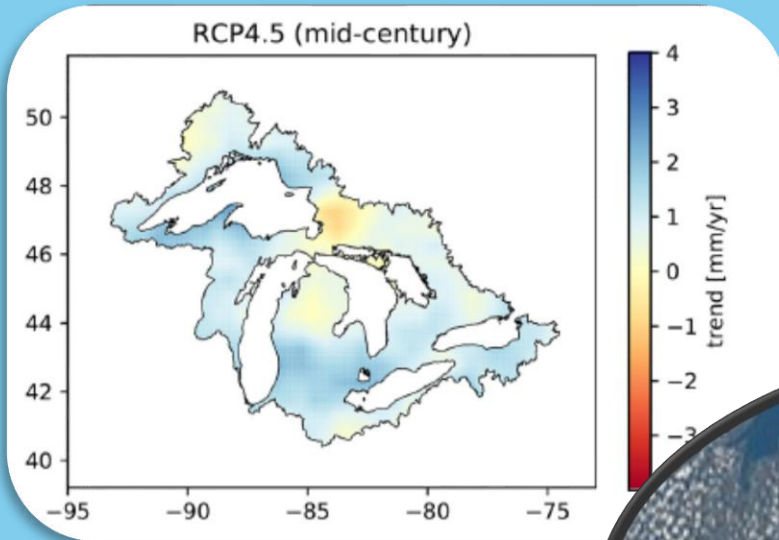
Communicate expected impacts that future development and climate change will have on nearshore water quality and ecosystem health to local stakeholders



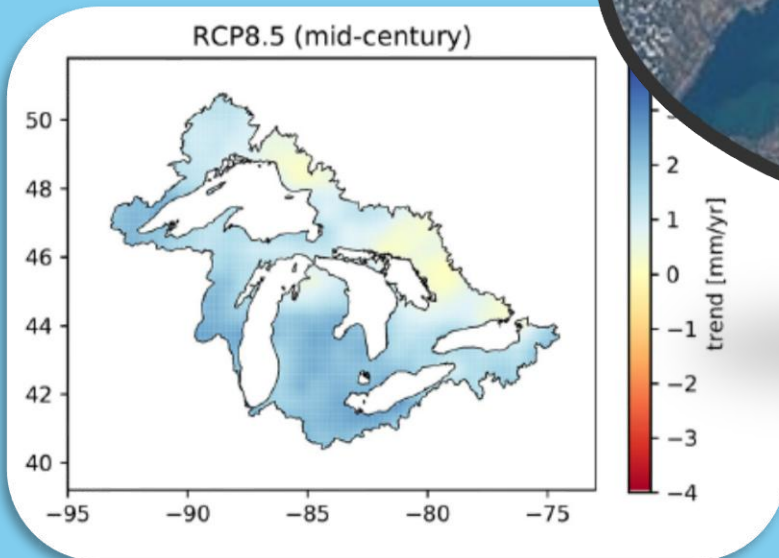


Why does it matter for decision making?

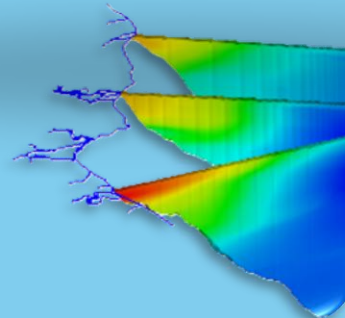
- Disconnect between the watershed and the lake
- Recreation
- Drinking water intakes
- “Ownership”
- Co-benefits
- It takes a village!



Shrestha et al., 2022: Frontiers in Water

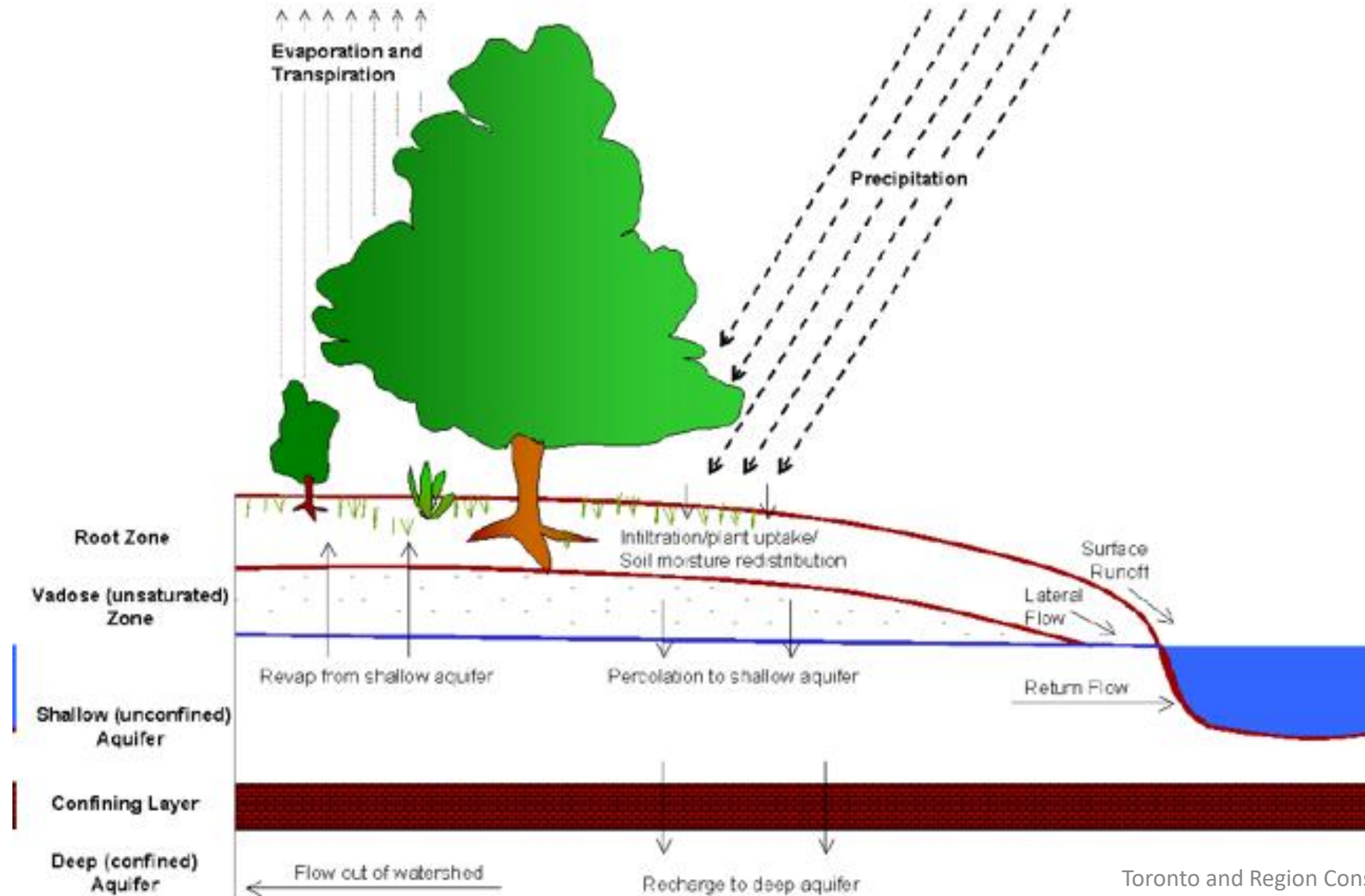


Shrestha et al., 2022: Frontiers in Water



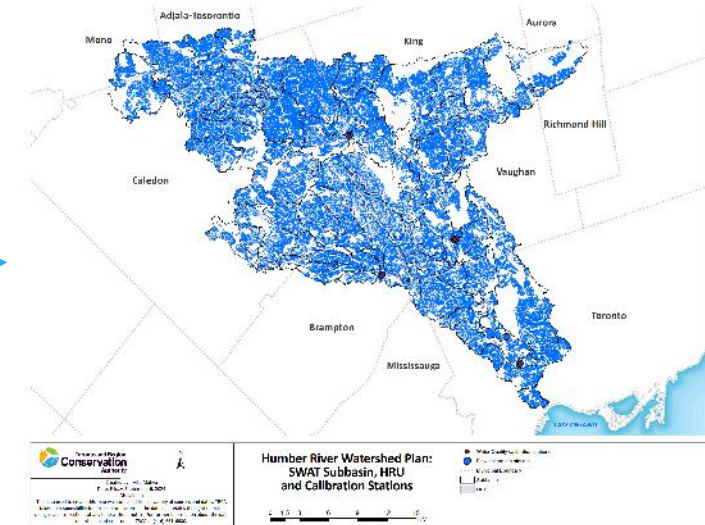
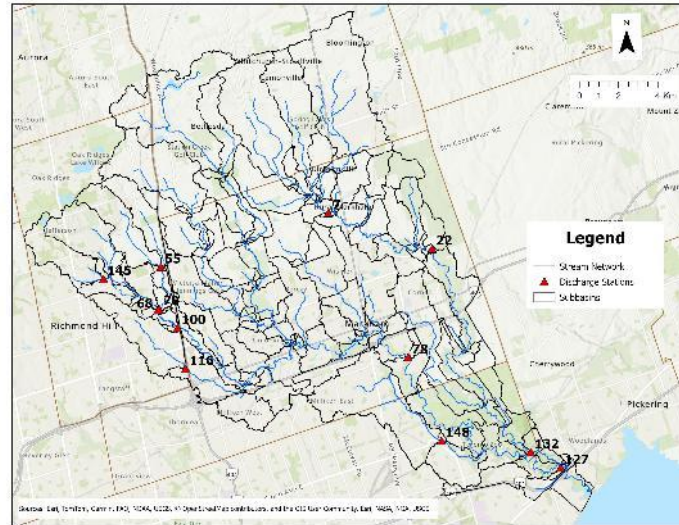
<https://frametoframe.ca/icy-waves-break-sunnyside-breakwater-Toronto>

Hydrology and Water Quality Model



SWAT Input

- DEM, Soil, and Land use
- Climate: Precipitation, Temperature, Solar radiation, Humidity, Wind speed
- Agricultural operation: planting, harvesting, fertilizer application
- Point sources: e.g. Water taking
- Stormwater Pond, conceptual LIDs
- Observed chemistry data



Calibration and Validation

SWAT Output

- Runoff and groundwater flow
- River discharge
- Nutrient/sediment yield
- Nutrient/sediment load

Climate

- 26 open climate models
- Statistically and dynamically downscaled models
- Bias corrected
- Under climate scenarios SSP2-4.5 and potentially SSP5-8.5



Dreissenids may be the primary regulator of phosphorus within the Great Lakes

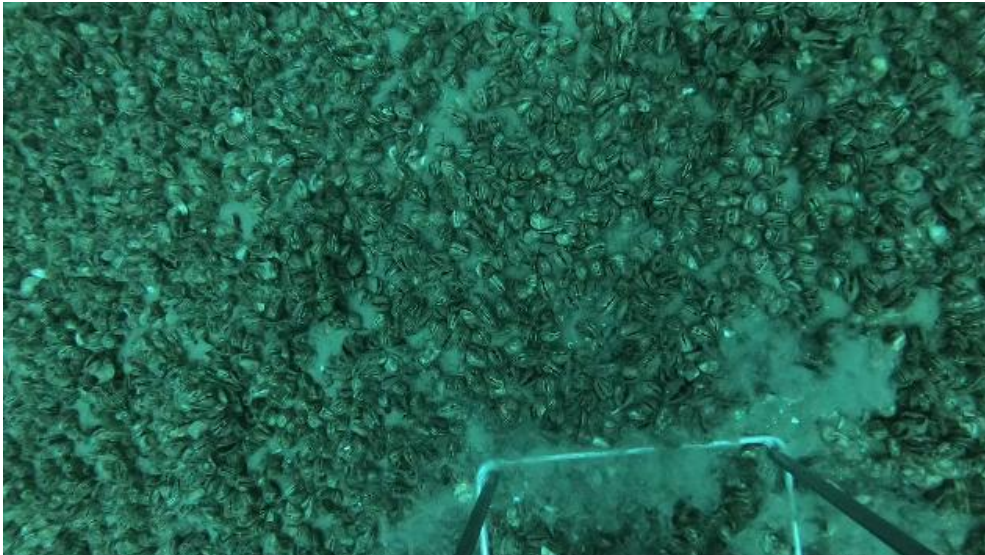
RESEARCH ARTICLE | ENVIRONMENTAL SCIENCES | ✓



Benthic invaders control the phosphorus cycle in the world's largest freshwater ecosystem

Jiying Li , Vadym Ianaiev , Audrey Huff ,  , and Sergei Katsev   [Authors Info & Affiliations](#)

Edited by David Strayer, Cary Institute of Ecosystem Studies, Ann Arbor, MI, and accepted by Editorial Board member Mary E. Power November 19, 2020 (received for review April 29, 2020)



Leveraging Partnerships to Generate a Lake-Wide Estimation of Dreissenid Biomass

Journal of Great Lakes Research 51 (2025) 102652



Contents lists available at ScienceDirect

Journal of Great Lakes Research

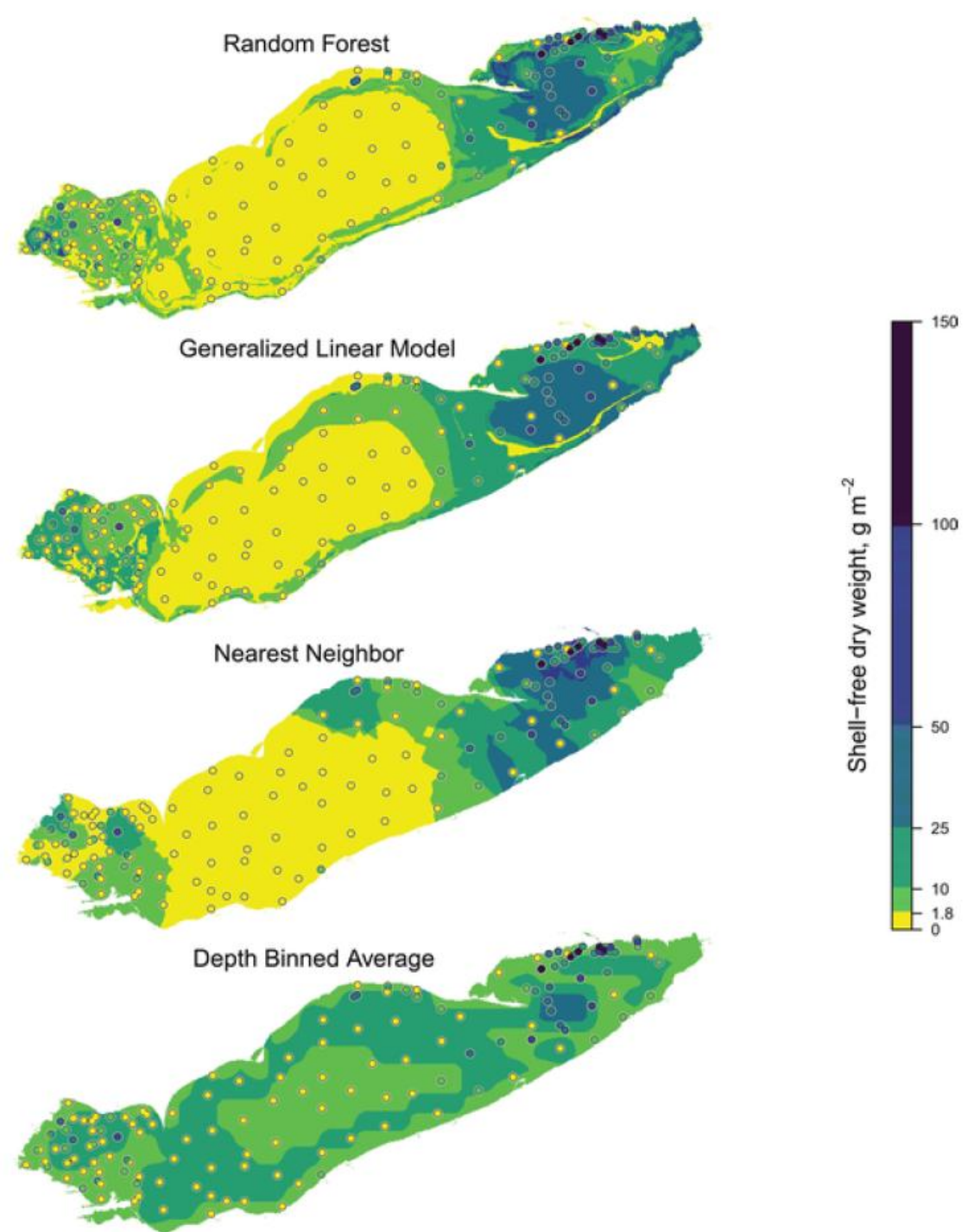
journal homepage: www.elsevier.com/locate/jglr



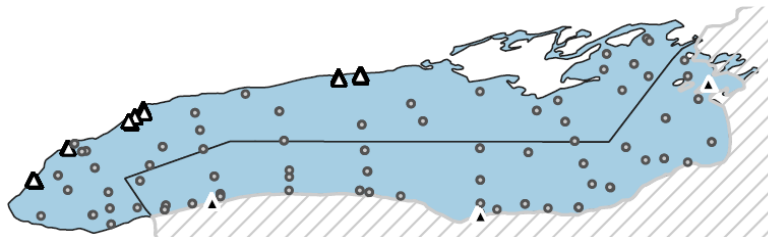
Developing the first binational dreissenid mussel biomass map for Lake Erie[☆]

Tyler J. Harrow-Lyle^{a,*}, Ashley K. Elgin^b, Mark D. Rowe^c, Peter J. Alsip^c, Lyubov E. Burlakova^{d,e}, Alexander Y. Karatayev^{d,e}, Megan McCusker^a,

Reza Valipour^a, David C. Depew^a



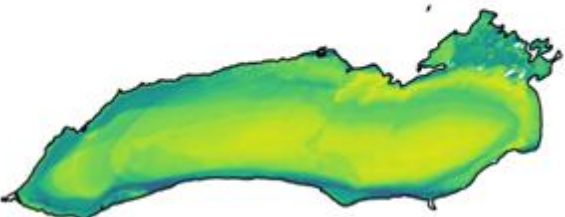
Leveraging Partnerships to Generate a Lake-Wide Estimation of Dreissenid Biomass



Data preprocessing and spatial cross-validation split

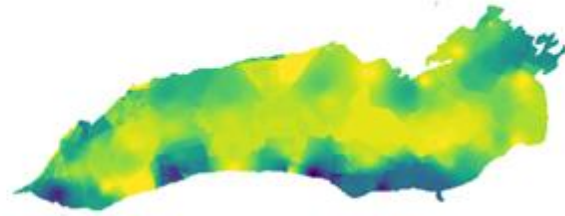
Model Generation

- New Methods
- Generalized Boosted Models
 - Generalized Linear Models
 - Random Forest



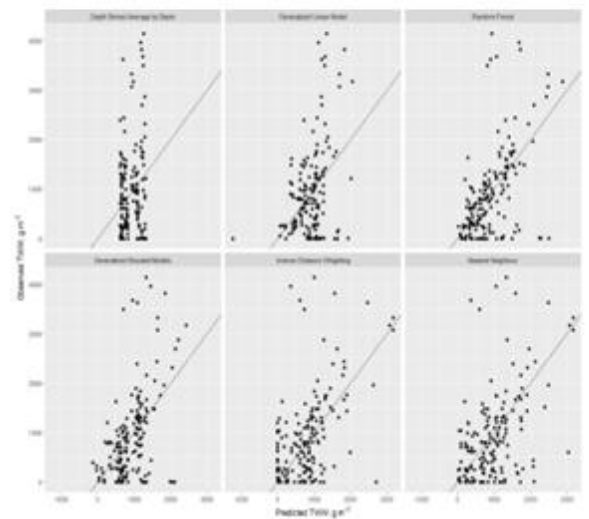
Random forest model of Lake Ontario

- Traditional Methods
- Inverse Distance Weighting
 - Nearest Neighbour
 - Depth-Binned Average

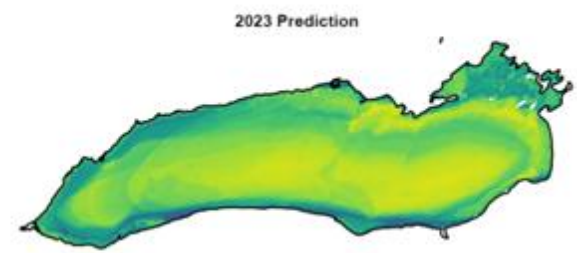


Nearest Neighbour model of Lake Ontario

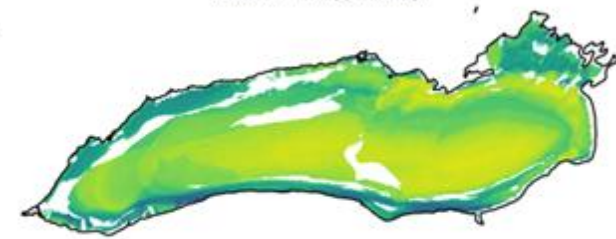
Model Selection and Comparison



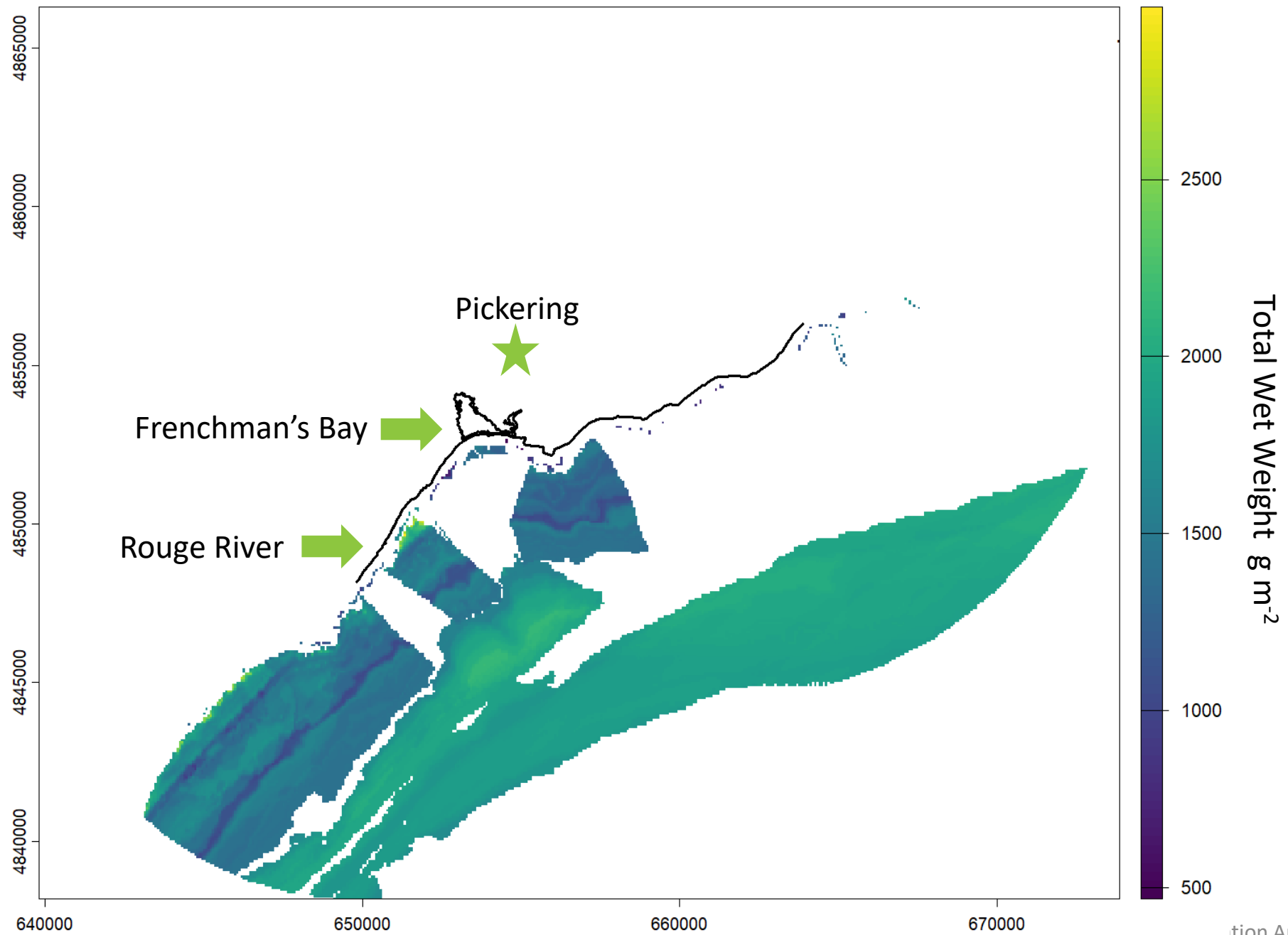
Spatial prediction mapping and determination of area of applicability



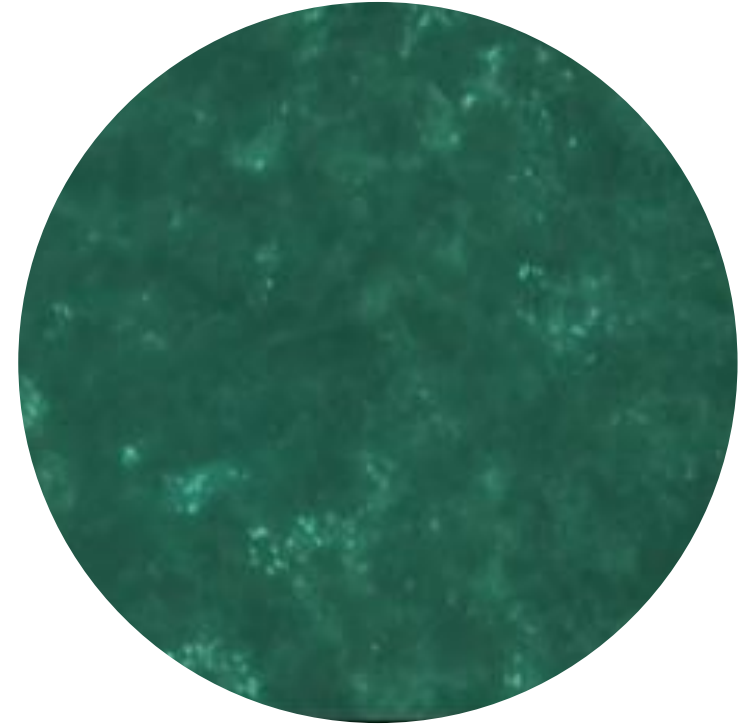
2023 Prediction



2023 Area of Applicability



Can *Cladophora* and dreissenid maps be developed for the area?



Generative Artificial Intelligence and Qualitative videography

nature ecology & evolution

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nature > nature ecology & evolution > progress > article

Progress | Published: 29 January 2025

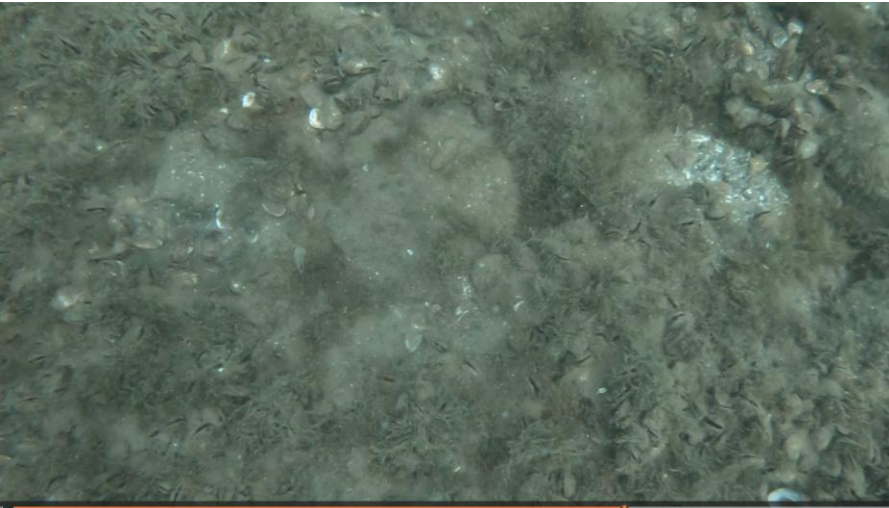
Generative AI as a tool to accelerate the field of ecology

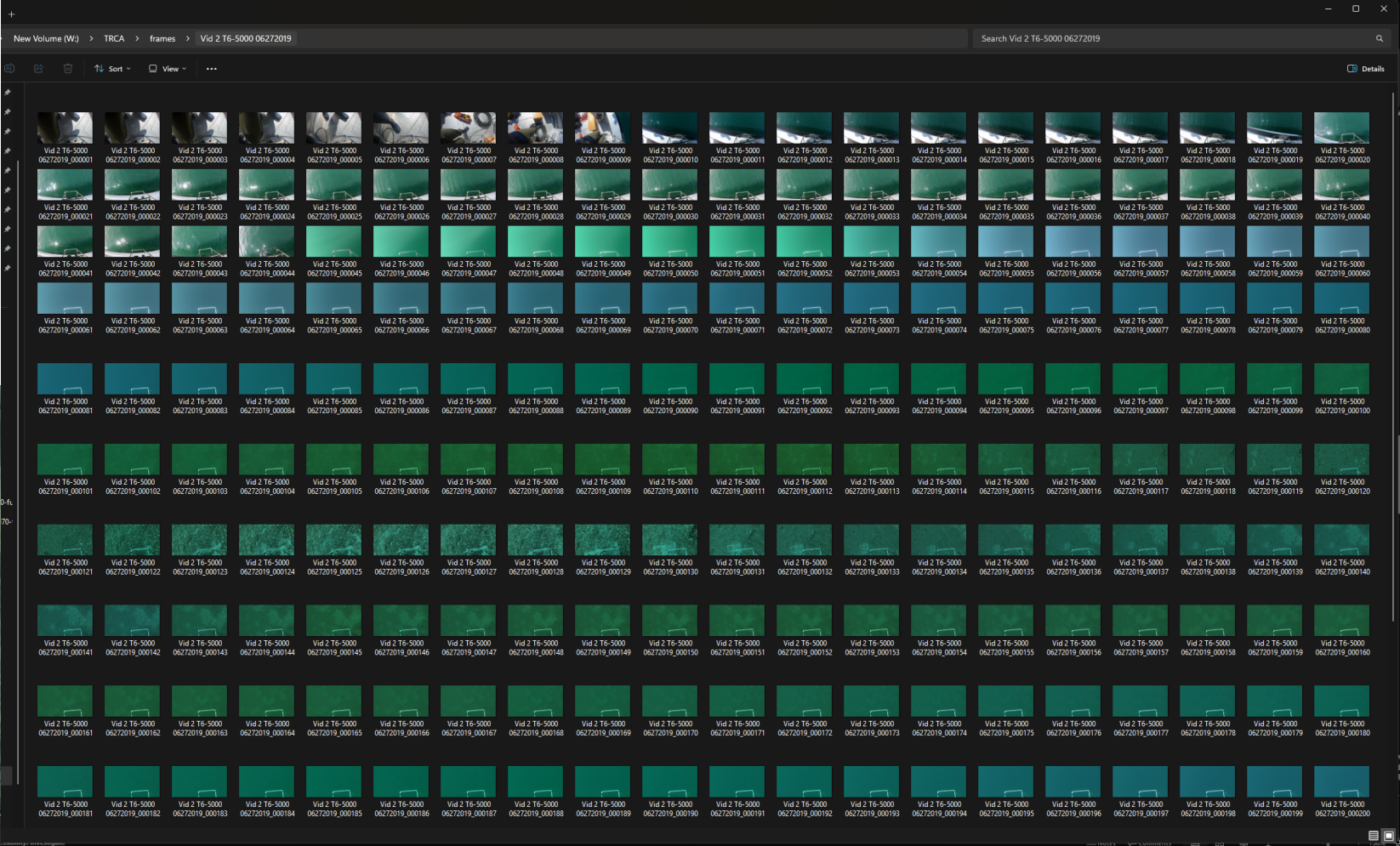
Kasim Rafiq✉

, Sara Beery, Meredith S. Palmer, Zaid Harchaoui & Briana Abrahms

Nature Ecology & Evolution

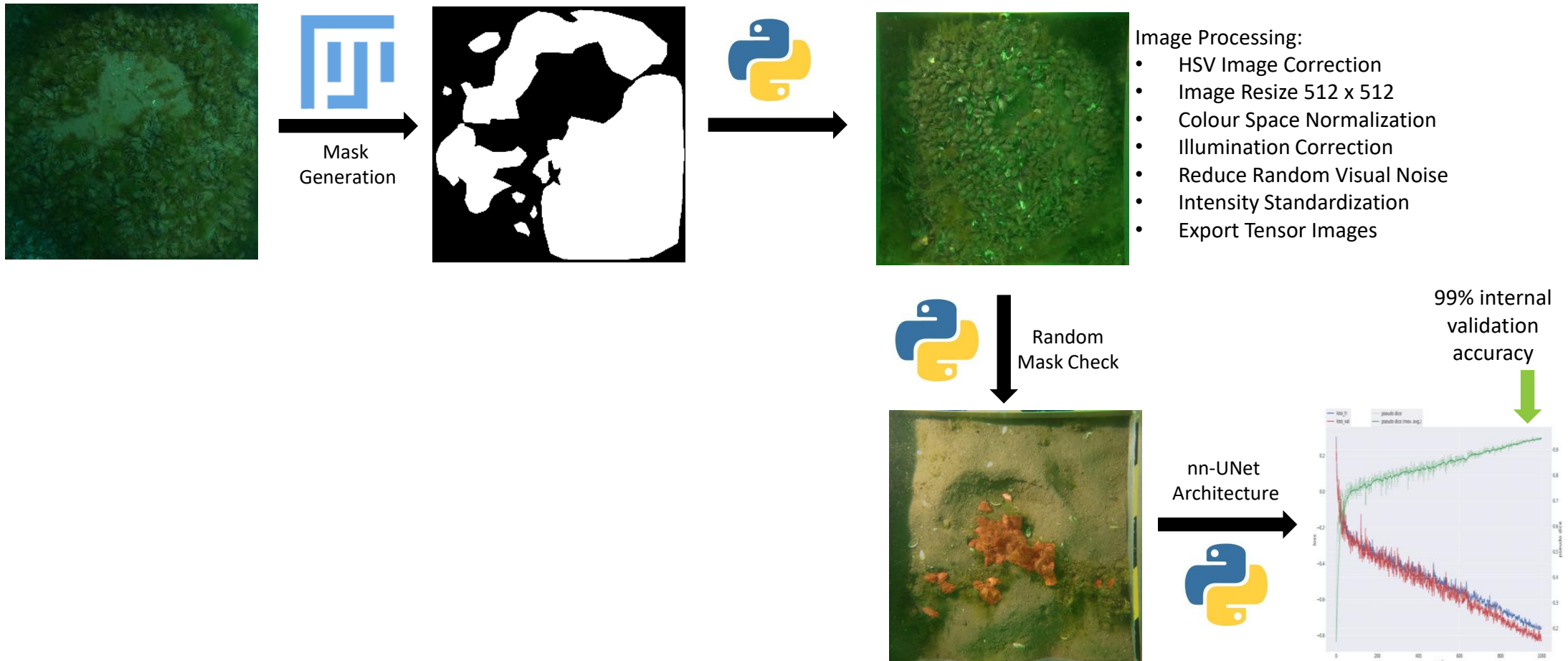
 9, 378–385 (2025) | [Cite this article](#)





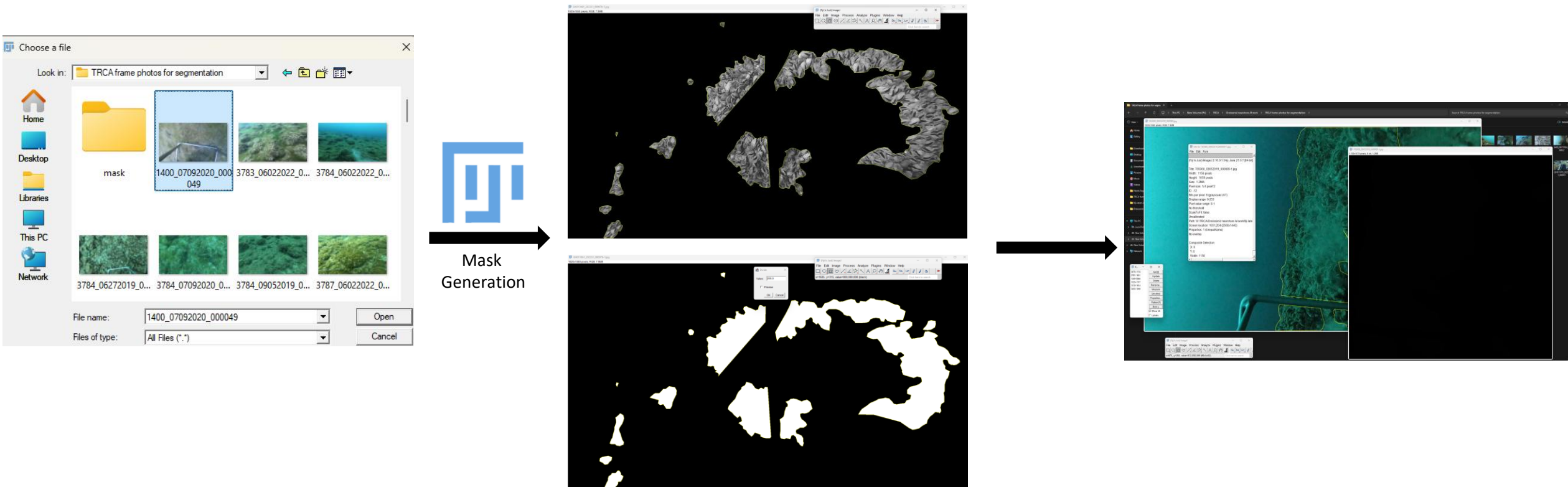
“Mussel Vision”: Dreissenid biomass from underwater video

Step 1: Model Setup and Training



“Mussel Vision”: Dreissenid biomass from underwater video

Step 2: Qualitative Video Processing for External Validation



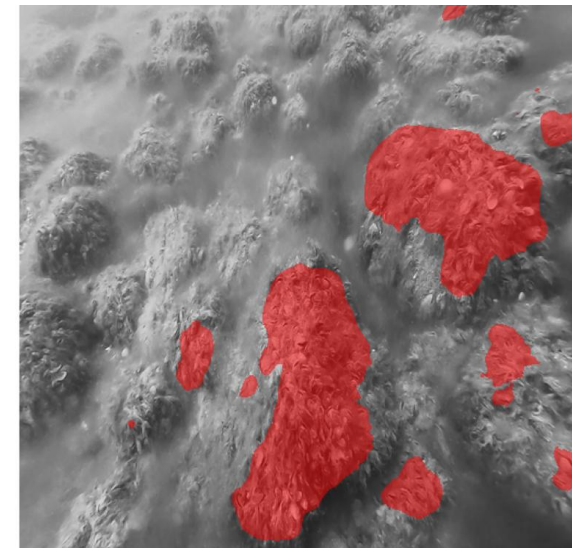
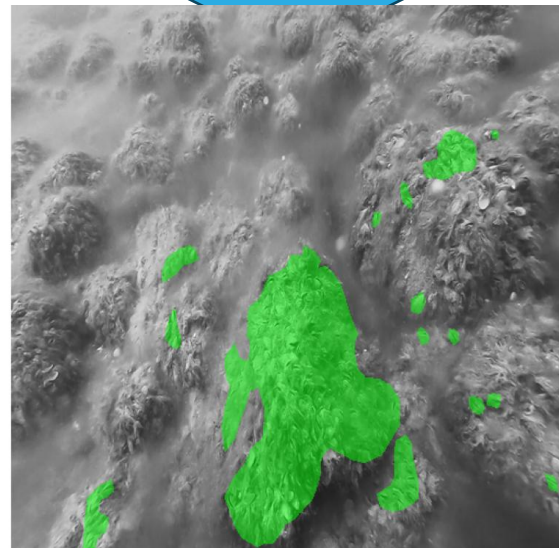
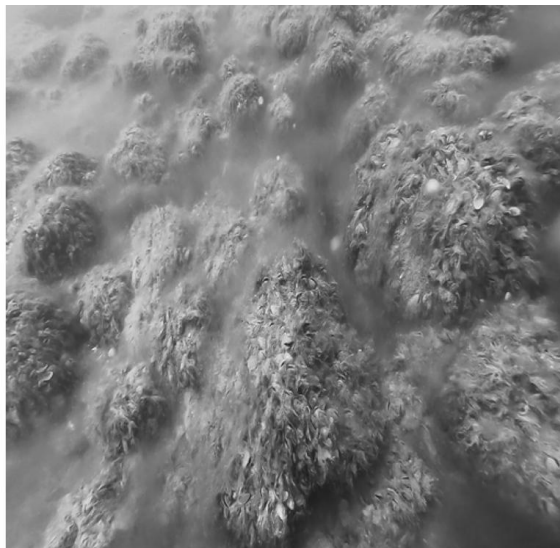
“Mussel Vision”: Dreissenid biomass from underwater video

Step 3: External Validation



Step 2: Qualitative Video Processing for External Validation

Step 1: Model Setup and Training



External Validation
84% accurate

Generalization Under Pressure: Correct Identifications Across Diverse Field Scenarios

Original



Annotated



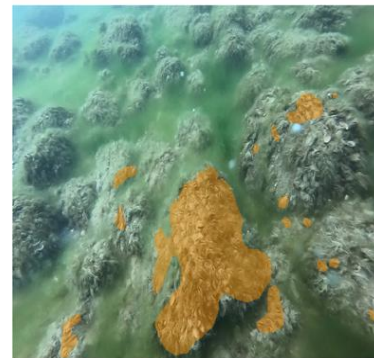
Predicted



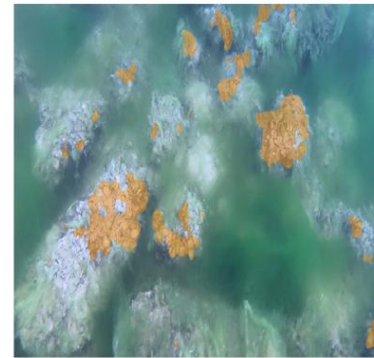
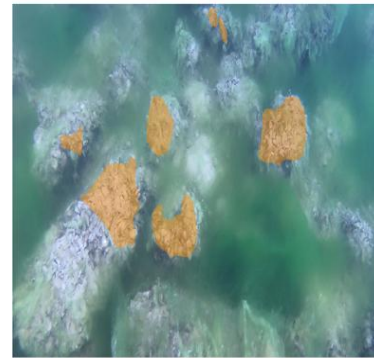
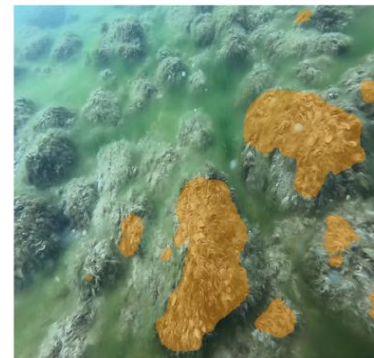
Original



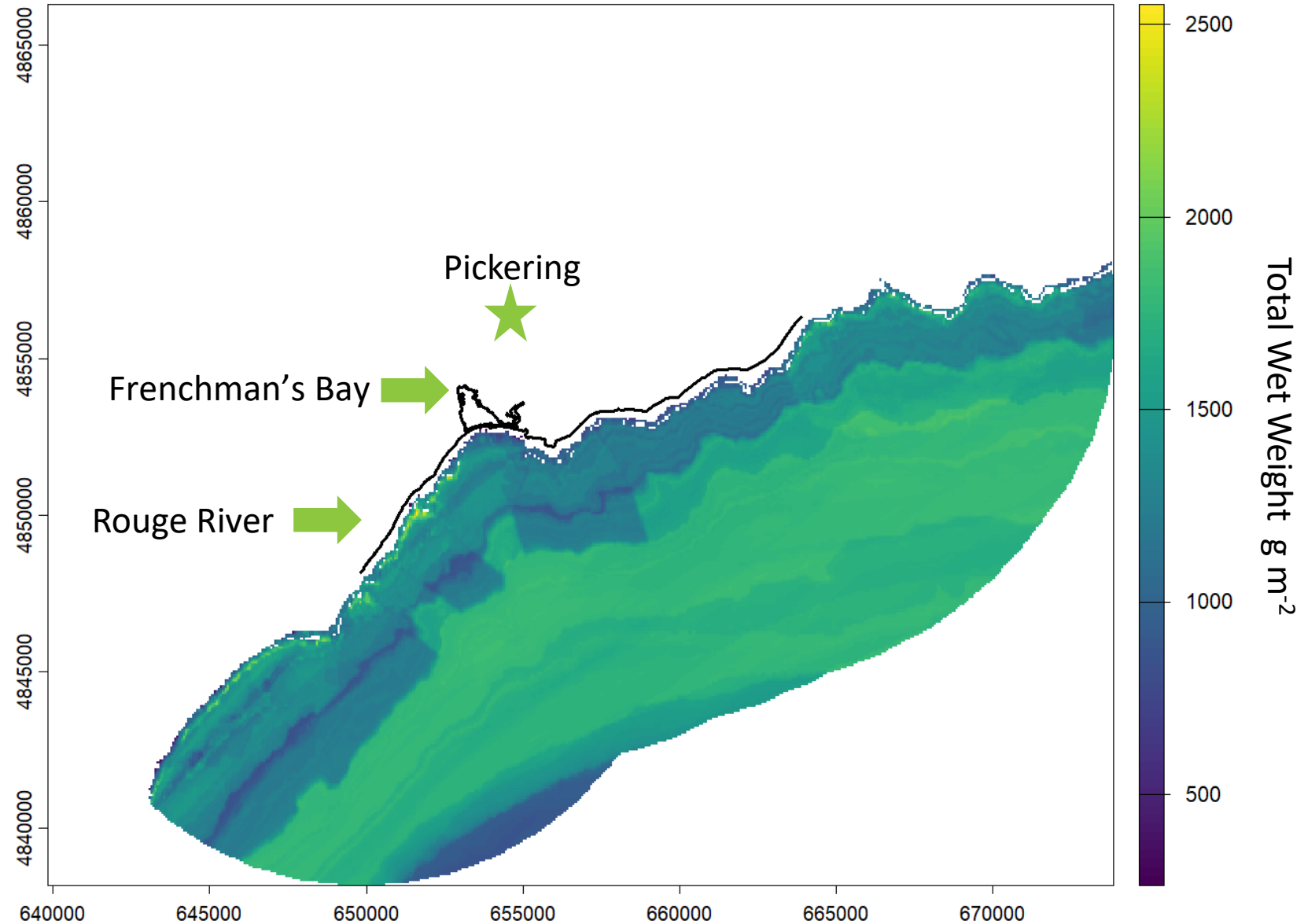
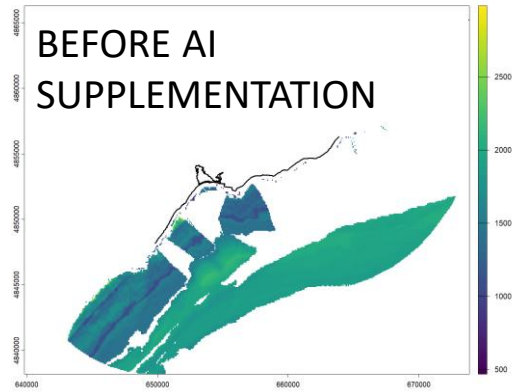
Annotated



Predicted

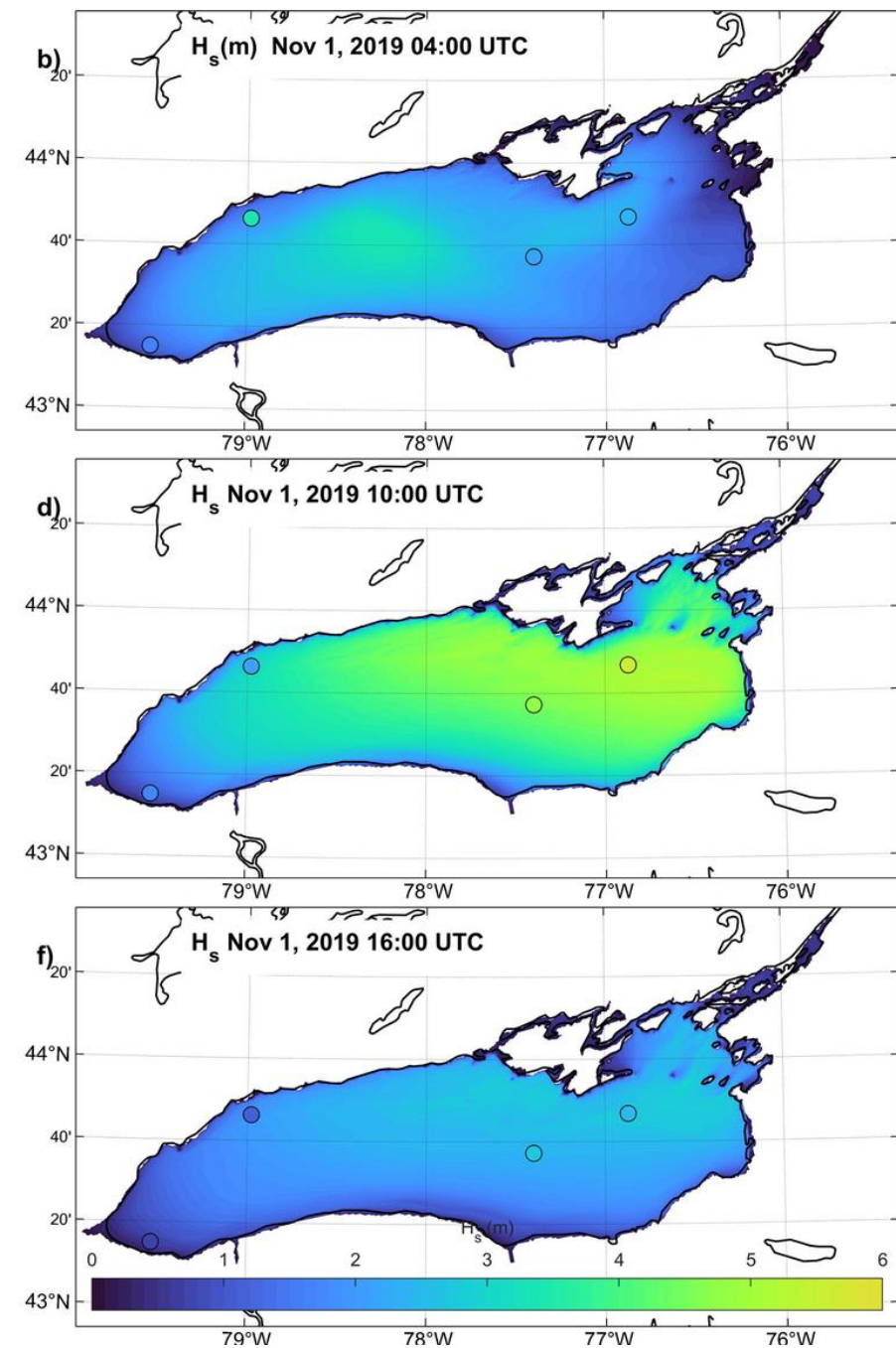
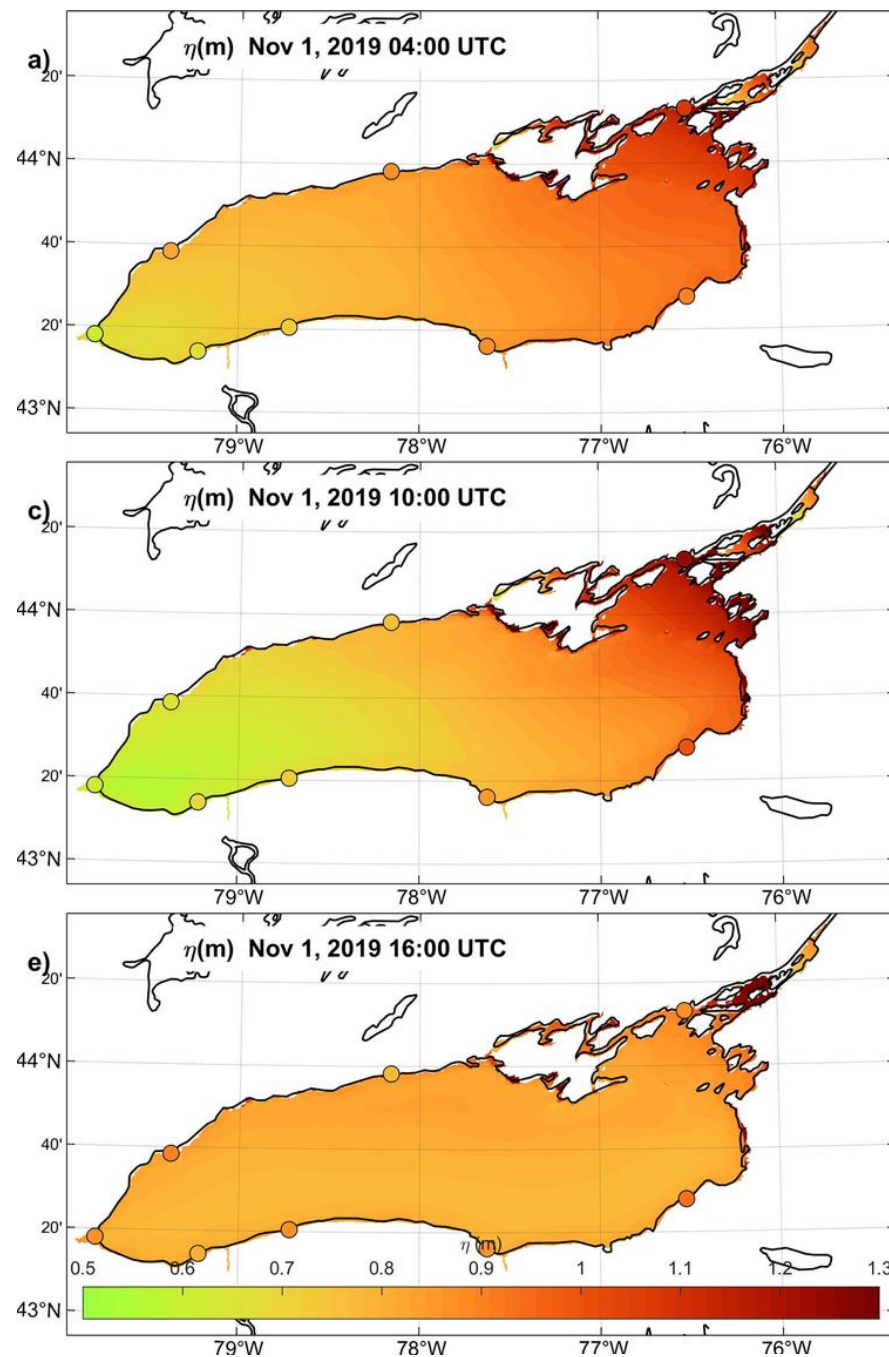


Pixel-Derived Biomass Estimates Fill Gaps in Spatial Predictions Across Durham Region

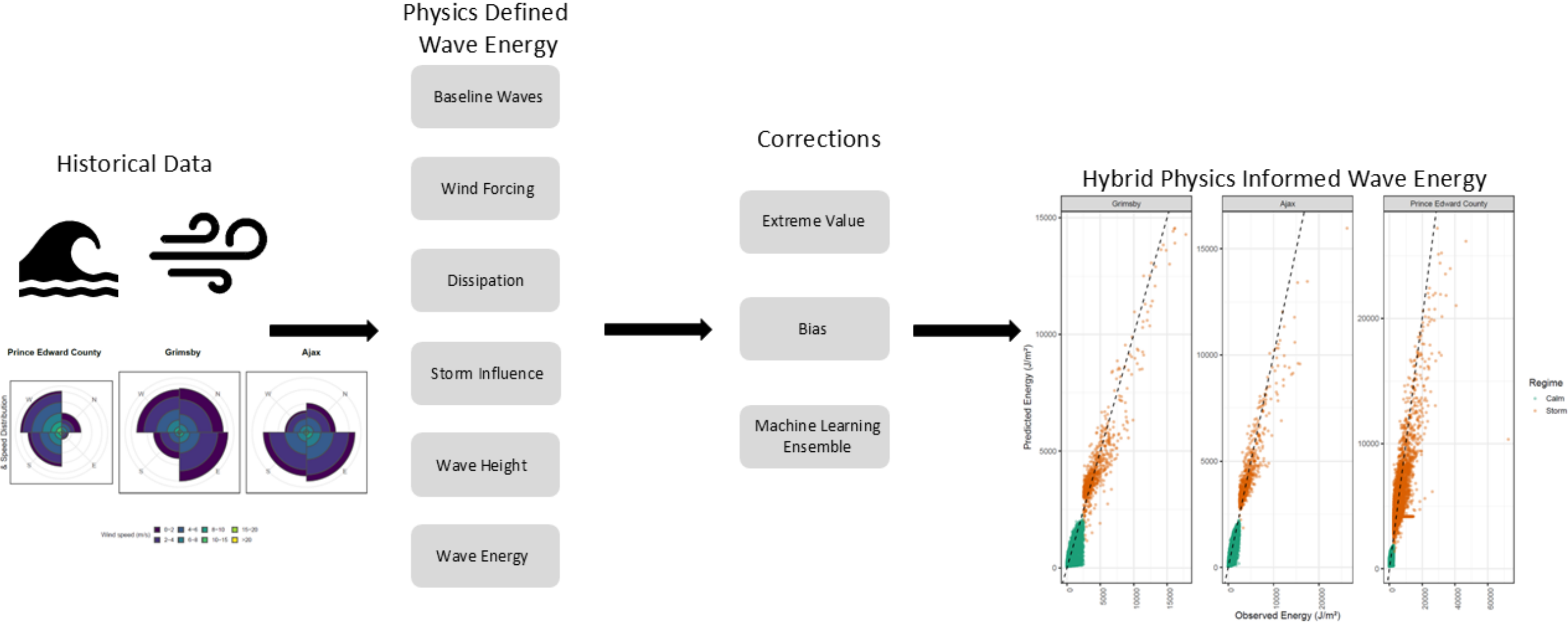


Wave model

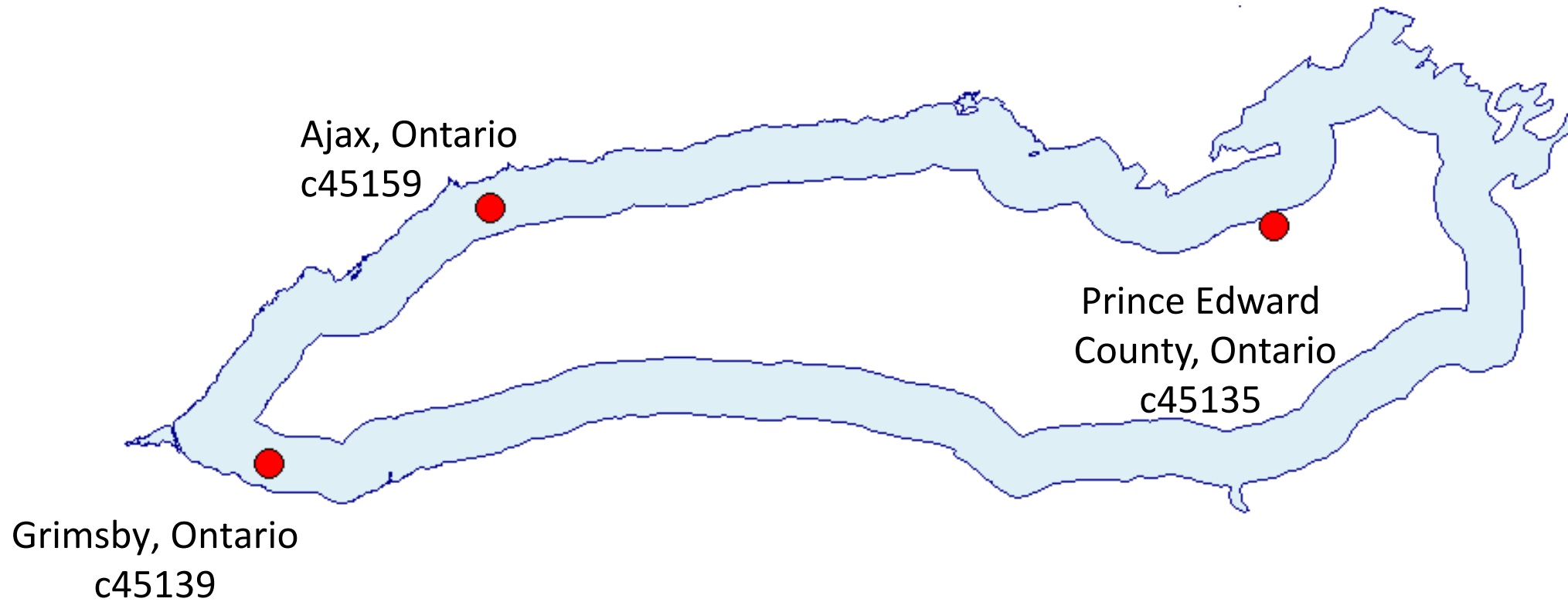
- Spectral Wave Models within Lake Ontario have extensive limitations when it comes to the nearshore



Making Better Waves: A Hybrid Model That Solves Spectral Limitations



Historical data



Physics defined wave energy and corrections

Physics Defined
Wave Energy

Baseline Waves

Wind Forcing

Dissipation

Storm Influence

Wave Height

Wave Energy

Corrections

Extreme Value

Bias

Machine Learning
Ensemble



$$H_{\text{base}} = 0.08 + 0.025 \ln \left[1 + \left(\frac{U}{U_0} \right)^2 \right]$$

$$G_L(U) = U^2, \quad U \leq U_c,$$

$$G(U) = [1 - S(U)]U^2 + S(U)c_H U.$$

$$A_S(U) = [1 + c_s \max(U - U_{s0}, 0)^2] \left[1 + \frac{a_s}{1 + \exp \left[-\frac{U - U_a}{U_0} \right]} \right],$$

$$D(H) = \frac{1}{1 + c_D H^{1.8}},$$

$$E = \frac{1}{8} \rho g H_{\text{phys}}^2,$$

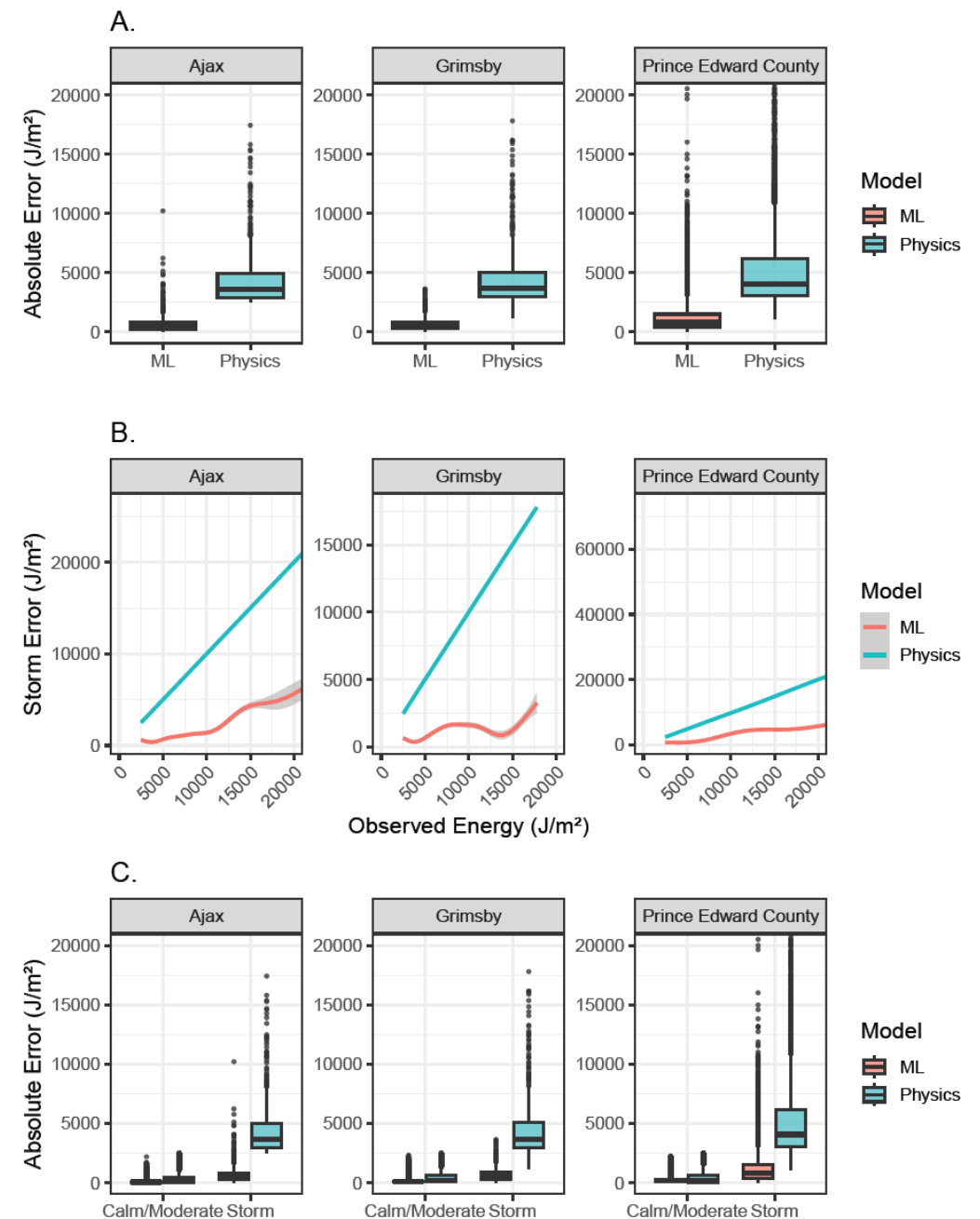
$$S(U) = \frac{1}{1 + \exp \left[-\frac{U - U_c}{U_s} \right]},$$

$$G_H(U) = c_H U,$$

$$H_{\text{phys}} = \alpha F_{\text{eff}} A_S(U) [G(U) + H + C_0] D(H),$$

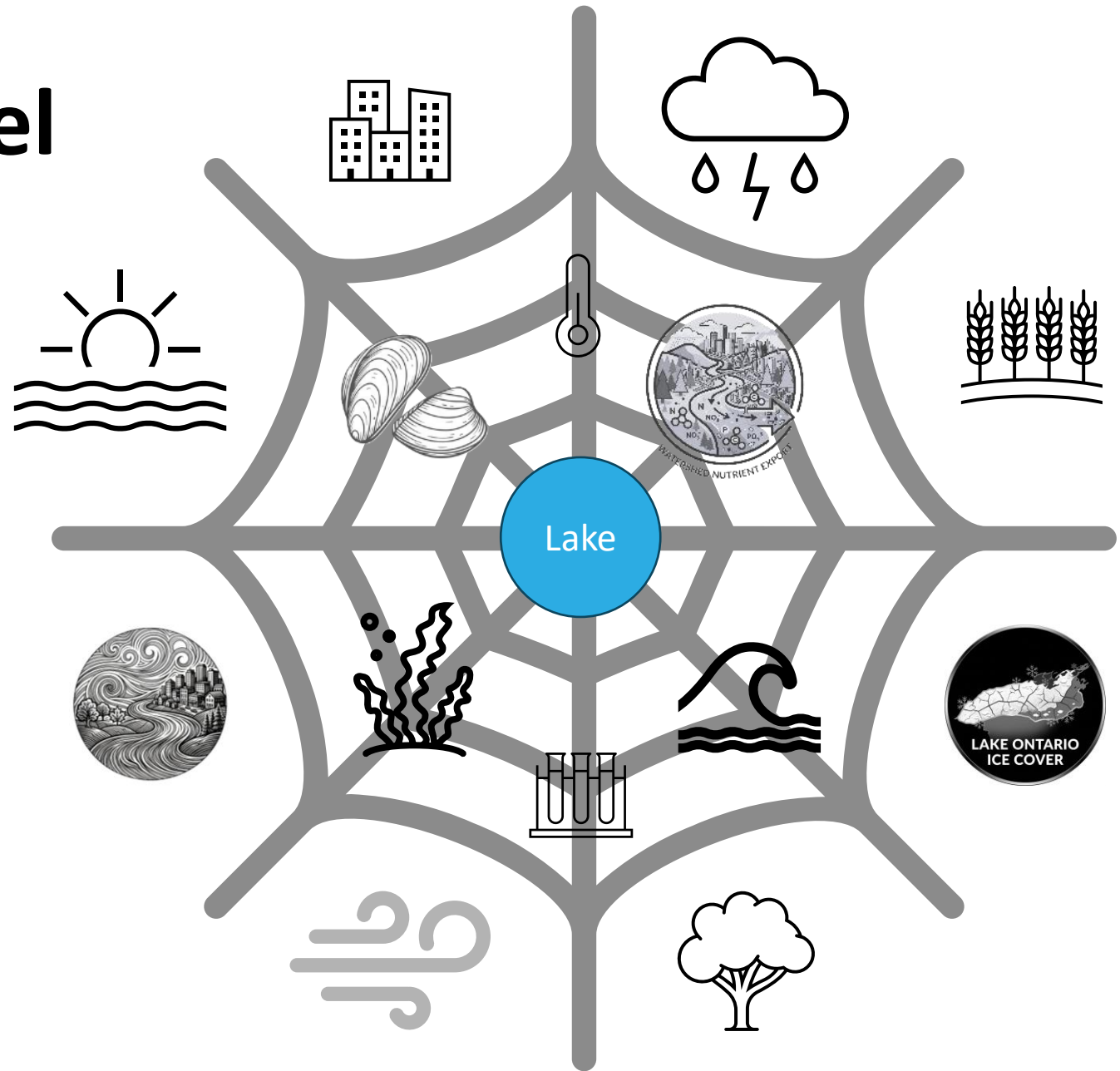
Hybrid Advantage: Lower Error

- Storm sea states are represented by the 95th percentile of extremes
- The hybrid model performs well and handles rare, high-energy events



Predictive Lake model

- Evaluate the best machine learning approach to predict nearshore water quality dynamics under future climate and development scenarios
 - Random forest
 - Support vector machine
 - Artificial neural network
 - Gaussian process regression
 - Ensemble bagged trees
 - Ensemble boosted trees
- What is the minimum amount of data required to feed machine learning methods?



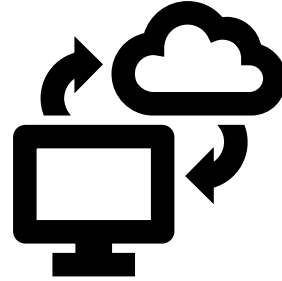
Big Data summary (current tally)



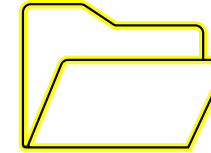
16 Organizations



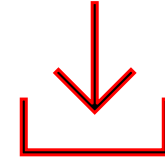
20 big brains



~3 TB



~3,400



>413,000



- 9 hours
- >1 day
- 5 days



Laptop
2.5 Super computers

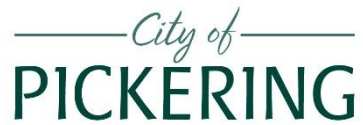


CPU: 72°C
GPU: 92°C

Integrated Watershed Planning



Williams Treaty First Nations Mississaugas of the Credit First Nation



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Upcoming GLFEI Call Recap and October 21st Symposium

RECAP:

Upcoming GLFEI Call for Applications



Project funding

- Minimum = \$100,000;
Maximum = approx. \$3 M
- Requested funding should be aligned with the scope and scale of the project
- Support for multi-year projects (minimum 2 years, up to 4 years)

Eligible applicants

- Conservation Authorities
- Indigenous organizations, governments, individuals, boards, commissions, communities, associations, and authorities
- Canadian municipal and local governments
- Canadian not-for-profit organizations
- Canadian research, academic, and educational institutions
- Canadian local organizations

Eligible expenses

- HR, including salaries and benefits
- Management and professional services
- Travel
- Material and supplies
- Printing, production and distribution costs
- Rental of equipment and capital assets
- Vehicle rental and operating costs
- Contractors, in support of program activities
- Overhead (reasonable share)
- GST/HST that is not reimbursable by CRA and PST not reimbursable by the provinces

2025 Symposium Highlights

- Held on December 10, 2025
- Nearly 80 people attended the full-day symposium
- Hosted by the Canada Water Agency

Next: Wednesday, October 21

Register here!



2026 Symposium Objectives



FOSTER LEARNING

through shared experiences and applied examples that enhance water quality, ecosystem health, and coastal resilience



PROMOTE COLLABORATION

by creating space for open dialogue on resilience principles and effective approaches to restoration and adaptation



DEMONSTRATE EFFECTIVE PARTNERSHIPS

that contribute to both scientific understanding and practical action in coastal systems



PROVIDE NETWORKING OPPORTUNITIES

with other researchers and practitioners who are working to improve Great Lakes water quality and ecosystem health

Thank you for joining today's session!

We hope to see you at the Symposium in Burlington on October 21!



Register here!

For questions, please contact Hailey.Adzija@cwa-aec.gc.ca or Sharon.Lam@trca.ca



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