



Community-based ice interventions in support of resilient winter trails in Nunatsiavut

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Lili Paradi



Nicole Gaul



Queen's northern research has a great student community!



Meagan Moroney

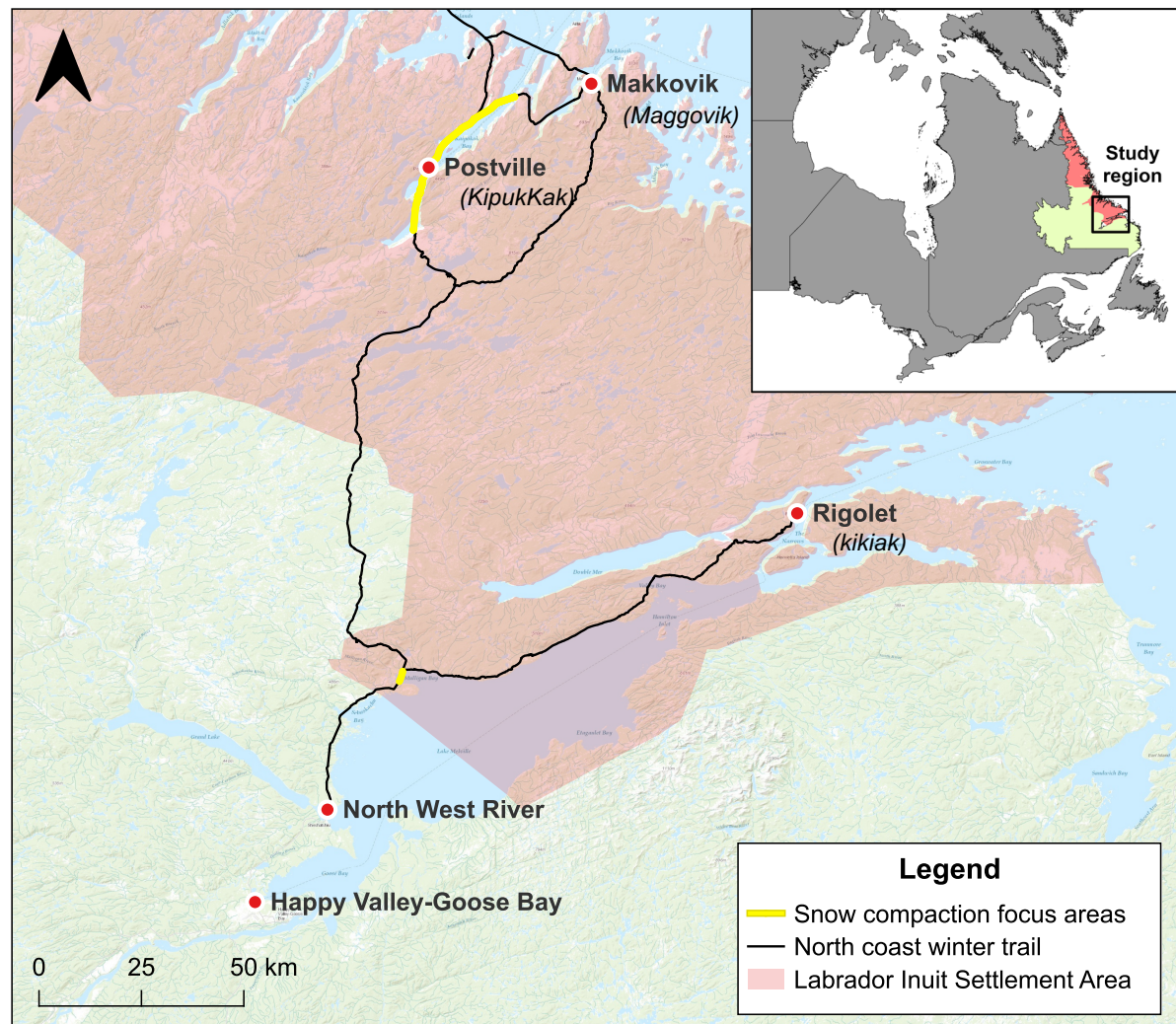


Nhu Le

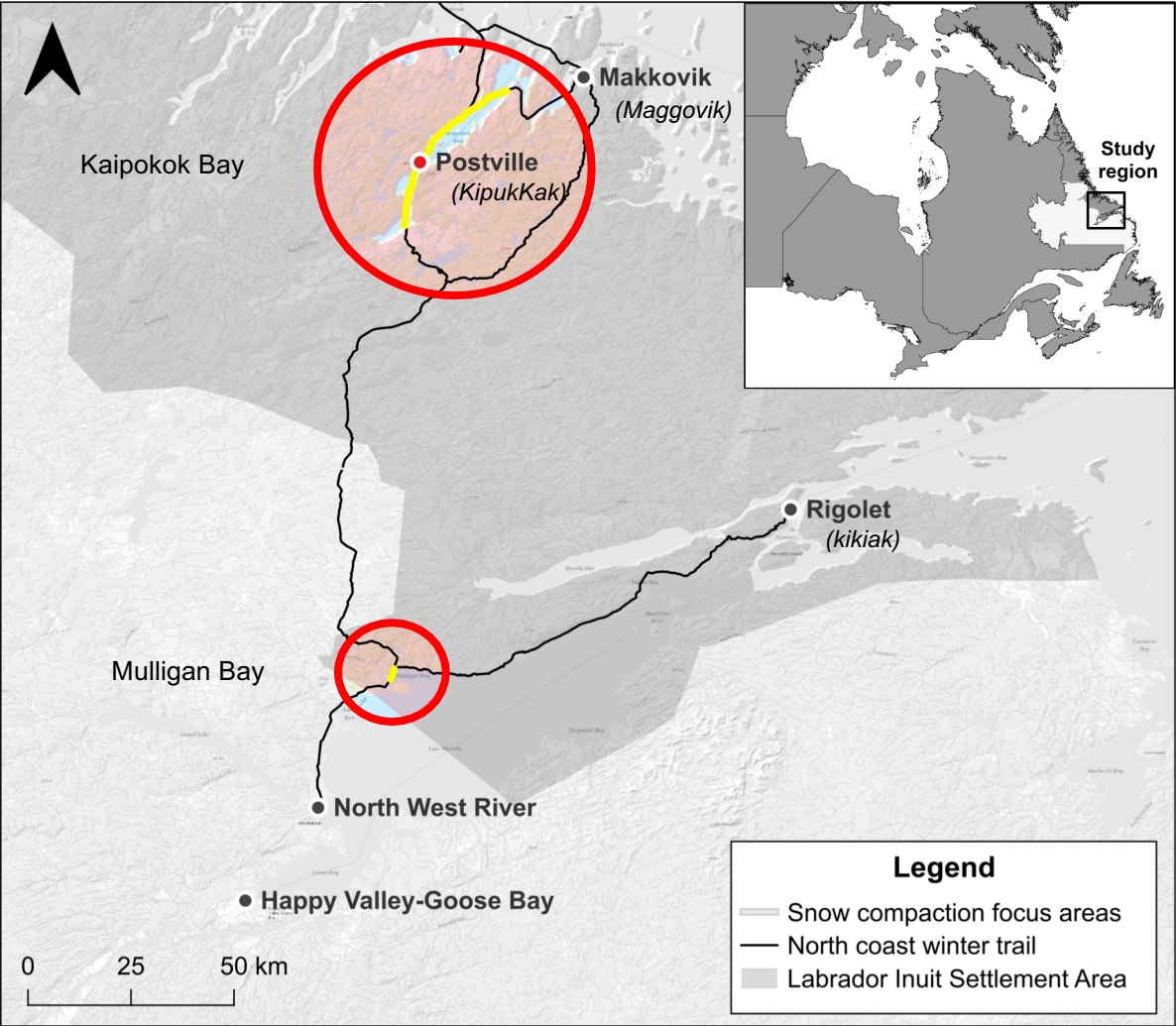


Madison Power

Nunatsiavut, Labrador, Canada

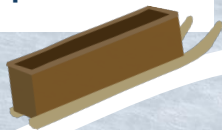


Nunatsiavut, Labrador, Canada





Winter trails are essential to accessing cultural keystone places, activities, and species



Call from Nunatsiavummiut for robust winter trails

Climate change is reducing trail access

Research rationale

- Ice crossings are particularly vulnerable to extreme years
- Increasing challenges with trail maintenance
- What can reliable winter trails look like?



North West River's mechanical groomer broke through the ice in 2018 (Saltwire, 2018).

Consistent ice and snow cover

Strong ice cover

Adaptability to changing conditions

Predictability

457
Operators
trained
since 2018



48,404
kilometres
monitored
since 2018



Dashboard

159
Smart
QAMUTIK
ice surveys
this ice season



991
Smart
QAMUTIK
ice surveys
to date

84
Smart
BUOYS
produced
since 2019



179
weekly
ice travel
safety
maps
produced
since 2022

Approximately

4000

hours of
employment
per year



Approximately

45,415

hours of
employment
in total

959
Inuktitut
ice terms
documented
by Elders + Youth
since 2019



December
2025



457

Operators



48,404

kilometres



The Mittimatalik Siku Asijjipallianinga (Sea Ice Climate Atlas): How Inuit Knowledge, Earth Observations, and Sea Ice Charts Can Fill IPCC Climate Knowledge Gaps

Katherine Wilson^{1*}, *Andrew Arreak*², *Sikumiut Committee*², *Trevor Bell*¹ and *Gita Ljubicic*³

¹ Department of Geography, Memorial University of Newfoundland, St. John's, NL, Canada, ² SmartICE Sea Ice Monitoring & Information Inc., Mittimatalik, NU, Canada, ³ School of Earth, Environment and Society, McMaster University, Hamilton, ON, Canada

QAMUTIK
ice surveys
to date

ice terms
documented
by Elders + Youth since 2019

December
2025



457

Operators



48,404

kilometres



The Mittimatalik Siku Asijjipallianinga (Sea Ice Climate Atlas): How Inuit

ᐅSila Qanuippa? (How's the Weather?): Integrating Inuit Qaujimajatuqangit and Environmental Forecasting Products to Support Travel Safety around Pond Inlet, Nunavut, in a Changing Climate

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^a Pond Inlet, Nunavut, Canada

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Katherine Wilson^{1*}, Andrew Arreak², Sikumiut Committee², Trevor Bell¹ and Gita Ljubicic³

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The Mittimatalik Siku Asijjipallianinga (See Ice Climate Atlas): How Inuit

Changing access to ice, land and water in Arctic communities

J. D. Ford ^{1,2*}, D. Clark², T. Pearce³, L. Berrang-Ford¹, L. Copland⁴, J. Dawson⁴, M. New ^{5,6} and
S. L Harper ⁷

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2025

457

Operators



48,404

kilometres



The Mittimatalik Siku Asijjipallianinga

(See Ice Climate Atlas): How Inuit

Changing access to ice, land and water in

Projected decrease in trail access in the Arctic

J. D. Ford ¹✉, D. G. Clark ², L. Copland ³, T. Pearce⁴, IHACC Research Team* & S. L. Harper ⁵

S. L. Harper ⁷

¹ Department of Geography, Memorial University of Newfoundland, St. John's, NL, Canada, ² SmartICE Sea Ice Monitoring & Information Inc., Mittimatalik, NU, Canada, ³ School of Earth, Environment and Society, McMaster University, Hamilton, ON, Canada

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The Mittimatalik Siku Asijjipallianinga (See Ice Climate Atlas): How Inuit

Initiatives looking at trail resilience?

S.LHarper 

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December
2025

Thick/fluffy snow insulates the ice from cold air.

Compaction of snow can increase its density.

Denser snow allows more cold air to pass through it.

Colder air reaching the ice leads to greater freezing.





Snowmobile-towed groomer drag
270 lbs



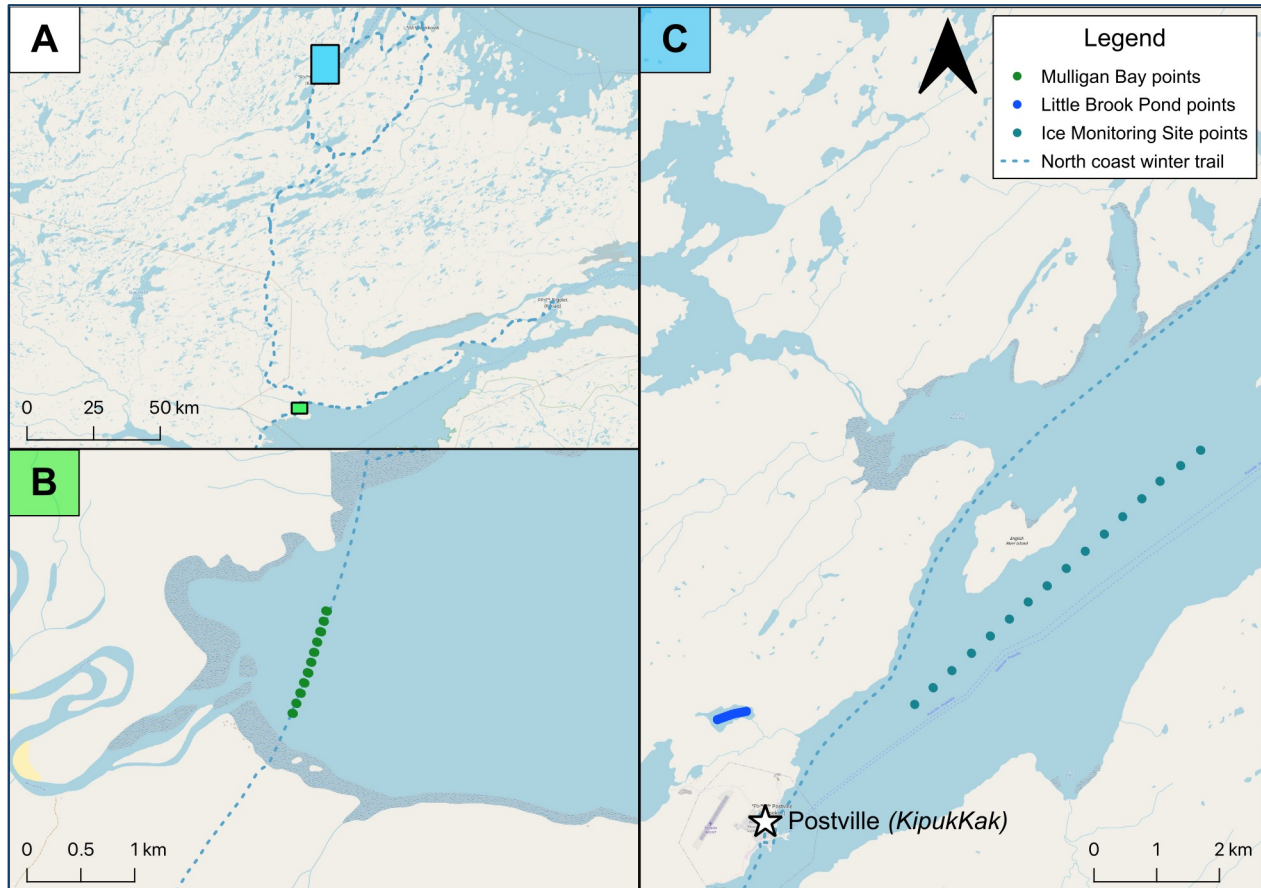
Conventional, mechanical groomer
~20,000 lbs fully-loaded

An aerial photograph of a person in a red jacket riding a snowmobile across a vast, textured snowfield. The snow has a wavy, rippled appearance. The snowmobile is moving from the upper left towards the lower right, leaving a trail behind it. The scene is brightly lit, casting shadows.

So...

Can snow compaction techniques be used to enhance the resilience of winter trail ice crossings in Nunatsiavut, Labrador?

Snow compaction: study sites



B Mulligan Bay

- 1 km, n=11 sampling points
- Controls 10-15 m off
- High-use trail crossing
- Mechanical groomer
 - n=4 passes, Jan 29 to Mar 15



C

Little Brook Pond

- 500 m, n=11 sampling points
- Controls 5 m off
- Small, freshwater pond
- Small groomer drag
 - n=16 passes, Feb 3 to Mar 8



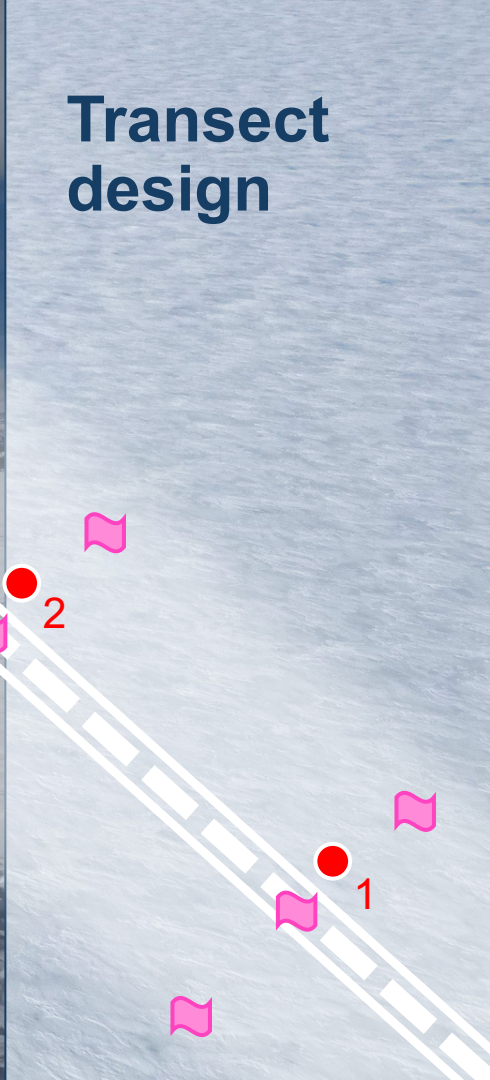
C Ice Monitoring Site

- 6 km, n=16 sampling points
- Controls 5 m off
- Brackish coastal estuary
- Small groomer drag
 - n=18 passes, Feb 3 to Mar 8





Transect design





Snow and surficial ice layers were identified and measured using snow pits. Snow density samples were collected at certain snow pits.



Ice thickness measurements were taken at the base of snow pits using a drill and weighted tape measure.

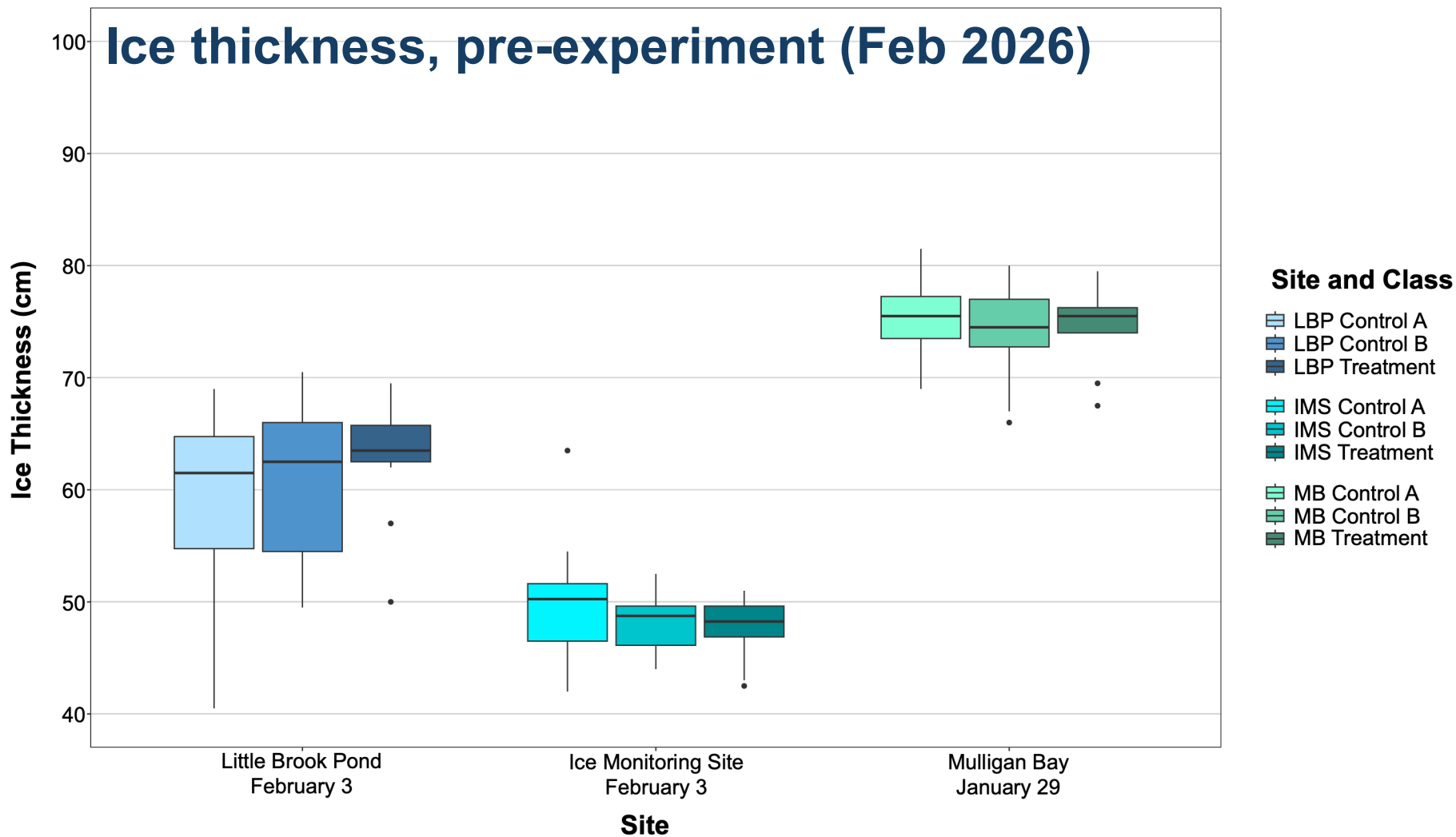


Point-based snow and ice measurements along the GPR transects were geolocated using a DGPS.

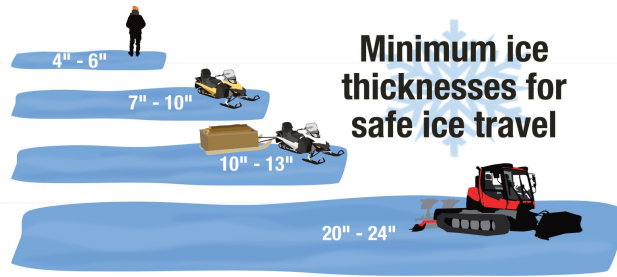


450 MHz ground penetrating radar (GPR) surveys were conducted along and across transects.

Ice thickness, pre-experiment (Feb 2026)



Ice thickness, pre-experiment (Feb 2026)



Source(s): Infrastructure Health & Safety Association. (2014). Best Practices for Building and Working Safely on Ice Covers in Ontario. Government of Alberta. (2024). Guide for Building and Working Safely on Ice Covers in Alberta. Postville Inuit Community Government. (2025). Personal Communication. Town of North West River. (2025). Personal Communication.

Ice Thickness (cm)

100
90
80
70
60
50
40

Little Brook Pond
February 3

Ice Monitoring Site
February 3

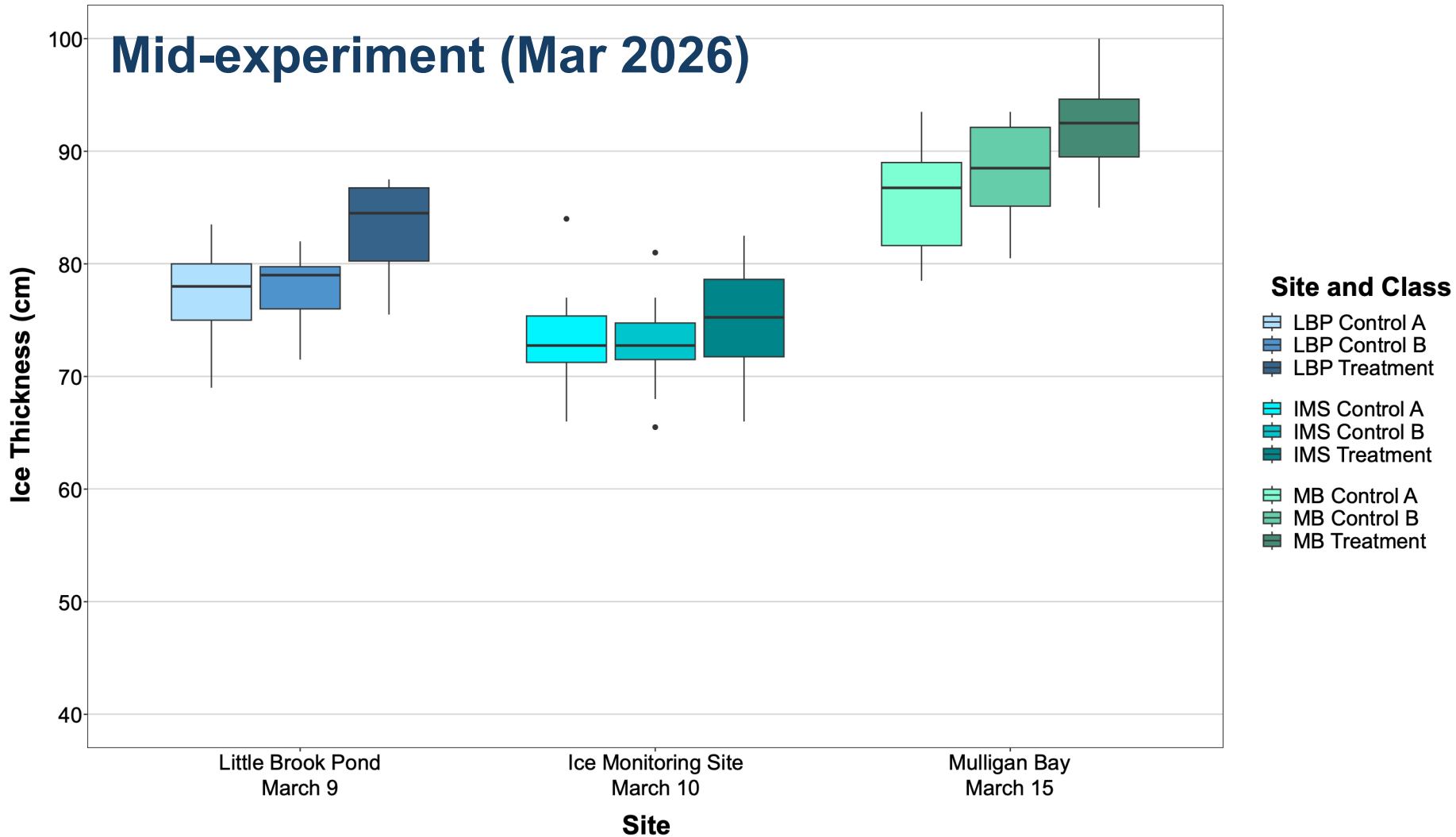
Mulligan Bay
January 29

Site

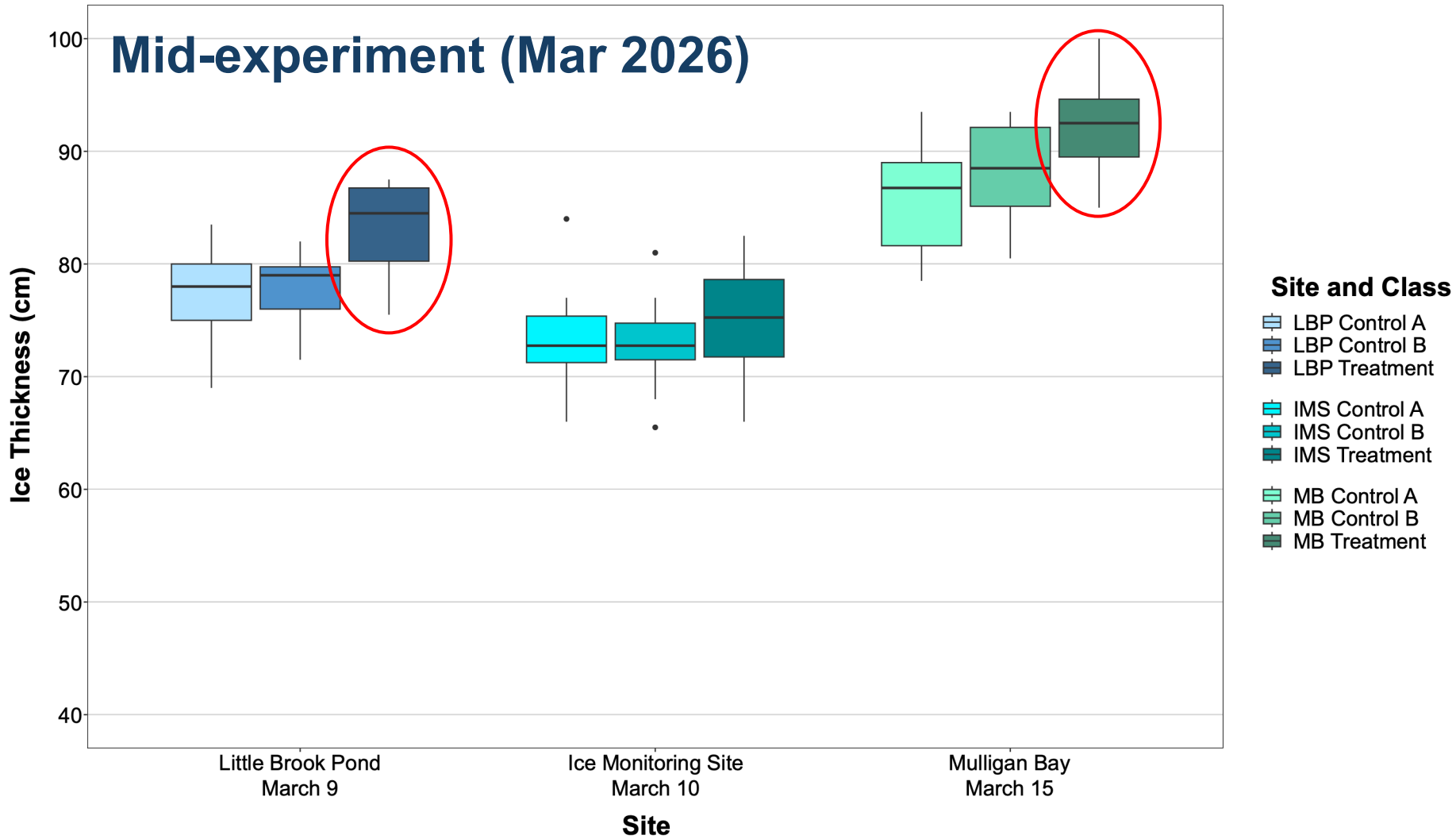
Site and Class

- LBP Control A
- LBP Control B
- LBP Treatment
- IMS Control A
- IMS Control B
- IMS Treatment
- MB Control A
- MB Control B
- MB Treatment

Mid-experiment (Mar 2026)

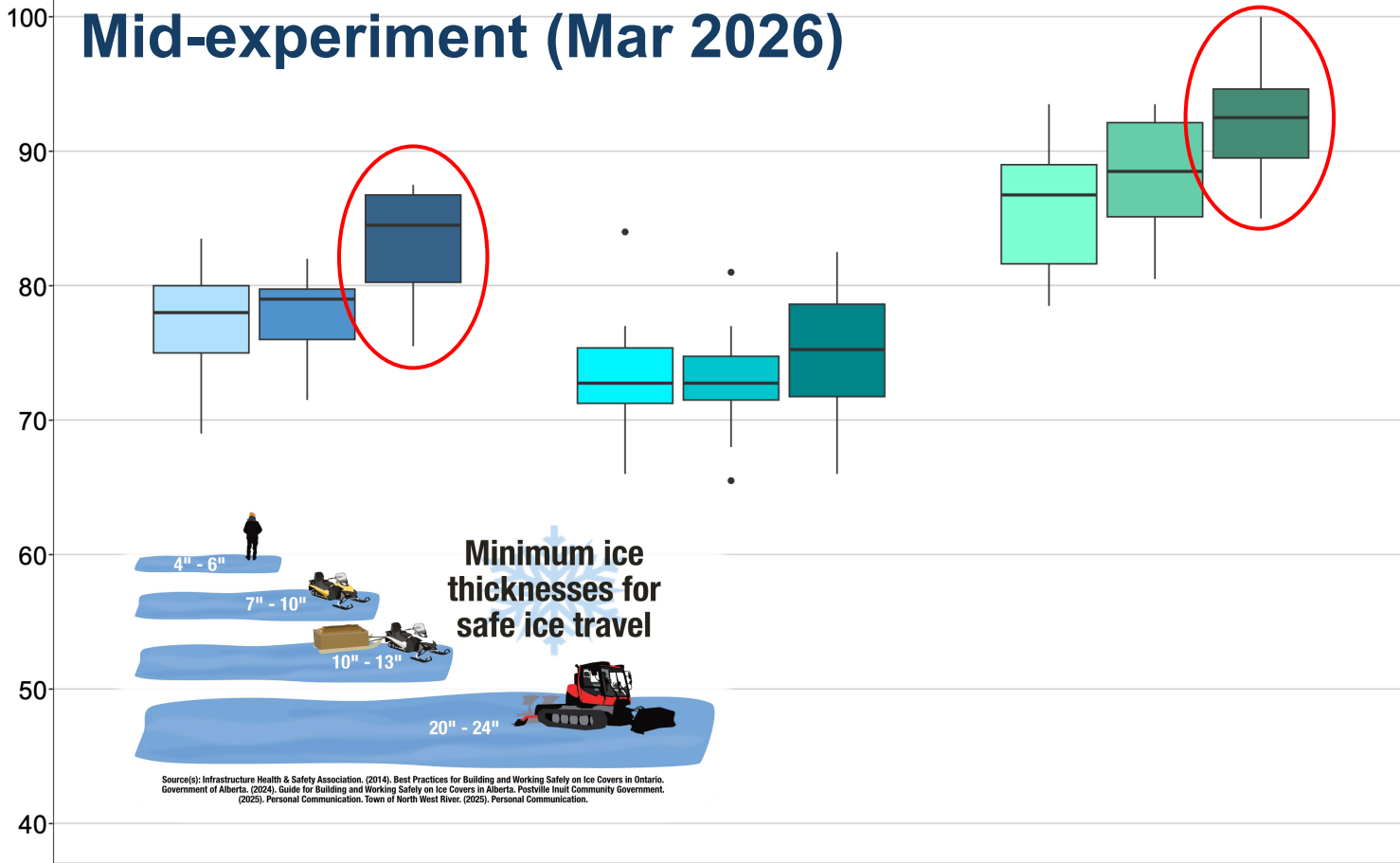


Mid-experiment (Mar 2026)



Mid-experiment (Mar 2026)

Ice Thickness (cm)



Site and Class

- LBP Control A
- LBP Control B
- LBP Treatment
- IMS Control A
- IMS Control B
- IMS Treatment
- MB Control A
- MB Control B
- MB Treatment



Source(s): Infrastructure Health & Safety Association. (2014). Best Practices for Building and Working Safely on Ice Covers in Ontario. Government of Alberta. (2024). Guide for Building and Working Safely on Ice Covers in Alberta. Postville Inuit Community Government. (2025). Personal Communication. Town of North West River. (2025). Personal Communication.

Little Brook Pond
March 9

Ice Monitoring Site
March 10

Mulligan Bay
March 15

Site

Preliminary results

1 treatment vs 2 controls

- Significantly higher mean ice thickness at **LBP** and **MB**
- Significantly higher snow density at **all*** sites (***IMS**)

No significant

- Difference in ice thickness homogeneity
- Difference in snow depth mean* or homogeneity (***LBP**)



Next steps

April 2026

- Timing close to onset of spring melt
- Host event(s) to discuss W26 with *KipukKak* (Postville) residents

Additional insights

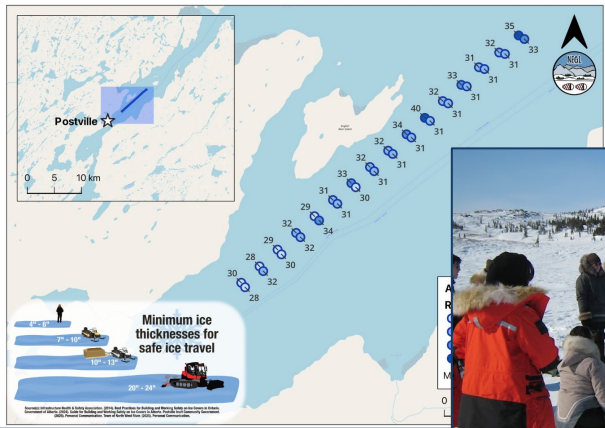
- GPR, ice core?, melt camera?

Workshops in S26, inform actionable findings to return to community

... and my thesis

Hi all,
Here is a map of ice thicknesses we measured on Kaipokok Bay this past Wednesday and Thursday. The lines pass near a lot of seal holes to the southeast. **Please use this map at your own discretion** - recent warm temperatures may have changed conditions. Overall, average ice thickness increased by about 4" from March 21st, and it gets a little bit thicker away from town.

If you have any questions about these measurements or would like to chat about ice travel, you can mes... **See more**



Winter in August BINGO NIGHT

Hosted by Erin Rendell and Lili Paradi, members of the winter trails research team.

- 📍 PICG Recreation Hall
- 🕒 Friday, August 8, 5:30PM
- 🎁 BBQ supper
Jackpot is a \$50 Mary Brown's gift card

Come for fun, food, and chats about winter trails!

Relationships along the way



WINTER TRAILS WORKSHOP

In August?? Yes!

ABOUT THIS PROJECT:

- How can we strengthen winter trail ice crossings?
- Comparing types of trail groomers
- Measuring ice thickness with different methods

WE WANT YOUR FEEDBACK!

Join us at...

- 📍 PICG Recreation Hall
- 🕒 Wednesday, August 6, 3-6PM
Thursday, August 7, 9-12AM or 3-6PM

... whichever time works for you!

Come share your opinions, thoughts, and questions about



Thank you

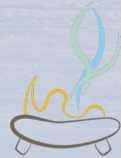


Crown-Indigenous Relations
and Northern Affairs Canada

Relations Couronne-Autochtones
et Affaires du Nord Canada



NSERC
CRSNG



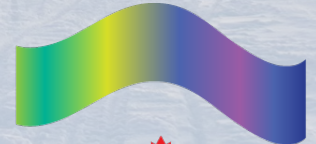
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kavamanga Government



Queen's
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RESEARCH CHAIRS
CHAIRES DE
RECHERCHE DU
CANADA



NSTP  **PFSN**

Northern Scientific
Training Program

Programme de formation
scientifique dans le Nord

Postville Inuit Community Government, Makkovik Inuit Community Government, Town of North West River



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