

## Abstract

Permafrost along the southern edge of Hudson Bay is classified as continuous, i.e. underlying >90% of the area. This extent of permafrost at such low latitudes is an anomaly, and results from the cooling effect of sea ice on the Bay. Due to rapid changes in sea ice, the continuous permafrost south of Hudson Bay is particularly vulnerable to change. This study examined vegetation-permafrost relations near the community of Fort Severn, ON. Near-surface permafrost occurred at 60% of the forested sites, 50% of the disturbed sites, and none of the shrubby sites. These results suggest that, if Fort Severn is representative of the area, the continuous permafrost zone of the Ontario Far North may have transitioned to discontinuous permafrost.

# The Distribution of Permafrost Near Fort Severn, Ontario.

*Candice Rémillard-Scott, Pascale Roy-Léveillé, David Pearson, Chantal Sarrazin-Delay*

Living With Lakes Center, School of the Environment, Fort Severn First Nation

## Introduction

Residents of Fort Severn, ON, report dramatic changes in local permafrost conditions. This research assessed permafrost distribution in the area by examining relation between vegetation and the occurrence of near-surface permafrost.

### Objectives:

- produce a map of land cover using satellite imagery and field data;
- investigate links between vegetation and near-surface permafrost presence;
- assess whether permafrost near Fort Severn is still continuous.



## Study Area and Site Selection

The area include in the analysis of satellite imagery extended to a maximum of 5 km from the center of the community of Fort Severn. Study sites were visited in the field to assess the vegetation cover characteristics and the presence or absence of permafrost, were also located within this 5 km radius, and selected on the basis of vegetation structure which was based on the remotely sensed imagery.

## Methods

### Spatial Analysis and GIS Landcover Classification

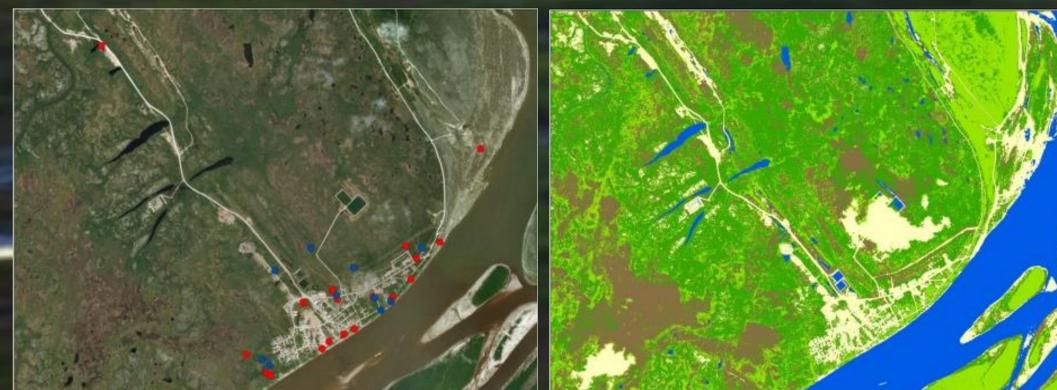
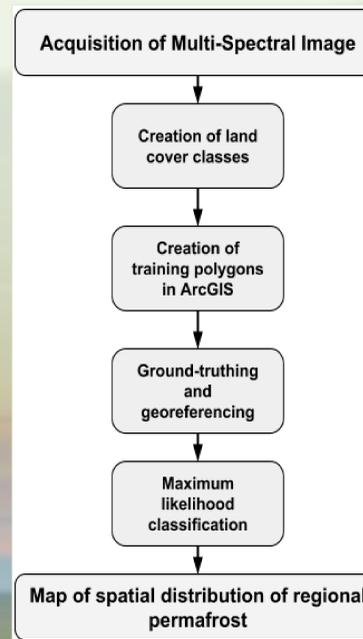
- Training polygons were created using a combination of satellite imagery and ground-truthing and then classified using maximum likelihood classification in ArcGIS.
- The study area was divided in landcover classes (open water, saturated ground, forested, shrubby and disturbed areas) to create a thematic vegetation map.

### Vegetation survey in the field

- Vegetation surveys were conducted in the field at forested, shrubby and disturbed study sites. A quadrant-method was used to assess composition of the herbaceous layer, shrub layer and tree canopy.

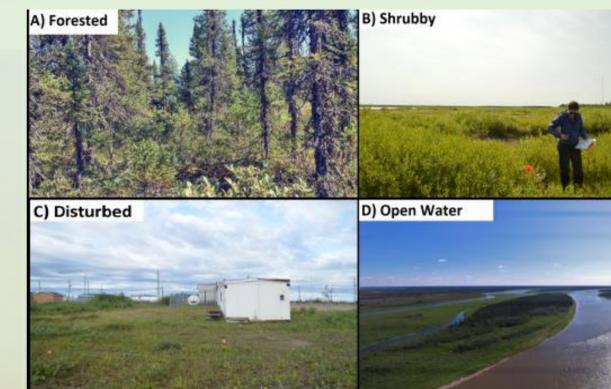
### Probing and Substrate Characterization

- Probing for frozen ground was conducted using a soil probe with a slide hammer to a maximum depth of 3 m, as previous studies indicate that permafrost is within 60 cm of the ground surface in this region.
- Substrate/permafrost conditions at each of the 30 sites surveyed was recorded.



## Results

- Maximum likelihood classification yielded accurate results for forested, shrubby, and open-water sites. It was least accurate for disturbed sites (9% of area), likely due to rapid changes in conditions.
- There is a strong relation between vegetation type and permafrost occurrence within this region, likely due to the importance of ecosystem-protected permafrost in an area affected by rapid environmental change.
- It is very likely that near-surface permafrost no longer underlies 90% of the area located within and around the community of Fort Severn, ON.
- If degrading permafrost buried between 3 m of sediment subsists in the area, it is likely rapidly degrading.



Landcover Classification	Sites Visited	Sites with Permafrost	Mean Organic Layer Thickness (cm)	Mean Depth to Permafrost (cm)	Dominant Mineral Sediment Texture
Forested	10	6	10 – 60	20 - 100	Organics, clay
Shrubby	10	0	10 – 20	No permafrost	Coarse to medium sand
Disturbed	10	4	10 – 20	110 – 200	Coarse to medium sand, some organics

## Conclusions

Satellite imagery, in conjunction with ground-truthing and georeferencing, allowed for successful mapping of vegetation cover near Fort Severn, ON. Because there was a strong relation between vegetation type and permafrost occurrence in this region, we were able to conclude that near-surface permafrost no longer underlies 90% the area located within and around the community of Fort Severn, ON. If permafrost distribution at Fort Severn is representative of the region, these results suggest that the continuous permafrost zone of the Ontario Far North may have transitioned to discontinuous permafrost.

## Acknowledgements

Funding from the Ontario Ministry of Indigenous Relations and Reconciliation  
 Members of Fort Severn First Nation (Sinclair Childforever, Dennis Kakekaspan, Rusty Miles)  
 Field Assistance from Tannis Croteau, Jake Porter and Andrea Hanson