



# Permafrost in the NWT

*- Data - Info Management – Analysis - Knowledge - Dissemination – Planning – Adaptation*

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# Permafrost in the NWT

Permafrost is ground (rock or soil) that stays frozen ( $< 0^{\circ}\text{C}$ ) for 2 or more years

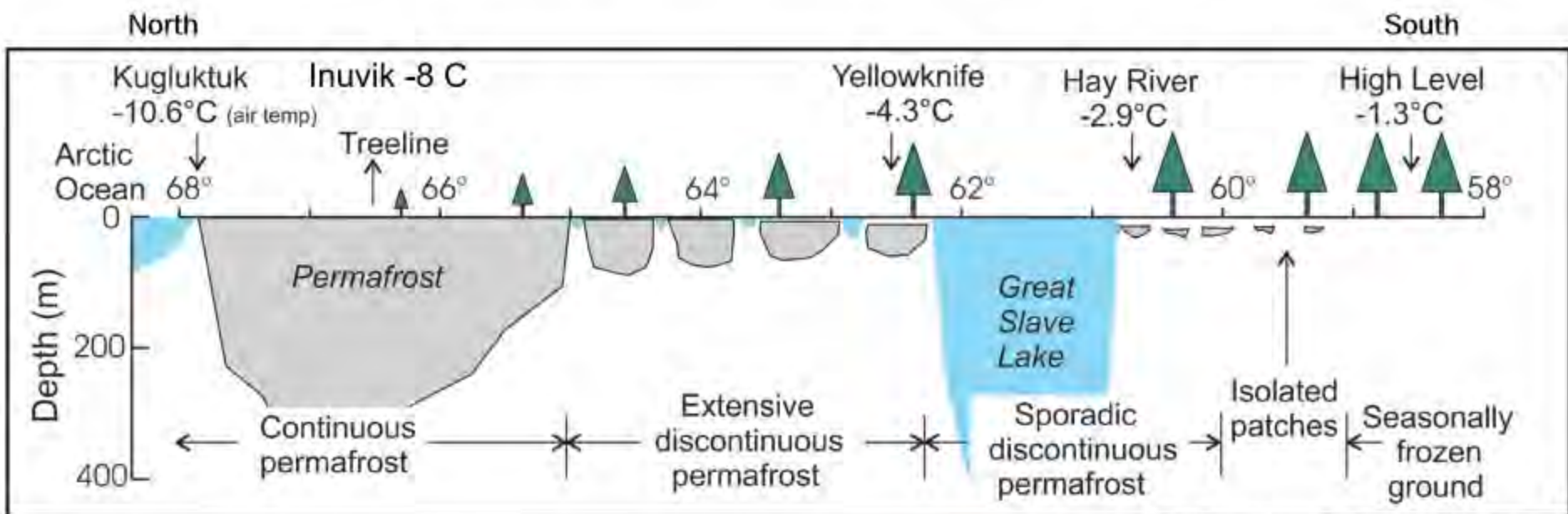
Permafrost provides a foundation for ecosystems, northern communities and infrastructure

Permafrost thaw is a primary cause of climate-driven landscape change in the north



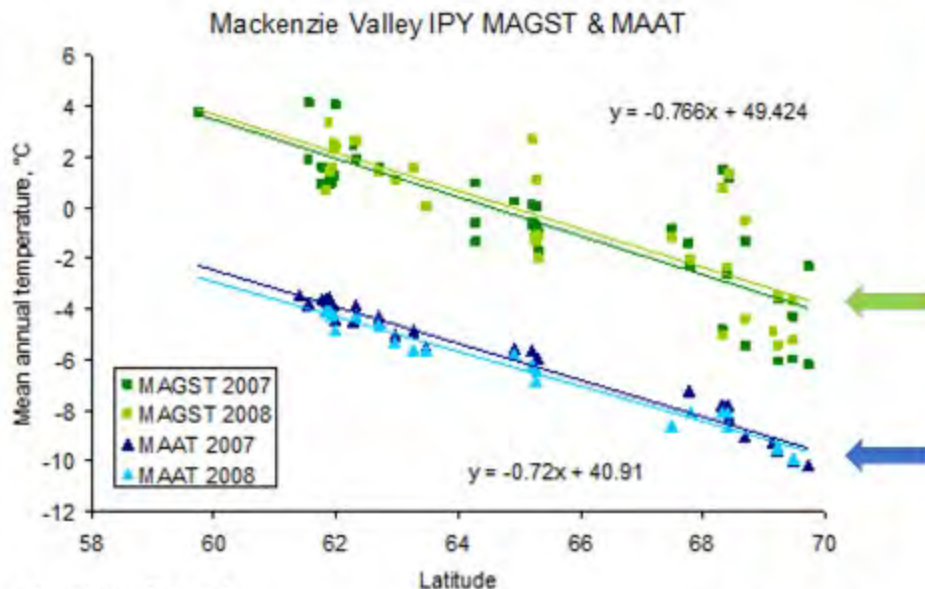
# Permafrost thickness

- Permafrost is a produce of past cold climate



Modified from Wolfe and Kokelj, 2019

# Air and ground temperatures



Northern Alberta /  
Nord de l'Alberta

Beaufort Sea /  
Mer de Beaufort

# The world of underground ice



# Melting ground ice in permafrost samples

Medium Ice Content

High Ice Content

Low Ice Content





# Characterizing permafrost

- Temperature
- Distribution
- Thickness
- Material properties
- Ice content





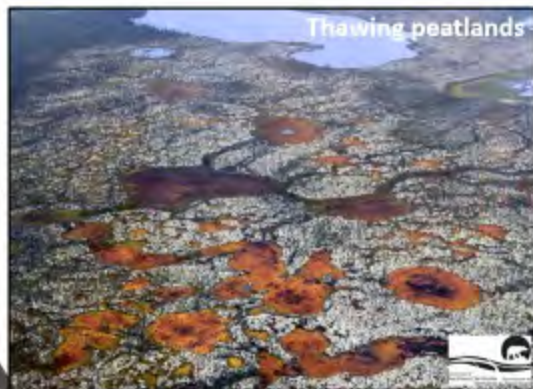
# Characterizing permafrost

- Temperature
- Distribution
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- Material properties
- Ice content

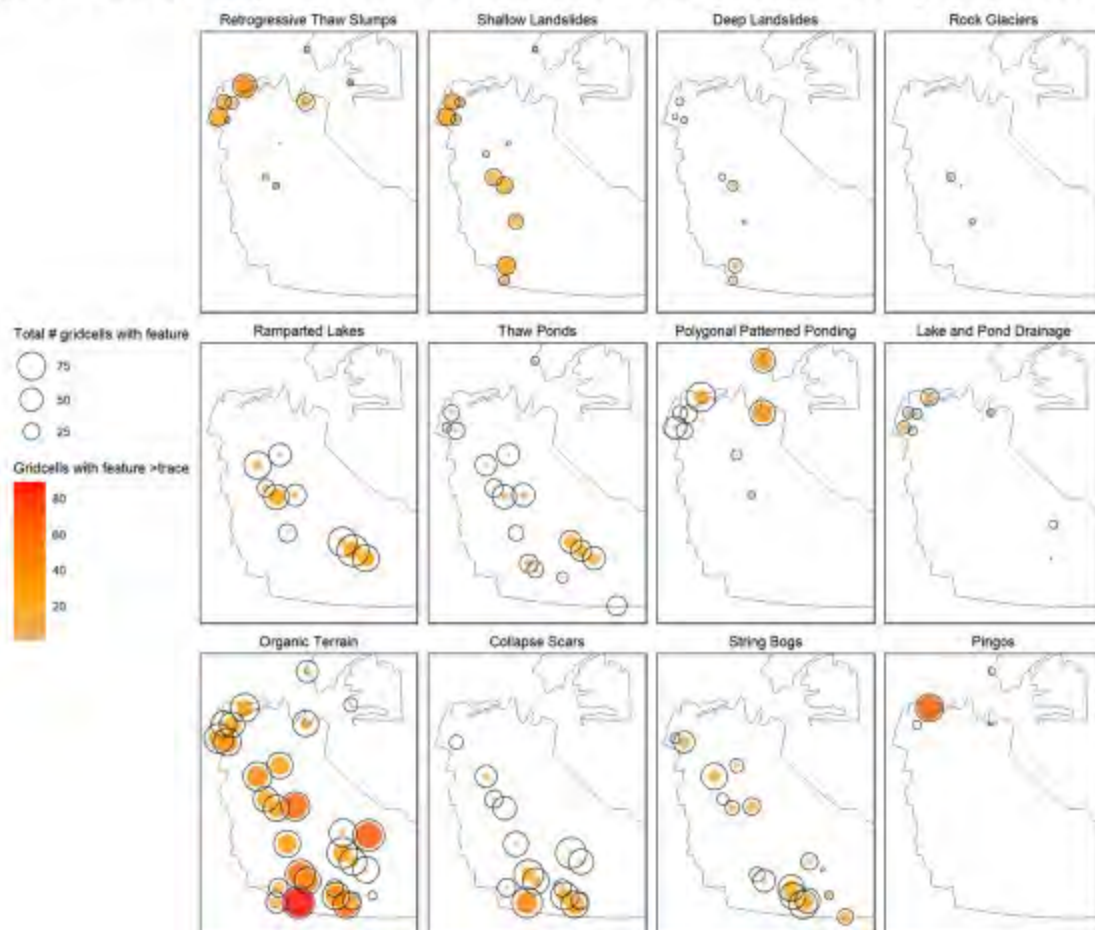
The past matters and it's what's inside that counts  
Le passé compte et c'est ce qu'il y a à l'intérieur qui compte



# Diverse response to permafrost thaw



# Contrasting sensitivity of NWT Communities to permafrost thaw



# Local conditions impact permafrost infrastructure interactions

- Vegetation
- Snow cover
- Water/drainage
- Ground ice
- Material properties



# Challenges with permafrost



## As permafrost changes, Inuvik's airport gets \$22M upgrade

Inuvik's airport, vulnerable to thawing Arctic permafrost, is to receive \$22 million in work destined to...



# Examples of adaptation measures



No single solution / Pas de solution unique



# Creating opportunities for generating and sharing knowledge

- Data collection, Data management, Characterization & Analyses = Knowledge = Informed adaptation
- Build a community of expertise: increase permafrost capacity
- Create opportunities for knowledge sharing



# Guidelines and standards

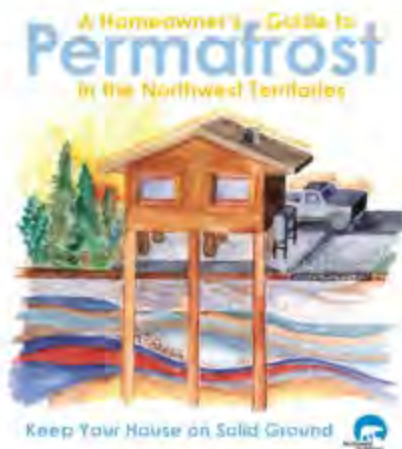
## National standards / Normes nationales



Standards Council of Canada  
Conseil canadien des normes



Standards Council of Canada  
Conseil canadien des normes



Webinar:

CAN/BNQ 9701-500/2022:  
Risk-Based Approach for  
Community Planning in Northern  
Regions – Requirements and  
Guidance

**BNQ**

Bureau de normalisation  
du Québec

- Sara Brown, Ashley Rudy & Lukas Arenson
- November 24, 2022



# What is a land development suitability map?

Representation of the **suitability and implications of ground conditions for existing or proposed land and/or infrastructure development**, based on mapping current and projected susceptibilities to a specific event or combination of events



Norman Wells (Photo A. Rudy)

# Terrain Susceptibility

Terrain mapping and characterization of the susceptibility of the terrain to geophysical processes or events **for current and projected future conditions** shall form the foundations for an LDS map.

## **At a minimum LDS maps shall be based:**

- susceptibility to permafrost related processes
- susceptibility to mass movement (e.g., landslide)
- susceptibility to riverine processes
- susceptibility to coastal processes
- susceptibility to other processes or events



# Land Development Suitability Map for Pond Inlet, Nunavut

Includes information on:

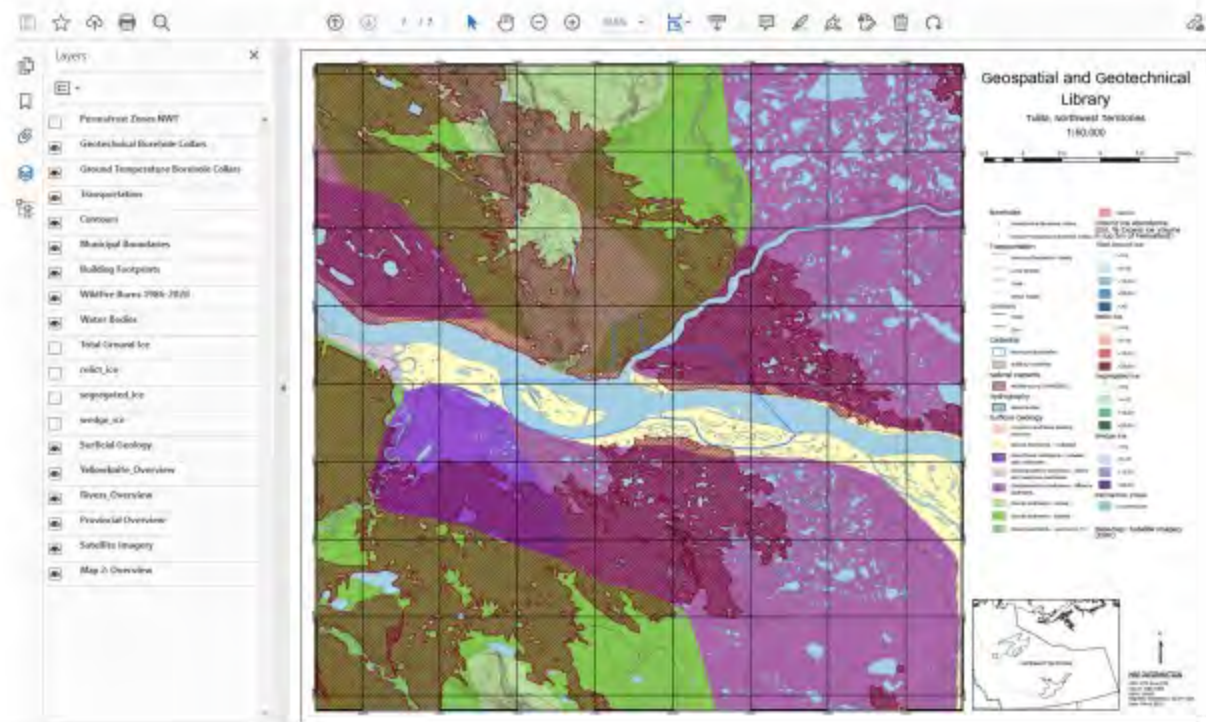
- Permafrost susceptibility
- Fluvial susceptibility
- Climate susceptibility



Single or Composite Susceptibility Level	Land Development Suitability		
	Infrastructure Vulnerability <span style="float: right;">← low      high →</span>		
<b>High</b>	Conditionally Suitable	Unsuitable	Unsuitable
<b>Moderate</b>	Generally Suitable	Conditionally Suitable	Unsuitable
<b>Low</b>	Generally Suitable	Generally Suitable	Generally Suitable

# Geotechnical data libraries

- Collection of existing, public geotechnical and spatial data relevant to permafrost geohazard mapping and adaptation planning

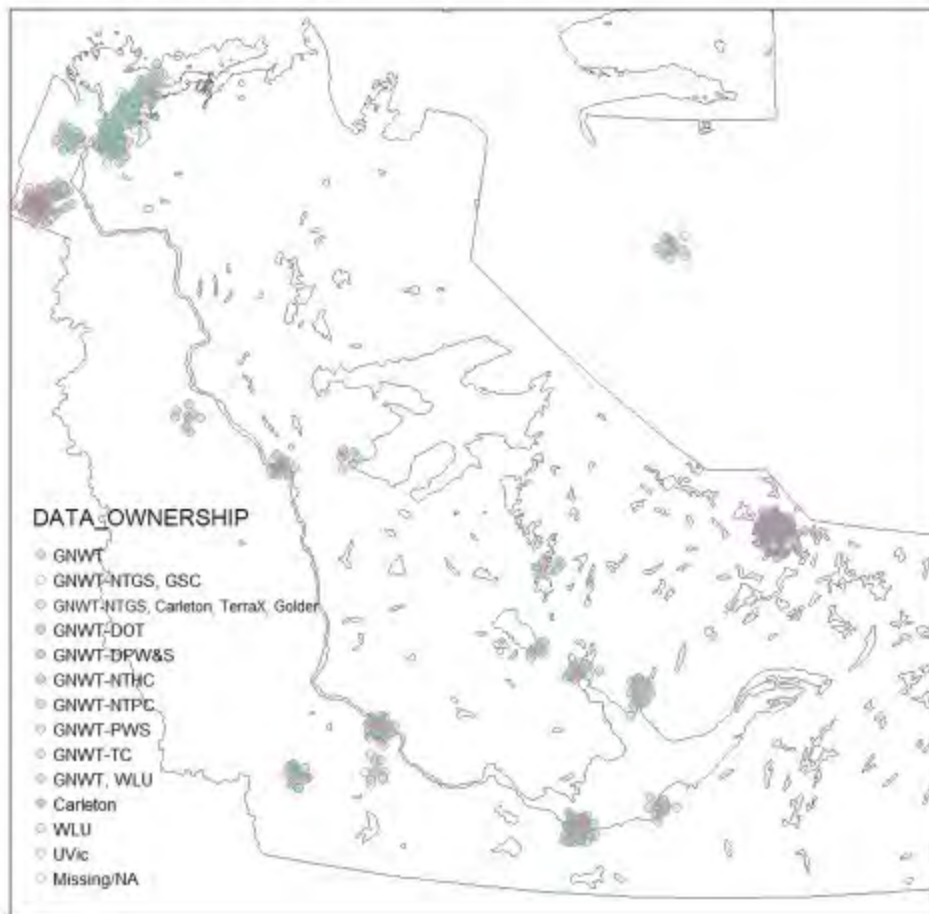


# NWT Permafrost Database

- Hub for NWT permafrost data
  - Link to other types of data and knowledge
- Data generated by Government, Academia, and Industry
- Standardize data collection, formats, and dissemination
- Publicly accessible
- Interoperable with other repositories and models

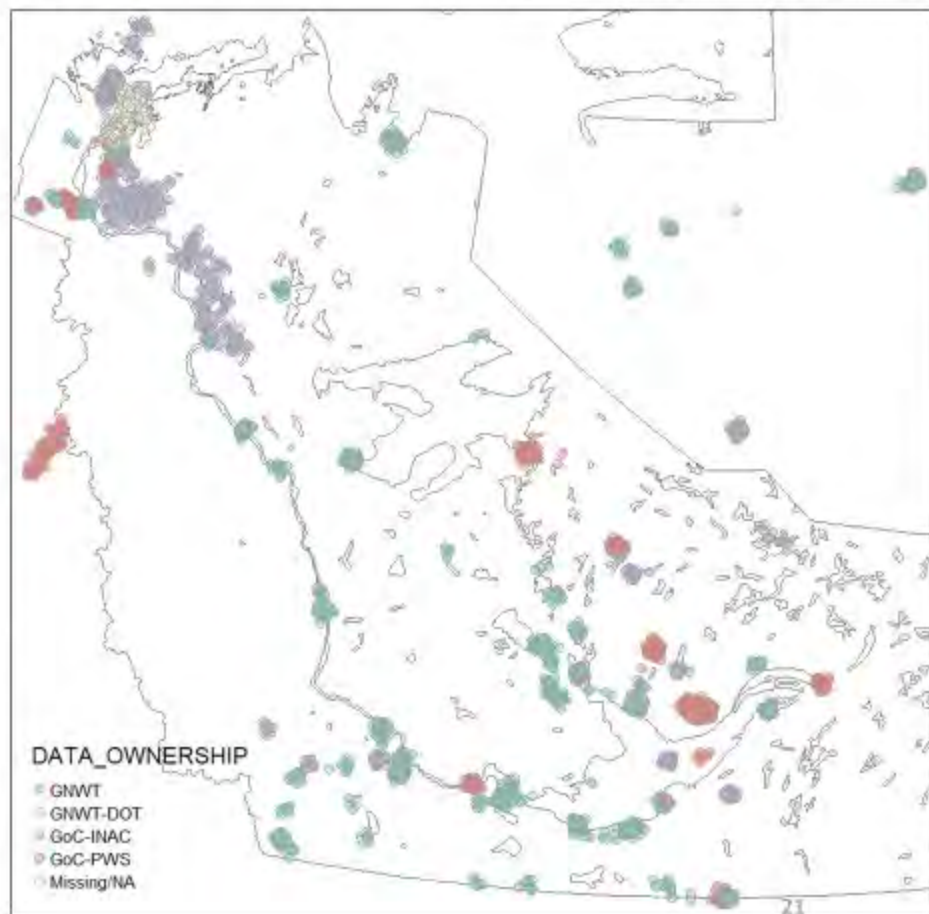


## Ground Temperature



## Geotechnical

Site locations adjusted to display overlap



2015

2016

2017

2018

2019

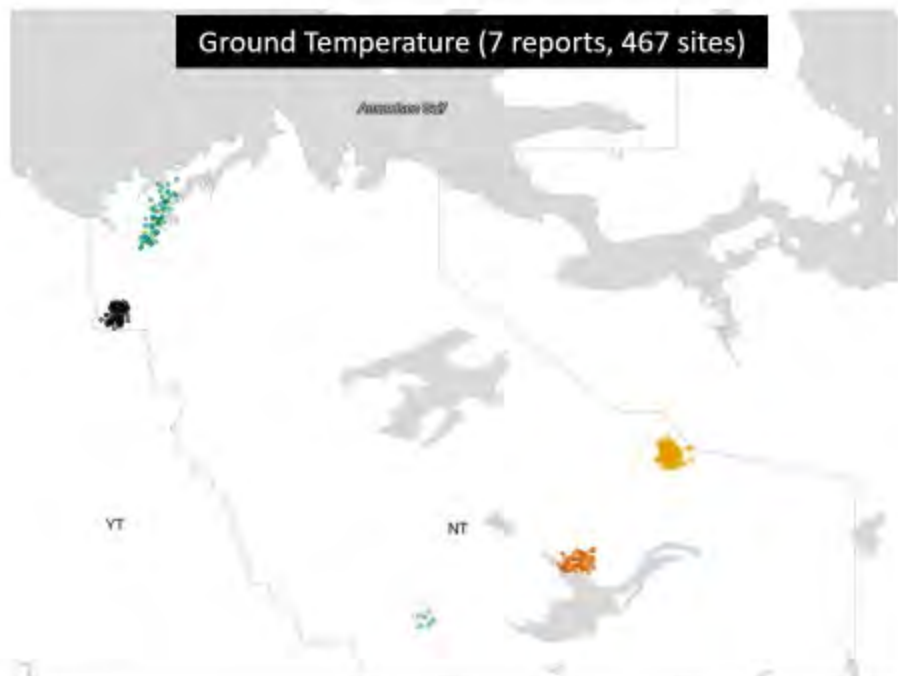
2020

2021

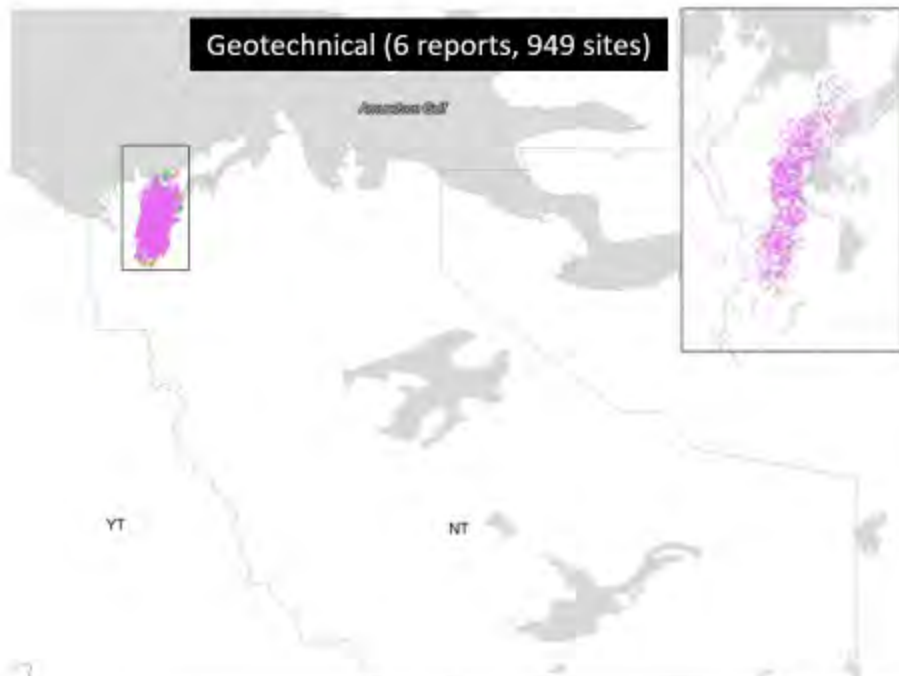
2022

- Data publications published as NTGS Open Report

Ground Temperature (7 reports, 467 sites)



Geotechnical (6 reports, 949 sites)



# Support adaptation by investing in a solid foundation of permafrost knowledge

- Permafrost changes in response to climate warming
- Permafrost is complex, with distinct “personalities”
- Variable landscape response and infrastructure challenges
- Data-management/stewardship - analyses - **information/knowledge**
- Dissemination – Planning - Adaptation
- Poor knowledge base = costly surprises





Mársı | Kinanāskomitin | Thank you | Merci | Haj' | Quana |  
Qujannamiik | Quyanainni | Máhsı | Máhsı | Mahsı

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