

Designing for Northern, Remote, and Arctic Communities

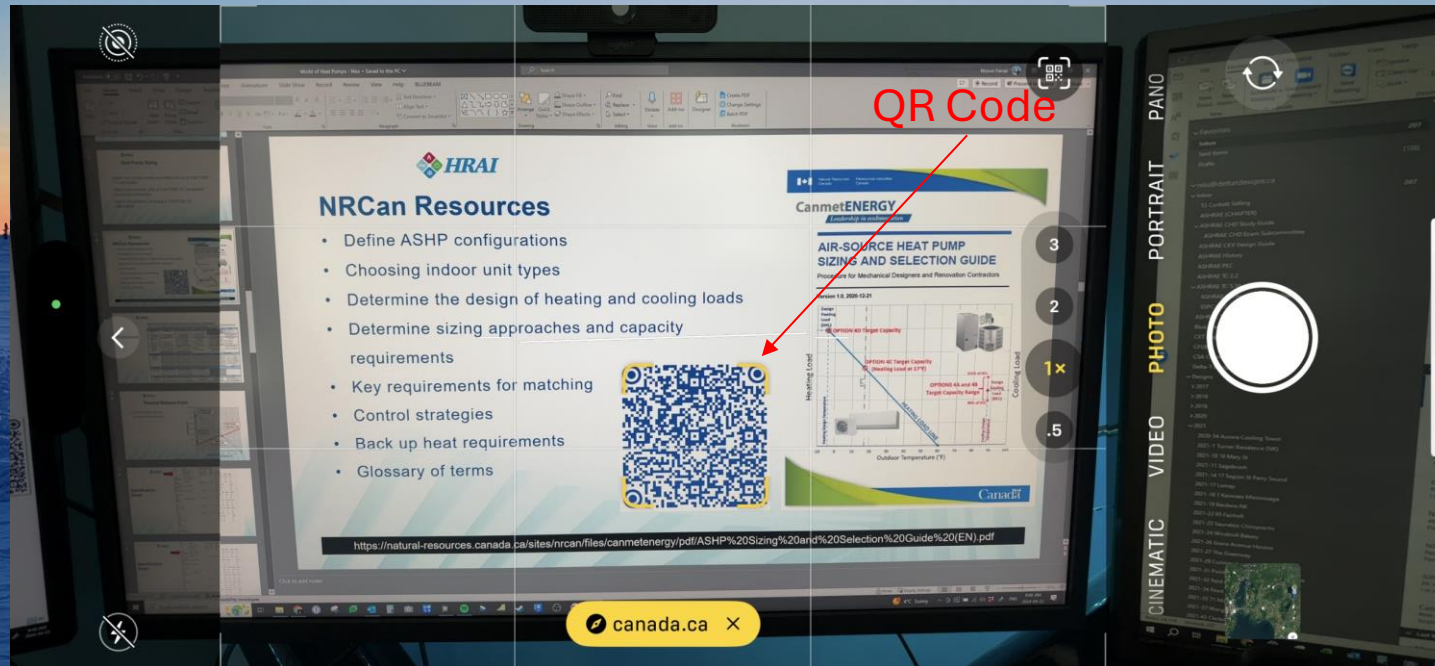
An aerial photograph of a vast, flat, and desolate Arctic landscape covered in snow and ice. A long, narrow, winding path or ridge of snow leads from the foreground towards the horizon. In the foreground, a blue sign with white text is planted in the snow. The sign reads "ARCTIC OCEAN" in large letters and "NUNERDYAR GAARDANI TASIUT" in smaller letters below it. A long shadow is cast by the sign onto the snow. In the distance, a small figure of a person can be seen standing on the snow.

An introduction to some of the unique circumstances facing northern communities, and how they influence building design.

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Presentation Summary

- Introduction & Bio
- Climate & Geography
 - Environmental Conditions
 - Geographical Challenges
- Energy and Infrastructure
 - Energy Supply & Efficiency
 - Infrastructure Considerations
- Communities, Culture and Customs
 - Cultural Sensitivity
 - Engagement and Collaboration
- Conclusion and Questions



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Buildings designed for use in Northern, Remote, and Arctic Communities face unique challenges that are not found in southern urbanized areas.

Special considerations must be given to these circumstances to ensure that buildings are safe and healthy for the occupants, and sustainable over the entire expected lifespan.

Niss Feiner, C.E.T, CHD,
RASDT, RHDT, RVDT



- Certified Engineering Technologist (OACETT) and Certified HVAC Designer (ASHRAE)
- In the mechanical construction & engineering industry since 2006.
- Completed courses at the University of Alaska in Northern Design:
 - *Fundamentals of Arctic Engineering*
 - *Northern Building Design*
- Instructor for HRAI and Professor in the HVAC Technology Program at George Brown College, Toronto.



Image credit: Delta-T Designs Inc.

An aerial photograph of a frozen body of water, likely a lake or river. The ice is dark blue and black, with a complex network of thin, white, vein-like cracks and patterns. Patches of white snow are scattered across the surface, particularly in the lower right and bottom left corners. The overall texture is rough and crystalline.

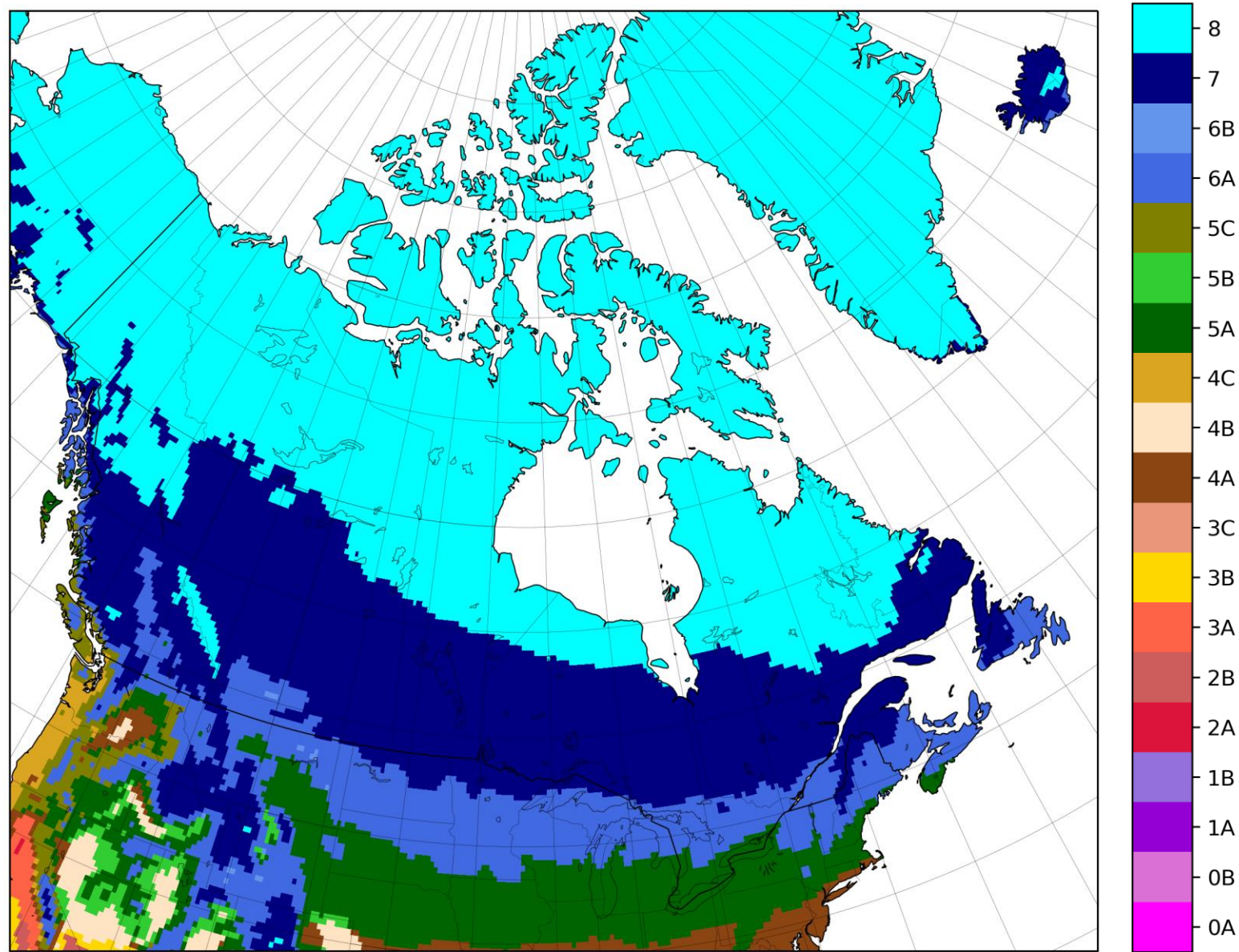
Climate & Geography

Environmental Considerations

Due to their latitude and the Earth's axial tilt, northern communities experience significant seasonal temperature swings and variations in daylight.

Above the Arctic Circle ($66^{\circ}34'N$), there is at least one day each year of continuous darkness and one day of 24-hour daylight. The further north, the longer these periods last.

This leads to prolonged, extremely cold winters with minimal sunlight and brief summers where daylight can exceed 18 hours.



Canadian Climate Zone Map – ASHRAE Standard 169-2021

So yeah.....it gets cold.



2021 ASHRAE Handbook — Fundamentals (IP)

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INUUVIK AP, NT, Canada

WMO: 719570

Lat: 68.304N Lon: 133.481W Elev: 222 StdP: 14.58 Time Zone: -7.00 (NAM) Period: 94-19 WBAN: 99999

Annual Heating, Humidification, and Ventilation Design Conditions

Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest Month WS/MCDB				MCWS/PCWD to 99.6% DB		WSF
			99.6%			99%			0.4%		1%				
	99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)
1	-39.1	-35.3	-47.3	0.3	-38.7	-43.8	0.4	-34.9	25.1	0.1	20.1	0.0	1.6	80	0.815

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB	
		0.4%		1%		2%		0.4%		1%		2%			
		DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	MCWS	PCWD
(a) 7	(b) 17.4	(c) 78.8	(d) 61.2	(e) 74.9	(f) 59.4	(g) 71.3	(h) 57.9	(i) 63.0	(j) 74.9	(k) 61.0	(l) 72.0	(m) 59.0	(n) 69.1	(o) 8.1	(p) 190

2021 ASHRAE Handbook — Fundamentals (SI)

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INUUVIK AP, NT, Canada

WMO: 719570

Lat: 68.304N Lon: 133.481W Elev: 68 StdP: 100.51 Time Zone: -7.00 (NAM) Period: 94-19 WBAN: 99999

Annual Heating, Humidification, and Ventilation Design Conditions

Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest Month WS/MCDB				MCWS/PCWD to 99.6% DB		WSF
			99.6%			99%			0.4%		1%				
	99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD	
(a) 1	(b) -39.5	(c) -37.4	(d) -44.0	(e) 0.0	(f) -39.3	(g) -42.1	(h) 0.1	(i) -37.2	(j) 11.2	(k) -17.7	(l) 9.0	(m) -17.8	(n) 0.7	(o) 80	(p) 0.815

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB	
		0.4%		1%		2%		0.4%		1%		2%			
		DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	MCWS	PCWD
(a) 7	(b) 9.7	(c) 26.0	(d) 16.2	(e) 23.8	(f) 15.2	(g) 21.8	(h) 14.4	(i) 17.2	(j) 23.8	(k) 16.1	(l) 22.2	(m) 15.0	(n) 20.6	(o) 3.6	(p) 190

How does the cold impact our designs?

- Heating and ventilating buildings takes an enormous amount of energy:
 - Large temperature difference between indoors and outdoors.
 - A significant portion of buildings are heated by oil medium efficiency boilers/furnaces which require combustion air and flues increasing the infiltration loads.
 - In most of the North energy is not transported by pipeline or wire. It must be trucked, shipped or flown up. The most common fuel sources are No.1 & No.2 Fuel Oil, and Liquid Propane Gas.
 - Many communities are on pumped water, where a potable water tank is installed in the building and is filled roughly every three days with 0°C (32°F) which acts as a heat sink for the HVAC system.
 - Sanitary piping and sewage tank require insulation and heat-tracing to prevent freezing.

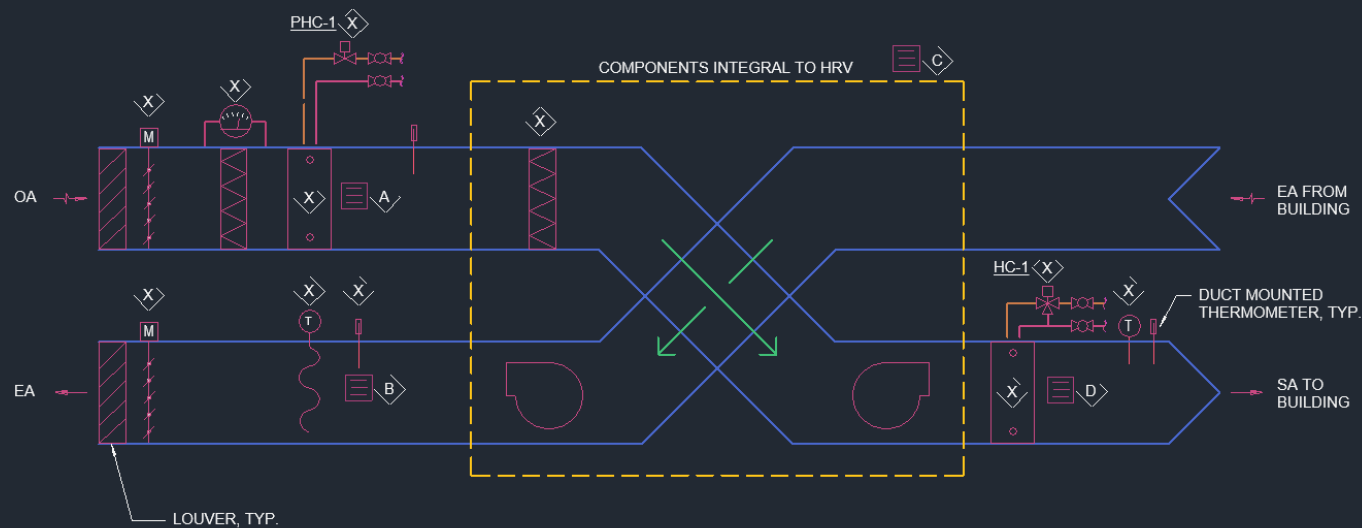


DIAGRAM KEY NOTES

1. FAIL OPEN CONTROL DAMPER.
2. MERV 8 SUMMER FILTER BANK W/ MAGNEHELIC GAUGE. FILTER TO BE IN THIS LOCATION DURING SUMMER OPERATION. ONLY ONE FILTER (SUMMER OR WINTER) IS TO BE INSTALLED AT A TIME.
3. PHC-1, FOR PIPING DIAGRAM SEE X/MX.
4. MERV 8 WINTER FILTER. FILTER TO BE IN THIS LOCATION DURING WINTER OPERATION ONLY.
5. AVERAGING EXHAUST TEMPERATURE SENSOR.
6. HC-1, FOR PIPING DIAGRAM SEE X/MX.
7. HRV SUPPLY AIR TEMPERATURE SENSOR.

MAINTENANCE PLACARDS

- A. "SUMMER FILTER: REPLACE WITH MERV 8 RATED FILTER. TO BE INSTALLED ONLY DURING SUMMER. DURING WINTER, FILTER IN HRV-1 (WINTER FILTER) TO BE INSTALLED. PRE-HEAT COIL, PHC-1: THREE-WAY VALVE MODULATES TO MAINTAIN AN EXHAUST TEMPERATURE OF MINIMUM 32 DEG F. THIS IS TO PREVENT HRV DEFROST CYCLES."
- B. "PRE-HEAT COIL, PHC-1, MODULATES TO MAINTAIN THE EXHAUST AIR TEMPERATURE AT A MINIMUM OF 32 DEG F AT THIS LOCATION. SEE PLACARD ON PHC-1."
- C. "HRV-1, HEAT RECOVERY VENTILATOR. UNIT TRANSFERS HEAT FROM BUILDING EXHAUST TO BUILDING SUPPLY. FILTER INSIDE THIS UNIT TO BE IN PLACE DURING WINTER. DURING SUMMER

SEQUENCE OF OPERATION

1. HRV TO BE PROVIDED WITH FACTORY CONTROLS THAT PROVIDE A 7-DAY PROGRAMMABLE OCCUPIED/UNOCCUPIED SCHEDULE AND HUMIDITY CONTROLS. ADDITIONAL CONTROLS TO BE PROVIDED FOR AIR TEMPERATURE AND DEFROST CONTROL MITIGATION.
2. UNOCCUPIED MODE:
 - A. HRV SHALL BE OFF.
 - B. OUTSIDE AND EXHAUST AIR DAMPERS SHALL BE CLOSED.
3. OCCUPIED MODE:
 - A. HRV SHALL OPERATE AT NORMAL SPEED.
 - B. OUTSIDE AND EXHAUST AIR DAMPERS SHALL BE OPEN WHEN HRV IS RUNNING.
 - C. PHC-1: THE TWO-WAY CONTROL VALVE SHALL MODULATE TO MAINTAIN AN HRV EXHAUST AIR TEMPERATURE OF AT LEAST 32 DEG F (ADJUSTABLE). THIS IS TO PREVENT THE UNIT FROM GOING INTO DEFROST. VALVE TO FAIL OPEN.
 - D. HC-1: THE THREE-WAY CONTROL VALVE SHALL MODULATE TO MAINTAIN AN HRV SUPPLY AIR TEMPERATURE OF 70 DEG F (ADJUSTABLE).
 - E. HRV CONTROLLER: THE HRV CONTROLLER SHALL CONTROL THE FOLLOWING:
 - a. SPACE RELATIVE HUMIDITY TO BE SET AT 40% RH. IF HUMIDITY RISES ABOVE THE SETPOINT, THE UNIT WILL OPERATE AT HIGH SPEED.
 - b. DEFROST CONTROL: INTENT OF DESIGN IS TO NOT HAVE THE UNIT GO INTO A DEFROST CYCLE.

Image credit: Cold Climate Engineering, LLC / Delta-T Designs Inc.

HRV's need to pre-heat intake air to prevent unit from going into defrost.

Fully saturated flue-gas can freeze up in the flue.



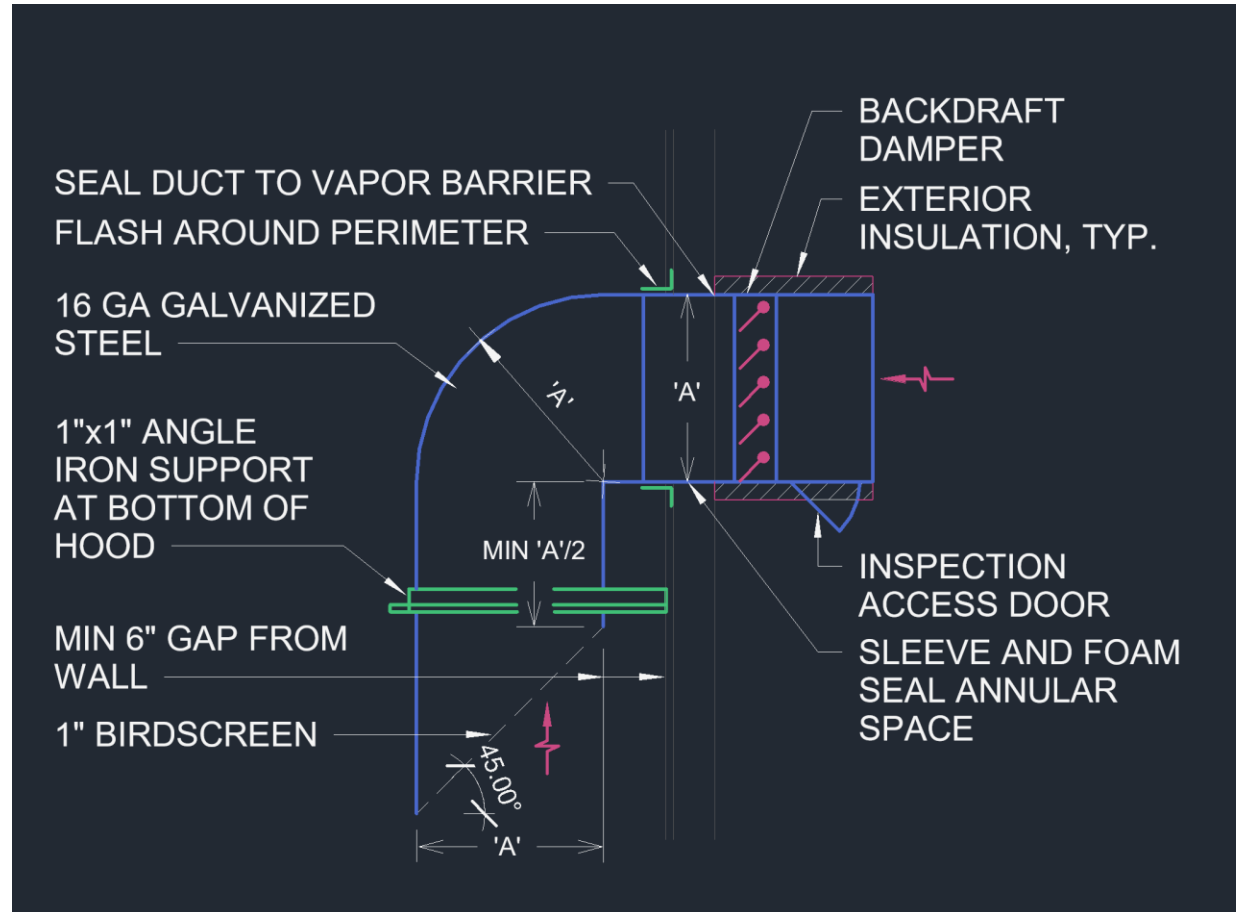
NORTHERN BUILDING DESIGN

FIGURE 5:
FROZEN FLUE
UNINSULATED FLUE
Richard Armstrong



FIGURE 6:
PULSE FURNACE AIR
INTAKE/EXHAUST
FREEZING OF INLETS
AND EXHAUST PIPES
Richard Armstrong

Intake and exhaust hoods need to be designed to mitigate obstruction from snow and ice blockage.





(a)



(b)



- Lack of water mains means water is pumped into tanks in the building.
- Good practice is to size them for 720-1300L per day, and a 3 day capacity.
- Thousands of litres of water pumped into the tank at 0°C is a parasitic load on the heating system southern buildings do not encounter.

Image credit:

- Cold Climate Design Guide, 2.Ed -ASHRAE

-Daley, Kiley & Castleden, Heather & Jamieson, Rob & Furgal, Chris & Ell, Lorna. (2014). Municipal water quantities and health in Nunavut households: an exploratory case study in Coral Harbour, Nunavut, Canada. International journal of circumpolar health.

All exposed piping (SANI, Pump down connections, etc) must be insulated and heat-traced to prevent freezing.



Septic tanks must be installed above grade to protect the permafrost and be insulated and heat-traced to ensure waste can flow in and out of the tank.

Permafrost (Perennially Frozen Ground)

- Active Layer is the region which temperature fluctuates above and below 0°C during the year.
- Permafrost is defined as soil or rock having temperatures below 0°C over at least two consecutive winters and the intervening summer.

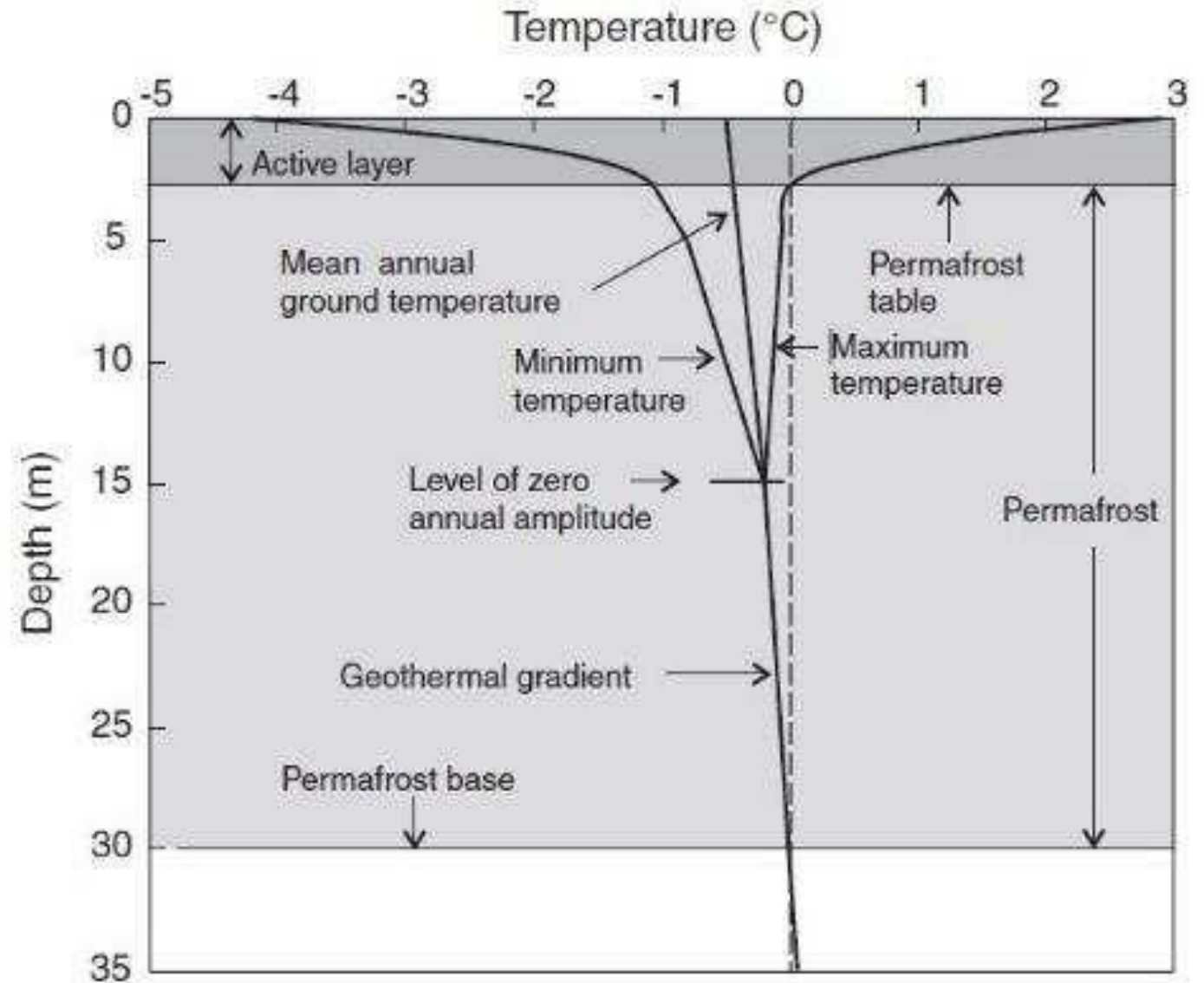


Image Source:

https://www.researchgate.net/publication/356747874_A_comparison_of_permafrost_landslides_in_previously_glaciated_and_unglaciated_terrain_along_the_Dempster_Highway_Eagle_Plains_Yukon_and_Peel_Plateau_and_Interior_Plain_Northwest_Territories

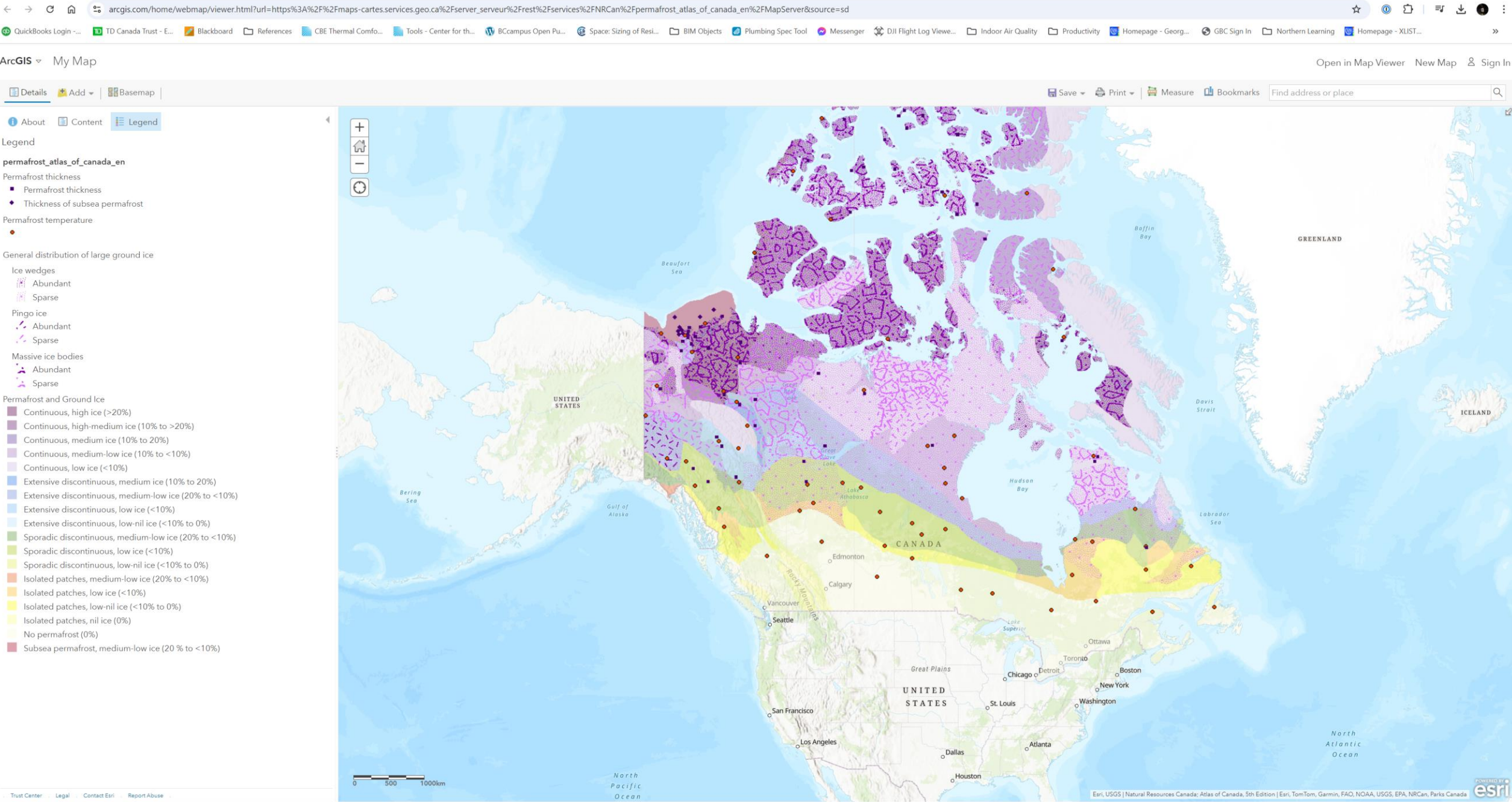


Image credit: Government of Canada

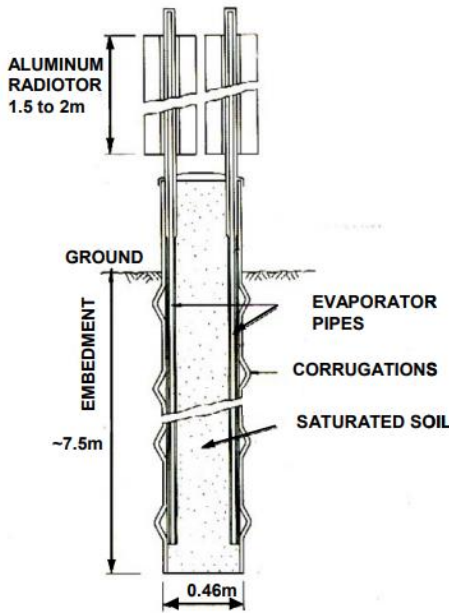


Permafrost provides structural stability to buildings and infrastructure. It must be maintained.

Raised Foundations

- Allow for cold air to flow under the building and keep the ground cold.
- Minimizes contact surface area between the floor and the ground reducing thermal conduction.
- Should have fencing to keep animals out and people from storing things under it.





a) Vertical thermosyphon tubes (Thermoprobes) within TAPS pile support system

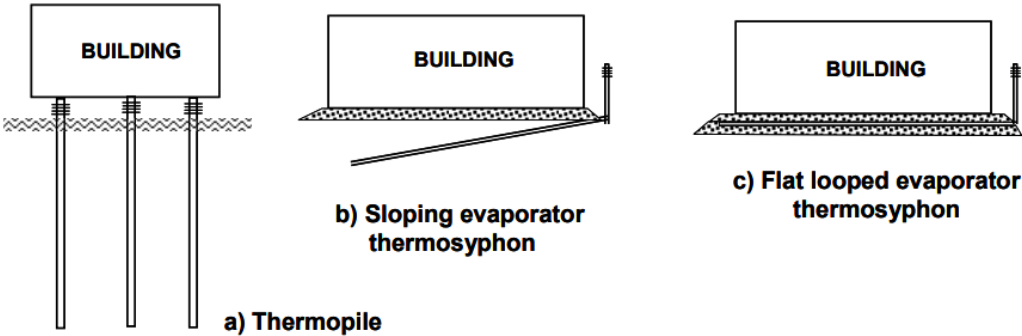


Figure 10. Three thermosyphon designs

Geographical Considerations

- The North is very vast with few year-round roads.
- Shipping of goods is done via:
 - Year-round roads and summer ferries.
 - Winter Ice roads over rivers and lakes.
 - River Barges
 - Sealift
 - Air



DriveNWT RoutesTNO



VIEW

English Français

Map Table

- CONTENT
- ☒ Now
 - ☒ Next 7 Days
 - ☐ Next 30 Days
 - ☒ Weight Restrictions
 - ☒ Road Conditions
 - ☒ Advisories
 - ☒ Ferries & Ice Crossings
 - ☒ Cameras

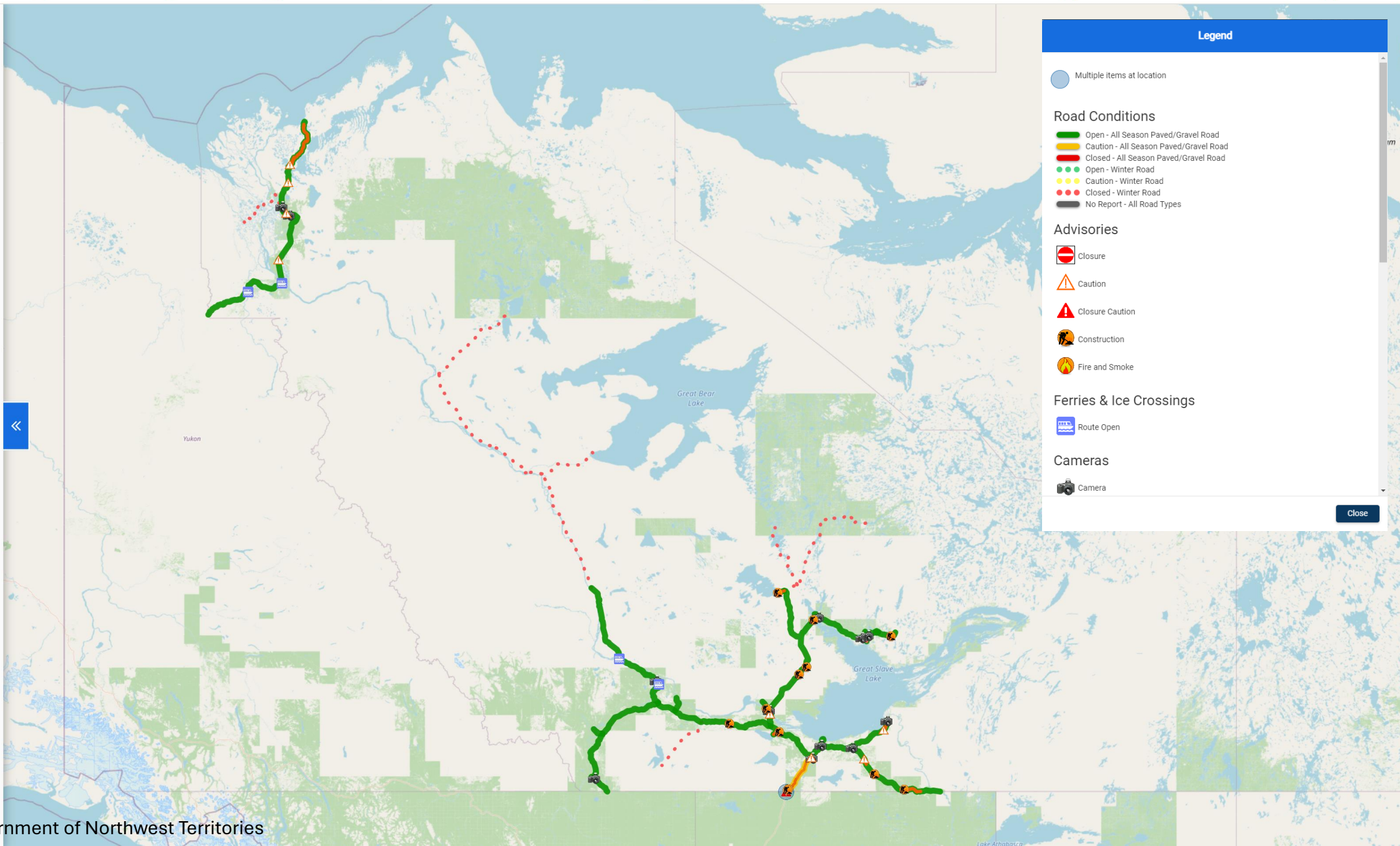
[Legend](#)

[Embed Current Map](#)

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Image credit: Government of Northwest Territories



Legend

Multiple items at location

Road Conditions

- Open - All Season Paved/Gravel Road
- Caution - All Season Paved/Gravel Road
- Closed - All Season Paved/Gravel Road
- Open - Winter Road
- Caution - Winter Road
- Closed - Winter Road
- No Report - All Road Types

Advisories

- Closure
- Caution
- Closure Caution
- Construction
- Fire and Smoke

Ferries & Ice Crossings

- Route Open

Cameras

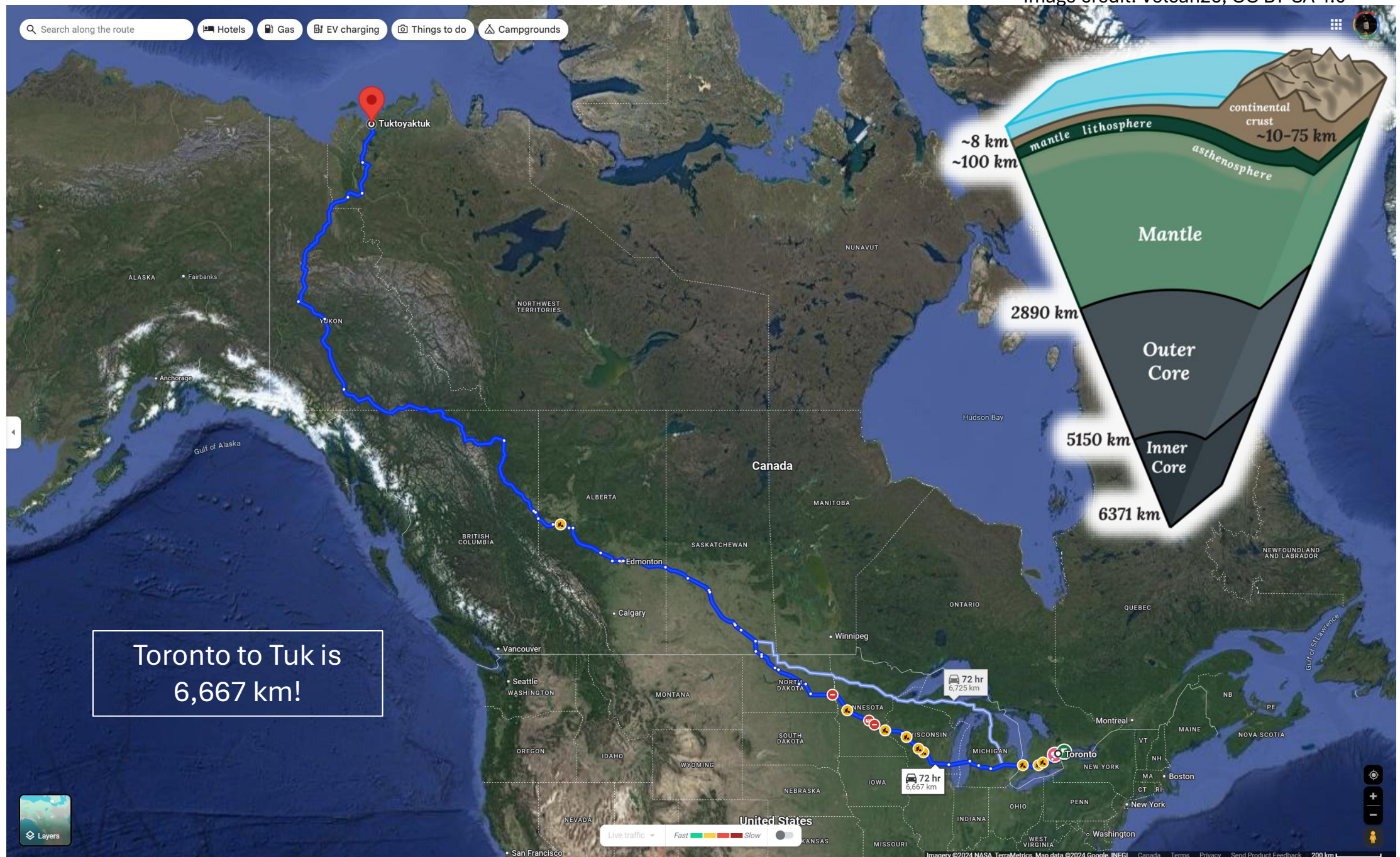
- Camera


Close



Shipping of goods is very costly and subject to natural constraints requiring long-term forecasting of projects and coordination.







These distances mean that even when connected by road, goods are very expensive.



CostcoGrocery



\$25.99



CostcoGrocery



\$18.99

Kirkland Signature Organic Maple Syrup, 1 L

★★★★★ (5,010)

Item may be available in your local warehouse, prices may vary.

Delivery Available



CostcoGrocery




\$44.99

Kirkland Signature Olive Oil, 3 L

★☆☆☆☆ (1)

Item may be available in your local warehouse, prices may vary.

 Delivery Available



PURE LEAF

Lemon Real Brewed Tea

547 ml

\$3.25 ea

\$3.79 ea

\$0.69 / 100ml

MULTI \$3.25 MIN 2

Price subject to change based on offers available at pick-up time.

Get this item with your grocery order.

ADD



Marvel Exclusive

KRAFT

Zesty Italian Salad Dressing

425 ml

\$4.00 ea

\$4.49 ea

\$1.06 / 100ml

MULTI \$4.00 MIN 2

Price subject to change based on offers available at pick-up time.

Get this item with your grocery order.

ADD



BICK'S

Sandwich Savers Tangy Dill Pickles

500 ml

\$5.79 ea

\$1.16 / 100ml

Get this item with your grocery order.

ADD

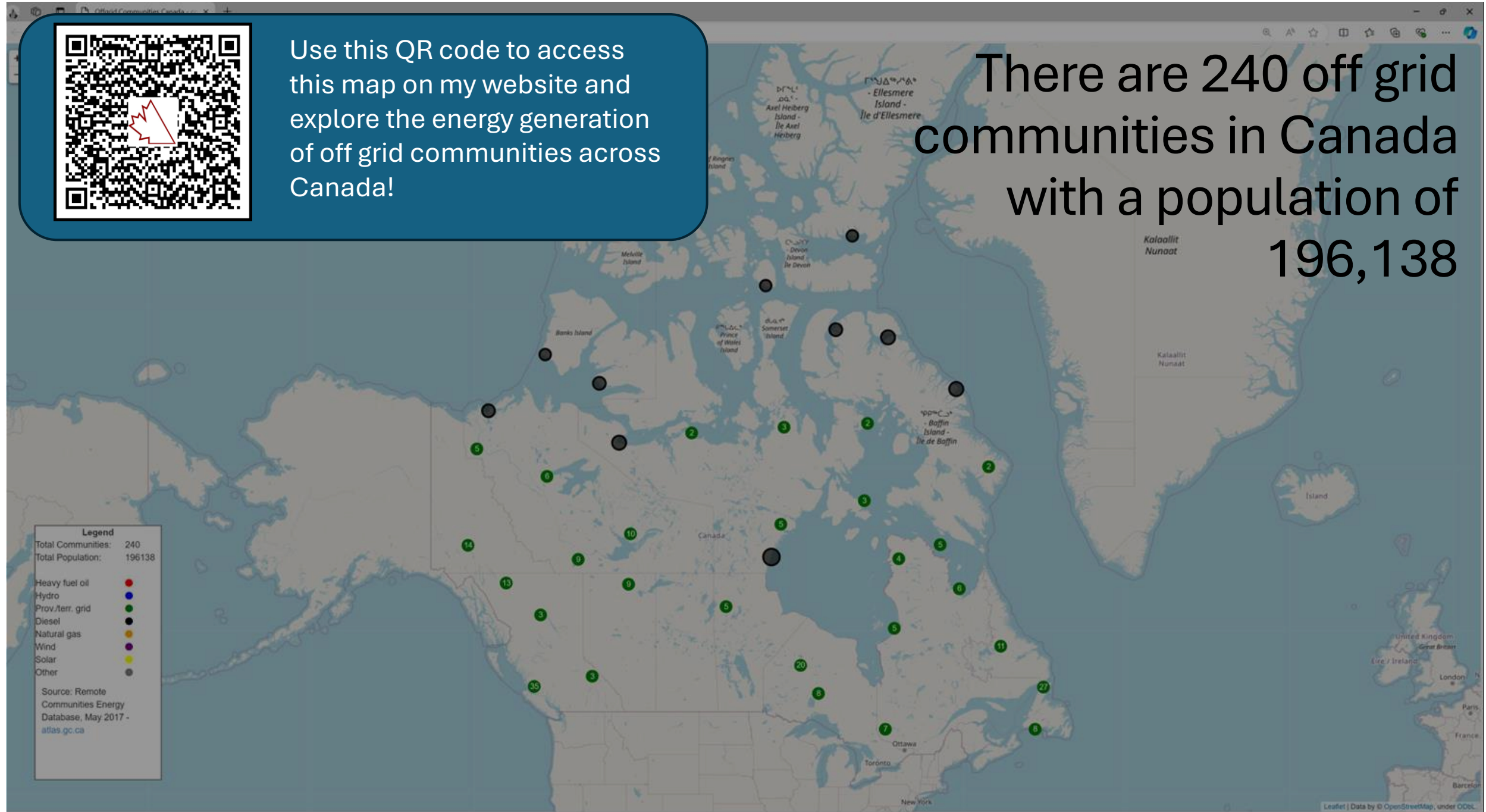
Energy and Infrastructure





Use this QR code to access this map on my website and explore the energy generation of off grid communities across Canada!

There are 240 off grid communities in Canada with a population of 196,138



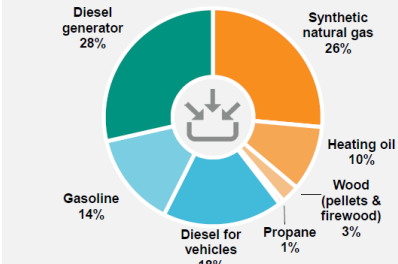


Most communities are supplied electricity from Diesel Electric Generators.

This makes electricity very inefficient, carbon intensive, and expensive.

Inuvik, NT

Energy Sources – 1 Year



Diesel generator produces electricity and heat

37% electricity
62% waste heat
1% recovered heat



Energy cost

Total: \$44,300,000
Cost per person: \$12,900

44% diesel generator	1% propane
18% synthetic natural gas	0.3% waste heat recovery
7% heating oil	15% diesel for vehicles
1% wood pellets	13% gasoline
1% firewood	



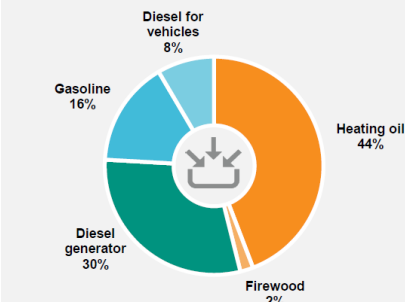
Renewable energy

3% of total energy
2% of total from firewood
1% of total from wood pellets
0.1% of total from solar PV

Unless otherwise noted, numbers reflect energy sources purchased or sourced in the community, and do not include industry or commercial transport. Percentages may not add to 100% due to rounding.

Tuktoyaktuk, NT

Energy Sources – 1 Year



Diesel generator produces electricity and heat

27% electricity
73% waste heat



Energy cost

Total: \$7,250,000
Cost per person: \$7,300

38% diesel generator
35% heating oil
1% firewood
0.1% propane
18% gasoline
8% diesel for vehicles



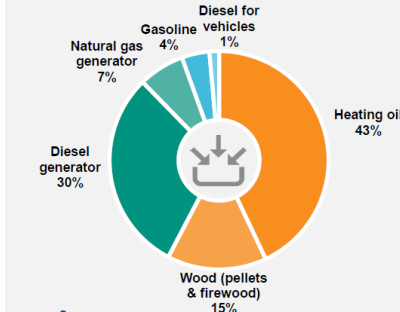
Renewable energy

2% of total energy
2% of total from firewood
0.03% of total energy from solar PV

Unless otherwise noted, numbers reflect energy sources purchased or sourced in the community, and do not include industry or commercial transport. Percentages may not add to 100% due to rounding.

Norman Wells, NT

Energy Sources – 1 Year



Diesel generator produces electricity and heat

30% electricity
70% waste heat



Energy cost

Total: \$10,800,000
Cost per person: \$13,400

29% diesel generator	1% firewood
22% natural gas	0.1% propane
36% heating oil	4% gasoline
7% wood pellets	1% diesel for vehicles



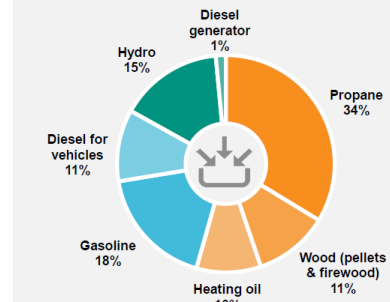
Renewable energy

14% of total energy
12% of total from wood pellets
2% of total from firewood

Unless otherwise noted, numbers reflect energy sources purchased or sourced in the community, and do not include industry or commercial transport. Percentages may not add to 100% due to rounding.

Hay River, NT

Energy Sources – 1 Year



Diesel generator produces electricity and heat

34% electricity
66% waste heat



Energy cost

Total: \$20,500,000
Cost per person: \$5,400

37% hydro	12% propane
1% diesel generator	9% heating oil
23% gasoline	3% wood pellets
12% diesel for vehicles	2% firewood



Renewable energy

26% of total energy
15% of total from hydro
8% of total from wood pellets
3% of total from firewood
0.04% of total from solar PV

Unless otherwise noted, numbers reflect energy sources purchased or sourced in the community, and do not include industry or commercial transport. Percentages may not add to 100% due to rounding.

Electricity in the North is very expensive.



Effective: 2012 01 01
Supersedes: 2009 02 01

RESIDENTIAL RATE SCHEDULE

Application

- For single-phase service at secondary voltage through a single meter.
- For normal use by a Dwelling.
- Not applicable to any commercial or industrial use.
- As requested by the City of Yellowknife, churches assessed as exempt will be entitled to this rate.

Rates

- The charge for service in any one billing month is the sum of the Customer Charge and Energy Charge, determined for each individual Point of Service.

Component	Charge
Customer Charge	\$18.00 / month
Energy Charge	23.72 ¢ / kW.h

- The minimum monthly charge is the Customer Charge.

Options and Riders

Price Adjustments – the following price adjustments (riders) may apply:

- Temporary Refund/Surcharge Rider (Rider E)
- Purchase Power Cost Adjustment Rider (Rider F)
- Cost Recovery/Refund Rider (Rider H)
- Interim Refundable Rate Rider (Rider K)
- Rate Adjustment Rider (Rider R)
- 25kV Deferral Account Rider (Rider T)
- Franchise Tax

The Terms and Conditions of Service for Northland Utilities (Yellowknife) Limited have the approval of the Public Utilities Board of the Northwest Territories. They form part of this rate schedule and apply to the Company and every customer supplied with electric service by the Company. Copies of the Terms and Conditions are available for inspection in the offices of Northland Utilities (Yellowknife) Limited during normal business hours, and can be accessed at www.northlandutilities.com.



Effective: 2024 06 01
Supersedes: 2023 06 01

Northland Utilities (Yellowknife) o/a Naka Power (Yellowknife) Purchase Power Cost Adjustment Rider (Rider F)

Applicable

- Rider F is applicable to all rate classes defined by the Company for services provided in the City of Yellowknife when a charge or refund is approved by the Board.

Rate

- The surcharge will be applied to all energy consumption as follows:

\$0.1217 per kWh

The Terms and Conditions of Service for Northland Utilities (Yellowknife) Limited o/a Naka Power (Yellowknife) have the approval of the Public Utilities Board of the Northwest Territories. They form part of this rate schedule and apply to the Company and every customer supplied with electric service by the Company. Copies of the Terms and Conditions are available for inspection in the offices of Northland Utilities (Yellowknife) Limited o/a Naka Power (Yellowknife) during normal business hours, and can be accessed at www.northlandutilities.com.

\$0.238 per kW.h is actually quite low for the North.

Iqaluit residential rate-payers are paying \$0.6733 per kW.h

QULLIQ ENERGY CORPORATION
Rate Schedules Effective October 1, 2023

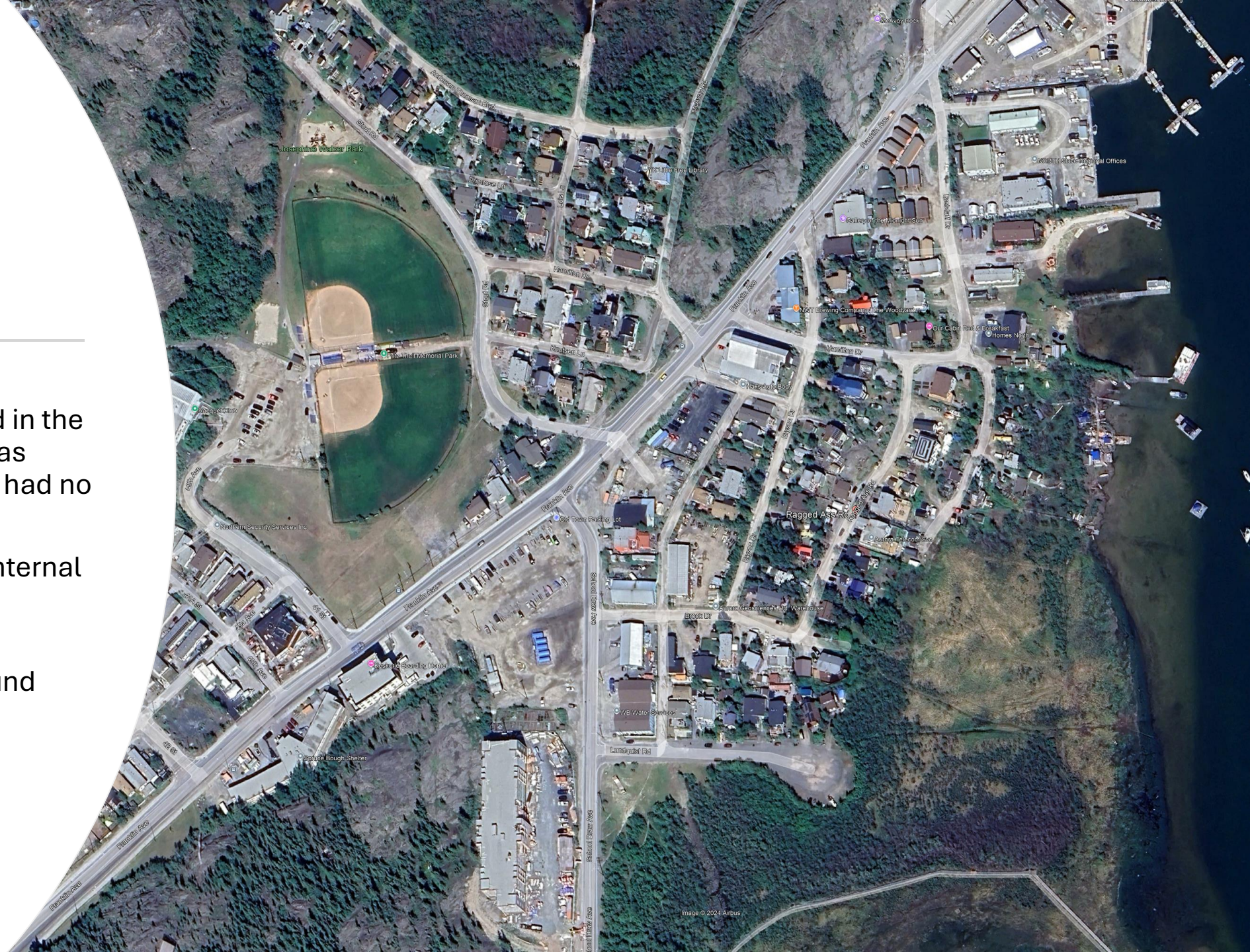
Plant No.	Plant Name	Domestic/Residential			Commercial		
		Non-Government	Government	Municipal Tax-Based Rate	Non-Government	Government	Municipal Tax-Based Rate
		(cents/KWh)	(cents/KWh)	(cents/KWh)	(cents/KWh)	(cents/KWh)	(cents/KWh)
501	Cambridge Bay	67.33	102.21	67.33	55.54	95.18	55.54
502	Gjoa Haven	67.33	102.21		55.54	95.18	
503	Taloyoak	67.33	102.21		55.54	95.18	
504	Kugaaruk	67.33	102.21		55.54	95.18	
505	Kugluktuk	67.33	102.21		55.54	95.18	
601	Rankin Inlet	67.33	102.21		55.54	95.18	
602	Baker Lake	67.33	102.21		55.54	95.18	
603	Arviat	67.33	102.21		55.54	95.18	
604	Coral Harbour	67.33	102.21		55.54	95.18	
605	Chesterfield Inlet	67.33	102.21		55.54	95.18	
606	Whale Cove	67.33	102.21		55.54	95.18	
607	Nauyasat	67.33	102.21		55.54	95.18	
701	Iqaluit	67.33	102.21		55.54	95.18	
702	Pangnirtung	67.33	102.21		55.54	95.18	
703	Kinngait	67.33	102.21		55.54	95.18	
704	Resolute Bay	67.33	102.21		55.54	95.18	
705	Pond Inlet	67.33	102.21		55.54	95.18	
706	Igloodik	67.33	102.21		55.54	95.18	
707	Sanirajak	67.33	102.21		55.54	95.18	
708	Qikiqtarjuaq	67.33	102.21		55.54	95.18	
709	Kimminut	67.33	102.21		55.54	95.18	
710	Arctic Bay	67.33	102.21		55.54	95.18	
711	Clyde River	67.33	102.21		55.54	95.18	
712	Grise Fiord	67.33	102.21		55.54	95.18	
713	Sanikiluaq	67.33	102.21		55.54	95.18	

Varying degrees of local infrastructure.

- Larger/planned communities have central utilities like water main and sewer. This can be extremely expensive to install, service and maintain.
- Local geology can make infrastructure extremely expensive when it requires blasting of bedrock, or permafrost protection is required.
- Water mains will freeze in the winter which is difficult and costly to repair in below freezing conditions.

Old-Town Yellowknife, NT

- Old-Town was first settled in the 30's before Yellowknife was established as a city, and had no public infrastructure.
- The buildings here have internal potable water tanks, and external sewage tanks.
- The city provides year-round septic pumping.



In the winter water is pumped into the holding tank via an external connection.

In the summer, the city lays HDPE pipe on the ground connecting each house to the public water main.



Image credit: Delta-T Designs Inc.



The extreme cold
wreaks havoc on public
works.

Image credit: Delta-T Designs Inc.



Inuvik, NT Utilidor

Water & Sewer Connections:

- 950 connections in total
- 16 km of above-ground Utilidor
- Less than 1 km of buried lines

Infrastructure History:

- Original Utilidor lines installed in the late 1950s by the federal government
- Town of Inuvik took ownership and operation of the system in June 2000, following an agreement with GNWT

Replacement Program:

- Replaces 500 meters of water and sewer lines annually
- Annual cost: ~\$1.5 million

Challenges:

- Arctic systems are more expensive to build and maintain
- Complex operation due to:
 - Extended cold winters
 - Thaw-sensitive permafrost





Use this QR code to see my
video from Inuvik further
explaining utilidors and how
the permafrost is protected in
Northern communities!



Tuktoyaktuk, NT

- Houses and public buildings are equipped with a potable water tank, and a sewage tank.
- The water truck brings potable water to fill the tanks, and the “honey truck” comes to empty them.



- Water trucks are filled at the water plant & reservoir.
- “Honey Trucks” are emptied at the sewage lagoon.





Use this QR code to see my video from Tuktoyaktuk further explaining the local infrastructure.

This is a Pingo! Watch the video for an explanation on what they are!



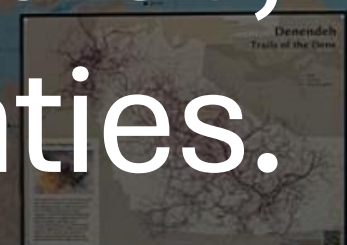
Sewage is emptied into the lagoon via a literal “poop chute”.



A close-up photograph of a traditional oil lamp. The lamp has a dark, possibly metal or ceramic, bowl-shaped body with a wide rim. Inside the bowl, a bright orange and yellow flame is burning. The lamp is supported by a dark, cylindrical pedestal. This entire assembly sits on a rectangular wooden base, which appears to be made of several layers of wood. The lamp is placed on a dark, textured surface that looks like animal skin or fur. In the background, there is a patterned fabric with green and white floral designs. The overall lighting is warm, highlighting the flame and the textures of the materials.

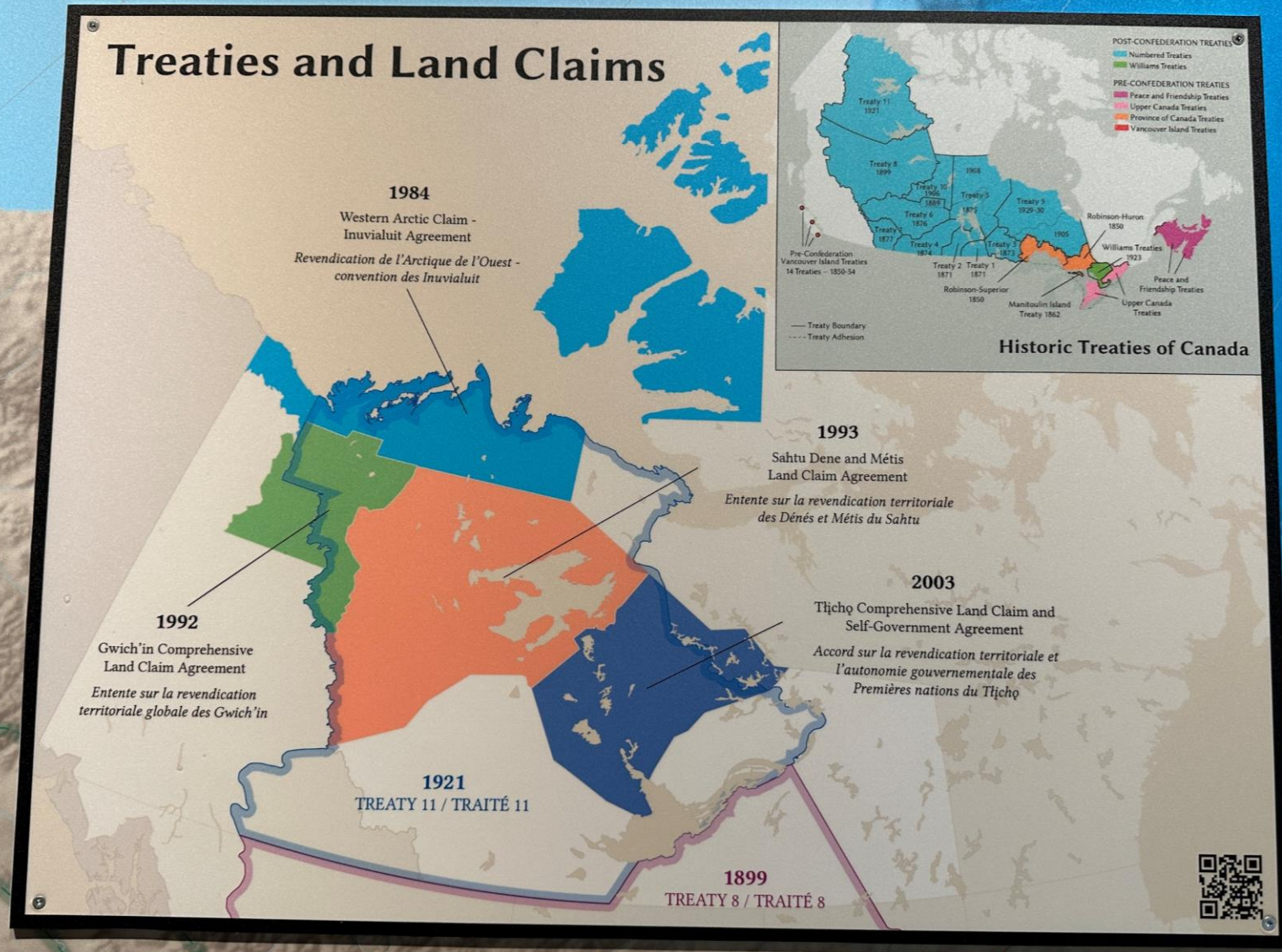
Communities, Culture, and Customs

The North is a vast
landscape of peoples,
cultures, and Treaties.



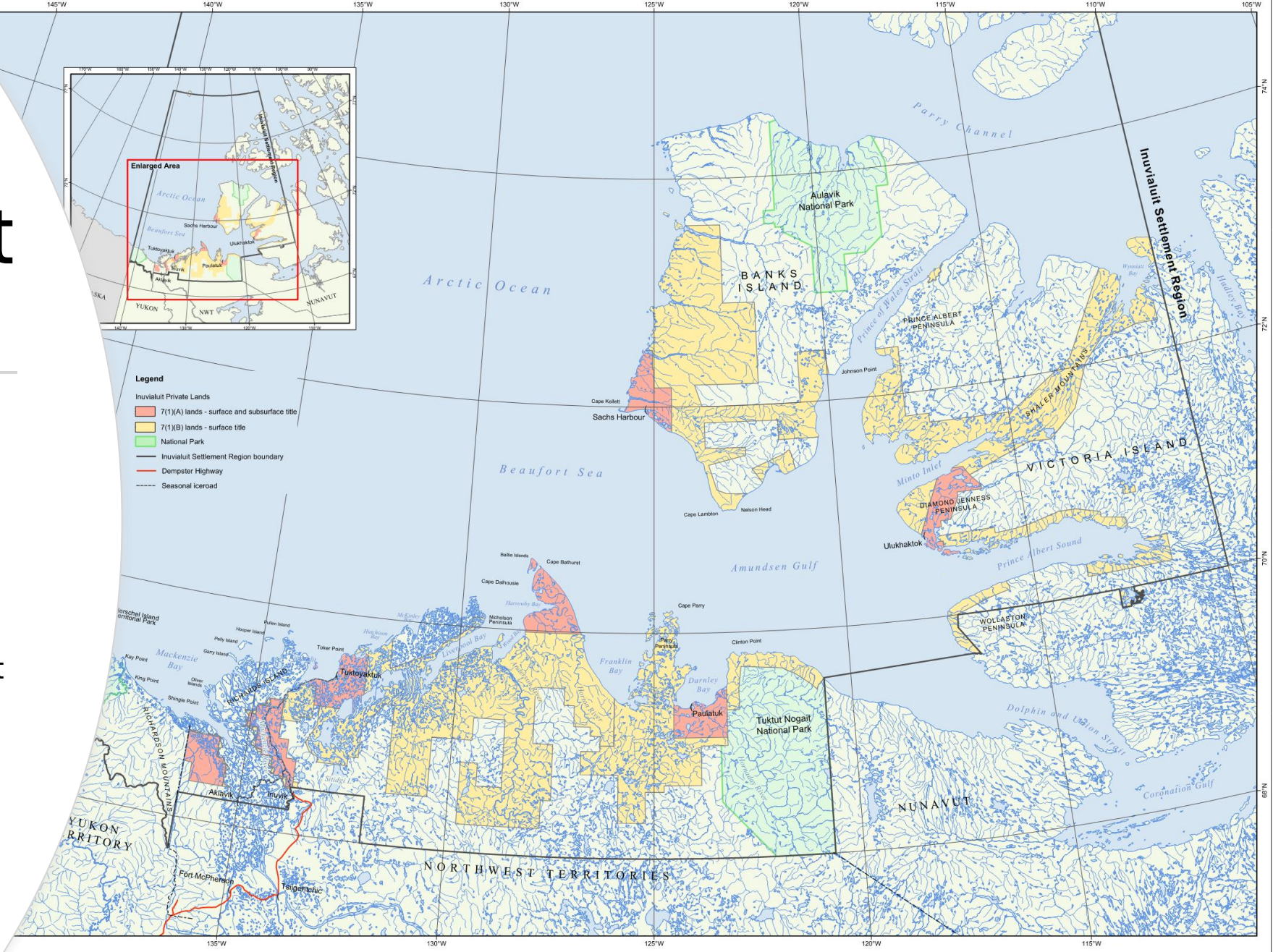
Treaties and Land Claims

- Treaties made between various First Nations and the Crown are binding and enshrined into the Charter of Rights and Freedoms.
- Terms and obligations vary from Treaty to Treaty.
- Some territories fall under Land Claim Agreements with self-government, and deeded ownership.



— Inuvialuit Settlement Region

- Under the Inuvialuit Final Agreement, implemented in 1984 ownership of these lands were transferred from the Government of Canada to the Inuvialuit people.
- Work being done in the ISR must be approved by the Inuvialuit as represented by the Inuvialuit Regional Corporation (IRC).



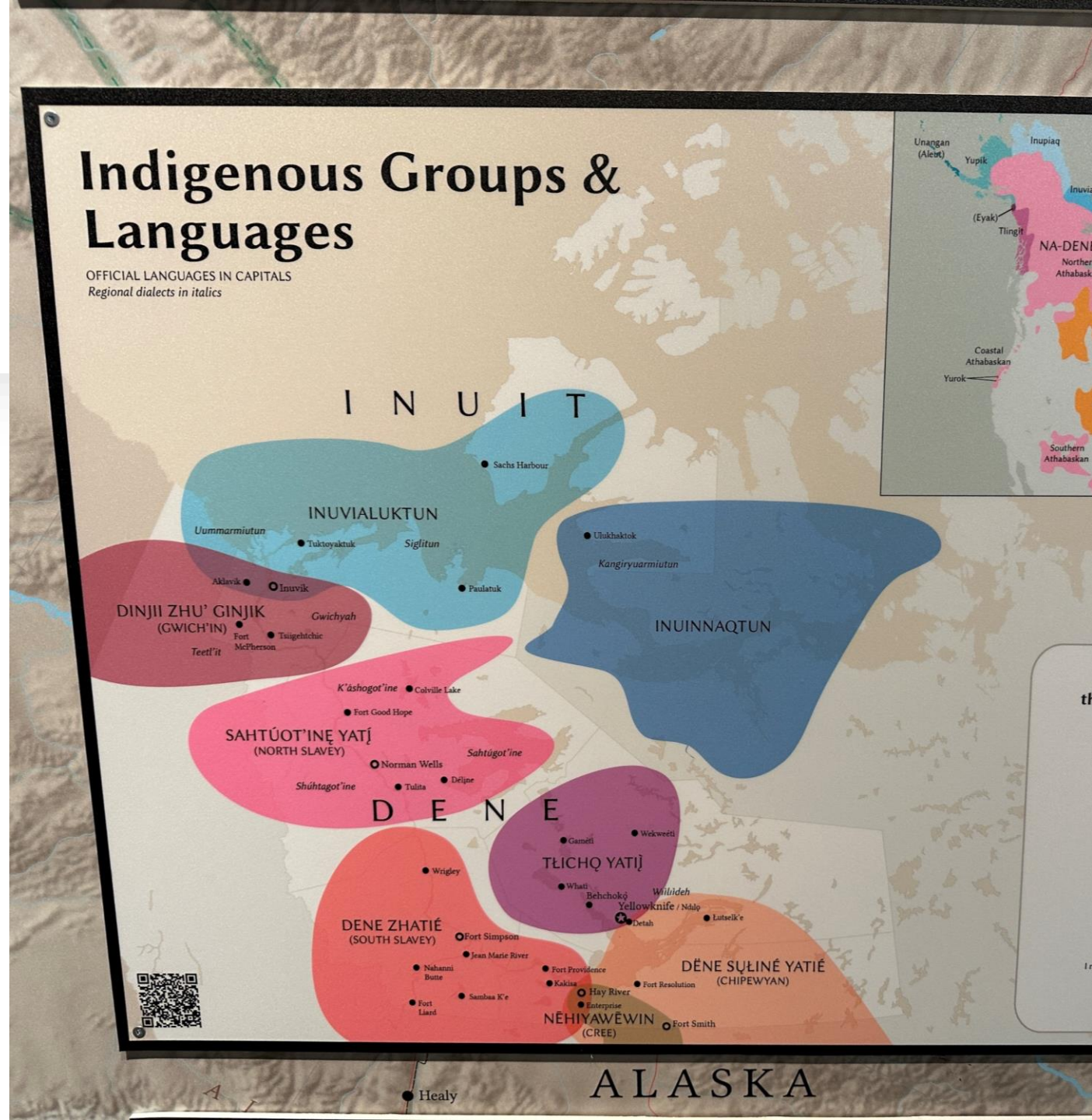
Inuvialuit Land Administration
Leaders in aboriginal land management

Inuvialuit Settlement Region
NORTHWEST TERRITORIES

This map is a general representation, which shows the approximate boundaries of the Inuvialuit Settlement Region. It is not intended to be used as a legal document. The map is based on the best available information at the time of its publication. The map is not intended to be used as a legal document. The map is based on the best available information at the time of its publication. The map is not intended to be used as a legal document. The map is based on the best available information at the time of its publication.

Different Nations and Customs

- The North is home to many different Nations and Cultures.
- Many practice sustenance lifestyles, both out of tradition, and practical need due to high cost of living.
- Many First Nation and Inuit governments place high priority for the well being of animals, and the supporting ecosystems.






Sustenance Lifestyles

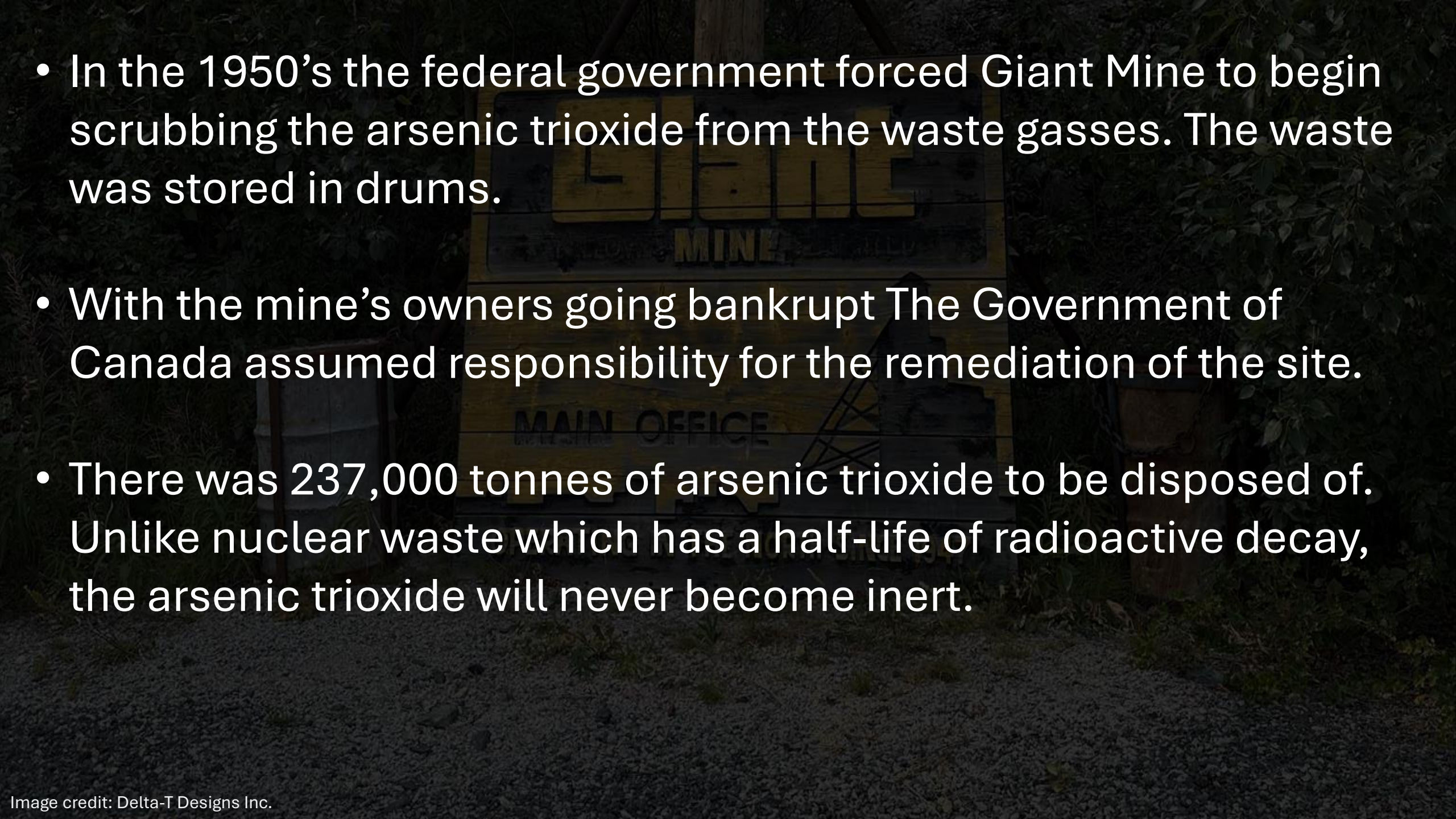
- Many people in the North live sustenance lifestyles meaning that they live off the land in some capacity.
- This includes:
 - Hunting and Fishing for “Country Meats”
 - Fur Trapping for clothing, art, or to sell for income.
 - Gathering of berries, medicines and other vegetation.
- This may be done to for most of their food or to supplement store bought goods due to high costs.
- Project scheduling should factor in hunting and fishing seasons that change regionally due to climate and migration patterns.

Resource extraction is the Past, Present, and Future of the North.



But the past can be quite dark, and affect future industry.

- 
- Giant Mine was a Gold Mine 5km north of Yellowknife, NT.
 - It operated from 1948-2004 and produced over 7,000,000 ozt of Gold.
 - The arsenopyrite ore was rich in gold, and arsenic. The roasting process released arsenic trioxide which is a highly toxic byproduct and water soluble.

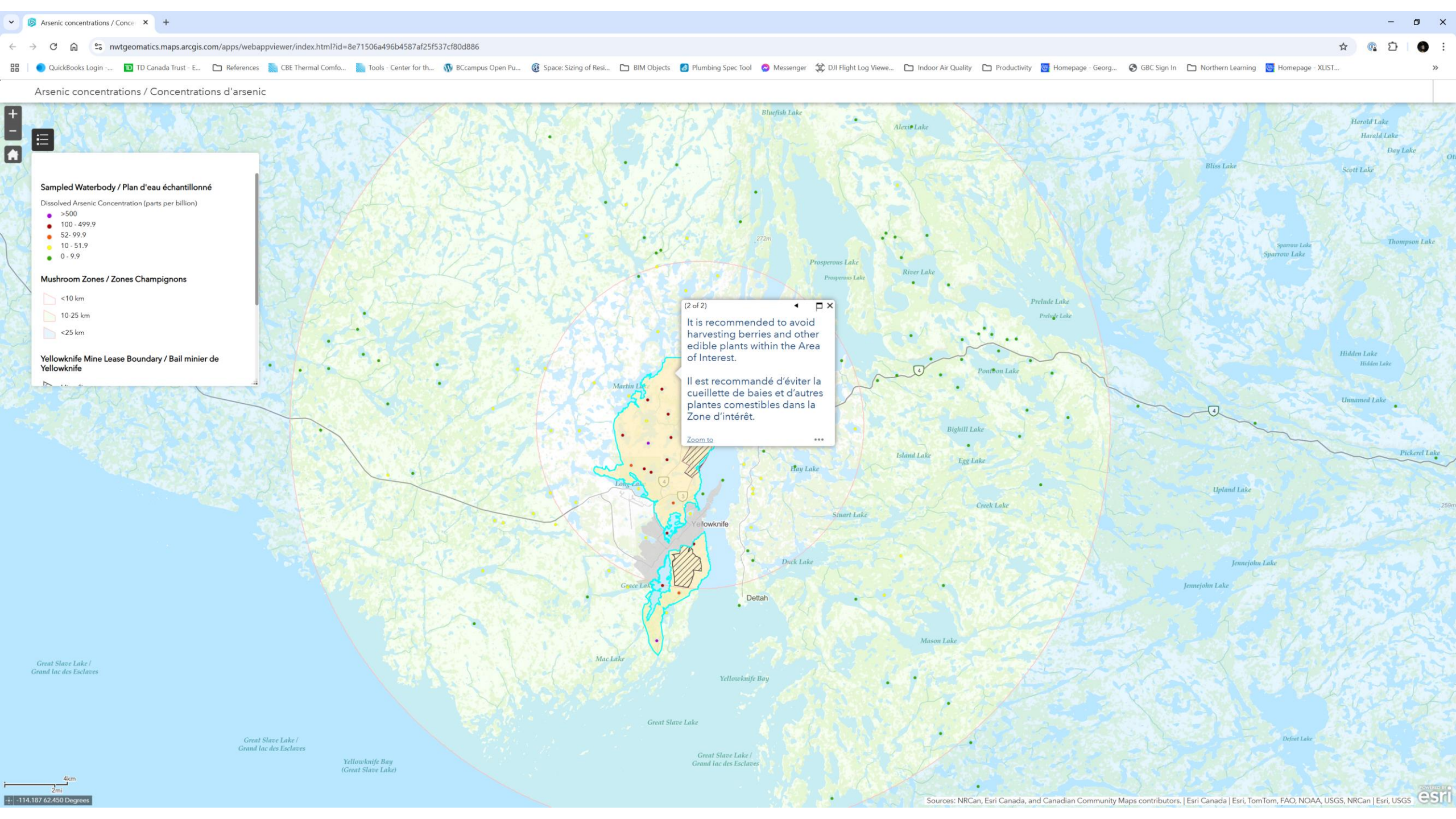
- 
- A wooden sign for the Giant Mine, Main Office, is the central focus of the background image. The sign is made of horizontal wooden planks and has the words "GIANT MINE" in large, bold, black letters at the top, and "MAIN OFFICE" in smaller, bold, black letters below it. The sign is set against a background of dense foliage and a gravel path.
- In the 1950's the federal government forced Giant Mine to begin scrubbing the arsenic trioxide from the waste gasses. The waste was stored in drums.
 - With the mine's owners going bankrupt The Government of Canada assumed responsibility for the remediation of the site.
 - There was 237,000 tonnes of arsenic trioxide to be disposed of. Unlike nuclear waste which has a half-life of radioactive decay, the arsenic trioxide will never become inert.

- The scrubbed arsenic trioxide is being stored in underground mine drifts and frozen to prevent it from leaking into the ground water.
- The Canadian Government is projected to spend \$4.38B between 2005 to 2038 on remediation.



Use this QR code to access the Government of Canada's website on the Giant Mine remediation project.





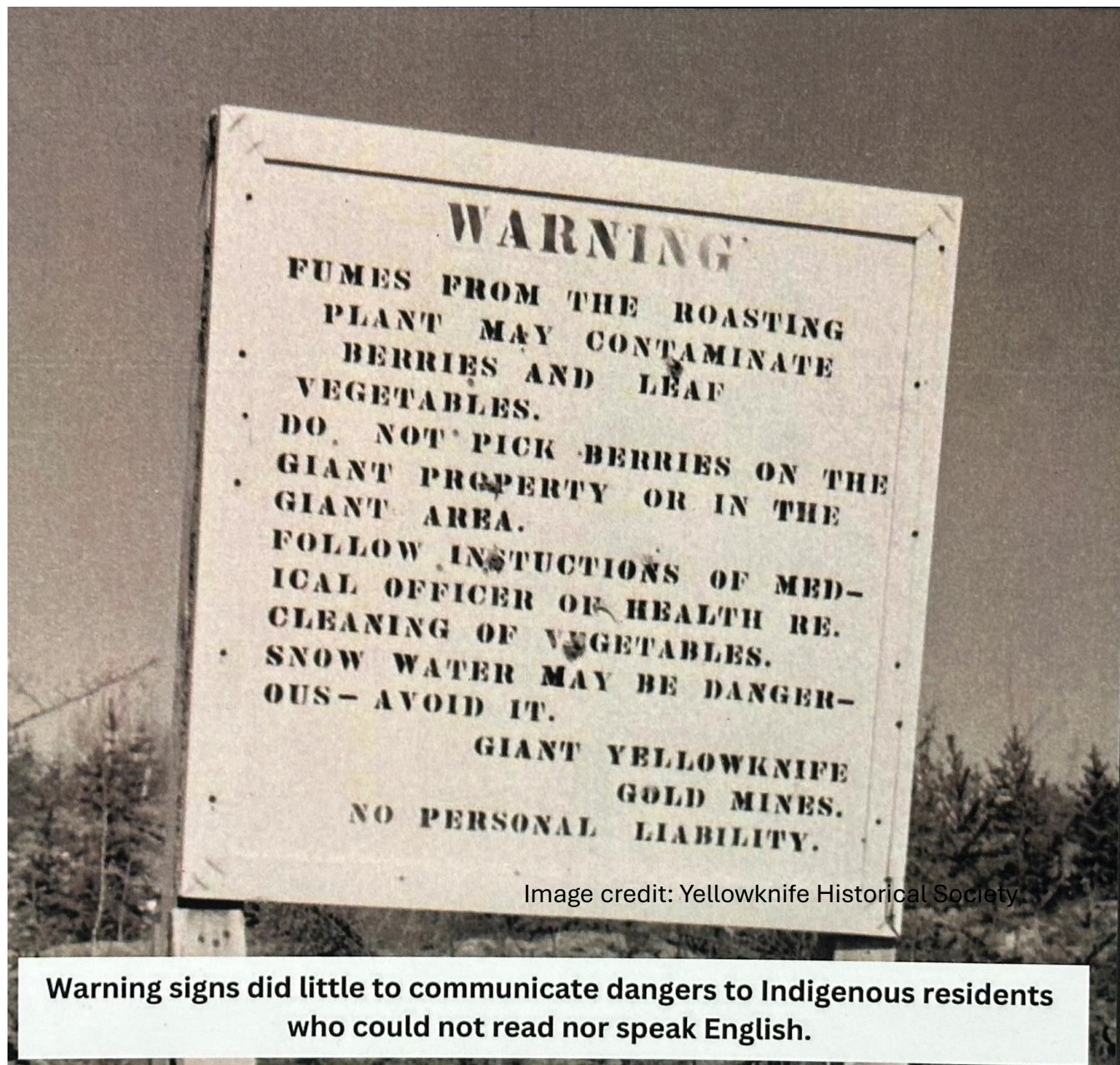


Image credit: Yellowknife Historical Society

Warning signs did little to communicate dangers to Indigenous residents who could not read nor speak English.



Child stands next to weight scale.
Arsenic hair testing in Yellowknife.
Photographer: Richard Ashton

United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)

- On June 21, 2021 the United Nations Declaration on the Rights of Indigenous Peoples Act received Royal Assent and came into immediate force adopting the UNDRIP into Canadian Law.
- Key principals of UNDRIP:
 - Self-determination: Indigenous peoples have the right to determine their political status and freely pursue their economic, social, and cultural development.
 - Land and Resources: Indigenous peoples have rights to the lands, territories, and resources they have traditionally owned, occupied, or used.
 - Free, Prior, and Informed Consent (FPIC): Governments must consult Indigenous peoples and obtain their consent before adopting measures that may affect their rights or territories.
 - Cultural Rights: Indigenous peoples have the right to revitalize, use, develop, and transmit their histories, languages, and traditions.
 - Non-Discrimination: All rights are guaranteed without discrimination, and states must prevent and remedy any discrimination against Indigenous peoples.



Use this QR code to access the Government of Canada's website outlining UNDRIP and Canada's obligations.

Truth and Reconciliation Commission of Canada: Calls to Action



Use this QR code to access
the Government of Canada's
website outlining the TRCC
Calls to Action

Business and Reconciliation

92. We call upon the corporate sector in Canada to adopt the United Nations Declaration on the Rights of Indigenous Peoples as a reconciliation framework and to apply its principles, norms, and standards to corporate policy and core operational activities involving Indigenous peoples and their lands and resources. This would include, but not be limited to, the following:

- i. Commit to meaningful consultation, building respectful relationships, and obtaining the free, prior, and informed consent of Indigenous peoples before proceeding with economic development projects.
- ii. Ensure that Aboriginal peoples have equitable access to jobs, training, and education opportunities in the corporate sector, and that Aboriginal communities gain long-term sustainable benefits from economic development projects.
- iii. Provide education for management and staff on the history of Aboriginal peoples, including the history and legacy of residential schools, the United Nations Declaration on the Rights of Indigenous Peoples, Treaties and Aboriginal rights, Indigenous law, and Aboriginal-Crown relations. This will require skills based training in intercultural competency, conflict resolution, human rights, and anti-racism.

Conclusion and Questions

Where to Learn More?

University of Alaska



Northern Building
Design Course



Fundamentals of
Arctic Engineering
Course

Where to Learn More?

References



ASHRAE Cold-Climate
Buildings Design
Guide



Building in the North
by EB Rice



Nunavut Good
Building Practices
Guideline



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