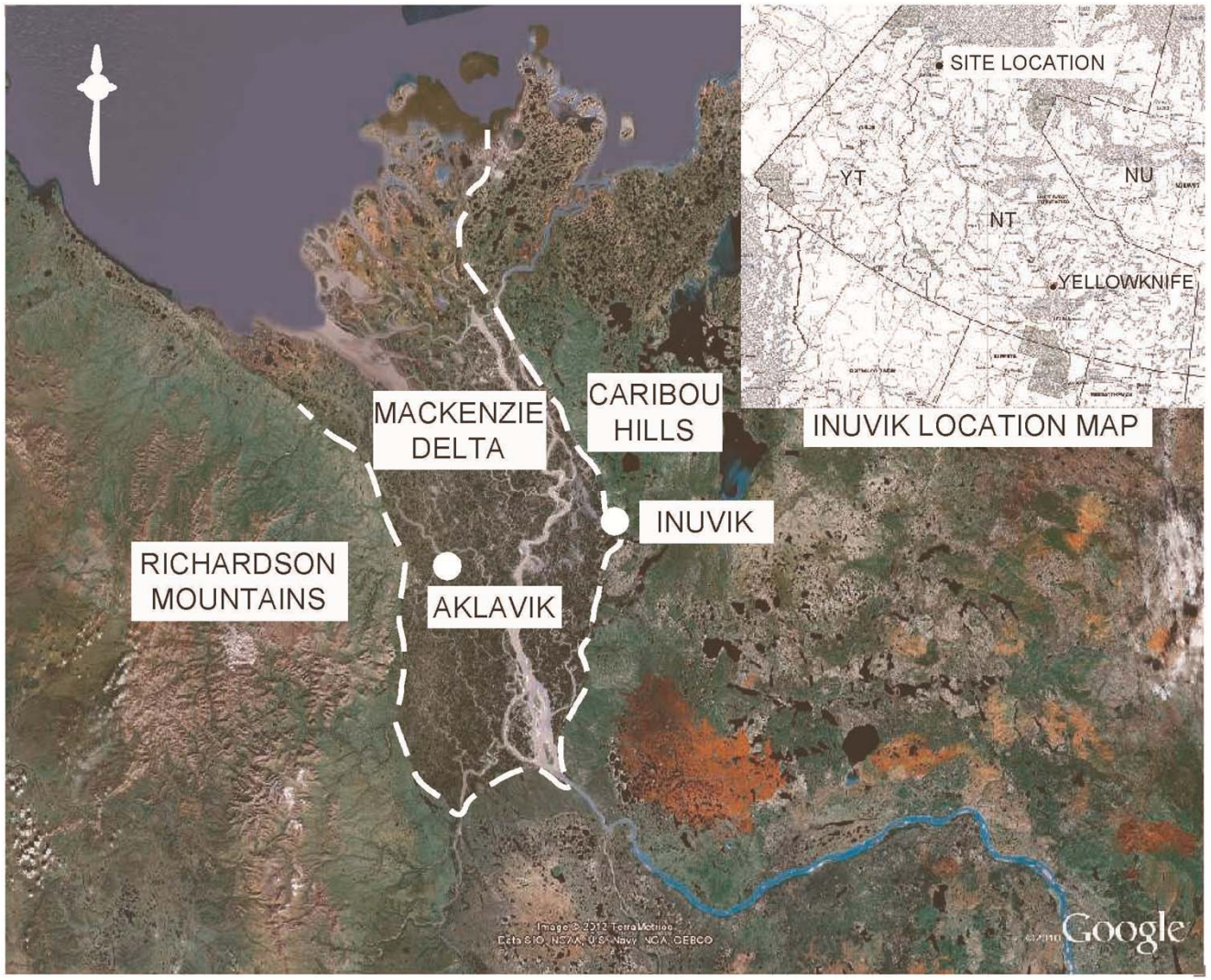
Climate Change Impact on the State of Permafrost at Inuvik, NWT

Presented at Pan-Territorial Permafrost Workshop

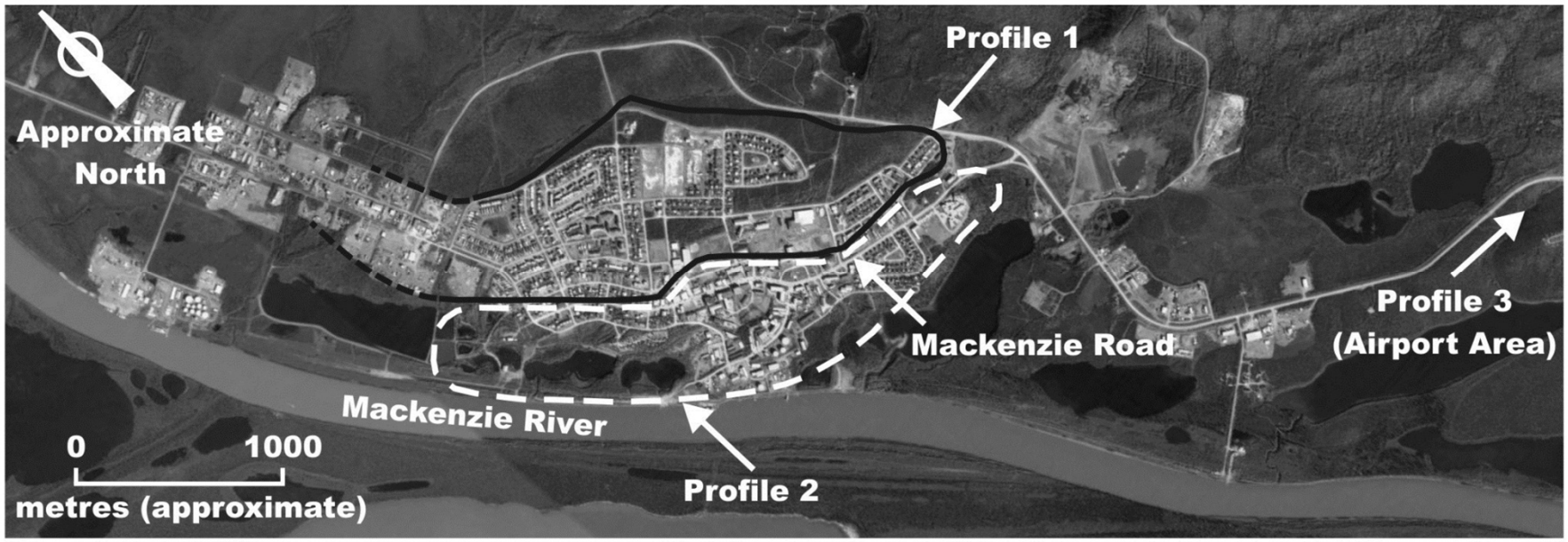
November 6, 2013

creating & delivering | BETTER SOLUTIONS

Inuvik Location/Geography

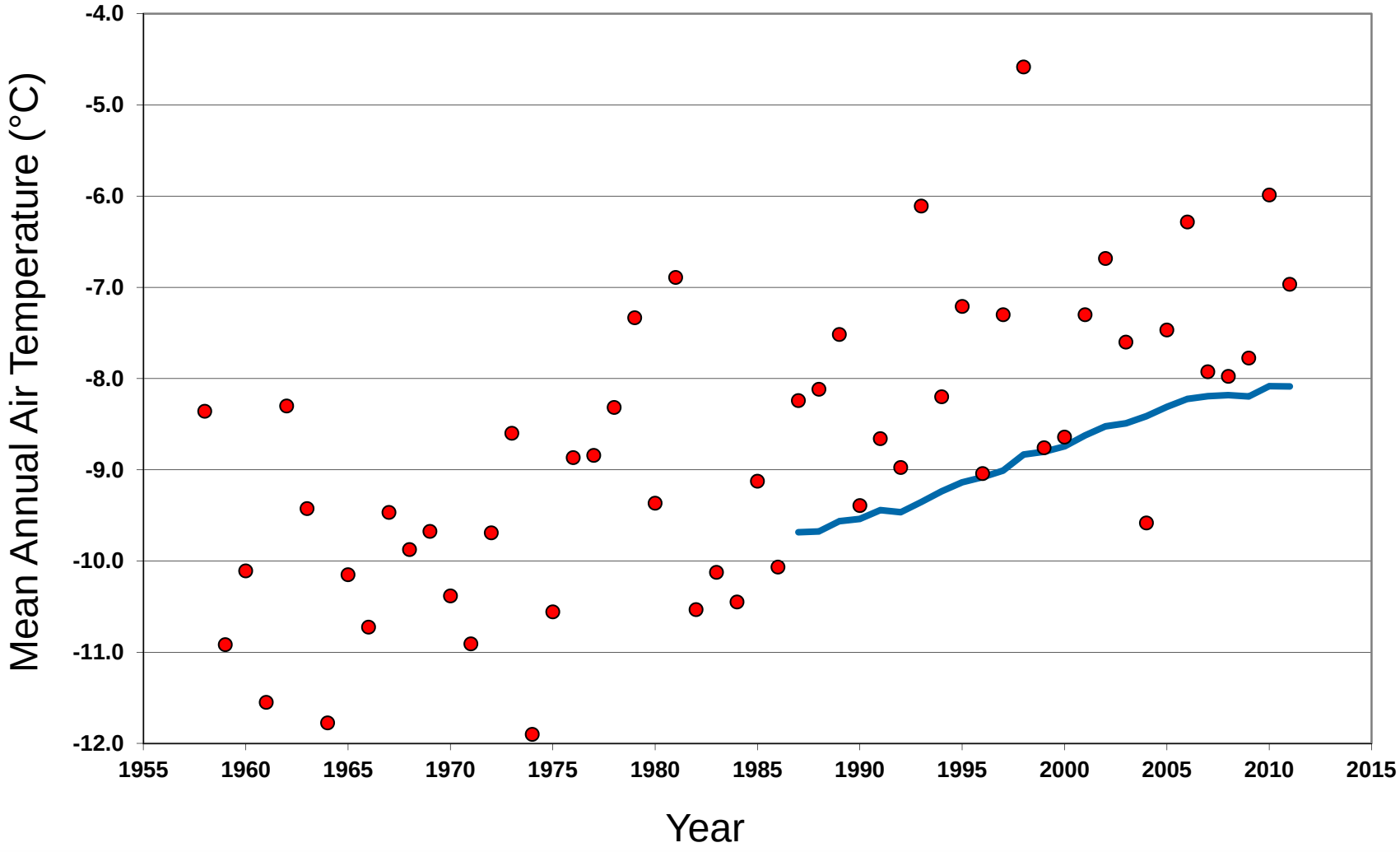


Western Arctic Research Centre Site Location - Geology



From Zhou et al 2008

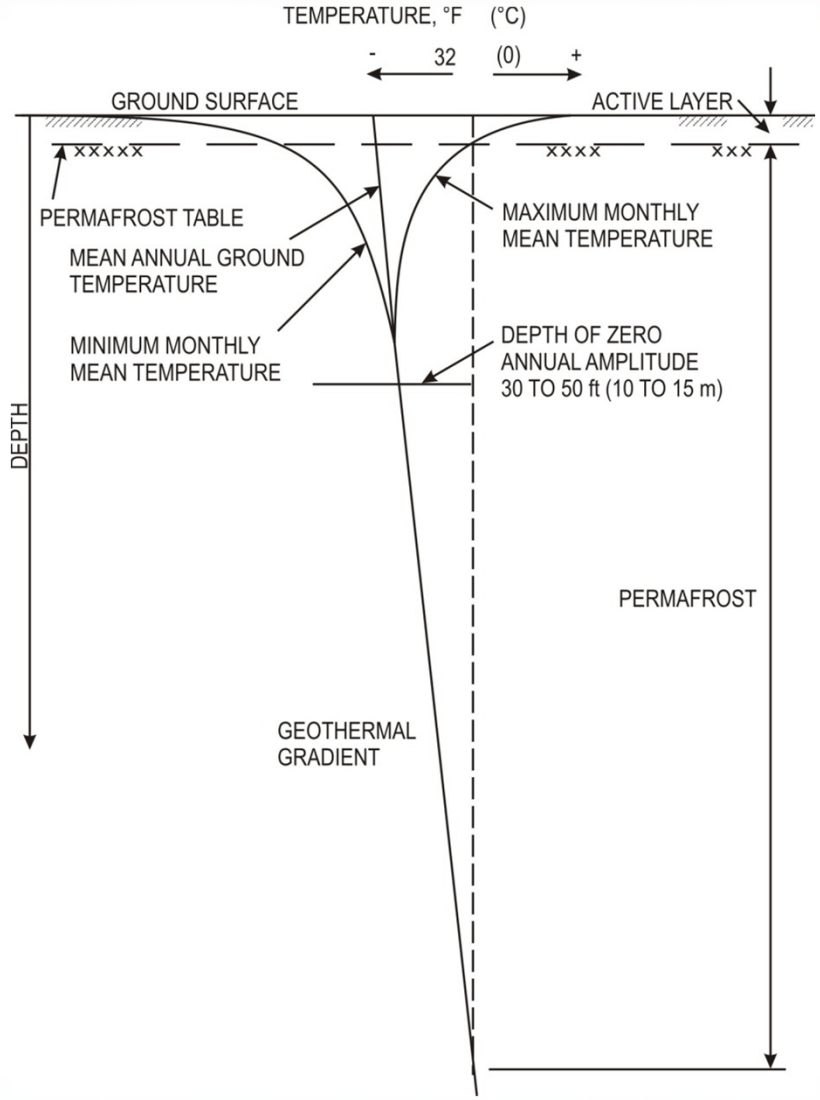
Inuvik Air Temperature Record



Inuvik Climate Data Summary

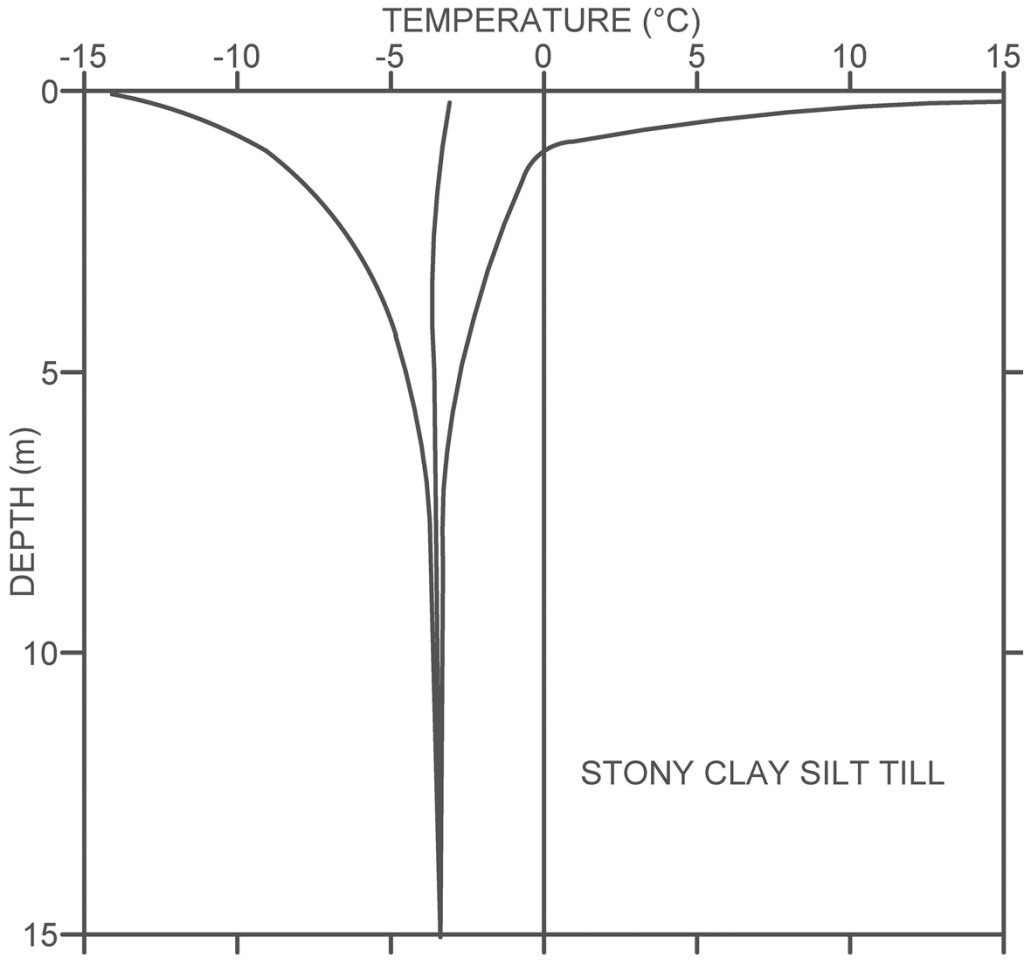
Parameter	1987 30-Year Moving Average	1971-2000 Normal	Current 30-Year Moving Average
Mean Annual Air Temperature (°C)	-9.7	-8.8	-8.1
Freezing Index (C°-days)	4663	4424*	4220
Thawing Index (C°-days)	1168	1270*	1304
Precipitation (mm)	255	248	248**
*these values differ slightly from Environment Canada Normals, as they were calculated from monthly means			
**precipitation data only available until 2006			

Typical Ground Temperature Regime in Permafrost



From Johnston 1981

Inuvik Ground Temperature: mid-1970's

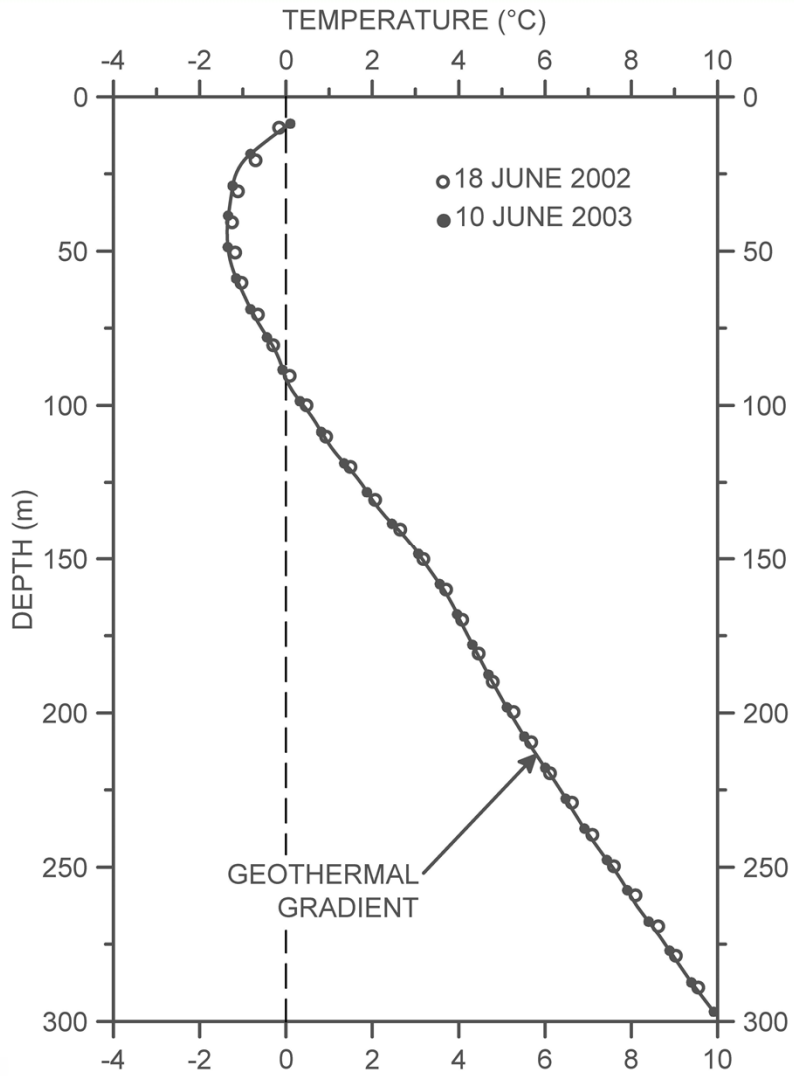


From Johnston 1981

Historical Ground Temperature Summary

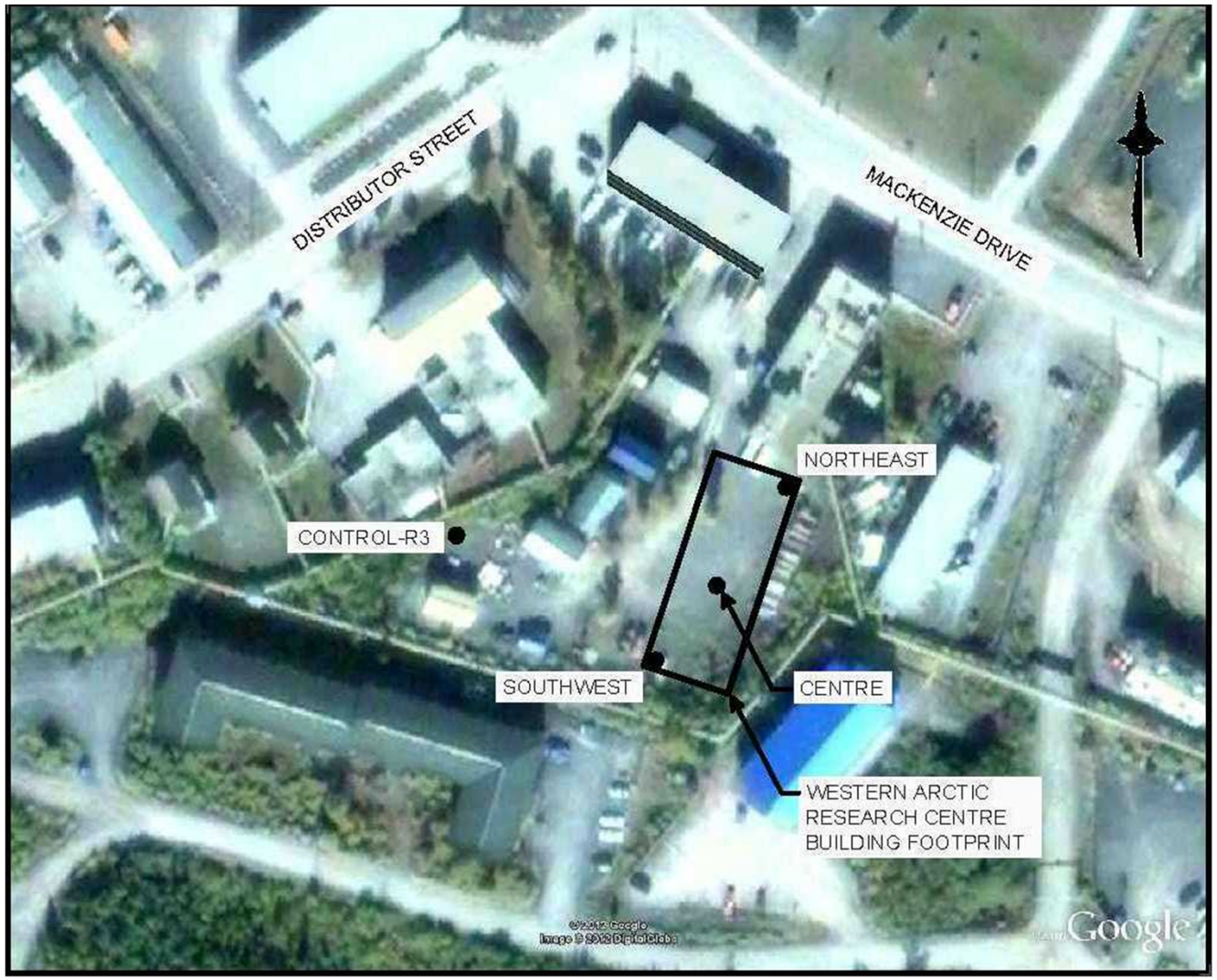
Time/Reference	MAGT (below seasonal fluctuation)	Active Layer Thickness (m)	Ground Temperature Gradient (C°/100 m)
Late 1950's (Pihlainen 1962)	-3.4	2.0 – 2.3	n/a
Early 1960's (Brown 1966)	-2.9 to -4.2	n/a	+3.3
Mid 1970's (Johnston 1981)	-3.4	1.2	+3.6

Navy Road Pit Ground Temperature Profile

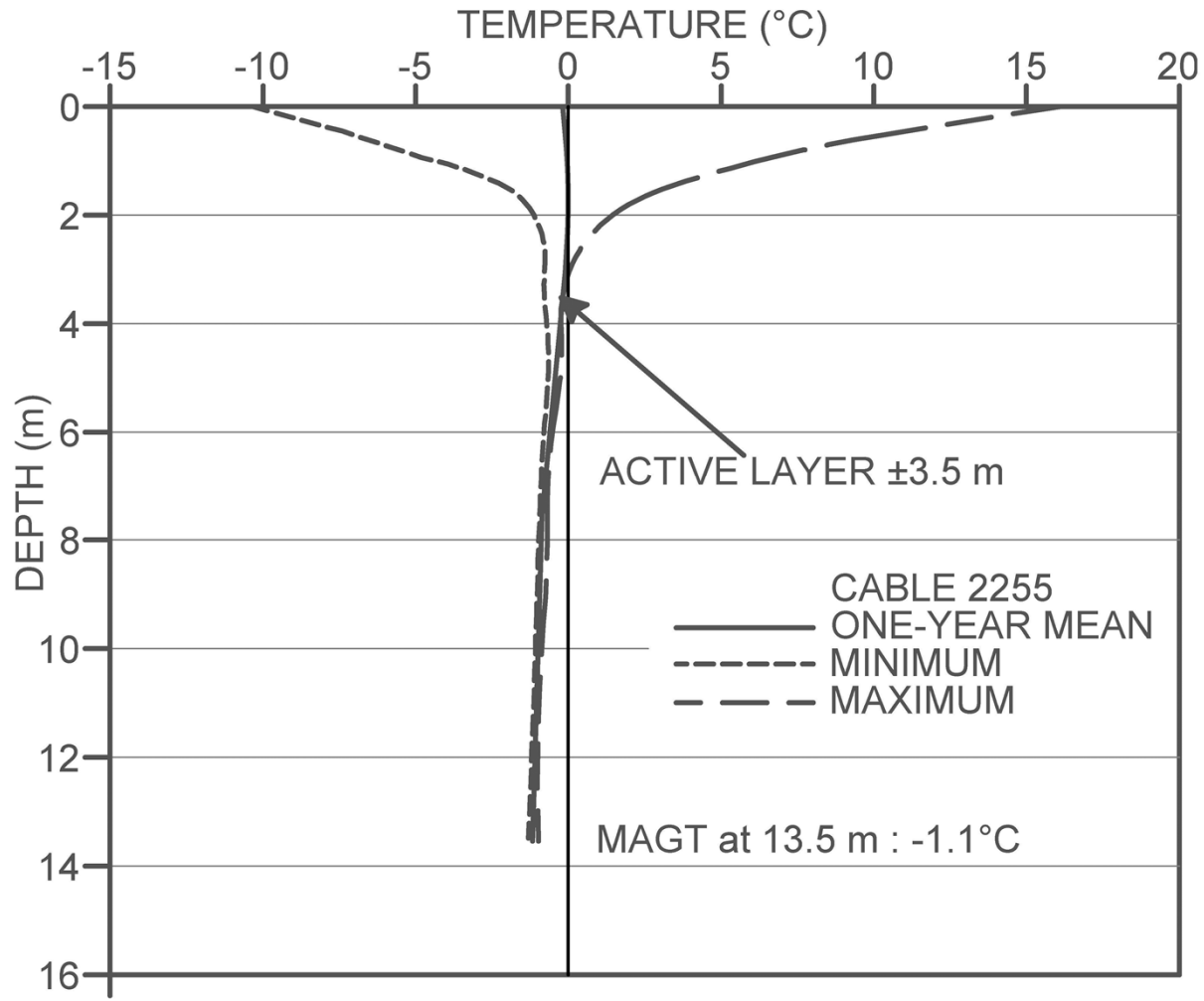


Burn et al, 2009

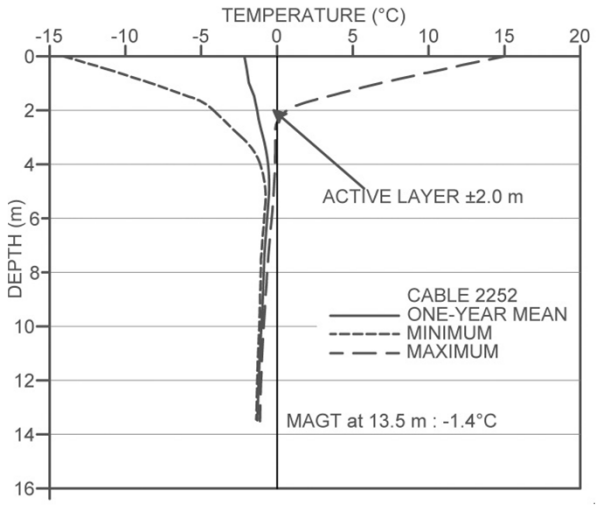
Western Arctic Research Centre Site Plan



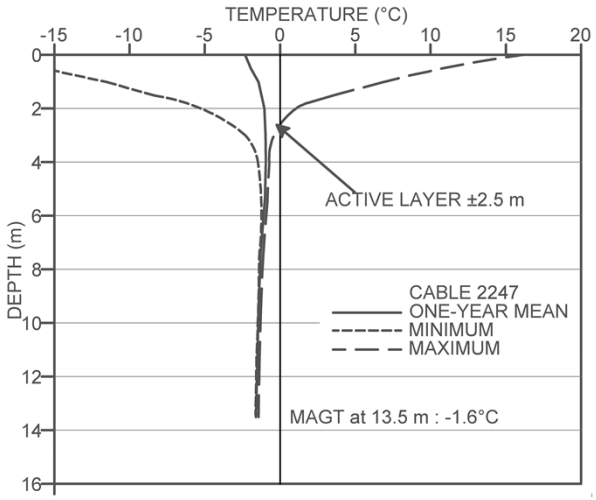
Annual Ground Temperatures at Control, 40 m West of WARC



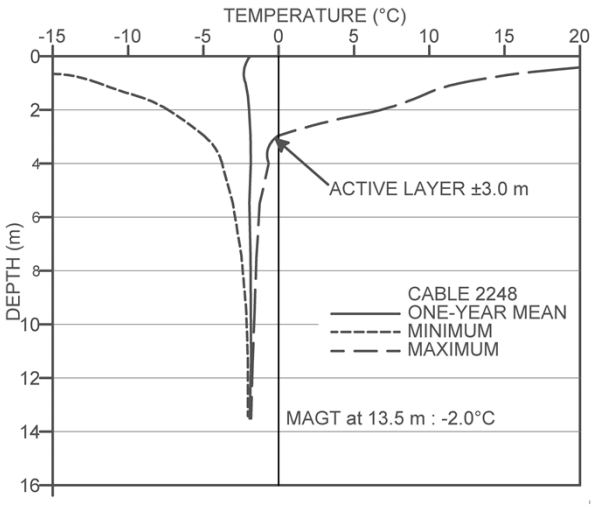
Annual Ground Temperatures Under WARC Building



SW Corner



Centre



NE Corner

WARC Ground Temperature Summary

Cable Location	MAGT (@ 13.5 m; °C)	Active Layer Thickness (m)	Ground Temperature Gradient (C°/100 m)
Control – 40 m W of building	-1.1	3.5	-10.7
SW corner of building	-1.4	2.0	-9.8
Centre of building	-1.6	2.5	-6.6
NE corner of building	-2.0	3.0	-0.9
Averages	-1.5	2.8	-7.0

Conclusions

- Mean annual air temperatures have increased about 2°C since mid-1970's
- Until mid-1970's apparently no significant impact on ground temperatures from community development
- Ground temperatures at WARC about 2°C warmer than in 1950's, apparently changing in step with air temperature
- Active layer thickness has increased by about 0.5 since community development
- Geothermal gradient in the area is about 3 to 5 C°/100 m, reflecting heat flux out of the ground
- Since 1980's ground temperature gradient in the upper 13 to 14 m is about -7 to -10 C°/100 m, reflecting heat flux into the ground
- Theoretical pile capacities have decreased by about 30% due to ground temperature and active layer changes
- Minimum embedments have increased by about 50%

Going Forward…

Questions?

Ed Hoeve: ehoeve@eba.ca
867.766.3728 x222

Thank You!