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Appendix B

Surficial Geology Map of Iqaluit

ACKNOWLEDGMENTS

This work was part of the Nunavut Climate Change Partnership (Mate and Reinhart, 2011) and supported through collaboration between the Canada-Nunavut Geoscience Office, Université Laval and Natural Resources Canada (Geological Survey of Canada). The authors would also like to express their thanks to the city of Iqaluit, Mr. J. Graham, the manager of the Iqaluit airport and his staff, Mr. T. Tremblay from the Canada-Nunavut Geoscience Office and field assistants P. Gosselin, A.-S. Carbonneau and C. Falardeau-Marcoux and to M. Horlink.

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Hodgson, D.A., 2003. Surficial geology, Frobisher Bay, Baffin island, Nunavut; Geological Survey of Canada, Map 2042A, scale 1:100 000.

Hodgson D.A., 2005. Quaternery geology of western Meta Incognita peninsula and Iqaluit area, Baffin Island, Nunavut. Geological Survey of Canada, Bulletin N°582, 72 p.

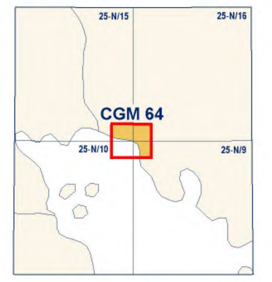
Mate, D. and Reinhart, F. (Ed.), 2011. Nunavut Climate Change Partnership Workshop, February 15-16, 2011; Geological Survey of Canada, Open File 6867, 1 CD-ROM. doi:10.4095/288645

Abstract

This map illustrates the surficial geology of Iqaluit, Nunavut's capital city. Rather flat, sandy and gravelly glaciofluvial and glaciomarine sediments extend under the airport and its surroundings as well as in Apex. Precambrian bedrock with partial and uneven till cover is found under newly built areas on hilly terrain and plateaus. The area is underlain by continuous permafrost, which causes important technical challenges for the maintenance of infrastructure. A larger scale view of the airport sector emphasizes patterned ground features and the networks of frost cracks.

Résumé

Cette carte présente les dépôts de surface de la région d'Iqaluit, capitale du Nunavut. Des dépôts fluvioglaciaires et glaciomarins sableux et graveleux formant des reliefs peu accidentés s'étendent sous l'aéroport et ses environs de même que dans le secteur d'Apex. Le roc précambrien partiellement couvert de till caractérise la plupart des secteurs de construction récente sur les collines et les plateaux. La ville est entièrement bâtie sur le pergélisol continu, ce qui représente un défi technique important pour le maintien de l'intégrité des infrastructures. Une étude à plus grande échelle du secteur de l'aéroport est aussi présentée afin d'illustrer le réseau de sols structurés et de fentes de contraction thermique.



National Topographic System reference

Cover illustration:
City of Iqaluit.
Photograph by A.-M. LeBlanc. 2011-050

Printed map:
Catalogue No. M183-1/64-2011E
ISBN 978-0-660-20140-5
Digital map:
Catalogue No. M183-1/64-2011E-PDF
ISBN 978-1-100-19600-8

doi:10.4095/289503

Natural Resources Canada — Ressources naturelles Canada

CANADIAN GEOSCIENCE MAP 64
(preliminary version)
SURFICIAL GEOLOGY
IQALUIT
Nunavut
1:15 000

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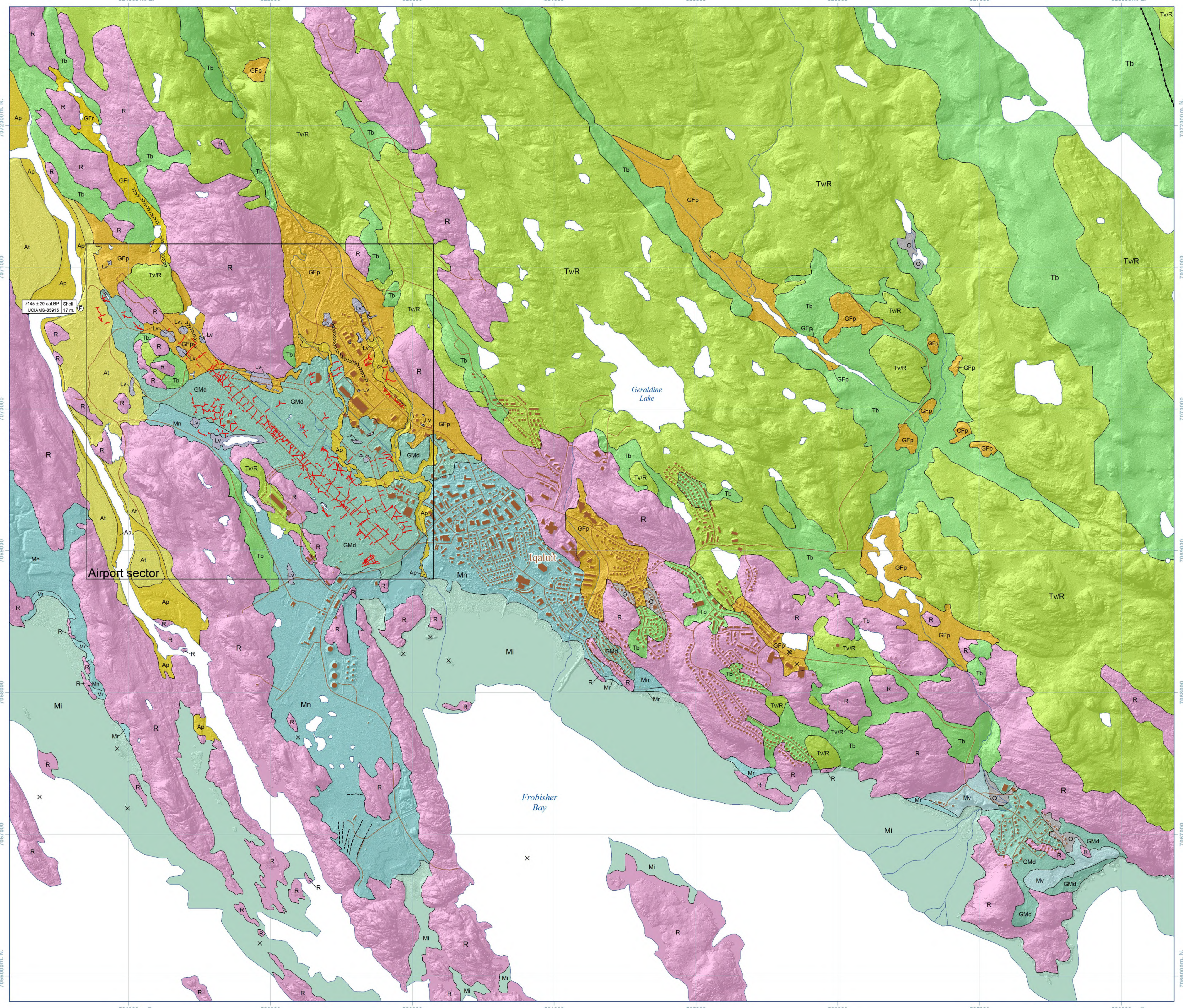

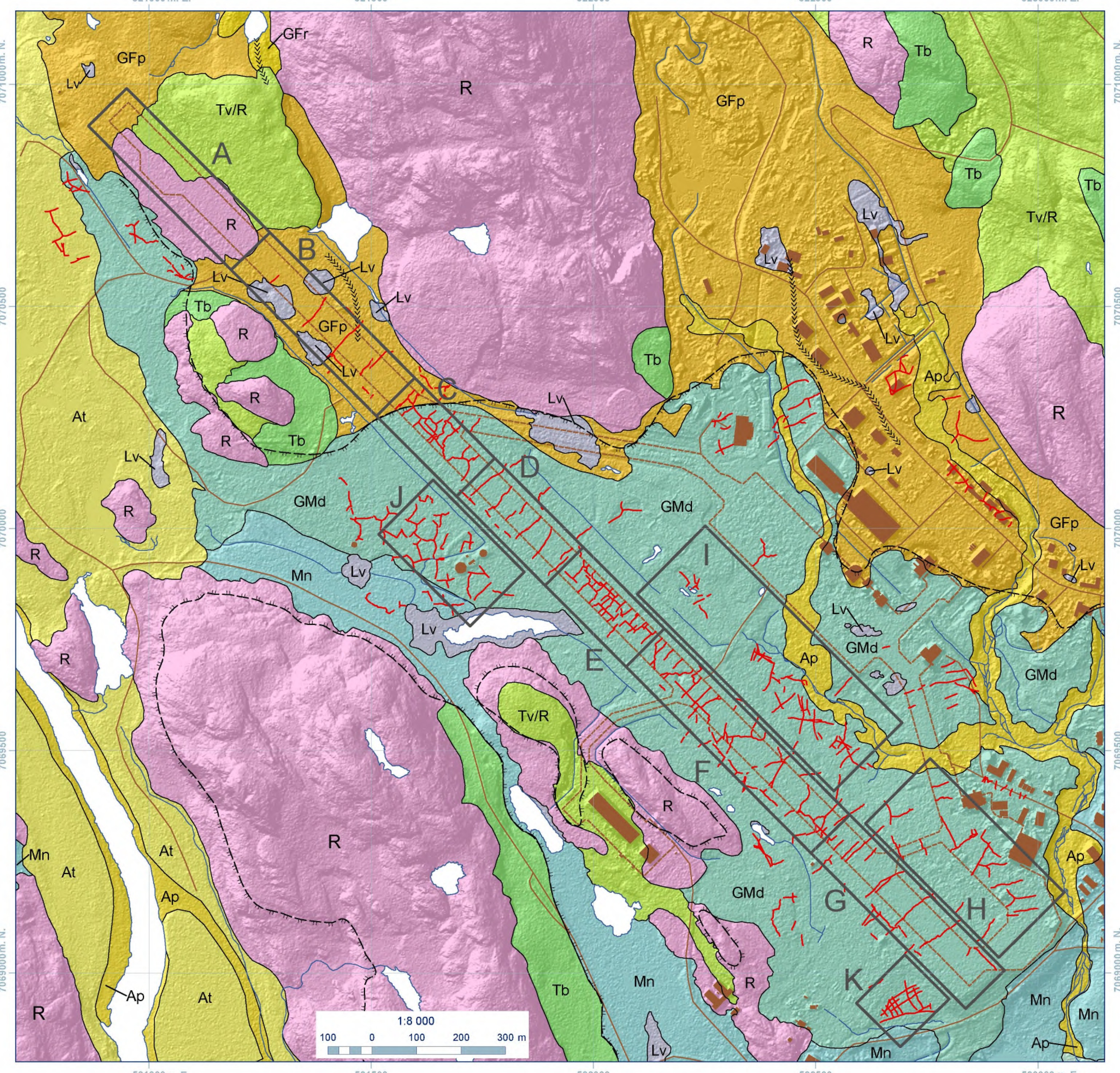

Airport sector: frost crack patterns

This map enlargement shows the surficial geology and frost crack patterns in the Iqaluit airport area. These patterns have been mapped based on ground surveys (2011) and from aerial photographs from 1976 (A24492-86 to 92 and 120 to 125) at the nominal scale of 1:6000. Only the cracks visible on the photographs (the main ones) were mapped. The current interpretation is that in runway sectors with widely spaced frost cracks transverse to the runway (B, D, G), winter frost contraction takes place principally in the thick embankment. Runway sectors on a thin embankment (C, E, F, H) have polygonal cracks patterns similar to nearby natural terrain (I, J, K). Therefore frost cracking would have propagated from the underlying pre-construction patterned ground. Sector A, with no large frost cracks is built on bedrock.

Large crack pattern

Sector	Pattern	Average crack spacing (m)	Interpretation
A	No major frost cracks	0	Runway on cut bedrock
B	Transverse	100	Thick embankment: little or no influence of the pre-construction cracking conditions
C	Orthogonal	45	Relatively thin embankment: pattern similar to natural terrain and influence by pre-construction cracking conditions
D	Transverse	45	Thick embankment: little or no influence of the pre-construction conditions
E	Orthogonal	12 to 30	Relatively thin embankment: pattern similar to natural terrain and influence by pre-construction cracking conditions
F	Transverse, longitudinal and oblique	85 (oblique) 25 (transverse)	Relatively thin embankment: pattern similar to natural terrain and influence by pre-construction cracking conditions
G	Transverse	85	Thick embankment: little or no influence of the pre-constructions conditions
H	Orthogonal	40	Relatively thin embankment: pattern similar to natural terrain and influence by pre-construction cracking conditions
I	Orthogonal non-oriented	2 to 60	Natural terrain: cracking pattern influenced by soil properties
J	Hexagonal (isotropic)	45 (larger ones) 25 (smaller ones)	Natural terrain: cracking pattern influenced by soil properties
K	Orthogonal oriented	30 (larger ones) 15 (smaller ones)	Natural terrain: cracking pattern influenced by soil properties

Table 1. Large crack pattern

QUATERNARY
HOLOCENE SEDIMENTS

O — ***Undifferientiated organic deposits:*** *thin organic rich soils in poorly drained sites.*

Alluvial and lacustrine deposits

Ap — ***Alluvial floodplain sediments:*** *gravel, sand, boulders, minor silt, and muck; 1–10 m thick; deposited in braidplains; actual floodplain.*

At — ***Alluvial terraced sediments:*** *gravel, sand, boulders, minor silt, and muck; 1–10 m thick on raised fluvial terraces. Ice-wedges present in the near surface permafrost.*

Lv — ***Lacustrine veneer:*** *gravel, sand, silty sand, and silt deposited in a lacustrine environment; includes allochthonous organic sediment and drained kettle lake sediments; may include reworked sediments from underlying units; includes drained kettle lake sediments.*

Actual marine deposits

Mi — ***Intertidal sediments:*** *silt and sandy silt deposited in the intertidal zone; mostly bouldary mudflats. No permafrost expected.*

Mr — ***Littoral and nearshore sediments:*** *sediments deposited as beaches. Permafrost may be present.*

Postglacial marine deposits: *sediments deposited during post-glacial regression of a high sea level.*

Mn — ***Littoral and nearshore sediments:*** *sand, silty sand, gravelly sand, and gravels generaly stratified and well sorted; deposited as beaches where ice wedges in permafrost may be occasionally present.*

Mv — ***Marine veneer:*** *sand, silty sand, gravelly sand, and gravel; 0.5–2 m thick; discontinuous cover of littoral and offshore sediments; characterised by beach ridges. Ice wedges occasionally present.*

Glaciomarine deposits: *sediments deposited in the high pro-glacial sea.*

GMd — ***Glaciomarine delta:*** *sand, silt, boulders, and gravel; 2–20 m thick; massive to crossbedded sediments that coarsen upwards in ice-contact deposits or at termination of outwash trains or meltwater channels; deposited in a higher postglacial sea. Near surface deposits are affected by extensive ice-wedge networks.*

Glaciofluvial deposits: *sediments deposited by meltwater behind, at, and in front of ice margins.*

GFr — ***Glaciofluvial esker deposits:*** *poorly stratified to sorted gravel, sand, and boulders; 5–20 m thick; forming ridges and hummocks; sediments deposited by meltwater behind, at, and in front of ice margins. May contain ice wedges and massive ice bodies.*

GFp — ***Glaciofluvial subaerial outwash plain:*** *stratified gravel and sand; 1–30 m thick; proglacial floodplains, terraces, and fans; includes kame terraces, buried esker ridges, minor subglacial, and subaquatic deposits, locally kettled: sediments deposited by meltwater behind, at, and in front of ice margins. May contain ice wedges and massive ice bodies.*

PLEISTOCENE AND EARLY HOLOCENE

Till: *sediments deposited in subglacial and ice-marginal environments.*

Tb — ***Till blanket:*** *diamicton; sand, gravel, and boulders in a silty sand matrix; 1–10 m thick; generally masks bedrock structure; also appears in end moraines; affected by periglacial processes such as solifluction lobes, frost boils, and sorted patterns. Susceptible to thaw slumping on slopes or in excavations.*

Tv — ***Till veneer:*** *diamicton, contains sand, stones, and boulders in a silty sand matrix; 0.5–2 m thick; bedrock topography is evident.*

PRE-QUATERNARY

R — ***Bedrock:*** *Precambrian.*

Geological boundary
Esker ridge
Moraine
Limit of submergence, glaciomarine - approximate
Beach crest
Frost cracks and ice wedge furrows- most evident
2006 drainage network
× *Bedrock outcrops*
Date / Material / Lab no / Elev.(m) — *^{14}C date location*
G — *Limit and label of frost cracks pattern sectors - airport area*

Recommended citation:
Allard, M., Doyon, J., Mathon-Dufour, V., LeBlanc, A.-M., L'Hérault, E., Mate, D., Oldenborger, G.A., and Sladen, W.E., 2012. Surficial geology, Iqaluit, Nunavut; Geological Survey of Canada, Canadian Geoscience Map 64 (preliminary version), scale 1:15 000. doi:10.4095/289503

Authors: M. Allard[1], J. Doyon[1], V. Mathon-Dufour[1], A.-M. LeBlanc[2], E. L'Hérault[1], D. Mate[3], G.A. Oldenborger[2], and W.E. Sladen[2]
[1] Centre for Northern Studies, Université Laval, Quebec
[2] Natural Resources Canada, Ottawa
[3] Canada-Nunavut Geoscience Office (CNGO), Iqaluit

Geology by M. Allard, J. Doyon, and V. Mathon-Dufour, 2010

Surficial and periglacial-permafrost geology mapping based on ground surveys (2010–2011; M. Allard, V. Mathon-Dufour, J. Doyon, E. L'Hérault and A-M. LeBlanc), and air photo interpretation by M. Allard, V. Mathon-Dufour and J. Doyon using 1:20 000 scale black and white vertical photos, flight line A11535, July 23, 1948, photos 1–43.

Cartography by J. Doyon, V. Mathon-Dufour, and R. Boivin

Map projection Universal Transverse Mercator, zone 19. North America Datum 1983

Infrastructure on this map provided by the city of Iqaluit, 2010.

SURFICIAL GEOLOGY
IQALUIT
Nunavut
1:15 000

250 0 250 500 750 1000 1250 1500 m

Shaded relief image prepared by J. Doyon and derived from digital elevation model created from 50cm Worldview-1 stereo satellite images acquired August 19, 2008. 1m DEM created with proprietary stereo image matching process by PhotoSat Information Ldt.

Illumination: azimuth 315°, altitude 45°, vertical factor 1x.

Proximity of the North Magnetic Pole causes the magnetic compass to be erratic in this area.
Magnetic declination 2012, 29°58'W, decreasing 25.0' annually.

This publication, including digital data, can be downloaded free of charge from GeoPub (http://geopub.nrcan.gc.ca/). It is also available from the Geological Survey of Canada Bookstore (http://gsc.nrcan.gc.ca/bookstore).

CANADIAN GEOSCIENCE MAP 64
(preliminary version)
SURFICIAL GEOLOGY
IQALUIT
Nunavut

Four trim marks around perimeter of map sheet. Trim map sheet first, then fold at folding marks.

Cover and additional panels are 17cm wide when folded.

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Appendix C

Field Photographs

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Iqaluit Airport	Iqaluit, NU	60615382

Photo No.	Date:	
1	29/10/2019	
Direction Photo Taken: Looking south-West		
Description: Completing Private Locates in the vicinity of MW19-01		
Photo No. 2	**Date:** 29/10/2019	
Direction Photo Taken: Looking Northwest		
Description: Completing Private Locates in the vicinity of MW19-03		

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Iqaluit Airport	Iqaluit, NU	60615382

Photo No.	Date:	
3	30/10/2019	
Direction Photo Taken: Looking North-East		
Description: Drilling MW19-01		

Photo No.	Date:	
4	30/10/2019	
Direction Photo Taken: Looking North-West		
Description: Semi-completed MW19-02. The PVC riser was later cut short and the stick up box was locked.		

Photo No.	Date:	
5	30/10/2019	
Direction Photo Taken: Looking West		
Description: Drilling of MW19-03.		

Photo No.	Date:	
6	30/10/2019	
Direction Photo Taken: Looking South		
Description: Completed MW19-01.		

PHOTOGRAPHIC LOG

Site Name: Iqaluit Airport	Site Location: Iqaluit, NU	Project No. 60615382

Photo No. 7	Date: 30/10/2019	
Direction Photo Taken:		
Description: Typical soil cutting generated by air-rotary drilling		

Photo No. 8	Date: 01/11/2019	
Direction Photo Taken:		
Description: The surface water body downgradient of MW19-01		

PHOTOGRAPHIC LOG

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Site Name:	Site Location:	Project No.
Iqaluit Airport	Iqaluit, NU	60615382

Photo No.	Date:	
9	29/10/2019	
Direction Photo Taken: Looking North		
Description: View of Iqaluit Airport old building (yellow colour) from location of MW19-02		

Photo No.	Date:	
10	03/11/2019	
Direction Photo Taken: Looking North-West		
Description: View of Iqaluit Airport runway just upgradient from location of MW19-03.		

Site Name: Iqaluit Airport	**Site Location:** Iqaluit, NU	**Project No.** 60615382

Photo No. 11 **Date:** 04/11/2019	
Direction Photo Taken:	
Description: Efforts to collect groundwater sample using low-flow sampling. Temperature was around -9 and groundwater temperature was at 0°C. The water got frozen as soon as it was pumped out of the well in the tubing and YSI flow cell.	
Photo No. 12 **Date:** 04/11/2019	
Direction Photo Taken:	
Description: Brought the pump, YSI and the flow cell inside the car to melt the ice clogging the flow, but the water still got frozen in the piece of tubing inside the well and make low flow pumping not feasible.	

PHOTOGRAPHIC LOG

Site Name:	Site Location:	Project No.
Iqaluit Airport	Iqaluit, NU	60615382

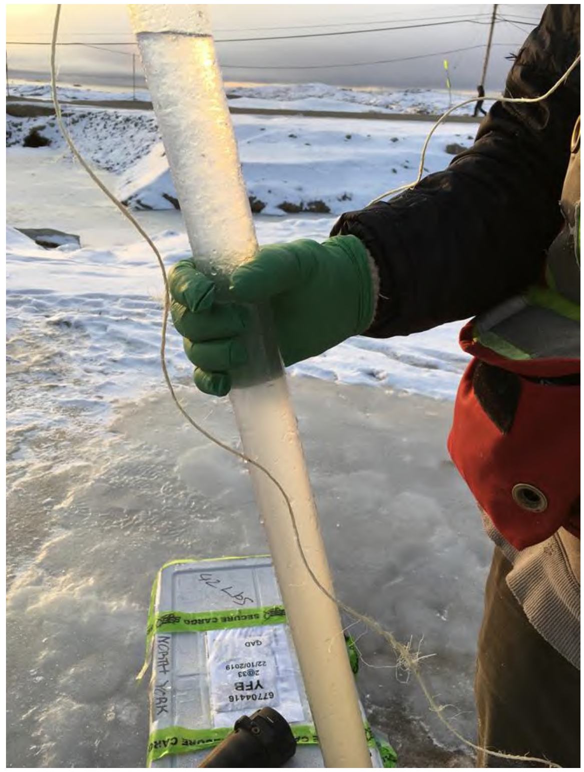
Photo No.	Date:	
13	05/11/2019	
Direction Photo Taken:		
Description: Switched to using bailers for collecting samples. The temperature was still around -10 °C. The groundwater in the bailer was slushy and started freezing immediately.		

Photo No.	Date:	
14	29/10/2019	
Direction Photo Taken:		
Description: Decontamination of drilling hammer with laboratory-supplied PFAS-Free water and PVC brush prior to collecting the equipment rinsate blank		