TECHNICAL MEMORANDUM

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TO:	Mr. Larry Connell Agnico-Eagle Mines Limited	**DATE:**	April 4, 2008
FROM:	Jianfeng Chen, Ben Wickland	**JOB NO:**	07-1413-0119/4000
REVIEWED BY:	John Hull	**DOC NO:**	646 Ver. 0
EMAIL:	jfchen@golder.com, bwickland@golder.com & jhull@golder.com		
RE:	**INAC REVIEW BY BRODIE CONSULTING LTD ON MEADOWBANK RECLAMATION COST ESTIMATE, MEADOWBANK GOLD PROJECT, NUNAVUT**		

The purpose of this technical memorandum is to address comments in the report prepared for INAC: Meadowbank Gold Project Reclamation Cost Estimate, by Brodie Consulting Ltd., March 2008 (Brodie 2008).

Issues raised by Brodie (2008) and responses are summarized in Table 1.

TABLE 1: Summary of Issues and Responses

Issue	Response
Closure costs predicted in Brodie (2008) do not allow for progressive reclamation of the tailings area.	The south cell of the TSF would or could be covered during operations and will therefore reduce closure costs.
Supply and availability of Non-PAG rock for use as cover material is questioned.	Required quantity of non-potentially acid generating (NPAG) rockfill for all construction on site, including covers, roads, and mill foundation is 6 Mm^3. Production is 24 Mm^3.
Brodie (2008) recommends the design thickness of rockfill covers be increased to 5 m, based on measurements at Ekati Diamond Mine.	A rockfill cover design thickness of 2 m is sufficient for the Meadowbank site, based on climate data, permafrost record, and thermistor measurements.

1.0 PROGRESSIVE RECLAMATION

As an assumption for the cost estimate for closure, Brodie (2008 page 6) assumes that no progressive reclamation is conducted. However, progressive closure is part of the mine plan as described in Section 12, Meadowbank Gold Project, Preliminary Reclamation and Closure Plan, Document 511, dated August 27, 2007. Overall project progressive reclamation activities are scheduled from Year 4 to Year 10.

Elements necessary for progressive reclamation on the tailings storage facility (TSF) – portion of the site include:

1. sufficient quantity of suitable rockfill cover available at time of reclamation,
2. sufficient area of tailings facility available, with time during operations for implementation of reclamation works,
3. mine construction equipment with sufficient production rates; and
4. consideration of requirements for blasting of re-handled material due to freezing if needed.

A sample scenario for progressive reclamation of the south cell of the TSF is illustrated in Figure 1, including volume requirements for rockfill cover and placement rates. Figure 1 illustrates that progressive reclamation is feasible.

1.1 Quantity of Rockfill Available

Rockfill for cover construction must be acid buffering or non-potentially acid generating (NPAG). Ultramafic rock (UM) is significantly acid buffering. Quartzite (Q) rock is almost pure sililca and only occasionally contains sulphides. The mixed combination of UM+Q rock fill types is therefore NPAG in the proportions indicated in MMC Mine Waste & Water Management. Document 500. August 2007, listed in Table 2.

TABLE 2: NPAG Rockfill Production

		Portage Pit		Goose Pit		Total (tonnes)	Volume NPAG (m^3)
	Year	**UM (tonnes)**	**Q (tonnes)**	**UM (tonnes)**	**Q (tonnes)**		
-2	2008	234,300	-	-		234,300	123,316
-1	2009	488,600	42,600	-		531,200	279,579
1	2010	7,350,600	21,600	-		7,372,200	3,880,105
2	2011	5,060,200	-	9,278,700	2,080,500	16,419,400	8,641,789
3	2012	4,748,300	285,300	7,501,100	442,700	12,977,400	6,830,211
4	2013	4,720,800	562,800	986,800	-	6,270,400	3,300,211
5	2014	1,538,500	22,000			1,560,500	821,316
6	2015					-	-
7	2016					-	-
8	2017					-	-
9	2018					-	-
10	2019					-	-
	Total						23,876,526

Source: MMC Mine Waste & Water Management. Document 500. August 2007. Volumes converted from tonnages assuming 1.9 t/m3 for UM+Q rock types

Total quantity of NPAG rockfill required for all construction, including capping for the Portage RSF, Vault RSF, and Portage TSF, roads, airstrip, and mill foundation was previously estimated at 6.3 Mm3 (Detailed Design of Central Dike, Doc. 420, March 2007).

By the production schedule in Table 2, the total quantity of NPAG material required for all construction on the site is available by Year 2, with more than double the required amount available by Year 3. By Year 6, the total quantity of NPAG rockfill available is 3 to 4 times the requirement for all site construction activities, including rockfill covers.

1.2 Availability of TSF For Closure

The tailings deposition sequence involves deposition in the south cell of the TSF until year 5.7, whereupon the south cell is filled, deposition switches to the north, and the south cell area may be reclaimed. The tailings deposition sequence therefore allows progressive closure of the south cell of the TSF by year 6.0. Detailed deposition planning may allow earlier reclamation of the south cell.

Progressive reclamation of the south cell of the TSF will proportionally reduce the cost of reclamation following operations. The total area of the Tailings Storage Facility (TSF) is 2,156,300 m2, divided into the south cell (812,800 m2) and the north cell (1,343,500 m2).

The total volume of NPAG rockfill required to cover the south area is 1,625,600 m3. The volume of material is further divided into possible phases of reclamation in Figure 1. Figure 1 illustrates closure of the south cell during operations from year 5.7 to year 7.2.

Re-handle of rockfill will be required to reclaim the south cell of the TSF. Depending on tailings beach slope angle and the NPAG rock production schedule, there may be opportunities to haul directly from the Portage or Goose Pit and place rockfill cover on the TSF.

1.3 Equipment Production Rates

Closure of the south cell before Year 8, as shown in Figure 1, would require rock placement rates between 2,307 and 3,720 m^3/day. This rate may be reduced over longer time frames.

Minimum equipment requirements for construction of the tailings cover include a loader or shovel, haul truck(s), and a bulldozer. For efficiency, length of haul by trucks, and length of push by bulldozer should be minimized. Detailed planning by AEM is required in this regard.

1.4 Requirements for Re-blasting of Frozen Rockfill Stockpiles

Construction of the rockfill cover during winter periods assumes that stockpiled rockfill may be excavated and placed without excessive clumping or agglomeration due to formation of ice. Typically, waste rock water contents are on the order of 3%, with fines contents less than 5%. The initial ice content in a rockfill stockpile will therefore be limited, but may increase depending on precipitation, and stockpile construction schedule. Based on the quantities of rockfill available, it is assumed that localized concentrations of ice may be selectively avoided for construction.

2.0 ROCKFILL COVER DESIGN THICKNESS

Brodie (2008) proposes that the Meadowbank rockfill cover design thickness of 2 m should be increased to 5 m to match active layer depths measured in rockfill at the Ekati Diamond Mine, (based on Draft report: BHP Billiton Diamonds Inc. 2007. Ekati Diamond Mine, Interim Closure & Reclamation Plan, Volume 1 – Draft – January 2007 (Ekati 2007)).

The 2 m design thickness for rockfill covers proposed for Meadowbank is based on conditions at Meadowbank. Modeling results and available thermistor measurements support the 2 m design rockfill thickness. Monitoring of areas reclaimed during operations for active layer depths will also allow evaluation of assumptions made during design.

It is noted that Ekati is in a warmer area, and that the monitoring results cited were issued as a draft only.

Conditions are reviewed and summarized here.

2.1 Permafrost

The Meadowbank and Ekati sites are marked in Figure 2. Ekati is located near the edge of the boundary between discontinuous and continuous permafrost, while Meadowbank is in a colder region of continuous permafrost.

Table 3 (attached) presents the permafrost thicknesses and depth of active layer for sites close to Meadowbank. Typical depth of active layer of sites near Meadowbank are on the order of 0.5 to 2 m. Permafrost data were accessed during March 2008 from: http://tsdmaps.gsc.nrcan.gc.ca/website/permafrost/permafroste.htm.

Ground temperatures have been monitored at Baker Lake since 1997 as part of the Circumpolar Active Layer Monitoring (CALM) program. Annual thaw depth reported for the Baker Lake CALM site in 2004 was 1.79 m. Permafrost data were accessed during March 2008 from http://www.udel.edu/Geography/calm/data/data-links.html.

The measured depths of active layers from selected thermistor data from the Meadowbank site are summarized in Table 4.

TABLE 4: Summary of Dike Thermistor Data for Meadowbank

Borehole	Location	Zero Amplitude Temperature (°C)	Vertical Depth of Active Layer (m)
02-GT-04	East Dike South Abutment	-6.5	1.3
02-GT-03	East Dike North Abutment	-2.5	3.5
03GT-TD-1	Central Dike North Abutment	NA	1.3
03GT-TD-5A	Central Dike South Abutment	NA	2.8
02GT-09	Stormwater Dike West Abutment	NA	3.8
02GT-10	Stormwater Dike East Abutment	--5.5	3.0

Source: Detailed Design of Central Dike, Doc. 420 March 2007. Volume 1, pp. 18

It is noted that the measured permafrost depths are at the proposed dike abutments and the boreholes are located near the lake shorelines. The measured active zones vary between 1.3 m and 3.8 m. However, the proximity to the lake will increase the depth of the active zone. The depth of the active layer is also impacted by other factors such as aspect, slope angle and soil type (i.e. rock, peat) at the borehole locations in which the thermistors are installed. Detailed review of the depth and actual controlling factors for the active layer on the tailings and RSF will be monitored.

Measured depths of the active layer for Ekati waste rock piles were on the order of 5 m. However, the active layer thickness has not yet stabilized - Ekati (2007) states on page 169 that "…Ground temperatures are continuing to get colder with time..."

2.2 Mean Annual Air Temperature

Mean Annual Air Temperature (MAAT) is calculated as the arithmetic mean of monthly temperatures. Values of MAAT for Ekati, Baker Lake and Meadowbank are summarized in Table 5. The MAATs of Ekati and Baker Lake were calculated based on the temperature data provided by Environment Canada (http://www.climate.weatheroffice.ec.gc.ca/). Ekati is nearly 3 degrees warmer than Meadowbank.

TABLE 5: MAAT Summary

Location	MAAT (°C)		Period of Record
	Average	2007	
EKATI	-8.5	-9.0	1998-2007
BAKER LAKE	-11.8	-11.0	1951-2007
MEADOWBANK	-11.3	n/a	1997-2005

2.3 Climate Change and Thermal Modeling Results

Thermal modeling for long term (up to 100 years) prediction of tailings freezeback has considered climate change issues (6.4 °C increase by the year 2100). Three scenarios with different tailings exposure time are considered in the model. The results show that the active layers of all scenarios are within or just below the 2 m thick rockfill cover. The rockfill cover design is analytically reasonable based on modeling in Section 4.1.2, Appendix III of the report: Detailed Design of Central Dike, Document 420. Convective cooling effects have not been considered in the modeling for the TSF. This is a factor in modeling at Ekati.

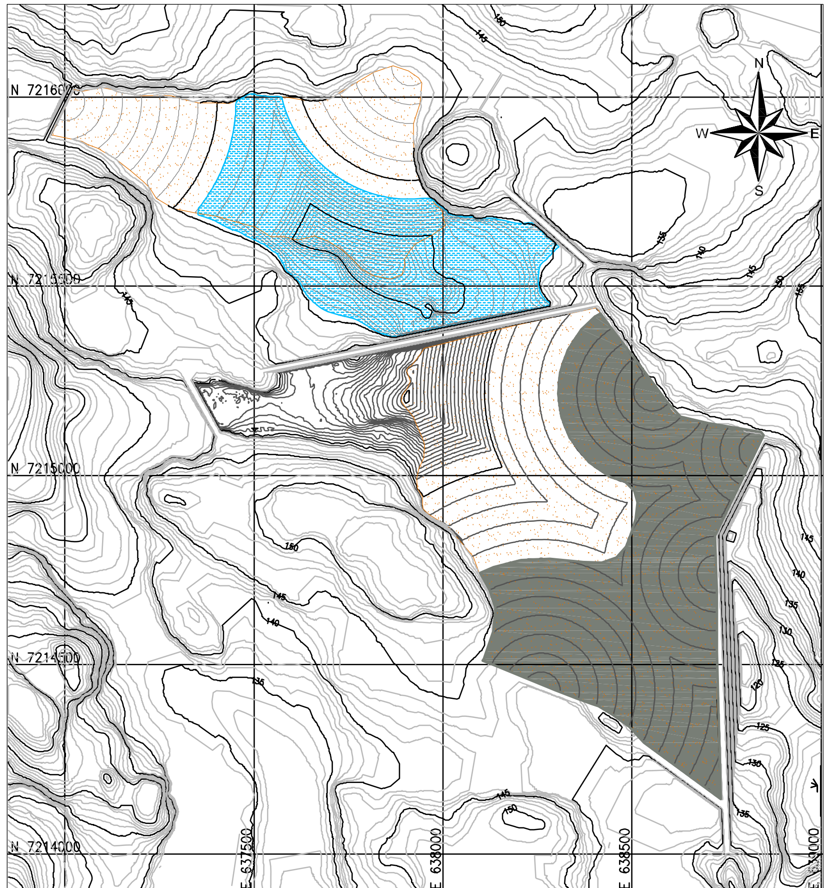
Additional thermal modeling of the TSF is currently in progress.

JC/BEW/JAH/lw/mrb
Attachment
O:\Final\2007\1413\07-1413-0119\Doc 646 Apr 4-2pm edits\Doc 646 0404_08 TMO Ver 0 INAC Reclamation Review by Brodie Consulting.doc

TABLE 3 Permafrost Thickness and Depth of Active Layer

Location	Borehole Identifier	Longitude (Deg)	Latitude (Deg)	Distance to Meadowbank Mine Site(km)	Permafrost Thickness (m)	Depth of Active Layer (m)	Notes
Meadowbank River*	GT583	95.42	65.30	45		0.77	Monitoring during 1974-1976
Thelon River	GT590	96.70	64.50	66		0.58	Monitoring during 1974-1976
Thirty Mile Lake	GT592	96.80	63.50	174		2.16	Monitoring during 1974-1976
Baker Lake	GT384	95.50	64.17	99		1.40	Monitoring during 1997-1999
Baker Lake	GT385	95.50	64.17	99		1.40	Monitoring during 1974-1976
Baker Lake	GT386	95.50	64.17	99		1.70	Monitoring during 1974-1976
Baker Lake	GT383/PF62	96.00	64.30	80	>500	0.75	Monitoring during1951-1980
Baker Lake	GT591/PF63	97.50	64.50	90	180 - 210	0.15 - 0.6	Kiggavik Mine, 75 km NW of Baker Lake
Baker Lake	PF64	97.82	64.00	146	195		80 km W of Baker Lake
Chesterfield Inlet	PF55	90.70	63.35	314	305		
Kazan River	PF56	95.85	63.65	155		0.15 - 0.2	
Kazan River	PF57	95.85	63.65	155		0.1 - 0.2	
Kazan River	PF58	95.85	63.65	155		0.1 - 0.2	
Kazan River	PF59	95.85	63.65	155		0.4	
Kazan River	GT593	97.10	63.04	227		1.11	Monitoring during 1974-1976
North Rankin Nickel	GT594/PF34	92.08	62.82	315	274.3		1962
Rankin Inlet	PF35	92.08	62.82	315	304.8		
Rankin Inlet	PF36	92.08	62.82	315	>270		
Rankin Inlet	GT595	92.00	62.83	315		3.33	Monitoring during 1974-1976
Rankin Inlet	GT596	92.00	62.83	315		1.5	Monitoring during 1974-1976
Rankin Inlet	GT597	92.00	62.83	315		1.17	Monitoring during 1974-1976
Rankin Inlet	GT598	92.00	62.83	315		1.24	Monitoring during 1974-1976

*Note: Meadowbank River is located about 45km NE of Meadowbank mine site(65° 01' 11.9", 96° 4' 7.11")

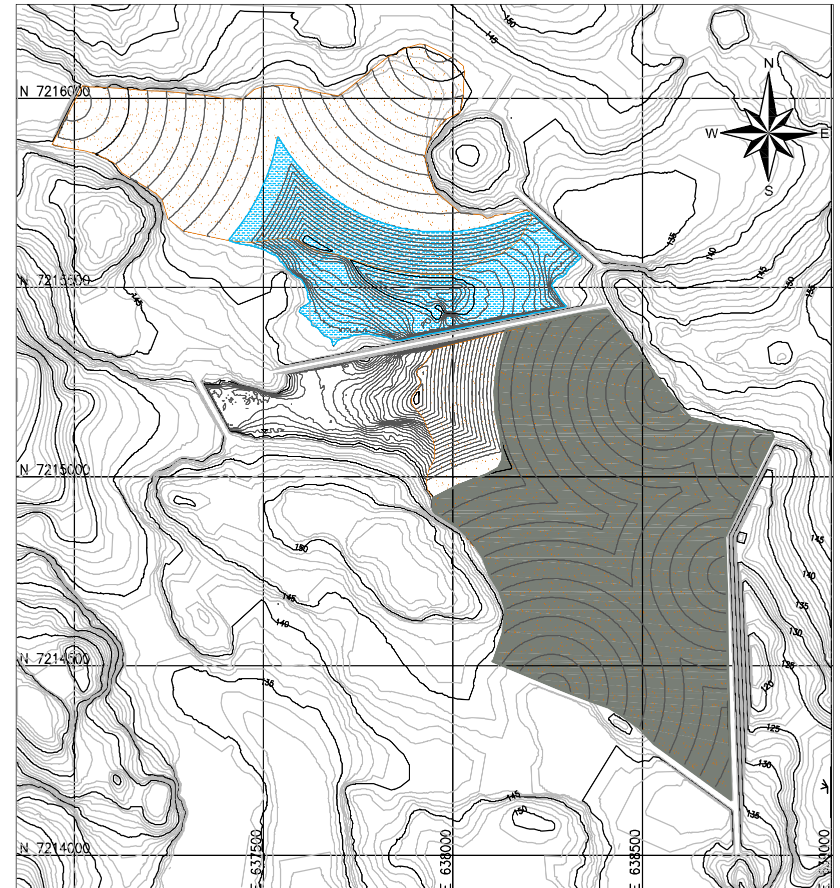


DISCHARGE OPERATING PERIOD: WINTER	from	11-JAN-16
	to	28-APR-16
FINAL DISCHARGE POINT ELEVATION	m a.s.l.	138.0
PARTIAL STORED TAILINGS VOLUME	Mm^3	0.63
CUMULATIVE STORED TAILINGS VOLUME	Mm^3	1.50
SUPERNATANT POND ELEVATION	m a.s.l.	134.4
ACTIVE SPIGOTS DURING THE PERIOD		1,3
POND AREA	ha	27.49
TAILINGS BEACH AREA	ha	17.69

STAGE #

2

NORTH

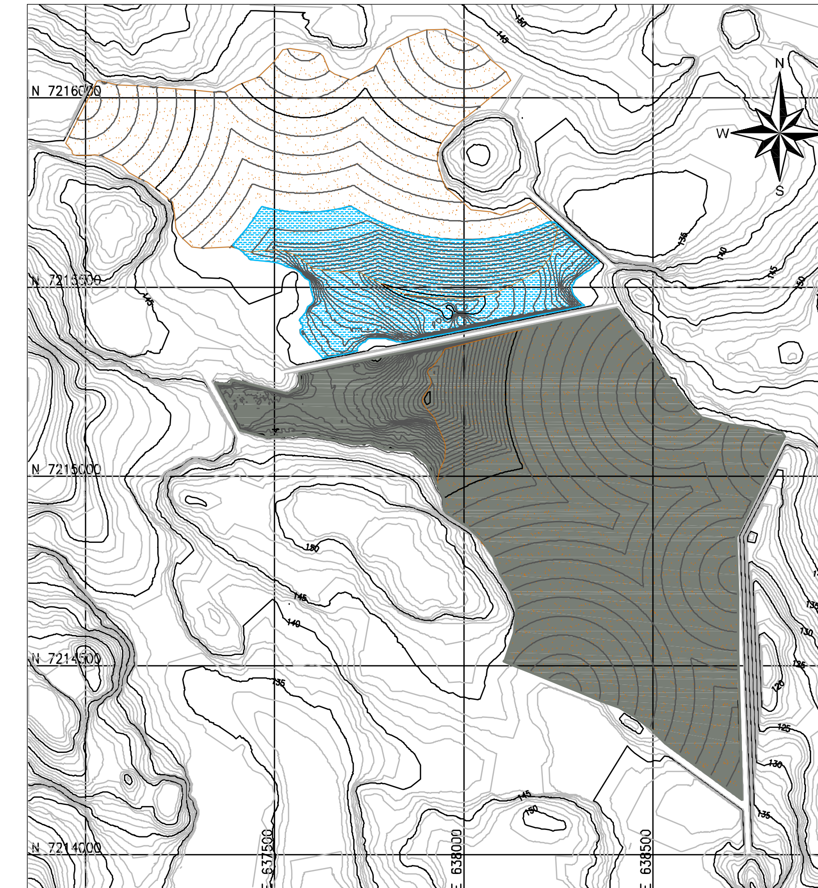


DISCHARGE OPERATING PERIOD: SUMMER	from	12-SEP-16
	to	20-OCT-16
FINAL DISCHARGE POINT ELEVATION	m a.s.l.	140.9
PARTIAL STORED TAILINGS VOLUME	Mm^3	0.22
CUMULATIVE STORED TAILINGS VOLUME	Mm^3	2.50
SUPERNATANT POND ELEVATION	m a.s.l.	136.0
ACTIVE SPIGOTS DURING THE PERIOD		1,3,1,3
POND AREA	ha	23.45
TAILINGS BEACH AREA	ha	31.53

STAGE #

6

NORTH



DISCHARGE OPERATING PERIOD: WINTER	from	17-FEB-17
	to	17-APR-17
FINAL DISCHARGE POINT ELEVATION	m a.s.l.	143.0
PARTIAL STORED TAILINGS VOLUME	Mm^3	0.34
CUMULATIVE STORED TAILINGS VOLUME	Mm^3	3.52
SUPERNATANT POND ELEVATION	m a.s.l.	137.5
ACTIVE SPIGOTS DURING THE PERIOD		2,1,3
POND AREA	ha	22.47
TAILINGS BEACH AREA	ha	40.65

STAGE #

9

NORTH

Tailings Deposition Stage (1% beach slopes)	Cumulative Tailings Area Covered (m^2)	UM + Q Rockfill (m^3)	Days of Cover Construction	Average Rockfill Placement Rate (m^3/day)
2 North	430,000	860,000	231	3,720
6 North	631,500	1,263,000	385	2,615
9 North	812,800	1,625,600	542	2,307

NOTES

FIGURES ARE ADAPTED FROM THE TAILINGS DEPOSITION PLAN PRESENTED IN MINE WASTE AND WATER MANAGEMENT, AUGUST 2007. DOCUMENT 500.
FIGURES SHOW CONCURRENT TAILINGS DEPOSITION IN NORTH CELL WITH ROCKFILL PLACEMENT IN SOUTH CELL.

SYMBOLS

SUPERNATANT POND

TAILINGS

UM + Q ROCKFILL COVER

0 200 400 600 800 1000

Scale in Metres

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK GOLD PROJECT

TITLE

SAMPLE PROGRESSIVE CLOSURE SCENARIO FOR TSF

Golder Associates

PROJECT No. 07-1413-0119			FILE No. 0714130119-FIG_1	
DESIGN	BW	01APR08	SCALE AS SHOWN	REV. –
CADD	JK	01APR08	**FIGURE 1**	
CHECK				
REVIEW				

REVISION DATE:08/04/03 09:27AM By: jkownacki CADD FILE: N:\Bur-Graphics\Projects\2007\1413\07-1413-0119\Drafting\0714130119-FIG_1.dwg

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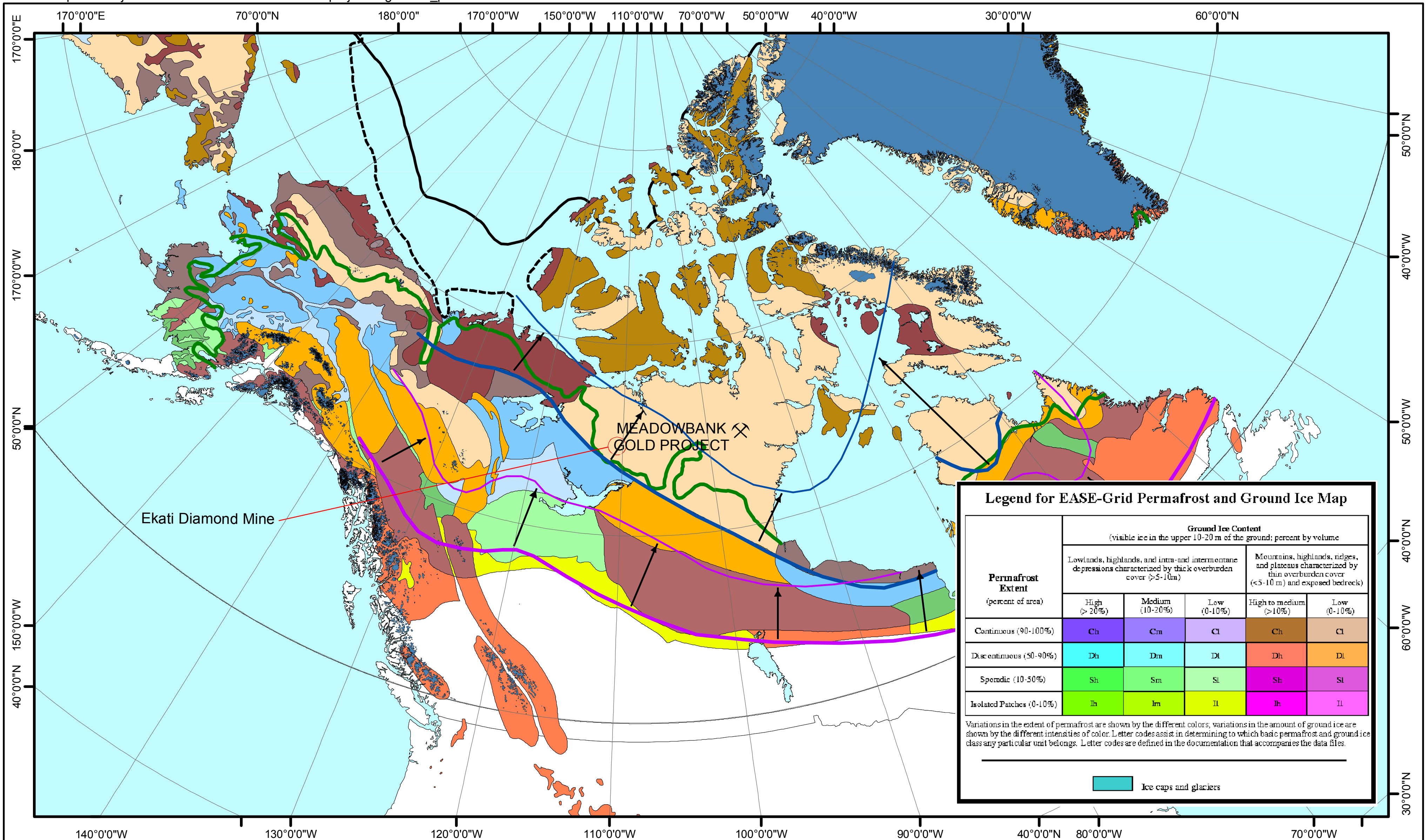

LEGEND

- TREELINE
- SEA-ICE EDGE LIMIT
- SUBSEA PERMAFROST LIMIT
- SOUTHERN BOUNDARY OF DISCONTINUOUS PERMAFROST - PRESENT
- SOUTHERN BOUNDARY OF DISCONTINUOUS PERMAFROST - PREDICTED
- SOUTHERN BOUNDARY OF CONTINUOUS PERMAFROST - PRESENT
- SOUTHERN BOUNDARY OF CONTINUOUS PERMAFROST - PREDICTED
- PREDICTED MOVEMENT OF PERMAFROST BOUNDARIES

NOTES

1) PROJECTION: LAMBERT AZIMUTHAL EQUAL AREA

0 300 600 900 1,200 1,500

Scale in Kilometres

REFERENCES

1) BROWN, J., O.J. FERRIANS JR., J.A. HEGINBOTTOM, AND E.S. MELNIKOV. 1998. CIRCUM-ARCTIC MAP OF PERMAFROST AND GROUND-ICE CONDITIONS. BOULDER, CO: NATIONAL SNOW AND ICE DATA CENTER/WORLD DATA CENTER FOR GLACIOLOGY. DIGITAL MEDIA.
2) PREDICTED PERMAFROST BOUNDARIES BASED ON WOO ET AL., 1992.

PROJECT

AEM **AGNICO-EAGLE MINES LIMITED**
MEADOWBANK GOLD PROJECT

TITLE

PERMAFROST MAP OF CANADA

Golder Associates
Burnaby, B.C.

PROJECT No. 07-1413-0119			SCALE AS SHOWN	REV. 0
DESIGN	BW	04 Apr. 2008	FIGURE 2	
GIS	CDB	04 Apr. 2008		
CHECK				
REVIEW				