KINROSS
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March 16, 2004

Our File: NWB1LUP0008 03Annual
Your File: Water Register
NWB1LUP0008

Executive Director
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU
X0B 1J0

Dear Sir:

RE: Echo Bay Mines Ltd., Lupin Gold Mine, Contwoyto Lake, NT; Water Licence No. NWB1LUP0008; 2003 Annual Report

Please accept this submission of the 2003 Annual Report for Water Licence NWB1LUP0008 as required by Part B, Item 5. The PDF file version of the Report contains all the QC data from Norwest Labs Ltd.

The 2003 Annual Report includes all the water use and waste disposal information as outlined in the mine's Water Licence. No discharge took place from the TCA in 2003. Release of the Sewage Lakes Disposal system took place from June through to August, 2003. All SNP data as outlined in the Licence is included within this report.

Should you have any questions or comments regarding this report, or if you require hard copies to supplement the electronic submission, please feel free to contact the undersigned at (780) 890-8797.

Yours truly,

C. Michael Tansey

C. Michael Tansey
Reclamation Manager, Lupin

Attach. 2003 Annual Report
cc B. Bried B. McCrank M. Ioli G. Budge

ECHO BAY MINES LTD.

a subsidiary of

KINROSS
Gold Corporation

2003
ANNUAL REPORT
LUPIN OPERATIONS

Submitted under

WATER LICENCE NWB1LUP0008
NUNAVUT WATER BOARD

Date: March 31, 2004
Prepared by: C. Michael Tansey
Reclamation Manager, Lupin

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INTRODUCTION

This report is submitted to fulfil requirements under Part B, Item 5 of Water Licence NWB1LUP0008 granted by the Nunavut Water Board pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada*.

The Annual Report for 2003 contains the following information that is required under Part B, Items 5(a) through (k).

a) the monthly and annual quantity in cubic metres of water pumped from Contwoyto Lake at Station 925-01;

b) the monthly and annual quantities in cubic metres of treated tailings effluent discharged at Station 925-10

c) the monthly and annual quantity in cubic metres of minewater discharged at Station 925-11;

d) the monthly and annual quantity in cubic metres of treated sewage effluent discharged at Station 925-14;

e) tabular summaries of all data generated under the Surveillance Network Program;

f) a summary of modifications and/or major maintenance work carried out on the water supply and the waste disposal facilities including all associated structures;

g) a list of unauthorized discharges and follow-up action taken;

h) revisions to the Contingency Plan;

i) revisions to the Abandonment and Restoration Plan;

j) a summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year; and

k) any other details on water use or waste disposal requested by the Board by November 1st of the year being reported.

A. FRESH WATER INTAKE VOLUME: Station 925-01

The quantity of fresh water pumped on a monthly basis from Contwoyto Lake is shown in Table No.1, 2003 Pumping Report (Appendix A). The yearly total was 681,584 m^3 as determined by flowmeter. Of this volume, 611,842 m^3 was used for industrial purposes with the remaining 67,002 m^3 being used as potable water.

The quantity of fresh water used in 2003 was relatively constant until August, when the mine and mill were placed on care and maintenance. From August until year-end, fresh water had to used to supplement the quantity of minewater pumped to tailings in order to permit the pumps to operate at an efficient level.

The volume of water obtained from Contwoyto Lake is currently measured through two meters. The potable water is metered as well as the excess water that is sent to the sewage lakes system. This excess water is a result of the minimum volume capacity of the pumps, the need for continued flow in the pipeline and maintenance of the fire protection water level within the mill raw water tank. The two meters combined produce a total volume pumped. During operations, all water pumped from the lake is metered and then the volume used as potable camp water is subtracted to give a process volume.

B. TREATED TAILINGS EFFLUENT: Station 925-10

Discharge of treated tailings effluent from Pond 2 (station 925-10) did not take place in 2003. With an adequate storage volume achieved during the 2002 discharge, the release of water from the TCA was not considered essential to the operation of the facility. Additional storage time was also viewed as being beneficial to the quality of all waters within the containment.

The Pond No.1 syphons on J Dam were operated from August 28, 2003 until September 1, 2003, transferring approximately 298,686 m^3 of water to Pond No.2. There was no requirement for treatment in 2003, given the excellent water quality of Pond No.1.

Water level surveys were carried out on July 17, 2003. Pond 1 water elevation was 484.097 metres, and Pond 2 water elevation was 480.642 metres. Due to the shutdown of operations on August 13, 2003, a final survey of the water elevations in Pond 1 and Pond 2 was not carried out in the fall. The quantity of water transferred from Pond 1 to Pond 2 after the last survey was done added approximately 0.325 metres to the elevation of Pond 2, bringing the water elevation to approximately 481.0 metres. This elevation provides approximately four metres of freeboard on the lowest elevation dam within Pond No.2.

C. MINEWATER: Station 925-11

The monthly and annual quantity of water pumped from the mine is included in Pumping

Report, Table 1. For the whole of 2003, all minewater was directed to the TCA via the tailings line. After the cessation of process activities in late August, fresh water had to be added to supplement the volume of mine water pumped to tails. The total quantity of water pumped from underground in 2003 was 47,427 m^3.

D. SEWAGE EFFLUENT: Station 925-14

The monthly and annual quantity of sewage effluent discharged to the environment from the second sewage lake at Station 925-14 is listed in the Pumping Report, Table No.1. Total flow for the seasonal discharge was approximately 219,373 m^3, between June 24 and August 11, 2003. The discharge volume is calculated from an ultrasonic flow meter on the single 8" syphon line. In April, 2003, the second sewage lake was treated with quicklime, as has been the practice for several years. The contents of two 1.4 tonne bags of quicklime were spread on the ice for natural mixing during spring melt. No pH adjustment was required during the discharge period and all licence parameters were maintained within limits.

E. SURVEILLANCE NETWORK PROGRAM DATA

Tabular summaries of data required under the Surveillance Network Program annexed to Water Licence NWB1LUP0008 are presented in Tables 1 and 2. Table No.1 summarizes the water use, waste disposal volumes and the monthly ore milled, recorded in dry tonnes. Table No.2 summarizes the water quality data collected at stations 925-01 and 925-14.

There was no decant from the TCA in 2003, therefore no results are presented for station 925-10.

The annual sample of freshwater was obtained at the pump house on April 28, 2003.

Located in Appendix B are copies of the 2003 analytical reports and QC data for the analysis of reference materials, requested of Norwest labs under the SNP QA/QC plan.

In addition to the freshwater use, mine water pumped from underground and the sewage lakes discharge volumes, the 2003 Pumping Report also includes the data for waste discharged to the tailings pond and tonnage used in the Paste Backfill process. These are calculated figures obtained from the mill daily statistics report.

F. MAINTENANCE WORK

A modification to the potable water distribution system in 2003 allowed UV treated water to be provided to the 100 to 400, and 1300 accommodation wings. Other than this, only routine maintenance work was carried out on the water supply and sewage disposal facilities in 2003.

Ndam

The main tailings line was extended along the length of the Ndam in order to maximize the deposition of tailings into the small cell bounded by this dam, adjacent to Cell 5. This section of tailings pipe was completed with Sclair (plastic) piping with several available discharge locations along the dam.

Other maintenance items completed were as follows:

- All recommended maintenance work was completed as specified in the 2003 Geotechnical Inspection of the Tailings Containment Perimeter Embankments carried out by BGC Engineering Inc. There are currently no other outstanding issues with respect to the 2003 or previous geotechnical inspections.

G. LIST OF UNAUTHORIZED DISCHARGES

There was one recorded unauthorized discharges during 2003 under Water Licence NWB1LUP0008.

- Spill Report No. 03-030. January 23, 2003. An estimated 10-15 litres of diesel fuel was spilled during the filling of the fuel truck at the main fuel refilling station located south of the powerhouse and surface mobile shop. The contaminated area was approximately 2m by 3m. The contaminated snow and surface sand was scraped up and removed to the burn pit area to be burned during normal refuse burning practice.

H. REVISIONS TO THE CONTINGENCY PLAN

On January 7, 2004, the NWB approved the Contingency Plan which they received on December 22, 2000. The Board requested that this Contingency Plan be updated to reflect the Lupin Care and Maintenance status that was in effect at the time the Contingency Plan was approved and that the Plan be resubmitted by March 6, 2004. Lupin has since resumed production activities and is no longer in a Care and Maintenance position. A revised Contingency Plan was nonetheless prepared which addresses the changes in Lupin site personnel, site contact names and numbers, and updated regulatory contact numbers. This updated Contingency Plan was provided to the Board by the date requested.

I. REVISIONS TO THE ABANDONMENT AND RESTORATION PLAN

On January 8, 2004, the Board requested that the previously approved interim A&R Plan be revised to reflect the Lupin Care and Maintenance status that was in effect at the date of the letter, and to specifically address 5 other items in a revised interim A&R Plan. Lupin has since resumed production activities and is no longer in Care and Maintenance. In accordance with the requirements of the water licence to provide a Final Abandonment and Restoration Plan at least 3 years prior to final abandonment, this Final A&R Plan is currently being prepared.

J. SUMMARY OF ABANDONMENT AND RESTORATION ACTIVITIES

2003 Abandonment and Restoration Activities

Centre Zone Crown Pillar

The Centre Zone Crown Pillar open stope, which was previously open from the 27-metre level to surface, was filled with cemented tailings paste backfill during 2003. Approximately 100,266 dry short tons of paste, at a cement content of close to 1%, were placed in the opening. Once the paste dried, it was then topped with surface material that had been stored when the original ground cover was removed to obtain access for mining. This activity has served a dual purpose by backfilling of one of the open crown pillars at surface as a step towards reclamation of the site, and by reducing the amount of tailings directed towards the surface TCA impoundment. (see photos 1, 2, 3, 4, and TCA Plan in Appendix 1)

Esker Cover

Progressive reclamation activities in the TCA during 2003 saw two areas within Cell 3, designated cells 3a and 3b, covered by approximately 1.0 metre of esker gravel. The work was carried out between August 5 and September 23, 2003, with a total area covered of approximately 62,350 square metres. The esker material is an effective cover medium that serves to eliminate dispersal by wind of dry tailings, and the embedded moisture layer prevents oxidation of the underlying tails and provides support for plant growth. (see photos 5, 6, 7)

Partially Saturated Granular Cover

In 2003, additional site information was accumulated in support of the "Partially Saturated Granular Cover" program for tails reclamation. Monitoring of pore water quality and the saturation status of the esker cover in Cell 1 continued from the previous year. Further to this work, a test pad was constructed in Cell 1 by effectively isolating a 20 metre by 40 metre area from the rest of the cell. This was accomplished by installing an impermeable liner in a 2.4 metre-deep trench surrounding the area, anchored well below the active zone. A thermistor and 2 water sample pipes were installed within the test pad area. The information gathered from this exercise in 2003 and ensuing years will be added to that previously obtained in support of the Partially Saturated Granular Cover program endorsed by Igor Holubec, geotechnical specialist. (see photos 8, 9)

Ground Temperature Monitoring

Collection of data from thermistor strings that were installed during 1995 (esker cover of Cells No.1, No.2 and in Dam 4) and in 2000 (Dam1a, Dam2 and Fingers Lake Esker) continued through 2003. In May 2003, new thermistor strings were installed in Dam6, Dam1a, Dam2, and Cell 1 (test pad) cover. Unfortunately, 2 of the 3 thermistors installed in Dam 6 were destroyed by a bear, as were the new thermistors installed in Dam1a and Dam2. A review of the containment dam temperature data was completed during data review of the 2003 Geotechnical Inspection of the TCA, carried out by BGC Engineering Inc. The information to date indicates that subzero temperatures are maintained at depth with no indications of warming.

At Dam 1a, Graph No.1 indicates that foundation temperatures continue to decrease over time. The active layer from the surface of the dam appears to be between 2.5 and 3 metres (with the exception of anomalous data from 2001, which indicated nearly a 4 metre active layer).

At the Dam 2 locations it was noted that the foundation zone appears to be cooling over the longer term with the downstream station being noticeably cooler than the upstream (Graph No.2). This is possibly due to the warming influence of the upstream water, although the same phenomenon is not evident in the Dam1a data. The active layer of the dam section remains at about 2-2.5m. The temperature information demonstrates that the core of the dam remains frozen and that the foundation of the dam is maintained below freezing year round.

Temperature monitoring in Dam 4 began with installation of thermistors in 1995. These strings were all installed along the downstream crest; one at each abutment and one in each of the "low" points of the foundation for a total of four strings. As mentioned in the Geotechnical Inspection, the data indicates an active layer of approximately 2 to 3 metres at the downstream crest as shown in Graphs 5, 6, 7 and 8. The profiles in the appendix are single date graphs for 1997-2003, using a date (October) that coincides with what are typically the warmest temperatures at a 2-3 metre depth, whereas the temperatures closer to surface are normally beginning to cool at this time. The four profiles are included within this Annual Report, although thermistor #2 was damaged beyond repair after readings were taken in July 2003.

It must be noted that the indicated active layer of the dams is not necessarily a true representation of the active surface layer as most thermistors that are currently in use on the dams have been installed near one of the crest slopes, not through the centre line of the dam. Therefore, there is some influence upon the active layer measured due to the slope of the dam (widening with vertical depth). This allows some warming to the dam crest (where the thermistor is located) from the slope side of the dam indicating a deeper active layer penetration than if the thermistor string was installed at the centre line. The temperature profile graphs for Dam 1a and Dam 2 (see Graphs 1 and 2) illustrate this further with the upstream thermistors (with a 1:2.5 embankment slope) indicating a slightly shallower active layer than the downstream thermistors (with a 1:1.5 embankment slope).

The data obtained from the Fingers Lake thermistor string (being on a near flat surface) gives a better representation of the true active layer. The data obtained monthly since installation in 2000 shows that subzero temperatures persist below the 1.3 metre depth and extend through to the bedrock, which is encountered at approximately 12.3m and is maintained at approximately –6° to –7°C. A depth of approximately 3 metres maintains the temperature below -2°C. See Graph No.3 'Fingers Lake Esker Temperature Profile' in the appendix. Actual excavation investigations have placed the maximum thaw depth in September to be approximately 1.3m depth, which is consistent with the thermistor data.

Temperature monitoring in Cell No.1 has been ongoing since installation of the original thermistor strings in 1995, when the cell was covered with 1 metre of esker gravel. The only string that is still actively monitored is string TC1-3. This string is located at the north east end of the cell near Cell No.1a. The other two strings in this cell are not providing data at many of the depths and the data is sparse. Graph No.4 shows the temperature profile at TC1-3 for the month of October during the years of monitoring. October is usually the month when the active layer has penetrated the deepest and significant cooling has begun at surface. There is still some warming that occurs further at depth, however the temperatures at these locations remain below 0°C year round. As with the esker thermistor, temperature readings below the 1.25-metre depth are consistently below the freezing point.

The 2 surviving thermistors of those installed in 2003 - in the test cover pad in Cell 1 and in Cell 3 upstream of Dam 6 - are shown in Graphs 9 and 10. The test pad thermistor is located about 75 metres northwest of the TC1-3 thermistor, and the results of both thermistors to date are consistent, showing persistently below freezing temperatures below the 1.25 metre depth. The Dam 6 thermistor is installed through a thin (0.5 to 1.0 metre) layer of tailings at the west edge of Cell 3, approximately 15 metres east of, and half-way along, Dam 6. Unfortunately, access to this thermistor has been limited due to water accumulation in late spring and severe drifting during the winter. The highest thermistor node is at the 3 metre depth below surface, and all temperature readings to date have been below freezing. (see photos 10, 11)

Planned Abandonment and Restoration Activities; 2004

- Continue to monitor all active thermistor strings installed in the esker cover of Cells 1 and 2, Dam4, Dam1a, Dam2, Fingers Lake Esker, and Dam6 to add to the database of information regarding the characteristics of the active thaw zone in natural esker, constructed dams and covered tailings.

- A major reclamation project planned for 2004 is to cover Cell 3 with 1.0 metre of esker gravel, as well as to complete the cover on Cell 2. If operations permit, the cell bounded by N Dam will also be covered.

- The West Zone Crown Pillar stope, currently open to surface from 87-metre level, will be filled to 27-metre level with paste backfill tailings. This will permit recovery of the crown pillar ore from surface, limit the amount of tailings being directed to the TCA, and act as a further step in the site reclamation process.

K. ANY OTHER DETAILS ON WATER USE OR WASTE DISPOSAL REQUESTED BY THE BOARD BY NOVEMBER 1st OF THE YEAR BEING REPORTED

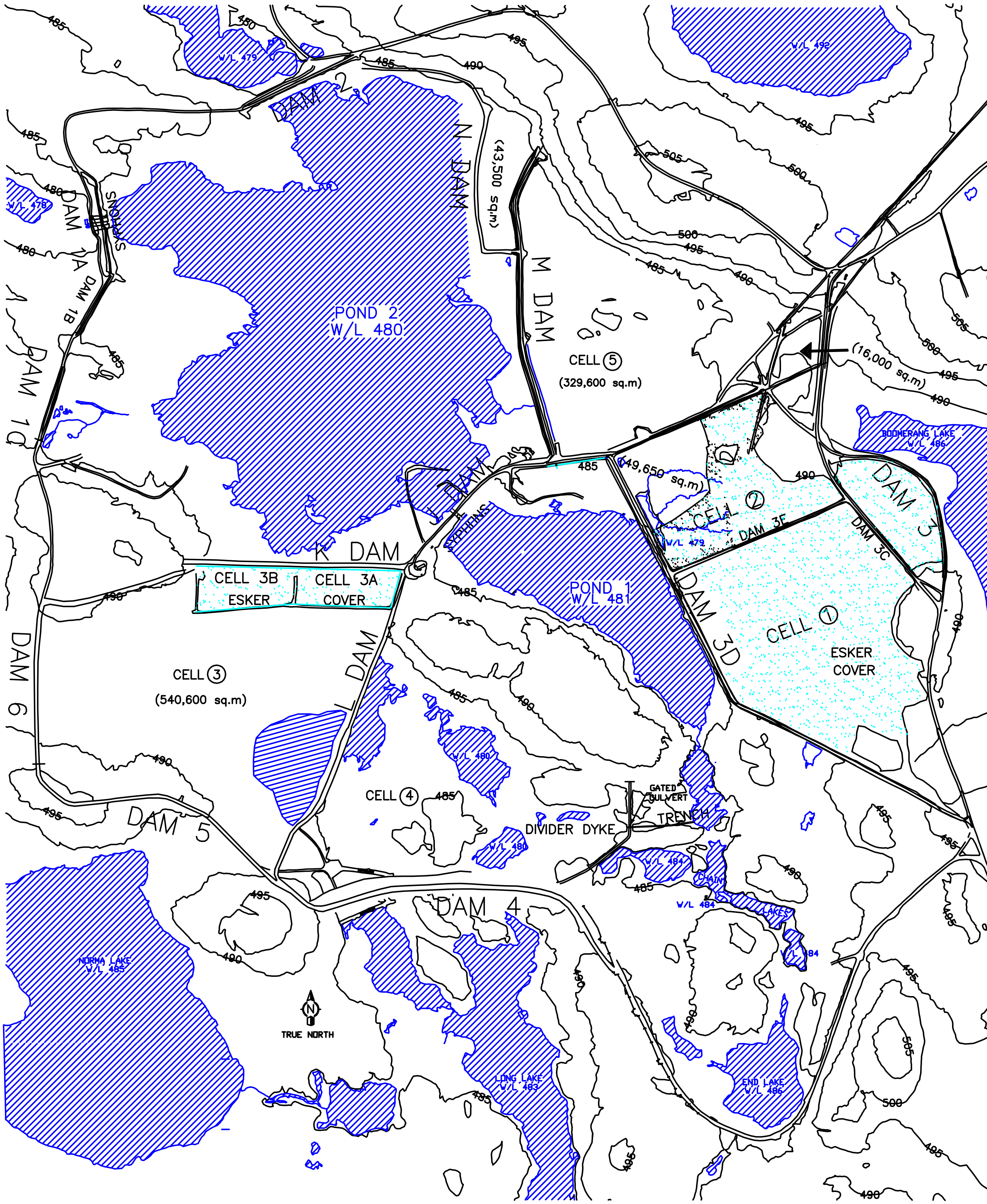
There were no requests received from the Board prior to November 1, 2003 for additional information to be included in this annual report.

On January 7th, 2004, however, the Board requested that an update to the Tailings Containment Area Management Report be included as part of this annual report. The requested update is included as Appendix C to this report.

On January 8th, 2004, the Board issued a review of the 2000, 2001 and 2002 Annual Reports for Lupin Mine and requested that the Licensee address a number of items arising from this review. The response to these items is included as Appendix D to this report.

APPENDIX A

FIGURES
TABLES
GROUND TEMPERATURE GRAPHS
PHOTOS



NOTE:
ORIGINAL SCALE - 1:2000 - PLOTTING RATIO OF 1=1 (METRIC)
REDUCED SCALE OF 1:5000 - PLOTTING RATIO IS 1=5 (METRIC)
SHEET NUMBERS REFER TO 1:2000 STEWART WEIR LAND DATA MAPS

MAPPING BASED ON PHOTOGRAMMETRY BY STEWART WEIR , AUG. 1989

MAP SCALE: 0 50 100 200 METERS

Lupin TCA.dwg

REVISIONS No	DATE	MADE BY	DESCRIPTION
1			
2			
3			
4	Oct/03	CNT	Updated Cell 3a, 3b
5	Feb/98	S.B.L.	Updated 1997 work

DATE	DRAWN BY	CHECKED	APPROVED
JAN\95	S.B.LOWE		

KINROSS GOLD CORPORATION
EBM – LUPIN MINE

OFFICE	DEPARTMENT
LUPIN	DEVELOPMENT

LUPIN MINE
TAILINGS AREA

MAP INDEX NUMBER	SCALE	DRAWING NUMBER
	1:5,000	

ECHO BAY MINES LTD.

WATER LICENCE NWB1LUP0008

2003

PUMPING REPORT

(CUBIC METERS)*

TABLE NO.1

	FRESHWATER FROM CONTWOYTO LAKE (METERED)			WASTE DISCHARGED TO TAILINGS POND (CALCULATED)						
MONTH	TOTAL	PROCESS	POTABLE	TOTAL	SOLUTION	SOLIDS	ORE Milled TONNES	BACKFILL SOLIDS	MINEWATER (METERED)	SEWAGE (CALC.)
January-03	80,244	73,551	6,693	84,641	70,515	14,126	51,427	3,607	3,697	0
February-03	78,814	71,826	6,988	52,106	43,142	8,965	47,144	7,292	4,072	0
March-03	82,353	74,341	8,012	71,302	58,506	12,796	47,317	3,520	3,013	0
April-03	76,560	69,499	7,061	62,782	51,047	11,735	43,826	3,377	4,294	0
May-03	80,301	73,895	6,406	74,844	62,464	12,381	44,928	3,112	4,470	0
June-03	75,819	69,617	6,202	58,896	46,066	12,830	44,319	2,453	4,759	40,825
July-03	81,114	73,894	7,220	54,568	43,098	11,470	37,945	1,615	6,098	144,641
August-03	67,239	61,434	5,805	15,519	12,845	2,674	12,576	1,663	4,735	33,907
September-03	18,758	11,018	5,000	0	0	0	0	0	2,536	0
October-03	8,479	6,159	2,320	0	0	0	0	0	4,902	0
November-03	14,752	11,745	3,007	0	0	0	0	0	2,450	0
December-03	17,151	14,864	2,287	0	0	0	0	0	2,400	0
TOTAL (m3)	681,584	611,842	67,002	474,659	387,683	86,975	329,482 t	26,639	47,427	219,373

ECHO BAY MINES LTD.
LUPIN GOLD MINE, Nunavut

WATER LICENCE NWB1LUP0008

2003
WATER QUALITY DATA

TABLE 2

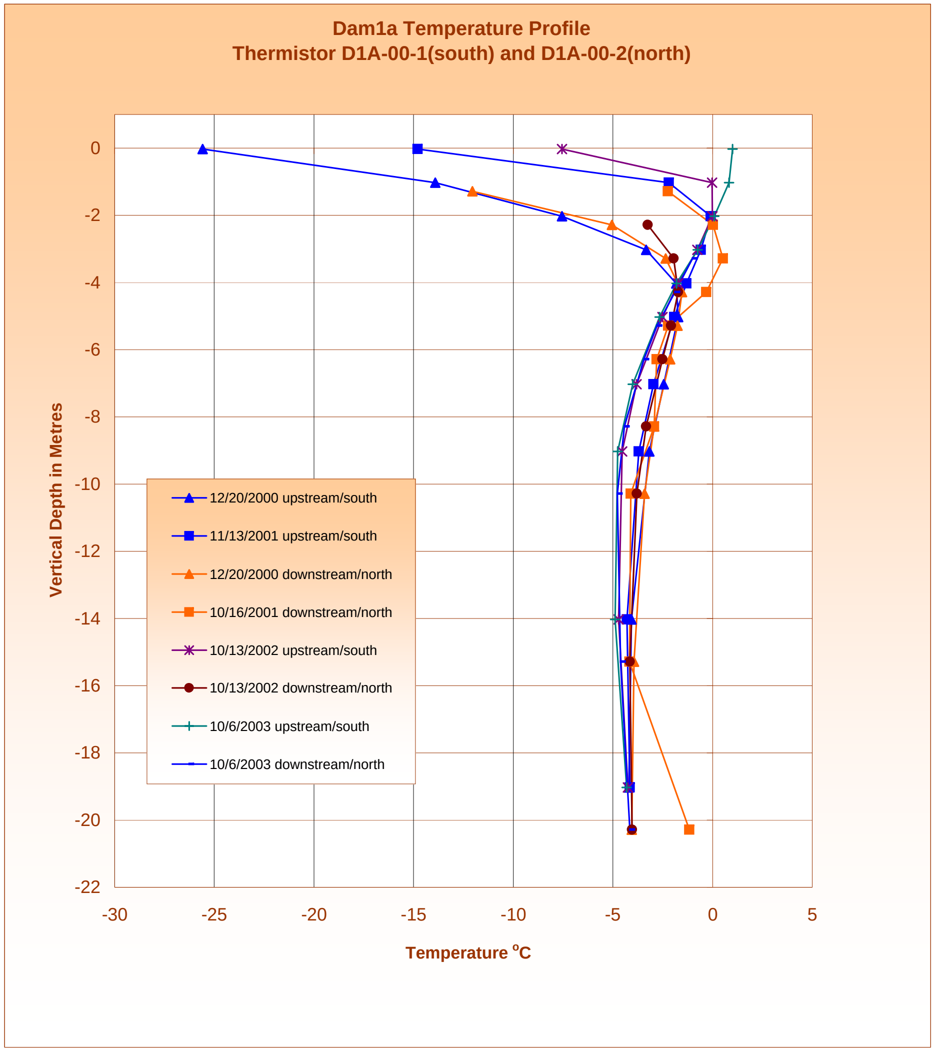
SURVEILLANCE NETWORK PROGRAM
MONTHLY REPORT - MONTHLY SUMMARY

- all units are in mg/L except pH which is unitless and where otherwise indicated.

DATE	SAMPLING STATION	TEMP ^0C	pH	TSS	Total CN	Total As	Cd (TOTAL METALS)	Cu	Hg	Ni	Pb	Fe	Zn	TEMP ^0C	F-col #/100mL	T-Alk	BOD_5
28-Apr-03	925-01	2.5	6.59	<1		0.0007	0.00005	0.002	<0.0002	0.0023	0.0018		0.003		<1		
24-Jun-03	925-14	7.9	9.0	10		0.0114	0.00002	0.004		0.0101	0.0004		0.021		<1		<4
22-Jul-03	925-14	16.7	7.0	<1		0.0145	0.00004	0.005		0.017	0.0002		0.034		<1		<4

DATE	SAMPLING STATION	Total Nitrate-N	Total Nitrite-N	TK-N	NH4-N	Total Ortho-P	Total Phosph.	Total O&G	Alk.	Hard.	uS/cm Cond.
28-Apr-03	925-01										19.9
24-Jun-03	925-14	4.52	<0.002	5.19	2.91	<0.05	0.17	n/v	10	247	
22-Jul-03	925-14	6.35	0.128	1.62	1.02	0.07	0.12	n/v	14	336	

Graph No.1



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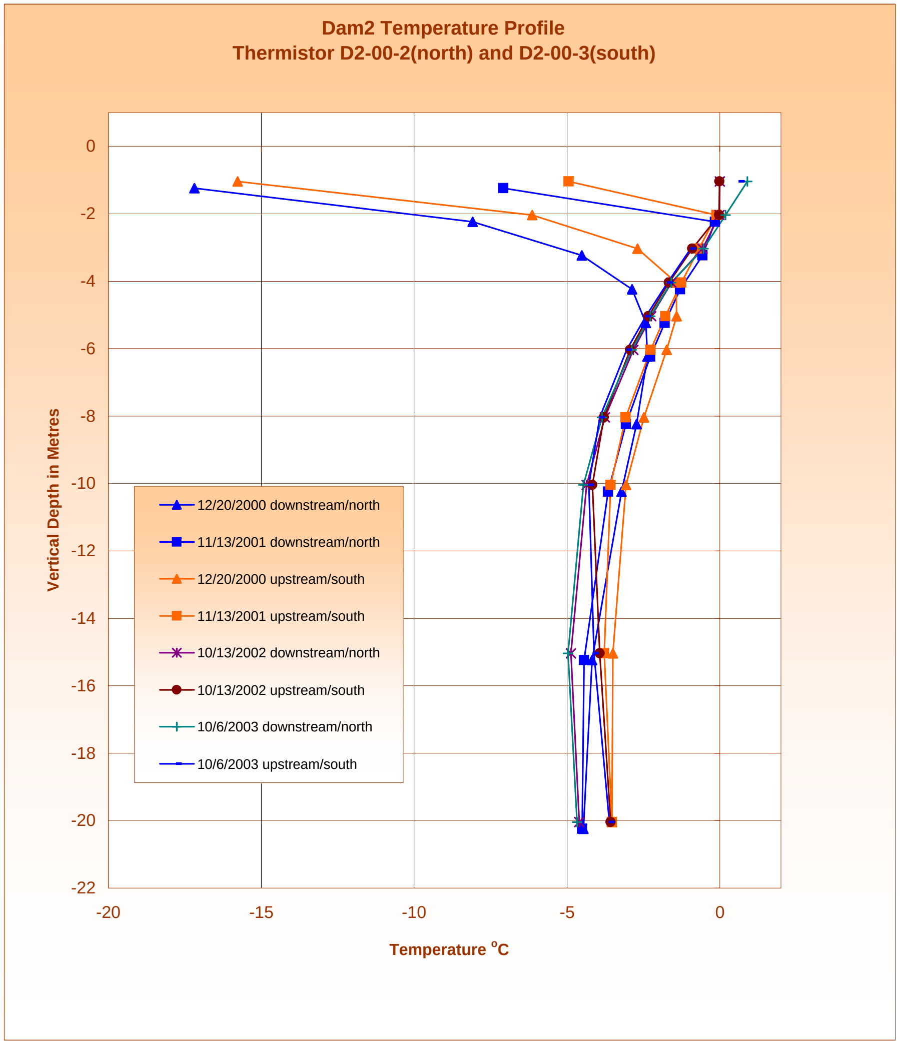

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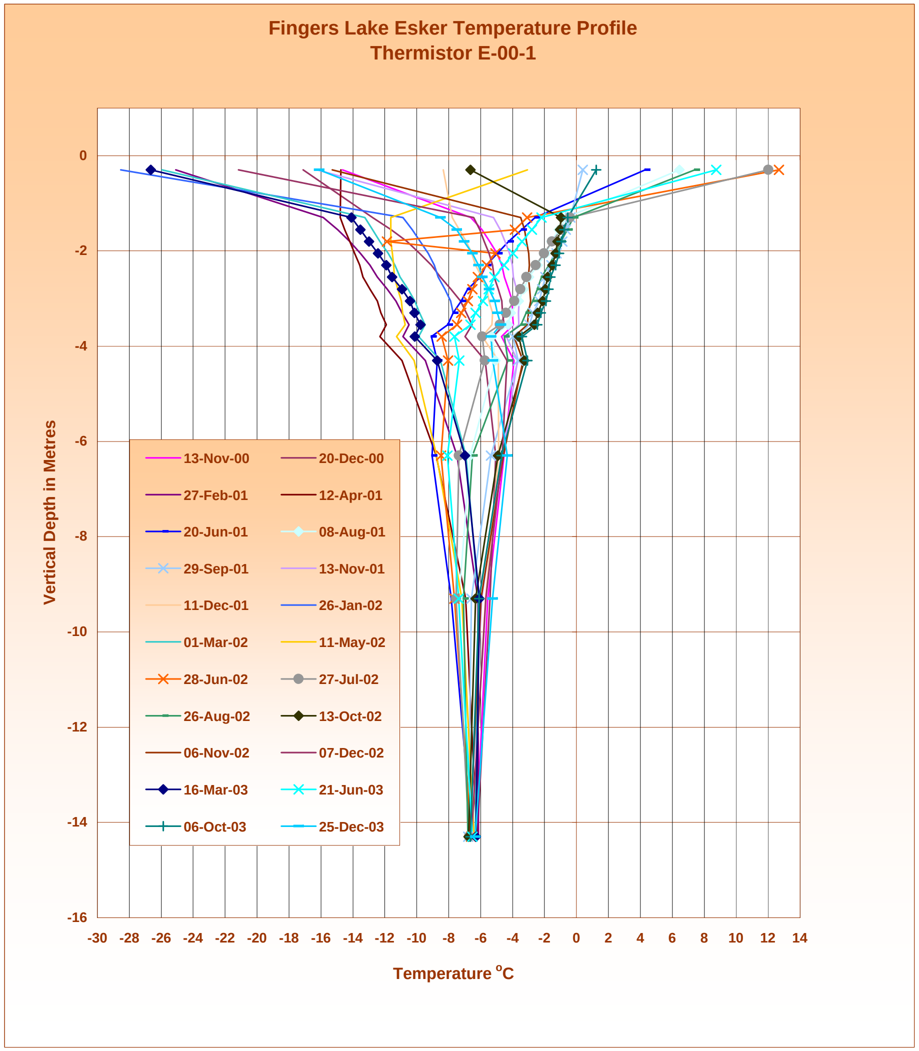

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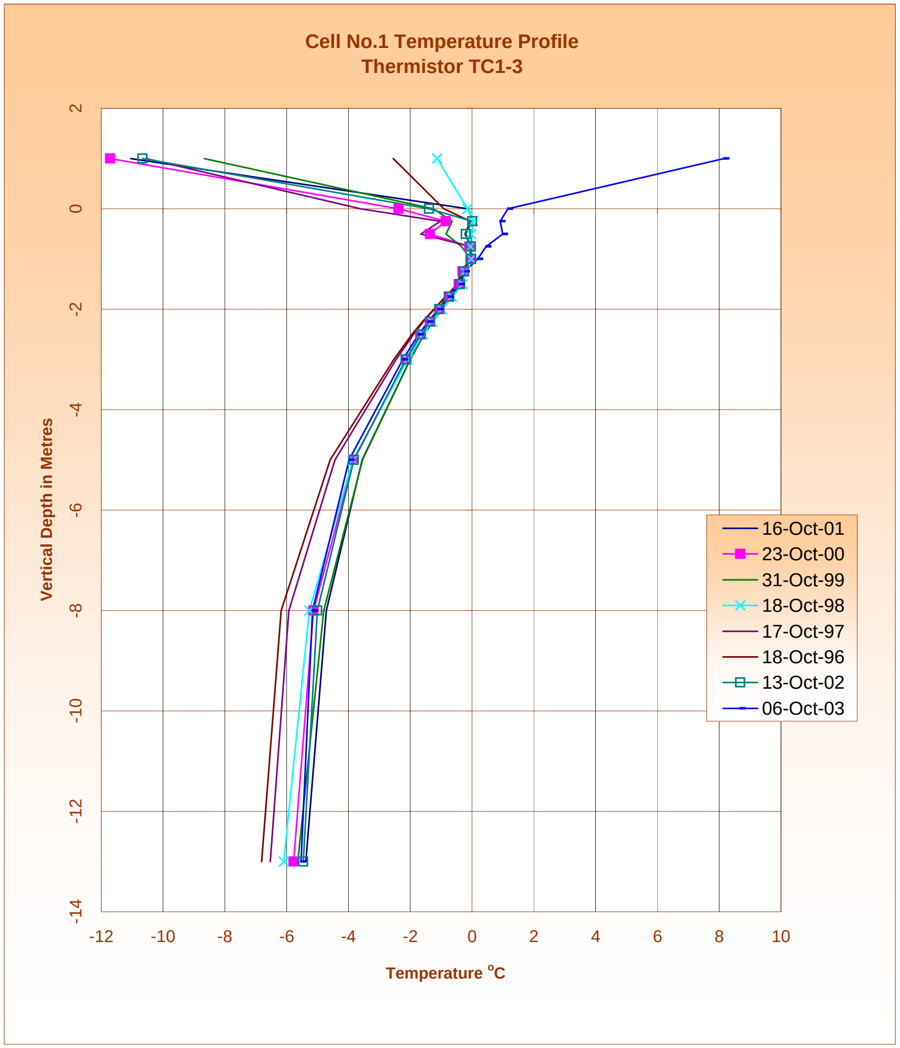

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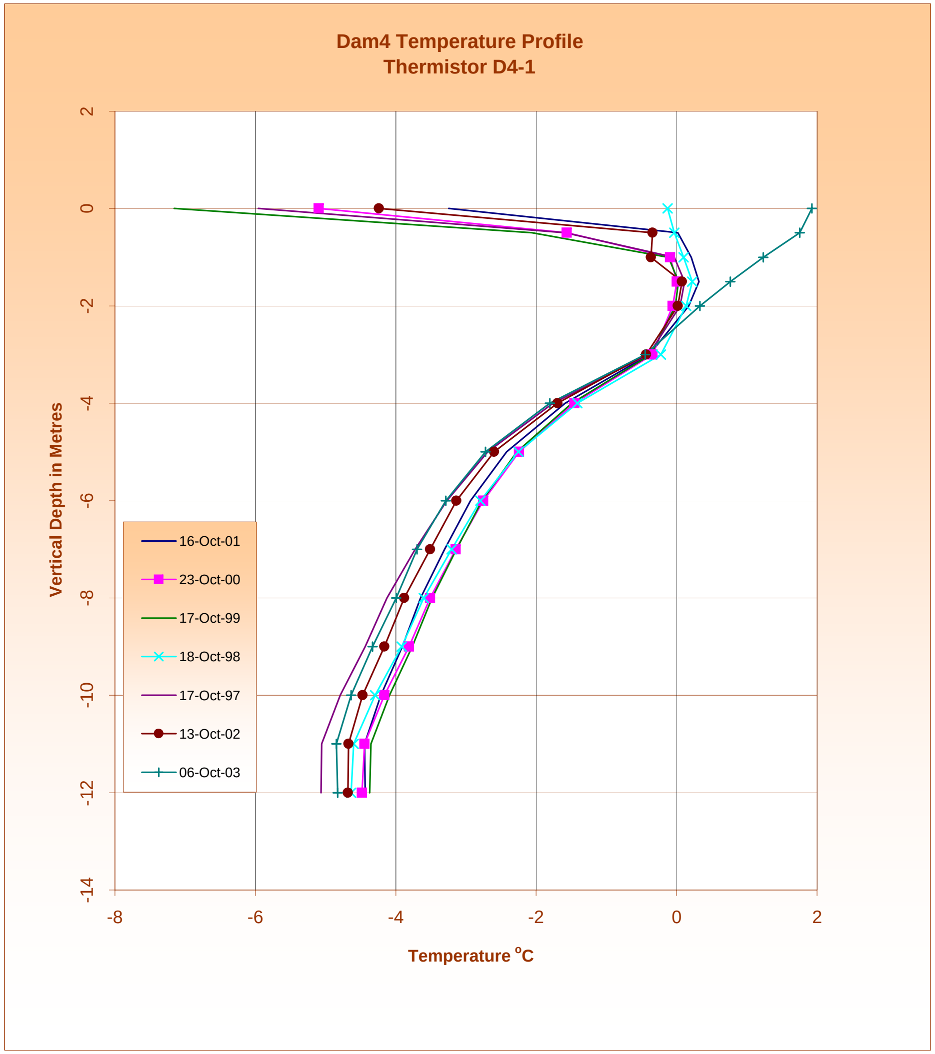
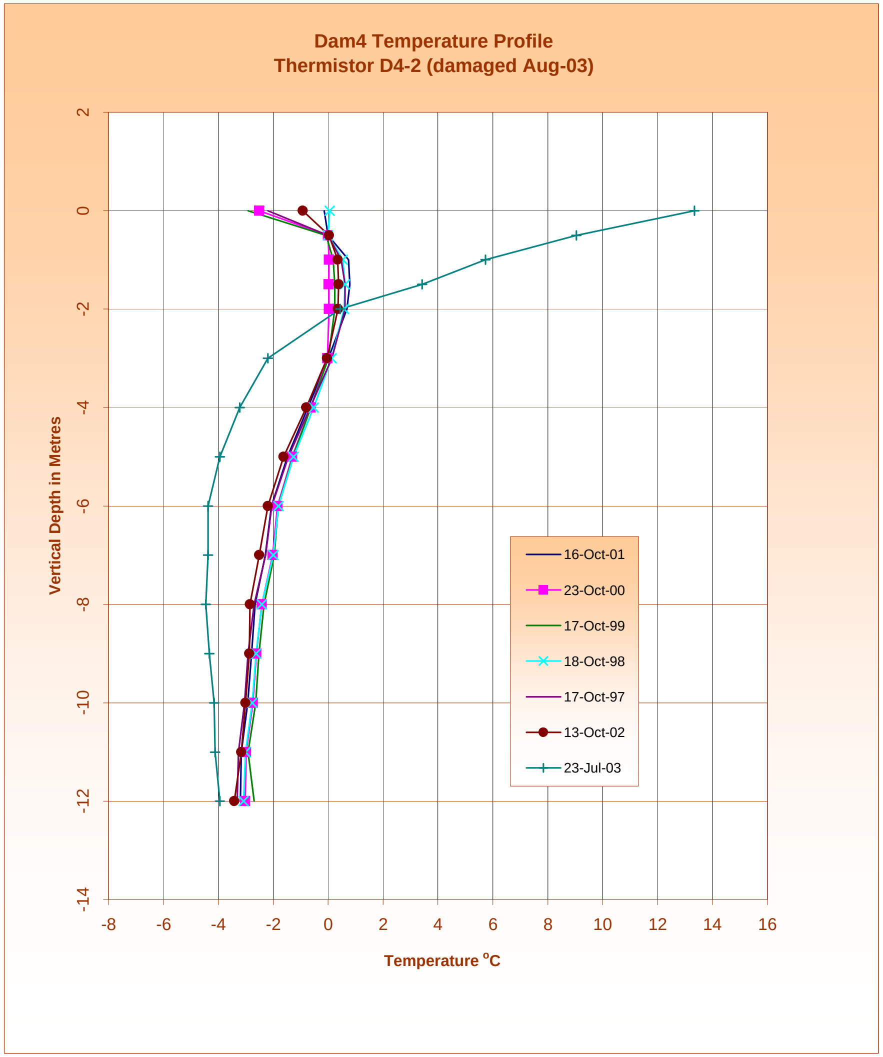
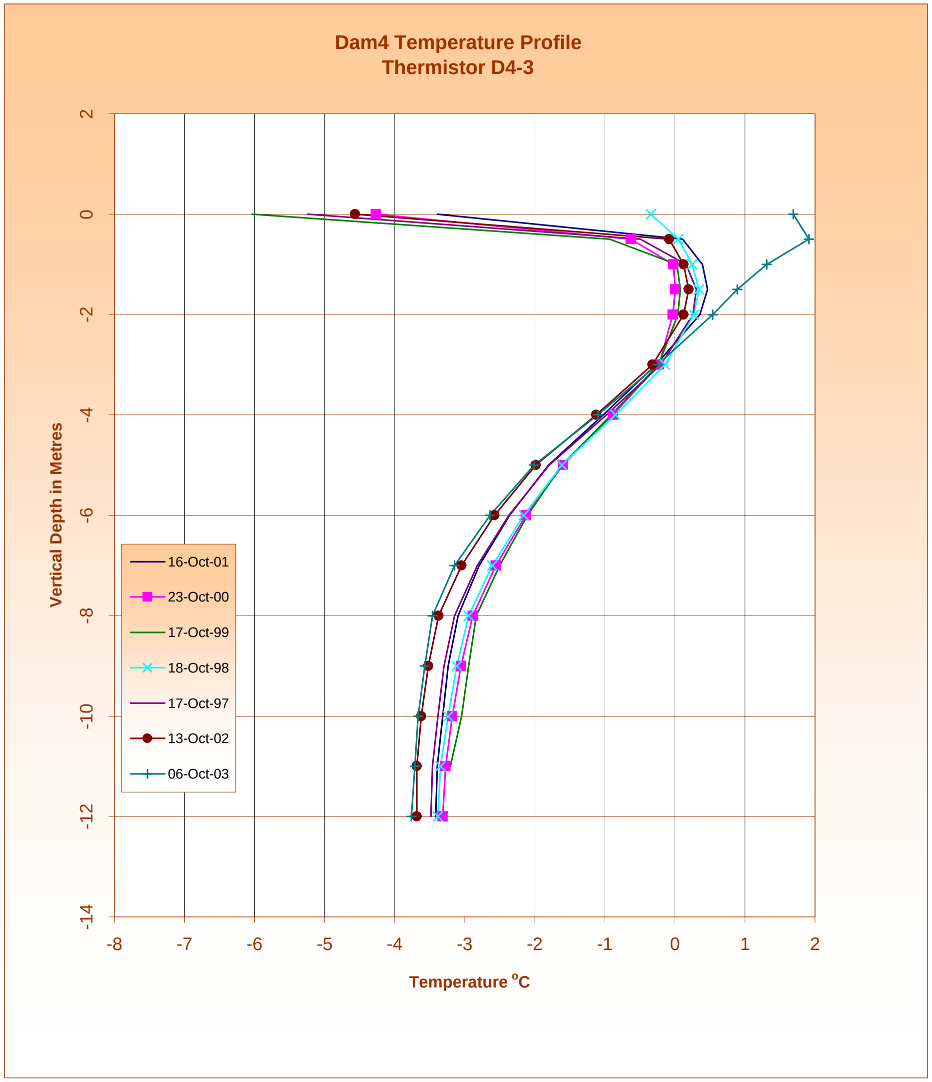


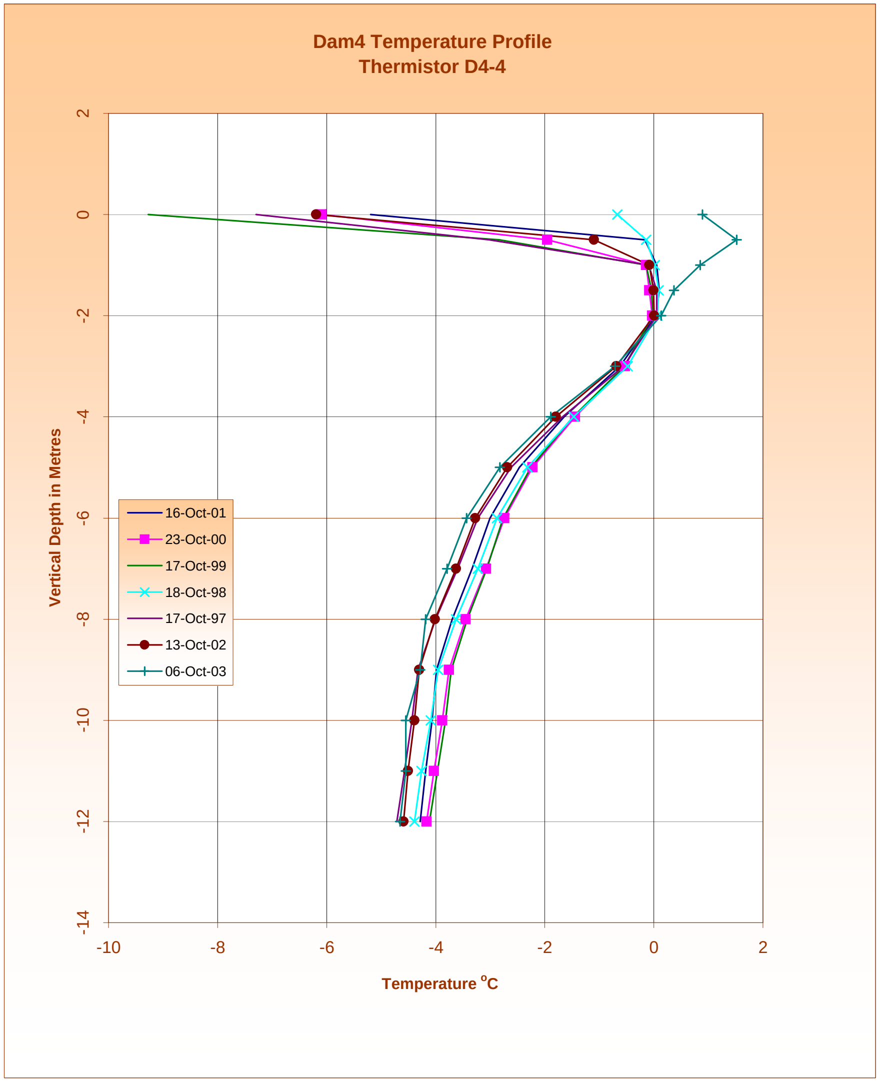
Graph No.6



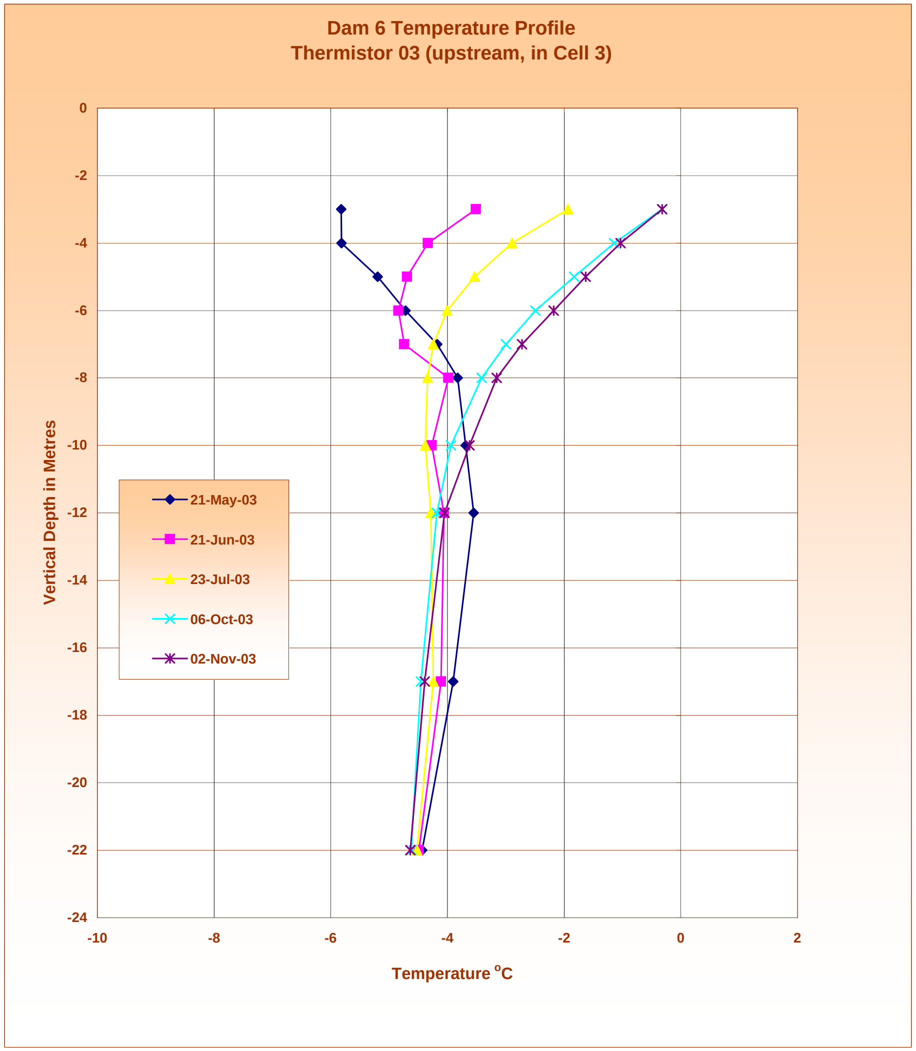
Graph No.7



Graph No.8



Graph No.9



Graph No.10

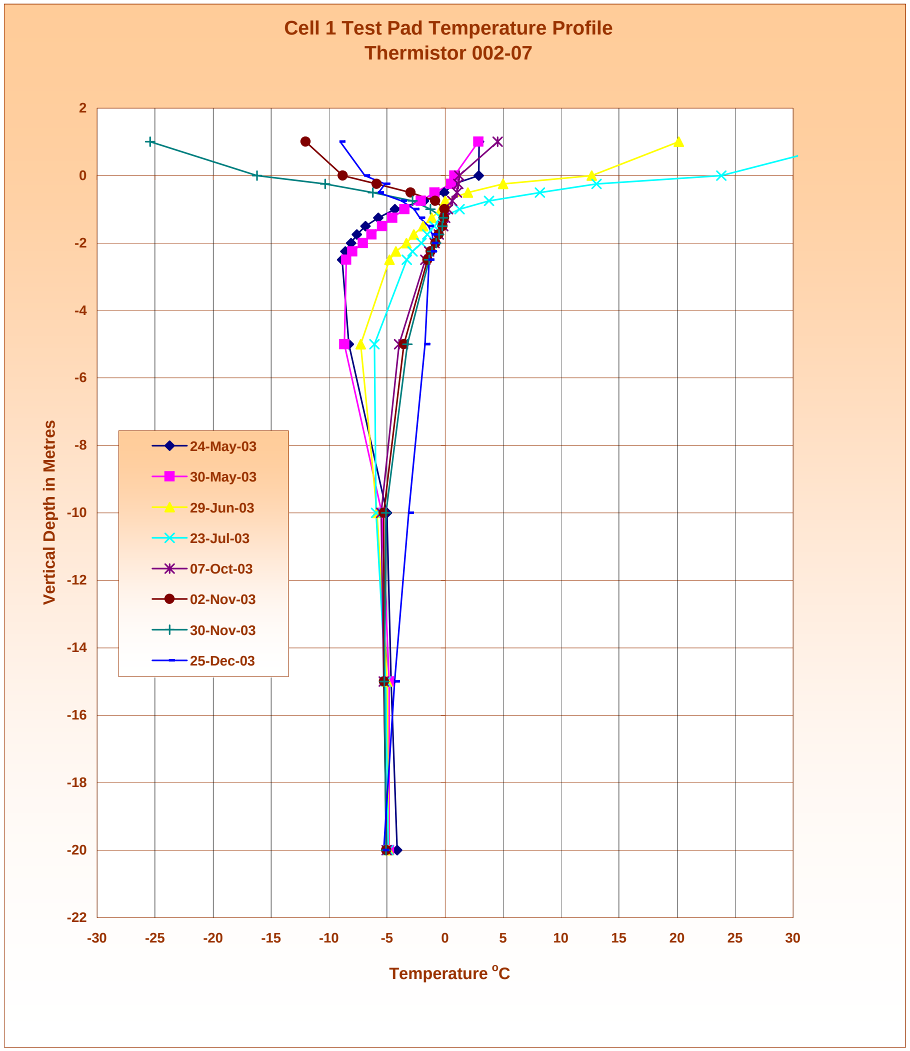


Photo 1 - Paste backfill being poured into Centre Zone crown pillar stope. View to east.

Photo 2 – Paste backfill being poured into Centre Zone crown pillar stope. View to south.

Photo 3 – Waste rock cap placed on paste filled stope.

Photo 4 – Landscaping over former open stope area.

Photo 5 – Cells 3A and 3B prior to placement of esker cover. View to southwest.

Photo 6 – Cells 3A and 3B after covered with esker material. View to northwest.

Photo 7 - Typical depth of esker cover on Cell 3A and 3B.

Photo 8 – Installing liner in Cell 1 test pad

Photo 9 – Cell 1 test pad after liner installation and grooming. Note thermistor (white pipe) in centre of test pad.

Photo 10 - Thermistor installed in Dam 6, destroyed by bear.

Photo 11 – Thermistor installed upstream of Dam 6 (Cell 3). Also attacked by a bear, but still useable.

APPENDIX B

Norwest Labs Ltd. Analytical and QC Reports

SNP 925-01	Apr 28/03	NWL # 230440-5	EBM Log # 30005
SNP 925-14	Jun 24/03	NWL # 240463-3	EBM Log # 30008
SNP 925-14	Jul 22/03	NWL # 245010-1	EBM Log # 30009

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Analytical Report

Norwest Labs
9938-67 Avenue
Edmonton, AB. T6E 0P5
Phone: (780) 438-5522
Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

NWL Number 230440-4
Sample Date Apr 23, 2003
Sample Description 925-14 Log No. 30004

Analyte		Units	Results	Results	Results	Detection Limit
Aggregate Organic Constituents						
Biochemical Oxygen Demand	5 Day	mg/L	<4			4
Inorganic Nonmetallic Parameters						
Ammonium - N	Dissolved	mg/L	22.0			0.05
Kjeldahl Nitrogen	Total	mg/L	245			0.05
Phosphorus	Total	mg/L	1.5			0.05
Phosphate	as P	mg/L	0.06			0.05
Metals Total						
Calcium	Total	mg/L	704	1.1		0.2
Iron	Total	mg/L	0.2	<0.1		0.1
Magnesium	Total	mg/L	53.0	0.6		0.2
Manganese	Total	mg/L	1.55	<0.005		0.005
Potassium	Total	mg/L	45.4	0.7		0.4
Silicon	Total	mg/L	2.50	0.14		0.05
Sodium	Total	mg/L	872	1.0		0.4
Sulphur	Total	mg/L	174	0.83		0.05
Mercury	Total	mg/L	-	<0.0002		0.0002
Aluminum	Total	mg/L	0.483	0.014		0.005
Antimony	Total	mg/L	0.0012	<0.0002		0.0002
Arsenic	Total	mg/L	0.0126	0.0007		0.0002
Barium	Total	mg/L	0.195	0.004		0.001
Beryllium	Total	mg/L	<0.0001	<0.0001		0.0001
Bismuth	Total	mg/L	<0.0005	<0.0005		0.0005
Boron	Total	mg/L	0.191	0.005		0.002
Cadmium	Total	mg/L	0.00033	0.00005		0.00001
Chromium	Total	mg/L	0.0009	0.0005		0.0005
Cobalt	Total	mg/L	0.0733	<0.0001		0.0001
Copper	Total	mg/L	0.008	0.002		0.001
Lead	Total	mg/L	0.0006	0.0018		0.0001
Lithium	Total	mg/L	2.84	0.002		0.001
Molybdenum	Total	mg/L	0.002	<0.001		0.001
Nickel	Total	mg/L	0.0628	0.0023		0.0005
Selenium	Total	mg/L	<0.0002	<0.0002		0.0002
Silver	Total	mg/L	<0.0001	<0.0001		0.0001
Strontium	Total	mg/L	14.2	0.010		0.001
Thallium	Total	mg/L	0.00008	<0.00005		0.00005
Tin	Total	mg/L	<0.001	<0.001		0.001

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9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

		NWL Number	230440-4	230440-5		
		Sample Date	Apr 23, 2003	Apr 28, 2003		
		Sample Description	925-14 Log No. 30004	925-01 Log No. 30005		
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Metals Total - Continued						
Titanium	Total	mg/L	0.0081	<0.0005		0.0005
Uranium	Total	mg/L	<0.0005	<0.0005		0.0005
Vanadium	Total	mg/L	<0.0001	<0.0001		0.0001
Zinc	Total	mg/L	0.215	0.003		0.001
Zirconium	Total	mg/L	<0.001	<0.001		0.001
Physical and Aggregate Properties						
Temperature of observed pH		°C	20.4	16.9		
Solids	Total Suspended	mg/L	<1	<1		1
Routine Water						
pH			6.00	6.59		
Electrical Conductivity		uS/cm at 25 °C	8120	19.9		1
Calcium	Dissolved	mg/L	675	-		0.2
Magnesium	Dissolved	mg/L	54.4	-		0.2
Nitrate - N		mg/L	41.1	-		0.004
Nitrite - N		mg/L	<0.02	-		0.002
Hydroxide		mg/L	<5	<5		5
Carbonate		mg/L	<6	7		6
Bicarbonate		mg/L	17	<5		5
P-Alkalinity	as CaCO3	mg/L	<5	<5		5
T-Alkalinity	as CaCO3	mg/L	14	6		5
Hardness	Dissolved as CaCO3	mg/L	1910	-		

		NWL Number	230440-5			
		Sample Date	Apr 28, 2003			
		Sample Description	925-01 Log No. 30005			
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	<1			1
Fecal Coliforms	Membrane Filtration	CFU/100 mL	<1			1

Approved by: Anthony Neumann, MSc
Laboratory Operations Manager

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Calgary Edmonton Winnipeg Lethbridge Surrey

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9818 International Airport
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Attn: David Hohnstein
Sampled By: D. Hohnstein
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Project
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Name:
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P.O.:
Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Inorganic Nonmetallic Parameters

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Ammonium - N	mg/L	<0.05	0.000	0.000	0.050	✓
Kjeldahl Nitrogen	mg/L	<0.05	0.000000	-0.000980	0.050000	✓
Phosphorus	mg/L	<0.05	0.00000	-0.00260	0.05000	✓
Phosphate	mg/L	<0.05	0.0000	-0.0500	0.0500	✓
Cyanide	mg/L	<0.001	0.00000	-0.00100	0.00100	✓

Material Used: Edmonton Method Blank
Date Acquired: May 02, 2003
Acquired By:

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Ammonium - N	mg/L	2.98	2.94	10.00	0.10	✓
Kjeldahl Nitrogen	mg/L	1.61	1.60	10.00	0.30	✓
Phosphate	mg/L	0.33	0.32	10.00	0.05	✓

Material Used: Edmonton Duplicate
Date Acquired: Apr 30, 2003
Acquired By: Linda Li

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Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Inorganic Nonmetallic Parameters (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Ammonium - N	mg/L	2.93	3.00	2.72	3.26	✓
Kjeldahl Nitrogen	mg/L	31.0	30.00	28.50	32.70	✓
Phosphorus	mg/L	3.94	4.00	3.72	4.24	✓
Cyanide	mg/L	0.075	0.0750	0.0703	0.0834	✓

Material Used: Water High
Date Acquired: May 02, 2003
Acquired By: Gordon Grensmann

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Ammonium - N	mg/L	0.78	0.800	0.715	0.881	✓
Kjeldahl Nitrogen	mg/L	4.98	5.00	4.72	5.39	✓
Phosphorus	mg/L	0.38	0.400	0.358	0.429	✓
Phosphate	mg/L	0.41	0.400	0.359	0.432	✓
Cyanide	mg/L	0.016	0.0150	0.0140	0.0172	✓

Material Used: Water Low
Date Acquired: May 02, 2003
Acquired By:

Aggregate Organic Constituents

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Biochemical Oxygen Demand	mg/L	203	200	165	208	✓

Material Used: Water High
Date Acquired: Apr 30, 2003
Acquired By:

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Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **230440**
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Physical and Aggregate Properties

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Solids	mg/L	<1	0.000	0.000	1.000	✓

Material Used: Edmonton Method Blank
Date Acquired: May 01, 2003
Acquired By: Iona McCloughan

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Solids	mg/L	82	85	10.0	5.0	✓

Material Used: Edmonton Duplicate
Date Acquired: Apr 29, 2003
Acquired By: Gordon Grensmann

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Fax: (780) 438-0396

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9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
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Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
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Routine Water

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Nitrate - N	mg/L	<0.004	0.0000	-0.0100	0.0100	✓
Nitrite - N	mg/L	<0.002	0.0000	-0.0100	0.0100	✓

Material Used: Edmonton Method Blank
Date Acquired: Apr 29, 2003
Acquired By: Tina Knott

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
pH		7.72	7.72	10.00	0.10	✓
Electrical Conductivity	dS/m at 25C	1.01	1.02	10.000	0.002	✓
Nitrate - N	mg/L	3.02	3.04	10.000	0.010	✓
Nitrite - N	mg/L	<0.01		10.000	0.010	✓
Hydroxide	mg/L	<5	<5	10.0		✓
Carbonate	mg/L	<6	<6	10.0		✓
Bicarbonate	mg/L	698	704	10.0		✓
P-Alkalinity	mg/L	<5	<5	10.0	5.0	✓
T-Alkalinity	mg/L	572	577	10.0	5.0	✓

Material Used: Edmonton Duplicate
Date Acquired: Apr 30, 2003
Acquired By: Amanda Mitchell

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Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
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Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Routine Water (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	247	250.0	225.0	275.0	✓
Magnesium	mg/L	104	100.0	90.0	110.0	✓

Material Used: Metals High
Date Acquired: Apr 29, 2003
Acquired By:

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	4.5	5.00	4.50	5.50	✓
Magnesium	mg/L	1.8	2.00	1.80	2.20	✓

Material Used: Metals Low
Date Acquired: Apr 29, 2003
Acquired By: Fernando Maglalang

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
pH		9.29	9.18	9.04	9.31	✓
Electrical Conductivity	dS/m at 25C	2.69	2.765	2.690	2.810	✓
Nitrate - N	mg/L	9.90	10.000	9.790	10.500	✓
Nitrite - N	mg/L	10.2	10.000	9.620	10.400	✓
P-Alkalinity	mg/L	510	524	496	552	✓
T-Alkalinity	mg/L	1010	1000	980	1029	✓

Material Used: Water High
Date Acquired: Apr 30, 2003
Acquired By: Amanda Mitchell

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
pH		6.90	6.86	6.84	6.94	✓
Electrical Conductivity	dS/m at 25C	0.073	0.0739	0.0739	0.0784	✓
Nitrate - N	mg/L	0.479	0.500	0.458	0.539	✓
Nitrite - N	mg/L	0.454	0.500	0.454	0.526	✓
P-Alkalinity	mg/L	61	60.4	48.8	72.0	✓
T-Alkalinity	mg/L	129	125	122	132	✓

Material Used: Water Low
Date Acquired: Apr 30, 2003
Acquired By: Amanda Mitchell

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NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
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Metals Total

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	<0.2	0.0000	-0.0312	0.2000	✓
Iron	mg/L	<0.1	0.0000	-0.0149	0.0290	✓
Magnesium	mg/L	<0.2	0.0000	-0.0305	0.0500	✓
Manganese	mg/L	<0.005	0.000000	-0.000700	0.001200	✓
Potassium	mg/L	<0.4	0.000	-0.102	0.400	✓
Silicon	mg/L	<0.05	0.0000	-0.0435	0.0933	✓
Sodium	mg/L	<0.4	0.000	-0.194	0.400	✓
Sulphur	mg/L	<0.05	0.0000	-0.0333	0.0447	✓
Mercury	mg/L	<0.0001	0.000000	-0.000111	0.000111	✓

Material Used: Edmonton Method Blank
Date Acquired: Apr 29, 2003
Acquired By: Fernando Maglalang

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Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
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Acct. Code:

NWL Lot ID: **230440**
Control Number:
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Metals Total (Continued...)

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC

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Metals Total (Continued...)

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Calcium	mg/L	27.7	27.7	10.0	0.6	✓
Iron	mg/L	<0.1	<0.1	10.0	0.0	✓
Magnesium	mg/L	6.8	6.8	10.0	0.2	✓
Manganese	mg/L	0.028	0.030	10.000	0.001	✓
Potassium	mg/L	3.2	3.1	10.0	1.2	✓
Silicon	mg/L	0.47	0.46	10.00	0.01	✓
Sodium	mg/L	11.0	10.9	10.0	1.2	✓
Sulphur	mg/L	3.62	3.60	10.00	0.03	✓
Mercury	mg/L	<0.0002	<0.0002	10.0000	0.0003	✓
Aluminum	ug/L	259	259	10.0	11.0	✓
Antimony	ug/L	<0.2	<0.2	10.0	0.4	✓
Arsenic	ug/L	1.0	1.0	10.0	0.4	✓
Barium	ug/L	67	66	10.0	2.2	✓
Beryllium	ug/L	<0.1	<0.1	10.0	0.2	✓
Bismuth	ug/L	<0.5	<0.5	10.0	1.1	✓
Boron	ug/L	28	27	10.0	4.4	✓
Cadmium	ug/L	0.14	0.14	10.00	0.02	✓
Chromium	ug/L	0.6	<0.5	10.0	1.1	✓
Cobalt	ug/L	<0.1	<0.1	10.0	0.2	✓
Copper	ug/L	3	4	10.0	2.2	✓
Lead	ug/L	0.3	0.3	10.0	0.2	✓
Lithium	ug/L	11	11	10.0	2.2	✓
Molybdenum	ug/L	<1	<1	10.0	2.2	✓
Nickel	ug/L	1.2	1.0	10.0	1.1	✓
Selenium	ug/L	<0.2	<0.2	10.0	0.4	✓
Silver	ug/L	<0.1	<0.1	10.0	0.2	✓
Strontium	ug/L	150	150	10.0	2.2	✓
Thallium	ug/L	<0.05	<0.05	10.00	0.11	✓
Tin	ug/L	<1	<1	10.0	2.2	✓
Titanium	ug/L	1.0	1.3	10.0	1.1	✓
Uranium	ug/L	<0.5	<0.5	10.0	1.1	✓
Vanadium	ug/L	0.1	0.1	10.0	0.2	✓
Zinc	ug/L	6	7	10.0	2.2	✓
Zirconium	ug/L	<1	<1	10.0	2.2	✓

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NWL Lot ID: **230440**
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Metals Total (Continued...)

Replicates		Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Material Used:	Edmonton Duplicate						
Date Acquired:	Apr 29, 2003						
Acquired By:	Jesse Dang						

Norwest Labs
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Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
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Report Number: 395995

Metals Total (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	49.7	50.0	45.0	55.0	✓
Iron	mg/L	2.0	2.00	1.80	2.20	✓
Magnesium	mg/L	17.8	20.0	18.0	22.0	✓
Manganese	mg/L	0.490	0.500	0.450	0.550	✓
Potassium	mg/L	50.1	50.0	45.0	55.0	✓
Silicon	mg/L	1.98	2.00	1.80	2.20	✓
Sodium	mg/L	51.4	50.0	45.0	55.0	✓
Sulphur	mg/L	10.0	10.00	9.00	11.00	✓
Mercury	mg/L	0.0007	0.000800	0.000720	0.000880	✓
Aluminum	ug/L	321	300	270	330	✓
Antimony	ug/L	11.3	12.0	10.8	13.2	✓
Arsenic	ug/L	11.3	12.0	10.8	13.2	✓
Barium	ug/L	60	60.0	54.0	66.0	✓
Beryllium	ug/L	5.8	6.00	5.40	6.60	✓
Bismuth	ug/L	33.0	30.0	27.0	33.0	✓
Boron	ug/L	126	120	108	132	✓
Cadmium	ug/L	0.60	0.600	0.540	0.660	✓
Chromium	ug/L	31.8	30.0	27.0	33.0	✓
Cobalt	ug/L	6.6	6.00	5.40	6.60	✓
Copper	ug/L	63	60.0	54.0	66.0	✓
Lead	ug/L	6.5	6.00	5.40	6.60	✓
Lithium	ug/L	64	60.0	54.0	66.0	✓
Molybdenum	ug/L	61	60.0	54.0	66.0	✓
Nickel	ug/L	31.6	30.0	27.0	33.0	✓
Selenium	ug/L	10.8	12.0	10.8	13.2	✓
Silver	ug/L	6.0	6.00	5.40	6.60	✓
Strontium	ug/L	63	60.0	54.0	66.0	✓
Thallium	ug/L	3.30	3.00	2.70	3.30	✓
Tin	ug/L	58	60.0	54.0	66.0	✓
Titanium	ug/L	31.5	30.0	27.0	33.0	✓
Uranium	ug/L	31.1	30.0	27.0	33.0	✓
Vanadium	ug/L	6.6	6.00	5.40	6.60	✓
Zinc	ug/L	58	60.0	54.0	66.0	✓
Zirconium	ug/L	62	60.0	54.0	66.0	✓

Material Used: Edmonton Digestion Check
Date Acquired: Apr 29, 2003
Acquired By: Jesse Dang

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Quality Control

Norwest Labs
9938-67 Avenue
Edmonton, AB. T6E 0P5
Phone: (780) 438-5522
Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2

Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Metals Total (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	253	250.0	225.0	275.0	✓
Iron	mg/L	9.5	10.00	9.00	11.00	✓
Magnesium	mg/L	103	100.0	90.0	110.0	✓
Manganese	mg/L	2.40	2.500	2.250	2.750	✓
Potassium	mg/L	264	250.0	225.0	275.0	✓
Silicon	mg/L	11.1	10.00	9.00	11.00	✓
Sodium	mg/L	262	250.0	225.0	275.0	✓
Sulphur	mg/L	53.7	50.00	45.00	55.00	✓
Mercury	mg/L	0.0029	0.00300	0.00267	0.00322	✓

Material Used: Metals High
Date Acquired: Apr 29, 2003
Acquired By: Fernando Maglalang

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Calgary Edmonton Winnipeg Lethbridge Surrey

Quality Control

Norwest Labs
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Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Metals Total (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	4.8	5.00	4.50	5.50	✓
Iron	mg/L	0.2	0.200	0.180	0.220	✓
Magnesium	mg/L	1.9	2.00	1.80	2.20	✓
Manganese	mg/L	0.049	0.0500	0.0450	0.0550	✓
Potassium	mg/L	5.1	5.00	4.50	5.50	✓
Silicon	mg/L	0.20	0.200	0.160	0.240	✓
Sodium	mg/L	5.4	5.00	4.50	5.50	✓
Sulphur	mg/L	0.94	1.000	0.900	1.100	✓
Mercury	mg/L	0.0008	0.000800	0.000720	0.000880	✓
Aluminum	ug/L	991	1000	900	1100	✓
Antimony	ug/L	39.6	40.0	36.0	44.0	✓
Arsenic	ug/L	38.8	40.0	36.0	44.0	✓
Barium	ug/L	196	200	180	220	✓
Beryllium	ug/L	19.3	20.0	18.0	22.0	✓
Bismuth	ug/L	99.8	100.0	90.0	110.0	✓
Boron	ug/L	402	400	360	440	✓
Cadmium	ug/L	2.20	2.00	1.80	2.20	✓
Chromium	ug/L	99.4	100.0	90.0	110.0	✓
Cobalt	ug/L	20.8	20.0	18.0	22.0	✓
Copper	ug/L	191	200	180	220	✓
Lead	ug/L	20.7	20.0	18.0	22.0	✓
Lithium	ug/L	203	200	180	220	✓
Molybdenum	ug/L	197	200	180	220	✓
Nickel	ug/L	99.7	100.0	90.0	110.0	✓
Selenium	ug/L	38.3	40.0	36.0	44.0	✓
Silver	ug/L	20.8	20.0	18.0	22.0	✓
Strontium	ug/L	200	200	180	220	✓
Thallium	ug/L	10.8	10.00	9.00	11.00	✓
Tin	ug/L	191	200	180	220	✓
Titanium	ug/L	98.8	100.0	90.0	110.0	✓
Uranium	ug/L	100	100.0	90.0	110.0	✓
Vanadium	ug/L	20.4	20.0	18.0	22.0	✓
Zinc	ug/L	195	200	180	220	✓
Zirconium	ug/L	203	200	180	220	✓

Material Used: Metals Low
Date Acquired: Apr 29, 2003
Acquired By:

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Quality Control

Norwest Labs
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Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 230440
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Metals Total (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Aluminum	ug/L	53	50.0	45.0	55.0	✓
Antimony	ug/L	2.0	2.00	1.80	2.20	✓
Arsenic	ug/L	2.0	2.00	1.80	2.20	✓
Barium	ug/L	10	10.00	9.00	11.00	✓
Beryllium	ug/L	1.0	1.000	0.900	1.100	✓
Bismuth	ug/L	5.3	5.00	4.50	5.50	✓
Boron	ug/L	21	20.0	18.0	22.0	✓
Cadmium	ug/L	0.10	0.1000	0.0900	0.1100	✓
Chromium	ug/L	5.5	5.00	4.50	5.50	✓
Cobalt	ug/L	1.1	1.000	0.900	1.100	✓
Copper	ug/L	10	10.00	9.00	11.00	✓
Lead	ug/L	1.1	1.000	0.900	1.100	✓
Lithium	ug/L	10	10.00	9.00	11.00	✓
Molybdenum	ug/L	10	10.00	9.00	11.00	✓
Nickel	ug/L	5.3	5.00	4.50	5.50	✓
Selenium	ug/L	1.9	2.00	1.80	2.20	✓
Silver	ug/L	1.0	1.000	0.900	1.100	✓
Strontium	ug/L	11	10.00	9.00	11.00	✓
Thallium	ug/L	0.55	0.500	0.450	0.550	✓
Tin	ug/L	10	10.00	9.00	11.00	✓
Titanium	ug/L	5.2	5.00	4.50	5.50	✓
Uranium	ug/L	5.3	5.00	4.50	5.50	✓
Vanadium	ug/L	1.1	1.000	0.900	1.100	✓
Zinc	ug/L	9	10.00	9.00	11.00	✓
Zirconium	ug/L	10	10.00	9.00	11.00	✓

Material Used: Metals Trace
Date Acquired: Apr 29, 2003
Acquired By:

NORWEST LABS
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Calgary Edmonton Winnipeg Lethbridge Surrey

Methodology and Notes

Norwest Labs
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Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **230440**
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Method of Analysis:

MethodName	Reference		Method	Date of Analys	Location	Analyst
(Ortho)Phosphate in Water	APHA	*	Automated Ascorbic Acid Reduction Method, 4500-P F	Apr 30, 2003	Norwest Labs Edmonton	Tina Knott
Alkalinity, pH, and EC in water	APHA	*	Conductivity - Laboratory Method, 2510 B	May 01, 2003	Norwest Labs Edmonton	Amanda Mitchell
Alkalinity, pH, and EC in water	APHA	*	Electrometric Method, 4500-H+ B	May 01, 2003	Norwest Labs Edmonton	Amanda Mitchell
Alkalinity, pH, and EC in water	APHA	*	Laboratory & Field Methods, 2550 B	May 01, 2003	Norwest Labs Edmonton	Amanda Mitchell
Alkalinity, pH, and EC in water	APHA	*	Titration Method, 2320 B	May 01, 2003	Norwest Labs Edmonton	Amanda Mitchell
Ammonium in Water	APHA	*	Automated Phenate Method, 4500-NH3 G	May 01, 2003	Norwest Labs Edmonton	Gordon Grensmann
Anions (Routine) by Ion Chromatography	APHA	*	Single-Column Ion Chromatography with Electronic Suppression, 4110 C	Apr 30, 2003	Norwest Labs Edmonton	Tina Knott
BOD in water	APHA	*	5 Day, 5210 B	May 05, 2003	Norwest Labs Edmonton	Iona McCloughan
Cyanide (Strong Acid Dissociable) in water	APHA	*	Total Cyanide after Distillation, 4500-CN- C	May 03, 2003	Norwest Labs Edmonton	Gordon Grensmann
Fecal Coliforms - MF	APHA		Fecal Coliform Membrane Filter Procedure, 9222 D	Apr 30, 2003	Norwest Labs Calgary	FengFei Zhou
Kjeldahl Nitrogen & Phosphorus (Total) in Water	APHA	*	Automated Ascorbic Acid Reduction Method, 4500-P F	Apr 29, 2003	Norwest Labs Edmonton	Tina Knott
Kjeldahl Nitrogen & Phosphorus (Total) in Water	QuikChem Method	*	Total Kjeldahl Nitrogen in Soil/Plant, 13-107-6-2-D	Apr 29, 2003	Norwest Labs Edmonton	Tina Knott
Mercury (Total) in water	MDMES	*	Determination of Mercury in Water by Cold Vapor Atomic Absor, 245.1	Apr 29, 2003	Norwest Labs Edmonton	Fernando Maglalang

Norwest Labs
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Calgary Edmonton Winnipeg Lethbridge Surrey

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Methodology and Notes

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID:
Name:
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **230440**
Control Number:
Date Received: Apr 28, 2003
Date Reported: May 09, 2003
Report Number: 395995

Metals ICP-MS (Total) in water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	May 01, 2003	Norwest Labs Edmonton	Jesse Dang
Metals Trace (Dissolved) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	May 01, 2003	Norwest Labs Edmonton	To Thong
Metals Trace (Total) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	Apr 30, 2003	Norwest Labs Edmonton	Fernando Maglalang
Metals Trace (Total) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	Apr 30, 2003	Norwest Labs Edmonton	To Thong
Solids Suspended (Total, Fixed and Volatile)	APHA	*	SS by Imhoff cone, 2540 F	Apr 29, 2003	Norwest Labs Edmonton	Amanda Mitchell
Solids Suspended (Total, Fixed and Volatile)	APHA	*	SS by Imhoff cone, 2540 F	May 05, 2003	Norwest Labs Edmonton	Iona McCloughan
Total Coliforms - MF	APHA		Standard Total Coliform Membrane Filter Procedure, 9222 B	Apr 30, 2003	Norwest Labs Calgary	FengFei Zhou

* Norwest method(s) is based on reference method

References:

APHA	Standard Methods for the Examination of Water and Wastewater
MDMES	Mthds for the Determination of Metals in Enviromental Smpls
QuikChem Method	Lachat Instruments
US EPA	US Environmental Protection Agency Test Methods

Comments:

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Analytical Report

Norwest Labs
7217 Roper Road
Edmonton, AB. T6B 3J4
Phone: (780) 438-5522
Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2

Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

		NWL Number	240463-1	240463-2	240463-3	
		Sample Date	Jun 24, 2003	Jun 24, 2003	Jun 24, 2003	
		Sample Description	SB2 Log No. 30006	SB5 Log No. 30007	925-14 Log No. 30008	
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Inorganic Nonmetallic Parameters						
Ammonium - N	Dissolved	mg/L	-	-	2.91	0.05
Kjeldahl Nitrogen	Total	mg/L	-	-	5.19	0.05
Phosphorus	Total	mg/L	-	-	0.17	0.05
Phosphate	as P	mg/L	-	-	<0.05	0.05
Cyanide	Strong Acid Dissociable	mg/L	0.002	0.002	-	0.002
Metals Dissolved						
Arsenic	Dissolved	mg/L	0.0114	0.0033	0.0097	0.0002
Metals Total						
Calcium	Total	mg/L	3.5	1.8	87.0	0.2
Iron	Total	mg/L	<0.1	0.2	0.2	0.1
Magnesium	Total	mg/L	1.2	0.9	6.8	0.2
Manganese	Total	mg/L	0.043	0.005	0.205	0.005
Potassium	Total	mg/L	0.5	0.4	5.4	0.4
Silicon	Total	mg/L	0.46	0.36	0.74	0.05
Sodium	Total	mg/L	1.4	1.1	96.8	0.4
Sulphur	Total	mg/L	4.50	2.02	23.6	0.05
Aluminum	Total	mg/L	0.029	0.063	0.128	0.005
Antimony	Total	mg/L	<0.0002	<0.0002	0.0004	0.0002
Arsenic	Total	mg/L	0.0142	0.0032	0.0114	0.0002
Barium	Total	mg/L	0.007	0.006	0.025	0.001
Beryllium	Total	mg/L	<0.0001	<0.0001	<0.0001	0.0001
Bismuth	Total	mg/L	<0.0005	<0.0005	<0.0005	0.0005
Boron	Total	mg/L	0.005	0.004	0.031	0.002
Cadmium	Total	mg/L	<0.00001	<0.00001	0.00002	0.00001
Chromium	Total	mg/L	0.0007	<0.0005	0.0007	0.0005
Cobalt	Total	mg/L	0.0032	0.0010	0.0095	0.0001
Copper	Total	mg/L	0.002	0.002	0.004	0.001
Lead	Total	mg/L	0.0003	<0.0001	0.0004	0.0001
Lithium	Total	mg/L	0.002	0.001	0.330	0.001
Molybdenum	Total	mg/L	<0.001	<0.001	0.001	0.001
Nickel	Total	mg/L	0.0193	0.0086	0.0101	0.0005
Selenium	Total	mg/L	<0.0002	<0.0002	<0.0002	0.0002
Silver	Total	mg/L	<0.0001	<0.0001	<0.0001	0.0001
Strontium	Total	mg/L	0.018	0.011	1.64	0.001
Thallium	Total	mg/L	<0.00005	<0.00005	<0.00005	0.00005
Tin	Total	mg/L	<0.001	<0.001	<0.001	0.001

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Analytical Report

Norwest Labs
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Edmonton, AB. T6B 3J4
Phone: (780) 438-5522
Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2

Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

		NWL Number	240463-1	240463-2	240463-3	
		Sample Date	Jun 24, 2003	Jun 24, 2003	Jun 24, 2003	
		Sample Description	SB2 Log No. 30006	SB5 Log No. 30007	925-14 Log No. 30008	
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Metals Total - Continued						
Titanium	Total	mg/L	0.0008	0.0010	0.0028	0.0005
Uranium	Total	mg/L	<0.0005	<0.0005	<0.0005	0.0005
Vanadium	Total	mg/L	0.0002	0.0002	<0.0001	0.0001
Zinc	Total	mg/L	0.014	0.009	0.021	0.001
Zirconium	Total	mg/L	<0.001	0.001	<0.001	0.001
Physical and Aggregate Properties						
Temp. of observed pH and EC		C	19.1	19.0	19.1	
Solids	Total Suspended	mg/L	1	2	10	1
Routine Water						
pH	Water	pH	-	-	9.0	0.1
pH			6.42	6.45	8.74	
Electrical Conductivity		uS/cm at 25C	40.7	23.3	1030	1
Calcium	Dissolved	mg/L	2.9	1.3	87.1	0.2
Magnesium	Dissolved	mg/L	1.1	0.7	7.2	0.2
Nitrate - N		mg/L	-	-	4.52	0.004
Nitrite - N		mg/L	-	-	<0.002	0.002
Hydroxide		mg/L	<5	<5	<5	5
Carbonate		mg/L	<6	<6	<6	6
Bicarbonate		mg/L	<5	<5	13	5
P-Alkalinity	as CaCO3	mg/L	<5	<5	<5	5
T-Alkalinity	as CaCO3	mg/L	<5	<5	10	5
Hardness	Dissolved as CaCO3	mg/L	12	6.3	247	

		NWL Number	240463-3			
		Sample Date	Jun 24, 2003			
		Sample Description	925-14 Log No. 30008			
Analyte		**Units**	**Results**	**Results**	**Results**	**Detection Limit**
Aggregate Organic Constituents						
Biochemical Oxygen Demand	5 Day	mg/L	<4			4
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	<1			1
Fecal Coliforms	Membrane Filtration	CFU/100 mL	<1			1

Approved by: Anthony Neumann, MSc
Laboratory Operations Manager

NORWEST LABS
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Calgary Edmonton Winnipeg Lethbridge Surrey

Quality Control

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Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2

Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Horticultural Water Results

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Phosphate	mg/L	<0.05	0.0000	-0.0500	0.0500	✓
Ammonium - N	mg/L	<0.05	0.000	0.000	0.050	✓
Nitrate - N	mg/L	<0.004	0.0000	-0.0100	0.0100	✓
Ammonium - N	mg/L	<0.05	0.000	0.000	0.050	✓

Material Used: Edmonton Method Blank
Date Acquired: Jun 28, 2003
Acquired By: Gordon Grensmann

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Carbonate	mg/L	<6	12	10.0		✓
Bicarbonate	mg/L	21	20	10.0		✓
Electrical Conductivity	uS/cm at 25C	50.7	50.1	10.0	0.2	✓
Hydroxide	mg/L	<5	<5	10.0		✓
pH		7.49	7.36	10.00	0.10	✓
Nitrate - N	mg/L	<0.02	<0.02	10.000	0.010	✓
Magnesium	mg/L	7.2	7.1	10.0	0.2	✓
Calcium	mg/L	87.1	87.0	10.0	0.6	✓
Ammonium - N	mg/L	5.86	5.86	10.00	0.10	✓
Electrical Conductivity	dS/m at 25C	0.051	0.050	10.000	0.002	✓

Material Used: Edmonton Duplicate
Date Acquired: Jun 26, 2003
Acquired By: Amanda Mitchell

NORWEST LABS
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Calgary Edmonton Winnipeg Lethbridge Surrey

Quality Control

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Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Agriculture Waters (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Magnesium	mg/L	107	100.0	94.6	109.0	✓
Calcium	mg/L	250	250.0	236.0	265.0	✓
Material Used: Metals High						
Date Acquired: Jun 25, 2003						
Acquired By: To Thong						
Magnesium	mg/L	1.9	2.00	1.64	2.08	✓
Calcium	mg/L	5.0	5.00	4.33	5.31	✓
Material Used: Metals Low						
Date Acquired: Jun 25, 2003						
Acquired By: To Thong						
P-Alkalinity	mg/L	528	524	496	552	✓
T-Alkalinity	mg/L	996	1000	980	1029	✓
Nitrate - N	mg/L	9.96	10.000	9.790	10.500	✓
Ammonium - N	mg/L	2.97	3.00	2.72	3.26	✓
Kjeldahl Nitrogen	mg/L	27.7	30.00	28.50	32.70	✓
Material Used: Water High						
Date Acquired: Jun 25, 2003						
Acquired By: Tina Knott						
Phosphate	mg/L	0.39	0.400	0.359	0.432	✓
P-Alkalinity	mg/L	64	60.4	48.8	72.0	✓
T-Alkalinity	mg/L	130	125	122	132	✓
Ammonium - N	mg/L	0.80	0.800	0.715	0.881	✓
Nitrate - N	mg/L	0.524	0.500	0.458	0.539	✓
Ammonium - N	mg/L	0.77	0.800	0.715	0.881	✓
Material Used: Water Low						
Date Acquired: Jun 28, 2003						
Acquired By: Gordon Grensmann						

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Fax: (780) 438-0396

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **240463**
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals Dissolved

Replicates		Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Arsenic		ug/L	<1	<1	10.0	0.4	✓
Material Used:	Edmonton Duplicate						
Date Acquired:	Jun 25, 2003						
Acquired By:	Jesse Dang						

Control Sample		Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Arsenic		ug/L	41.7	40.0	36.0	44.0	✓
Material Used:	Metals Low						
Date Acquired:	Jun 25, 2003						
Acquired By:	Jesse Dang						
Arsenic		ug/L	2.2	2.00	1.80	2.20	✓
Material Used:	Metals Trace						
Date Acquired:	Jun 25, 2003						
Acquired By:	Jesse Dang						

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Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Inorganic Nonmetallic Parameters

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Kjeldahl Nitrogen	mg/L	<0.05	0.000000	-0.000980	0.050000	✓
Phosphorus	mg/L	<0.05	0.00000	-0.00260	0.05000	✓
Phosphate	mg/L	<0.05	0.0000	-0.0500	0.0500	✓
Cyanide	mg/L	<0.001	0.00000	-0.00100	0.00100	✓

Material Used: Edmonton Method Blank
Date Acquired: Jul 02, 2003
Acquired By:

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Kjeldahl Nitrogen	mg/L	6.78	5.95	10.00	0.30	✓
Phosphate	mg/L	140	150	10.00	0.05	✓

Material Used: Edmonton Duplicate
Date Acquired: Jun 25, 2003
Acquired By: Tina Knott

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Ammonium - N	mg/L	3.00	3.00	2.72	3.26	✓
Kjeldahl Nitrogen	mg/L	27.7	30.00	28.50	32.70	✓
Phosphorus	mg/L	4.20	4.00	3.72	4.24	✓
Cyanide	mg/L	0.083	0.0750	0.0703	0.0834	✓

Material Used: Water High
Date Acquired: Jul 02, 2003
Acquired By: Gordon Grensmann

Kjeldahl Nitrogen	mg/L	5.30	5.00	4.72	5.39	✓
Phosphorus	mg/L	0.38	0.400	0.358	0.429	✓
Phosphate	mg/L	0.41	0.400	0.359	0.432	✓
Cyanide	mg/L	0.016	0.0150	0.0140	0.0172	✓

Material Used: Water Low
Date Acquired: Jul 02, 2003
Acquired By: Gordon Grensmann

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9818 International Airport
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T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Aggregate Organic Constituents

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Biochemical Oxygen Demand	mg/L	<4	0.000	0.000	2.000	✓

Material Used: BOD - Blank
Date Acquired: Jun 26, 2003
Acquired By: Maria Gaborni

Certified Reference Material	Units	Measured	Target	% Recovery	Passed QC
Biochemical Oxygen Demand	mg/L	49	62.0		✓

Material Used: S0090 - BOD
Date Acquired: Jun 26, 2003
Acquired By: Maria Gaborni

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Biochemical Oxygen Demand	mg/L	156	180	130	230	✓

Material Used: BOD - G/GA
Date Acquired: Jun 26, 2003
Acquired By: Maria Gaborni

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9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Physical and Aggregate Properties

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Solids	mg/L	<1	0.000	0.000	1.000	✓

Material Used: Edmonton Method Blank
Date Acquired: Jun 25, 2003
Acquired By: Andrew Jong

Certified Reference Material	Units	Measured	Target	% Recovery	Passed QC
Solids	mg/L	90	84.0		✓

Material Used: S0089 - SS
Date Acquired: Jun 26, 2003
Acquired By: Maria Gaborni

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Solids	mg/L	3	2	10.0	5.0	✓

Material Used: Edmonton Duplicate
Date Acquired: Jun 25, 2003
Acquired By: Andrew Jong

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Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
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Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Routine Water

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Nitrite - N	mg/L	<0.002	0.0000	-0.0100	0.0100	✓

Material Used: Edmonton Method Blank
Date Acquired: Jun 25, 2003
Acquired By: Tina Knott

Certified Reference Material	Units	Measured	Target	% Recovery	Passed QC
pH	pH	8.0	8.15		✓

Material Used: S0091 - pH
Date Acquired: Jun 26, 2003
Acquired By: Maria Gaborni

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Nitrite - N	mg/L	<0.01	<0.01	10.000	0.010	✓
Carbonate	mg/L	<6	<6	10.0		✓
P-Alkalinity	mg/L	<5	<5	10.0	5.0	✓
T-Alkalinity	mg/L	17	17	10.0	5.0	✓

Material Used: Edmonton Duplicate
Date Acquired: Jun 26, 2003
Acquired By: Amanda Mitchell

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Report to: Echo Bay Mines Ltd.

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Edmonton, AB, Canada
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Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Routine Water (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
pH		9.23	9.18	9.04	9.31	✓
Electrical Conductivity	dS/m at 25C	2.69	2.765	2.690	2.810	✓
Nitrite - N	mg/L	9.89	10.000	9.620	10.400	✓

Material Used: Water High
Date Acquired: Jun 25, 2003
Acquired By: Tina Knott

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
pH		6.91	6.86	6.84	6.94	✓
Electrical Conductivity	dS/m at 25C	0.074	0.0739	0.0739	0.0784	✓
Nitrite - N	mg/L	0.504	0.500	0.454	0.526	✓

Material Used: Water Low
Date Acquired: Jun 25, 2003
Acquired By: Tina Knott

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Edmonton, AB, Canada
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Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **240463**
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals Total

Blanks	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	0.6	0.0000	-0.0312	0.2000	✓
Iron	mg/L	<0.1	0.0000	-0.0149	0.0290	✓
Magnesium	mg/L	0.2	0.0000	-0.0305	0.0500	✓
Manganese	mg/L	0.009	0.000000	-0.000700	0.001200	✓
Potassium	mg/L	0.7	0.000	-0.102	0.400	✓
Silicon	mg/L	0.06	0.0000	-0.0435	0.0933	✓
Sodium	mg/L	1.1	0.000	-0.194	0.400	✓
Sulphur	mg/L	0.13	0.0000	-0.0333	0.0447	✓

Material Used: Edmonton Method Blank
Date Acquired: Jun 25, 2003
Acquired By: To Thong

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Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals Total (Continued...)

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC

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Attn: David Hohnstein
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Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **240463**
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals Total (Continued...)

Replicates	Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Calcium	mg/L	16.4	15.8	10.0	0.6	✓
Iron	mg/L	214	215	10.0	0.0	✓
Magnesium	mg/L	3.3	3.1	10.0	0.2	✓
Manganese	mg/L	1.45	1.45	10.000	0.001	✓
Potassium	mg/L	7.7	7.2	10.0	1.2	✓
Silicon	mg/L	6.68	6.38	10.00	0.01	✓
Sodium	mg/L	84.2	83.7	10.0	1.2	✓
Sulphur	mg/L	25.0	24.1	10.00	0.03	✓
Aluminum	ug/L	690	690	10.0	11.0	✓
Antimony	ug/L	<4	<4	10.0	0.4	✓
Arsenic	ug/L	5.1	5.5	10.0	0.4	✓
Barium	ug/L	37	33	10.0	2.2	✓
Beryllium	ug/L	<2	<2	10.0	0.2	✓
Bismuth	ug/L	<10	<10	10.0	1.1	✓
Boron	ug/L	200	200	10.0	4.4	✓
Cadmium	ug/L	<0.2	<0.2	10.00	0.02	✓
Chromium	ug/L	<10	<10	10.0	1.1	✓
Cobalt	ug/L	7.2	7.3	10.0	0.2	✓
Copper	ug/L	41	42	10.0	2.2	✓
Lead	ug/L	40.5	39.5	10.0	0.2	✓
Lithium	ug/L	<20	<20	10.0	2.2	✓
Molybdenum	ug/L	<20	<20	10.0	2.2	✓
Nickel	ug/L	71	71	10.0	1.1	✓
Selenium	ug/L	<4	<4	10.0	0.4	✓
Silver	ug/L	<2	<2	10.0	0.2	✓
Strontium	ug/L	52	54	10.0	2.2	✓
Thallium	ug/L	<1	<1	10.00	0.11	✓
Tin	ug/L	<20	<20	10.0	2.2	✓
Titanium	ug/L	440	440	10.0	1.1	✓
Uranium	ug/L	<10	<10	10.0	1.1	✓
Vanadium	ug/L	<2	<2	10.0	0.2	✓
Zinc	ug/L	140	160	10.0	2.2	✓
Zirconium	ug/L	<20	<20	10.0	2.2	✓

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Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **240463**
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals Total (Continued...)

Replicates		Units	Replicate1	Replicate2	% RSD Criteria	Absolute Criteria	Passed QC
Material Used:	Edmonton Duplicate						
Date Acquired:	Jun 25, 2003						
Acquired By:	Jesse Dang						

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9818 International Airport
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T5J2T2

Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals Total (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	48.4	48.2	45.5	50.8	✓
Iron	mg/L	1.9	1.92	1.82	2.02	✓
Magnesium	mg/L	17.1	18.6	16.6	20.6	✓
Manganese	mg/L	0.479	0.479	0.451	0.506	✓
Potassium	mg/L	47.6	47.8	43.5	52.0	✓
Silicon	mg/L	2.00	1.97	1.78	2.16	✓
Sodium	mg/L	48.4	49.1	44.3	53.8	✓
Sulphur	mg/L	10.2	9.68	8.73	10.60	✓
Aluminum	ug/L	320	316	273	360	✓
Antimony	ug/L	11.5	11.4	10.3	12.6	✓
Arsenic	ug/L	11.8	11.5	10.5	12.5	✓
Barium	ug/L	57	61.2	54.0	68.3	✓
Beryllium	ug/L	6.2	5.87	5.09	6.66	✓
Bismuth	ug/L	29.6	29.9	26.3	33.4	✓
Boron	ug/L	119	124	106	142	✓
Cadmium	ug/L	0.52	0.603	0.482	0.724	✓
Chromium	ug/L	31.0	31.3	26.8	35.7	✓
Cobalt	ug/L	6.6	6.17	5.12	7.22	✓
Copper	ug/L	61	62.7	54.4	71.0	✓
Lead	ug/L	6.2	6.08	5.25	6.90	✓
Lithium	ug/L	66	63.4	53.7	73.1	✓
Molybdenum	ug/L	59	62.1	55.7	68.6	✓
Nickel	ug/L	30.4	31.6	27.5	35.8	✓
Selenium	ug/L	11.2	11.2	10.2	12.1	✓
Silver	ug/L	6.2	6.20	5.48	6.92	✓
Strontium	ug/L	61	64.2	58.2	70.2	✓
Thallium	ug/L	3.08	3.04	2.47	3.62	✓
Tin	ug/L	56	59.3	53.8	64.9	✓
Titanium	ug/L	31.9	30.9	26.1	35.7	✓
Uranium	ug/L	30.7	30.8	26.9	34.7	✓
Vanadium	ug/L	6.6	6.18	5.23	7.13	✓
Zinc	ug/L	65	58.9	48.4	69.4	✓
Zirconium	ug/L	63	63.1	55.5	70.8	✓

Material Used: Edmonton Digestion Check
Date Acquired: Jun 25, 2003
Acquired By: Jesse Dang

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Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
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T5J2T2

Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
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Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals Total (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	247	250.0	232.0	274.0	✓
Iron	mg/L	9.4	10.00	9.10	10.30	✓
Magnesium	mg/L	99.8	100.0	92.0	112.0	✓
Manganese	mg/L	2.38	2.500	2.270	2.630	✓
Potassium	mg/L	252	250.0	225.0	280.0	✓
Silicon	mg/L	11.0	10.00	9.00	11.00	✓
Sodium	mg/L	249	250.0	221.0	281.0	✓
Sulphur	mg/L	52.0	50.00	48.50	56.00	✓

Material Used: Metals High
Date Acquired: Jun 25, 2003
Acquired By: To Thong

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9818 International Airport
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T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
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Acct. Code:

NWL Lot ID: 240463
Control Number:
Date Received: Jun 24, 2003
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Report Number: 416061

Metals Total (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Calcium	mg/L	4.8	5.00	4.25	5.22	✓
Iron	mg/L	0.2	0.200	0.163	0.232	✓
Magnesium	mg/L	1.8	2.00	1.66	1.99	✓
Manganese	mg/L	0.049	0.0500	0.0435	0.0522	✓
Potassium	mg/L	4.9	5.00	4.36	5.61	✓
Silicon	mg/L	0.24	0.200	0.160	0.240	✓
Sodium	mg/L	5.2	5.00	4.39	6.07	✓
Sulphur	mg/L	0.99	1.000	0.822	1.130	✓
Aluminum	ug/L	975	1000	900	1100	✓
Antimony	ug/L	40.3	40.0	36.0	44.0	✓
Arsenic	ug/L	40.4	40.0	36.0	44.0	✓
Barium	ug/L	187	200	180	220	✓
Beryllium	ug/L	20.1	20.0	18.0	22.0	✓
Bismuth	ug/L	98.5	100.0	90.0	110.0	✓
Boron	ug/L	371	400	360	440	✓
Cadmium	ug/L	2.17	2.00	1.80	2.20	✓
Chromium	ug/L	96.4	100.0	90.0	110.0	✓
Cobalt	ug/L	21.2	20.0	18.0	22.0	✓
Copper	ug/L	184	200	180	220	✓
Lead	ug/L	20.4	20.0	18.0	22.0	✓
Lithium	ug/L	203	200	180	220	✓
Molybdenum	ug/L	192	200	180	220	✓
Nickel	ug/L	96.2	100.0	90.0	110.0	✓
Selenium	ug/L	39.4	40.0	36.0	44.0	✓
Silver	ug/L	20.4	20.0	18.0	22.0	✓
Strontium	ug/L	193	200	180	220	✓
Thallium	ug/L	10.3	10.00	9.00	11.00	✓
Tin	ug/L	189	200	180	220	✓
Titanium	ug/L	95.4	100.0	90.0	110.0	✓
Uranium	ug/L	100	100.0	90.0	110.0	✓
Vanadium	ug/L	22.0	20.0	18.0	22.0	✓
Zinc	ug/L	199	200	180	220	✓
Zirconium	ug/L	192	200	180	220	✓

Material Used: Metals Low
Date Acquired: Jun 25, 2003
Acquired By: Jesse Dang

NORWEST LABS
Agri-Food & Environmental Group
Calgary Edmonton Winnipeg Lethbridge Surrey

Quality Control

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Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.

9818 International Airport
Edmonton, AB, Canada
T5J2T2

Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **240463**
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals Total (Continued...)

Control Sample	Units	Measured	Target	Lower Limit	Upper Limit	Passed QC
Aluminum	ug/L	51	50.0	45.0	55.0	✓
Antimony	ug/L	2.0	2.00	1.80	2.20	✓
Arsenic	ug/L	1.9	2.00	1.80	2.20	✓
Barium	ug/L	9	10.00	9.00	11.00	✓
Beryllium	ug/L	0.9	1.000	0.900	1.100	✓
Bismuth	ug/L	5.0	5.00	4.50	5.50	✓
Boron	ug/L	22	20.0	18.0	22.0	✓
Cadmium	ug/L	0.09	0.1000	0.0900	0.1100	✓
Chromium	ug/L	5.1	5.00	4.50	5.50	✓
Cobalt	ug/L	1.1	1.000	0.900	1.100	✓
Copper	ug/L	9	10.00	9.00	11.00	✓
Lead	ug/L	1.0	1.000	0.900	1.100	✓
Lithium	ug/L	10	10.00	9.00	11.00	✓
Molybdenum	ug/L	10	10.00	9.00	11.00	✓
Nickel	ug/L	4.7	5.00	4.50	5.50	✓
Selenium	ug/L	1.9	2.00	1.80	2.20	✓
Silver	ug/L	1.0	1.000	0.900	1.100	✓
Strontium	ug/L	11	10.00	9.00	11.00	✓
Thallium	ug/L	0.52	0.500	0.450	0.550	✓
Tin	ug/L	9	10.00	9.00	11.00	✓
Titanium	ug/L	4.9	5.00	4.50	5.50	✓
Uranium	ug/L	5.2	5.00	4.50	5.50	✓
Vanadium	ug/L	1.1	1.000	0.900	1.100	✓
Zinc	ug/L	9	10.00	9.00	11.00	✓
Zirconium	ug/L	10	10.00	9.00	11.00	✓

Material Used: Metals Trace
Date Acquired: Jun 25, 2003
Acquired By: Jesse Dang

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Methodology and Notes

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.
9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **240463**
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Method of Analysis:

Method Name	Reference		Method	Date Analysis Completed	Location	Analyst
(Ortho)Phosphate in Water	APHA	*	Automated Ascorbic Acid Reduction Method, 4500-P F	Jun 25, 2003	Norwest Labs Edmonton	Tina Knott
Alkalinity, pH, and EC in water	APHA	*	Conductivity - Laboratory Method, 2510 B	Jun 27, 2003	Norwest Labs Edmonton	Amanda Mitchell
Alkalinity, pH, and EC in water	APHA	*	Electrometric Method, 4500-H+ B	Jun 27, 2003	Norwest Labs Edmonton	Amanda Mitchell
Alkalinity, pH, and EC in water	APHA	*	Laboratory & Field Methods, 2550 B	Jun 27, 2003	Norwest Labs Edmonton	Amanda Mitchell
Alkalinity, pH, and EC in water	APHA	*	Titration Method, 2320 B	Jun 27, 2003	Norwest Labs Edmonton	Amanda Mitchell
Ammonium in Water	APHA	*	Automated Phenate Method, 4500-NH3 G	Jun 28, 2003	Norwest Labs Edmonton	Gordon Grensmann
Anions (Routine) by Ion Chromatography	APHA		Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	Jun 26, 2003	Norwest Labs Edmonton	Tina Knott
BOD in water	APHA	*	5 Day, 5210 B	Jul 02, 2003	Norwest Labs Surrey	Maria Gaborni
Cyanide (Strong Acid Dissociable) in water	APHA	*	Total Cyanide after Distillation, 4500-CN- C	Jul 02, 2003	Norwest Labs Edmonton	Gordon Grensmann
Fecal Coliforms - MF	APHA		Fecal Coliform Membrane Filter Procedure, 9222 D	Jun 30, 2003	Norwest Labs Calgary	Myla Gadin
Kjeldahl Nitrogen & Phosphorus (Total) in Water	APHA	*	Automated Ascorbic Acid Reduction Method, 4500-P F	Jun 25, 2003	Norwest Labs Edmonton	Tina Knott
Kjeldahl Nitrogen & Phosphorus (Total) in Water	QuikChem Method	*	Total Kjeldahl Nitrogen in Soil/Plant, 13-107-6-2-D	Jun 25, 2003	Norwest Labs Edmonton	Tina Knott

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Methodology and Notes

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Report to: Echo Bay Mines Ltd.
9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project
ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **240463**
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

Metals ICP-MS (Dissolved) in water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	Jun 27, 2003	Norwest Labs Edmonton	Jesse Dang
Metals ICP-MS (Total) in water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	Jun 27, 2003	Norwest Labs Edmonton	Jesse Dang
Metals Trace (Dissolved) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	Jun 26, 2003	Norwest Labs Edmonton	To Thong
Metals Trace (Total) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	Jun 27, 2003	Norwest Labs Edmonton	To Thong
pH in water	APHA	*	Electrometric Method, 4500-H+ B	Jun 30, 2003	Norwest Labs Surrey	Maria Gaborni
Solids Suspended (Total, Fixed and Volatile)	APHA	*	TSS Dried at 103-105'C, 2540 D	Jun 26, 2003	Norwest Labs Edmonton	Andrew Jong
Solids Suspended (Total, Fixed and Volatile)	APHA	*	TSS Dried at 103-105'C, 2540 D	Jun 30, 2003	Norwest Labs Surrey	Maria Gaborni
Total Coliforms - MF	APHA		Standard Total Coliform Membrane Filter Procedure, 9222 B	Jun 30, 2003	Norwest Labs Calgary	Myla Gadin

* Norwest method(s) is based on reference method

References:

APHA	Standard Methods for the Examination of Water and Wastewater
QuikChem Method	Lachat Instruments
US EPA	US Environmental Protection Agency Test Methods

Comments:

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Methodology and Notes

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.
9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company: Echo Bay Mines Ltd.

Project ID:
Name: Monitoring Requirements 2002
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **240463**
Control Number:
Date Received: Jun 24, 2003
Date Reported: Jul 02, 2003
Report Number: 416061

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Analytical Report

Bill to:	Echo Bay Mines Ltd.	Project		NWL Lot ID:	245010
eport to:	Echo Bay Mines Ltd. 9818 International Airport Edmonton, AB, Canada T5J2T2	ID:	Monitoring Requirements 2003	Control Number:	
		Name:		Date Received:	Jul 22, 2003
		Location:		Date Reported:	Jul 30, 2003
Attn:	David Hohnstein	LSD:		Report Number:	425121
Sampled By:	D. Hohnstein	P.O.:			
Company:		Acct. Code:	Requisition No. L48906		

NWL Number 245010-1
Sample Date Jul 22, 2003
Sample Description 925-14 Log No. 30009
Matrix Water - General

Analyte		Units	Results	Results	Results	Detection Limit
Aggregate Organic Constituents						
Biochemical Oxygen Demand	5 Day	mg/L	<4			4
Inorganic Nonmetallic Parameters						
Ammonium - N	Dissolved	mg/L	1.02			0.05
Kjeldahl Nitrogen	Total	mg/L	1.62			0.05
Phosphorus	Total	mg/L	0.12			0.05
Phosphate	as P	mg/L	0.07			0.05
Metals Total						
Calcium	Total	mg/L	118			0.2
Iron	Total	mg/L	0.3			0.1
Magnesium	Total	mg/L	9.8			0.2
Manganese	Total	mg/L	0.215			0.005
Potassium	Total	mg/L	7.6			0.4
Silicon	Total	mg/L	0.82			0.05
Sodium	Total	mg/L	142			0.4
Sulphur	Total	mg/L	33.2			0.05
Aluminum	Total	mg/L	0.091			0.005
Antimony	Total	mg/L	0.0007			0.0002
Arsenic	Total	mg/L	0.0145			0.0002
Barium	Total	mg/L	0.036			0.001
Beryllium	Total	mg/L	<0.0002			0.0001
Bismuth	Total	mg/L	<0.001			0.0005
Boron	Total	mg/L	0.057			0.002
Cadmium	Total	mg/L	0.00004			0.00001
Chromium	Total	mg/L	<0.001			0.0005
Cobalt	Total	mg/L	0.0093			0.0001
Copper	Total	mg/L	0.005			0.001
Lead	Total	mg/L	0.0002			0.0001
Lithium	Total	mg/L	0.457			0.001
Molybdenum	Total	mg/L	0.002			0.001
Nickel	Total	mg/L	0.0170			0.0005
Selenium	Total	mg/L	<0.0004			0.0002
Silver	Total	mg/L	<0.0002			0.0001
Strontium	Total	mg/L	2.44			0.001
Thallium	Total	mg/L	<0.0001			0.00005
Tin	Total	mg/L	<0.002			0.001

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Analytical Report

Bill to:	Echo Bay Mines Ltd.	**Project**		**NWL Lot ID:**	**245010**
eport to:	Echo Bay Mines Ltd.	**ID:**	Monitoring Requirements 2003	Control Number:	
	9818 International Airport Edmonton, AB, Canada T5J2T2	**Name:**		Date Received:	Jul 22, 2003
		Location:		Date Reported:	Jul 30, 2003
Attn:	David Hohnstein	**LSD:**		Report Number:	425121
Sampled By:	D. Hohnstein	**P.O.:**			
Company:		**Acct. Code:**	Requisition No. L48906		

NWL Number 245010-1
Sample Date Jul 22, 2003
Sample Description 925-14 Log No. 30009
Matrix Water - General

Analyte		Units	Results	Results	Results	Detection Limit
Metals Total - Continued						
Titanium	Total	mg/L	0.0030			0.0005
Uranium	Total	mg/L	<0.001			0.0005
Vanadium	Total	mg/L	<0.0002			0.0001
Zinc	Total	mg/L	0.034			0.001
Zirconium	Total	mg/L	0.003			0.001
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	<1			1
Fecal Coliforms	Membrane Filtration	CFU/100 mL	<1			1
Physical and Aggregate Properties						
Temp. of observed pH and EC		C	19.7			
Solids	Total Suspended	mg/L	<1			1
Routine Water						
pH	Water	pH	7.0			0.1
pH			6.85			
Calcium	Dissolved	mg/L	118			0.2
Magnesium	Dissolved	mg/L	10			0.2
Nitrate - N		mg/L	6.35			0.004
Nitrite - N		mg/L	0.128			0.002
Hydroxide		mg/L	<5			5
Carbonate		mg/L	<6			6
Bicarbonate		mg/L	17			5
P-Alkalinity	as CaCO3	mg/L	<5			5
T-Alkalinity	as CaCO3	mg/L	14			5
Hardness	Dissolved as CaCO3	mg/L	336			

Approved by: Michelle Seveck, BSc
Quality Control Officer

NORWEST LABS

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Methodology and Notes

Bill to: Echo Bay Mines Ltd.
Report to: Echo Bay Mines Ltd.
9818 International Airport
Edmonton, AB, Canada
T5J2T2
Attn: David Hohnstein
Sampled By: D. Hohnstein
Company:

Project
ID: Monitoring Requirements 2003
Name:
Location:
LSD:
P.O.:
Acct. Code: Requisition No. L48906

NWL Lot ID: **245010**
Control Number:
Date Received: Jul 22, 2003
Date Reported: Jul 30, 2003
Report Number: 425121

Method of Analysis:

MethodName	Reference		Method	Date Analysis Completed	Location
(Ortho)Phosphate in Water	APHA	*	Automated Ascorbic Acid Reduction Method, 4500-P F	Jul 23, 2003	Norwest Labs Edmonton
Alkalinity, pH, and EC in water	APHA	*	Electrometric Method, 4500-H+ B	Jul 24, 2003	Norwest Labs Edmonton
Alkalinity, pH, and EC in water	APHA	*	Laboratory & Field Methods, 2550 B	Jul 24, 2003	Norwest Labs Edmonton
Alkalinity, pH, and EC in water	APHA	*	Titration Method, 2320 B	Jul 24, 2003	Norwest Labs Edmonton
Ammonium in Water	APHA	*	Automated Phenate Method, 4500-NH3 G	Jul 28, 2003	Norwest Labs Edmonton
Anions (Routine) by Ion Chromatography	APHA		Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	Jul 24, 2003	Norwest Labs Edmonton
BOD in water	APHA	*	5 Day, 5210 B	Jul 29, 2003	Norwest Labs Surrey
Fecal Coliforms - MF	APHA		Fecal Coliform Membrane Filter Procedure, 9222 D	Jul 24, 2003	Norwest Labs Calgary
Kjeldahl Nitrogen & Phosphorus (Total) in Water	Alberta Research Council	*	Nitrogen, Total Kjeldahl, 07021 626	Jul 23, 2003	Norwest Labs Edmonton
Kjeldahl Nitrogen & Phosphorus (Total) in Water	APHA	*	Automated Ascorbic Acid Reduction Method, 4500-P F	Jul 23, 2003	Norwest Labs Edmonton
Metals ICP-MS (Total) in water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	Jul 25, 2003	Norwest Labs Edmonton
Metals Trace (Dissolved) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	Jul 24, 2003	Norwest Labs Edmonton
Metals Trace (Total) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	Jul 24, 2003	Norwest Labs Edmonton
pH in water	APHA	*	Electrometric Method, 4500-H+ B	Jul 23, 2003	Norwest Labs Surrey
Solids Suspended (Total, Fixed and Volatile)	APHA	*	TSS Dried at 103-105'C, 2540 D	Jul 25, 2003	Norwest Labs Surrey
Total Coliforms - MF	APHA		Standard Total Coliform Membrane Filter Procedure, 9222 B	Jul 24, 2003	Norwest Labs Calgary

* Norwest method(s) is based on reference method

References:

Alberta Research Council	Methods Manual for Chemical Analysis of Water and Wastes
APHA	Standard Methods for the Examination of Water and Wastewater
US EPA	US Environmental Protection Agency Test Methods

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Methodology and Notes

Bill to:	Echo Bay Mines Ltd.	**Project**		**NWL Lot ID:**	**245010**
Report to:	Echo Bay Mines Ltd.	**ID:**	Monitoring Requirements 2003	Control Number:	
	9818 International Airport	**Name:**			
	Edmonton, AB, Canada	**Location:**		Date Received:	Jul 22, 2003
	T5J2T2			Date Reported:	Jul 30, 2003
Attn:	David Hohnstein	**LSD:**		Report Number:	425121
Sampled By:	D. Hohnstein	**P.O.:**			
Company:		**Acct. Code:**	Requisition No. L48906		

APPENDIX C

2004 Tailings Containment Area Management Report
(including technical paper "Partially Saturated Granular Cover for Reactive Tailings in Permafrost, Lupin Mine Experience, Nunavut, Canada")

ECHO BAY MINES LTD.

a subsidiary of

KINROSS
Gold Corporation

2004
TAILINGS CONTAINMENT AREA MANAGEMENT REPORT LUPIN OPERATIONS

Submitted under

WATER LICENCE NWB1LUP000
NUNAVUT WATER BOARD

March 31, 2004

2004 Lupin TCA Management Report

Executive Summary

The Lupin Mine, owned and operated by Echo Bay Mines Ltd. (a wholly owned subsidiary of Kinross Gold Corporation) was granted a renewal of the mine's Water Licence on July 1, 2000. This Licence has an expiry date of June 30, 2008. In August, 2003, mine operations were suspended and the property was placed on care and maintenance. In January, 2004, the decision was made to resume operations, on a smaller scale and for a limited time period, to recover remnant ore. Current plans are for the mine to operate at a reduced production rate of 1,100 tonnes per day for an 11-month duration.

Total Tails Containment Area capacity as of April, 2000, when the mine resumed production after the first shutdown period (January 1998 to April 2000), was 2,610,875 cubic metres (including containment within the area bounded by N-Dam). Since then, the mine has directed a total of 503,540 cubic metres of tailings solids to the Tails Containment Area. Accounting for water balances (entrained and free tailings water and spring runoff, less summer discharge and decant), total storage available for use in all areas of the TCA is approximately 808,000 m^3 as of the end of December 2003.

The planned mine production schedule for the upcoming remnant mining program includes a throughput of 408,723 dry short tons between March 1, 2004 and January 31, 2005, utilizing approximately 38% of the current TCA solids storage capacity (Cell 5, N Dam). This planned usage includes the ability of the mine to accept approximately 24% of the tailings produced by the mill as paste fill in the underground openings (historical average between 2000 and 2003). However, it is planned to substantially increase the use of pastefill underground and reduce the amount of tails directed to the TCA, as any non-essential void can now be filled as part of the mine decommissioning process.

With the limited mining life remaining at the property, there are no immediate plans for major modifications within the TCA to increase capacity. Should the need arise, however, several options are available. The first option would be to cover the west side of Cell 3, adjacent to Dam 6, with esker gravel and build a berm to prevent water migration towards Dam 6. Raising the elevation of L Dam would be carried out at the same time. This would allow the further deposition of tails into Cell 3, which is presently close to capacity. A second choice would be the use of Cell No.4. A final option of utilizing the End Lake areas would be a choice only once the more environmentally/economical options have been exhausted.

Since the issuing of the last TCA Management Report in March 2001, additional thermistors have been installed within the TCA and perimeter dams. The data generated from these thermistors will add to the considerable amount of subsurface thermal data already accumulated. This information will be used in developing final closure plans for the perimeter dams and covered tailings cells.

Lupin Mine Tailings Containment Area Management Report

INTRODUCTION

The Lupin Mine, owned and operated by Echo Bay Mines Ltd. (a wholly owned subsidiary of Kinross Gold Corporation) applied for and was granted a renewal of the site Water Licence on July 1, 2000. This Licence has a current expiry date of June 30, 2008. Within Part G: Conditions Applying to Studies, under Item 1, there is a requirement to submit for approval by the Board, a "Tailings Containment Area Management Report". Such report was prepared and submitted to the Board in March 2001. On January 7th, 2004, the Licensee received notification that the 2001 report was approved, but updating was required due to the time elapsed since the submission. Also, Lupin had suspended operations in August, 2003, and the mine was placed on care and maintenance. The Board requested that the revised TCA Management Report address this scenario. Since this request by the Board, Lupin has resumed production.

This report has been prepared to fulfill the requirement of the Licence and provide the Board with information regarding the current capacity of the tailings containment, planned production at the Lupin Mine, utilization of the facility, and planned modifications to the TCA. As well, the 5 conditions itemized in the January 7, 2004, letter of approval have been addressed.

BACKGROUND

The milling process used to recover the gold from the ore at Lupin results in a waste material referred to as tailings. This is the end result of a process that involves crushing and grinding of the ore, pre-aeration and addition of lead nitrate to reduce overall chemical consumption and improve gold recovery, leaching with a cyanide solution and aeration, filtration to remove the solids component from the gold bearing solution and final recovery using the Merrill-Crowe process involving the precipitation of gold using zinc under oxygen deficient conditions. The remaining solids and "barren" solution (being barren of gold) are combined and pumped to the Tailings Containment Area (TCA) for deposition and holding for treatment prior to release of water to the environment.

The Lupin Mine has been in operation since 1982, utilizing the Tailings Containment Area that was initially designed for a 5 year production life and total containment. The TCA has evolved considerably since this initial design and is now configured with five main solids deposition cells (two of which have been filled and covered with esker gravel) and two main water storage ponds to provide treatment and holding time prior to release of water to the environment. The system takes advantage of the natural degradation of cyanide (by ultraviolet light) occurring within the cells and Pond No.1, and supplements that process, when needed, with the addition of an iron salt for arsenic removal and lime for pH control, thereby meeting Water Licence effluent quality limits prior to release. (Please see drawing "Lupin Mine - Tailings Area", attached).

TAILINGS CONTAINMENT AREA UTILIZATION

The mill tailings are deposited at the TCA year round and must be managed in such a way to maximize the volume available at the facility. This has been accomplished by rotating deposition of tailings between at least two of the cells during winter/summer. By rotating and keeping the deposition of material thin during the winter months, summer thaw is allowed to penetrate and remove a considerable portion of the solution from the solids. Even with this method, the settled tailings retain approximately 50% of the original moisture content. Without rotating the deposition of tailings and maintaining active areas to a depth less than the annual thaw, all solution that accompanies the tailings solids would be retained (frozen). This would ultimately consume storage volume much more rapidly and decrease the useable life of the current facility.

Decanted tailings solution is removed from the cells by either pumping or gravity flow through Cell No.4 and Pond No.1. Water removal is usually completed during the summer months from approximately mid-June through to early September. The larger capacity Cell No.5 has been used for winter tailings storage during the past production period and is pumped free of water as late into the year as possible in an attempt to reduce any ice lens formation that might not thaw during the following season.

A detailed tailings distribution spreadsheet, showing cell deposition and capacity on a month-by-month basis since April 2000, is included with this report. This spreadsheet also indicates the anticipated mine and milling production schedule for the remaining life of the mine, along with the estimated volumes of solids and liquid wastes to be deposited within the TCA. The volumes being transported to the TCA for storage are based on historical paste backfill utilization which has reduced the volume of mill tailings sent to the TCA by approximately 24% between April 2000 and August 2003.

PLANNED PRODUCTION AND TAILINGS DEPOSITION

The planned production schedule is based on a 2004 mine plan which intends to recover only ore blocks which were developed prior to the mine shutdown in August 2003, and remnant pillars requiring limited underground development. Following recovery of this ore, the Lupin ore body will be essentially exhausted, under current economic conditions.

The planned production tonnage that will require disposal at the TCA will be reduced by at least 24% through the use of solids in the paste backfill process. During the upcoming mining period, this will amount to a volume savings of approximately 104,650 m^3 when taking into account both the solids and the potential retained water content.

As of February 2004, the current mine plan for the Lupin Mine will see a throughput of 408,723 dry short tons, utilizing storage capacity at the TCA of 293,055 cubic metres (includes solids plus entrained water, after summer decant) between March 2004 and January 2005. Approximately 475,000 cubic metres of storage will remain at the completion of mining in January 2005.

TCA STORAGE CAPACITY

The spreadsheet contains, in detail, the expected monthly production figures from the mine and mill. It includes actual production figures from April 2000 to August 2003, and the anticipated production from March 2004 to January 2005. The following table summarizes this spreadsheet and provides information on the available storage within the TCA for two distinct time periods. The first column represents the minimum storage available after winter use, prior to summer decanting of tailings solution (before thaw). The second column indicates the available storage after summer use and decant of tailings solution along with any accumulated runoff from spring melt and seasonal precipitation.

TCA AVAILABLE STORAGE (m^3)

YEAR	END OF MAY (Before water decant)	END OF AUGUST (After water decant)
2000	2,542,126	2,300,623
2001	1,553,257	1,816,274
2002	1,187,838	1,307,706
2003	675,671	879,591
2004	494,443	681,761
2005	325,108	575,108

CHANGES TO TCA SINCE MARCH 2001

As requested in the letter from the Board, dated January 7, 2004, the following describes the modifications to the Tailings Containment Area since the previously approved 2001 Tailings Management Plan was submitted in March 2001. (The 2001, 2002 and 2003 modifications are also described in the respective Lupin Annual Report submissions to the Board.)

2001 - A temporary catchment pond was created on the Pond No.2 side of the M dam, adjacent to the abutment with J dam, to contain a minor seepage through locally fractured bedrock from Cell 5 through to Pond #2. The contained water was pumped back into Cell No.5 to limit the contamination of Pond No.2. Pumping of Cell No.5 water was then initiated and water levels in the cell were lowered. Water flow through to the Pond No.2 side of M dam was stopped. To permanently address the seepage problem, a containment berm was built on the upstream side and filled with tailings solids to seal the fractures in the bedrock. No further seepage has occurred.

A second lift of run-of-mine waste rock was placed on "xdam", an internal dyke within Cell No.5. This permeable structure has been an effective strategy to aid in the retention of tailings solids in the upper portion of the cell, allowing more room for the solution to accumulate adjacent to M dam. This water is pumped to another cell during summer decant.

A portion of the containment dyke for the internal Cell No.3b was constructed for future deposition of tailings. This dyke is an extension of, and similar in dimensions to, that of the Cell 3a dyke (approximately 300 metres long by 100 metres wide). These mini-cells will allow for progressive reclamation to take place (described later in this report).

2002 - The main tailings line was extended along the length of the M dam in order to maximize the deposition of tailings during the winter months in Cell 5. This section of tailings pipe was completed with Sclair (plastic) piping with several available discharge locations along the dam.

Discharge from Pond #2 to the environment took place from July 15 to September 7, 2002, utilizing the siphons at Dam 1a. A total of 3,102,895 m^3 of water was released.

2003 - The main tailings line along M dam was extended to run along N dam, at the northeast end of Cell 5. This area contained tailings that were placed a number of years ago and had started to oxidize. The line was modified to discharge the tailings in a 30-metre wide swath, rather than at just one discharge point. By periodically moving this system along the top of N dam, the amount of beach area against the dam was maximized. This provided an effective seal along the upstream side of N dam. All oxidized tailings were successfully covered.

PROGRESSIVE RECLAMATION ACTIVITIES SINCE MARCH 2001

As requested in the letter from the Board, dated January 7, 2004, the following describes the progressive reclamation activities carried out on the property since the previously approved 2001 Tailings Management Plan was submitted in March 2001. (The 2001, 2002 and 2003 activities are also described in detail in the respective Lupin Annual Report submissions to the Board.)

2001 - Progressive reclamation activities included the removal of several camp accommodation annexes and the dismantling/removal of approximately six kilometres of six inch tailings line. This line was used initially during startup of the mill (1982) and was taken out of service in 1989 when it was replaced with an eight inch line in conjunction with a mill expansion.

2002 - Backfilling of the Centre Zone Crown Pillar stope with mill tailings was begun in 2002. This stope was open from surface to the 27-metre level. Approximately 20,074 dry short tons of tails were placed in the stope, as a step towards reclamation of the site. The use of paste backfill also reduces pressure on the surface TCA facility.

In an effort to improve the ability for vegetation to establish naturally, a tillage unit was purchased and customised to work with a grader on site. This unit proved to work well in opening up the surface of the esker cover and bringing some of the coarse materials to the surface. This should greatly enhance the surface's ability for natural placement of seed and moisture retention to encourage plant growth in the area. Several locations were worked with the tillage unit including the entire Cell 1a area, the north corner of Cell 1, the east corner of Cell 2 and the cover that was placed over the East Zone Crown Pillar.

2003 - Progressive reclamation activities during 2003 saw two areas within Cell 3, designated cells 3a and 3b, covered by approximately 1.0 metre of esker gravel. The work was carried out between August 5 and September 23, 2003, with a total area covered of approximately 62,350 square metres. The esker material is an effective cover medium that serves to eliminate dispersal by wind of dry tailings, and the embedded moisture layer prevents oxidation of the underlying tails and provides support for plant growth.

Backfilling of the Centre Zone Crown Pillar open stope with paste backfill was completed. Approximately 100,266 dry short tons of paste backfill, at a cement content of close to 1%, were placed in the opening in 2003. Once the paste dried, it was then topped with surface material that had been stored when the original ground cover was removed to obtain access for mining.

FUTURE MODIFICATION PLANS

Although the holding capacity of the TCA has diminished since the last major expansion in 2000 (raising M dam), it is still sufficient to contain the limited amount of tails that will be produced during the upcoming final phase of mining. Efforts will also be focused on maximizing the disposal of tails into the underground openings, and reducing the pressure on the TCA even further. As such, there are no plans to modify existing perimeter or internal dams.

The TCA summary table, above, included the capacity of all available cells, excluding that of Cell No.4 which is used mainly as a holding cell (natural degradation of cyanide and metals treatment) for water prior to transfer to Pond No.1. Using Cell 4 for tails disposal is still an option, if circumstances require its use, by constructing an internal divider dyke between this cell and Pond No.1.

Currently there are no plans for bringing additional ore(s) in to Lupin from other sites. The only other ore that has been processed at the Lupin Mine is the kimberlite bulk samples of both the Tahera Jericho project and the deBeers Snap Lake project. The tailings and coarse waste from both these projects have been disposed of at the TCA within the current cells (Cell No.2). This material is not to be used as a final cover, but has been placed (graded) within the cell and will be covered with esker as will the remainder of Cell No.2. Fine tailings material from the bulk sample projects were deposited within the Cell No.5 and have since been covered with fresh tailings material from the Lupin mill. There are no plans for processing other ores or to utilize any of the previous kimberlite materials as a cover.

FUTURE TAILINGS MANAGEMENT STUDIES

In November 2000, BGC Engineering Inc. expanded the existing thermistor coverage within the TCA by installing new thermistors within the TCA perimeter dams, covered tailings and the Fingers Lake esker. Thermistors were installed at the crest locations of Dam1a and Dam2, as well as at one location in the Fingers Lake Esker. In May 2003, additional thermistors were installed in Cell 3 (upstream of Dam 6) and Cell 1 (esker cover test plot). These strings are functioning well and are providing data that supports the closure management planning scenario currently being developed.

In April, 2003, I. Holubec Consulting Inc. submitted a report to Echo Bay Mines on the use of esker gravel as a "Partially Saturated Granular Cover" for Lupin mine tailings. (A paper presented on this subject at the 7th International Symposium on Mining in the Arctic is attached as an appendix to this document.) The report provides research and case history information on existing granular covers, supplemented by historical Lupin thermal and water quality data, and a recommended course of field studies to confirm that the proposed cover meets all tailings rehabilitation requirements. The principle of this design is to maintain a water-saturated zone within the granular cover to provide an oxygen barrier over the tailings.

The proposed thin partially saturated granular cover has many positive attributes, such as:

- The water layer provides a barrier to oxidation that is not dependent on having permafrost within the tailings;
- Is not sensitive to annual temperature changes or global warming;
- Will support vegetation because of the proximity of the water surface to the top of the cover;
- A thin cover reduces the impact on the esker deposits. Eskers serve as a preferable animal habitat;
- Is more economical to construct since less material is used; and
- Provides a more easily constructible cover for use in remote locations.

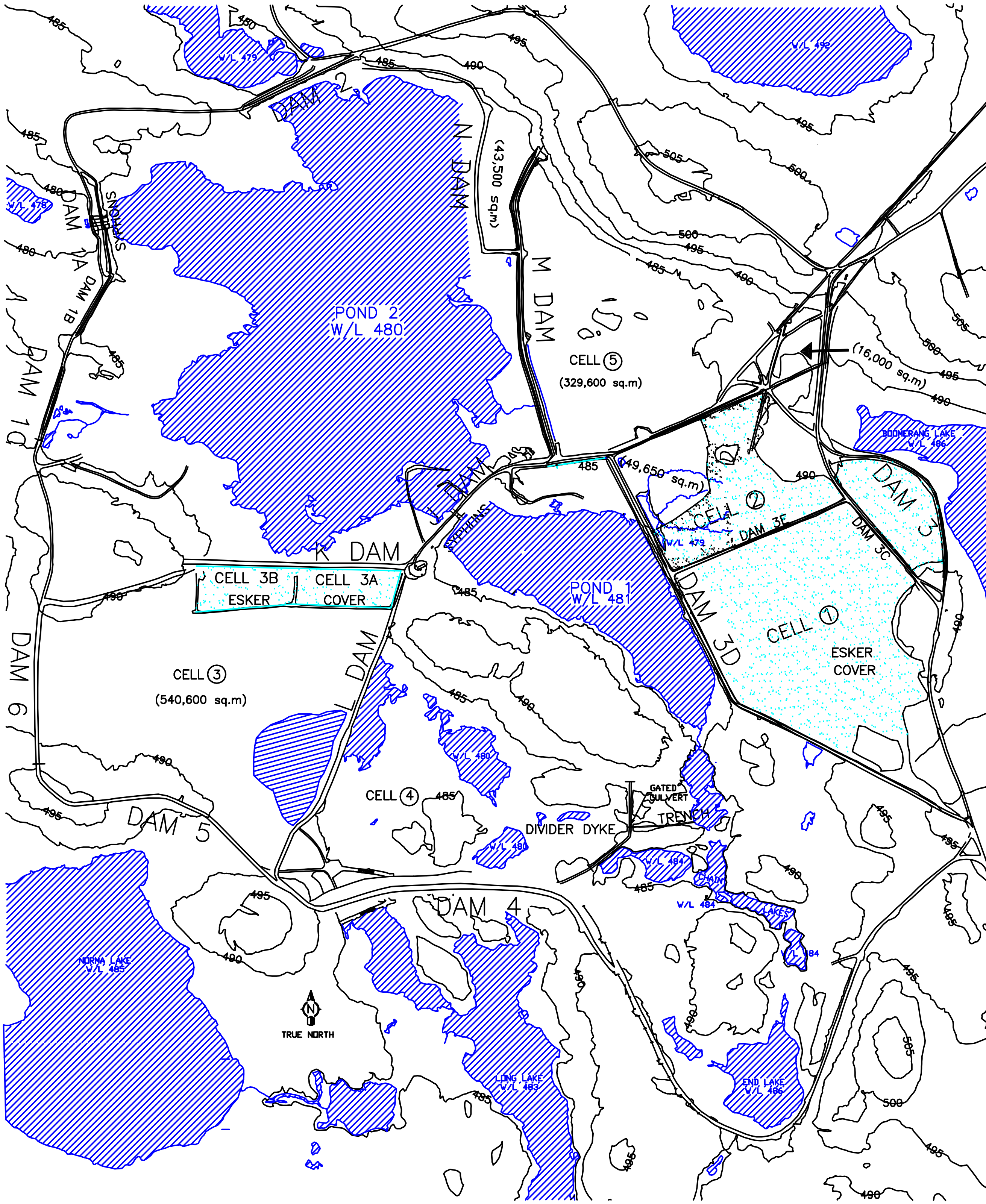
In 2003, monitoring of pore water quality and the saturation status of the esker cover in Cell 1 continued from the previous year. Further to this work, in May 2003, a test pad was constructed in Cell 1 by effectively isolating a 20 metre by 40 metre area from the rest of the cell. This was accomplished by installing an impermeable liner in a 2.4 metre-deep trench surrounding the area, well below the active zone. A thermistor and 2 water sample pipes were installed within this test pad area. This isolated test cell will provide ongoing data on natural water balance and thermal regime.

APPENDIX CONTENTS

Lupin Tails Containment Area drawing

Lupin Tails Containment Capacity 2004

Partially Saturated Granular Cover; Holubec, Hohnstein; Iqaluit 2003



NOTE:
ORIGINAL SCALE – 1:2000 – PLOTTING RATIO OF 1=1 (METRIC)
REDUCED SCALE OF 1:5000 – PLOTTING RATIO IS 1=5 (METRIC)
SHEET NUMBERS REFER TO 1:2000 STEWART WEIR LAND DATA MAPS

MAPPING BASED ON PHOTOGRAMMETRY BY STEWART WEIR , AUG. 1989

MAP SCALE
0 50 100 200 METERS

Lupin TCA.dwg

No.	DATE	MADE BY	DESCRIPTION
1			
2			
3			
4	Oct/03	CHT	Updated Cell 3a, 3b
5	Feb/98	S.B.L.	Updated 1997 work

DATE	DRAWN BY	CHECKED	APPROVED
JAN\95	S.B.LOWE		

KINROSS GOLD CORPORATION
EBM – LUPIN MINE

OFFICE	DEPARTMENT
LUPIN	DEVELOPMENT

LUPIN MINE
TAILINGS AREA

MAP INDEX NUMBER	SCALE	DRAWING NUMBER
	1:5,000	

LUPIN TAILS CONTAINMENT AREA CAPACITY 2004

TCA update 2004.xls
cmt

% water permanently retained in tails = 57% (includes water retained in ice lenses)
% remaining water decanted over summer = 93.0%
% mill throughput to tails = 75.9% avg 2000, 2001, 2002, 2003
Average ratio water/solids = 4.37 cu.m. water to 1 cu.m solids (Apr 2000 to Aug 2003)
Bulk Density of solids = 3.01 Tonnes/cu.m @ 0% moisture content
Cell 5 Capacity = 1,956,500 cu m to 488.5 elev (as of Sep 2000)
Cell 3 Capacity = 525,000 cu m to 488.5 elev (as of Jun 2000)
Cell 2 Capacity = 39,375 cu m to 488.5 elev (as of Jun 2000)
N Dam Capacity = 90,000 cu m to 483 elev
TOTAL CAPACITY = 2,610,875 cubic metres

							CELL 5					CELL 3					CELL 2			N Dam					
	Monthly Tons Milled	Monthly Paste U/G	Monthly Solids To Tails	Monthly Solids To Tails	Monthly Solids To Tails	Monthly Water To Tails	Monthly Solids To Cell 5	Monthly Water To Cell 5	Total Slurry Volume to Cell 5	Cumul Slurry Volume in cell	Storage Capacity Volume Remaining	Monthly Solids To Cell 3	Monthly Water To Cell 3	Monthly Slurry Volume to Cell 3	Cumul Slurry Volume retained	Storage Capacity Volume Remaining	Monthly Slurry Volume to Cell 2	Cumul Slurry Volume retained	Storage Capacity Volume Remaining	Monthly Solids To N Dam	Monthly Water To N Dam	Monthly Slurry Volume To N Dam	Cumul Slurry Volume retained	Storage Capacity Volume Remaining	**TOTAL STORAGE CAPACITY**
	(dst)	(dst)	(dst)	(tonnes)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	(cu.m)	**(cu.m)**
Apr 2000	57,357	4,771	52,586	47,696	15,860	52,889	15,860	52,889	68,749	68,749	1,887,751					525,000			39,375					90,000	2,542,126
May	52,588	15,846	36,742	33,325	11,165	52,400	11,165	52,400	63,565	332,314	1,624,186					525,000			39,375					90,000	2,278,561
Jun	66,024	13,309	52,715	47,813	15,613	65,717	15,327	64,001	79,328	224,642	1,731,858	286	1,716	2,002	1,264	523,736			39,375					90,000	2,384,969
Jul	51,834	14,233	37,601	34,104	11,459	53,817	0	0	0	224,642	1,731,858	11,459	53,817	65,276	43,399	481,601			39,375					90,000	2,342,834
Aug	52,847	12,484	40,363	36,609	12,173	52,699	0	0	0	224,642	1,731,858	12,173	52,699	64,872	85,610	439,390			39,375					90,000	2,300,623
Sep	57,730	11,902	45,828	41,566	13,820	69,468	3,981	19,091	23,072	247,714	1,708,786	5,240	27,464	32,704	106,505	418,495	27,512	17,659	21,716					90,000	2,238,997
Oct	52,136	9,728	42,408	38,464	12,790	51,153	12,790	51,153	63,943	311,657	1,644,843				106,505	418,495		abandoned	0					90,000	2,153,338
Nov	52,171	15,212	36,959	33,522	11,147	52,562	11,147	52,562	63,709	375,366	1,581,134				106,505	418,495								90,000	2,089,629
Dec	65,259	10,707	54,552	49,479	16,517	61,063	16,517	61,063	77,580	452,946	1,503,554				106,505	418,495								90,000	2,012,049
Jan 2001	51,585	10,374	41,211	37,378	12,429	47,436	12,429	47,436	59,865	512,811	1,443,689				106,505	418,495								90,000	1,952,184
Feb	52,246	11,619	40,627	36,849	12,268	50,574	12,268	50,574	62,842	575,653	1,380,847				106,505	418,495								90,000	1,889,342
Mar	64,469	13,746	50,723	46,006	15,297	63,308	15,297	63,308	78,605	654,258	1,302,242				106,505	418,495								90,000	1,810,737
Apr	49,024	17,341	31,683	28,736	9,555	45,464	9,555	45,464	55,019	709,277	1,247,223				106,505	418,495								90,000	1,755,718
May	51,416	16,764	34,652	31,429	10,451	52,010	10,451	52,010	62,461	911,738	1,044,762				106,505	418,495								90,000	1,553,257
Jun	64,957	16,647	48,310	43,817	14,517	63,949	11,002	53,192	64,194	936,414	1,020,086	3,514	10,758	14,272	116,151	408,849								90,000	1,518,935
Jul	48,986	19,359	29,627	26,872	8,935	42,376	0	0	0	633,041	1,323,459	8,935	42,376	51,311	149,240	375,760								90,000	1,789,219
Aug	56,935	23,999	32,936	29,873	9,933	42,503	0	0	0	571,376	1,385,124	9,933	42,503	52,436	183,400	341,600								90,000	1,816,724
Sep	65,564	17,799	47,765	43,323	14,382	55,402	2,561	12,578	15,139	564,827	1,391,673	11,820	42,823	54,643	219,629	305,371								90,000	1,787,044
Oct	59,818	20,774	39,044	35,413	11,776	43,233	0	0	0	564,827	1,391,673	11,776	43,233	55,009	256,048	268,952								90,000	1,750,625
Nov	59,291	7,878	51,413	46,632	16,061	53,900	7,840	25,295	33,135	597,962	1,358,538	8,221	28,605	36,826	280,574	244,426								90,000	1,692,964
Dec	61,190	24,733	36,457	33,066	12,751	58,592	12,751	58,592	71,343	669,305	1,287,195				280,574	244,426								90,000	1,621,621
Jan 2002	48,427	11,543	36,884	33,454	11,124	44,938	11,124	44,938	56,062	725,367	1,231,133				280,574	244,426								90,000	1,565,559
Feb	48,872	10,887	37,985	34,452	11,453	52,803	11,453	52,803	64,256	789,623	1,166,877				280,574	244,426								90,000	1,501,303
Mar	53,475	10,357	43,118	39,108	13,004	57,947	13,004	57,947	70,951	860,574	1,095,926				280,574	244,426								90,000	1,430,352
Apr	43,406	19,399	24,007	21,774	7,433	46,628	7,433	46,628	54,061	914,635	1,041,865				280,574	244,426								90,000	1,376,291
May	47,744	19,478	28,266	25,637	8,269	50,184	8,269	50,184	58,453	1,103,088	853,412				280,574	244,426								90,000	1,187,838
Jun	56,731	2,635	54,096	49,065	16,397	58,974	8,259	29,380	37,639	1,140,727	815,773	8,139	29,593	37,732	305,581	219,419								90,000	1,125,192
Jul	49,853	5,571	44,282	40,164	13,355	51,952	0	0	0	1,002,264	954,236	13,355	51,952	65,307	348,548	176,452								90,000	1,220,688
Aug	47,820	11,051	36,769	33,349	11,089	47,487	0	0	0	877,089	1,079,411	11,089	47,487	58,576	386,705	138,295								90,000	1,307,706
Sep	59,682	9,248	50,434	45,744	15,210	63,366	3,030	14,110	17,140	859,810	1,096,690	12,179	49,256	61,435	426,960	98,040								90,000	1,284,730
Oct	52,295	13,125	39,170	35,527	11,732	49,609	0	0	0	859,810	1,096,690	11,732	49,609	61,341	466,969	58,031								90,000	1,244,721
Nov	52,906	11,322	41,584	37,717	12,534	51,252	0	0	0	859,810	1,096,690	12,534	51,252	63,786	508,717	16,283								90,000	1,202,973
Dec	61,732	13,917	47,815	43,368	14,421	64,771	13,399	58,356	71,755	931,565	1,024,935	1,021	6,415	7,436	513,394	11,606								90,000	1,126,541
Jan 2003	63,965	11,532	52,433	47,557	15,814	63,570	15,814	63,570	79,384	1,010,949	945,551				513,394	11,606								90,000	1,047,157
Feb	51,968	21,147	30,821	27,955	9,391	51,961	9,391	51,961	61,352	1,072,301	884,199				513,394	11,606								90,000	985,805
Mar	52,158	10,209	41,949	38,048	12,716	59,132	12,716	59,132	71,848	1,144,149	812,351				513,394	11,606								90,000	913,957
Apr	48,310	9,794	38,516	34,934	11,819	53,439	11,819	53,439	65,258	1,209,407	747,093				513,394	11,606								90,000	848,699
May	49,525	9,024	40,501	36,734	12,225	60,803	12,225	60,803	73,028	1,382,435	574,065				513,394	11,606								90,000	675,671
Jun	48,853	7,112	41,741	37,859	12,589	53,361	12,589	53,361	65,950	1,392,569	563,931			0	513,394	11,606								90,000	665,537
Jul	41,827	4,682	37,145	33,691	11,339	50,743	763	4,160	4,923	1,176,973	779,527	0	4,360	4,360	515,879	9,121				10,577	42,223	52,800	21,133	68,867	857,515
Aug	13,864	4,821	9,043	8,202	2,727	34,644	0	0	0	1,139,591	816,909	25	20,710	20,735	527,709	0				2,702	13,934	16,636	27,318	62,682	879,591
Sep	0	0	0	0	0	21,294	0	21,294	21,294	1,160,885	795,615											0	27,318	62,682	858,297
Oct	0	0	0	0	0	13,381	0	13,381	13,381	1,174,266	782,234											0	27,318	62,682	844,916
Nov	0	0	0	0	0	17,202	0	17,202	17,202	1,191,468	765,032											0	27,318	62,682	827,714
Dec	0	0	0	0	0	19,551	0	19,551	19,551	1,211,019	745,481											0	27,318	62,682	808,163
Jan 2004	0	0	0	0	0	21,131	0	20,000	20,000	1,231,019	725,481											0	27,318	62,682	788,163
Feb	0	0	0	0	0	24,981	0	20,000	20,000	1,251,019	705,481											0	27,318	62,682	768,163
Mar	34,327	8,258	26,069	23,645	7,855	34,291	7,855	34,291	42,146	1,293,165	663,335											0	27,318	62,682	726,017
Apr	32,113	7,725	24,388	22,120	7,349	32,079	7,349	32,079	39,428	1,332,593	623,907											0	27,318	62,682	686,589
May	34,327	8,258	26,069	23,645	7,855	34,291	7,855	34,291	42,146	1,524,739	431,761											0	27,318	62,682	494,443
Jun	46,178	11,109	35,069	31,808	10,567	46,129	0	0	0	1,424,739	531,761									10,567	46,129	56,696	49,418	40,582	572,343
Jul	47,285	11,375	35,910	32,570	10,821	47,235	0	0	0	1,324,739	631,761									10,821	47,235	58,056	72,047	17,953	649,714
Aug	46,178	11,109	35,069	31,808	10,567	46,129	0	0	0	1,274,739	681,761									10,567	46,129	56,696	94,147	0	681,761
Sep	34,327	8,258	26,069	23,645	7,855	34,291	7,855	34,291	42,146	1,316,885	639,615														639,615
Oct	33,220	7,992	25,228	22,882	7,602	33,185	7,602	33,185	40,787	1,357,672	598,828														598,828
Nov	33,220	7,992	25,228	22,882	7,602	33,185	7,602	33,185	40,787	1,398,459	558,041														558,041
Dec	34,327	8,258	26,069	23,645	7,855	34,291	7,855	34,291	42,146	1,440,605	515,895														515,895
Jan 2005	33,220	7,992	25,228	22,882	7,602	33,185	7,602	33,185	40,787	1,481,392	475,108														475,108
Feb		0	0	0	0	0	0	0	0	1,481,392	475,108														475,108
Mar		0	0	0	0	0	0	0	0	1,481,392	475,108														475,108
Apr		0	0	0	0	0	0	0	0	1,481,392	475,108														475,108
May		0	0	0	0	0	0	0	0	1,631,392	325,108														325,108
Jun		0	0	0	0	0	0	0	0	1,531,392	425,108														425,108
Jul		0	0	0	0	0	0	0	0	1,431,392	525,108														525,108
Aug		0	0	0	0	0	0	0	0	1,381,392	575,108														575,108

Partially Saturated Granular Cover for Reactive Tailings in Permafrost

Lupin Mine Experience, Nunavut, Canada

Igor Holubec,
I. Holubec Consulting Inc

David Hohnstein
Kinross Gold Corporation

To be presented at the

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ABSTRACT

Rehabilitation of reactive tailings surfaces is a challenge worldwide and becomes even more so in the Arctic regions. A frequently proposed tailings rehabilitation concept for arctic mines is to encapsulate the tailings in permafrost that requires considerable cover thickness. Thick covers are, however, difficult to vegetate because of a lack of moisture near the cover surface. Published information shows that thick granular pads/covers do not support vegetation because of dryness at their surfaces. Exploration companies working in the National Petroleum Reserve of Alaska have adopted a practice to use thin gravel pads, less than 1 m, that encourages early natural revegetation.

Kinross Gold Corporation (formerly Echo Bay Mines Ltd) has covered some of the tailings cells with about 1 m of esker sand material at the Lupin Mine (Lupin) starting in 1995. Temperature, water level and water quality have been monitored to the present date. It was observed that the sand cover over tailings: a) maintained a saturated zone in the lower 0.3 m depth of the cover during the thaw season; b) water quality within the saturated zone is near discharge limits and is improving, and c) in areas where the cover thickness varies between 0.6 to 1.0 m it is supporting natural revegetation.

Research and field tests in southern climates have shown that a water depth of 0.3 m provides an oxygen barrier. Therefore the 1 m sand cover that is saturated in its lower part provides an oxygen barrier for the tailings. Whereas quite thick granular covers are required to provide complete permafrost encapsulation. Water cover research in southern climates and the seven-year monitoring data at the covered cells demonstrate the validity of a partially saturated granular cover design for the Lupin tailings closure. The attractiveness of this cover design is that it is not sensitive to yearly temperature fluctuations and global warming and can promote natural revegetation.

INTRODUCTION

Some mines produce waste rock and tailings that contain sulphide minerals that may lead to acid generation and metal leaching when they are exposed to oxygen and water (AMD). Many mines, past, present or planned, are located in permafrost regions. This is common in Canada where about 50 percent of the total land surface is located within permafrost. Permafrost has been defined as “a thermal condition in soil or rock having temperatures below 0ºC persisting over at least two consecutive winters and the intervening summer” (Brown and Kupsch 1974). In the 1980’s AMD was recognized as being environmentally detrimental. The mining industry and governments initiated the Canadian Mine Environmental Neutral Drainage (MEND) program for the understanding of AMD and to develop prevention and remediation measures. Most of the studies concentrated on the prevention and control of AMD in non-permafrost regions.

Permafrost regions provide an attractive environment for using the cold climate to construct frozen containment structures and encapsulate the sulphide bearing waste rock and tailings within permanently frozen ground. However, the development of effective preventive and control measures is complex in permafrost because the effect of air and ground temperatures, presence of ice within the ground, limited availability of construction materials and challenging construction seasons that have to be added to the design considerations applicable in non-permafrost regions. Furthermore, only limited case history information is available because many mines in the Canadian permafrost were closed before AMD was identified and some mines ran into financial difficulties leaving the sites in receivership (Lauer 2001). The operating or just closed mines and two diamonds mines that have started operating recently are addressing metal leaching and are developing preventive and control measures. These mines are in various stages of developing reclamation plans, or are in the state of applying reclamation measures. This paper presents an attractive cover design for potentially metal leaching tailings in permafrost that is based on a concept proposed by Holubec (1993) and now supported by Lupin mine field data collected from a sulphide tailings cell that has been covered for about 7 years. The Lupin tailings operation is explained in a paper presented by Wilson (1989).

TAILINGS COVER DESIGNS

Two basic cover designs for reactive tailings have been developed in the non-permafrost regions and one for permafrost regions (MEND 5.4.2d, 2001). For non-permafrost regions the two cover designs consists of 'dry' covers and 'water cover' and for permafrost regions it is proposed to cover the tailings with a sufficiently thick 'clean' (non-reactive) material that will encapsulate the tailings permanently within permafrost. Three covers and a range of their thicknesses are illustrated schematically in Figure 1 and are discussed in the next sections.

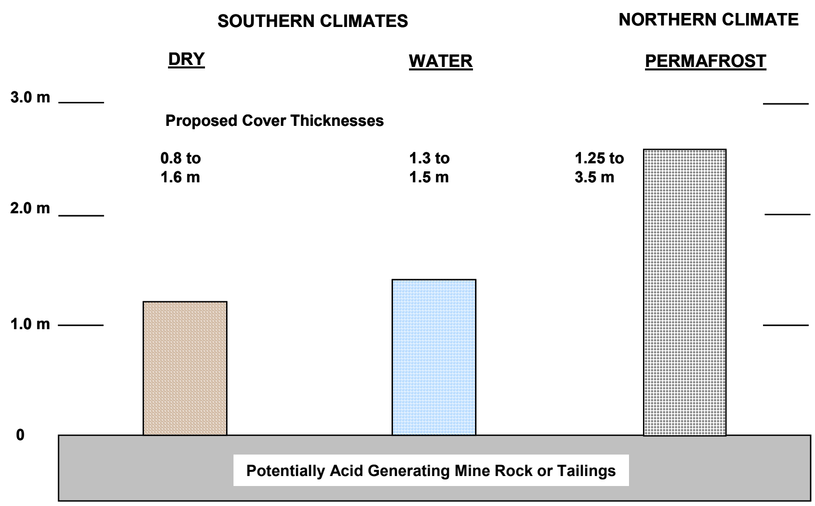

Figure 1. Schematic presentation of cover design to prevent or control AMD

Dry Covers

Dry covers have been widely used as an AMD preventive and control technique around the world. The objectives of the dry covers are to minimize water infiltration and provide an oxygen barrier. In most cases they do not stop sulphide oxidation and metal leaching completely and AMD seepage exits at the slope toes. They also are expected to resist wind and water erosion and provide a medium for vegetation. A wide range of cover designs have been used in the past; varying from a single layer of non-compacted soil to establish vegetation, dust suppression and control water infiltration to a multi layered cover that provides capillary control and decreases oxygen and water infiltration into the tailings (MEND 5.4.2d, 2001). The cover designs varied from a two-layer 0.8 m thick clay cover used at Equity Silver Mine (Aziz 1997) to reduce seepage, to more complex multi layer cover design studied at Waite Amulet (MEND 2.21.1, 1992) and Les Terrain Auriferes (MEND 2.22.4, 2000).

Most of these covers have used a clayey sandy gravel material (till) that is not commonly available in permafrost regions. It should also be noted that many of the mine sites where these covers were used continue to collect and treat water. This latter is not suitable for remote permafrost regions where access is not readily available after closure.

Water Covers

Research (MEND 5,4,2d, 2001) and actual mine site case histories (Davé and Vivyurka 1994) have demonstrated that water covers inhibit AMD. The depth of water over tailings is not governed by a criterion to create an oxygen barrier but to prevent tailings mobilization by wave action and ice scour (Atkins et al 1997). From theoretical studies that were also confirmed by field observations at Equity Silver tailings pond, it was determined that a water depth of 1.3 to 1.4 m is required (Atkins et al 1997) to combat wave and ice scour action. It is difficult to maintain a water cover in permafrost regions because the evaporation of water at the pond water surface is greater than normal precipitation in most Canadian permafrost regions (Latham 1988). Also it is costly to maintain the structural components of a water retention system in remote areas.

An important finding for the proposed partially saturated granular cover for permafrost regions is the research work done at Noranda Technology Centre that assessed the depth of water required to prevent oxidation of sulphide tailings under various conditions (Li et al 1997). They found that 0.3 m depth of 'stagnant' water is sufficient to inhibit tailings oxidation. This depth is supported by the results of two test-cells constructed adjacent to Louvicourt tailings pond (MEND 2.12.1c, 1992).

PERMAFROST ENCAPSULATION STRATEGIES

Encapsulation of reactive tailings within permafrost appears to be an attractive prevention and control option and has been pursued for some time. However, conclusive case histories are lacking because of the complexities permafrost poses and the lack of field information. Information is starting to become available from Rankin Inlet (Meldrum et al 2001), Nanisivik (Elberling 2001), and from Closure or Restoration Plans submitted to the respective Water Boards by Ekati Diamond Mine (2000), Diavik (2001), Nanisivik Mine (2002) and now Lupin. The development of a tailings cover design for permafrost and supporting monitoring results from Lupin where reactive tailings were covered about 7 years ago and dams and tailings temperature data have been collected for over 20 years (Geocon, 1990) are presented in this paper.

Conceptual or final designs for covers are in varied states of development. Cover design concepts that have or are being submitted to regulatory agencies are as follows:

Ekati – A layered cover consisting of fine grain soils to retain moisture overlain by granitic waste rock. Anticipated thickness of 1.5 to 2.0 m.

Diavik – A composite cover of 0.5 m of silty sand till overlain by 3 m of clean mine rock. Anticipated that the active zone will extend into the silty sand but the silty sand, being fully saturated, will form an oxidation barrier.

Nanisivik – One meter of shale (sandy gravel sizes) covered with 0.25 m of esker sand and gravel. Permafrost is anticipated to stay within the cover.

Lupin – Tailings to be contained within cells and covered with about 1 m of esker sand. Covers will be designed so that at least 0.3 m of the esker cover will remain saturated and thereby provide an oxygen barrier.

The proposed cover concepts are illustrated in Figure 2.

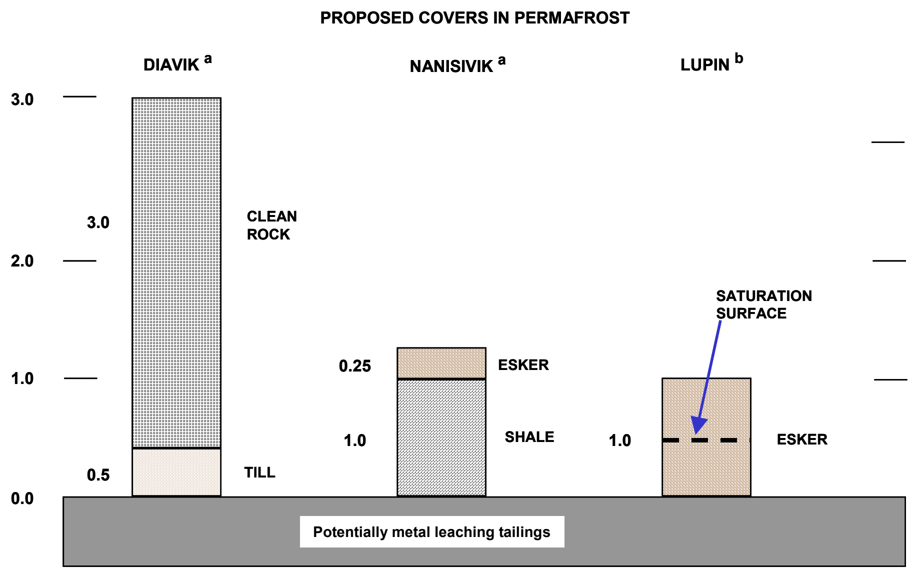

Figure 2. Proposed Cover Concepts of Reactive Tailings in Permafrost

PERMAFROST

The presence of permafrost and the depth of the active zone (depth to which the ground will thaw during the summer) are dependent on many factors and therefore are greatly variable. These are affected by the climate and terrain factors; such as, vegetation cover, overburden (soil or rock) and its saturation, snow cover, slope orientation and human disturbance or construction (Johnston 1981). The effect of these variables on the permafrost, and therefore also on the cover design are illustrated by the Geological Survey Canada compilation of the relationship between Mean Annual Air Temperatures versus Mean Annual Ground Temperature (GSC 2000) shown in Figure 3.

The scatter of data illustrates that for a given mean annual temperature there can be a range of mean annual ground temperatures. For a typical continuous permafrost location that has a mean annual air temperature of minus 10ºC the mean annual ground temperature may vary from –3ºC to –8ºC. This range of mean annual ground temperatures is also indicative of the likely variation to active zone depth.

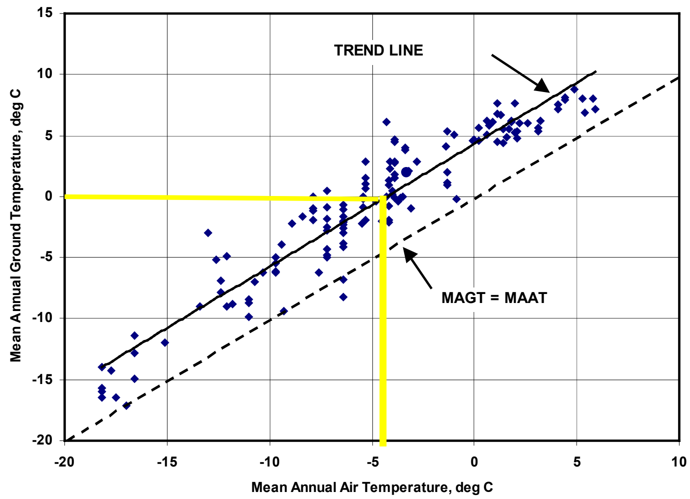

Figure 3. Relationship between mean annual air temperature and mean annual near-surface ground temperature (GSC 2000)

Extensive temperature monitoring over many years at the Lupin Mine illustrates a large variation of the depth of the active zone. The range of active zone depth for 4 stratigraphic conditions is illustrated on Figure 4.

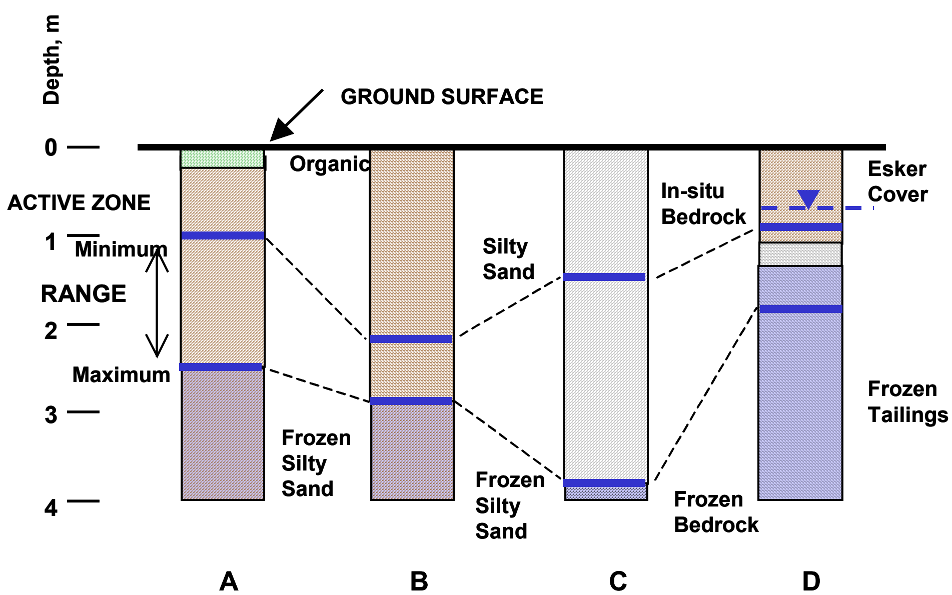

Figure 4. Depth of active zone for 4 stratigraphies.

A) Natural ground with variable vegetation cover thickness.
B) Moist silty sand below dam crest.
C) Local fractured bedrock.
D) Tailings covered with 1.1 m of esker sand and gravel.

The above illustrates that the depth of the active zone in natural ground with varied thickness of vegetation cover varied from 1 to 2.5 m (A); under the dam crests that are underlain by moist silty sand the active zone was observed to vary between 2.5 and 3.2 m (B); at local bedrock exposures with minimal or no soil cover and with local bedrock being fractured the active zone varied between 2.5 to 4 m (C) and finally at reclaimed tailings cells that have an average of 1.1 m of esker sand cover, and the bottom 0.3 m of the esker sand being saturated, the active zone was observed to be between 1.2 and 1.8 m (D). This variation of the active zone in the esker sand covered cell was observed across six locations within the reclaimed tailings cell.

While the depth of thaw varied across the covered tailings, the depth of thaw also changed over the 7-year monitoring period. The thaw depth changes during the summer at one thermistor monitoring station are illustrated in Figure 5.

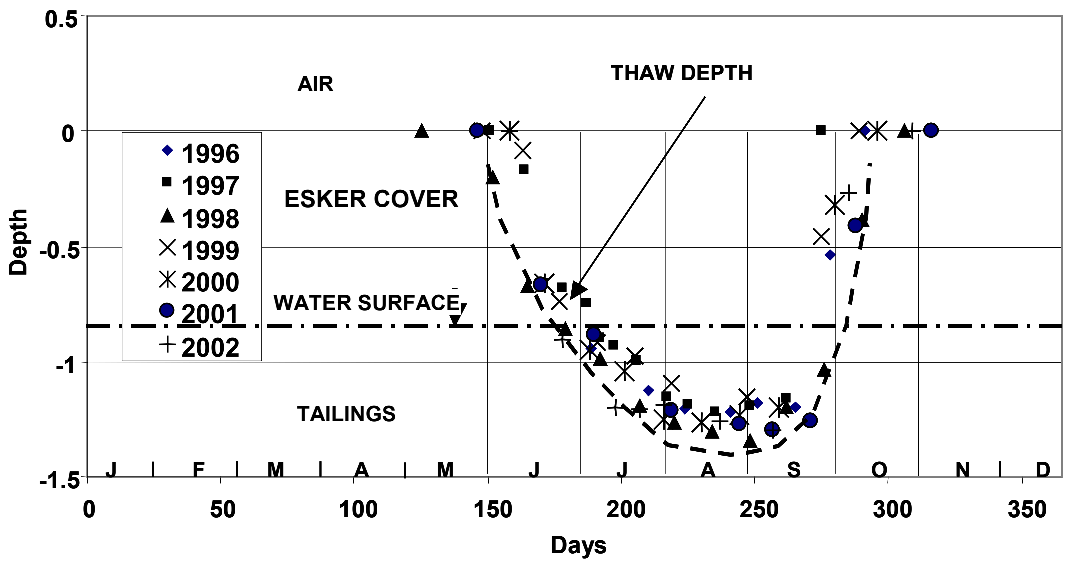

Figure 5. Variation of thaw depth in esker cover tailings

Figure 5 illustrates that at one location with the same stratigraphy the thaw depth can vary from year to year depending on the year's climate. At this covered cell location the thaw depth varied from 1.15 to 1.35 m during the 7 years of monitoring.

The data collected from Lupin shows that the active zone can vary from a maximum of 3.3 and 4.0 m within moist silty sand and fractured bedrock respectively to a minimum of 1.2 to 1.8 m in tailings covered with 1.1 m of esker sand. The first range would be representative of a 'dry' permafrost cover while the second range would be representative of a sand cover with saturation at its base.

It is concluded that the active zone depth at the Lupin Mine studied locations varied from 1.2 to 4 m. In areas with thick peat cover, the active zone would be smaller. The variation is predominantly dependent on the degree of water saturation or ice content. It is based on the conditions at the measured locations with normal snow covers appropriate for these locations. It does not take into consideration orientation of the cover, such as a sloping cover over mine rock dump, temperatures during higher temperatures that may occur for instance over a 100 year period or global warming. All these factors would increase the depth of the active zone.

LUPIN MINE CELL MONITORING EXPERIENCE

Lupin Mine is located in a low relief undulating topography underlain by continuous permafrost approximately 400 km northeast of Yellowknife and 285 km southeast of Kugluktuk. The tailings disposal was constructed within a relatively small watershed area located about 5 km south of the plant. The poor availability of suitable core construction material and the existence of cold mean annual air temperature of –11.8ºC resulted in the decision to develop the tailings containment by constructing dams from thawed local overburden with the anticipation that they would freeze over one to two years. A liner, that was keyed into permafrost, was provided within the dam to hold the water until the dams froze. The dams were constructed in the summer of 1981 and the plant was put into operation in 1982. The design basis of using frozen dams required extensive temperature monitoring from 1982 to this date.

The tailings facility was developed based on total water containment for the first 4 to 7 years. This would provide time to evaluate the tailings water quality and develop water treatment method if this was found to be necessary. Increased production of ore resulted in the adoption of a tailings management strategy to deposit the tailings within cells and provide two ponds for water quality improvement before discharge. Since 1985, water was discharged from a downstream polishing pond to control water level based on the dam requirements to keep them frozen.

Internal partitioning of the tailings area in 1985 and the covering of filled tailings cells in 1995 provided an opportunity to add temperature measurements to the dam temperature monitoring. These developments resulted in the acquisitioning of extensive temperature data that support the development of the proposed partially saturated granular cover for Lupin's tailings. Figure 6 illustrates Lupin tailings facility with the numerous cells used to store the tailings and ponds to manage the water.

Progressive reclamation of the filled tailings cells was started in 1995 to combat tailings oxidation. The tailings were covered with a nominal one-meter of esker sand containing some gravel. In November 1995, five strings of thermistors were installed to measure the temperatures within the esker cover, through the tailings and into the underlying natural ground. The length of the thermistor strings was 13 m. The thermistor strings became gradually in-operative with only one string providing readings to this date. Aside from the temperature monitoring, water sampling wells were installed at 3 locations besides each thermistor installation to monitor water levels and take samples for water quality determination within the cover pores.

An evaluation of the covered cell performance provided support for a partially saturated granular cover design proposed earlier by Holubec (1993). As a result of this positive evaluation, additional monitoring was decided upon and the construction of control cells are planned.

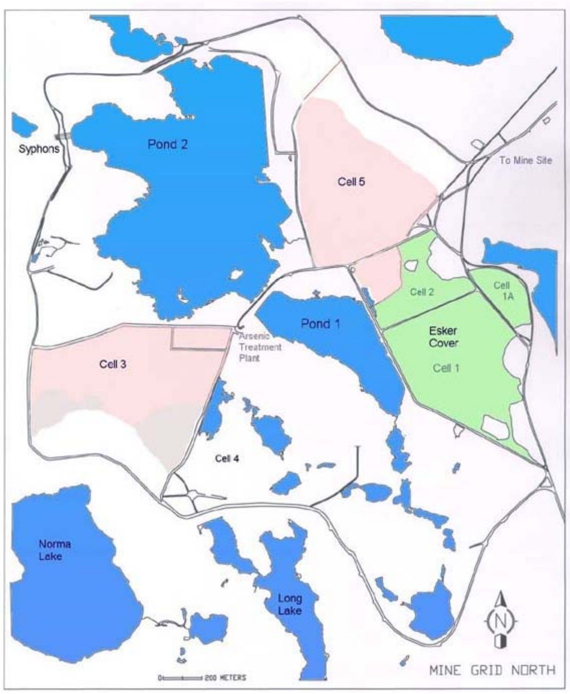

Figure 6. Lupin Mine tailings facility

In 2002 nine pipes were installed within Cell 1 to establish more accurately the thickness of the esker cover, monitor the water level within the esker and to obtain samples for water quality testing. An aerial view of Cell 1 is shown on Photo 7.

Cell 1 has approximate dimensions of about 600 m by 700 m. The tailings were discharged from perimeter dikes, shown on Figure 6, resulting in beaches being developed adjacent to the dike crests and a depressed tailings surface was formed in the centre of Cell 1. The 9 pipes and the earlier 1995 thermistor strings show that the esker cover thickness is about 1.1 m over the beaches and 0.6 m in the central portion of the cell. At the beaches the water saturation level within the esker was observed to be 0.3 m and within the central portion the water level was near the top of the esker.

Two water wells installed during 1995 showed the water quality within the cover material was improving with time. Water samples obtained from 9 pipes installed in the esker in 2002 and the ponded water from the central portion of Cell 1 showed the water quality to be near discharge limits.

Photo 7. Air view of esker covered Cell 1

Ground temperature monitoring within Cell 1 (illustrated in Figure 5) is representative of the results obtained from other thermistor data. The information of interest in this figure is that the active zone penetrated a maximum of 0.3 m into the tailings, stayed unfrozen for only a period of about 2.5 months and the maximum temperature of the thawed zone (just at the esker/tailings interface) was less than 4ºC. Average temperature at 1.0 m depth was 2.7ºC. This means that even if the tailings were unsaturated, the oxidation process at this lower temperature for a period of 2.5 months in a year would reduce considerably the oxidation of the tailings.

A final observation from Cell 1 was that in areas with less than 1 m of esker cover, vegetation started to develop on top of the cover without any seeding or fertilizing (Photo 8). The vegetation originated from organics growing in the esker deposit from where the cover material was obtained.

Revegetation of disturbed areas with thin granular material was also observed at an abandoned airstrip at the Lupin site. Parts of an abandoned airstrip where the granular was stripped for use at other places supported more vegetation than in the remaining undisturbed section of the airstrip with a thicker granular pad. The observation that thinner granular pads support vegetation more readily was observed at the Alaska National Petroleum Reserve. They observed that the areas with thinner pads retain sufficient moisture to enable grasses to establish and the pads recede more quickly into the surrounding landscape. As a result the oil exploration companies have adopted a practice to use thin gravel pads, 0.5 m thick, for winter exploration to minimize impact on the ground and foster quicker revegetation (Brewer 1983).

PROPOSED PARTIALLY SATURATED GRANULAR COVER

Information presented in this paper leads to three major conclusions directed towards the design of covers for potentially leaching tailings in permafrost regions; namely:

Photo 8. Vegetation developed on Cell 1 esker cover without assistance.

1) Active zone depth. In the absence of vegetation cover, moisture level within the surface material is the dominant factor determining the depth of the active zone. The depth of the active zone can vary from 3.5 m in rock cover, 3.0 m in low moisture sands to 1.3 m in sands that are saturated to within 0.5 m of the ground surface.

2) Active zone depth fluctuation. Depth of the active zone will fluctuate over time due to climatic changes, snow cover thickness and will vary between points within a covered area. The fluctuation of the active zone increases in drier covers.

3) Influence of water cover. Research into water covers has shown that 0.3 m water depth over reactive tailings, if the water is stagnant, is sufficient to provide an oxygen barrier.

Based on 20 years of ground temperature monitoring and 7 years of monitoring of sand covered tailings at Lupin and a literature review of performance of gravel pads on permafrost (Holubec 1994), Lupin is proposing to use a partially saturated granular cover over the tailings as a reclamation option. This cover is based on the above three conclusions.

A requirement for the partially saturated granular cover is that a saturation level within the esker cover is naturally maintained so that a closure 'walk-away' is attained. A 0.3 m open water cover over the tailings surface would be difficult to maintain at Lupin, and most permafrost regions, because of high evaporation during July and August. However, a saturated zone at the base of a granular cover should decrease the rate of evaporation to maintain a saturation zone. Preliminary water level measurements within the existing Lupin's covered cells support this concept. More rigorous study of the water balance within the partially saturated cells will be made by the installation of designed test pads within the existing covered tailings and on newly covered tailings.

CONCLUSIONS

Reclamation of potentially leaching tailings requires covering of the tailings surface to prevent wind erosion and the leaching of metals. In non-permafrost regions, dry and water cover approaches are employed. Dry covers are normally used to limit erosion, promote vegetation and reduce oxidation. Elimination of seepage is difficult to attain with these covers. Water covers are very effective in preventing oxidation of the tailings. But water depths of at least 1.3 m are required to prevent tailings being disturbed by wave action or ice scour. Without these disturbances, water depth of 0.3 m would be sufficient to provide an oxygen barrier.

In permafrost regions the designs considered in non-permafrost regions are not suitable because of a lack of appropriate cover materials, likely disturbance of the covers by frost action and the need to have maintenance free covers due to the inaccessibility of most mine sites.

A common cover design approach for the reclamation of tailings is intended to provide sufficient cover material that will encapsulate the tailings within permafrost. The main challenge in the design of this type of cover is to establish an economic cover thickness that will contain the active (thaw) zone within the cover using site available materials. The depth of the active zone is governed by many factors, such as climate, cover orientation, material type, saturation, snow depth aside of vegetation that is normally absent for long time in the cold regions. In the design of cover to encapsulate the tailings, or waste rock, within permafrost, temperature fluctuations over the years and global warming have to be taken into consideration.

'Dry' covers in permafrost regions would require cover thicknesses of 3 to 4 m to permanently encapsulate tailings or mine rock in permafrost if clean rock or relative dry sand and gravel material are used for the cover. The required thickness decreases as the saturation within the base of the cover is increased. A cover thickness in the order of about 2.0 m is required for 'moist' or ice rich covers to permanently encapsulate the tailings within permafrost. Both these covers require a large quantity of material to reclaim tailings and waste rock surfaces.

An alternative cover design for permafrost is a partially saturated granular cover that is presented in this paper. The principle of this design is to maintain a 0.3 m saturated water level within the granular cover to provide an oxygen barrier over the tailings.

The proposed thin partially saturated granular cover has many positive attributes, such as:

- Provides a water oxygen barrier that is not dependent on having permafrost within the tailings.
- Is not sensitive to annual temperature changes or global warming.
- Will support vegetation because of the proximity of the water surface to the top of the cover.
- If esker material is used for cover material, it decreases the required volumes and thereby reduces the disturbance of the esker deposits. Eskers serve as a preferable animal habitat.
- Is more economical to construct since less material is used.
- Provides a more easily constructible cover for use in remote locations.

This cover design is applicable for tailings surfaces that are nearly level. Since beached tailings have a minor slope, occasional internal baffles within the cover may be required to limit water migration where the deposited tailings surface have a minimal slope. The need for the baffles on sloping tailings surfaces depends on the permeability of the cover material.

This cover design is not suitable for steeply sloping surface, such as in the case of dams and waste rock dumps. Since 'dry' covers require a considerable thickness of cover material, especially if the slopes face towards the south, it may be preferable to design tailings pond and waste rock dumps with minimum slope areas and maximum horizontal surface areas to maximize the use of the partially saturated granular cover.

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APPENDIX D

Response to NWB Review of 2000, 2001, 2002 Annual Reports

RESPONSE TO NWB REVIEW OF 2000, 2001, 2002 ANNUAL REPORTS

In their letter of January 7, 2004, the Board asked Licensee to address 4 items arising from their review of the Lupin Annual Reports of the previous 3 years.

1. *That in 2002, the daily discharge limit of treated tailings effluent discharged at Station Number 925-10 exceeded License limits mandated in Part D, Item 3 (70 000 m^3/day). On July 20, (70 361 m^3); July 21 (71 670 m^3); and July 30 (70 662 m^3). These incidents were apparently not noted by INAC inspectors.*

Response: Echo Bay confirms that the licensed discharge volumes were exceeded on the dates specified. The amount of the exceedence was very low, between 0.5% and 2.4% of the allowed daily volumes. Adjustment of the volume of the 20-inch diameter siphon flow is by manually-operated gate valve. The licence exceedence on those 3 days was probably due to the coarse nature of the operator adjustments of the siphon flow, or possible errors in flow meter readout.

2. *That in 2000, on the following dates, water quality parameters did not meet the guidelines established by the NWB in Part D, Iem 5 of the License for effluent discharged at Station Number 925-15: Total Cyanide – August 22 to 27; Total Arsenic – August 14. These incidents were apparently not reported by INAC inspectors.*

Response: After re-checking the water quality data for the dates specified and not finding any parameters that fell outside the guidelines, Echo Bay asked the NWB to provide evidence of the incidents in question. The NWB responded that the exceedences did not, in fact, exist and to disregard this request.

3. *That in 2002 the following daily water quality parameter did not meet the guidelines established in Part D, Item 5 of the License for effluent discharged at Station Number 925-15: Total Arsenic – July 31. This incident was apparently not reported on by INAC inspectors.*

Response: After re-checking the water quality data for the dates specified and not finding any parameters that fell outside the guidelines, Echo Bay asked the NWB to provide evidence of the incidents in question. The NWB responded that the exceedences did not, in fact, exist and to disregard this request.

4. *That a follow-up report on spill 02-591 (minewater leak), which occurred in 2002, was required by the INAC inspector, pursuant to Part H, Item 4© of the License. The NWB requests to know whether this matter has been addressed or not.*

Response: As indicated by the attached letter, a follow-up report on spill 02-591 was issued to the Water Resources Officer, DIAND. There is no record of NWB having been copied.

ECHO BAY MINES

Lupin Operation
9818 International Airport
Edmonton, AB T5J 2T2
Tel: (780) 890-7000
Fax: (780) 890-8814

December 16, 2002

Our File: NWB1LUP0008 2002 Admin
Your File: Water Register
NWB1LUP0008

Water Resources Officer
DIAND
Nunavut District
P.O. Box 100
Iqaluit, NU X0A 0H0

Dear Sir

RE: Echo Bay Mines Ltd., Lupin Gold Mine, Contwoyto Lake, NU.; Water Licence NWB1LUP0008; SPILL REPORT NO. 02-591

Please find attached a copy of NWT Spill Report No. 02-591 which was filed by fax on December 9, 2002.

DATE/TIME/LOCATION

At approximately 10:30 hours on December 9, 2002 a mill operator found an estimated 200 to 300 USG of mine water had leaked outside the mill building onto the ground. The spill covered an area of approximately 4 to 5 m^2.

CAUSE

The water line that transports mine water to the discharge point on surface developed a leak, allowing the water to spill onto the ground.

CORRECTIVE ACTION

Upon discovery of the spill, the mine dewatering pumps were immediately shut down. The mine water line that leaves the mill was disconnected and the water line re-routed so that the mine water is now discharged to the tailings containment area.

CLEAN-UP

The water has gone below surface along side the building, with some remaining within snow and ice between the buildings.

If you have any questions or require further information, please contact the undersigned at (780) 890-8779.

Sincerely,

Hugh Ducasse
Manager, Loss Control and Environmental Affairs

cc: Bill Burton
Dave Hohnstein
Mill Operations