Appendix 11

- **A Submission to the Northwest Territories Water Board in Support of an Application for Water Licence Renewal, Water Licence N7L2-0925, December 1995.**

A Submission

to the

Northwest Territories Water Board

In Support of an Application for Water Licence Renewal

WATER LICENCE NO. N7L2-0925

By

ECHO BAY MINES LTD.

Lupin Gold Mine

Contwoyto Lake, NT

December, 1994

Table of Contents

List of Figures

INTRODUCTION

This submission is presented in support of Echo Bay Mines Ltd.'s application, dated June 9, 1994, to renew Water Licence N7L2-0925. A copy of the application for renewal (Schedule III) is included in the appendix. As indicated in the initial letter, Echo Bay is applying to renew the licence for an eight year period and incorporate changes where seen appropriate in areas of operational constraints, and licence effluent limits where necessary.

These changes are not to be viewed as an open door, but as an attempt to bring the overall licence specifications in line with regulations elsewhere and other relative licences in the Northwest Territories. Echo Bay Mines Ltd. continues to emphasize it's Corporate Environmental Policy in all areas, and will strive to meet or exceed all requirements to minimize environmental impact in the course of exploration, mining and processing of mineral resources.

BACKGROUND INFORMATION

Echo Bay Mines Ltd. came into existence in the early 1960's, formed by a group of investors with the intentions of leasing the former Eldorado property at Port Radium, on the shores of Great Bear Lake, and an adjoining Cominco property known to have silver and copper ore within it's boundaries. The Eldorado facilities were resurrected, and the mining of silver from the new Echo Bay Mine commenced in 1964. By 1976, the silver ore reserves from the initial site were depleted and the old Eldorado Mine was re-opened and mined for it's silver and copper ore.

The total mill production during the period 1964 through to 1982 amounted to 35.5 million troy ounces of silver and 10 million pounds of copper. At the close of production in 1982, an equipment salvage program was initiated, and site restoration began. Restoration was completed in 1985.

LUPIN BACKGROUND

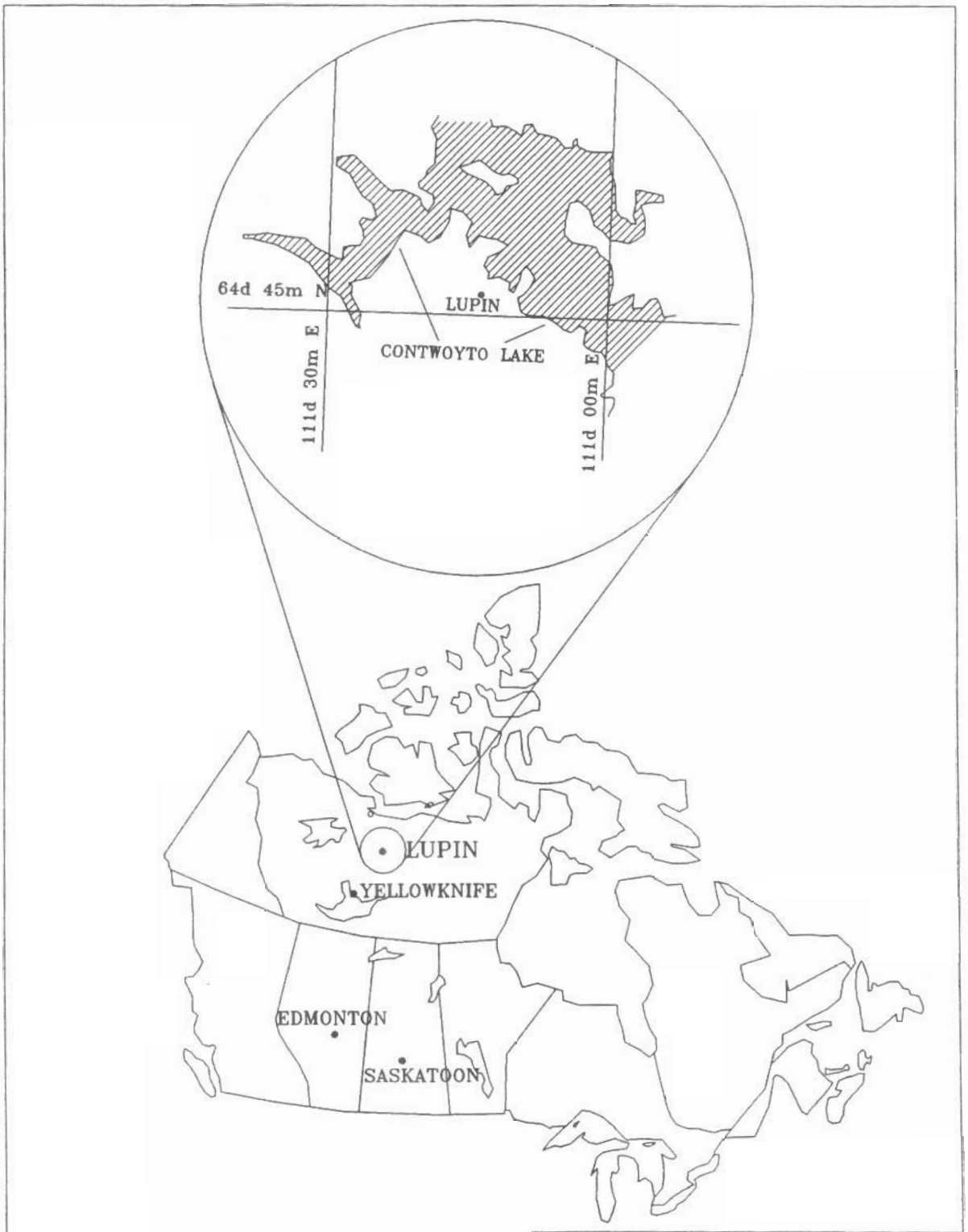
The Lupin Mine is located on the west shore of Contwoyto Lake, in the Northwest Territories approximately 400 km northeast of Yellowknife and 80 km south of the Arctic Circle. The coordinates are 65°46′ Latitude and 111°14′ Longitude (Figure 1).

The Lupin gold deposit was discovered in 1960 as a result of reconnaissance sampling and mapping programs conducted by the Canadian Nickel Company Ltd, a subsidiary of Inco Limited. Between 1961 and 1964 the Canadian Nickel Company Limited conducted exploration in the Lupin area which included geological mapping, geophysical surveying, trenching, stripping and channel sampling.

In February 1979, Echo Bay obtained an option on the Lupin property from Inco and proceeded with an underground exploration program. The program, in 1979 and 1980, included driving a decline at -15% grade to the 110 meter level and conducting extensive diamond drilling down to the 200 meter level, as well as a single deep hole to the 470 meter level. The geological information indicated enough ore reserves to provide 6 years production; based on the potential to develop in excess of two million tons of ore with a mill designed to process an average 950 tons per day. The single hole indicated a continuation of ore and the potential to extend the mine life.

In August 1980, the decision was made to proceed with development and construction of the Lupin Mine. The plant design was based on the airlifting capability of a C130 Hercules to transport all components to the site. During the 20 months of construction, the Hercules aircraft made 1,100 flights, carrying 25 tons of construction material each time. Construction was completed on schedule in March 1982 and preproduction commissioning began.

During 1983, an expansion program was completed that increased the throughput of the mill to 1,200 tons per day. Construction included the installation of a rod mill, a second 1,000 ton fine ore storage bin, additional filters and a maintenance bay extension. From 1983 through to 1993, the mine and mill have completed additional expansions to increase capacity to a nominal 2,300 tons per day. In 1994, the Paste Backfill Project will be completed providing mine safety and underground support.



ECHO BAY MINES LTD.
LUPIN N.W.T.

LOCATION MAP

Fig. 1

Commercial production began in October 1982. On April 28, 1993, a major milestone was reached when the mine poured it's 2,000,000th troy ounce of gold. The reserves as of December 31, 1993, were 3.27 million tons of proven and probable ore at a grade of 0.280 ounces gold per ton, and containing 916,000 ounces of gold.

SITE FACILITIES

Other than the transportation requirement for materials and supplies necessary to sustain the workforce and industrial operations, the Lupin site is completely self-contained and relatively compact. There are two main areas; the residential complex consisting of accommodations, kitchen and recreation centre, and the industrial complex comprised of milling and maintenance areas, headframe, hoistroom, powerhouse, warehouse and office facilities (Figure 2).

TRANSPORTATION

Echo Bay established it's Aviation Department in 1975 by operating a DC-3 leased from Eldorado Nuclear. This success led to the purchase of a Convair 640 with a freight door. With the option on the Lupin property, Echo Bay's requirements changed and a move to lease a Lockheed C130 Hercules was made. This aircraft and it's crews amassed an enviable safety record delivering the $135 million Lupin Project without incident and on schedule.

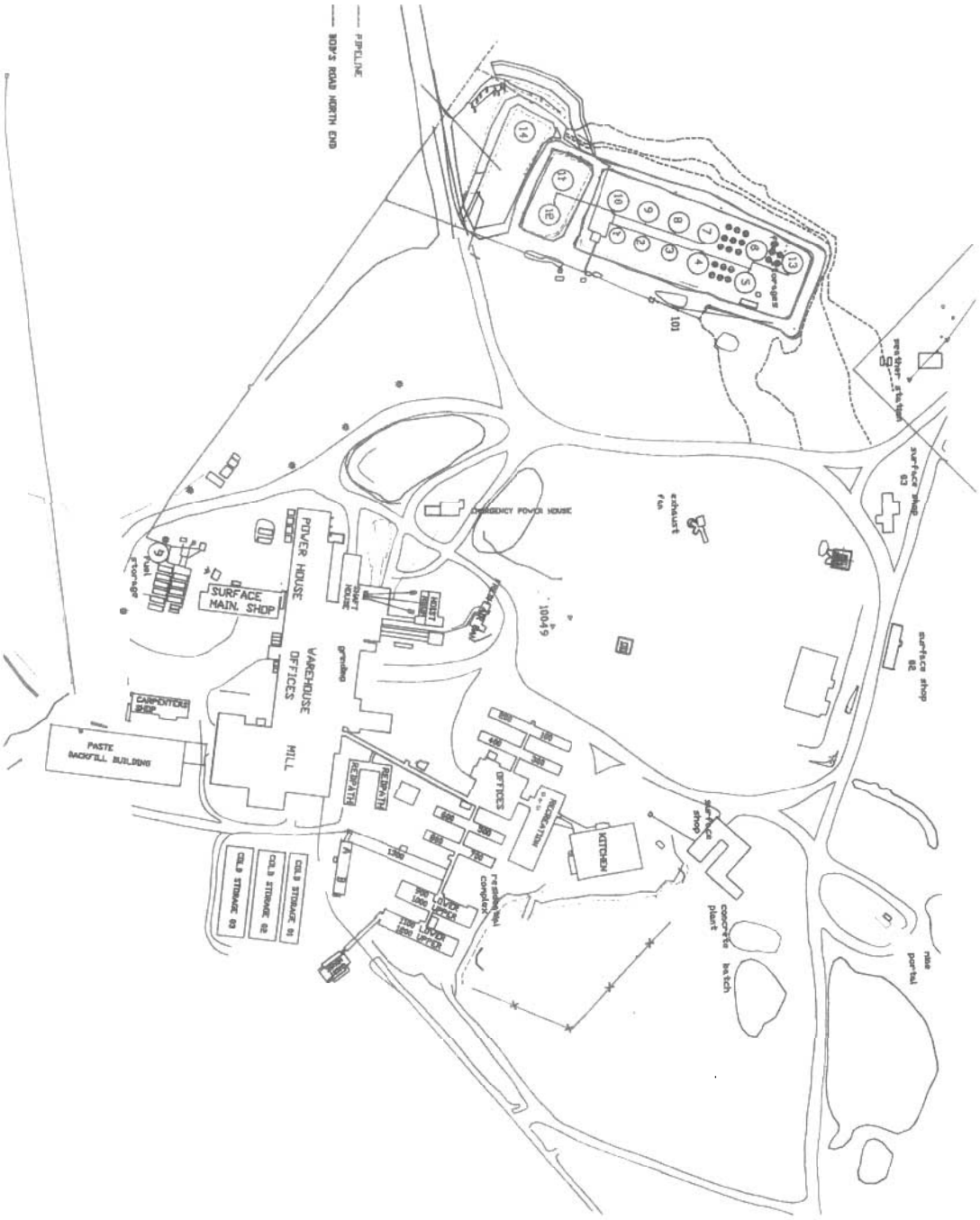
In January 1983, Echo Bay Mines constructed the first ice road from Yellowknife to Lupin, covering a distance of 665 km of which 75% is over frozen lakes. Two base camps serve as maintenance and rest stops for the 36 hour round trip from Yellowknife to Lupin. The winter road season is 12 weeks long (3 weeks construction and 9 weeks transportation) from early January through to mid-March. In 1994, over 16 million pounds of freight and 23 million litres of fuel were trucked to Lupin via the road.

POWER GENERATION

Power is supplied on site through Lupin's diesel engine operated powerhouse which generates over 72 million kilowatt hours per year, consuming over 16 million litres (4.14 million gallons) of P40 (diesel) fuel oil. A fuel tank farm containing 11 large storage vessels and numerous smaller tanks has a total storage capacity of over 18 million litres (4.8 million gallons).

The total installed generator capacity is 19.5 megawatts in the main powerhouse. This is provided by three Ruston RK diesel generators, four General Motors EMD645E4B diesel generators and an EMD 710G4B diesel generator. In an emergency situation, an additional 1.2 megawatts can be produced by utilizing two Caterpillar D398 diesel generators enclosed in a separate building.

Fuel, being an expensive commodity at Lupin, is utilized to it's greatest extent. The waste heat that is produced during power generation is harnessed through heat exchangers. A mixture of 50/50 glycol and water is continually circulated through the heat exchangers absorbing the conductive waste heat from hot lubricating oil, jacket



Please view length wise

(FIGURE 2) General Site Plan

water and exhaust gases. The glycol is then pumped throughout the minesite where heat is required for use in unit heaters, simple baseboard heaters or liquid-air heat exchangers. The fresh air supply to underground, offices, accommodations, kitchen facilities and the domestic hot water are all heated by means of the waste heat recovery system. The Lupin powerhouse currently generates power with a fuel efficiency of 17.5 kilowatts per imperial gallon of fuel oil.

GEOLOGY

The gold mineralization at Lupin is confined to a folded and metamorphosed iron formation and the mineralization may be termed "stratabound". The iron formation horizons consist of both silicate facies and sulphide facies metamorphosed to an amphibolite + quartz rich rock. In plan view the gold bearing iron formation appears as a Z-shaped structure (**Figure 3**) made up of three zones; the West, Centre and East zones. Total strike length of the three zones is in excess of 900 meters, confirmed to a depth of 1800 meters below surface. The ore horizon provides a 3 dimensional view of the ore body (**Figure 4**).

The mineralogy of the ore at Lupin consists mainly of amphibole, quartz, occasionally garnet, pyrrhotite, arsenopyrite, minor pyrite and trace chalcopyrite. Also found in trace amounts are scheelite, apatite, epidote, calcite, tourmaline, and some arsenides (notably loellingite). The gold is fine grained, generally less than 100 microns in diameter, and is associated mainly with pyrrhotite and arsenopyrite. Although not common, visible gold has been reported, usually in close proximity to quartz veining.

The ore at Lupin, with its small percentage of sulphide, has been shown through various studies to be capable of generating acid upon oxidation. The waste rock produced in the mining process contains very little sulphur (approx. 0.5%) and is considered to have very little potential for acid production. Additional information is included under the tailings disposal section along with an attachment in the appendix on recent results.

Ore reserves at year end 1993 stood at 3,211,700 short tons grading 0.281 ounces per ton. In addition, there are 2,944,300 short tons grading 0.250 ounces per ton in the possible category. Graphs showing historical gold reserve and gold production for the Lupin Mine are presented on pages 9 & 10. In total, at a projected milling rate of 2000 tpd (down from the 1994 rate of 2300 tpd), the current reserves extend the mine life slightly beyond 8 years.

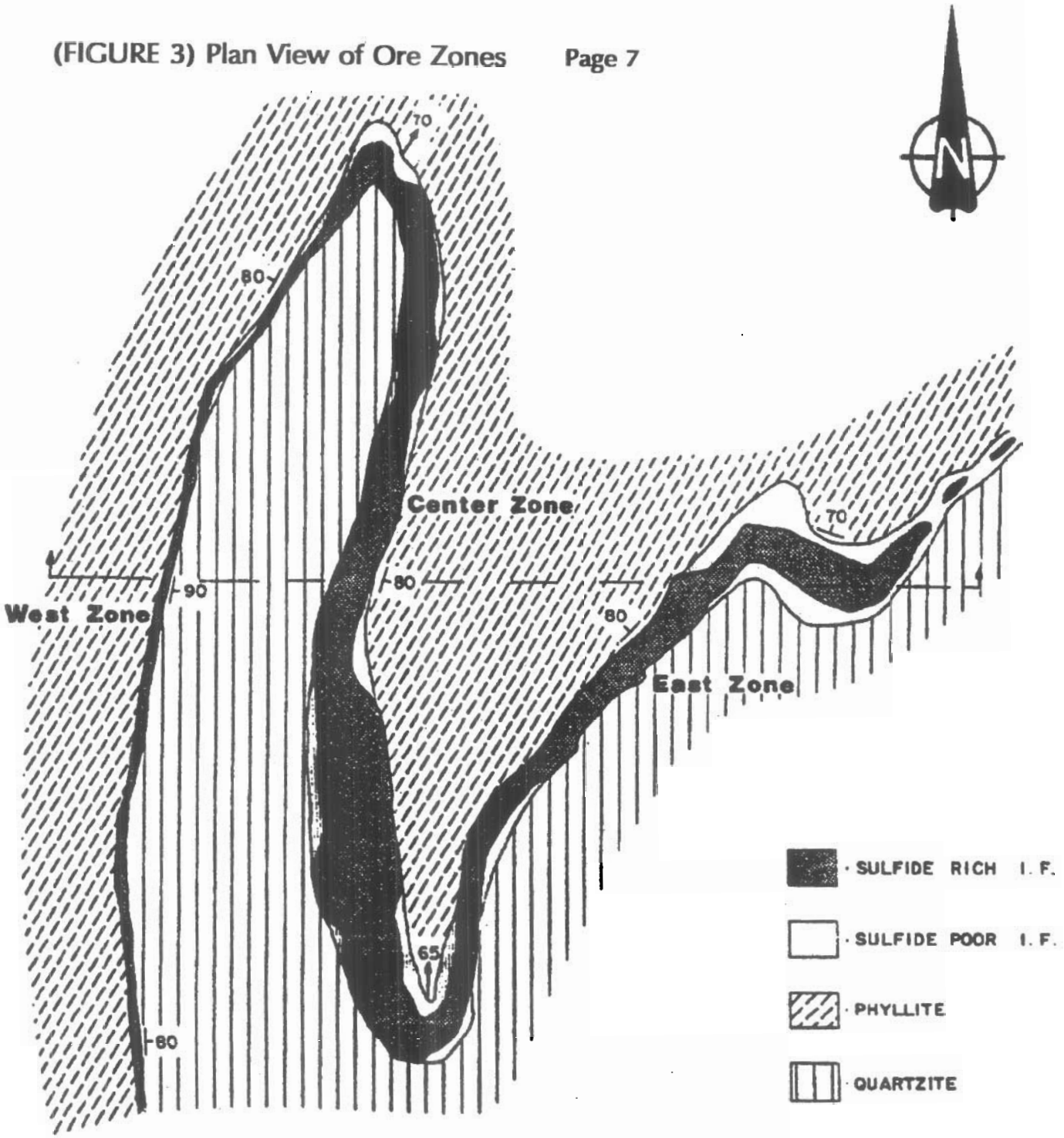
MINING; METHODS AND EQUIPMENT

Main Shaft

Shaft sinking began in 1982, to an original depth of 369 meters below the surface collar. After being extended on three occasions, the present shaft bottom is at the 1210 meter level. Hoisting speed has also been increased to 1825 feet per minute.

The current configuration of the shaft is as a three compartment shaft from surface to the 250 meter level, then as a four compartment shaft from the 250 meter level through

(FIGURE 3) Plan View of Ore Zones



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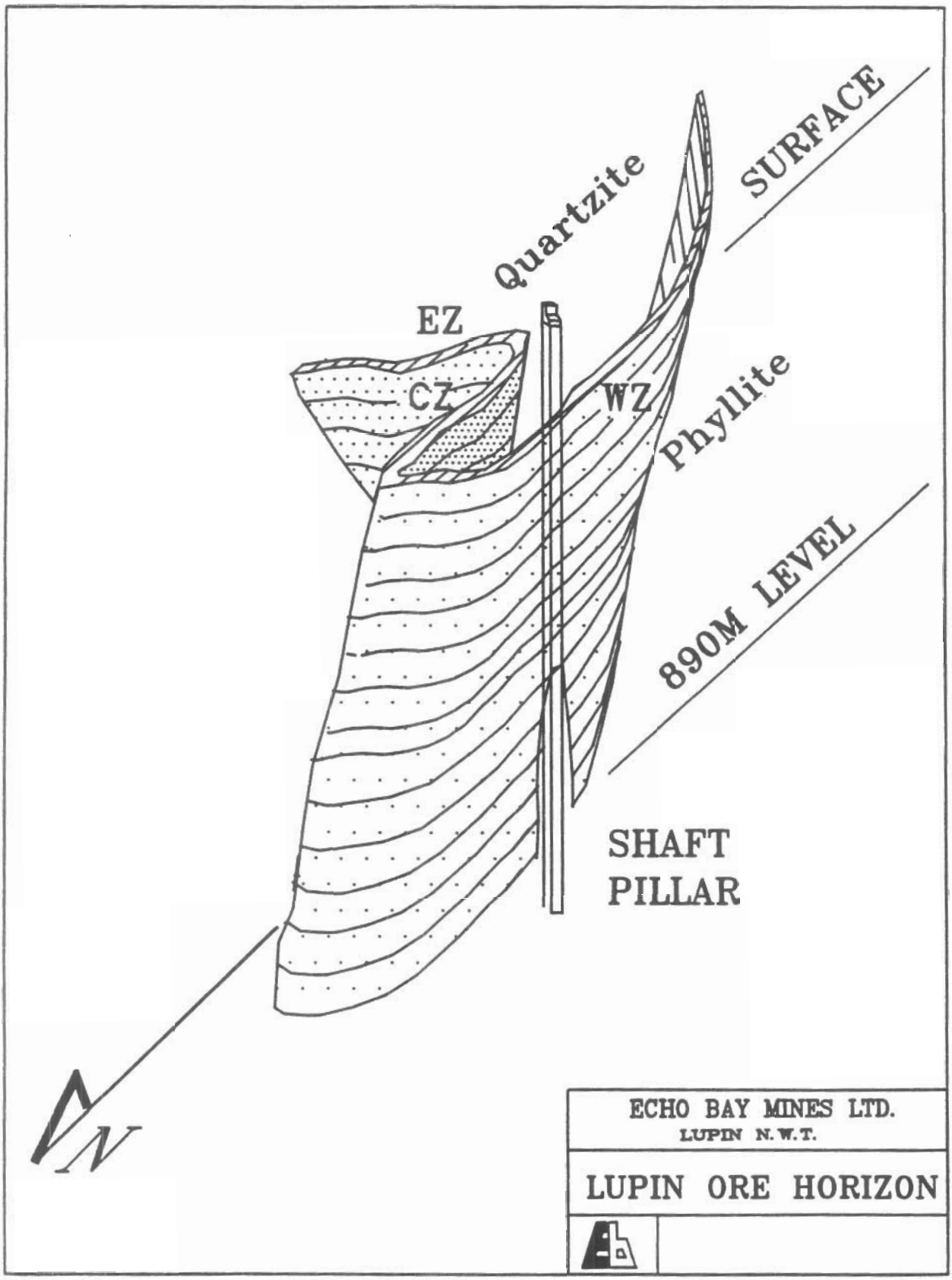
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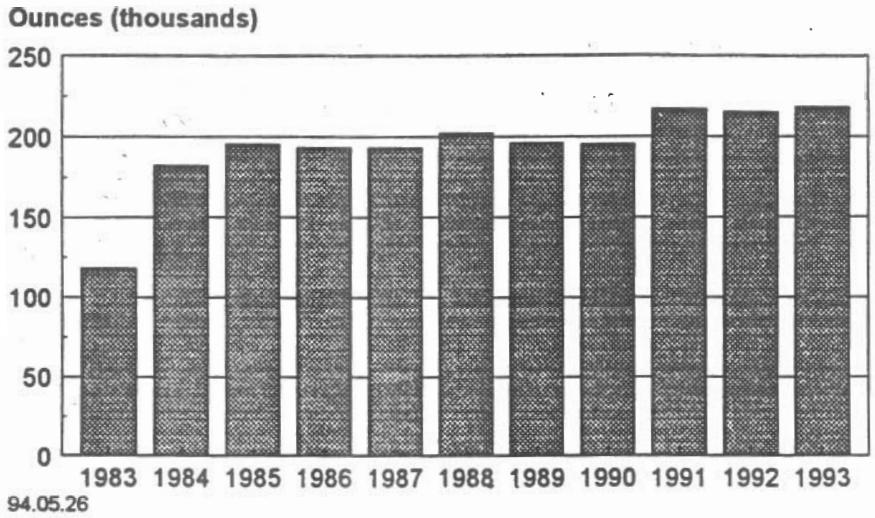
ECHO BAY MINES LTD.
LUPIN N.W.T.
LUPIN ORE HORIZON

GOLD PRODUCTION HISTORY
Lupin Operation



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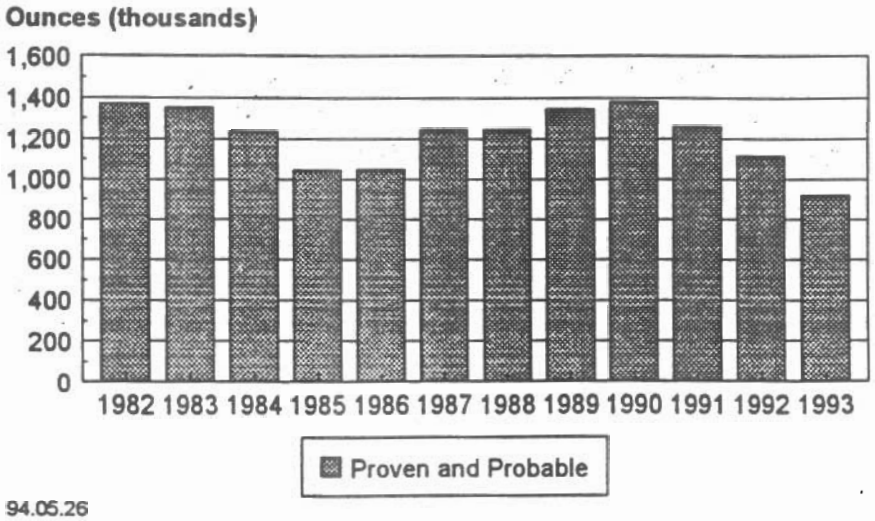
GOLD RESERVE HISTORY
Lupin Operation



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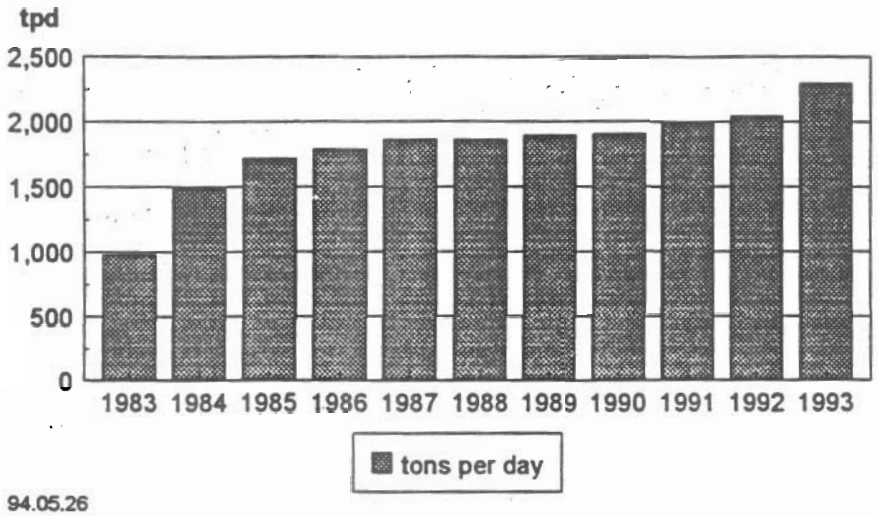
PRODUCTION HISTORY (tons)
Lupin Operation



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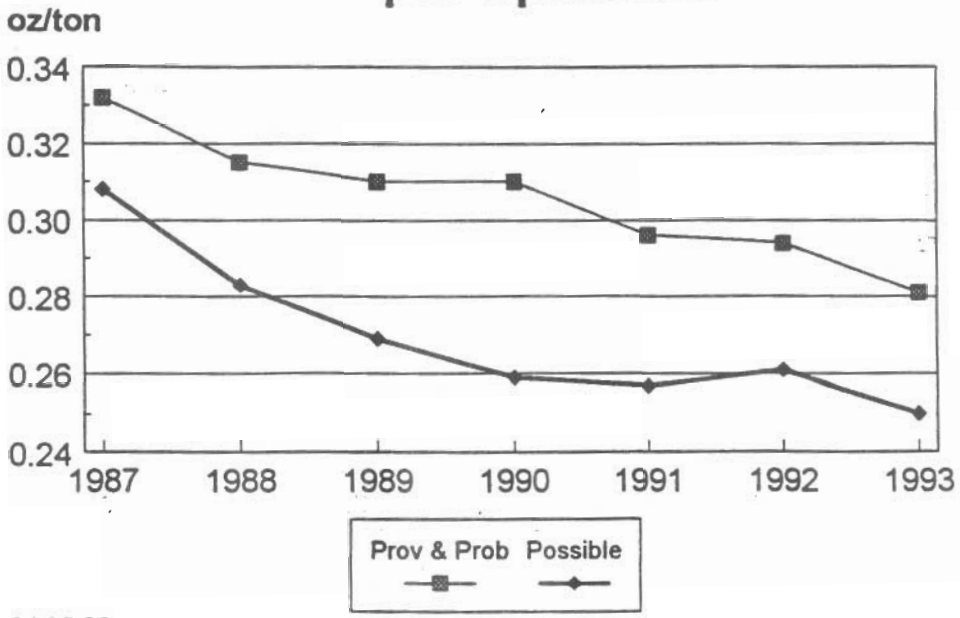
ORE RESERVE GRADE HISTORY
Lupin Operation



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to the 1210 meter level. The fourth is a manway and service compartment. In 1992, the third shaft compartment was converted to a service cage compartment with a new service hoist installed at surface. Emergency egress from the mine is provided by the service hoist equipped with emergency power (or via the ramp).

Ramp

An access ramp extends from surface to the 1240 meter level. It is an inclined (15%) closed spiral 5m W x 3.5m H between 87 meter level and 1130 meter level with the exception of the 650 meter level through to the 890 meter level, where it is a figure eight spiral. At surface through to the 87 meter level there are several long straight sections. The ramp, essential for the highly mechanized mining method used, provides for the movement of men, equipment and materials as required.

Mining Methods

The mining methods in use at Lupin are highly mechanized, making use of diesel scooptrams, haulage trucks and electric-hydraulic drilling equipment. Mine productivity of about 40 tons per manshift is achieved in producing the 2,000 tons per day of ore. The Center zone produces 60% of this daily requirement and the West zone provides the remaining 40%.

During drift development a fleet of 4 Tamrock Maximatics, 1 Minimatic and 5 Micromatics are used. Stope slot raises are driven conventionally using stopers. A raiseborer was used to drive the ore/waste pass raises from the 650 meter level to the 1130 meter level. Alimak raise climbers are also used to drive ore and waste pass raises. The muck removal in the larger headings is done with a fleet of nine, six-yard diesel scooptrams. Five, 26-ton haul trucks are used for long tramming distances. The smaller West zone headings are mucked using a fleet of five, two-yard scoops

Mine production at Lupin began with sublevel longhole open stoping in the Center and East zones. All areas above 810 meters were developed by this method. There has been no further development below the 330 meter level in the East zone. The West zone is much narrower and was first mined by shrinkage and then by a "Raise Platform Mining" method involving raising and breasting with Alimak raise climbers. This was replaced with sublevel longhole open stoping similar to the Center zone (For further detail on these mining methods refer to **Figure A-1** in Appendix A).

With an increase in rock stresses due to depth and excavation, ground control becomes an increasing concern. Methods are being changed to integrate backfill into the mining cycle. Mining is now being converted to a "sub-level retreat under consolidated fill" approach **(Figure A-2)**. The mined out panels are backfilled prior to mining the adjacent panel or the panel below.

Production is accomplished through a process of drilling, blasting and mucking. Generally, in the Center zone, longhole drilling consists of parallel drill rings at a maximum of 1.5 meters apart and toe spacing within a ring is a maximum of 1.8 meters apart. Drill holes are 70mm (2.75 inches) diameter.

The West zone is developed in a similar way with smaller equipment. Drill holes are 50mm (2 inch) diameter and are drilled in a 3 hole : 2 hole pattern, with each ring separated by 0.75 meters and a maximum toe spacing of 1.5 meters.

Individual stope blasts are in the range of four to eight thousand tons in the Center zone and one thousand tons in the West zone. The holes are loaded with ANFO blasting agent (ammonium nitrate/fuel oil) primed with nitroglycerin based high explosive and detonated by millisecond delay electric caps. Average powder factors are 0.45 kg/ton (1 lb/ton) for the Center zone and 0.87 kg/ton (1.9 lb/ton) for the West zone.

The broken ore is mucked using six yard and two yard scooptrams. The ore is hauled to a grizzly equipped with a rockbreaker which covers the orepass to prevent the entry of oversize material. When conversion to the "sublevel retreat under consolidated fill" method is complete, all mucking will be done from the stope brow or by remote units, eliminating the waste haulage.

Ground support requirements have been increasing over time as mining depths increase and stress in the rock increases. Prior to 1987, only local roofbolting was done in problem areas. Systematic roof bolting then began, which has evolved into roofbolting all backs, using grouted rebar in haulage ways and ramps, and to wall bolt in all waste developments. Cable bolting and dywidag bolting of stope walls from ore sub-drifts was initiated in 1990. With increased stresses, it is anticipated that cable bolting of all stope backs may become necessary as mining progresses.

Backfilling of the underground voids was first used in 1990 when esker sand was hauled to the mine. After consideration of numerous methods, the paste fill method has been chosen for continued backfill. This involves taking the filter cake from the second stage filters in the mill (tailings), conveying it to the paste plant where it is mixed in a pan mixer with cement and water to create the paste. This material is pumped to the shaft where it then flows by gravity to the stope to be filled. The system design is for 120 tons per hour.

The mine is provided with several other ancillary services. Underground ventilation (heated when necessary through the powerhouse waste heat recovery system) is supplied by a 1000 hp, 84 inch diameter Joy axivane fan with a rated capacity of 300,000 cfm at 12.5 inches water gauge static pressure. A similar sized fan exhausts contaminated air to the surface. Fresh air is distributed to the working faces through a combination of 30 inch and 42 inch fabric vent tubing via 30, 50 and 75 hp axial flow fans.

Mine water supply is provided on demand from the surface to the 490m level and then to the 650m level. Dewatering of the mine workings is accomplished using four main sumps. The sumps, each having two pumps, transfer the water in stages to the surface where the six inch discharge line directs water to either the mill or to the second sewage lagoon. Being a relatively dry mine, most of the water seeps into the workings below the permafrost level at approximately 500 meters below surface. Average dewatering flows (including that contributed by supply water) are in the 12-20 Imperial Gallons Per Minute (IGPM) range.

An underground repair shop is located at the 650 meter level. The staff of 32 maintenance personnel completes maintenance and major overhauling of the 66 units in the mobile machinery fleet. In conjunction with the main shop area there are separate bays for steam cleaning, lubrication, mechanical/electrical/welding inspections, tire and wheel maintenance and painting. Pneumatic drill repairs are also done underground.

MILLING

The current Lupin milling process incorporates crushing, grinding, pre-aeration, leaching, filtration and recovery. The overall availability of the mill in 1993 was 98.6% for an average hourly throughput of 97.1 tons. In 1993 several expansion projects were completed including the addition of a new screen plant, a new seven foot Symons shorthead cone crusher, high capacity thickener, preaeration and leach tank agitator conversions. This effectively increased the mill's capacity to a nominal 2300 dry short tons per day. **(Figures A-3, A-4, and A-5 illustrate the process flow)**

Crushing

The ore from the mine is processed through a primary jaw crusher underground to less than 5.5 inches. It is then hoisted to the 600 ton coarse ore bin on surface. A secondary cone-crusher reduces the ore to -1.5 inches which then passes over a vibrating screen. The material larger than 5/8 inch is fed into the tertiary cone-crusher and recirculated over the screen until it passes through the 5/8 inch openings. The fine ore is then conveyed to two 1,000 ton capacity fine ore bins which feed the grinding circuit. The crushing circuit has a rated capacity of 240 tons per hour.

Grinding

Further reduction of the ore size is required to liberate the gold from the host rock. This is carried out with a rod mill feeding two ball mills in parallel. The discharge of the mills is classified using hydrocyclones. The underflow from the cyclones (+200 mesh or coarse material) is fed back to the ball mills, while the overflow from the cyclones (-200 mesh or fine material) is pumped to the pre-aeration circuit at about 33% solids. The grinding circuit's target grind is 57% passing 400 mesh.

Pre-aeration

The cyclone overflow is fed to the centre well of the pre-aeration thickener where settling of the solid fraction takes place. The overflow solution is returned to a recycle water tank and is re-used in the grinding circuit. The underflow (slurry) from the thickener is pumped to the first of three 82,000 usg (310 m^3) pre-aeration tanks. These tanks provide air to oxidize the sulphide minerals, which would otherwise consume large amounts of cyanide. The circuit is finely tuned, operating under alkaline conditions, adding lead nitrate reagent and using primary filtrate to dilute the incoming thickener underflow density to 45%.

Leaching

Slurry from the pre-aeration circuit is leached with cyanide in six consecutive 129,000 usg (488 m^3) agitated and aerated tanks. The liberated gold particles are now taken into solution by a reaction between the added cyanide, oxygen and water. Lime is added to maintain a pH of about 10 within the circuit. After approximately 30 hours retention, the slurry is transferred to the cyanidation thickener where separation of solid and liquid fractions again take place. The overflow solution from the Leach Thickener contains the gold (pregnant solution) and is sent to the pregnant solution tank. The underflow, containing some gold value, is pumped to the filtration circuit.

Filtration

A two stage filtration system separates the dissolved gold from the solids by washing with barren solution. Each of the two stages consists of four vacuum drum filters. The slurry contacts the outside of the filter unit while the solution is drawn through the filter unit. Solution is returned to the cyanidation thickener or pumped to preaeration as dilution water. The second stage is also washed by either barren, fresh or recycle water with the solution being returned to the cyanidation thickener. From the filtration circuit, the filter cake is either repulped and pumped out to the tailings containment area, or it is transferred to the paste plant to be processed into backfill material for use underground.

Recovery

The pregnant solution from the cyanidation thickener overflow is processed through three pressure clarifiers to remove fine suspended solids. Oxygen is then removed in a de-aeration or Crowe tower prior to precipitation. Zinc dust is added to precipitate the gold which is then collected in the precipitation presses. The resultant solution, "barren" of any gold values, is bled to tailings or recirculated throughout the plant.

Once a filter press becomes loaded with precipitate, it is taken off line and emptied/transferred to the refinery. The precipitate, mixed with suitable fluxes, is smelted in the bullion furnace to produce dore bullion and slag. The slag is returned to the mill to be reprocessed. The bullion contains approximately 85% gold and 12% silver, the impurities being base metals.

Paste Backfill

The concept of paste backfill was initially suggested for the Lupin site in 1987. After the completion of numerous studies a system was designed and construction completed. Initial testing of the plant and performance is ongoing. The paste plant process is illustrated in **Figure A-6.**

In general, the paste is a high density mixture of water and fine solid particles (tailings) with a low moisture content, typically between 10% and 25%. Cement may be added as a component of the paste and an aggregate (waste rock) can generally be added without greatly changing the pipeline transport characteristics. The material is then pumped to the active stopes or to inactive upper mine voids via pipeline.

It is estimated that 50% of the mill tailings could be handled with this process on a full time basis and, 100% of the mill tailings on an initial part-time basis.

Any tailings produced by the mill that cannot be utilized underground will be pumped to the tailings containment area as in the past. All waters currently generated from the milling process, and during paste fill operations, will have to be handled at the tailings containment.

TAILINGS DISPOSAL/HANDLING AND TREATMENT

Tailings from the filtration circuit (that is not used for backfill), is repulped with plant recycle water and bleed from the barren tank to be pumped via an eight inch (insulated and heat traced) pipeline to the tailings containment area approximately 6 km southwest of the mine site. An historical review of the tailings impoundment design follows, indicating key features and major changes that have taken place, not only in the past licence term, but since startup of the mill.

Tailings Impoundment Area Design

The initial design throughput of the mill led to a total containment design for the tailings impoundment. To isolate the tailings impoundment area, the construction of several external dams were required. These were designed with an impermeable liner to prevent initial seepage and allow the gradual migration of permafrost into the dam core.

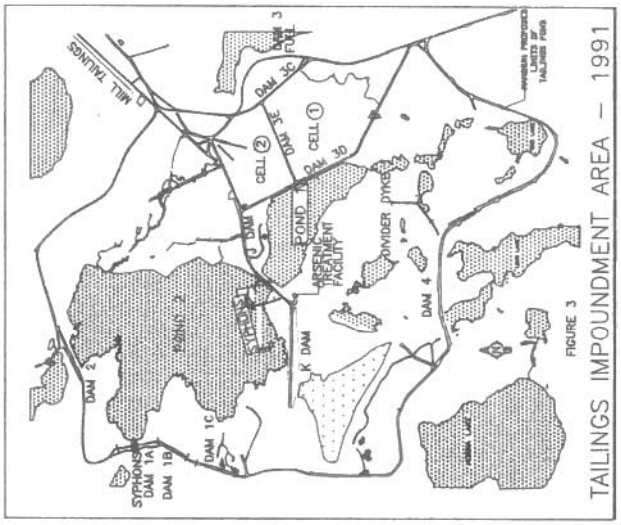
Upon further exploration work subsequent to mine start-up, ore reserves were substantially increased. Following considerable expansion, the mill production was increased to approximately 1590 tonnes per day. A number of waste management and environmental studies followed, resulting in the concept of a two-pond in series treatment design. **Figure 5** shows the initial tailings pond plan view and the two pond concept.

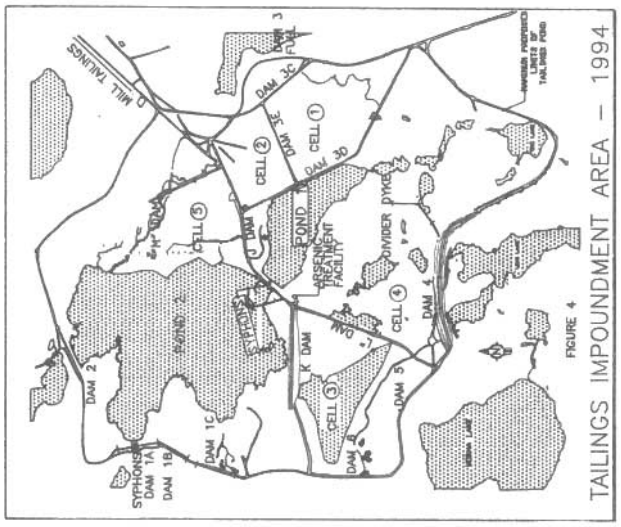
Beginning in 1985, construction on the main internal dyke (JDam) took place separating what is currently Pond No.1 and Pond No.2. This effectively divided the impoundment into two distinct areas; tailings deposition and a polishing pond.

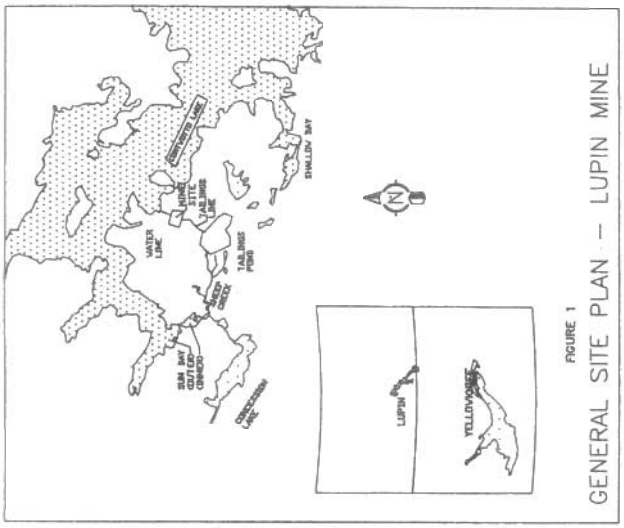
Through the waste management studies, bench/pilot scale treatment studies and overall monitoring of the impoundment basin, it was determined that the concept of natural degradation could be effective in lowering cyanide and metal concentrations to near or below the Water Licence limits with the exception of arsenic. Recommendations from further investigative studies indicated that the arsenic could be removed from the water with ferric sulphate as an iron/arsenic precipitate.

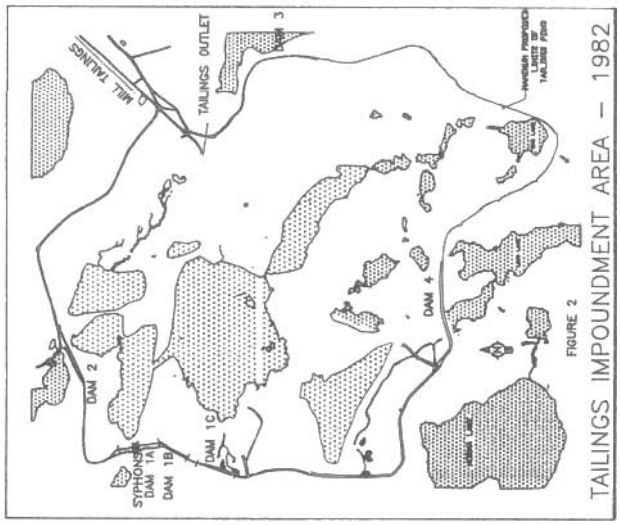
The current treatment system used today was designed and put into operation in 1986. This system was to take advantage of the natural degradation occurring within Pond No.1 and supplement it with Iron addition for arsenic removal, thereby meeting Water Licence discharge requirements.

(FIGURE 5) Tailings Impoundment Area
(1982 - Present)









Further construction in 1986 through to 1988 developed the Solids Retention Cells No.1 and No.2 (Dam3d and Dam3e). The tailings would now be allowed to separate into solid and liquid fractions, maintaining the solids in a contained area and allowing the solution to report or be transferred to Pond No.1 for treatment. These individual "Cells" now prevent intermixing of fresh tailings with water that has been in the impoundment for at least one year and subjected to the natural degradation phenomena.

In 1989, an additional design was formulated for the construction of the internal dyke known as KDam. In 1990, with a maximum estimated storage of two years remaining in Cells No.1 and 2, the construction of the KDam took place. This created a third solids retention cell from the southern arm of Pond No.2. Total storage capacity of this new cell was in excess of eight years with the assumption that additional perimeter dams would be constructed when required.

Discharge to the newly created Cell No.3 began in September 1990. Investigative work along with the installation of thermistor (temperature monitoring) stations in the KDam and Cells No.1 and 2 were completed in October 1990, prior to the design of perimeter dams No.4, No.5 and No.6.

Construction of the perimeter dams was completed as scheduled during the summer of 1992. In addition to these dams, internal divider dams L and M were completed to: LDam) to divide Cell No.3 into two smaller cells, and MDam) to provide spring runoff control in the northeast corner of Pond No.2 which had been identified as a source of contaminated water from old oxidized tailings. Refer to **Figure 5** for a detailed drawing of the tailings impoundment as it appears as of August 1994.

Storage Capacity

As is indicated in **Figure 5**, the tailings impoundment has five areas (cells) that are currently reserved for tailings deposition for solid/liquid separation. The estimated storage capacity of these areas has been recently revised according to the latest surveys completed in 1993 and 1994. The following table summarizes these cells and their respective capacities based on a mill production rate of 2100 mtpd (dry) or a final volume deposition of 1660 m^3/day. Approximately 2600 m^3/day is required for over winter storage as total containment.

The following storage estimation below does not include the End Lake area that had previously been taken into account. End Lake, with the addition of another small perimeter dam, would increase storage capacity by approximately 2.5 years to a total of 8.8 years, or to mine life without the backfill option. Another more likely option, is to upgrade the LDam structure to provide storage to the 489 meter elevation. This would add an estimated two to three years storage to Cell No.5.

The storage capacity of the facility will dramatically change as the paste backfill system matures and the amount of tailings material sent to the underground stopes increases. The amount of solids transported to the containment cells along with the entrapped moisture will decrease. It is anticipated that the backfill program will use 100% of the tailings solids during the first few years and then 50% of the tailings solids produced

annually thereafter. This would then extend the solids storage capacity of the current facility to well beyond mine life at approximately 14 years.

TAILINGS IMPOUNDMENT

Table No.1 STORAGE CAPACITY

LOCATION	MAXIMUM ELEVATION (Meters)	VOLUME (m^3)	STORAGE IN DAYS	STORAGE IN YEARS
CELL NO.1	489.0	144,420	87	0.24
CELL NO.2	489.0	286,200	172	0.47
CELL NO.3	489.0	987,700	595	1.63
CELL NO.4	488.0	2,125,140	1280	3.51
CELL NO.5	484.5	200,000*	120	0.33
TOTAL	-	3,743,460	2254	6.18

* Estimated from 1992 survey and recent depostion

Treatment Concept and Design Changes

The treatment concept was developed in 1984-85 prior to the first initial treatment of the single pond system. The concept was based on three important aspects of the Lupin mine:

- The harsh climatic conditions of the area result in an open water season of approximately 10 to 12 weeks. Decant from the system and treatment are not feasible outside of this window.
- Due to the remoteness of the mine, any treatment system designed must be economical in terms of capital equipment and reagent requirements.
- Must meet the tailings discharge water quality standards specified in the Water Licence.

The investigative studies indicated that, despite the relatively short open water season, natural degradation occurring within the tailings pond could effectively reduce the cyanide and metals to below licence limits, with the exception of arsenic. Study results along with a literature review indicated that the natural processes taking place could include:

- Lowering of pH due to the dissolution of atmospheric carbon dioxide into the tailings pond water thereby shifting the cyanide equilibrium to the gaseous phase allowing subsequent evolution and dissociation into the atmosphere.
- Photo-decomposition of metal/cyanide complexes by ultraviolet light (sunlight).

- The oxidation of cyanide to cyanate, bicarbonate and ammonia by air/water interaction.
- Gravity sedimentation of precipitated metals (metal hydroxides) and low soluble cyanide complexes in the tailings pond.

The two pond system is operated in a way that maximizes to the greatest extent, the benefits of Natural Degradation. The impoundment has evolved to incorporate the solids storage cells as a primary holding area for initial Natural Degradation treatment.

The "Decant and fill" process throughout the system begins with the discharge to the environment of treated water within Pond No.2 (treated the previous year). This decant is carried out by means of a syphon system (two 500mm diameter pipes) and is based entirely on the water head pressure between the pond and the receiving stream. The water level in Pond No.2 therefor, can only be lowered to within ±0.25 meters of a design limit.

After completion of the Pond No.2 decant, Pond No.1 water is transferred to Pond No.2 utilizing a similar syphon design **(Figure 6)**. During this transfer, ferric sulphate and more recently, lime are added to the water. The ferric sulphate is injected into the intake side of the syphon which allows an initial mix period during transfer for the reaction to take place with the arsenic. The lime is added at the outlet end of the syphons to increase the pH and assist in the floc formation. Addition of lime prior to ferric sulphate is not recommended due to the possible formation of a less desirable (less stable) arsenic hydroxide.

After treatment at the JDam, water is transferred from the Cell No.4 area through a gated culvert and gravity flow to the southeast end of Pond No.1. This takes place during the latter part of August through to freeze-up. This water has undergone considerable natural degradation during the summer, lowering contaminant levels anywhere from 20% for arsenic to 95% for cyanide. The table below shows the typical reduction in contaminant levels during mid-summer within Cell No.4.

TYPICAL NATURAL DEGRADATION
CELL NO.4

Table No.2

DATE / PARAMETER	pH	TOTAL CYANIDE	ARSENIC	ZINC	NICKEL	COPPER
JULY 5, 1994	8.04	-	3.15	0.64	0.38	2.54
JULY 12, 1994	7.87	0.81	3.85	0.26	0.27	1.09
AUGUST 10, 1994	-	0.38	2.85	0.07	0.14	0.51
PERCENT REDUCTION	-	53 %	26 %	89 %	64 %	80 %

Total cyanide concentrations in Cell No.4 prior to July are in the range of 10-20 ppm, increasing the percent reduction considerably. Further natural degradation will occur within Pond No.1 over the following 10 months (stabilizing during the winter) prior to

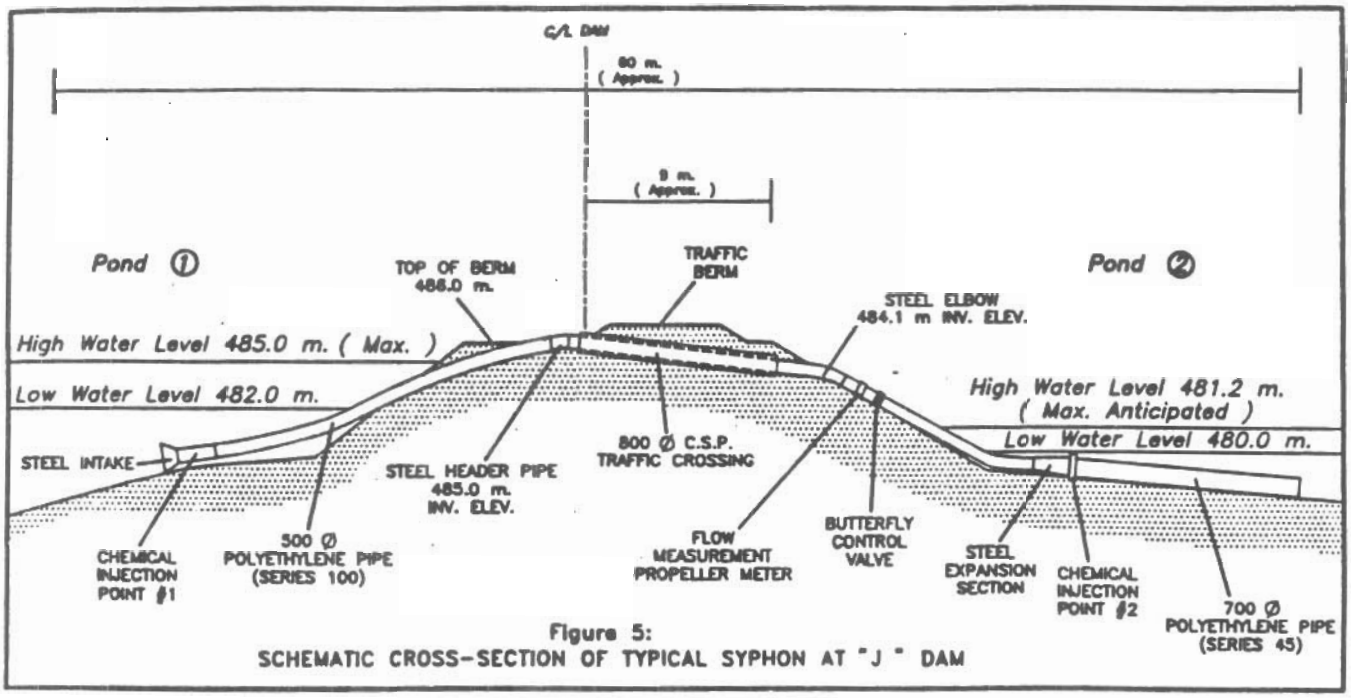
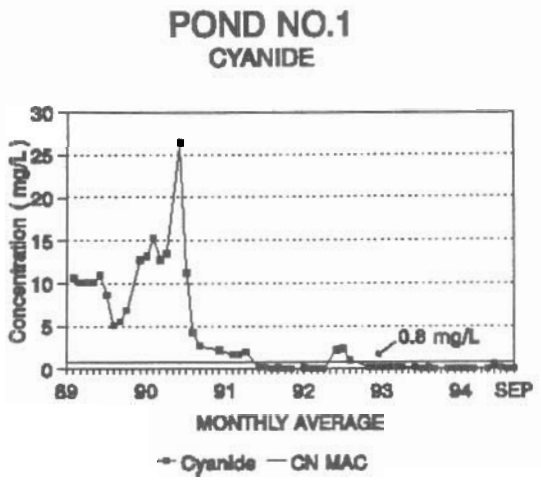


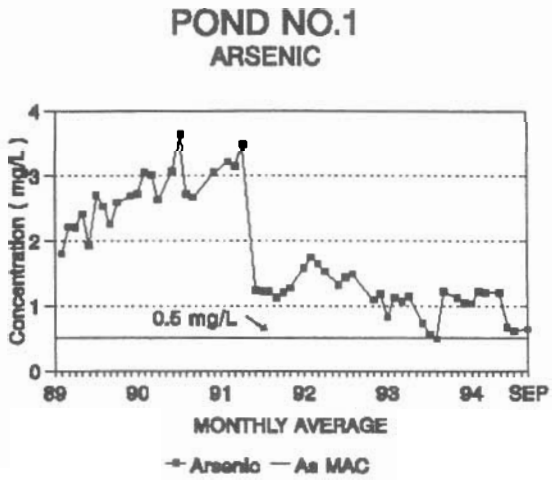
Figure 5:
SCHEMATIC CROSS-SECTION OF TYPICAL SYPHON AT "J " DAM

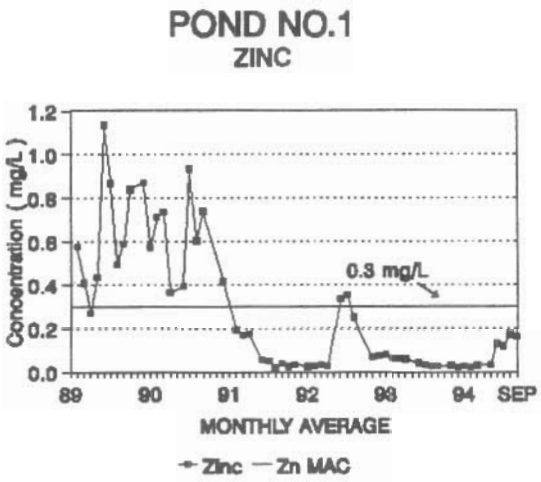
the treatment scenario beginning once again the following year.

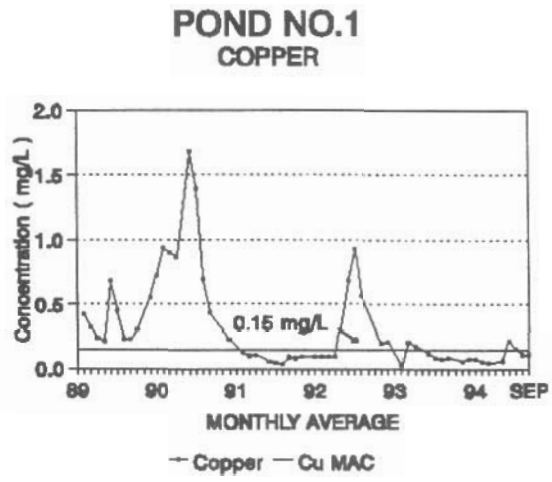
The excellent natural treatment that is attained can be attributed to several factors with the most important being; the long summer hours at Lupin, the shallow depth of Cell No.4, the long retention period throughout the system and the diverting of mill tailings flow to a separate area for the summer duration.

The graphs below illustrate the added benefit to Pond No.1 and ultimate water quality of the extended storage period that Cell No.4 provides. Considerable decreases in the Pond water contaminant concentrations can be attributed to this system.









Included on the above is the Maximum Average Concentration line that is applied to the **final effluent** of the system. It is interesting to note that since 1991 nearly all parameters are meeting these limits at the Pond No.1 stage prior to the water entering Pond No.2.

In reviewing the above graphs, there are two main points of change within the trend

that is common to all contaminants. The first is the effect that the change in tailings flow to Cell #3 in September of 1990, had on the contaminant level. All 4 contaminants decreased by the fall of 1991 and have generally remained low through to 1994. The second, is the sudden increase in concentration during the summer of 1992. This was a result of pumping water from Cell #4.

The chemical treatment that takes place during the transfer of water from Pond No.1 involves a very simple but effectively designed treatment facility. Components of the system are itemized below:

- Building structure housing two 13,500L ferric sulphate mix tanks complete with two "Bredel" chemical hose pumps for accurate metering of the ferric solution into the syphons. Also within the building is a single 13,500L lime mix tank(1994) and a transfer pump.
- A two ton hoist for moving and loading the bulk bags of ferric sulphate.
- Outside the building is a single 20,000L lime solution storage tank complete with a distribution pump for feeding the lime slurry to the syphons.
- Located on the Pond No.2 side of the JDam is a make-up water pump to provide water for mixing of reagents and cleaning of the facility. The drains from all tanks discharge to the Pond No.1 side of the JDam.
- The two 500mm syphons discharge into a "mixing" zone area of Pond No.2. This area was completed in 1992 and serves two main purposes; to allow adequate slow mix time for the floc to develop by separating the immediate discharge of the syphons from Pond No.2, and it contains the floc within a limited area.

Actual treatment dosage rates used at the facility are based on the theoretical molar ratio of 10:1 Iron:Arsenic quoted in various literature references. Bench scale testwork is completed annually prior to full scale operation to determine the optimum dosages and obtain a preliminary idea of the water quality expected. As is illustrated in the following table, the actual ratio varies on a yearly basis and is entirely dependent on the amount of arsenic available in the feed water (Pond No.1) with the exception of 1992 which may have been influenced by a poorly settled sample used in the analysis. A minimum amount of Iron is generally needed to promote the floc formation and precipitation. The treatment program in 1994 ran extremely well as bench scale testwork indicated the lowest iron requirement (as mg/L) in recent years.

The lime addition is not included in the table as it was just recently incorporated into the treatment system in 1993. The dosage rates are based on a minimum requirement of 1.5 times the iron addition to offset the acidity contributed by the ferric sulphate. The treatment efficiencies for the past licence term are based on the initial arsenic content of Pond No.1 water and the analysis at station 925-15 during treatment. The analysis on station 925-15 is carried out on a settled sample to determine water quality after precipitation is completed. This provides an excellent representation of the expected water quality in Pond No.2 after treatment.

Table No.3 DISCHARGE AND TREATMENT DATA

YEAR	VOLUME DISCHARGED POND NO.2 (m^3)	VOLUME TREATED POND NO.1 (m^3)	Fe:As MOLAR RATIO	INITIAL ARSENIC POND NO.1 (mg/L)	RESIDUAL ARSENIC POND NO.1 (mg/L)	TREATMENT EFFICIENCY % Arsenic Removed
1990	837,246	379,000	15.2 : 1	2.69	0.17	93.7
1991	771,280	177,545	33.4 : 1	1.17	0.07	94.0
1992	1,214,636	645,450	14.5 : 1	1.48	0.30	79.7
1993	704,575	499,314	49.6 : 1	0.54	0.042	92.2
1994	863,868	635,034	23.7 : 1	0.60	0.025	95.8
AVG	878,321					

The general performance of the system as a whole with regard to water quality is covered in the section on the Surveillance Network Program and the results achieved during the existing licence period.

ARD (Acid Rock Drainage) POTENTIAL AT LUPIN

Extensive studies completed in the past have shown that the Lupin tailings, given the proper conditions, will oxidize and produce the byproducts necessary for the formation of acidic runoff. Typical Lupin tailings contain approximately 3% sulphur(total) and have a NP/MPA (Neutralizing potential/Maximum Potential Acidity) ratio of less than three. A ratio of greater than three (as in the Lupin waste rock with a sulfur content of < 0.5 %) indicates a low potential for acid generation and no concern with respect to ARD. A copy of the most recent testwork with regard to acid generating potential is included in the appendix. The waste rock material (samples 1 through 6) referred to in this report was sampled from a stockpile of crushed material used for resurfacing the airstrip in 1994.

Since the most recent Licence renewal for the Lupin mine in 1990, Echo Bay Mines Ltd. has increased its Research and Development activity with regard to the Acid Generating Potential of the mill tailings and mitigative measures/abandonment plans for eventual closing of the containment area.

Included in these studies was a 1991-1992, 30 week column leach program (kinetic test) and a follow-up 1993 16 week leaching program on mitigative measures for an area that is currently producing acidic water within the impoundment. As well, in 1992 a study was completed on the assessment of water chemistry and remedial measures for the Lupin Tailings Management System with regard to the affects of the exposed tailings within Pond No.2. Please refer to the list of studies included in Appendix C which covers all environmental related studies during the past licence period.

At present, Echo Bay Mines Ltd. has retained the services of Klohn-Crippen for the engineering, geophysical and data interpretation of a test plot area on Cell No.1.

This will, over the next few years, provide for further delineation of the abandonment requirements for the solids storage area of the tailings containment.

WATER USE

Contwoyto Lake, Northwest Territories, is the source of all water used for the Lupin mining and milling operations. The water is supplied to the site via a 1.5 km six inch, heat traced and insulated pipeline. Three Byron Jackson 75 hp pumps, one operating, one on automatic and one as a spare, deliver approximately 700 usgpm to the mill's process water tank. The potable water system is fed by a three inch line located immediately after the main water meter and prior to the process water tank. Potable water is metered prior to the potable storage tank before distribution.

The following table summarizes the fresh water pumped from Contwoyto Lake, and it's distribution to process and camp supplies as well as water pumped from the mine.

WATER USE AT LUPIN, N.W.T.

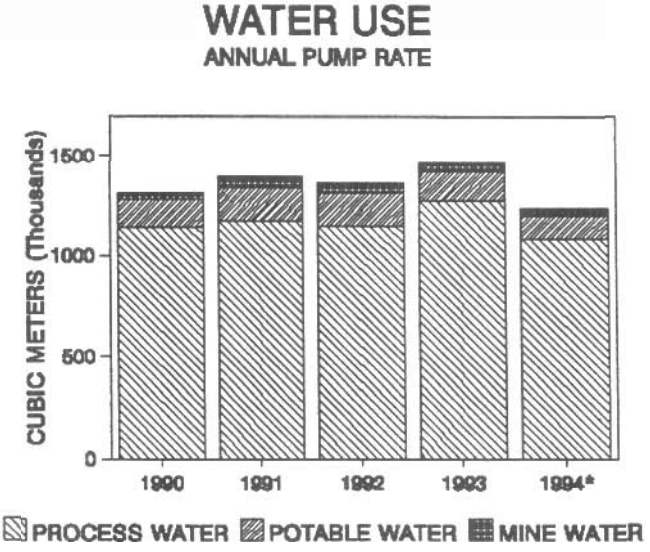
Table No.4 (Cubic Meters)

YEAR	WATER PUMPED FROM CONTWOYTO LAKE	TO PROCESS	TO POTABLE	FROM MINE
1990	1,280,000	1,139,654	140,346	33,588
1991	1,334,523	1,174,656	159,867	62,867
1992	1,309,590	1,148,082	161,508	45,412
1993	1,418,256	1,270,842	147,414	45,083
1994*	1,195,245	1,080,869	114,375	42,558
AVERAGE	**1,279,453**	**1,162,820**	**144,702**	**45,902**

* VOLUMES ARE PRORATED FROM YEAR TO DATE FIGURES THAT INCLUDE NOVEMBER, 1994.

The water use figures are graphically presented at right. The 1994 bar indicates a projected annual figure based on actual rates that include November 1994.

A slight decrease was experienced during 1994 with regard to all areas. There is not expected to be any major change in either water use or production of minewater during current life-of-mine.



If anything, water use should decrease as paste fill and mining methods minimize ore dilution and mill throughput is decreased slightly. Mine water will increase slightly due to backfill bleed.

A general water balance flowsheet **(Figure A-7)** shows the distribution of water throughout the site with approximate volumes for both use and disposal. The mill is the largest user of water which accounts for the majority of the process water. Within the process water volume, water is also used by the powerhouse, surface maintenance shop, underground and most recently the paste backfill plant. The potable system supplies the camp accommodations complex and kitchen as well as the office areas, mine and mill drys.

The current licence allows for a total freshwater use of 1.7 million cubic meters on an annual basis. Based on the previous fives years of data (approximately 77% of maximum) and the anticipated increase with regard to water use in the backfill (approx. 22,000 m^3), this volume should be sufficient for the licence renewal application term.

Also included under Part B of licence N7L2-0925 "CONDITIONS APPLYING TO WATER USE" is Item 3, which reads, "The annual quantity of Minewater pumped from the mine shall not exceed 150,000 cubic meters". This section is slightly misleading and needs some clarification. Currently, Lupin pumps approximately 46,000 m^3/year of water from the mine workings that is disposed to tails (or sewage). With the commissioning of the backfill project, this water volume is expected to increase to approximately 68,000 m^3. The increase in volume (as well as a portion of the original 46,000 m^3) has already been accounted for in the freshwater that has been metered from Contwoyto Lake. It is a point of clarification that is required, as it may become more apparent if at some point maximum flows are encountered or it may affect a new "water use fee" calculation that may be put into place in the future.

LICENCE TERM

Echo Bay Mines Ltd. is requesting an expiry date of May 31, 2003, providing a licence term of 8 years. This corresponds with the current Mine Life and ore reserves. Exploration at depth and on the surface continues in order to expand reserves.

An Application For Renewal will be proceeding at least one year prior to the expiry date to provide a suitable review period. At this time the Restoration plans and activities in the tailings area will have generated data and be available for a critical review. During this time frame, providing there have been no changes to the current mine life plan, Echo Bay Mines Ltd. will be seeking approval of the Abandonment and Restoration Implementation Schedule. Any concerns or final clauses can be included in the licence at that time.

COMPLIANCE HISTORY - CURRENT LICENCE TERM

Review of Licence Conditions

PART A - General Conditions

Item 3. All water use fees have been paid annually in advance.

Item 4. The Security Deposit in the amount of $400,000 has been maintained to the satisfaction of the Board. Given the good performance of Echo Bay Mines Ltd. in the Northwest Territories at the Lupin mine site and the past performance at the Port Radium site, an adjustment is not recommended.

Echo Bay Mines Ltd. recognizes the liability with regard to the Abandonment/Closure requirements of the Lupin Operation and associated facilities. A reclamation reserve of approximately $17 million is currently being accumulated on a monthly basis during the life of mine to facilitate progressive restoration of the property prior to mine closure.

Item 5. All reporting has been submitted as required in a timely manner.

Item 7. Compliance with the Surveillance Network Program annexed to the Licence has been met almost without error. Minor omittance with regard to sampling frequency and sample analyses have occurred on several occasions during the term. These however, have not been detrimental to the overall performance under the program.

PART B - Conditions Applying To Water Use

Item 2. As was shown in Table 4 on page 24, the annual quantity of water withdrawn from Contwoyto Lake for domestic and mill use did not exceed the 1.7 million cubic meter maximum. It is not expected that there will be any substantial increase in the amount of water to be used during the next Licence term. Planned mill tonnage will be down slightly from 1993 and 1994. Some additional water use with the paste backfill will balance out the use.

Item 3. The annual quantity of Minewater pumped from the mine is not expected to reach the maximum of 150,000 m^3. Additional water will be pumped from underground due to the anticipated bleed from the paste fill during its setup. This should result in an increase of the current flow to approximately 68,000 m^3. It has been stressed that the majority of this water is supplied to the underground from the surface supply and would have been taken into account as part of the annual quantity from Contwoyto Lake.

PART C - Conditions Applying To Waste Disposal

Item 1. This item has been revised through a recent amendment to take into consideration an alternative use for mill tailings (underground backfill).

Item 2. Compliance with regard to discharge date has been maintained. In 1990, discharge commenced on July 2nd as authorized by the controller to accommodate the KDam construction schedule.

Item 3. To this date there has been no concern raised with regard to the past actual discharge rate from the Tailings Containment Area. Echo Bay's concern is that a maximum 60,000 m^3 restricts the operational mode of the system. The flow rate is determined by the number of syphons operating and the water elevation in the Pond. Average flows for the duration of decant with two syphons will fall within the 60,000 m^3, however initial flow rates may exceed this level by 10-15%.

Item 4. The Lupin Operation has maintained and in some areas significantly surpassed all effluent quality standards during the existing licence term. The only exception to the above being a 1992 unauthorized discharge which occurred from the tailings containment area at the Dam4 location.

Item 5. All items with regard to operation and maintenance of the Containment Area have been complied with. Annual geotechnical inspections have been completed and reports submitted in a timely fashion. Regular daily and weekly inspections of the facilities have been more consistent and records maintained.

Item 7. All effluent discharged from the Sewage Lakes Disposal System has met or surpassed the Effluent Quality Standards as set in the Licence in most areas. In the past, special attention has been given to the pH of the effluent and the difficulty in remaining above a pH of 6.0. This has been handled during 1993 and 1994 through liming. With the reclamation work at an old spill site and the option of returning the minewater discharge to the tailings area, the concern should be short term.

PART D - Conditions Applying To Spill Prevention and Contingency Planning

General The Spill Prevention and General Contingency Plans have been approved by the Board, subject to annual review and updates. These updates have been submitted as required and typically include revisions to contact personnel and phone number changes.

Item 7. All spills and unauthorized discharges of waste that have occurred at the site have been reported to the appropriate authorities, followed by detailed reports for each occurrence. A brief description of these incidents follows for the past licence term.

SPILL REPORT SUMMARY

Spills and unauthorized discharges that have occurred during the existing Licence term have been limited to the following:

- miscellaneous oil and solvent spills during storage or delivery around the site

- minor accidental tailings spills from the emergency dump ponds and associated facilities (1993), and
- a single major spill from the Tailings Containment Area due to deficiencies in estimated capacity and the "retaining structure" (1992). Echo Bay Mines Ltd. was charged under Section 36(3) of the Fisheries Act.

It is felt that all spills and unauthorized discharges associated with Water Licence N7L2-0925 have been handled appropriately and meet the conditions applied within the Licence. From the reporting stages through to the final clean-up and restoration where required, any potential negative effects on the environment have been minimized. Additional measures/systems have been incorporated where necessary to reduce the risk of recurrence.

With regard to the 1992 spill, additional follow up monitoring has been ongoing and is summarized under a separate heading. This includes water quality work carried out by Echo Bay and fisheries studies completed by RL & L Environmental Services.

PART E - Conditions Applying to Modifications

All modifications made to the water supply and the waste disposal facilities have satisfied the conditions of the Licence and approval by the Board. Plans and drawings were submitted as required. These modifications have included:

Construction of the KDam (1990)

Construction of Dams 4, 5 and 6 (1992)

Modifications to the internal arrangement of the cells by placement of divider dams referred to as LDam and MDam (1992)

Additional mixing facilities at the Arsenic Treatment Facility to accommodate lime addition in the treatment of water (1993, 1994)

PART F - Conditions Applying to Abandonment and Restoration

There have been no major revisions to the Lupin Operation's Abandonment and Restoration Plan as approved. There have been several studies during the Licence term addressing the ARD (Acid Rock Drainage) characteristics of the Lupin tailings and waste rock. The Board has been kept informed of these study results.

In 1994, the initial background work for a study on cover materials for the tailings cells was completed. Unfortunately, due to the unusually warm weather encountered during the spring, construction on the test plots was suspended. This work will continue in spring, 1995. Progress of the study is expected to be part of the annual review of A & R activities.

Surveillance Network Program

The Surveillance Network Program annexed to the Water Licence has been followed diligently during the Licence term. There was only one proposed revision to the Program proposed during the five year term. This was in regard to the 1992 tailings spill and recommended sampling frequency for the downstream environment. As Echo Bay had initiated the sampling program and expressed full intentions of continuing the monitoring, the proposed change was dismissed. Monitoring continued as requested for the duration of the summer. Results of the monitoring for 1993 and 1994 are included at the end of this SNP discussion.

All reporting with regard to the SNP has been submitted on a timely basis as required summarizing all information dealing with sampling and flow monitoring specifics. These include the results of the Quality Assurance program approved by the controller.

Detailed Review of the Surveillance Network Program With Regard To Effluent Water Quality

Tailings Containment Area

Part C, Item 4 of the current Licence specifies that all waste discharged from the Tailings Containment Area shall meet the following effluent quality standards:

EFFLUENT WATER QUALITY STANDARDS

Table No.4

Parameter	Maximum Average Concentration (mg/L)	Maximum Concentration of Any Grab Sample (mg/L)
Total Arsenic	0.5	1.0
Total Cyanide	0.8	1.6
Total Copper	0.15	0.3
Total Lead	0.05	0.1
Total Nickel	0.1	0.2
Total Zinc	0.3	0.6
Suspended Solids	15	30

pH greater than 6.0 and no visible sheen of oil and grease

The water from Tailings Pond No.2 is discharged annually upon verification of water quality. Discharge begins no sooner than July 15th as stipulated within the licence and usually continues for a two week duration. Prior to discharge, during and after discharge, various locations are sampled on a regular basis to provide analytical data on the effluent and the receiving environment. This information is submitted to the controller with the monthly reports. These data are summarized in the tables included in Appendix B, sorted by sampling station and listed chronologically. A table listing the average values used in the graphing is also included.

In general, the water quality of the annual effluent discharge has been excellent with regard to the above Water Quality Limits. There were no non-compliance events during the discharge periods, although some concern has been expressed by Echo Bay as to the zinc and nickel levels that have approached the Maximum Average Concentration limits. These occurrences were mainly during the 1992 and 1993 decant periods.

Each parameter is reviewed individually with comments regarding any trends/ anomalies that may be occurring along with concerns that Echo Bay may have with regard to the current water quality standard. For the most part, the capability of holding water within the Cell No.3 and No.4 containments for the summer has assisted the improvement of Pond No.1 water. This has benefits when it is transferred to Pond No.2.

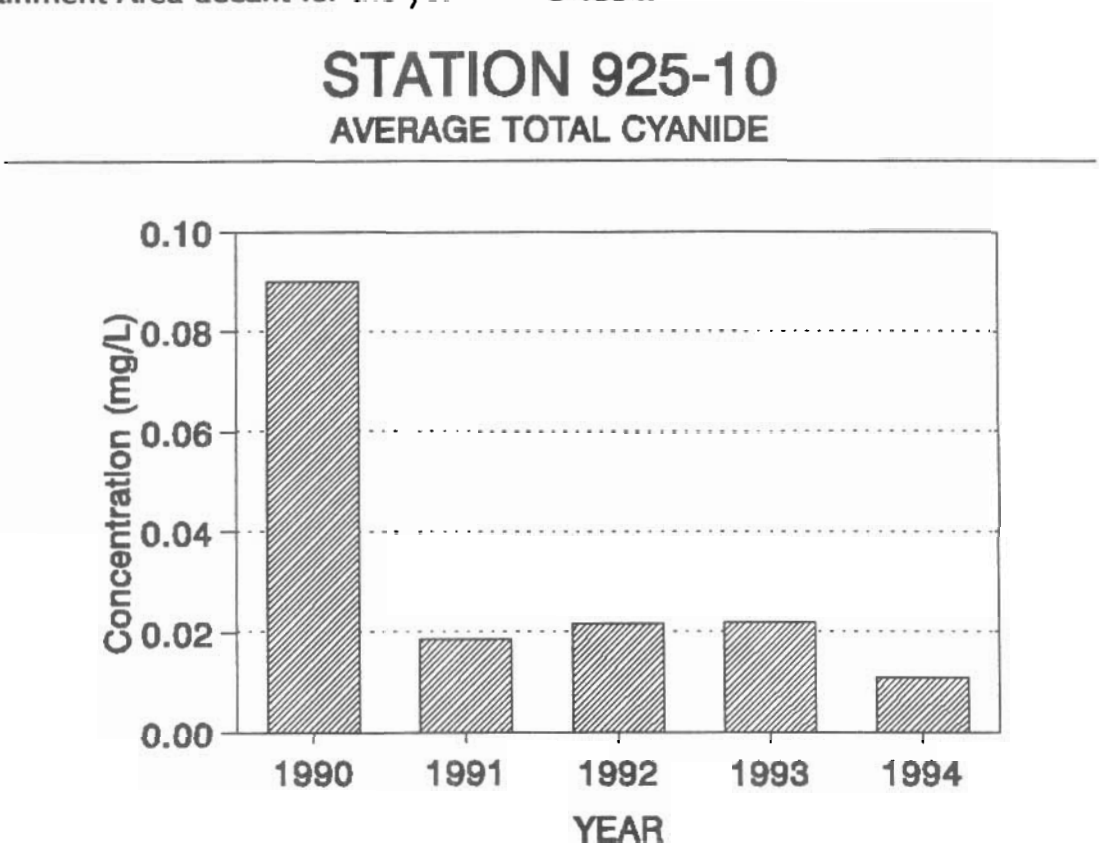
Maintaining suitable water quality within Pond No.2 has been a function of controlling the metals that are already present, be it precipitate on the bottom of the pond or incoming contamination from the north east tailings beach. This has been a challenge during the past three years. Incorporating lime addition into the treatment scheme and controlling the incoming runoff from the tailings beach has had some success.

Total Cyanide; Maximum Average Concentration (MAC) = 0.8 mg/L

The total cyanide concentration in the Tailings Containment Area decant has been consistently below 0.2 mg/L since 1990 and below 0.05 mg/L since 1992. A value of 0.16 mg/L was observed once in 1990 and 0.15 mg/L twice in 1991. Consequently this parameter has not been a concern with regard to discharge water quality.

The significant factor in the ability to maintain the low cyanide levels is the extended holding time that has been available since the addition of the KDam in 1990. The water that collects in Cells No.3 and No.4 is held until after Pond No.1 treatment is completed in early August. This provides optimum conditions for natural degradation of cyanide.

The graph below shows the average total cyanide concentration in the Tailings Containment Area decant for the years 1990-1994.



Total Arsenic; MAC = 0.5 mg/L

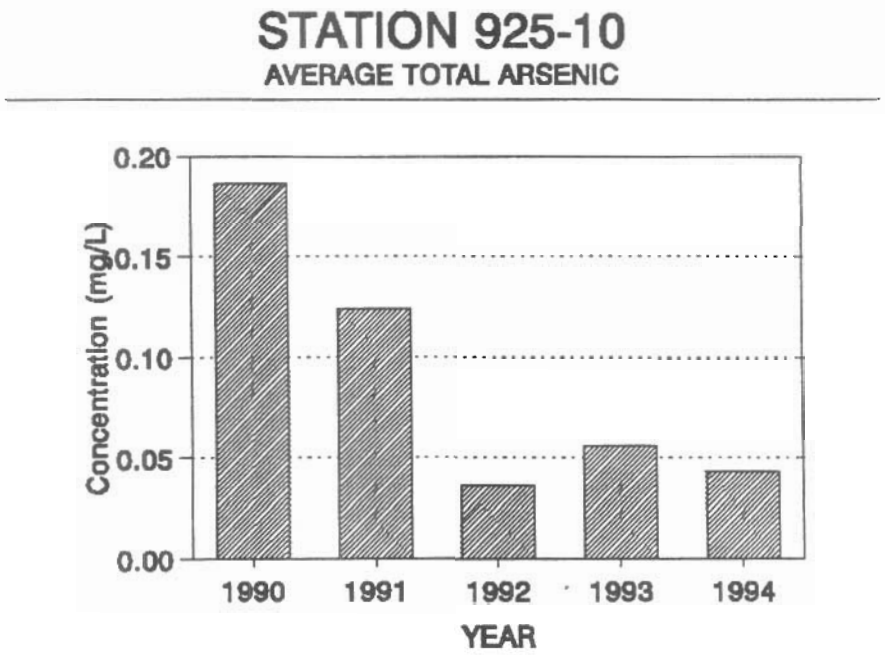
The total arsenic concentration in the Tailings Containment Area decant has been maintained below 0.3 mg/L since 1990 and below 0.1 mg/L since 1992. The decant in 1994 was generally below 0.05 mg/L, a considerable accomplishment since pre-1990 when levels were closer to the 0.5 mg/L limit.

The significant factor is again the ability to hold the water for a longer period of time prior to transferring to Pond No.2 for final polishing. Holding in Cell No.4 during the summer appears to remove approximately 25% of the arsenic. Another 25% removal occurs in Pond No.1 prior to treatment the following year.

Additional credit can be placed on the improved operation of the Arsenic treatment facility and the addition of the chemical metering pumps for controlled ferric sulphate addition. An efficient control of the chemical dosage results in a more consistent treated water quality. The lime addition in 1993 and 1994 also plays an important role in the water quality of Pond No.2.

A change in the overall water chemistry (improved overall in Pond No.1) has also had an effect on the treatment success. In 1994, bench scale tests indicated that approximately half the iron dosage (of that used in previous years) was required to achieve the same removal efficiency. Bench scale testwork indicated a residual arsenic concentration less than 0.02 mg/L at these lower dosages. Full scale dosages were 90% of the target with samples indicating excellent removal (station id. 925-15 in Appendix B).

The graph below shows the average total arsenic concentration in the Tailings Containment Area decant for the 1990-1994 period.



Total Copper; MAC = 0.15 mg/L

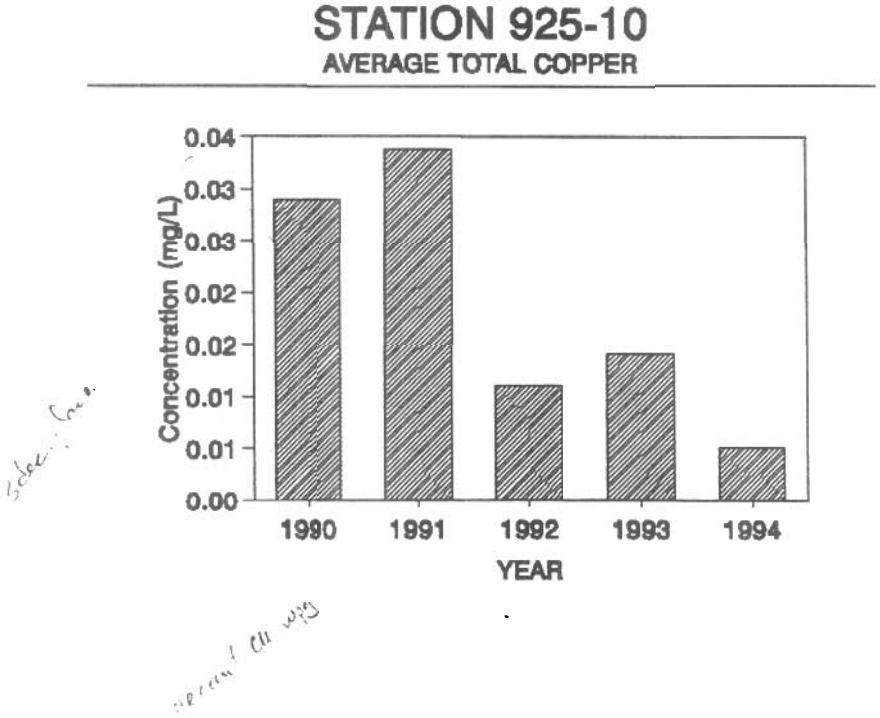
The total copper concentration in the Tailings Containment Area decant has been maintained below 0.05 mg/L since 1990 and more recently below 0.02 mg/L in 1994. The highest level observed during the current licence term was 0.045 mg/L in 1990 and the lowest was detection limit (0.003 mg/L) in 1994.

This is again a considerable improvement in water quality in comparison to pre-1990 when levels were at 0.30 mg/L (MAC prior to renewal in 1990 was 0.3 mg/L). By 1988 and 1989 effluent concentrations had decreased to below 0.1 mg/L.

The ability to hold water for an extended period has a role in controlling the copper concentrations prior to transfer to Pond No.2. Prior to developing the containment cell structure of the storage facility copper concentrations were on the rise annually until 1987. At this time, the effect of separating the solids storage from the liquid holding areas began to show. Copper levels in Pond No.1 reached a peak of approximately 3.5 mg/L in 1987 and declined to 0.3 mg/L in 1989. Levels have continued to decrease, and since construction of the KDam in 1990, copper levels in Pond No.1 have slipped to below 0.2 mg/L.

The copper levels in the tailings solution have not changed significantly in the past. Average concentrations of "soluble" copper (ie. after filtration) have been in the 4-8 mg/L range with levels occurring as high as 11-12 mg/L. An overall decrease in the final effluent of the system is therefor significant.

The graph below shows the average total copper concentration in the Tailings Containment Area decant for the 1990-1994 period.



Total Zinc; MAC = 0.3 mg/L

The total zinc concentration in the Tailings Containment Area decant has been maintained below the 0.3 mg/L MAC during the 1990-1994 period. Zinc concentration in the effluent reached historical low levels in 1989 and 1990. A 0.11 mg/L concentration was observed in July 1990. An annual rise in effluent zinc level has occurred in 1991 and 1992 peaking at a 0.28 mg/L in August 1992.

During the 1990 and 1991 periods, the zinc concentration of Pond No.1 had continued to decrease and improve the quality of water being transferred to Pond No.2. Pond No.1 zinc levels were below 0.05 mg/L, a result of the KDam construction and change in configuration of the Containment Area. With this information at hand, efforts were focused to other areas of probable cause.

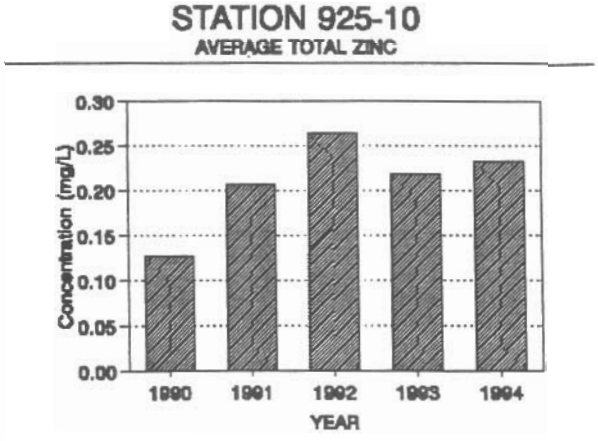
During the same period considerable annual pH fluctuations were occurring within Pond No.2. Historical low pH values were observed during the winter months with corresponding increases in zinc, nickel and copper levels. In order to maintain water quality within licence limits, a liming program was initiated in 1992 whereby lime was spread on the Pond No.2 ice surface prior to spring melt.

During 1993 and 1994 this program has been repeated along with incorporation of lime addition during the transfer of water from Pond No.1. This has helped to maintain adequate alkalinity and lower metal concentrations from the high in 1992.

The root of the cause was determined to be the significant contribution of acidity to Pond No.2 from the tailings beach on the north east corner. This tailings area (originally deposited at startup through to 1984) is situated in an area that receives considerable runoff in the spring and is subject to drying during the summer. These conditions are optimum for enhancing oxidation and producing acidic runoff. Water diversion/ treatment and fresh tailings deposition have appeared to provide a short term solution.

The graph below shows the average total zinc concentration in the Tailings Containment Area decant for the years 1990-1994.

In the Licence Renewal Application covering letter, Echo Bay Mines Ltd. had requested an increase in the total zinc limit to allow some operational flexibility. The proposed limit of **0.5 mg/L** was in place with the previous licence term and is not uncommon at other mining operations. The latest research into Best Available Technology Economically Achievable (BATEA) for the mining sector was carried out and incorporated into Ontario's new Clean Water Regulation and revisions to the Metal Mining Liquid



Effluent Regulations. The research did not find demonstrable need for change to effluent limits currently in place (0.5 mg/L) or new regulations being drafted.

The commitment of Echo Bay Mines Ltd. to improve operations and minimize the potential effects of the mine has been demonstrated in the past and will continue to be a priority in the future. The recent involvement in ARET (Accelerated Reduction Elimination of Toxics), a volunteer challenge to industry and government, has given Echo Bay a path to demonstrate the commitment in reducing emissions. In the plan submitted to the ARET Secretariat, Echo Bay has focused on zinc as a prime concern. The release to the environment in Kilograms (usually reported in tonnes at other sites), has been targeted for a reduction of 50% by the year 2000. A significant reduction that should be realistically achievable.

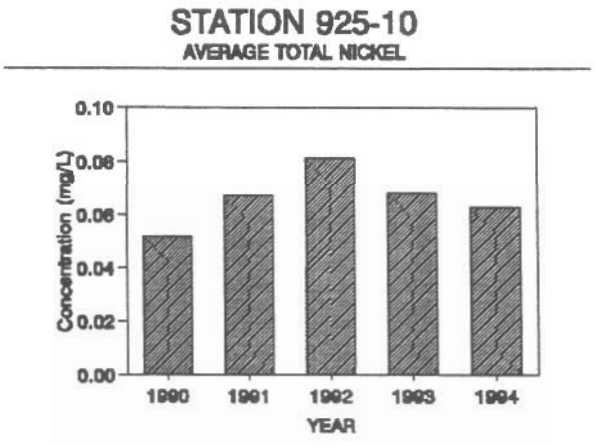
Total Nickel; MAC = 0.1 mg/L

The total nickel concentration in the Tailings Containment Area decant has been maintained below the 0.1 mg/L MAC limit during the 1990-1994 period. Nickel concentration in the effluent prior to 1990 averaged approximately 0.05 mg/L. The average concentration increased to a single peak level observed in 1993 of 0.097 mg/L. 1994 levels had decreased to an average of 0.07 mg/L.

The nickel concentration in Pond No.1 water had been decreasing during this period (as had the zinc) and therefor was not seen as an influence on Pond No.2. The low pH fluctuations in Pond #2 seem to have had the same influence on the nickel as occured with zinc. The increase in 1993 is likely due to the transfer of water from Cell No.4 during the dewatering phase prior to Dam4 construction in 1992. This resulted in abnormally higher initial nickel levels before transfer to Pond No.2.

The graph below shows the average total nickel concentration in the Tailings Containment Area decant for the 1990-1994 period.

In the Licence Renewal Application covering letter, Echo Bay Mines Ltd. had requested an increase in the total nickel limit to 0.3 mg/L to allow operational flexibility and provide a more suitable analytical working range. The current 0.1 mg/L limit on nickel is one of the lowest regulated. An increase, if favourably considered, would result in a limit that is similar to NWT industry standard but still below the newly proposed regulation in Ontario and the revised MMLER (0.5 mg/L).



Total Lead; MAC = 0.05 mg/L

The total lead concentration in the Tailings Containment Area decant has been maintained at or near detection limits (below the 0.05 mg/L MAC limit) during the 1990-1994 period. As a result of the low levels observed the results have not been incorporated into graphical format. Please refer to the data tables provided in Appendix B.C

In the Licence Renewal Application covering letter, Echo Bay Mines Ltd. had requested an increase in the total lead limit to **0.2 mg/L** to provide a more suitable analytical working range.

Historical data show that effluent from the Tailings Containment Area has lead concentrations consistently at or below the detection limits for lead. The existing standard for total lead is only one order of magnitude greater than the best detection limits of Flame AA. An increase to **0.2 mg/L** would be consistent with NWT industry standard and the newly proposed Ontario regulation and the current MMLER (0.2 mg/L).

A further request was to reduce the sample/analyses requirement of the SNP to reflect the limited occurrence of lead. A suggestion would be to sample/analyze for lead once per year, two weeks prior to decant.

Suspended Solids; MAC = 15 mg/L

During the 1990-1994 period, the suspended solids (non-filterable residue; NFR) concentration in the Tailings Containment Area decant has most often been maintained below the 15 mg/L MAC, and never exceeded the limit of 30 mg/L for any one grab sample.

In 1992, a result of 29.5 mg/L was observed on September 3rd and 17.8 mg/L was observed on September 6th. The readings were considered to be the result of high winds disturbing the sandy bottom and surrounding shoreline. The dam face is covered with crushed wasterock as rip-rap. Other constituents did not show any change in concentration, leading to believe that the added suspended solids came from the sand.

Generally, the suspended solids content of the effluent is below 10 mg/L and more often below 5 mg/L .

Suspended solids data is located in the appendix. There is no change requested.

Oil and Grease, pH; no visible sheen of oil and grease, pH greater than 6.0

These are standard effluent quality criteria and have been met during the 1990-1994 period. The effluent is transferred from the pond using a syphon system which removes the water from beneath the surface. This limits the possibility of "skimming" an oil film from the surface. The pH has been controlled through the use of lime and additional dosages when required. Lime has also been used during the transfer of water from Pond No.1 to compensate for the acidity introduced via the ferric sulphate.

Data for pH is available within the appendix for review. There are no recommended changes to these items.

METALS RELEASE HISTORY

In addition to the effluent monitoring carried out at the minesite, the historical contaminant loadings to the receiving stream have also been tabulated for review and comment.

The body of water that receives the tailings pond decant is ultimately the Sun Bay area in the western arm of Contwoyto Lake. Decant initially began in 1985 and has occurred annually since. The first two years of discharge accounted for more than 8.5 million cubic meters of water. Annual discharges from 1987 onward have generally averaged between 800,000 m^3 and 1.2 million m^3.

The main cause for changes in the decant water volume has been the change in flow configuration within the Tailings Containment Area. Significant changes have been the addition of solids containment cells in 1987 and the KDam in 1990. Both changes resulted in delayed water transport through the system. The KDam divided Pond No.2 and formed a new solids area. Flow from this area was retained for more than a year prior to transfer to Pond No.1.

The table on the following page summarizes the data while the graphs illustrate the reduction in contaminant loadings over the 10 year period. Significant reductions in the loadings to Sun Bay have occurred with regard to cyanide, arsenic and copper.

The zinc loading has increased since 1987 to peak in 1992 when considerable difficulty was encountered with maintaining pH levels within Pond No.2. Zinc loading has decreased since then with lower effluent concentrations.

The fluctuating lead loadings are due to estimates based on volume of decant and less than detection limit assays.

In 1994 a loading of 10 kg or less was experienced for three out of seven contaminants. Comparing the 1994 and 1990 data, there has been a combined reduction of approximately 24% in total metal and cyanide loadings in 1994. This is significant as there was additional volume discharged in 1994 as well.

Fresh Water Supply; Chemical Analyses

Results from the annual sampling and analyses from station 925-01 are included in Appendix C for review. The year 1990 includes additional analyses that were required prior to Licence renewal June 1, 1990. There are no concerns with the quality of the fresh water.

METALS RELEASE HISTORY

Lupin Mine
Contwoyto Lake, NWT

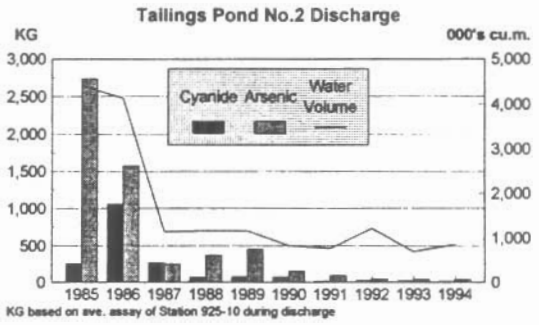
ECHO BAY MINES LTD.

SUMMARY

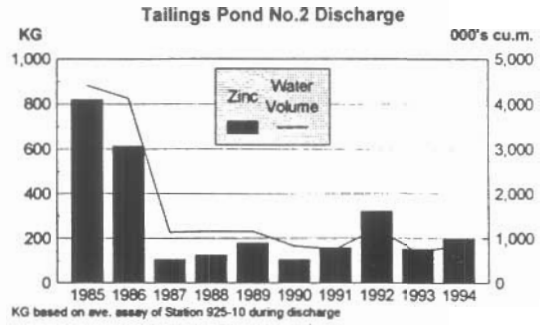
LOADINGS (Kg) TO SUN BAY - CONTWOYTO LAKE
LUPIN MINE

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
NFR	56,098	112,489	7,761	5,368	9,334	4,233	3,680	5,154	3,053	2,404
Cyanide	258	1,061	272	67	76	75	14	26	16	10
Arsenic	2,739	1,576	255	376	457	156	95	44	39	37
Zinc	819	613	107	128	181	107	161	321	154	201
Lead	18	17	5	5	5	3	3	5	14	4
Nickel	163	209	60	52	57	43	52	99	48	54
Iron	9,043	8,211	1,011	948	1,096	1,036	421	449	269	257
Copper	390	841	252	86	46	24	26	13	10	4
Water Volume 000's cu.m.	4,414	4,126	1,143	1,163	1,162	837	771	1,215	705	864

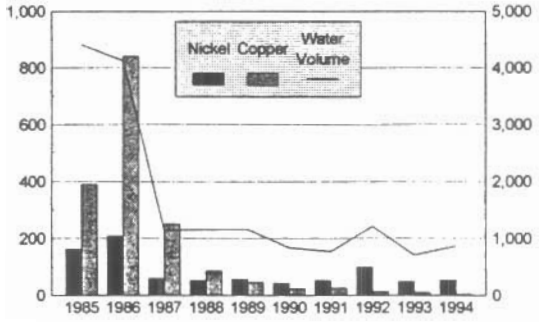
CYANIDE & ARSENIC
Loading to Sun Bay
Lupin Mine



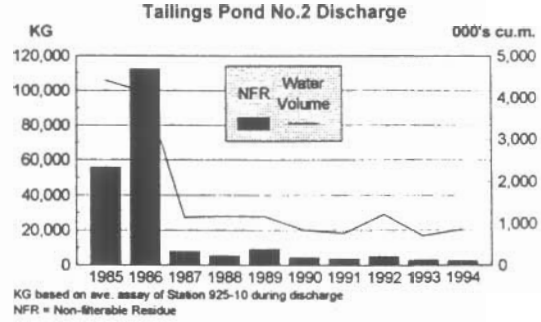
ZINC Loading to Sun Bay
Lupin Mine



NICKEL & COPPER
Loading to Sun Bay
Lupin Mine



NFR Loading to Sun Bay
Lupin Mine



SEWAGE LAKES DISPOSAL SYSTEM

Part C, Item 7 of the current Licence specifies that all waste discharge from the Sewage Lakes Disposal System shall not exceed the following effluent quality standards:

Parameter	Maximum Average Concentration
Total Arsenic	0.05 mg/L
Total Copper	0.20 mg/L
Total Lead	0.05 mg/L
Total Nickel	0.30 mg/L
Total Zinc	0.50 mg/L
BOD_5	30 mg/L
Suspended Solids	35 mg/L
Fecal Coliform	1000 colony forming units/100 mL

The waste shall have a pH greater than 6.0 and no visible sheen of oil and grease.

Throughout the duration of the current licence term, compliance with all parameter MAC's have been met with the exception of pH. There have been several occasions (in 1991 and 1992) in which the effluent pH dropped below the minimum of 6.0. During both discharge years the effluent quality with regard to all other parameters was excellent. In 1993 and 1994, discharge was suspended when pH dropped below 6, allowing time to lime the water prior to resuming discharge.

Please refer to the data tables included in Appendix B for a results summary of all samples obtained with regard to station 925-14.

The low pH that has been occurring during late summer is thought to have two main causes. The first, and probably most important, is the location of the 1987 tailings line spill on the hillside within the sewage drainage basin. This area had oxidized and was producing acidic runoff during the spring thaw. The contribution of acidity and metals to the sewage system resulted in lower pH and ultimately slightly poorer effluent quality. The second component in the equation was thought to be the minewater. Tests on the water confirmed that it consumes some alkalinity and has very poor buffering qualities itself. Routing the water through the mill since November, 1993 appeared to assist in water quality though lime was required again in 1994. A combination of the two probably produced the effect shown.

In 1994, a proposal was submitted regarding the removal of tailings and the reclamation of the 1987 tailings line spill. This involved mobilizing equipment to remove approximately 15,000 m^3 of tailings and natural ground in an effort to remove the main cause of the pH fluctuations within the sewage lakes system. Approximately 15,000 m^3 of esker material would be brought in to re-grade the land.

An estimated 80% of the work was completed before ground conditions prevented any further work. Continuation of the project is expected in 1995 to contour the area and remove minor amounts of tailings material remaining. A summary report will be submitted at the completion of the reclamation work.

Additional Monitoring and Studies With Respect To The May 30, 1992 Tailings Spill

On June 1, 1992, Echo Bay Mines Ltd. contacted the Emergency Spill Line to report a spill with regard to the seepage through Dam4b of the Tailings Containment Area. The spill (record #92-105) was the result of accumulated tailings material within the impoundment and excessive spring melt exceeding maximum operating levels. It amounted to an estimated 3 million gallons of liquid escaping to the environment.

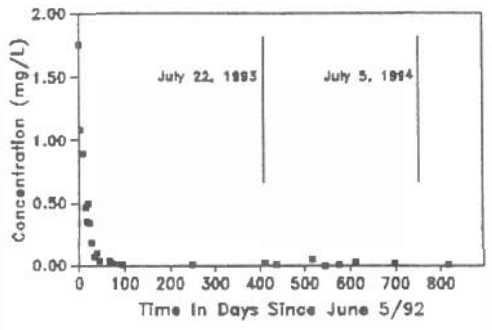
In the week that followed June 1, 1992, a considerable amount of co-ordination, construction, monitoring and downstream sampling had taken place all on a proactive basis. The seepage was under control and contained by June 6, 1992 through placement of fill material on the upstream side of the dam and also by constructing a catchment berm. Any further seepage was returned to the tailings containment while at the same time the containment area was being pumped out to Pond No.1 (an independent area of the impoundment). Pumping continued throughout the summer.

Construction of Dam4 (designed in late 1990 and scheduled for construction), was completed on August 28, 1992 along with Dams 5 and 6 to complete the Cell No.3 and No.4 containment areas. These structures have added an estimated 8 years of storage to the facility.

In addition to the construction completed to the impoundment facility, numerous studies and continued monitoring of the downstream environment has taken place. Monitoring of the downstream area, known as the south basin, was extensive through 1992 with follow-up sampling and analyses in 1993 and 1994. The latter sampling was restricted to Long Lake and limited sampling at the downstream stations.

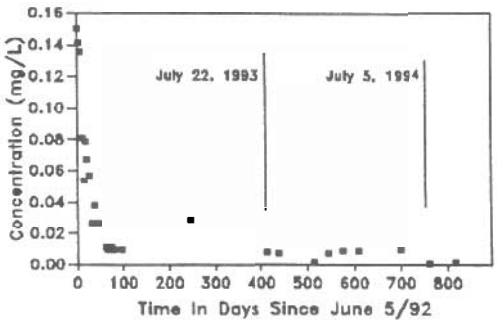
The initial samples obtained from Long Lake were taken at the outlet stream. Samples picked up in 1992 and 1993 are those from a center location of the lake at mid-depth with the exception of spring sample periods which were from the outlet. These results have been summarized in the following graphs to give an indication of the recovery time frame and current water quality with the lake.

LONG LAKE
CYANIDE



Follow-up Sampling To The 1992 Tailings Spill

LONG LAKE
COPPER



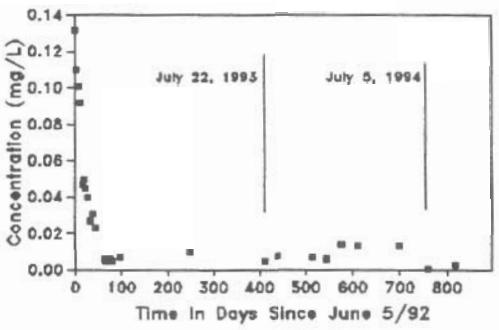
Follow-up Sampling To The 1992 Tailings Spill

The preceding graphs indicate the cyanide and copper levels within the lake overflow since June 5, 1992 and at lake centre location during 1993-94. The cyanide concentration was the highest among the parameters tested at 1.76 mg/L on the first day of sampling. Initial recovery was quick and within one week the cyanide level had decreased to half at 0.89 mg/L. Within four weeks the level had dropped further to below 0.2 mg/L. By September 1992 cyanide level was near detection limits.

Copper was similar with an initial concentration of 0.15 mg/L. After four weeks the levels had been reduced to approximately one third. By September 1992 the copper concentration had dropped to 0.01 mg/L. The latest results observed indicate copper at or near detection limits.

The following three graphs indicate the zinc, nickel and arsenic concentrations as monitored through to August 31, 1994.

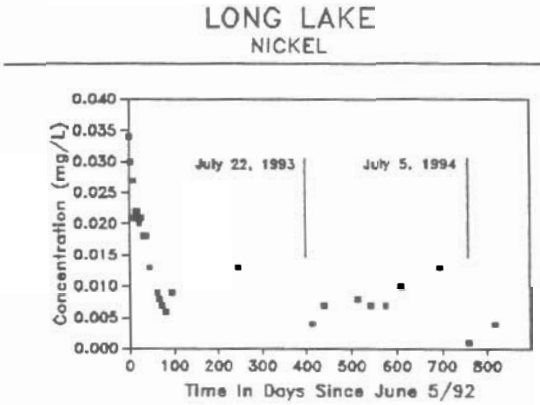
The zinc levels have recovered very well and are currently at or near detection limit. The slight increase during the winter of 1994 is thought to be due to a concentrating effect through freezing.



Follow-up Sampling To The 1992 Tailings Spill

The nickel concentrations were initially at 0.034 mg/L and decreased to near detection limits by September 1992. In 1994, at or near detection values were obtained.

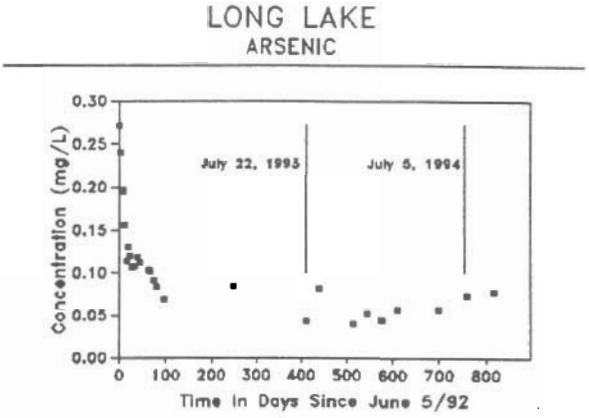
As in zinc, the values seemed to increase marginally over the winter as ice accumulation takes place. It would not be unusual to see an increase due to the concentrating affect of ice cover as the deepest locations are only five meters.



Follow - up Sampling to 1992 Tailings Spill

The final graph on the following page shows the trend for arsenic, and its behaviour over the two year period. With an initial concentration of 0.272 mg/L, a decrease of 50% was not realized until after the second month. Arsenic appears to behave opposite to the other metals in that concentrations decrease during the winter and increase during the spring to maximum levels in July.

Some of the fluctuations in all parameters may be due to the leaching of residual contaminants that may have collected on the shoreline during the initial spill. Even though the seepage was virtually suspended solids free, metal absorbtion and precipitation may have taken place.



Follow-up Sampling To The 1992 Tailings Spill

All the additional data that has been collected from the South Basin post 1992 is included in the appendix for general information. All levels are at or near background/detection limit at some point during the year. The initial spring samples indicate a slight increase in levels, again due most likely to the flushing of the system during the run-off that occurs ~~in the spring~~.

FISHERIES STUDIES

During the initial period after the spill Echo Bay initiated fisheries investigations with regard to the effects of the incident on the downstream environment. The completed reports have been submitted to the Board for review. Further investigations into the recruitment of grayling and other fish species into the Long Lake system were completed in 1993. During this time period fish were observed in Long Lake and associated waters. There was also a significant number of fish transferred to the Lake from the upstream creek (Norma Pond Creek) that would have naturally perished in the creek.

Please refer to the list of studies included in the appendix for a complete account of studies taken place.

Summary

In reviewing the information contained in this submission, it is important to note that Echo Bay Mines Ltd. has put in place considerable measures to ensure that compliance has been met.

With the exception of the tailings spill in 1992, full compliance has been attained with respect to all terms and conditions of the existing water licence. Echo Bay believes that due diligence along with the appropriate action and response prevented what could have been a much more serious event.

Any minor deviation from the licence conditions has met the previous approval of the Board or Controller where applicable.

Echo Bay Mines Ltd. has focused numerous studies on the ARD potential of the tailings and is currently investigating means of controlling the effects and preventing future development of ARD. This will assist in the annual review/revision of current plans and in the preparation of an A & R plan for final implementation.

The second area of studies has been with regard to the fisheries aspect both as an ongoing decant concern in Sun Bay and in the additional studies following the 1992 tailings spill.

Echo Bay Mines Ltd. is applying for renewal of Water Licence N7L2-0925 and specific changes (amendment) with regard to water use and waste disposal. In summary, the changes and requests include;

1) Licence term; requesting a term of 8 years commencing on June 1, 1995 and ending May 31, 2003.

2) Security deposit; Echo Bay respectfully requests that the amount of security deposit remain at $400,000.

3) Part B, Item 3; Mine water use clarification. The current wording does not account for the mine water that is a portion of the existing freshwater. The surface freshwater contribution will increase as the paste backfill process matures. Bleed water from the paste is surface water in origin.

4) Part C, Item 3; Restricted flow rate from the syphon system. Request an increase to 70,000 m^3 or greater to accommodate the flow rate from syphons during discharge.

5) Part C, Item 7; Effluent quality standards. Requesting a change to the zinc, nickel, and lead parameters with MAC as follows;

   Zinc: 0.5 mg/L MAC
   Nickel: 0.3 mg/L MAC
   Lead: 0.2 mg/L MAC

The most significant amendment proposed is the change in effluent quality standards. Since the initial granting of a water licence in 1981 for the purpose of mining and milling at the Lupin mine, Echo Bay has made every effort possible to meet or surpass the limits of the licence.

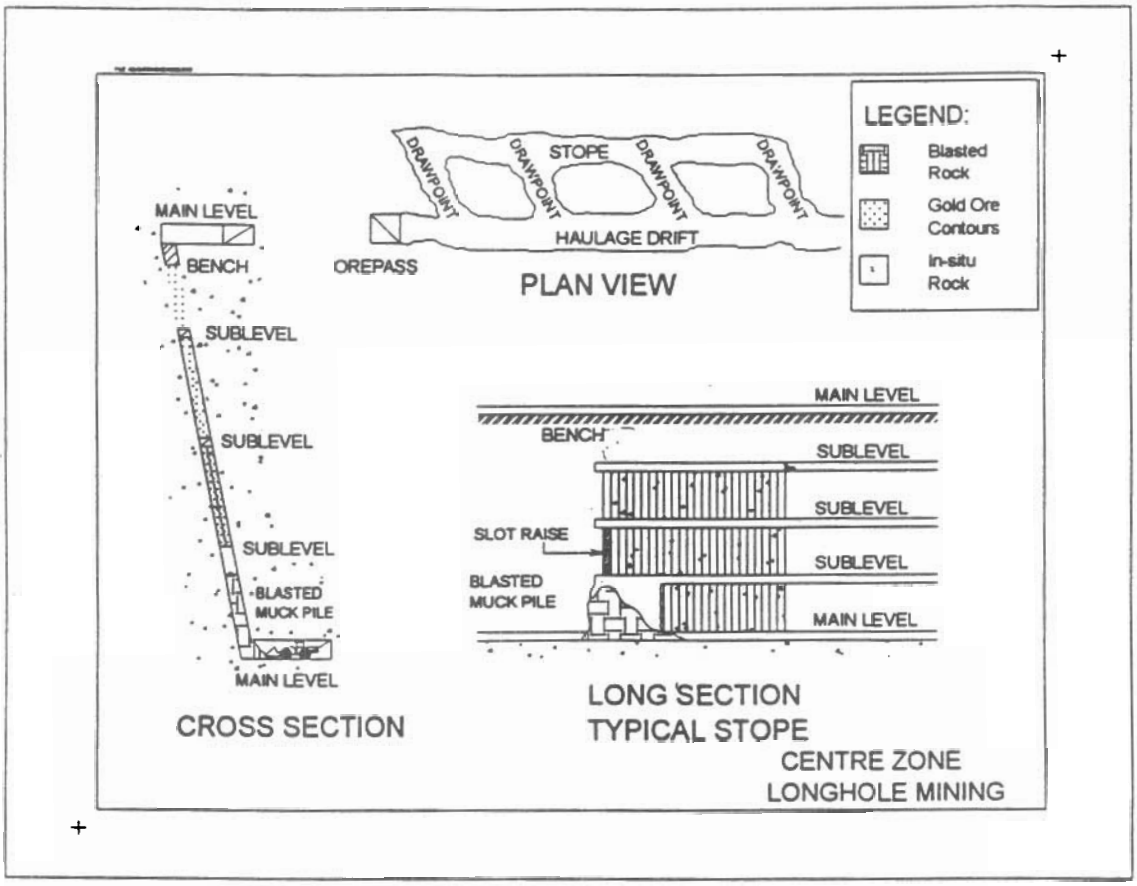
The Water Board's responsibility to ensure that the effluent quality standards protect the aquatic environment is recognized. These standards however, must also reflect a current best available scientific justification. Under recent review, the Metal Mining Liquid Effluent Regulations and the proposed new Ontario Clean Water Regulation have made no change to the previous standards based on available information.

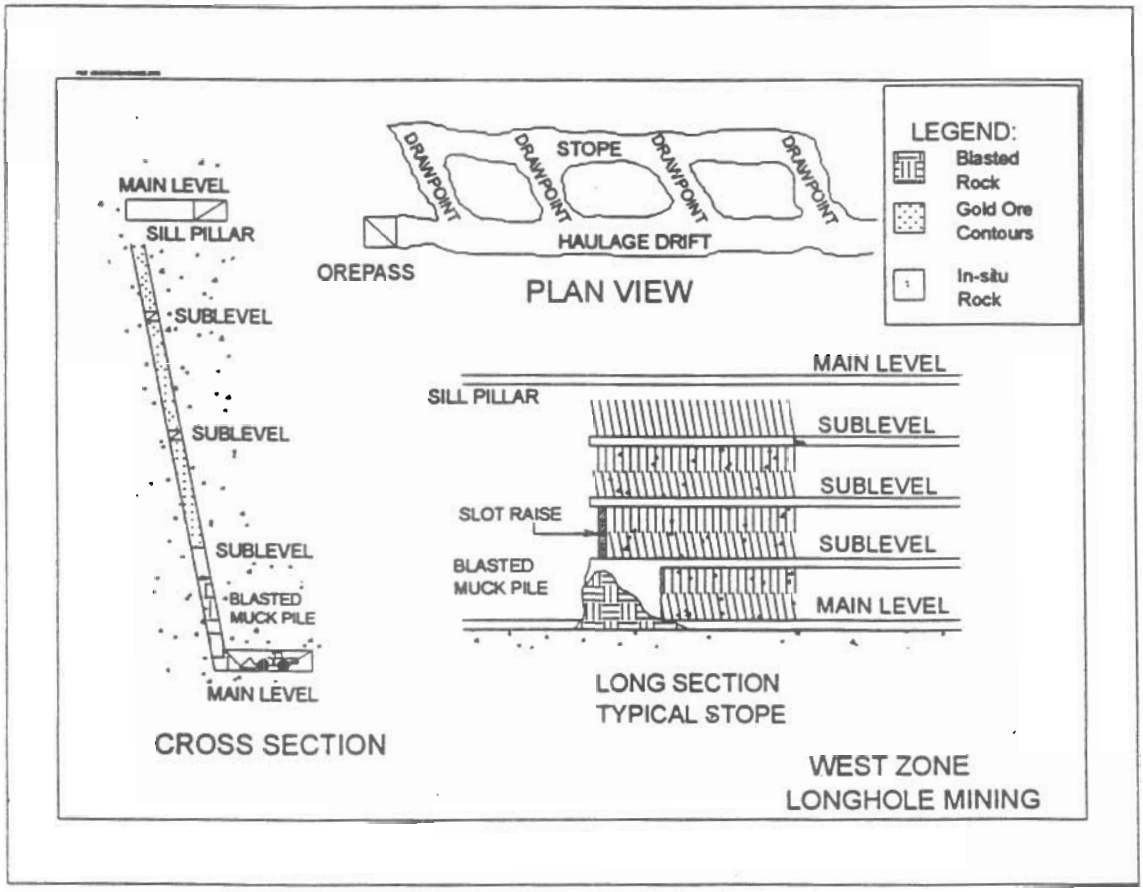
The favorable consideration of the information and comments made throughout the submission and in the initial licence renewal application covering letter is stressed during review. The time and effort required is greatly appreciated.

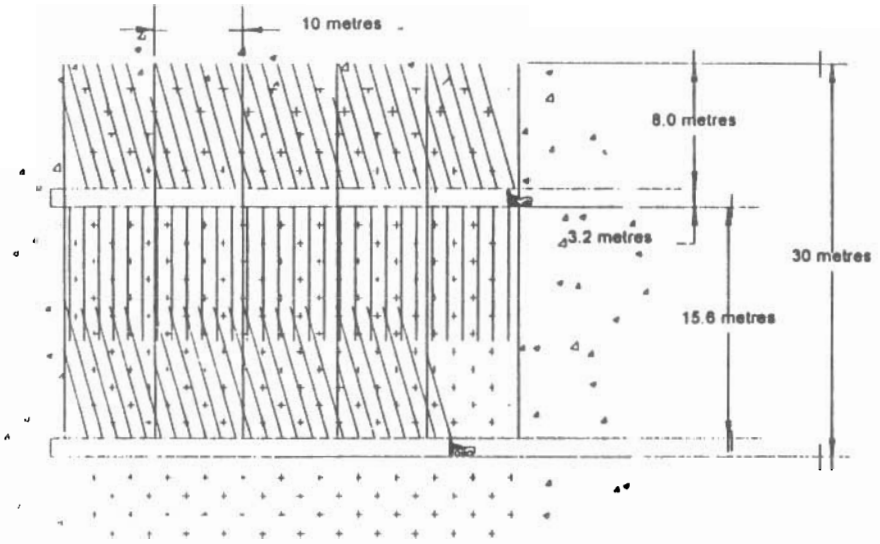
Echo Bay Mines Ltd. is looking forward to presenting it's position to the N.W.T. Water Board at the Public hearing forum scheduled for the 18th of January, 1995 in Coppermine, N.W.T. at 7:00pm.

APPENDIX A
Schematic Diagrams

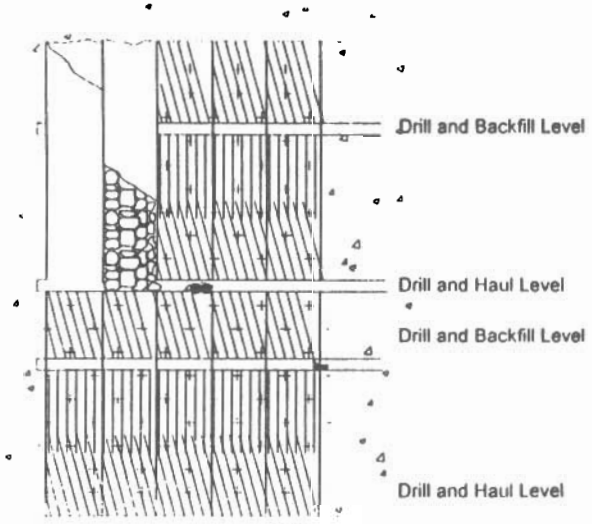
(FIGURE A-1) Centre & West Zone Longhole Mining Method



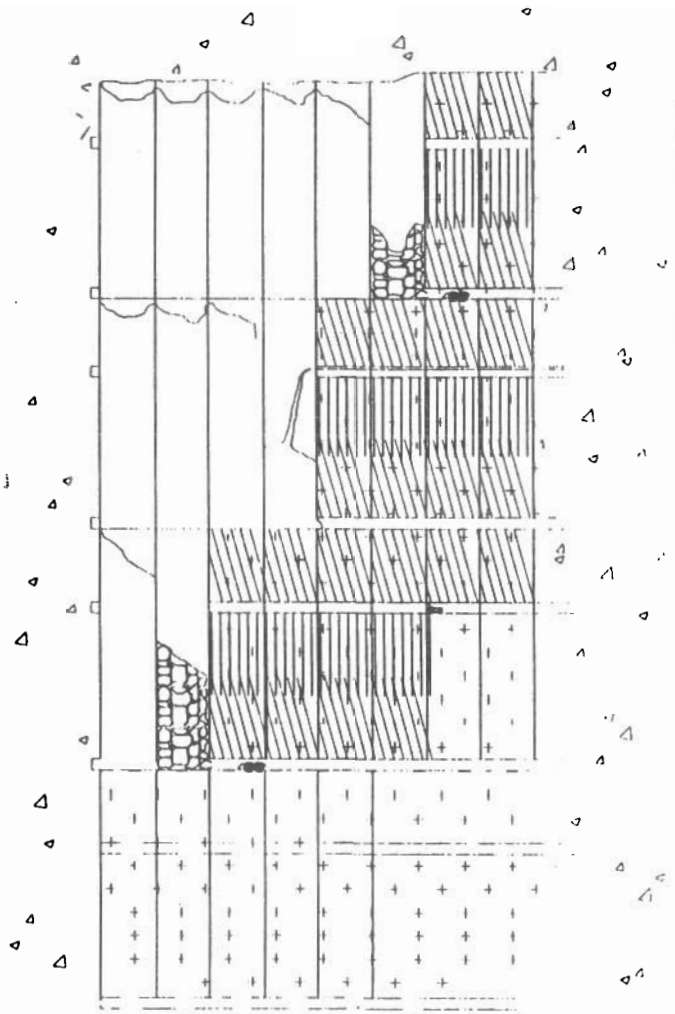




1. Panels of dimensions 10 metres long by 30 metres high are drilled, using both up and downholes.



2. Once a panel has been mined out, it is backfilled. The adjacent panel can then be mined after the paste backfill has hardened.



3. Mining may then proceed in a top-down sub-level retreat fashion as is illustrated above.

LEGEND:

- Blasted Rock
- Gold Ore Contours
- In-situ Rock
- Paste Backfill

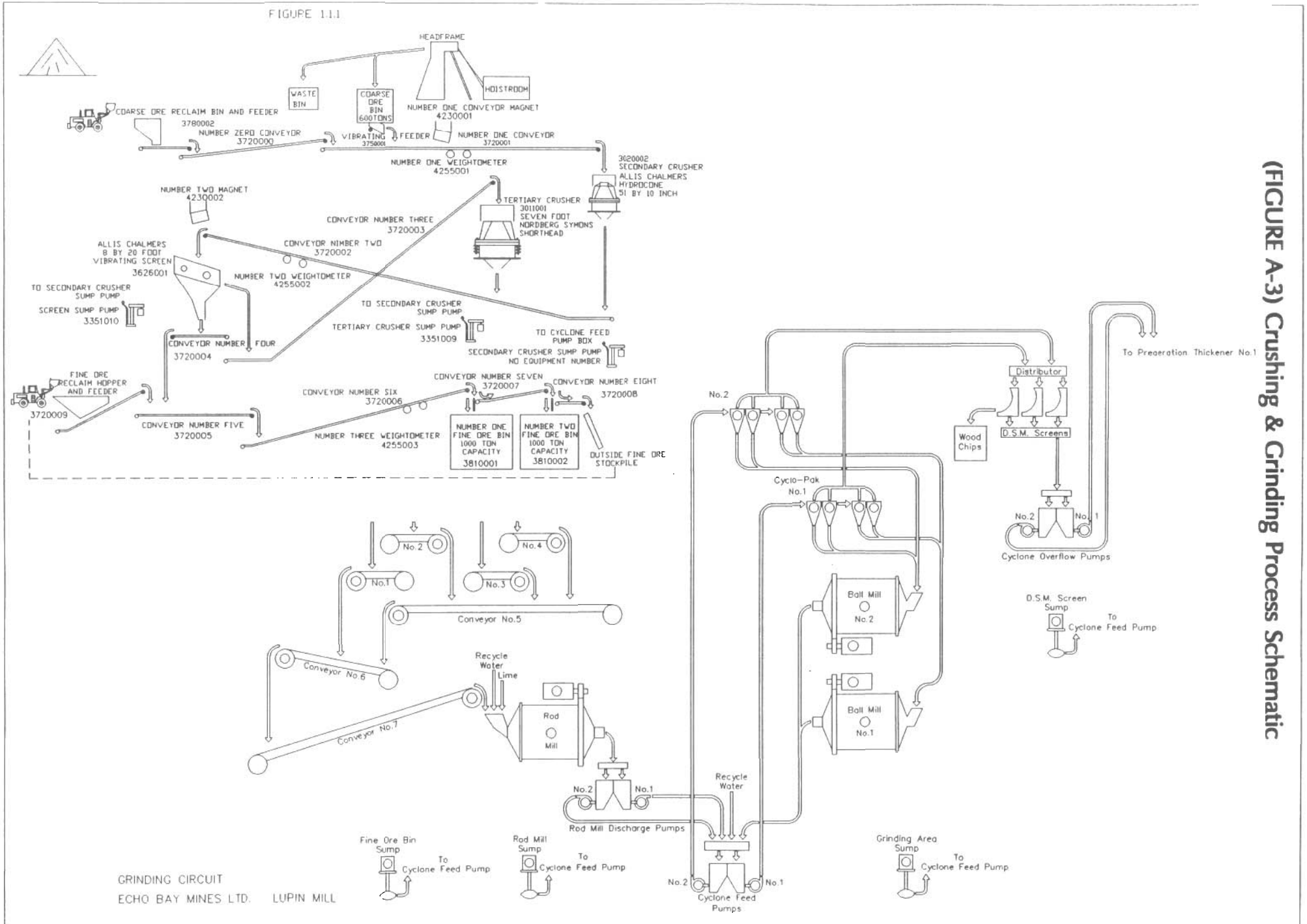
ECHO BAY MINES LTD
LUPIN N.W.T.

SUBJECT: Sublevel Retreat Under Consolidated Paste Backfill

DATE 22/06/94 DRAWN D.J.W. CHK BY

SCALE NTS No

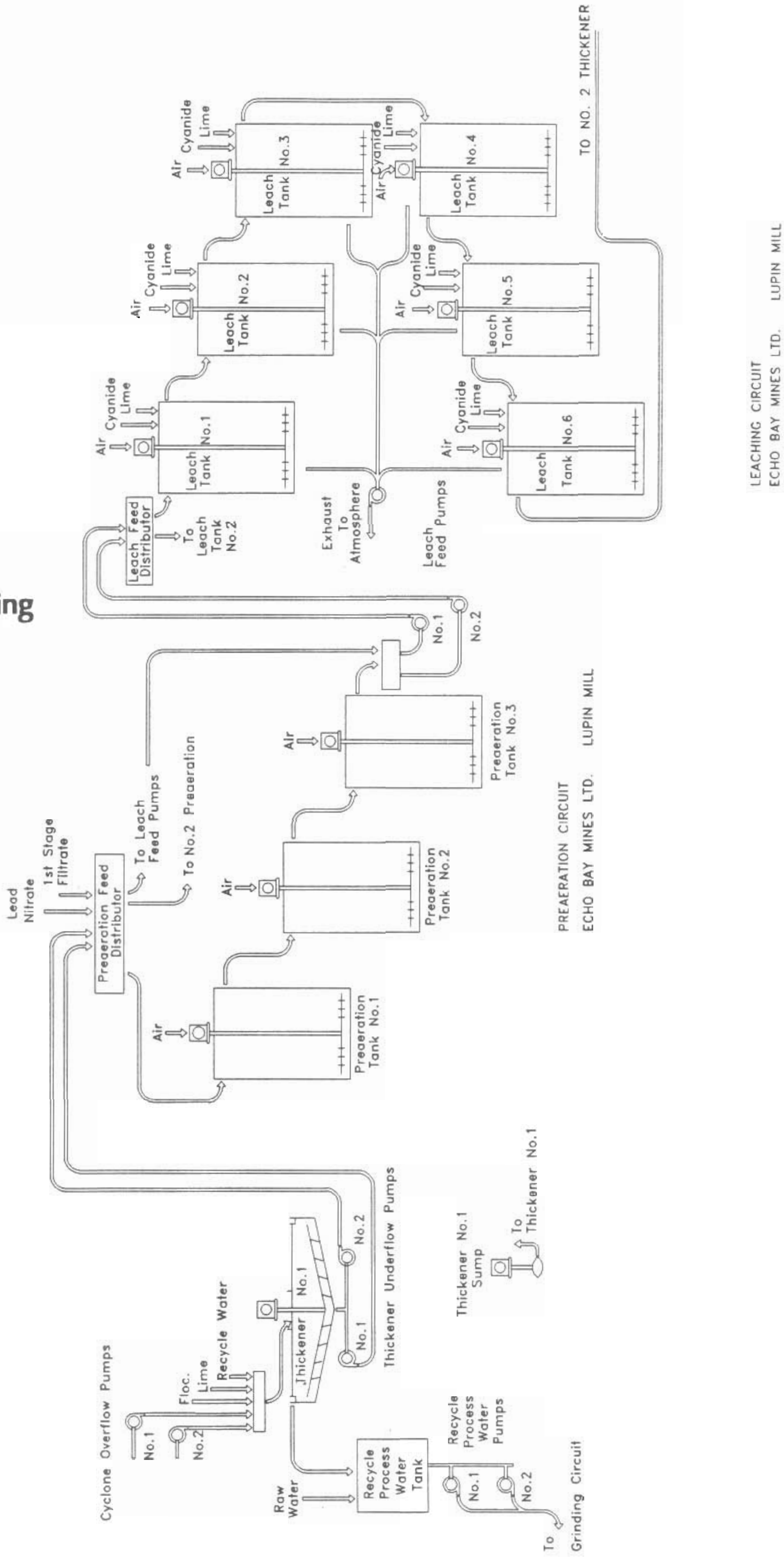
(FIGURE A-2) Sublevel Retreat Under Consolidated Paste Backfill



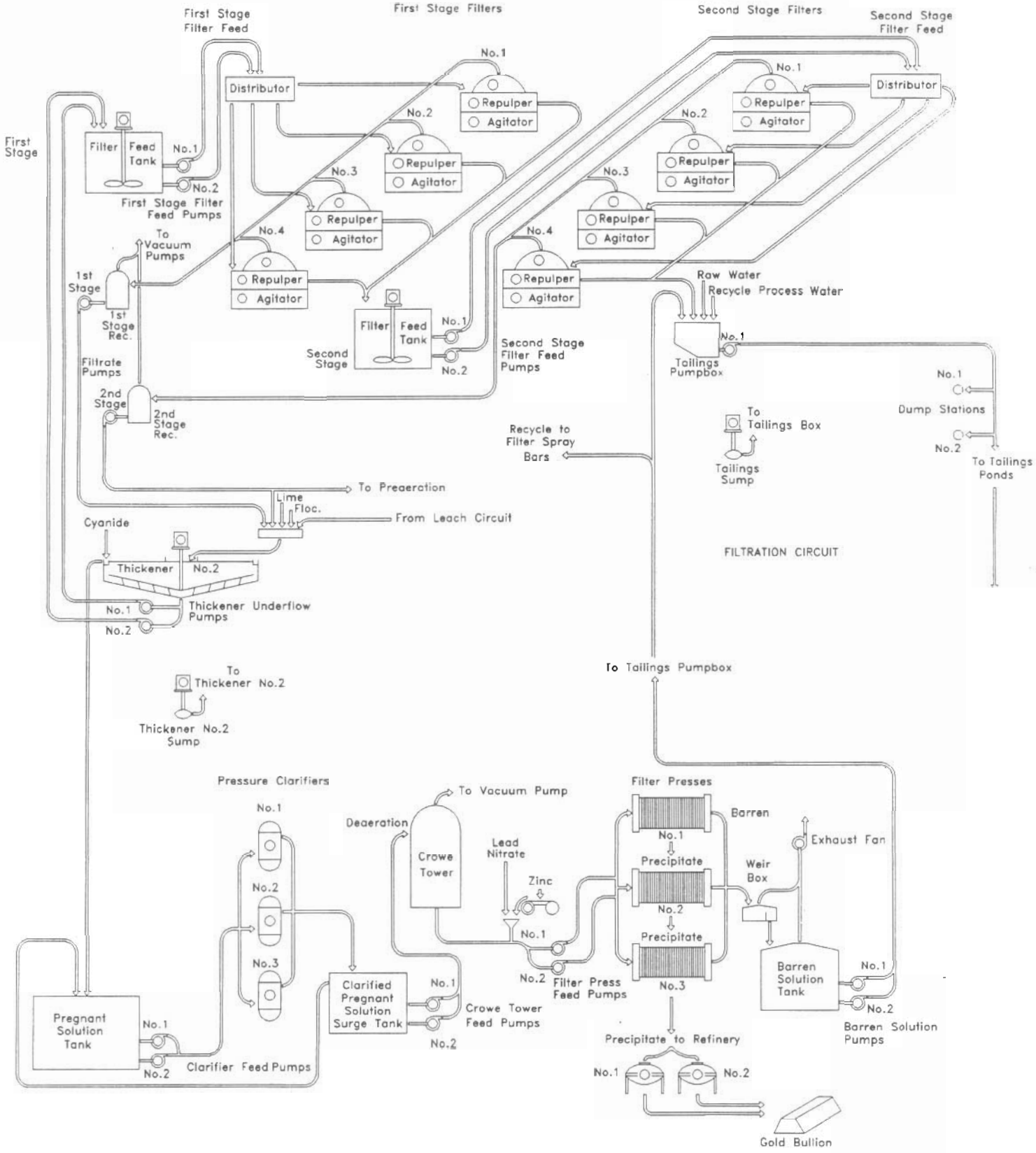
(FIGURE A-3) Crushing & Grinding Process Schematic

(FIGURE A-4)

Pre Aeration & Leaching Circuit Schematic



(FIGURE A-5) Filtration & Recovery Circuit Schematic

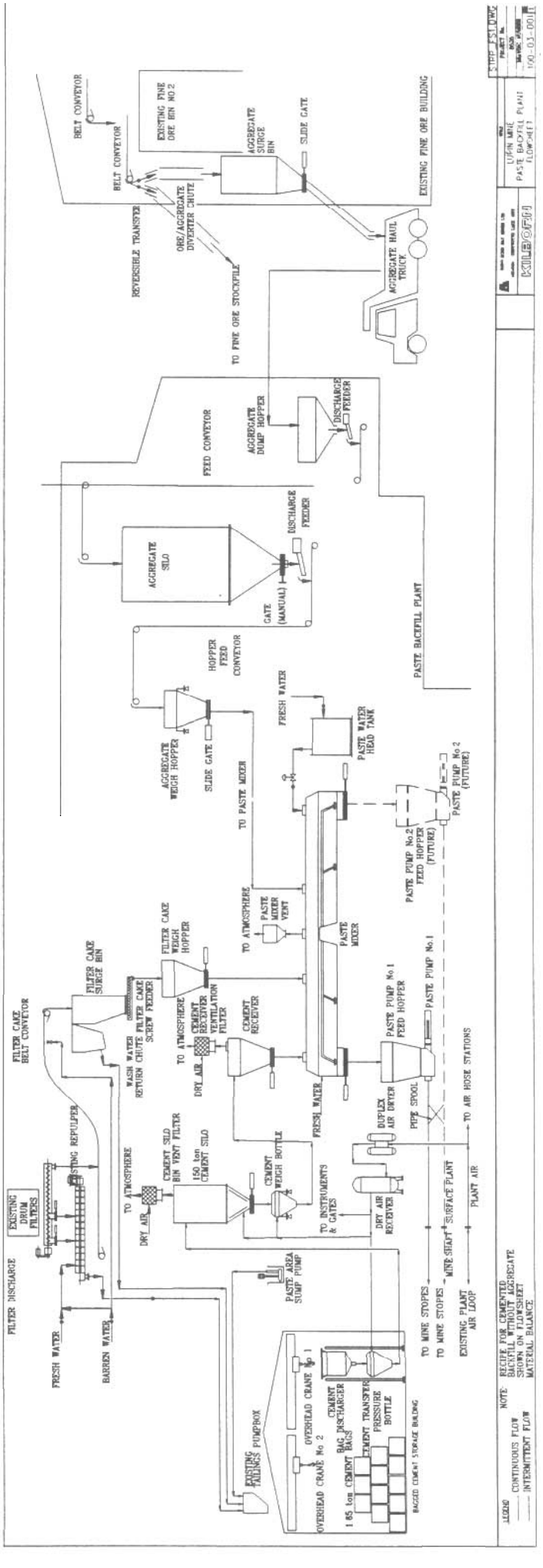


ECHO BAY MINES LTD. LUPIN MILL

RECOVERY CIRCUIT

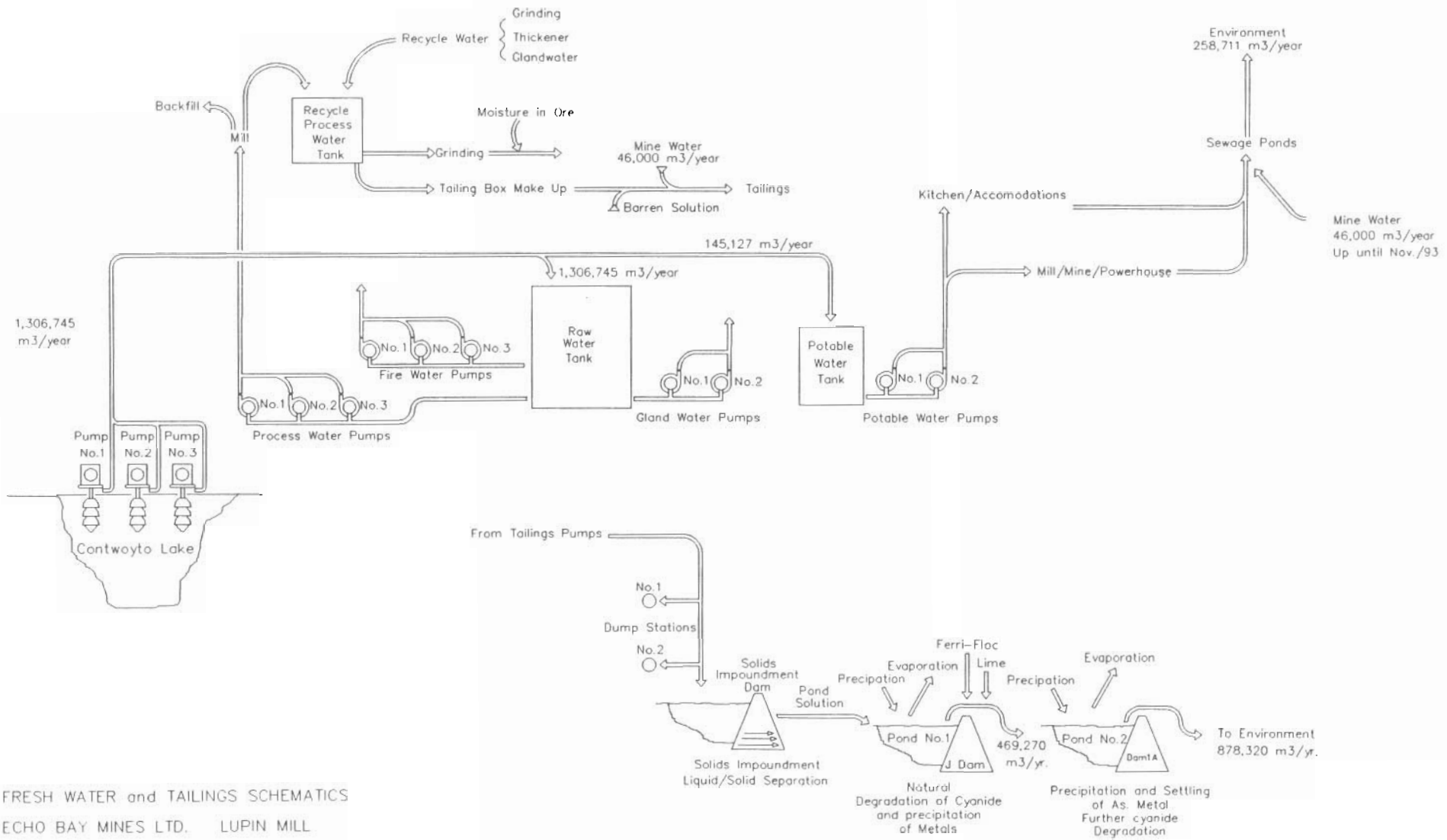
(FIGURE A-6)

Paste Backfill Plant Flowsheet



(FIGURE A-7)

Freshwater & Tailings Schematic



FRESH WATER and TAILINGS SCHEMATICS
ECHO BAY MINES LTD. LUPIN MILL
VOLUMES ARE AVERAGE 1990 – 1994

APPENDIX B

Letter of Application for Licence Renewal

ECHO BAY MINES LTD.

Mailing Address:
Lupin Operation
Bag No. 1
Nisku, Alberta
T0C 2G0

Lupin Operation
No. 10, Yellowknife Airport
Yellowknife, N.W.T.
X1A 3T2

Phone: (403) 890-7000

Fax: (403) 890-8766

June 9, 1994

Our File: Lupin Water 1994
Your File: Water Register
#N7L2-0925

Mr. Gordon Wray
Chairman
Northwest Territories Water Board
9th Floor Precambrian Building
P.O. Box 1500
Yellowknife, NT
X1A 2R3

Dear Mr. Wray:

RE: **Echo Bay Mines Ltd., Lupin Mine**
Contwoyto Lake, NT
Water Register No. N7L2-0925
Application for Water Licence Renewal

The Lupin Mine, Located near Contwoyto Lake, NT currently operates under Water Licence N7L2-0925 granted by the Northwest Territories Water Board pursuant to the Northwest Territories Waters Act and Regulations. The Licence renewal date was June 1, 1990 and the expiry date is May 31, 1995.

With the above in mind, please find enclosed a completed Schedule III application form and the application fee of $30.00 (Cheque No.12097) payable to the Receiver General for Canada.

This application is submitted in advance to allow adequate processing time, and preparation time, should a public hearing be required. Echo Bay Mines could be prepared to participate in the Public Hearing process in the fourth quarter of 1994, allowing a reasonable review time for issuance of a new licence prior to the May 31, 1995 expiry date.

The following is a brief history of our existing water licence and the changes that have occurred since originating in 1981.

- Initial application submitted on July 7, 1980
- Public Hearing held on January 20, 1981

- Effective date of Licence N7L2-0925 June 1, 1981, expiry date May 31, 1987
- Amendment No.1 dated April 1, 1982; allowing discharge of camp wastes to the sewage lakes system
- Public hearing held on March 21, 1985; Amendment No.2 dated August 1, 1985 was issued allowing discharge of mine water to the sewage lakes subject to the effluent quality criteria at the outlet; increased the zinc effluent criteria for the tailings pond from 0.05 ppm to 0.5 ppm, and, extended the licence period to expire on May 31, 1990.
- August 29, 1985; an Emergency Amendment was granted by the Minister and the Board to discharge the tailings pond at arsenic concentrations in excess of licence limits.
- July 17, 1989; Licence Renewal Application submitted.
- Public Hearing held on November 22, 1989
- Effective date of Licence N7L2-0925 (Renewal) June 1, 1990; expiry date May 31, 1995
- There have been no amendments to the Licence and attached SNP as issued since June 1, 1990. An application for an amendment has been submitted with regard to the planned use of washed mill tailings within the underground backfill.

As it is expected that a clause by clause review of the Licence will take place during the renewal process, Echo Bay Mines Ltd. respectfully submits the following comments and requested changes in this regard.

LICENCE N7L2-0925

PART A; GENERAL CONDITIONS

Items 1,2 & 3

No change

Item 4

This section should be rewritten to reflect the change in reference to the Northwest Territories Waters Act (Section 17(1)) and its Regulations (Paragraph 12(1)). The amount of the security deposit is negotiable, however, we believe that the amount of $400,000 is reasonable and should be maintained.

Taking into account Lupin's excellent compliance history and the annual accrual of an Abandonment and Reclamation Fund, we believe the specified amount suitable to cover compensation if required under Section

17(2) of the Northwest Territories Waters Act. Further comment can be provided at a later date.

Item 5 Reporting requirements should be rewritten to clarify the submission date of the report and its content, and eliminate possible misinterpretation of the Act and Regulations (Paragraph 15(1) of the Regulations).

Items 6,7,8,9,10 and 11

No change

PART B; CONDITIONS APPLYING TO WATER USE

Item 1 No change

Item 2 No change. The annual water consumption for domestic and mill use during the current licence term increased from 1,280,000 m^3 in 1990 to 1,418,500 m^3 in 1993. This represents an increase of 10% over the four year period. As there are no dramatic changes anticipated with the operations, the current maximum water use of 1,700,000 m^3/year would be adequate for the next licence term.

Item 3 No change

PART C; CONDITIONS APPLYING TO WASTE DISPOSAL

Item 1 This clause should be rewritten to reflect Lupin's capacity to utilize and incorporate the solids portion of the tailings into the underground backfill.

Item 2 No change

Item 3 The discharge rate of 60,000 m^3/day from the Tailings Containment Area has been of a concern at Lupin due to the difficulty in controlling the rate to a precise flow.

The decant system at Lupin currently consists of three 20 inch syphons. Operating via gravity, they are dependent on water elevation within the pond. The flow can be controlled to some degree with the valves located on the discharge end, albeit difficult. At the operating elevations currently in place it is usually an "all or nothing" flow due to the head pressure.

Historically, each syphon has been capable of approximately 30-35,000 m^3/day at the water elevations maintained within the pond. Only two syphons are operated with the third on standby. Therefor, an operating maximum extended to 70,000 m^3/day would be a realistic approach. This has its merits only in the first few days of decant, after which, the flow

rates begin to naturally decline due to water elevation change within the pond and the system is operated to its maximum.

Item 4 Effluent Quality Standards

The following table lists the current effluent quality standards in place, Echo Bay Mines Ltd.'s requested changes to the standards as well as the Metal Mining Liquid Effluent Regulations standards and the newly drafted Ontario Clean Water Regulation as references.

All concentrations are expressed in mg/L

PARAMETER	Maximum Average Concentration (MAC)	Requested Change:	Ontario Clean Water Regulations for The Mining Sector	Metal Mining Liquid Effluent Regulations (MAC)
Total Arsenic	0.5	no change	0.5	0.5
Total Cyanide	0.8	no change	1.0	
Total Copper	0.15	no change	0.3	0.3
Total Lead	0.05	0.2	0.2	0.2
Total Nickel	0.1	0.3	0.5	0.5
Total Zinc	0.3	0.5	0.5	0.5
Suspended Solids	15	no change	15	25

The pH of the effluent shall be greater than 6.0 and have no visible sheen of oil and grease

The Maximum Concentration of any Grab sample is equivalent to twice the Average (MAC) level: ie: Arsenic = 1.0ppm

The requested changes outlined above are representative of the current operating status of the Lupin Mine, achievements during the 1990 to 1995 licence term and, they represent water quality standards which reflect, as well, the industry trend. The MMLER and Ontario's new Clean Water Regulation reflect the latest research into the best available technology (BAT) for the mining sector and should be considered when determining effluent quality standards.

The requested increase in the Lead standard reflects the analytical constraint utilizing flame Atomic Absorption Spectrophotometry (Flame A.A.). In the past, Lupin has consistently reported values below the detection limit. The existing standard is only one order of magnitude greater than the best detection limits of the Flame AA.

The requested increase in the Nickel standard is analytical in nature as well, however, the operational focus is of greater concern. During the past

two years nickel levels have been 80% to 90% of the maximum level. Lupin's current 0.1 mg/L limit is the among the lowest regulated. This, coupled with a best analytical accuracy of ± 5%, results in reported values that may or may not be approaching the Licence standard. An increase in the standard would broaden that working range.

The requested increase in the **Zinc** standard would bring Lupin in line with current **MMLER** regulations and the drafted **Ontario Mining Sector Limits Regulation** (see table above). These regulations have recently been under review. The lack of demonstrable need for change and current BAT may result in no changes taking place to the current MMLER Standards and the passing of the new Ontario regulation.

Maintaining a low level of zinc in Pond No.2 has been an on-going concern for the operation. This low level is not warranted by known toxicity data or the current standards generally applied to industry.

Echo Bay has continually worked at maintaining pH levels in Pond No.2 and with it keeping the zinc levels at a minimum. It has been an uphill battle with the amount of fresh water (nil alkalinity) from runoff entering the system and the recent problems with runoff from the original tailings beach.

In regard to the **Arsenic, Cyanide** and **Copper** standards, there is no immediate concerns with these parameters. Although Copper standards are among the most stringent in the industry, concentrations were maintained at low levels with the control of pH; Arsenic removal has been successful with the operation of the chemical addition facility and Cyanide removal has been **excellent** within the system through natural degradation processes.

The **pH** and **Oil and Grease** parameters are standard and do not require addressing. A neutral pH is advisable with regard to metals and the oil and grease parameter (although there has not been a problem) have been controlled through the subsurface withdrawal of water during decant.

Item 5 — No change. Item 5(g) could be written to include "... unless otherwise approved by the Controller" or "... during ice free, open water conditions". This is requested as there may be a situation due to scheduling, be it construction or availability of the consultant, that conducting the Inspection in July is inappropriate.

Item 6 — No change

Item 7 The concern with the Lead standard here is common as with the Tailings discharge. The 0.05 mg/L limit is too near the detection limits of Flame AA, historically there has not been a problem with lead in the effluents and reported values have been consistently below detection limits.

Item 8 No change. It is understood that the current utilization of the minewater within the mill circuit results in its ultimate disposal to the Tailings Containment Area.

Items 9,10 & 11 No change

PART D; CONDITIONS APPLYING TO SPILL PREVENTION AND CONTINGENCY PLANNING

Items 1 through 7

No change. Echo Bay Mines Ltd. currently maintains annually revised contingency plans under two headings; General Contingency Plan and an Oil and Toxic Materials Spill Contingency Plan. The latest revisions (organizational charts and phone listings) were noted approved in a letter received from the Board dated February 7, 1994.

PART E CONDITIONS APPLYING TO MODIFICATIONS

No change to this section

PART F CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

Echo Bay Mines Ltd. maintains an approved **Abandonment and Restoration Plan** with the Board subject to annual updates and revision.

Items l,m Since Licence renewal in 1990, Echo Bay Mines Ltd. has been actively involved in research work regarding the Acid Generating Potential of the tailings and mitigative measures/abandonment plans for eventual closing of the containment area. Listed below are the programs that have been undertaken:

Acid Rock Drainage Study - March, 1992; Klohn-Leonoff for Echo Bay Mines Ltd. Static tests of Tailings and Waste rock for chemical characterization; a 30 week column leach program (kinetic test) testing cover materials in cold and room temperature environments.

Assessment of Water Chemistry and Remedial Measures for the Lupin Tailings Management System - July, 1992; Klohn-Leonoff for Echo Bay Mines Ltd. Review of water chemistry, past treatment conditions and affects of the exposed tailings area along the N.W. corner of Pond No.2 were investigated.

Column Leaching Study; Evaluation of ARD Control Measures - December, 1993; Klohn-Leonoff for Echo Bay Mines Ltd. Investigation of ARD control measures for the tailings deposition area utilized between 1982 and 1985.

Echo Bay Mines Ltd., along with various consultants, have completed the design study and recommendations regarding implementation of a Paste Backfill Process at Lupin. The utilization of tailings material underground will provide additional control and prevention in the difficult task of dealing with material that, given the proper conditions, has the potential to generate acid.

Echo Bay Mines Ltd. plans to retain the services of Klohn-Crippen (Klohn-Leonoff) to assist in the continual development of the tailings management plan. This is to include a Test Cover Plot and monitoring program within the filled portion of Cell No.1; initiated in 1994. As well, an assessment of an area covered with esker material in 1987 adjacent to Cell No.1 will be completed.

Evaporation Studies At The Lupin Mine Site Using Stable Isotopes, 1991-94; Department of Earth Sciences, University of Waterloo. The principal objectives are to measure evaporation and water balance of tailings pond treatment systems in northern climates; and to calibrate an isotope mass balance model to be used as an operational method for characterizing water balance of natural lakes and tailings ponds. This information is expected to provide a valuable tool in the assessment of eventual closure strategies for the Lupin Tailings Impoundment.

SURVEILLANCE NETWORK PROGRAM

Currently there are no major concerns with the Surveillance Network Program dated June 1, 1990. However, we do suggest the removal of the requirement to sample and analyze for Lead in all samples obtained. This would reflect the limited occurrence of lead in the Lupin process streams. A once per year analysis can be performed prior to decant and if an occurrence does show, then the sampling/analyses can be increased.

Part B, Items 11,12

An approved Quality Assurance Plan is currently in place and implemented. These clauses should be rewritten to indicate its presence.

LICENCE TERM

Echo Bay Mines Ltd. requests an expiry date of May 31, 2003, providing a licence term of 8 years. This corresponds with the current Mine Life and ore reserves. Exploration at depth and on the surface continues in order to expand reserves.

An Application For Renewal will be proceeding at least one year prior to the expiry date to provide a suitable review period. At this time the Restoration plans and activities in the tailings area will have generated data and be available for a critical review. During this time frame, providing there have been no changes to the current mine life plan, Echo Bay Mines Ltd. will be seeking approval of the Abandonment and Restoration Implementation Schedule. Any concerns or final clauses can be included in the licence at that time.

ADDITIONAL RELATED STUDIES

Echo Bay Mines Ltd. has continued to carry out or provide support for environmental monitoring programs related to the decant pathway of the tailings impoundment discharge and the receiving water body. These studies are a continuation of the Aquatics Studies Program of 1983 to 1985 and 1988. The most recent programs included:

- **Fisheries Investigations at the Lupin Gold Mine, Contwoyto Lake, NT, 1990**; Fish Tissue Metal Analysis - R.L. & L. Environmental Services, and Seep Creek Investigations - Dept. of Fisheries and Oceans.
- **Application of Selected Monitoring Methods to the Assessment of Impacts on Contwoyto Lake from Lupin Mine Effluent. Phase 2-Longterm Assessment; 1990**. Environmental Protection, Conservation & Protection, Northwest Territories District Office, Yellowknife, NT. **DRAFT ONLY**; March 1991.
- **Metal Concentration in Fish Tissue - Contwoyto Lake, NT; Echo Bay Mines Ltd.**, 1993; R.L. & L. Environmental Services LTd., report currently in the Draft stage.

OTHER STUDIES

Echo Bay Mines Ltd. initiated and has continued studies in regard to a spill that occurred between the 30th of May, 1992 and the 5th of June, 1992. This spill resulted in the release of deleterious substances into waters frequented by fish, locally known as Long Lake and its associated waters.

Studies continue to date with regard to Long Lake and the natural establishment of a fisheries population. These studies are listed below:

- **1992 Fisheries Investigation of Long Lake Near The Lupin Gold Mine, Contwoyto Lake, NT; September 1992.** R.L.&L Environmental Services Ltd., Edmonton, Alberta
- **1992 South Basin Fishery Inventory Study** (Included fish tissue metal analysis). R.L.&L. Environmental Services Ltd., Edmonton, Alberta
- **1993 Long Lake/South Basin Arctic Grayling Study, July/August 1993.** R.L.&L. Environmental Services Ltd., Edmonton, Alberta; report in draft stage.

In addition to the above studies, Echo Bay Mines Ltd., has continued to monitor the water quality of Long Lake and its drainage course in an effort to provide supplementary information to that acquired during the fisheries investigations.

OTHER CONSIDERATIONS

As Lupin is located in the new Nunavut Settlement Area, and Echo Bay has always expressed its concern with the northern settlements, the ability of these residents and representatives to attend a Public Hearing should be addressed. If such a hearing is required, we respectfully request that it be held at Coppermine, NT.

I appreciate your time and consideration of the above and the attached application. If you have any questions, comments or there is a requirement for additional information, please feel free to contact the undersigned at your convenience (403) 890-8787.

Yours truly,

M.R. Walker, Sr.
General Manager, Lupin

Attach.

MRW/dbh

cc: D. Naccarati (Denver)
W.D. Burton
D. Hohnstein
R.B. Ferguson

SCHEDULE III
(Subsection 6(1))

APPLICATION FOR LICENCE, AMENDMENT OF LICENCE, OR RENEWAL OF LICENCE

APPLICATION/LICENCE NO: (amendment or renewal only) N7L2-0925

1. NAME AND MAILING ADDRESS OF APPLICANT
Echo Bay Mines Ltd.
Lupin Operation
Bag No.1 Nisku, AB
T0C 2G0
TELEPHONE: (403) 890 7000 FAX: (403) 890 8766

2. ADDRESS OF HEAD OFFICE IN CANADA IF INCORPORATED
Echo Bay Mines Ltd.
1210 Manulife Place
10180-101 Street, Edmonton, AB T5J 3S4
TELEPHONE: (403)496-9002 FAX: (403) 424-7378

3. LOCATION OF UNDERTAKING (describe and attach a map, indicating watercourses and location of any proposed waste deposits)
Lupin Mine
Contwoyto Lake, NT
Latitude 65° 46' 05" Longitude 111° 14' 45"

4. DESCRIPTION OF UNDERTAKING (describe and attach plans)
Mining Milling and associated camp operations

5. TYPE OF UNDERTAKING

1. Industrial	___	4. Power	___	6. Conservation	___
2. Mining and milling	X	5. Agriculture	___	7. Recreation	___
3. Municipal	___				

8. Miscellaneous (describe) ___

6. WATER USE

To obtain water	X	Flood control	___
To cross a watercourse	___	To divert water	___
To modify the bed or bank of a watercourse	___	To alter the flow of, or store, water	___

Other (describe) ___

7. QUANTITY OF WATER INVOLVED (litres per second, litres per day or cubic metres per year, including both quantity to be used and quality to be returned to source)
Use of 1,700,000 cubic meters of water
to be returned to source following suitable treatment and storage methods
required to reduce contaminant levels

SCHEDULE III—*Concluded*

APPLICATION FOR LICENCE, AMENDMENT OF LICENCE, OR RENEWAL OF LICENCE—*Concluded*

8. WASTE DEPOSITED (quantity, quality, treatment and disposal)

Approx. 840,000 dst of tailings solids plus 50% solution by weight. Solids removal via settling, liquid portion treated through Natural Degradation processes and chemically treated to remove contaminants.

9. OTHER PERSONS OR PROPERTIES AFFECTED BY THIS UNDERTAKING (give name, mailing address and location; attach list if necessary)

N/A

10. PREDICTED ENVIRONMENTAL IMPACTS OF UNDERTAKING AND PROPOSED MITIGATION

It is believed that there will be no adverse environmental impacts that cannot be mitigated with known technology.

11. CONTRACTOR AND SUB-CONTRACTORS (names, addresses and functions)

N/A

12. STUDIES UNDERTAKEN TO DATE (attach list if necessary)

Many studies have been undertaken to date. These have been listed in detail in the cover documentation. They comprise acid generation testwork and mitigation, various fisheries investigations, and a four year study dealing with evaporation.

13. PROPOSED TIME SCHEDULE

Licence Renewal

Start date June 1, 1995 Completion date May 31, 2003

David Hohnstein	Manager Env. Affairs	David Hohnstein	June 9, 1994
NAME (Print)	TITLE (Print)	SIGNATURE	DATE

FOR OFFICE USE ONLY

APPLICATION FEE Amount: $ _____ Receipt No.:_____

WATER USE DEPOSIT Amount: $ _____ Receipt No.:_____

APPENDIX C
SNP Data

ECHO BAY MINES LTD.
LUPIN MINE; WATER LICENCE N7L3–0925
ENVIRONMENTAL ANALYSIS SUMMARY

1995 LICENCE RENEWAL SUMMARY; STATION 925–10

– All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	TOTAL METALS Zn	Pb	Ni	Cu	TEMP °C
EFFLUENT QUALITY LIMITS		>6.0	15	0.8	0.5	0.3	0.05	0.1	0.15	
02–Jul–90	925–10	6.98	2.4	0.07	0.18	0.115	< 0.004	0.050	0.030	
03–Jul–90	925–10	6.95	3.2	0.11	0.20	0.140	< 0.004	0.050	0.028	
04–Jul–90	925–10	7.00	4.0	0.10	0.18	0.120	< 0.004	0.050	0.045	
05–Jul–90	925–10	7.01	6.0	0.10	0.20	0.113	< 0.004	0.048	0.030	
06–Jul–90	925–10	6.99	4.4	0.10	0.19	0.120	< 0.004	0.050	0.030	
07–Jul–90	925–10	7.03	5.2	0.11	0.16	0.123	< 0.004	0.045	0.028	
08–Jul–90	925–10	6.52	4.4	0.16	0.21	0.122	< 0.004	0.055	0.026	
09–Jul–90	925–10	6.28	4.8	0.08	0.20	0.128	< 0.004	0.052	0.029	
10–Jul–90	925–10	6.71	4.4	0.10	0.16	0.130	< 0.004	0.050	0.026	
11–Jul–90	925–10	7.12	4.0	0.07	0.16	0.140	< 0.004	0.050	0.029	
11–Jul–90	925–10G	7.17	4.8	0.07	0.20	0.145	< 0.004	0.052	0.029	
12–Jul–90	925–10	7.23	5.2	0.08	0.18	0.135	< 0.004	0.058	0.029	
13–Jul–90	925–10	7.11	10.0	0.08	0.17	0.130	< 0.004	0.055	0.029	
14–Jul–90	925–10	7.07	5.7	0.07	0.19	0.125	< 0.004	0.055	0.024	
15–Jul–90	925–10	7.05	6.8	0.09	0.21	0.130	< 0.004	0.058	0.026	
16–Jul–90	925–10	7.44	5.6	0.06	0.21	0.125	< 0.004	0.050	0.026	
15–Jul–91	925–10	6.93	6.6	0.01	0.12	0.226	< 0.004	0.078	0.034	
16–Jul–91	925–10	6.99	3.8	0.02	0.12	0.229	< 0.004	0.073	0.026	
17–Jul–91	925–10	6.84	7.4	0.04	0.12	0.216	< 0.004	0.053	0.031	
18–Jul–91	925–10	6.88	5.8	0.05	0.12	0.221	< 0.004	0.058	0.031	
20–Jul–91	925–10	6.83	3.6	0.015	0.13	0.195	< 0.004	0.068	0.028	
21–Jul–91	925–10	6.86	3.4	0.009	0.12	0.190	< 0.004	0.068	0.033	
22–Jul–91	925–10	6.76	2.2	0.012	0.12	0.200	< 0.004	0.068	0.035	
23–Jul–91	925–10	6.78	3.4	0.011	0.13	0.205	< 0.004	0.068	0.038	
24–Jul–91	925–10	6.75	3.4	0.015	0.13	0.210	< 0.004	0.068	0.038	
25–Jul–91	925–10	6.92	2.8	0.011	0.13	0.210	< 0.004	0.068	0.038	
26–Jul–91	925–10	6.69	12.6	0.007	0.17	0.213	< 0.004	0.068	0.040	
27–Jul–91	925–10	6.74	4.2	0.006	0.07	0.210	< 0.004	0.070	0.033	
24–Aug–92	925–10	7.09	3.0	0.042	0.032	0.266	< 0.004	0.090	0.015	
25–Aug–92	925–10	7.20	3.6	0.026	0.038	0.261	< 0.004	0.085	0.013	
26–Aug–92	925–10	7.22	1.6	0.03	0.036	0.254	< 0.004	0.085	0.013	
27–Aug–92	925–10	7.32	1.6	0.02	0.037	0.254	< 0.004	0.080	0.010	
28–Aug–92	925–10	7.32	n/a	0.03	0.034	0.259	< 0.004	0.081	0.006	9
29–Aug–92	925–10	7.31	n/a	0.02	0.038	0.274	< 0.004	0.086	0.018	8
30–Aug–92	925–10	7.28	1.8	0.02	0.034	0.266	< 0.004	0.084	0.010	8
31–Aug–92	925–10	7.19	2.6	0.019	0.037	0.284	< 0.004	0.084	0.009	6
01–Sep–92	925–10	7.11	1.8	0.02	0.036	0.271	< 0.004	0.084	0.010	6
02–Sep–92	925–10	7.29	1.0	0.03	0.036	0.276	< 0.004	0.086	0.006	6
03–Sep–92	925–10	7.32	29.5	0.02	0.033	0.284	< 0.004	0.076	0.013	5
05–Sep–92	925–10	7.14	2.6	0.04	0.037	0.256	< 0.004	0.079	0.008	4
06–Sep–92	925–10	7.07	17.8	0.02	0.032	0.261	< 0.004	0.084	0.008	4

ECHO BAY MINES LTD.
LUPIN MINE; WATER LICENCE N7L3–0925
ENVIRONMENTAL ANALYSIS SUMMARY

1995 LICENCE RENEWAL SUMMARY; STATION 925–10

– All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	Zn	TOTAL METALS Pb	Ni	Cu	TEMP °C
EFFLUENT QUALITY LIMITS		>6.0	15	0.8	0.5	0.3	0.05	0.1	0.15	
07–Sep–92	925–10	7.25	4.4	0.03	0.032	0.264	< 0.004	0.076	0.010	5
08–Sep–92	925–10	7.10	4.4	0.02	0.050	0.254	< 0.004	0.089	0.009	4.5
09–Sep–92	925–10	7.06	1.0	n/a	0.033	0.260	< 0.004	0.080	0.014	4.0
10–Sep–92	925–10	7.07	1.2	0.02	0.034	0.258	0.005	0.078	0.011	4.5
11–Sep–92	925–10	7.15	1.0	0.01	0.033	0.255	< 0.004	0.073	0.014	5.3
12–Sep–92	925–10	7.08	1.6	0.01	0.032	0.260	< 0.004	0.075	0.011	5.4
13–Sep–92	925–10	7.11	5.2	0.01	0.052	0.268	< 0.004	0.075	0.011	4.9
14–Sep–92	925–10	7.07	3.4	0.02	0.036	0.260	< 0.004	0.073	0.011	3.4
09–Sep–92	925–10	7.06	1.0	n/a	0.033	0.260	< 0.004	0.080	0.014	4.0
10–Sep–92	925–10	7.07	1.2	0.02	0.034	0.258	0.005	0.078	0.011	4.5
11–Sep–92	925–10	7.15	1.0	0.01	0.033	0.255	< 0.004	0.073	0.014	5.3
12–Sep–92	925–10	7.08	1.6	0.01	0.032	0.260	< 0.004	0.075	0.011	5.4
13–Sep–92	925–10	7.11	5.2	0.01	0.052	0.268	< 0.004	0.075	0.011	4.9
14–Sep–92	925–10	7.07	3.4	0.02	0.036	0.260	< 0.004	0.073	0.011	3.4
15–Jul–93	925–10	7.06	N/A	0.027	0.044	0.235	< 0.008	0.076	0.020	9
16–Jul–93	925–10	7.10	N/A	0.030	0.046	0.219	< 0.008	0.074	0.020	9.5
17–Jul–93	925–10	7.12	N/A	0.023	0.047	0.211	< 0.008	0.070	0.023	9.5
18–Jul–93	925–10	7.14	N/A	0.030	0.046	0.209	< 0.008	0.066	0.013	9
19–Jul–93	925–10	7.13	N/A	0.019	0.048	0.214	< 0.008	0.071	0.023	9
20–Jul–93	925–10	7.17	15.4	0.030	0.046	0.211	< 0.008	0.074	0.025	9.5
21–Jul–93	925–10	7.06	N/A	0.021	0.072	0.175	< 0.005	0.056	0.009	10
23–Jul–93	925–10	7.09	N/A	0.008	0.050	0.226	< 0.020	0.086	0.009	10
24–Jul–93	925–10	7.07	2.1	0.020	0.064	0.215	< 0.020	0.089	0.006	9.5
25–Jul–93	925–10	7.20	4.5	0.016	0.074	0.235	< 0.020	0.092	0.011	10
26–Jul–93	925–10	7.04	2.5	0.024	0.069	0.259	< 0.020	0.097	0.008	10.5
27–Jul–93	925–10	6.91	1.5	0.037	0.060	0.222	< 0.020	0.090	0.006	10
15–Jul–94	925–10	6.82		0.015	0.048	0.214	< 0.004	0.058	0.003	15
16–Jul–94	925–10	6.81		0.012	0.050	0.200	< 0.004	0.065	0.008	15
17–Jul–94	925–10	6.68	2.5	0.010	0.050	0.198	< 0.004	0.065	0.008	16
18–Jul–94	925–10	6.35	2.0	0.012	0.042	0.200	< 0.004	0.063	0.008	15
20–Jul–94	925–10	6.79	1.4	0.011	0.045	0.220	< 0.004	0.070	0.005	15
21–Jul–94	925–10	6.82	2.2	0.012	0.042	0.283	< 0.004	0.070	0.005	15.5
22–Jul–94	925–10	6.53	0.4	0.011	0.043	0.240	< 0.004	0.070	0.005	14
23–Jul–94	925–10	6.38	1.3	0.009	0.038	0.230	< 0.004	0.068	0.003	13
24–Jul–94	925–10	6.37	1.0	0.010	0.042	0.228	< 0.004	0.070	< 0.003	15
25–Jul–94	925–10	6.38	0.7	0.013	0.044	0.263	< 0.004	0.068	0.003	16
26–Jul–94	925–10	6.45	9.7	0.01	0.043	0.253	< 0.004	0.070	0.003	15
27–Jul–94	925–10	6.75	2.6	0.010	0.039	0.228	< 0.004	0.068	< 0.003	15.5
28–Jul–94	925–10	6.47	8.0	0.01	0.041	0.253	0.005	0.073	0.016	15
MAXIMUM VALUE		7.44	29.5	0.15	0.208	0.284		0.097	0.045	

ECHO BAY MINES LTD.
LUPIN MINE; WATER LICENCE N7L3-0925
ENVIRONMENTAL ANALYSIS SUMMARY

1995 LICENCE RENEWAL SUMMARY; STATIONS 925-15, 925-16 AND 925-17

- All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	TOTAL METALS Zn	Pb	Ni	Cu	TEMP °C
19-Aug-92	925-15	8.80	15.3	0.81	0.37	0.144	< 0.004	0.056	0.148	10.5
04-Aug-93	925-15	7.92		0.032	0.042	0.031	0.005	0.060	< 0.001	
10-Aug-94	925-15	8.41	4.6	0.049	0.025	0.020	0.009	0.021	0.009	11.5
19-Aug-94	925-15	8.38	3.7	0.063	0.026	0.028	< 0.004	0.014	0.014	12
26-Jun-91	925-16A	6.75	2.8	0.02	0.11	0.168	< 0.004	0.060	0.021	8.0
04-Jul-91	925-16A	6.97	2.0	0.02	0.11	0.180	< 0.004	0.063	0.021	12.2
27-Jul-92	925-16A	6.72	1.2	< 0.005	0.017	0.358	< 0.004	0.096	0.034	
19-Aug-92	925-16A	7.15	1.6	0.09	0.031	0.289	< 0.004	0.091	0.008	11
01-Jul-93	925-16A	7.07	1.0	0.015	0.027	0.159	< 0.005	0.053	0.009	9.5
10-Jul-93	925-16A	6.98	1.8	0.012	0.033	0.198	0.006	0.081	0.009	
27-Jun-94	925-16A	7.03	3.6	0.034		0.200	< 0.004	0.053	0.010	13.5
12-Jul-94	925-16A	7.53		0.014	0.057	0.209	< 0.004	0.060	0.003	16
28-Jun-90	925-16B	6.27	1.6	0.08	0.17	0.128	< 0.004	0.062	0.052	
26-Jun-91	925-16B	6.64	3.2	0.02	0.11	0.175	< 0.004	0.063	0.021	8.0
04-Jul-91	925-16B	6.95	1.8	0.02	0.10	0.175	< 0.004	0.058	0.019	12.1
27-Jul-92	925-16B	6.65	3.2	0.007	0.016	0.360	< 0.004	0.091	0.036	
19-Aug-92	925-16B	7.15	1.2	0.09	0.032	0.284	< 0.004	0.089	0.009	10.5
01-Jul-93	925-16B	6.58	0.9	0.021	0.032	0.239	< 0.005	0.065	0.014	8
10-Jul-93	925-16B	6.96	1.4	0.018	0.030	0.188	0.006	0.079	0.011	
27-Jun-94	925-16B	6.64	1.4	0.022	0.047	0.220	< 0.004	0.058	0.007	
12-Jul-94	925-16B	6.70		0.008	0.047	0.196	0.005	0.060	0.003	15
26-Jun-91	925-17A	6.68	1.4	0.03	0.09	0.178	< 0.004	0.063	0.024	8.0
04-Jul-91	925-17A	6.99	1.8	0.09	0.10	0.170	< 0.004	0.058	0.021	12.2
27-Jul-92	925-17A	6.65	1.4	0.023	0.017	0.370	< 0.004	0.093	0.036	
19-Aug-92	925-17A	7.06	1.4	0.07	0.030	0.284	< 0.004	0.089	0.009	11
01-Jul-93	925-17A	7.04	1.3	0.020	0.028	0.146	< 0.005	0.053	0.011	10
10-Jul-93	925-17A	7.02	0.8	0.038	0.0285	0.204	< 0.005	0.071	0.016	
27-Jun-94	925-17A	6.82	4.8	0.005	0.041	0.173	< 0.004	0.045	0.005	14
12-Jul-94	925-17A	7.09	<	0.005	0.054	0.251	0.005	0.065	0.005	16
28-Jun-90	925-17B	6.64	3.6	0.06	0.16	0.129	< 0.004	0.053	0.037	
26-Jun-91	925-17B	6.65	1.8	0.02	0.09	0.183	< 0.004	0.060	0.026	8.0
04-Jul-91	925-17B	6.93	2.4	0.02	0.10	0.173	< 0.004	0.053	0.024	12.1
27-Jul-92	925-17B	6.66	1.0	0.012	0.018	0.358	< 0.004	0.096	0.034	15.5
19-Aug-92	925-17B	7.01	1.0	0.10	0.029	0.314	< 0.004	0.091	0.009	11
01-Jul-93	925-17B	6.30	6.0	0.019	0.043	0.351	< 0.005	0.110	0.001	8.5
10-Jul-93	925-17B	6.96	1.6	0.041	0.0265	0.204	< 0.005	0.071	0.016	
27-Jun-94	925-17B	6.41	6.4	0.014	0.042	0.213	0.009	0.053	0.007	
12-Jul-94	925-17B	7.15		0.024	0.051	0.201	< 0.004	0.063	0.005	15.5

ECHO BAY MINES LTD.
LUPIN MINE; WATER LICENCE N7L3–0925
ENVIRONMENTAL ANALYSIS SUMMARY

1995 LICENCE RENEWAL SUMMARY; STATIONS 925–20, 925–21 and 925–22

– All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	TOTAL METALS Zn	Pb	Ni	Cu	TEMP °C
25–Jun–90	925–20	6.20	12.0	0.01	0.0029	0.014	< 0.002	0.012	0.010	
03–Jul–90	925–20	6.31	33.6	0.008	0.0032	0.012	< 0.002	0.009	0.009	
10–Jul–90	925–20	6.70	1.2	0.026	0.095	0.098	< 0.004	0.055	0.012	
16–Jul–90	925–20	6.47	1.2	0.01	0.028	0.115	< 0.002	0.062	0.012	
16–Jul–91	925–20	6.44	7.4	0.004	0.0082	0.004	< 0.002	0.006	0.005	14.5
24–Jul–91	925–20	5.58	3.2	0.021	0.019	0.215	< 0.004	0.096	0.017	18.0
24–Aug–92	925–20	6.40	3.4	0.012	0.019	0.010	< 0.004	0.012	0.011	9
31–Aug–92	925–20	7.35	0.5	0.014	0.014	0.148	< 0.004	0.067	0.006	4.5
08–Sep–92	925–20	6.49	0.4	0.014	0.0125	0.169	< 0.004	0.059	0.007	3.6
12–Jul–93	925–20	5.98	3.4	0.009	0.0027	0.014	< 0.005	0.012	0.006	11.5
21–Jul–93	925–20	6.13	5.5	0.009	0.0054	0.021	< 0.004	0.059	0.006	14
18–Jul–94	925–20	6.02	1.0	0.023	0.011	0.145	< 0.004	0.066	0.007	16
26–Jul–94	925–20	6.71	0.3	0.01	0.0090	0.278	< 0.004	0.060	0.013	18.5
25–Jun–90	925–21	6.50	1.4	< 0.005	0.0003	0.001	< 0.002	0.002	0.001	
03–Jul–90	925–21	6.45	0.8	0.007	0.0005	0.001	< 0.002	< 0.001	0.001	
10–Jul–90	925–21	6.85	0.7	0.015	0.0005	< 0.001	< 0.002	0.001	< 0.001	
16–Jul–90	925–21	6.96	1.0	< 0.005	0.0003	< 0.001	< 0.002	< 0.001	0.001	
16–Jul–91	925–21	6.60	0.5	0.005	0.0002	0.001	< 0.002	0.001	0.002	13.5
24–Jul–91	925–21	6.71	0.6	0.01	0.0004	0.001	< 0.002	0.001	0.002	17.5
24–Aug–92	925–21	6.41	0.2	< 0.005	< 0.0002	0.001	< 0.004	0.001	0.001	8
31–Aug–92	925–21	6.43	0.5	< 0.005	< 0.0002	0.002	< 0.004	0.001	0.001	4
08–Sep–92	925–21	6.88	< 0.2	0.010	< 0.0002	0.001	< 0.004	0.002	0.001	2.1
12–Jul–93	925–21	6.37	0.4	0.011	0.0007	0.001	< 0.005	0.001	0.001	11
21–Jul–93	925–21	6.48	0.6	0.010	0.0008	0.002	< 0.004	0.001	0.001	11.5
18–Jul–94	925–21	6.51	0.6	0.013	0.0002	0.001	< 0.004	0.001	< 0.001	17
26–Jul–94	925–21	6.70	< 0.2	< 0.005	0.0003	0.003	< 0.004	< 0.001	0.002	17.5
03–Mar–90	925–22	5.80	2.2	0.006	0.0053	0.029	< 0.002	0.012	0.004	
25–Jun–90	925–22	6.60	1.9	< 0.005	0.0003	0.003	< 0.002	< 0.002	0.004	
03–Jul–90	925–22	4.80	1.2	0.007	0.0005	0.004	< 0.002	< 0.001	0.001	
10–Jul–90	925–22	6.60	0.6	0.006	0.0024	0.012	< 0.002	0.013	0.002	
16–Jul–90	925–22	6.49	0.7	0.006	0.0033	0.018	< 0.002	0.009	0.003	
09–Jul–91	925–22	6.65	1.1	n/a	0.0009	0.001	< 0.002	0.001	0.001	7.0
16–Jul–91	925–22	6.74	0.6	< 0.005	0.0006	0.001	< 0.002	0.001	0.002	15.0
24–Jul–91	925–22	6.47	0.8	0.013	0.0038	0.026	< 0.002	0.014	0.002	17.0
31–Jul–91	925–22	6.47	0.2	0.003	0.0031	0.058	< 0.002	0.025	0.004	14.1
13–Aug–91	925–22	6.67	1.0	0.003	0.0018	0.008	< 0.002	0.004	0.003	16.5
17–Aug–92	925–22	6.54	0.5	< 0.01	0.0010	0.002	< 0.004	0.002	< 0.001	12.8
24–Aug–92	925–22	6.30	0.3	< 0.005	0.0012	0.001	< 0.004	< 0.001	0.001	9

ECHO BAY MINES LTD.
LUPIN MINE; WATER LICENCE N7L3-0925
ENVIRONMENTAL ANALYSIS SUMMARY

1995 LICENCE RENEWAL SUMMARY; STATION 925-22 cont.

- All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	Zn	TOTAL METALS Pb	Ni	Cu	TEMP °C
31-Aug-92	925-22	6.32	0.2	0.011	0.0042	0.048	< 0.004	0.019	0.004	6
31-Aug-92	925-22-2			0.012	0.0042	0.053	< 0.004	0.017	0.005	
31-Aug-92	925-22-3			0.014	0.0043	0.052	< 0.004	0.018	0.004	
08-Sep-92	925-22	6.33	0.3	0.006	0.0035	0.063	< 0.004	0.025	0.004	3.0
08-Sep-92	925-22-2			< 0.005	0.0040	0.074	< 0.004	0.018	0.005	
08-Sep-92	925-22-3			< 0.005	0.0030	0.049	< 0.004		0.003	
15-Sep-92	925-22	6.64	0.2	0.008	0.0038	0.077	< 0.004	0.039	0.004	5.9
15-Sep-92	925-22-2			0.005	0.0043	0.079	< 0.004	0.030	0.004	
15-Sep-92	925-22-3			0.008	0.0039	0.076	< 0.004	0.031	0.004	
15-Sep-92	925-22	6.64	0.2	0.008	0.0038	0.077	< 0.004	0.039	0.004	5.9
15-Sep-92	925-22-2			0.005	0.0043	0.079	< 0.004	0.030	0.004	
15-Sep-92	925-22-3			0.008	0.0039	0.076	< 0.004	0.031	0.004	
10-Jul-93	925-22-1	6.70		< 0.005	0.0010	0.006	< 0.005	0.001	0.007	11.5
10-Jul-93	925-22-2	6.52		0.005	0.0009	0.004	< 0.005	0.002	0.007	11.5
10-Jul-93	925-22-3	6.50		0.007	0.0008	0.006	< 0.005	0.002	0.005	11.5
12-Jul-93	925-22-1	6.43	0.6	< 0.005	0.0005	0.002	< 0.005	0.001	0.001	11
12-Jul-93	925-22-2	6.44	0.8	< 0.005	0.0007	< 0.001	< 0.005	< 0.001	0.001	11
12-Jul-93	925-22-3	6.43	0.2	0.005	0.0007	0.001	< 0.005	< 0.001	0.001	11
21-Jul-93	925-22-1	6.19 <	0.2	0.010	0.0019	0.019	< 0.004	0.010	0.002	12
21-Jul-93	925-22-2	4.27	0.2	0.013	0.0019	0.020	< 0.004	0.009	0.001	12
21-Jul-93	925-22-3	6.08	0.2	0.011	0.0019	0.020	< 0.004	0.010	0.001	12
29-Jul-93	925-22-1	6.26 <	0.2	< 0.005	0.0014	0.008	< 0.005	0.007	0.003	12
29-Jul-93	925-22-2	6.31		< 0.005	0.0017	0.009	< 0.005	0.007	< 0.001	12
29-Jul-93	925-22-3	6.40		< 0.005	0.0018	0.009	< 0.005	0.007	0.002	12
05-Aug-93	925-22-1	6.25	0.4	0.003	0.0009	0.007	< 0.004	0.001	0.001	13.5
05-Aug-93	925-22-2	6.31	0.4	0.009	0.0015	0.007	0.005	0.002	0.001	13.5
05-Aug-93	925-22-3	6.30	0.1	0.005	0.0014	0.008	< 0.004	0.001	0.001	13.5
13-Aug-93	925-22-1	6.90	0.4	0.006	0.0009	0.004	< 0.004	0.003	0.001	
13-Aug-93	925-22-2	6.12	0.4	0.007	0.0008	0.004	< 0.004	0.003	0.001	
13-Aug-93	925-22-3	6.29	0.5	0.005	0.0010	0.004	< 0.004	0.003	0.001	
11-Jul-94	925-22	6.36	0.5	< 0.005	0.0011	0.002	< 0.004	0.002	< 0.001	17
18-Jul-94	925-22	6.68	1.2	< 0.005	0.0016	0.001	< 0.004	0.002	< 0.001	16
26-Jul-94	925-22	6.18 <	0.2	0.005	0.0018	0.053	< 0.004	< 0.001	0.003	16.5
07-Aug-94	925-22	5.65 <	0.2	0.015	0.0014	0.059	< 0.004	0.021	< 0.001	14
18-Aug-94	925-22	6.16	1.2		0.0010	0.034	< 0.004	0.017	< 0.001	13
18-Aug-94	925-22-2				0.0011	0.032	< 0.004	0.018	< 0.001	
18-Aug-94	925-22-3				0.0010	0.032	< 0.004	0.018	< 0.001	

ECHO BAY MINES LTD.
LUPIN MINE; WATER LICENCE N7L3-0925
ENVIRONMENTAL ANALYSIS SUMMARY

1995 LICENCE RENEWAL SUMMARY; STATIONS 925-23 and 925-24

- All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	TOTAL METALS Zn	Pb	Ni	Cu	TEMP °C
03-Mar-90	925-23	5.90	0.5	0.008	0.0026	0.021	< 0.002	0.007	0.004	
11-Jul-94	925-23	6.40	0.5	< 0.005	0.0010	0.002	< 0.004	0.001	< 0.001	18
11-Jul-94	925-23-2	6.41	0.2	< 0.005	0.0009	0.003	< 0.004	0.002	< 0.001	
11-Jul-94	925-23-3	6.46	0.2	< 0.005	0.0011	0.002	< 0.004	0.002	< 0.001	
18-Jul-94	925-23	6.73	0.7	< 0.005	0.0014	0.002	< 0.004	0.001	< 0.001	16
18-Jul-94	925-23-2	6.71	0.6	< 0.005	0.0013	0.002	< 0.004	0.001	< 0.001	16
18-Jul-94	925-23-3	6.73	0.6	< 0.005	0.0013	0.001	< 0.004	0.001	< 0.001	16
26-Jul-94	925-23	6.18	0.2	< 0.005	0.0008	0.018	< 0.004	0.005	0.002	16.5
26-Jul-94	925-23-2	6.26		< 0.005	0.0009	0.016	< 0.004	0.005	< 0.001	
26-Jul-94	925-23-3	6.29		< 0.005	0.0010	0.015	< 0.004	0.005	< 0.001	
07-Aug-94	925-23	5.70	< 0.2	0.017	0.0009	0.059	< 0.004	0.020	< 0.001	14
07-Aug-94	925-23-2	5.79	< 0.2	0.019	0.0009	0.057	< 0.004	0.019	< 0.001	
07-Aug-94	925-23-3	5.83	0.2	0.014	0.0009	0.050	< 0.004	0.015	< 0.001	
18-Aug-94	925-23	6.34	0.8		0.0008	0.030	< 0.004	0.017	< 0.001	13
03-Mar-90	925-24	6.14	< 0.2	0.003	0.0010	0.008	< 0.002	0.002	0.002	
25-Jun-90	925-24	6.44	4.9	< 0.005	0.0011	0.006	< 0.002	< 0.002	0.005	
03-Jul-90	925-24	6.46	0.8	0.007	0.0005	0.001	< 0.002	< 0.001	0.001	
10-Jul-90	925-24	6.52	1.1	0.003	0.0022	0.025	< 0.002	0.005	0.002	
16-Jul-90	925-24	6.50	0.5	0.007	0.0020	0.009	< 0.002	0.003	0.002	
09-Jul-91	925-24	6.70	1.3	0.004	0.0010	0.001	< 0.002	0.001	0.001	6.6
16-Jul-91	925-24	6.59	0.4	0.008	0.0008	0.001	< 0.002	0.001	0.001	12.0
24-Jul-91	925-24	6.35	0.2	0.013	0.0010	0.006	< 0.002	0.003	0.002	10.5
31-Jul-91	925-24	6.59	0.6	0.002	0.0012	0.013	< 0.002	0.006	0.003	11.3
13-Aug-91	925-24	6.67	0.3	0.033	0.0002	0.006	< 0.002	0.004	0.002	12.0
17-Aug-92	925-24	6.49	0.4	< 0.01	0.0005	0.002	< 0.004	0.002	< 0.001	10.4
24-Aug-92	925-24	6.24	0.2	< 0.005	0.0007	0.001	< 0.004	0.001	0.001	8
31-Aug-92	925-24	6.37	0.4	< 0.005	0.0009	0.001	< 0.004	0.001	0.001	7
08-Sep-92	925-24	6.34	< 0.2	0.01	0.0012	0.015	< 0.004	0.005	0.001	4.2
15-Sep-92	925-24	6.24	0.3	< 0.005	0.0020	0.020	< 0.004	0.007	0.001	5.9
22-Sep-92	925-24	6.21	< 0.2	< 0.005	0.0011	0.017	< 0.004	0.008	0.003	1.1
15-Sep-92	925-24	6.24	0.3	< 0.005	0.0020	0.020	< 0.004	0.007	0.001	5.9
22-Sep-92	925-24	6.21	< 0.2	< 0.005	0.0011	0.017	< 0.004	0.008	0.003	1.1
10-Jul-93	925-24	6.62		0.006	0.0007	0.005	< 0.005	0.002	0.006	10
12-Jul-93	925-24	6.66	0.2	< 0.005	0.0009	< 0.001	< 0.005	0.001	0.002	10.5
21-Jul-93	925-24	6.28	0.4	0.006	0.0014	0.007	< 0.004	0.005	0.002	12
29-Jul-93	925-24	6.32	0.3	0.007	0.0016	0.014	< 0.005	0.008	0.002	12
05-Aug-93	925-24	6.24	0.4	0.012	0.0011	0.007	0.004	0.002	< 0.001	13
13-Aug-93	925-24	6.33	0.5	0.004	0.0010	0.003	< 0.004	0.002	0.001	
11-Jul-94	925-24	6.43	0.8	< 0.005	0.0007	0.003	< 0.004	0.002	< 0.001	12
18-Jul-94	925-24	6.70	0.7	< 0.005	0.0009	0.002	< 0.004	0.002	< 0.001	12
26-Jul-94	925-24	6.36	0.9	< 0.005	0.0005	0.011	< 0.004	0.001	0.004	12
07-Aug-94	925-24	6.08	< 0.2	0.012	0.0004	0.033	< 0.004	0.012	< 0.001	11
18-Aug-94	925-24	6.09	0.5		0.0005	0.025	< 0.004	0.012	< 0.001	11

ECHO BAY MINES LTD.
LUPIN MINE; WATER LICENCE N7L3–0925
ENVIRONMENTAL ANALYSIS SUMMARY

1995 LICENCE RENEWAL SUMMARY; STATION 925–25 and FIELD BLANKS

– All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	TOTAL METALS Zn	Pb	Ni	Cu	TEMP °C
03–Mar–90	925–25	6.24 <	0.2	0.001	0.0012	0.003	< 0.002	< 0.001	0.002	
25–Jun–90	925–25	6.30	4.1	< 0.005	0.0003	0.004	< 0.002	< 0.002	0.009	
03–Jul–90	925–25	6.40	0.4	0.01	0.0005	0.002	< 0.002	< 0.001	0.001	
10–Jul–90	925–25	6.62	0.4	0.007	0.0006	0.006	< 0.002	< 0.001	< 0.001	
16–Jul–90	925–25	6.69	0.8	0.007	0.0005	0.002	< 0.002	0.001	0.002	
09–Jul–91	925–25	6.62	0.6	0.003	0.0010	0.001	< 0.002	0.001	0.001	5.4
16–Jul–91	925–25	6.56	0.2	0.006	0.0006	0.001	< 0.002	0.001	0.002	7.0
24–Jul–91	925–25	6.51	0.6	0.008	0.0002	0.003	< 0.002	0.002	0.002	8.0
31–Jul–91	925–25	6.65	0.8	0.002	0.0007	0.007	< 0.002	0.003	0.002	9.3
13–Aug–91	925–25	6.75	0.3	0.033	0.0003	0.005	< 0.002	0.002	0.002	10.5
17–Aug–92	925–25	6.40 <	0.2	< 0.01	0.0003	0.002	< 0.004	0.002	< 0.001	8.9
24–Aug–92	925–25	6.25 <	0.2	0.005	0.0006		< 0.004	< 0.001	< 0.001	8
31–Aug–92	925–25	6.12	0.4	< 0.005	0.0005	0.003	< 0.004	0.002	0.001	7
08–Sep–92	925–25	6.56	0.3	0.005	0.0003	0.001	< 0.004	0.001	0.001	5.3
15–Sep–92	925–25	6.51	0.3	< 0.005	0.0005	0.006	< 0.004	0.002	0.001	6.5
22–Sep–92	925–25	6.63	0.2	< 0.005	0.0005	0.004	< 0.004	0.003	0.004	2.6
15–Sep–92	925–25	6.51	0.3	< 0.005	0.0005	0.006	< 0.004	0.002	0.001	6.5
22–Sep–92	925–25	6.63	0.2	< 0.005	0.0005	0.004	< 0.004	0.003	0.004	2.6
12–Jul–93	925–25	6.45	0.2	< 0.005	0.0006	0.001	< 0.005	< 0.001	0.002	4.5
21–Jul–93	925–25	6.30 <	0.2	< 0.005	0.0010	0.003	< 0.004	0.002	0.001	12
29–Jul–93	925–25	6.41	0.4	< 0.005	0.0012	0.005	< 0.005	0.008	0.001	12
05–Aug–93	925–25	6.30	0.4	0.004	0.0008	0.003	< 0.004	< 0.001	< 0.001	11
13–Aug–93	925–25	6.44	0.3	0.004	0.0007	0.002	< 0.004	0.001	0.001	
11–Jul–94	925–25	6.40	0.5	< 0.005	0.0005	0.003	< 0.004	0.001	< 0.001	11.5
18–Jul–94	925–25	6.65	0.4	< 0.005	0.0004	0.001	< 0.004	0.002	< 0.001	9
26–Jul–94	925–25	6.40	0.8	< 0.005	0.0004	0.006	< 0.004	0.001	0.002	10
07–Aug–94	925–25	6.22	0.4	0.006	0.0003	0.004	< 0.004	0.001	< 0.001	10
18–Aug–94	925–25	6.11	0.6		0.0004	0.020	< 0.004	0.011	< 0.001	10.5
24–Aug–92	FIELD BLK			< 0.005		0.001	< 0.004	< 0.001	< 0.001	
31–Aug–92	FIELD BLK			< 0.005 <	0.0002	0.004	< 0.004	0.001	0.001	
08–Sep–92	FIELD BLK			0.006 <	0.0002	< 0.001	< 0.004	0.001	0.001	
15–Sep–92	FIELD BLK			< 0.005	0.0003	0.012	< 0.004	< 0.001	0.004	
22–Sep–92	FIELD BLK			< 0.005	0.0002	< 0.001	< 0.004	0.002	0.005	
15–Sep–92	FIELD BLK			< 0.005	0.0003	0.012	< 0.004	< 0.001	0.004	
22–Sep–92	FIELD BLK			< 0.005	0.0002	< 0.001	< 0.004	0.002	0.005	
10–Jul–93	FIELD BLK			< 0.005	0.0007	< 0.001	< 0.005	0.001	0.009	
12–Jul–93	FIELD BLK			< 0.005 <	0.0002	< 0.001	< 0.005	< 0.001	0.003	
21–Jul–93	FIELD BLK			< 0.005 <	0.0002					
29–Jul–93	FIELD BLK			< 0.005	0.0012	0.017	< 0.005	0.013	< 0.001	
05–Aug–93	FIELD BLK			< 0.005	0.0005	0.004	< 0.004	< 0.001	< 0.001	
13–Aug–93	FIELD BLK			< 0.005		< 0.001	< 0.004	< 0.001	< 0.001	
11–Jul–94	FIELD BLK				0.0002					
18–Jul–94	FIELD BLK			< 0.005		0.004	< 0.004	< 0.001	< 0.001	
26–Jul–94	FIELD BLK			< 0.005		0.015	< 0.004	< 0.001	< 0.001	
07–Aug–94	FIELD BLK			< 0.005 <	0.0002					

ECHO BAY MINES LTD.
LUPIN MINE; WATER LICENCE N7L3-0925
ENVIRONMENTAL ANALYSIS SUMMARY

1995 LICENCE RENEWAL SUMMARY; STATIONS 925-01 and 925-14

- All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total As	Zn	TOTAL METALS Pb	Ni	Cu	Cd	Hg	Ca	Mg	NO2/NO3	Cl	SO4	COND. umhos	F-col #/100mL	BOD5
07-Jan-90	925-01	6.80	<1	0.0009	< 0.002	< 0.002	< 0.01	0.01	< 0.003	0.0012	2.20	0.8	<0.05	0.5	2.0	13	<1	
30-Jul-90	925-01	6.80	<1	0.0010	0.010	< 0.050	< 0.01	0.01	< 0.002	0.0013					12			
30-Mar-91	925-01	5.90	<1	0.0006	0.029	0.004	< 0.008	0.009	0.005	0.0014							<1	
07-Apr-92	925-01	6.80	3.0	< 0.0002	0.006	< 0.002	< 0.001	< 0.001	< 0.001	0.0025							<1	
13-May-93	925-01		2.0	0.0004	< 0.001	< 0.001	< 0.001	< 0.001	< 0.002	< 0.0002							<1	
21-Apr-94	925-01	6.70	3.0	0.0003	< 0.004	0.001	< 0.002	< 0.001	< 0.002	0.0002							<1	
04-Jun-90	925-14	5.50	4.0	0.016	0.051	< 0.002	0.022	< 0.004									81	7.0
09-Jul-90	925-14	6.80	2.0	0.004	0.047	< 0.004	0.013	0.009									43	2.0
30-Jul-90	925-14	6.20	5.0	0.009	0.072	< 0.050	< 0.010	0.012									<1	2.0
27-Aug-90	925-14	5.60	1.4	0.005	0.052	< 0.004	0.014	0.006									3000	1.0
03-Oct-90	925-14	4.70	3.0															
06-Jun-91	925-14	5.10	11.0	0.04	0.075	< 0.001	0.019	0.010									<1	1.0
05-Jul-91	925-14	6.50	4.0	0.0044	0.040	< 0.002	0.012	< 0.001									2	1
09-Aug-91	925-14	6.10	3	0.0043	0.085	0.002	0.023	0.006									4	<1
05-Sep-91	925-14	5.60	3	0.0064	0.088	< 0.002	0.026	0.006									3	1
08-Jun-92	925-14	5.90	17.0	0.064	0.080	< 0.002	0.023	0.008									<1	2.3
02-Jul-92	925-14	6.70	2.0	0.0059	0.057	0.002	0.008	0.006									<1	0.5
06-Aug-92	925-14	6.00	11.0	0.0048	0.176	< 0.002	0.020	0.003									3	3.7
14-Sep-92	925-14	4.70	6.0	0.0064	0.133	0.001	0.006	0.003									2	1.0
10-Jun-93	925-14	6.40	14.0	0.024	0.063	0.001	0.013	0.014									<1	4
12-Jul-93	925-14	6.60	6.0	0.019	0.130	< 0.001	0.029	0.027									<1	2
23-Sep-93	925-14	6.40	101	0.018	0.160	0.003	0.047	0.023									4	6
10-Jun-94	925-14	7.00	12.0	0.009	0.043	< 0.001	0.009	0.007									35	2
08-Jul-94	925-14	6.00	9.0	0.008	0.038	< 0.001	0.017	0.007										
01-Sep-94	925-14	5.98	2.0	0.0161	0.069	< 0.004	0.030	< 0.005										

NOTE: All reported analyses results for Stations 925-01 and 925-14 have been completed by Norwest Labs Ltd., Edmonton, Alberta

ECHO BAY MINES LTD.
ENVIRONMENTAL ANALYSIS SUMMARY

AVERAGE ANNUAL DECANT ANALYSES AT STATION 925–10

– All units are in mg/l except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	Zn	Pb	TOTAL METALS Ni	Cu	VOLUME (m^3)
	MAC	>6	15	0.8	0.5	0.3	0.05	0.1	0.15	N/A
AVG 1990	925–10	6.98	5.1	0.09	0.19	0.128 <	0.004	0.052	0.029	837,246
AVG 1991	925–10	6.82	4.8	0.019	0.12	0.208 <	0.004	0.067	0.034	771,280
AVG 1992	925–10	7.18	4.2	0.022	0.036	0.264 <	0.004	0.081	0.011	1,214,636
AVG 1993	925–10	7.09	4.3	0.022	0.056	0.219 <	0.02	0.068	0.014	704,575
AVG 1994	925–10	6.585	2.8	0.011	0.043	0.233 <	0.004	0.063	0.005	863,868

MAC = Maximum Average Concentration as per Water Licence

ECHO BAY MINES LTD.
ENVIRONMENTAL ANALYSIS SUMMARY

AVERAGE ANNUAL DECANT ANALYSES AT STATION 925-14

- All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total As	Zn	TOTAL METALS Pb	Ni	Cu	BOD5	F-col #/100mL	VOLUME (m^3)
	MAC	>6.0	35	0.05	0.50	0.05	0.3	0.2	30	1000	
1990	925-14	6.12	2.3	0.008	0.050	< 0.004	0.016	0.007	3	780	308,765
1991	925-14	5.70	5.0	0.010	0.070	< 0.004	0.022	0.013	2	1	316,500
1992	925-14	5.50	7.8	0.011	0.064	< 0.004	0.016	0.009	2	2	235,770
1993	925-14	6.06	16.7	0.013	0.116	< 0.004	0.021	0.011	4	2	217,140
1994	925-14	6.15	11.8	0.008	0.046	< 0.004	0.017	0.006	2	13	215,380

ALL ANALYSES CARRIED OUT IN THE LUPIN ENVIRONMENTAL LAB WITH THE EXCEPTION OF BOD5 AND F-COLIFORMS WHICH WERE COMPLETED BY NORWEST LABS LTD., EDMONTON

MAC = Maximum Average Concentration as per Water Licence

ECHO BAY MINES LTD.
ENVIRONMENTAL ANALYSIS

TAILINGS EFFLUENT LOADING TO SUN BAY; CONTWOYTO LAKE

1985 THROUGH TO 1994

– measured in Kg

DATE	SAMPLING STATION	NFR	Total CN	Total As	Zn	TOTAL METALS Pb	Ni	Fe	Cu	VOLUME OF DECANT m³
AVG 1985	925–10	56098	258	2739	819	< 18	163	9043	390	4,413,507
AVG 1986	925–10	112489	1061	1576	613	< 17	209	8211	841	4,126,199
AVG 1987	925–10	7761	272	255	107	< 5	60	1011	252	1,142,687
AVG 1988	925–10	5638	67	376	128	< 5	52	948	86	1,163,214
AVG 1989	925–10	9334	76	457	181	< 5	57	1096	46	1,162,239
AVG 1990	925–10	4233	75	156	107	< 3	43	1036	24	837,246
AVG 1991	925–10	3680	14	95	161	< 3	52	421	26	771,280
AVG 1992	925–10	5154	26	44	321	< 5	99	449	13	1,214,636
AVG 1993	925–10	3053	16	39	154	< 14	48	269	10	704,575
AVG 1994	925–10	2404	10	37	201	3	54	257	4	863,868

Data is based on an average assay during the entire decant period.
Less than figures for Lead are due to results reported as detection limits and change in the volume discharged.

ECHO BAY MINES LTD.
ENVIRONMENTAL ANALYSIS
SURVEILANCE NETWORK PROGRAM

LONG LAKE SAMPLING SUMMARY; 1992 – 1994

– All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	TOTAL METALS Zn	Pb	Ni	Cu	TEMP °C
05–Jun–92	SBASIN–2	6.43		1.76	0.272	0.132	< 0.004	0.034	0.150	
08–Jun–92	SBASIN–2	7.16	1.8	1.09	0.240	0.110	< 0.004	0.030	0.141	
13–Jun–92	SBASIN–2	7.05	1.6	0.89	0.196	0.101	< 0.004	0.027	0.136	2.4
17–Jun–92	SBASIN–2	6.91	0.7	0.46	0.156	0.092	< 0.004	0.021	0.081	
20–Jun–92	SBASIN–2	6.69	1.2	0.35	0.114	0.047	< 0.004	0.022	0.054	5
24–Jun–92	SBASIN–2	6.78	0.4	0.50	0.130	0.050	< 0.004	0.022	0.079	4.5
27–Jun–92	SBASIN–2	7.08	1.4	0.35	0.120	0.045	< 0.004	0.020	0.067	7
01–Jul–92	SBASIN–2	6.97	0.8	0.18	0.107	0.040	< 0.004	0.021	0.057	8
08–Jul–92	SBASIN–2	6.89	0.2	0.07	0.108	0.027	< 0.004	0.018	0.027	7
13–Jul–92	SBASIN–2	6.79	0.6	0.10	0.118	0.031	< 0.004	0.018	0.038	
20–Jul–92	SBASIN–2	6.91	1.0	0.041	0.112	0.023	< 0.004	0.013	0.027	15
06–Aug–92	SBASIN–2	7.26	1.0		0.103	0.006	< 0.004	0.009	0.011	8
10–Aug–92	SBASIN–2	7.05	0.4	0.035	0.102	0.005	< 0.004	0.008	0.010	11.5
17–Aug–92	SBASIN–2	7.03	0.5	0.018	0.092	0.006	< 0.004	0.007	0.011	12
24–Aug–92	SBASIN–2	6.55		0.013	0.084	0.005	< 0.004	0.006	0.010	8.5
08–Sep–92	SBASIN–2	7.00	0.2	0.006	0.069	0.007	< 0.004	0.009	0.010	4.0
09–Feb–93	LONG LK.	7.41	9.0	0.012	0.084	0.010	< 0.004	0.013	0.029	
22–Jul–93	SBASIN–2	6.09	0.3	0.015	0.044	0.005	0.004	0.004	0.008	14
17–Aug–93	LONG LK.	6.55	0.6	0.005	0.083	0.008	< 0.004	0.007	0.007	
02–Nov–93	LONG LK.	6.84	0.6	0.048	0.041	0.007	< 0.004	0.008	0.002	
01–Dec–93	LONG LK.	6.38	0.6	0.003	0.052	0.006	< 0.004	0.007	0.007	
02–Jan–94	LONG LK.	7.06	1.8	0.005	0.045	0.014	< 0.004	0.007	0.009	
06–Feb–94	LONG LK.	6.55	0.8	0.027	0.057	0.013	< 0.004	0.010	0.009	
05–May–94	LONG LK.	7.41	2.5	0.014	0.057	0.013	< 0.004	0.013	0.010	
05–Jul–94	LONG LK.	6.81			0.074	< 0.001	< 0.004	< 0.001	< 0.001	
31–Aug–94	LONG LK.	6.26	0.5	< 0.005	0.078	0.003	< 0.004	0.004	0.002	13

ECHO BAY MINES LTD.
ENVIRONMENTAL ANALYSIS
SURVEILANCE NETWORK PROGRAM SUMMARY

SOUTH BASIN

– All units are in mg/L except for pH which is unitless and conductivity, measured in umhos/cm

DATE	SAMPLING STATION	pH	NFR	Total CN	Total As	Zn	TOTAL METALS Pb	Ni	Cu	TEMP °C
09–Jun–93	SBASIN3–1	5.75	1.7	0.021	0.055	0.010	< 0.004	0.009	0.007	1.5
09–Jun–93	SBASIN3–2	5.62	1.0	0.022	0.057	0.013	< 0.004	0.009	0.008	
09–Jun–93	SBASIN3–3	5.66	1.1	0.020	0.056	0.015	< 0.004	0.007	0.013	
09–Jun–93	SBASIN 4	5.41	4.8	0.016	0.026	0.005	< 0.004	0.002	0.003	1.5
09–Jun–93	SBASIN 5	4.85	4.8	0.016	0.020	0.006	< 0.004	0.005	0.004	1.5
09–Jun–93	SBASIN 6	4.87	2.2	0.014	0.035	0.006	< 0.004	0.002	0.006	1.5
09–Jun–93	SBASIN 8	5.81	0.6	0.019		0.010	< 0.004	0.008	0.004	1.5
09–Jun–93	SBASIN 9	5.08	0.9	0.010		0.009	< 0.004	0.006	0.013	1.5
22–Jul–93	SBASIN 3	5.14	1.5	0.022		0.039	0.005	0.044	0.014	15.5
22–Jul–93	SBASIN 4	6.25	1.2	0.021		0.004	0.004	0.002	0.005	13
22–Jul–93	SBASIN 5	6.30	0.4	0.020		0.004	< 0.004	< 0.001	0.002	13.5
22–Jul–93	SBASIN 6	6.21	1.8	0.021		0.004	< 0.004	0.002	0.005	12.5
22–Jul–93	SBASIN 8	6.40	0.7	0.019		0.005	< 0.004	0.005	0.009	14
22–Jul–93	SBASIN 9	6.59	0.5	0.014		0.006	0.006	0.010	0.008	14
17–Aug–93	LONG LK#1	6.54	0.5	0.005	0.085	0.010	< 0.004	0.007	0.006	
17–Aug–93	LONG LK#3	6.55	0.4	<0.005	0.088	0.008	< 0.004	0.007	0.006	
10–Jun–94	SBASIN 3	6.20	1.4	<0.005	0.061	0.005	< 0.004	0.010	< 0.001	
10–Jun–94	SBASIN 4	5.91	1.5	0.008	0.056	0.004	< 0.004	0.004	< 0.001	
10–Jun–94	SBASIN4–2	5.84	2.4	0.006	0.056	0.003	< 0.004	0.004	< 0.001	
10–Jun–94	SBASIN4–3	5.80	3.6	<0.005	0.057	0.004	< 0.004	0.004	< 0.001	
10–Jun–94	SBASIN 5	5.77	1.4	0.013	0.057	0.004	< 0.004	0.003	< 0.001	
10–Jun–94	SBASIN 6	6.00	2.2	0.006	0.047	0.004	< 0.004	0.005	< 0.001	
10–Jun–94	SBASIN 8	6.12	1.0	<0.005	0.047	0.003	< 0.004	0.007	< 0.001	
10–Jun–94	SBASIN 9	6.18	1.2	0.005	0.050	0.007	< 0.004	0.009	< 0.001	

APPENDIX D
List of Miscellaneous Studies

LIST OF STUDIES UNDERTAKEN DURING LICENCE TERM 1990-1994

ABANDONMENT/RESTORATION

Acid Rock Drainage Study - March, 1992; Klohn-Leonoff for Echo Bay Mines Ltd. Static tests of Tailings and Waste rock for chemical characterization; a 30 week column leach program (kinetic test) testing cover materials in cold and room temperature environments.

Assessment of Water Chemistry and Remedial Measures for the Lupin Tailings Management System - July, 1992; Klohn-Leonoff for Echo Bay Mines Ltd. Review of water chemistry, past treatment conditions and affects of the exposed tailings area along the N.W. corner of Pond No.2 were investigated.

Column Leaching Study; Evaluation of ARD Control Measures - December, 1993; Klohn-Leonoff for Echo Bay Mines Ltd. Investigation of ARD control measures for the tailings deposition area utilized between 1982 and 1985.

Echo Bay Mines Ltd., along with various consultants, have completed the design study and recommendations regarding implementation of a Paste Backfill Process at Lupin. The utilization of tailings material underground will provide additional control and prevention in the difficult task of dealing with material that, given the proper conditions, has the potential to generate acid.

Echo Bay Mines Ltd. plans to retain the services of Klohn-Crippen (Klohn-Leonoff) to assist in the continual development of the tailings management plan. This is to include a Test Cover Plot and monitoring program within the filled portion of Cell No.1; initiated in 1994. As well, an assessment of an area covered with esker material in 1987 adjacent to Cell No.1 will be completed.

Evaporation Studies At The Lupin Mine Site Using Stable Isotopes, 1991-94; Department of Earth Sciences, University of Waterloo. The principal objectives are to measure evaporation and water balance of tailings pond treatment systems in northern climates; and to calibrate an isotope mass balance model to be used as an operational method for characterizing water balance of natural lakes and tailings ponds. This information is expected to provide a valuable tool in the assessment of eventual closure strategies for the Lupin Tailings Impoundment.

FISHERIES RELATED STUDIES

Echo Bay Mines Ltd. has continued to carry out or provide support for environmental monitoring programs related to the decant pathway of the tailings impoundment discharge and the receiving water body. These studies are a continuation of the Aquatics Studies Program of 1983 to 1985 and 1988. The most recent programs included:

- **Fisheries Investigations at the Lupin Gold Mine, Contwoyto Lake, NT, 1990;** Fish Tissue Metal Analysis - R.L. & L. Environmental Services, and Seep Creek Investigations - Dept. of Fisheries and Oceans.
- **Application of Selected Monitoring Methods to the Assessment of Impacts on Contwoyto Lake from Lupin Mine Effluent. Phase 2-Longterm Assessment; 1990.** Environmental Protection, Conservation & Protection, Northwest Territories District Office, Yellowknife, NT. **DRAFT ONLY**-March 1991.

FISHERY STUDIES CONTINUED

- **Metal Concentration in Fish Tissue - Contwoyto Lake, NT; Echo Bay Mines Ltd., 1993;** R.L. & L. Environmental Services Ltd., report currently in the Draft stage.
- **Movements of Lake Trout In The Sun Bay Area And West Arm Of Contwoyto Lake., 1994-1995;** R.L. & L. Environmental Services Ltd., work is currently in progress.

OTHER STUDIES

Echo Bay Mines Ltd. initiated and has continued studies in regard to a spill that occurred between the 30th of May, 1992 and the 5th of June, 1992. This spill resulted in the release of deleterious substances into waters frequented by fish, locally known as Long Lake and its associated waters.

Studies continue to date with regard to Long Lake and the natural establishment of a fisheries population. These studies are listed below:

- **1992 Fisheries Investigation of Long Lake Near The Lupin Gold Mine, Contwoyto Lake, NT; September 1992.** R.L.&L Environmental Services Ltd., Edmonton, Alberta
- **1992 South Basin Fishery Inventory Study** (Included fish tissue metal analysis). R.L.&L. Environmental Services Ltd., Edmonton, Alberta
- **1993 Long Lake/South Basin Arctic Grayling Study, July/August 1993.** R.L.&L. Environmental Services Ltd., Edmonton, Alberta; report in draft stage.

APPENDIX E
Acid Base Accounting

KLOHN-CRIPPEN

November 23, 1994

Echo Bay Mines Ltd.
Lupin Operations
Bag #1
Nisku, Alberta
T0C 2G0

David Hohnstein, CET
Manager, Environmental Affairs

Dear Mr. Hohnstein:

ABA Test Report Interpretation

This letter report is a brief interpretation of the ABA test results mailed to you on September 7, 1994 (our project number: PB 6745 0101). In summary, the waste rock samples have a very low acidic drainage generation potential and the tailings samples will probably produce acidic drainage, but currently are not.

The six waste rock samples submitted have a neutralization potential to maximum acidity potential ratio (NP:MPA) greater than three, the value above which it is accepted that there is no concern with respect to ARD. This is due to the low sulphide content and the neutralization potential in excess of the maximum acidity potential. Three of the samples have NP:MPA values greater than four, due to the lower sulphur content, and thus further lowering the potential for acidic drainage. The paste pH values measured for the waste rock samples are neutral to alkaline, indicating that significant amounts of sulphide oxidation has not occurred within the waste rock samples.

The two tailings samples have an NP:MPA ratio less than one, the value below which there is insufficient neutralizing capability to counteract the acidity produced. The tailings have a significantly higher amount of sulphur, relative to the waste rock samples, and a decreased amount of neutralization potential, resulting in an insufficient amount of neutralization potential to consume all the acidity that may be produced if ARD develops. Consequently, the tailings material has a high probability of producing acidic drainage if it is exposed to the appropriate environment. This is expected in tailings material generated at the Lupin Mine, based on our previous experience. However, the paste pH values are slightly alkaline, suggesting that there is no appreciable amounts of oxidation that has occurred.

If you have any questions regarding the interpretation, please call me at 279-4366.

Yours very truly,

KLOHN-CRIPPEN CONSULTANTS LTD.

Diana Sollner, EIT
Project Engineer

Klohn Crippen Environmental Laboratory
ACID BASE ACCOUNTING TEST REPORT

LUPIN
Project

Project No.: PB67450101

Date Reported : 31-Aug.-94
Page: 1
of: 1

	Sample I.D.	S (tot) %	Paste pH	NP	MPA	NNP	NP/MPA Ratio
1.	1	0.62	7.91	63.57	19.37	44.20	3.28
2.	2	0.57	7.93	64.22	17.81	46.41	3.61
3.	3	0.59	7.92	67.99	18.44	49.55	3.69
4.	4	0.35	8.03	53.17	10.94	42.23	4.86
5.	5	0.41	8.09	67.99	12.81	55.18	5.31
6.	6	0.48	7.92	62.40	15.00	47.40	4.16
7.	Dup. of 6	0.47	7.93	61.75	14.69	47.06	4.20
8.	Tailings 1	2.75	8.86	49.40	85.94	-36.54	0.58
9.	Tailings 2	2.58	8.52	45.76	80.62	-34.86	0.57
10.	Canmet Tails Std.(1.66% S)	1.63					

R. Kaplan

Rima Kaplan, P.Eng.
Laboratory Manager

Notes :

1. Analytical methods employed are described in "Field and Laboratory Methods Applicable to Overburden and Minesoils", EPA 600/2-78-054, pp. 45-55, 1978
2. NP = Neutralization Potential, as determined by acid consumption test
   MPA = Maximum Potential Acidity (calculated from total sulphur content by %S (tot) x 31.25)
   NNP (Net Neutralization Potential) = NP - MPA
3. NP, MPA and NNP are expressed in tonnes $CaCO_3$ equiv. per 1000 tonnes sample
4. Samples with negative NNP are potential acid producers