Tamias Associates

Column leaching characteristics of Cullaton Lake B and Shear Zone tailings.

Phase 2: Cold temperature leaching
FINAL REPORT

prepared by:

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June 1996

Work performed for Homestake Canada Ltd. by the Elliot Lake Laboratory of CANMET (Centre for Mineral and Energy Technology).

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Preface

This report contains the results of work carried out by Dr. Nand Davé of the Elliot Lake laboratory, Canada Center for Mineral and Energy Technology (CANMET), Natural Resources Canada (NRCan), Elliot Lake, Ontario.

Dr. Davé heads the Surface Environmental Research Laboratory in Elliot Lake and researches mechanisms of Acid Rock Drainage, and tests methods of controlling this phenomenon. This report describes experiments conducted to understand the Acid Rock Drainage mechanism at cold temperatures.

The assistance of Ms. D. Horne, Ms. Y. Boucher, and Mr. T. P. Lim in this work is gratefully acknowledged.

Column Leaching Characteristics of Cullaton Lake B and Shear (S) - Zones Tailings Phase 2: Cold Temperature Leaching

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EXECUTIVE SUMMARY

Cold temperature column leaching tests at 2 °C and 10 °C were conducted for Cullaton Lake B and Shear (S) - Zones tailings to evaluate their oxidation and leaching characteristics at low ambient temperatures. The tests were an extension of an earlier room temperature study at 25 °C (Phase 1) in which both B and S - Zones tailings produced acidic drainage under laboratory simulation conditions (Davé, 1992).

The low temperature leaching studies were designed to simulate conditions similar to those expected within the tailings at the Cullaton Lake site after implementation of a decommissioning plan of covering the tailings with approximately 1.5 m of wasterock and overburden for promoting freezing and permafrost conditions within the tailings. It was anticipated that during the frost free period some of the tailings might thaw to temperatures ranging between 0 °C and 10 °C.

These tests were conducted in clear acrylic columns, 12.5 cm in diameter and 80 cm high. Duplicate columns were filled with well mixed tailings from each zone, inoculated with a solution containing *Thiobacillus ferrooxidans* culture and placed in a walk-in refrigerated experimental cold chamber. The tailings were allowed to weather under unsaturated

conditions at the desired cold temperatures of 2 °C and 10 °C, and leached by rinsing with well aerated natural lake water chilled to the same experimental temperature.

The leaching scheme consisted of batch additions of 1 l (litre) natural lake water, once every one or two weeks, to each experimental column undergoing weathering. The columns were allowed to drain freely during the intermediate period. Effluent was collected and analyzed for pH, redox potential (Eh), electrical conductance (Ec), total acidity, total alkalinity, and dissolved concentrations of SO_4^{2-}, total Fe, Ca, Mg, Al, Mn, Sb, As, Cu, Ni, Zn, Pb, Hg, Si, and CN^{1-}. The tailings were first weathered and leached at 2 °C for two years, and then at 10 °C for another year. For starting the leaching experiment at 10 °C, the experimental chamber and tailings were warmed to the desired temperature, individual tailings homogenized and the columns recharged. The column leaching results are as follows:

- Oxidation and acid generation occurred in both B and S - Zones tailings at low (2 °C) and intermediate (10 °C) temperatures. The rate of acid generation was low and the occurrence of acidic drainage was delayed at these temperatures compared to those observed at 25 °C in the previous study by Davé (1992).

- The B - Zone tailings contained relatively high sulphide (2.31% as S) and high total available alkalinity (45.36 kg $CaCO_3$/tonne tailings), and had a large negative net neutralization potential (NNP) of -26.84 kg $CaCO_3$/tonne tailings. The acid generation rate in the tailings at 2°C was low such that a reasonable degree of acid neutralization was achieved and acidic drainage prevented during most of the leaching period at this temperature.

- Acidic drainage occurred near the end of the leaching period at 2 °C but the overall impact in terms of total acidity and effluent metal loading was low.

- Near the end of the two year leaching at 2 °C, the drainage effluent was characterized by a pH of ~ 6.6, acidity ~ 300 mg $CaCO_3$ /l, and concentrations of SO_4^{2-} at ~ 2,000 mg/l, Fe ~ 150 mg/l, Ca ~ 500 mg/l, Mg ~ 100 mg/l, Al ~ 0.15 mg/l, and Mn ~ 20 mg/l. Trace amounts of As ~ 0.1 mg/l, Ni ~ 0.1 mg/l, and Pb ~ 0.5 mg/l were also observed. Cu, Sb, Hg, and Zn levels were below detection limits.

- A cumulative total of 21% of the total sulphur contained in the B - Zone tailings was mobilized and removed as total sulphate in the effluent during the two year leaching period at 2 °C. Approximately 10% of this total sulphur was present in the soluble form which leached rapidly, within two months, at the beginning of the experiment. The remaining ~ 11% of the total sulphur was removed as a result of acid generation and neutralization at 2 °C.

- The magnitude of acidic drainage initially increased for B - Zone tailings during leaching at 10°C. Concentration peaks for acidity, iron and some metals were observed after approximately two months of leaching. The effluent was characterized by a pH of ~ 5.0, moderate acidity ~ 850 mg $CaCO_3$/l, and concentrations of SO_4^{2-} at ~ 3,500 mg/l, Fe ~ 450 mg/l, Ca ~ 500 mg/l, Mg ~ 100 mg/l, Al ~ 0.2 mg/l, and Mn ~ 22 mg/l. Low concentrations of As ~ 0.2 mg/l, Ni ~ 0.15 mg/l, Pb ~ 0.5 mg/l, and Sb ~ 0.05 mg/l, were also observed, but Cu, Hg, and Zn levels were below detection. After peaking, the magnitude of the acidic drainage gradually decreased with time to a low level in the last six months of leaching.

- A cumulative total of 5.3% of the total sulphur contained in the B- Zone tailings was further mobilized and released during one year of leaching at 10 °C.

- In contrast to the room temperature (25°C) leaching of the B - Zone tailings (Davé, 1992), the above results indicated very slow oxidation at 2°C and an initial slight to moderate oxidation during leaching at 10°C. The overall impact of acidic drainage from B - Zone tailings was low, in the short term, at colder temperatures due to

complete acid neutralization. The tailings retained appreciable amounts of moisture (85-100% pore volume saturation) during laboratory leaching, which further limited oxidation and acidification, thereby controlling acidic drainage and reducing its impact.

- The S - Zone tailings contained relatively low sulphide (0.4% as S) and low total available alkalinity (2.0 kg $CaCO_3$/tonne tailings), and had a moderate negative net neutralization potential (NNP) of -10.5 kg $CaCO_3$/tonne tailings. The acid generation rate in these tailings was also low at 2 °C, but because of low available alkalinity there was insufficient acid neutralization and acidic drainage occurred early in the 2 °C leaching period.

- During the middle of the two year leaching period at 2 °C, acid drainage peaked where effluent was characterized with a pH of ~ 3.0, moderate acidity ~ 600 mg $CaCO_3$/l, and dissolved concentrations of SO_4^{2-} at ~ 700 mg/l, Fe ~ 175 mg/l, Al ~ 25 mg/l, Mn ~ 30 mg/l, As ~ 0.4 mg/l, Cu ~1.2 mg/l, Ni ~ 1.0 mg/l, Zn ~0.4 mg/l, Pb ~ 2.0 mg/l, and Si ~ 50 mg/l. Effluent concentrations of Ca and Mg were low at 30 and 10 mg/l respectively. Sb was present at trace levels, ~ 0.03 mg/l, and Hg levels were below detection.

- A cumulative total of 42% of the total sulphur contained in the S - Zone tailings was mobilized and released during the two year leaching at 2 °C. The tailings contained approximately 25% of the total sulphur in the soluble form which was quickly removed within first two months of leaching at 2 °C. Further leaching at 2 °C resulted in an additional mobilization and removal of sulphate in the amount equivalent to 17% of the total sulphur contained in the tailings.

- With the raising of the leaching temperature to 10 °C, the acidic drainage continued and increased in magnitude for S - Zone tailings. Similar to B - Zone tailings, effluent concentration peaks for acidity, iron and metal loading were also observed initially

during leaching at 10°C. The effluent was characterized by a pH of ~ 3.0, moderate acidity of ~ 650 mg $CaCO_3$/l, and dissolved concentrations of SO_4^{2-} at ~ 1,500 mg/l, Fe ~ 225 mg/l, Ca ~ 500 mg/l, Mg ~ 100 mg/l, Al ~ 25 mg/l, Mn ~ 30 mg/l, As ~ 0.2 mg/l, Cu ~ 1.2 mg/l, Ni ~ 1.5 mg/l, Zn ~ 1.0 mg/l, Pb ~ 2.0 mg/l, and Si at 50 mg/l. As was the case for 2°C leaching, the effluent concentrations of Sb were at trace levels, ~ 0.06 mg/l, and Hg concentrations were below detection. The magnitude of the acid drainage, after peaking, also decreased slowly with time to a low level in the last six months of leaching.

- A cumulative total of 13% of the total sulphur contained in the S- Zone tailings was further mobilized and released during one year of leaching at 10 °C.

- The S - Zone tailings were also characterized by a high moisture retention and poor drainage that limited the oxidation, acidification and overall impact to the well drained upper layer.

- In contrast to what was seen with B - Zone tailings, no significant reduction in acidic drainage from S - Zone tailings was observed during leaching at lower temperatures from that of room temperature (25°C) in the earlier study, reflecting the low total available alkalinity and inadequate neutralization in S - Zone tailings.

- It is recommended that the data should be further examined and analyzed to obtain acid generation and metal loading rates at the three study temperatures (25°C, 10°C, and 2°C). Quantitative microbiological studies should also be undertaken to distinguish between (and measure) chemical and biotic oxidation at low temperatures.

- The tailings facility at the Cullaton Lake site should also be assessed for its current physical, chemical, mineralogical and biological status by undertaking suitable field studies.

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1.0 INTRODUCTION

1.1 Background to Study

This report describes the column leaching study of the Cullaton Lake mine tailings and compares cold temperature results to those obtained under warm conditions, and is the second in a series of reports that recommends ways of safely decommissioning the tailings and waste management facilities at the site.

The Cullaton Lake Gold Mines Ltd., owned by Homestake Canada Inc., is located in the district of Nunavut and Keewatin sub-district, Northwest Territories, at 61° 16' north latitude and 98° 30' west longitude. The property is located 416 km northwest of Churchill, Manitoba, and 620 km north of Thompson, Manitoba (Fig. 1). The site is at the tree line and in the zone of continuous permafrost.

The Company (Cullaton Lake Gold Mines Ltd.) operated a 300 tonnes per day gold mill at the site from October 1981 to August 1985 and produced about 100,000 ounces of gold. The site has been on care and maintenance since September 1985, and in 1992 the tailings surface was covered with a 1.5 m layer of wasterock and overburden for promoting freezing and permafrost conditions within the tailings.

The ore milled at the site came from two distinct orebodies referred to as the B - and Shear (S) - Zones. A total of 373,000 tonnes of ore was processed at the mill, of which 150,000 tonnes came from the B - Zone, and the balance of 223,000 tonnes from the Shear (S) - Zone. The B - Zone is located at the mill site, and the Shear (S) - Zone is located approximately 5 km to the north (Fig. 2).

The Cullaton Lake B - Zone deposit was a gold-bearing iron formation in a turbiditic sedimentary basin which formed part of the Rankin Inlet - Ennadi Archean greenstone belt in the Keewatin geological district of the Northwest Territories. The belt consisted of

clastic sediments (turbidites), pillow lavas and iron formations. This assemblage was indicative of an eugeosynclinal environment.

The B - Zone iron formation consisted of four distinct facies, namely, carbonate, silicate, oxide and sulphide. The gold mineralization was confined in a strata bound nature to the sulphide facies iron formation. Pyrrhotite and pyrite were the dominant sulphides with lesser amounts of arsenopyrite and chalcopyrite. Gold occurred free in the non-metalliferous gangue and showed no preference for any one sulphide (Page, 1983; Trow, 1991).

The Shear (S) - Zone was located in a discontinuous ridge outcrop of orthoquartzite. Gold occurred in the fractured and sheared orthoquartzite at the Shear (S) - Zone deposit. Mineralization was found in altered shears, breccia zones, pyritic shears, and pyritic sericitic impure quartzite (Chataway and Hanson, 1983; Trow, 1991).

Because of pyrite, pyrrhotite and other reactive sulphide mineralization of the orebodies, the acid rock drainage related issues from tailings and wasterock needed to be addressed. The Elliot Lake Laboratory, CANMET, Energy, Mines and Resources Canada, Elliot Lake, Ontario, was contracted to conduct detailed kinetic leaching tests on Cullaton Lake B- and S - Zone tailings. Results of column leaching tests performed at room temperature and under conditions of batch leaching and rest cycles have been reported previously (Davé, 1992). This report is on work carried out at low (2 °C) and intermediate (10 °C) temperatures.

Previous tests were of a worst case scenario of favourable oxidation and leaching conditions at room temperature (25 °C). In reality, for most of the year at the northern site, ambient temperatures are quite low where both chemical and biological oxidation processes proceed slowly (Knapp, 1987).

Available data and the RATAP model showed that there was considerable decrease in the rate of oxidation as the temperature approached 0 °C. The relative rate of oxidation reduced to about 10% of the relative rate occurring between 25 °C and 30 °C. However, little is know about further decrease in acid generation rate at temperatures below 0 °C (GEOCON, 1993).

Nearly half of Canada is covered by permafrost and there are approximately 190 mines and important mineral deposits in the Yukon and Northwest Territories (Kane and Brown, 1986). Permafrost encapsulation and cold temperature conditions at northern latitudes offer unique management options for reactive tailings and wasterock which are of interest and should be pursued.

Current tests were undertaken at cold temperatures to evaluate differences in leaching characteristics among different temperature regimes. Low temperature leaching studies were designed to simulate conditions similar to those expected within the tailings at the Cullaton Lake site after implementation of a decommissioning plan of covering the tailings with approximately 1.5 m of wasterock and overburden for promoting freezing and permafrost conditions within the tailings. It was anticipated that during the frost free period some of the tailings might thaw to temperatures ranging between 0 °C and 10 °C.

1.2 ARD and Its Control

Acid Rock Drainage, or ARD is a term used to define drainage that occurs as a result of oxidation of sulphide minerals exposed to air and water (British Columbia Acid Mine Drainage Task Force Report, 1989). ARD is also referred to as Acid Mine Drainage (AMD). This phenomenon, however, is not confined to mining activities, as it may occur wherever sulphate bearing rock is exposed to water and air.

Reactive sulphide minerals, oxygen and water, in combination cause ARD. The process is accelerated several orders of magnitude by biological activity. In ARD, the biological

oxidation is caused by bacteria such as *Thiobacillus ferrooxidans* and *Thiobacillus thiooxidans*. These bacteria are capable of oxidizing iron and sulphur from their environments to obtain energy. Growth of the bacteria is manifested by a decrease in pH and an increase in the concentration of oxidized iron. *Thiobacillus ferrooxidans* are most active in waters with a pH of approximately 3.2.

In the presence of air and water, the sulphide mineral is oxidized, in this instance, the mineral is pyrite:

$$FeS_2 + 7/2\ O_2 + H_2O = Fe^{2+} + 2\ SO_4^{2-} + 2\ H^+$$

An oxidizing environment will further oxidize the ferrous to ferric iron,

$$Fe^{2+} + 1/4\ O_2 + H^+ = Fe^{3+} + 1/2\ H_2O$$

For pH's above 3, the ferric iron is readily hydrolyzed producing ferric hydroxide precipitate and a further decline in pH,

$$Fe^{3+} + 3\ H_2O = Fe(OH)_3 + 3\ H^+$$

The ferric iron not precipitated as ferric hydroxide may oxidize additional pyrite as:

$$FeS_2 + 14\ Fe^{3+} + 8\ H_2O = 15\ Fe^{2+} + 2\ SO_4^{2-} + 16\ H^+$$

The result of these reactions is a distinct orange tinge to the host material as well as low pH pore water, capable of leaching heavy metals and other soluble minerals from the host rock. The major environmental impact of this process is felt when such low pH water migrates into the receiving environment, be it lake, river, stream, or other receiver. The

high acidity and metal content of this mobilized water may cause serious damage to plant or animal life in these receiving areas, through acidification and adsorption of these metals.

Through research of the ARD problem, controls have been devised for dealing with ARD. These controls include: the control of the acid generation process, the control of the ARD migration and the collection and treatment of ARD. Control of the acid generation process is the preferred measure. It is preferred because if acid generation is eliminated or reduced to an insignificant level, there is no danger of contaminants entering the environment. The success of this control measure depends on inhibiting the oxidation of the sulphides.

Permafrost encapsulation is believed to be a significant method for abatement of ARD. Factors that affect ARD generation in northern environments include the following:

- low temperature conditions slow chemical and biochemical oxidation of sulphide minerals (Klohn Leonoff, 1992);
- Snow, ground frost and ice cover provide a barrier of limited permeability for oxygen diffusion, thereby limiting the rate of sulphide oxidation;
- bacteria responsible for sulphide oxidation reactions and accelerating the release of acidity have limited activity at temperatures below 5°C; and
- high precipitation events that occur during seasonal snow melt periods can result in detrimental effects on receiving environments by flushing any accumulated oxidation products from the surface of the waste material.

Since pyrite oxidation is an exothermic reaction, and pore water does not freeze entirely below 0°C, the effectiveness of permafrost as an oxidation mitigator is questionable (Morin, 1995).

This study was undertaken to determine the chemical oxidation rate and acid generation potential, including metal release and changes in leachate water chemistry, for Cullaton Lake tailings at low and intermediate temperatures.

1.3 Site Description

Page (1983), and Chataway and Hanson (1983) have studied the geology and mineralogy of the Cullaton Lake area in detail. A brief summary is provided here for background.

The mine property is located within the Churchill Structural Province of the Canadian Shield in what is termed the Kaminak sub-province, a Precambrian greenstone belt which extended from the Saskatchewan border to the Rankin Inlet.

The oldest units were intercalated volcanic and sedimentary rocks of Archean age called the Henik Group. This group consisted of heterogeneous volcanic rocks, predominantly andesite and basalt, intercalated with clastic sediments of greywacke and argillite composition.

The Archean Henik Group was separated from the Lower Proterozoic Montgomery Lake Group by a series of plutonic and associated metamorphic rocks. This sequence was comprised of various bodies of granodiorite and monzonite which had transformed the Henik Group rocks into a variety of gneisses and schists.

The lower Proterozoic Montgomery Lake Group lay unconformably above the Henik Group and the intrusive metamorphosed sequence. This group was comprised of a thick series of boulder-conglomerate, greywacke, quartzite and siltstone.

The Hurwitz Group, Aphebian in age, lay unconformably above the Montgomery Lake Group. It was comprised of a broad assemblage of clastic sedimentary rocks, including conglomerate, orthoquartzite, slate, shale, dolomite, greywacke and arkose.

A sequence of middle Proterozoic intrusive rocks consisting of granite, quartz monzonite, granodiorite, gabbro and diabase dykes intruded the rocks of the above-described groups.

B - Zone

Gold mineralization in the B - Zone was confined to sulphide iron formations in the sedimentary sequence of the Henik group.

Based on dominant mineralogy, the B - Zone iron formation consisted of four distinct facies, namely, carbonate, oxide, silicate, and sulphide. The gold mineralization was confined in a strata bound nature to the sulphide facies iron formation. The carbonate iron formation consisted of layered chert and ankerite; the oxide iron formation consisted of chert, magnetite, and siderite with minor iron sulphides and chlorites; the silicate iron formation consisted of chert, chlorite and minor amounts of stilpnomelane, minnesotaite and siderite; and the sulphide iron formation consisted of chert, pyrrhotite, pyrite, arsenopyrite, magnetite, siderite, minor chalcopyrite and chlorite. The sulphide facies was found within, or bordering the oxide facies and ranged in thickness from 0.6 to 17.5 m.

The gold occurred free in the non-metalliferous gangue and showed no preference to any one sulphide or arsenide mineral.

The trace element content of the B - Zone iron formation was comparable to that of the Algoman type iron formation with the exception of increased amounts of Au and Ag. Au and Ag were enriched in the iron formation in all lithologies, and displayed a positive correlation with As and S. Sr, Y, Rb, Ce, Ba, Ni and Zn form a group of elements which showed a strong positive correlation within the group, and negative correlation with Au, Ag, S and As. Zn, Co, Cu and Sb as in most Algoman type deposits occurred in very low abundances, and their distribution did not correlate with that of any other element. It was assumed that the local concentrations of these elements controlled their abundances.

The veins of the deposit contained low quantities of gold compared to lithologies that they transected.

Approximately twelve iron formations in the Cullaton Lake district occurred along a strike length of 30 km and through a stratigraphic thickness of up to 15 km. The lithological control of gold in the B - Zone orebody might also be found 1.8 km down strike from the deposit in the same iron formation. The same relationship was also found in an iron formation (the A-Zone iron formation) 0.6 km west of the B - Zone. The other iron formations of the district were sampled in outcrop and boulders, and it was demonstrated that the high gold content of sulphide lithology persisted throughout the district.

The association of economic quantities of gold with sulphide iron formation suggested a sedimentary origin for the gold. The wide geographical and stratigraphic distribution of the high-gold sulphide lithology suggested that gold was introduced into the turbiditic basin in hydrothermal solution for the entire history of the basin. The localization of gold with a discrete lithology suggested that the precipitation of gold was controlled by local chemical-sedimentary conditions within the basin, rather than proximity to a discharge site. It was suggested that gold, arsenic and antimony remained in solution as thio complexes. Precipitation of these elements was prompted by the reduction of reduced sulphur species as a consequence of the local precipitation of iron sulphides.

Shear (S) - Zone

The Shear (S) - Zone area was underlain by orthoquartzite and slate, shale and siltstone. The former occurred as a discontinuous ridge of outcrop extending almost the length of the property in a north-south direction.

The orthoquartzite was white with variations of pink to red, fine-grained to glassy, and varied from thin bedded to thick bedded or massive. Typically, the orthoquartzite was composed of 97% or more quartz, with only scattered sericite, feldspar and magnetite. Less pure quartzites occurring in the lower part of the unit were commonly sheared and contained sericite and pyrite.

A greywacke underlay the orthoquartzites with a conformable contact indicating that the greywacke was a part of the Hurwitz Group and not the Henik volcanic. The thinly bedded shale, slate and siltstone unit occurred stratigraphically above the orthoquartzite and the contact area was an interbedded transition zone of siltstone and quartzites with strong hematitic staining.

Gold occurred in the fractured and sheared orthoquartzite in the Shear - Zone orebody. Mineralization was found in: a) altered shears; b) breccia zones; c) pyritic shears; and d) pyritic sericitic impure quartzite.

The altered Shear Zones were extensive and related to the regional structural patterns. Alteration products common to most zones were saponite, limonite, and hematite with occasional chlorite, epidote and sericite. Quartz and tourmaline were present in some zones. Gold occurred as free gold, visibly as sheared flecks or as fine nuggets and as a residue after the transformation of auriferous pyrite to limonite.

A vuggy quartz pyritic quartzite breccia containing gold appeared within an altered Shear Zone having pyrite with milky white quartz matrix.

Unaltered Shear Zones consisting of closely spaced pyrite-filled fractures were also gold bearing. The pyrite occurred as loosely packed filling in the fractures. Generally, these zones were narrow and appeared discontinuous.

A different type of gold mineralization was observed in the impure sheared sericitic quartzite consisting of 5 to 15% pyrite (8% average), disseminated to semi-massive in places. The alteration products of the Shear Zones were not present, but strong sericite and/or epidote was present in the sheared rock, possibly having been introduced post-deformation.

A characteristic feature of the auriferous zones was a pyritic halo extending from 0.5 to 6 m. The pyrite content averaged 2 to 3% but could be as much as 15%. Generally, the pyritic halo had a low gold content.

2.0 EXPERIMENTAL METHODOLOGY
KINETIC LEACHING TESTS

2.1 Experimental Arrangement

Column lysimeter leaching tests were conducted for both B- and Shear (S) - Zones tailings at cold temperatures (2 °C and 10 °C), to determine their oxidation and leaching characteristics at representative field temperature conditions similar to those existing at the site through much of the frost free season.

The equipment consisted of four clear acrylic columns, open at the top but closed at the bottom, with overflow valves near the top of the columns and drainage valves at the bottoms. Attached to the drainage valves were polyethylene hoses. These hoses were included to ease collection of effluent in the collection bottles. Each leaching column consisted of a clear acrylic tube, 80 cm in height and 12.5 cm in diameter, the bottom of which contained 7.5 cm thick layers of clean gravel and sand for bed support and filter purposes (Fig. 3).

A wooden support stand was used to hold the columns upright and to raise the columns off the floor. A representation of the columns and stand is given in Fig. 4.

The columns had been previously used in tailings experiments and, therefore, had to be cleaned. Each column was filled with approximately 10 l of distilled water, acidified with 200 ml of concentrated hydrochloric acid and allowed to sit overnight. The following day, the acid-water mixture was drained from the columns. The columns were then thoroughly

rinsed with cold tap water to remove the last of the acid and other material still remaining in the columns. The columns were then rinsed again with distilled water and replaced in the support stand and left to air dry.

2.2 Sampling Procedures

2.2.1 Tailings Sampling, Loading of Columns and Placement in the Cold Temperature Chamber

The tailings used in the experiment were transported from the Cullaton Lake mine to the Elliot Lake laboratory in four metallic containers. Two of these containers were filled with B - Zone tailings while the other two were filled with S - Zone tailings.

To achieve a representative sample, both B - Zone tailings samples were combined into one sample and the S - Zone tailings combined into another separate sample. Each combination sample was mixed together in a clean dry cement mixer. After thirty minutes of mixing, the sample was removed from the mixer and the columns were charged. Two of the columns were charged with B - Zone tailings and the other two were charged with S - Zone tailings. Each B and S - Zone column contained exactly 9.7 kg of tailings as received (wet).

The support stand with columns was then moved into a refrigerated cold temperature chamber which was maintained at the desired experimental temperatures for the duration of the study.

2.2.2 Inoculation with Bacterial Culture

Since the experiment involved ARD, inoculation of the samples with *Thiobacillus ferrooxidans* was necessary. A mixture of 500 ml of lake water and 100 ml of mine water containing the bacterial culture was placed in the cold chamber so as to reach experimental

temperature before being added to the columns. Upon addition of this mixture of mine and lake water, a compaction of 4.5 cm was noted in the S - Zone columns, while the B - Zone columns exhibited a compaction of 2.4 cm. The columns were then left to acclimatize for a week.

2.2.3 Leaching Scheme

Column leaching at 2 °C was carried out from January 1992 to December 1993 / January 1994. In December 1993, the temperature regulator of the experimental chamber malfunctioned resulting in freezing of test samples. The problem was quickly rectified, the samples were allowed to thaw completely by raising the chamber temperature to approximately 5 °C, and the leaching experiment at 2 °C was continued. The freezing of the tailings, however, had altered sample condition as well as the effluent quality, resulting in the loss of its previously established leaching reference point with respect to the elapsed time. The experiment was continued for another month but in January 1994 when the effluent quality did not re-establish, it was discontinued.

The experimental chamber temperature was then raised to 10 °C and the second leaching condition was established. Before starting the leaching experiment at 10 °C, the test columns were removed temporarily from the cold chamber, the tailings samples homogenized individually, the columns recharged and returned to the experimental chamber. While mixing the samples outside, adequate precautions were taken to keep temperatures close to 10 °C. The experimental columns were allowed to acclimatize for few weeks in the test chamber but were not re-inoculated with the *Thiobacillus ferrooxidans* culture solution. The leaching cycle at 10°C was initiated in February 1994 and continued till February 1995.

The test samples were allowed to weather at the experimental temperatures and rinsed periodically with natural lake water that was added to the columns at the rate of 1 l (litre) per week till October 1992, thereafter the schedule was changed to 1 l every two weeks.

Effluent collection bottles were of an opaque white plastic, with a short handle. The bottles were 26 cm high, of rectangular shape having base dimensions of 10 cm x 10 cm. These were acid-washed prior to sample collection. After filling water to which a small amount of concentrated hydrochloric acid was added, the bottles were set aside, so that the acid could fully combine with the water already in the bottles. After one day, the containers were rinsed thoroughly with cold tap water and then with distilled water, then set aside to air dry. Once dry, the bottles were weighed.

After the first week into the experiment, no water had collected in the effluent bottles. A 500 ml portion of lake water was added to each column and the water was allowed to drain for another week. The following week, drainage effluent had collected in the sample bottles and testing could begin. The amount of sample collected was small, therefore the amount of water added to the columns was increased to 1 l.

2.2.4 Water Sampling, Filtration and Sample Preservation

The sample bottles together with the collected effluent were first weighed to determine the effluent volumes. The samples were sub-divided and initial sample aliquots for pH, redox potential, conductivity and ferrous iron measurements were taken. The remaining samples were filtered to remove all the suspended solids and preserved for other analytical procedures.

The filtration was accomplished using a 1 l filtration flask, a filtration funnel and a 0.45 µm membrane filter. The flask was connected to a vacuum system for filtration.

The sample collected in the effluent containers was poured into the filtration funnel in 250 ml portions until the entire content of the containers was filtered. The filtrate was then poured into three different sample bottles, a 1 l plastic bottle, a 100 ml plastic bottle, and a 100 ml amber glass bottle.

To the 1 l plastic bottle, concentrated hydrochloric acid was added, while concentrated nitric acid was added to the 100 ml plastic bottle. 5N sodium hydroxide was added to the 100 ml amber glass bottle. These two acids and base were added to the samples to preserve them. The three bottles contained water samples that would be used for three different purposes.

The amber bottle was used to hold sample that would be analyzed for cyanide content. The CN^{1-} ion is very reactive and unstable and will react when exposed to sunlight which necessitated the sample preservation in an amber bottle. The 5N sodium hydroxide also inhibited the CN^{1-} ion's reactivity by increasing the pH and hence loss of cyanide as HCN gas. Sodium hydroxide was added until the pH was 12 or greater.

High reactivity of the sample in the 1 l and 100 ml plastic bottles was not the primary reason for the addition of acid. The acid was added because certain cations, such as Al, Cd, Cu. Fe, Pb, Mn, Zn and Ag, were subject to loss by precipitation, adsorption on, or ion exchange with the container walls. Between one to five percent acid by volume of sample was added to preserve the sample at a pH of approximately 2.0. At this pH the ions remained in solution and both the adsorption and ion exchange were minimal.

2.3 Analytical Procedures and Quality Assurance/Quality Control (QA/QC)

2.3.1 Water Samples

The water samples were analyzed for pH, redox potential (Eh), electrical conductance (Ec), total acidity, total alkalinity and dissolved concentrations of SO_4^{2-}, Al, Sb, As, Ca, Cu, ferrous iron (Fe^{2+}), total Fe, Pb, Mg, Mn, Hg, Ni, Si and Zn. The water samples were pre-filtered with 0.45 μm membrane filters and stabilized with dilute nitric acid for dissolved metals and hydrochloric acid for SO_4^{2-} determinations as described above. The acid was added to the sample in the amount of 30 ml per litre.

For most analyses, the Standard Methods for the Examination of Water and Waste Water, American Public Health Association (Greenberg et. al., 1992), were followed. Dissolved metals/elements concentrations were measured using an Inductively Coupled Argon Plasma Atomic Emission Spectrophotometer (ICAP-AES), and SO_4^{2-} concentrations were determined using radiochemical methods as described below.

2.3.1.1 Primary Parameters

pH, Eh, Ec, Total Acidity, Total Alkalinity

The primary parameters were measured in water samples as collected and prior to their filtration for maintaining sample integrity, without loss of dissolved gasses or oxidation of metal ions specially ferrous Fe^{2+}. The pH was measured using a standard glass body combination pH electrode with a saturated Ag / AgCl reference electrode. The redox-potential, Eh, was measured using a platinum and a calomel (Hg / Hg_2Cl_2) reference electrodes. The measured Eh was normalized to standard hydrogen electrode references (NHE) by adding calomel and hydrogen electrodes potential difference of +244 mV. The electrical conductivity, Ec, was measured using a small volume (5 ml) conductivity cell. All these parameters were measured at the cold sample temperature (as received) and normalized to the standard room temperature of 25 °C with an automatic temperature compensator (ATC) or a temperature compensation procedure for Ec measurements.

Total acidity and alkalinity were measured by titrametric methods. The acidity in sample solutions containing hydrolizable metal ions, e.g. Fe^{3+}, Al^{3+}, etc. and polyvalent cations, was measured as a maximum potential acidity by lowering the pH below 4 and oxidizing the reduced ionic species with few drops of 30% H_2O_2,. The sample solution was then titrated with a standard alkalinity (NaOH) solution to pH 8.3 using a potentiometric titration method.

The alkalinity was also measured using a potentiometric titration method. An aliquot of sample solution was titrated with a standard acid (H_2SO_4) solution to pH 4.5. For low alkalinity solutions, additional titrant was carefully added to reduce the pH exactly 0.3 pH units and the total titrant volume was used for alkalinity calculations.

2.3.1.2 Elemental Analysis

Quantitative analysis of dissolved metals and sulphur in solution samples was performed using a Thermo Jarrel Ash Inductively Coupled Argon Plasma - Atomic Emission Spectrophotometer (ICAP-AES), model Polyscan 61E. Elemental concentrations were measured following appropriate wave length calibration, standardization, matrix matching, inter-element and background corrections, and quality control.

Each solution sample was analyzed three times and the analytical results had a typical variance of less than 3%. A quality control (QC) sample, having a similar composition and matrix, was also analyzed every ten samples, and the system stability was checked by the observing variance in the QC sample elemental concentrations. A QC fail command was set at the analyte variance exceeding 5% each element, and upon the detection of the fail command the instrument was automatically re-calibrated and the analyses repeated. Typical detection limits for the ICAP AES were below 0.03 mg/l for most elements.

2.3.1.3 Sulphate Analysis

For solution samples, the sulphate concentrations, in the absence of other soluble sulphur species, were measured using the above described ICAP-AES. In other cases, a radiochemical tracer technique using a gamma emitter Ba-133 radioisotope was used .
The radiometric method consisted of precipitating sulphate as Ba (Ba-133)SO_4 by the addition of a precipitating solution containing a fixed ratio of $BaCl_2$ / (Ba-133)Cl_2 concentrations. The sulphate concentration was determined by measuring the recovery of

Ba-133 radioisotope using a gamma spectroscopy system. The instrument measured the activity of Ba-133 isotope using its 356 keV gamma energy peak with a 10 cm x 10 cm diameter NaI(Tl) detector. By fixing the concentration ratio of $BaCl_2$ (Ba-133)Cl_2, three precipitating solutions, A, B and C were used to measure total sulphate concentrations in the ranges of 10 - 100 mg, 1 - 10 mg and 0 - 1 mg SO_4^{-2}, in sample aliquots, respectively.

This method was preferred over other conventional methods e.g. gravimetric, turbidity etc., for its applicability over a wide concentration range without requiring sample dilution, and ease of operation. The method allowed preparation of samples in large batches, and counting them at a later date and time without affecting results. For very low sulphate concentrations (<10 mg/l) the ICAP-AES method was used.

2.3.1.4 Cyanide Analysis

For both solid and solution samples, total cyanide concentrations were measured, following acid digestion and cyanide distillation, using an automated colourimetric cyanide analyzer. A solution containing cyanide was injected in a distillator and the condensate collected in a cell containing cyanide complexing colouring reagents. The cyanide concentration was then automatically determined by measuring the transmittance (absorbance) of a characteristic wavelength of light.

2.3.1.5 Minimum Detection Limits

For solution samples, the measured instrumental detection limits, defined as 3σ where σ is the standard deviation of the instrumental noise at background concentrations, were on the order of 0.001 to 0.03 mg/l for most metals and SO_4^{-2} for the analytical methods used.

2.3.2 Solid Samples

The tailings solid samples were pulverized to less 40 µm size and analyzed for solid phase elemental compositions following acid digestions and complete dissolutions of the samples. The sample solutions were individually brought to a standard volume and were analyzed using the above described procedures.

The particle size distribution of the dry tailings was determined using the American Standard Testing Method (ASTM) for screen analysis.

2.3.2.1 Sample Digestion

For metal analysis, a pulverized tailings sample (0.5 - 1.0 g) was completely dissolved, first by digesting it with 20 ml of HNO_3 in a 100 ml Teflon beaker and boiling it to dryness, followed by addition of 30 ml of HF and digestion at 100 °C for silica removal. The sample was cooled and digested with 15 ml of a cocktail containing perchloric, nitric and hydrofluoric acids in the ratio of 2:1:7, slowly at 110 °C till dryness, followed by baking at 180 °C till all the white fumes of perchloric acid dissociation were expelled. The sample was cooled again and dissolved completely in 50 ml of 50% HCl, by boiling, if necessary. All sample solutions were stabilized by adding HCl to a final concentration of 10% acid. The final volume of the sample solution was brought to 1 l for most metals, and 100 ml for trace metal analysis, by adding de-ionized water.

For volatile elements, e.g. Pb, the samples were dissolved with nitric acid (following silica destruction) in high pressure Teflon vessels in a microwave digestion oven. The digested samples were then dissolved in 50% HCl as above.

2.3.2.2 Sulphur Speciation

For solid samples, the sulphur species were determined by measuring concentrations of total sulphur, total sulphate sulphur and obtaining the total sulphide sulphur concentration by difference.

The total sulphur concentration was measured using a Leco furnace sulphur analyzer. A measured amount of dry pulverized sample was ignited at a high temperature in an electric spark furnace and the total sulphur concentration was determined by measuring the total quantity of evolved sulphur dioxide gas using gas chromatography. Occasionally, total sulphur concentration was also determined by complete destruction of the silica matrix and oxidation of sulphides to sulphates either by Na_2O_2 fusion or perchloric acid digestion as described before, followed by measurement of total sulphate concentration in the sample solution by gamma spectroscopy or ICAP-AES.

The total sulphate sulphur concentration of the sample was determined by leaching it with distilled water for a period of 24 h to dissolve all water soluble sulphates, and measuring the dissolved sulphate concentration by gamma spectroscopy or ICAP-AES.

2.3.2.3 Quality Assurance / Quality Control (QA/QC)

The QA/QC program consisted of analyzing 15-20% additional sample replicates, sample and reagent blanks, certified reference standards for solid and liquid samples together with an inter-laboratory comparison program of unknown and reference samples.

For quality control, all solid samples were digested in duplicates, together with matrix matched control samples consisting of Canadian Certified Reference Material Standards (CCRMP) for Base Metal Tailings and Ore, and appropriate sample and reagent blanks. All samples were processed concurrently through the analytical procedures. For dissolved metals, instrumental analytical standard deviations were set at the 5% variation

level of a quality control (QC) sample for an automatic QC pass/fail check and re-standardization. The overall precision and accuracy of all measured analytical parameters were between ± 5 to 10% levels depending on the parametric concentration.

3.0 RESULTS

3.1 Solid Phase Comparison

The physical parameters and chemical compositions of both B and Shear (S) - Zones tailings are given, respectively, in Tables 1 and 2.

The B - Zone tailings were characterized by a dark greenish-grey colour, relatively fine texture and particle size distribution diameters, d_{10} and d_{50}, of 35 and 65µm, respectively, for 10% and 50% passing. The tailings had relatively high total sulphur and iron contents of 2.63% (as S) and 20% (Fe) respectively, a total water extractable sulphate concentration of 0.32% (as S), and a negative net neutralization potential (NNP) of -26.8 kg $CaCO_3$/tonne of tailings.

The Shear (S) - Zone tailings were characterized by a brownish-orange colour, slightly coarse texture with particle size distribution parameters, d_{10} and d_{50}, of 45 and 100µm, respectively. The S - Zone tailings had low total sulphur and iron contents of 0.5% (as S) and 3.0% (Fe), respectively, a total water extractable sulphate concentration of 0.09% (as S), and a less negative net neutralization potential (NNP) of -10.5 kg $CaCO_3$/tonne of tailings.

Both tailings were net acid producers, although for the Shear - Zone, both the total sulphur content and total available alkalinity were low (Table 2). The tailings retained appreciable amounts of moisture, ~ 10% by weight, and had very poor drainage

characteristics, as reported by Davé (1992) in the previous room temperature leaching study.

3.2 Column Leaching Results

The column leaching results for 2 °C and 10 °C for B -Zone tailings are given in Tables 3 and 4, respectively. The corresponding results for S - Zone tailings are given in table 5 and 6, respectively.

The effluent water quality parameters and their variations with time are plotted in Figs. 5 to 28 for B - Zone; for sample temperature, pH, Eh(NHE), Ec, total acidity, total alkalinity, dissolved concentration of SO_4^{2-}, effluent SO_4^{2-} loading rate, percent cumulative total SO_4^{2-}loading, and dissolved concentrations of total Fe, Ca, Mg, Al, Mn, Sb, As, Cu, Pb, Hg, Ni, Si, Zn, total CN^{1-} and total cumulative effluent volume, respectively. Results for 2 °C and 10 °C are plotted separately, in figures marked with (a) and (b), respectively. The corresponding S - Zone parameters are given in Figs. 29 to 52.

The cold sample temperatures, shown as laboratory cold temperatures in Figs. 5 and 29, were recorded in the laboratory prior to conducting other measurements at those temperatures. Because of sample handling, the laboratory-measured cold temperatures were 1 to 2 °C higher than the actual experimental cold chamber temperatures.

The collected effluent volumes were measured, as received, at cold sample temperatures, and were later normalized to the laboratory room temperature (25 °C). The effluent pH, Eh, and Ec were measured at both laboratory cold and ambient room (laboratory warm) temperatures, but because of fluctuations in sample temperatures, all these parameters were temperature compensated to a standard room temperature of 25 °C. This was accomplished with automatic temperature compensating (ATC) probes connected to the

instruments. All other parameters were measured after warming the samples to room temperature.

Initially, at the beginning of the experiment, the drainage effluent from both the tailings contained high total dissolved solids (high Ec) and elevated concentrations of calcium and magnesium sulphates which leached rapidly over a short period of 1 to 1.5 months (Figs. 8, 15, 16, 32, 39 and 40). This period represented dissolution and removal of soluble minerals e.g. sulphates of calcium and magnesium from the tailings, present in the tailings as residual minerals from the milling process or accumulated as a result of previous exposure of the tailings to the weathering process leading up to the experimental time. After this initial period, the changes observed in various parameters were characteristic of the weathering and leaching at the experimental temperatures. The detailed results for the two tailings at 2 °C and 10 °C are as follows:

3.2.1 B - Zone Tailings:

pH, Eh, and Ec

The drainage effluent pH, Eh, and Ec profiles for the B - Zone tailings are shown in Figs. 6 to 8 respectively. The pH decreased slowly from the initial 7.0 - 7.5 range to approximately 6.5 - 6.8 over the two-year leaching period at 2°C. With the initiation of leaching at 10°C, the pH gradually decreased to 5.0 - 5.2 range for a period of approximately nine months, and recovered to ~ 7.0 near the end of the experimental period (Fig. 6b).

The normalized redox potential, Eh(NHE), decreased very slowly during leaching at 2 °C from 500 - 550 mV range to ~ 300 - 400 mV. The decrease was more pronounced for redox potentials measured after the sample was warmed to room temperature (Fig. 7a), where the values were approximately 100 - 150 mV lower than at cold sample temperatures. The redox potentials increased gradually during the 10 °C leaching period,

and were in the range of 350 - 500 mV for both sample cold and room temperatures (Fig. 7b).

The effluent electrical conductance, Ec, decreased rapidly, from an initial 14,000 - 14,500 µs/cm range to ~ 250 - 300 µs/cm, during the first two months of leaching and remained constant at ~ 250 µs/cm for the rest of the leaching period at 2 °C (Fig. 8a). At the beginning of the 10 °C leaching, Ec first increased to ~ 380 µs/cm for a short period of time, then decreased slowly to ~ 200 µs/cm (Fig. 8b) for the rest of the leaching period.

In contrast to the room temperature (25°C) leaching of the B - Zone tailings (Davé, 1992), the above results indicated very slow oxidation at 2°C and an initial slight to moderate oxidation at 10 °C. These results are further confirmed by the production of moderate acidity, Fe, and other metals at 10°C, as discussed below.

Total Acidity and Alkalinity

The total acidity and alkalinity profiles for the B - Zone tailings are shown, respectively, in Figs. 9 and 10. The tailings started to produce slightly acidic effluents after a period of approximately 1.5 years at 2 °C when the acidity increased from zero to ~ 300 mg $CaCO_3$/l. During the same period, the effluent alkalinities decreased from approximately 350 mg $CaCO_3$/l to 100 mg $CaCO_3$/l (Fig. 10a).

After the column freeze-up and re-initiation of leaching at 2 °C, the acidities had decreased to near zero (December 1993 - January 1994). With the leaching of columns at 10 °C, the effluent acidities increased rapidly to approximately 900 mg $CaCO_3$/l peak, and decreased to near zero towards the end of the experimental period (Fig. 9b). During the same period, the corresponding effluent alkalinities decreased from ~ 150 mg $CaCO_3$/l to less than 10 mg $CaCO_3$/l (Fig. 10b).

Sulphate and Iron

The B - Zone sulphate and iron concentration profiles are shown in Figs. 11 and 14, respectively. The loading rate as (µg SO_4^{2-} /kg tailings/day) and percent cumulative total loading of sulphate are given in Figs. 12 and 13, respectively.

Similar to Ec, the dissolved sulphate concentration in the effluent decreased very rapidly, from approximately 16,000 mg/l to ~ 1,500 mg/l during the first two months, and increased very slowly to ~ 2,500 mg/l near the end of the leaching period at 2 °C (Fig. 11a). At the beginning of the 10 °C leaching period, the sulphate concentration increased slightly to ~ 3,000 mg/l and then decreased slowly to approximately 2,000 mg/l (Fig. 11b).

The B - Zone sulphate loading rate at 2 °C decreased from an initial high of ~ 215,000 µg SO_4^{2-} /kg tailings/day to ~ 10,000 µg SO_4^{2-} /kg tailings/day and then increased very slowly to ~ 15,000 µg SO_4^{2-} /kg tailings/day near the end of the 2 °C leaching period (Fig. 12a). At 10 °C, the sulphate loading rate remained nearly constant at about 10,000 µg SO_4^{2-} /kg tailings/day (Fig. 12b).

During the 2 °C leaching period, a cumulative total of 21% of the total sulphur contained in the B - Zone tailings was mobilized and removed as total sulphate in the effluent (Fig. 13a). Approximately 10% of the total sulphur was present in the water soluble form, which leached rapidly within two months at the beginning of the experiment. The remaining ~ 11% of the total sulphur was removed as a result of acid generation and neutralization during the balance 1.8 y of leaching at 2 °C. Leaching of the tailings at 10 °C for 1 y, mobilized an additional 5.3% of total sulphur in the effluent (Fig. 13b).

As there was complete acid neutralization in B - Zone tailings during both the leaching periods and the effluent was saturated with respect to gypsum, the effluent sulphate

drainage loading was controlled by gypsum solubility. Thus, further deduction of sulphur oxidation and acid generation rates from the sulphate drainage data was not possible.

The dissolved total iron concentration profiles were similar to those of acidity (Figs. 9 and 14). The dissolved iron concentration increased, from zero to ~ 150 mg/l, near the end of the 2 °C leaching period and peaked at ~ 450 mg/l at the beginning of the 10 °C leaching. Near the end of the 10 °C leaching period, the dissolved iron concentration had returned to near zero (Fig. 14b).

As observed previously, the B - Zone tailings started to produce slightly acidic effluents at 2°C after a period of 1.25 years, and moderate acid generation when leached at 10 °C but only for a short duration of approximately 8 months. The latter observations were similar to those observed at 25 °C leaching, where characteristic acidic effluent peaks were observed for a short period of time. (Davé, 1992).

Calcium and Magnesium

The B - Zone calcium and magnesium profiles are shown in Figs. 15 and 16, respectively. The effluent calcium concentrations initially decreased from ~ 500 mg/l to ~ 400 mg/l during the flushing period of approximately 15 days, thereafter increased to ~ 650 mg/l saturation level of dissolved gypsum. It decreased slowly to ~550 mg/l during the remainder of the 2 °C leaching period and remained constant during leaching at 10°C (Fig. 15b). The results indicated dissolution of the residual gypsum from the tailings, as well as, on going acid generation and limestone neutralization.

The dissolved magnesium and SO_4^{2-} concentrations profiles were also similar (Figs. 11 and 16). The effluent magnesium concentration decreased initially, from a high of ~3,200 mg/l to a low in the range of ~50 - 80 mg/l, during first two months of leaching at 2 °C and remained constant in the low range for another 1.5 years. Near the end of 2 °C leaching and with the beginning of the 10 °C leaching period, Mg concentration increased

gradually to a 200 mg/l peak and decreased slowly to a very low concentration of ~ 8 - 10 mg/l with further leaching at 10 °C (Figs. 16a and b).

Aluminium and Manganese

Figs. 17 and 18 show, respectively, the B - Zone aluminium and manganese leaching profiles. The drainage effluent contained dissolved aluminium on the order of 0.1 - 0.15 mg/l throughout both the leaching periods with no definite trends. The effluent manganese concentration slowly increased from an initial level of ~ 5 - 10 mg/l to ~ 20 mg/l during 2 °C leaching. During the 10 °C leaching period, the manganese profile was similar to that of total iron concentration, peaking at 20 - 25 mg/l and decreasing gradually to a range of 1 - 2 mg/l (Fig. 18b).

Both iron and manganese profiles indicated delayed occurrence of acidic drainage at 2 °C, which increased in magnitude as the temperature was raised from 2 °C to 10 °C. The effluent, at the observed pH and Eh values, contained mostly Fe^{2+} and Mn^{2+} species.

Other Metals:

Sb, As, Cu, Pb, Hg, Ni, Si (dissolved) and Zn

Figs. 19 - 26, show the B - Zone drainage profiles for Sb, As, Cu, Pb, Hg, Ni, Si (dissolved), and Zn, respectively. The results indicated limited drainage of As in the range of 0.1 - 0.2 mg/l, Ni ~ 0.1 - 0.15 mg/l, Pb ~ 0.05 - 0.1 mg/l and dissolved Si ~ 2 - 4 mg/l. Except for Pb, the increased concentrations of these elements were observed during oxidation and leaching at 10 °C. Cu and Zn concentrations were very low to near background concentrations. Dissolved Sb concentrations were also low, ~ 0.02 - 0.05 mg/l, during most of the leaching period and occasionally in the range of ~ 0.1 - 0.25 mg/l. Dissolved Hg concentration was below detection.

Total Dissolved Cyanide

The dissolved CN^{1-} drainage profile for leaching of B - Zone tailings at 2 °C is shown in Fig. 27. Most of the cyanide contained in the tailing porewater, present as a residual milling reagent, was removed within the first 1.5 months of leaching at 2 °C, from an initial 800 µg/l level to ~ 10 µg/l, and the remainder was mobilized in low concentrations, ~ 2 - 10 µg/l, during additional 5 months of leaching. Thereafter, no cyanide was observed in the drainage effluents at both 2 °C and 10 °C leaching.

3.2.2 Shear (S) - Zone Tailings:

pH, Eh, and Ec

The temperature profiles for Shear (S) - Zone leaching regime are shown in Fig. 29, and the drainage effluent pH, Eh, and Ec profiles are shown in Figs. 30 to 32, respectively.

The effluent pH increased initially from 6.2 to 6.8 over a 3 month period and then decreased rapidly to < 4.0 in another 3 months. It declined slowly to 3.0 during the rest of the leaching period at 2 °C (Fig. 30a). No further pH changes were observed during the 10 °C leaching period (Fig. 30b).

The redox potential, Eh(NHE), increased gradually with time, from initial 400 mV to ~ 750 mV, during leaching at 2 °C (Fig. 31a). No further changes in Eh were observed during leaching at 10 °C (Fig. 31b).

The electrical conductance, Ec, decreased very rapidly, from the initial 8,000 µs/cm value to 2,000 µs/cm, during the first 1.5 months and declined further to ~ 500 µs/cm in additional six months of leaching. It increased gradually to 1,200 µs/cm during the rest of the 2 °C leaching period (Fig. 32a). At the beginning of the 10°C leaching period,

Ec peaked at around 3,000 µs/cm and then decreased gradually to 1,000 µs/cm near the end of the leaching (Fig. 32b).

These results are similar to those at 25 °C leaching reported by Davé (1992), indicating oxidation and acidic drainage at all three leaching temperatures. The S - Zone tailings contained less total available alkalinity (~2.0 kg $CaCO_3$/tonne) which resulted in early occurrence of acid drainage at low temperatures compared to B - Zone tailings. This observation is further supplemented by acidity, sulphate, total iron, and other metals results as discussed below.

Total Acidity and Alkalinity

The total acidity and alkalinity profiles for the S - Zone tailings are shown, respectively, in Figs. 33 and 34. After removal of the initial and stored acidity during the first month, the tailings started to produce mildly acidic effluents within 5 months of leaching at 2 °C. The acidity production was rapid and lasted for the balance of the 2°C leaching period, having acidities in the range of 500 - 600 mg $CaCO_3$/l. During 10°C leaching, acidity production peaked at ~ 700 mg $CaCO_3$/l and then decreased rapidly to low acidities on the order of ~ 100 mg $CaCO_3$/l (Fig. 33b). The alkalinity production decreased correspondingly from an initial range of 40 - 45 $CaCO_3$/l to zero during first 10 months of leaching at 2 °C (Fig. 34a).

In comparison to leaching at 25 °C in the earlier study, the acidity production at 2 °C was slightly lower and its occurrence delayed by approximately 2 months. However, similar to the previous study (Davé, 1992), strong acidic drainage only occurred for a limited period indicating a surface activity phenomenon.

Sulphate and Iron

The effluent sulphate and dissolved total iron profiles for Shear (S) - Zone tailings are shown in Figs. 35 and 38, respectively. The loading rate, as (μg SO_4^{2-} /kg tailings/day), and percent cumulative total loading of sulphate are given in Figs. 36 and 37, respectively.

As with the B - Zone tailings, the sulphate and Ec profiles were also similar for the S - Zone tailings. The dissolved sulphate concentration in the effluent decreased from approximately 5,000 mg/l to ~ 1,500 mg/l during the first 1.5 months of leaching and then slowly to the range between 100 - 200 mg/l prior to the onset of acid drainage at 2 °C. During the acidic drainage period at 2 °C, the sulphate concentration increased to 500 mg/l (Fig. 35a). During 10 °C leaching, it first peaked at ~ 2,500 mg/l and then decreased slowly to levels of 100 - 150 mg/l (Fig. 35b).

For S - Zone, the effluent sulphate loading rate at 2 °C decreased from an initial high of ~ 70,000 μg SO_4^{2-} /kg tailings/day at the start of the experiment to a very low rate of ~ 2000 μg SO_4^{2-} /kg tailings/day. With further leaching at 2 °C, it increased slowly to 5000 μg SO_4^{2-} /kg tailings/day (Fig. 36a). Leaching at 10 °C, initially caused an increase in the sulphate loading to a peak rate of ~ 12,000 μg SO_4^{2-} /kg tailings/day, and then a slow decrease to a very low rate of ~ 1200 μg SO_4^{2-} /kg tailings/day (Fig. 36b).

In the absence of sufficient neutralizing buffer, the S - Zone tailings produced acidic effluents which were unsaturated with respect to gypsum. The effluent sulphate loading rate, thus, corresponded directly to total sulphur oxidation and acid generation rates.

The cumulative total sulphate loading of the effluents from S - Zone tailings were relatively high at both the leaching temperatures, where approximately 42% and 13% of the total sulphur contained in the tailings were mobilized and removed, respectively, at 2 °C and 10 °C (Figs. 37a and b). The experimental tailings contained approximately 25%

of the total sulphur in the water soluble form which was quickly removed at the beginning, within first two months of leaching at 2 °C. Further leaching at 2 °C resulted in an additional mobilization and removal of sulphate in the amount equivalent to 17% of the total sulphur contained in the tailings. The three year combined leaching at the two temperatures (2 °C and 10 °C) removed approximately 30% of the total sulphur contained in the S - Zone tailings by further oxidizing them.

The dissolved total iron concentration profile was similar to that of acidity (Figs. 33 and 38). The acidic drainage in S - Zone tailings was accompanied by iron drainage which began at about 6 months during the 2 °C leaching period. Dissolved iron concentrations increased slowly, from zero to ~ 200 mg/l, during leaching at 2 °C and peaked at ~ 250 mg/l with the initiation of the 10 °C leaching. It rapidly decreased to the range of ~ 10 - 20 mg/l with additional leaching at 10 °C (Fig. 38 b).

Similar to observations made for acidity, and in comparison to room temperature leaching (Davé, 1992), iron mobilization and drainage at 2 °C leaching condition was slow and delayed. Also, because the leaching at this temperature was abruptly halted, the total duration of acidic drainage and its continuity at this temperature also ended prematurely. It was, however, clearly evident from the Shear - Zone acidity and dissolved iron profiles that there was no significant reduction in acidic drainage, except delayed occurrence, from these tailings at 2 °C in comparison to room temperature leaching results. The data also defined the acid drainage period when other metals were mobilized.

Calcium and Magnesium

The calcium and magnesium profiles for Shear (S) - Zone tailings are shown in Figs. 39 and 40, respectively. The effluent calcium concentrations increased initially from 400 mg/l to ~ 550 mg/l during the first 3 months of leaching, then decreased rapidly to ~ 50 mg/l with the onset of acid drainage. Because of low available alkalinity, no significant acid neutralization was realized and acidic drainage occurred early in the S - Zone. During the

10°C leaching period, additional drainage of Ca occurred initially at 500 - 550 mg/l and decreased rapidly to low concentrations of 30 -50 mg/l (Fig. 39b).

The dissolved magnesium, Ec, and SO_4^{2-} concentration profiles were also similar, where the effluent magnesium concentration decreased from 700 mg/l to 10 mg/l during the first few months of leaching and remained constant at the low range for the rest of the leaching at 2 °C. For the 10 °C leaching period, a concentration peak at 100 mg/l, similar to Ec and SO_4^{2}, was also observed (Figs 32b, 35b and 40b).

Aluminium and Manganese

Figs. 41 and 42 show, respectively, the aluminium and manganese leaching profiles. Similar to iron, significant aluminium drainage occurred at 20 - 30 mg/l level with the production of acidity while leaching at 2 °C. The drainage decreased rapidly with decreasing acid production during the 10 °C leaching period (Fig. 41b).

The effluent manganese concentration decreased slowly from an initial 170 mg/l level to ~ 10 mg/l during the first three months of leaching at 2 °C, then increased to ~ 30 mg/l with the occurrence of acidic drainage and declined to 5 - 10 mg/l range with further leaching at 2 °C. During 10 °C leaching, manganese levels peaked at ~ 40 mg/l and decreased gradually to < 5 mg/l (Fig. 42b). These observations, similar to Fe, corresponded to oxidation and acidic drainage at 2 °C and 10 °C.

Other Metals:

Sb, As, Cu, Pb, Hg, Ni, Si (dissolved) and Zn

Figs. 43 - 50 show, respectively, the S - Zone leaching profiles for Sb, As, Cu, Pb, Hg, Ni, Si and Zn. With the onset of acidic drainage, significant leaching was observed for As ~ 0.1 - 0.3 mg/l, Cu ~ 0.05 - 1.2 mg/l, Ni ~ 0.5 - 1.5 mg/l, Zn ~ 0.1 - 1.0 mg/l, Pb ~ 0.1 -

2.0 mg/l, and dissolved Si ~ 10 - 50 mg/l at both 2 °C and 10 °C. Similar to B - Zone tailings, effluent concentrations of Sb and Hg were very low, ~ 0.03 mg/l and below detection, respectively.

Total Dissolved Cyanide

The S - Zone cyanide leaching profile for 2 °C is shown in Fig. 51. The dissolved cyanide concentration of the effluent was very low, ranging between 2 - 10 µg/l, and its drainage lasted only for a limited duration at 2 °C. The acid generation in S - Zone caused complete destruction and removal of cyanide during early stages of leaching at 2 °C. No cyanide drainage was observed at 10 °C

4.0 DISCUSSION

It is clearly evident from these results that oxidation and acid generation occurred for both B- and S - Zone tailings at 2 °C and 10 °C. The rate of acid generation was less and the occurrence of acidic drainage was delayed at both 2 °C and 10 °C in comparison to those observed at 25 °C in the earlier study by Davé (1992).

For B - Zone tailings, containing relatively high sulphide (2.31% as S) and total available alkalinity (45.36 kg $CaCO_3$/tonne), the acid generation rate was low enough at 2 °C that a reasonable degree of acid neutralization was achieved and acidic drainage prevented during most of the leaching period except near the end when some acidic drainage occurred. This process continued as the transition was made from 2 °C to 10 °C, where the magnitude of the acid drainage increased, but still the neutralization continued which moderated the effluent pH and acidity. The overall impact of acid drainage was thus low for B - Zone tailings at both leaching temperatures of 2 °C and 10 °C.

For S - Zone tailings, containing low sulphide (0.4% as S) and total available alkalinity (2.0 kg $CaCO_3$/tonne), the acid generation rate was also low at cold temperatures, but because of low available alkalinity there was insufficient acid neutralization and acidic drainage occurred early during the 2 °C leaching period.

Acid drainage continued with additional leaching at 2 °C and its magnitude increased during leaching at 10 °C, but because of the high moisture retention characteristics of these tailings as well, the overall impact of acid drainage was again limited in magnitude and duration. However, for S - Zone tailings, the low temperature acidic drainage was accompanied by release of iron, sulphate, and metals in moderate concentrations.

In comparison to the previous room temperature (25 °C) leaching results (Davé, 1992), there was a significant reduction in acid drainage and metal loading from B - Zone tailings at low temperatures. The contributing factors were low acid generation and high available alkalinity. However, for S - Zone tailings, similar impact at low temperatures was not realized as these tailings contained low available alkalinity.

Although the 2 °C leaching period was terminated prematurely, because of the equipment malfunction and freezing of test samples, sufficient information had been obtained to predict continuation of acidic drainage, perhaps of a weaker strength but for longer duration, from S - Zone tailings at low temperatures. The data should be further analyzed to obtain acid generation and metal loading rates at the three study temperatures.

In addition to reduced acid generation and delayed acidic drainage at low temperatures, the water retention characteristics of the both B- and S - Zones offered the greatest control on overall acidic drainage from these tailings. As noted in the previous study by Davé (1992), both B - and S - Zone tailings retained appreciable amounts of moisture (~ 85 - 100% pore volume saturation) during laboratory leaching, which decreased oxidation and acid generation rates and further reduced the impact of acidic drainage.

It has been clearly demonstrated in the previous and current study that for Cullaton Lake B - and S - Zones tailings, the zone of oxidation and acidification is limited to the uppermost active layer, approximately 10 - 15 cm in thickness. In the field, this thickness may vary depending on site topography, hydrology, and climate. Because of extreme and prolonged low temperatures and relatively dry conditions prevailing in the Nunavut-Keewatin districts, winter drying and desiccation may lead to exposure and oxidation of tailings at greater depths.

Since 1993, the exposed tailings surface has been covered with a 1.5 m layer of wasterock and overburden (Trow Consulting Engineers, 1995). Temperature profiles within the tailings area indicated a cooling trend and upward migration of the permafrost level in the tailings, although this level is increasing slowly as seen from Table 7 and Figs. 53 - 56. The slow upward rise in the permafrost level was attributed to the placement of cover during summer months, probably caused by poor heat dissipation through the wasterock insulating cover and longer cooling period than if the wasterock was placed, for example, during winter months (Homestake Canada Inc., 1994).

Additional field studies are required for site characterization with respect to active zone of freezing, thawing and oxidation; moisture characteristics; and chemical, mineralogical, and microbial compositions of the tailings in assessing their current weathering and oxidation status.

Cullaton Lake data were compared with those of 59 other mines and 385 others kinetic tests from the International Kinetic Database (Morin et al., 1995). The rate of sulphide oxidation in mg/ SO_4/kg/wk at 25 °C (Phase 1 study; Davé, 1992) was shown to be moderate to high. However, leaching rates of copper and zinc from tailings at the site were shown to be low to very low. This indicated that some form of ARD mitigation was occurring within the tailings mass at the site where cold temperatures and freezing conditions are present at least 8 - 10 months a year.

During operations, sodium cyanide consumption for both B - Zone and Shear (S) - Zone ore was at the rate of 2 kg/tonne ore. Cyanide concentrations of tailings porewater at the site ranged between 200 - 300 mg/l (Napier, 1996). Although cyanide concentration decreased with decreasing pH, where it is lost through formation of HCN, the toxicity of tailings seepage water is influenced by the formation of metal complexes in cyanide solutions (Higgs, 1992).

5.0 SUMMARY AND CONCLUSIONS

Cold temperature leaching studies at 2 °C and 10 °C were conducted for Cullaton B - and Shear (S) - Zones tailings to evaluate their oxidation and leaching characteristics at low temperatures.

The results showed that oxidation and acidic drainage occurred in both tailings at these temperatures. The rate of acid generation was less and acidic drainage occurred later at 2 °C than at 10 °C.

The overall impact of acid drainage at cold temperatures was lower for B - Zone tailings than for S - Zone as the former contained higher total available alkalinity.

Both B - and S - Zones tailings also retained appreciable amounts of moisture which limited oxidation and acidification to the well drained upper layer and provided further control on acidic drainage.

6.0 RECOMMENDATIONS

It is recommended that all the available data for the three leaching temperatures, 25 °C (from phase 1), and 10 °C and 2 °C from the present study, should be examined further and analyzed to obtain acid generation and metal loading rates at these temperatures. The tailings management facility at the Cullaton Lake site should also be assessed for its current physical, chemical, mineralogical and biological status by undertaking suitable field studies.

7.0 REFERENCES

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Figures

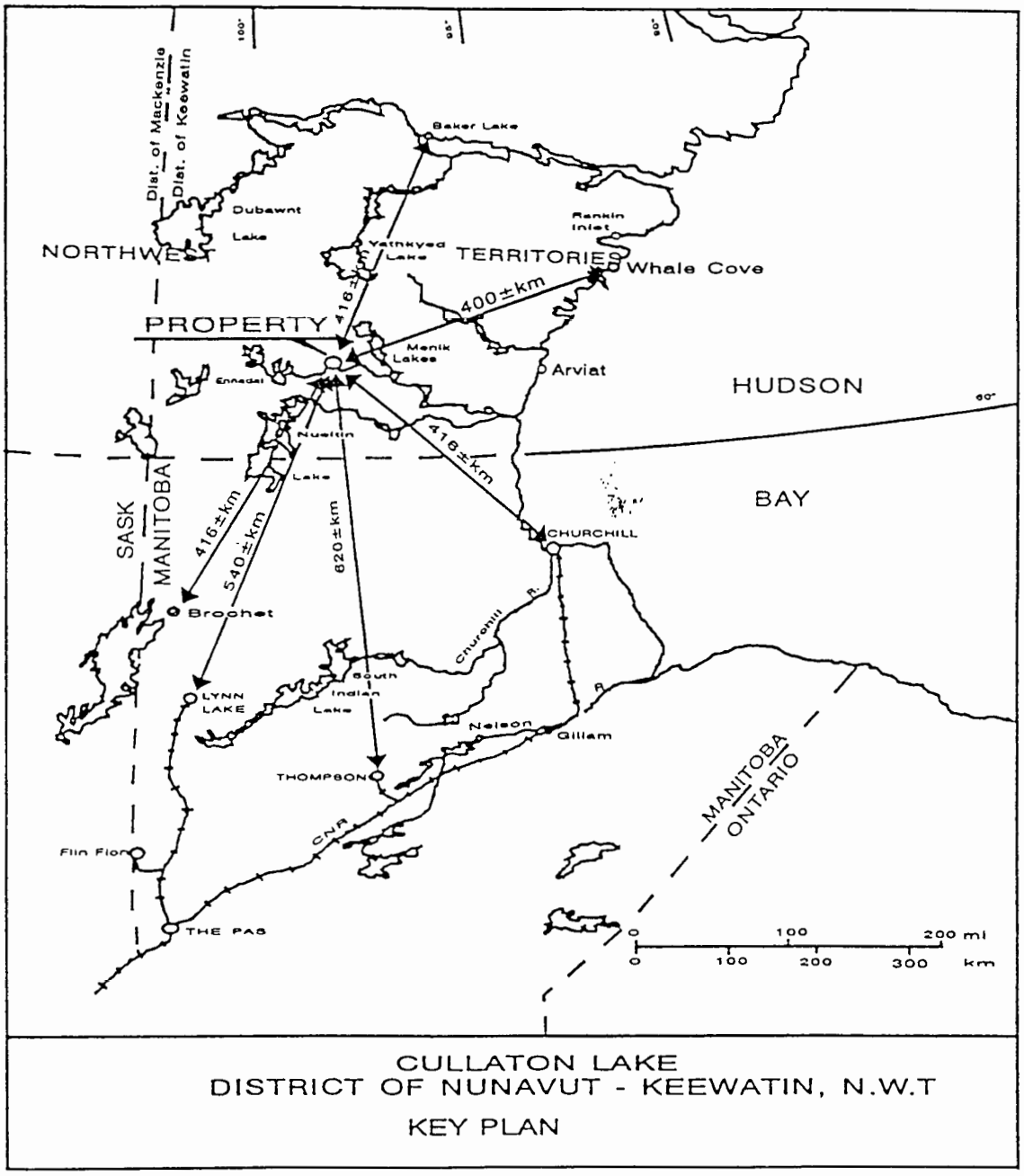


Fig. 1 Location of Cullaton Lake mine, Northwest Territories.

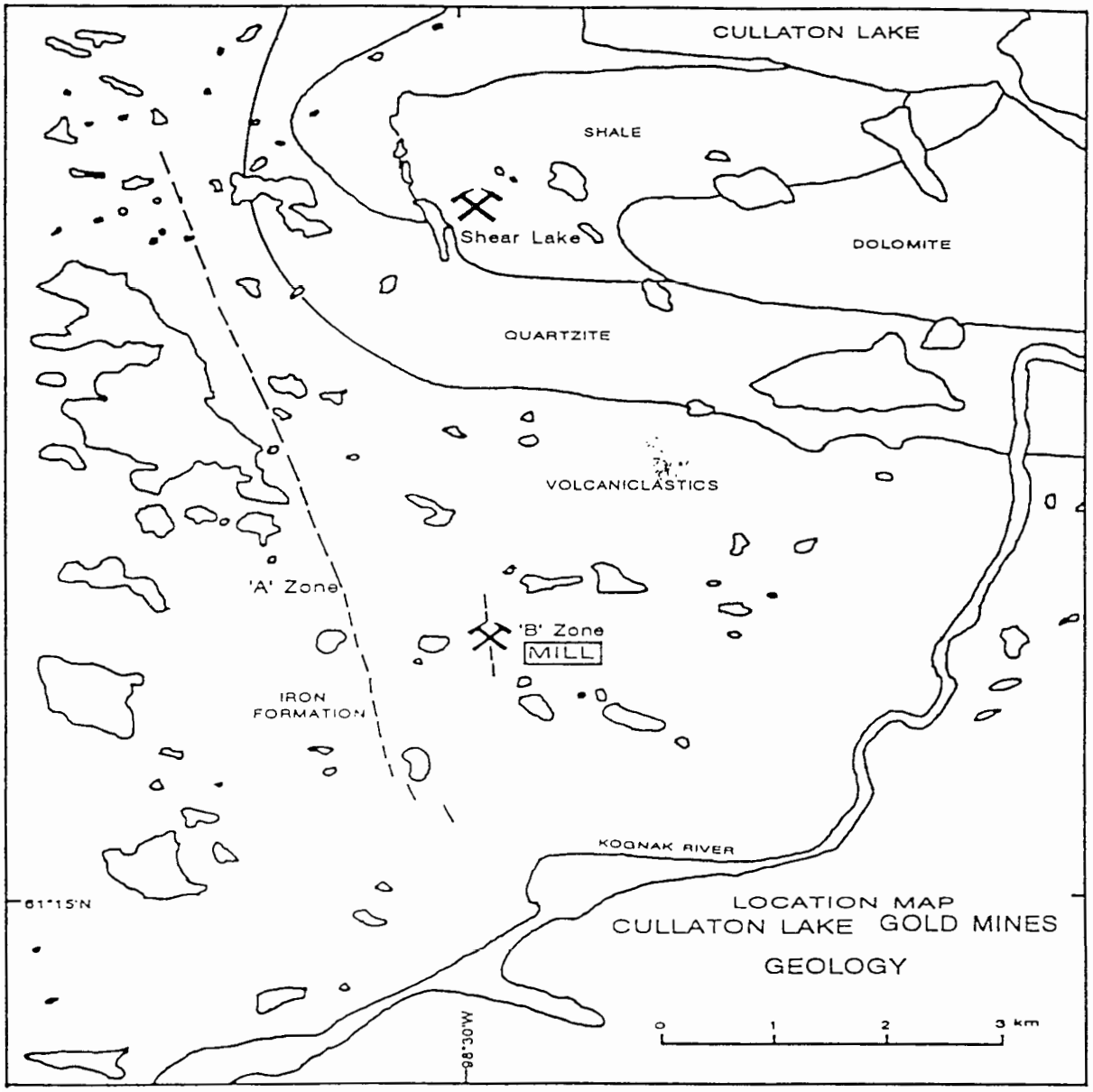


Fig. 2 Location of B- and Shear-Zones at the Cullaton Lake mine property.

Column vertical section

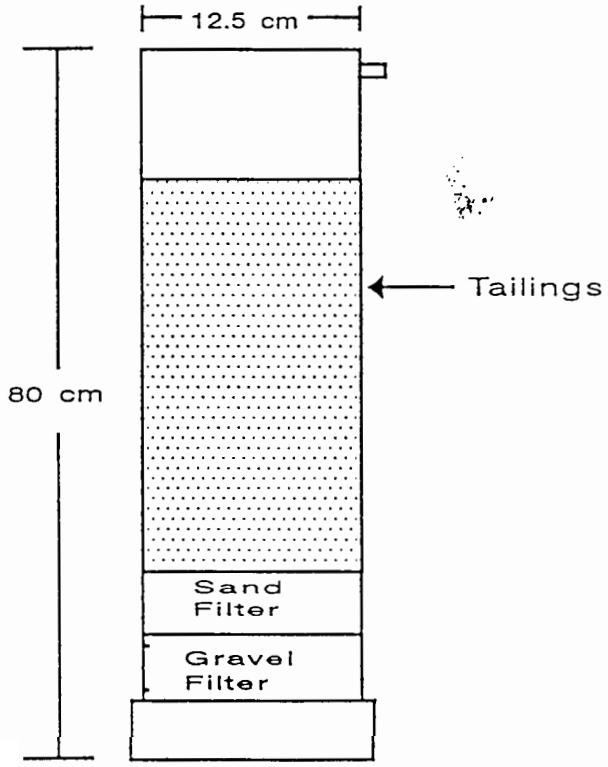


Fig. 3 Vertical section of a leaching column.

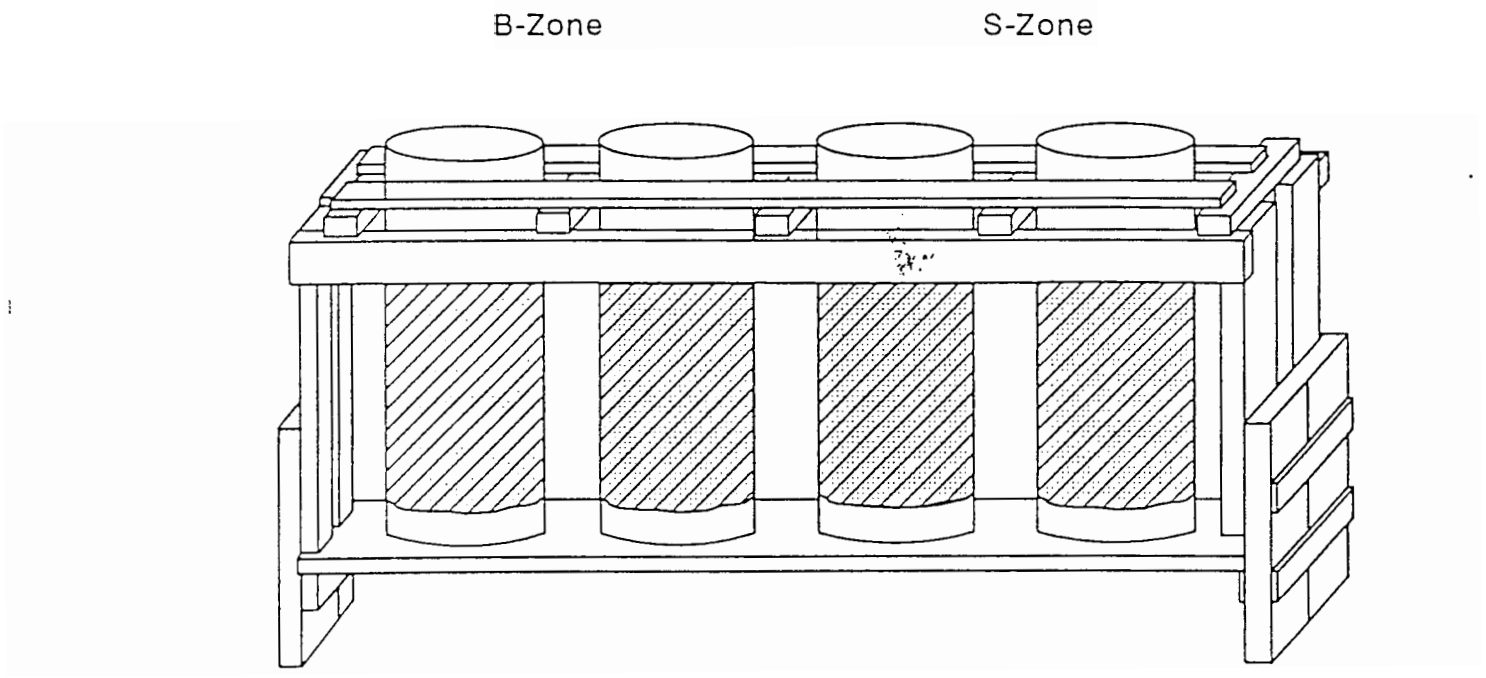


Fig. 4 Experimental arrangement of leaching columns.

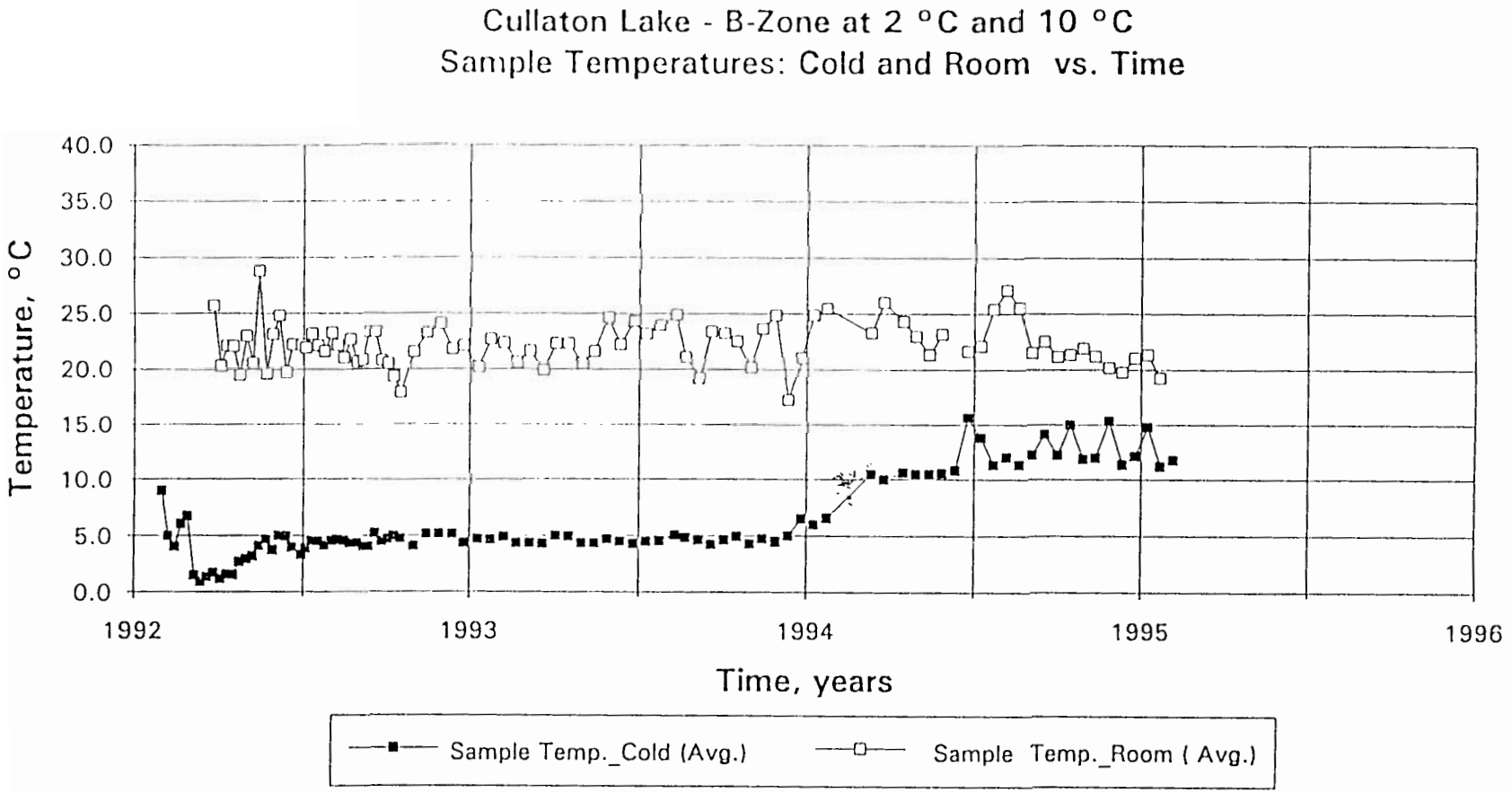


Fig. 5 B - Zone: effluent sample temperatures at cold and room conditions.

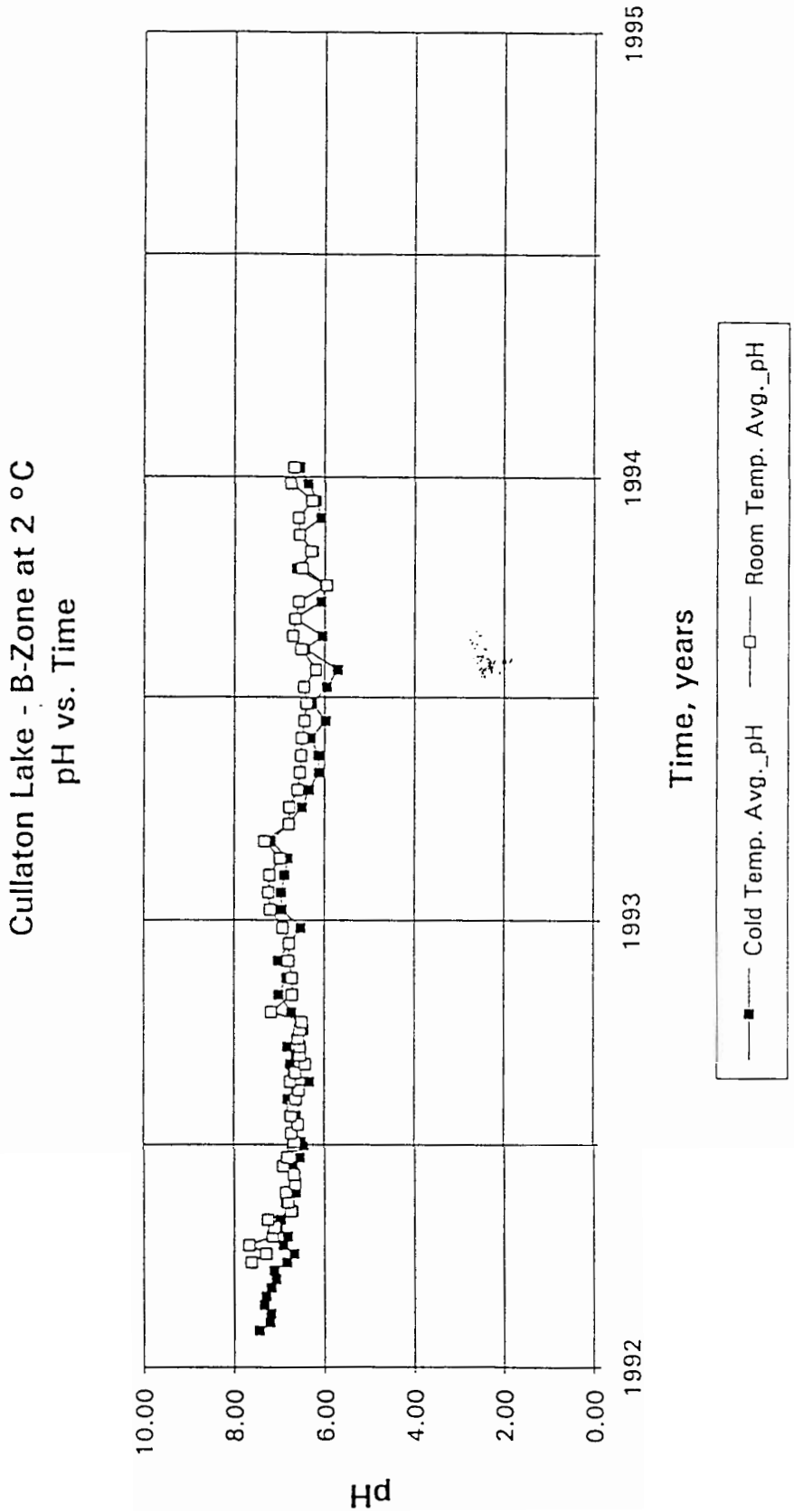


Fig. 6a B - Zone: effluent pH's at 2 °C and room temperature.

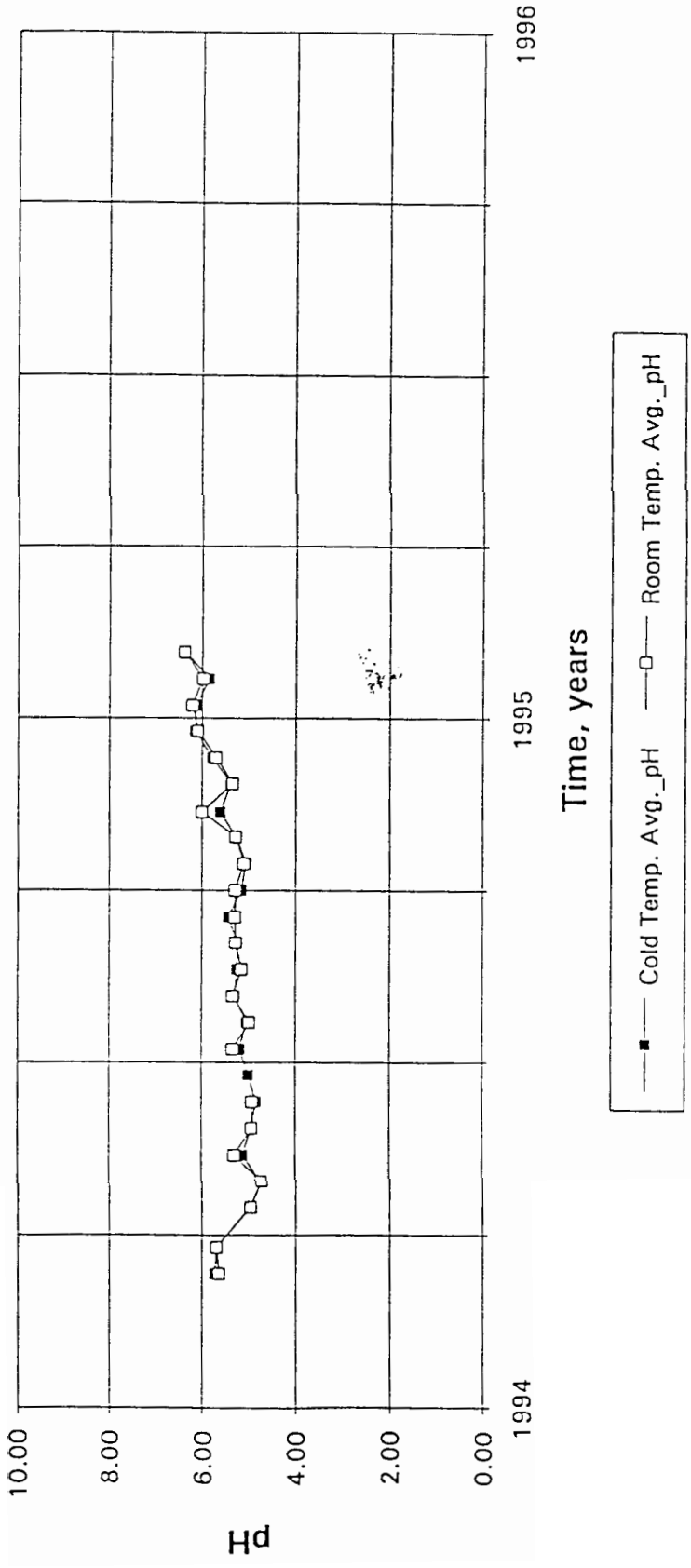


Fig. 6b B - Zone: effluent pH's at 10 °C and room temperature.

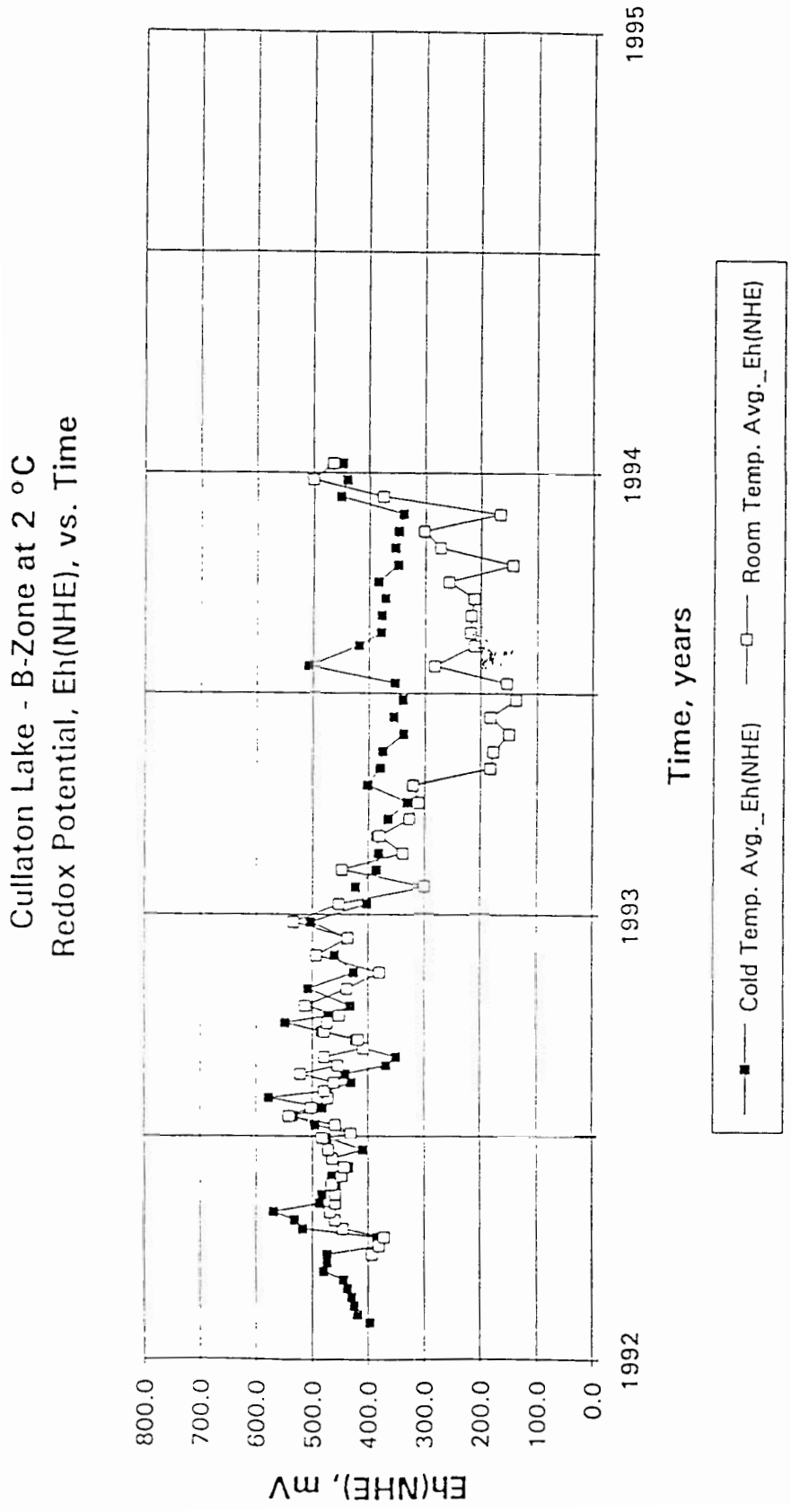


Fig. 7a B - Zone: effluent normalized redox potentials, Eh (NHE), at 2 °C and room temperature.

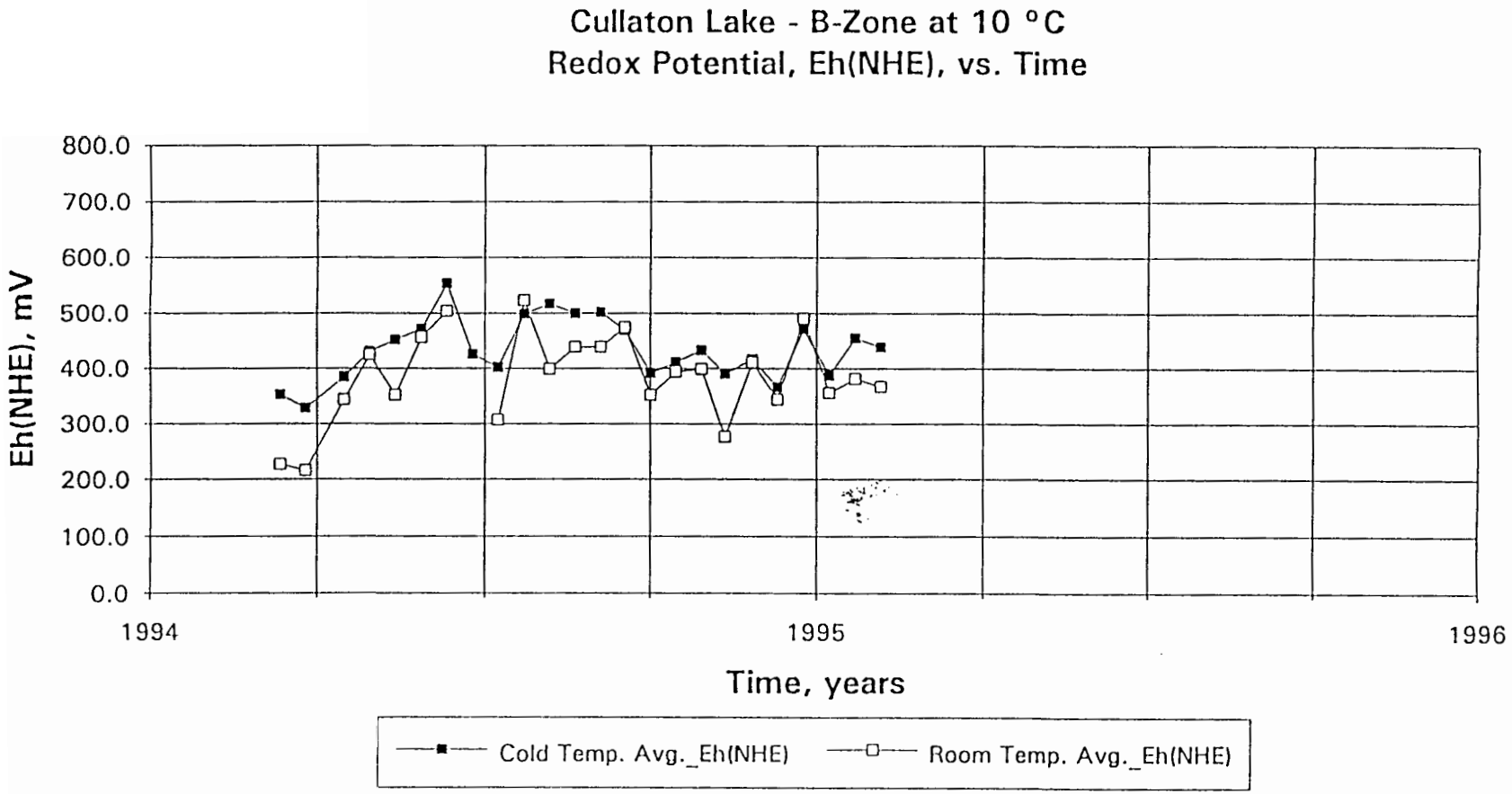


Fig. 7b B - Zone: effluent normalized redox potentials, Eh (NHE), at 10 °C and room temperature.

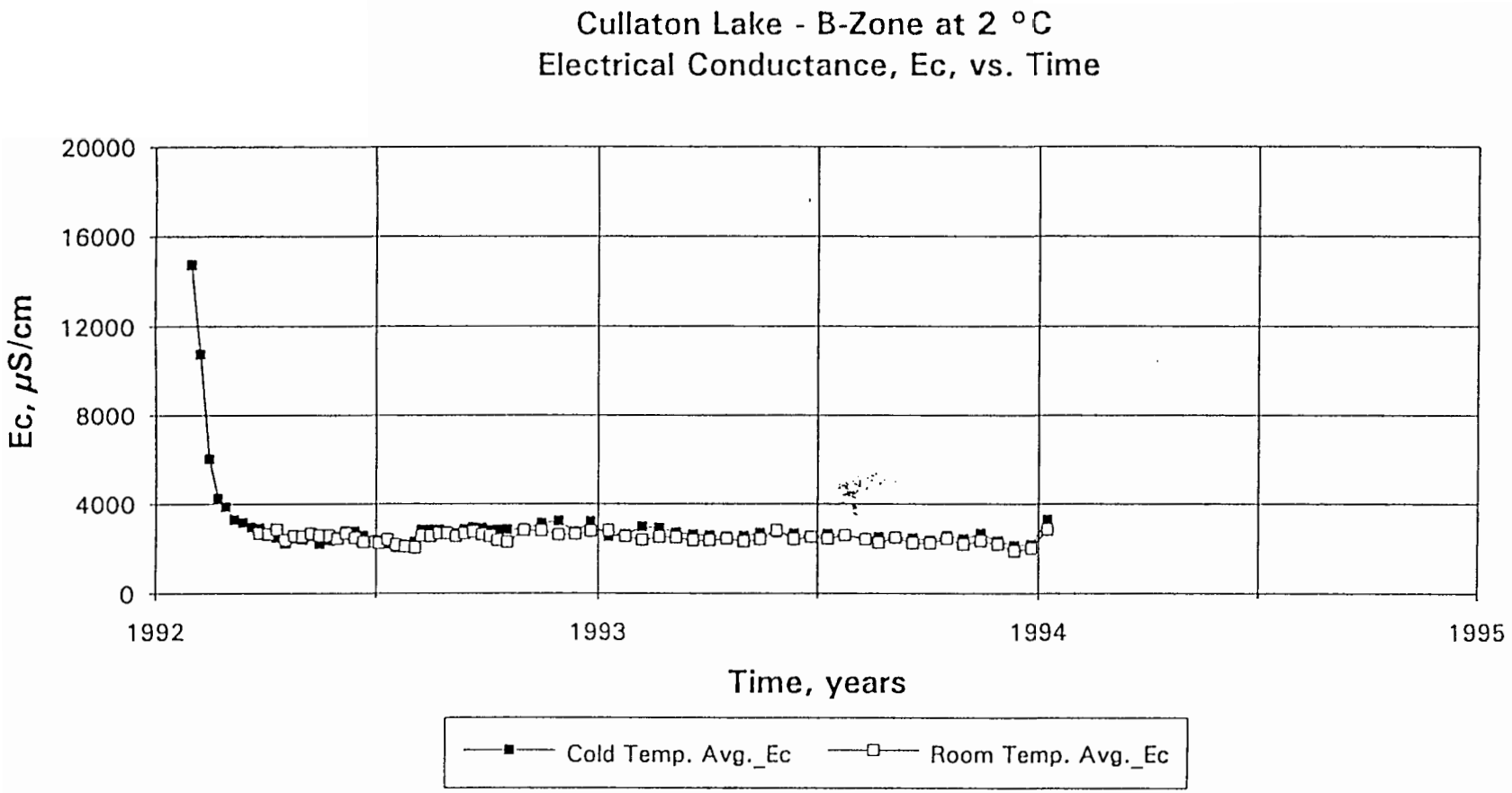


Fig. 8a B - Zone: effluent electrical conductances, Ec, at 2 °C and room temperature.

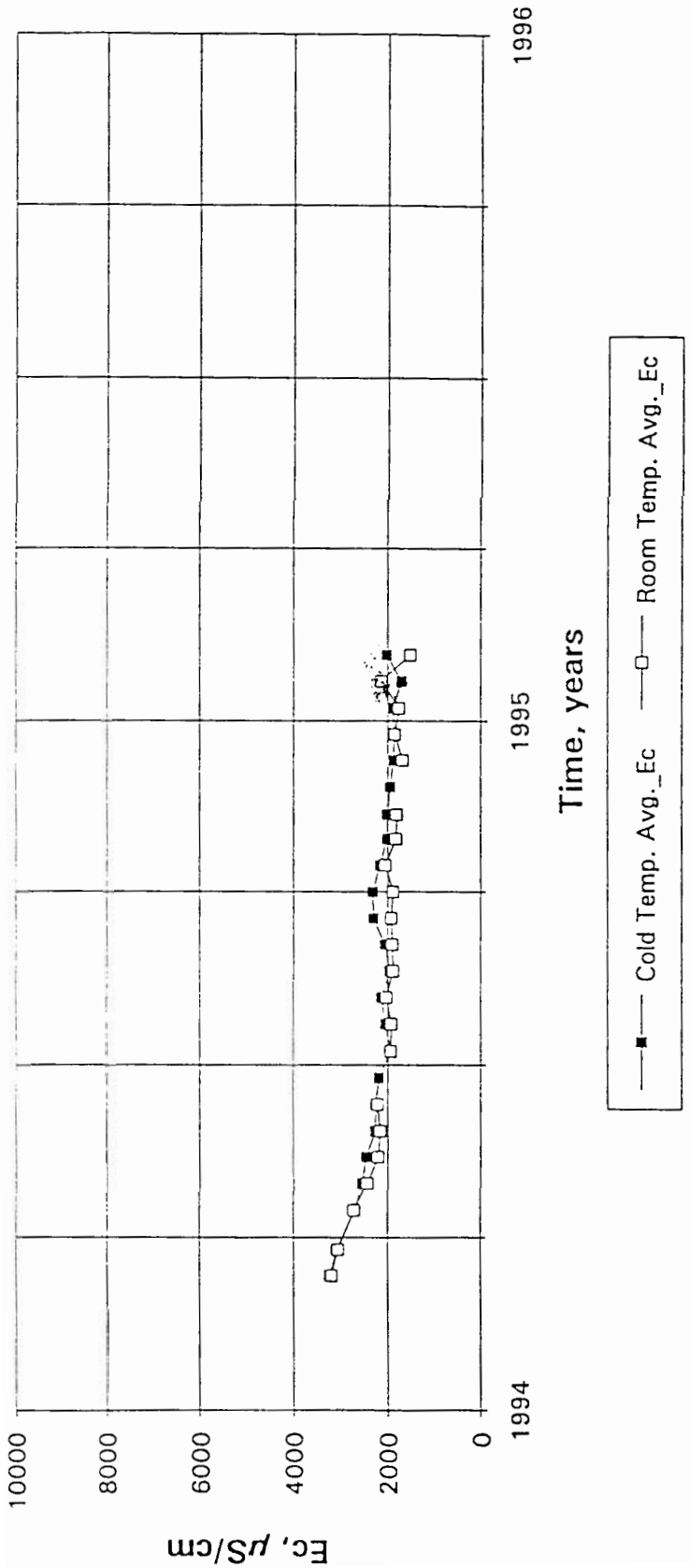


Fig. 8b B - Zone: effluent electrical conductances, Ec, at 10 °C and room temperature.

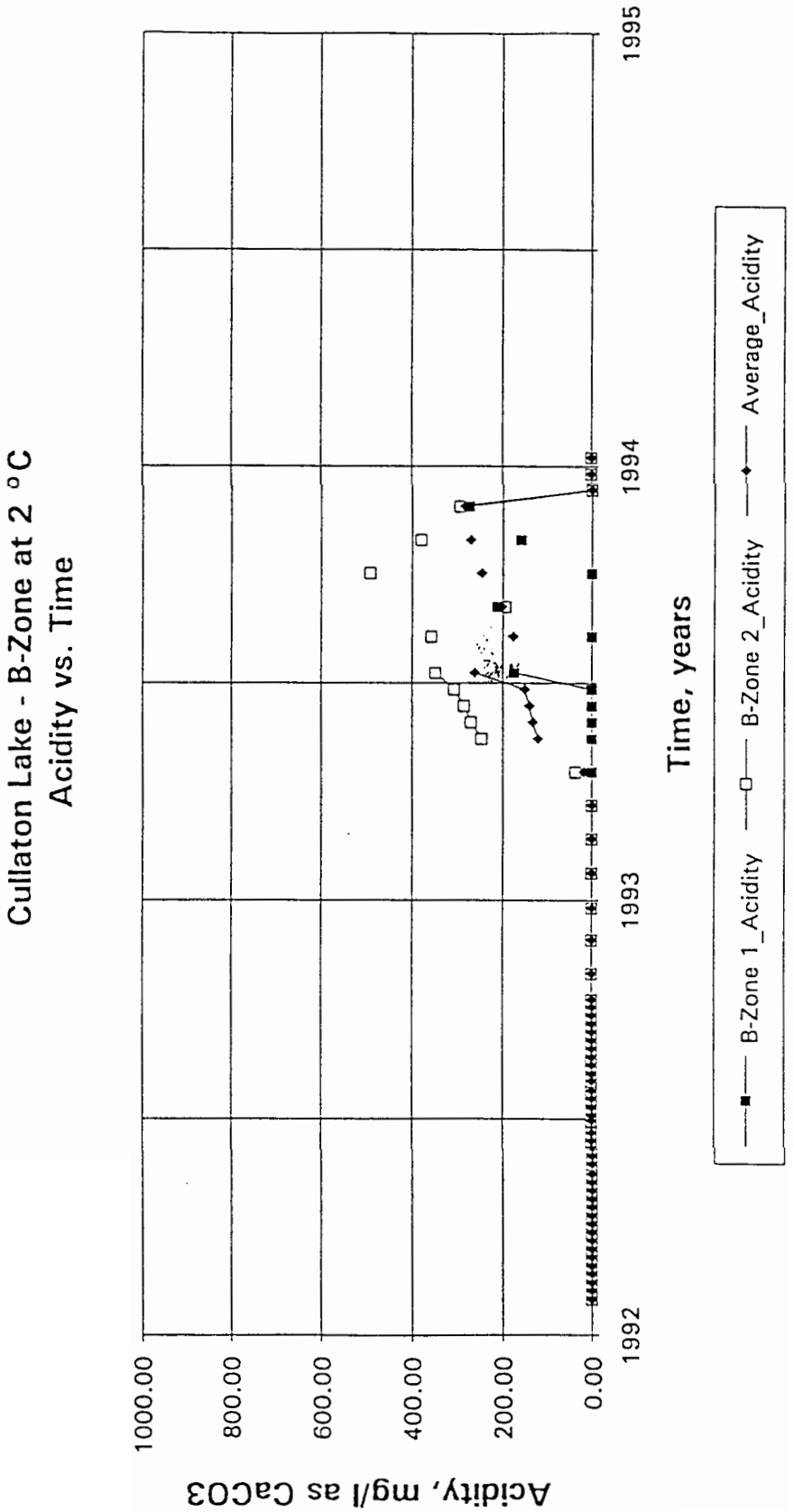


Fig. 9a B - Zone: effluent total acidity at 2 °C.

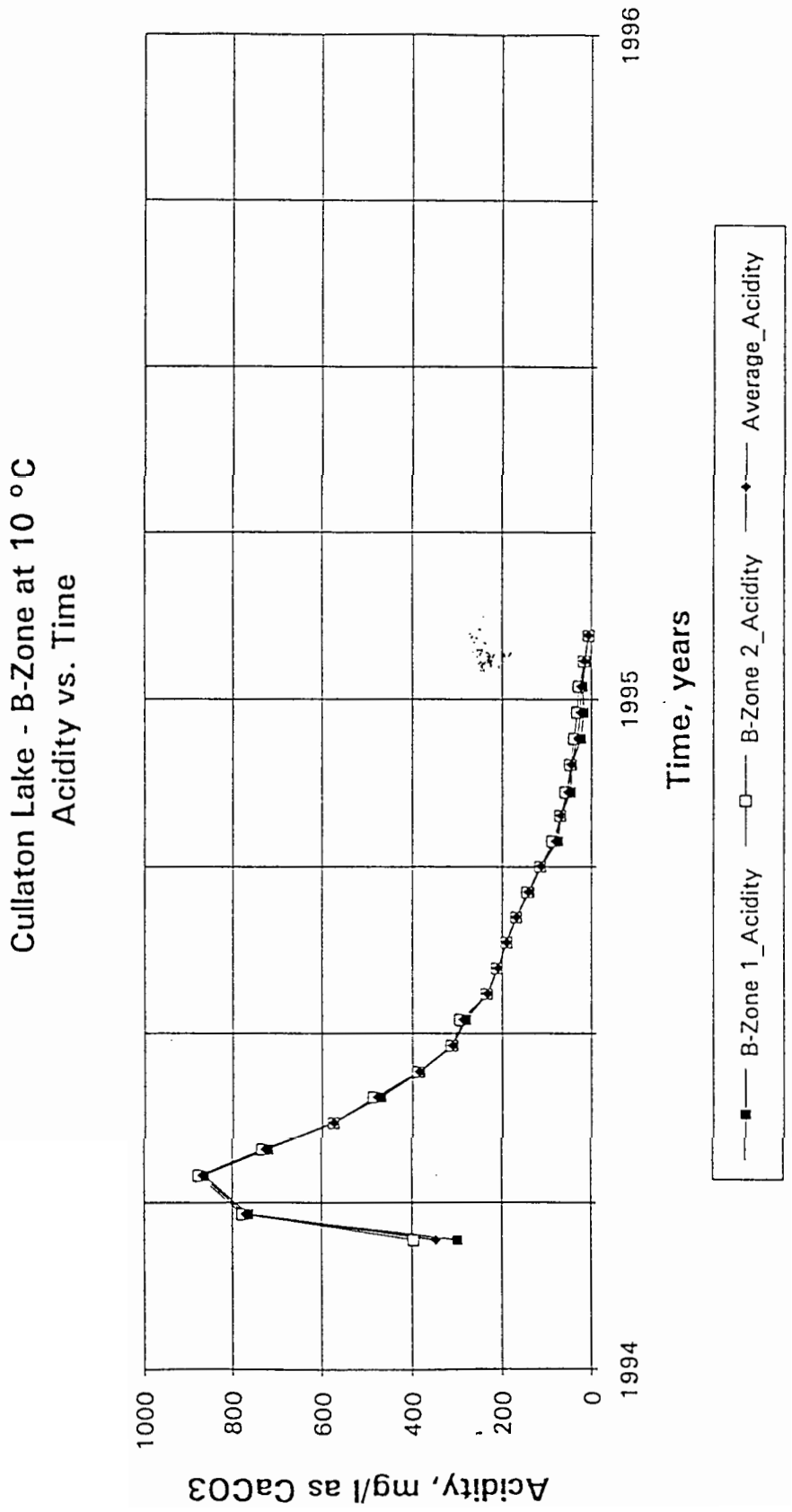


Fig. 9b B - Zone: effluent total acidity at 10 °C.

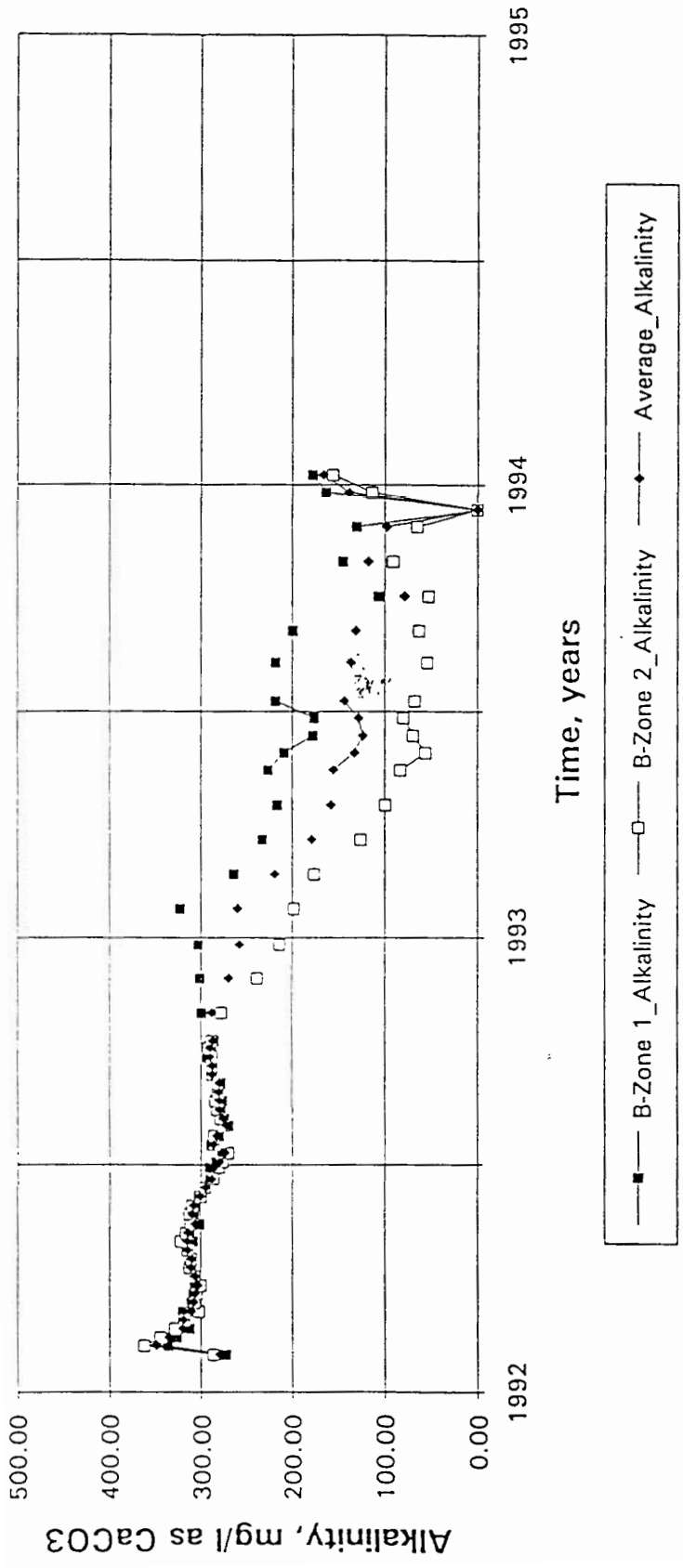


Fig. 10a B - Zone: effluent total alkalinity at 2 °C.

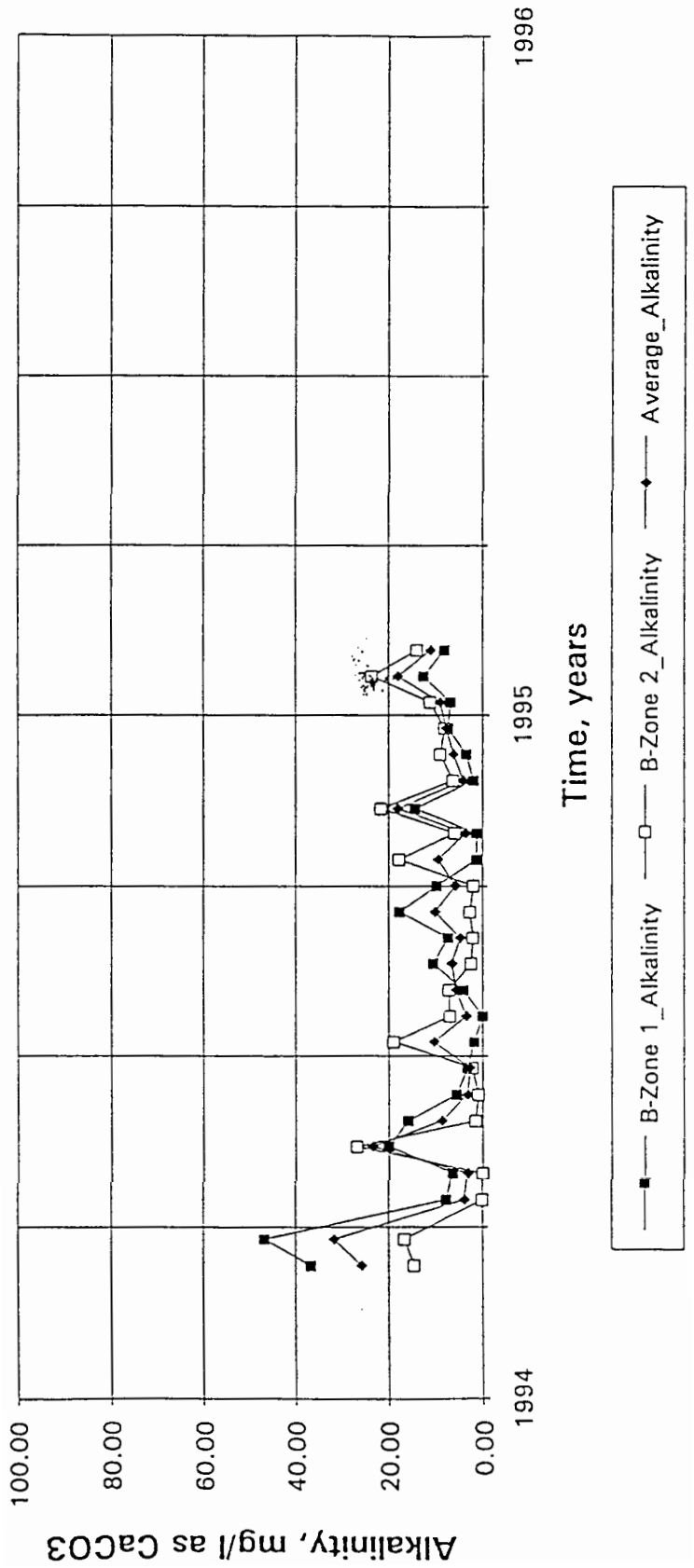


Fig. 10b B - Zone: effluent total alkalinity at 10 °C.

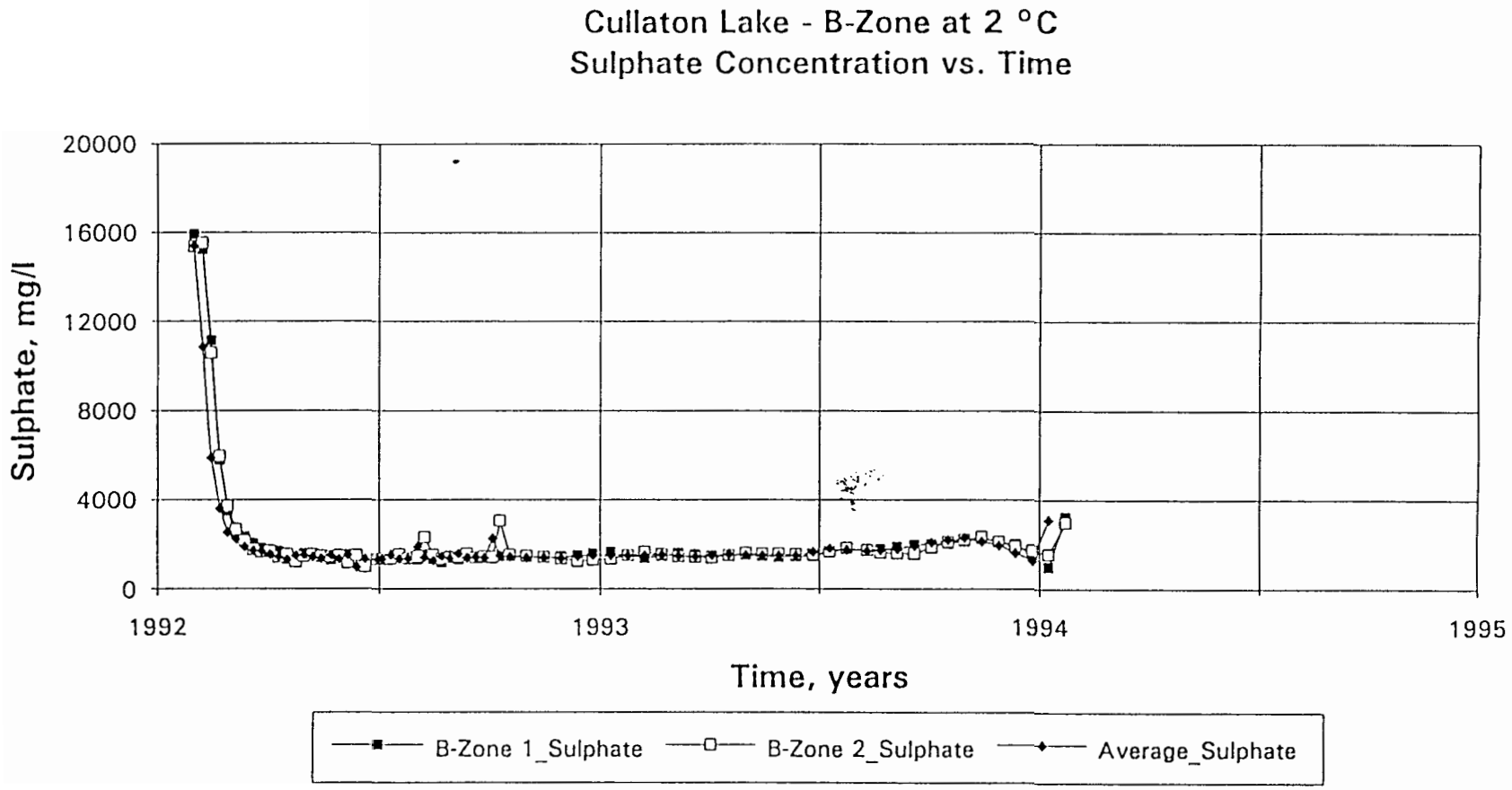


Fig. 11a B - Zone: effluent dissolved sulphate concentration at 2 °C.

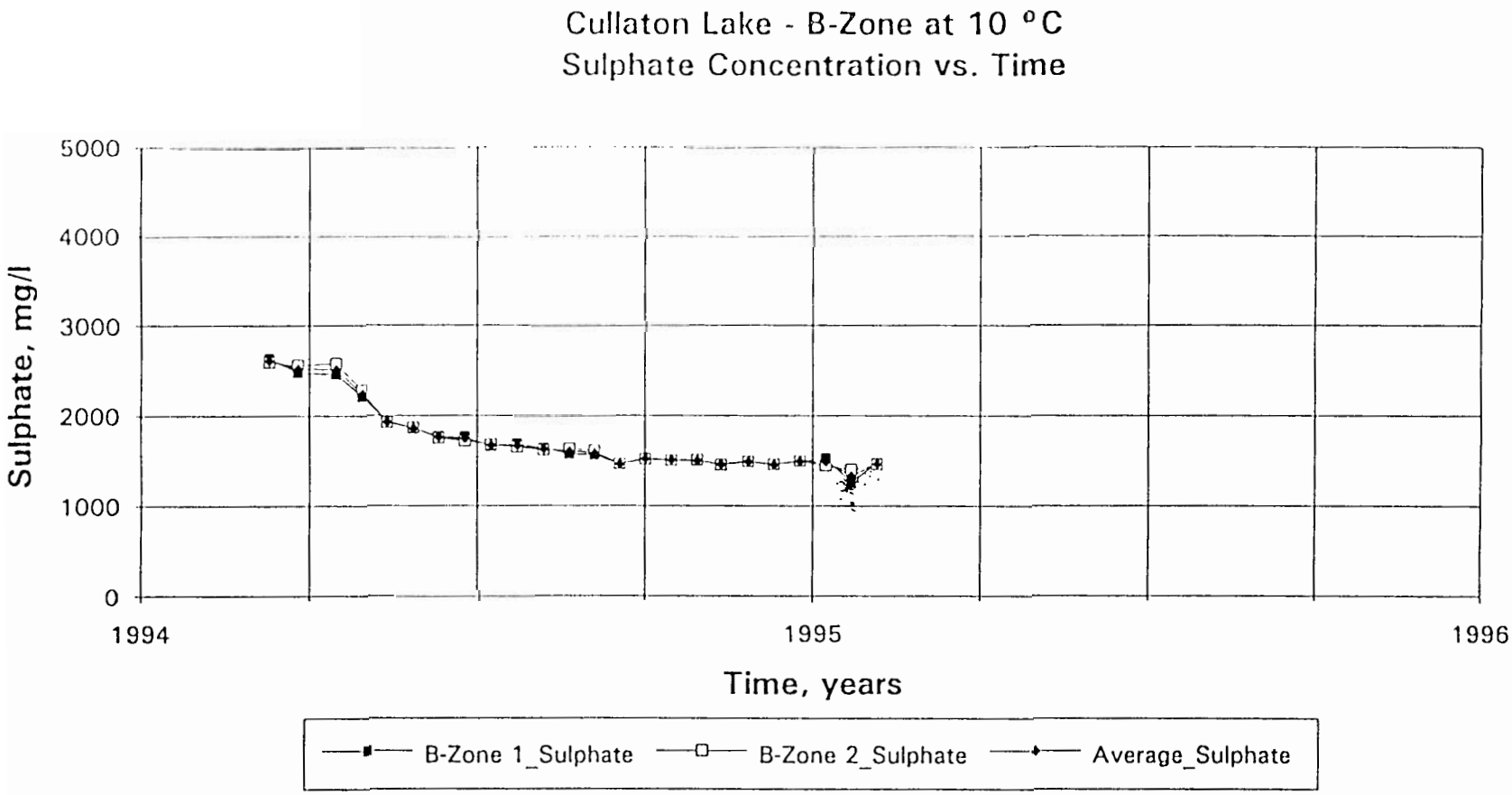


Fig. 11b B - Zone: effluent dissolved sulphate concentration at 10 °C.

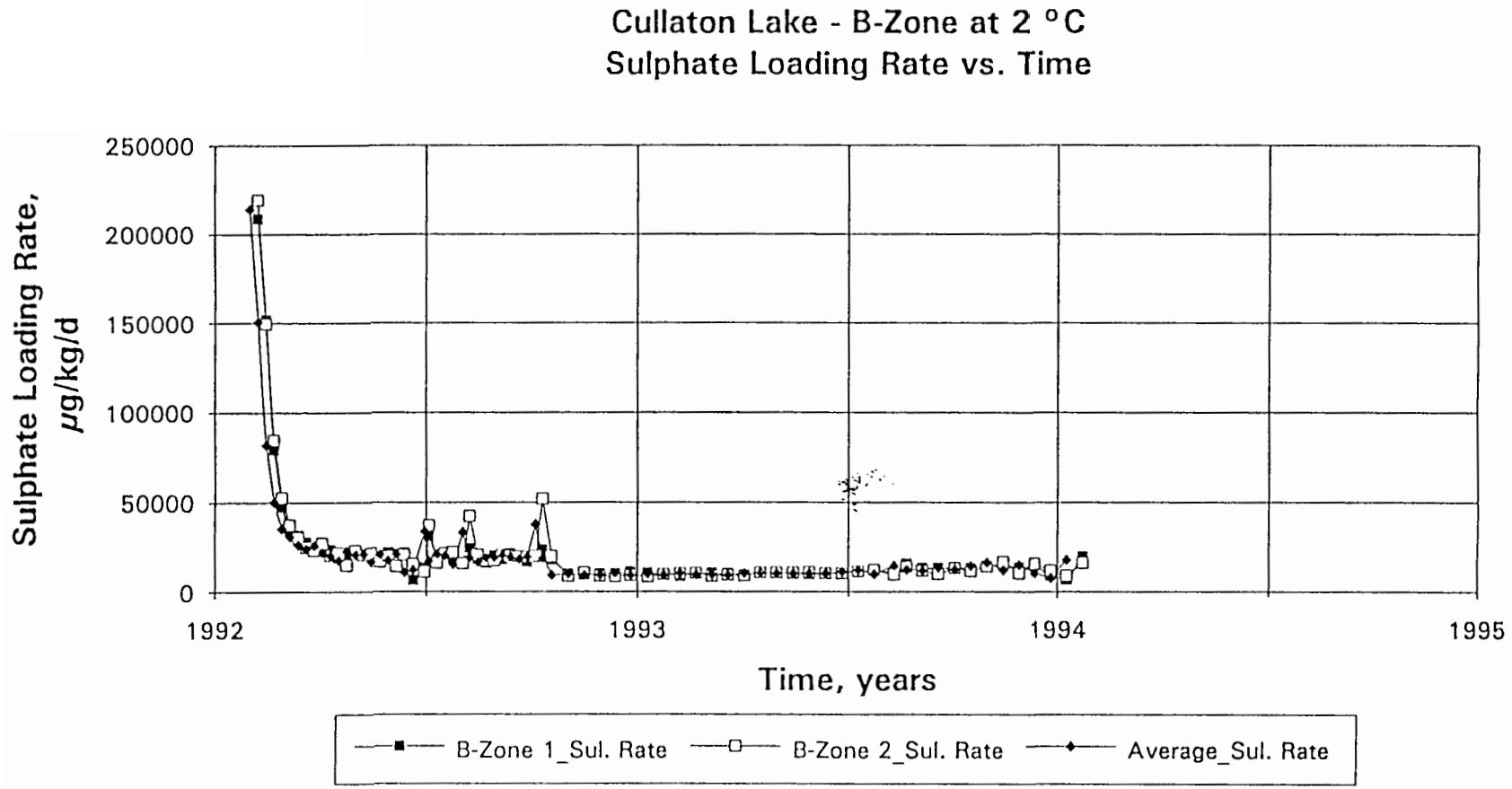


Fig. 12a B - Zone: effluent dissolved sulphate loading rate at 2 °C.

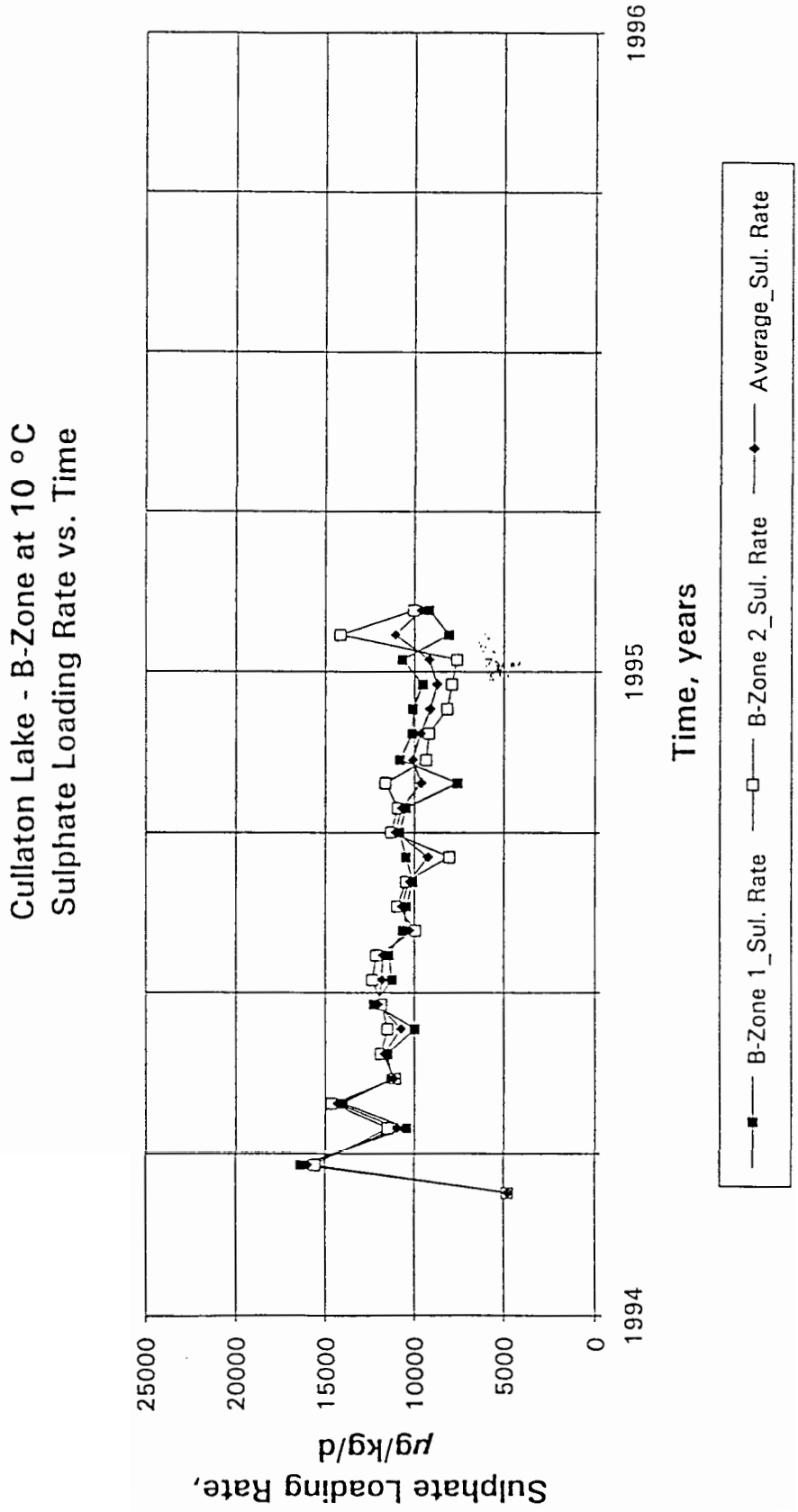


Fig. 12b B - Zone: effluent dissolved sulphate loading rate at 10 °C.

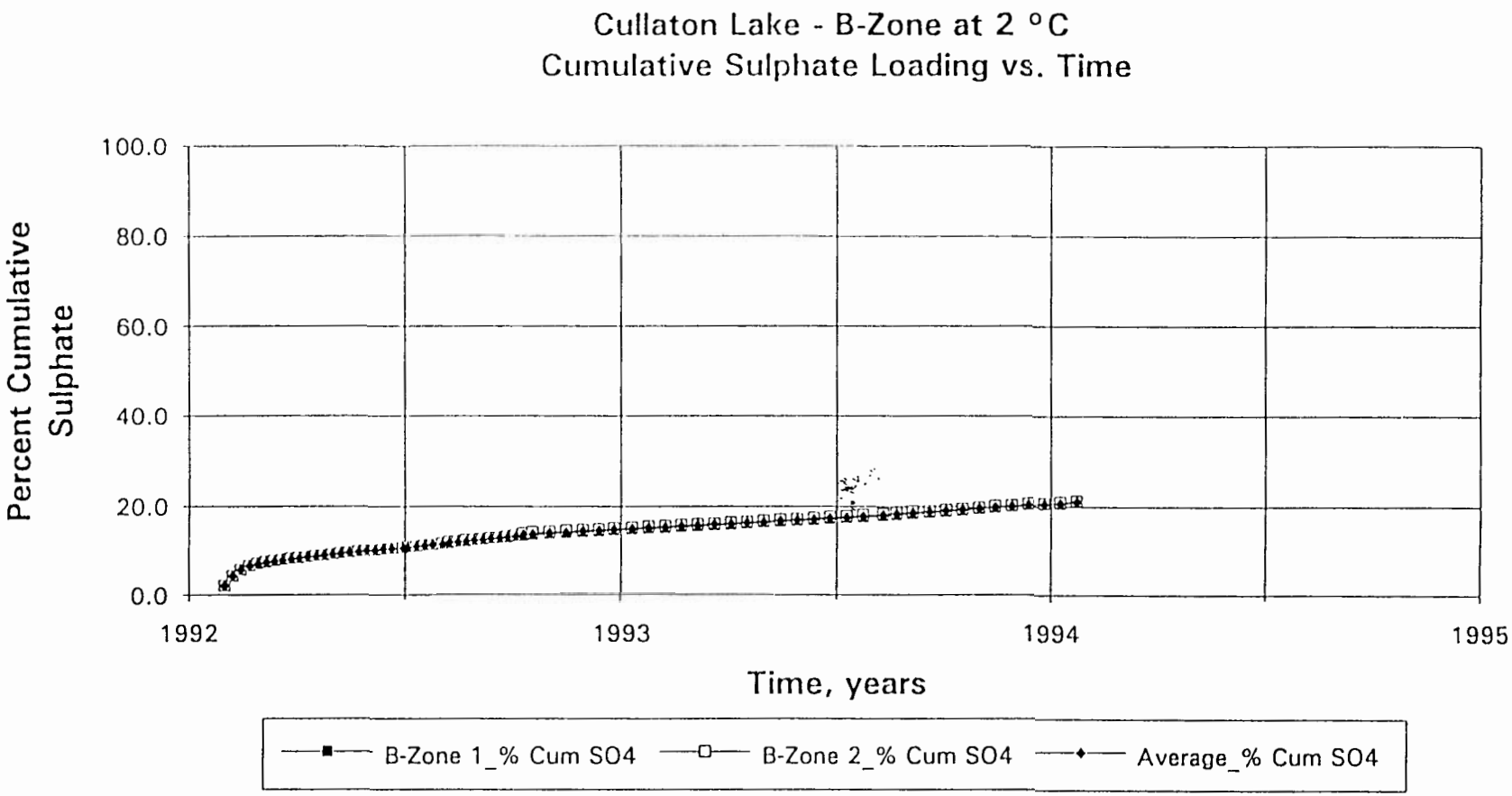


Fig. 13a B - Zone: effluent percent cumulative total sulphate loading at 2 °C.

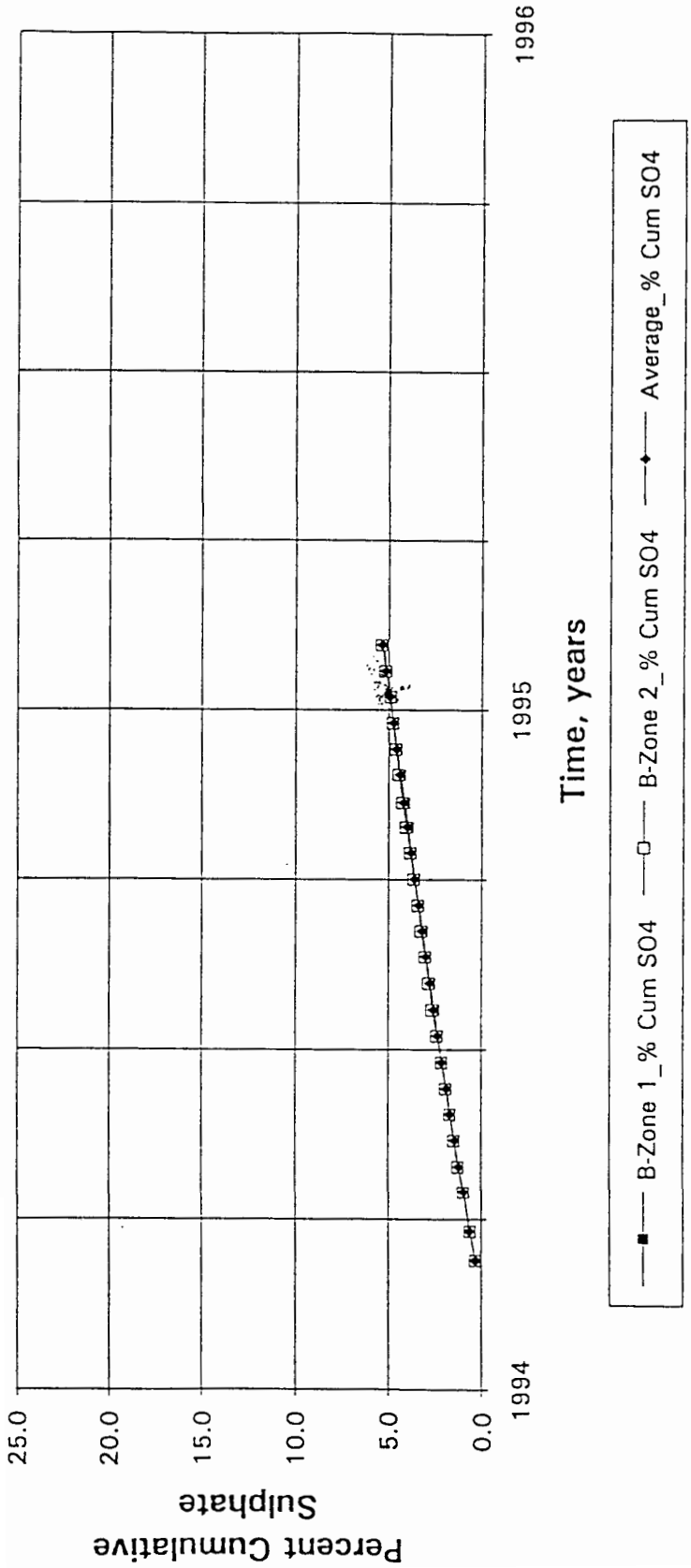


Fig. 13b B - Zone: effluent percent cumulative total sulphate loading at 10 °C.

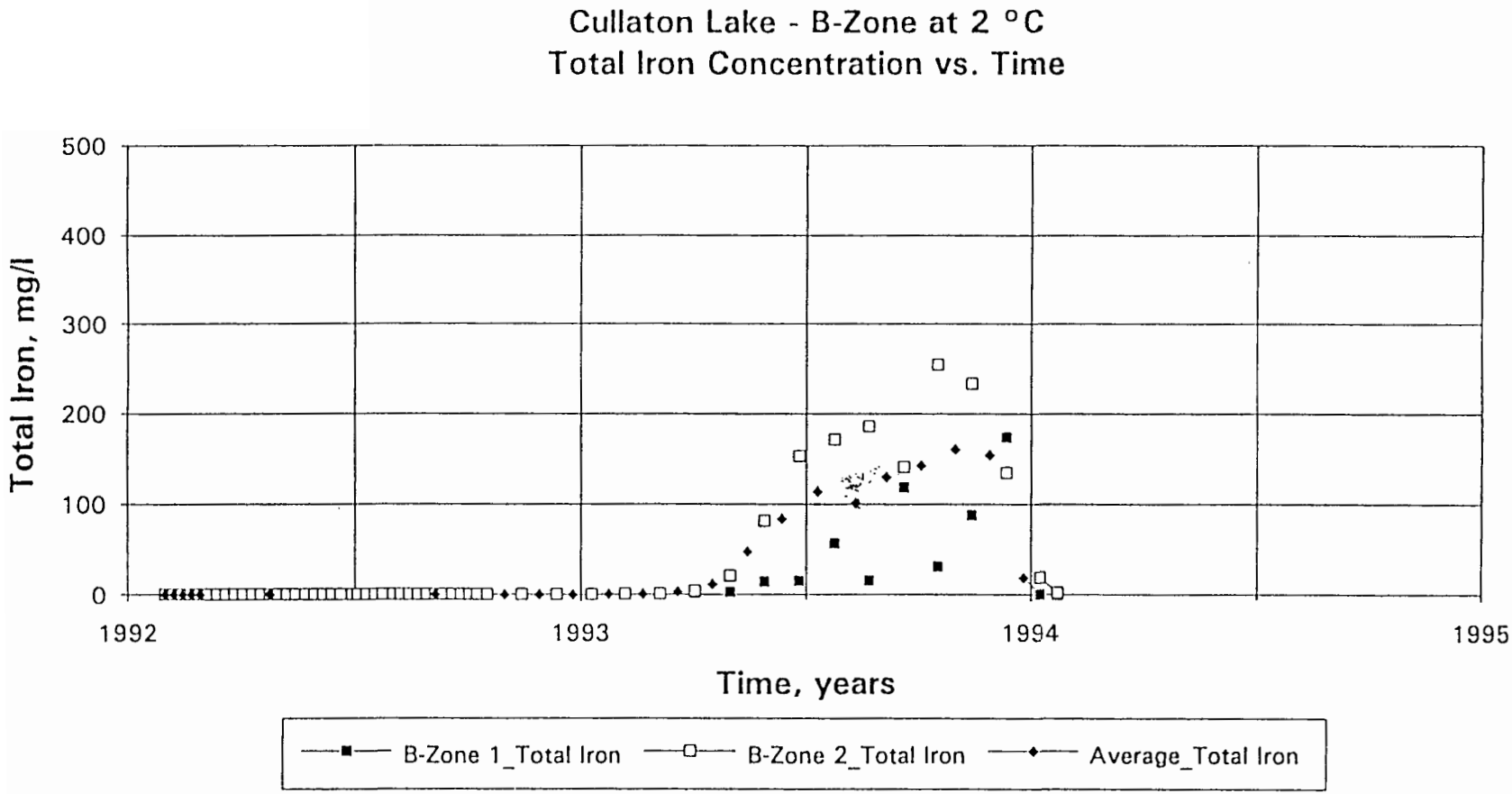


Fig. 14a B - Zone: effluent dissolved total iron concentration at 2 °C.

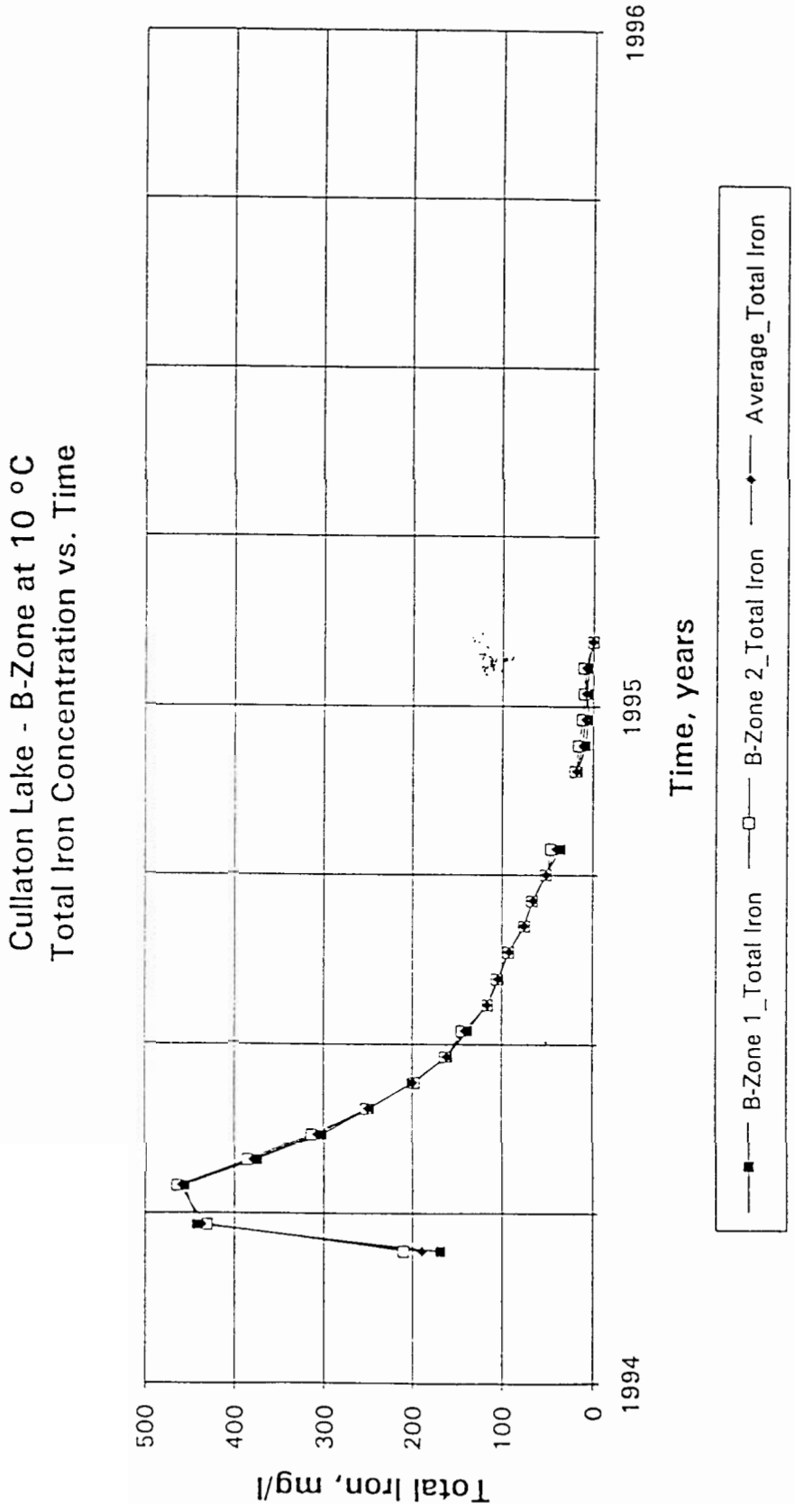


Fig. 14b B - Zone: effluent dissolved total iron concentration at 10 °C.

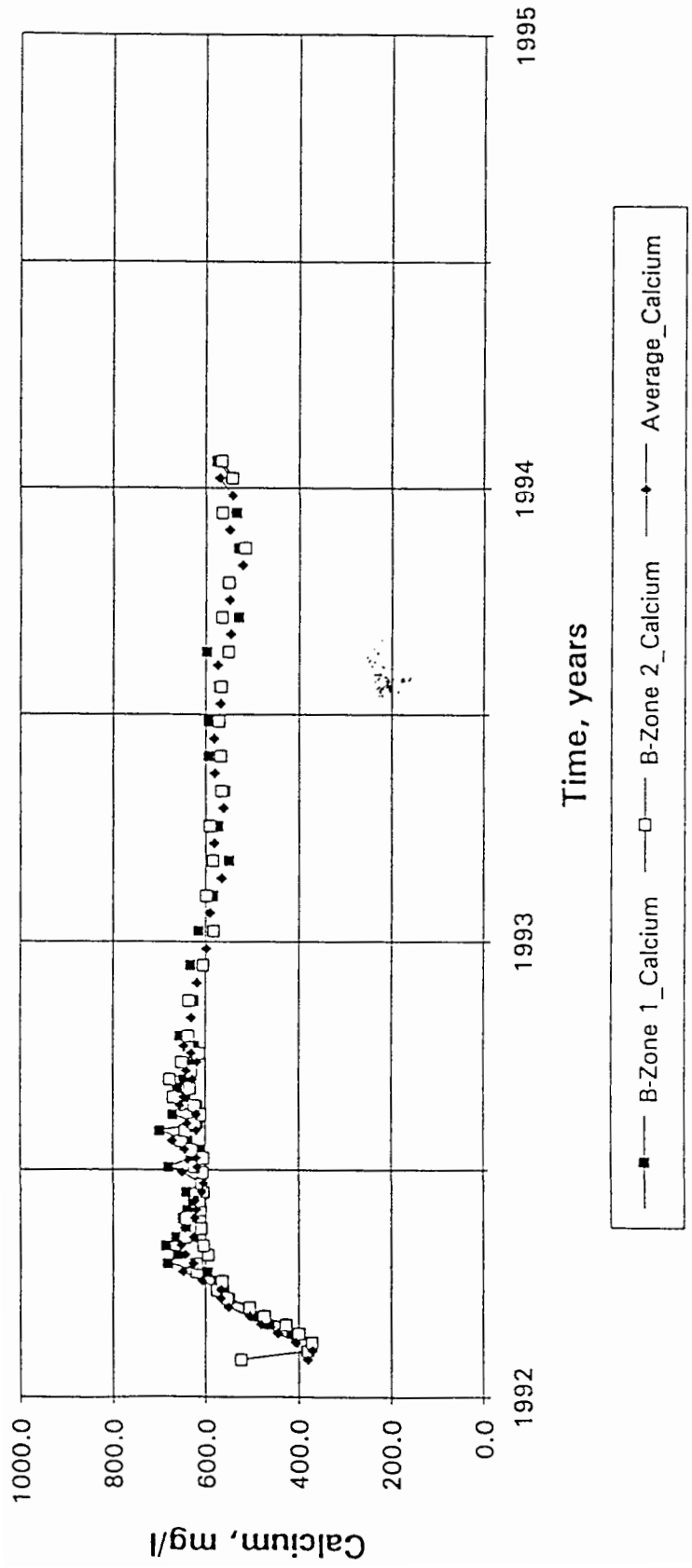


Fig. 15a B - Zone: effluent dissolved calcium concentration at 2 °C.

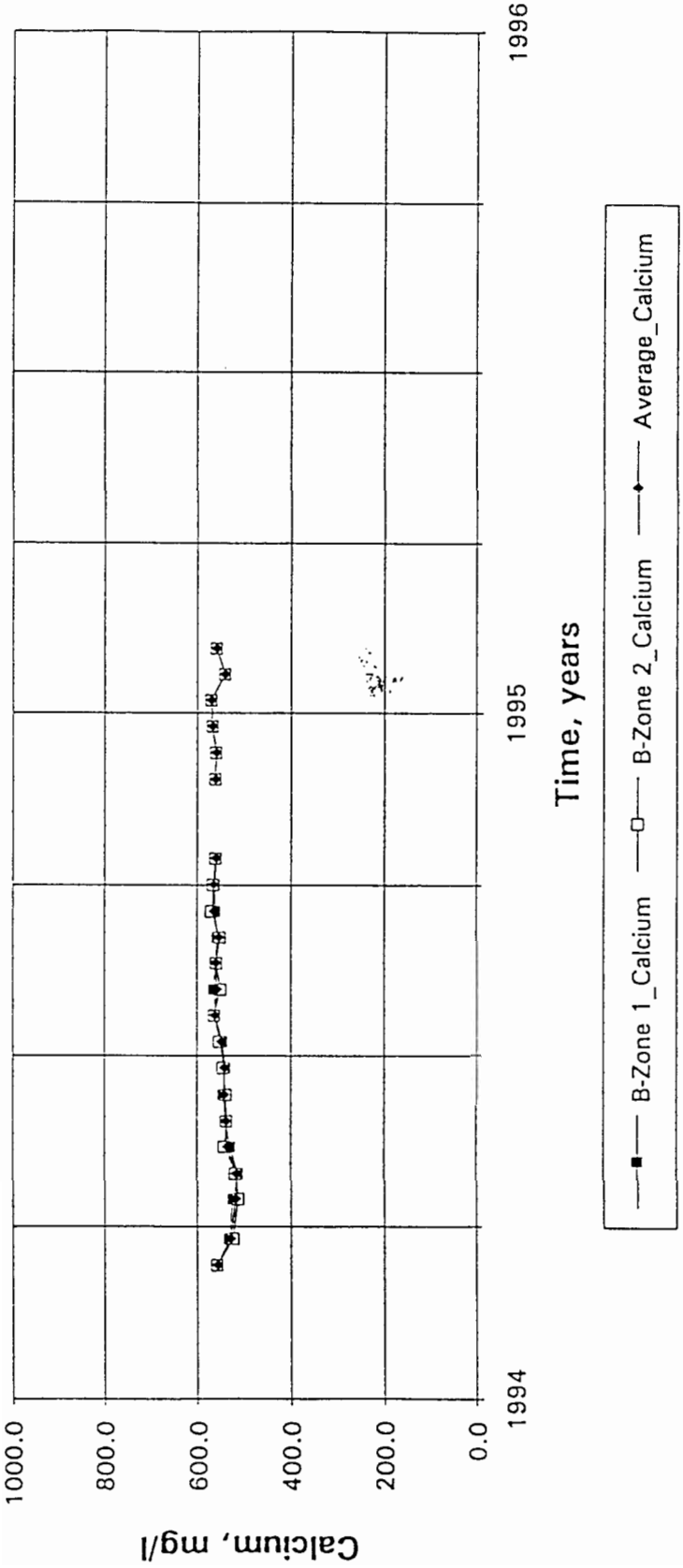


Fig. 15b B - Zone: effluent dissolved calcium concentration at 10 °C.

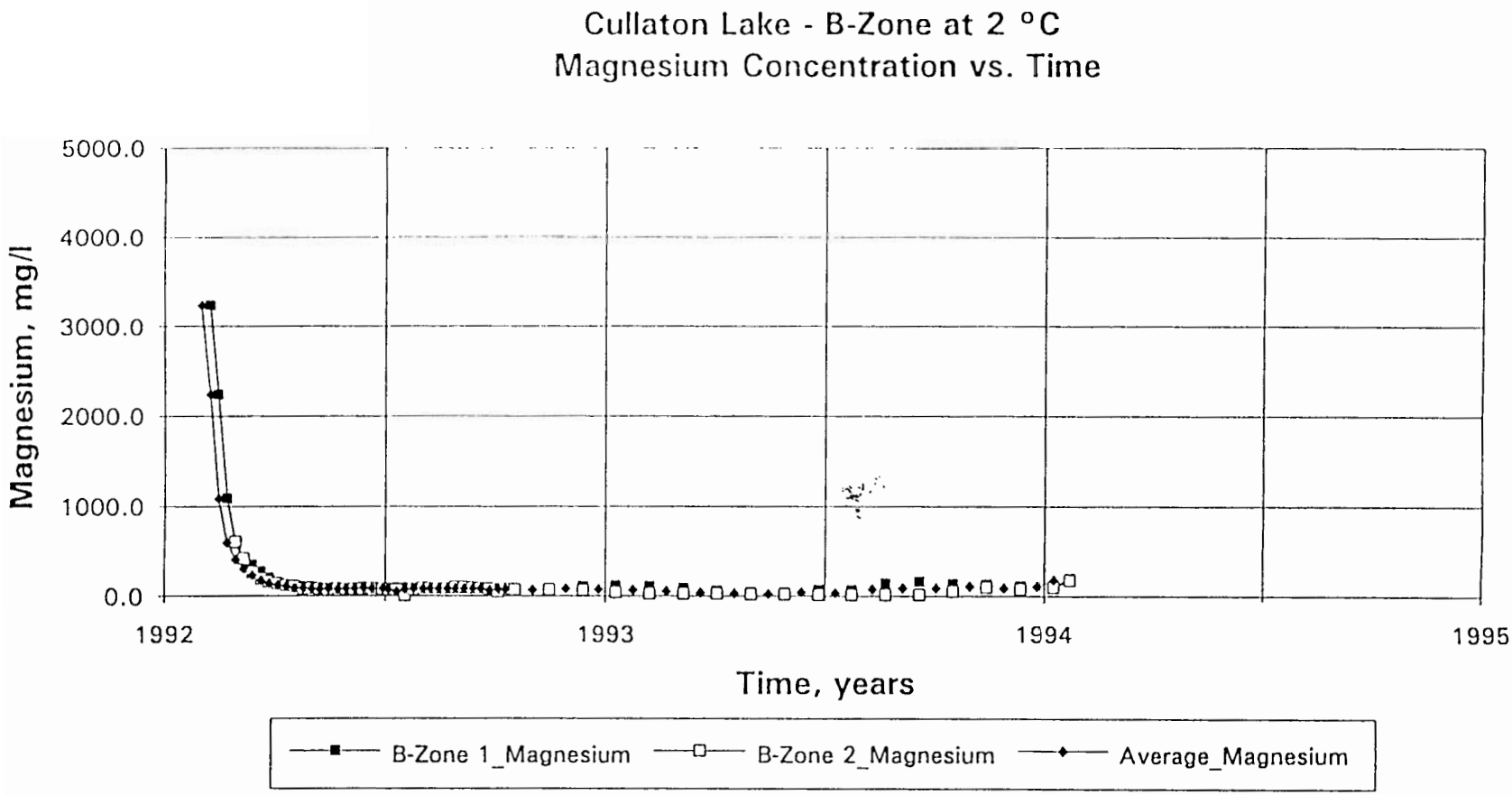


Fig. 16a B - Zone: effluent dissolved magnesium concentration at 2 °C.

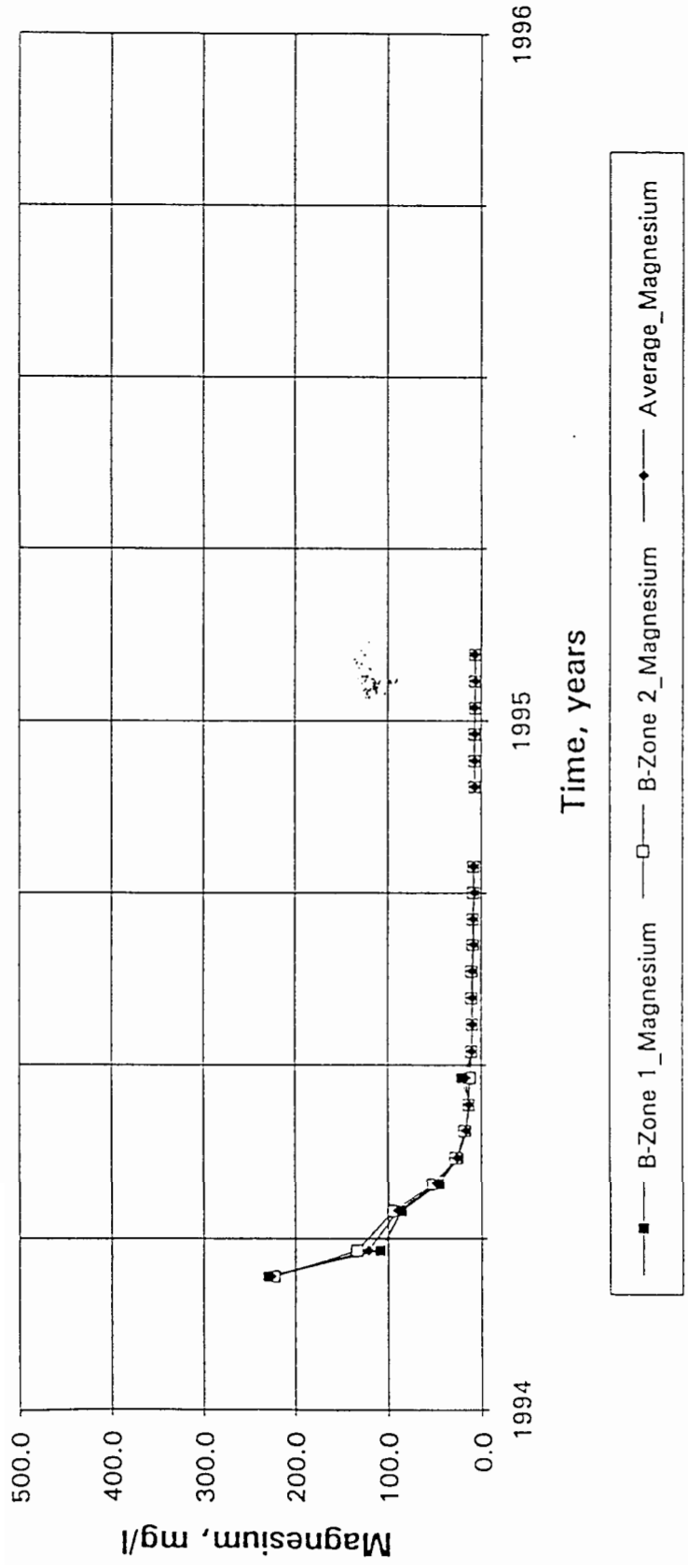


Fig. 16b B - Zone: effluent dissolved magnesium concentration at 10 °C.

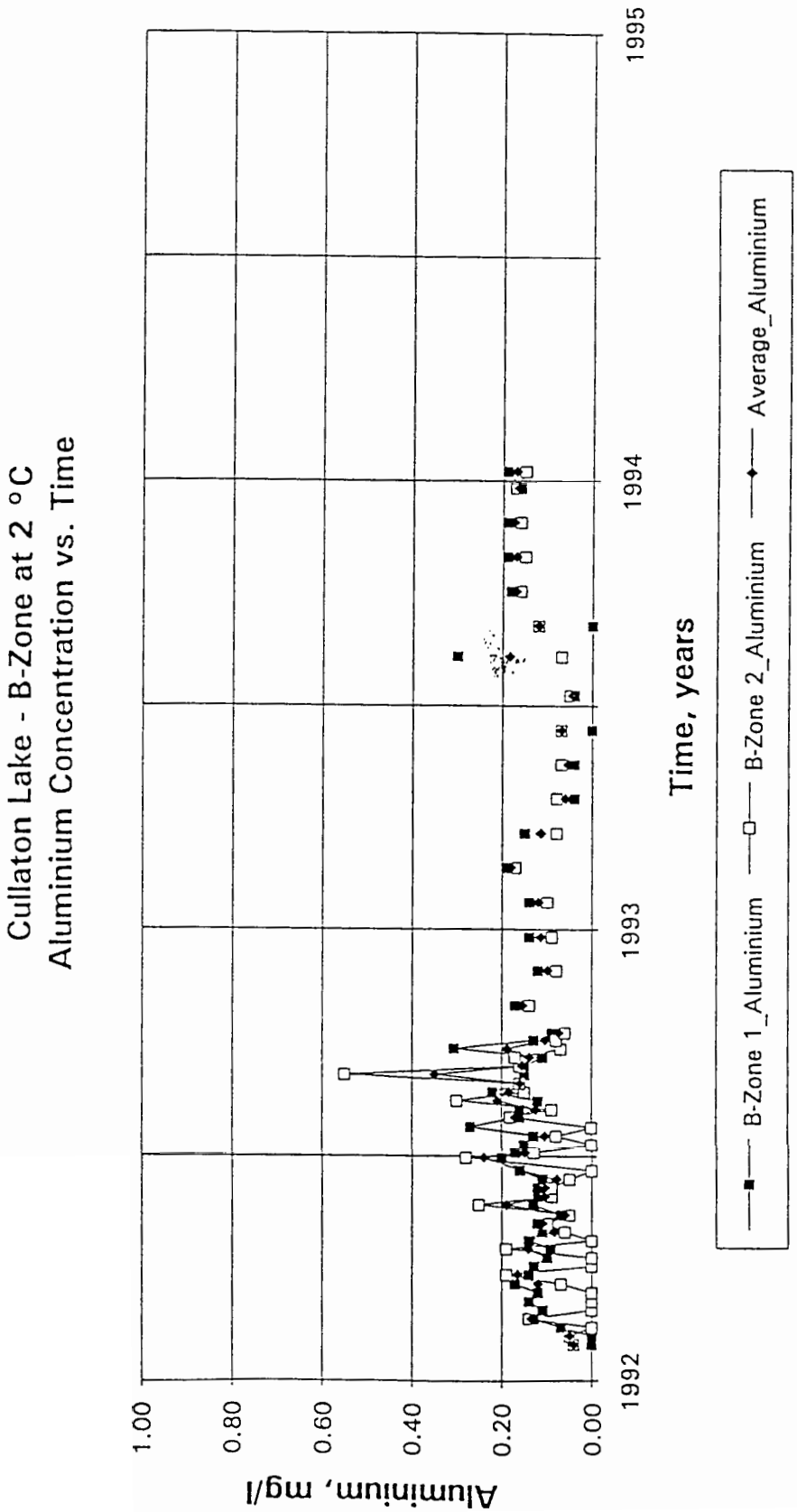


Fig. 17a B - Zone: effluent dissolved aluminium concentration at 2 °C.

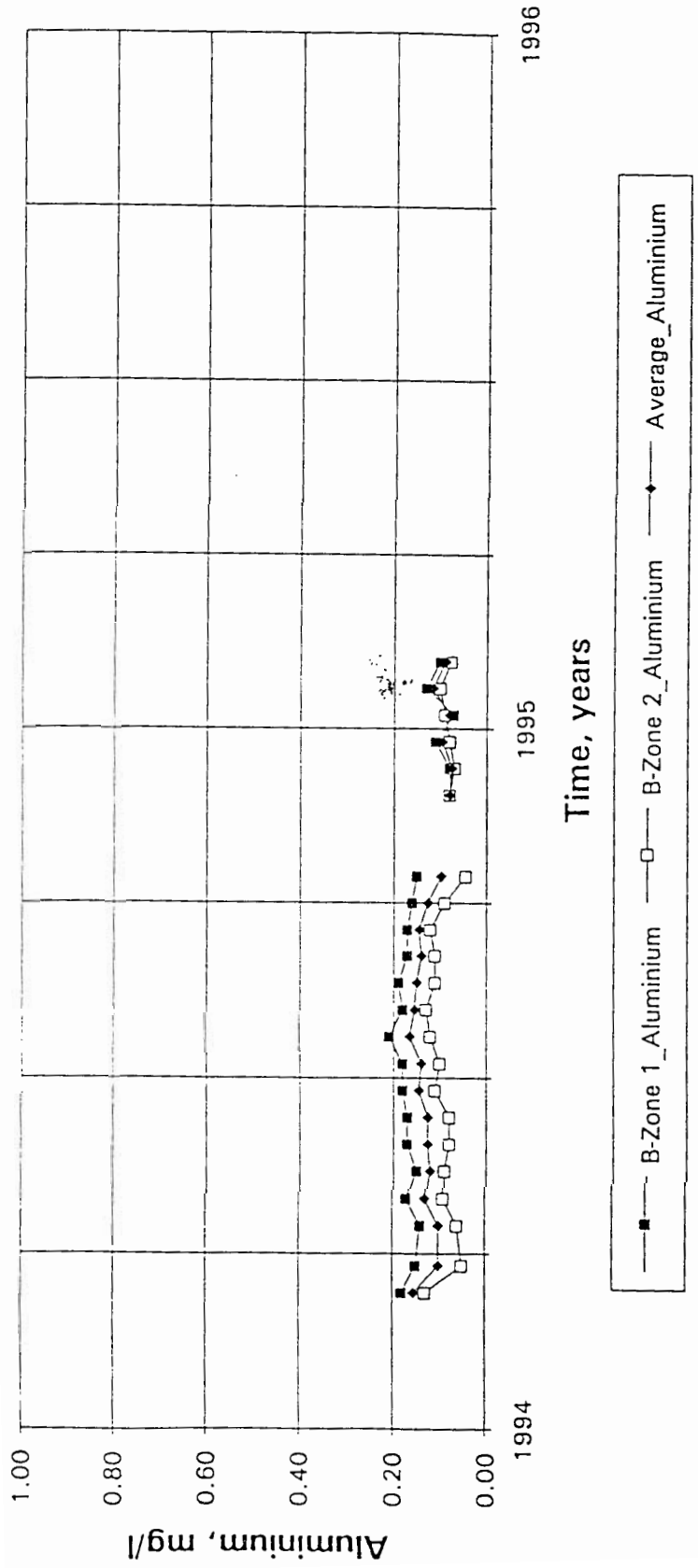


Fig. 17b B - Zone: effluent dissolved aluminium concentration at 10 °C.

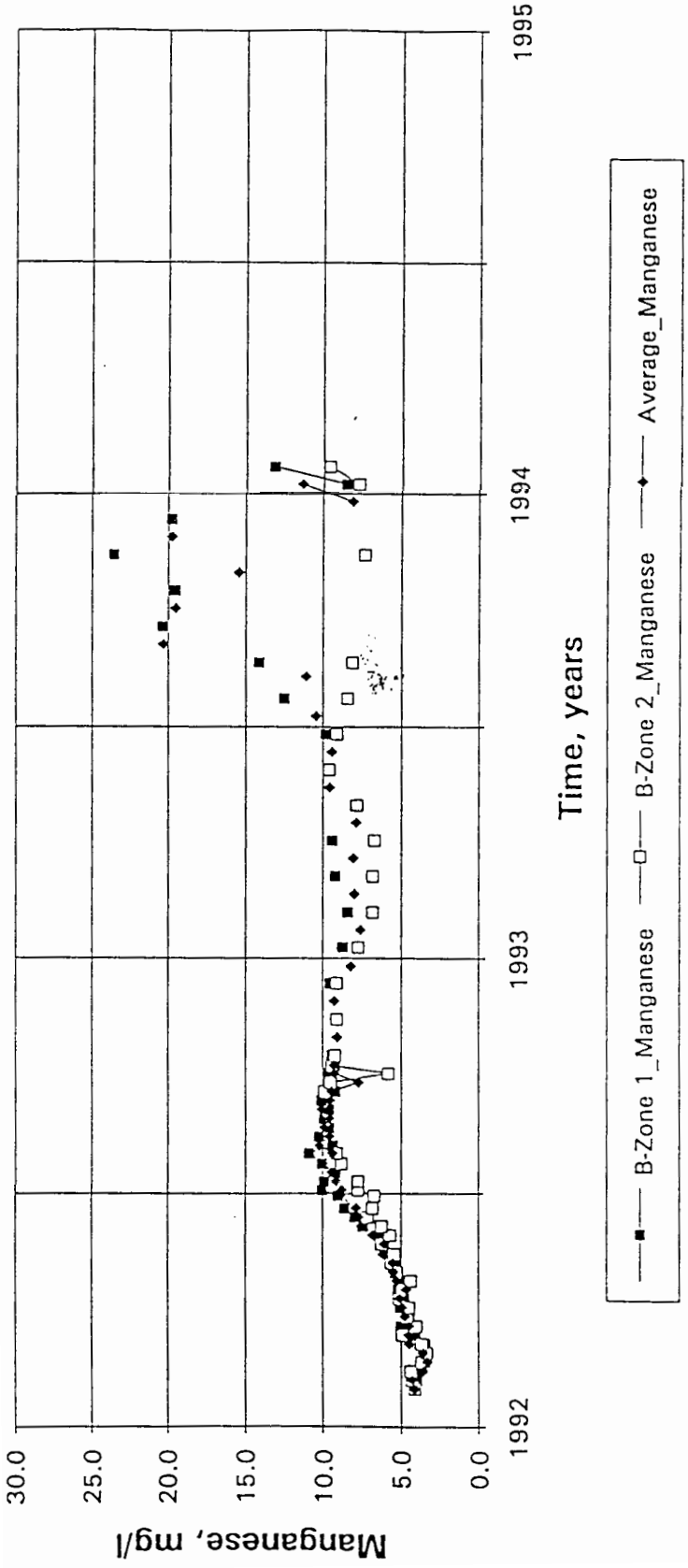


Fig. 18a B - Zone: effluent dissolved manganese concentration at 2 °C.

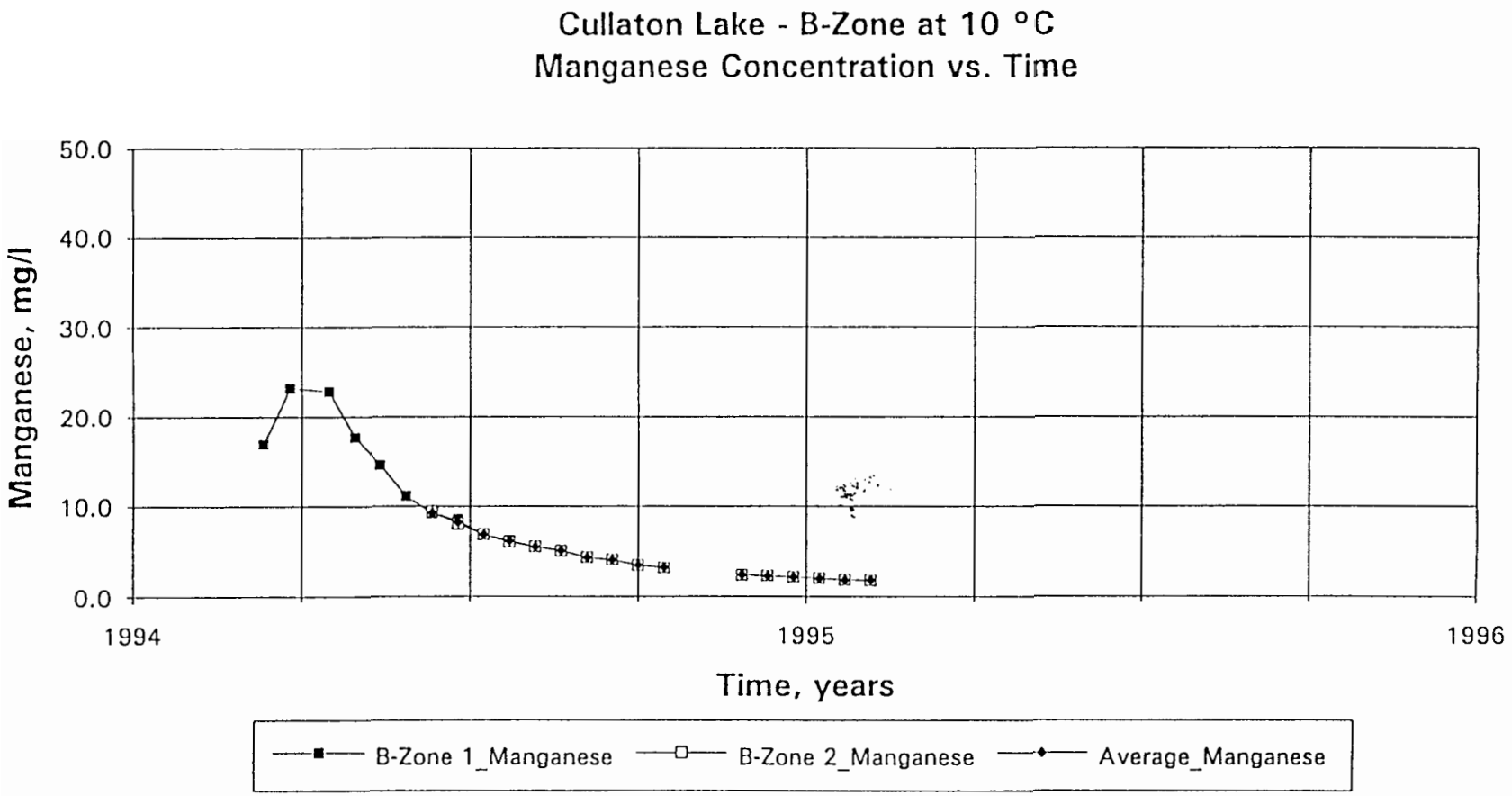


Fig. 18b B - Zone: effluent dissolved manganese concentration at 10 °C.

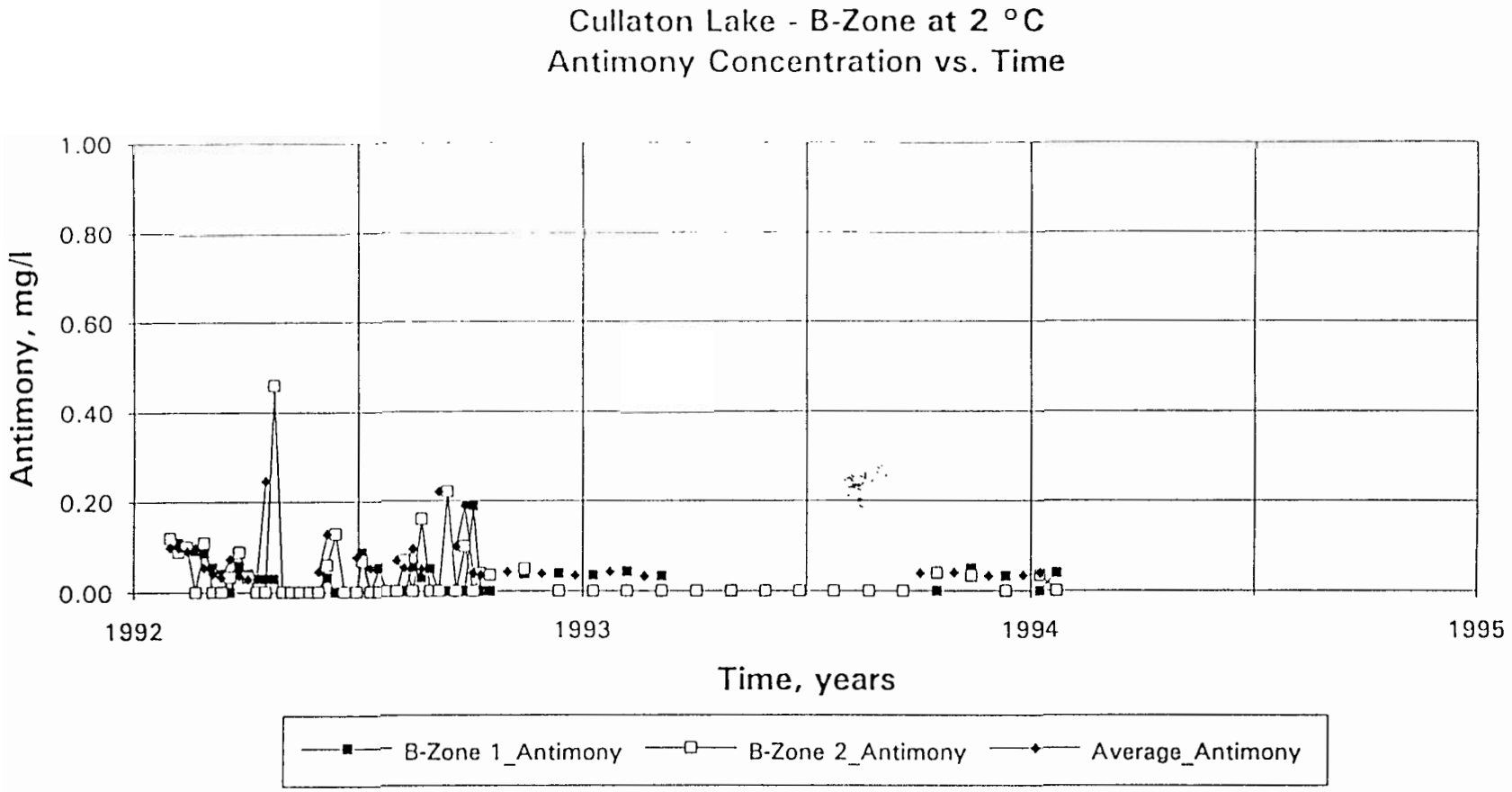


Fig. 19a B - Zone: effluent dissolved antimony concentration at 2 °C.

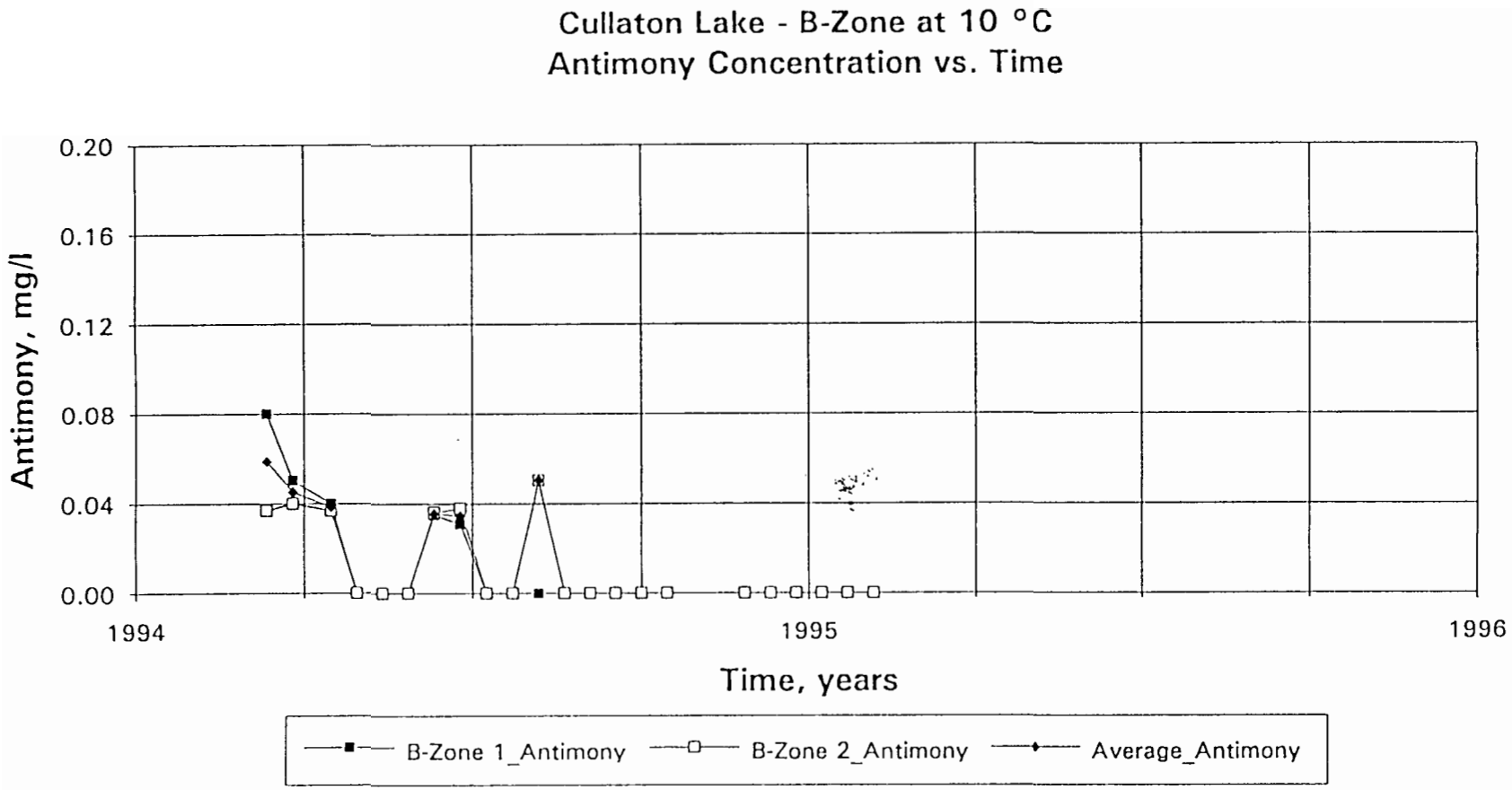


Fig. 19b B - Zone: effluent dissolved antimony concentration at 10 °C.

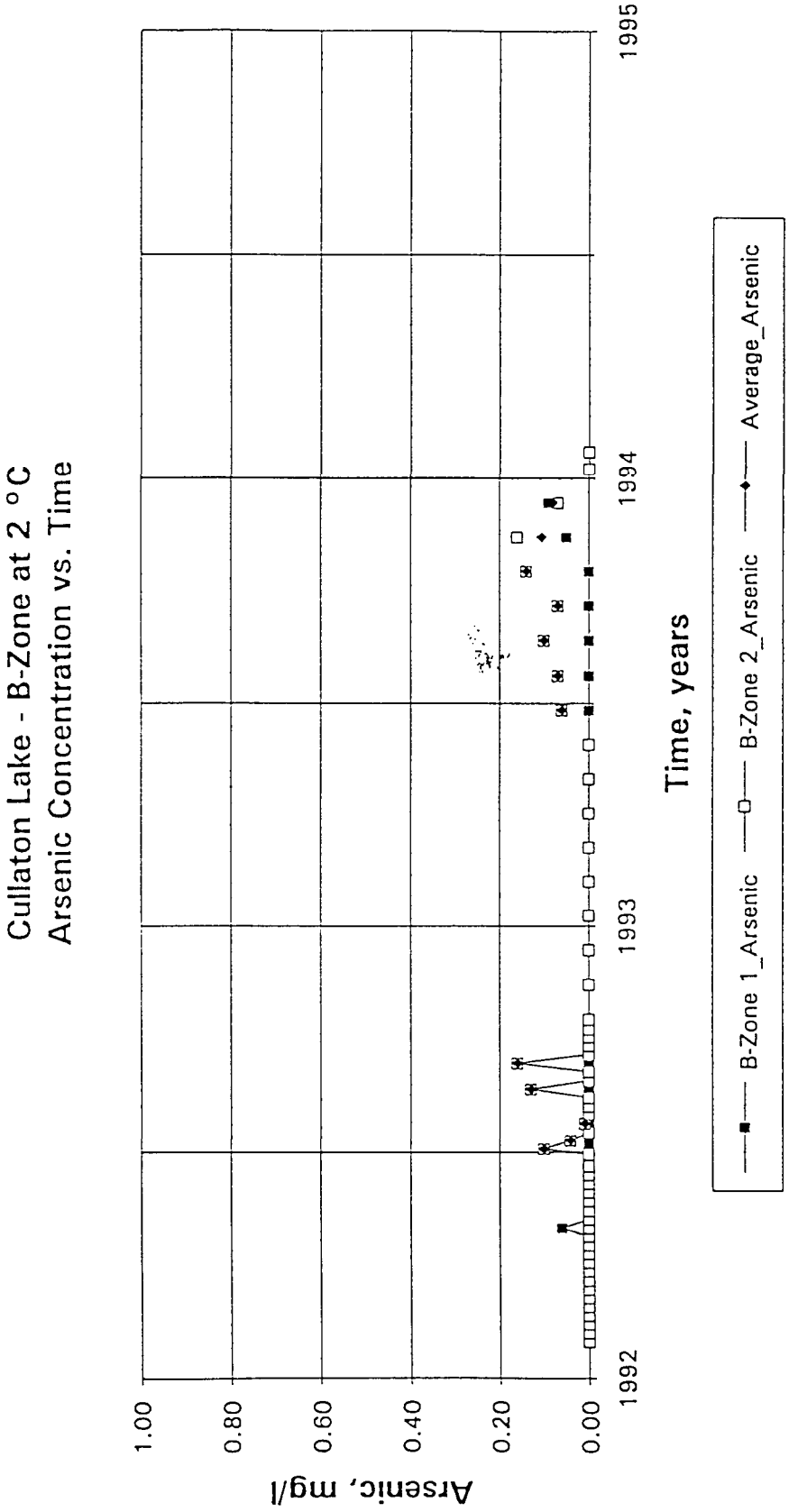


Fig. 20a B - Zone: effluent dissolved arsenic concentration at 2 °C.

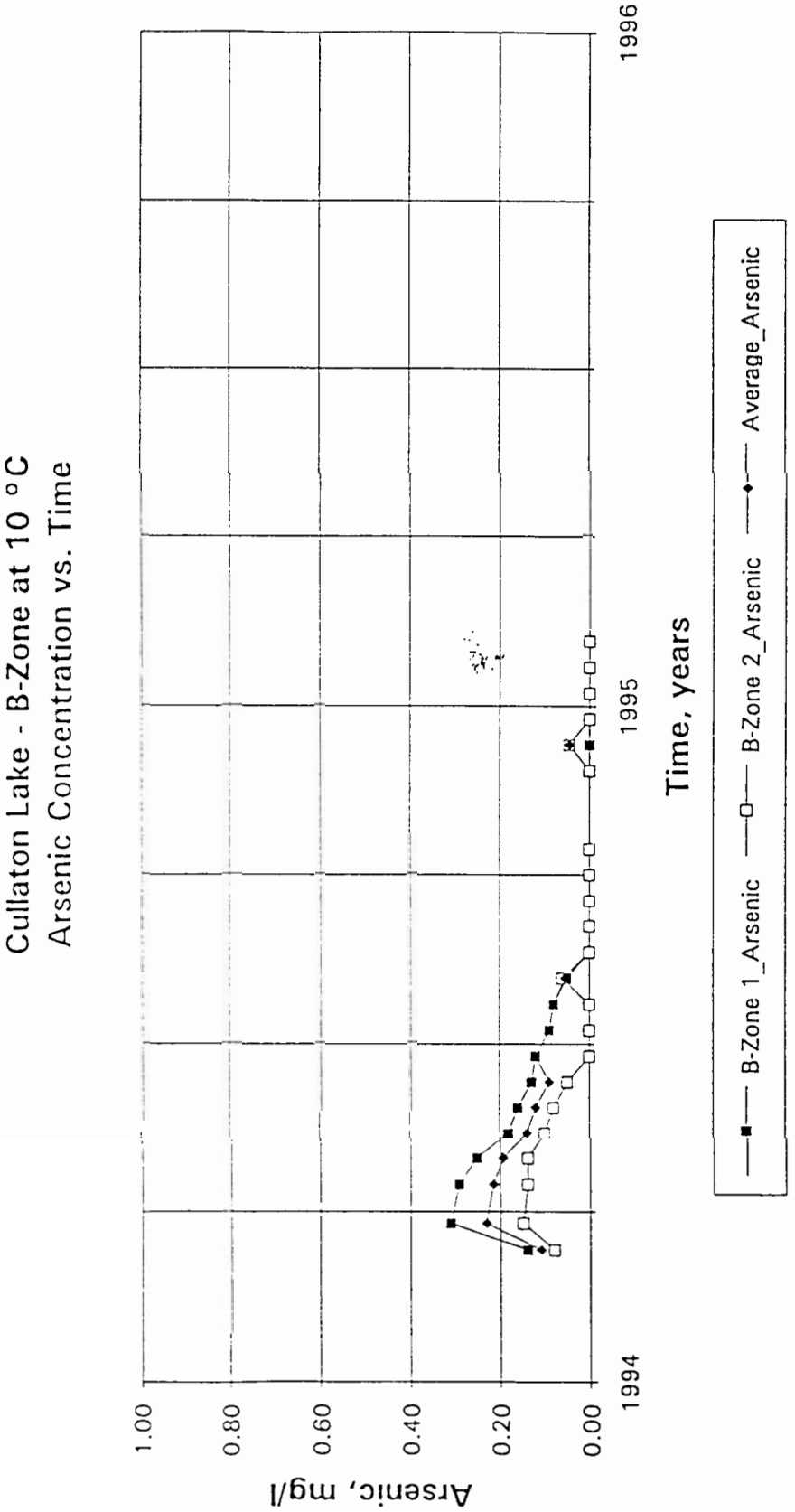


Fig. 20b B - Zone: effluent dissolved arsenic concentration at 10 °C.

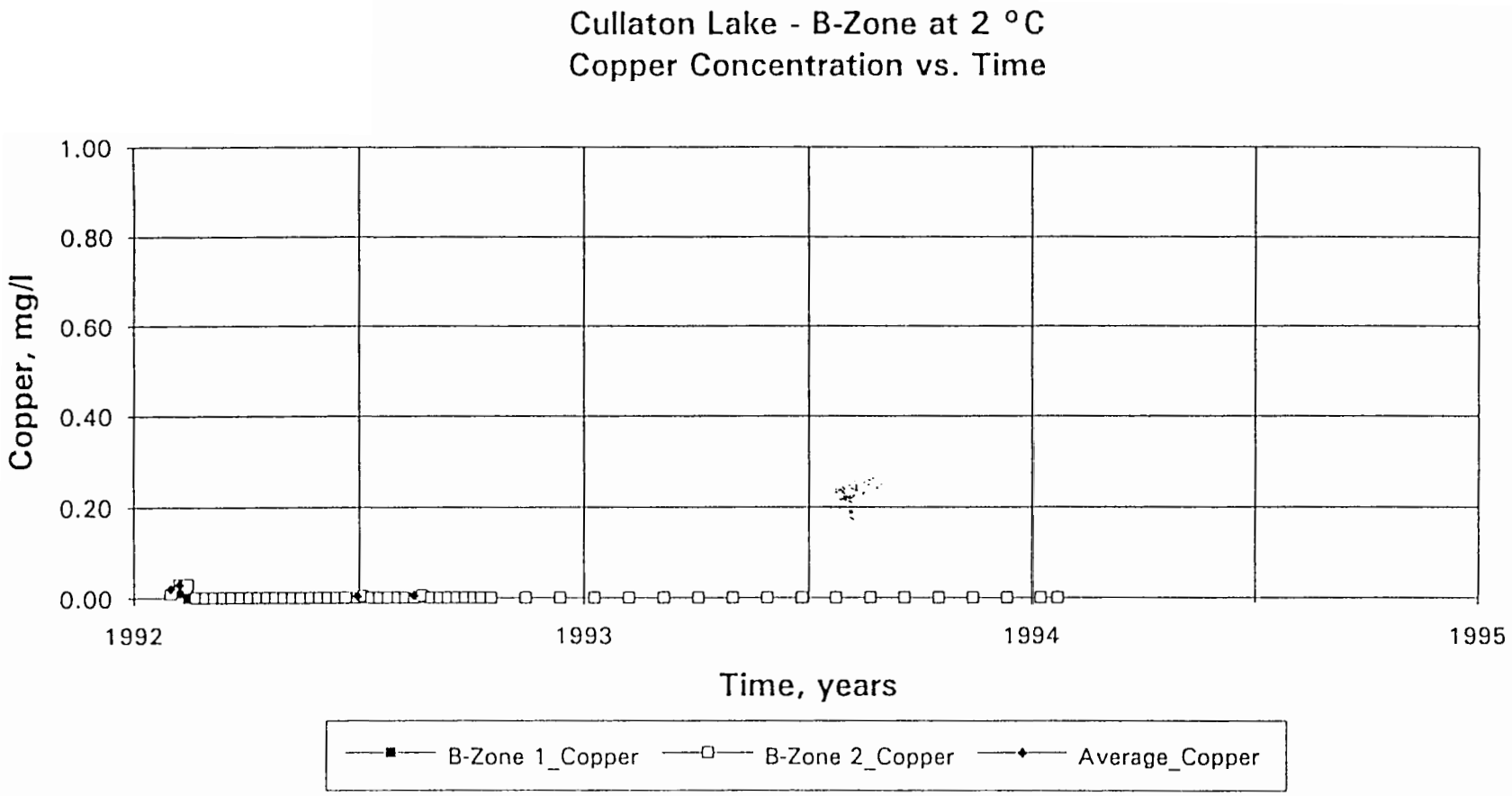


Fig. 21a B - Zone: effluent dissolved copper concentration at 2 °C.

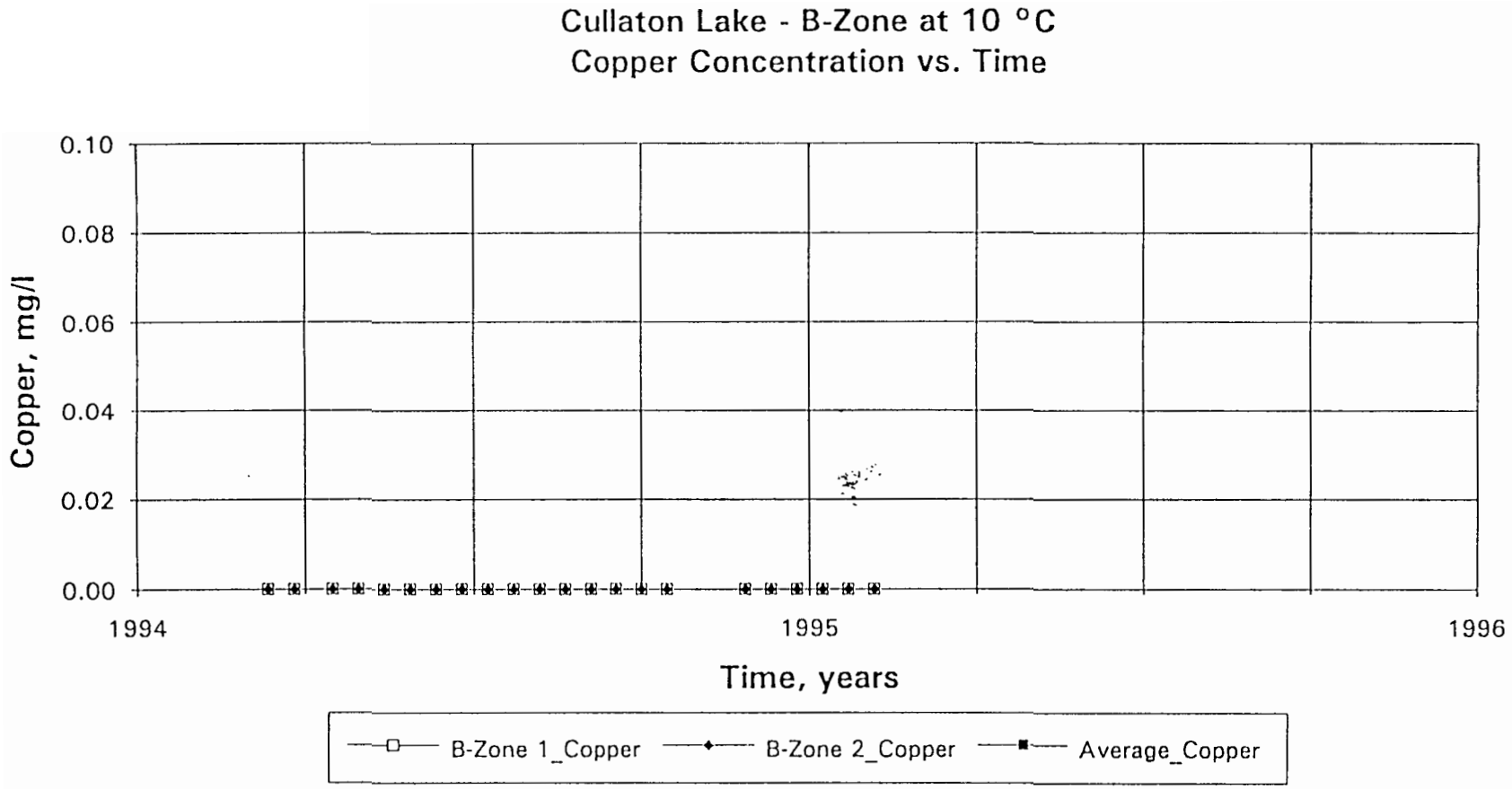


Fig. 21b B - Zone: effluent dissolved copper concentration at 10 °C.

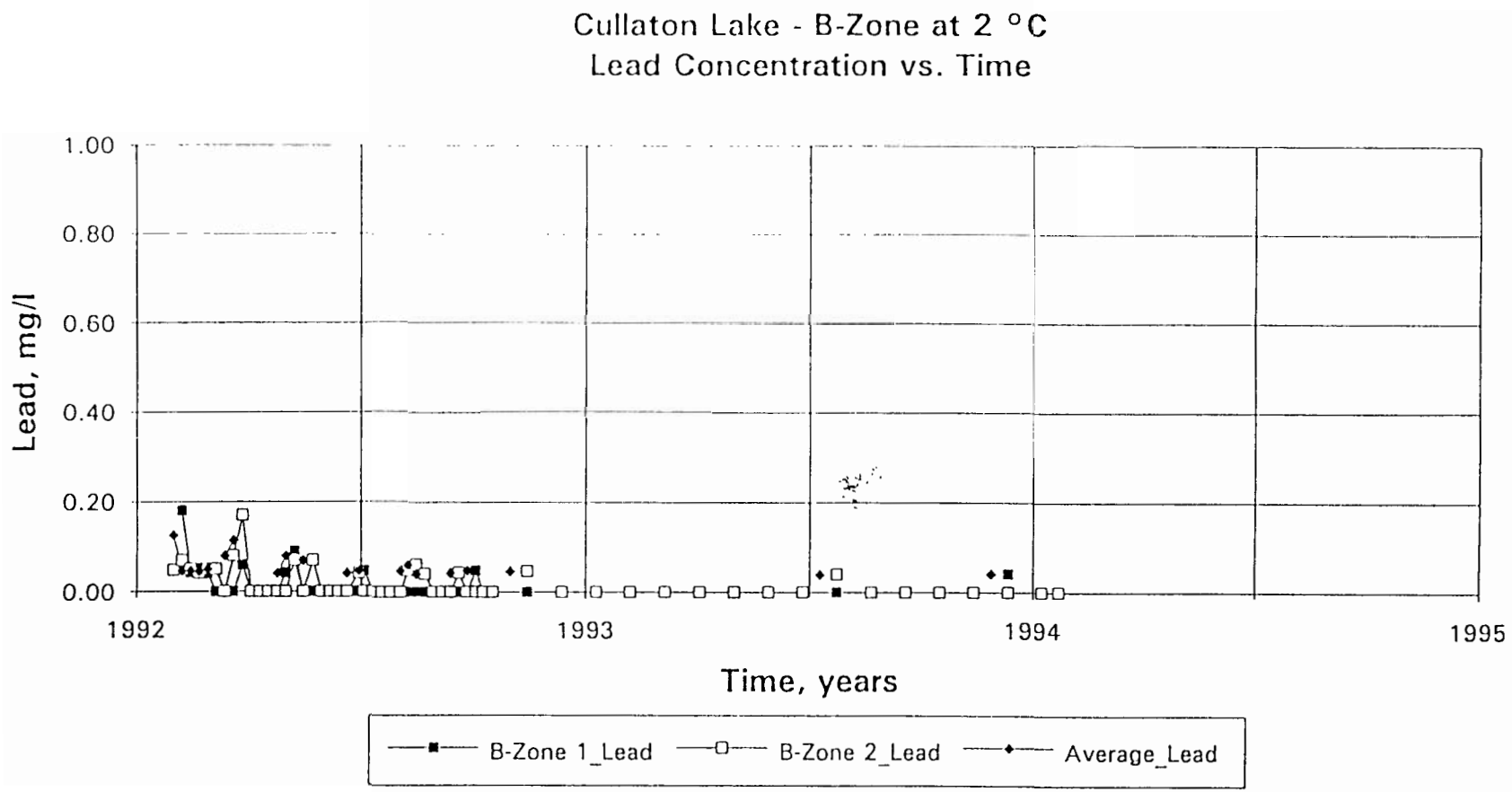


Fig. 22a B - Zone: effluent dissolved lead concentration at 2 °C.

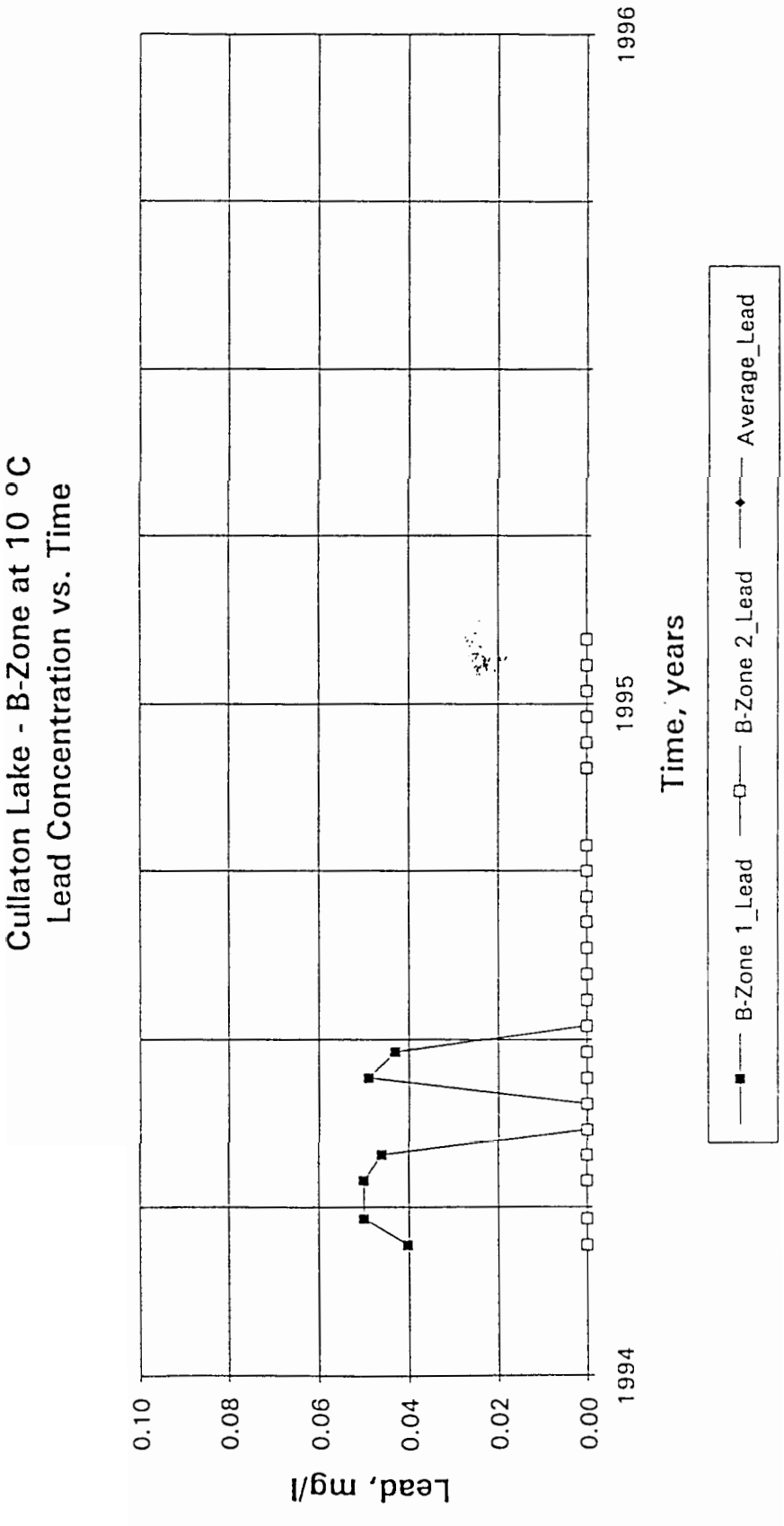


Fig. 22b B - Zone: effluent dissolved lead concentration at 10 °C.

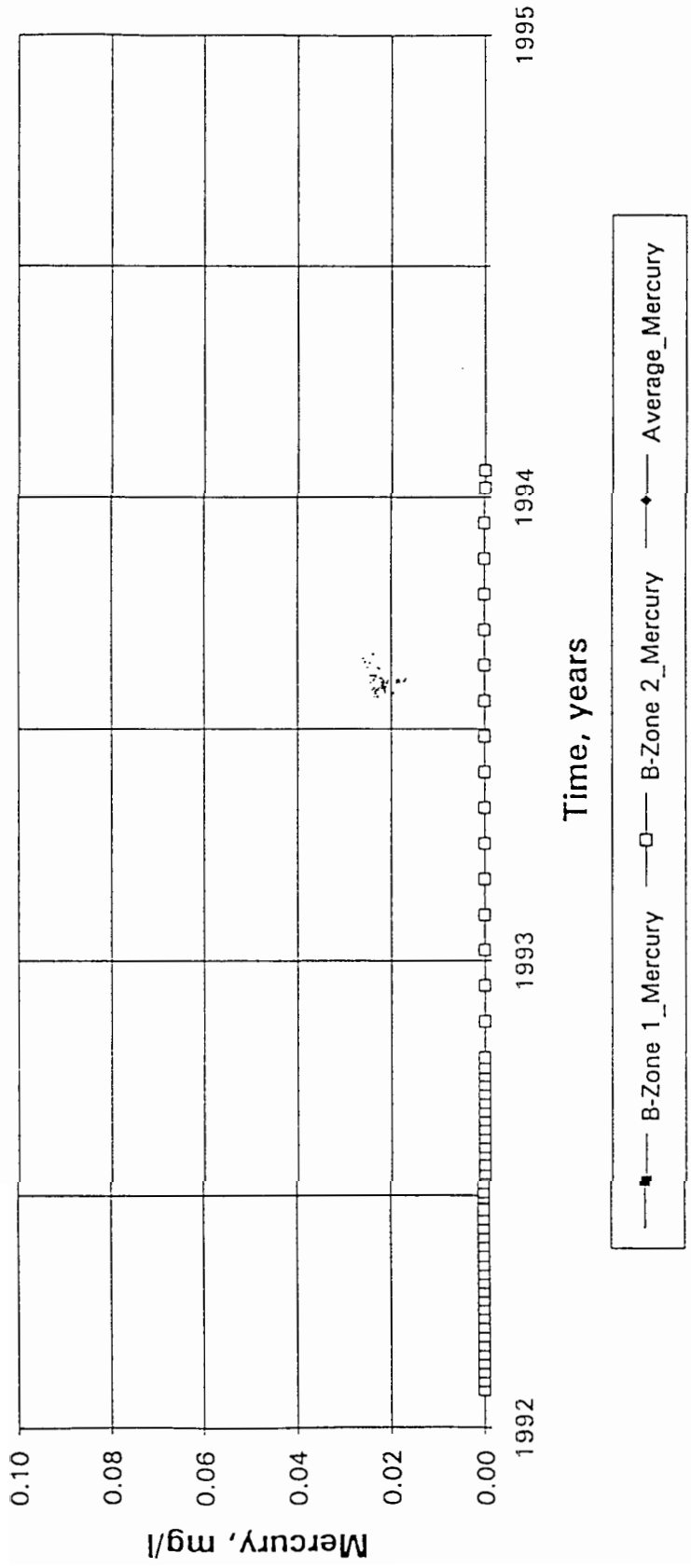


Fig. 23a B - Zone: effluent dissolved mercury concentration at 2 °C.

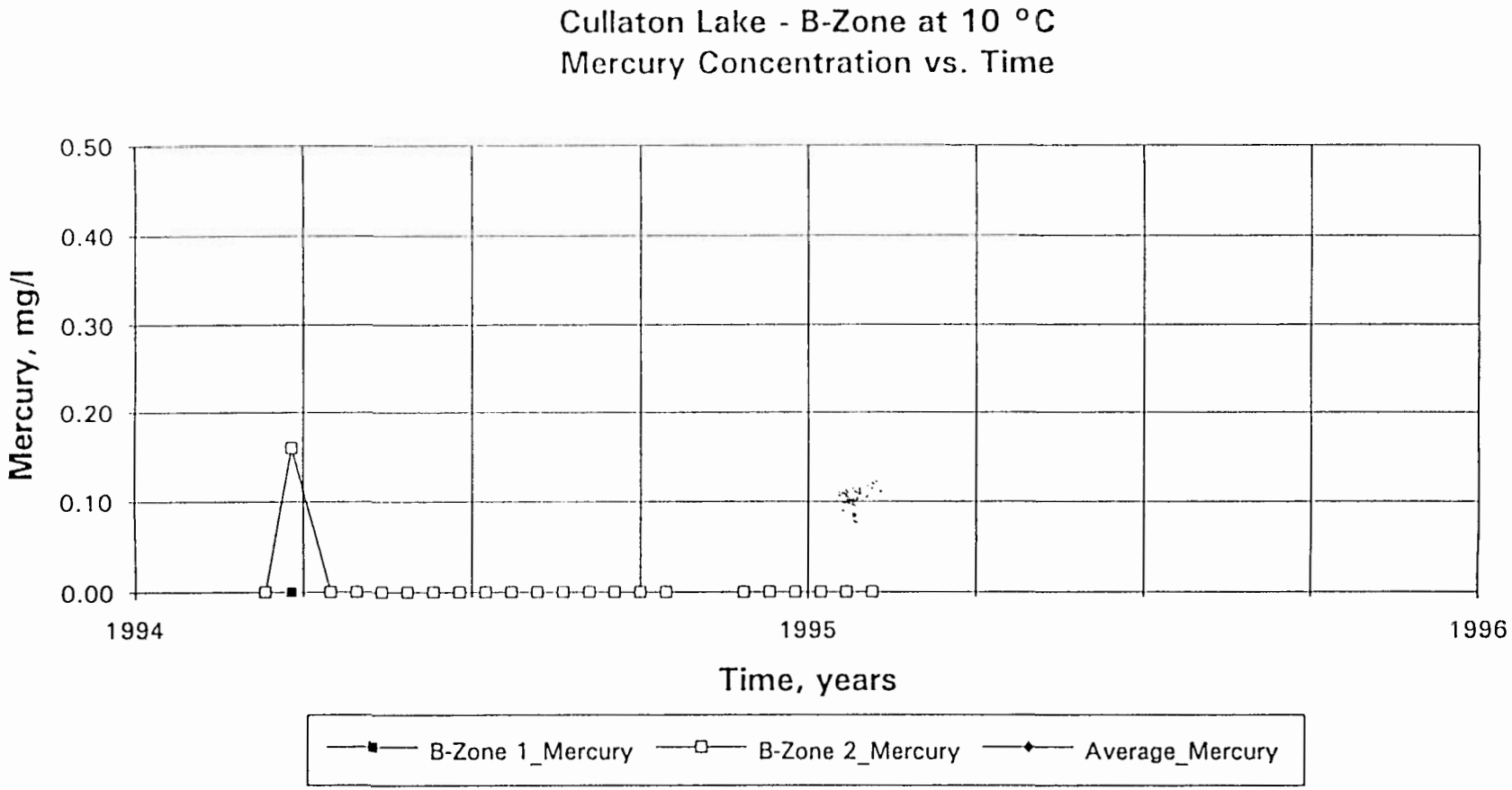


Fig. 23b B - Zone: effluent dissolved mercury concentration at 10 °C.

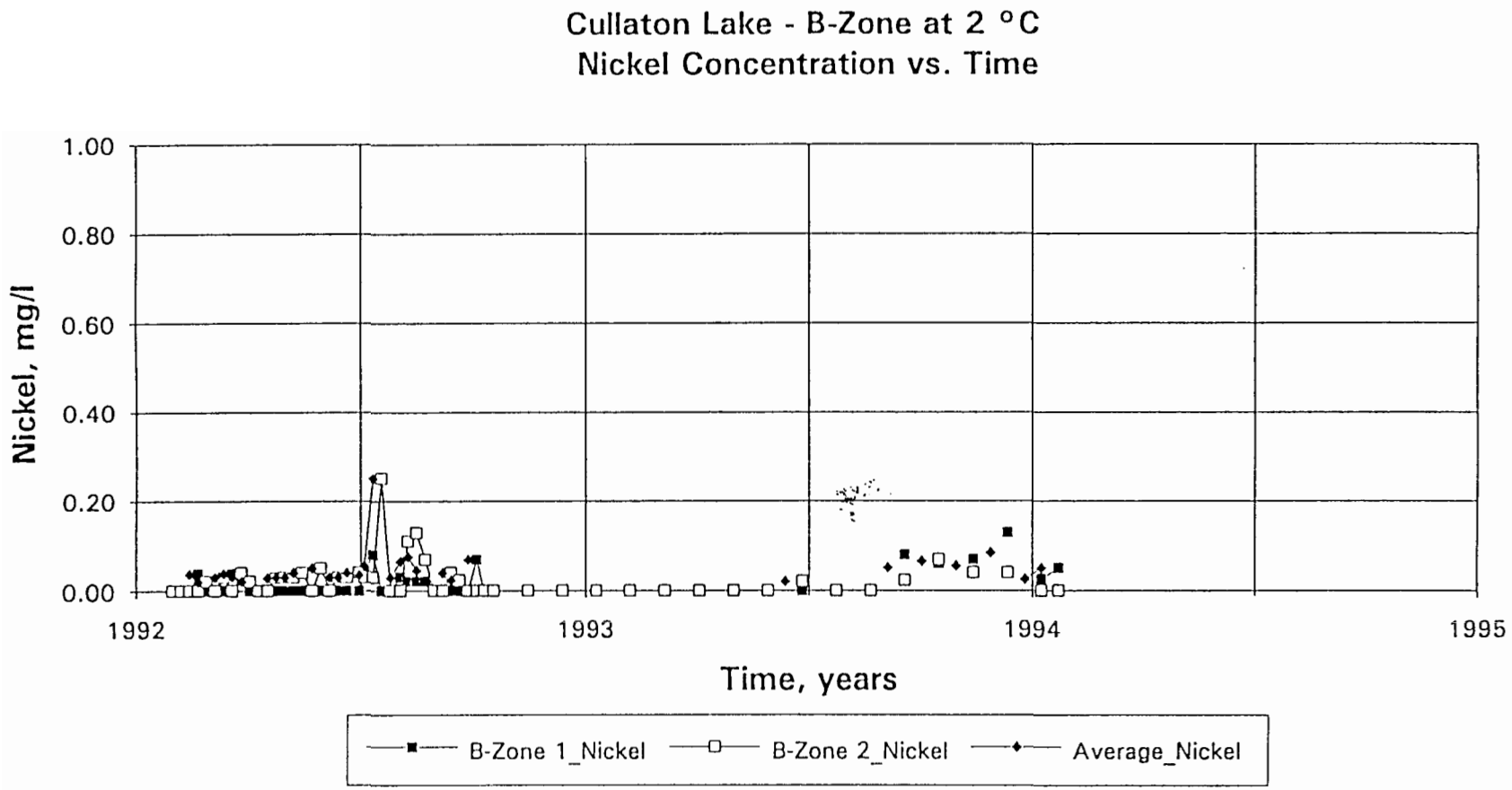


Fig. 24a B - Zone: effluent dissolved nickel concentration at 2 °C.

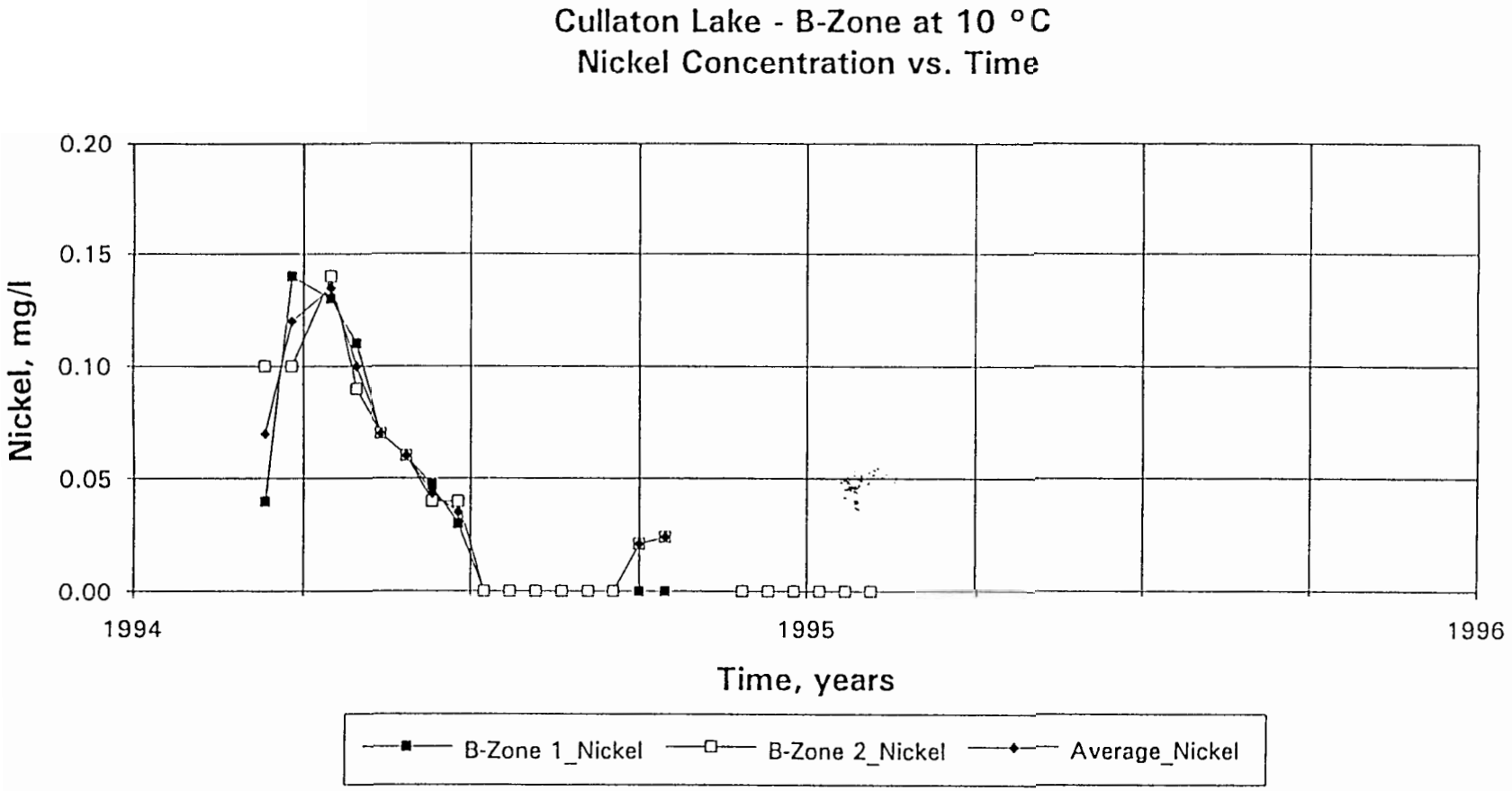


Fig. 24b B - Zone: effluent dissolved nickel concentration at 10 °C.

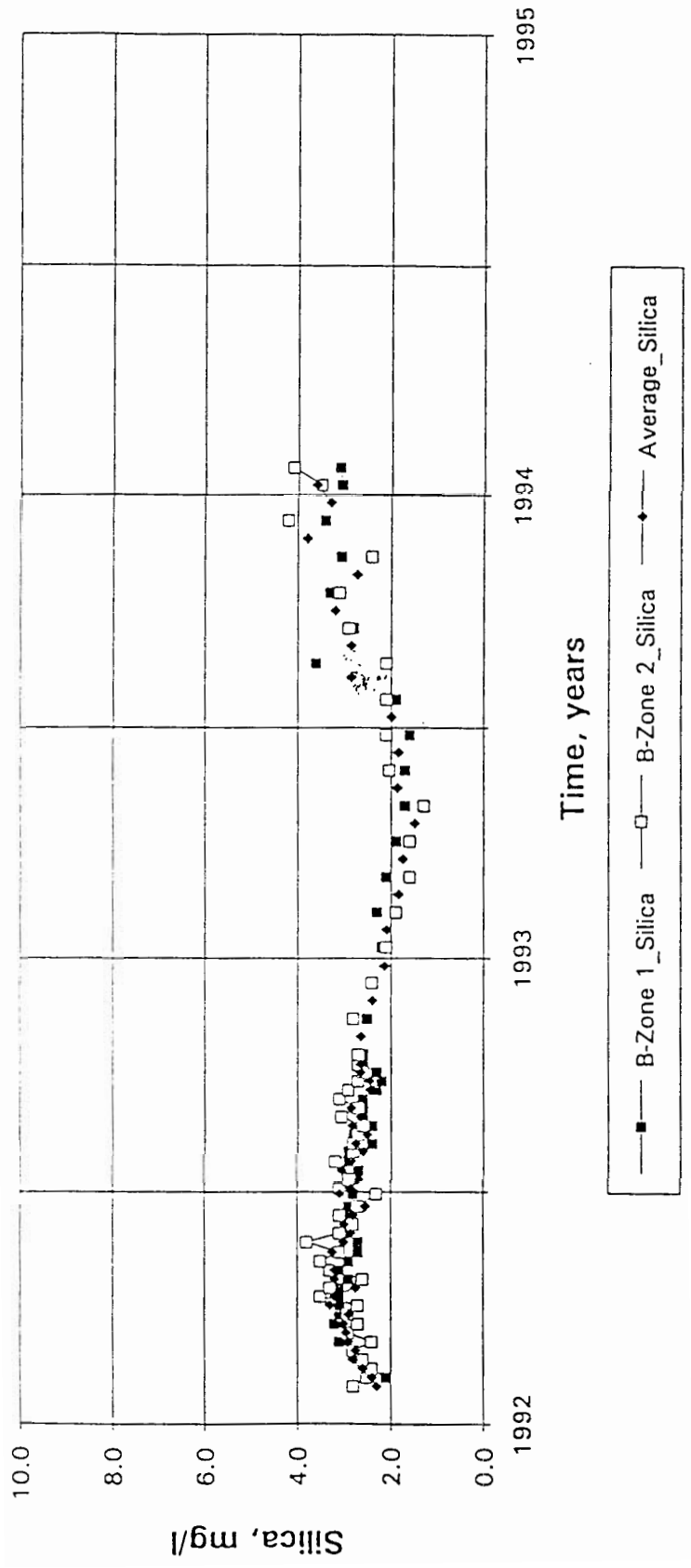


Fig. 25a B - Zone: effluent dissolved silica concentration at 2 °C.

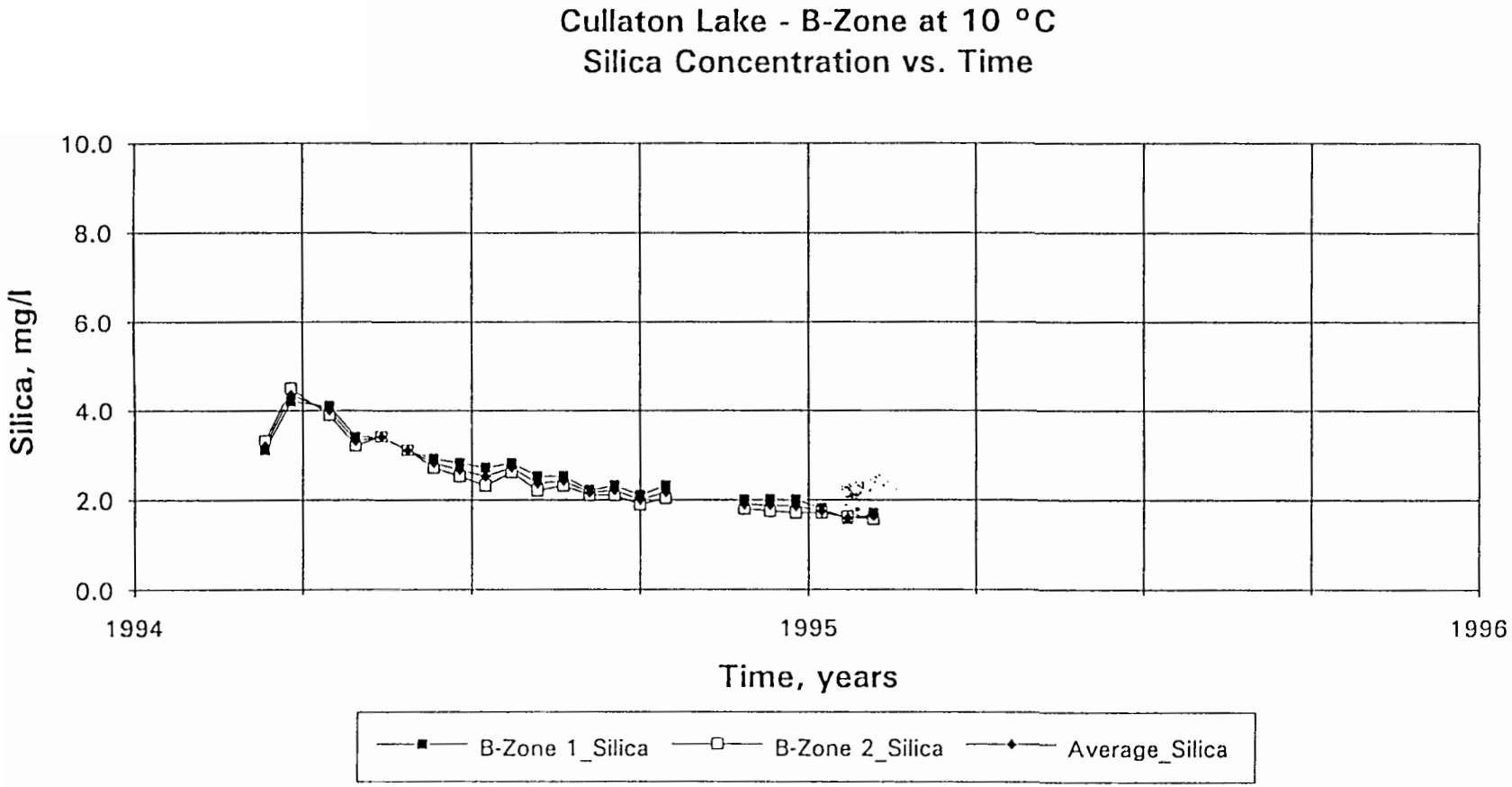


Fig. 25b B - Zone: effluent dissolved silica concentration at 10 °C.

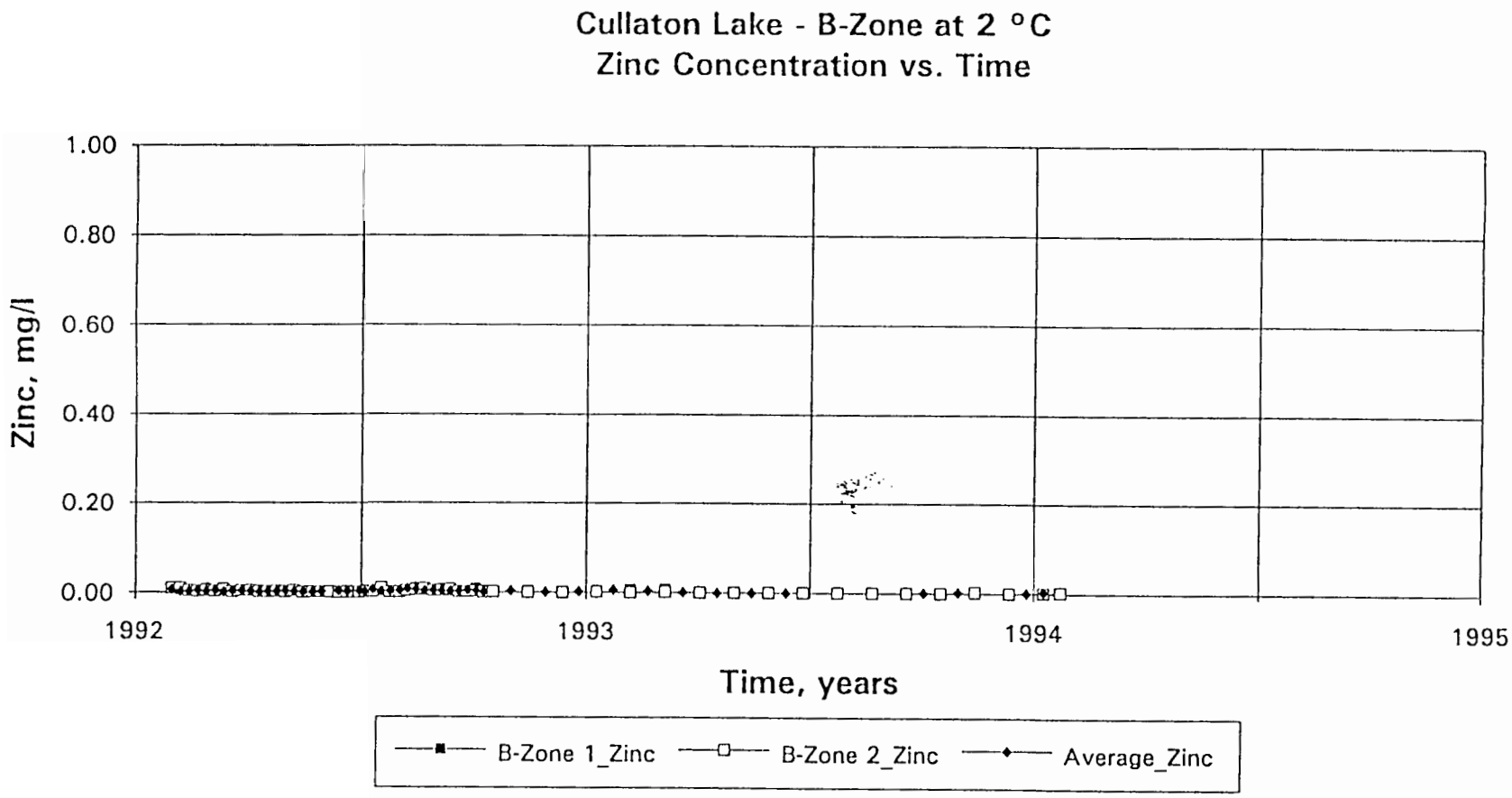


Fig. 26a B - Zone: effluent dissolved zinc concentration at 2 °C.

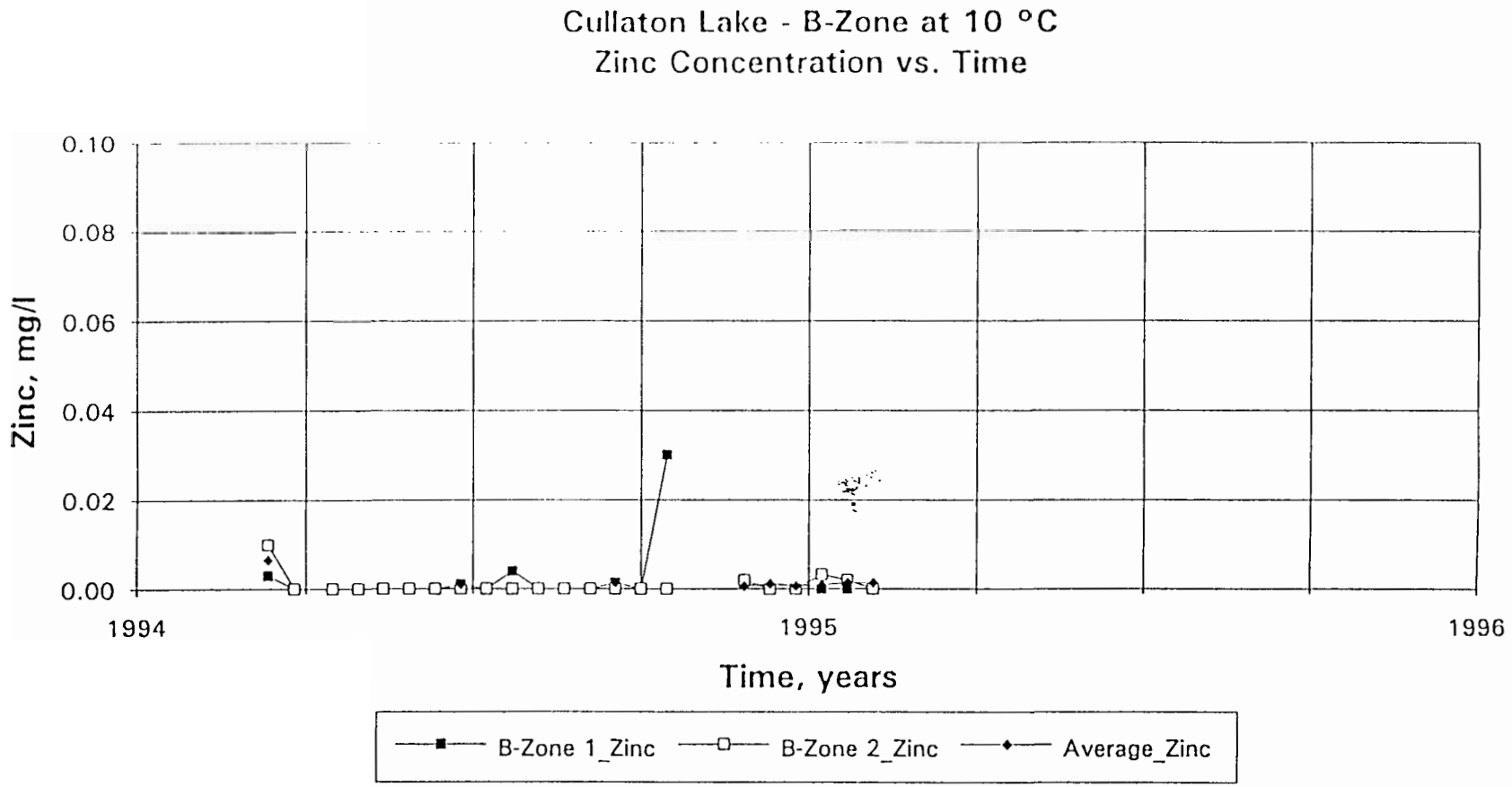


Fig. 26b B - Zone: effluent dissolved zinc concentration at 10 °C.

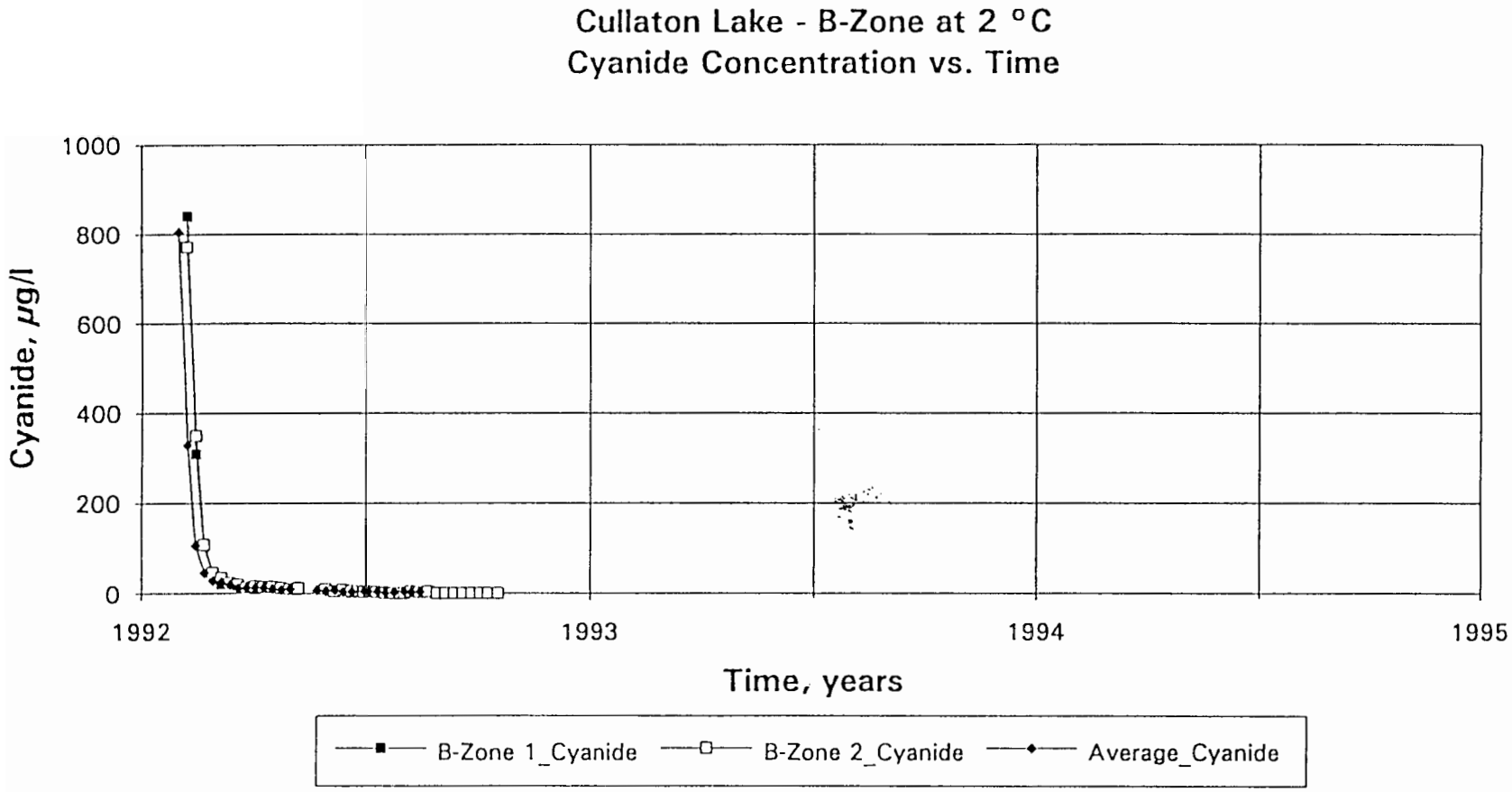


Fig. 27 B - Zone: effluent dissolved total cyanide concentration at 2 °C.

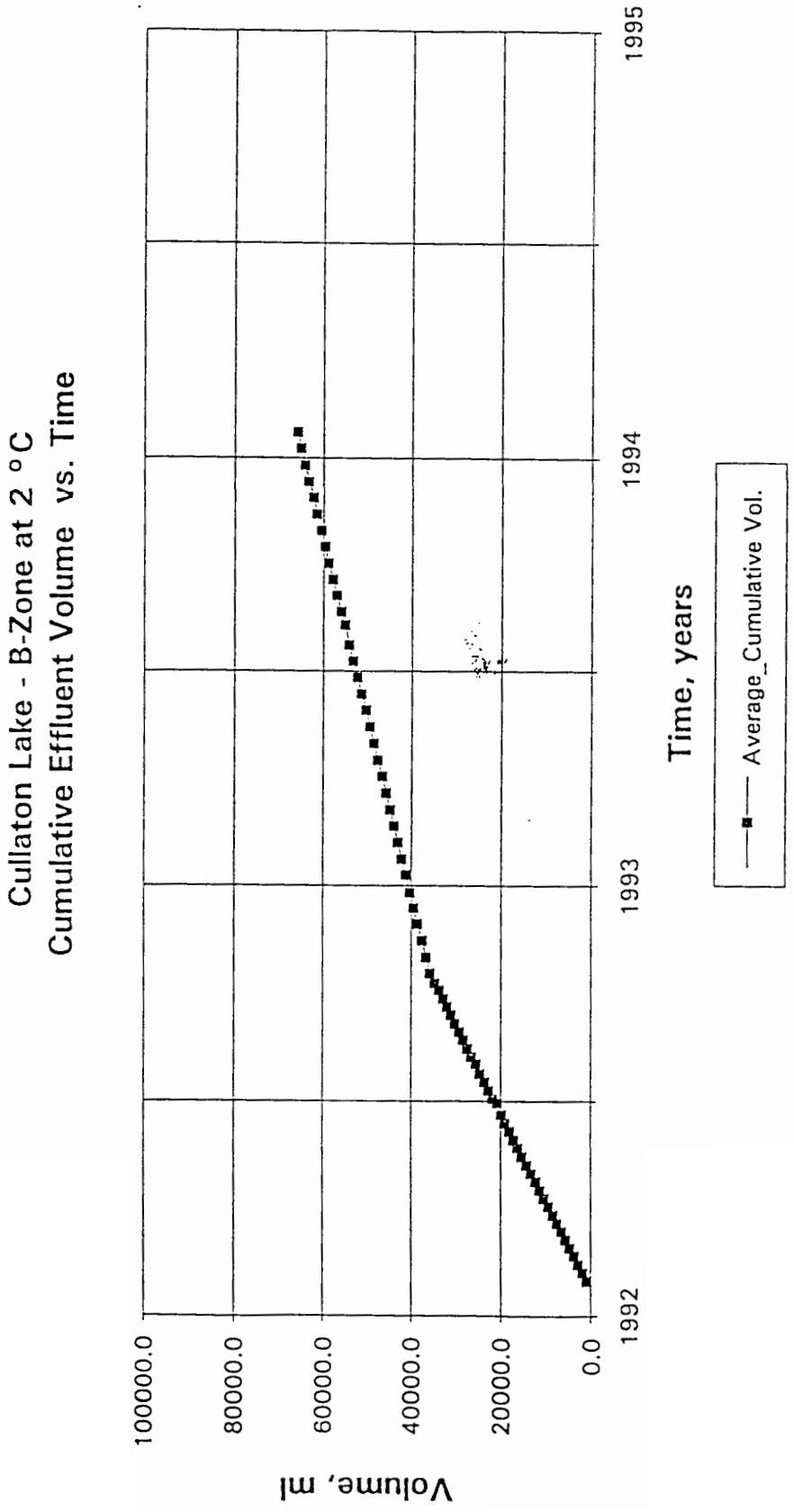


Fig. 28a B - Zone: total cumulative effluent volume at 2 °C.

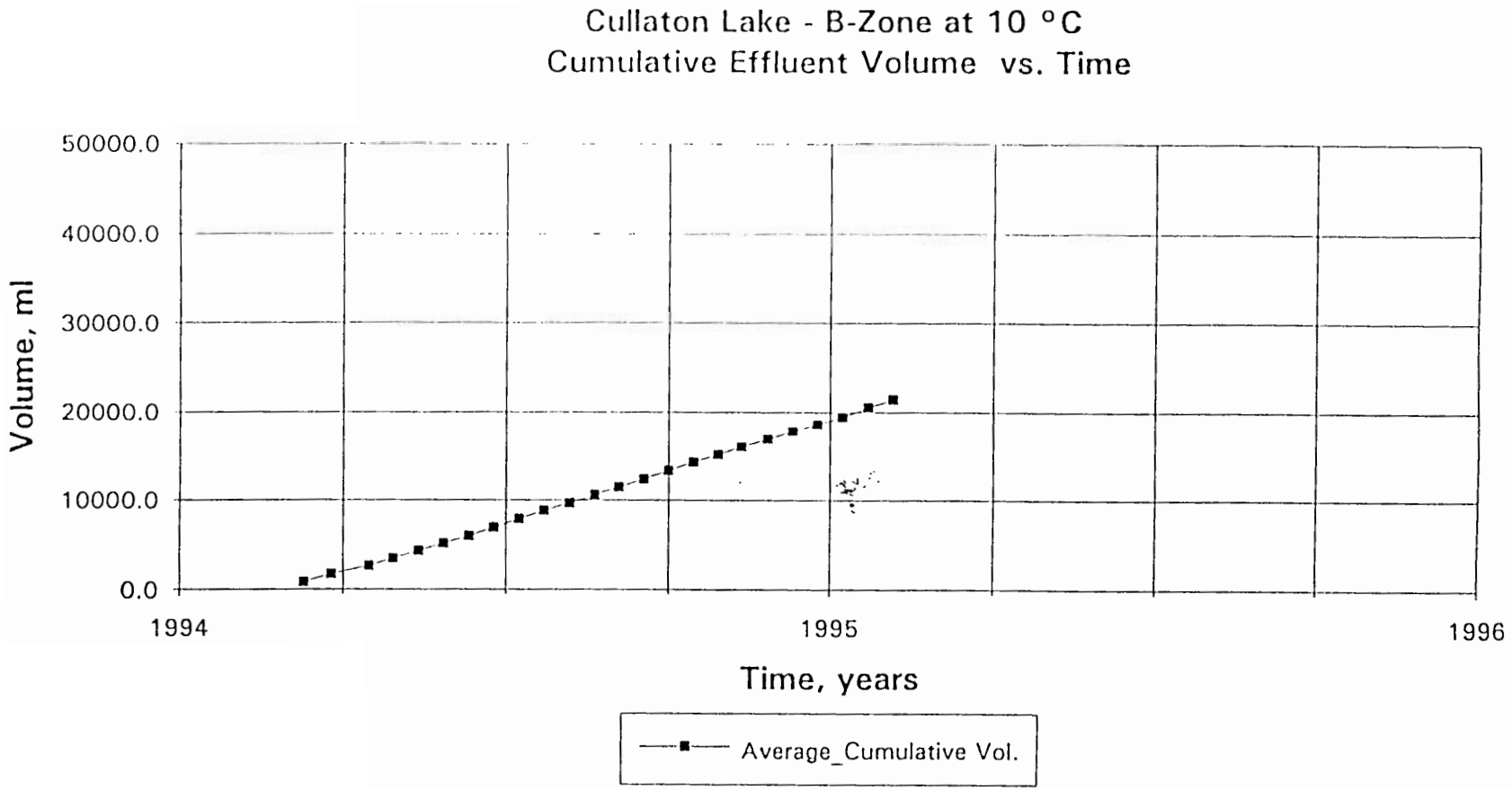


Fig. 28b B - Zone: total cumulative effluent volume at 10 °C.

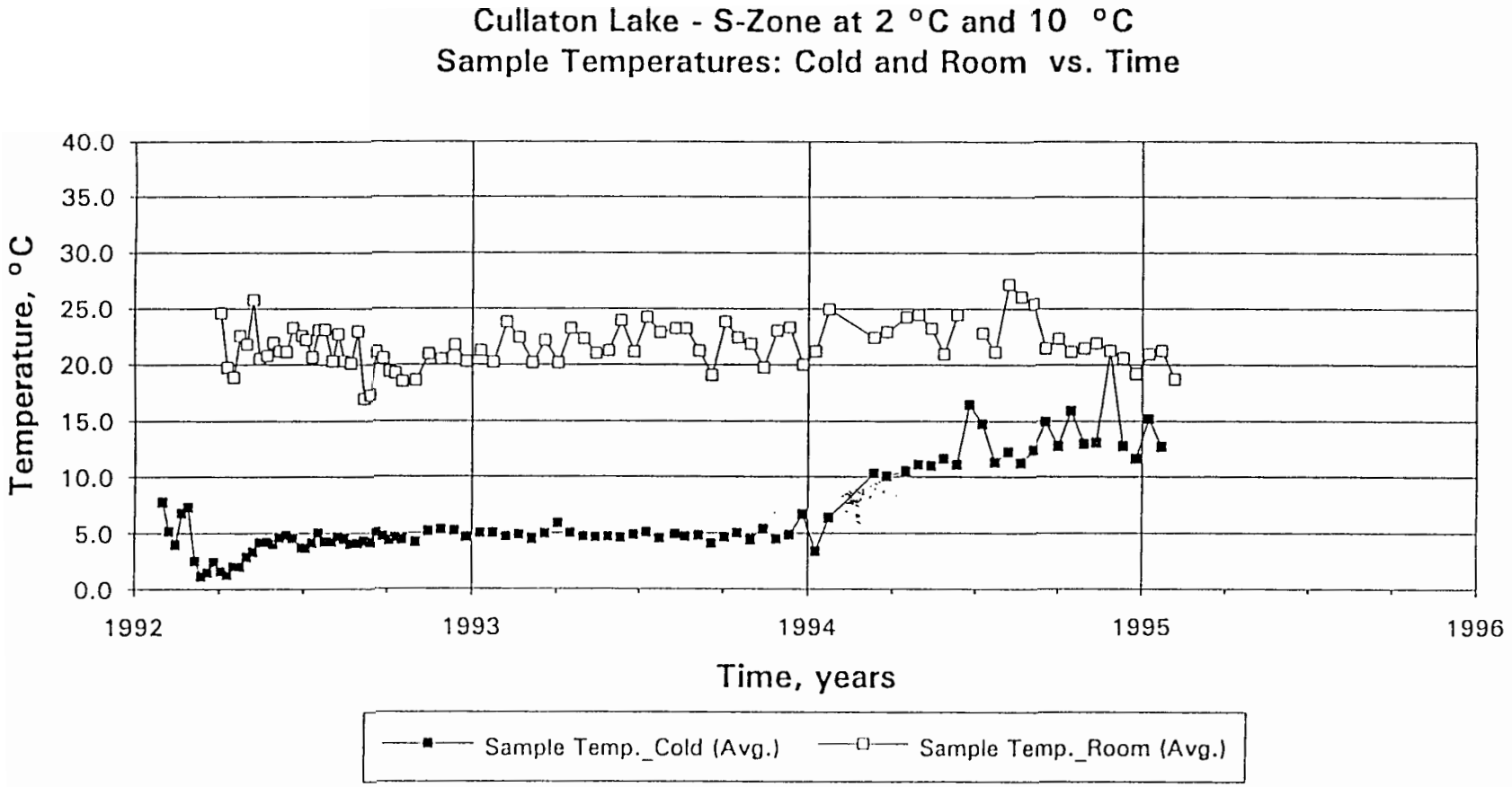


Fig. 29 S - Zone: effluent sample temperatures at cold and room conditions.

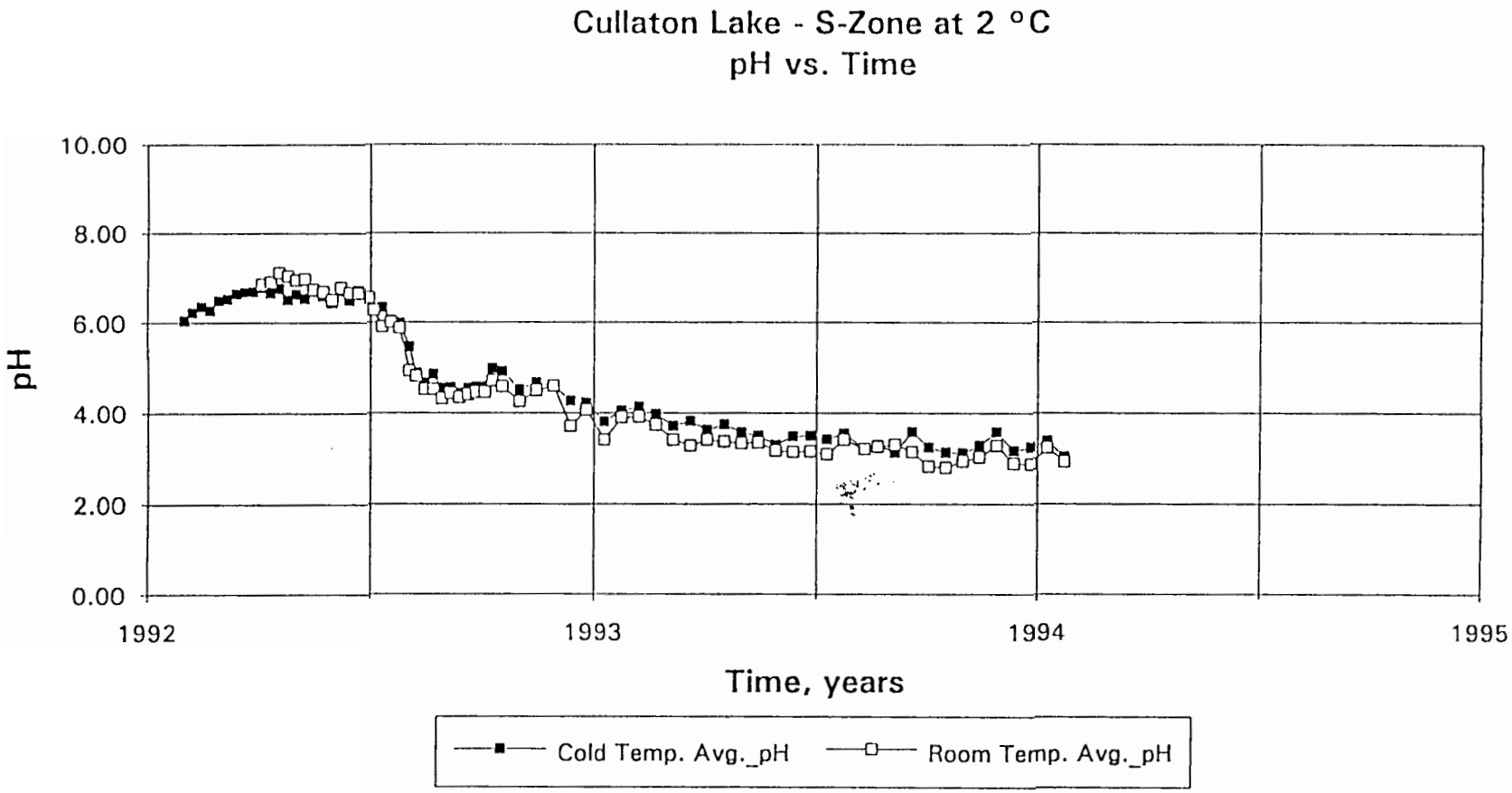


Fig. 30a S - Zone: effluent pH's at 2 °C and room temperature.

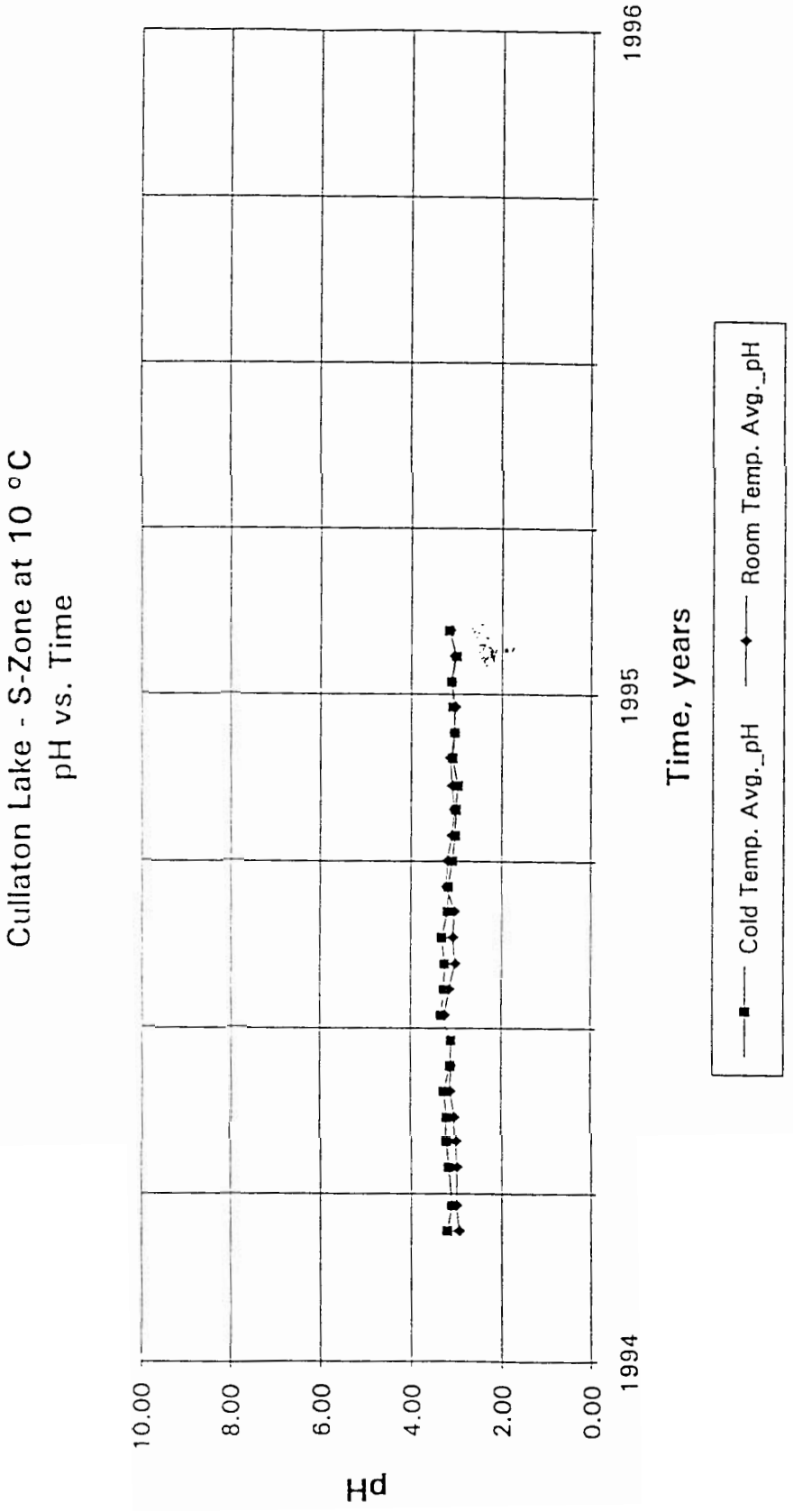


Fig. 30b S - Zone: effluent pH's at 10 °C and room temperature.

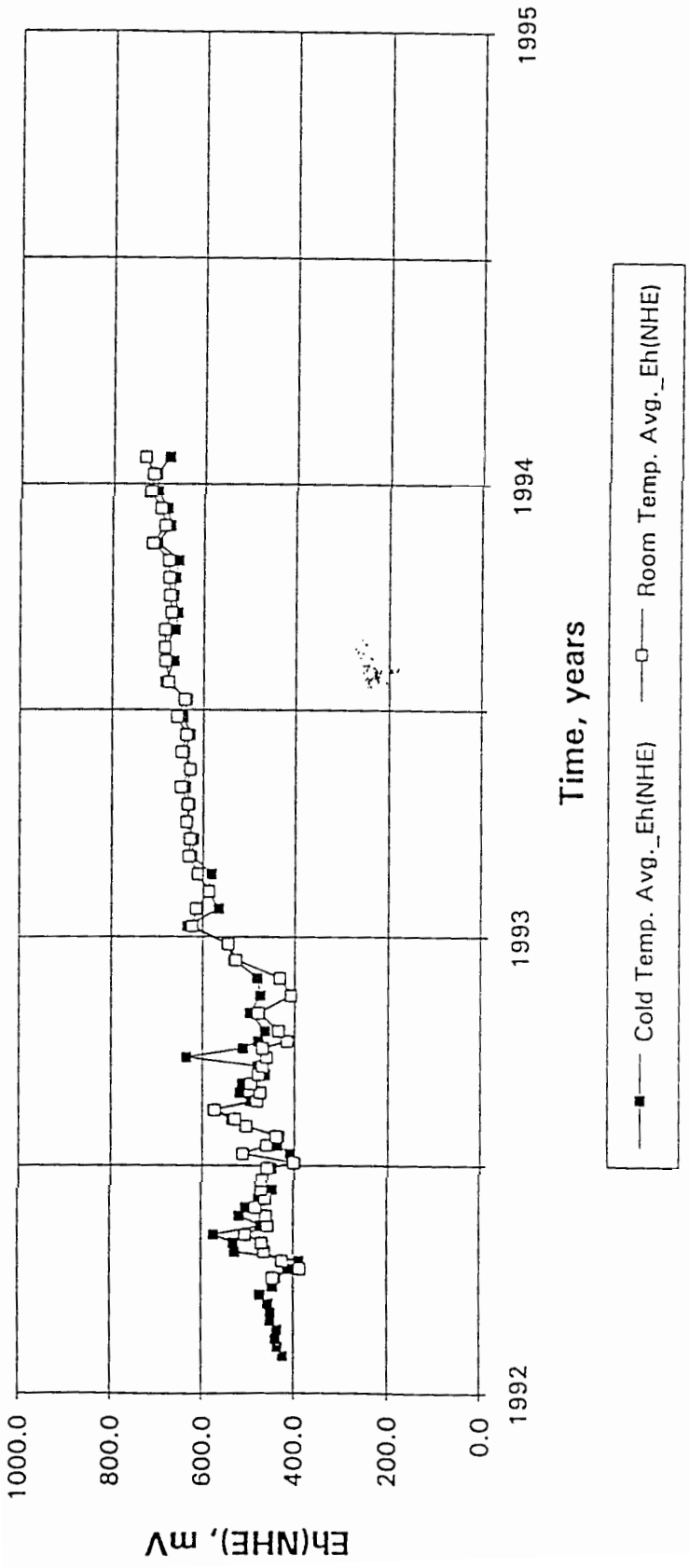


Fig. 31a S - Zone: effluent normalized redox potentials, Eh (NHE), at 2 °C and room temperature.

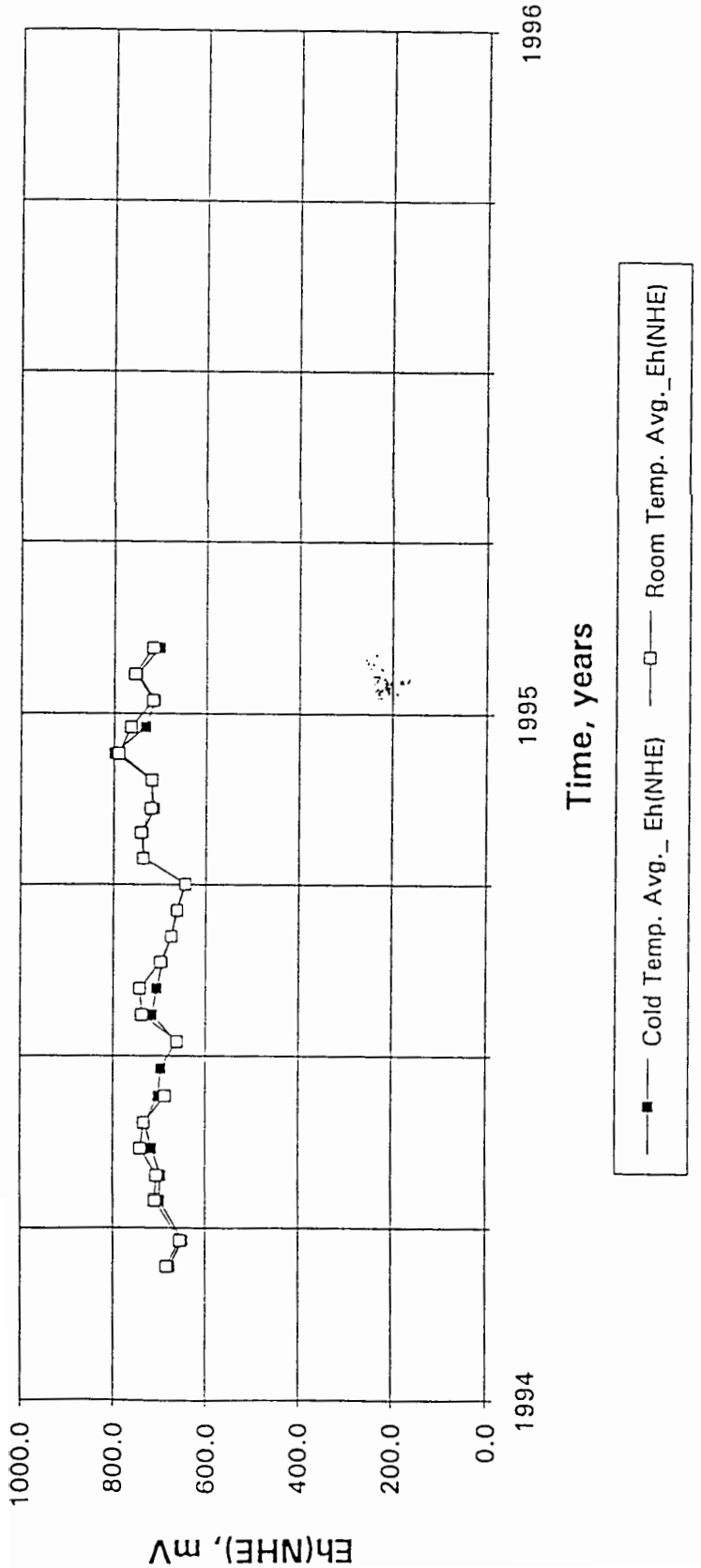


Fig. 31b S - Zone: effluent normalized redox potentials, Eh (NHE), at 10 °C and room temperature.

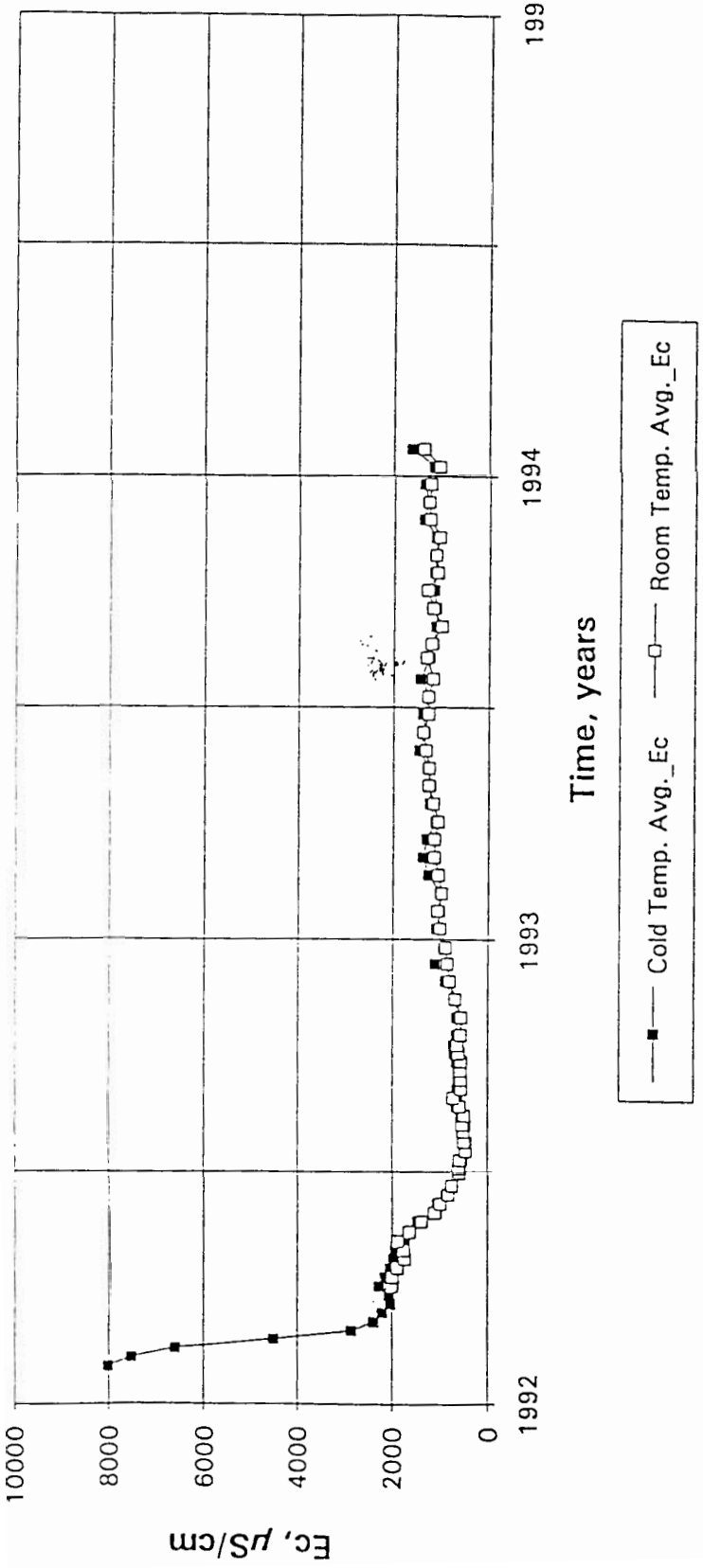


Fig. 32a S - Zone: effluent electrical conductances, Ec, at 2 °C and room temperature.

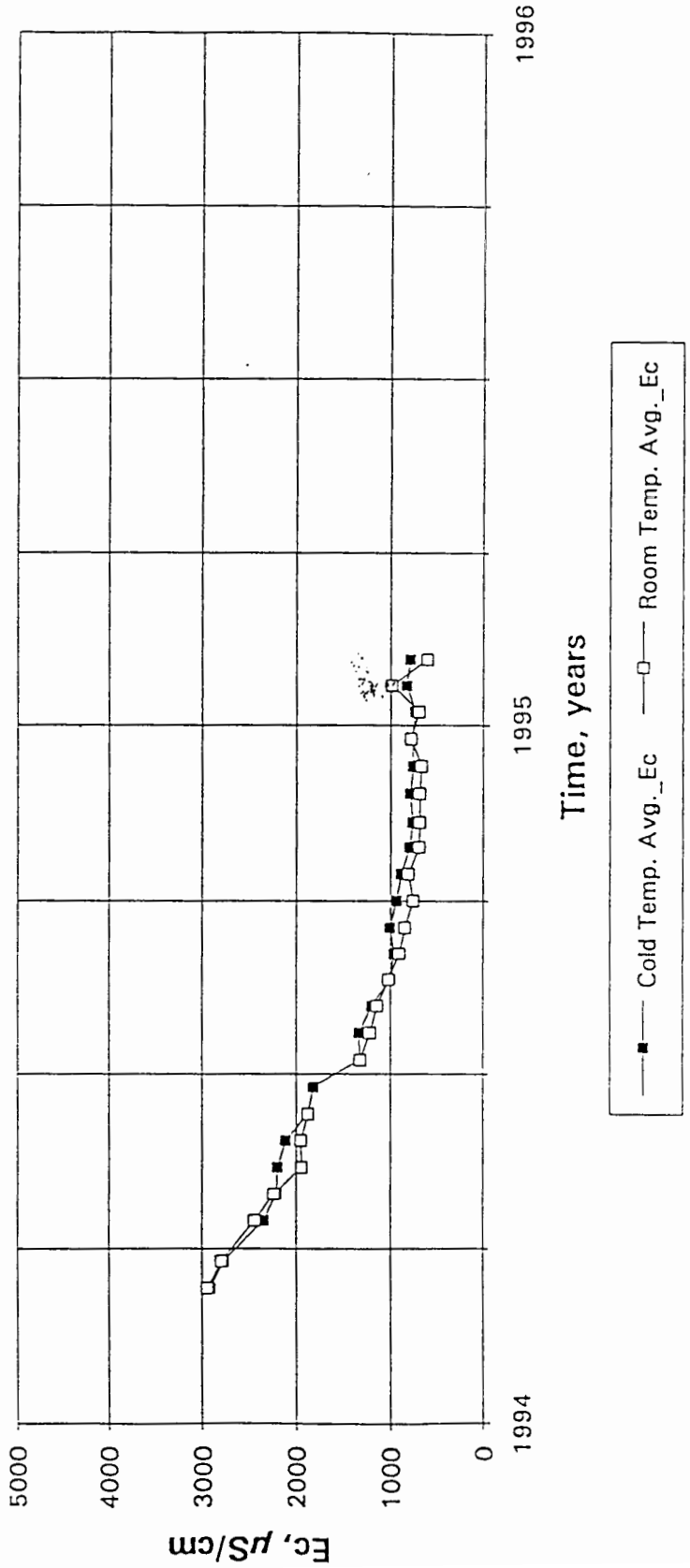


Fig. 32b S - Zone: effluent electrical conductances, Ec, at 10 °C and room temperature.

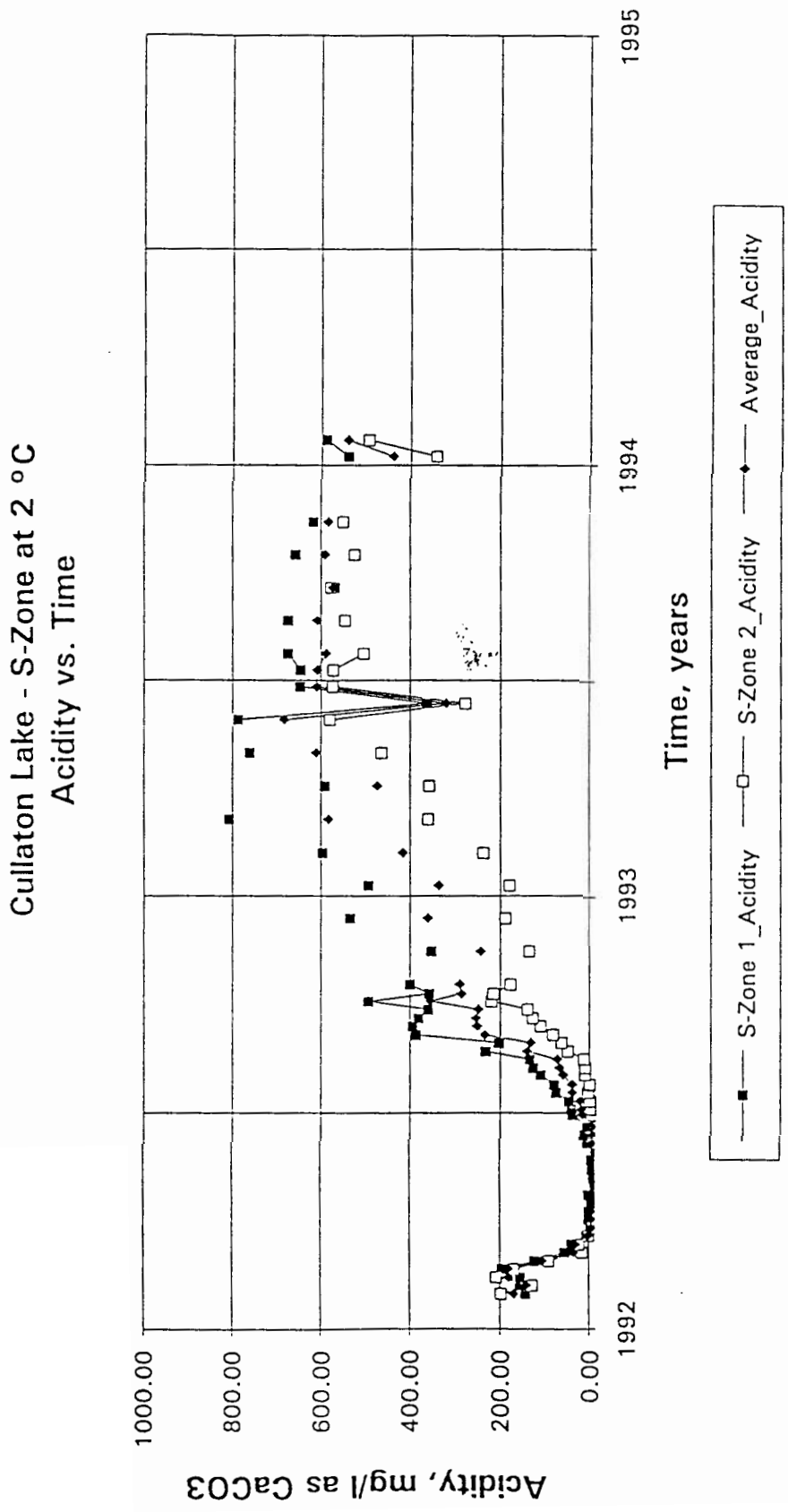


Fig. 33a S - Zone: effluent total acidity at 2 °C.

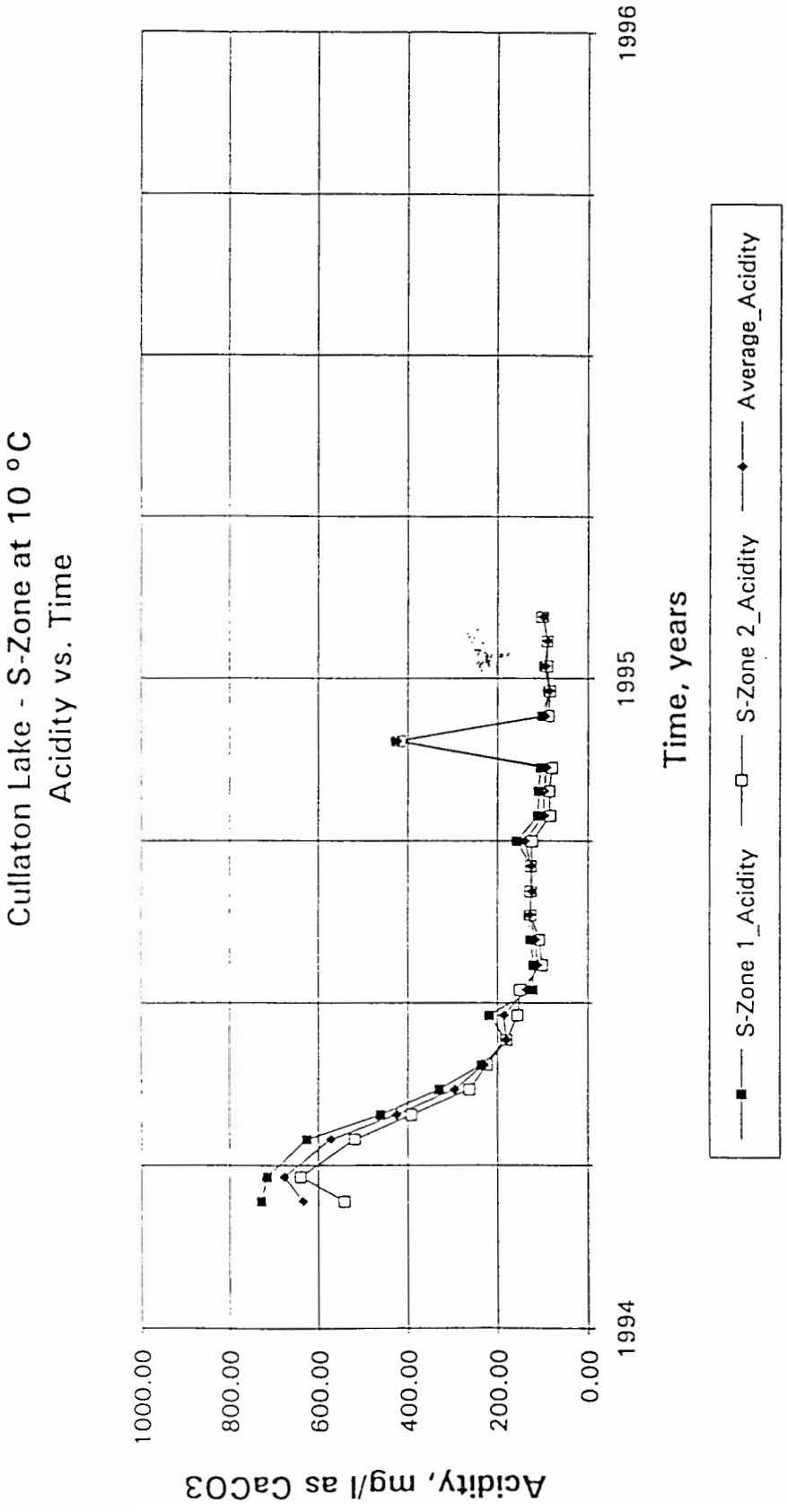


Fig. 33b S - Zone: effluent total acidity at 10 °C.

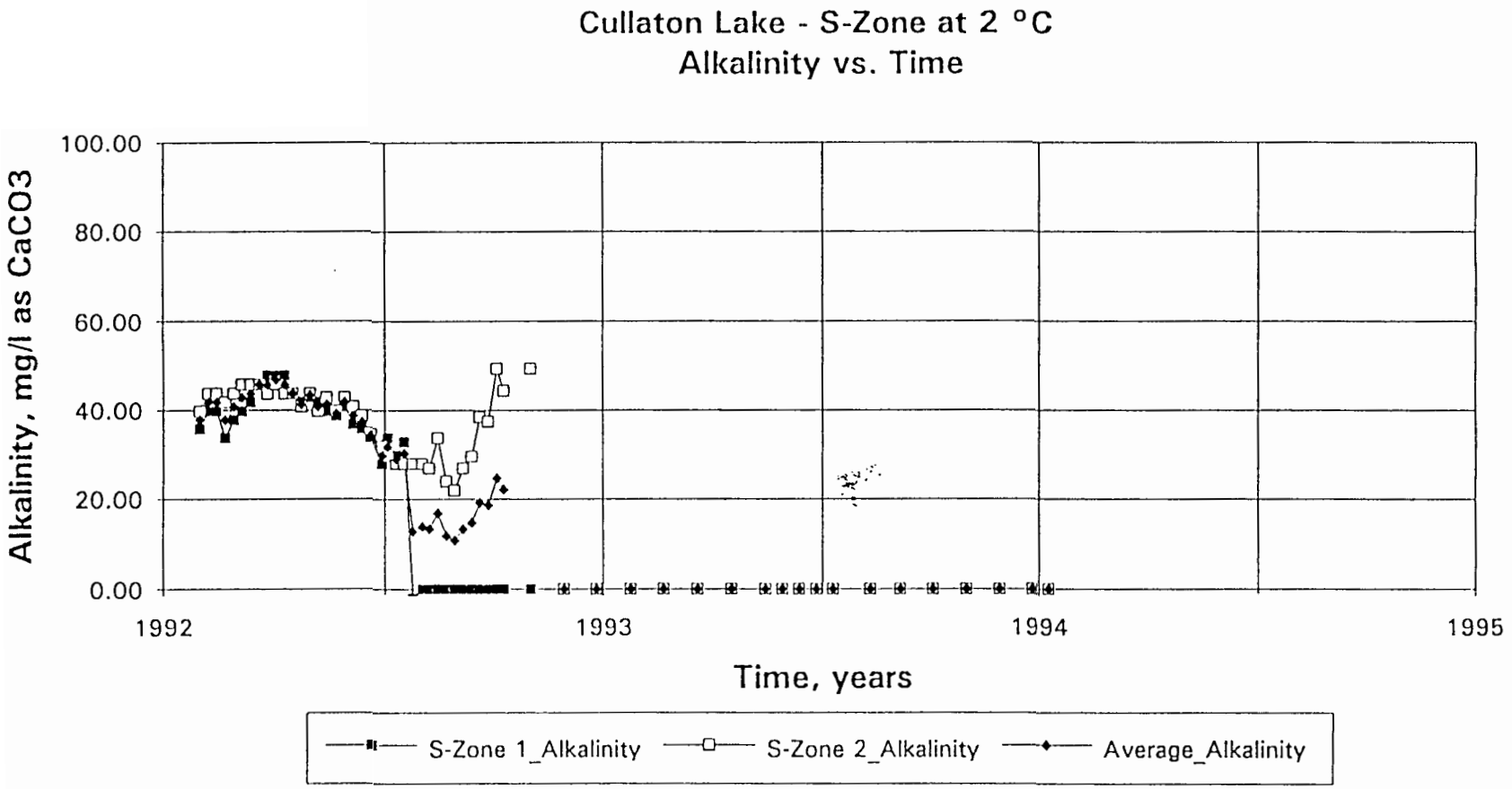


Fig. 34a S - Zone: effluent total alkalinity at 2 °C.

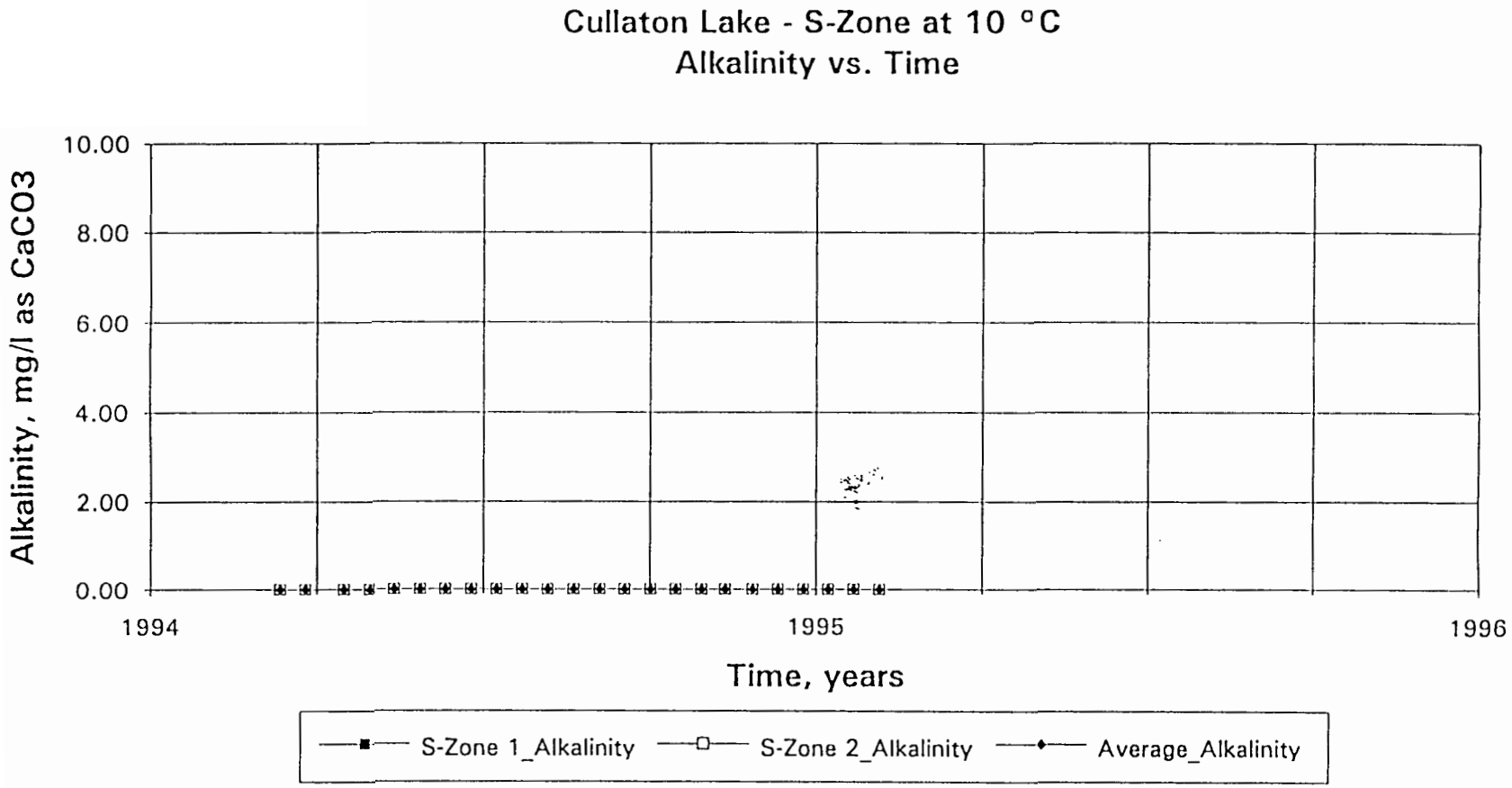


Fig. 34b S - Zone: effluent total alkalinity at 10 °C.

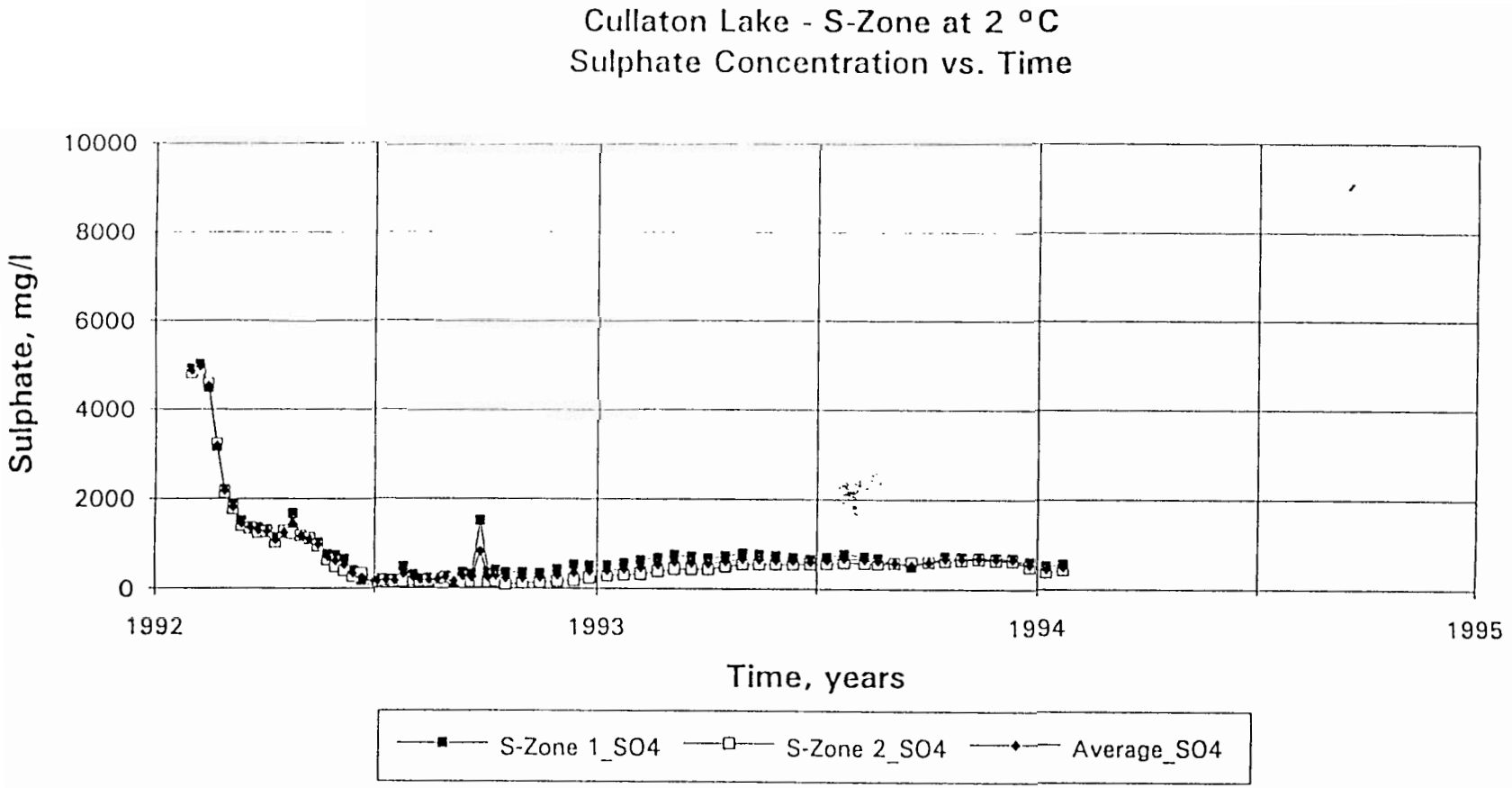


Fig. 35a S - Zone: effluent dissolved sulphate concentration at 2 °C.

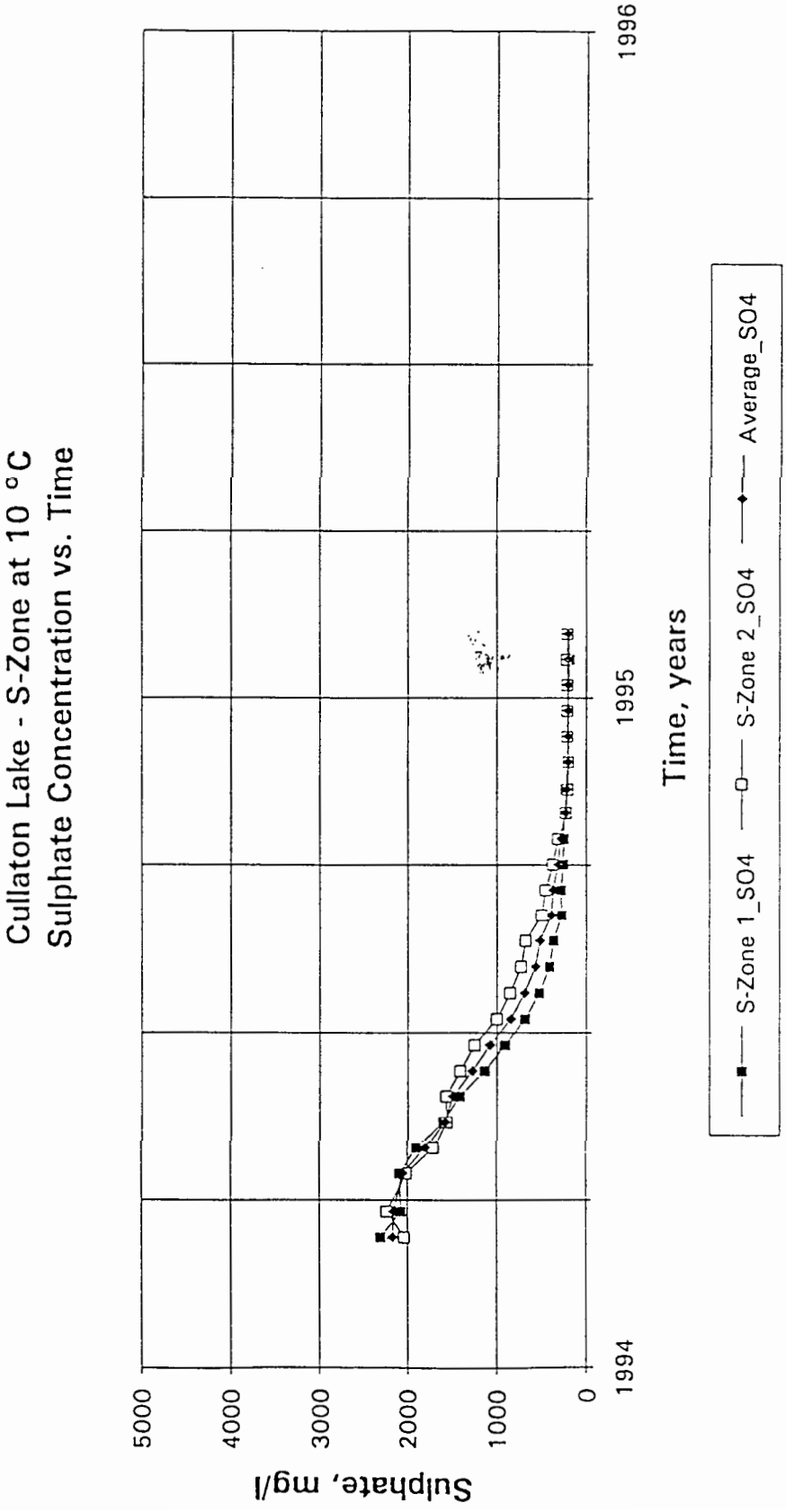


Fig. 35b S - Zone: effluent dissolved sulphate concentration at 10 °C.

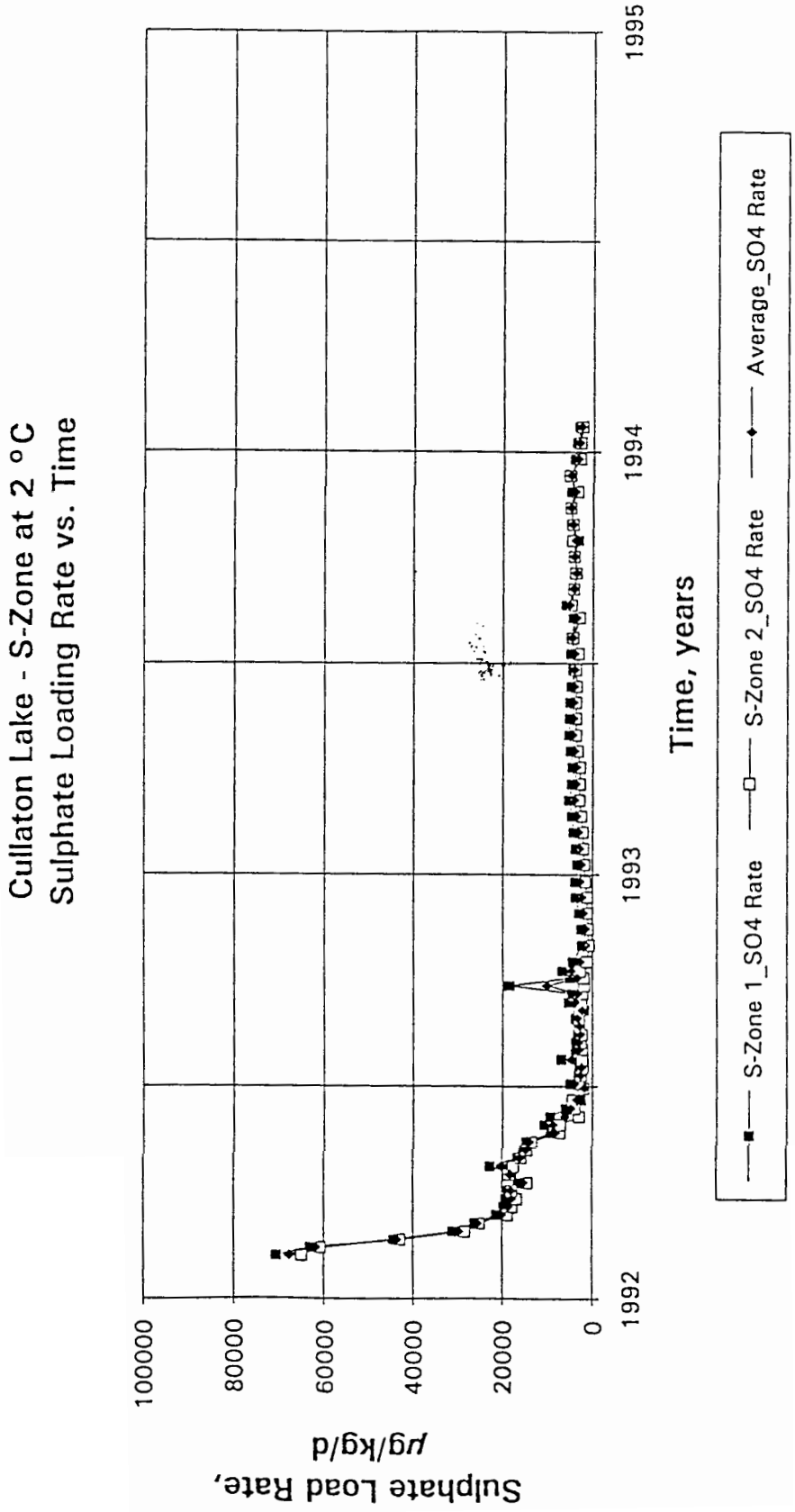


Fig. 36a S - Zone: effluent dissolved sulphate loading rate at 2 °C.

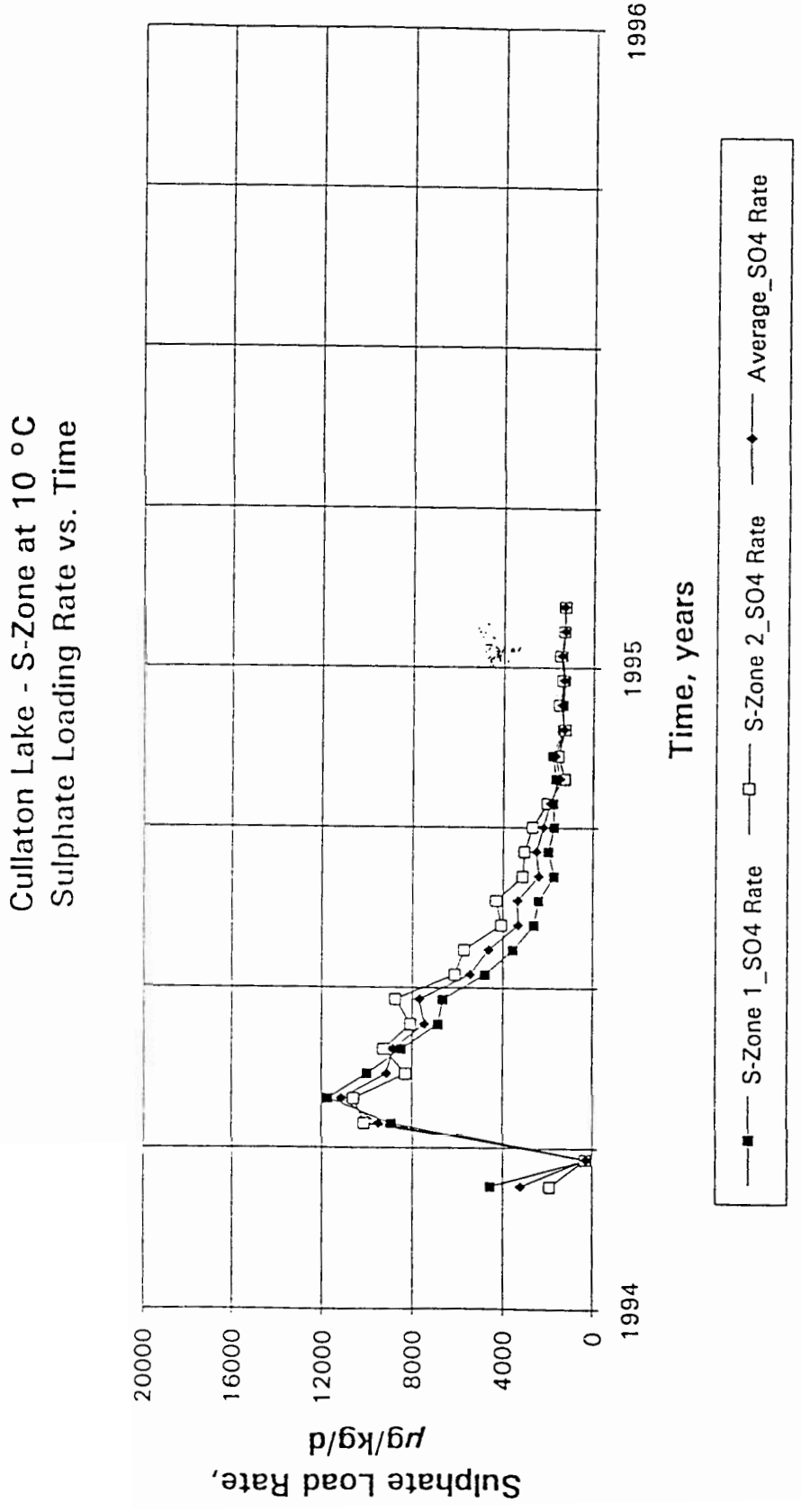


Fig. 36b S - Zone: effluent dissolved sulphate loading rate at 10 °C.

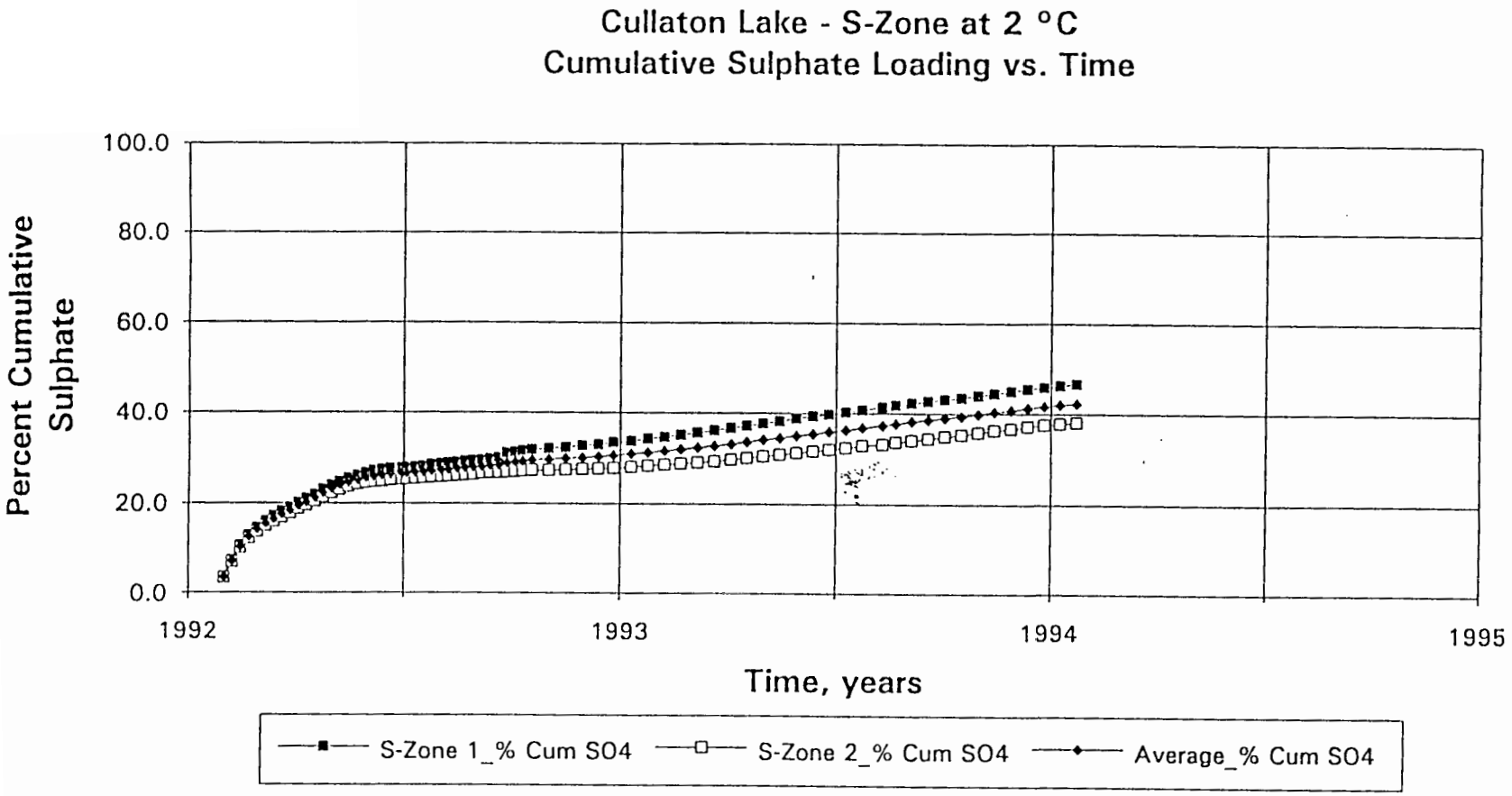


Fig. 37a S - Zone: effluent percent cumulative total sulphate loading at 2 °C.

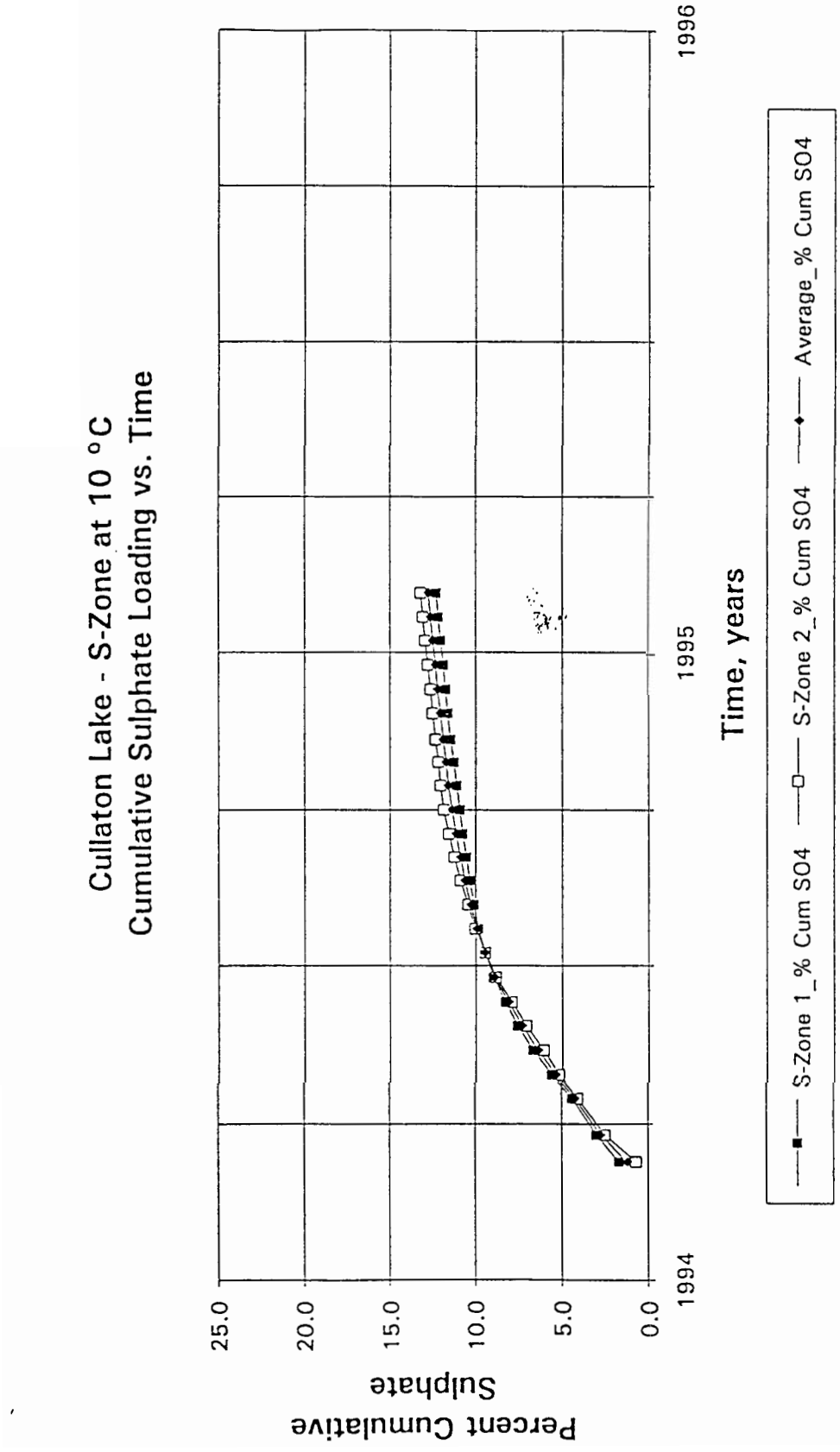


Fig. 37b S - Zone: effluent percent cumulative total sulphate loading at 10 °C.

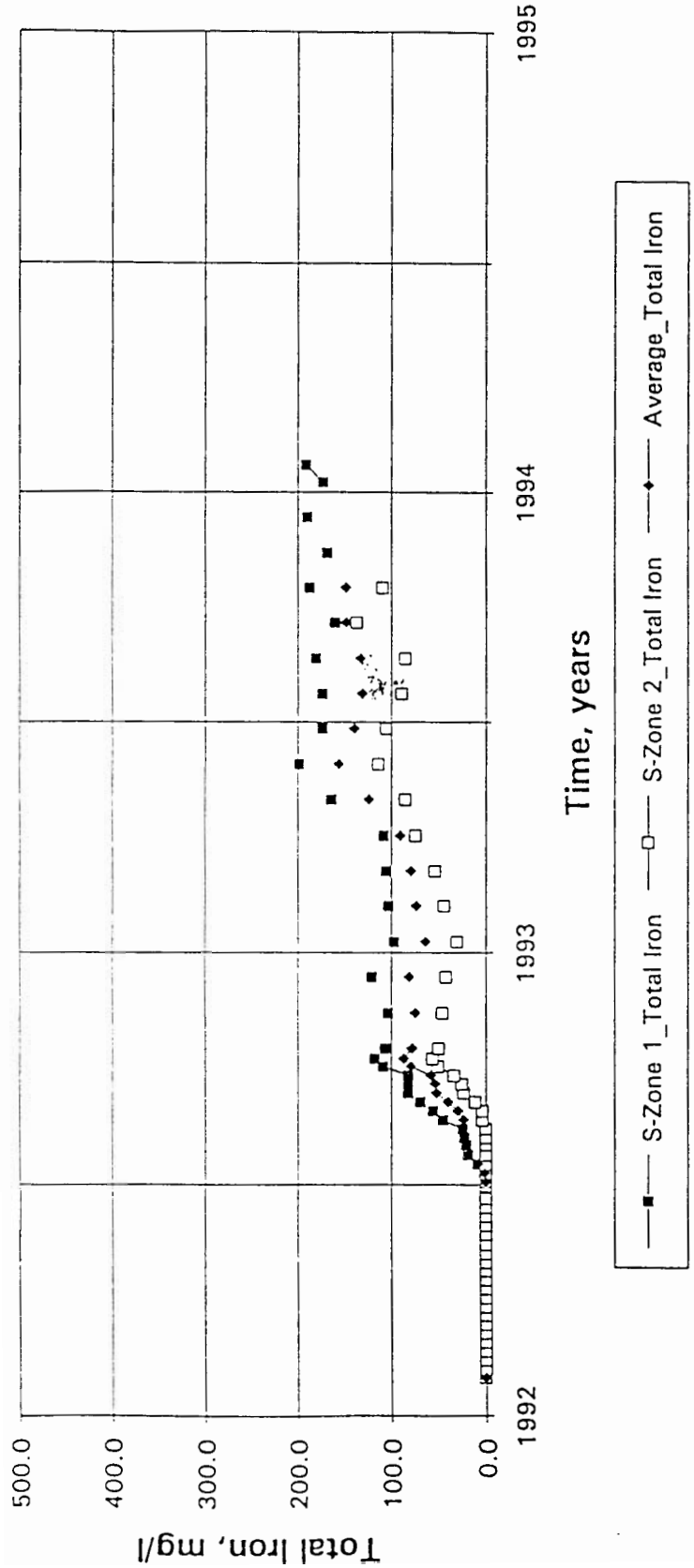


Fig. 38a S - Zone: effluent dissolved total iron concentration at 2 °C.

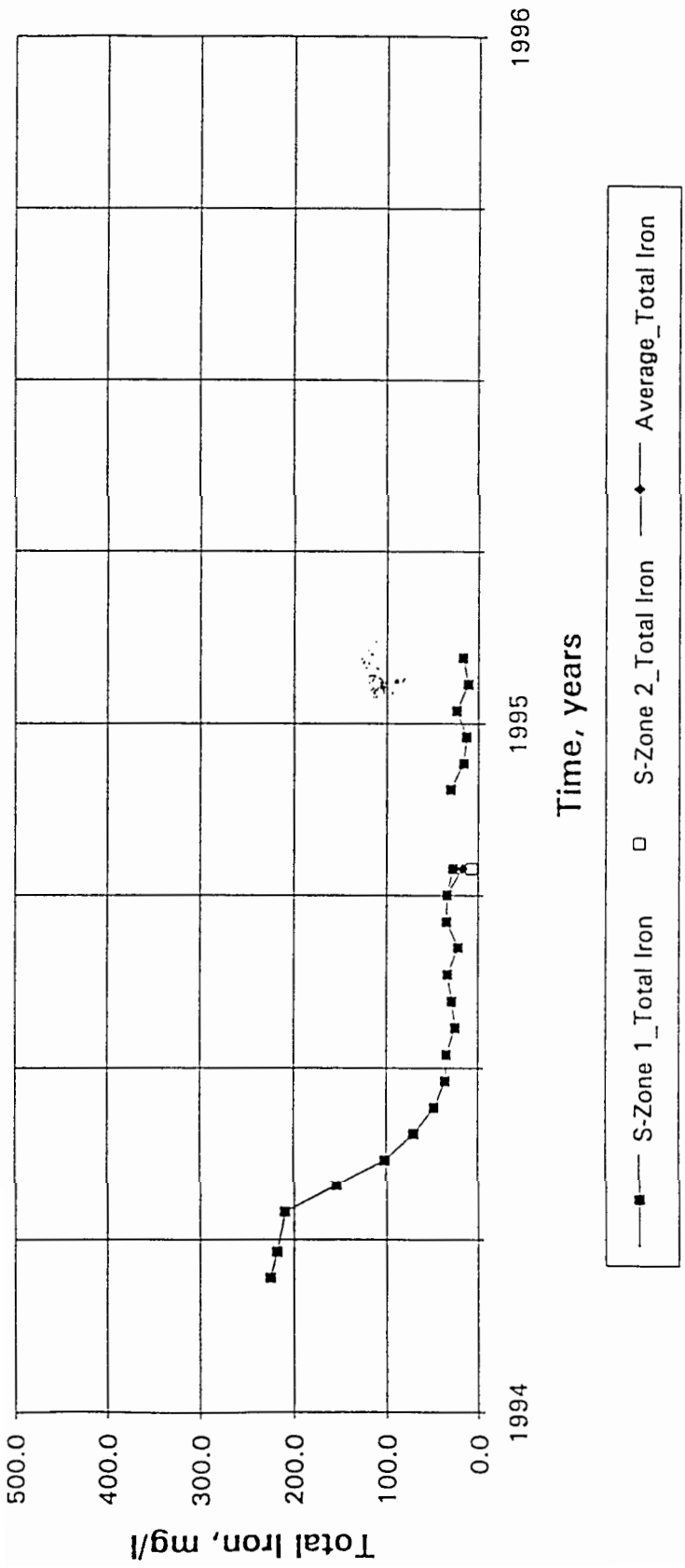


Fig. 38b S - Zone: effluent dissolved total iron concentration at 10 °C.

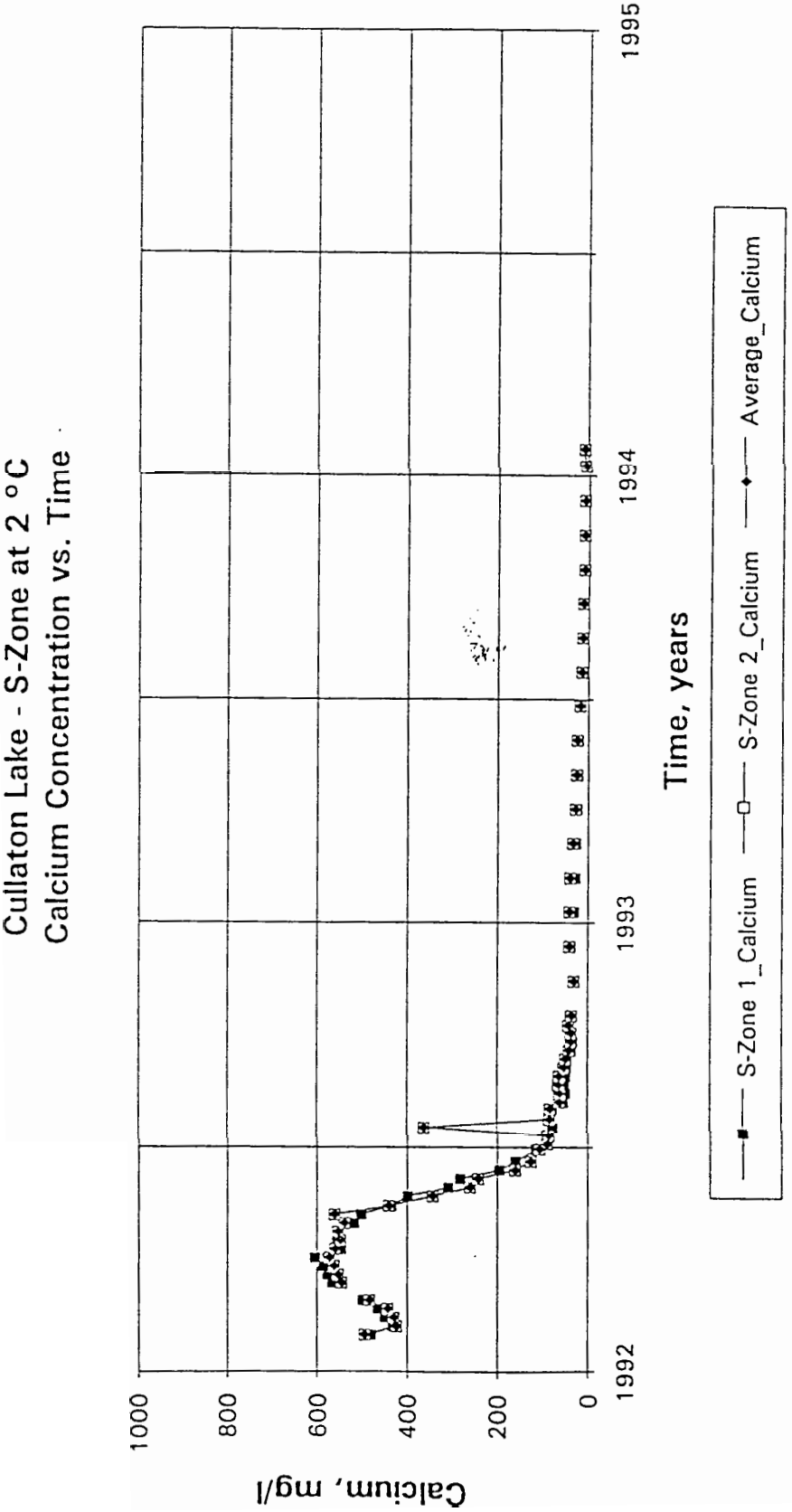


Fig. 39a S - Zone: effluent dissolved calcium concentration at 2 °C.

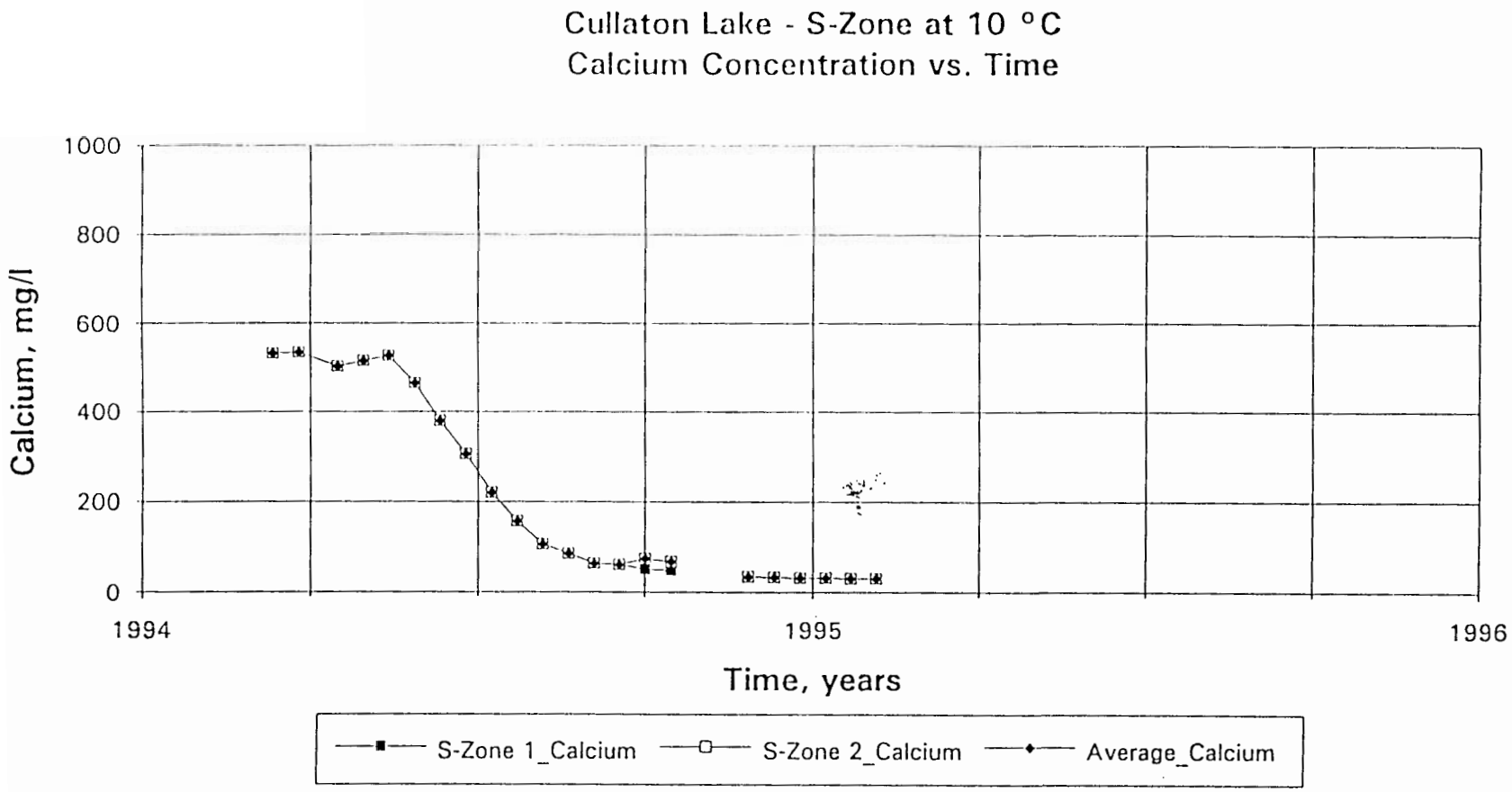


Fig. 39b S - Zone: effluent dissolved calcium concentration at 10 °C..

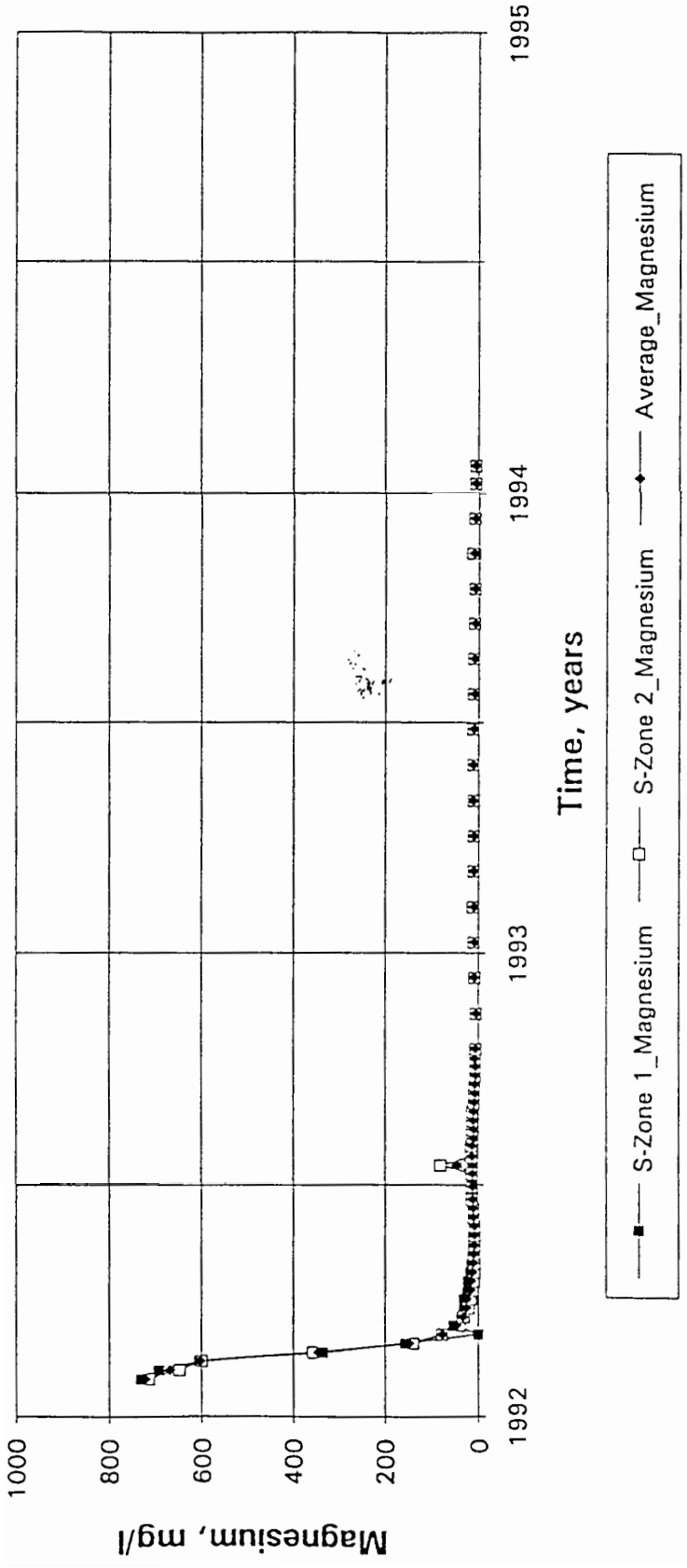


Fig. 40a S - Zone: effluent dissolved magnesium concentration at 2 °C.

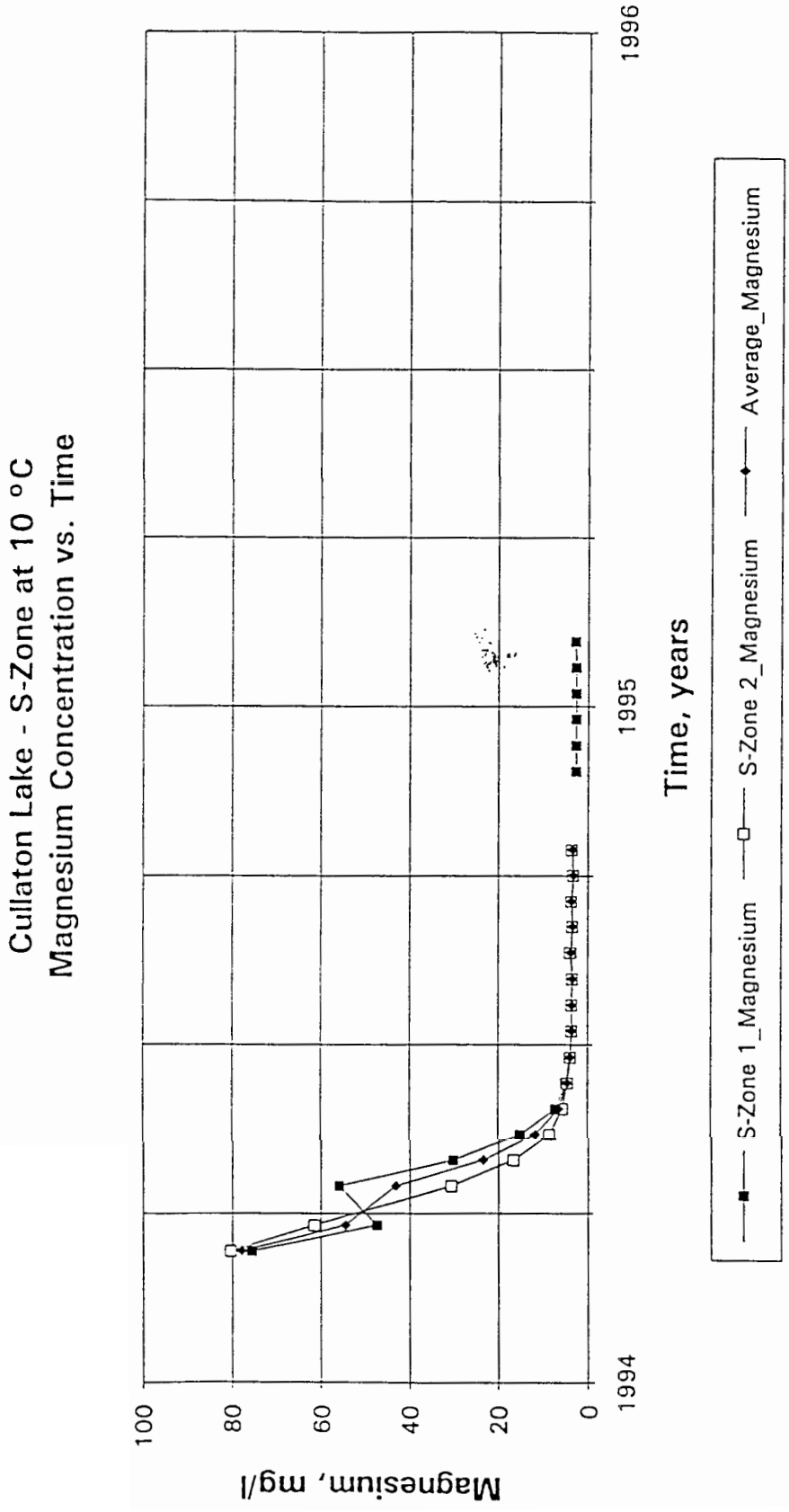


Fig. 40b S - Zone: effluent dissolved magnesium concentration at 10 °C.

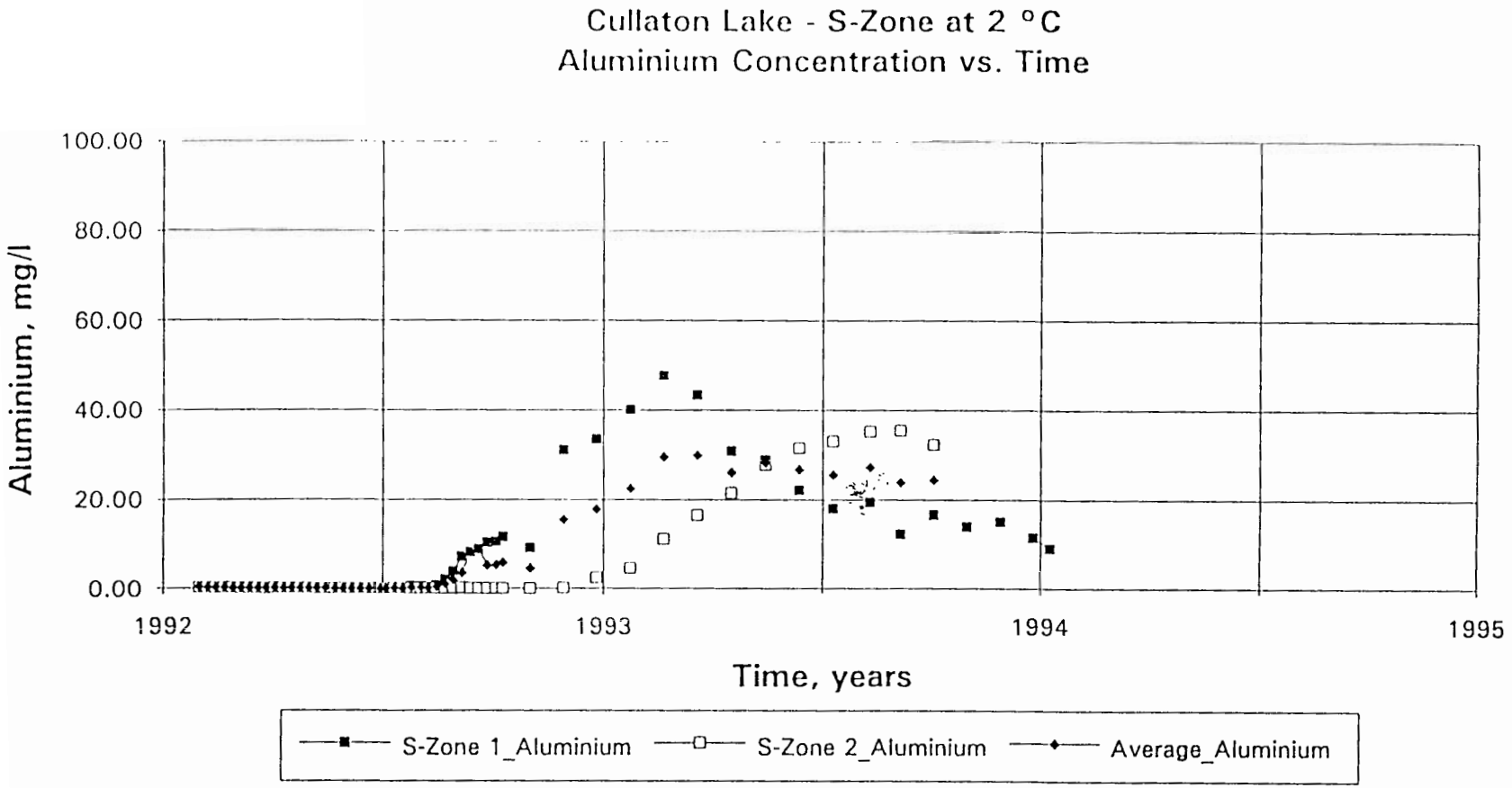


Fig. 41a S - Zone: effluent dissolved aluminium concentration at 2 °C.

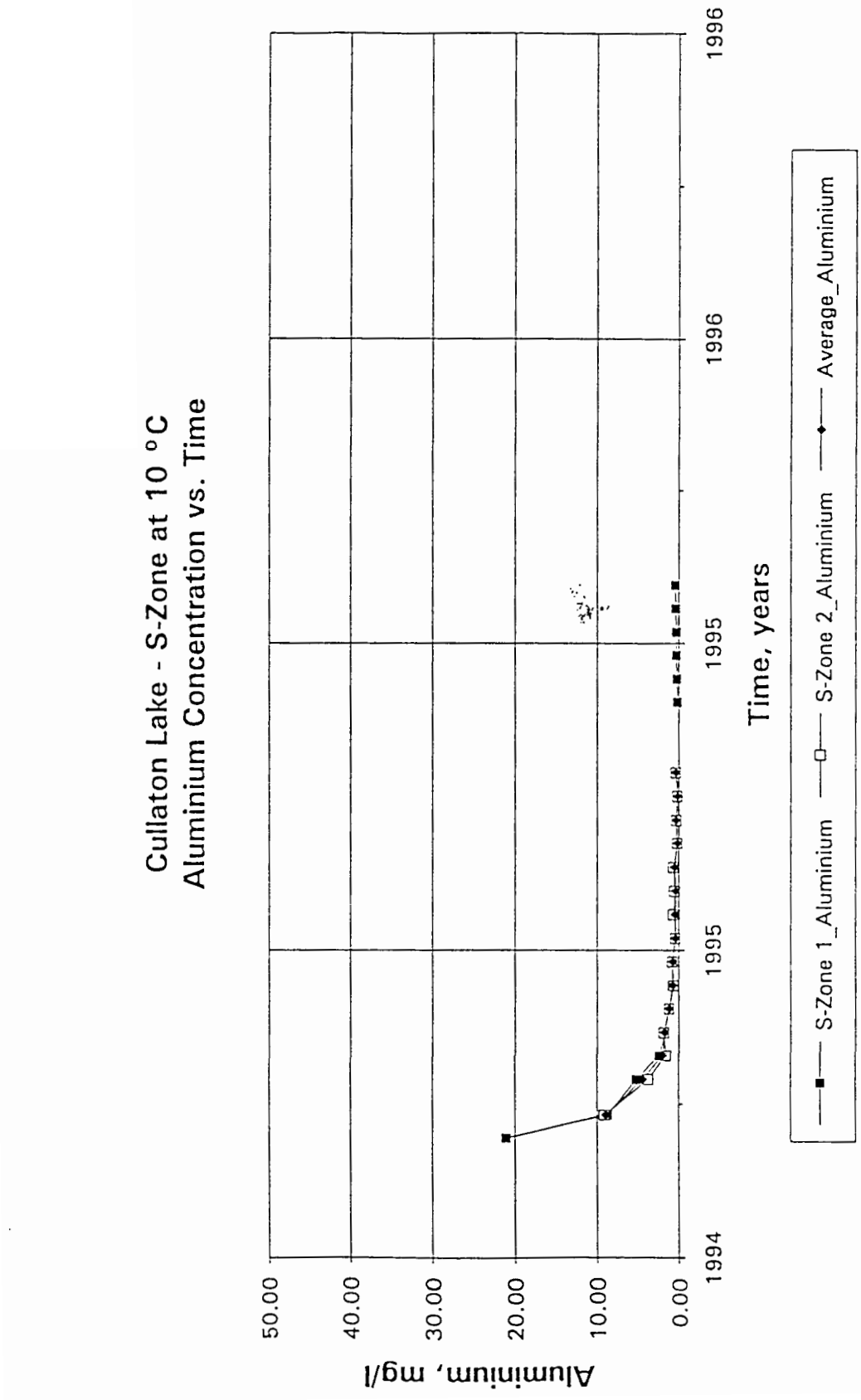


Fig. 41b S - Zone: effluent dissolved aluminium concentration at 10 °C.

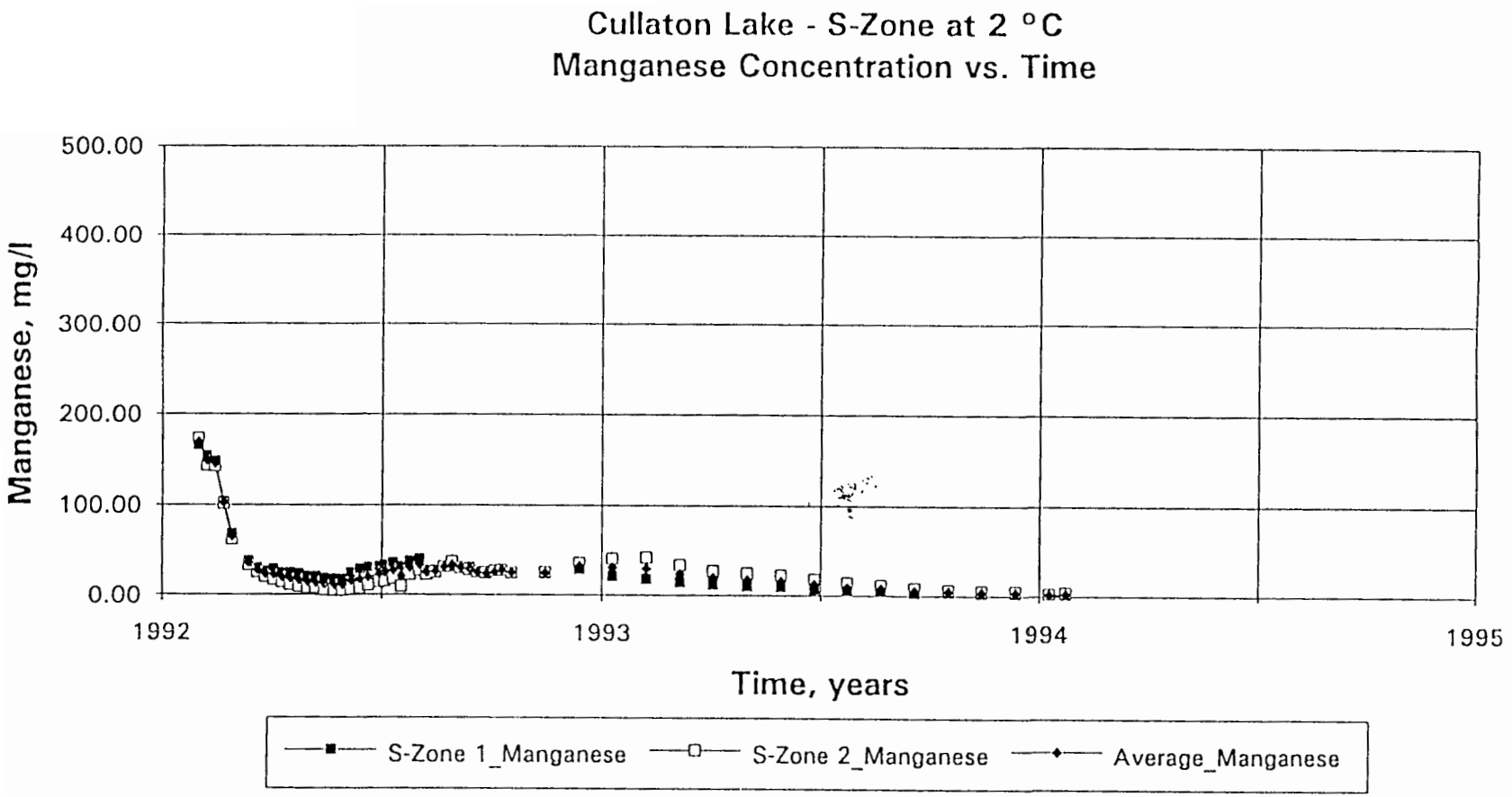


Fig. 42a S - Zone: effluent dissolved manganese concentration at 2 °C.

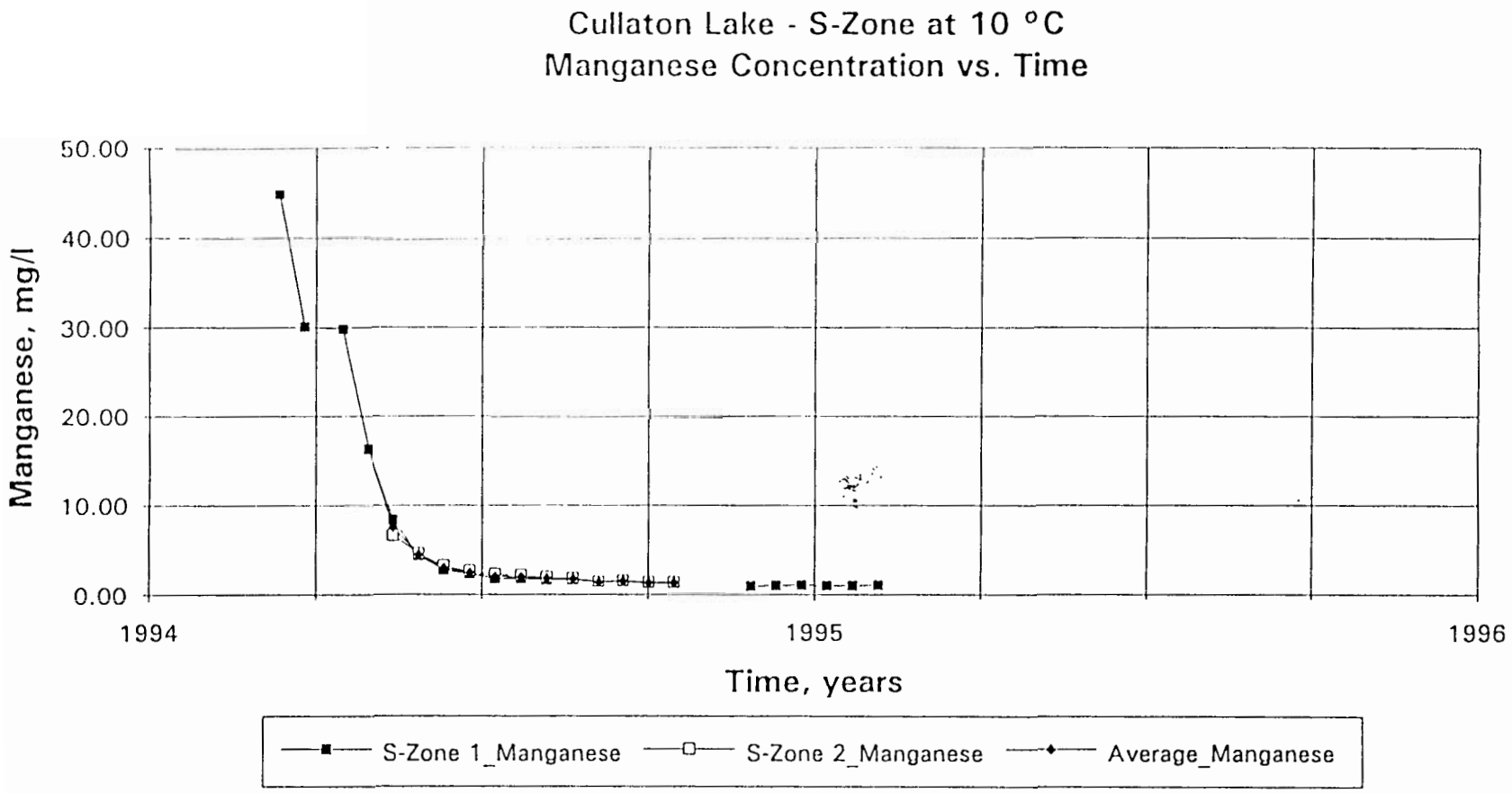


Fig. 42b S - Zone: effluent dissolved manganese concentration at 10 °C.

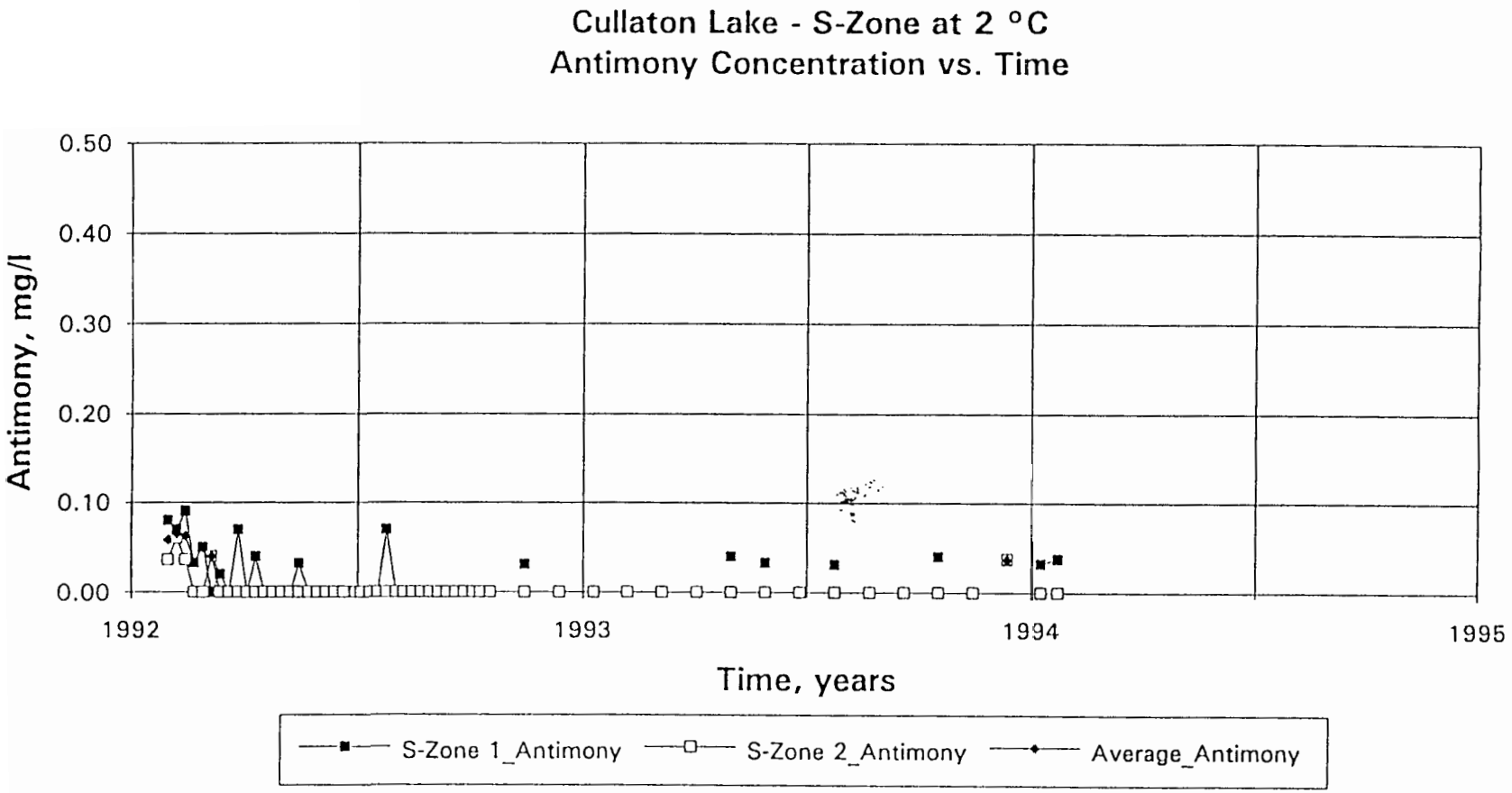


Fig. 43a S - Zone: effluent dissolved antimony concentration at 2 °C.

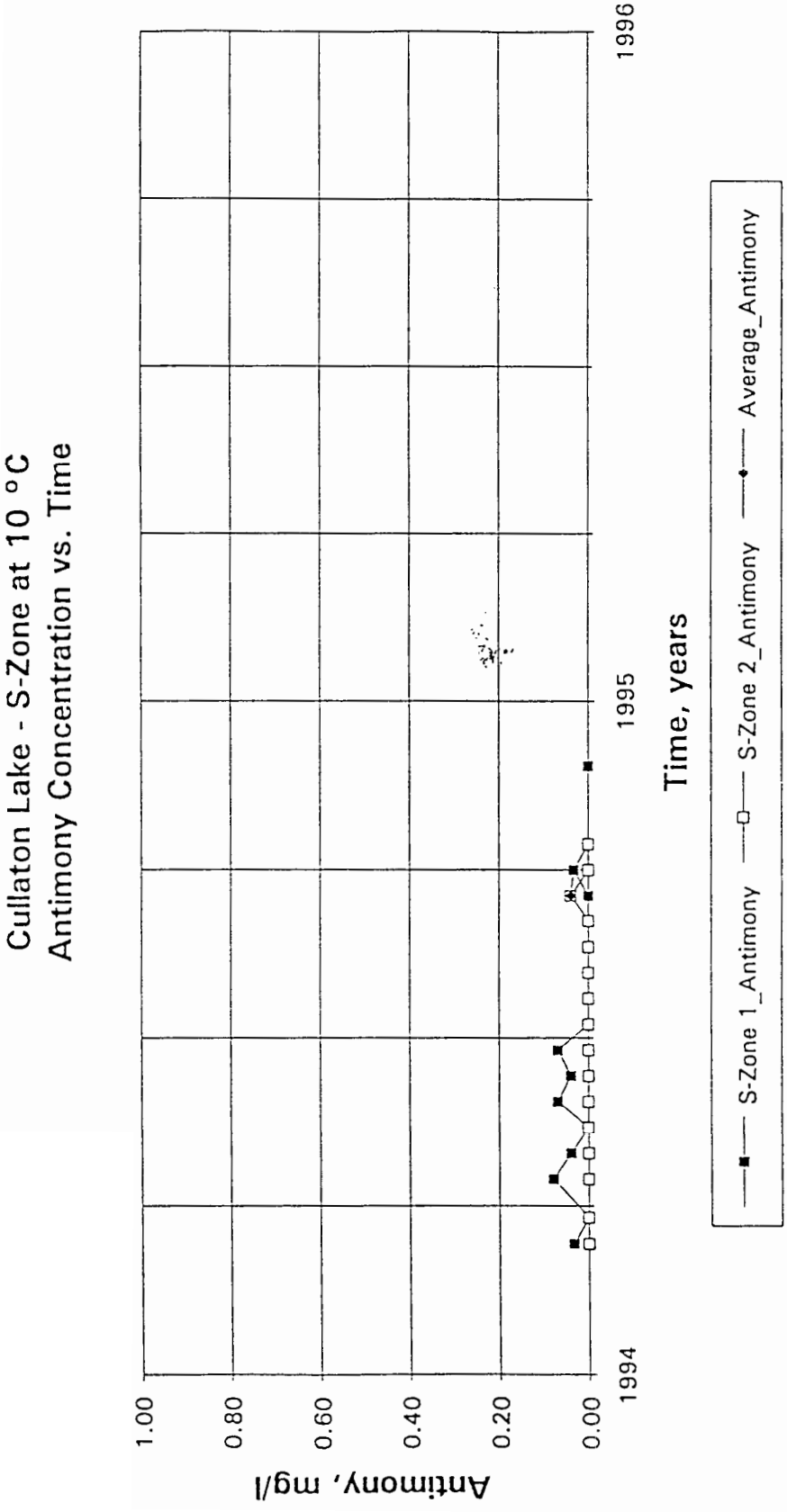


Fig. 43b S - Zone: effluent dissolved antimony concentration at 10 °C.

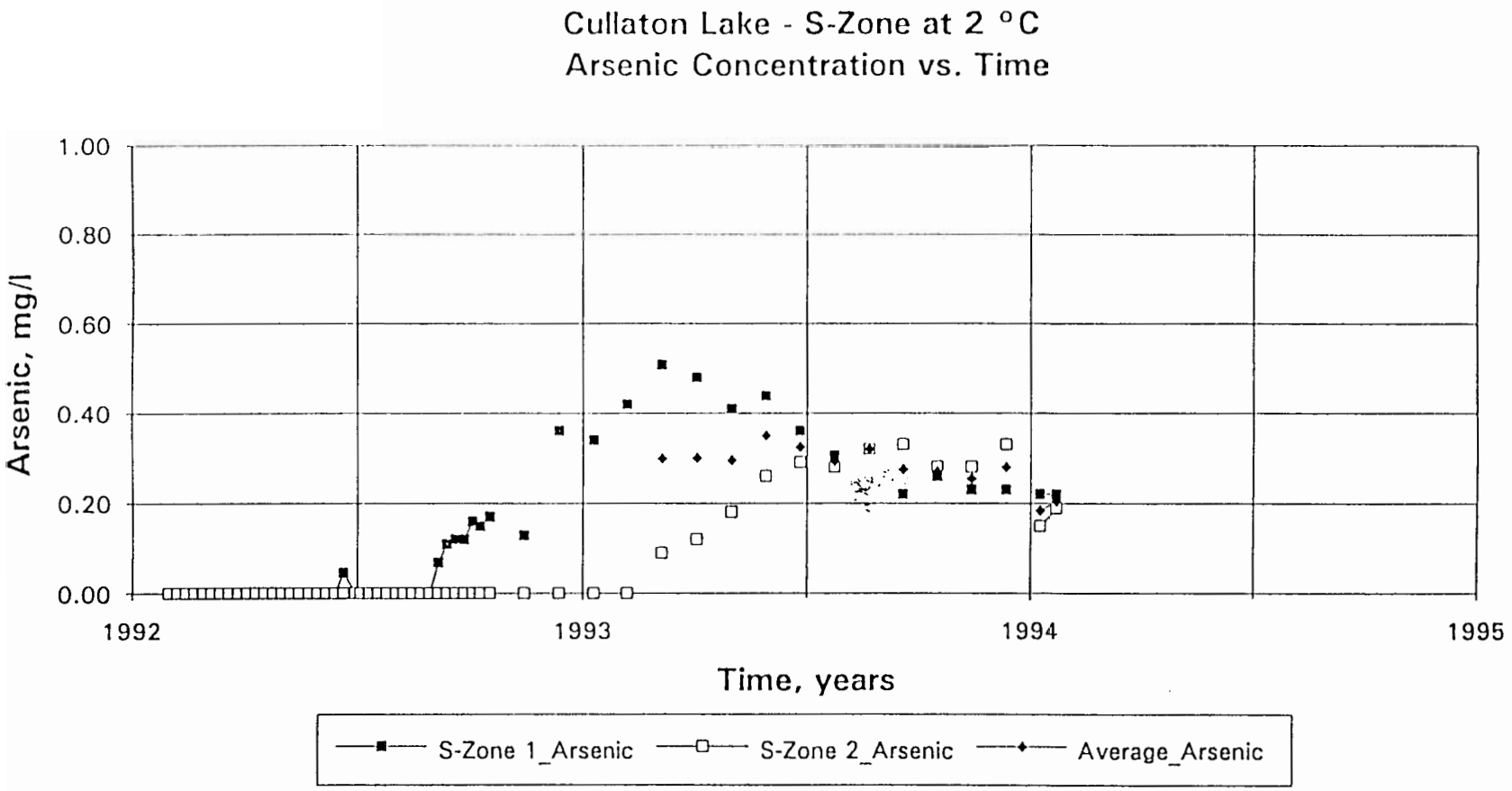


Fig. 44a S - Zone: effluent dissolved arsenic concentration at 2 °C.

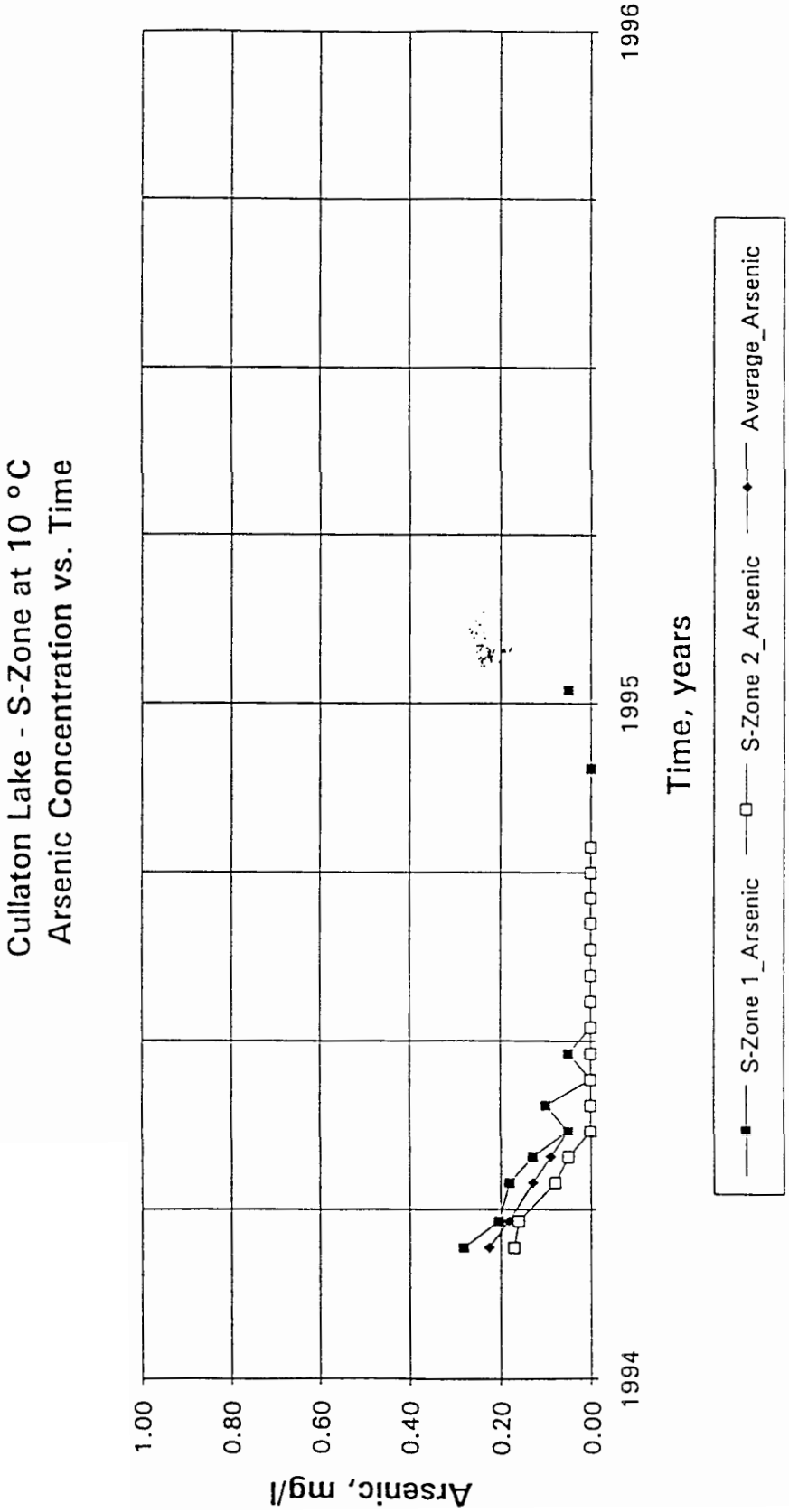


Fig. 44b S - Zone: effluent dissolved arsenic concentration at 10 °C.

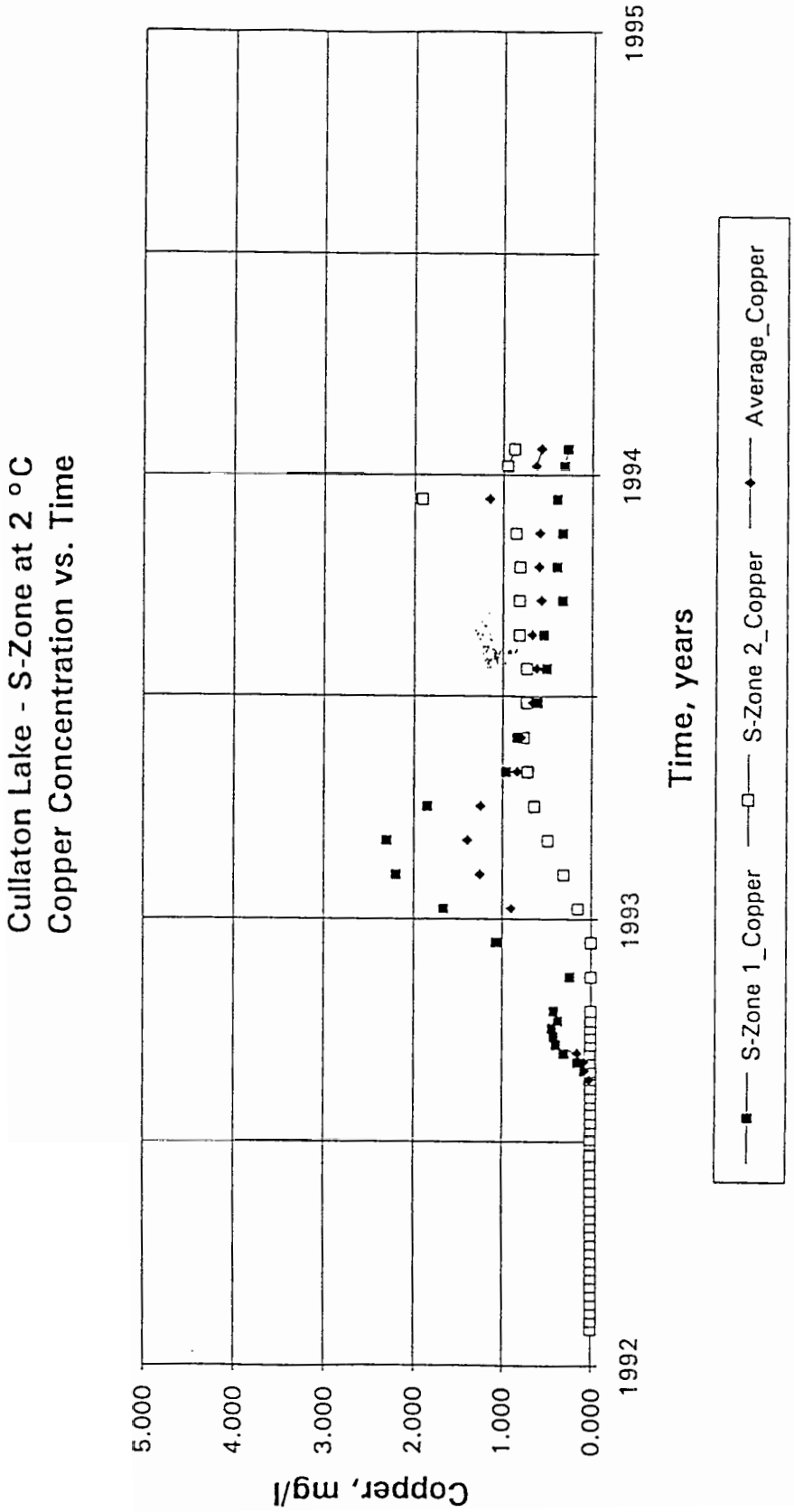


Fig. 45a S - Zone: effluent dissolved copper concentration at 2 °C.

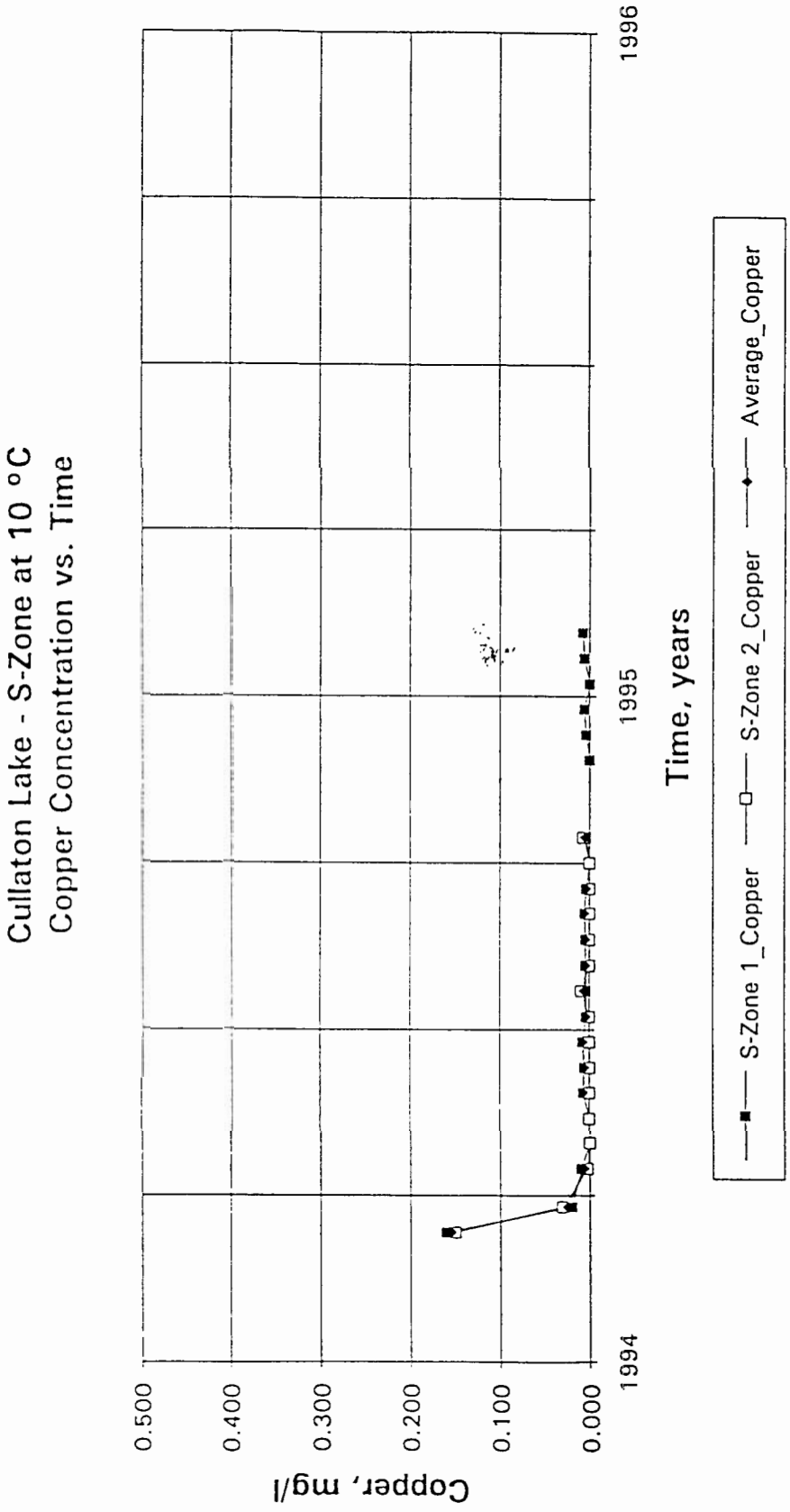


Fig. 45b S - Zone: effluent dissolved copper concentration at 10 °C.

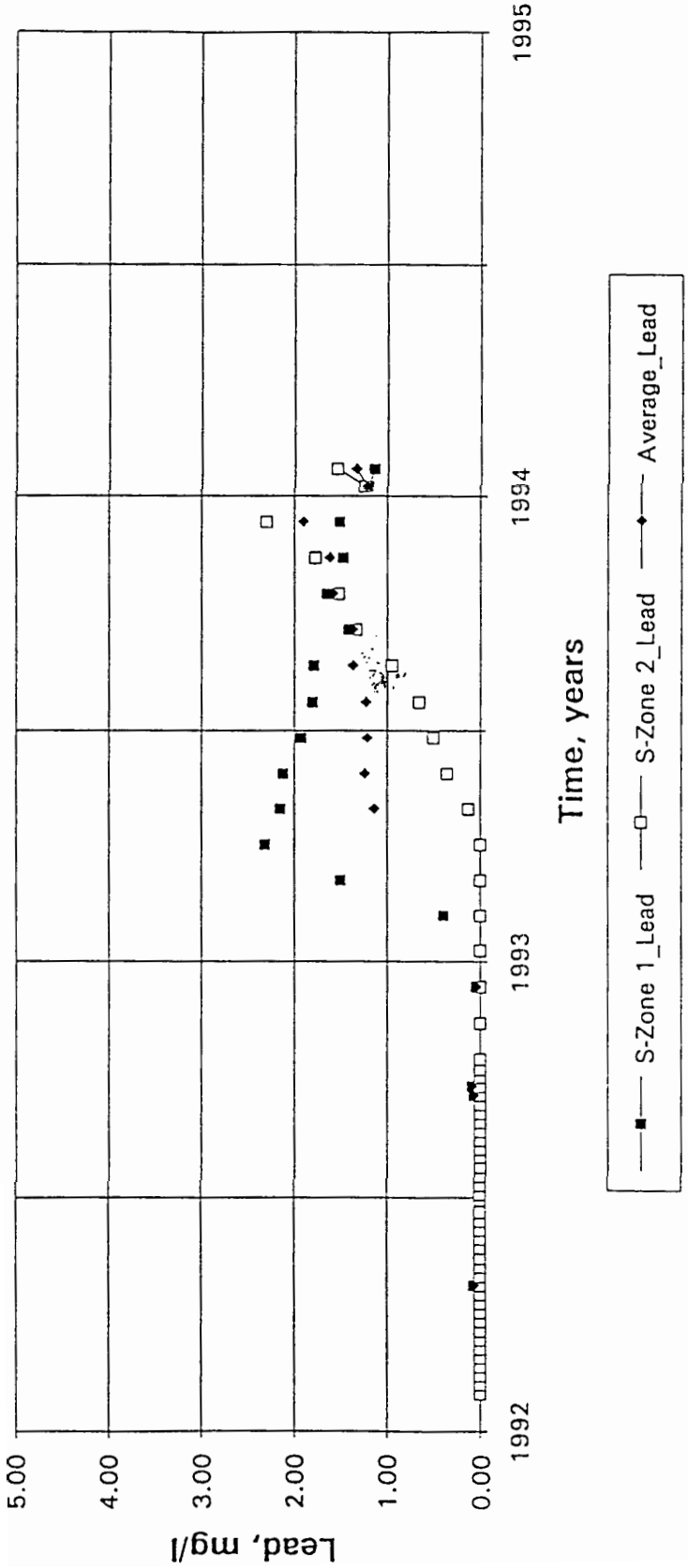


Fig. 46a S - Zone: effluent dissolved lead concentration at 2 °C.

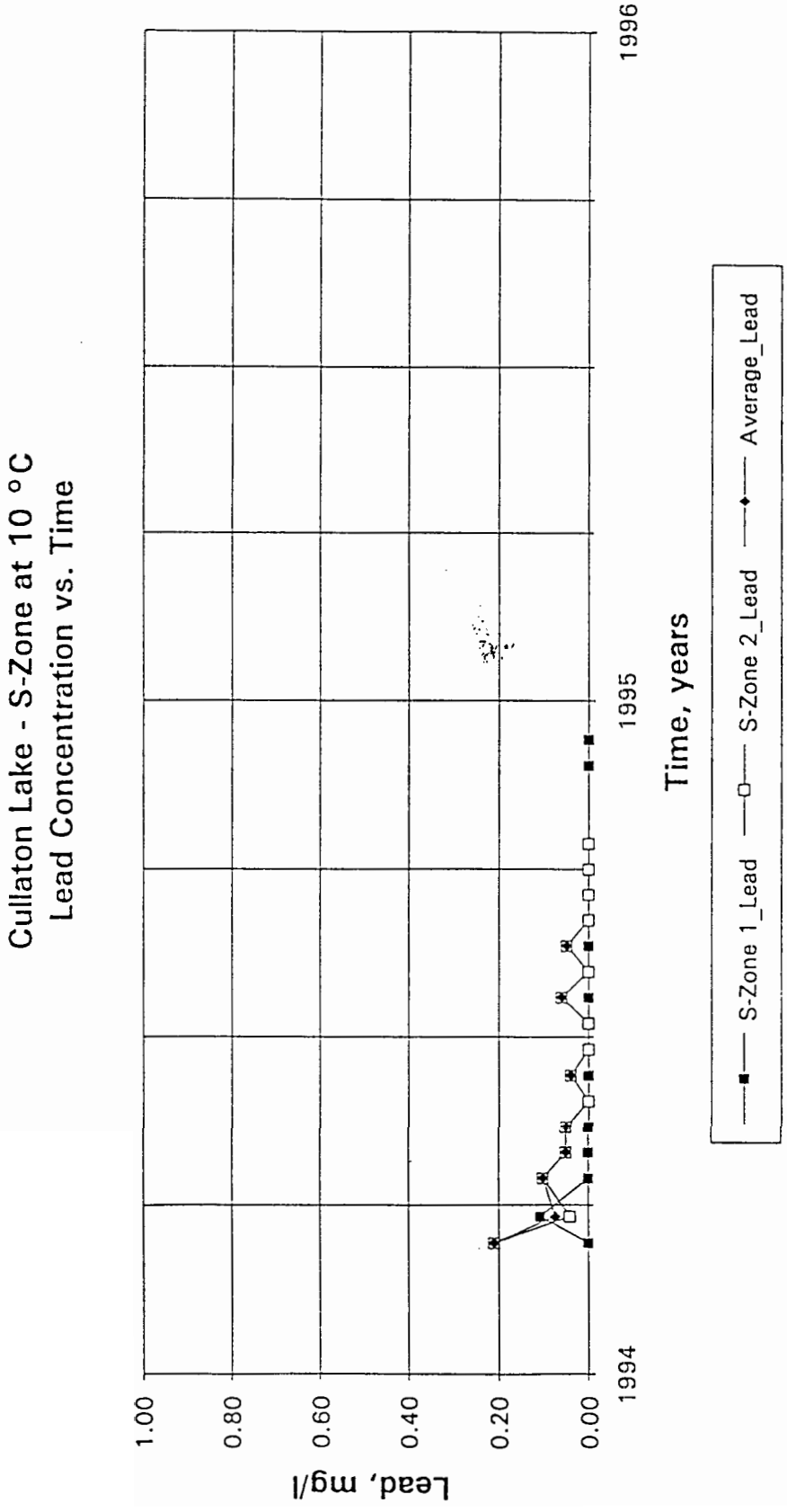


Fig. 46b S - Zone: effluent dissolved lead concentration at 10 °C.

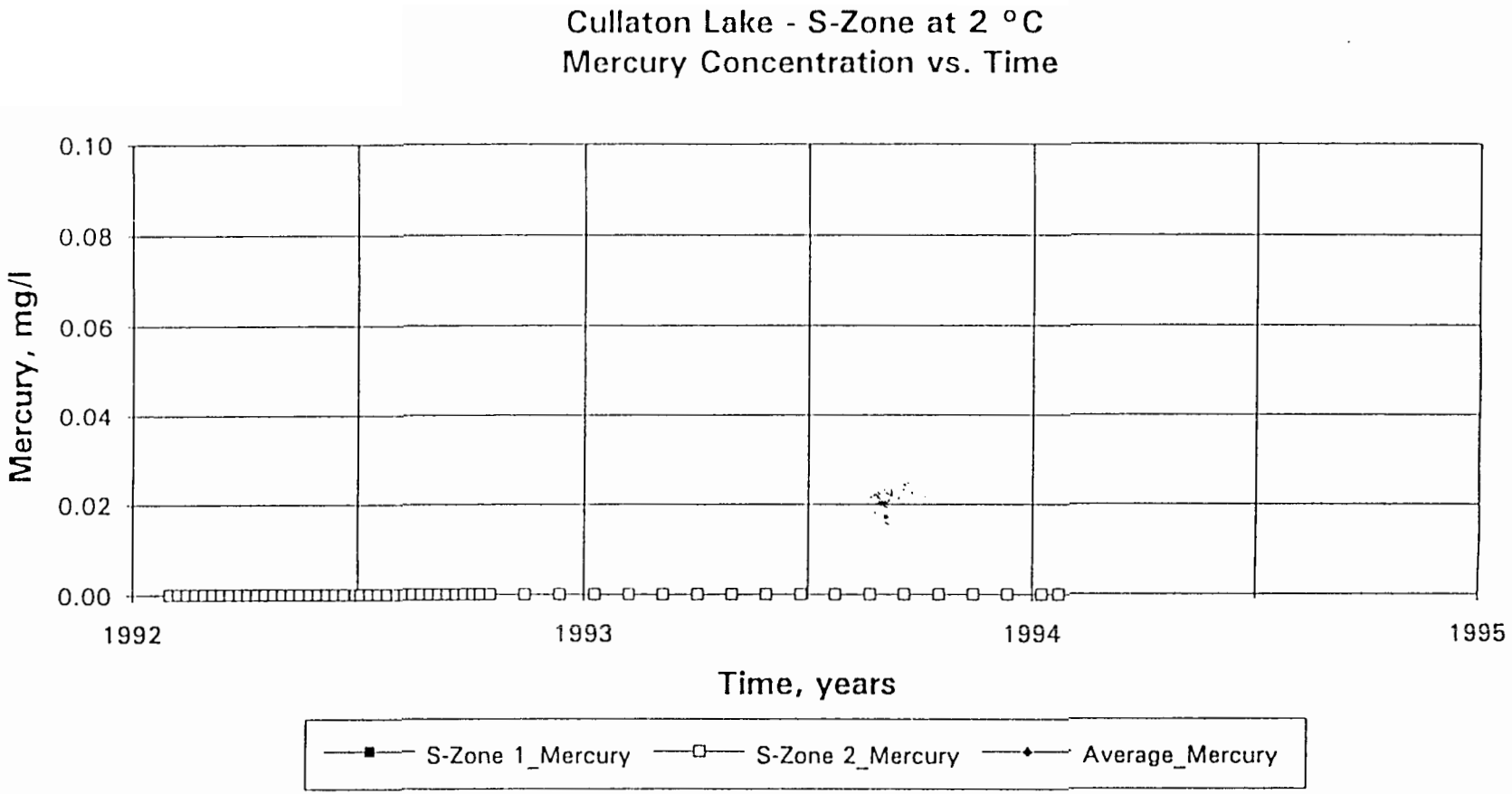


Fig. 47a S - Zone: effluent dissolved mercury concentration at 2 °C.

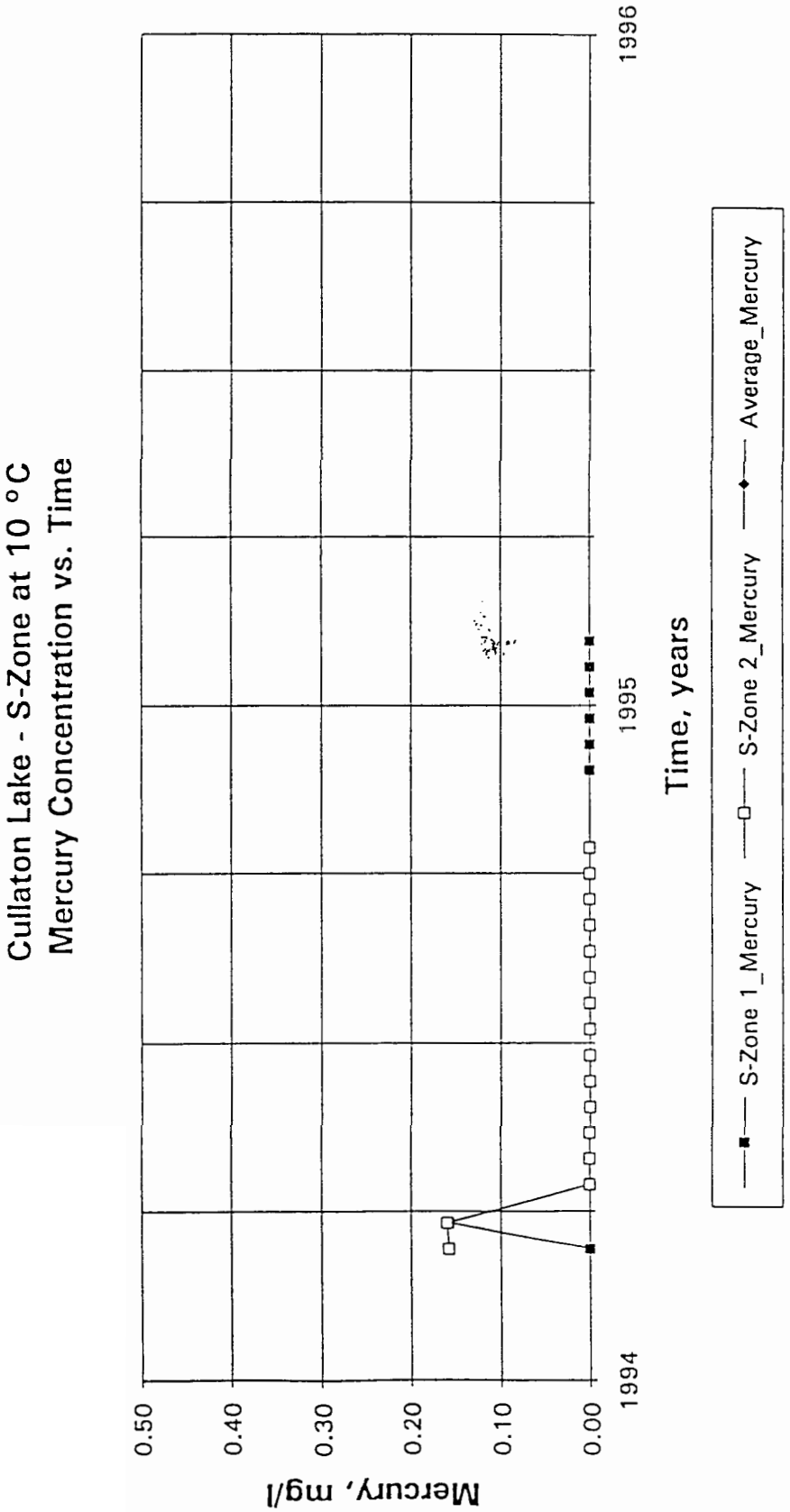


Fig. 47b S - Zone: effluent dissolved mercury concentration at 10 °C.

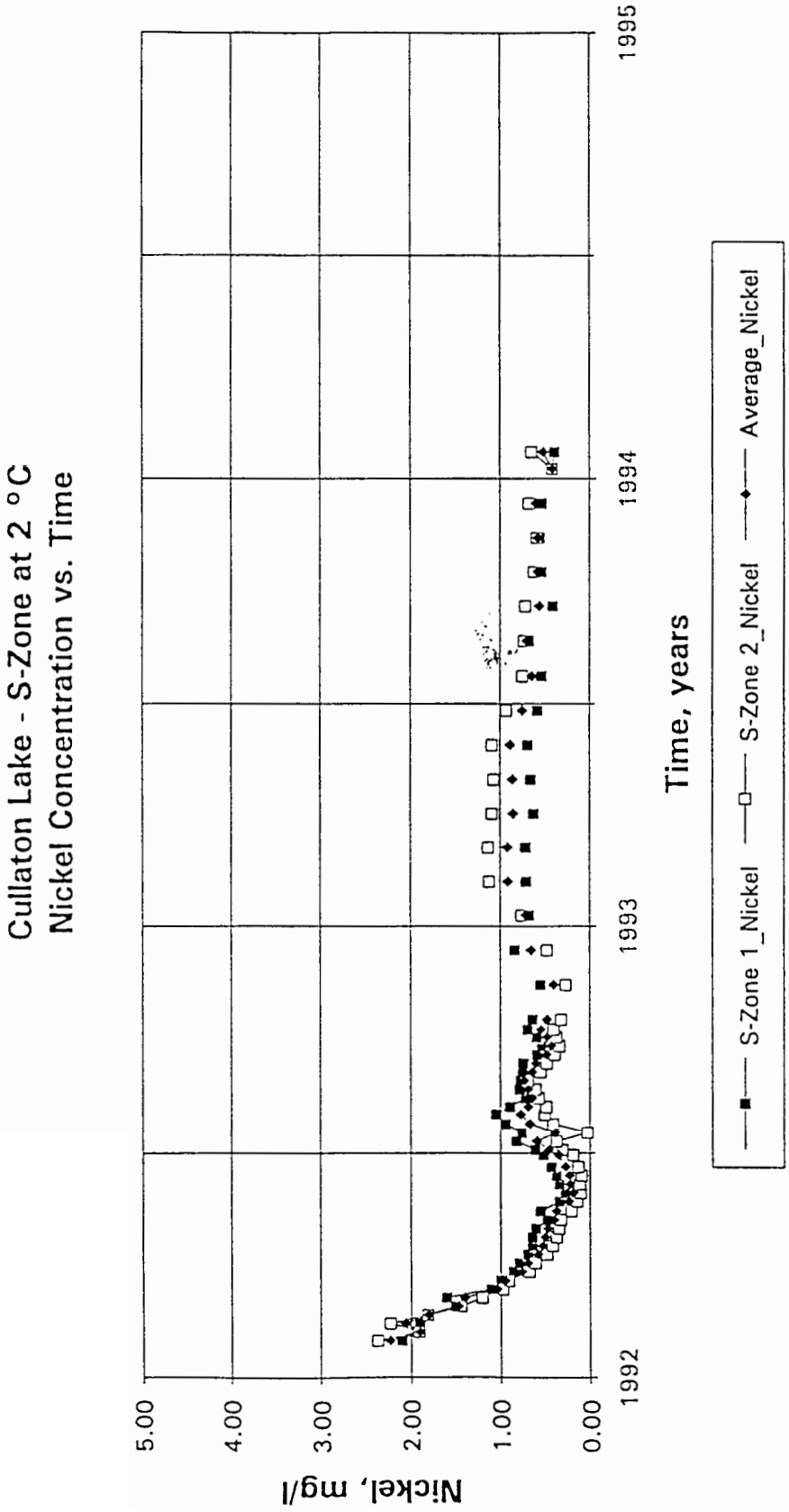


Fig. 48a S - Zone: effluent dissolved nickel concentration at 2 °C.

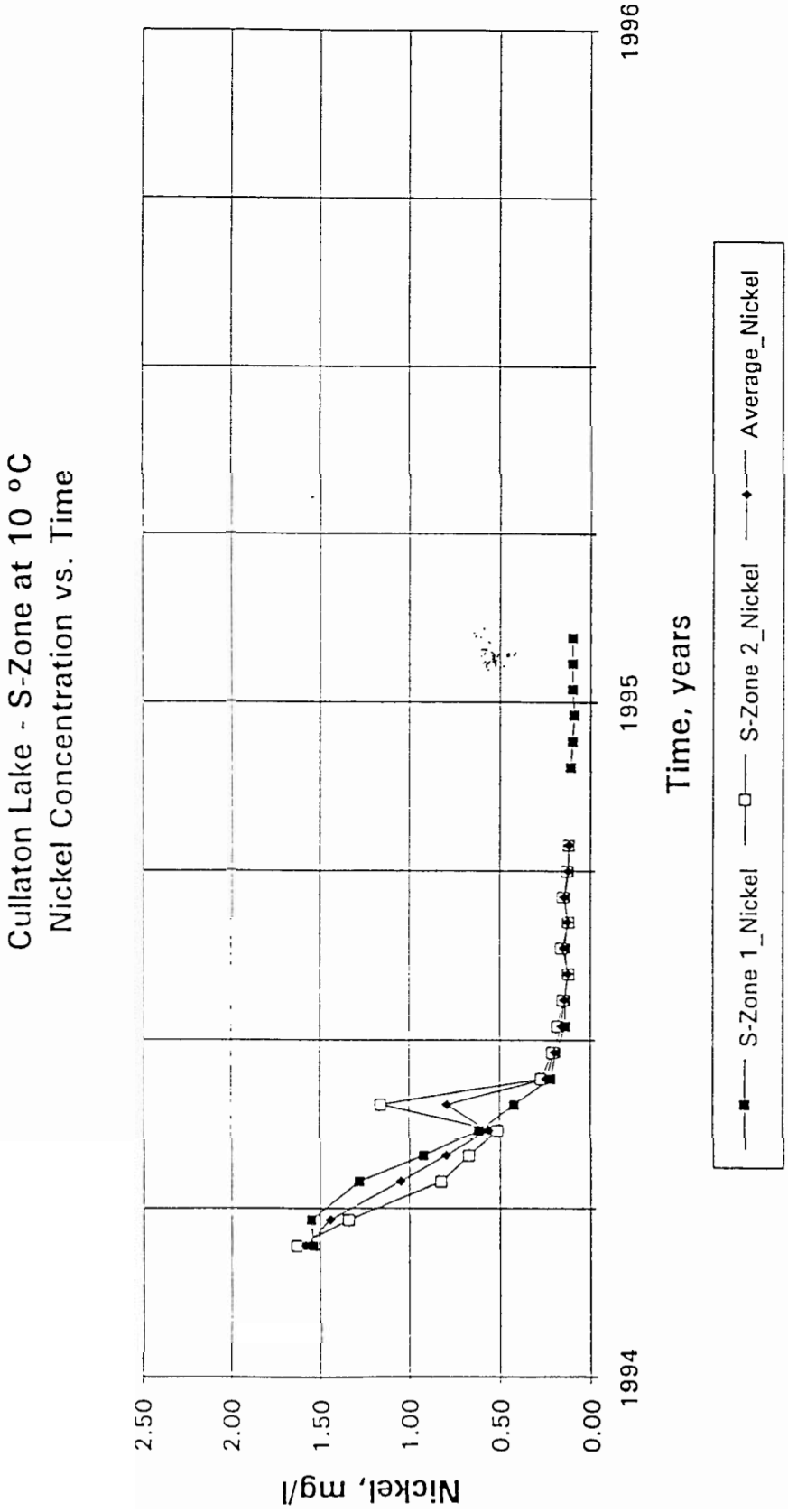


Fig. 48b S - Zone: effluent dissolved nickel concentration at 10 °C.

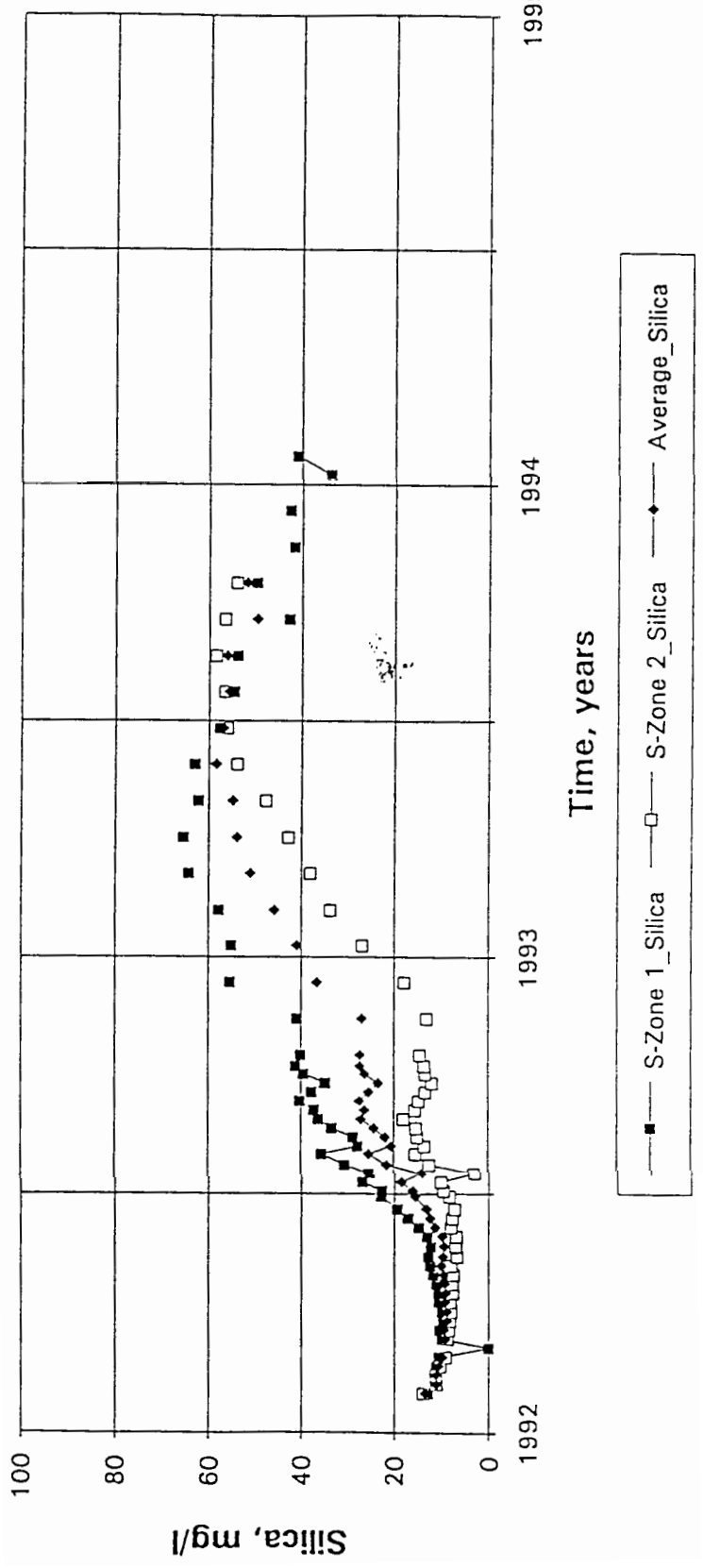


Fig. 49a S - Zone: effluent dissolved silica concentration at 2 °C.

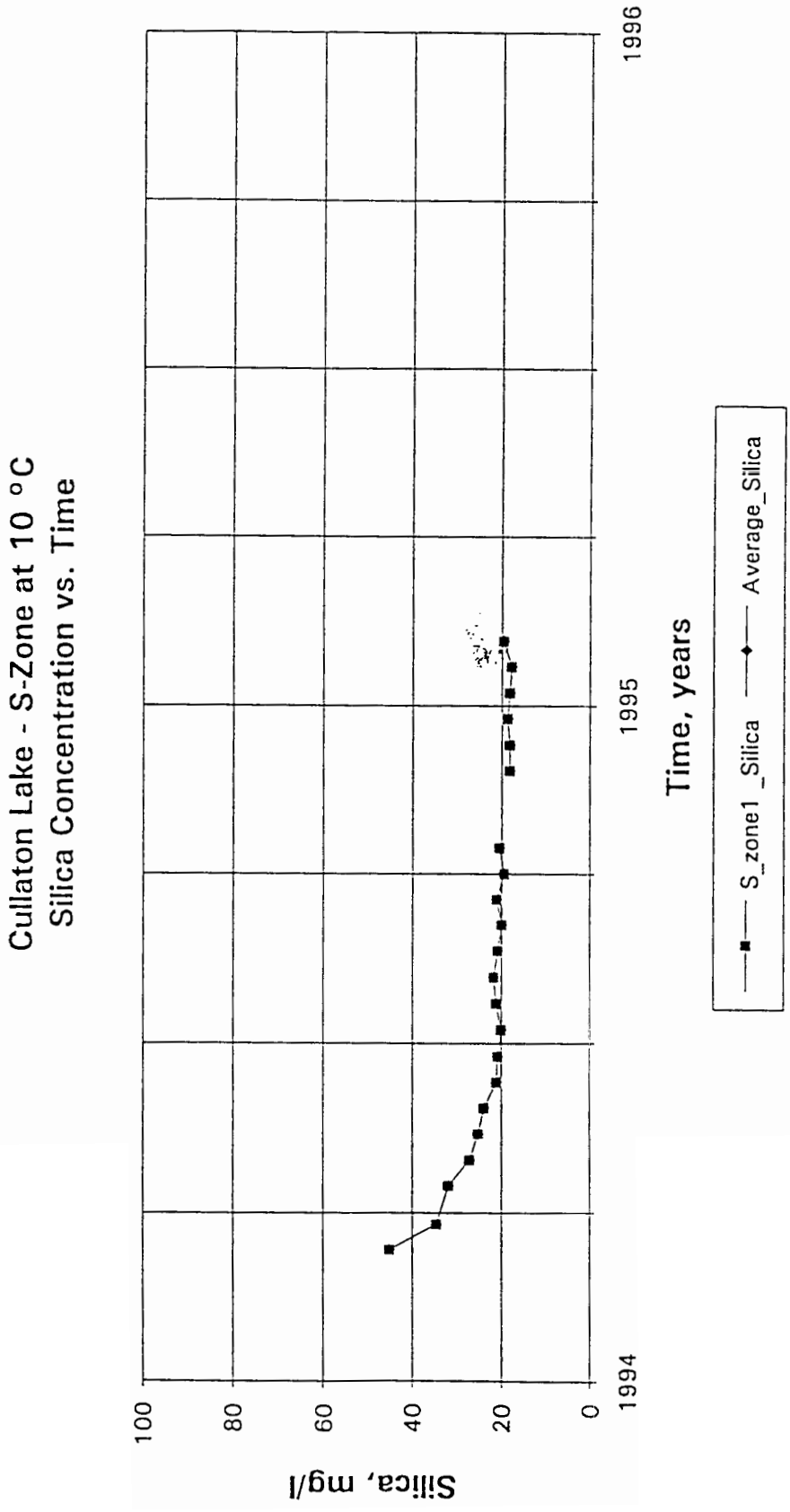


Fig. 49b S - Zone: effluent dissolved silica concentration at 10 °C.

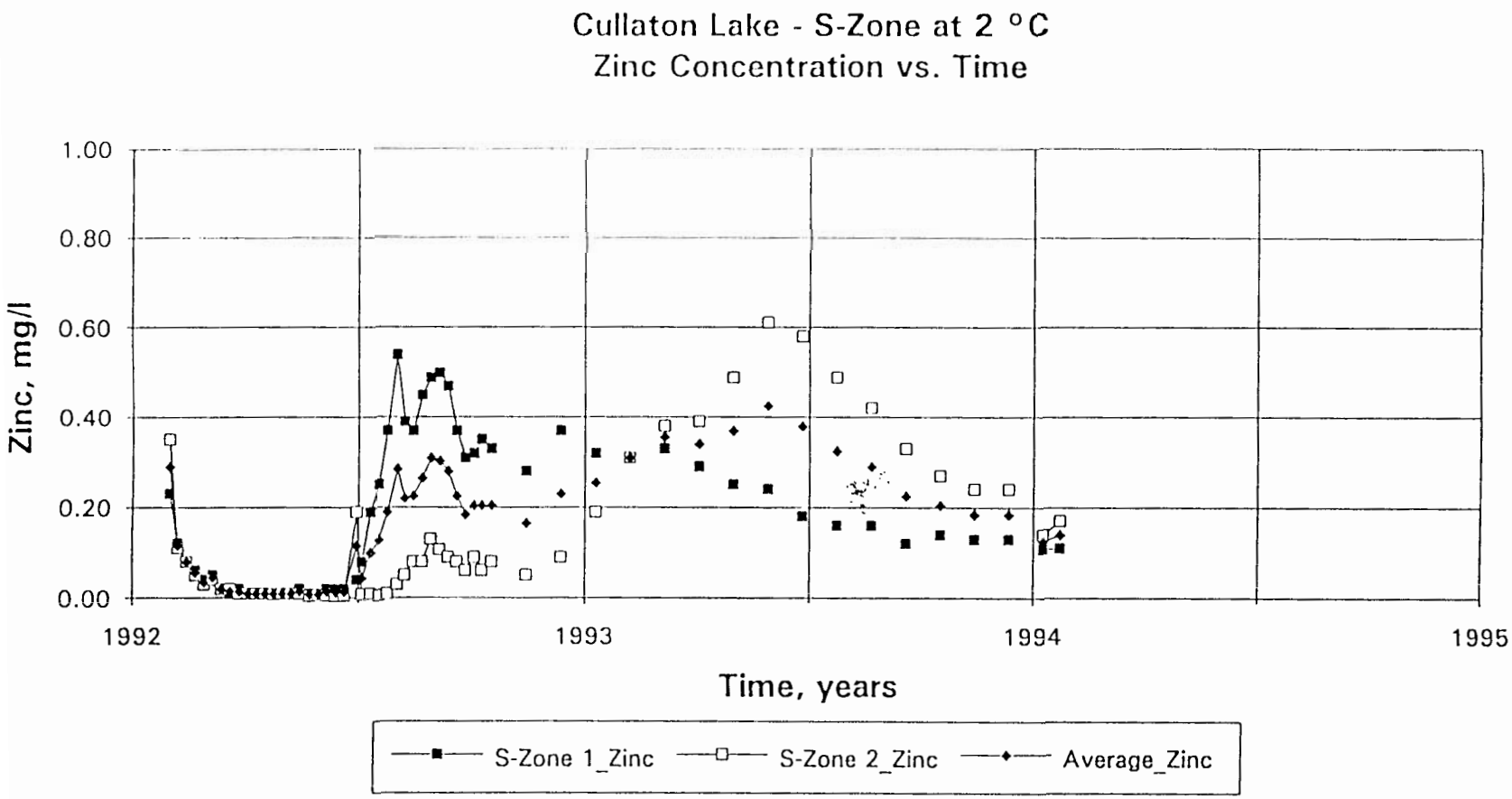


Fig. 50a S - Zone: effluent dissolved zinc concentration at 2 °C.

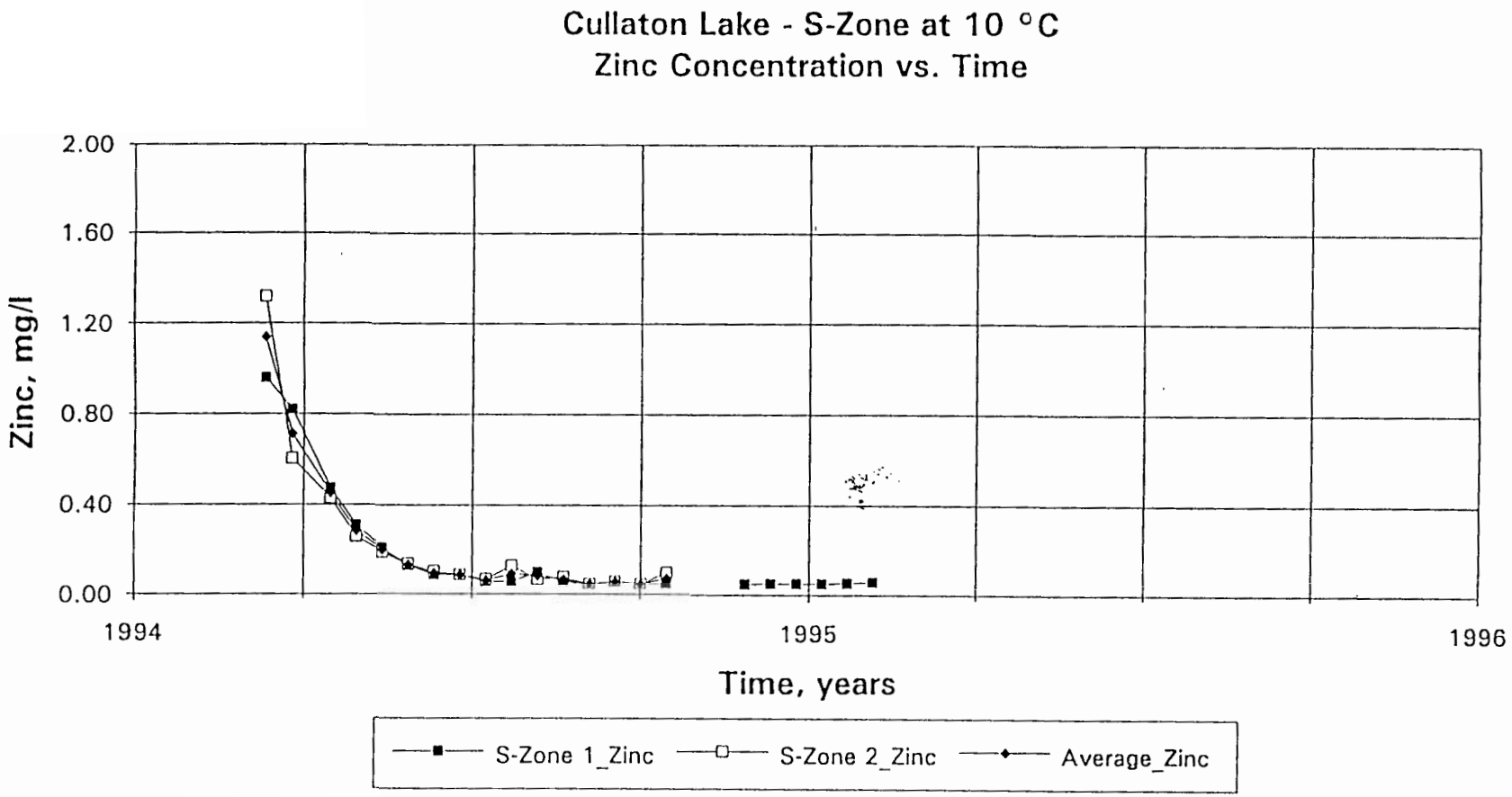


Fig. 50b S - Zone: effluent dissolved zinc concentration at 10 °C.

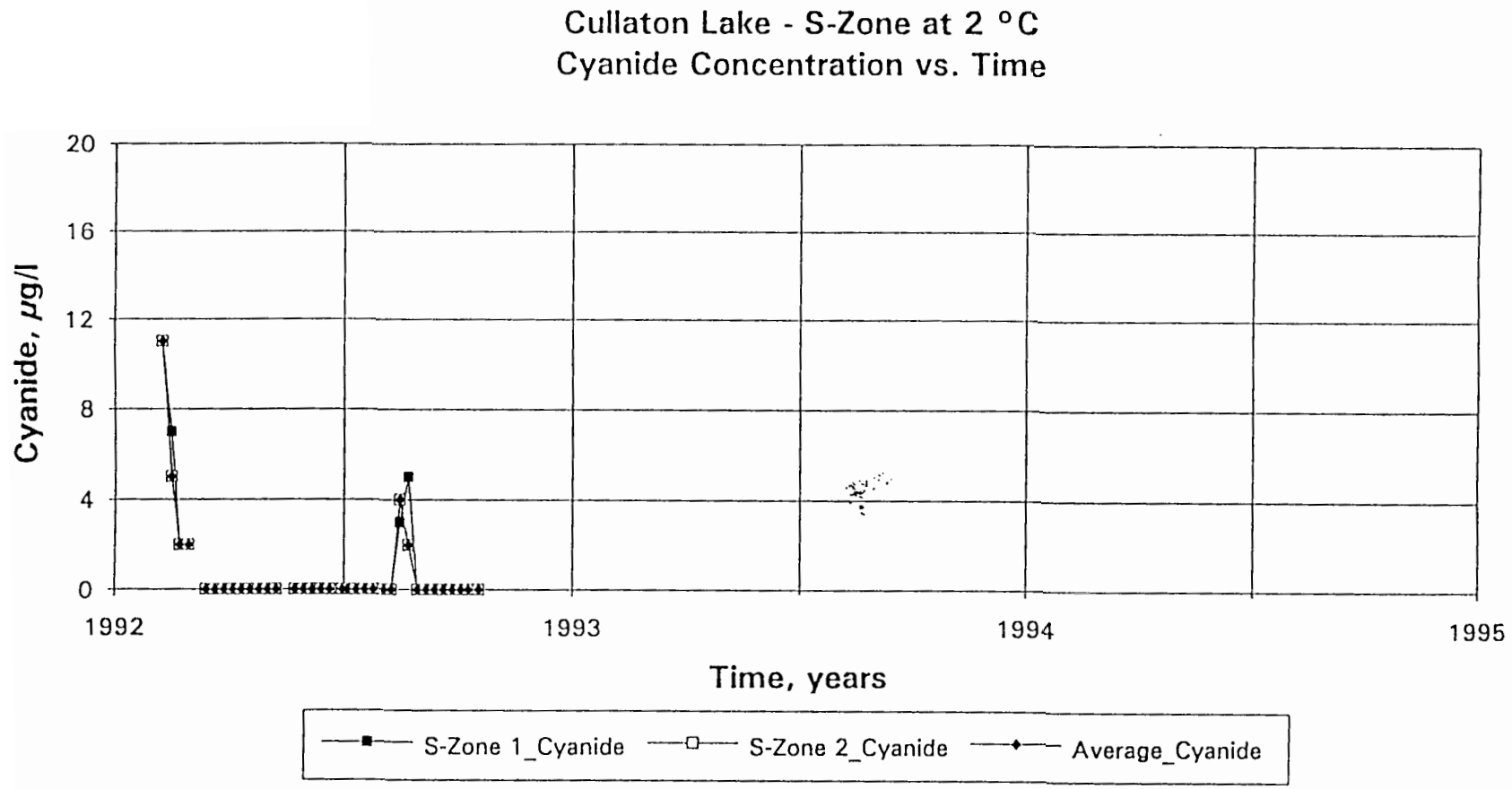


Fig. 51. S - Zone: effluent dissolved total cyanide concentration at 2 °C.

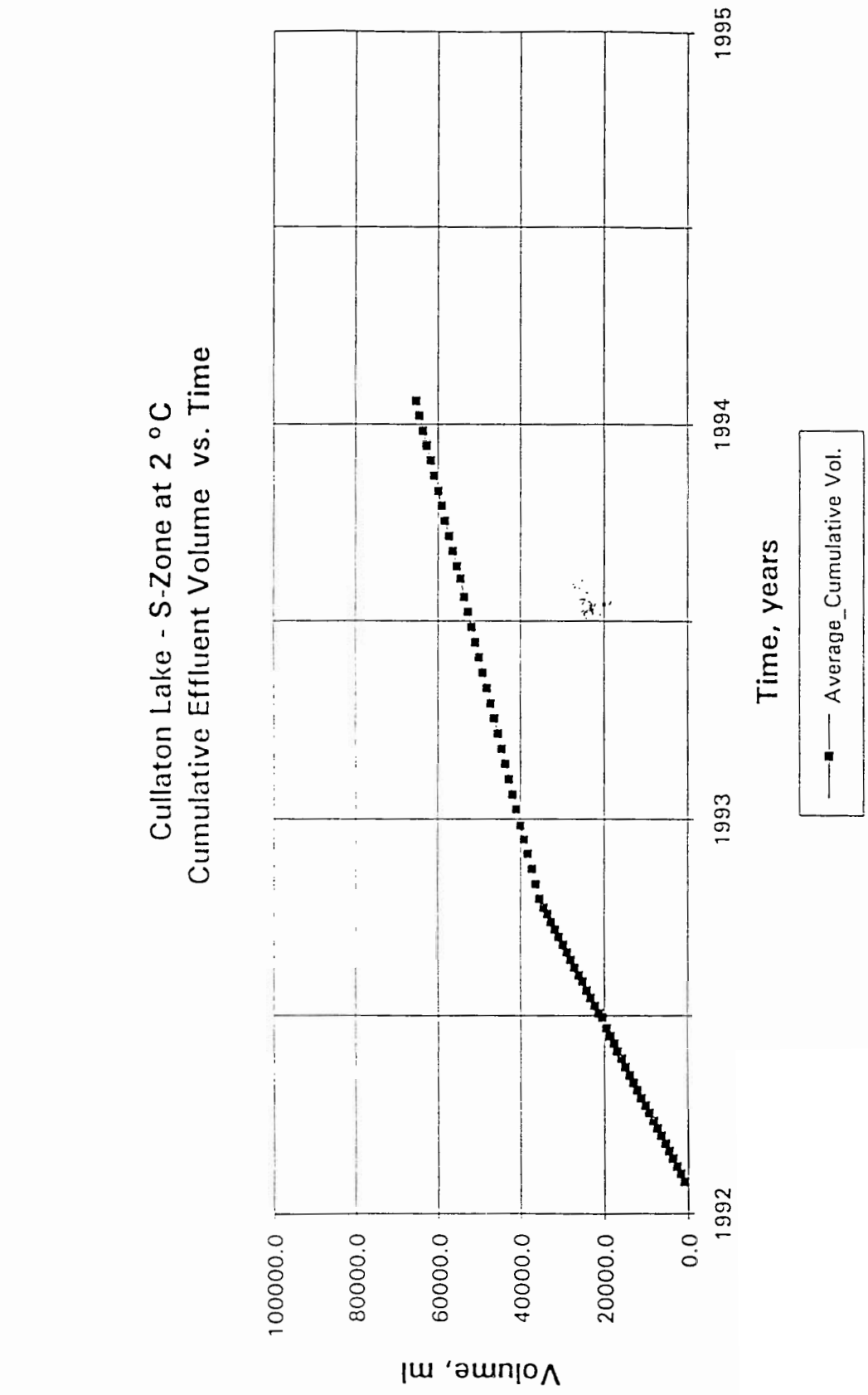


Fig. 52a S - Zone: total cumulative effluent volume at 2 °C.

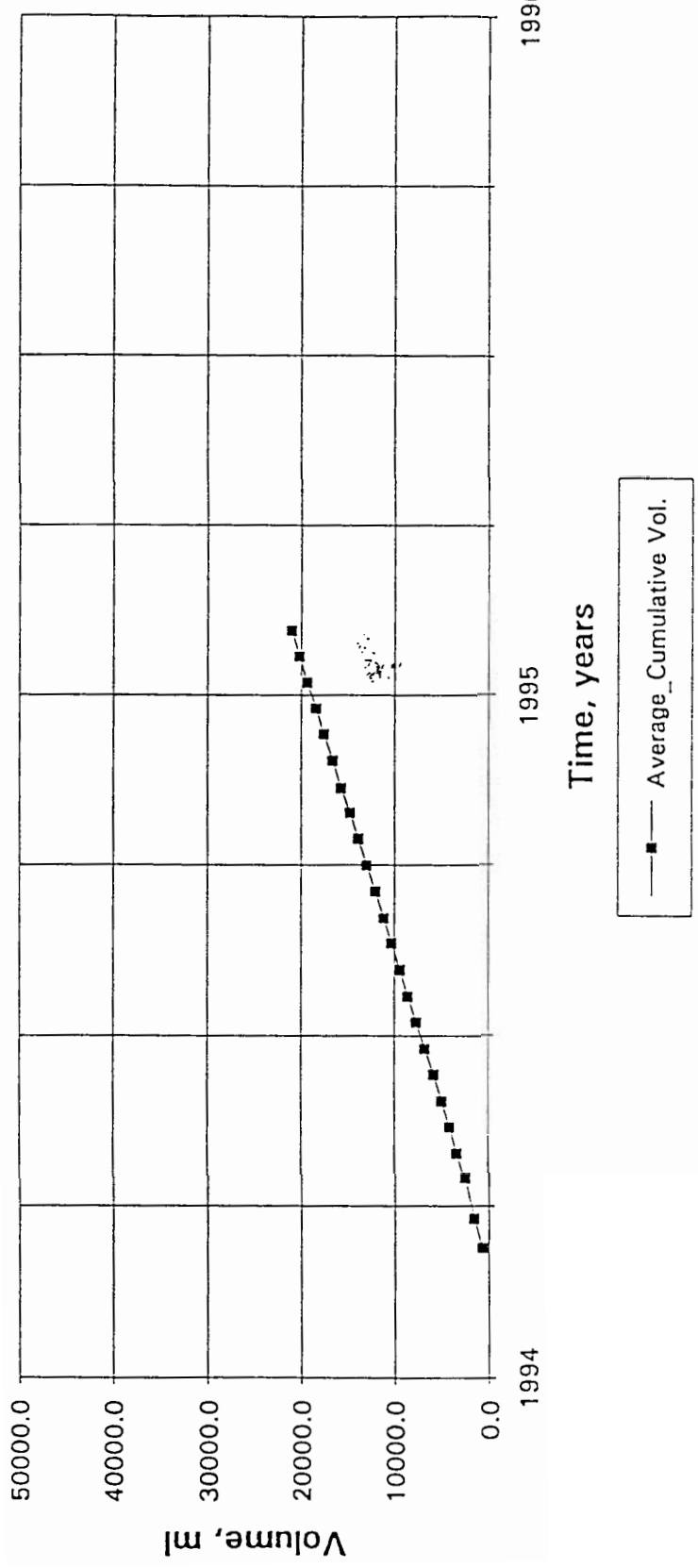
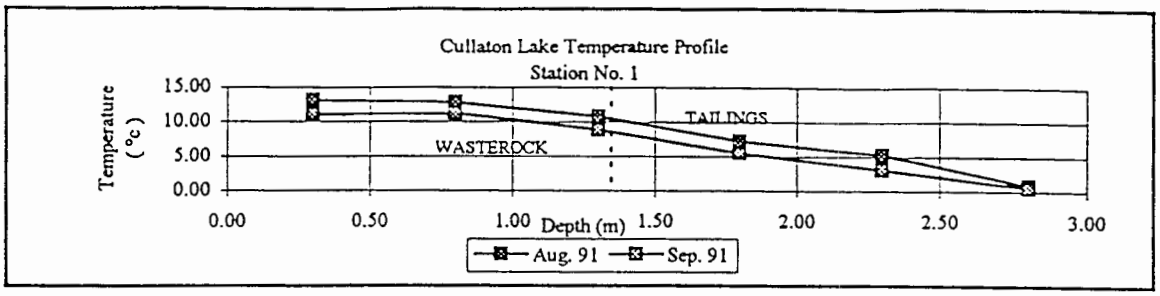
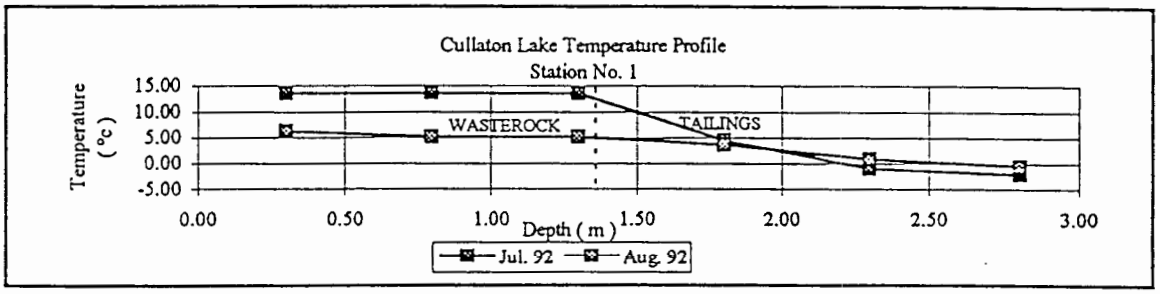
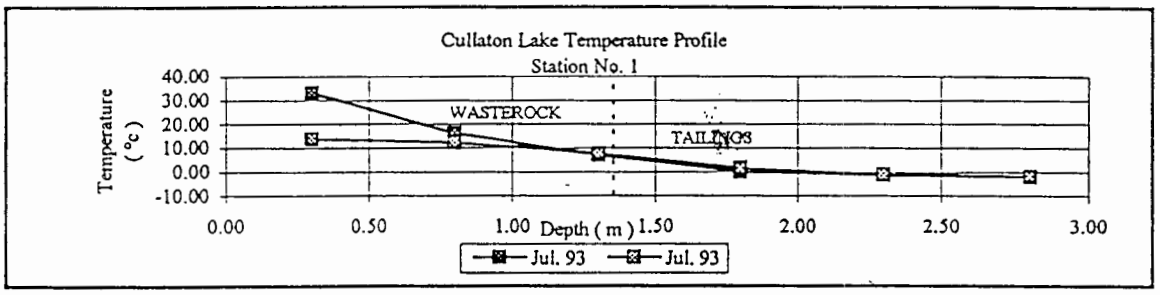
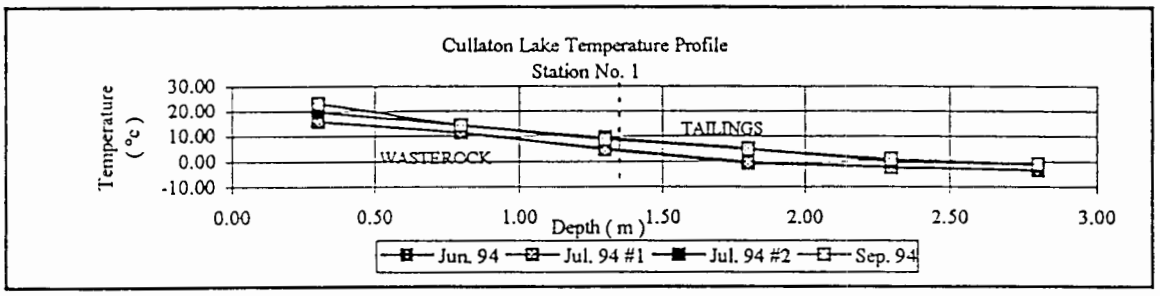


Fig. 52b S - Zone: total cumulative effluent volume at 10 °C









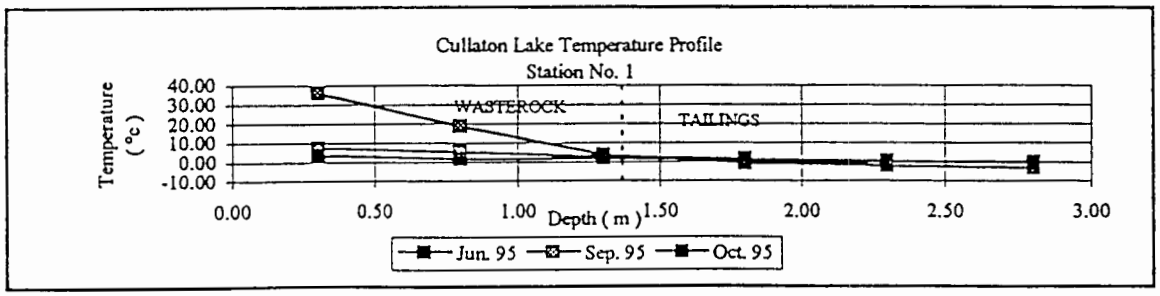
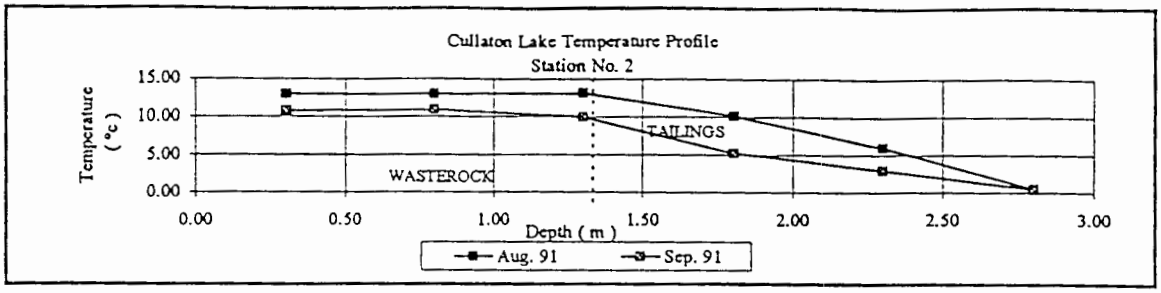
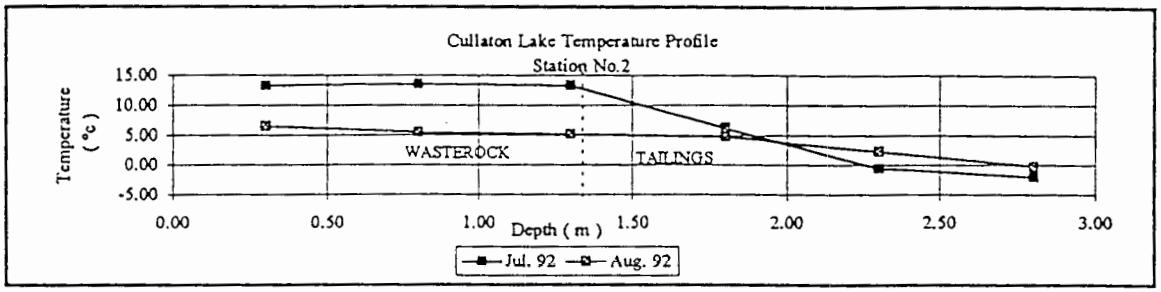
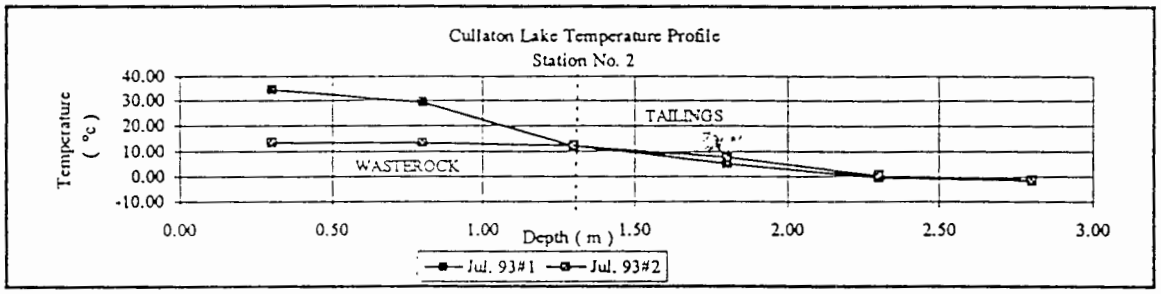
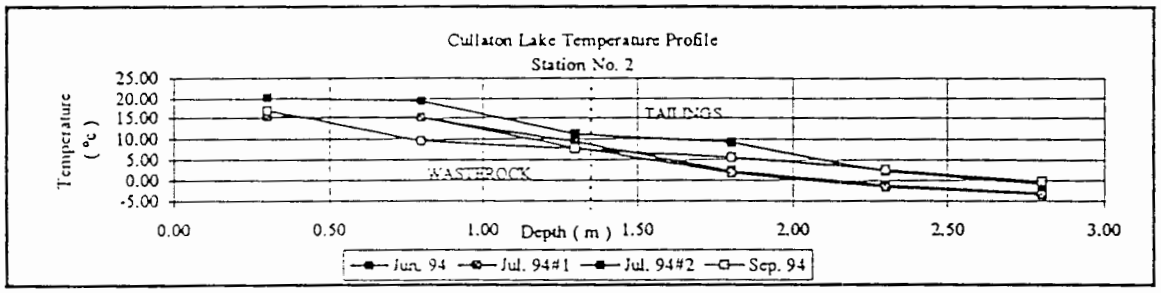


Fig. 53 Temperature profiles in wasterock and tailings at the Cullaton Lake site, Station 1.









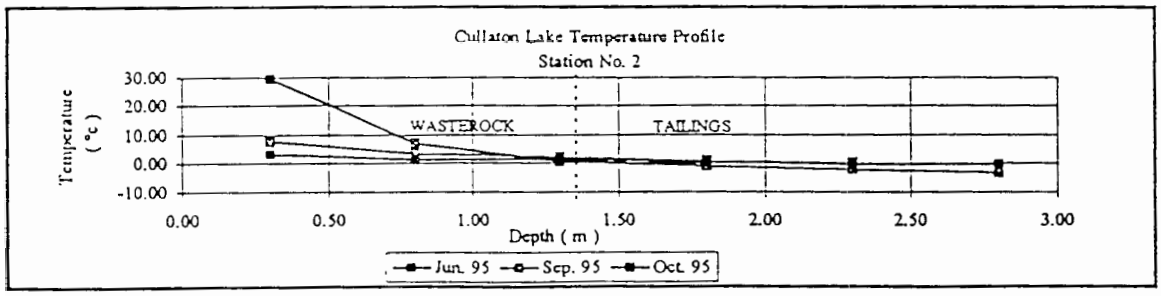
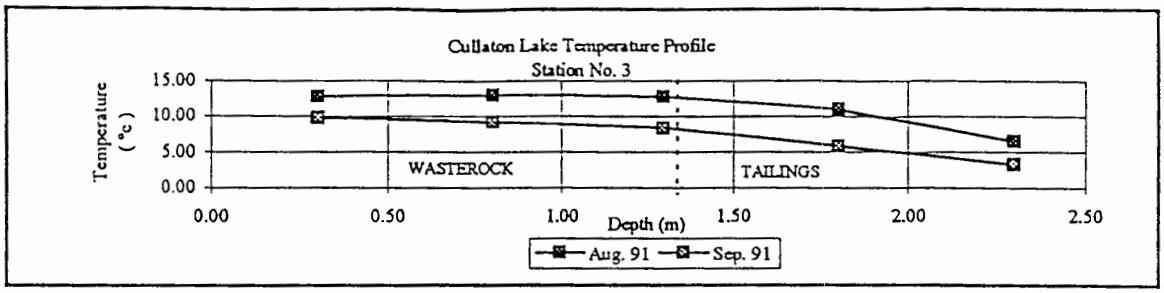
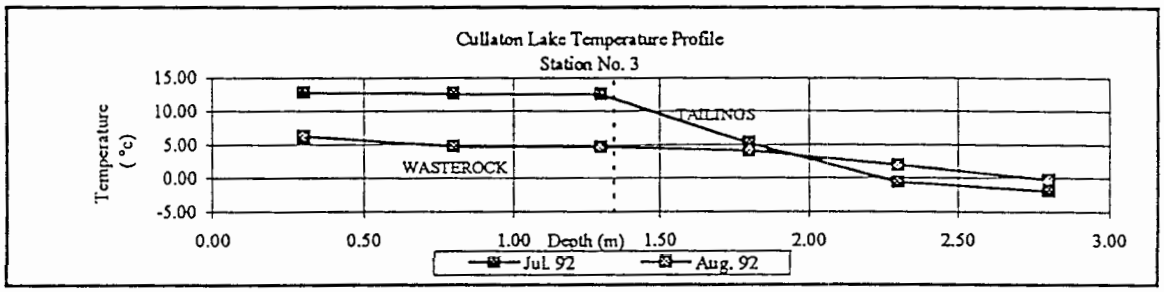
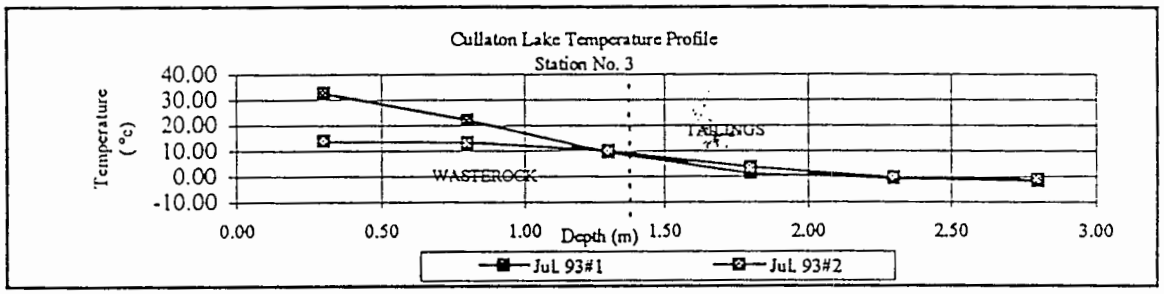
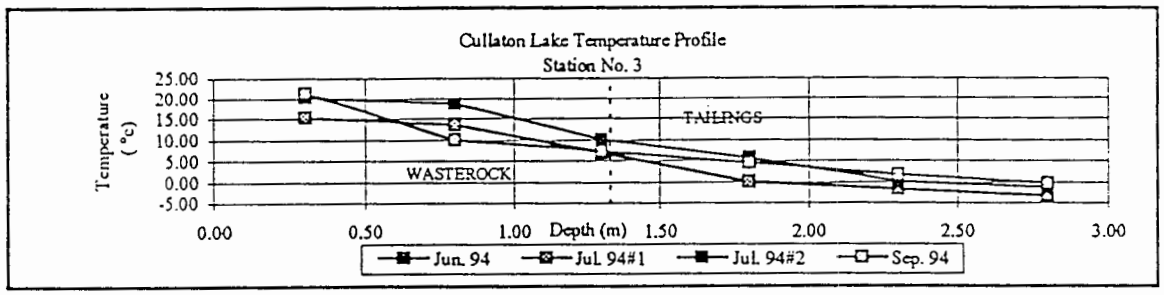


Fig. 54 Temperature profiles in wasterock and tailings at the Cullaton Lake site, Station 2.









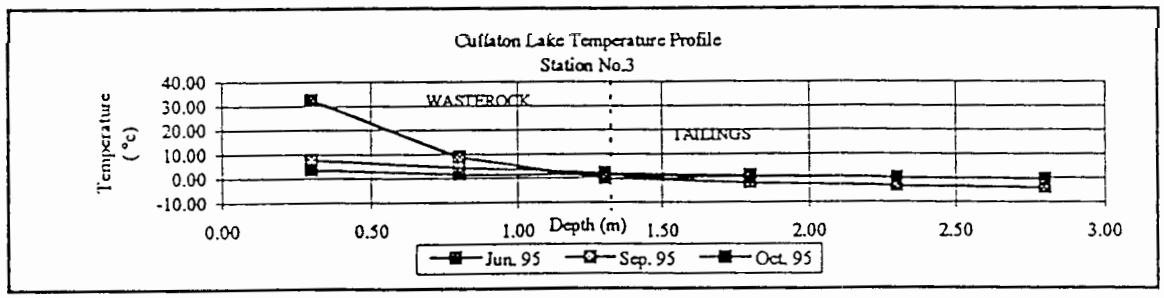
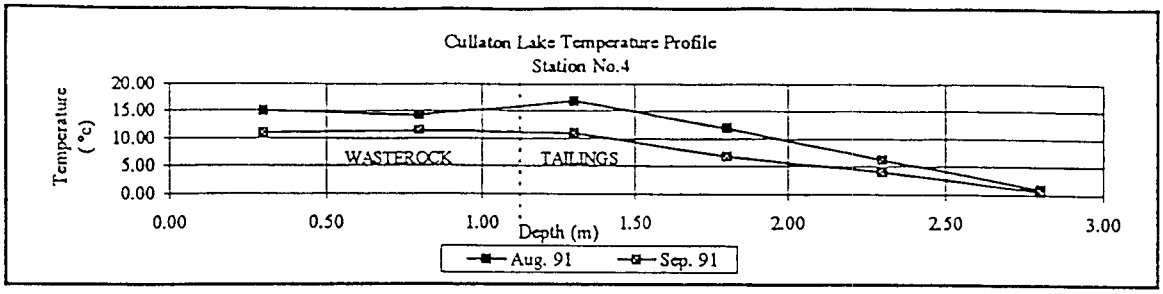
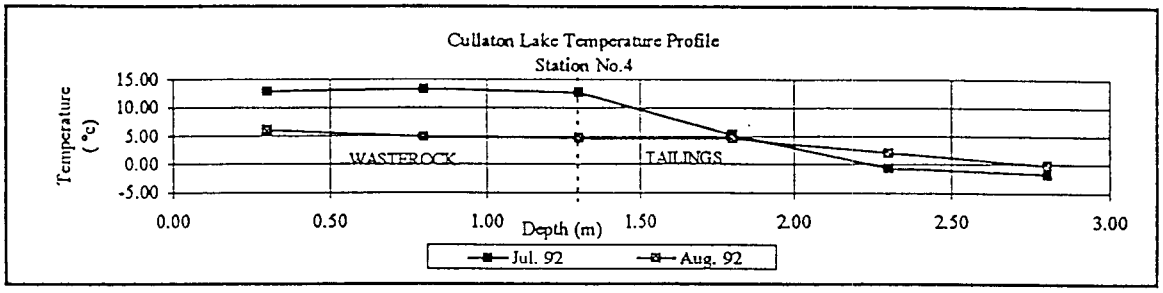
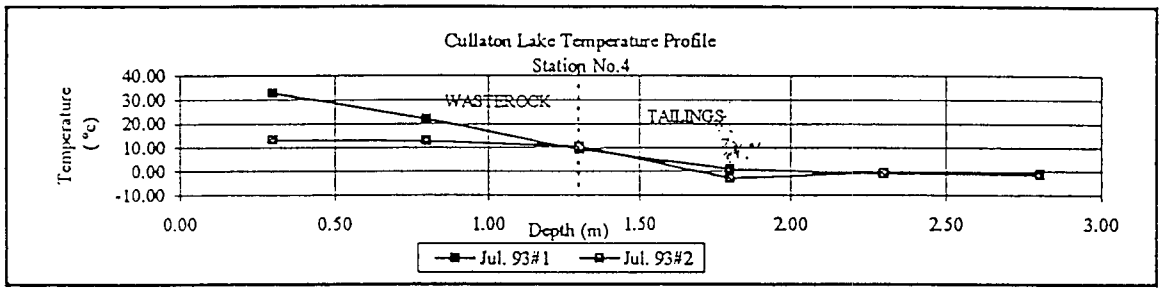
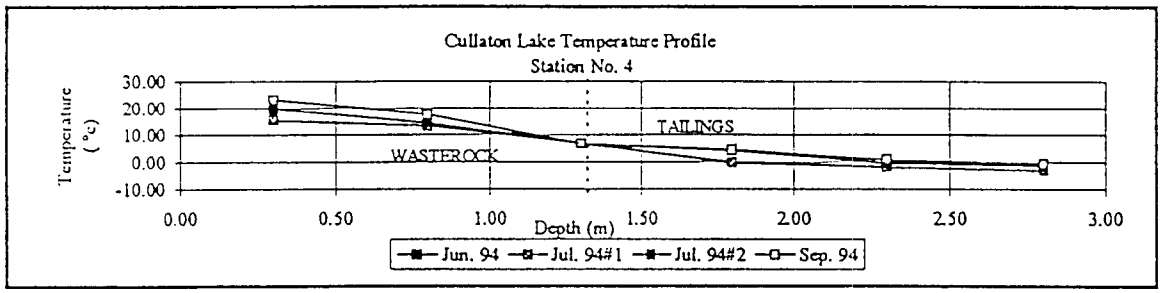


Fig. 55 Temperature profiles in wasterock and tailings at the Cullaton Lake site, Station 3.









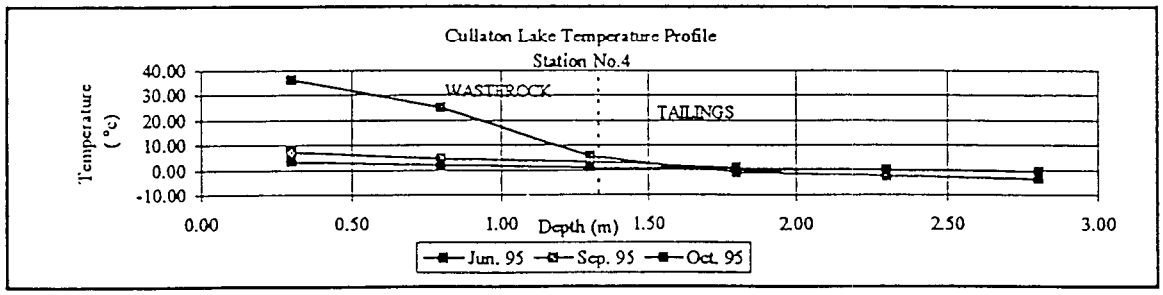


Fig. 56 Temperature profiles in wasterock and tailings at the Cullaton Lake site, Station 4.

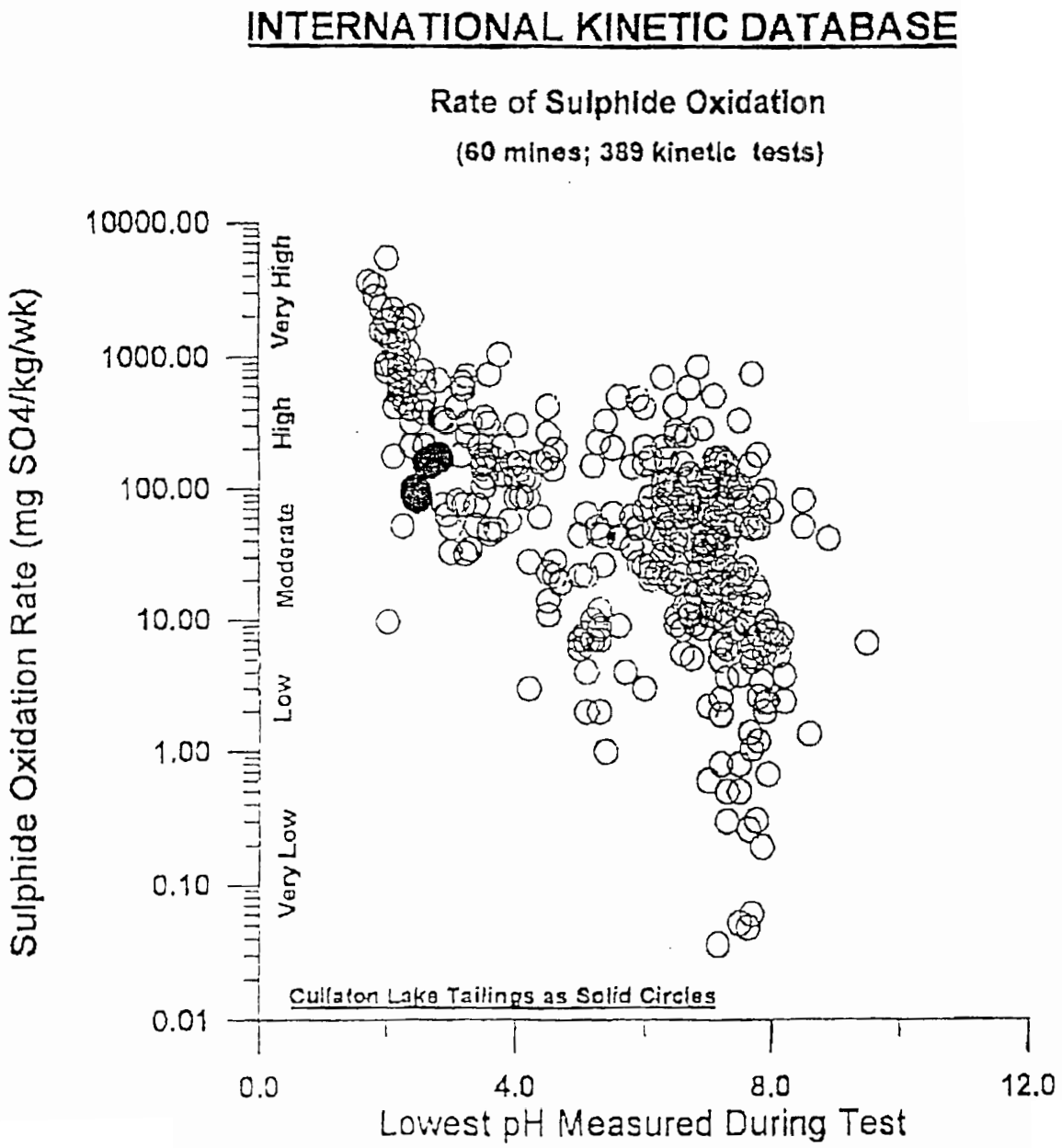


Fig. 57 International Kinetic Database: - rate of sulphide oxidation.

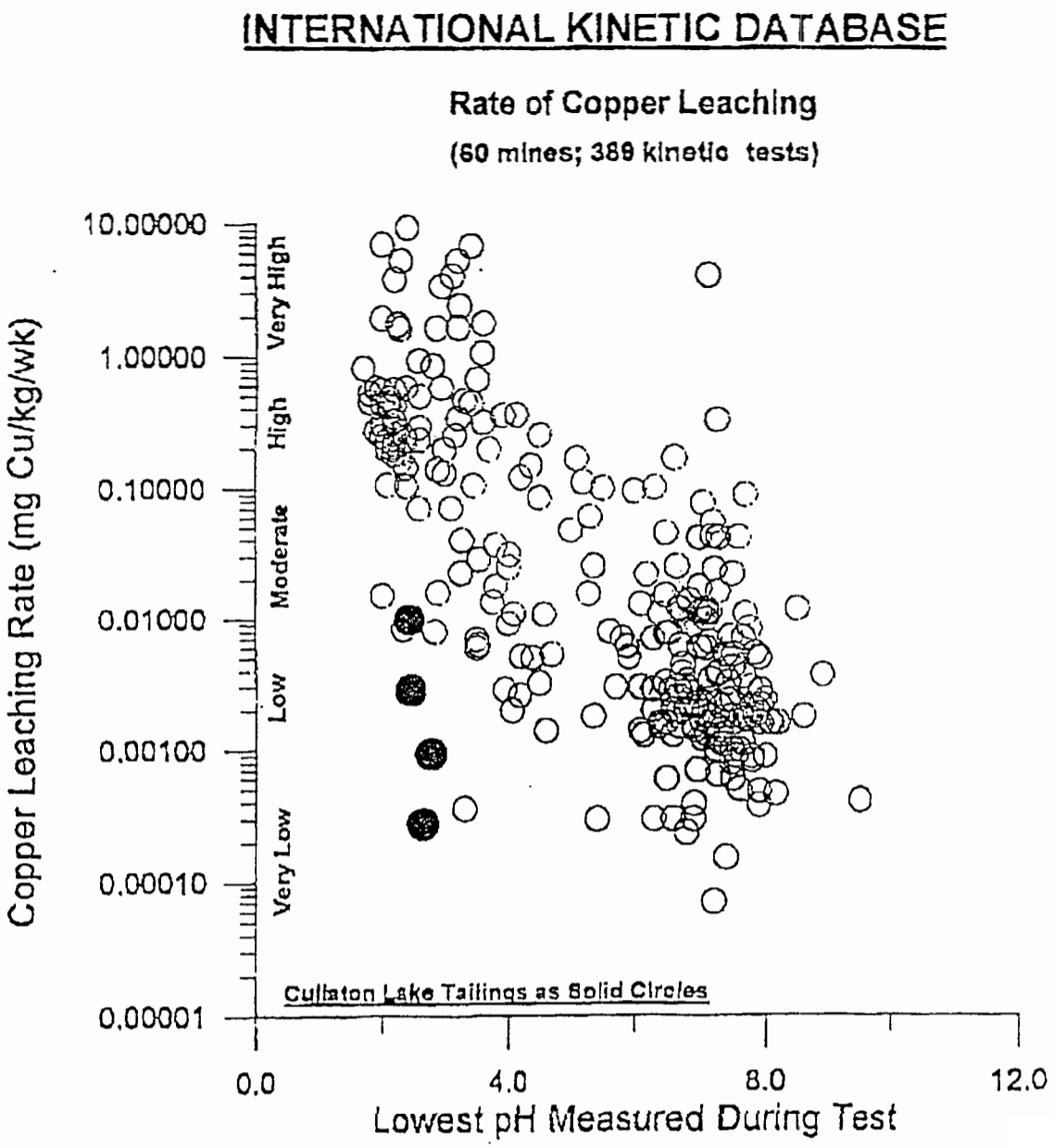


Fig. 58 International Kinetic Database: - rate of copper leaching.

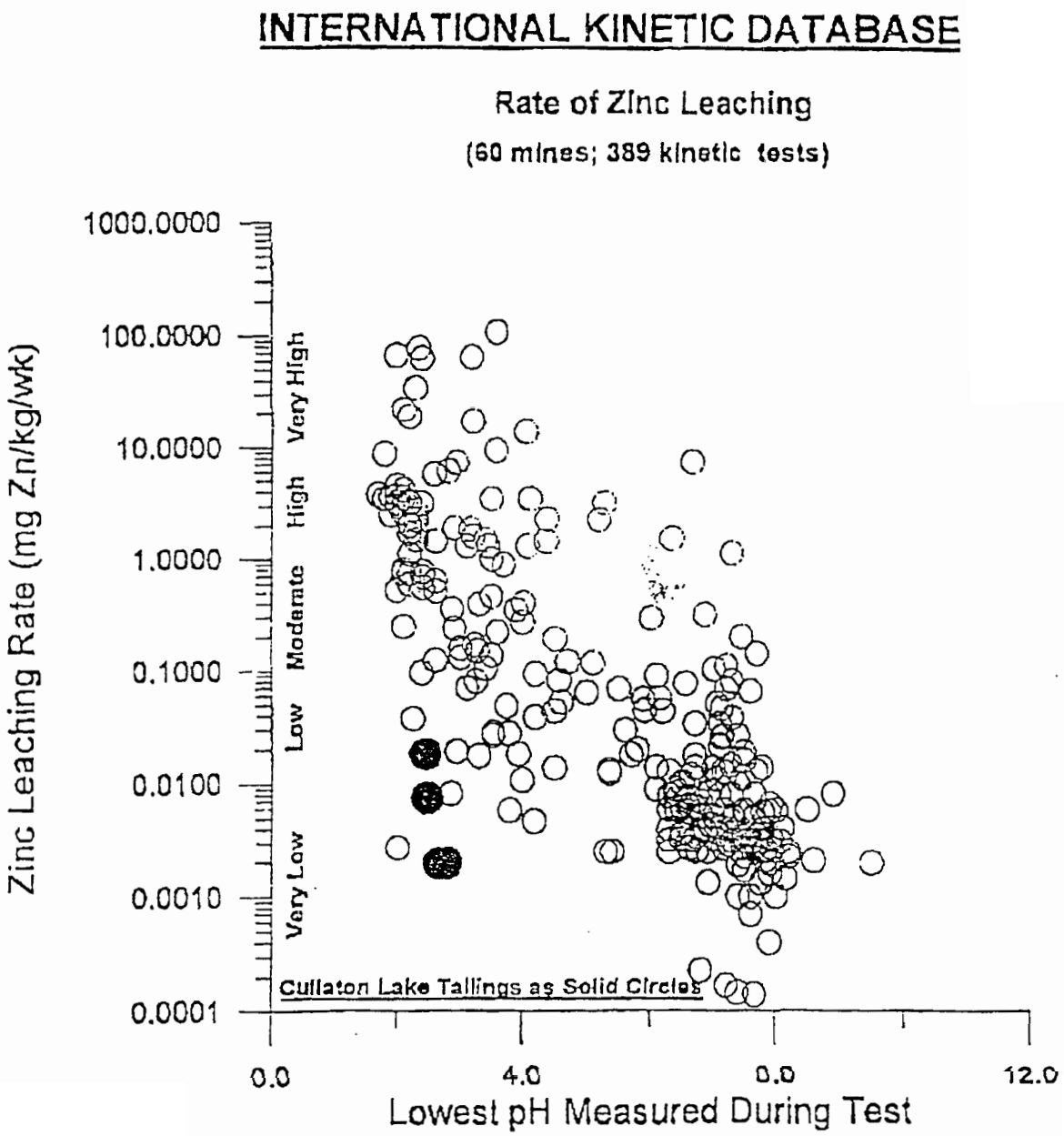


Fig. 59 International Kinetic Database: - rate of zinc leaching.

Tables

Table 1. Physical characteristics of B and Shear (S) - Zones tailings.

Parameter	**B - Zone**	**Shear (S) Zone**
Colour	Greenish grey	Brownish orange
Texture	sandy silt	sandy silt
Particle size	70% less than 100 μm	50% less than 100 μm
D_{50}	65 μm	100 μm
D_{10}	35 μm	45 μm
Moisture content (% wt)	9.3	9.5
Wet bulk density (tonne / m^3)	1.80	1.58
Grain density (tonne / m^3)	3.00	2.50
Porosity (%)	40	36.8
Wet mass of tailings in Column (kg)	9.7	9.7
Total bulk volume dry tailings (l)	4.89	5.56
Total pore volume dry tailings (l)	1.95	2.05
% pore volume moisture saturation	46	45

Table 2. Chemical characteristics of B and Shear (S) - Zones tailings. All concentration values are given in percentiles, except where noted.

Parameter / Element	**B - Zone**	**Shear (S) Zone**
Al (%)	1.62 ± 0.008	0.47 ± 0.003
Ba (μg/g)	83.6 ± 0.6	101.5 ± 0.8
Ca (%)	2.37 ± 0.032	0.09 ± 0.002
Cd (μg/g)	<10	<10
Co (μg/g)	<10	16.1 ± 0.52
Cr (μg/g)	36.4 ± 0.2	24.4 ± 0.2
Cu (μg/g)	45.4 ± 0.3	15.5 ± 0.3
Fe (%)	20.07 ± 0.085	2.96 ± 0.01
K (%)	0.305 ± 0.07	0.15 ± 0.025
Mg (%)	0.88 ± 0.006	0.057 ± 0.003
Mn (%)	0.09 ± 0.0003	0.01 ± 0.0001
Na (%)	0.14 ± 0.001	0.06 ± 0.002
Ni (μg/g)	60.6 ± 10.8	48.6 ± 1.1
Total phosphorus (% P)	0.06 ± 0.014	0.009 ± 0.006
Pb (μg/g)	65.8 ± 1.9	48.4 ± 0.9
Total sulphur (% S)	2.63 ± 0.32	0.49 ± 0.1
Soluble sulphur (as % S)	0.32 ± 0.01	0.09 ± 0.01
Total sulphide sulphur (as % S)	2.31 ± 0.33	0.4 ± 0.11
Ti (%)	0.069 ± 0.0008	0.012 ± 0.0002
V (μg/g)	58.6 ± 2.0	15.4 ± 0.4
Zn (μg/g)	45.7 ± 0.4	12.1 ± 0.1
Zr (μg/g)	53.1 ± 3.0	44.4 ± 1.2
Total acid generation potential, kg $CaCO_3$/tonne	72.2	12.5
Total alkalinity, kg $CaCO_3$/tonne	45.36	12.5
Net neutralization potential, kg $CaCO_3$/tonne	-26.84	-10.5

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Days From Start	VOLUME (ml) CBZ1	VOLUME (ml) CBZ2	VOLUME (ml) AVERAGE	CUMULATIVE VOLUME (ml)	LAB. pH pH(LAB) CBZ1 COLD TEMP.	LAB. pH pH(LAB) CBZ1 ROOM TEMP.	LAB. pH pH(LAB) CBZ2 COLD TEMP.	LAB. pH pH(LAB) CBZ2 ROOM TEMP.
30-Jan-92	0	927.4	958.5	943.0	943.0	7.93		7.92	
6-Feb-92	7	927.4	958.5	943.0	1886.0	7.41		7.49	
13-Feb-92	14	927.4	958.5	943.0	2829.0	7.00		7.61	
20-Feb-92	21	927.4	958.5	943.0	3772.0	7.04		7.43	
27-Feb-92	28	927.4	958.5	943.0	4715.0	7.31		7.36	
5-Mar-92	35	927.4	958.5	943.0	5658.0	7.18		7.43	
12-Mar-92	42	927.4	958.5	943.0	6601.0	7.16		7.20	
19-Mar-92	49	927.4	958.5	943.0	7544.0	6.97		7.22	
26-Mar-92	56	927.4	958.5	943.0	8486.9	7.03		7.22	
2-Apr-92	63	966.3	1091.1	1028.7	9515.6	6.60	7.59	7.30	7.64
9-Apr-92	70	971.0	974.5	972.7	10488.3	6.49	7.23	7.04	7.38
16-Apr-92	77	973.1	962.3	967.7	11456.0	6.75	7.48	7.18	8.00
23-Apr-92	84	973.2	837.2	905.2	12361.2	6.98	7.03	6.69	7.35
30-Apr-92	91	969.8	1092.8	1031.3	13392.5	6.98	7.07	7.12	7.16
7-May-92	98	952.0	905.7	928.9	14321.4	6.91	7.14	7.04	7.43
14-May-92	105	1011.3	993.4	1002.4	15323.8	6.74	6.78	6.68	6.72
22-May-92	113	982.3	901.4	941.8	16265.6	6.86	7.01	6.84	6.66
29-May-92	120	983.7	903.6	943.6	17209.2	6.61	6.82	6.68	6.89
5-Jun-92	127	946.2	833.6	889.9	18099.1	6.63	6.63	6.68	6.69
12-Jun-92	134	964.8	937.7	951.3	19050.4	6.63	6.71	6.72	6.65
19-Jun-92	141	435.7	1069.3	752.5	19802.9	6.58	6.77	6.78	7.00
29-Jun-92	151	993.4	797.4	895.4	20698.3	6.45	6.75	6.71	6.96
3-Jul-92	155	933.2	1073.7	1003.5	21701.7	6.40	6.67	6.51	6.72
10-Jul-92	162	960.4	824.6	892.5	22594.2	6.56	6.72	6.47	6.62
17-Jul-92	169	946.7	941.9	944.3	23538.5	6.73	6.75	6.69	6.72
24-Jul-92	176	941.8	1107.4	1024.6	24563.1	6.63	6.61	6.61	6.55

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Days From Start	VOLUME (ml) CBZ1	VOLUME (ml) CBZ2	VOLUME (ml) AVERAGE	CUMULATIVE VOLUME (ml)	LAB. pH pH(LAB) CBZ1 COLD TEMP.	LAB. pH pH(LAB) CBZ1 ROOM TEMP.	LAB. pH pH(LAB) CBZ2 COLD TEMP.	LAB. pH pH(LAB) CBZ2 ROOM TEMP.
1-Aug-92	184	909.2	850.8	880.0	25443.1	6.75	6.72	6.54	6.78
7-Aug-92	190	931.8	1065.3	998.6	26441.6	6.65	6.73	6.70	6.67
14-Aug-92	197	923.9	919.9	921.9	27363.5	6.77	6.60	6.84	6.67
21-Aug-92	204	925.0	884.9	905.0	28268.5	6.80	6.52	6.48	6.62
28-Aug-92	211	936.4	844.2	890.3	29158.8	6.19	6.99	6.59	6.59
4-Sep-92	218	931.4	975.7	953.5	30112.3	6.75	6.72	6.65	6.59
11-Sep-92	225	937.3	852.2	894.8	31007.1	6.74	6.32	6.78	6.59
18-Sep-92	232	953.9	944.6	949.3	31956.3	6.61	6.51	6.68	6.57
25-Sep-92	239	832.0	916.4	874.2	32830.5	6.80	6.53	6.83	6.56
2-Oct-92	246	962.0	965.0	963.5	33794.0	6.53	6.57	6.71	6.60
8-Oct-92	252	951.6	985.8	968.7	34762.6	6.39	6.60	6.55	6.52
16-Oct-92	260	955.8	1008.3	982.1	35744.7	6.53	6.40	6.55	6.61
30-Oct-92	274	955.9	812.3	884.1	36628.8	6.64	7.11	6.85	7.28
13-Nov-92	288	929.5	1035.4	982.5	37611.2	6.96	6.59	7.06	6.88
27-Nov-92	302	936.7	912.3	924.5	38535.7	6.94	6.78	6.78	6.67
11-Dec-92	316	945.7	930.7	938.2	39473.9	6.97	6.70	7.09	6.93
24-Dec-92	329	909.1	896.4	902.8	40376.7	6.69	6.70	6.91	6.88
8-Jan-93	344	933.5	929.9	931.7	41308.4	6.34	7.10	6.90	6.79
22-Jan-93	358	905.7	896.9	901.3	42209.7	6.88	7.09	7.04	7.36
5-Feb-93	372	874.6	855.7	865.2	43074.8	6.98	7.20	6.94	7.28
19-Feb-93	386	920.4	920.7	920.6	43995.4	6.93	7.29	6.86	7.15
5-Mar-93	400	902.3	818.8	860.5	44855.9	6.82	7.07	6.82	6.90
19-Mar-93	414	908.5	889.7	899.1	45755.0	7.16	7.17	7.22	7.61
2-Apr-93	428	894.5	891.7	893.1	46648.1	6.89	6.94	6.74	6.69
16-Apr-93	442	930.6	970.3	950.5	47598.6	6.41	6.90	6.62	6.68
30-Apr-93	456	960.6	906.6	933.6	48532.2	6.19	6.75	6.64	6.48

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Days From Start	VOLUME (ml) CBZ1	VOLUME (ml) CBZ2	VOLUME (ml) AVERAGE	CUMULATIVE VOLUME (ml)	LAB. pH pH(LAB) CBZ1 COLD TEMP.	LAB. pH pH(LAB) CBZ1 ROOM TEMP.	LAB. pH pH(LAB) CBZ2 COLD TEMP.	LAB. pH pH(LAB) CBZ2 ROOM TEMP.
14-May-93	470	926.2	913.3	919.8	49451.9	6.01	6.72	6.31	6.44
28-May-93	484	939.5	954.0	946.8	50398.7	6.07	6.73	6.23	6.38
11-Jun-93	498	947.7	917.0	932.3	51331.0	6.39	6.67	6.24	6.39
25-Jun-93	512	987.2	913.7	950.5	52281.5	6.35	6.77	5.77	6.26
9-Jul-93	526	928.6	945.6	937.1	53218.6	6.24	6.63	6.35	6.28
23-Jul-93	540	932.4	911.0	921.7	54140.3	6.00	6.43	5.91	6.50
9-Aug-93	557	939.2	939.1	939.1	55079.4	5.51	6.19	6.11	6.21
20-Aug-93	568	947.3	916.6	931.9	56011.3	6.39	6.82	6.49	6.34
3-Sep-93	582	976.8	974.1	975.5	56986.8	6.05	6.92	6.05	6.56
17-Sep-93	596	934.6	870.2	902.4	57889.2	6.81	6.80	6.57	6.54
1-Oct-93	610	945.8	962.3	954.1	58843.3	6.05	6.58	6.11	6.58
15-Oct-93	624	907.7	741.5	824.6	59667.9	6.00	6.07	6.02	5.83
29-Oct-93	638	935.3	868.5	901.9	60569.7	6.44	6.35	6.98	6.74
12-Nov-93	652	962.1	982.7	972.4	61542.1	6.27	6.43	6.25	6.22
26-Nov-93	666	889.7	669.7	779.7	62321.8	6.62	6.67	6.56	6.45
10-Dec-93	680	988.2	1113.8	1051.0	63372.8	6.21	6.57	6.00	6.60
24-Dec-93	694	821.3	935.7	878.5	64251.3	6.06	6.52	6.37	6.17
7-Jan-94	708	931.8	793.8	862.8	65114.1	6.24	6.89	6.60	6.64
21-Jan-94	722	840.8	733.7	787.2	65901.3	6.58	6.73	6.53	6.63

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. pH pH(LAB) AVERAGE COLD TEMP.	LAB. pH pH(LAB) AVERAGE ROOM TEMP.	EH Eh(mV) CBZ1 COLD TEMP.	EH Eh(mV) CBZ1 ROOM TEMP.	EH Eh(mV) CBZ2 COLD TEMP.	EH Eh(mV) CBZ2 ROOM TEMP.	EH Eh(mV) AVERAGE COLD TEMP.	EH Eh(mV) AVERAGE ROOM TEMP.	EH(NHE) (mV) CBZ1 COLD TEMP.
30-Jan-92	7.92		202.2		163.7		183.0		446.2
6-Feb-92	7.45		150.0		154.2		152.1		394.0
13-Feb-92	7.21		178.5		170.4		174.5		422.5
20-Feb-92	7.20		182.2		177.7		180.0		426.2
27-Feb-92	7.33		203.5		167.3		185.4		447.5
5-Mar-92	7.29		196.9		188.5		192.7		440.9
12-Mar-92	7.18		200.6		198.5		199.6		444.6
19-Mar-92	7.08		249.7		221.7		235.7		493.7
26-Mar-92	7.11		238.2		219.9		229.1		482.2
2-Apr-92	6.84	7.61	235.8	177.4	223.1	120.1	229.5	148.8	479.8
9-Apr-92	6.68	7.30	130.1	179.0	142.7	93.0	136.4	136.0	374.1
16-Apr-92	6.92	7.66	135.4	111.2	143.4	143.2	139.4	127.2	379.4
23-Apr-92	6.82	7.15	269.4	218.7	277.5	181.8	273.5	200.3	513.4
30-Apr-92	7.05	7.11	287.6	220.0	286.4	210.0	287.0	215.0	531.6
7-May-92	6.97	7.26	328.5	222.4	321.6	226.5	325.1	224.5	572.5
14-May-92	6.71	6.75	235.5	212.7	249.8	215.3	242.7	214.0	479.5
22-May-92	6.85	6.81	220.4	217.4	256.9	210.5	238.7	214.0	464.4
29-May-92	6.64	6.85	204.6	228.3	222.7	214.0	213.7	221.2	448.6
5-Jun-92	6.65	6.66	224.2	202.9	215.4	202.2	219.8	202.6	468.2
12-Jun-92	6.67	6.68	191.5	204.2	190.0	193.9	190.8	199.1	435.5
19-Jun-92	6.71	6.92	219.0	222.0	220.0	217.0	219.5	219.5	463.0
29-Jun-92	6.55	6.83	151.7	205.0	177.7	249.4	164.7	227.2	395.7
3-Jul-92	6.46	6.69	230.0	276.2	230.0	199.7	230.0	238.0	474.0
10-Jul-92	6.52	6.67	189.5	191.3	179.3	178.5	184.4	184.9	433.5
17-Jul-92	6.71	6.73	248.9	264.0	252.0	163.7	250.5	213.9	492.9
24-Jul-92	6.62	6.57	283.2	302.2	295.1	292.2	289.2	297.2	527.2

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. pH pH(LAB) AVERAGE COLD TEMP.	LAB. pH pH(LAB) AVERAGE ROOM TEMP.	EH Eh(mV) CBZ1 COLD TEMP.	EH Eh(mV) CBZ1 ROOM TEMP.	EH Eh(mV) CBZ2 COLD TEMP.	EH Eh(mV) CBZ2 ROOM TEMP.	EH Eh(mV) AVERAGE COLD TEMP.	EH Eh(mV) AVERAGE ROOM TEMP.	EH(NHE) (mV) CBZ1 COLD TEMP.
1-Aug-92	6.64	6.75	224.8	280.4	249.6	234.0	237.2	257.2	468.8
7-Aug-92	6.67	6.70	350.7	173.5	316.3	281.2	333.5	227.4	594.7
14-Aug-92	6.80	6.63	228.6	237.0	231.8	231.0	230.2	234.0	472.6
21-Aug-92	6.62	6.56	241.3	214.0	128.4	220.0	184.9	217.0	485.3
28-Aug-92	6.33	6.75	184.4	284.9	207.5	269.1	196.0	277.0	428.4
4-Sep-92	6.69	6.64	53.6	206.0	194.9	213.0	124.3	209.5	297.6
11-Sep-92	6.76	6.43	108.5	232.0	105.2	236.0	106.9	234.0	352.5
18-Sep-92	6.64	6.54	194.0	166.7	136.2	161.7	165.1	164.2	438.0
25-Sep-92	6.82	6.54	148.1	179.7	210.3	165.7	179.2	172.7	392.1
2-Oct-92	6.61	6.58	237.2	236.0	243.7	233.0	240.5	234.5	481.2
8-Oct-92	6.46	6.56	326.5	231.0	283.5	227.0	305.0	229.0	570.5
16-Oct-92	6.54	6.50	171.0	211.0	283.5	202.0	227.3	206.5	415.0
30-Oct-92	6.73	7.18	166.6	272.1	207.6	266.6	187.1	269.4	410.6
13-Nov-92	7.01	6.72	274.7	231.0	253.5	155.3	264.1	193.2	518.7
27-Nov-92	6.85	6.72	188.9	191.0	172.6	78.7	180.8	134.9	432.9
11-Dec-92	7.03	6.80	243.5	295.0	189.0	202.0	216.3	248.5	487.5
24-Dec-92	6.79	6.78	200.7	213.0	183.5	170.3	192.1	191.7	444.7
8-Jan-93	6.53	6.92	306.5	347.3	210.4	232.0	258.5	289.7	550.5
22-Jan-93	6.95	7.20	161.0	311.0	155.4	103.6	158.2	207.3	405.0
5-Feb-93	6.96	7.24	195.6	78.5	160.3	32.1	178.0	55.3	439.6
19-Feb-93	6.89	7.21	151.4	240.3	130.3	165.2	140.9	202.8	395.4
5-Mar-93	6.82	6.98	144.4	107.0	129.8	80.7	137.1	93.9	388.4
19-Mar-93	7.18	7.34	137.9	63.1	145.7	210.1	141.8	136.6	381.9
2-Apr-93	6.81	6.80	123.4	91.3	118.4	74.4	120.9	82.9	367.4
16-Apr-93	6.51	6.78	126.4	87.7	47.5	45.8	87.0	66.8	370.4
30-Apr-93	6.35	6.60	170.6	73.0	144.3	80.6	157.5	76.8	414.6

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. pH pH(LAB) AVERAGE COLD TEMP.	LAB. pH pH(LAB) AVERAGE ROOM TEMP.	EH Eh(mV) CBZ1 COLD TEMP.	EH Eh(mV) CBZ1 ROOM TEMP.	EH Eh(mV) CBZ2 COLD TEMP.	EH Eh(mV) CBZ2 ROOM TEMP.	EH Eh(mV) AVERAGE COLD TEMP.	EH Eh(mV) AVERAGE ROOM TEMP.	EH(NHE) (mV) CBZ1 COLD TEMP.
14-May-93	6.14	6.56	126.6	-70.7	144.6	-50.7	135.6	-60.7	370.6
28-May-93	6.14	6.52	140.0	-75.2	122.1	-55.5	131.1	-65.4	384.0
11-Jun-93	6.31	6.51	98.2	-98.2	89.7	-87.8	94.0	-93.0	342.2
25-Jun-93	5.98	6.45	114.5	-56.7	108.7	-65.4	111.6	-61.1	358.5
9-Jul-93	6.29	6.42	106.1	-109.5	84.4	-101.7	95.3	-105.6	350.1
23-Jul-93	5.95	6.46	103.0	-97.9	115.6	-81.7	109.3	-89.8	347.0
9-Aug-93	5.71	6.20	304.7	114.2	223.3	-37.2	264.0	38.5	548.7
20-Aug-93	6.43	6.52	193.3	-11.7	152.3	-54.8	172.8	-33.3	437.3
3-Sep-93	6.05	6.70	137.0	-26.6	130.7	-25.1	133.9	-25.9	381.0
17-Sep-93	6.67	6.66	141.1	-59.6	126.4	6.3	133.8	-26.7	385.1
1-Oct-93	6.08	6.58	147.7	-9.1	107.1	-55.6	127.4	-32.4	391.7
15-Oct-93	6.01	5.95	153.8	89.7	125.1	-64.4	139.5	12.7	397.8
29-Oct-93	6.62	6.50	121.6	-96.0	88.5	-102.8	105.1	-99.4	365.6
12-Nov-93	6.26	6.31	117.8	26.3	100.5	29.8	109.2	28.1	361.8
26-Nov-93	6.59	6.56	71.8	70.5	134.7	44.9	103.3	57.7	315.8
10-Dec-93	6.09	6.58	75.2	-82.8	115.6	-71.4	95.4	-77.1	319.2
24-Dec-93	6.19	6.30	250.3	148.8	162.3	114.4	206.3	131.6	494.3
7-Jan-94	6.37	6.76	196.0	372.6	195.2	141.3	195.6	257.0	440.0
21-Jan-94	6.56	6.68	249.7	291.6	155.4	148.8	202.6	220.2	493.7

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	EH(NHE) (mV) CBZ1 ROOM TEMP.	EH(NHE) (mV) CBZ2 COLD TEMP.	EH(NHE) (mV) CBZ2 ROOM TEMP.	EH(NHE) (mV) AVERAGE COLD TEMP.	EH(NHE) (mV) AVERAGE ROOM TEMP.	LAB. Ec Ec(LAB) CBZ1 COLD TEMP.	LAB. Ec Ec(LAB) CBZ1 ROOM TEMP.	LAB. Ec Ec(LAB) CBZ2 COLD TEMP.	LAB. Ec Ec(LAB) CBZ2 ROOM TEMP.
30-Jan-92		407.7		427.0		15460		12500	
6-Feb-92		398.2		396.1		15350		14140	
13-Feb-92		414.4		418.5		10690		10800	
20-Feb-92		421.7		424.0		5990		6080	
27-Feb-92		411.3		429.4		4240		4260	
5-Mar-92		432.5		436.7		4170		3560	
12-Mar-92		442.5		443.6		3740		2820	
19-Mar-92		465.7		479.7		3260		3040	
26-Mar-92		463.9		473.1		2870		3040	
2-Apr-92	421.4	467.1	364.1	473.5	392.8	2750	2700	3030	2640
9-Apr-92	423.0	386.7	337.0	380.4	380.0	2490	2720	2710	2560
16-Apr-92	355.2	387.4	387.2	383.4	371.2	2580	2750	2370	2940
23-Apr-92	462.7	521.5	425.8	517.5	444.3	2010	2260	2450	2530
30-Apr-92	464.0	530.4	454.0	531.0	459.0	2400	2580	2540	2540
7-May-92	466.4	565.6	470.5	569.1	468.5	2480	2520	2360	2570
14-May-92	456.7	493.8	459.3	486.7	458.0	2460	2760	2670	2580
22-May-92	461.4	500.9	454.5	482.7	458.0	2160	2560	2240	2610
29-May-92	472.3	466.7	458.0	457.7	465.2	2320	2570	2390	2580
5-Jun-92	446.9	459.4	446.2	463.8	446.6	2410	2410	2600	2450
12-Jun-92	448.2	434.0	437.9	434.8	443.1	2810	2690	2710	2630
19-Jun-92	466.0	464.0	461.0	463.5	463.5	2810	2520	2740	2420
29-Jun-92	449.0	421.7	493.4	408.7	471.2	2710	2310	2470	2250
3-Jul-92	520.2	474.0	443.7	474.0	482.0	2430	2340	2330	2230
10-Jul-92	435.3	423.3	422.5	428.4	428.9	2380	2190	2270	2250
17-Jul-92	508.0	496.0	407.7	494.5	457.9	2280	2440	2110	2400
24-Jul-92	546.2	539.1	536.2	533.2	541.2	2120	2210	1979	2150

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	EH(NHE) (mV) CBZ1 ROOM TEMP.	EH(NHE) (mV) CBZ2 COLD TEMP.	EH(NHE) (mV) CBZ2 ROOM TEMP.	EH(NHE) (mV) AVERAGE COLD TEMP.	EH(NHE) (mV) AVERAGE ROOM TEMP.	LAB. Ec Ec(LAB) CBZ1 COLD TEMP.	LAB. Ec Ec(LAB) CBZ1 ROOM TEMP.	LAB. Ec Ec(LAB) CBZ2 COLD TEMP.	LAB. Ec Ec(LAB) CBZ2 ROOM TEMP.
1-Aug-92	524.4	493.6	478.0	481.2	501.2	2130	1996	2190	2170
7-Aug-92	417.5	560.3	525.2	577.5	471.4	2370	2090	2230	1980
14-Aug-92	481.0	475.8	475.0	474.2	478.0	2830	2560	2840	2570
21-Aug-92	458.0	372.4	464.0	428.9	461.0	2850	2510	2830	2590
28-Aug-92	528.9	451.5	513.1	440.0	521.0	2860	2690	2810	2660
4-Sep-92	450.0	438.9	457.0	368.3	453.5	2730	2650	2750	2680
11-Sep-92	476.0	349.2	480.0	350.9	478.0	2640	2530	2700	2560
18-Sep-92	410.7	380.2	405.7	409.1	408.2	2970	2710	2740	2620
25-Sep-92	423.7	454.3	409.7	423.2	416.7	2970	2740	2930	2730
2-Oct-92	480.0	487.7	477.0	484.5	478.5	2970	2650	2880	2580
8-Oct-92	475.0	527.5	471.0	549.0	473.0	2840	2610	2830	2490
16-Oct-92	455.0	527.5	446.0	471.3	450.5	2880	2380	2830	2340
30-Oct-92	516.1	451.6	510.6	431.1	513.4	2950	2290	2730	2300
13-Nov-92	475.0	497.5	399.3	508.1	437.2	3010	3000	2710	2640
27-Nov-92	435.0	416.6	322.7	424.8	378.9	3370	2950	2900	2640
11-Dec-92	539.0	433.0	446.0	460.3	492.5	3580	2820	2890	2430
24-Dec-92	457.0	427.5	414.3	436.1	435.7	3050	2820	2440	2460
8-Jan-93	591.3	454.4	476.0	502.5	533.7	3070	2960	3350	2600
22-Jan-93	555.0	399.4	347.6	402.2	451.3	3030	3020	2040	2610
5-Feb-93	322.5	404.3	276.1	422.0	299.3	2880	2740	2340	2360
19-Feb-93	484.3	374.3	409.2	384.9	446.8	2950	2540	2970	2240
5-Mar-93	351.0	373.8	324.7	381.1	337.9	2910	2610	2910	2390
19-Mar-93	307.1	389.7	454.1	385.8	380.6	2610	2550	2830	2420
2-Apr-93	335.3	362.4	318.4	364.9	326.9	2650	2390	2590	2350
16-Apr-93	331.7	291.5	289.8	331.0	310.8	2650	2380	2510	2340
30-Apr-93	317.0	388.3	324.6	401.5	320.8	2460	2390	2540	2460

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	EH(NHE) (mV) CBZ1 ROOM TEMP.	EH(NHE) (mV) CBZ2 COLD TEMP.	EH(NHE) (mV) CBZ2 ROOM TEMP.	EH(NHE) (mV) AVERAGE COLD TEMP.	EH(NHE) (mV) AVERAGE ROOM TEMP.	LAB. Ec Ec(LAB) CBZ1 COLD TEMP.	LAB. Ec Ec(LAB) CBZ1 ROOM TEMP.	LAB. Ec Ec(LAB) CBZ2 COLD TEMP.	LAB. Ec Ec(LAB) CBZ2 ROOM TEMP.
14-May-93	173.3	388.6	193.3	379.6	183.3	2600	2310	2520	2320
28-May-93	168.8	366.1	188.5	375.1	178.7	2750	2390	2630	2430
11-Jun-93	145.8	333.7	156.2	338.0	151.0	2860	3040	2570	2580
25-Jun-93	187.3	352.7	178.6	355.6	183.0	2810	2470	2510	2370
9-Jul-93	134.5	328.4	142.3	339.3	138.4	2660	2610	2370	2430
23-Jul-93	146.1	359.6	162.3	353.3	154.2	2840	2520	2440	2340
9-Aug-93	358.2	467.3	206.8	508.0	282.5	3030	2600	2210	2590
20-Aug-93	232.3	396.3	189.2	416.8	210.8	2710	2650	2190	2170
3-Sep-93	217.4	374.7	218.9	377.9	218.2	2840	2510	2210	1986
17-Sep-93	184.4	370.4	250.3	377.8	217.4	2840	2710	2160	2240
1-Oct-93	234.9	351.1	188.4	371.4	211.7	2530	2290	2410	2180
15-Oct-93	333.7	369.1	179.6	383.5	256.7	2340	2250	2360	2200
29-Oct-93	148.0	332.5	141.2	349.1	144.6	2600	2480	2510	2380
12-Nov-93	270.3	344.5	273.8	353.2	272.1	2500	2190	2360	2180
26-Nov-93	314.5	378.7	288.9	347.3	301.7	2910	2480	2420	2210
10-Dec-93	161.2	359.6	172.6	339.4	166.9	2340	2150	2330	2190
24-Dec-93	392.8	406.3	358.4	450.3	375.6	2270	1960	2010	1814
7-Jan-94	616.6	439.2	385.3	439.6	501.0	2290	2010	2060	2020
21-Jan-94	535.6	399.4	392.8	446.6	464.2	3350	2850	3220	2850

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. Ec Ec(LAB) AVERAGE COLD TEMP.	LAB. Ec Ec(LAB) AVERAGE ROOM TEMP.	SAMPLE TEMP.(C) CBZ1 COLD	SAMPLE TEMP.(C) CBZ1 ROOM	SAMPLE TEMP.(C) CBZ2 COLD	SAMPLE TEMP.(C) CBZ2 ROOM	SAMPLE TEMP.(C) AVERAGE COLD	SAMPLE TEMP.(C) AVERAGE ROOM	ACIDITY (mg/l) CBZ1
30-Jan-92	13980		9.7		8.3		9.0		0.00
6-Feb-92	14745		6.1		3.9		5.0		0.00
13-Feb-92	10745		4.2		3.9		4.1		0.00
20-Feb-92	6035		5.4		6.8		6.1		0.00
27-Feb-92	4250		6.6		6.9		6.8		0.00
5-Mar-92	3865		1.1		1.9		1.5		0.00
12-Mar-92	3280		1.0		0.9		1.0		0.00
19-Mar-92	3150		1.2		1.5		1.4		0.00
26-Mar-92	2955		1.5		1.9		1.7		0.00
2-Apr-92	2890	2670	1.3	26.7	1.1	24.7	1.2	25.7	0.00
9-Apr-92	2600	2640	1.6	21.0	1.5	19.6	1.6	20.3	0.00
16-Apr-92	2475	2845	2.1	21.1	1.0	23.1	1.6	22.1	0.00
23-Apr-92	2230	2395	3.3	22.1	2.0	21.9	2.7	22.0	0.00
30-Apr-92	2470	2560	2.8	19.8	3.1	19.1	3.0	19.5	0.00
7-May-92	2420	2545	3.3	22.4	3.1	23.5	3.2	23.0	0.00
14-May-92	2565	2670	4.9	22.1	3.3	19.0	4.1	20.6	0.00
22-May-92	2200	2585	5.1	29.8	4.2	27.8	4.7	28.8	0.00
29-May-92	2355	2575	3.5	19.6	4.0	19.6	3.8	19.6	0.00
5-Jun-92	2505	2430	5.7	22.2	4.4	24.0	5.1	23.1	0.00
12-Jun-92	2760	2660	4.6	25.1	5.3	24.5	5.0	24.8	0.00
19-Jun-92	2775	2470	3.7	20.5	4.3	19.0	4.0	19.8	0.00
29-Jun-92	2590	2280	3.3	22.5	3.4	21.9	3.4	22.2	0.00
3-Jul-92	2380	2285	3.7	22.5	4.1	21.8	3.9	22.2	0.00
10-Jul-92	2325	2220	4.5	21.7	4.6	22.0	4.6	21.9	0.00
17-Jul-92	2195	2420	4.6	22.5	4.4	23.8	4.5	23.2	0.00
24-Jul-92	2050	2180	4.1	22.8	4.2	21.3	4.2	22.1	0.00

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. Ec Ec(LAB) AVERAGE COLD TEMP.	LAB. Ec Ec(LAB) AVERAGE ROOM TEMP.	SAMPLE TEMP.(C) CBZ1 COLD	SAMPLE TEMP.(C) CBZ1 ROOM	SAMPLE TEMP.(C) CBZ2 COLD	SAMPLE TEMP.(C) CBZ2 ROOM	SAMPLE TEMP.(C) AVERAGE COLD	SAMPLE TEMP.(C) AVERAGE ROOM	ACIDITY (mg/l) CBZ1
1-Aug-92	2160	2083	4.6	20.9	4.5	22.2	4.6	21.6	0.00
7-Aug-92	2300	2035	5.1	25.1	4.2	21.4	4.7	23.3	0.00
14-Aug-92	2835	2565	4.6	22.9	4.5	21.4	4.6	22.2	0.00
21-Aug-92	2840	2550	4.2	20.4	4.5	21.6	4.4	21.0	0.00
28-Aug-92	2835	2675	4.3	21.0	4.4	24.3	4.4	22.7	0.00
4-Sep-92	2740	2665	4.1	20.9	4.0	20.4	4.1	20.7	0.00
11-Sep-92	2670	2545	4.2	20.7	3.9	20.9	4.1	20.8	0.00
18-Sep-92	2855	2665	5.5	24.4	5.0	22.2	5.3	23.3	0.00
25-Sep-92	2950	2735	4.3	23.9	4.7	22.7	4.5	23.3	0.00
2-Oct-92	2925	2615	4.9	21.9	4.5	19.6	4.7	20.8	0.00
8-Oct-92	2835	2550	4.9	21.3	5.0	19.7	5.0	20.5	0.00
16-Oct-92	2855	2360	4.5	19.7	5.0	18.9	4.8	19.3	0.00
30-Oct-92	2840	2295	4.3	17.1	3.9	18.7	4.1	17.9	
13-Nov-92	2860	2820	5.2	22.2	5.2	20.8	5.2	21.5	0.00
27-Nov-92	3135	2795	5.3	22.4	5.0	24.1	5.2	23.3	
11-Dec-92	3235	2625	5.3	24.6	5.1	23.5	5.2	24.1	0.00
24-Dec-92	2745	2640	4.5	21.9	4.2	21.6	4.4	21.8	
8-Jan-93	3210	2780	4.8	21.3	4.6	22.9	4.7	22.1	0.00
22-Jan-93	2535	2815	4.7	19.2	4.6	21.1	4.7	20.2	
5-Feb-93	2610	2550	4.7	22.1	5.1	23.2	4.9	22.7	0.00
19-Feb-93	2960	2390	4.6	22.8	4.1	21.9	4.4	22.4	
5-Mar-93	2910	2500	4.7	20.9	4.0	20.3	4.4	20.6	0.00
19-Mar-93	2720	2485	4.0	21.6	4.6	21.6	4.3	21.6	
2-Apr-93	2620	2370	4.7	20.0	5.4	19.8	5.1	19.9	0.00
16-Apr-93	2580	2360	5.2	23.0	4.7	21.5	5.0	22.3	
30-Apr-93	2500	2425	4.5	22.2	4.2	22.4	4.4	22.3	0.00

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. Ec Ec(LAB) AVERAGE COLD TEMP.	LAB. Ec Ec(LAB) AVERAGE ROOM TEMP.	SAMPLE TEMP.(C) CBZ1 COLD	SAMPLE TEMP.(C) CBZ1 ROOM	SAMPLE TEMP.(C) CBZ2 COLD	SAMPLE TEMP.(C) CBZ2 ROOM	SAMPLE TEMP.(C) AVERAGE COLD	SAMPLE TEMP.(C) AVERAGE ROOM	ACIDITY (mg/l) CBZ1
14-May-93	2560	2315	4.7	19.6	4.0	21.4	4.4	20.5	
28-May-93	2690	2410	4.9	21.8	4.5	21.3	4.7	21.6	0.00
11-Jun-93	2715	2810	4.6	24.8	4.4	24.5	4.5	24.7	0.00
25-Jun-93	2660	2420	4.1	21.5	4.5	22.9	4.3	22.2	0.00
9-Jul-93	2515	2520	4.5	24.6	4.5	23.9	4.5	24.3	0.00
23-Jul-93	2640	2430	4.4	23.1	4.7	23.2	4.6	23.2	175.48
9-Aug-93	2620	2595	5.0	23.5	5.2	24.3	5.1	23.9	
20-Aug-93	2450	2410	5.1	24.9	4.6	24.9	4.9	24.9	0.00
3-Sep-93	2525	2248	4.7	21.3	4.6	20.8	4.7	21.1	
17-Sep-93	2500	2475	4.1	18.9	4.4	19.4	4.3	19.2	210.92
1-Oct-93	2470	2235	4.4	23.4	4.9	23.3	4.7	23.4	
15-Oct-93	2350	2225	4.7	22.4	5.2	24.0	5.0	23.2	0.00
29-Oct-93	2555	2430	4.2	22.9	4.4	22.1	4.3	22.5	
12-Nov-93	2430	2185	4.6	20.5	4.9	19.8	4.8	20.2	160.12
26-Nov-93	2665	2345	4.4	22.4	4.5	24.8	4.5	23.6	
10-Dec-93	2335	2170	5.0	25.1	5.0	24.6	5.0	24.9	272.44
24-Dec-93	2140	1887	6.5	17.9	6.6	16.6	6.6	17.3	N.S.S.
7-Jan-94	2175	2015	6.0	20.8	6.1	21.2	6.1	21.0	0.00
21-Jan-94	3285	2850	6.4	24.9	6.8	24.8	6.6	24.9	0.00

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	ACIDITY (mg/l) CBZ2	ACIDITY (mg/l) AVERAGE	ALKALINITY (mg/l) CBZ1	ALKALINITY (mg/l) CBZ2	ALKALINITY (mg/l) AVERAGE	Al (mg/l) CBZ1	Al (mg/l) CBZ2	Al (mg/l) AVERAGE	As (mg/l) CBZ1
30-Jan-92	0.00	0.00	149.18	159.12	154.15	NA	<0.04		
6-Feb-92	0.00	0.00	272.49	286.42	279.45	<0.04	0.04	0.04	<0.044
13-Feb-92	0.00	0.00	336.14	362.00	349.07	<0.04	0.05	0.05	<0.044
20-Feb-92	0.00	0.00	326.20	344.10	335.15	0.07	<0.04	0.07	<0.044
27-Feb-92	0.00	0.00	312.27	328.19	320.23	0.13	0.14	0.14	<0.044
5-Mar-92	0.00	0.00	320.23	318.24	319.23	0.11	<0.04	0.11	<0.044
12-Mar-92	0.00	0.00	320.23	302.33	311.28	0.14	<0.04	0.14	<0.044
19-Mar-92	0.00	0.00	310.28	306.31	308.30	0.12	<0.04	0.12	<0.044
26-Mar-92	0.00	0.00	308.30	304.32	306.31	0.17	0.07	0.12	<0.044
2-Apr-92	0.00	0.00	306.31	300.34	303.32	0.14	0.19	0.17	<0.044
9-Apr-92	0.00	0.00	306.31	306.31	306.31	0.13	<0.04	0.13	<0.044
16-Apr-92	0.00	0.00	310.28	312.27	311.28	0.10	<0.04	0.10	<0.044
23-Apr-92	0.00	0.00	310.28	310.28	310.28	0.09	0.19	0.14	<0.044
30-Apr-92	0.00	0.00	315.26	314.26	314.76	0.14	<0.04	0.14	0.06
7-May-92	0.00	0.00	308.30	322.22	315.26	0.11	0.06	0.09	<0.044
14-May-92	0.00	0.00	312.27	316.25	314.26	0.12	0.10	0.11	<0.044
22-May-92	0.00	0.00	301.33	311.28	306.31	0.07	0.05	0.06	<0.044
29-May-92	0.00	0.00	307.30	312.27	309.79	0.13	0.25	0.19	<0.044
5-Jun-92	0.00	0.00	306.31	309.29	307.80	0.12	0.09	0.11	<0.044
12-Jun-92	0.00	0.00	302.33	299.34	300.84	0.12	0.09	0.11	<0.044
19-Jun-92	0.00	0.00	295.37	295.37	295.37	0.11	0.05	0.08	<0.044
29-Jun-92	0.00	0.00	290.39	286.42	288.41	0.16	<0.04	0.16	<0.044
3-Jul-92	0.00	0.00	290.39	280.45	285.42	0.20	0.28	0.24	<0.044
10-Jul-92	0.00	0.00	283.43	276.47	279.95	0.17	0.13	0.15	<0.044
17-Jul-92	0.00	0.00	277.47	270.50	273.98	0.15	<0.04	0.15	<0.044
24-Jul-92	0.00	0.00	288.41	285.42	286.91	0.13	0.08	0.11	<0.044

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	ACIDITY (mg/l) CBZ2	ACIDITY (mg/l) AVERAGE	ALKALINITY (mg/l) CBZ1	ALKALINITY (mg/l) CBZ2	ALKALINITY (mg/l) AVERAGE	Al (mg/l) CBZ1	Al (mg/l) CBZ2	Al (mg/l) AVERAGE	As (mg/l) CBZ1
1-Aug-92	0.00	0.00	280.45	285.42	282.94	0.27	<0.04	0.27	<0.044
7-Aug-92	0.00	0.00	270.50	275.48	272.99	0.16	0.18	0.17	<0.044
14-Aug-92	0.00	0.00	274.48	278.46	276.47	0.16	0.09	0.13	<0.044
21-Aug-92	0.00	0.00	278.46	282.44	280.45	0.12	0.30	0.21	<0.044
28-Aug-92	0.00	0.00	276.47	284.43	280.45	0.22	0.15	0.19	<0.044
4-Sep-92	0.00	0.00	280.45	281.44	280.95	0.16	0.16	0.16	<0.044
11-Sep-92	0.00	0.00	278.46	282.44	280.45	0.15	0.55	0.35	<0.044
18-Sep-92	0.00	0.00	287.91	287.91	287.91	0.15	0.16	0.16	<0.044
25-Sep-92	0.00	0.00	287.91	287.91	287.91	0.11	0.17	0.14	<0.044
2-Oct-92	0.00	0.00	293.83	287.91	290.87	0.31	0.07	0.19	<0.044
8-Oct-92	0.00	0.00	288.90	291.86	290.38	0.13	0.08	0.11	<0.044
16-Oct-92	0.00	0.00	285.94	288.90	287.42	0.09	0.06	0.08	<0.044
30-Oct-92									
13-Nov-92	0.00	0.00	299.74	278.05	288.90	0.17	0.14	0.16	<0.044
27-Nov-92									
11-Dec-92	0.00	0.00	301.18	239.07	270.12	0.12	0.08	0.10	<0.044
24-Dec-92									
8-Jan-93	0.00	0.00	303.51	213.98	258.75	0.14	0.09	0.12	<0.044
22-Jan-93									
5-Feb-93	0.00	0.00	322.84	197.97	260.40	0.14	0.10	0.12	<0.044
19-Feb-93									
5-Mar-93	0.00	0.00	264.31	176.00	220.15	0.19	0.17	0.18	<0.044
19-Mar-93									
2-Apr-93	0.00	0.00	233.15	124.99	179.07	0.15	0.08	0.12	<0.044
16-Apr-93									
30-Apr-93	37.09	18.54	216.57	99.11	157.84	0.04	0.08	0.06	<0.044

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	ACIDITY (mg/l) CBZ2	ACIDITY (mg/l) AVERAGE	ALKALINITY (mg/l) CBZ1	ALKALINITY (mg/l) CBZ2	ALKALINITY (mg/l) AVERAGE	Al (mg/l) CBZ1	Al (mg/l) CBZ2	Al (mg/l) AVERAGE	As (mg/l) CBZ1
14-May-93									
28-May-93	245.62	122.81	226.90	83.18	155.04	0.04	0.07	0.06	<0.044
11-Jun-93	268.02	134.01	208.86	56.46	132.66				
25-Jun-93	284.06	142.03	177.06	69.70	123.38	<0.04	0.07	0.07	<0.044
9-Jul-93	305.94	152.97	175.75	79.91	127.83				
23-Jul-93	347.20	261.34	218.76	68.11	143.44	0.04	0.05	0.05	<0.044
9-Aug-93									
20-Aug-93	356.30	178.15	218.45	54.40	136.43	0.30	0.07	0.19	<0.044
3-Sep-93									
17-Sep-93	194.04	202.48	199.29	63.40	131.35	<0.04	0.12	0.12	<0.044
1-Oct-93									
15-Oct-93	492.07	246.04	105.84	53.53	79.69	0.18	0.16	0.17	<0.044
29-Oct-93									
12-Nov-93	379.63	269.88	144.33	90.54	117.44	0.19	0.15	0.17	0.05
26-Nov-93									
10-Dec-93	292.63	282.54	130.13	65.30	97.72	0.19	0.16	0.18	0.09
24-Dec-93	N.S.S.	N.S.S.	N.S.S.	N.S.S.	N.S.S.				
7-Jan-94	0.00	0.00	163.21	113.21	138.21	0.16	0.17	0.17	<0.044
21-Jan-94	0.00	0.00	177.70	155.17	166.44	0.19	0.15	0.17	<0.044

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	As (mg/l) CBZ2	As (mg/l) AVERAGE	Ca (mg/l) CBZ1	Ca (mg/l) CBZ2	Ca (mg/l) AVERAGE	Cu (mg/l) CBZ1	Cu (mg/l) CBZ2	Cu (mg/l) AVERAGE	Fe TOTAL (mg/l) CBZ1	Fe TOTAL (mg/l) CBZ2
30-Jan-92	<0.044			523.0	523.0		0.010	0.010		0.48
6-Feb-92	<0.044		383.5	377.8	380.7	0.012	0.030	0.021	0.35	0.33
13-Feb-92	<0.044		370.7	370.8	370.8	<0.004	0.030	0.030	0.16	0.15
20-Feb-92	<0.044		413.6	398.1	405.9	<0.004	<0.004		0.042	0.03
27-Feb-92	<0.044		462.9	427.0	445.0	<0.004	<0.004		0.17	0.01
5-Mar-92	<0.044		487.4	473.0	480.2	<0.004	<0.004		0.006	<0.005
12-Mar-92	<0.044		505.1	504.9	505.0	<0.004	<0.004		<0.005	<0.005
19-Mar-92	<0.044		547.8	553.0	550.4	<0.004	<0.004		<0.005	<0.005
26-Mar-92	<0.044		559.3	574.4	566.9	<0.004	<0.004		<0.005	<0.005
2-Apr-92	<0.044		572.5	563.0	567.8	<0.004	<0.004		<0.005	<0.005
9-Apr-92	<0.044		595.2	619.6	607.4	<0.004	<0.004		<0.005	<0.005
16-Apr-92	<0.044		681.7	619.4	650.6	<0.004	<0.004		<0.005	<0.005
23-Apr-92	<0.044		661.5	593.9	627.7	<0.004	<0.004		<0.005	<0.005
30-Apr-92	<0.044	0.06	685.6	603.7	644.7	<0.004	<0.004		0.0078	<0.005
7-May-92	<0.044		663.9	644.3	654.1	<0.004	<0.004		<0.005	<0.005
14-May-92	<0.044		642.3	609.6	626.0	<0.004	<0.004		<0.005	<0.005
22-May-92	<0.044		649.6	643.1	646.4	<0.004	<0.004		<0.005	<0.005
29-May-92	<0.044		639.6	610.4	625.0	<0.004	<0.004		<0.005	<0.005
5-Jun-92	<0.044		628.6	613.6	621.1	<0.004	<0.004		<0.005	<0.005
12-Jun-92	<0.044		642.6	603.7	623.2	<0.004	<0.004		<0.005	<0.005
19-Jun-92	<0.044		608.4	609.3	608.9	<0.004	<0.004		<0.005	<0.005
29-Jun-92	<0.044		606.1	606.0	606.1	<0.004	<0.004		<0.005	<0.005
3-Jul-92	0.10	0.10	680.8	623.0	651.9	<0.004	0.004	0.004	<0.005	<0.005
10-Jul-92	0.042	0.04	632.9	603.8	618.4	<0.004	<0.004		<0.005	<0.005
17-Jul-92	<0.044		610.3	63.9	337.1	<0.004	<0.004		<0.005	<0.005
24-Jul-92	0.01	0.01	638.4	653.9	646.2	<0.004	<0.004		<0.005	<0.005

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	As (mg/l) CBZ2	As (mg/l) AVERAGE	Ca (mg/l) CBZ1	Ca (mg/l) CBZ2	Ca (mg/l) AVERAGE	Cu (mg/l) CBZ1	Cu (mg/l) CBZ2	Cu (mg/l) AVERAGE	Fe TOTAL (mg/l) CBZ1	Fe TOTAL (mg/l) CBZ2
1-Aug-92	<0.044		700.5	645.3	672.9	<0.004	<0.004		<0.005	<0.005
7-Aug-92	<0.044		615.9	624.8	620.4	<0.004	<0.004		<0.005	<0.005
14-Aug-92	<0.044		672.0	611.0	641.5	<0.004	<0.004		0.04	<0.005
21-Aug-92	0.13	0.13	617.9	624.5	621.2	<0.004	0.006	0.006	<0.005	<0.005
28-Aug-92	<0.044		642.9	670.5	656.7	<0.004	<0.004		<0.005	<0.005
4-Sep-92	<0.044		660.0	634.0	647.0	<0.004	<0.004		<0.005	<0.005
11-Sep-92	0.16	0.16	647.5	678.8	663.2	<0.004	<0.004		<0.005	0.01
18-Sep-92	<0.044		629.2	631.5	630.4	<0.004	<0.004		<0.005	<0.005
25-Sep-92	<0.044		632.3	652.1	642.2	<0.004	<0.004		<0.005	<0.005
2-Oct-92	<0.044		625.8	613.8	619.8	<0.004	<0.004		<0.005	<0.005
8-Oct-92	<0.044		624.6	639.0	631.8	<0.004	<0.004		<0.005	<0.005
16-Oct-92	<0.044		656.9	637.1	647.0	<0.004	<0.004		<0.005	<0.005
30-Oct-92										
13-Nov-92	<0.044		625.6	637.9	631.8	<0.004	<0.004		<0.005	0.01
27-Nov-92										
11-Dec-92	<0.044		633.9	605.8	619.9	<0.004	<0.004		<0.005	0.12
24-Dec-92										
8-Jan-93	<0.044		615.5	582.8	599.2	<0.004	<0.004		<0.005	0.35
22-Jan-93										
5-Feb-93	<0.044		584.3	599.7	592.0	<0.004	<0.004		<0.005	0.94
19-Feb-93										
5-Mar-93	<0.044		548.8	583.7	566.3	<0.004	<0.004		0.34	0.74
19-Mar-93										
2-Apr-93	<0.044		573.9	591.9	582.9	<0.004	<0.004		2.5	4.3
16-Apr-93										
30-Apr-93	<0.044		557.8	566.1	562.0	<0.004	<0.004		3.1	20.68

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	As (mg/l) CBZ2	As (mg/l) AVERAGE	Ca (mg/l) CBZ1	Ca (mg/l) CBZ2	Ca (mg/l) AVERAGE	Cu (mg/l) CBZ1	Cu (mg/l) CBZ2	Cu (mg/l) AVERAGE	Fe TOTAL (mg/l) CBZ1	Fe TOTAL (mg/l) CBZ2
14-May-93										
28-May-93	<0.044		594.3	567.7	581.0	<0.004	<0.004		14.05	81.26
11-Jun-93										
25-Jun-93	0.06	0.06	594.3	571.5	582.9	<0.004	<0.004		14.78	152.9
9-Jul-93										
23-Jul-93	0.07	0.07	570.9	566.5	568.7	<0.004	<0.004		56.67	171.6
9-Aug-93										
20-Aug-93	0.1	0.10	598.5	551.0	574.8	<0.004	<0.004		15.82	186.1
3-Sep-93										
17-Sep-93	0.07	0.07	528.6	565.1	546.9	<0.004	<0.004		118.3	140.9
1-Oct-93										
15-Oct-93	0.14	0.14	547.5	550.2	548.9	<0.004	<0.004		31.2	254.2
29-Oct-93										
12-Nov-93	0.16	0.11	528.4	514.5	521.5	<0.004	<0.004		87.48	233.4
26-Nov-93										
10-Dec-93	0.07	0.08	534.3	564.6	549.5	<0.004	<0.004		173.8	134.1
24-Dec-93										
7-Jan-94	<0.044		543.8	541.2	542.5	<0.004	<0.004		<0.005	18.48
21-Jan-94	<0.044		574.8	564.7	569.8	<0.004	<0.004		0.0056	2.2

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Fe TOTAL (mg/l) AVERAGE	Hg (mg/l) CBZ1	Hg (mg/l) CBZ2	Hg (mg/l) AVERAGE	Mg (mg/l) CBZ1	Mg (mg/l) CBZ2	Mg (mg/l) AVERAGE	Mn (mg/l) CBZ1	Mn (mg/l) CBZ2	Mn (mg/l) AVERAGE
30-Jan-92	0.48	<0.15	<0.15						4.1	4.1
6-Feb-92	0.34	<0.15	<0.15		3240.0		3240.0	4.0	4.3	4.2
13-Feb-92	0.16	<0.15	<0.15		2242.0		2242.0	4.2	4.4	4.3
20-Feb-92	0.04	<0.15	<0.15		1086.0		1086.0	3.5	3.7	3.6
27-Feb-92	0.09	<0.15	<0.15		581.6	610.9	596.3	3.3	3.4	3.4
5-Mar-92	0.01	<0.15	<0.15		395.3	417.6	406.5	3.5	3.7	3.6
12-Mar-92		<0.15	<0.15		350.1	256.6	303.4	4.1	4.9	4.5
19-Mar-92		<0.15	<0.15		269.4	188.6	229.0	5.0	4.1	4.5
26-Mar-92		<0.15	<0.15		196.9	158.1	177.5	4.5	4.6	4.6
2-Apr-92		<0.15	<0.15		151.9	133.1	142.5	5.0	4.5	4.8
9-Apr-92		<0.15	<0.15		125.9	118.4	122.2	4.8	5.1	5.0
16-Apr-92		<0.15	<0.15		119.7	105.5	112.6	5.2	4.9	5.1
23-Apr-92		<0.15	<0.15		105.4	82.2	93.8	5.0	4.4	4.7
30-Apr-92	0.01	<0.15	<0.15		101.4	84.7	93.0	5.2	5.3	5.3
7-May-92		<0.15	<0.15		91.1	81.5	86.3	5.4	5.6	5.5
14-May-92		<0.15	<0.15		89.0	73.9	81.4	5.7	5.4	5.6
22-May-92		<0.15	<0.15		92.7	84.5	88.6	6.1	6.2	6.1
29-May-92		<0.15	<0.15		85.2	78.9	82.0	6.4	5.7	6.1
5-Jun-92		<0.15	<0.15		93.9	79.0	86.4	7.4	6.2	6.8
12-Jun-92		<0.15	<0.15		95.9	81.1	88.5	7.9	7.1	7.5
19-Jun-92		<0.15	<0.15		91.6	88.3	89.9	8.6	6.8	7.7
29-Jun-92		<0.15	<0.15		88.6	77.6	83.1	9.0	6.7	7.9
3-Jul-92		<0.15	<0.15		91.4	74.5	83.0	10.1	7.7	8.9
10-Jul-92		<0.15	<0.15		93.3	65.0	79.2	9.9	7.7	8.8
17-Jul-92		<0.15	<0.15		91.1	11.0	51.0	9.2		9.2
24-Jul-92		<0.15	<0.15		84.8	71.8	78.3	10.1	8.8	9.4

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Fe TOTAL (mg/l) AVERAGE	Hg (mg/l) CBZ1	Hg (mg/l) CBZ2	Hg (mg/l) AVERAGE	Mg (mg/l) CBZ1	Mg (mg/l) CBZ2	Mg (mg/l) AVERAGE	Mn (mg/l) CBZ1	Mn (mg/l) CBZ2	Mn (mg/l) AVERAGE
1-Aug-92		<0.15	<0.15		86.8	91.2	89.0	10.9	9.1	10.0
7-Aug-92		<0.15	<0.15		90.1	86.7	88.4	9.4		9.4
14-Aug-92		<0.15	<0.15		90.5	82.5	86.5	10.2		10.2
21-Aug-92		<0.15	<0.15		88.1	85.2	86.7	9.6		9.6
28-Aug-92		<0.15	<0.15		79.3	97.6	88.5	10.0		10.0
4-Sep-92		<0.15	<0.15		76.5	98.3	87.4	9.6		9.6
11-Sep-92	0.01	<0.15	<0.15		81.9	92.0	87.0	10.1		10.1
18-Sep-92		<0.15	<0.15		83.1	84.6	83.8	9.2	9.9	9.6
25-Sep-92		<0.15	<0.15		91.2	79.9	85.6	9.4	9.5	9.5
2-Oct-92		<0.15	<0.15		84.9	48.5	66.7	9.6	5.8	7.7
8-Oct-92		<0.15	<0.15		81.7	78.8	80.3	9.2	9.4	9.3
16-Oct-92		<0.15	<0.15		77.4	75.6	76.5	9.4	9.2	9.3
30-Oct-92										
13-Nov-92	0.01	<0.15	<0.15		80.1	70.7	75.4	9.1	9.1	9.1
27-Nov-92										
11-Dec-92	0.12	<0.15	<0.15		107.7	64.7	86.2	9.5	9.1	9.3
24-Dec-92										
8-Jan-93	0.35	<0.15	<0.15		117.3	43.0	80.2	8.7	7.7	8.2
22-Jan-93										
5-Feb-93	0.94	<0.15	<0.15		110.6	30.2	70.4	8.4	6.8	7.6
19-Feb-93										
5-Mar-93	0.54	<0.15	<0.15		90.9	26.0	58.4	9.2	6.8	8.0
19-Mar-93										
2-Apr-93	3.40	<0.15	<0.15		60.6	25.7	43.2	9.4	6.7	8.1
16-Apr-93										
30-Apr-93	11.89	<0.15	<0.15		41.5	23.3	32.4	7.9	7.8	7.9

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Fe TOTAL (mg/l) AVERAGE	Hg (mg/l) CBZ1	Hg (mg/l) CBZ2	Hg (mg/l) AVERAGE	Mg (mg/l) CBZ1	Mg (mg/l) CBZ2	Mg (mg/l) AVERAGE	Mn (mg/l) CBZ1	Mn (mg/l) CBZ2	Mn (mg/l) AVERAGE
14-May-93										
28-May-93	47.66	<0.15	<0.15		41.6	18.9	30.2	9.6	9.6	9.6
11-Jun-93										
25-Jun-93	83.84	<0.15	<0.15		75.4	17.4	46.4	9.8	9.1	9.5
9-Jul-93										
23-Jul-93	114.14	<0.15	<0.15		67.2	15.8	41.5	12.5	8.4	10.5
9-Aug-93										
20-Aug-93	100.96	<0.15	<0.15		141.4	14.9	78.2	14.1	8.1	11.1
3-Sep-93										
17-Sep-93	129.60	<0.15	<0.15		162.9	18.4	90.6	20.3		20.3
1-Oct-93										
15-Oct-93	142.70	<0.15	<0.15		137.3	50.8	94.0	19.5		19.5
29-Oct-93										
12-Nov-93	160.44	<0.15	<0.15		129.4	96.3	112.9	23.6	7.3	15.4
26-Nov-93										
10-Dec-93	153.95	<0.15	<0.15		112.3	79.1	95.7	19.8		19.8
24-Dec-93										
7-Jan-94	18.48	<0.15	<0.15		127.0	97.6	112.3	8.5	7.7	8.1
21-Jan-94	1.10				191.6	175.8	183.7	13.2	9.6	11.4

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Ni (mg/l) CBZ1	Ni (mg/l) CBZ2	Ni (mg/l) AVERAGE	Pb (mg/l) CBZ1	Pb (mg/l) CBZ2	Pb (mg/l) AVERAGE	Sb (mg/l) CBZ1	Sb (mg/l) CBZ2	Sb (mg/l) AVERAGE	Si (mg/l) CBZ1
30-Jan-92		<0.02			0.05			0.12	0.12	
6-Feb-92	<0.02	<0.02		0.18	0.07	0.13	0.11	0.09	0.10	2.1
13-Feb-92	<0.02	<0.02		0.04	0.05	0.05	0.10	0.10	0.10	2.4
20-Feb-92	0.038	<0.02	0.04	0.05	0.04	0.05	0.09	<0.03	0.09	2.6
27-Feb-92	<0.02	0.021	0.02	0.04	0.05	0.05	0.09	0.11	0.10	2.8
5-Mar-92	<0.02	<0.02		<0.04	0.05	0.05	0.06	<0.03	0.06	3.1
12-Mar-92	<0.02	0.03	0.03	<0.04	<0.04		0.04	<0.03	0.04	2.9
19-Mar-92	0.038	<0.02	0.04	<0.04	0.08	0.08	<0.03	0.03	0.03	3.2
26-Mar-92	0.023	0.04	0.03	0.06	0.17	0.11	0.06	0.09	0.07	3.1
2-Apr-92	<0.02	0.0208	0.02	<0.04	<0.04		0.04	0.03	0.04	3.1
9-Apr-92	<0.02	<0.02		<0.04	<0.04		0.03	<0.03	0.03	3.1
16-Apr-92	<0.02	<0.02		<0.04	<0.04		0.03	<0.03	0.03	3.1
23-Apr-92	<0.02	0.028	0.03	<0.04	<0.04		0.03	0.46	0.25	2.9
30-Apr-92	<0.02	0.03	0.03	0.04	<0.04	0.04	<0.03	<0.03		3.1
7-May-92	<0.02	0.03	0.03	0.09	0.07	0.08	<0.03	<0.03		2.9
14-May-92	<0.02	0.04	0.04	<0.04	<0.04		<0.03	<0.03		2.7
22-May-92	<0.02	<0.02		<0.04	0.07	0.07	<0.03	<0.03		2.7
29-May-92	<0.02	0.05	0.05	<0.04	<0.04		<0.03	<0.03		2.9
5-Jun-92	<0.02	<0.02		<0.04	<0.04		0.03	0.06	0.05	2.9
12-Jun-92	<0.02	0.03	0.03	<0.04	<0.04		<0.03	0.13	0.13	2.9
19-Jun-92	<0.02	0.03	0.03	<0.04	<0.04		<0.03	<0.03		2.9
29-Jun-92	<0.02	0.04	0.04	<0.04	0.04	0.04	<0.03	<0.03		2.8
3-Jul-92	0.04	0.03	0.04	0.05	<0.04	0.05	0.09	0.07	0.08	3.1
10-Jul-92	0.08	0.03	0.06	<0.04	<0.04		<0.03	<0.03		2.8
17-Jul-92	<0.02	0.25	0.25	<0.04	<0.04		0.05	<0.03	0.05	2.7
24-Jul-92	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.9

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Ni (mg/l) CBZ1	Ni (mg/l) CBZ2	Ni (mg/l) AVERAGE	Pb (mg/l) CBZ1	Pb (mg/l) CBZ2	Pb (mg/l) AVERAGE	Sb (mg/l) CBZ1	Sb (mg/l) CBZ2	Sb (mg/l) AVERAGE	Si (mg/l) CBZ1
1-Aug-92	0.03	<0.02	0.03	<0.04	<0.04		<0.03	<0.03		2.9
7-Aug-92	0.021	0.11	0.07	<0.04	0.05	0.05	<0.03	0.07	0.07	2.4
14-Aug-92	0.021	0.13	0.08	<0.04	0.06	0.06	0.05	<0.03	0.05	2.8
21-Aug-92	0.0208	0.07	0.05	<0.04	0.04	0.04	0.03	0.16	0.10	2.4
28-Aug-92	<0.02	<0.02		<0.04	<0.04		0.05	<0.03	0.05	2.6
4-Sep-92	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.6
11-Sep-92	<0.02	0.04	0.04	<0.04	<0.04		<0.03	0.22	0.22	2.6
18-Sep-92	<0.02	0.023	0.02	<0.04	0.04	0.04	<0.03	<0.03		2.3
25-Sep-92	<0.02	<0.02		<0.04	<0.04		<0.03	0.10	0.10	2.2
2-Oct-92	0.07	<0.02	0.07	0.05	<0.04	0.05	0.19	<0.03	0.19	2.3
8-Oct-92	<0.02	<0.02		<0.04	<0.04		<0.03	0.04	0.04	2.6
16-Oct-92	<0.02	<0.02		<0.04	<0.04		<0.03	0.04	0.04	2.6
30-Oct-92										
13-Nov-92	<0.02	<0.02		<0.04	0.05	0.05	0.04	0.05	0.04	2.5
27-Nov-92										
11-Dec-92	<0.02	<0.02		<0.04	<0.04		0.04	<0.03	0.04	2.4
24-Dec-92										
8-Jan-93	<0.02	<0.02		<0.04	<0.04		0.04	<0.03	0.04	2.2
22-Jan-93										
5-Feb-93	<0.02	<0.02		<0.04	<0.04		0.04	<0.03	0.04	2.3
19-Feb-93										
5-Mar-93	<0.02	<0.02		<0.04	<0.04		0.03	<0.03	0.03	2.1
19-Mar-93										
2-Apr-93	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		1.9
16-Apr-93										
30-Apr-93	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		1.7

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Ni (mg/l) CBZ1	Ni (mg/l) CBZ2	Ni (mg/l) AVERAGE	Pb (mg/l) CBZ1	Pb (mg/l) CBZ2	Pb (mg/l) AVERAGE	Sb (mg/l) CBZ1	Sb (mg/l) CBZ2	Sb (mg/l) AVERAGE	Si (mg/l) CBZ1
14-May-93										
28-May-93	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		1.7
11-Jun-93										
25-Jun-93	<0.02	0.021	0.02	<0.04	<0.04		<0.03	<0.03		1.6
9-Jul-93										
23-Jul-93	<0.02	<0.02		<0.04	0.04	0.04	<0.03	<0.03		1.9
9-Aug-93										
20-Aug-93	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		3.6
3-Sep-93										
17-Sep-93	0.08	0.024	0.05	<0.04	<0.04		<0.03	<0.03		2.8
1-Oct-93										
15-Oct-93	0.06	0.07	0.07	<0.04	<0.04		<0.03	0.04	0.04	3.3
29-Oct-93										
12-Nov-93	0.07	0.04	0.06	<0.04	<0.04		0.05	0.03	0.04	3.1
26-Nov-93										
10-Dec-93	0.13	0.04	0.09	0.04	<0.04	0.04	0.03	<0.03	0.03	3.4
24-Dec-93										
7-Jan-94	0.026	<0.02	0.03	<0.04	<0.04		<0.03	0.04	0.04	3.1
21-Jan-94	0.05	<0.02	0.05	<0.04	<0.04		0.04	<0.03	0.04	3.1

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Si (mg/l) CBZ2	Si (mg/l) AVERAGE	Zn (mg/l) CBZ1	Zn (mg/l) CBZ2	Zn (mg/l) AVERAGE	Sulphate (mg/l) CBZ1	Sulphate (mg) CBZ1	Sulphate (µg/kg/d) CBZ1	Cum Sul (mg) CBZ1
30-Jan-92	2.8	2.8		0.010	0.010	15912	14757.9		14758
6-Feb-92	2.5	2.3	0.005	0.009	0.007	15259	14152.3	208429	28910
13-Feb-92	2.4	2.4	0.002	0.005	0.004	11139	10331.0	152150	39241
20-Feb-92	2.6	2.6	0.002	0.003	0.003	5786	5366.3	79032	44607
27-Feb-92	2.8	2.8	0.008	0.004	0.006	3490	3236.9	47672	47844
5-Mar-92	2.4	2.8	0.003	0.003	0.003	2438	2261.3	33303	50106
12-Mar-92	2.9	2.9	0.004	0.007	0.006	2329	2159.8	31809	52266
19-Mar-92	2.7	3.0	<0.001	0.002	0.002	2038	1890.3	27839	54156
26-Mar-92	2.9	3.0	0.005	0.004	0.005	1825	1692.3	24923	55848
2-Apr-92	2.7	2.9	0.003	0.005	0.004	1716	1658.4	24424	57506
9-Apr-92	3.5	3.3	0.004	0.002	0.003	1667	1618.3	23833	59125
16-Apr-92	3.3	3.2	0.002	0.002	0.002	1324	1288.3	18974	60413
23-Apr-92	2.6	2.8	0.003	0.003	0.003	1424	1385.7	20407	61799
30-Apr-92	3.3	3.2	0.004	0.002	0.003	1568	1520.1	22388	63319
7-May-92	3.5	3.2	0.003	0.005	0.004	1519	1445.7	21292	64765
14-May-92	3.1	2.9	0.003	<0.001	0.003	1399	1414.8	20837	66179
22-May-92	3.8	3.3	0.002	0.002	0.002	1297	1273.7	16414	67453
29-May-92	3.1	3.0	0.002	0.002	0.002	1532	1507.0	22195	68960
5-Jun-92	2.8	2.9	0.003	0.002	0.003	1515	1434.0	21119	70394
12-Jun-92	3.1	3.0	<0.001	<0.001		1546	1491.3	21963	71886
19-Jun-92	2.7	2.8	0.004	<0.001	0.004	995	433.7	6387	72319
29-Jun-92	2.3	2.6	0.003	<0.001	0.003	1340	1330.9	13720	73650
3-Jul-92	3.1	3.1	0.006	0.002	0.004	1278	1193.0	30747	74843
10-Jul-92	2.9	2.9	0.003	0.001	0.002	1330	1277.5	18815	76121
17-Jul-92		2.7	0.003	0.010	0.007	1484	1404.5	20684	77525
24-Jul-92	3.2	3.1	0.003	<0.001	0.003	1314	1237.5	18225	78762

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Si (mg/l) CBZ2	Si (mg/l) AVERAGE	Zn (mg/l) CBZ1	Zn (mg/l) CBZ2	Zn (mg/l) AVERAGE	Sulphate (mg/l) CBZ1	Sulphate (mg) CBZ1	Sulphate (µg/kg/d) CBZ1	Cum Sul (mg) CBZ1
1-Aug-92	2.8	2.9	0.003	<0.001	0.003	1321	1201.4	15482	79964
7-Aug-92	2.8	2.6	0.004	0.004	0.004	1520	1416.1	24331	81380
14-Aug-92	2.7	2.8	0.010	0.006	0.008	1310	1210.2	17823	82590
21-Aug-92	2.6	2.5	0.005	0.008	0.007	1176	1087.5	16016	83678
28-Aug-92	3.1	2.8	0.006	0.004	0.005	1477	1383.1	20369	85061
4-Sep-92	2.7	2.7	0.007	0.005	0.006	1322	1231.0	18129	86292
11-Sep-92	3.1	2.9	0.003	0.007	0.005	1548	1450.9	21368	87743
18-Sep-92	2.9	2.6	0.003	0.002	0.003	1388	1323.7	19495	89066
25-Sep-92	2.7	2.5	0.003	0.002	0.003	1377	1145.4	16870	90212
2-Oct-92	2.6	2.5	0.009	0.003	0.006	1360	1308.7	19273	91520
8-Oct-92	2.7	2.7	0.004	<0.001	0.004	1444	1374.5	23616	92895
16-Oct-92	2.7	2.7	<0.001	0.002	0.002	1469	1404.2	18095	94299
30-Oct-92						1425	1361.9	10029	95661
13-Nov-92	2.8	2.7	0.005	<0.001	0.005	1380	1283.2	9449	96944
27-Nov-92						1435	1344.3	9899	98288
11-Dec-92	2.4	2.4	0.002	<0.001	0.002	1490	1408.9	10375	99697
24-Dec-92						1566	1423.8	11291	101121
8-Jan-93	2.1	2.2	0.004	0.002	0.003	1643	1533.4	10539	102655
22-Jan-93						1497	1355.8	9984	104010
5-Feb-93	1.9	2.1	0.007	<0.001	0.007	1351	1181.9	8704	105192
19-Feb-93						1468	1351.0	9948	106543
5-Mar-93	1.6	1.9	0.008	0.001	0.005	1584	1429.4	10526	107973
19-Mar-93						1525	1385.1	10199	109358
2-Apr-93	1.6	1.8	0.002	<0.001	0.002	1465	1310.4	9649	110668
16-Apr-93						1489	1385.4	10202	112054
30-Apr-93	1.3	1.5	0.001	<0.001	0.001	1513	1452.9	10699	113507

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Si (mg/l) CBZ2	Si (mg/l) AVERAGE	Zn (mg/l) CBZ1	Zn (mg/l) CBZ2	Zn (mg/l) AVERAGE	Sulphate (mg/l) CBZ1	Sulphate (mg) CBZ1	Sulphate (µg/kg/d) CBZ1	Cum Sul (mg) CBZ1
14-May-93						1462	1353.9	9970	114860
28-May-93	2.0	1.9	0.001	<0.001	0.001	1411	1325.8	9763	116186
11-Jun-93						1435	1359.6	10012	117546
25-Jun-93	2.1	1.9	0.001	<0.001	0.001	1458	1439.5	10600	118985
9-Jul-93						1620	1504.3	11077	120490
23-Jul-93	2.1	2.0	<0.001	<0.001		1782	1661.4	12234	122151
9-Aug-93						1772	1663.8	10090	123815
20-Aug-93	2.1	2.9	<0.001	<0.001		1761	1668.6	15638	125483
3-Sep-93						1864	1820.6	13406	127304
17-Sep-93	2.9	2.9	<0.001	<0.001		1966	1837.4	13530	129141
1-Oct-93						1998	1889.4	13913	131031
15-Oct-93	3.1	3.2	0.002	<0.001	0.002	2029	1842.1	13565	132873
29-Oct-93						2137	1998.3	14715	134871
12-Nov-93	2.4	2.7	<0.001	0.003	0.003	2244	2158.6	15895	137030
26-Nov-93						2127	1892.7	13937	138923
10-Dec-93	4.2	3.8	<0.001	<0.001		2011	1987.3	14634	140910
24-Dec-93						1495	1228.1	9044	142138
7-Jan-94	3.5	3.3	0.001	0.002	0.001	980	912.9	6723	143051
21-Jan-94	4.1	3.6	0.005	0.003	0.004	3224	2710.6	19960	145761

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	% Cum Sul CBZ1	Sulphate (mg/l) CBZ2	Sulphate (mg) CBZ2	Sulphate (µg/kg/d) CBZ2	Cum Sul (mg) CBZ2	% Cum Sul CBZ2	Sulphate (mg/l) AVERAGE	Sulphate % Cum AVERAGE	Sulphate (µg/kg/d) AVERAGE
30-Jan-92	2.1	15383	14745.1		14745	2.1	15648	2.1	
6-Feb-92	4.2	15522	14878.7	219126	29624	4.3	15391	4.2	213778
13-Feb-92	5.7	10578	10139.5	149330	39763	5.7	10859	5.7	150740
20-Feb-92	6.4	5971	5723.6	84295	45487	6.6	5879	6.5	81663
27-Feb-92	6.9	3721	3567.0	52533	49054	7.1	3606	7.0	50103
5-Mar-92	7.2	2662	2551.9	37584	51606	7.4	2550	7.3	35444
12-Mar-92	7.5	2155	2065.5	30419	53671	7.7	2242	7.6	31114
19-Mar-92	7.8	1760	1686.8	24842	55358	8.0	1899	7.9	26341
26-Mar-92	8.0	1633	1565.4	23055	56924	8.2	1729	8.1	23989
2-Apr-92	8.3	1697	1851.5	27268	58775	8.5	1707	8.4	25846
9-Apr-92	8.5	1410	1373.5	20229	60149	8.7	1538	8.6	22031
16-Apr-92	8.7	1533	1475.6	21732	61624	8.9	1429	8.8	20353
23-Apr-92	8.9	1200	1004.2	14789	62628	9.0	1312	9.0	17598
30-Apr-92	9.1	1440	1573.4	23173	64202	9.2	1504	9.2	22780
7-May-92	9.3	1542	1396.6	20568	65598	9.4	1530	9.4	20930
14-May-92	9.5	1469	1459.7	21497	67058	9.7	1434	9.6	21167
22-May-92	9.7	1438	1296.5	16707	68355	9.8	1367	9.8	16560
29-May-92	9.9	1460	1319.4	19432	69674	10.0	1496	10.0	20814
5-Jun-92	10.1	1154	962.3	14172	70636	10.2	1335	10.2	17645
12-Jun-92	10.4	1498	1404.5	20685	72041	10.4	1522	10.4	21324
19-Jun-92	10.4	972	1039.9	15315	73081	10.5	984	10.5	10851
29-Jun-92	10.6	1321	1053.5	10861	74134	10.7	1330	10.6	12291
3-Jul-92	10.8	1346	1445.4	37253	75580	10.9	1312	10.8	34000
10-Jul-92	11.0	1327	1094.0	16112	76674	11.0	1328	11.0	17464
17-Jul-92	11.2	1543	1453.8	21410	78127	11.3	1514	11.2	21047
24-Jul-92	11.3	1366	1512.3	22272	79640	11.5	1340	11.4	20248

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	% Cum Sul CBZ1	Sulphate (mg/l) CBZ2	Sulphate (mg) CBZ2	Sulphate (µg/kg/d) CBZ2	Cum Sul (mg) CBZ2	% Cum Sul CBZ2	Sulphate (mg/l) AVERAGE	Sulphate % Cum AVERAGE	Sulphate (µg/kg/d) AVERAGE
1-Aug-92	11.5	1430	1216.6	15678	80856	11.6	1376	11.6	15580
7-Aug-92	11.7	2304	2454.8	42179	83311	12.0	1912	11.9	33255
14-Aug-92	11.9	1526	1404.0	20677	84715	12.2	1418	12.0	19250
21-Aug-92	12.1	1338	1184.3	17442	85899	12.4	1257	12.2	16729
28-Aug-92	12.3	1391	1174.4	17296	87074	12.5	1434	12.4	18833
4-Sep-92	12.4	1431	1396.0	20559	88470	12.7	1376	12.6	19344
11-Sep-92	12.6	1577	1344.0	19793	89814	12.9	1563	12.8	20581
18-Sep-92	12.8	1398	1320.3	19445	91134	13.1	1393	13.0	19470
25-Sep-92	13.0	1440	1319.2	19429	92453	13.3	1408	13.2	18149
2-Oct-92	13.2	1404	1355.3	19960	93808	13.5	1382	13.3	19617
8-Oct-92	13.4	3058	3014.9	51802	96823	13.9	2251	13.7	37709
16-Oct-92	13.6	1529	1541.6	19865	98365	14.2	1499	13.9	18980
30-Oct-92	13.8	1469	1193.6	8789	99558	14.3	1447	14.1	9409
13-Nov-92	14.0	1410	1459.8	10750	101018	14.5	1395	14.3	10099
27-Nov-92	14.2	1325	1208.5	8899	102227	14.7	1380	14.4	9399
11-Dec-92	14.4	1239	1153.5	8494	103380	14.9	1365	14.6	9435
24-Dec-92	14.6	1286	1152.7	9141	104533	15.1	1426	14.8	10216
8-Jan-93	14.8	1333	1239.1	8516	105772	15.2	1488	15.0	9528
22-Jan-93	15.0	1488	1334.6	9828	107107	15.4	1493	15.2	9906
5-Feb-93	15.2	1644	1406.4	10357	108513	15.6	1498	15.4	9530
19-Feb-93	15.3	1542	1419.6	10454	109933	15.8	1505	15.6	10201
5-Mar-93	15.6	1440	1179.2	8683	111112	16.0	1512	15.8	9605
19-Mar-93	15.8	1419	1262.9	9300	112375	16.2	1472	16.0	9750
2-Apr-93	15.9	1399	1247.3	9185	113622	16.4	1432	16.2	9417
16-Apr-93	16.1	1495	1450.6	10682	115073	16.6	1492	16.4	10442
30-Apr-93	16.3	1591	1442.6	10623	116515	16.8	1552	16.6	10661

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	% Cum Sul CBZ1	Sulphate (mg/l) CBZ2	Sulphate (mg) CBZ2	Sulphate (µg/kg/d) CBZ2	Cum Sul (mg) CBZ2	% Cum Sul CBZ2	Sulphate (mg/l) AVERAGE	Sulphate % Cum AVERAGE	Sulphate (µg/kg/d) AVERAGE
14-May-93	16.5	1577	1440.4	10607	117956	17.0	1519	16.8	10288
28-May-93	16.7	1563	1491.2	10981	119447	17.2	1487	17.0	10372
11-Jun-93	16.9	1550	1421.2	10466	120868	17.4	1492	17.2	10239
25-Jun-93	17.1	1537	1404.2	10340	122272	17.6	1497	17.4	10470
9-Jul-93	17.4	1678	1586.3	11681	123859	17.8	1649	17.6	11379
23-Jul-93	17.6	1818	1656.5	12198	125515	18.1	1800	17.8	12216
9-Aug-93	17.8	1717	1612.2	9777	127128	18.3	1744	18.1	9933
20-Aug-93	18.1	1615	1480.2	13873	128608	18.5	1688	18.3	14756
3-Sep-93	18.3	1597	1555.7	11456	130164	18.7	1730	18.5	12431
17-Sep-93	18.6	1579	1374.1	10119	131538	18.9	1773	18.8	11825
1-Oct-93	18.9	1839	1769.7	13032	133307	19.2	1918	19.0	13473
15-Oct-93	19.1	2099	1556.3	11461	134864	19.4	2064	19.3	12513
29-Oct-93	19.4	2212	1920.8	14144	136785	19.7	2174	19.6	14430
12-Nov-93	19.7	2325	2284.3	16821	139069	20.0	2284	19.9	16358
26-Nov-93	20.0	2115	1416.5	10431	140485	20.2	2121	20.1	12184
10-Dec-93	20.3	1906	2122.8	15632	142608	20.5	1958	20.4	15133
24-Dec-93	20.5	1723	1612.7	11876	144221	20.8	1609	20.6	10460
7-Jan-94	20.6	1541	1223.2	9007	145444	20.9	1260	20.8	7865
21-Jan-94	21.0	2969	2178.7	16044	147623	21.3	3097	21.1	18002

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	TOTAL CN µg/l CBZ1	TOTAL CN µg/l CBZ2	TOTAL CN µg/l AVERAGE
30-Jan-92			
6-Feb-92	840	770	805
13-Feb-92	310	350	330
20-Feb-92	106	109	107.5
27-Feb-92	46	46	46
5-Mar-92	21	35	28
12-Mar-92	25	24	24.5
19-Mar-92	19	20	19.5
26-Mar-92	12	13	12.5
2-Apr-92	10	16	13
9-Apr-92	12	14	13
16-Apr-92	12	14	13
23-Apr-92	10	12	11
30-Apr-92	8	9	8.5
7-May-92	10	12	11
14-May-92			
22-May-92			
29-May-92	8	9	8.5
5-Jun-92	7	4	5.5
12-Jun-92	7	8	7.5
19-Jun-92	2	6	4
29-Jun-92	7	3	5
3-Jul-92	7	4	5.5
10-Jul-92	6	3	4.5
17-Jul-92	4	<2	4
24-Jul-92	2	<2	2

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	TOTAL CN µg/l CBZ1	TOTAL CN µg/l CBZ2	TOTAL CN µg/l AVERAGE
1-Aug-92	3	<2	3
7-Aug-92	5	4	4.5
14-Aug-92	4	3	3.5
21-Aug-92	4	5	4.5
28-Aug-92	<2	<2	
4-Sep-92	<2	<2	
11-Sep-92	<2	<2	
18-Sep-92	<2	<2	
25-Sep-92	<2	<2	
2-Oct-92	<2	<2	
8-Oct-92	<2	<2	
16-Oct-92	<2	<2	
30-Oct-92	-	-	
13-Nov-92	-	-	
27-Nov-92	-	-	
11-Dec-92	-	-	
24-Dec-92	-	-	
8-Jan-93	-	-	
22-Jan-93	-	-	
5-Feb-93	-	-	
19-Feb-93	-	-	
5-Mar-93	-	-	
19-Mar-93	-	-	
2-Apr-93	-	-	
16-Apr-93	-	-	
30-Apr-93	-	-	

Table 3: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	TOTAL CN µg/l CBZ1	TOTAL CN µg/l CBZ2	TOTAL CN µg/l AVERAGE
14-May-93	-	-	
28-May-93	-	-	
11-Jun-93	-	-	
25-Jun-93	-	-	
9-Jul-93	-	-	
23-Jul-93	-	-	
9-Aug-93	-	-	
20-Aug-93	-	-	
3-Sep-93	-	-	
17-Sep-93	-	-	
1-Oct-93	-	-	
15-Oct-93	-	-	
29-Oct-93	-	-	
12-Nov-93	-	-	
26-Nov-93	-	-	
10-Dec-93	-	-	
24-Dec-93	-	-	
7-Jan-94	-	-	
21-Jan-94	-	-	

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	Days From Start	VOLUME (ml) CBZ1	VOLUME (ml) CBZ2	VOLUME (ml) AVERAGE	CUMULATIVE VOLUME (ml)	LAB. pH pH(LAB) CBZ1 COLD TEMP.	LAB. pH pH(LAB) CBZ1 ROOM TEMP.	LAB. pH pH(LAB) CBZ2 COLD TEMP.	LAB. pH pH(LAB) CBZ2 ROOM TEMP.
11-Mar-94	49	851.19	878.05	864.6	864.6	5.80	5.80	5.65	5.52
25-Mar-94	63	897.39	825.41	861.4	1726.0	5.84	5.87	5.59	5.55
15-Apr-94	84	865.12	911.68	888.4	2614.4	5.18	5.32	4.84	4.77
29-Apr-94	98	861.08	873.04	867.1	3481.5	4.88	4.93	4.64	4.59
13-May-94	112	790.40	782.21	786.3	4267.8	5.31	5.26	5.00	5.36
27-May-94	126	845.52	869.16	857.3	5125.1	5.27	5.36	4.77	4.73
10-Jun-94	140	766.06	893.91	830.0	5955.1	5.03	5.13	4.73	4.81
24-Jun-94	154	943.58	939.44	941.5	6896.6	4.99	NSS	5.04	NSS
8-Jul-94	168	920.50	1001.40	961.0	7857.6	4.97	5.05	5.60	6.21
22-Jul-94	182	920.50	1001.40	961.0	8818.5	4.85	4.80	5.38	5.28
5-Aug-94	196	883.80	834.10	859.0	9677.5	5.25	5.20	5.35	5.56
19-Aug-94	210	901.68	914.54	908.1	10585.6	5.51	5.60	5.09	4.94
2-Sep-94	224	880.30	883.90	882.1	11467.7	5.36	5.40	5.16	5.19
16-Sep-94	238	972.90	741.30	857.1	12324.8	5.68	5.84	5.23	5.01
30-Sep-94	252	963.80	1017.90	990.9	13315.6	5.42	5.69	5.00	5.10
14-Oct-94	266	943.20	989.30	966.3	14281.9	4.81	4.84	5.65	5.93
28-Oct-94	280	687.80	1049.40	868.6	15150.5	5.01	4.99	5.62	5.68
10-Nov-94	293	932.90	811.00	872.0	16022.4	5.46	5.90	5.87	6.17
25-Nov-94	308	986.38	895.20	940.8	16963.2	5.17	5.12	5.83	5.87
9-Dec-94	322	938.30	758.30	848.3	17811.5	5.78	5.69	5.78	5.69
23-Dec-94	336	862.60	715.50	789.1	18600.6	6.21	6.16	6.11	6.03
6-Jan-95	350	949.34	715.24	832.3	19432.9	6.12	6.20	6.15	6.24
20-Jan-95	364	873.21	1372.72	1123.0	20555.8	5.88	5.95	5.83	6.01
3-Feb-95	378	846.50	934.52	890.5	21446.3	6.26	6.28	6.51	6.52

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	LAB. pH pH(LAB) AVERAGE COLD TEMP.	LAB. pH pH(LAB) AVERAGE ROOM TEMP.	EH Eh(mV) CBZ1 COLD TEMP.	EH Eh(mV) CBZ1 ROOM TEMP.	EH Eh(mV) CBZ2 COLD TEMP.	EH Eh(mV) CBZ2 ROOM TEMP.	EH Eh(mV) AVERAGE COLD TEMP.	EH Eh(mV) AVERAGE ROOM TEMP.	EH(NHE) (mV) CBZ1 COLD TEMP.
11-Mar-94	5.72	5.63	116.10	-54.20	100.7	19.8	108.4	-17.2	360.1
25-Mar-94	5.70	5.69	83.40	-51.80	84.4	-5.2	83.9	-28.5	327.4
15-Apr-94	4.97	4.96	160.1	49.3	119.7	150.1	139.9	99.7	404.1
29-Apr-94	4.74	4.73	182.6	172.5	190.0	187.0	186.3	179.8	426.6
13-May-94	5.13	5.31	219.0	98.4	195.5	116.8	207.3	107.6	463.0
27-May-94	4.94	4.94	220.9	152.3	232.2	270.3	226.6	211.3	464.9
10-Jun-94	4.84	4.93	308.8	229.5	311.8	289.3	310.3	259.4	552.8
24-Jun-94	5.01	NSS	181.2	NSS	181.7	NSS	181.5	NSS	425.2
8-Jul-94	5.19	5.34	184.5	158.3	131.6	-32.4	158.1	63.0	428.5
22-Jul-94	5.05	4.98	270.2	293.8	239.2	265.5	254.7	279.7	514.2
5-Aug-94	5.30	5.34	276.8	143.5	268.2	166.2	272.5	154.9	520.8
19-Aug-94	5.25	5.15	250.3	159.9	262.0	229.5	256.2	194.7	494.3
2-Sep-94	5.25	5.28	271.7	145.3	244.4	244.3	258.1	194.8	515.7
16-Sep-94	5.43	5.29	201.5	182.9	247.8	277.8	224.7	230.4	445.5
30-Sep-94	5.16	5.29	128.6	57.3	167.2	158.1	147.9	107.7	372.6
14-Oct-94	5.06	5.11	215.4	228.1	118.3	70.2	166.9	149.2	459.4
28-Oct-94	5.27	5.27	198.8	184.4	177.1	125.0	188.0	154.7	442.8
10-Nov-94	5.61	6.01	175.1	42.6	117.9	22.1	146.5	32.4	419.1
25-Nov-94	5.37	5.34	194.1	214.7	149.7	119.0	171.9	166.9	438.1
9-Dec-94	5.78	5.69	151.4	140.9	91.9	57.8	121.7	99.4	395.4
23-Dec-94	6.16	6.09	231.3	272.1	222.0	220.8	226.7	246.5	475.3
6-Jan-95	6.13	6.22	183.8	155.2	103.0	68.1	143.4	111.7	427.8
20-Jan-95	5.85	5.99	218.4	108.5	202.7	165.3	210.6	136.9	462.4
3-Feb-95	6.37	6.39	209.5	107.1	179.2	138.1	194.4	122.6	453.5

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	EH(NHE) (mV) CBZ1 ROOM TEMP.	EH(NHE) (mV) CBZ2 COLD TEMP.	EH(NHE) (mV) CBZ2 ROOM TEMP.	EH(NHE) (mV) AVERAGE COLD TEMP.	EH(NHE) (mV) AVERAGE ROOM TEMP.	LAB. Ec Ec(LAB) CBZ1 COLD TEMP.	LAB. Ec Ec(LAB) CBZ1 ROOM TEMP.	LAB. Ec Ec(LAB) CBZ2 COLD TEMP.	LAB. Ec Ec(LAB) CBZ2 ROOM TEMP.
11-Mar-94	189.8	344.7	263.8	352.4	226.8	3260	3200	3170	3170
25-Mar-94	192.2	328.4	238.8	327.9	215.5	3010	2980	3150	3100
15-Apr-94	293.3	363.7	394.1	383.9	343.7	2750	2690	2620	2730
29-Apr-94	416.5	434.0	431.0	430.3	423.8	2560	2430	2520	2440
13-May-94	342.4	439.5	360.8	451.3	351.6	2480	2180	2440	2230
27-May-94	396.3	476.2	514.3	470.6	455.3	2300	2100	2220	2220
10-Jun-94	473.5	555.8	533.3	554.3	503.4	2330	2280	2160	2140
24-Jun-94	NSS	425.7	NSS	425.5	NSS	2170	NSS	2200	NSS
8-Jul-94	402.3	375.6	211.6	402.1	307.0	1967	1923	1929	1946
22-Jul-94	537.8	483.2	509.5	498.7	523.7	2040	1900	2050	1935
5-Aug-94	387.5	512.2	410.2	516.5	398.9	2210	2040	2060	2010
19-Aug-94	403.9	506.0	473.5	500.2	438.7	1942	1860	1982	1915
2-Sep-94	389.3	488.4	488.3	502.1	438.8	2070	1888	2040	1902
16-Sep-94	426.9	491.8	521.8	468.7	474.4	2300	1905	2310	1928
30-Sep-94	301.3	411.2	402.1	391.9	351.7	2280	1890	2340	1876
14-Oct-94	472.1	362.3	314.2	410.9	393.2	2170	2070	2150	2020
28-Oct-94	428.4	421.1	369.0	432.0	398.7	2010	1795	2020	1827
10-Nov-94	286.6	361.9	266.1	390.5	276.4	2020	1807	2000	1804
25-Nov-94	458.7	393.7	363.0	415.9	410.9	1962	N.S.S.	1940	N.S.S.
9-Dec-94	384.9	335.9	301.8	365.7	343.4	1872	1711	1851	1649
23-Dec-94	516.1	466.0	464.8	470.7	490.5	1864	1857	1846	1827
6-Jan-95	399.2	347.0	312.1	387.4	355.7	1900	1724	1863	1776
20-Jan-95	352.5	446.7	409.3	454.6	380.9	1637	2070	1760	2200
3-Feb-95	351.1	423.2	382.1	438.4	366.6	2020	1515	2020	1511

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	LAB. Ec Ec(LAB) AVERAGE COLD TEMP.	LAB. Ec Ec(LAB) AVERAGE ROOM TEMP.	SAMPLE TEMP.(C) CBZ1 COLD	SAMPLE TEMP.(C) CBZ1 ROOM	SAMPLE TEMP.(C) CBZ2 COLD	SAMPLE TEMP.(C) CBZ2 ROOM	SAMPLE TEMP.(C) AVERAGE COLD	SAMPLE TEMP.(C) AVERAGE ROOM	ACIDITY (mg/l) CBZ1
11-Mar-94	3215	3185	10.5	27.3	10.5	23.6	10.5	25.5	297.75
25-Mar-94	3080	3040	10.2	21.7	9.9	24.8	10.1	23.3	764.07
15-Apr-94	2685	2710	10.7	24.1	10.6	27.9	10.7	26.0	861.63
29-Apr-94	2540	2435	10.6	23.7	10.4	24.8	10.5	24.3	719.69
13-May-94	2460	2205	10.4	23.6	10.6	22.3	10.5	23.0	574.88
27-May-94	2260	2160	10.3	20.8	10.9	21.8	10.6	21.3	470.38
10-Jun-94	2245	2210	10.9	24.0	10.8	22.3	10.9	23.2	382.63
24-Jun-94	2185	NSS	15.5	NSS	15.8	NSS	15.7	NSS	307.64
8-Jul-94	1948	1935	13.6	21.5	14.0	21.7	13.8	21.6	280.00
22-Jul-94	2045	1918	11.9	21.6	10.8	22.5	11.4	22.1	231.80
5-Aug-94	2135	2025	11.2	26.0	12.8	24.8	12.0	25.4	210.12
19-Aug-94	1962	1888	11.3	25.4	11.4	28.8	11.4	27.1	190.46
2-Sep-94	2055	1895	11.8	26.4	12.7	24.7	12.3	25.6	168.67
16-Sep-94	2305	1917	13.2	21.5	15.0	21.4	14.1	21.5	138.27
30-Sep-94	2310	1883	11.9	22.5	12.5	22.5	12.2	22.5	112.78
14-Oct-94	2160	2045	15.0	21.2	15.0	21.0	15.0	21.1	74.88
28-Oct-94	2015	1811	11.8	21.3	11.9	21.3	11.9	21.3	67.88
10-Nov-94	2010	1806	12.1	21.9	11.8	21.8	12.0	21.9	46.61
25-Nov-94	1951	#DIV/0!	15.6	21.2	15.1	21.1	15.4	21.2	44.13
9-Dec-94	1862	1680	11.7	20.2	11.0	20.1	11.4	20.2	23.19
23-Dec-94	1855	1842	12.4	19.9	11.8	19.6	12.1	19.8	17.80
6-Jan-95	1882	1750	14.3	20.7	15.3	21.3	14.8	21.0	19.35
20-Jan-95	1699	2135	10.9	21.4	11.5	21.2	11.2	21.3	12.79
3-Feb-95	2020	1513	11.6	19.5	11.9	18.9	11.8	19.2	8.03

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	ACIDITY (mg/l) CBZ2	ACIDITY (mg/l) AVERAGE	ALKALINITY (mg/l) CBZ1	ALKALINITY (mg/l) CBZ2	ALKALINITY (mg/l) AVERAGE	Al (mg/l) CBZ1	Al (mg/l) CBZ2	Al (mg/l) AVERAGE	As (mg/l) CBZ1
11-Mar-94	395.96	346.86	36.64	14.67	25.66	0.18	0.13	0.16	0.14
25-Mar-94	776.11	770.09	46.79	16.66	31.73	0.15	0.05	0.10	0.31
15-Apr-94	875.69	868.66	7.70	0.00	3.85	0.14	0.06	0.10	0.29
29-Apr-94	731.98	725.84	6.46	0.00	3.23	0.17	0.09	0.13	0.25
13-May-94	574.39	574.63	19.94	26.80	23.37	0.15	0.09	0.12	0.18
27-May-94	487.32	478.85	15.83	1.53	8.68	0.17	0.08	0.13	0.16
10-Jun-94	387.25	384.94	5.60	0.98	3.29	0.17	0.08	0.13	0.13
24-Jun-94	312.34	309.99	3.28	2.26	2.77	0.18	0.11	0.15	0.12
8-Jul-94	292.90	286.45	1.83	18.94	10.38	0.18	0.10	0.14	0.09
22-Jul-94	234.08	232.94	0.08	6.92	3.50	0.21	0.12	0.17	0.08
5-Aug-94	210.88	210.50	4.19	7.14	5.66	0.18	0.13	0.16	0.05
19-Aug-94	189.05	189.75	10.56	2.52	6.54	0.19	0.11	0.15	<0.044
2-Sep-94	167.09	167.88	7.29	2.12	4.71	0.17	0.11	0.14	<0.044
16-Sep-94	143.86	141.06	17.70	2.69	10.20	0.17	0.12	0.15	<0.044
30-Sep-94	114.26	113.52	9.73	1.95	5.84	0.16	0.09	0.13	<0.044
14-Oct-94	86.73	80.81	1.34	17.77	9.56	0.15	0.05	0.10	<0.044
28-Oct-94	68.90	68.39	1.28	5.96	3.62				
10-Nov-94	58.13	52.37	14.31	21.67	17.99				
25-Nov-94	47.08	45.61	2.01	6.27	4.14	0.08	0.08	0.08	<0.044
9-Dec-94	38.89	31.04	3.46	9.01	6.24	0.08	0.07	0.08	<0.044
23-Dec-94	32.02	24.91	7.37	8.14	7.76	0.11	0.08	0.10	<0.044
6-Jan-95	28.04	23.70	6.78	11.09	8.94	0.07	0.09	0.08	<0.044
20-Jan-95	17.53	15.16	12.51	23.50	18.01	0.13	0.10	0.12	<0.044
3-Feb-95	6.34	7.19	8.08	13.94	11.01	0.10	0.08	0.09	<0.044

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	As (mg/l) CBZ2	As (mg/l) AVERAGE	Ca (mg/l) CBZ1	Ca (mg/l) CBZ2	Ca (mg/l) AVERAGE	Cu (mg/l) CBZ1	Cu (mg/l) CBZ2	Cu (mg/l) AVERAGE	Fe TOTAL (mg/l) CBZ1	Fe TOTAL (mg/l) CBZ2
11-Mar-94	0.08	0.11	555.5	556.6	556.1	<0.004	<0.004		168.8	210.3
25-Mar-94	0.15	0.23	532.0	522.0	527.0	<0.004	<0.004		441.7	430.4
15-Apr-94	0.14	0.22	523.3	512.2	517.8	<0.004	<0.004		454.8	463.3
29-Apr-94	0.14	0.20	511.7	517.9	514.8	<0.004	<0.004		374	385.1
13-May-94	0.10	0.14	529.4	541.1	535.3	<0.004	<0.004		301.4	313
27-May-94	0.08	0.12	538.6	536.1	537.4	<0.004	<0.004		248.3	252.2
10-Jun-94	0.049	0.09	544.8	538.3	541.6	<0.004	<0.004		200.6	197.5
24-Jun-94	<0.044	0.12	539.2	544.1	541.7	<0.004	<0.004		160.6	163.1
8-Jul-94	<0.044	0.09	544.9	552.5	548.7	<0.004	<0.004		138.1	144.3
22-Jul-94	<0.044	0.08	560.5	562.7	561.6	<0.004	<0.004		116.7	115.8
5-Aug-94	0.06	0.06	564.6	549.5	557.1	<0.004	<0.004		102.8	105.5
19-Aug-94	<0.044		561.4	558.0	559.7	<0.004	<0.004		92.06	92.08
2-Sep-94	<0.044		556.5	550.7	553.6	<0.004	<0.004		76.06	74.97
16-Sep-94	<0.044		560.4	569.8	565.1	<0.004	<0.004		65.92	66.59
30-Sep-94	<0.044		562.6	566.1	564.4	<0.004	<0.004		51.89	52.02
14-Oct-94	<0.044		558.6	560.7	559.7	<0.004	<0.004		36.23	46.33
28-Oct-94										
10-Nov-94										
25-Nov-94	<0.044			561.2	561.2	<0.004	<0.004		17.51	19.82
9-Dec-94	0.045	0.05		559.5	559.5	<0.004	<0.004		8.41	16.19
23-Dec-94	<0.044			567.0	567.0	<0.004	<0.004		6.2	12.54
6-Jan-95	<0.044			569.8	569.8	<0.004	<0.004		6.4	10.41
20-Jan-95	<0.044			540.3	540.3	<0.004	<0.004		6.2	11.29
3-Feb-95	<0.044			558.5	558.5	<0.004	<0.004		1	0.4625

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	Fe TOTAL (mg/l) AVERAGE	Hg (mg/l) CBZ1	Hg (mg/l) CBZ2	Hg (mg/l) AVERAGE	Mg (mg/l) CBZ1	Mg (mg/l) CBZ2	Mg (mg/l) AVERAGE	Mn (mg/l) CBZ1	Mn (mg/l) CBZ2	Mn (mg/l) AVERAGE
11-Mar-94	189.55	<0.15	<0.15		229.6	222.9	226.3	16.9		16.9
25-Mar-94	436.05	<0.15	0.16		108.0	133.3	120.7	23.2		23.2
15-Apr-94	459.05	<0.15	<0.15		85.6	93.8	89.7	22.8		22.8
29-Apr-94	379.55	<0.15	<0.15		45.8	52.1	48.9	17.7		17.7
13-May-94	307.20	<0.15	<0.15		24.8	27.9	26.4	14.5		14.5
27-May-94	250.25	<0.15	<0.15		16.1	18.0	17.1	11.0		11.0
10-Jun-94	199.05	<0.15	<0.15		13.2	13.7	13.4	9.2	9.4	9.3
24-Jun-94	161.85	<0.15	<0.15		21.4	12.2	16.8	8.5	8.0	8.3
8-Jul-94	141.20	<0.15	<0.15		10.1	10.3	10.2	6.9	6.9	6.9
22-Jul-94	116.25	<0.15	<0.15		10.0	9.8	9.9	6.3	6.1	6.2
5-Aug-94	104.15	<0.15	<0.15		9.3	10.2	9.7	5.6	5.6	5.6
19-Aug-94	92.07	<0.15	<0.15		9.1	10.1	9.6	5.2	5.1	5.2
2-Sep-94	75.52	<0.15	<0.15		8.2	9.1	8.6	4.4	4.4	4.4
16-Sep-94	66.26	<0.15	<0.15		8.8	9.2	9.0	4.1	4.1	4.1
30-Sep-94	51.96	<0.15	<0.15		7.9	8.4	8.2	3.6	3.5	3.6
14-Oct-94	41.28	<0.15	<0.15		8.6	8.6	8.6	3.3	3.2	3.3
28-Oct-94										
10-Nov-94										
25-Nov-94	18.67	<0.15	<0.15		7.4	7.4	7.4	2.5	2.4	2.5
9-Dec-94	12.30	<0.15	<0.15		7.9	7.2	7.6	2.3	2.3	2.3
23-Dec-94	9.37	<0.15	<0.15		7.6	7.2	7.4	2.2	2.2	2.2
6-Jan-95	8.41	<0.15	<0.15		7.1	6.9	7.0	2.1	2.1	2.1
20-Jan-95	8.75	<0.15	<0.15		6.9	6.7	6.8	1.9	1.9	1.9
3-Feb-95	0.73	<0.15	<0.15		7.5	6.8	7.2	1.9	1.8	1.9

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	Ni (mg/l) CBZ1	Ni (mg/l) CBZ2	Ni (mg/l) AVERAGE	Pb (mg/l) CBZ1	Pb (mg/l) CBZ2	Pb (mg/l) AVERAGE	Sb (mg/l) CBZ1	Sb (mg/l) CBZ2	Sb (mg/l) AVERAGE	Si (mg/l) CBZ1
11-Mar-94	0.04	0.1	0.07	0.04	<0.04	0.04	0.08	0.04	0.06	3.1
25-Mar-94	0.14	0.1	0.12	0.05	<0.04	0.05	0.05	0.04	0.05	4.2
15-Apr-94	0.13	0.14	0.14	0.05	<0.04	0.05	0.04	0.04	0.04	4.1
29-Apr-94	0.11	0.09	0.10	0.05	<0.04	0.05	<0.03	<0.03		3.4
13-May-94	0.07	0.07	0.07	<0.04	<0.04		<0.03	<0.03		3.4
27-May-94	0.06	0.06	0.06	<0.04	<0.04		<0.03	<0.03		3.1
10-Jun-94	0.047	0.04	0.04	0.05	<0.04	0.05	0.04	0.04	0.04	2.9
24-Jun-94	0.03	0.04	0.04	0.04	<0.04	0.04	0.03	0.04	0.03	2.8
8-Jul-94	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.7
22-Jul-94	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.8
5-Aug-94	<0.02	<0.02		<0.04	<0.04		<0.03	0.05	0.05	2.5
19-Aug-94	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.5
2-Sep-94	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.2
16-Sep-94	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.3
30-Sep-94	<0.02	0.021	0.02	<0.04	<0.04		<0.03	<0.03		2.1
14-Oct-94	<0.02	0.024	0.02	<0.04	<0.04		<0.03	<0.03		2.3
28-Oct-94										
10-Nov-94										
25-Nov-94	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.0
9-Dec-94	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.0
23-Dec-94	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		2.0
6-Jan-95	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		1.8
20-Jan-95	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		1.6
3-Feb-95	<0.02	<0.02		<0.04	<0.04		<0.03	<0.03		1.7

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	Si (mg/l) CBZ2	Si (mg/l) AVERAGE	Zn (mg/l) CBZ1	Zn (mg/l) CBZ2	Zn (mg/l) AVERAGE	Sulphate (mg/l) CBZ1	Sulphate (mg) CBZ1	Sulphate (µg/kg/d) CBZ1	Cum Sul (mg) CBZ1
11-Mar-94	3.3	3.2	0.003	0.010	0.007	2636	2243.8	4721	2244
25-Mar-94	4.5	4.4	<0.001	<0.001		2481	2226.7	16397	4470
15-Apr-94	3.9	4.0	<0.001	<0.001		2462	2129.8	10455	6600
29-Apr-94	3.2	3.3	<0.001	<0.001		2209	1902.1	14006	8502
13-May-94	3.4	3.4	<0.001	<0.001		1941	1533.9	11295	10036
27-May-94	3.1	3.1	<0.001	<0.001		1853	1566.9	11538	11603
10-Jun-94	2.7	2.8	<0.001	<0.001		1769	1355.0	9978	12958
24-Jun-94	2.5	2.7	0.001	<0.001	0.001	1770	1670.5	12301	14629
8-Jul-94	2.3	2.5	<0.001	<0.001		1662	1530.1	11267	16159
22-Jul-94	2.6	2.7	0.004	<0.001	0.004	1691	1556.9	11465	17716
5-Aug-94	2.2	2.4	<0.001	<0.001		1640	1449.9	10676	19165
19-Aug-94	2.3	2.4	<0.001	<0.001		1575	1419.8	10455	20585
2-Sep-94	2.1	2.2	<0.001	<0.001		1558	1371.8	10101	21957
16-Sep-94	2.1	2.2	0.001	<0.001	0.001	1465	1424.9	10492	23382
30-Sep-94	1.9	2.0	<0.001	<0.001		1530	1475.0	10862	24857
14-Oct-94	2.0	2.2	0.030	<0.001	0.030	1509	1423.7	10484	26281
28-Oct-94						1495	1027.9	7569	27309
10-Nov-94						1465	1366.3	10835	28675
25-Nov-94	1.8	1.9	0.002	0.002	0.001	1495	1474.2	10132	30149
9-Dec-94	1.8	1.9	<0.001	<0.001	0.001	1459	1368.6	10078	31518
23-Dec-94	1.7	1.9	<0.001	<0.001	0.001	1500	1294.3	9531	32812
6-Jan-95	1.7	1.8	<0.001	0.003	0.001	1530	1452.9	10699	34265
20-Jan-95	1.6	1.6	<0.001	0.002	0.002	1255	1095.8	8069	35361
3-Feb-95	1.6	1.6	<0.001	<0.001	0.002	1474	1247.4	9185	36608

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	% Cum Sul CBZ1	Sulphate (mg/l) CBZ2	Sulphate (mg) CBZ2	Sulphate (µg/kg/d) CBZ2	Cum Sul (mg) CBZ2	% Cum Sul CBZ2	Sulphate (mg/l) AVERAGE	Sulphate % Cum AVERAGE	Sulphate (µg/kg/d) AVERAGE
11-Mar-94	0.3	2594	2277.7	4792	2278	0.3	2615	0.3	4756
25-Mar-94	0.6	2562	2114.8	15573	4392	0.6	2522	0.6	15985
15-Apr-94	1.0	2578	2350.5	11539	6743	1.0	2520	1.0	10997
29-Apr-94	1.2	2280	1990.2	14655	8733	1.3	2244	1.2	14331
13-May-94	1.4	1922	1503.6	11072	10237	1.5	1931	1.5	11184
27-May-94	1.7	1864	1619.8	11928	11856	1.7	1858	1.7	11733
10-Jun-94	1.9	1752	1566.6	11536	13423	1.9	1761	1.9	10757
24-Jun-94	2.1	1717	1613.1	11879	15036	2.2	1744	2.1	12090
8-Jul-94	2.3	1682	1684.2	12402	16720	2.4	1672	2.4	11835
22-Jul-94	2.6	1650	1652.6	12169	18373	2.6	1671	2.6	11817
5-Aug-94	2.8	1615	1346.8	9918	19720	2.8	1628	2.8	10297
19-Aug-94	3.0	1631	1491.9	10986	21212	3.1	1603	3.0	10720
2-Sep-94	3.2	1608	1421.7	10469	22633	3.3	1583	3.2	10285
16-Sep-94	3.4	1468	1087.9	8011	23721	3.4	1466	3.4	9252
30-Sep-94	3.6	1512	1539.6	11337	25261	3.6	1521	3.6	11099
14-Oct-94	3.8	1503	1487.4	10953	26748	3.9	1506	3.8	10719
28-Oct-94	3.9	1509	1584.1	11665	28332	4.1	1502	4.0	9617
10-Nov-94	4.1	1453	1178.0	9342	29510	4.3	1459	4.2	10089
25-Nov-94	4.3	1489	1332.5	9158	30843	4.4	1492	4.4	9645
9-Dec-94	4.5	1459	1106.0	8145	31949	4.6	1459	4.6	9111
23-Dec-94	4.7	1498	1071.5	7890	33020	4.8	1499	4.7	8711
6-Jan-95	4.9	1447	1034.7	7619	34055	4.9	1489	4.9	9159
20-Jan-95	5.1	1402	1924.1	14169	35979	5.2	1328	5.1	11119
3-Feb-95	5.3	1459	1363.1	10037	37342	5.4	1466	5.3	9611

Table 4: Effluent water quality parameters and leaching characteristics of B - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	TOTAL CN µg/l CBZ1	TOTAL CN µg/l CBZ2	TOTAL CN µg/l AVERAGE
11-Mar-94	-	-	
25-Mar-94	-	-	
15-Apr-94	-	-	
29-Apr-94	-	-	
13-May-94	-	-	
27-May-94	-	-	
10-Jun-94	-	-	
24-Jun-94	-	-	
8-Jul-94	-	-	
22-Jul-94	-	-	
5-Aug-94	-	-	
19-Aug-94	-	-	
2-Sep-94	-	-	
16-Sep-94	-	-	
30-Sep-94	-	-	
14-Oct-94	-	-	
28-Oct-94	-	-	
10-Nov-94	-	-	
25-Nov-94	-	-	
9-Dec-94	-	-	
23-Dec-94	-	-	
6-Jan-95	-	-	
20-Jan-95	-	-	
3-Feb-95	-	-	

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	DAYS FROM START	VOLUME (ml) CSZ1	VOLUME (ml) CSZ2	VOLUME (ml) AVERAGE	CUMMULATIVE VOLUME (ml)	LAB. pH pH(LAB) CSZ1 COLD TEMP.	LAB. pH pH(LAB) CSZ1 ROOM TEMP.	LAB. pH pH(LAB) CSZ2 COLD TEMP.	LAB. pH pH(LAB) CSZ2 ROOM TEMP.
30-Jan-92	0	955.7	902.3	929.0	929.0	6.92		5.75	
6-Feb-92	7	955.7	902.3	929.0	1858.0	6.31		6.15	
13-Feb-92	14	955.7	902.3	929.0	2787.0	6.34		6.34	
20-Feb-92	21	955.7	902.3	929.0	3716.0	6.21		6.36	
27-Feb-92	28	955.7	902.3	929.0	4645.0	6.44		6.53	
5-Mar-92	35	955.7	902.3	929.0	5574.1	6.42		6.69	
12-Mar-92	42	955.7	902.3	929.0	6503.1	6.58		6.71	
19-Mar-92	49	955.7	902.3	929.0	7432.1	6.63		6.73	
26-Mar-92	56	955.7	902.3	929.0	8361.1	6.59		6.85	
2-Apr-92	63	960.5	952.7	956.6	9317.7	6.65	6.77	6.98	6.99
9-Apr-92	70	968.6	947.2	957.9	10275.5	6.50	6.74	6.96	7.18
16-Apr-92	77	982.9	980.5	981.7	11257.2	6.67	7.05	6.87	7.18
23-Apr-92	84	922.7	962.4	942.6	12199.8	6.41	6.83	6.66	7.43
30-Apr-92	91	944.7	910.8	927.8	13127.5	6.70	6.98	6.57	6.94
7-May-92	98	943.4	869.4	906.4	14033.9	6.64	7.02	6.46	6.93
14-May-92	105	962.9	964.6	963.7	14997.7	6.55	6.55	6.97	7.09
22-May-92	113	940.6	877.3	909.0	15906.6	6.56	6.54	6.67	6.93
29-May-92	120	973.7	986.0	979.9	16886.5	6.44	6.46	6.46	6.58
5-Jun-92	127	957.7	519.0	738.3	17624.8	6.56	6.63	7.60	7.45
12-Jun-92	134	957.3	996.2	976.7	18601.6	6.54	6.72	6.46	6.63
19-Jun-92	141	953.2	862.0	907.6	19509.2	6.73	6.50	6.70	6.95
29-Jun-92	151	930.8	1013.5	972.2	20481.3	6.82	6.39	6.41	6.81
3-Jul-92	155	934.9	834.8	884.9	21366.2	6.44	6.05	6.17	6.80
10-Jul-92	162	954.0	953.5	953.7	22319.9	6.11	5.69	6.85	6.30
17-Jul-92	169	921.8	944.7	933.3	23253.2	5.88	5.83	6.29	6.29
24-Jul-92	176	961.7	955.0	958.3	24211.5	5.90	5.70	6.12	6.19

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	DAYS FROM START	VOLUME (ml) CSZ1	VOLUME (ml) CSZ2	VOLUME (ml) AVERAGE	CUMMULATIVE VOLUME (ml)	LAB. pH pH(LAB) CSZ1 COLD TEMP.	LAB. pH pH(LAB) CSZ1 ROOM TEMP.	LAB. pH pH(LAB) CSZ2 COLD TEMP.	LAB. pH pH(LAB) CSZ2 ROOM TEMP.
1-Aug-92	184	950.8	931.2	941.0	25152.5	5.20	4.64	6.28	6.42
7-Aug-92	190	955.8	953.5	954.6	26107.2	4.63	4.52	5.51	6.38
14-Aug-92	197	934.5	957.7	946.1	27053.3	4.37	4.22	6.03	6.54
21-Aug-92	204	934.8	934.1	934.5	27987.7	4.57	4.23	5.99	5.96
28-Aug-92	211	922.5	854.4	888.5	28876.2	4.28	4.05	5.80	5.84
4-Sep-92	218	947.4	936.7	942.1	29818.2	4.29	4.14	5.87	6.05
11-Sep-92	225	972.1	948.2	960.2	30778.4	4.17	4.05	5.88	5.97
18-Sep-92	232	946.2	927.5	936.9	31715.2	4.26	4.12	5.97	6.07
25-Sep-92	239	820.8	854.3	837.6	32552.8	4.29	4.16	6.11	6.09
2-Oct-92	246	939.4	935.4	937.4	33490.2	4.30	4.17	5.98	6.15
8-Oct-92	252	937.4	953.7	945.6	34435.7	4.69	4.42	6.31	6.32
16-Oct-92	260	937.4	953.7	945.6	35381.3	4.63	4.29	6.15	6.33
30-Oct-92	274	904.5	928.4	916.5	36297.7	4.22	3.95	6.46	6.27
13-Nov-92	288	955.2	946.7	951.0	37248.7	4.38	4.20	6.28	6.70
27-Nov-92	302	909.8	932.5	921.2	38169.8	4.30	4.30	6.49	6.42
11-Dec-92	316	942.6	923.5	933.1	39102.9	3.98	3.41	6.13	5.89
24-Dec-92	329	921.0	924.0	922.5	40025.4	3.96	3.79	5.02	4.91
8-Jan-93	344	948.0	953.3	950.7	40976.0	3.96	3.40	3.70	3.39
22-Jan-93	358	891.2	918.7	905.0	41881.0	3.98	3.92	4.13	3.88
5-Feb-93	372	912.7	910.5	911.6	42792.6	3.97	3.72	4.43	4.25
19-Feb-93	386	896.6	904.4	900.5	43693.1	3.87	3.59	4.11	3.93
5-Mar-93	400	949.6	897.1	923.4	44616.4	3.59	3.24	3.87	3.68
19-Mar-93	414	879.3	883.4	881.4	45497.8	3.72	3.03	3.95	3.84
2-Apr-93	428	902.6	889.6	896.1	46393.9	3.50	3.27	3.80	3.61
16-Apr-93	442	900.5	929.3	914.9	47308.8	3.65	3.30	3.86	3.44
30-Apr-93	456	910.3	933.1	921.7	48230.5	3.50	3.22	3.64	3.46

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	DAYS FROM START	VOLUME (ml) CSZ1	VOLUME (ml) CSZ2	VOLUME (ml) AVERAGE	CUMMULATIVE VOLUME (ml)	LAB. pH pH(LAB) CSZ1 COLD TEMP.	LAB. pH pH(LAB) CSZ1 ROOM TEMP.	LAB. pH pH(LAB) CSZ2 COLD TEMP.	LAB. pH pH(LAB) CSZ2 ROOM TEMP.
14-May-93	470	911.4	916.5	914.0	49144.4	3.33	3.20	3.72	3.54
28-May-93	484	933.1	936.4	934.8	50079.2	3.23	3.02	3.34	3.34
11-Jun-93	498	916.5	897.1	906.8	50986.0	3.33	2.99	3.69	3.36
25-Jun-93	512	910.0	928.4	919.2	51905.2	3.51	3.04	3.46	3.29
9-Jul-93	526	920.4	778.6	849.5	52754.7	3.27	2.97	3.69	3.28
23-Jul-93	540	836.7	1023.5	930.1	53684.8	3.55	3.34	3.54	3.46
9-Aug-93	557	983.3	871.6	927.4	54612.3	3.10	3.11	3.30	3.34
20-Aug-93	568	901.0	888.7	894.9	55507.1	3.15	3.13	3.50	3.39
3-Sep-93	582	981.2	999.3	990.2	56497.4	3.01	3.28	3.28	3.33
17-Sep-93	596	945.9	907.2	926.6	57423.9	3.49	3.31	3.70	3.00
1-Oct-93	610	912.2	929.8	921.0	58344.9	3.03	2.73	3.64	2.93
15-Oct-93	624	597.9	963.3	780.6	59125.5	2.99	2.65	3.22	2.91
29-Oct-93	638	883.4	927.0	905.2	60030.7	2.98	2.70	3.29	3.46
12-Nov-93	652	920.2	1011.9	966.0	60996.8	3.11	2.89	3.51	3.19
26-Nov-93	666	908.9	698.1	803.5	61800.3	3.52	3.18	3.68	3.43
10-Dec-93	680	954.8	1119.0	1036.9	62837.2	3.07	2.63	3.24	3.34
24-Dec-93	694	918.7	791.8	855.2	63692.4	3.24	2.83	3.22	2.92
7-Jan-94	708	926.1	1015.8	970.9	64663.4	3.33	3.19	3.41	3.26
21-Jan-94	722	739.4	756.6	748.0	65411.4	3.00	2.88	3.03	2.94

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. pH pH(LAB) AVERAGE COLD TEMP.	LAB. pH pH(LAB) AVERAGE ROOM TEMP.	EH Eh(mV) CSZ1 COLD TEMP.	EH Eh(mV) CSZ1 ROOM TEMP.	EH Eh(mV) CSZ2 COLD TEMP.	EH Eh(mV) CSZ2 ROOM TEMP.	EH Eh(mV) AVERAGE COLD TEMP.	EH Eh(mV) AVERAGE ROOM TEMP.	EH(NHE) (mV) CSZ1 COLD TEMP.
30-Jan-92	6.04		182.2		174.7		178.5		426.2
6-Feb-92	6.23		186.6		194.5		190.6		430.6
13-Feb-92	6.34		193.3		194.3		193.8		437.3
20-Feb-92	6.28		185.5		197.3		191.4		429.5
27-Feb-92	6.49		193.6		218.3		206.0		437.6
5-Mar-92	6.53		212.0		198.2		205.1		456.0
12-Mar-92	6.64		215.4		206.6		211.0		459.4
19-Mar-92	6.68		243.1		212.3		227.7		487.1
26-Mar-92	6.70		215.1		185.1		200.1		459.1
2-Apr-92	6.78	6.86	223.0	202.0	165.9	199.8	194.5	200.9	467.0
9-Apr-92	6.67	6.90	158.7	138.8	176.4	143.6	167.6	141.2	402.7
16-Apr-92	6.75	7.11	136.6	177.1	148.7	183.9	142.7	180.5	380.6
23-Apr-92	6.52	7.04	285.6	235.6	278.4	202.6	282.0	219.1	529.6
30-Apr-92	6.63	6.95	281.9	217.0	288.9	230.0	285.4	223.5	525.9
7-May-92	6.54	6.98	328.7	263.6	328.5	255.3	328.6	259.5	572.7
14-May-92	6.71	6.74	224.0	214.3	228.3	208.2	226.2	211.3	468.0
22-May-92	6.61	6.69	274.0	212.1	270.6	216.6	272.3	214.4	518.0
29-May-92	6.45	6.52	254.8	235.5	262.7	237.7	258.8	236.6	498.8
5-Jun-92	6.72	6.78	230.3	221.2	230.2	210.8	230.3	216.0	474.3
12-Jun-92	6.50	6.67	202.6	234.5	201.5	216.0	202.1	225.3	446.6
19-Jun-92	6.72	6.66	226.0	223.0	222.0	227.0	224.0	225.0	470.0
29-Jun-92	6.56	6.56	197.7	211.0	215.0	217.4	206.4	214.2	441.7
3-Jul-92	6.29	6.27	144.5	93.6	161.7	222.2	153.1	157.9	388.5
10-Jul-92	6.34	5.90	143.7	238.6	186.0	295.3	164.9	267.0	387.7
17-Jul-92	6.04	6.01	157.7	153.3	228.0	278.5	192.9	215.9	401.7
24-Jul-92	5.99	5.88	135.0	100.5	242.2	289.7	188.6	195.1	379.0

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. pH pH(LAB) AVERAGE COLD TEMP.	LAB. pH pH(LAB) AVERAGE ROOM TEMP.	EH Eh(mV) CSZ1 COLD TEMP.	EH Eh(mV) CSZ1 ROOM TEMP.	EH Eh(mV) CSZ2 COLD TEMP.	EH Eh(mV) CSZ2 ROOM TEMP.	EH Eh(mV) AVERAGE COLD TEMP.	EH Eh(mV) AVERAGE ROOM TEMP.	EH(NHE) (mV) CSZ1 COLD TEMP.
1-Aug-92	5.46	4.93	259.9	233.0	263.6	286.1	261.8	259.6	503.9
7-Aug-92	4.88	4.82	265.6	249.0	316.2	317.4	290.9	283.2	509.6
14-Aug-92	4.67	4.52	362.6	358.3	303.2	299.2	332.9	328.8	606.6
21-Aug-92	4.85	4.52	314.2	345.1	186.0	127.7	250.1	236.4	558.2
28-Aug-92	4.55	4.33	354.6	349.7	191.2	109.5	272.9	229.6	598.6
4-Sep-92	4.57	4.43	345.8	348.9	190.3	150.4	268.1	249.7	589.8
11-Sep-92	4.45	4.34	295.1	354.3	145.2	113.4	220.2	233.9	539.1
18-Sep-92	4.55	4.41	348.2	346.3	121.7	103.5	235.0	224.9	592.2
25-Sep-92	4.59	4.46	340.4	335.4	444.8	96.3	392.6	215.9	584.4
2-Oct-92	4.59	4.46	329.8	329.5	204.9	120.5	267.4	225.0	573.8
8-Oct-92	4.98	4.72	293.8	293.1	174.9	53.0	234.4	173.1	537.8
16-Oct-92	4.92	4.59	314.7	312.5	125.6	69.1	220.2	190.8	558.7
30-Oct-92	4.53	4.25	343.2	345.8	160.2	121.1	251.7	233.5	587.2
13-Nov-92	4.67	4.50	317.5	312.1	142.6	15.0	230.1	163.6	561.5
27-Nov-92	4.60	4.60	317.2	308.9	156.6	66.0	236.9	187.5	561.2
11-Dec-92	4.27	3.70	373.0	372.0	201.0	193.8	287.0	282.9	617.0
24-Dec-92	4.22	4.06	360.6	364.2	246.0	234.3	303.3	299.3	604.6
8-Jan-93	3.81	3.39	366.6	370.6	414.6	389.0	390.6	379.8	610.6
22-Jan-93	4.05	3.90	361.8	362.8	278.1	381.8	320.0	372.3	605.8
5-Feb-93	4.14	3.90	370.3	377.0	318.4	307.2	344.4	342.1	614.3
19-Feb-93	3.97	3.73	338.3	378.7	336.8	356.3	337.6	367.5	582.3
5-Mar-93	3.70	3.40	403.4	413.8	356.8	362.3	380.1	388.1	647.4
19-Mar-93	3.82	3.27	394.2	412.0	358.9	358.2	376.6	385.1	638.2
2-Apr-93	3.62	3.40	413.6	417.4	369.1	370.8	391.4	394.1	657.6
16-Apr-93	3.74	3.37	401.5	412.5	371.3	368.0	386.4	390.3	645.5
30-Apr-93	3.56	3.33	403.6	415.3	386.0	398.2	394.8	406.8	647.6

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. pH pH(LAB) AVERAGE COLD TEMP.	LAB. pH pH(LAB) AVERAGE ROOM TEMP.	EH Eh(mV) CSZ1 COLD TEMP.	EH Eh(mV) CSZ1 ROOM TEMP.	EH Eh(mV) CSZ2 COLD TEMP.	EH Eh(mV) CSZ2 ROOM TEMP.	EH Eh(mV) AVERAGE COLD TEMP.	EH Eh(mV) AVERAGE ROOM TEMP.	EH(NHE) (mV) CSZ1 COLD TEMP.
14-May-93	3.48	3.34	393.7	398.1	373.3	373.1	383.5	385.6	637.7
28-May-93	3.28	3.15	408.0	418.0	386.4	391.5	397.2	404.8	652.0
11-Jun-93	3.47	3.14	400.7	412.7	371.3	375.8	386.0	394.3	644.7
25-Jun-93	3.48	3.15	395.3	420.4	407.2	410.2	401.3	415.3	639.3
9-Jul-93	3.41	3.09	408.2	418.1	376.8	379.5	392.5	398.8	652.2
23-Jul-93	3.55	3.40	434.7	428.2	446.0	436.8	440.4	432.5	678.7
9-Aug-93	3.18	3.20	422.7	445.2	418.9	436.8	420.8	441.0	666.7
20-Aug-93	3.29	3.24	451.7	452.5	434.1	429.9	442.9	441.2	695.7
3-Sep-93	3.12	3.30	416.3	438.7	420.6	445.4	418.5	442.1	660.3
17-Sep-93	3.58	3.13	408.3	425.2	419.7	431.6	414.0	428.4	652.3
1-Oct-93	3.24	2.82	419.6	437.1	425.5	426.6	422.6	431.9	663.6
15-Oct-93	3.12	2.79	412.2	429.1	424.7	436.7	418.5	432.9	656.2
29-Oct-93	3.11	2.93	416.0	435.4	407.9	432.6	412.0	434.0	660.0
12-Nov-93	3.28	3.02	465.4	475.0	451.8	463.7	458.6	469.4	709.4
26-Nov-93	3.58	3.27	440.4	456.4	421.0	427.8	430.7	442.1	684.4
10-Dec-93	3.15	2.87	474.4	464.6	400.5	438.0	437.5	451.3	718.4
24-Dec-93	3.23	2.87	449.7	472.2	469.0	476.8	459.4	474.5	693.7
7-Jan-94	3.37	3.22	460.6	467.0	463.0	471.8	461.8	469.4	704.6
21-Jan-94	3.01	2.91	417.7	468.1	450.3	503.7	434.0	485.9	661.7

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	EH(NHE) (mV) CSZ1 ROOM TEMP.	EH(NHE) (mV) CSZ2 COLD TEMP.	EH(NHE) (mV) CSZ2 ROOM TEMP.	EH(NHE) (mV) AVERAGE COLD TEMP.	EH(NHE) (mV) AVERAGE ROOM TEMP.	LAB. Ec Ec(LAB) CSZ1 COLD TEMP.	LAB. Ec Ec(LAB) CSZ1 ROOM TEMP.	LAB. Ec Ec(LAB) CSZ2 COLD TEMP.	LAB. Ec Ec(LAB) CSZ2 ROOM TEMP.
30-Jan-92		418.7		422.5		8360		7660	
6-Feb-92		438.5		434.6		7560		7480	
13-Feb-92		438.3		437.8		6580		6620	
20-Feb-92		441.3		435.4		4030		4990	
27-Feb-92		462.3		450.0		2990		2700	
5-Mar-92		442.2		449.1		2420		2330	
12-Mar-92		450.6		455.0		2170		2220	
19-Mar-92		456.3		471.7		2030		2050	
26-Mar-92		429.1		444.1		2110		2010	
2-Apr-92	446.0	409.9	443.8	438.5	444.9	2310	2020	2210	1960
9-Apr-92	382.8	420.4	387.6	411.6	385.2	2200	2020	2080	1940
16-Apr-92	421.1	392.7	427.9	386.7	424.5	2050	2050	2010	1710
23-Apr-92	479.6	522.4	446.6	526.0	463.1	1960	1710	1970	1740
30-Apr-92	461.0	532.9	474.0	529.4	467.5	1930	1760	1940	1760
7-May-92	507.6	572.5	499.3	572.6	503.5	1670	1980	1820	1780
14-May-92	458.3	472.3	452.2	470.2	455.3	1510	1650	1710	1640
22-May-92	456.1	514.6	460.6	516.3	458.4	1440	1550	1470	1210
29-May-92	479.5	506.7	481.7	502.8	480.6	1240	1310	893	924
5-Jun-92	465.2	474.2	454.8	474.3	460.0	1190	1130	901	840
12-Jun-92	478.5	445.5	460.0	446.1	469.3	986	937	730	711
19-Jun-92	467.0	466.0	471.0	468.0	469.0	914	839	593	655
29-Jun-92	455.0	459.0	461.4	450.4	458.2	732	667	539	521
3-Jul-92	337.6	405.7	466.2	397.1	401.9	608	680	502	519
10-Jul-92	482.6	430.0	539.3	408.9	511.0	548	516	515	634
17-Jul-92	397.3	472.0	522.5	436.9	459.9	509	470	418	432
24-Jul-92	344.5	486.2	533.7	432.6	439.1	495	532	395	457

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	EH(NHE) (mV) CSZ1 ROOM TEMP.	EH(NHE) (mV) CSZ2 COLD TEMP.	EH(NHE) (mV) CSZ2 ROOM TEMP.	EH(NHE) (mV) AVERAGE COLD TEMP.	EH(NHE) (mV) AVERAGE ROOM TEMP.	LAB. Ec Ec(LAB) CSZ1 COLD TEMP.	LAB. Ec Ec(LAB) CSZ1 ROOM TEMP.	LAB. Ec Ec(LAB) CSZ2 COLD TEMP.	LAB. Ec Ec(LAB) CSZ2 ROOM TEMP.
1-Aug-92	477.0	507.6	530.1	505.8	503.6	584	550	483	451
7-Aug-92	493.0	560.2	561.4	534.9	527.2	459	592	458	453
14-Aug-92	602.3	547.2	543.2	576.9	572.8	589	521	511	461
21-Aug-92	589.1	430.0	371.7	494.1	480.4	653	601		556
28-Aug-92	593.7	435.2	353.5	516.9	473.6	673	765	614	670
4-Sep-92	592.9	434.3	394.4	512.1	493.7	743	634	537	477
11-Sep-92	598.3	389.2	357.4	464.2	477.9	759	656	484	445
18-Sep-92	590.3	365.7	347.5	479.0	468.9	730	686	503	461
25-Sep-92	579.4	688.8	340.3	636.6	459.9	777	656	533	460
2-Oct-92	573.5	448.9	364.5	511.4	469.0	838	730	566	493
8-Oct-92	537.1	418.9	297.0	478.4	417.1	875	758	551	510
16-Oct-92	556.5	369.6	313.1	464.2	434.8	812	717	502	424
30-Oct-92	589.8	404.2	365.1	495.7	477.5	807	677	508	436
13-Nov-92	556.1	386.6	259.0	474.1	407.6	839	817	519	555
27-Nov-92	552.9	400.6	310.0	480.9	431.5	1108	988	684	596
11-Dec-92	616.0	445.0	437.8	531.0	526.9	1425	1067	806	636
24-Dec-92	608.2	490.0	478.3	547.3	543.3	1078	1075	764	711
8-Jan-93	614.6	658.6	633.0	634.6	623.8	1260	1130	929	883
22-Jan-93	606.8	522.1	625.8	564.0	616.3	1177	1172	856	948
5-Feb-93	621.0	562.4	551.2	588.4	586.1	1176	1136	830	804
19-Feb-93	622.7	580.8	600.3	581.6	611.5	1474	1215	1026	852
5-Mar-93	657.8	600.8	606.3	624.1	632.1	1603	1340	1147	930
19-Mar-93	656.0	602.9	602.2	620.6	629.1	1585	1348	1012	907
2-Apr-93	661.4	613.1	614.8	635.4	638.1	1238	1165	969	938
16-Apr-93	656.5	615.3	612.0	630.4	634.3	1357	1299	1101	1013
30-Apr-93	659.3	630.0	642.2	638.8	650.8	1378	1431	1048	1089

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	EH(NHE) (mV) CSZ1 ROOM TEMP.	EH(NHE) (mV) CSZ2 COLD TEMP.	EH(NHE) (mV) CSZ2 ROOM TEMP.	EH(NHE) (mV) AVERAGE COLD TEMP.	EH(NHE) (mV) AVERAGE ROOM TEMP.	LAB. Ec Ec(LAB) CSZ1 COLD TEMP.	LAB. Ec Ec(LAB) CSZ1 ROOM TEMP.	LAB. Ec Ec(LAB) CSZ2 COLD TEMP.	LAB. Ec Ec(LAB) CSZ2 ROOM TEMP.
14-May-93	642.1	617.3	617.1	627.5	629.6	1513	1417	1017	1057
28-May-93	662.0	630.4	635.5	641.2	648.8	1690	1488	1205	1137
11-Jun-93	656.7	615.3	619.8	630.0	638.3	1548	1539	1133	1192
25-Jun-93	664.4	651.2	654.2	645.3	659.3	1556	1378	1212	1129
9-Jul-93	662.1	620.8	623.5	636.5	642.8	1369	1426	1117	1125
23-Jul-93	672.2	690.0	680.8	684.4	676.5	1441	1345		977
9-Aug-93	689.2	662.9	680.8	664.8	685.0	1430	1491	1046	1128
20-Aug-93	696.5	678.1	673.9	686.9	685.2	1386	1346	933	1053
3-Sep-93	682.7	664.6	689.4	662.5	686.1	1257	1014	976	974
17-Sep-93	669.2	663.7	675.6	658.0	672.4	1237	1303	1006	1061
1-Oct-93	681.1	669.5	670.6	666.6	675.9	1274	1442	1031	1155
15-Oct-93	673.1	668.7	680.7	662.5	676.9	1351	1245	925	909
29-Oct-93	679.4	651.9	676.6	656.0	678.0	1312	1273	928	971
12-Nov-93	719.0	695.8	707.7	702.6	713.4	1293	1168	948	910
26-Nov-93	700.4	665.0	671.8	674.7	686.1	1574	1401	1168	1097
10-Dec-93	708.6	644.5	682.0	681.5	695.3	1440	1405	1151	1125
24-Dec-93	716.2	713.0	720.8	703.4	718.5	1550	1393	1174	1059
7-Jan-94	711.0	707.0	715.8	705.8	713.4	1410	1221	884	825
21-Jan-94	712.1	694.3	747.7	678.0	729.9	1726	1435	1507	1287

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. Ec Ec(LAB) AVERAGE COLD TEMP.	LAB. Ec Ec(LAB) AVERAGE ROOM TEMP.	SAMPLE TEMP.(C) CSZ1 COLD	SAMPLE TEMP.(C) CSZ1 ROOM	SAMPLE TEMP.(C) CSZ2 COLD	SAMPLE TEMP.(C) CSZ2 ROOM	SAMPLE TEMP.(C) AVERAGE COLD	SAMPLE TEMP.(C) AVERAGE ROOM	ACIDITY (mg/l) CSZ1
30-Jan-92	8010		7.8		7.8		7.8		141.53
6-Feb-92	7520		5.9		4.5		5.2		155.48
13-Feb-92	6600		4.1		3.9		4.0		154.06
20-Feb-92	4510		9.4		4.2		6.8		193.94
27-Feb-92	2845		6.0		8.6		7.3		121.34
5-Mar-92	2375		2.1		2.9		2.5		53.89
12-Mar-92	2195		0.9		1.4		1.2		39.05
19-Mar-92	2040		2.0		1.0		1.5		4.46
26-Mar-92	2060		2.1		2.7		2.4		-3.53
2-Apr-92	2260	1990	2.2	23.9	1.0	25.2	1.6	24.6	0.50
9-Apr-92	2140	1980	1.0	19.1	1.6	20.3	1.3	19.7	0.49
16-Apr-92	2030	1880	2.2	19.5	1.8	18.2	2.0	18.9	-5.54
23-Apr-92	1965	1725	2.4	20.9	1.6	24.2	2.0	22.6	0.45
30-Apr-92	1935	1760	2.7	21.4	3.1	22.1	2.9	21.8	-12.61
7-May-92	1745	1880	3.1	23.8	3.6	27.7	3.4	25.8	-10.60
14-May-92	1610	1645	4.2	20.9	4.1	20.1	4.2	20.5	-7.60
22-May-92	1455	1380	4.1	21.2	4.3	20.3	4.2	20.8	-5.59
29-May-92	1067	1117	4.0	22.0	4.1	21.9	4.1	22.0	-14.65
5-Jun-92	1046	985	4.6	23.2	4.6	19.1	4.6	21.2	3.43
12-Jun-92	858	824	4.6	17.6	5.0	24.6	4.8	21.1	11.42
19-Jun-92	754	747	4.4	22.5	4.7	24.0	4.6	23.3	5.38
29-Jun-92	636	594	3.8	21.6	3.7	23.5	3.8	22.6	37.47
3-Jul-92	555	600	3.6	21.3	3.8	23.1	3.7	22.2	39.44
10-Jul-92	532	575	4.1	20.3	4.2	21.0	4.2	20.7	45.64
17-Jul-92	464	451	4.7	22.6	5.4	23.5	5.1	23.1	74.44
24-Jul-92	445	495	4.1	22.9	4.4	23.3	4.3	23.1	78.41

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. Ec Ec(LAB) AVERAGE COLD TEMP.	LAB. Ec Ec(LAB) AVERAGE ROOM TEMP.	SAMPLE TEMP.(C) CSZ1 COLD	SAMPLE TEMP.(C) CSZ1 ROOM	SAMPLE TEMP.(C) CSZ2 COLD	SAMPLE TEMP.(C) CSZ2 ROOM	SAMPLE TEMP.(C) AVERAGE COLD	SAMPLE TEMP.(C) AVERAGE ROOM	ACIDITY (mg/l) CSZ1
1-Aug-92	534	501	4.2	20.5	4.3	20.1	4.3	20.3	109.22
7-Aug-92	459	523	4.6	23.8	4.7	21.6	4.7	22.7	125.11
14-Aug-92	550	491	4.2	20.0	4.7	20.6	4.5	20.3	133.06
21-Aug-92	653	579	3.8	20.0	4.3	20.2	4.1	20.1	231.37
28-Aug-92	644	718	4.1	21.5	4.1	24.4	4.1	23.0	202.16
4-Sep-92	640	556	4.4	16.6	4.2	17.3	4.3	17.0	386.49
11-Sep-92	622	551	4.4	17.0	4.0	17.6	4.2	17.3	393.43
18-Sep-92	617	574	5.0	20.6	5.0	21.6	5.0	21.1	380.54
25-Sep-92	655	558	4.6	21.1	4.8	20.0	4.7	20.6	358.74
2-Oct-92	702	612	4.5	19.1	4.2	19.6	4.4	19.4	493.52
8-Oct-92	713	634	4.7	18.9	4.5	19.5	4.6	19.2	357.21
16-Oct-92	657	571	4.3	19.1	4.5	17.9	4.4	18.5	400.11
30-Oct-92	658	557	3.9	18.3	4.5	18.9	4.2	18.6	
13-Nov-92	679	686	5.2	20.5	5.2	21.3	5.2	20.9	351.22
27-Nov-92	896	792	4.9	20.3	5.8	20.6	5.4	20.5	
11-Dec-92	1116	852	5.4	21.9	5.1	21.5	5.3	21.7	533.82
24-Dec-92	921	893	4.5	20.7	4.8	19.8	4.7	20.3	
8-Jan-93	1095	1007	5.1	21.0	5.0	21.4	5.1	21.2	492.98
22-Jan-93	1017	1060	5.7	21.1	4.4	19.3	5.1	20.2	
5-Feb-93	1003	970	4.6	23.7	4.8	23.8	4.7	23.8	596.39
19-Feb-93	1250	1034	5.1	23.1	4.6	21.7	4.9	22.4	
5-Mar-93	1375	1135	4.3	20.5	4.6	19.8	4.5	20.2	807.24
19-Mar-93	1299	1128	4.2	23.4	5.7	20.9	5.0	22.2	
2-Apr-93	1104	1052	6.1	19.9	5.7	20.4	5.9	20.2	591.43
16-Apr-93	1229	1156	4.7	23.7	5.4	22.7	5.1	23.2	
30-Apr-93	1213	1260	4.6	22.3	4.8	22.2	4.7	22.3	760.23

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	LAB. Ec Ec(LAB) AVERAGE COLD TEMP.	LAB. Ec Ec(LAB) AVERAGE ROOM TEMP.	SAMPLE TEMP.(C) CSZ1 COLD	SAMPLE TEMP.(C) CSZ1 ROOM	SAMPLE TEMP.(C) CSZ2 COLD	SAMPLE TEMP.(C) CSZ2 ROOM	SAMPLE TEMP.(C) AVERAGE COLD	SAMPLE TEMP.(C) AVERAGE ROOM	ACIDITY (mg/l) CSZ1
14-May-93	1265	1237	4.2	20.9	5.1	21.0	4.7	21.0	
28-May-93	1448	1313	4.8	21.3	4.6	21.1	4.7	21.2	787.21
11-Jun-93	1341	1366	4.6	24.5	4.6	23.3	4.6	23.9	362.37
25-Jun-93	1384	1254	4.9	21.0	4.8	21.2	4.9	21.1	647.03
9-Jul-93	1243	1276	5.2	24.1	5.0	24.3	5.1	24.2	646.50
23-Jul-93	1441	1161	4.4	23.4	4.7	22.3	4.6	22.9	674.55
9-Aug-93	1238	1310	4.6	23.6	5.2	22.8	4.9	23.2	
20-Aug-93	1160	1200	4.8	23.3	4.6	23.1	4.7	23.2	674.68
3-Sep-93	1117	994	4.7	21.4	4.9	21.0	4.8	21.2	
17-Sep-93	1122	1182	4.1	19.3	4.1	18.8	4.1	19.1	568.37
1-Oct-93	1153	1299	4.6	24.0	4.7	23.6	4.7	23.8	
15-Oct-93	1138	1077	4.8	23.2	5.3	21.6	5.1	22.4	658.11
29-Oct-93	1120	1122	4.4	22.0	4.4	21.6	4.4	21.8	
12-Nov-93	1121	1039	5.5	20.1	5.3	19.4	5.4	19.8	617.09
26-Nov-93	1371	1249	4.5	21.8	4.5	24.2	4.5	23.0	
10-Dec-93	1296	1265	4.8	23.4	4.9	23.2	4.9	23.3	N.S.S.
24-Dec-93	1362	1226	6.7	20.0	6.7	20.0	6.7	20.0	
7-Jan-94	1147	1023	3.3	20.6	3.4	21.7	3.4	21.2	538.61
21-Jan-94	1617	1361	6.0	24.9	6.8	25.0	6.4	25.0	588.70

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	ACIDITY (mg/l) CSZ2	ACIDITY (mg/l) AVERAGE	ALKALINITY (mg/l) CSZ1	ALKALINITY (mg/l) CSZ2	ALKALINITY (mg/l) AVERAGE	Al (mg/l) CSZ1	Al (mg/l) CSZ2	Al (mg/l) AVERAGE	As (mg/l) CSZ1
30-Jan-92	196.80	169.17	0.00	0.00	0.00	0.38	0.73	0.56	<0.044
6-Feb-92	127.29	141.38	35.80	39.78	37.79	0.45	0.37	0.41	<0.044
13-Feb-92	207.06	180.56	39.78	43.76	41.77	0.36	0.29	0.33	<0.044
20-Feb-92	168.77	181.36	39.78	43.76	41.77	0.34	0.23	0.29	<0.044
27-Feb-92	90.06	105.70	33.81	41.77	37.79	0.28	0.24	0.26	<0.044
5-Mar-92	16.00	34.94	37.79	43.76	40.77	0.15	0.18	0.17	<0.044
12-Mar-92	22.62	30.84	39.78	45.75	42.76	0.22	0.23	0.23	<0.044
19-Mar-92	0.49	2.48	41.77	45.75	43.76	0.18	0.14	0.16	<0.044
26-Mar-92	-7.56	-5.54	45.75	45.75	45.75	0.25	0.14	0.20	<0.044
2-Apr-92	-9.57	-4.53	47.74	43.76	45.75	0.22	0.09	0.16	<0.044
9-Apr-92	-11.57	-5.54	47.74	45.75	46.74	0.19	0.11	0.15	<0.044
16-Apr-92	-19.60	-12.57	47.74	43.76	45.75	0.22	0.13	0.18	<0.044
23-Apr-92	-21.65	-10.60	43.76	43.76	43.76	0.18	0.11	0.15	<0.044
30-Apr-92	-29.67	-21.14	41.77	40.77	41.27	0.18	0.107	0.14	<0.044
7-May-92	-40.64	-25.62	42.76	43.76	43.26	0.18	0.13	0.16	<0.044
14-May-92	-33.71	-20.65	41.77	39.78	40.77	0.23	<0.04	0.23	<0.044
22-May-92	-39.75	-22.67	39.78	42.76	41.27	0.19	0.1	0.15	<0.044
29-May-92	-37.77	-26.21	38.79	39.78	39.28	0.11	0.05	0.08	<0.044
5-Jun-92	-18.63	-7.60	40.77	42.76	41.77	0.16	0.05	0.11	<0.044
12-Jun-92	-24.69	-6.64	36.80	40.77	38.79	0.09	<0.04	0.09	<0.044
19-Jun-92	-16.66	-5.64	35.80	38.79	37.29	0.06	0.0405	0.05	0.047
29-Jun-92	-5.66	15.91	33.81	34.81	34.31	0.041	0.047	0.04	<0.044
3-Jul-92	-1.66	18.89	27.85	31.82	29.84	<0.04	0.044	0.04	<0.044
10-Jul-92	-2.04	21.80	33.81	29.84	31.82	0.06	0.07	0.07	<0.044
17-Jul-92	2.93	38.69	29.84	27.85	28.84	<0.04	0.12	0.12	<0.044
24-Jul-92	-1.04	38.68	32.82	27.85	30.33	0.08	<0.04	0.08	<0.044

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	ACIDITY (mg/l) CSZ2	ACIDITY (mg/l) AVERAGE	ALKALINITY (mg/l) CSZ1	ALKALINITY (mg/l) CSZ2	ALKALINITY (mg/l) AVERAGE	Al (mg/l) CSZ1	Al (mg/l) CSZ2	Al (mg/l) AVERAGE	As (mg/l) CSZ1
1-Aug-92	8.89	59.06	-1.99	27.85	12.93	0.63	0.044	0.34	<0.044
7-Aug-92	8.89	67.00	0.00	27.85	13.92	0.605	0.044	0.32	<0.044
14-Aug-92	11.87	72.47	0.00	26.85	13.43	0.36	0.06	0.21	<0.044
21-Aug-92	47.60	139.49	0.00	33.81	16.91	0.85	0.046	0.45	<0.044
28-Aug-92	62.34	132.25	0.00	23.87	11.93	2.09	0.06	1.08	<0.044
4-Sep-92	81.15	233.82	0.00	21.88	10.94	3.93	0.043	1.99	0.07
11-Sep-92	108.87	251.15	0.00	26.85	13.43	7.25	0.13	3.69	0.11
18-Sep-92	127.06	253.80	0.00	29.58	14.79	8.2	<0.04	8.20	0.12
25-Sep-92	138.01	248.38	0.00	38.45	19.23	8.9	<0.04	8.90	0.12
2-Oct-92	218.30	355.91	0.00	37.47	18.73	10.42	0.05	5.24	0.16
8-Oct-92	214.40	285.80	0.00	49.30	24.65	10.7	0.07	5.39	0.15
16-Oct-92	176.69	288.40	0.00	44.37	22.19	11.7	0.046	5.87	0.17
30-Oct-92									
13-Nov-92	134.12	242.67	0.00	49.30	0.00	9.3	0.08	4.69	0.13
27-Nov-92									
11-Dec-92	187.59	360.70	0.00	0.00	0.00	31.1	0.13	15.62	0.36
24-Dec-92									
8-Jan-93	178.72	335.85	0.00	0.00	0.00	33.43	2.5	17.97	0.34
22-Jan-93									
5-Feb-93	236.95	416.67	0.00	0.00	0.00	40.2	4.7	22.45	0.42
19-Feb-93									
5-Mar-93	359.44	583.34	0.00	0.00	0.00	47.8	11.21	29.51	0.509
19-Mar-93									
2-Apr-93	356.90	474.16	0.00	0.00	0.00	43.4	16.47	29.94	0.48
16-Apr-93									
30-Apr-93	463.62	611.92	0.00	0.00	0.00	30.8	21.46	26.13	0.41

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	ACIDITY (mg/l) CSZ2	ACIDITY (mg/l) AVERAGE	ALKALINITY (mg/l) CSZ1	ALKALINITY (mg/l) CSZ2	ALKALINITY (mg/l) AVERAGE	Al (mg/l) CSZ1	Al (mg/l) CSZ2	Al (mg/l) AVERAGE	As (mg/l) CSZ1
14-May-93									
28-May-93	579.66	683.43	0.00	0.00	0.00	28.8	27.72	28.26	0.44
11-Jun-93	275.93	319.15	0.00	0.00	0.00				
25-Jun-93	574.00	610.52	0.00	0.00	0.00	22.1	31.45	26.78	0.36
9-Jul-93	572.49	609.50	0.00	0.00	0.00				
23-Jul-93	503.16	588.86	0.00	0.00	0.00	18.1	33.02	25.56	0.305
9-Aug-93									
20-Aug-93	545.15	609.92	0.00	0.00	0.00	19.4	35.16	27.28	0.32
3-Sep-93									
17-Sep-93	577.72	573.05	0.00	0.00	0.00	12.3	35.45	23.88	0.22
1-Oct-93									
15-Oct-93	524.25	591.18	0.00	0.00	0.00	16.6	32.16	24.38	0.26
29-Oct-93									
12-Nov-93	549.77	583.43	0.00	0.00	0.00	14		14.00	0.23
26-Nov-93									
10-Dec-93	N.S.S.	N.S.S.	0.00	0.00	0.00	15.07		15.07	0.23
24-Dec-93									
7-Jan-94	341.71	440.16	0.00	0.00	0.00	11.5		11.50	0.22
21-Jan-94	493.40	541.05	0.00	0.00	0.00	9.12		9.12	0.22

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	As (mg/l) CSZ2	As (mg/l) AVERAGE	Ca (mg/l) CSZ1	Ca (mg/l) CSZ2	Ca (mg/l) AVERAGE	Cu (mg/l) CSZ1	Cu (mg/l) CSZ2	Cu (mg/l) AVERAGE	Fe TOTAL (mg/l) CSZ1	Fe TOTAL (mg/l) CSZ2	Fe TOTAL (mg/l) AVERAGE
30-Jan-92	<0.044		480.1	508.8	494.45	<0.003	<0.003		<0.005	0.6	0.6
6-Feb-92	<0.044		431.7	415.6	423.65	<0.003	<0.003		<0.005	<0.005	
13-Feb-92	<0.044		449.2	413.3	431.25	<0.003	<0.003		<0.005	<0.005	
20-Feb-92	<0.044		464.6	421.8	443.20	<0.003	<0.003		<0.005	<0.005	
27-Feb-92	<0.044		497.9	470.5	484.20	<0.003	<0.003		<0.005	<0.005	
5-Mar-92	<0.044					<0.003	<0.003		<0.005	<0.005	
12-Mar-92	<0.044		565.3	526	545.65	<0.003	<0.003		<0.005	<0.005	
19-Mar-92	<0.044		576.2	530.6	553.40	<0.003	<0.003		<0.005	<0.005	
26-Mar-92	<0.044		585.2	538.8	562.00	<0.003	<0.003		<0.005	<0.005	
2-Apr-92	<0.044		604.5	539.1	571.80	<0.003	<0.003		<0.005	<0.005	
9-Apr-92	<0.044		546.2	571.9	559.05	<0.003	<0.003		<0.005	<0.005	
16-Apr-92	<0.044		554.1	542.2	548.15	<0.003	<0.003		<0.005	<0.005	
23-Apr-92	<0.044		554.2	553.1	553.65	<0.003	<0.003		<0.005	<0.005	
30-Apr-92	<0.044		517.6	559.3	538.45	<0.003	<0.003		<0.005	<0.005	
7-May-92	<0.044		502.7	617.9	560.30	<0.003	<0.003		<0.005	<0.005	
14-May-92	<0.044		435.2	446.3	440.75	<0.003	<0.003		<0.005	<0.005	
22-May-92	<0.044		398.2	287.8	343.00	<0.003	<0.003		<0.005	<0.005	
29-May-92	<0.044		307.8	212.7	260.25	<0.003	<0.003		<0.005	<0.005	
5-Jun-92	<0.044		281.3	201.5	241.40	<0.003	<0.003		<0.005	<0.005	
12-Jun-92	<0.044		194	125.5	159.75	<0.003	<0.003		<0.005	<0.005	
19-Jun-92	<0.044	0.047	159	93.5	126.25	<0.003	<0.003		<0.005	<0.005	
29-Jun-92	<0.044		114.5	98.7	106.60	<0.003	<0.003		<0.005	<0.005	
3-Jul-92	<0.044		92.5	87.69	90.10	<0.003	<0.003		0.8	<0.005	0.8
10-Jul-92	<0.044		89.6	82.96	86.28	<0.003	<0.003		2.1	<0.005	2.1
17-Jul-92	<0.044		75.36	647.5	361.43	<0.003	<0.003		9.4	<0.005	9.4
24-Jul-92	<0.044		83.62	82.48	83.05	<0.003	<0.003		19.2	<0.005	19.2

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	As (mg/l) CSZ2	As (mg/l) AVERAGE	Ca (mg/l) CSZ1	Ca (mg/l) CSZ2	Ca (mg/l) AVERAGE	Cu (mg/l) CSZ1	Cu (mg/l) CSZ2	Cu (mg/l) AVERAGE	Fe TOTAL (mg/l) CSZ1	Fe TOTAL (mg/l) CSZ2	Fe TOTAL (mg/l) AVERAGE
1-Aug-92	<0.044		78.73	86.61	82.67	<0.003	<0.003		21.5	<0.005	21.5
7-Aug-92	<0.044		54.26	70.32	62.29	<0.003	<0.003		23.0	<0.005	23.0
14-Aug-92	<0.044		49.38	73.17	61.28	<0.003	<0.003		25.5	<0.005	25.5
21-Aug-92	<0.044		51.76	76.67	64.22	0.020	<0.003	0.020	45.4	4.2	24.8
28-Aug-92	<0.044		48.55	77.48	63.02	0.070	<0.003	0.070	56.0	4.3	30.2
4-Sep-92	<0.044	0.070	48.05	58.76	53.41	0.150	0.008	0.079	69.3	11.5	40.4
11-Sep-92	<0.044	0.110	46.03	52.52	49.28	0.300	0.007	0.154	81.7	23.7	52.7
18-Sep-92	<0.044	0.120	37.27	45.12	41.20	0.390	<0.003	0.390	82.1	25.9	54.0
25-Sep-92	<0.044	0.120	33.65	42.07	37.86	0.420	<0.003	0.420	82.1	34.2	58.2
2-Oct-92	<0.044	0.160	35.82	39.44	37.63	0.440	<0.003	0.440	109.0	50.4	79.7
8-Oct-92	<0.044	0.150	42.73	41.75	42.24	0.370	<0.003	0.370	117.9	56.4	87.1
16-Oct-92	<0.044	0.170	38.79	34.99	36.89	0.420	<0.003	0.420	106.8	49.8	78.3
30-Oct-92											
13-Nov-92	<0.044	0.130	30.62	32.88	31.75	0.240	<0.003	0.240	103.9	45.9	74.9
27-Nov-92											
11-Dec-92	<0.044	0.360	38.88	43.06	40.97	1.070	<0.003	1.070	120.6	42.1	81.4
24-Dec-92											
8-Jan-93	<0.044	0.340	31.37	50.24	40.81	1.660	0.150	0.905	97.0	30.7	63.8
22-Jan-93											
5-Feb-93	<0.044	0.420	28.71	50.39	39.55	2.200	0.310	1.255	102.9	44.5	73.7
19-Feb-93											
5-Mar-93	0.09	0.300	27.44	39.77	33.61	2.300	0.490	1.395	105.6	53.9	79.7
19-Mar-93											
2-Apr-93	0.12	0.300	24.57	33.51	29.04	1.850	0.640	1.245	108.1	74.0	91.0
16-Apr-93											
30-Apr-93	0.18	0.295	23.09	29.75	26.42	0.960	0.720	0.840	163.4	84.9	124.1

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	As (mg/l) CSZ2	As (mg/l) AVERAGE	Ca (mg/l) CSZ1	Ca (mg/l) CSZ2	Ca (mg/l) AVERAGE	Cu (mg/l) CSZ1	Cu (mg/l) CSZ2	Cu (mg/l) AVERAGE	Fe TOTAL (mg/l) CSZ1	Fe TOTAL (mg/l) CSZ2	Fe TOTAL (mg/l) AVERAGE
14-May-93											
28-May-93	0.26	0.350	22.58	26.61	24.60	0.830	0.760	0.795	198.5	113.7	156.1
11-Jun-93											
25-Jun-93	0.29	0.325	16.97	20.76	18.87	0.610	0.730	0.670	173.3	105.7	139.5
9-Jul-93											
23-Jul-93	0.28	0.293	14.4	15.32	14.86	0.510	0.730	0.620	173.2	88.8	131.0
9-Aug-93											
20-Aug-93	0.32	0.320	14.01	13.61	13.81	0.540	0.810	0.675	180.4	85.2	132.8
3-Sep-93											
17-Sep-93	0.33	0.275	12.35	11.84	12.10	0.330	0.810	0.570	159.6	137.1	148.4
1-Oct-93											
15-Oct-93	0.28	0.270	10.92	9.101	10.01	0.390	0.805	0.598	187.4	109.4	148.4
29-Oct-93											
12-Nov-93	0.28	0.255	9.23	9.46	9.35	0.330	0.850	0.590	168.3		168.3
26-Nov-93											
10-Dec-93	0.33	0.280	10.13	9.23	9.68	0.390	1.910	1.150	189.7		189.7
24-Dec-93											
7-Jan-94	0.15	0.185	8.5	5.93	7.22	0.309	0.950	0.630	172.4		172.4
21-Jan-94	0.19	0.205	8.96	7.08	8.02	0.270	0.870	0.570	191.2		191.2

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Hg (mg/l) CSZ1	Hg (mg/l) CSZ2	Hg (mg/l) AVERAGE	Mg (mg/l) CSZ1	Mg (mg/l) CSZ2	Mg (mg/l) AVERAGE	Mn (mg/l) CSZ1	Mn (mg/l) CSZ2	Mn (mg/l) AVERAGE	Ni (mg/l) CSZ1	Ni (mg/l) CSZ2
30-Jan-92	<0.15	<0.15		730	713.9	721.95	165.40	172.60	169.00	2.100	2.370
6-Feb-92	<0.15	<0.15		691.6	647.2	669.40	153.60	143.50	148.55	1.900	1.910
13-Feb-92	<0.15	<0.15		604.9	599.6	602.25	147.80	142.60	145.20	1.900	2.230
20-Feb-92	<0.15	<0.15		334.6	357.3	345.95	103.20	101.10	102.15	1.800	1.810
27-Feb-92	<0.15	<0.15		156.7	139.5	148.10	68.13	61.80	64.97	1.500	1.440
5-Mar-92	<0.15	<0.15		<0.001	76.78	76.78				1.600	1.200
12-Mar-92	<0.15	<0.15		53.05	40.44	46.75	37.60	33.10	35.35	1.100	0.970
19-Mar-92	<0.15	<0.15		35.84	30.81	33.33	29.57	25.30	27.44	0.990	0.909
26-Mar-92	<0.15	<0.15		31.46	20.88	26.17	26.70	20.20	23.45	0.850	0.680
2-Apr-92	<0.15	<0.15		31.68	16.94	24.31	28.45	16.50	22.48	0.790	0.608
9-Apr-92	<0.15	<0.15		23.31	11.86	17.59	24.74	14.30	19.52	0.690	0.480
16-Apr-92	<0.15	<0.15		21.68	9.47	15.58	24.80	11.05	17.93	0.640	0.420
23-Apr-92	<0.15	<0.15		17.65	8.57	13.11	22.94	9.40	16.17	0.640	0.370
30-Apr-92	<0.15	<0.15		15.1	8.32	11.71	20.78	8.20	14.49	0.600	0.350
7-May-92	<0.15	<0.15		12.55	9.03	10.79	19.70	7.60	13.65	0.480	0.330
14-May-92	<0.15	<0.15		10.86	7.6	9.23	18.30	5.60	11.95	0.550	0.210
22-May-92	<0.15	<0.15		10.19	7.5	8.85	17.50	4.60	11.05	0.340	0.140
29-May-92	<0.15	<0.15		9.73	8.6	9.17	17.70	4.80	11.25	0.280	0.102
5-Jun-92	<0.15	<0.15		12.47	10.8	11.64	24.60	6.06	15.33	0.340	0.110
12-Jun-92	<0.15	<0.15		11.83	11.27	11.55	28.10	7.30	17.70	0.370	0.090
19-Jun-92	<0.15	<0.15		12.4	14.28	13.34	30.20	10.20	20.20	0.430	0.130
29-Jun-92	<0.15	<0.15		11.87	14.99	13.43	31.90	14.08	22.99	0.520	0.190
3-Jul-92	<0.15	<0.15		11.68	14.61	13.15	32.90	15.60	24.25	0.610	0.310
10-Jul-92	<0.15	<0.15		12.63	14.1	13.37	35.60	18.10	26.85	0.820	0.370
17-Jul-92	<0.15	<0.15		11.66	80.8	46.23	31.70	9.00	20.35	0.760	0.029
24-Jul-92	<0.15	<0.15		14.48	14.51	14.50	37.50	22.40	29.95	0.940	0.410

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Hg (mg/l) CSZ1	Hg (mg/l) CSZ2	Hg (mg/l) AVERAGE	Mg (mg/l) CSZ1	Mg (mg/l) CSZ2	Mg (mg/l) AVERAGE	Mn (mg/l) CSZ1	Mn (mg/l) CSZ2	Mn (mg/l) AVERAGE	Ni (mg/l) CSZ1	Ni (mg/l) CSZ2
1-Aug-92	<0.15	<0.15		13.08	15.38	14.23	39.80	27.08	33.44	1.040	0.510
7-Aug-92	<0.15	<0.15		10.3	12.37	11.34	27.20	22.70	24.95	0.890	0.490
14-Aug-92	<0.15	<0.15		9.73	13.03	11.38	27.30	25.05	26.18	0.720	0.570
21-Aug-92	<0.15	<0.15		10.03	13.76	11.90	31.20	30.60	30.90	0.780	0.609
28-Aug-92	<0.15	<0.15		9.2	13.38	11.29	31.02	36.30	33.66	0.770	0.690
4-Sep-92	<0.15	<0.15		9.04	9.81	9.43	30.90	29.40	30.15	0.750	0.550
11-Sep-92	<0.15	<0.15		8.61	8.83	8.72	30.07	27.70	28.89	0.740	0.480
18-Sep-92	<0.15	<0.15		7.19	7.73	7.46	25.80	25.10	25.45	0.590	0.390
25-Sep-92	<0.15	<0.15		6.56	7.26	6.91	23.40	24.70	24.05	0.540	0.340
2-Oct-92	<0.15	<0.15		7.19	6.8	7.00	25.70	26.30	26.00	0.590	0.370
8-Oct-92	<0.15	<0.15		8.37	7.1	7.74	28.20	27.06	27.63	0.690	0.406
16-Oct-92	<0.15	<0.15		7.49	5.97	6.73	25.40	24.60	25.00	0.640	0.320
30-Oct-92											
13-Nov-92	<0.15	<0.15		6.76	5.6	6.18	24.10	24.90	24.50	0.550	0.270
27-Nov-92											
11-Dec-92	<0.15	<0.15		10.97	8.59	9.78	28.90	35.20	32.05	0.840	0.480
24-Dec-92											
8-Jan-93	<0.15	<0.15		9.34	10.42	9.88	21.20	40.80	31.00	0.680	0.760
22-Jan-93											
5-Feb-93	<0.15	<0.15		10.06	11.65	10.86	18.00	41.80	29.90	0.710	1.120
19-Feb-93											
5-Mar-93	<0.15	<0.15		11.12	11.05	11.09	14.90	33.40	24.15	0.720	1.130
19-Mar-93											
2-Apr-93	<0.15	<0.15		10.45	10.76	10.61	12.20	27.30	19.75	0.630	1.090
16-Apr-93											
30-Apr-93	<0.15	<0.15		11.63	11.4	11.52	10.70	24.30	17.50	0.660	1.070

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Hg (mg/l) CSZ1	Hg (mg/l) CSZ2	Hg (mg/l) AVERAGE	Mg (mg/l) CSZ1	Mg (mg/l) CSZ2	Mg (mg/l) AVERAGE	Mn (mg/l) CSZ1	Mn (mg/l) CSZ2	Mn (mg/l) AVERAGE	Ni (mg/l) CSZ1	Ni (mg/l) CSZ2
14-May-93											
28-May-93	<0.15	<0.15		12.33	12.64	12.49	9.70	22.60	16.15	0.690	1.090
11-Jun-93											
25-Jun-93	<0.15	<0.15		10.3	11.88	11.09	7.30	18.40	12.85	0.580	0.930
9-Jul-93											
23-Jul-93	<0.15	<0.15		9.49	10.2	9.85	5.90	14.20	10.05	0.540	0.750
9-Aug-93											
20-Aug-93	<0.15	<0.15		9.707	10.39	10.05	5.10	11.50	8.30	0.680	0.730
3-Sep-93											
17-Sep-93	<0.15	<0.15		7.29	9.73	8.51	3.70	8.60	6.15	0.410	0.720
1-Oct-93											
15-Oct-93	<0.15	<0.15		8.42	8.75	8.59	3.80	6.60	5.20	0.540	0.620
29-Oct-93											
12-Nov-93	<0.15	<0.15		6.99	13.34	10.17	2.90	5.40	4.15	0.560	0.590
26-Nov-93											
10-Dec-93	<0.15	<0.15		7.18	9.66	8.42	2.80	5.40	4.10	0.530	0.680
24-Dec-93											
7-Jan-94	<0.15	<0.15		5.44	5.23	5.34	2.03	2.90	2.47	0.420	0.420
21-Jan-94	<0.15	<0.15		5.68	6.24	5.96	2.10	4.03	3.07	0.390	0.650

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Ni (mg/l) AVERAGE	Pb (mg/l) CSZ1	Pb (mg/l) CSZ2	Pb (mg/l) AVERAGE	Sb (mg/l) CSZ1	Sb (mg/l) CSZ2	Sb (mg/l) AVERAGE	Si (mg/l) CSZ1	Si (mg/l) CSZ2	Si (mg/l) AVERAGE	Zn (mg/l) CSZ1
30-Jan-92	2.235	<0.04	<0.04		0.08	0.04	0.06	13	13.9	13.45	0.230
6-Feb-92	1.905	<0.04	<0.04		0.07	0.06	0.07	11.3	11.06	11.18	0.120
13-Feb-92	2.065	<0.04	<0.04		0.09	0.04	0.06	11.4	11.1	11.25	0.080
20-Feb-92	1.805	<0.04	<0.04		0.03	<0.03	0.03	11.08	10.3	10.69	0.060
27-Feb-92	1.470	<0.04	<0.04		0.05	<0.03	0.05	10.57	9.1	9.84	0.040
5-Mar-92	1.400	<0.04	<0.04		<0.03	0.04	0.04	<0.001			0.050
12-Mar-92	1.035	<0.04	<0.04		0.02	<0.03	0.02	9.9	8.7	9.30	0.020
19-Mar-92	0.950	<0.04	<0.04		<0.03	<0.03		10.39	8.5	9.45	0.010
26-Mar-92	0.765	<0.04	<0.04		0.07	<0.03	0.07	9.6	8.2	8.90	0.020
2-Apr-92	0.699	<0.04	<0.04		<0.03	<0.03		9.9	7.9	8.90	0.010
9-Apr-92	0.585	<0.04	<0.04		0.04	<0.03	0.04	10.5	8.03	9.27	0.010
16-Apr-92	0.530	<0.04	<0.04		<0.03	<0.03		10.7	7.6	9.15	0.010
23-Apr-92	0.505	0.07	<0.04	0.07	<0.03	<0.03		11.08	7.7	9.39	0.010
30-Apr-92	0.475	<0.04	<0.04		<0.03	<0.03		11.66	7.5	9.58	0.010
7-May-92	0.405	<0.04	<0.04		<0.03	<0.03		12.3	8.02	10.16	0.010
14-May-92	0.380	<0.04	<0.04		0.03	<0.03	0.03	12.7	6.7	9.70	0.020
22-May-92	0.240	<0.04	<0.04		<0.03	<0.03		12.15	6.9	9.53	0.010
29-May-92	0.191	<0.04	<0.04		<0.03	<0.03		12.9	6.8	9.85	0.010
5-Jun-92	0.225	<0.04	<0.04		<0.03	<0.03		14.7	8.02	11.36	0.020
12-Jun-92	0.230	<0.04	<0.04		<0.03	<0.03		17.03	7.7	12.37	0.020
19-Jun-92	0.280	<0.04	<0.04		<0.03	<0.03		19.3	7.2	13.25	0.020
29-Jun-92	0.355	<0.04	<0.04		<0.03	<0.03		22.8	8.4	15.60	0.040
3-Jul-92	0.460	<0.04	<0.04		<0.03	<0.03		22.7	9.6	16.15	0.080
10-Jul-92	0.595	<0.04	<0.04		<0.03	<0.03		26.9	10.2	18.55	0.190
17-Jul-92	0.395	<0.04	<0.04		<0.03	<0.03		25.3	3.05	14.18	0.250
24-Jul-92	0.675	<0.04	<0.04		0.07	<0.03	0.07	30.5	12.4	21.45	0.370

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Ni (mg/l) AVERAGE	Pb (mg/l) CSZ1	Pb (mg/l) CSZ2	Pb (mg/l) AVERAGE	Sb (mg/l) CSZ1	Sb (mg/l) CSZ2	Sb (mg/l) AVERAGE	Si (mg/l) CSZ1	Si (mg/l) CSZ2	Si (mg/l) AVERAGE	Zn (mg/l) CSZ1
1-Aug-92	0.775	<0.04	<0.04		<0.03	<0.03		35.6	15.4	25.50	0.540
7-Aug-92	0.690	<0.04	<0.04		<0.03	<0.03		27.8	13.5	20.65	0.390
14-Aug-92	0.645	<0.04	<0.04		<0.03	<0.03		28.8	15.02	21.91	0.370
21-Aug-92	0.695	<0.04	<0.04		<0.03	<0.03		33.3	15.3	24.30	0.450
28-Aug-92	0.730	<0.04	<0.04		<0.03	<0.03		36.3	17.9	27.10	0.490
4-Sep-92	0.650	<0.04	<0.04		<0.03	<0.03		37.2	15.5	26.35	0.500
11-Sep-92	0.610	<0.04	<0.04		<0.03	<0.03		40.3	14.7	27.50	0.470
18-Sep-92	0.490	0.07	<0.04	0.07	<0.03	<0.03		37.7	13.3	25.50	0.370
25-Sep-92	0.440	0.09	<0.04	0.09	<0.03	<0.03		34.8	11.9	23.35	0.310
2-Oct-92	0.480	<0.04	<0.04		<0.03	<0.03		39.5	13.3	26.40	0.320
8-Oct-92	0.548	<0.04	<0.04		<0.03	<0.03		41.2	13.6	27.40	0.350
16-Oct-92	0.480	<0.04	<0.04		<0.03	<0.03		40.2	14.5	27.35	0.330
30-Oct-92											
13-Nov-92	0.410	<0.04	<0.04		0.03	<0.03	0.03	40.9	13.01	26.96	0.280
27-Nov-92											
11-Dec-92	0.660	0.047	<0.04	0.05	<0.03	<0.03		55.5	17.8	36.65	0.370
24-Dec-92											
8-Jan-93	0.720	<0.04	<0.04		<0.03	<0.03		55.2	26.9	41.05	0.320
22-Jan-93											
5-Feb-93	0.915	0.401	<0.04	0.40	<0.03	<0.03		57.9	33.8	45.85	0.310
19-Feb-93											
5-Mar-93	0.925	1.5	<0.04	1.50	<0.03	<0.03		64.2	38.1	51.15	0.330
19-Mar-93											
2-Apr-93	0.860	2.32	<0.04	2.32	<0.03	<0.03		65.4	42.8	54.10	0.290
16-Apr-93											
30-Apr-93	0.865	2.15	0.13	1.14	0.04	<0.03	0.04	62.2	47.6	54.90	0.250

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Ni (mg/l) AVERAGE	Pb (mg/l) CSZ1	Pb (mg/l) CSZ2	Pb (mg/l) AVERAGE	Sb (mg/l) CSZ1	Sb (mg/l) CSZ2	Sb (mg/l) AVERAGE	Si (mg/l) CSZ1	Si (mg/l) CSZ2	Si (mg/l) AVERAGE	Zn (mg/l) CSZ1
14-May-93											
28-May-93	0.890	2.12	0.36	1.24	0.03	<0.03	0.03	63.04	53.9	58.47	0.240
11-Jun-93											
25-Jun-93	0.755	1.92	0.51	1.22	<0.03	<0.03		57.8	56.1	56.95	0.180
9-Jul-93											
23-Jul-93	0.645	1.8	0.66	1.23	0.03	<0.03	0.03	54.7	56.6	55.65	0.160
9-Aug-93											
20-Aug-93	0.705	1.79	0.95	1.37	<0.03	<0.03		53.9	58.5	56.20	0.160
3-Sep-93											
17-Sep-93	0.565	1.41	1.33	1.37	<0.03	<0.03		42.7	56.6	49.65	0.120
1-Oct-93											
15-Oct-93	0.580	1.65	1.52	1.59	0.04	<0.03	0.04	49.7	54.1	51.90	0.140
29-Oct-93											
12-Nov-93	0.575	1.47	1.77	1.62	<0.03	<0.03		41.6		41.60	0.130
26-Nov-93											
10-Dec-93	0.605	1.51	2.3	1.91	0.04	0.04	0.04	42.6		42.60	0.130
24-Dec-93											
7-Jan-94	0.420	1.2	1.24	1.22	0.03	<0.03	0.03	33.7		33.70	0.108
21-Jan-94	0.520	1.14	1.54	1.34	0.04	<0.03	0.04	40.9		40.90	0.110

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Zn (mg/l) CSZ2	Zn (mg/l) AVERAGE	Sulphate (mg/l) CSZ1	Sulphate (mg) CSZ1	Sulphate (µg/kg/d) CSZ1	Cum Sul (mg) CSZ1	% Cum Sul CSZ1	Sulphate (mg/l) CSZ2	Sulphate (mg) CSZ2	Sulphate (µg/kg/d) CSZ2
30-Jan-92	0.350	0.290	4916	4697.9		4698	3.6	4812.7	4343	
6-Feb-92	0.110	0.115	5020	4797.6	70657	9496	7.3	4897.3	4419	65081
13-Feb-92	0.080	0.080	4484	4285.3	63111	13781	10.7	4578.2	4131	60842
20-Feb-92	0.050	0.055	3154	3014.4	44394	16795	13.0	3226.3	2911	42876
27-Feb-92	0.030	0.035	2205	2107.3	31035	18902	14.6	2140.7	1932	28449
5-Mar-92	0.040	0.045	1858	1776.1	26157	20678	16.0	1777.3	1698	25014
12-Mar-92	0.020	0.020	1512	1444.9	21279	22123	17.1	1413.8	1276	18788
19-Mar-92	0.020	0.015	1389	1327.0	19543	23450	18.1	1341.5	1210	17827
26-Mar-92	0.010	0.015	1355	1295.1	19073	24745	19.1	1258.8	1136	16728
2-Apr-92	0.010	0.010	1300	1249.1	18396	25994	20.1	1268.7	1209	17801
9-Apr-92	0.010	0.010	1144	1107.6	16313	27102	21.0	1038.9	984	14492
16-Apr-92	0.010	0.010	1232	1211.1	17837	28313	21.9	1279.2	1254	18471
23-Apr-92	0.008	0.009	1671	1541.7	22705	29855	23.1	1223.6	1178	17344
30-Apr-92	0.010	0.010	1174	1109.2	16337	30964	23.9	1173.0	1068	15734
7-May-92	0.010	0.010	1088	1026.4	15117	31991	24.7	1128.1	981	14445
14-May-92	0.009	0.015	1029	990.5	14587	32981	25.5	954.7	921	13563
22-May-92	0.005	0.008	776	729.7	9404	33711	26.1	644.6	566	7288
29-May-92	0.007	0.009	740	720.5	10611	34431	26.6	495.0	488	7188
5-Jun-92	0.006	0.013	662	634.4	9344	35066	27.1	394.8	205	3018
12-Jun-92	0.004	0.012	416	398.7	5871	35464	27.4	276.2	275	4052
19-Jun-92	0.006	0.013	185	176.1	2594	35641	27.6	341.7	295	4338
29-Jun-92	0.190	0.115	188	175.3	1807	35816	27.7	192.8	195	2014
3-Jul-92	0.008	0.044	205	192.1	4951	36008	27.8	146.0	122	3142
10-Jul-92	0.010	0.100	223	212.3	3126	36220	28.0	174.1	166	2444
17-Jul-92	0.006	0.128	212	195.6	2880	36416	28.2	145.6	138	2026
24-Jul-92	0.010	0.190	489	470.7	6932	36886	28.5	160.2	153	2254

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Zn (mg/l) CSZ2	Zn (mg/l) AVERAGE	Sulphate (mg/l) CSZ1	Sulphate (mg) CSZ1	Sulphate (µg/kg/d) CSZ1	Cum Sul (mg) CSZ1	% Cum Sul CSZ1	Sulphate (mg/l) CSZ2	Sulphate (mg) CSZ2	Sulphate (µg/kg/d) CSZ2
1-Aug-92	0.030	0.285	307	292.3	3766	37179	28.7	182.5	170	2190
7-Aug-92	0.050	0.220	224	214.2	3681	37393	28.9	160.7	153	2633
14-Aug-92	0.080	0.225	236	220.6	3249	37614	29.1	164.4	157	2318
21-Aug-92	0.080	0.265	213	199.2	2934	37813	29.2	205.9	192	2833
28-Aug-92	0.130	0.310	275	253.5	3733	38066	29.4	237.9	203	2994
4-Sep-92	0.106	0.303	134	126.7	1867	38193	29.5	210.7	197	2906
11-Sep-92	0.090	0.280	368	357.8	5270	38551	29.8	182.7	173	2552
18-Sep-92	0.080	0.225	328	310.4	4572	38861	30.0	164.3	152	2245
25-Sep-92	0.060	0.185	1524	1251.1	18425	40112	31.0	143.8	123	1809
2-Oct-92	0.090	0.205	365	343.1	5052	40455	31.3	143.0	134	1970
8-Oct-92	0.060	0.205	416	390.2	6704	40845	31.6	167.1	159	2738
16-Oct-92	0.080	0.205	364	341.5	4400	41187	31.8	99.4	95	1221
30-Oct-92			357	323.0	2379	41510	32.1	123.3	115	843
13-Nov-92	0.050	0.165	350	334.3	2461	41844	32.3	147.3	139	1027
27-Nov-92			443	403.2	2969	42247	32.7	167.2	156	1148
11-Dec-92	0.090	0.230	536	505.6	3723	42753	33.0	187.1	173	1273
24-Dec-92			529	487.5	3866	43241	33.4	238.5	220	1748
8-Jan-93	0.190	0.255	522	495.1	3403	43736	33.8	289.9	276	1899
22-Jan-93			583	519.3	3824	44255	34.2	306.3	281	2072
5-Feb-93	0.310	0.310	643	587.1	4323	44842	34.7	322.8	294	2164
19-Feb-93			702	629.0	4632	45471	35.2	383.9	347	2557
5-Mar-93	0.380	0.355	760	721.7	5314	46193	35.7	445.0	399	2940
19-Mar-93			719	632.3	4656	46825	36.2	445.1	393	2895
2-Apr-93	0.390	0.340	678	612.2	4508	47437	36.7	445.1	396	2916
16-Apr-93			735	661.6	4872	48099	37.2	497.5	462	3404
30-Apr-93	0.490	0.370	791	720.1	5303	48819	37.7	549.8	513	3778

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Zn (mg/l) CSZ2	Zn (mg/l) AVERAGE	Sulphate (mg/l) CSZ1	Sulphate (mg) CSZ1	Sulphate (µg/kg/d) CSZ1	Cum Sul (mg) CSZ1	% Cum Sul CSZ1	Sulphate (mg/l) CSZ2	Sulphate (mg) CSZ2	Sulphate (µg/kg/d) CSZ2
14-May-93			767	698.6	5145	49518	38.3	551.7	506	3724
28-May-93	0.610	0.425	742	692.3	5098	50210	38.8	553.6	518	3818
11-Jun-93			703	644.6	4747	50855	39.3	555.5	498	3670
25-Jun-93	0.580	0.380	665	604.9	4455	51459	39.8	557.4	518	3811
9-Jul-93			721	663.9	4889	52123	40.3	572.6	446	3283
23-Jul-93	0.490	0.325	778	650.9	4793	52774	40.8	587.9	602	4431
9-Aug-93			738	726.0	4403	53500	41.4	577.8	504	3054
20-Aug-93	0.420	0.290	699	629.6	5901	54130	41.8	567.7	504	4728
3-Sep-93			599	587.9	4329	54718	42.3	577.1	577	4247
17-Sep-93	0.330	0.225	499	472.5	3479	55190	42.7	586.5	532	3918
1-Oct-93			613	559.2	4118	55749	43.1	608.2	565	4164
15-Oct-93	0.270	0.205	727	434.4	3199	56184	43.4	629.8	607	4467
29-Oct-93			724	639.4	4708	56823	43.9	646.3	599	4412
12-Nov-93	0.240	0.185	721	663.3	4885	57486	44.4	662.8	671	4939
26-Nov-93			711	646.4	4760	58133	44.9	648.5	453	3334
10-Dec-93	0.240	0.185	701	669.7	4931	58802	45.5	634.2	710	5226
24-Dec-93			613	563.0	4146	59365	45.9	509.2	403	2969
7-Jan-94	0.140	0.124	524	485.5	3575	59851	46.3	384.2	390	2874
21-Jan-94	0.170	0.140	567	419.2	3087	60270	46.6	434.6	329	2421

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Cum Sul (mg) CSZ2	% Cum Sul CSZ2	Sulphate (mg/l) AVERAGE	Sulphate % Cum AVERAGE	Sulphate (µg/kg/d) AVERAGE	TOTAL CN (µg/l) CSZ1	TOTAL CN (µg/l) CSZ2	TOTAL CN (µg/l) AVERAGE
30-Jan-92	4343	3.4	4864	3.5				
6-Feb-92	8762	6.8	4959	7.1	67869	11	11	11
13-Feb-92	12893	10.0	4531	10.3	61977	7	5	6
20-Feb-92	15804	12.2	3190	12.6	43635	2	2	2
27-Feb-92	17736	13.7	2173	14.2	29742	2	2	2
5-Mar-92	19434	15.0	1818	15.5	25586			
12-Mar-92	20710	16.0	1463	16.6	20034	<2	<2	
19-Mar-92	21920	16.9	1365	17.5	18685	<2	<2	
26-Mar-92	23056	17.8	1307	18.5	17901	<2	<2	
2-Apr-92	24265	18.8	1285	19.4	18098	<2	<2	
9-Apr-92	25249	19.5	1091	20.2	15402	<2	<2	
16-Apr-92	26503	20.5	1256	21.2	18154	<2	<2	
23-Apr-92	27681	21.4	1447	22.2	20024	<2	<2	
30-Apr-92	28749	22.2	1174	23.1	16035	<2	<2	
7-May-92	29730	23.0	1108	23.9	14781	<2	<2	
14-May-92	30651	23.7	992	24.6	14075			
22-May-92	31217	24.1	710	25.1	8346	<2	<2	
29-May-92	31705	24.5	617	25.6	8899	<2	<2	
5-Jun-92	31909	24.7	529	25.9	6181	<2	<2	
12-Jun-92	32185	24.9	346	26.1	4962	<2	<2	
19-Jun-92	32479	25.1	263	26.3	3466	<2	<2	
29-Jun-92	32675	25.3	191	26.5	1911	<2	<2	
3-Jul-92	32796	25.4	176	26.6	4046	<2	<2	
10-Jul-92	32962	25.5	198	26.7	2785	<2	<2	
17-Jul-92	33100	25.6	179	26.9	2453	<2	<2	
24-Jul-92	33253	25.7	325	27.1	4593	<2	<2	

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Cum Sul (mg) CSZ2	% Cum Sul CSZ2	Sulphate (mg/l) AVERAGE	Sulphate % Cum AVERAGE	Sulphate (µg/kg/d) AVERAGE	TOTAL CN (µg/l) CSZ1	TOTAL CN (µg/l) CSZ2	TOTAL CN (µg/l) AVERAGE
1-Aug-92	33423	25.8	245	27.3	2978	<2	<2	
7-Aug-92	33576	26.0	192	27.4	3157	<2	<2	
14-Aug-92	33734	26.1	200	27.6	2784	3	4	3.5
21-Aug-92	33926	26.2	210	27.7	2883	5	2	3.5
28-Aug-92	34129	26.4	256	27.9	3364	<2	<2	
4-Sep-92	34327	26.5	172	28.0	2386	<2	<2	
11-Sep-92	34500	26.7	275	28.2	3911	<2	<2	
18-Sep-92	34652	26.8	246	28.4	3408	<2	<2	
25-Sep-92	34775	26.9	834	28.9	10117	<2	<2	
2-Oct-92	34909	27.0	254	29.1	3511	<2	<2	
8-Oct-92	35068	27.1	292	29.3	4721	<2	<2	
16-Oct-92	35163	27.2	232	29.5	2811	<2	<2	
30-Oct-92	35277	27.3	240	29.7	1611	-	-	
13-Nov-92	35417	27.4	249	29.9	1744	-	-	
27-Nov-92	35573	27.5	305	30.1	2059	-	-	
11-Dec-92	35746	27.6	362	30.3	2498	-	-	
24-Dec-92	35966	27.8	384	30.6	2807	-	-	
8-Jan-93	36242	28.0	406	30.9	2651	-	-	
22-Jan-93	36524	28.2	445	31.2	2948	-	-	
5-Feb-93	36818	28.5	483	31.6	3244	-	-	
19-Feb-93	37165	28.7	543	31.9	3594	-	-	
5-Mar-93	37564	29.0	602	32.4	4127	-	-	
19-Mar-93	37957	29.3	582	32.8	3776	-	-	
2-Apr-93	38353	29.6	562	33.2	3712	-	-	
16-Apr-93	38816	30.0	616	33.6	4138	-	-	
30-Apr-93	39329	30.4	670	34.1	4540	-	-	

Table 5: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 2 degrees Celsius.

SAMPLE DATE	Cum Sul (mg) CSZ2	% Cum Sul CSZ2	Sulphate (mg/l) AVERAGE	Sulphate % Cum AVERAGE	Sulphate (µg/kg/d) AVERAGE	TOTAL CN (µg/l) CSZ1	TOTAL CN (µg/l) CSZ2	TOTAL CN (µg/l) AVERAGE
14-May-93	39834	30.8	659	34.5	4434	-	-	
28-May-93	40353	31.2	648	35.0	4458	-	-	
11-Jun-93	40851	31.6	629	35.4	4208	-	-	
25-Jun-93	41369	32.0	611	35.9	4133	-	-	
9-Jul-93	41814	32.3	647	36.3	4086	-	-	
23-Jul-93	42416	32.8	683	36.8	4612	-	-	
9-Aug-93	42920	33.2	658	37.3	3728	-	-	
20-Aug-93	43424	33.6	633	37.7	5314	-	-	
3-Sep-93	44001	34.0	588	38.2	4288	-	-	
17-Sep-93	44533	34.4	543	38.5	3699	-	-	
1-Oct-93	45098	34.9	611	39.0	4141	-	-	
15-Oct-93	45705	35.3	678	39.4	3833	-	-	
29-Oct-93	46304	35.8	685	39.9	4560	-	-	
12-Nov-93	46975	36.3	692	40.4	4912	-	-	
26-Nov-93	47428	36.7	680	40.8	4047	-	-	
10-Dec-93	48137	37.2	668	41.3	5079	-	-	
24-Dec-93	48541	37.5	561	41.7	3557	-	-	
7-Jan-94	48931	37.8	454	42.0	3224	-	-	
21-Jan-94	49260	38.1	501	42.3	2754	-	-	

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	DAYS FROM START	VOLUME (ml) CSZ1	VOLUME (ml) CSZ2	VOLUME (ml) AVERAGE	CUMMULATIVE VOLUME (ml)	LAB. pH pH(LAB) CSZ1 COLD TEMP.	LAB. pH pH(LAB) CSZ1 ROOM TEMP.	LAB. pH pH(LAB) CSZ2 COLD TEMP.	LAB. pH pH(LAB) CSZ2 ROOM TEMP.
11-Mar-94	49	941.8	441.2	691.5	691.5	3.32	2.94	3.02	2.96
25-Mar-94	785	804.5	1027.2	915.9	1607.4	3.12	2.97	3.08	3.00
15-Apr-94	806	869.7	1021.8	945.8	2553.1	3.16	2.91	3.18	3.08
29-Apr-94	820	839.3	846.3	842.8	3395.9	3.22	3.00	3.22	3.02
13-May-94	834	851.2	725.8	788.5	4184.4	3.18	3.03	3.21	3.03
27-May-94	848	819.6	807.2	813.4	4997.8	3.27	3.14	3.25	3.11
10-Jun-94	862	823.1	782.9	803.0	5800.8	3.10	3.09	3.13	3.14
24-Jun-94	876	989.5	958.6	974.0	6774.9	3.10	NSS	3.12	NSS
8-Jul-94	890	949.0	830.5	889.8	7664.6	3.27	3.21	3.40	3.32
22-Jul-94	904	915.3	910.4	912.8	8577.4	3.29	3.18	3.23	3.11
5-Aug-94	918	852.9	759.5	806.2	9383.6	3.26	3.04	3.22	2.99
19-Aug-94	932	898.9	861.0	879.9	10263.6	3.31	3.05	3.31	3.09
2-Sep-94	946	840.8	850.1	845.5	11109.0	3.12	2.99	3.26	3.08
16-Sep-94	960	948.8	906.0	927.4	12036.4	3.17	3.20	3.17	3.21
30-Sep-94	974	900.8	981.0	940.9	12977.3	3.04	3.13	3.13	3.26
14-Oct-94	988	952.2	870.5	911.4	13888.7	3.06	3.20	2.96	3.01
28-Oct-94	1002	949.6	768.1	858.9	14747.5	3.05	3.08	2.95	3.00
10-Nov-94	1015	977.0	946.4	961.7	15709.2	3.05	3.20	2.89	3.00
25-Nov-94	1030	946.1	896.2	921.2	16630.4	3.18	3.23	3.00	3.05
9-Dec-94	1044	900.1	971.8	936.0	17566.3	3.09	3.06	2.98	3.03
23-Dec-94	1058	857.2	862.5	859.9	18426.2	3.09	3.05	3.07	2.99
6-Jan-95	1072	928.9	948.8	938.9	19365.0	3.23	3.21	3.02	3.03
20-Jan-95	1086	877.5	804.4	840.9	20205.9	3.03	3.07	2.97	3.02
3-Feb-95	1100	907.2	787.3	847.3	21053.2	3.10	3.07	3.24	3.22

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	LAB. pH pH(LAB) AVERAGE COLD TEMP.	LAB. pH pH(LAB) AVERAGE ROOM TEMP.	EH Eh(mV) CSZ1 COLD TEMP.	EH Eh(mV) CSZ1 ROOM TEMP.	EH Eh(mV) CSZ2 COLD TEMP.	EH Eh(mV) CSZ2 ROOM TEMP.	EH Eh(mV) AVERAGE COLD TEMP.	EH Eh(mV) AVERAGE ROOM TEMP.	EH(NHE) (mV) CSZ1 COLD TEMP.
11-Mar-94	3.20	2.94	422.6	430.0	445.0	453.0	433.8	441.5	666.6
25-Mar-94	3.10	2.99	393.3	399.1	419.4	425.8	406.4	412.5	637.3
15-Apr-94	3.17	2.99	437.2	446.3	477.4	488.3	457.3	467.3	681.2
29-Apr-94	3.22	3.01	454.0	465.0	454.1	462.7	454.1	463.9	698.0
13-May-94	3.19	3.03	424.3	464.1	522.7	532.4	473.5	498.3	668.3
27-May-94	3.26	3.12	461.2	462.1	517.4	518.4	489.3	490.3	705.2
10-Jun-94	3.12	3.11	463.7	446.3	456.4	443.4	460.1	444.9	707.7
24-Jun-94	3.11	NSS	454.5	NSS	453.8	NSS	454.2	NSS	698.5
8-Jul-94	3.33	3.25	438.8	437.5	402.7	399.5	420.8	418.5	682.8
22-Jul-94	3.26	3.14	451.4	475.4	494.8	514.8	473.1	495.1	695.4
5-Aug-94	3.24	3.01	429.7	456.7	497.6	541.5	463.7	499.1	673.7
19-Aug-94	3.31	3.07	437.9	441.0	463.2	471.8	450.6	456.4	681.9
2-Sep-94	3.19	3.03	446.7	448.6	419.7	414.0	433.2	431.3	690.7
16-Sep-94	3.17	3.21	415.4	412.4	427.0	425.3	421.2	418.9	659.4
30-Sep-94	3.08	3.19	418.7	415.3	388.9	385.9	403.8	400.6	662.7
14-Oct-94	3.01	3.10	441.5	444.0	541.8	542.3	491.7	493.2	685.5
28-Oct-94	3.00	3.04	476.3	479.1	511.0	517.2	493.7	498.2	720.3
10-Nov-94	2.96	3.09	406.3	410.3	532.9	545.3	469.6	477.8	650.3
25-Nov-94	3.08	3.13	406.4	407.0	549.4	542.5	477.9	474.8	650.4
9-Dec-94	3.03	3.04	561.5	552.7	546.3	538.4	553.9	545.6	805.5
23-Dec-94	3.08	3.02	484.1	509.4	493.9	529.8	489.0	519.6	728.1
6-Jan-95	3.11	3.11	412.4	412.3	527.1	534.0	469.8	473.2	656.4
20-Jan-95	3.00	3.05	506.0	511.4	508.4	512.6	507.2	512.0	750.0
3-Feb-95	3.16	3.13	509.9	542.1	406.4	406.7	458.2	474.4	753.9

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	EH(NHE) (mV) CSZ1 ROOM TEMP.	EH(NHE) (mV) CSZ2 COLD TEMP.	EH(NHE) (mV) CSZ2 ROOM TEMP.	EH(NHE) (mV) AVERAGE COLD TEMP.	EH(NHE) (mV) AVERAGE ROOM TEMP.	LAB. Ec Ec(LAB) CSZ1 COLD TEMP.	LAB. Ec Ec(LAB) CSZ1 ROOM TEMP.	LAB. Ec Ec(LAB) CSZ2 COLD TEMP.	LAB. Ec Ec(LAB) CSZ2 ROOM TEMP.
11-Mar-94	674.0	689.0	697.0	677.8	685.5	2880	2970	2940	2920
25-Mar-94	643.1	663.4	669.8	650.4	656.5	2830	2720	2710	2866
15-Apr-94	690.3	721.4	732.3	701.3	711.3	2420	2530	2280	2360
29-Apr-94	709.0	698.1	706.7	698.1	707.9	2250	2280	2190	2200
13-May-94	708.1	766.7	776.4	717.5	742.3	2230	1935	2180	1948
27-May-94	706.1	761.4	762.4	733.3	734.3	2060	1940	2170	1960
10-Jun-94	690.3	700.4	687.4	704.1	688.9	1750	1720	2000	2020
24-Jun-94	NSS	697.8	NSS	698.2	NSS	1650	NSS	1980	NSS
8-Jul-94	681.5	646.7	643.5	664.8	662.5	1158	1159	1488	1479
22-Jul-94	719.4	738.8	758.8	717.1	739.1	1095	1012	1564	1420
5-Aug-94	700.7	741.6	785.5	707.7	743.1	974	907	1412	1366
19-Aug-94	685.0	707.2	715.8	694.6	700.4	833	839	1179	1192
2-Sep-94	692.6	663.7	658.0	677.2	675.3	831	765	1084	1038
16-Sep-94	656.4	671.0	669.3	665.2	662.9	882	729	1132	958
30-Sep-94	659.3	632.9	629.9	647.8	644.6	858	693	1010	819
14-Oct-94	688.0	785.8	786.3	735.7	737.2	781	740	984	874
28-Oct-94	723.1	755.0	761.2	737.7	742.2	763	682	820	707
10-Nov-94	654.3	776.9	789.3	713.6	721.8	720	657	801	712
25-Nov-94	651.0	793.4	786.5	721.9	718.8	749	652	832	718
9-Dec-94	796.7	790.3	782.4	797.9	789.6	726	648	790	690
23-Dec-94	753.4	737.9	773.8	733.0	763.6	738	793	800	766
6-Jan-95	656.3	771.1	778.0	713.8	717.2	674	635	801	750
20-Jan-95	755.4	752.4	756.6	751.2	756.0	781	916	875	1062
3-Feb-95	786.1	650.4	650.7	702.2	718.4	819	619	754	582

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	LAB. Ec Ec(LAB) AVERAGE COLD TEMP.	LAB. Ec Ec(LAB) AVERAGE ROOM TEMP.	SAMPLE TEMP.(C) CSZ1 COLD	SAMPLE TEMP.(C) CSZ1 ROOM	SAMPLE TEMP.(C) CSZ2 COLD	SAMPLE TEMP.(C) CSZ2 ROOM	SAMPLE TEMP.(C) AVERAGE COLD	SAMPLE TEMP.(C) AVERAGE ROOM	ACIDITY (mg/l) CSZ1
11-Mar-94	2910	2945	10.2	21.8	10.5	23.0	10.4	22.4	727.56
25-Mar-94	2770	2793	10.2	22.4	10.0	23.4	10.1	22.9	714.74
15-Apr-94	2350	2445	10.8	24.3	10.3	24.1	10.6	24.2	626.33
29-Apr-94	2220	2240	11.1	23.8	11.1	25.1	11.1	24.5	461.42
13-May-94	2205	1942	11.1	22.5	10.9	23.9	11.0	23.2	327.90
27-May-94	2115	1950	11.7	20.3	11.5	21.5	11.6	20.9	234.70
10-Jun-94	1875	1870	11.3	24.5	10.9	24.4	11.1	24.5	182.09
24-Jun-94	1815	NSS	16.0	NSS	16.9	NSS	16.5	NSS	217.06
8-Jul-94	1323	1319	14.3	22.6	15.1	23.0	14.7	22.8	121.70
22-Jul-94	1330	1216	11.5	20.3	11.1	21.9	11.3	21.1	120.30
5-Aug-94	1193	1137	11.7	27.4	12.8	27.0	12.3	27.2	126.56
19-Aug-94	1006	1016	11.0	27.6	11.5	24.5	11.3	26.1	131.23
2-Sep-94	958	902	11.9	24.1	12.9	26.7	12.4	25.4	123.01
16-Sep-94	1007	844	15.7	21.4	14.2	21.4	15.0	21.4	126.04
30-Sep-94	934	756	12.9	22.3	12.6	22.2	12.8	22.3	157.76
14-Oct-94	883	807	15.8	21.2	16.0	21.0	15.9	21.1	110.16
28-Oct-94	792	695	13.1	21.4	12.8	21.4	13.0	21.4	109.13
10-Nov-94	761	685	13.3	21.8	12.8	21.9	13.1	21.9	105.80
25-Nov-94	791	685	21.2	21.2	21.2	21.2	21.2	21.2	427.64
9-Dec-94	758	669	12.7	20.4	12.8	20.7	12.8	20.6	101.56
23-Dec-94	769	780	11.5	19.3	11.7	19.0	11.6	19.2	89.29
6-Jan-95	738	693	15.0	20.8	15.4	21.0	15.2	20.9	97.45
20-Jan-95	828	989	12.6	21.2	12.8	21.2	12.7	21.2	89.96
3-Feb-95	787	601	12.4	18.7	13.6	18.7	13.0	18.7	97.17

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	ACIDITY (mg/l) CSZ2	ACIDITY (mg/l) AVERAGE	ALKALINITY (mg/l) CSZ1	ALKALINITY (mg/l) CSZ2	ALKALINITY (mg/l) AVERAGE	Al (mg/l) CSZ1	Al (mg/l) CSZ2	Al (mg/l) AVERAGE	As (mg/l) CSZ1
11-Mar-94	542.12	634.84	0.00	0.00	0.00	21.1		21.10	0.28
25-Mar-94	639.97	677.36	0.00	0.00	0.00	8.78	9.09	8.94	0.204
15-Apr-94	518.47	572.40	0.00	0.00	0.00	5.23	3.81	4.52	0.18
29-Apr-94	390.67	426.05	0.00	0.00	0.00	2.44	1.61	2.03	0.13
13-May-94	260.35	294.12	0.00	0.00	0.00	1.804	1.89	1.85	0.05
27-May-94	222.18	228.44	0.00	0.00	0.00	1.27	1.21	1.24	0.1
10-Jun-94	179.56	180.82	0.00	0.00	0.00	0.84	0.68	0.76	<0.044
24-Jun-94	154.85	185.95	0.00	0.00	0.00	0.79	0.83	0.81	0.05
8-Jul-94	149.63	135.66	0.00	0.00	0.00	0.42	0.48	0.45	<0.044
22-Jul-94	101.63	110.96	0.00	0.00	0.00	0.41	0.71	0.56	<0.044
5-Aug-94	107.93	117.25	0.00	0.00	0.00	0.38	0.59	0.49	<0.044
19-Aug-94	125.69	128.46	0.00	0.00	0.00	0.47	0.702	0.59	<0.044
2-Sep-94	126.36	124.69	0.00	0.00	0.00	0.29	0.21	0.25	<0.044
16-Sep-94	126.12	126.08	0.00	0.00	0.00	0.407	0.37	0.39	<0.044
30-Sep-94	122.37	140.07	0.00	0.00	0.00	0.25	0.19	0.22	<0.044
14-Oct-94	83.63	96.90	0.00	0.00	0.00	0.37	0.4	0.39	<0.044
28-Oct-94	86.36	97.75	0.00	0.00	0.00				
10-Nov-94	79.35	92.58	0.00	0.00	0.00				
25-Nov-94	417.34	422.49	0.00	0.00	0.00	0.25		0.25	<0.044
9-Dec-94	87.39	94.48	0.00	0.00	0.00	0.28		0.28	
23-Dec-94	83.39	86.34	0.00	0.00	0.00	0.34		0.34	
6-Jan-95	89.61	93.53	0.00	0.00	0.00	0.36		0.36	0.051
20-Jan-95	89.92	89.94	0.00	0.00	0.00	0.42		0.42	
3-Feb-95	101.44	99.31	0.00	0.00	0.00	0.5		0.50	

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	As (mg/l) CSZ2	As (mg/l) AVERAGE	Ca (mg/l) CSZ1	Ca (mg/l) CSZ2	Ca (mg/l) AVERAGE	Cu (mg/l) CSZ1	Cu (mg/l) CSZ2	Cu (mg/l) AVERAGE	Fe TOTAL (mg/l) CSZ1	Fe TOTAL (mg/l) CSZ2	Fe TOTAL (mg/l) AVERAGE
11-Mar-94	0.17	0.225	531.3		531.30	0.160	0.150	0.155	225.1		225.1
25-Mar-94	0.16	0.182	534.5		534.50	0.020	0.030	0.025	218.1		218.1
15-Apr-94	0.08	0.130	502.6		502.60	0.010	0.003	0.007	209.8		209.8
29-Apr-94	0.05	0.090	515.2		515.20	<0.003	<0.003		154.3		154.3
13-May-94	<0.044	0.050	526		526.00	<0.003	<0.003		101.2		101.2
27-May-94	<0.044	0.100	465.7		465.70	0.007	<0.003	0.007	70.2		70.2
10-Jun-94	<0.044		379.8		379.80	0.006	<0.003	0.006	48.1		48.1
24-Jun-94	<0.044	0.050	306.1		306.10	0.008	<0.003	0.008	36.1		36.1
8-Jul-94	<0.044		220.4		220.40	0.004	<0.003	0.004	35.0		35.0
22-Jul-94	<0.044		157.1		157.10	0.004	0.009	0.007	25.2		25.2
5-Aug-94	<0.044		107		107.00	0.005	<0.003	0.005	28.8		28.8
19-Aug-94	<0.044		85.72		85.72	0.005	<0.003	0.005	33.3		33.3
2-Sep-94	<0.044		63.87		63.87	0.006	<0.003	0.006	21.7		21.7
16-Sep-94	<0.044		62.43		62.43	0.004	<0.003	0.004	34.6		34.6
30-Sep-94	<0.044		51.32	99.09	75.21	<0.003	<0.003		34.2		34.2
14-Oct-94	<0.044		49.63	87.28	68.46	0.004	0.007	0.006	27.9	7.1	17.5
28-Oct-94											
10-Nov-94											
25-Nov-94			34.39		34.39	<0.003			30.2		30.2
9-Dec-94			33.22		33.22	0.004		0.004	16.3		16.3
23-Dec-94			32.95		32.95	0.006		0.006	12.8		12.8
6-Jan-95		0.051	32.13		32.13	<0.003			24.2		24.2
20-Jan-95			31.73		31.73	0.006		0.006	11.2		11.2
3-Feb-95			30.73		30.73	0.008		0.008	16.6		16.6

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	Hg (mg/l) CSZ1	Hg (mg/l) CSZ2	Hg (mg/l) AVERAGE	Mg (mg/l) CSZ1	Mg (mg/l) CSZ2	Mg (mg/l) AVERAGE	Mn (mg/l) CSZ1	Mn (mg/l) CSZ2	Mn (mg/l) AVERAGE	Ni (mg/l) CSZ1	Ni (mg/l) CSZ2
11-Mar-94	<0.15	0.158		75.51	80.36	77.94	44.80		44.80	1.540	1.630
25-Mar-94	0.158	0.16		47.27	61.52	54.40	30.10		30.10	1.550	1.340
15-Apr-94	<0.15	<0.15		55.78	30.61	43.20	29.80		29.80	1.280	0.820
29-Apr-94	<0.15	<0.15		30.12	16.63	23.38	16.30		16.30	0.920	0.670
13-May-94	<0.15	<0.15		14.93	8.47	11.70	8.40	6.60	7.50	0.610	0.510
27-May-94	<0.15	<0.15		7.15	5.65	6.40	4.40	4.60	4.50	0.420	1.160
10-Jun-94	<0.15	<0.15		4.86	4.48	4.67	2.80	3.30	3.05	0.220	0.270
24-Jun-94	<0.15	<0.15		4.2	3.92	4.06	2.30	2.70	2.50	0.190	0.210
8-Jul-94	<0.15	<0.15		3.53	3.606	3.57	1.80	2.30	2.05	0.140	0.180
22-Jul-94	<0.15	<0.15		3.73	3.62	3.68	1.80	2.20	2.00	0.140	0.150
5-Aug-94	<0.15	<0.15		3.49	3.56	3.53	1.70	2.03	1.87	0.130	0.120
19-Aug-94	<0.15	<0.15		3.69	4.01	3.85	1.70	1.90	1.80	0.140	0.160
2-Sep-94	<0.15	<0.15		3.37	3.54	3.46	1.40	1.50	1.45	0.130	0.120
16-Sep-94	<0.15	<0.15		3.63	3.77	3.70	1.50	1.60	1.55	0.140	0.150
30-Sep-94	<0.15	<0.15		3.28	3.32	3.30	1.30	1.40	1.35	0.120	0.130
14-Oct-94	<0.15	<0.15		3.43	3.57	3.50	1.30	1.40	1.35	0.120	0.120
28-Oct-94											
10-Nov-94											
25-Nov-94	<0.15			2.71		2.71	1.00		1.00	0.110	
9-Dec-94	<0.15			2.71		2.71	1.07		1.07	0.099	
23-Dec-94	<0.15			2.76		2.76	1.08		1.08	0.090	
6-Jan-95	<0.15			2.73		2.73	1.05		1.05	0.100	
20-Jan-95	<0.15			2.7		2.70	1.03		1.03	0.100	
3-Feb-95	<0.15			2.8		2.80	1.10		1.10	0.100	

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	Ni (mg/l) AVERAGE	Pb (mg/l) CSZ1	Pb (mg/l) CSZ2	Pb (mg/l) AVERAGE	Sb (mg/l) CSZ1	Sb (mg/l) CSZ2	Sb (mg/l) AVERAGE	Si (mg/l) CSZ1	Si (mg/l) CSZ2	Si (mg/l) AVERAGE	Zn (mg/l) CSZ1
11-Mar-94	1.585	<0.04	0.21	0.21	0.03	<0.03	0.03	45.2		45.20	0.960
25-Mar-94	1.445	0.108	0.041	0.07	<0.03	<0.03		34.5		34.50	0.820
15-Apr-94	1.050	<0.04	0.102	0.10	0.08	<0.03	0.08	31.8		31.80	0.470
29-Apr-94	0.795	<0.04	0.05	0.05	0.04	<0.03	0.04	27.1		27.10	0.310
13-May-94	0.560	<0.04	0.05	0.05	<0.03	<0.03		25.2		25.20	0.210
27-May-94	0.790	<0.04	<0.04		0.07	<0.03	0.07	23.9		23.90	0.130
10-Jun-94	0.245	<0.04	0.0401	0.04	0.04	<0.03	0.04	21.09		21.09	0.090
24-Jun-94	0.200	<0.04	<0.04		0.07	<0.03	0.07	20.9		20.90	0.090
8-Jul-94	0.160	<0.04	<0.04		<0.03	<0.03		20.1		20.10	0.060
22-Jul-94	0.145	<0.04	0.06	0.06	<0.03	<0.03		21.2		21.20	0.060
5-Aug-94	0.125	<0.04	<0.04		<0.03	<0.03		21.8		21.80	0.103
19-Aug-94	0.150	<0.04	0.049	0.05	<0.03	<0.03		20.9		20.90	0.060
2-Sep-94	0.125	<0.04	<0.04		<0.03	<0.03		19.9		19.90	0.050
16-Sep-94	0.145	<0.04	<0.04		<0.03	0.04	0.04	21.06		21.06	0.060
30-Sep-94	0.125	<0.04	<0.04		0.03	<0.03	0.03	19.4		19.40	0.050
14-Oct-94	0.120	<0.04	<0.04		<0.03	<0.03		20.5		20.50	0.050
28-Oct-94											
10-Nov-94											
25-Nov-94	0.110	<0.04			<0.03			18.13		18.13	0.050
9-Dec-94	0.099	<0.04						18.16		18.16	0.052
23-Dec-94	0.090							18.63		18.63	0.053
6-Jan-95	0.100							18.15		18.15	0.052
20-Jan-95	0.100							17.77		17.77	0.054
3-Feb-95	0.100							19.56		19.56	0.060

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	Zn (mg/l) CSZ2	Zn (mg/l) AVERAGE	Sulphate (mg/l) CSZ1	Sulphate (mg) CSZ1	Sulphate (µg/kg/d) CSZ1	Cum Sul (mg) CSZ1	% Cum Sul CSZ1	Sulphate (mg/l) CSZ2	Sulphate (mg) CSZ2	Sulphate (µg/kg/d) CSZ2
11-Mar-94	1.320	1.140	2303	2168.7	4563	2169	1.7	2042	901	1895
25-Mar-94	0.601	0.711	2075	1669.7	234	3838	3.0	2238	2299	322
15-Apr-94	0.430	0.450	2090	1817.6	8923	5656	4.4	2015	2059	10108
29-Apr-94	0.260	0.285	1897	1591.7	11721	7248	5.6	1697	1436	10574
13-May-94	0.190	0.200	1595	1357.9	9999	8606	6.7	1553	1127	8298
27-May-94	0.140	0.135	1405	1151.3	8478	9757	7.5	1559	1259	9270
10-Jun-94	0.105	0.098	1131	931.1	6857	10688	8.3	1401	1097	8079
24-Jun-94	0.090	0.090	912	902.2	6644	11590	9.0	1242	1190	8764
8-Jul-94	0.070	0.065	686	650.8	4792	12241	9.5	999	830	6110
22-Jul-94	0.130	0.095	529	483.8	3563	12725	9.8	849	773	5693
5-Aug-94	0.070	0.087	414	353.3	2602	13078	10.1	727	552	4067
19-Aug-94	0.080	0.070	363	326.5	2404	13405	10.4	676	582	4287
2-Sep-94	0.050	0.050	280	235.2	1732	13640	10.5	498	423	3115
16-Sep-94	0.060	0.060	283	268.3	1975	13908	10.8	458	415	3057
30-Sep-94	0.050	0.050	259	233.6	1720	14142	10.9	371	364	2683
14-Oct-94	0.100	0.075	252	239.6	1764	14381	11.1	317	276	2035
28-Oct-94			236	223.8	1648	14605	11.3	226	173	1276
10-Nov-94			231	225.6	1789	14831	11.5	206	195	1546
25-Nov-94		0.050	209	197.8	1359	15028	11.6	200	179	1230
9-Dec-94		0.052	201	181.2	1334	15210	11.8	211	205	1513
23-Dec-94		0.053	197	168.9	1244	15379	11.9	213	184	1354
6-Jan-95		0.052	201	186.4	1373	15565	12.0	211	200	1473
20-Jan-95		0.054	190	167.1	1231	15732	12.2	218	175	1290
3-Feb-95		0.060	202	183.4	1351	15915	12.3	212	167	1229

Table 6: Effluent water quality parameters and leaching characteristics of S - Zone tailings at 10 degrees Celsius.

SAMPLE DATE	Cum Sul (mg) CSZ2	% Cum Sul CSZ2	Sulphate (mg/l) AVERAGE	Sulphate % Cum AVERAGE	Sulphate (µg/kg/d) AVERAGE	TOTAL CN (µg/l) CSZ1	TOTAL CN (µg/l) CSZ2	TOTAL CN (µg/l) AVERAGE
11-Mar-94	901	0.7	2172	1.2	3229	-	-	
25-Mar-94	3200	2.5	2157	2.7	278	-	-	
15-Apr-94	5259	4.1	2052	4.2	9515	-	-	
29-Apr-94	6695	5.2	1797	5.4	11148	-	-	
13-May-94	7822	6.0	1574	6.3	9149	-	-	
27-May-94	9081	7.0	1482	7.3	8874	-	-	
10-Jun-94	10178	7.9	1266	8.1	7468	-	-	
24-Jun-94	11368	8.8	1077	8.9	7704	-	-	
8-Jul-94	12198	9.4	842	9.4	5451	-	-	
22-Jul-94	12971	10.0	689	9.9	4628	-	-	
5-Aug-94	13523	10.5	571	10.3	3335	-	-	
19-Aug-94	14105	10.9	520	10.6	3346	-	-	
2-Sep-94	14528	11.2	389	10.9	2423	-	-	
16-Sep-94	14944	11.6	370	11.2	2516	-	-	
30-Sep-94	15308	11.8	315	11.4	2202	-	-	
14-Oct-94	15584	12.0	285	11.6	1900	-	-	
28-Oct-94	15757	12.2	231	11.7	1462	-	-	
10-Nov-94	15952	12.3	218	11.9	1668	-	-	
25-Nov-94	16132	12.5	204	12.0	1295	-	-	
9-Dec-94	16337	12.6	206	12.2	1424	-	-	
23-Dec-94	16521	12.8	205	12.3	1299	-	-	
6-Jan-95	16721	12.9	206	12.5	1423	-	-	
20-Jan-95	16896	13.1	204	12.6	1260	-	-	
3-Feb-95	17063	13.2	207	12.7	1290	-	-	

Table 7: Temperature distribution in wasterock cover and tailings as a function of time at various monitoring locations at the Cullaton Lake site.

Station No. 1	Marker I.D.	Depth (m)	Temperature (°c) Aug. 91	Sep. 91	Jul. 92	Aug. 92	Jul. 93#1	Jul. 93#2	Jun. 94	Jul. 94 #1	Jul. 94 #2	Sep. 94	Jun. 95	Sep. 95	Oct. 95
	0.00	0.30	13.20	11.00	13.50	6.20	33.10	13.70	15.60	15.60	19.60	23.00	35.99	7.36	3.42
	1.00	0.80	12.80	11.20	13.60	5.10	16.00	12.00	11.30	11.30	14.00	14.00	18.51	5.25	1.64
	2.00	1.30	10.80	8.80	13.50	5.10	8.80	7.60	5.00	4.60	9.20	8.40	3.74	2.97	1.73
	3.00	1.80	7.20	5.40	4.40	3.60	0.00	1.50	-0.20	-0.70	4.90	4.70	-0.76	1.44	1.25
	4.00	2.30	5.20	3.00	-0.90	0.90	-1.30	-1.00	-2.10	-2.60	-0.20	1.10	-2.18	0.32	0.41
	5.00	2.80	0.80	0.50	-2.10	-0.40	-2.10	-1.80	-3.30	-3.60	-1.30	-0.90	-3.13	-0.27	-0.26

Station No. 2	Marker I.D.	Depth (m)	Temperature (°c) Aug. 91	Sep. 91	Jul. 92	Aug. 92	Jul. 93#1	Jul. 93#2	Jun. 94	Jul. 94#1	Jul. 94#2	Sep. 94	Jun. 95	Sep. 95	Oct. 95
	0.00	0.30	13.00	10.80	13.30	6.50	34.50	13.70	15.40	15.40	20.20	16.90	29.36	7.45	3.11
	1.00	0.80	13.00	11.00	13.60	5.50	29.40	13.40	15.30	15.20	19.30	9.40	7.07	3.33	1.23
	2.00	1.30	13.20	10.00	13.40	5.20	12.40	12.30	9.30	8.00	11.10	7.70	0.64	2.16	1.51
	3.00	1.80	10.20	5.20	6.20	4.70	5.20	7.80	2.40	1.70	9.10	5.50	-1.15	0.82	0.84
	4.00	2.30	6.00	3.00	-0.50	2.30	-0.50	0.60	-1.10	-1.80	2.20	2.60	-2.16	0.08	-0.38
	5.00	2.80	0.50	0.40	-2.00	-0.20	-1.80	-1.40	-3.00	-3.40	-1.00	-0.20	-3.43	-0.60	-0.56

Station No. 3	Marker I.D.	Depth (m)	Temperature (°c) Aug. 91	Sep. 91	Jul. 92	Aug. 92	Jul. 93#1	Jul. 93#2	Jun. 94	Jul. 94#1	Jul. 94#2	Sep. 94	Jun. 95	Sep. 95	Oct. 95
	0.00	0.30	12.80	9.80	12.80	6.20	32.50	13.80	15.30	15.30	20.20	21.30	32.39	7.53	3.45
	1.00	0.80	13.00	9.20	12.60	4.70	22.00	13.10	13.60	13.60	18.50	10.00	8.71	4.34	1.76
	2.00	1.30	12.80	8.40	12.50	4.60	9.20	10.00	7.00	6.80	10.10	7.30	-0.20	2.25	1.57
	3.00	1.80	11.00	5.80	5.20	4.10	1.20	3.40	0.10	0.00	5.70	4.50	-1.93	0.89	1.00
	4.00	2.30	6.50	3.20	-0.60	2.00	-0.90	-0.60	-1.70	-1.80	0.10	1.60	-3.23	0.12	0.12
	5.00	2.80	0.80	0.50	-1.90	-0.20	-1.90	-1.50	-3.30	-3.50	-1.30	-0.40	-4.20	-0.48	-0.44

Station No. 4	Marker I.D.	Depth (m)	Temperature (°c) Aug. 91	Sep. 91	Jul. 92	Aug. 92	Jul. 93#1	Jul. 93#2	Jun. 94	Jul. 94#1	Jul. 94#2	Sep. 94	Jun. 95	Sep. 95	Oct. 95
	0.00	0.30	15.00	11.00	12.90	6.00	32.90	13.40	15.40	15.40	19.50	23.10	36.25	7.29	3.57
	1.00	0.80	14.20	11.50	13.30	4.80	22.00	12.90	13.30	13.20	14.50	17.50	25.04	4.79	2.16
	2.00	1.30	16.80	11.00	12.70	4.60	9.20	10.50	6.70	6.70	6.80	6.80	5.79	3.43	1.29
	3.00	1.80	12.00	6.80	5.20	4.50	1.00	-3.00	-0.10	-0.20	4.20	4.50	-1.02	1.13	0.95
	4.00	2.30	6.20	4.00	-0.70	2.00	-1.00	-0.70	-2.00	-2.00	-0.40	1.00	-2.38	0.18	0.22
	5.00	2.80	1.00	0.60	-1.70	-0.20	-1.00	-1.50	-3.10	-3.20	-1.50	-0.60	-3.53	-0.39	-0.39