

96-3828

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FINAL REPORT RL 8804 KING RIVER DELTA
PROJECT 1995 ELISNA PTY LTD

 **Cotteloe** CORPORATION
Box 211, Princeton, NJ 08540 USA

SYNOPSIS

During tenure of licences covering the King River Delta Cottesloe Corporation, its associates and a predecessor group systematically investigated the deposit and each of its valuable components. Proposals for development of the resource also were prepared. Over the years four separate backers for the project were secured. Three sponsored testwork. Government has been furnished with detailed accounts of these surveys and other studies of the deposit. All this material is on file in Hobart. Collective expenditure on the project now stands at an estimated \$1,900,000.

Recently a six-month search for companies willing to mine the Delta was completed. From a starting list of 129 organizations 70 were contacted. The majority were provided with summary data and additional material relevant to the venture. Meetings were held with each of the 22 tentatively interested. Eleven of these conducted independent appraisals.

Unfortunately collapse of world sulphur markets over the past decade has reduced value of the Delta's most useful component to a quarter of its worth in 1986. Both short- and long-term prospects for sulphur are bleak. This deters investment in the venture. Extracting metallic components of Delta sediment without substantial credit for its sulphur is considered too great a risk to assume.

Since no serious commitment could be obtained from companies canvassed Cottesloe Corporation is abandoning the project.

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I**BACKGROUND**

The King River Delta project and deposit are fully described in a report submitted to Tasmania's Mines Department on applying to have Exploration Licence 2/74 covering the Delta converted to a retention licence. Relevant pages from that report are reproduced at Appendix A.

For information regarding exploitation of the resource, refer to the same report. It outlines mining and processing proposed, discusses economics, demand for commodities to be produced and likely impact of the venture.

The retention licence application was lodged - and approved - in 1987. Modifications to the development plan it presented, necessitated subsequently by global recession, collapse of the Communist bloc, tightening environmental protection law and other factors affecting mineral markets worldwide, are given in annual reports on the licence written since the application date.

In 1993 and 1994 a major campaign was conducted to attract backing for the Delta enterprise. Details follow.

II

SEARCH

A list of companies possibly wishing to acquire the Delta venture or participate in it was prepared. Names were obtained from these sources.

- Australian Consulate General, New York
- Australian telephone books, Yellow Pages, capital cities
- Australian Stock Exchange, Melbourne
- Cobalt Development Institute, Ipswich
- Commonwealth Development Corporation, London
- Corporate Affairs, Victoria
- Financial Times Mining Year Book, geographic and product indices
- Industrial Minerals, London
- New Zealand telephone books, Yellow Pages, major cities
- New Zealand Trade Development Board
- Register of Australian Mining
- Tasmania Development and Resources' exploration and retention licence lists and plots
- US Bureau of Mines publications.

In drawing up the list, agents in North America, Britain and Australia also were consulted.

In addition a list of 72 domestic share-broking houses was compiled; 14 are in Brisbane, 15 in Sydney, 22 in Melbourne, 11 in Adelaide, 8 in Perth, and 2 in Launceston. The venture was discussed with representatives of the leading houses at each centre, 27 in all, in a hunt for client companies to which it could appeal; several candidates emerged. Brokerages contacted are

- ANZ McCaughan Securities
- Bain Securities
- Baring Securities Australia Ltd
- BOS Stockbroking Ltd
- D J Carmichael Pty Ltd
- Citicorp Scrimgeour Vickers
- County Natwest Securities
- Dominguez Barry Samuel Montagu
- Eyres Reed Ltd
- Hambros Equities Ltd
- Hartly Poynton
- Hogan and Partners
- James Capel
- Jardine Fleming Securities
- Kirke Securities
- Lance Jones Ltd

McIntosh Hamson Hoare Govett
 Montagu Partners
 Nevitts Ltd
 K J Polkinghorne & Co
 Porter Western Ltd
 Potter Warburg Ltd
 Saw James Ltd
 Shadforths
 Todd Partners
 C J Weedon
 J B Were and Son

Dredging companies, too, were considered - 9 from Queensland, 12 from New South Wales, 5 from Victoria, 1 from Tasmania and 1 from overseas. The 8 of principal interest, shown below, were added to the candidate list.

Berry Dredging	Frankston, Victoria
Dredecos	Hemment, Queensland
Duncan & Russell	Dromana, Victoria
Ellicott Machine Corp	Baltimore, MD, USA
Hall Contracting	Buderim, Queensland
Houben Bros	St Ives, NSW
Tas Dredging Services	Launceston, Tasmania
West Ham Dredging	N Sydney, NSW

Collectively the searches yielded 116 names.

The list of these potential candidates was subdivided, according to the principal merit of each, into 13 categories thus:

	<u>Number</u>	<u>Retained</u>
1. Major companies	8	5
2. Companies having more than 1 Tasmanian exploration licence	11	5
3. Companies having 1 Tasmanian exploration licence	16	9
4. Companies having 1 or more Tasmanian retention licences	4	6
5. Mineral sand producers	13	2
6. Cobalt producers	7	3
7. Pyrite/sulphur/acid producers	7	5
8. Copper producers	4	2
9. Domestic companies also exploring abroad	11	4
10. Companies of general favourability	15	7
11. Foreign companies	4	2
12. Brokers' referrals	8	7
13. Dredgers	8	8

Companies in each subdivision were ranked. Ranking was based on various criteria, among them annual revenue, recent profit or loss, exploration expenditure, lease holdings, commodities sought, Tasmanian interests, capabilities in dredging/mineral processing/smelting.

Names of higher ranking companies in each subdivision were retained and transferred to a working list. This was discussed with Tasmania's Development and Resources Department, who proffered 13 additional names for consideration. Five were added to the list, raising the number retained to 70. After further research and vetting 19 of the 70 were set aside and 51 kept.

Of the total 78 companies sidelined, 41 were reserved for possible contact later; 37 were rejected.

Companies were rejected because of being possible competitors or because of corporate difficulties they face. Several were found to have withdrawn from Australia; a few had dissolved. Others struck off are subsidiaries of companies on the working list. The 37 removed are these.

AAC
 Armada
 Australian Consolidated Minerals
 Australian Zircon
 Cavenridge
 City Resources
 Cobalt Industries
 Comeda Energy Co
 Cooper Resources
 Currumbin
 Dowa
 Elf
 Elders NZ
 Emperor Australia
 Fodina Minerals
 Forsyth Australia
 Freeport McMoran
 Greater Fingal Mines
 Hunter Resources
 Kalbara
 Major Mining
 Mareeba Mines
 MIM
 Mistral Mines

MPTC/MMC/Urangesellschaft
Mineral Holdings Ltd
Newmont Mining
Nord Resources
Pennzoil
Phoenix Enterprises
Odina Mining
Reynolds Metals
Solution Mining
Texas Gulf
Triarc
Westralian Sands
WMC

The list of those reserved for any future contact warranted is as follows.

Boliden
Chemical Cleaning Co of NZ
Cliffs International/Pickands Mather
CRA
CSR
Cyprus
Delta Gold
Exxon
Farmers Fertilizer Corp NZ Ltd
Fernz Corporation., NZ
Galveston Mining
JCI
Lynch Mining
Macraes Mining
Mineral Resources NZ Ltd
Mitsui
Moraga Resources
Outokumpu
Pechiney
Phelps Dodge
Pelsart
Portman Mining
Preussag
QNI
Spectrum Resources NZ
Sumitomo

III

APPROACH

Besides the 8 dredging companies contacted, all 51 companies hereunder were approached.

- * Aberforyle
- Amoco
- * Anglo Australian
- * AO/Ashton
- * Arimco
- Austmin Gold
- * Aztec
- * Barclays, London
- Beaconsfield
- BHP Minerals
- * Billiton-Shell
- Black Hill Minerals/Triad Minerals
- Bruce Resources
- BRGM
- Capricorn
- Centaur/Great Central Mines/GM Resources
- Charter Consolidated, London
- Climax
- * Cobalt Resources/Queensway Mines
- Consolidated Rutile/Cudgen
- * Credit Lyonnais, London
- Devex ltd
- Dominion Mining
- Esmeralda Exploration
- * Gencor, S Africa
- * Gwalia Consolidated/Sons of Gwalia
- * Golden Shamrock/Adelaide Chemical Co
- Goldstream/Montroyal
- Hancock Resources
- Jervois
- Mac Mining
- Metals Ex
- Mineral Deposits Ltd
- Minproc Engineering Services
- NBH Peko
- Newcrest
- Normandy-Poseidon
- * Pancontinental

- * Pasminco
- Peak Gold
- Pioneer
- Plutonic Resources
- * Rand Mines, S Africa
- * RGC
- * Savage River Mines
- Stirling Resources
- * Strategic/Arboyne/Austmin Res/Majestic
- * Transhex Mining, S Africa
- Triako
- Valiant
- * Western Reefs

* visited

Initial approaches were made by telephone, in nearly every instance to managing director or general manager.

Seventeen companies wished not to be considered further. Twentynine requested extra information. Material sent to them included summary and locality maps shown on the next two pages.

Meetings were held with 22 of the interested companies. Eleven were provided with past reports and detailed data for study and analysis by their technical and finance departments.

Besides organizations invited to take over or participate in the Delta venture, several companies were asked to quote on costs of mining the deposit and transporting pre-concentrate or concentrate.

MINERALS VENTURE · TASMANIA AUSTRALIA

American company Cottesloe Corporation and Australian associate Elisna Pty Ltd seek partner with technical and financial resources required to mine and treat tailings capable of yielding sulphur, cobalt and copper. Deposit comprises man-made delta at King River mouth in protected west coast bay, Macquarie Harbour : (maps overleaf). Deposit and potential comprehensively investigated. Profitable exploitation feasible. Attractions of proposed enterprise as follows.

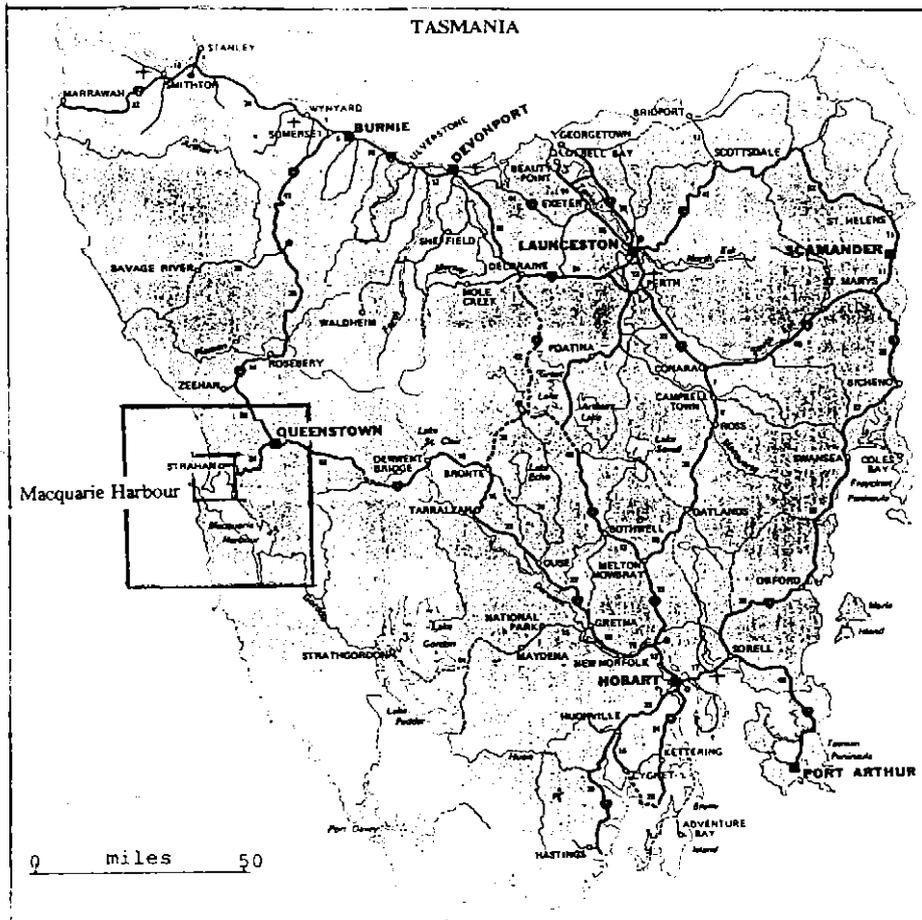
- Large reserves, fully leased: 100,000,000 mt proved, additional 25,000,000 mt probable.
- Easily dredged: tailings consist of unconsolidated sand and silt extending from metre above sea level to 35 metres below; effectively, mined milled stacked ore.
- Useful 6% of tailings - pyritic sulphide - mainly unlocked grains: simple mechanical procedures concentrate bulk fast, inexpensively.
- In total, pyritic concentrate will contain approximately 14,000,000 lbs cobalt, 97,000,000 lbs copper, 3,000,000 mt sulphur, and 48 tonnes silver/gold.
- Flash smelting process identified which yields elemental sulphur, sulphur dioxide, clean saleable iron oxide, metal-rich residue, together with surplus heat for power generation.
- Process used successfully in Europe for fifteen years, producing up to 122,000 mt sulphur per year.
- Substantial market for elemental sulphur as Australasian countries lack natural reserves and import commodity from Canada. Since 1980 some 8,000,000 mt shipped to Australia/New Zealand.
- Freight and insurance alone on Commonwealth's average annual import would amount to about A\$40,000,000 at current rates. In future, rates likely to increase. These built-in premiums on imported sulphur provide cushion to offset cost of producing commodity domestically from sulphide.
- In national interest to reduce growing foreign debt by curtailing overseas expenditure. Sulphur available from King Delta's proved pyrite reserve sufficient to meet 15% of Australia's traditional sulphur consumption for twenty years.
- Elemental sulphur preferred for basic feedstock in fertiliser manufacture and other chemical industries as on weight basis three times more economical to transport than hydrous, acid form : also, relatively safe.
- Pyrite better source of element than base metal sulphides because roughly twice sulphur content and generally lower in arsenic, antimony, other poisons and process contaminants.
- King Delta pyrite most competitive raw material for Australian sulphur production because of quantity available, economics of extracting and concentrating it, and proximity of main industrial centres, largest agricultural markets.
- Supplemental amounts of pyrite probably available from another big tailings deposit nearby : composition similar to that of King Delta.
- Staged exploitation of Delta proposed : allows early start-up with only modest capital requirements.
- Stage I envisages mining shallow inshore fourteenth of Delta by contractors, tributors, or on toll basis to yield pyrite concentrate for sale as is : additional credits to accrue from cobalt, copper, silver, gold it contains.
- Second stage conditional on success of first. Initial phases to be funded by Stage I revenue.
- Stage II provides for mining remaining 93% of Delta and processing concentrate, probably at mainland site, to yield sulphur, byproducts, and derivative chemicals : for example, projected output would permit manufacture of 87,000,000 kg copper sulphate worth over twice value of component sulphur, copper.
- Government and public likely to approve venture as besides economic advantages offers environmental benefits. Dredging, treatment will abstract toxic components and transfer cleaned sediment to deep bay floor.
- Operation will remove Delta, restoring seventeen miles of valley behind it - clogged and poisoned by tailings - to original unpolluted state.
- Now opportune time to launch enterprise, before sulphur price - at twenty-year low through recession - rises and chance to produce sulphur domestically generates competition.
- Fertiliser use, hence sulphur demand, must increase if Australian wool, meat and wheat production is ever to recover.

For further information please contact -

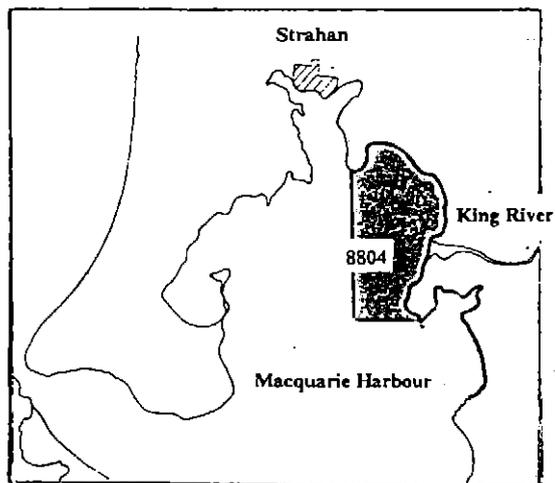
S R M Harvey, Managing Director, Elisna Pty Ltd
Wentworth House, 59 Cameron Street Launceston, Tas, 7250 Australia
Telephone, 003 31 7055. Facsimile, 003 34 1772

or

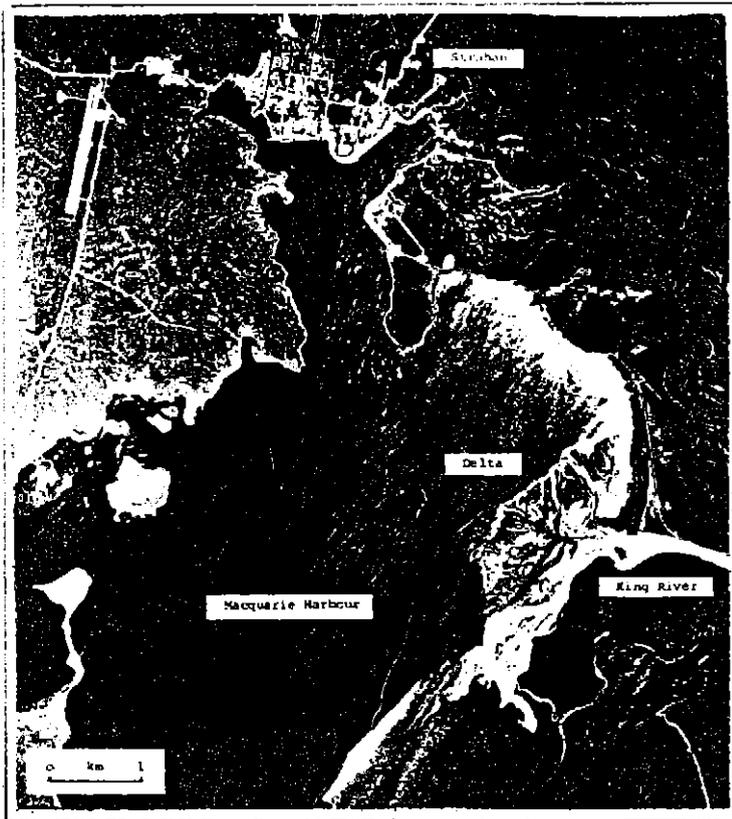
G W Taylor, President, Cottesloe Corporation
Box 211, Princeton, New Jersey, 08542 USA
Telephone, 609 921 3192. Facsimile, 609 924 9020



5 cm



RETENTION LICENCE 8804



KING RIVER DELTA

IV**RESPONSE**

Quotes

Quotes received for dredging Delta sediment vary, from contractor to contractor, by several hundred percent. Far the lowest and otherwise most attractive figure is that provided by Mineral Deposits Ltd, the BHP subsidiary, which estimates the upper 5 or 6 metres of the Delta - to be removed as Phase I of the modified mining plan - can be dredged and treated to yield sulphidic pre-concentrate at a cost of approximately \$1.00/cu.metre. This assumes plant processing 500 to 600 tph. Mineral Deposits experimented on Delta sediment in the 'seventies so are acquainted with material to be handled.

Other companies which expressed interest in the possibility of carrying on this work are Ellicott, Hall Contracting and West Ham Dredging.

Mineral Deposits proposed producing finished concentrate at a shore plant, by standard mechanical means. More tests are needed, though, to determine likely cost of such beneficiation. An alternative considered was to have pre-concentrate upgraded by flotation at Rosebery. This was discussed with Pasmenco. Rosebery has the capacity but, again, bulk tests are required to obtain recovery rates and probable price.

Shipping concentrate from Burnie would mean hauling it by road to the rail loading point at Melba Flats, near Zeehan, or at Rosebery. Local contractors quote \$7.50 to \$8/mt for haulage to Melba Flats: to Rosebery the figure is \$9.75. From either locality concentrate then would be transported to dockside by train. Emu Bay Railway Company quotes a price of \$25/mt for railage, handling and ship-loading. Large savings in transport costs could be effected by constructing an offshore loading facility at Strahan akin to that used for loading magnetite sand off the west coast of New Zealand's North Island.

Backing

Ultimately no company approached elected to join or acquire the venture. When the campaign in search of support for it was in progress, few miners were taking on additional projects. Among those that were, gold projects generally proved the only kind desired.

Responses of the eleven companies which did study proposals regarding the Delta Venture in some detail varied but are unanimous in considering prospects of exploiting the deposit difficult, technically and in economic terms.

Adverse state of the sulphur industry is seen as the chief deterrent. It has long been apparent that profitable exploitation of the Delta deposit depends upon sale of its sulphur component, in addition to its copper and cobalt. A decade ago when sulphur prices were high and still

increasing, and fertilizer use in Australia and New Zealand was near zenith, the two countries were importing large quantities of elemental sulphur. At the time it still was one of the key materials in superphosphate manufacture. Since then there have been radical changes. Drought, flood, fire, falling wool prices and curtailment of overseas wheat markets, coupled with global recession have crippled agriculture and halved fertilizer demand. Domestic production of it has plummeted. Remaining producers are switching to near-exclusive use of byproduct acid they generate in treating metallic sulphides. One large group has been buying out traditional sulphur-burning operations to remove competition these offered to sales and direct use of its own acid. Furthermore, changed technology is reducing - even eliminating - sulphuric acid use in phosphate processing.

Delta sulphide, it is claimed, cannot readily compete with established West Coast sulphide sources because of lower metal content and, in part, because existing roasters in Tasmania are not flexible enough to handle both this lower grade as well as the accustomed higher grade charge.

Such grade limitation also makes economics of shipping Delta concentrate for treatment in Japan unfavourable. If credits could be obtained for cobalt, gold and silver extracted, shipment would be profitable; but in the experience of at least one West Coast mine, Japanese purchasers disallow the credits.

The flash smelting route Cottesloe originally proposed, yielding elemental sulphur and byproduct acid and metals via a method employed in Europe for many years, with conspicuous success, now would be hard to implement, even if domestic demand for elemental sulphur had not eroded. High capital cost of plant - in the vicinity of \$100,000,000 - constitutes one barrier. Another is that with continued growth in development of natural gas fields worldwide (many, sour), ever-increasing quantities of recovered sulphur, a byproduct in purifying sour gases, are coming on to international markets. Sulphur prices fell steadily in consequence, from a high of approximately US \$140/mt in 1985/86 to a low in 1993 of about \$30/mt, a drop of over 75%.

Dumping by eastern bloc countries exacerbated has matters. Also, with adoption of less lenient environmental regulations, more and more contained sulphur is being reclaimed through scrubbing of stack gases, recycling of spent acid and similar procedures.

Hydrometallurgical means of extracting copper, cobalt, gold and silver from Delta pyrite pose problems in that acid conditions are required in recovering the first two metals, alkaline conditions for removing the other pair. Cost of running both circuits probably would be prohibitive.

A further concern is that of competition: with mounting interest in cobalt, several deposits already have been located in Australia with grades superior to that of Delta pyrite. Some Mt Isa tailings even, allegedly assay 1% Co; tonnages available are very large. Development of these concentrations and of like resources abroad probably will depress future cobalt prices.

The view also was expressed that funds could better be utilized hunting other comparatively rich sources of cobalt rather than in extracting it from the lower grade Delta deposit.

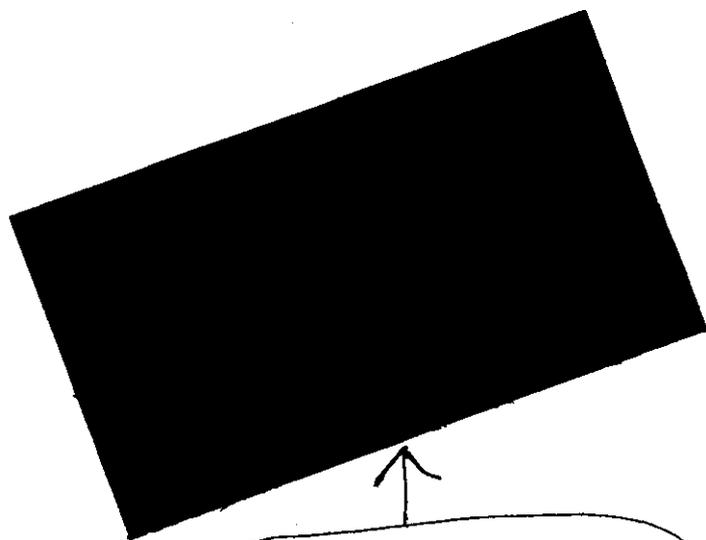
Several candidate companies raised the issue of State or Commonwealth assistance, reasoning that as removal of Delta and toxic fractions of its sediment would benefit the environment and reverse degradation which Government sanctioned and even paid for partly, the work should be subsidized. With subsidies, tax breaks and other incentives, economics of the project might become favourable enough to attract developers.

However, as overall response to endeavours to have the King River Delta deposit exploited has been negative, Cottesloe Corporation is relinquishing Retention Licence 8804 and terminating interest in the venture.

APPENDIX

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MINERAL POTENTIAL
KING RIVER DELTA
MACQUARIE HARBOUR
TASMANIA



NR PLEASE REFER TO
LATER REPORTS FOR
REVISED FIGURES
AND MODIFIED PLAN

20 December 1987

SUMMARY

Mill tailings dumped into tributary at Mt Lyell copper mine, Queenstown, have formed a man-made delta at mouth of King River in sheltered bay, Macquarie Harbour. Over 120,000,000 tonnes have accumulated. Deposit grows about 1% annually while dumping continues.

Delta's mineral resources investigated by half-dozen domestic and foreign companies. Mt Lyell drilled upper 3 m of delta's exposed, inshore fifth to determine pyrite content. Holb/ Aberdare made surficial survey of Harbour floor, then cored it; later studied delta's cobalt prospects, next those of sulphur; in 1985 as Elisna P/L sampled delta's top surface, below and above sea level, for gold. Cities Service, major US copper miner, drilled entire delta. Recently, Planet Resources/Cottesloe drilled upper half of emergent 20% of deposit, examining gold distribution. Most investigators also sponsored recovery tests and studies. Delta and components generally well-characterised as a result.

Delta extends from just above sea level at coast to water depth of 35 m at toe. Maximum thickness 32 m, average 7.5 m. Area, 8 sq km. Oxidising conditions in freshwater stratum from Harbour surface to depth of 8 to 11 m, reducing environment below: deposit layered similarly. Sediment sandy inshore to silty offshore. Average SG, about 1.67. Riverine sand under delta, black muds all over Harbour floor beneath and beyond delta apron.

Delta enriched in number of elements. Contents of sulphur, molybdenum, 45 to 55 x crustal abundance: gold, copper, 25 to 35 x; barium, rare earths, 10 to 15 x; cobalt, 3 to 5 times.

Sediment quartzose, chloritic: averages 5 to 6% pyrite. This sulphide relatively coarse-grained, well-liberated; contains all deposit's cobalt, roughly half of which is secondary. Copper occurs partly in chalcopyrite grains -- 50% of them locked in silicates and other non-sulphides- and partly in secondary form, plated on many of minerals comprising deposit. Most secondary copper, cobalt, form in lower, reducing two-thirds of delta; in upper layer, cobalt and possibly some copper being dissolved: Average 55% of gold present confined to sulphides, balance is free. Barite, monazite, other useful heavies, two-thirds locked.

Proved 100,000,000 tonnes of delta sediment contain 2,900,000 tonnes sulphur, over 125,000 tonnes copper and 8,000 tonnes

cobalt, plus at least 14 tonnes gold. Each of the 5- to 6,000,000 tonnes pyritic sulphide in the deposit runs some 50% S and carries approximately 6 kg copper, 1 1/4 kg cobalt and 1 1/2 g gold, at present worth a total of \$170 Australian.

King Delta exploitable at low cost because most mining and milling steps unnecessary; sediment represents ore, already stripped, extracted, crushed, stacked as prepared plant feed. Merely requires pumping by dredge to trailing beneficiation plant consisting of screens, cyclones, cones. Dense fifth of sediment containing 75 to 90% of deposit's sulphur, cobalt, and gold plus 30 to 40% of its copper, barite, monazite to be piped to concentrator at shore edge. Cleaned four-fifths from floating plant to be discharged in deep water south and southwest of delta. Projected mining rate, 5,000,000 mty: life, 20 years.

At shore facility further separation using spirals, other mechanical means plus flotation will yield sulphide concentrate for treatment at metallurgical plant elsewhere. Alternatively, concentrate may be toll processed, or sold as is.

Metallurgical stage will permit some of pyritic sulphur to be recovered in elemental state, a form easier to handle, transport, sell, than commoner derivative, sulphuric acid. Number of tried production methods available. Process used in Finland for 15 years converts 40% of sulphur to desired state. Canadian process converts 10% more. Norwegian reduction method converts up to 80% of total sulphur. European plant employing last procedure formerly produced 100,000 tons elemental sulphur per year.

Final step in treating delta concentrate involves retrieval of metals or metallic compounds, either from vapour phase or from cinder generated in sulphide roast, by standard LIX/electrowinning procedures.

Economics of proposed project attractive. Delta's extractable sulphur, gold, cobalt and copper worth minimum \$636,000,000 Australian at recent commodity prices and exchange rate. Bonuses likely from redefining deposit boundaries to raise grade and yield, also from iron oxide, barite, other probable byproducts. Estimated costs: \$120,000,000 capital and financing, \$368,000,000 operating. Should result in post tax profit of about \$74,000,000 or ca. \$3,700,000 per year at net rate of 15%. Apparent profitability confirms outcome of both economic analyses made by previous investigator, Cities Service. Cities calculated either copper and associated metals or contained sulphur sold for acid manufacture at 40% of brimstone price prevailing then would provide return of 15 to 17% after

tax. Present scheme will combine these two contemplated by Cities, and will benefit further by yielding gold, a component Cities overlooked.

Gold, not subject to normal supply/demand relationship, readily disposed of. Though little market for sulphuric acid because of Australia's long-standing excess in production capacity, substantial demand exists for elemental sulphur. Commonwealth and NZ lack domestic reserves. The two countries buy all needed abroad at cost of more than \$100,000,000 per year. Sulphur from King Delta capable of meeting eighth to quarter of Australia's current requirement annually for 20 years. Strategic considerations ensure long-term export market for Nation's cobalt. Besides helping cut country's overseas trade deficit by reducing sulphur imports and raising cobalt sales, delta project will contribute significantly to Tasmania's gold and copper output.

Uniquely, mining phase itself will have positive effect, allowing acid tailings which now poison seventeen miles of river bed to be washed away, and valley floors restored. Delta -- artificial -- will disappear too, after sulphides, heavy metals abstracted, and cleaned sediment deposited in deep water. Harbour waters turbid from Gordon River discharge, and floor naturally toxic, essentially lifeless; thus electrically-driven dredge, pumps, separatory equipment unlikely to harm environment. Delta coast practically uninhabited. As mining to be confined to bay, and shore plant built on strip reclaimed from Harbour, project will not affect traditional land use.

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DEPOSIT

I

BACKGROUND

Location

Deposit comprises delta of western Tasmania's King River. Lies at northeast corner of land-locked Macquarie Harbour. Road distances: to village of Strahan, 5 km; Queenstown, 40 km; Burnie, 230 km; Hobart, 300 km.

Origin

Delta consists of tailings from Mt Lyell mine at Queenstown, approximately 10% river sediment from King catchment, and material of secondary origin. Massive sulphide deposits of Mt Lyell have accounted for nearly a quarter of Australia's total production of primary copper, for a third of all pyrite mined in Tasmania, and about a fifth of the State's output of gold and silver.

Delta has formed since turn of century when large-scale exploitation at Mt Lyell began. Deposit continues to be augmented by about 1,250,000 mt tailings per year. Operations at Mt Lyell scheduled to end in 1989. Recent rise in copper price may prolong mine life.

History

Several surveys made involving King Delta.

In 1970/72 Mt Lyell drilled upper 10 feet of inshore, exposed part to determine pyrite content. Planned to produce sulphuric acid for use in manufacture of superphosphate. Scheme abandoned when Government ended fertilizer subsidy.

Overseas group subsequently incorporated as Aberdare explored Macquarie Harbour in 1973, at reconnaissance scale: target, deposits of Kupferschiefer type at formative stage. Concentrations of base metals, silver or uranium accumulating in some such bodies may be profitable to mine because of economies in exploiting unconsolidated sediments free of overburden. Black muds of Harbour floor below sill depth do indeed prove high in secondary sulphide, enriched in cobalt, copper, other elements. Highest grades found at King River Delta however, where contents raised by addition of primary material in Lyell spoil.

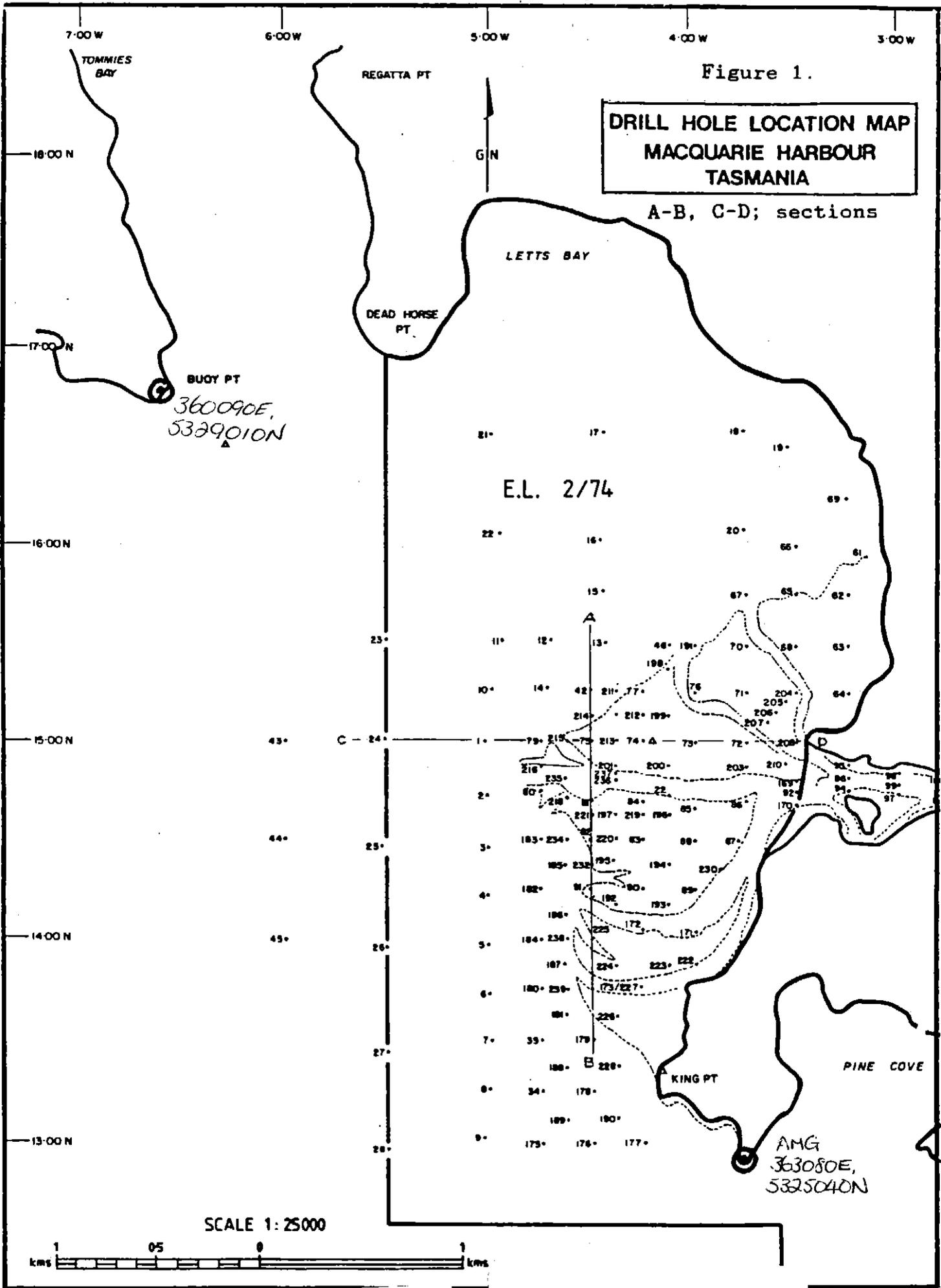


Figure 1.

**DRILL HOLE LOCATION MAP
MACQUARIE HARBOUR
TASMANIA**

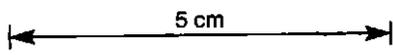
A-B, C-D; sections

E.L. 2/74

360090E,
5329010N

AMG
363080E,
5325040N

SCALE 1: 25000



AMG REFERENCE POINTS ADDED

Cities Service, US oil, gas and copper producer--brought in as partner - sponsored closer study by Aberdare. This confirmed first phase results.

In 1975 Cities drilled delta fully (Figure 1) and commissioned process tests, as third phase. Found delta copper would cost less to produce than that from Company's porphyry deposit at Miami, in American southwest. Postponed mine construction at Macquarie Harbour awaiting rise in copper price. Cities later compelled to drop this and all other overseas minerals projects because of a corporate policy change.

Cities also showed pyrite component of Delta sediment may be extracted efficiently, cheaply. Due to oversupply of sulphuric acid could not dispose of deposit as source of material for acid manufacture. Elisna Pty Ltd, company Cities acquired to hold exploration licence, made over to Aberdare, plus tenement.

Work by latter concern established essentially all Delta cobalt in pyrite. Aberdare/Elisna and associate Terra Marine granted Union Oil of California option to develop deposit. Union began lab studies; withdrew when cobalt price, elevated by civil war in Zaire, receded.

Further investigation by Aberdare demonstrates entire delta surface, exposed and submerged, enriched in gold: concentration not high, but consistent, pervasive. Licence transferred to independent US explorer, Cottesloe Corporation; and Planet/Constellation, Australian natural resources group, attracted to participate and to determine gold distribution within delta.

Upper layers of inshore exposed section of deposit bored for Planet by contractor. All delta sediment penetrated proves to be enriched in gold.

Above surveys described in reports submitted to Government by respective companies: see appendix.

II

DELTA

Definition

Drilling, sample, assay, other test data of surveys described provide accurate picture of King Delta's configuration, composition. Drilling undertaken totals some 2500 m. About 1750 samples collected.

Sampling method employed in Mt Lyell delta study described in Company's annual reports on licence. Aberdare's Phase II samples of delta toe and rest of Macquarie Harbour collected by means of gravity corer; splits of all material cored lodged at Mines Department's Launceston lab when survey ended. Cities' samples for assay obtained by RC drilling: Figure 1. Samples collected in Aberdare's study of gold at delta surface dredged or dug; cuts lodged at Mines' lab. Planet's samples retrieved from augered holes by sludge pump; splits held by Mines.

Taking Cities' 2.5 m isopach as boundary, delta covers 8 sq km, extending 4 km NNE/SSW, 2.0 km ESE/WNW; see Figure 8. Thickness: 2.5 to 32 m, average 7.5 m. Volume: 60,000 cubic metres.

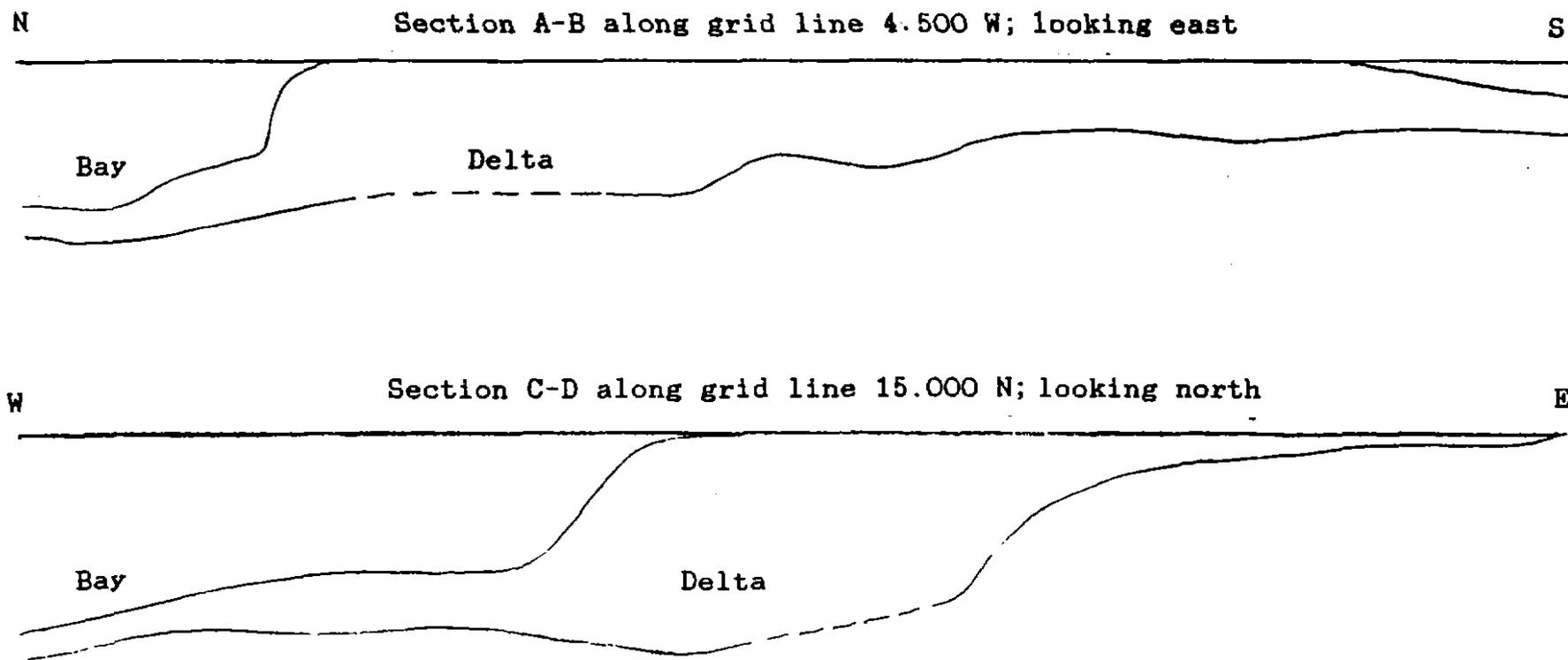
Apron of delta, 2.5 to 0 m thick, covers entire northern sixth of Macquarie Harbour.

Delta semi-lunate in plan; outer face curved. Innermost fifth of area flat-topped, generally above water. Sediment thickens seaward to reach maximum under west edge of exposed top. Delta face descends at slope varying from 2 to 12°. Slope diminishes from 20 m below sea level outwards: see Figure 2.

Water depth over delta, 0 - 35 metres. Water fresh to salt. Freshwater/saltwater interface off delta typically at depth of 8 m. Harbour waters and floor below sill depth of 11 m largely stagnant, high in H₂S. No appreciable tide, swell or surf in Harbour; chop only.

Sediment in deposit sandy near King River mouth, silty towards outer edges of delta.

Figure 2. Cross sections, King River Delta, Macquarie Harbour western Tasmania



Horizontal scale, 1:10,000. Vertical scale, 1:1000.

725097

Grainsize:	Microns	BSS Mesh	ASS Mesh	Delta Proper	Outer Edge
	+250	+ 60	+ 60	16%	
	+180	+ 85	+ 80	31%	
	+125	+120	+115	23%	25%
	-125	-120	-115	30%	75%

Sediment essentially unconsolidated, free of clays, boulders; thin localised developments of ironpan; occasional pebble bands, tree trunks.

Composition: quartzose sediment running average 14% heavy minerals.

Specific gravity of delta sediment varies, increasing shoreward. Mt Lyell determined values ranging from 1.566 to 1.890. Aberdare arrived at a figure of 1.574 for material from west edge of Delta's exposed top. Splits measured at Amdel by more accurate procedures give value of 1.625. Rough determination by Planet's contractor puts SG of material augered at 1.80. For reserve calculation of following pages average of 1.666 assumed, say 1.67.

Table 1. Average grades in sediment of King River Delta,
Macquarie Harbour, western Tasmania

Element	Abundance, ppm		Concentration Delta x Crust
	Earth's Crust	Delta Sediment	
Ag	0.1	1.3	13
Co	23	87	3.7
Cu	45	1,255	27
Mo	1	46	46
Zn	65	185	2.8
As	2	30	15
Au	0.004	0.140	35
Ba	400	4,200	10.5
Ce & La	64	880	13.7
S	520	29,000	55
Sb	0.2	3	15
Se	0.09	3	33
Sn	3	15	5
Th	10	26	2.6
Li	2	15	7.5
W	1	30	30

III

CHEMISTRY

Contents of useful and other elements present in Delta sediment and in derivative splits and concentrates were measured in course of surveys listed. Several thousand determinations made. Bulk of analytical work handled by eight separate laboratories.

Variety of analytical methods used, including emission spectroscopy, XRF, AAS, ICPA, fire assay and wet chemical. Some differences in results depending on sample, lab, and technique, but otherwise general agreement.

Grades regarded as average for delta shown at Table I. Values tabulated for Cu, Zn, Co, Mo and Ag dependable, each embodying individual analyses of hundreds of samples representing entire deposit. Other values stemming from fewer, less representative samples, are approximations.

Within delta, grades range to about 35% below or above averages. Gold and copper grades decrease seaward from the King River mouth; those of cobalt and barium rise.

Copper distribution at the delta is depicted in Figure 3. Grade averages about 850 ppm Cu at the delta toe and about 1,700 ppm inshore.

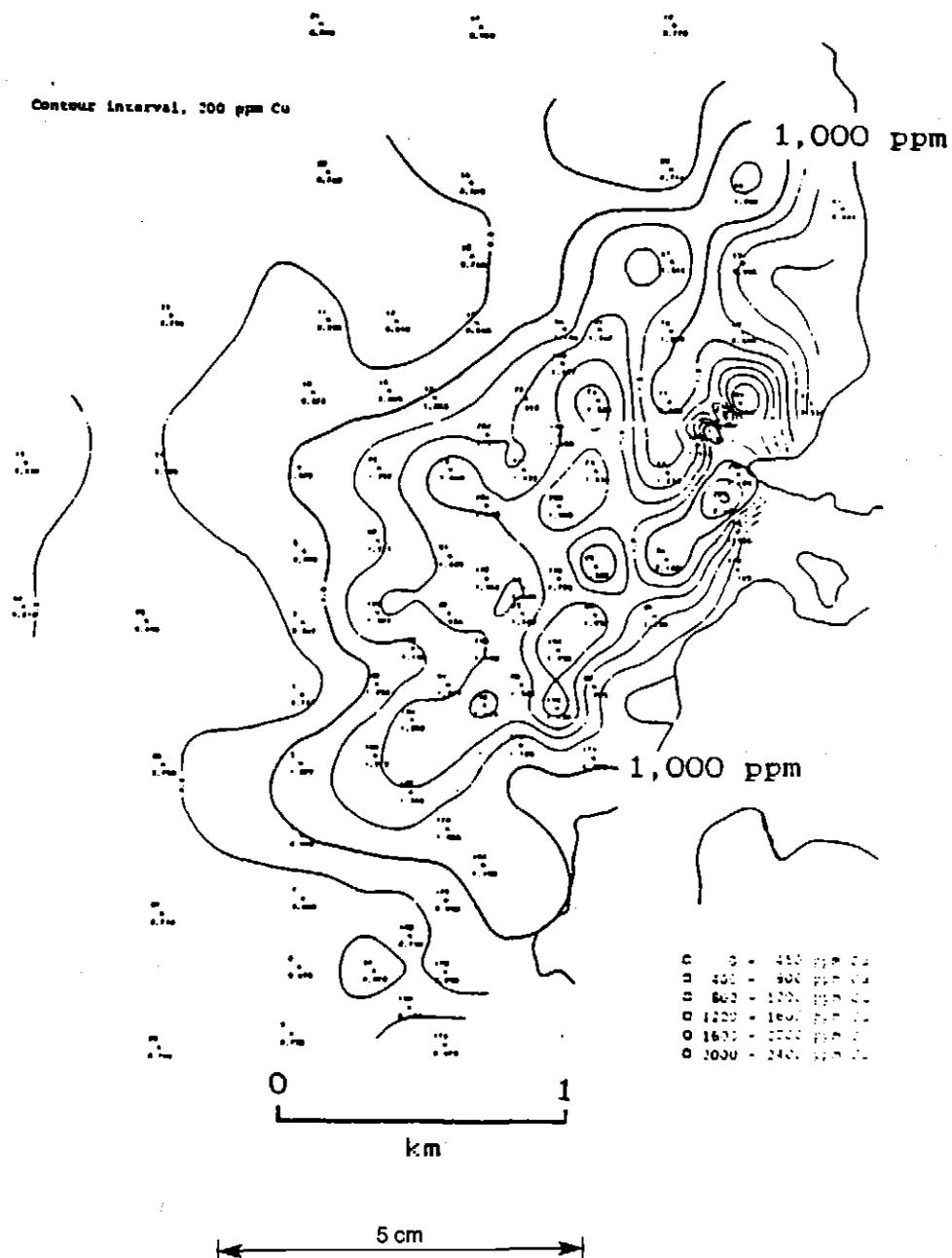
Gold grades of the delta's upper surface vary from 140 ppb Au over the toe through 170 ppb across the face to 210 ppb for the exposed top. Averages based on whole samples.

Planet drilling of upper few metres of exposed section yielded sample apparently lower in gold, but a third is barren sediment underlying delta, material which should be excluded from their grade computation. Second, finer-grained gold thought to comprise 30 to 40% of delta total was almost certainly lost in pumping sample from augerholes.

Discounting dilution by basal material but making no adjustment for pumping losses, uppermost 2.5 m Planet drilled averages 122 ppb Au, and 3 m beneath, 77 ppb.

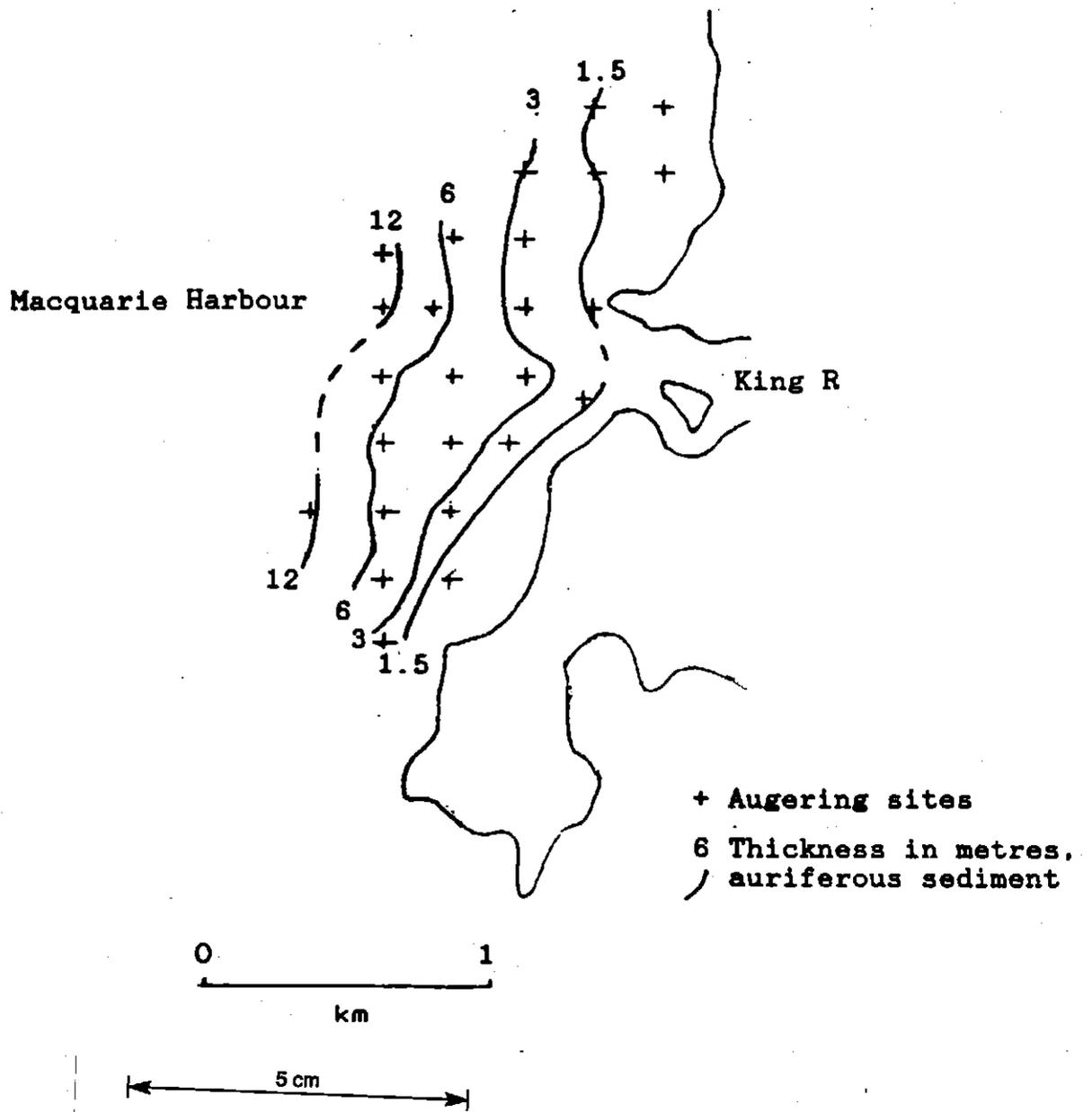
Note: Planet's deepest drillholes, unbottomed at 15 m, 16 m, terminate in mineral-bearing sediment assaying 130 ppb Au, despite maximum pumping in sample retrieval. (Figure 4)

Figure 3. Copper grade, King River Delta, Tasmania



Probably, gold content toward base of delta is above that at surface because percentage of riverine sediment -- likely source of free gold -- should be higher in deeper layers laid down when Lyell production and resultant tailings output were lower. Gold in tailings component of delta sediment also should rise at depth, as in past Lyell worked higher grade ore and recovered smaller proportions of precious metals.

Figure 4. Thickness of gold-bearing sediment, exposed section of King River Delta, Tasmania. Derived from sampling by Planet Resources Group.



IV

MINERALOGY

Heavy mineral suite comprises average seventh of delta mass; proportion rises inshore, falls offshore. Approximate constitution: 40% silicates; 40% sulphides; 13% iron carbonate, oxides and hydroxides; 7% miscellaneous.

Silicate component mainly sericite, chlorite. Sulphide component principally pyrite, some chalcopyrite, chalcocite?, plus minor bornite, sphalerite, molybdenite. Iron compounds chiefly siderite, haematite, limonite, goethite, small amount magnetite. Miscellaneous fraction, barite, monazite, zircon, apatite, rutile, leucoxene, chromite, tourmaline, topaz, cassiterite, gold.

Cobalt confined to pyrite. Electron probe study indicates pyrite grains in specimens examined partly devoid of element, other parts carry 0.75 to 3.4% Co. In main, this observation refers to primary pyrite and cobalt.

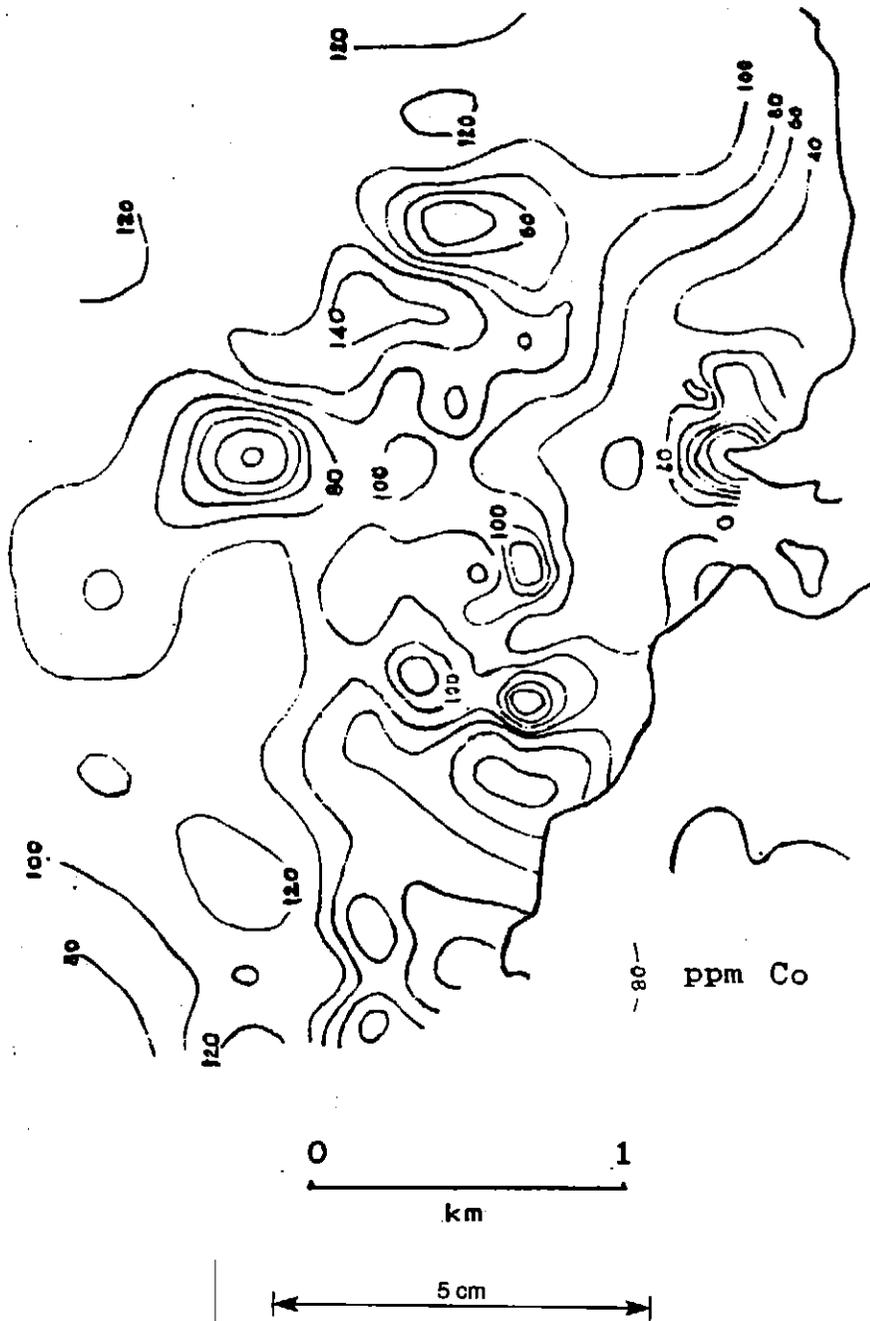
Estimated 40% of cobalt in deposit secondary, probably occurring as layer of cobalt sulphide on surfaces of primary and secondary pyrite found in lower-lying delta sediment, particularly that below 8 to 11 m depth. Thus sediment at King River mouth runs about 55 ppm Co whereas, offshore, averages approximately 115 ppm. Effect illustrated in Figure 5, showing cobalt distribution delta-wide.

Deposition of cobalt in reducing environment at depth possibly balanced by solution of element in Queen/King river bed and upper parts of delta, an oxidising realm.

Roughly two-thirds of delta's copper found in particles of chalcopyrite introduced via Lyell tailings. Other third thought to comprise secondary copper deposited as thin films on grains of most mineral species making up deposit. Process appears to operate throughout delta but presumably more marked at depth, further from shore, where it may offset some of grade drop produced by decrease in percentage of primary copper present.

Delta gold probably occurs in two states, an estimated 55% exsolved in pyrite, and other sulphides?, the rest free. Occurrence inferred from several considerations and test results. Gold distribution does not duplicate fully that of sulphur or copper in splitting sediment on basis of varying density, particle size.

Figure 5. Cobalt grade, King Delta, Tasmania



In flotation, higher proportion of gold lost than of sulphur. Amalgamation recovers only some of total gold. Lyell gold losses too small to account for grade at delta. Figure 6 shows proportion of exsolved gold to cobalt and thus, by association, to primary sulphide.

Barium of deposit in the sulphate, barite. Rare earths resident in monazite.

Most of silver thought secondary: may occur as halide.

Delta sediment fairly well sorted and sized, with majority of heavy minerals conspicuously finer in grain size than bulk of quartzose and other silicate particles.

Figure 7 displays distribution of elements concentrated in deposit, according to size of host particles. Note similarity of cobalt and sulphur graphs, and association of most metallic elements shown with particles under 38 microns in diameter; such association specially marked in case of silver.

Degrees of liberation lowest towards coastal margin of deposit where sediment coarsest grained; increase seaward with fall in average grain size.

Useful components of delta commonly occurring as relatively large grains -- pyrite for example, barite, apatite and magnetite -- all well-liberated. Delta's chalcopyrite and zircon, medium- to fine-grained, partially locked. About 60% of chalcopyrite occurs in other material, mainly in quartz, chlorite, mica, haematite; some in magnetite, pyrite. Monazite, rutile, typically fine-grained at delta, poorly liberated.

Slope: 100 ppm Co ~ 110 ppb Au
200 ppm Co ~ 220 ppb Au

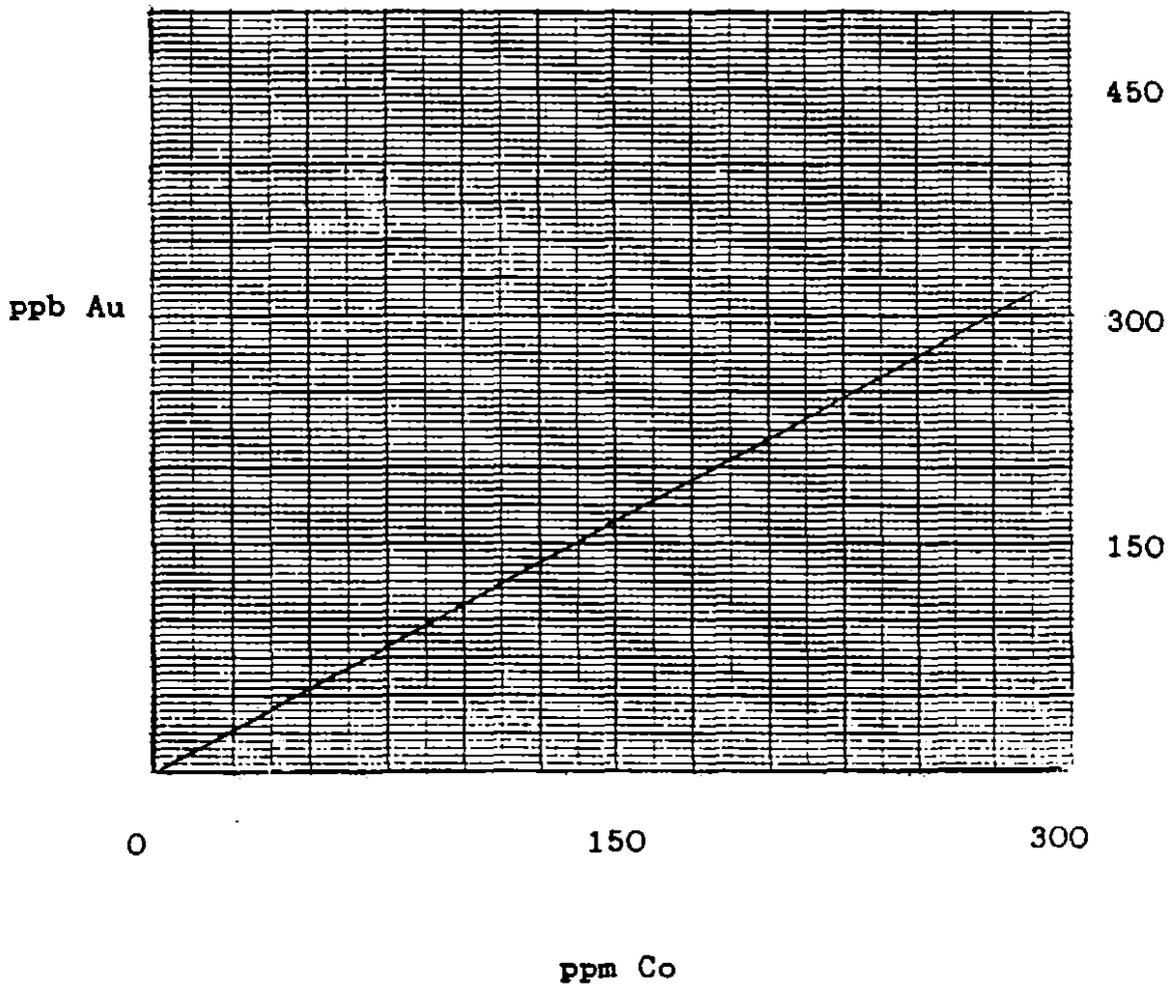
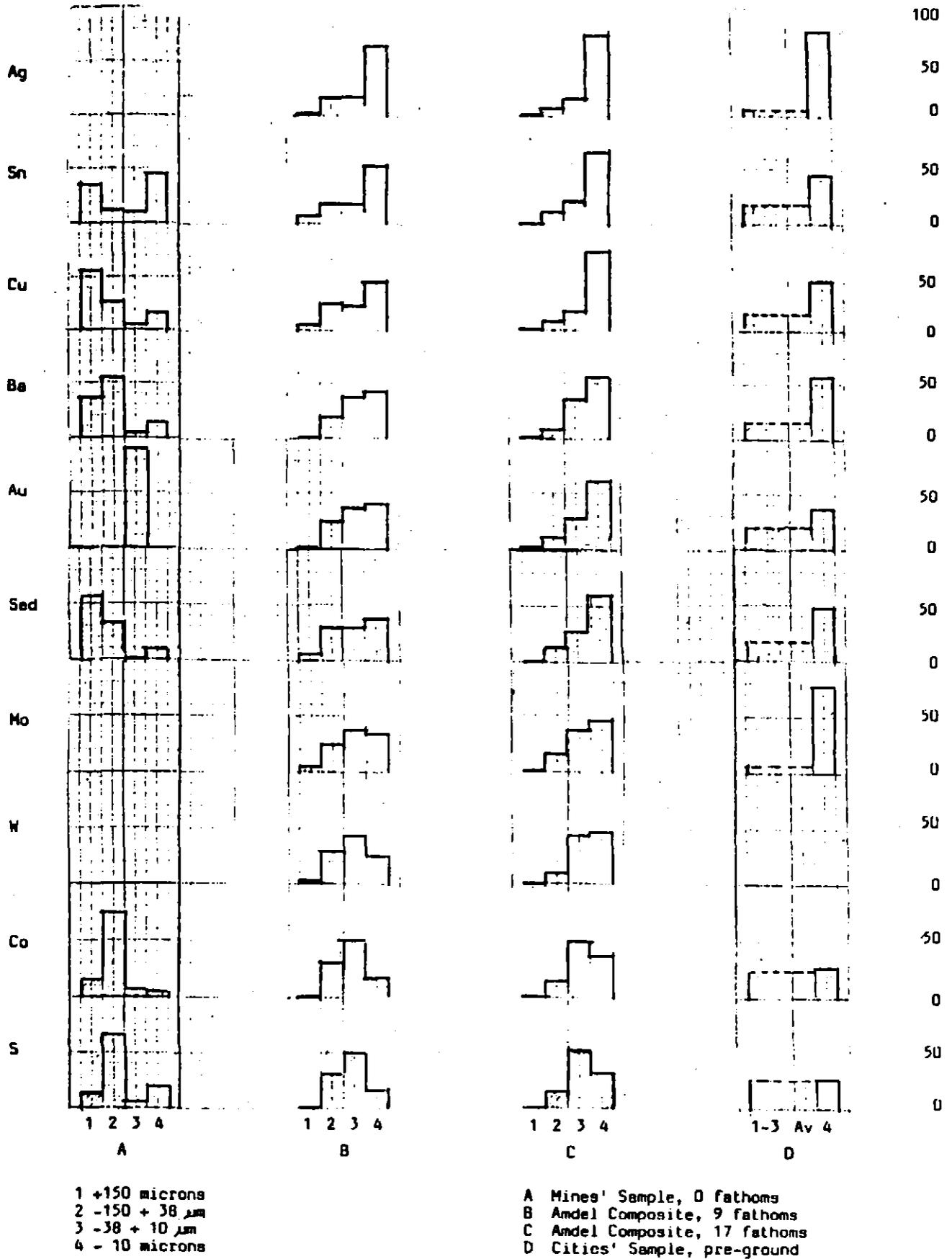


Figure 6. Gold/cobalt proportions in King Delta sulphide.

Figure 7. Elemental Distribution in Weight Percent, King Delta Sediment



(A-D: reference 1985 Annual Report)

CONTENT

On completion of 1975 drilling campaign Cities Service put King Delta sediment reserve at 100,000,000 mt proved, plus 25,000,000 mt probable: density, cut-off thickness not stated. Cities' isopach map reproduced at Figure 8.

Data given here, Section II, show volume of deposit within Cities' 2.5 m isopach is 60,000,000 cubic metres and likely density is 1.67 gm/cc for sediment in place. This defines 100,000,000 mt proved reserve.

Tailings added since 1975 estimated to amount to extra 15,000,000 mt. No reduction needed for small fraction carried into bay because approximately balanced by deposition at delta of riverine sediment derived naturally.

Further reserve of probable category made up of sediment lying seaward of cut-off isopach and by additional material at delta base. Existence of latter likely as some thirty percent of Cities' bores, mainly deeper holes, failed to penetrate full thickness of deposit.

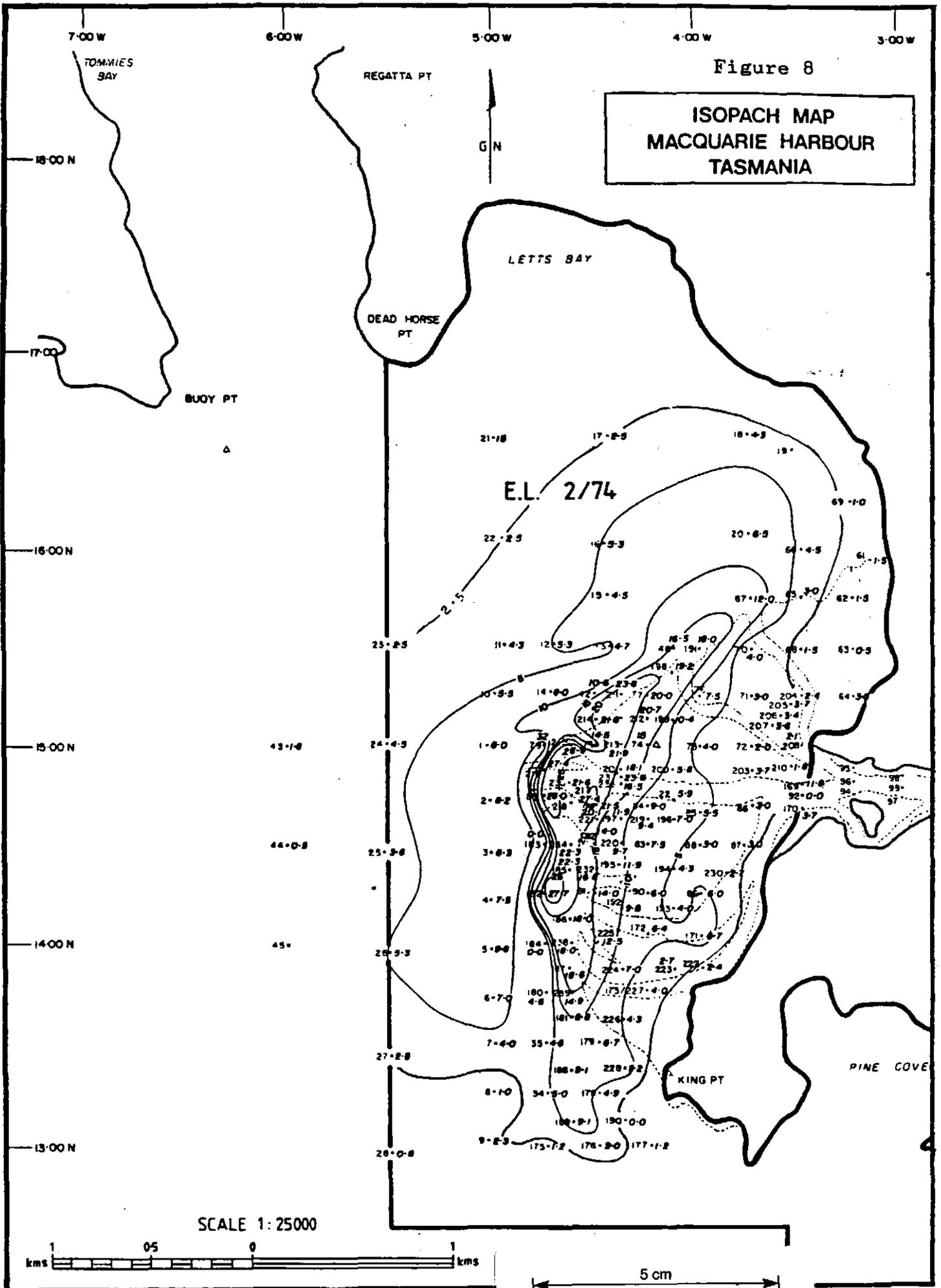
Quantities of delta's principal elements and minerals in situ shown below.

Table 2. Contained reserve: King Delta, Tasmania

Element /Mineral	Grade	Total in 100 M mt
Au	140 ppb	14,000 kg
S	2.9 %	2,900,000 mt
Co	87 ppm	8,700,000 kg
Cu	1,255 ppm	125,500,000 kg
Mo	46 ppm	4,600,000 kg
Ag	1.3 ppm	130,000 kg
Barite	7,000 ppm	700,000 mt
Monazite	2,000 ppm	200,000 mt

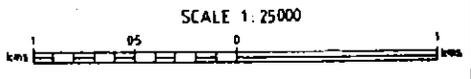
Figure 8

ISOPACH MAP
MACQUARIE HARBOUR
TASMANIA

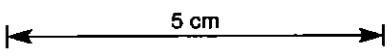




LEGEND
 — S — See Bathymetric contour



BATHYMETRY MAP
 MACQUARIE HARBOUR
 TASMANIA



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