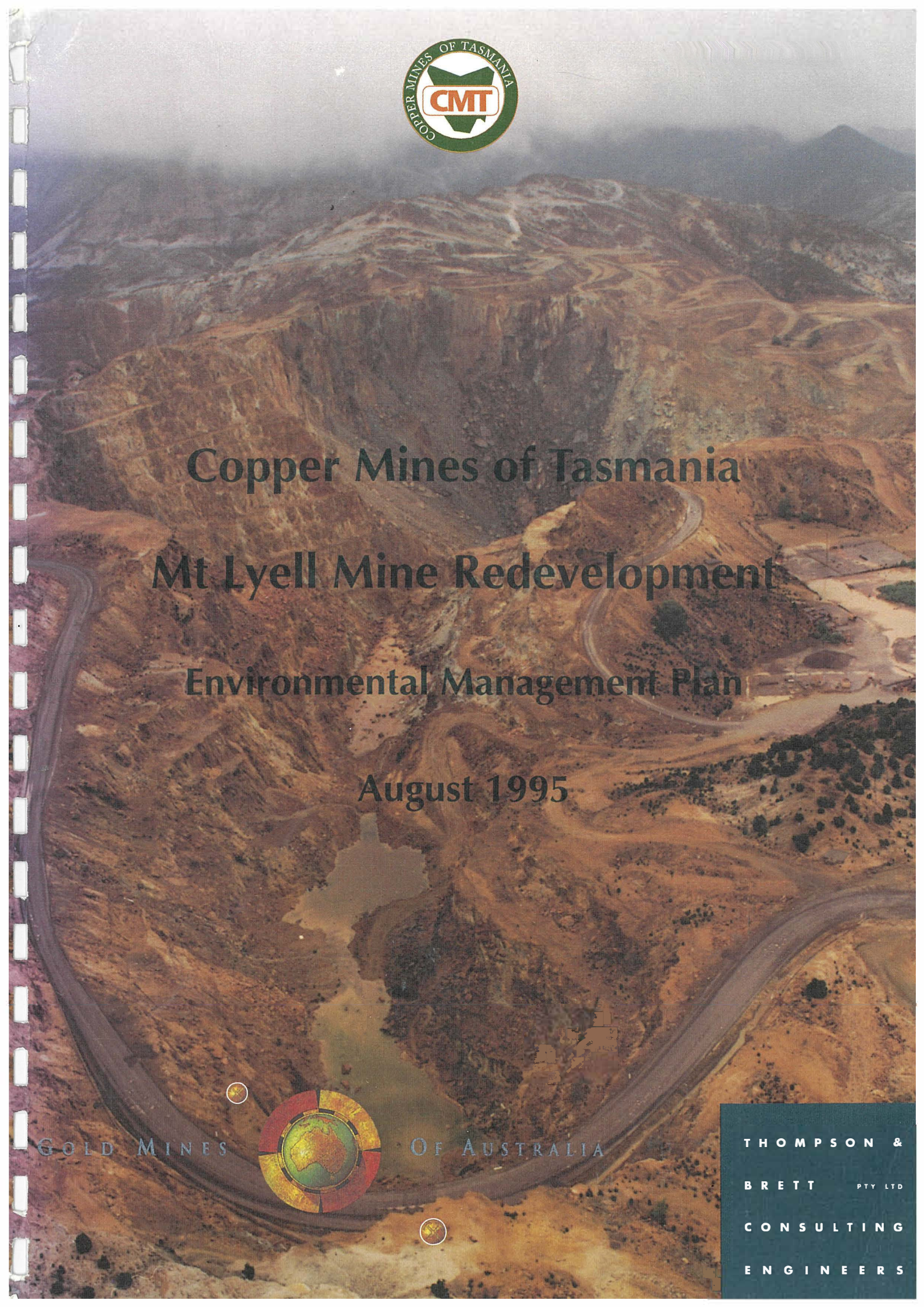
COPPER MINES OF TASMANIA
CMT
Copper Mines of Tasmania
Mt Lyell Mine Redevelopment
Environmental Management Plan
August 1995
GOLD MINES
OF AUSTRALIA
THOMPSON &
BRETT PTY LTD
CONSULTING
ENGINEERS

EXECUTIVE SUMMARY

The Mt Lyell Mine in Queenstown is one of Australia's major mining operations with a history of production over more than 100 years. The mine is classified as an operation of "world scale" significance.

The Mt Lyell Mining and Railway Co (MLMRC) ceased mining at the site in December 1994, closing its operation.

Following calls by the Tasmanian State Government for expressions of interest in redeveloping the mine, Copper Mines of Tasmania, a fully owned subsidiary of Gold Mines of Australia, was granted a mining lease and indemnity from actions concerning pollution from previous occupation and use of the leased land. The redevelopment of the Mt Lyell Mine has been designated a Project of State Significance under the State Policies and Projects Act, 1993 (SPPA) and an Agreement between the State Government and the Company formalised by the Copper Mines of Tasmania Act (CMT Act).

Copper Mines of Tasmania committed to expenditure of $5 million on a detailed evaluation and feasibility study to investigate the viability of a major re-development of the site. Copper Mines of Tasmania took possession of the site in late December 1994. So far approximately $22.2 million have been spent by the Company in building the tailings dam, initial development works and refurbishment of equipment.

This EMP is a requirement of the approval system for the project under the CMT Act and the SPPA.

The document describes details of the proposed development and the environmental management systems to be put into place on the site to ensure minimum environmental impact from the project, given the conditions of the leased land following pollution from previous occupation and use.

Mining activities over the past century have resulted in substantial modifications to the environmental conditions within and surrounding the leases now held by CMT. The primary environmental impacts of past operation and use of the leased land have been identified as:

- significant changes to the landscape;
- severe depletion of natural vegetation cover;
- modified stormwater runoff characteristics, both quality, and quantity;
- external water discharges including mine water and tailings;
- increased sediment deposition within the King River and Macquarie Harbour, and
- deterioration of water quality of receiving waters.

Previous mining has substantially changed the physical characteristics of the landscape. Open-cut mining has left the leases with a number of deep pits and past underground operations have left numerous shafts and adits.

Overburden material from mine excavations has been placed in waste rock dumps which have generally been located around the perimeter of the open-cut mines. Preliminary indications are that these pyrite rich dumps will continue to generate acid drainage for the next 400 to 500 years. Approximately 53 million tonnes of waste rock are estimated to have been dumped about the lease site in the last 100 years.

Vegetation has been stripped from a widespread area due to past clearing activities, mining, fires and from sulphur dioxide generated by smelting effectively denuding the hills. Since closure of the smelters in 1969 some regeneration of the vegetation has occurred.

Peak intensities and the average annual runoff volumes of stormwater have increased since mining activity commenced in 1893, due to the reduction in vegetation and this has resulted in increased erosion. Runoff from the site has become more acidic and contains high metal loadings due to acid drainage from the pyrite rich waste rock dumps and exposed mineralised rock.

Acid drainage is also contributed to by
- mine dewatering from the Prince Lyell Shaft,
- adit discharges, and
- groundwater discharge from flooded workings.

Acid drainage, as a result of these past activities, finds its way to Haulage Creek and into the Queen River. However some acid drainage water from the old workings discharges into the Linda Creek and Comstock Creek catchments which ultimately drain to Lake Burbury. To minimise metals discharge into Lake Burbury, diversion works were undertaken by the Hydro Electric Commission to divert acid drainage from these catchments to the East Queen River, prior to the Lake being formed. These measures have been mostly successful with relatively low remaining acid drainage levels currently being discharged to Lake Burbury.

Water quality in the Queen River below the confluence with Haulage Creek exhibits high concentrations of dissolved copper, aluminium, manganese, and iron which render these streams an inhospitable environment for aquatic and riparian species. Dewatering of the underground mine workings contributes to these conditions. However, closure and flooding of the mine would not result in significant reduction in water contamination from the overall site.

CMT proposes the continued underground mining of the Prince Lyell orebody. Future development will extend this operation to the Western Tharsis deposit. CMT suggests that an expenditure of $900,000,000 has the potential to produce some 400,000 tonnes of copper and 500,000 ounces of gold over the first 10 years of the project. Initial product will comprise copper concentrate shipped overseas for processing though in the longer term, CMT will pursue several options for restoring downstream processing of the concentrate to the site.

The CMT Act requires that a dam be constructed for storage of tailings from the operation. The preferred site is at Princess Creek to the west of Queenstown aerodrome. This site has been selected following a review of several alternative sites.

On consideration, only the Princess Creek site and the Lyell Comstock Creek sites were found worthy of serious investigation. The Comstock site has been rejected due to major cost implications of the massive earthworks required, serious engineering concerns regarding seepage through foundations, the potential impact on Lake Burbury in the event of dam leakage or failure and the potential for sterilising potential mineral deposits beneath the site.

Construction of an initial Stage I dam was commenced in early 1995 so as to be completed before the winter weather precluded any construction activities. The dam was completed in July. However, it will not be used until approval is granted by the Government. In the event that approval for the Project is not granted the Stage I dam site will be rehabilitated. A preliminary overall plan of the overall Princess Creek Scheme is presented in Figure 4.32 showing the expected extent of water cover at the 15 year storage level and also the potential maximum extent of the storage, being in excess of 60 years at the expected increased production level. Schematic representations of the dam are presented in Figures 5.10, 5.11 and 5.12.

The scheme proposes a dam on the Princess Creek at the northern end of a relatively narrow gorge cut by the Creek through the range of hills on the western side of the Queen River. This is some 500 metres above a Botanical Garden Reserve considered by some to be of conservation significance. Tailings will be pumped to the dam, allowed to settle and decant water will be discharged into Princess Creek.

The tailings pipeline will be laid above ground on a route leaving the northern end of the mill and crossing the West Queen River and the Lyell Highway approximately 250m north of the current Mt Lyell offices, rising up a gully parallel to the highway and then following a route of lowest possible elevation across the elevated plateau to the north east of the Queenstown Airport. The pipe would skirt the eastern and southern boundaries of the airport site and traverse Howard Plains to discharge at the dam. The tailings pipe will be laid around the northern edge of the tailings dam and will feature several discharge points, strategically placed to allow even spread of tailings to the dam.

Preliminary detail of the dam is shown in Figure 4.34. It will comprise a zoned earthfill dam with an initial height of 45m, giving a crest level of RL 220. Normal water level will fluctuate between RL 215 and 216 depending on natural catchment inflow. This first lift will cater for the first 5 years of tailings storage, with three further lifts being contemplated during the current 15 year mine plan.

The fourth lift would be intended to leave the dam in a suitable condition for abandonment if the mine were to close after 15 years. If production continues after 15 years, and CMT is confident of increasing mining reserves, the dam has the potential for further staged raising in 3 to 5 m increments, eventually reaching a height of 85m (crest RL 260).

The staged development of the dam is shown diagrammatically in Figures 4.35, 4.36, 4.37 and 4.38

For each stage of the dam there will be a primary spillway designed to pass floods up to those with an annual exceedence probability of 1 in 100. This spillway will comprise a concrete drop structure leading to an outlet pipe fitted with a valve which will be capable of adjustment to vary the outflow from the dam. This will enable storage of water during high inflow periods for release during dry periods, thus allowing control of discharge water quantity and quality. In addition the control valve will allow emergency shut off of the outflow in the event of an environmental incident, such as an oil spill or excessive suspended solids content in the storage. The potential storage in the dam in the event of an incident will be in the order of several weeks which will allow for remedial measures to be introduced. Each stage of the dam will also feature a secondary spillway channel cut into the rock of the western abutment, designed for extreme flood events which exceed the capacity of the outlet tower.

During construction the Princess Creek flow will be diverted through a concrete pipe at creek bed level. This will be sized in conjunction with a coffer dam incorporated into the upstream toe of the dam to pass flood flows. The sizing of the coffer dam and diversion will be subject to detailed design.

A silt trap will be created about 260m downstream of the ultimate toe of the consisting of a concrete weir creating a pond of about 1,500m^3 capacity and giving a retention time of 1.5 hrs for median flow.

The tailings dam system proposed will be suitable for either;

- subaqueous discharge, where tailings are distributed directly beneath the water surface by pipe to a floating pontoon, or
- subaerial discharge where tailings are discharge to a beach with pondage of water minimised

The method proposed for the tailings dam comprises a hybrid of the two methods with tailings being discharged from the bank of the pond away from the dam wall. Initially the majority of tailings would flow beneath the water surface but gradually a beach would develop below the discharge pipe. The pondage water level would be progressively raised to inundate the beach discharge.

The development of a beach is preferred for practical reasons due to the creation of better tailings density and more even distribution achievable compared to subaqueous methods. However the performance of the method will be closely monitored during the first few months of operation and conversion to subaqueous discharge methods can readily be adopted if oxidation of exposed tailings proves to be affecting release water quality.

The tailings discharge points and the resulting beach will be kept remote from the dam wall and water release point to ensure a large deep pondage at the dam. .

Tailings have significant potential for neutralisation of acid drainage. CMT proposes a method where the maximum neutralising capacity of the tailings will be utilised following a development and study period in which outstanding environmental questions are resolved through a programme of monitoring and testing. In order to maximise the tailings neutralisation capacity it is necessary to mix the tailings

thoroughly with the acid drainage. The resulting pH of the mixture causes dissolved metals to precipitate with the tailings, reducing the dissolved metal concentration of the water.

CMT proposes to discharge decant water from the tailings dam to Princess Creek. The management of this emission will be important to CMT's operations. The Company has been advised by the Sustainable Development Advisory Council (SDAC), that it would be desirable to maintain a water quality and flow regime in Princess Creek which will support a healthy (although not necessarily pristine) aquatic ecosystem, the objectives being to maintain water which is aesthetically acceptable and suitable for secondary contact recreation.

Since under the CMT Act, CMT is not liable for any pollution arising from previous use of the land, only a small proportion of the acid drainage pumped from the Prince Lyell mine will be attributable to CMT's operation. CMT is confident that it can treat this proportion of the mine water with the tailings from the processing area and meet the Regulations under the EPA 1973 for discharges to the Princess Creek. However, CMT is prepared to maximise the neutralising capacity of the tailings by treating additional acid drainage beyond that for which it is liable. Though by carrying out this additional treatment, it is likely that the decant water generated from the tailings dam may be unable to meet the Regulatory levels for some parameters, such as sulphate and calcium, since sulphate and calcium levels are virtually unaffected by tailings neutralisation.

These substances are not considered to be toxic to aquatic life but may have an effect on the interaction of minerals in the Creek water. CMT proposes to use the Stage I dam operation to gather information on the quantity of mine water which can be treated with tailings while generating a decant water which can be confidently discharged to Princess Creek without adversely affecting its ecology

The role of the EMP is to provide a framework for Best Practice Environmental Management (BPEM) of CMT operations on the Leased Land as specified in the CMT Act.

The EMP outlines the environmental policies, management processes, hazards, contingency plans and background information on site conditions. The EMP describes how the mine site, tailings dam and associated infrastructure will be managed so as to meet acceptable environmental performance standards.

The EMP demonstrates CMT's environmental commitment in carrying out the redevelopment of the Mt Lyell site. CMT is in no doubt that its operations at Queenstown will result in an eventual improvement, not only to the site and its immediate environs, but also to the impacts which are presently affecting the waters of the Queen and King Rivers and Macquarie Harbour caused by previous use of the site. These environmental benefits will occur in addition to the economic benefits which the operation of the mine will bring to the West Coast and to Tasmania as a whole.

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1.0 PREAMBLE

In October 1994, Gold Mines of Australia and the Tasmanian Government signed an Agreement, later incorporated in the Copper Mines of Tasmania Pty Ltd (Agreement) Act 1994 (CMT Act) declaring the project to re-develop the Mount Lyell Mine "a Project of State Significance" (POSS) and requiring the submission of an Environmental Management Plan (EMP) to the sustainable Development Advisory Council (SDAC) for assessment under the State Policies and Projects Act (SPPA) 1993. The re-development of the Mount Lyell Mine will be the first such assessment under this legislation to be carried out by SDAC.

As a consequence of the CMT Act the Minister for Environment and Land Management, the Hon. John Cleary, tabled his Direction to SDAC in respect of the CMT Project in Parliament on the 7th February 1995. The Direction was subsequently approved following debate in both Houses. Essentially the Minister's Direction instructs SDAC to undertake an integrated assessment of the CMT Project and directs the Council on the essential matters which it must consider in its assessment.

This EMP is provided as a public document in line with the Guidelines prepared by SDAC, as a consequence of the Minister's Direction and comments received by Council following a public comment and scoping period. The guidelines are attached to this EMP as Appendix A.

The EMP has incorporated responses in line with the public and agency submissions to the draft EMP that was submitted to SDAC in April 1995. This document is intended to provide SDAC with sufficient information to be able to assess the likely environmental effects of the proposed development and the adequacy of the on-going environmental management prescriptions which will be put in place when the operation of the mine recommences. The EMP will provide an important resource for SDAC's determinations on environmental authorisations for the proposed development

The EMP will also provide the community and government agencies with information so that informed comment on the project can be made to SDAC following public release of the documentation. SDAC may take these comments into account in the formulation of its report to the Minister.

In December 1994, the closure of the Mount Lyell Mining and Railway Company operations ended a significant chapter in the Mining History of Tasmania. However, a century of mining and processing operations have resulted in significant levels of environmental pollution to the region. Whilst closure of the operation was viewed as an economic and environmental necessity by its previous operators, CMT is most strongly of the opinion that the mine has the potential to continue making a significant contribution to the Tasmanian economy well into the next century.

Mining operations at Queenstown commenced in 1893 and over the past 102 years the mine has produced over 1,300,000 tonnes of copper and 1,200,000 ounces of gold.

Copper Mines of Tasmania Pty Ltd (CMT), a subsidiary of Gold Mines of Australia Ltd (GMA), is currently formulating an operations strategy to re-develop the large gold/copper deposits at Queenstown, Tasmania.

CMT has been evaluating the economic potential of the Mount Lyell orebodies since April 1994 and have committed some $5,000,000 to provide a detailed economic, engineering and environmental study by April 1995. The decision to proceed with the Project was confirmed by CMT's Board of Directors in May with the Company subject to necessary approvals committing to develop an underground mining operation at Mount Lyell which will produce 40,000 tonnes of copper, 45,000 ounces of gold and 200,000 ounces of silver on an annual basis.

A number of factors will contribute to the "re-birth" of the mine and these can be generally summarised as:-

- re-evaluation of the underground and open-cut ore resources to take into account modern mining practice
- rationalisation of labour levels to ensure optimum use of automation
- implementation of an Environmental Management Plan to ensure that environmental disturbance is minimised and to improve the existing situation
- The passing of the CMT Act, in December 1994, to categorise the re-development of Mount Lyell as a Project of State Significance and provide an environmental indemnity for all disturbances carried out prior to December 1994.
- evaluation of recent innovations in the production of copper metal, in order to study the financial benefits of introducing downstream processing on site.
- the expenditure of significant amounts of capital funds for mine development.
- the achievement of reasonably high copper price contracts in order to maximise returns during the early years of the project to justify the capital expenditure.

CMT is proposing a mining and treatment operation at Queenstown that will have operating costs of over $100,000,000 per annum when full scale operations are achieved in 1998.

Some $65,000,000 of this expenditure will be distributed within Australia, of which over $40,000,000 will contribute to the economic growth of Tasmania. In order to facilitate this proposal, GMA raised over $43,000,000 in January 1995 to augment existing cash reserves held by the Company. This money has been used to fund the construction stage of the project, which commenced in May 1995. The commissioning of the new operation is scheduled to commence in November 1995, with the first copper concentrate being shipped overseas in the first quarter of 1996.

CMT will ensure that it carries out all operations at Queenstown with regard to Best Practice Environmental Management (BPEM), as it is modified by pre-existing and on-going contamination and Pollution caused by previous occupation or use of the Leased Land as described in the CMT Act. BPEM is outlined in the Environmental Management and Pollution Control Act 1994 at section 4, as:
" *the management of the activity to achieve an on-going minimisation of the activities environmental harm through cost-effective measures assessed against the current international and national standards applicable to the activity*".

However for the Queenstown site, the effect of the CMT Act has been to modify BPEM in recognition of the on-going pollution caused by previous use or occupation of the Leased Land. The Company will outline, in the main body of the EMP, how the environmental management system and technology to be employed at the mine will achieve the minimisation of environmental harm.

BPEM considerations applicable to green field mine sites may never be achieved at the CMT lease. It would be both impractical and inequitable to apply national and international pollution standards to the CMT operations given the incredibly high levels of pre-existing contamination and pollution on the site which have created a number of significant problems relating to ongoing pollution, particularly acid drainage.

The method by which CMT will achieve site specific environmental objectives for its operation will be defined in this Environmental Management Plan (EMP). It is through the EMP process that the Tasmanian community can examine CMT's operations and be assured that CMT will carry out all procedures and processes with regard to BPEM but having regard to the pre-existing environmental conditions within the lease site. The Tasmanian Government has indemnified CMT from responsibility for the pollution caused by previous operations and use of the leased land. Consequently, national and international standards applicable to "green-fields" operations must be reviewed to take this into account to ensure that the standards applied to the CMT operation are practical and equitable. This is not an exemption from existing laws of the State but is a recognition that the site is highly contaminated and has been adversely affected by previous use.

CMT is totally cognisant of its environmental and social responsibility with respect to the re-opening of the mine and propose to ensure that all of its operations are carried out in such a way as to minimise geomorphological and environmental disturbance. However, 100 years of previous mining and treatment operations at Mount Lyell have left a pollution legacy that may continue for over 500 years.

The complexity and multiplicity of the existing environmental influences at the mine provide a number of difficulties when trying to segregate the "old" from the "new". However, when considering the overall environmental implications of CMT's proposed operations, cognisance must be taken of the fact that the implementation of the EMP will ultimately improve the environmental devastation that would otherwise remain a blight on the Queenstown region, the Queen and King river system and Macquarie Harbour.

CMT is committed to a pro-active environmental policy and will work with Government and regulating authorities in their remediation programs in regard to previous environmental degradation.

2.0 PRELIMINARIES

2.1 ACKNOWLEDGMENTS

This Environmental Management Plan has been prepared by Thompson & Brett Pty Ltd, Consulting Engineers, with the assistance of numerous companies and individuals with specific expertise in various fields.

The following list of contributors acknowledges their assistance and the areas of their specific input:

David Brett	Thompson & Brett Pty Ltd	project manager and engineering
Bob Chesterman	ESS Pty Ltd	general research and water chemistry
Isobel Stanley	Copper Mines Of Tasmania	policy direction and editorial
Peter Secker	Copper Mines Of Tasmania	mine development information
Hamish Bohannan	Copper Mines Of Tasmania	detailed mine operational policy
John Davis	Copper Mines Of Tasmania	mine geology and exploration
John Geoghegan	Consultant to CMT	background to existing infrastructure
Alan Thompson	Thompson & Brett	transportation
Tim Duckett	Land Management and Rehabilitation Services Pty Ltd	sediment and weed control advice
Graeme Campbell	Graeme Campbell & Associates	geochemistry of tailings and mine water
Assoc. Prof. Alistair Richardson	University of Tasmania	terrestrial Invertebrate study
Dr Peter Davies	Freshwater Systems	freshwater ecology
Roger Parkyn	Hydro Electricity Commission	hydrology of dam site
Ken Morrison	Consultant	geological survey
David Wilson	Hydro Electricity Commission	engineering geology
Andrew North	Consultant	botanical survey
Cathie Searle	Consultant	archaeological survey
Dr Stuart Miller	Environmental Geochemistry International	geochemistry of tailings and mine water
Donna Craig	Craig & Ehrlich, Solicitors	legal review
Dr Nick Clarke	Imtech Pty Ltd	metallurgical process, geochemistry of tailings and acid drainage
Rob Rowell	Landfile Consultancy	MapInfo mapping

2.2 DEFINITIONS

The following definitions apply to terms used in this Environmental Management Plan

1. **"Authorisation" means:**

a) any authorisation, approval, agreement, consent, licence, permit, franchise, permission, filing, registration, resolution, direction, declaration and exemption; and

b) in relation to any matter affecting the CMT Project which will be restricted or prohibited in whole or in part by law if, within the specified period after receipt of notification, a Government Agency intervenes or acts, the expiry of such period without the Government Agency intervening or acting.

2. **"Best Practice Environmental Management" - BPEM** - as defined in the CMT Act:

   BPEM refers to the definition in the Environmental Management and Pollution Control Act, 1994, as qualified by the clause 4.1 (j) of the CMT Act, which is BPEM achievable, always having regard to any pre-existing contamination and on-going pollution caused by the previous use or occupation of the Leased Land for which it is not responsible and having regard to the state of the Leased Land.

3. **"CMT Act"** refers to the Copper Mines of Tasmania Pty. Ltd. (Agreement) Act, 1994.

4. **"CMT Project"** means the commercial operations to be carried on by CMT on the Leased Land represented by Commercial Production.

5. **"CMT Proposal"** means the development proposal submitted by Gold Mines of Australia Pty Ltd to the Crown.

6. **"EMAPCA"** means the Environmental Management and Pollution Control Act 1994.

7. **"Environmental Requirement"** means Commonwealth, State or local law or regulation, including without limitation any dangerous goods or poisons law, regulation, direction, guideline, ordinance, code, order, approval or plan or which governs or affects any substance's or Pollutant's manufacture, use handling, treatment, transportation, (incorporating the Australian Code for Transportation of Dangerous Goods by Road and Rail) storage, control, management, disposal or labelling, including Australian Standards published by the Standards Association of Australia and Tasmanian State environmental policies, standards and requirements and environmental terms and conditions of any authorisation or lease or other requisite needed for CMT to operate.

8. **"EMP"** means Environmental Management Plan, ie this document

9. **"Indemnity"** or **"Indemnified Claim"** refers to the indemnities provided for in the CMT Act and the definition of indemnified claim in the CMT Act.

10. **"Leased Land"** means the land and the licences and easements comprised with and ancillary to Consolidated Mining Leases Numbers 30M/80 and 28M/83.

11. **"Pollutants"** has the meaning assigned to that expression by the EMAPCA.

12. **"Pollution"** has the meaning assigned to that expression by the EPA and also to the expression "Environmental Harm" in the EMAPCA.

13. **"Programme of Environmental Works"** means the long term programme of environmental improvement works, for those parts of the Leased Land affected by mining operations, which will be prepared by CMT within two years of the Commencement Date.

14. **"SDAC"** means the Sustainable Development Authority Council established under the SPPA.

15. **"SPPA"** means the State Policies and Projects Act, 1993.

16. **"environmental harm"** means any adverse effect on the environment (of whatever degree or duration) and includes environmental nuisance as defined by EMAPCA.

2.3 GLOSSARY OF TERMS

bioremediation	improvement of environmental condition by biological means
bunded	enclosure of areas with impermeable walls to trap spills of liquid contaminants
complexing	the binding of metallic ions to other chemical species which, in the specific area of interest to this EMP, potentially reduces the bioavailability of potentially toxic substances.
dewater	The operation of removing water, in the context of this EMP, the pumping of water from the active mine areas or construction sites
development	underground tunnels for access or ventilation
downtime	time when the plant and/or equipment of the CMT operation is not in operation, due either to breakdown or normal maintenance shut down.
frother	chemical additive to the concentrating process that causes production of a froth to separate mineral particles
geomembrane	impermeable sheet used in geotechnical applications
hydrocyclones	equipment used for separation of size fractions of crushed ore utilising centrifugal force
lugeon	unit of water pressure testing and grouting of foundations
phreatic surface	the upper surface of the saturated groundwater zone
spigotting	the operation of discharging tailings in a way to separate coarse particles
stope	an underground excavation resulting from the removal of ore
subaerial	tailings discharge to beaches exposed to the atmosphere
subaqueous	tailings discharge beneath water to prevent exposure to the atmosphere
sublevel	intermediate level in a stoping operation between main access levels
subvertical	approximately vertical (geology) shaft between to points underground (mining)
underflow	the thickened portion of solids discharged from a thickener
victaulic	a proprietary, quick release pipe jointing system

3.0 INTRODUCTION

3.1 Corporate Information

Copper Mines of Tasmania Pty Ltd (CMT) is a subsidiary of Gold Mines of Australia Limited (GMA), an Australian owned company, listed on the Australian Stock Exchange.

GMA has emerged as a significant Australian mining company following its formation as a merger of Eastmet Ltd., Metana Minerals and Paragon Resources NL. with substantial assets, three operational mines and several active exploration projects.

Currently the three main operating assets of the group comprise the Youanmi Gold Mine, the Temora Gold Mine and the Reedy Gold Mine, all 100% owned by GMA and generating direct employment for over 400 people.

The Reedy Gold Mine is located 65 Km south west of Meekatharra in the Murchison Gold Field of Western Australia. The Mining tenements including and surrounding the Reedy Gold Mine total an area of more than 600 sq Km and cover those areas considered to be prospective for gold mineralisation within about 25 Km of the Reedy treatment plant. The mining tenements include the historic gold mining centres of Reedy, Burnakura, Federal City, Tuckanarra and Kohinoor. Mining at Reedy includes both open cut and underground operations

The mining tenements, including and surrounding the Youanmi Gold Mine cover approximately 722 sq. Km south west of Sandstone in the Murchison Gold Field of WA. Underground mining commenced at Youanmi in October 1994 following a history of open cut mining. Gold is now being produced utilising bacterial leach technology provided by the Western Australian company Bactech (Australia) Pty Ltd in which GMA has a share holding.

The Temora Gold Mine is located at Gidginbung Hill, 15 Km north of Temora in NSW. The Mining tenements in this area in which GMA has a direct interest or secondary involvement, cover an area of more than 1300 sq Km. All mining is by open cut operations in a single pit.

In addition to the above three main assets, the GMA Group is involved in various joint ventures around Australia.

GMA's issued capital comprises 343 million ordinary shares, with a market captalisation of over $100 Million. The Company had cash and bullion of A$ 61.7 million on hand at 31 December 1994.

GMA currently has 170,000 ounces covered under forward sales gold hedge contracts, which will realise an average price of A$ 596 per ounce when sold. This significantly reduces GMA's susceptibility to gold price fluctuations.

CMT has been formed following the signing of a Memorandum of Understanding with the Tasmanian Government committing GMA to expenditure of $5 million on a program of evaluation and detailed feasibility study into the viability of mining and ore processing at

Mount Lyell. CMT are currently evaluating the feasibility of the Mount Lyell project and obtaining the necessary approvals. Subject to proving project viability and being granted all necessary approvals the Company will be responsible for proceeding with development of the project.

The following are the corporate details for Copper Mines of Tasmania Pty Ltd

ACN Number	ACN 065 339 835
Registered Office	161 Great Eastern Highway,
Belmont, WA. 6104	
Administrative Office	Copper Mines of Tasmania
	PO Box 84,
	Queenstown, Tasmania, 7467
Telephone	(004) 711 666
Facsimile	(004) 711 916
Chairman	Mr M Block
Chief Executive Officer	Mr S Everett
Directors	Mr A Love
	Mr A Fletcher
	Mr A McLeod
Resident Mine Manager	Mr H Bohannan
Environmental Manager	Mrs I Stanley

3.2 Rationale for the Project

The Mount Lyell Mine at Queenstown in Western Tasmania is one of Australia's major mining projects with a long history of production. The mining leases covering the site, as shown in Figure 3.1, extend over a distance of about 7 Km north-south and 3 Km east-west, and are host to some twenty ore bodies, many of which have been mined over a long period of time, principally for copper. Gold and silver have also been very important products. In September 1986, Mount Lyell became one of the few base metals mines in Australia to have produced 100 million tonnes of ore. The mine is an operation of "world scale" significance.

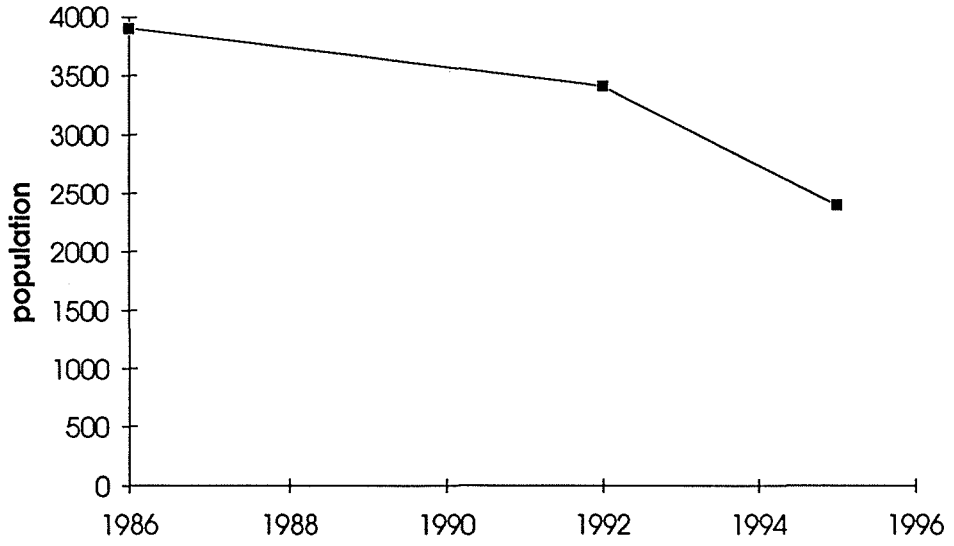
The district of Lyell was built up around mining with the Mount Lyell Mining and Railway Company being the financial life blood of the community for more than a century. The closure of the Mount Lyell Mining and Railway Company in 1994 resulted in a reduction of the local Queenstown population, as shown in Chart 3.1. The current unemployment rate of 18% is high, and is indicative of the trend towards reduced employment at the mine which has occurred over several years. This figure would be much higher if there was not a tendency for people to leave the area when there is no work. Indeed many of the population have historically been transient with employment at the mine being the main reason for living in the region. This transient group in the community also includes public servants (Police, teachers etc.) for whom Queenstown is, for many, no more than a temporary posting.

There is, however, a significant group in the community who are settled and consider Queenstown to be their home. It is this group of people for whom the future of mining operations would have far greater social and economic significance. Although tourism is an expanding industry in the town, it is not a significant employer and employment at the mine is still seen as being essential to the maintenance of a viable town with the current level of facilities.

Queenstown would remain as a community with the absence of a mining operation but the prosperity of the community would suffer greatly. It is the opinion of the Salvation Army (Pers. Comm.) that the cessation of mining operations in Queenstown would have devastating results on family life with major socio-economic problems and a large burden on welfare resources.

Reports from Queenstown residents suggest that the positive outlook provided by the future CMT operation is giving hope to the community with many people staying on in the town in the expectation of future employment opportunities. Not only will CMT's operation increase local employment but it will give the town a sense of direction and improve the economic outlook of the local area.

Chart 3.1 Queenstown Population 1986 - 1995



With the impending closure of the operations of Mount Lyell Mining & Railway Company (MLMRC) the Tasmanian Government formed the Mount Lyell Task Force charged to prepare for the withdrawal of MLMRC and to encourage the ongoing development of the site by other operators. Expressions of interest were sought from the mining industry.

On the 30 April 1994 Gold Mines of Australia Limited (GMA) submitted to the Tasmanian Government a detailed proposal involving the expenditure of $5 million over an 18 month period as part of a feasibility study of the Mount Lyell mining lease following the cessation of activities by MLMRC. The expenditure of this amount was dependant on:

- the granting of a 15 year mining lease;

- the operation being granted a Project of State Significance as described by the State Policies and Projects Act 1993; and
- indemnity from actions concerning pollution and land disturbance by the previous lease holders as ratified by the Tasmanian State Government via the CMT Act, 1994.

On 28 June 1994 a Memorandum of Understanding was signed with the Government based on the above parameters and a formal agreement was signed on 13 October 1994. This agreement was approved by Parliament during November 1994 and was ratified by the Governor in Council on 16 December 1994.

CMT believe that the mine can be operated profitably by taking advantage of current buoyant copper prices to justify capital expenditure to

- Modify the underground mining methods
- Modernise and expand the milling operation
- Significantly increase production rates to achieve economies of scale
- In the longer term, move towards on site processing

The results of CMT's recently completed project feasibility study indicate the potential to the 90 Series at the Prince Lyell orebody (900 m below surface level , or 600 m below sea level) for a total of over 25 million tonnes at an average grade of 1.3% Cu for a 0.75% Cu cut-off.

Drilling of the Western Tharsis is nearing completion and preliminary results indicate a significant resource.

Tables 3.1 and 3.2 highlight the surface and underground resources that CMT believe could be mined at Mount Lyell over the next century.

Table 3.1
Underground Resources

LOCATION	TONNAGE	GRADE(% Cu)
Prince Lyell	36,000,000	1.2
Western Tharsis	15,000,000	1.1

In addition to these resources there is potential for additional reserves to be added to Crown Lyell, Cape Horn and Royal Tharsis. Work undertaken by the previous operators will be confirmed and developed by CMT in their ongoing exploration program.

Table 3.2
Surface Resources

LOCATION	TONNAGE	GRADE (% Cu)
Royal Tharsis	1,000,000	1
Prince Lyell	85,000,000	0.9
West Lyell	354,000,000	0.54

CMT believe that the Prince Lyell and Western Tharsis deposits can be mined between the depths 600 metres and 900 metres below surface at production rates increasing from 2,000,000 to 3,500,000 tonnes per annum. This will allow an interim mine life of over 10 years, and provide sufficient time to develop additional mining areas.

Preliminary evaluations by Signet Engineering, an international engineering consultancy company, indicate that an underground mining operation concentrating on the Prince Lyell and Western Tharsis underground deposits would be economically viable. The initial study indicates that total expenditure of over $900,000,000 has the potential to produce some 400,000 tonnes of copper product and 500,000 ounces of gold over the initial 10 year period.

On the basis of the Signet Feasibility Study and the ore reserve drilling, the GMA Board of Directors gave approval in April 1995 for an expenditure program of about $50,000,000 to redevelop the Queenstown operation, subject to approval of an operating licence.

Work has since commenced on;
- refurbishment of the flotation plant
- upgrade of the shaft and underground crushing facilities

Work has continued on;
- development of the exploration decline to access the lower unmined area of the Prince Lyell deposit
- drilling of the Western Tharsis orebody
- the pipeline route to the Stage 1 tailings dam which was completed in July 1995

It is envisaged that commercial mining operations at Mount Lyell will recommence in November 1995. Re-commissioning of the treatment plant will take place in December 1995 and the first overseas shipment of concentrate will occur in the first quarter of 1996.

3.3 History of the Site

Mineralisation was discovered at Iron Blow at Mount Lyell in 1893 and at that time was viewed as a gold project. The Mount Lyell Mining and Railway Company Limited (MLMRC) was formed in 1893 and full scale production commenced in 1896. Since that time production has continued uninterrupted, until December 1994. In the 1890's apart

from MLMRC's operation, there existed some 42 other registered companies on the Mount Lyell mining field. However these companies were progressively acquired by MLMRC which finally obtained full control of the mineral field in 1933.

During the life of Mount Lyell, ore has been won from six principal areas as shown in Figure 3.2.

- The Blow - South Lyell;
- West Lyell including various Prince Lyell lodes, Royal Tharsis, A-Lens and Razorback;
- North Lyell including the North Lyell lodes, Crown Lyell lodes, 12 West and Lyell Tharsis;
- Cape Horn - a group of lodes, only one of which has been mined;
- Lyell Comstock - a group of four lodes; and
- The Lyell Blocks, Lyell Consols and King Lyell on the east side of the mining lease. These deposits host what are known as copper clays.

By far the greatest ore production has come from the Prince Lyell lodes mined in the West Lyell open pit. The down plunge extensions of these lodes below the floor of the open pit were mined in large open stopes up until December 1994.

3.4 Legislative Background

The operations of a mining company in Tasmania are required to conform with legislation under the following Acts:

Mining Act 1929
Mines Inspection Act 1968 and the
Mines Inspection Regulations, 1991
Dangerous Goods Act 1976
Environment Protection Act 1973
Industrial Safety and Welfare Act 1977
Aboriginal Relics Act 1975
Land Use Planning and Approvals Act 1993

and the Environmental Management and Pollution Control Act 1994 (EMAPCA) when it commences.

CMT will also be required to operate in accordance with the CMT Act, 1994.

A mining company is required to hold mining leases under the Mining Act. The Mount Lyell Mining and Railway Company Limited (MLMRC) held Mining Leases 30M/80 and 28M/83 over a combined area of 1,236 ha. These were conditionally surrendered on the 30 December 1994 and an application for transfer made by CMT. The leases 1M/95 and 2M/95 have subsequently been made to CMT to cover the mining area and an additional lease 5M/95 given to cover the tailings dam area as shown on Figure 3.1.

The Licence to Operate Scheduled Premises No. 3320, held by MLMRC under the Environment Protection Act 1973, has been transferred to CMT to allow the company to undertake limited activities on the lease until the finalisation of the approvals process

under the State Policies and Approvals Act. A copy of this licence is attached as Appendix B.

Specific licences required include:

Licence for lasers: Lasers will be used for aligning tunnels underground. No lasers are in use at present and their use is not anticipated until about November 1995 at which time an application for a licence shall be made.

Explosives Storage: Currently explosives are stored underground in an approved magazine. Once production has commenced, extra capacity will be required on surface. Explosives will be supplied by either ICI Explosives or Dyno Wesfarmers both of whom are international manufacturers and suppliers of explosives. The successful supplier will be making an application for the storage of explosives on the CMT lease. It is not expected that this application will be before November 1995.

Explosive Mixing: As with explosives storage on surface, explosive mixing will be the responsibility of the successful supplier who will make application in due course. Again it is not expected that this will be before November 1995.

Dangerous Goods Licence: Currently dangerous goods, such as diesel, are stored under the existing licence covering the site. A new licence will be applied for in the new year once CMT has started operation and established new storage facilities. Approval for the new storage premises will be sought concurrently. CMT will not be selling or giving away diesel and will not therefore be applying for a franchise license.

Sewage: Existing septic tanks and sewerage facilities are covered by ongoing licenses. However CMT is currently reviewing the sewage plan. It is expected that a significant upgrade of sewage facilities will commence in October 1995 which will require new septic tank permits for which application will be made to the local council at that time.

Use of Tip: A local contractor is used for collection and disposal of rubbish. It is not anticipated that CMT will apply for a licence to cart and dispose of rubbish.

Radiation Licence: Radioactive sources will be used in instrumentation for process control. The process control system is currently out for tender and as such the final requirement has not been established. It is anticipated that licence for the control of radioactive substance will be sought in September 1995.

Radio Communications: A radio system for communication around the leases and underground is currently being evaluated for installation in about November 1995. A license be sought at that time.

Electrical Contractor License: It will be desirable for CMT to have direct control of any electrical contractors working on the lease. An electrical contractor license will be sought from the HEC in August 1995.

Poisons Act 1971: Discussions are currently being held with the Queenstown Hospital with regard to First Aid facilities held on site. It may be that certain scheduled

substances need to be held on site, such as Entonox, in which case approvals shall be sought.

Concentrate Cartage: The cartage of concentrate from Queenstown to Burnie has been contracted to Emu Bay Railway. CMT will therefore not be applying for cartage or railway licenses.

Underground Equipment. All diesel equipment introduced underground must be approved by the Tasmania Development and Resources Mineral Resources Industry Services Division. Applications for such approvals are made fairly frequently directly to the Department.

Halon Extinguishers: There are currently existing Halon fire extinguishers on site. A survey of all fire extinguishers were recently carried out and a decision will be made on whether to keep the Halon extinguishers. A permit may be required if any are kept, after 31st December 1995.

Tailings Dam: A permit to construct dam structures is required from Tasmania Development & Resources. The Stage 1 dam has been approved and conditions of approval are being complied with. A report on construction will be submitted during August 1995. An application for approval of the Stage 2 dam will be submitted on completion of design.

3.5 CMT/GMA AGREEMENT WITH THE CROWN AND CMT ACT

CMT received approval from the Crown to commence feasibility studies in an Agreement with the Crown on 13 October 1994. This Agreement was enacted as part of the Copper Mines of Tasmania Pty. Ltd. Agreement Act, 1994.

The Act details the commitments of each of the parties in relation to development options, environmental responsibilities and indemnities and royalties. The CMT project was declared a "Project of State Significance" under the SPPA. Under this legislation, SDAC must undertake an assessment of the project and make the initial determinations on authorisations and any conditions attached to them. Ongoing authorisations (and conditions) will be issued by the body or bodies nominated by SDAC under the SPPA subject to the criteria in the CMT Act. The CMT Project referral to SDAC was tabled in the Tasmanian Parliament on 7 February 1995 and the Draft Guidelines for the CMT EMP were made public on 10 February 1995.

SDAC are currently undertaking their assessment and approval process under the SPPA (as varied by the CMT Act). Figure 3.4 provides an overview of the integrated assessment and project approval process.

The CMT Act does not provide CMT with an exemption from environmental regulation of its operations and it will not be implemented in that way. The Act recognises that Mount Lyell is a unique site and that a new operator should not be required to remediate 100 years of pre-existing contamination and pollution. The CMT Act indemnifies CMT for damages caused by contamination and pollution caused by any previous occupation or

use of the Leased Land. However, CMT operations will be subject to environmental regulation and BPEM. To ensure that CMT is not made indirectly liable for existing and ongoing pollution caused by previous occupation and use of the Leased Land, environmental standards which are set for the operation and BPEM must take this into account. The CMT Act refers to this as the "formulated position". The CMT indemnity and "formulated" position are intended to ensure that the CMT operation is subject to environmental regulation while also ensuring that the regulation does not result in retrospective responsibility for environmental damage not caused directly by CMT. SDAC will determine environmental standards and authorisation conditions for the CMT project that are specific to this unique site and related to CMT operations.

The role of this EMP is to provide a framework for BPEM of CMT operations on the Leased Land. The EMP will be reviewed in 12 months time in the context of the monitoring data available at that time, an operating mine, and the Tasmanian State Water Quality Policy. Within 2 years, the CMT Project will have a Programme of Environmental Works directed at improving the environmental management of CMT operations. CMT intends to immediately begin this process of enhanced environmental management which, in many instances, will eventually exceed the position outlined in the EMP.

The most significant environmental provisions in the CMT Act are as follows:

- CMT's operations must have regard to Best Practice Environmental Management achievable, having regard to pre-existing contamination and ongoing pollution caused by the previous occupation and use of the Leased Land as defined in the CMT Act.

- SDAC will formulate a position in respect to future environmental assessment criteria, environmental standards and requirements for operations on the Leased Land taking into account the effect of the previous occupation and use of the Leased Land as defined in the CMT Act.

- licence transfers, amendments and authorisations will be determined according to the CMT Act and SDAC requirements and standards determined under the CMT Act.

- dewatering of the Prince Lyell Mine may continue without further treatment or approvals until either, following consultation with the Crown, the mine is allowed to flood, the commencement of commercial production, or at the latest, 30 June 1996.

- in the event that commercial production is found to be viable CMT will develop a mining operation subject to the necessary authorisations.

- CMT to co-operate with local tourist initiatives where they do not conflict with CMT's operations.

- CMT to observe the heritage values of specific identified sites listed in Annexure B to the Agreement and consult with the Crown in the event of activities which may affect the sites.

- CMT to provide and environmental report to assist in understanding the impact of previous mining and other activities on the Leased Land and this report to be used in the development and approval of the EMP.

- CMT will improve environmental management at the site by:

    1. building a tailings dam to contain all solid effluent from CMT's operations,
    2. preparing an EMP for approval by SDAC and in accordance with SDAC guidelines,
    3. preparing, within two years of re-commencing mining operations, a Programme of Environmental Works, the content to be in agreement with the Director of Environmental Control.

3.6 Products

The initial stages of CMT's proposed operation at the site will be limited to production levels of 160,000 tonnes per annum of copper concentrate, comprising approximately 39,000 tonnes of copper, 800 tonnes of cobalt, 7.5 tonnes of silver and 0.8 tonne of gold. This will be shipped overseas for smelting. Concentrate production will commence at a rate of approximately 5400 tonnes per month and build up to full production of 13,000 tonnes per month over a period of around 3 years.

During MLMRC operation only around 60 % of total gold was recovered from the ore and no revenue was received for the cobalt. It is apparent that the improved recovery of gold, and particularly the recovery of cobalt, have the potential to improve mine cash flow. At current prices the in situ value of cobalt in Prince Lyell ore is worth 3.4 times the value of gold in the ore and 44% of the value of the copper content at a grade of 1.45%.

Mineralogical and metallurgical investigations will be necessary to demonstrate whether some or all of the minor metals can be recovered economically, by what process and at what capital and operating cost.

The Company also considers that there is potential for re-establishing downstream processing of the concentrate at the Mount Lyell site, but not for at least several years after recommissioning of the primary facility. Hydrometallurgical processes could be operated at small scale, but smelting would probably only be economic at an ore treatment rate of at least 3.5 mtpa.

CMT has examined five processes for on-site metal production:

The Cuprex process
The BHAS process
The Sirosmelt process
The Bio-Leach process
The Intec process

The viability of introducing on-site secondary processing at Mount Lyell will be the subject of a future feasibility study.

4.0 EXISTING ENVIRONMENT AND DEVELOPMENT DESCRIPTION

The following section describes the existing environment of the site and gives details of the proposed development. The text is complemented with maps, many of which are based on a GIS system, MapInfo, which has been developed by CMT to assist presentation of graphical information to SDAC.

Section 4.1 (I) of the CMT Act required CMT to commission an environmental report on the extent of the environmental impact of previous mining and other operations. This report, the Environmental Review by Gutteridge Haskins and Davey Pty Ltd (GHD), was submitted to the Department of Environment and Land Management in December 1994 and subsequently put on public display.

In describing the existing environment of the lease site reference has been made to the information presented in the Environmental Review. GHD found that mining activities over the past century have resulted in substantial modifications to the environmental conditions within and surrounding the leases now held by CMT. The primary environmental impacts noted relate to:

- significant changes to the landscape;
- severe depletion of natural vegetation cover;
- runoff characteristics, both quality, and quantity;
- external discharges including mine water and tailings;
- sediment deposition within the King River and Macquarie Harbour, and
- water quality of receiving waters.

Previous operations were noted by GHD to have substantially changed the physical characteristics of the landscape. Open-cut mining has left the leases with a number of deep pits including the Iron Blow, the first major open-cut, and the West Lyell, the largest and most recent open-cut. The final water level in these pits was noted be dependent upon future mining activities.

Overburden material from open cut excavations has been placed in waste rock dumps which have generally been located around the perimeter of the open-cut mines and preliminary indications are that these pyrite rich dumps will continue to generate acid drainage for the next 400 to 500 years.

GHD noted that loss of vegetation has occurred over a widespread area due to fires, both natural and as a result of clearing activities, mining and from sulphur dioxide generated by smelting. Since closure of the smelters in 1969 some regeneration has occurred. Without human intervention the landscape is believed likely to fully regenerate, although with a restricted number of species. Regeneration rates are expected to be faster to the west where the weathered rock profile is greatest and there is a young, poorly developed soil.

GHD noted that runoff from the site has changed dramatically since the commencement of mining. Peak intensities and the average annual runoff volumes have increased due to the limited vegetation, which has also resulted in an increased sediment load. Runoff

has also become more acidic and has higher metal loadings due to acid drainage from the pyrite rich waste rock dumps. It is only in recent years that the waste rock dumps have been designed to minimise acid drainage and rehabilitation trials have commenced. However, the impact of these advancements on acid drainage generation rates is at this stage negligible.

GHD suggested that revegetation would be environmentally beneficial for a number of reasons. Apart from the visual benefit, which many dispute, revegetation may decrease the volume of mine drainage, the intensity of runoff discharge and the sediment load to surface water bodies. Revegetation options involve either natural or human intervention processes.

GHD also noted other sources of acid drainage on the leased land as
- mine dewatering from the Prince Lyell Shaft,
- adit discharges, and
- groundwater discharge from flooded workings.

GHD show that the majority of acid drainage finds its way to Haulage Creek and into the Queen River. However some acid drainage water discharges into the Linda Creek and Comstock Creek catchments which ultimately drain to Lake Burbury. To minimise metals discharge into Lake Burbury, diversion works have been undertaken to divert acid drainage from these catchments to the East Queen River. These measures have been mostly successful with relatively low remaining acid drainage levels currently being discharged to Lake Burbury.

Water quality in the Queen River below the confluence with Haulage Creek, and subsequently the King River, is noted to be highly inhibitory to animal and plant life. The high concentrations of suspended solids and dissolved copper, aluminium, manganese, and iron in the river water render it an inhospitable environment for aquatic and riparian species. Water in the Linda and Comstock Creeks also carries high concentrations of copper, aluminium, manganese, zinc and iron and has a low pH and is also harmful to aquatic species.

GHD note that the most significant impact of the tailings has been on the Queen and King River downstream of the mine. During operations by MLMRC, the high solids content increased the turbidity of the streams and altered the colour until deposition at the Macquarie Harbour delta. Deposition of tailings has occurred along the King River downstream of the confluence with the Queen River where the flow velocity has decreased, and at the mouth of the King River where a delta of approximately 100,000,000 tonnes has been deposited. This delta is generally capped by a layer of oxidised tailings.

Material in the delta serves as a potentially leachable reservoir of copper, iron, manganese, aluminium and zinc, which is circulated around the harbour to varying degrees by the various currents. The impact of these metals (inorganic toxicants) and suspended solids on recreational and commercial fishing in the harbour is the subject of much research and debate.

Other environmental impacts reported by GHD have resulted from the disposal of solid and hazardous wastes, and spillage of hydrocarbons mainly around the mill area. These impacts, while significant, are considered to be minor in comparison with the environmental modifications described above.

GHD carried out a qualitative assessment of future environmental conditions for both the mine closure and continued mining options. Without tailings discharge, the acidity of the Queen and King Rivers was predicted to increase. This was believed likely to result in further mobilisation of metals which may have an adverse impact upon the Macquarie Harbour, particularly at the delta.

GHD predicted that acid drainage would continue to be generated on site independent of the future of mining operations and management practices adopted. They also suggested that cessation or alteration of operations at Mount Lyell may result in uncontrolled events. For example, rising water levels in inadequately sealed adits and old workings may breach the seals and cause damage to nearby structures such as roads or buildings. This effect may be possible in the Iron Blow area, which was the focus of workings by many prospectors and small mining companies in the late nineteenth century.

Other future environmental issues identified by GHD relate to:

- development and revegetation in Aboriginal site areas;
- maintenance of historical infrastructure;
- management of solid and hazardous wastes;
- management of contaminated sites; and
- occupational health and safety constraints.

These issues have been taken up in this EMP and are discussed in detail in the following sections.

4.1 SITE/LOCALITY DESCRIPTION

The Mount Lyell Mine is located immediately north of the town of Queenstown, approximately 40 Km inland from the west coast of Tasmania as shown on Figure 3.1.

4.1.1 Mining Lease Area

The three mining leases are held by CMT to cover their areas of interest. These are shown on Figure 4.1. The mineralised area is covered by leases 1M/95 and 2M/95, totalling some 12.36 sq. Km, whilst the tailings disposal area is covered by lease 5M/95 of some 11 sq. Km.

CMT have also taken out exploration leases (EL's) over 40 sq. Km. within the vicinity of the mine as shown on Figure 4.1.

4.1.2 Surrounding Land Tenure

The land tenure for the area surrounding the leases is shown in Figure 4.2

The mining leases cover areas of mainly Crown Reserve but some small areas are within the Queenstown town boundary. Various other reserves within the area include the Queenstown Aerodrome, Botanical Gardens Reserve near 5M/95 and gravel and water catchment reserves.

The Queenstown Aerodrome has a single runway running ENE and WSW, suitable for light planes. The land is maintained by the West Coast Council on behalf of the Civil Aviation Authority.

The Hydro Electric Commission has tenure over Lake Burbury, to the east of the leases, and the area to the west of the Lake south to the Darwin Dam.

Small pockets of private freehold land exist outside the Queenstown town boundary mainly along the main road access routes.

4.1.3 Land Zoning

A planning scheme for the Queenstown area is under development by the West Coast Council but is not yet available. The West Coast Council has been actively consulted regarding future developments for the mine site.

4.1.4 Conservation and Scientific Value Areas

The lease area and much of the surrounding land surface has been severely impacted by mining, firewood collection, bushfires and exploration activity and as a result, many of the natural conservation values have been depleted. Colour aerial photos of the lease and surrounding areas provide visual evidence of the impact of the above activities as shown in Plate 1

Downstream from the proposed tailings dam site there is a Botanical Garden Reserve of 57 Acres. This area is held by the West Coast Council on a 99 year lease due for expiry in 2002. From historical records this was set up at the request of the people of Queenstown as a protected area due to the bushfire devastation of much of the surrounding countryside as described in a transcript of the original letter requesting gazetting of the reserve presented on Figure 4.3. The area has been burnt since its original gazetting and, as will be discussed later in this document, apart from one exception does not appear to contain flora of any particular conservation significance and features a range of introduced weeds. The exception is a sedge (*Carex polyantha*) which is widespread in Tasmania but is classified as rare, being known from less than twenty 10 x 10 Km^2 areas.

Whilst originally intended to be used for public recreation, the tracks to the area have not been maintained and access is currently quite difficult. The area also has a historic association with mining, with numerous tramways crossing the area as part of early

timber gathering operations to fire the MLMRC smelter. Several small gold mines were located in the vicinity of the Reserve area. The Reserve features three attractive water falls depicted in Plates 12, 13 and 14. The Reserve will be regarded as an area to be conserved as part of the management procedures adopted by CMT.

The area proposed for flooding by the tailings dam is largely moorland and scrub. A rare endemic species *Centrolepis paludicola* has been identified beside four wheel drive tracks in the area but the majority of the identified sites are not in areas to be flooded during the current mine plan. The existing specimens near work sites are being protected as described later.

4.1.5 Archaeological and Aboriginal Sites & Relics

Several archaeological surveys have been carried out in and around the lease areas.

Keith Corbett, of the Geological Survey of Tasmania, wrote a brief paper in 1980, on a number of Aboriginal sites he recorded around Queenstown during geological mapping. It is not a comprehensive survey, but records 30 sites around the East and West Queen Rivers, and around the Reservoir and Conglomerate Creeks.

Jim Stockton produced a PhD thesis in 1982 entitled "The Prehistoric Geography of North West Tasmania", for which he surveyed two sample quadrants and one transect near Queenstown for Aboriginal sites, amongst other areas of north west Tasmania. He recorded a total of 18 Aboriginal sites.

Both Corbett and Stockton remark on the tendency for Aboriginal sites to be located on flat hilltops and ridges, and also on the use of stone materials which are derived from river cobbles which are abundant in local rivers and creeks.

Stockton and Corbett were amongst the first people to record sites inland from the west coast, and the significance of the density of sites in this area is only beginning to be understood.

In 1993, Celmara Pocock undertook the first archaeological work for the Mount Lyell Mining and Railway Company's Revegetation Programme, in the form of a brief inspection of the 1992/93 revegetation area. She outlined two recommendations: firstly, that formal archaeological surveys be conducted before future revegetation takes place, and secondly, that a National Estate Grant be applied for to survey the whole of the mining lease.

In response to the first recommendation, a survey was carried out in July 1994 in the 1993/94 revegetation area, by Cathie Searle. This survey recorded a total of 10 sites in an area of approximately 15 ha, suggesting that this area was used on a regular basis by an established, local population. The locations of these sites are recorded on Figure 4.4 which has been made available under separate cover to SDAC due to the confidential nature of this information.

A survey of the tailings dam site was carried out in 1994 by Ms Cathie Searle (Searle, 1994). No sign of Aboriginal occupation was found at that site.

As will be described in Section 5, CMT will support a full survey of the whole of the leased land, with the co-operation of Government Agencies, and will develop a policy about Aboriginal sites and relics which will allow for proper respect and conservation.

4.1.6 Heritage and Historical Value Areas

Documentation of the heritage and historical aspects of the mine and surrounding areas has been undertaken by a number of authors and experts over recent years. These include Blainey (1993), Rae (1993) and Godden Mackay (1994)

Interest in mining in the Queenstown area developed with a visit by Charles Gould, the Government Geologist, in February 1862 to carry out a geological survey of the area. Although charged with the task of establishing the occurrence of gold in the area, Gould found only a few traces of copper, presumed to be in the vicinity of Mount Lyell (Blainey, 1993).

Between 1862 and the early 1880's, a number of attempts were made to prospect and mine gold in the Mount Lyell area, however all met with little success. It was not until 1883 that a significant discovery of gold ore was made at the "Iron Blow" outcrop by Bill and Mick McDonough and their partner Steve Karlson. The area was worked for both alluvial and hard rock gold by a number of prospectors until 1893 when extensive copper mineralisation was discovered in the Iron Blow deposit. The Mount Lyell Mining and Railway Company Limited was formed at this time to mine the deposit, which marked the commencement of large scale mining in the area.

At the turn of the century up to 42 companies were active in the area, however, the Mount Lyell Mining and Railway Company Limited became the sole survivor of that initial boom and continued to operate continuously in the area for over 100 years until closure of its operations in December 1994.

In the early years of mining, both surface and underground techniques were employed to win copper at a number of ore-bodies. These included the Comstock, Crown Lyell, Cape Horn, North Lyell and Lyell Tharsis deposits. However, by the early 1930's, the higher grade ore deposits (>1.5% Cu) were depleted and attention was directed to the larger lower grade deposits in the West Lyell area which were considered suitable for large scale open-cut mining methods. A schedule of historic mine development is presented in Table 4.1. The location of the historical mining areas is shown on Figure 3.2.

The West Lyell Open Cut commenced production in 1935, and produced around 57 million tonnes of ore at an average grade of 0.72% Cu by its closure in 1972. With the Open Cut increasing in depth, the West Lyell haulage tunnel was developed during the 1950's to expedite ore haulage to the mill. This tunnel, combined with the North Lyell haulage tunnel from the North and Crown Lyell workings at 11 Level, also provided underground drainage and a major link between the workings and processing.

Approximately 47 million tonnes of waste rock and overburden (rock and soil, with non commercial levels of mineral, removed from the open cut areas) were also produced from the Open Cut during this period, with overburden to ore ratio of 0.82:1. The waste

rock has been deposited in dumps across the leased area. Some of this material has copper content of marginal economic grade and could have future processing potential.

Table 4.2 details the production statistics for the West Lyell Open Cut during its lifetime.

After closure of the West Lyell Open Cut in 1972, operations were transferred underground to the principal ore-bodies of Prince Lyell, Royal Tharsis, Intermediate Lens and A Lens. Operations will continue in the Prince Lyell orebody which extends at depth below the southern end of the old West Lyell Open Cut.

Table 4.1
Extraction Dates for Mount Lyell Orebodies

DEPOSIT	EXTRACTION DATES	PRODUCTION (Million Tonnes)
Iron Blow	1894 - 1922	5.6
North Lyell	1896 -1972	4.6
Crown Lyell and Twelve West	1931 - 1942	
"	1953 - 1954	
"	1959 - 1978	
"	1980 - 1985	4.2
West Lyell Open-cut	1934 - 1978	58.3
Lyell Comstock	1913 - 1921	
"	1929 - 1959	1.3
Prince Lyell	1969 onwards	continuing
Razorback	1964 - 1969	0.2
Lyell Tharsis	1970 - 1977	1.5
Cape Horn	1969 - 1978	3.8
Royal Tharsis	1902 - 1905	
"	1930 - 1937	
"	1940 - 1959	
"	1964 - 1966	
"	1968	
"	1972 - 1974	
"	1976	
"	1981	
"	1992	1.6

Table 4.2
Production Statistics For The West Lyell Open Cut

Total Mined	Copper	Gold	Silver
158,311,985 tonnes	0.72%	0.25 g/tonne	1.66 g/tonne

Prior to the introduction of smelting at Mount Lyell, ore produced from the Mount Lyell field was exported overseas for processing (Blainey, 1978). In 1896 the development of

pyritic smelting at Mount Lyell enabled the ore to be processed on site. The process was dependent upon the sulphides present in massive pyrite ore for fuel. The heat generated by the sulphides combustion then sustained the smelting process. It was the first time the process was used anywhere in the world and greatly improved the viability of the operation by eliminating the requirement for carbonaceous fuels. The waste products of the smelting process were estimated at 200,000 tonnes per annum of sulphur dioxide (SO_2), and approximately 6 million tonnes of black siliceous slag which was deposited adjacent to the smelter operations in the Queen River valley, as shown on Figure 4.5. The slag contains little sulphur, is low in heavy metal concentration and believed resistant to leaching (GHD, 1994). Consequently it is not considered to pose any environmental hazard.

As pyrite grades began to decline, alternative fuel sources were used to supplement the pyritic process. Eventually pyrite was replaced by coal as the main source fuel for the smelters in approximately 1904. At the same time, copper grades also began to decline as high grade ore bodies were depleted, and in 1922, pre-concentration of ore using flotation technology became necessary to maintain the viability of the smelting operation. This combination of flotation and on site smelting were used at Mount Lyell for almost 50 years to treat the available ore. However, despite pre-concentration, the small scale of the Mount Lyell smelters and high maintenance costs led to decreasing efficiencies and in 1969 on-site smelting ceased in preference to producing a 26% copper concentrate for export to overseas smelters.

Consistent with the social and environmental standards at the time, tailings produced by the pre-concentration process were discharged to the Queen/King River system and eventually Macquarie Harbour. At this time it was also found that the tailings were able to mobilise the smelter slag and that too was discharged to the river system. A total of approximately 100 million tonnes were discharged from the site over a period of some 71 years.

One of the tasks devolved to the Mining Heritage Committee by the Mount Lyell Task Force was to prepare a brief for a heritage survey for the Mount Lyell site. The contract for the survey was won and undertaken by Godden-Mackay Pty Ltd which completed the work and submitted a detailed report dated May 1994.

The study listed items and areas on a scale of 1 to 5, with 5 being the highest priority in terms of overall cultural and heritage significance. A list of the items considered by Godden Mackay to be of the highest significance is set out in Table 4.3 with locations of these marked on Figure 4.5.

The recommendations contained within the Godden-Mackay report formed the basis of the Governments responsibilities in the preservation of the Heritage items.

Table 4.3
Site Items Areas Designated as of Very High Significance

Name	Area
Royal Tharsis Mine Open Cut, Shafts and Adits	West Lyell
Water Tank and Supply	Smelter
Lake Margaret Sub-Station	Administration
Stores (Foundry)	Railway
Western Services (Carpenters Shop)	Railway
Atlas Copco	Railway
General Office Building	Administration
Assay Office	Administration
North Lyell Headframe	Administration
North Lyell Tunnel Portal - 1928	Tunnel Yard
Iron Blow Open Cut	Iron Blow
West Lyell Open Cut	West Lyell

4.1.7 Topography and Drainage

The topography of the site is dominated by the north-south ridges of the West Coast Range with Mount Sedgwick, Mount Lyell and Mt Owen reaching 1275, 900 and 1146 m elevation respectively. The two major streams of the area, the Queen and King Rivers, have been forced to flow from north to south, flowing in to Macquarie Harbour. To the west of the Queen River the landform becomes an uplifted Tertiary peneplain, dissected by deep gorges and narrow valleys. One of these, the Princess Creek is the proposed site for the mines tailings dam. The topography and major catchment areas of the site are shown in Figure 4.6. Detailed topography of the lease areas showing major modifications is shown on Figure 4.7

Within mining lease 1M/95 Philosophers Ridge divides the watershed of upper Queen River catchment from the tributary streams that flow east into Lake Burbury. The ridge line at approximately 480m links Mount Owen with the Cape Horn Spur and Mount Lyell. The watershed to the north of the lease area is less well defined with drainage from the heavily vegetated Comstock Valley reporting to Lake Burbury and to the west drainage reporting to the East Queen River. The Queen River joins the King River south of Lynchford and drains to Macquarie Harbour.

Significant changes to landforms have been brought about by the excavation of ore from surface deposits, by the deposition of waste rock, and by the construction of railway lines, roads, processing plants, office blocks, conveyor systems, dams and storage areas. The relatively steep slopes of up to 1 to 2 coupled with the significant surface and sub surface landform alterations over the past one hundred years have resulted in a severely disturbed landscape with past severe erosion and soil removal. This has exposed mineralised bedrock, allowing oxidation of sulphides and adding to acid drainage as discussed by GHD (GHD, 1994). Furthermore run-off of rainwater from bare areas has increased and has lead to an increase in short term flash flooding. The various open cut mine sites, and other disturbed areas collect rainwater and direct it

underground. Here it becomes contaminated thus adding to acid drainage flow from old workings and the Prince Lyell mine being developed by CMT. This aspect is discussed in detail in Section 4.1.17

4.1.8 Access and Transport Routes

Access and transport routes to and around the site are shown in Figures 4.8 and 4.9

Access to the site is via a road link from Hobart or Burnie or via the fishing and tourist port of Strahan. Historically, rail transport has played a significant part in bringing supplies and equipment to Queenstown and the mine. The road access to Hobart was only formed in 1932 and prior to that the rail link to Strahan provided the main access to the mine. A road link to Strahan was built in 1937 and a connecting road link to the Emu Bay Railway at Zeehan was completed 1941.

Access to the mine site is restricted by a security gate and fencing. Public access to parts of the lease are permitted in areas such as the Iron Blow viewing point. Fencing between the road near the top of Philosophers Ridge prevents further access where ground subsidence round the open cut are presents a hazard. Fences have also been constructed at a number of places along the main highway to Hobart out of Queenstown where vehicles might stop. Access by the general public to some restricted areas of the mine lease is possible via guided mine tours. A number of locations on the lease present hazards due to the presence of shafts and unstable ground and as a result access needs to be carefully controlled.

Materials and goods transported to the mine site arrive via road from either Burnie or Hobart. Some light urgent freight is delivered by the 3 times weekly light plane service from Hobart to Queenstown. Low cloud and severe weather occasionally limits access to the local airstrip and planes are diverted to Strahan.

Transport routes within the lease consist of underground access to the Prince Lyell orebody via the main decline. Ore and waste rock will be hoisted to the surface via the Prince Lyell Shaft following an upgrade of the hoisting and crushing facilities scheduled to be completed by October 1995. Until that time , all material is brought to the surface via the Main Decline. Waste rock will then be stored in a stockpile close to the Prince Lyell Shaft as described in Section 4.1.9.

Until the commissioning of the new FAG mill, ore will be transported from the Prince Lyell Shaft to the mill via a 1.2 Km overland conveyor system. After commissioning the first FAG mill, which will be located close to the shaft, the conveyor will be replaced by a slurry pipeline linking the shaft and the mill. Access roads are present on the surface to various parts of the lease area. Not all roads are used or maintained and access to some parts of the lease are possible only by high clearance four wheel drive vehicles or on foot. Many roads on the lease have been blocked to restrict access to sections where caving may occur such as to the west of the West Lyell open cut.

Copper concentrate produced at the mine site will be transported under contract to the Melba Flats siding for loading on to the Emu Bay Railway Co. rail system to Burnie as discussed later in the EMP in Section 4.3.5.

4.1.9 Location of Materials Storage Areas

Figure 4.10 shows the location of various proposed materials storage areas. These comprise ore stockpiles, concentrate stockpiles and raw materials used in the operation.

A short term 1000 tonne underground ore storage is located adjacent to the vertical lift shaft.

Until commissioning of the FAG mills, a short term ore stockpile of approximately 40,000 tonne capacity will be located adjacent to the Prince Lyell Headframe and will be utilised by CMT to provide a 24 hour buffer between the mine and the mill. A 300 tonne surge bin within the concentrator building provides the ore feed to the concentrator. Upon commissioning of the mill, a new stockpile system will be established adjacent to the shaft, also about 40,000 tonnes live capacity, but utilising mechanised plate feeders to feed the mill.

Concentrate from the filter plant is to be held under cover in a storage prior to loading on the semi-trailer for road transport off site. The storage shed has capacity for about 8,000 tonnes of concentrate.

Raw materials stockpiled and used on the site consist of lime, lubricants, explosives, maintenance materials etc, and storages of fuels, oils and flotation agents that are described in greater detail in other sections of this document.

4.1.10 Location of Waste Disposal Areas

Waste rock, comprising overburden and excavated material, generally with less than 0.5% copper content, has been removed from underground and deposited on the southern side of the slag dump by MLMRC during recent years. CMT will continue this practice initially before establishing a new waste rock dump close to the Prince Lyell Shaft. The existing dump on the slag heap will be closed off to a designed profile and compaction, so as to substantially reduce the pre-existing severe erosion and drainage problems. A proper drainage channel with suitable rip-rap is being constructed and a wet lands established to polish any remaining seepage.

Historically there are many waste rock dumps on the lease adjacent to each location where material has been removed from underground or surface excavations. The location of the main historical waste rock dumps on the MLMRC lease are also shown in Figure 4.11.

The waste rock can contain significant content of minerals including sulphides. These are prone to oxidation and the formation of acid drainage. The waste rock dumps are a significant source of acid drainage on the lease (GHD, 1994).

Slag derived from smelting operations on site was deposited over a wide area between the furnaces and the banks of the Queen River. The current partially revegetated stockpile of approximately 5 million tonnes represents only a portion of the total historical production of this material.

Solid waste disposal areas have been located at various sites and a hazardous waste disposal site was operated by MLMRC adjacent to the Prince Lyell Shaft. These areas are marked on Figure 4.12. The solid waste comprised general industrial waste of scrap metal, tyres, plastic, timber and also general wastes and putrescibles. The hazardous waste comprised mainly oil impregnated material with some asbestos and sulphuric acid, all in drums.

A new solid waste disposal site has been identified and is discussed later in this EMP.

4.1.11 Adits and Excavations from Historical Mining Activities

Figure 4.13 shows various historical pits, shaft and adits that are known to exist around the site. This does not claim to be a complete and accurate accounting of these features but represents the best available information.

4.1.12 Mine Site Geology and Characterisation of the Orebody

The Mount Lyell mining field is located at the southern end of the Mount Read Volcanic Sequence, which is a Cambrian belt of sedimentary and volcanic rocks lying in the Dundas Trough as shown in Figure 4.14. This belt is 20 to 30 Km wide over a North South strike of some 230 Km, and is bounded by two blocks of Proterozoic metasediments, the Tyennan Block and Rocky Cape Block. The nature of the belt dominates both the geology and the topography of western Tasmania. The belt is divided into two distinct stratigraphic zones by a number of major north- south striking faults, particularly the Henty Fault . North and west of this fault zone is the Central Volcanic Complex and overlying correlates (mainly andesites) of the Dundas Group. The massive sulphide deposits at Rosebery, Hercules, Mount Farrell, Que River and Hellyer are located within this group.

To the south and east of the fault zone the Mount Read Volcanics comprise a younger Central Volcanic Complex of mainly feldspar-rich rhyolitic volcanics, flanked by the volcano-sedimentary "Western Sequence". The Tyndall Group overlies both of these sequences and comprises quartz and feldspar-phyric lavas and pyroclastics. In the Mount Lyell area, the Mount Read Volcanic Sequence is bounded to the east by the Great Lyell Fault and is juxtaposed with the early Ordovician Owen Conglomerate as shown in Figure 4.15.

The highly siliceous Owen Conglomerate is unconformably overlain by the Ordovician Pioneer Beds, which also unconformably overlie both the Central Volcanic Complex and Tyndall Group volcanics to the west of the fault. The Pioneer Beds grade into the overlying Ordovician Gordon Limestone.

The Mount Lyell mining field occurs within the steeply dipping overturned limb of a large anticline to the west of the Great Lyell Fault. The mineralisation at Mount Lyell lies in an extensive zone of intense hydrothermal alteration which occurs over at least 8 Km of strike length within the mine sequence. The host rocks are volcanics, altered by low grade metamorphism, which is thought to have occurred contemporaneously with the

sulphide mineralisation. Alteration ranges from intense silicification to quartz-sericite and quartz-sericite-chlorite assemblages, commonly in association with carbonates.

Copper mineralisation is thought to have been related to exhalative and shallow hydrothermal deposition within the volcanic pile. Five main styles of mineralisation which have been recognised in the Mount Lyell Field are defined in Table 4.4.

Table 4.4
Ore Deposit Styles, Mineralogy and Occurrence

Type A	disseminated and stringer pyrite-chalcopyrite	Prince Lyell, A Lens, Royal Tharsis, Western Tharsis, Cape Horn
Type B	massive pyrite-chalcopyrite	The Blow, South Lyell
Type C	massive stratiform pyrite-galena-sphalerite-chalcopyrite	Comstock Open-Cut, Tasman
Type D	bornite-chalcopyrite	North Lyell, 12 West, Crown 3, Lyell Tharsis
Type E	copper clay native copper-cuprite-goethite	Lyell Blocks, Lyell Consols, King Lyell

The massive sulphide deposits (Types B and C) occur near the top of the mine sequence, and although largely recrystallised, preserve some indication of exhalative sea-floor origin. The larger volume but lower grade Type A deposits occur stratigraphically below the massive sulphide mineralisation and Type D ores. Type E ore occurs within the clay horizons of the Ordovician Gordon Limestone.

The economic copper resource depends on grade, mining and processing costs. The wide ore zone represented by the Prince Lyell 0.5% copper envelope can be resolved into four higher grade ore lenses. These lenses are called the North, South, North Footwall and South Footwall lenses within which there are high grade cores where a 1.5% copper cut off is applied. For each lens the high grade core and the main mineralised unit (MMU) have been modelled using a computer geological model. The lenses vary in length from 80 to 250 metres and in width from 10 to 70 metres.

These higher grade lenses have been the focus of recent mining operations in the 50 and 60 series of the Prince Lyell Mine.

Figure 4.16 shows a longitudinal section of the mine and the ore resource.

Exploration of the leases in the past, away from the known deposits, has been limited and there is good potential to locate new mineralisation in such a highly mineralised area.

4.1.13 Soils & Erosion

Soils on the mining lease are of a generally poor quality following the massive historical disturbances, bushfires and extensive sheet erosion. However there are no areas of the

leased land where the natural geology, geomorphology and soil type are particularly predisposed to erosion. All sites of current erosion are due to disturbance of the previously stable soil and vegetation regimes by past and current operations involved with use of the land. Much of the past disturbed area is now stable and slowly being rehabilitated naturally.

Temporary erosion problems of local scale exist in two distinctly different areas with the soil geology, historical usage and present engineering activities substantially different in each area. These are:

- Mining Leases 1M/95 and 2M/95 which cover the known mineralised area. Most of the original soil was eroded from this area during the period of pyritic smelting but soil and vegetation are slowly redeveloping. Residual pockets of original soil show a thin, skeletal, duplex soil type rich in rock fragments. The soil is physically stabilised by plant roots and thin peat and reflects the mineralogy of the underlying oxidised bedrock.

  Rock types and derived sub-soils at Mount Lyell consist of 60% felsic (aluminium silicate rich) volcanics, 20% mafic volcanics and 20% siliceous sediments. Most of the felsic volcanics are overprinted with a sericite-chlorite-pyrite alteration style which is a naturally occurring source of acidic drainage. This material lies in a broad band extending along Philosophers Ridge and covering most of the higher regions of lease 1M/95.

  Local erosion of sub-soil and decomposed rock occurs around the West Lyell open cut due to subsidence and related ground deformation, and at some waste rock stockpiles. This erosion mainly effects the internal areas of the open cut and does not contribute greatly to the silt load to streams leaving the site.

  Waste rock dumps have been a significant source of erosion products washed into waterways in the past with several examples over the lease where siltation from dump erosion has caused blockage of drainage culverts and damage to site roads. Run-off impact from future dumps will be minimised by a combination of better siting, classification and separation of material types within the dumps and design of dumps with particular consideration of surface drainage.

- Mining Lease 5M/95 which covers the Princess Creek tailings dam site. Here the geology consists entirely of sedimentary rocks composed of quartz, aluminium silicates and minor calcium carbonate. No major devegetation and soil erosion related to mining and smelting has occurred in this area. Consequently a complete cover of natural soils remains except in areas of current earthworks. This soil is also thin and rocky, predominantly a sub-soil overlain by a thin peat horizon.

  Soils developed on the Shale/siltstone units are podsolised, with a clayey horizon between the peat and decomposed bedrock. Soils are poorly developed and often absent on the sandstones. They consist mainly of leached, loosely bound fine quartz sand and silt.

Frequent summer bushfires expose the sandstone soils on the steeper slopes to minor erosion with widespread, short term charcoal and silt contamination of the creeks. The site is currently in this condition after a fire in January 1995.

Current earthworks are leading to some erosion during rain periods. The effect of this is being minimised as described above. All areas disturbed by current works will be rehabilitated on completion of construction operations.

Severe turbidity in streams from the lease during heavy rain is evidence of continuing widespread erosion. The steepness of the site and the large flow rates during rainfall make control of erosion extremely difficult using artificial means.

Revegetation of the site and fire control are seen as the only effective long term erosion control methods.

4.1.14 Flora

The historical impact of wild fires, sulphur dioxide emissions, land disturbance including overburden removal, and clearing and sluicing activities has created a major impact on the surrounding landscape and over a fifty year period removed much of the vegetation within the mining lease area and for an extensive region to the east of the smelter which has in turn led to impact on the local river systems with erosion, siltation and discharge of acidic, metal laden run-off water. Blainey (1993) indicated that 1 to 1.3 metres of topsoil in the upper reaches of the Linda Valley was sluiced away in the early search for gold. The high rainfall coupled with the lack of vegetation scoured much of the remaining topsoil into the fast flowing streams resulting in large areas of exposed rock that give the hills to the east of Queenstown their characteristic form and colour. Early photographs (Rae, 1993) of 1912 show that most of the vegetation on the hills behind the smelter had been destroyed, a few remaining tree skeletons and stumps were visible. Some of these stumps have remained and are able to provide a sheltered micro environment for seedlings as graphically illustrated in Plate 7.

Kirkpatrick (Ref Kirkpatrick, J.B. *Native Vegetation of the West Coast Region of Tasmania*, in Landscape and Man Royal Society of Tasmania, pp55-80 (1977)) has described the vegetation of the region in some detail. The previous extent and variety of the vegetation in the lease area can be extrapolated from historical photographs and comparisons with adjacent ridges that have escaped degradation.

The predominant vegetation features are the presence of dense temperate rainforest in the valleys and sheltered slopes of the mountain ranges with a deep humus rich soil. Species present include Acacia *melanoxylon* (blackwood), Nothofagus *cunninghamii* (myrtle), Athrotaxis *selaginoides* (King Billy pine), Eucryphiaceae *lucida* (leatherwood); and Athersperma *moschatum* (sassafras) and Lagarostrobos *franklinii* in the deeper soil along river gullies. Bordering areas contain Eucalyptus *obliqua* and on higher slopes above 600 m, and in more exposed areas with shallower soils, subalpine communities are present with Eucalyptus *nitida* (Smithton peppermint) growing to varying heights depending on the degree of exposure. Gymnoschoenus *sphaerocephalus* (buttongrass) is also present on flat or swampy areas over glacial till.

Vegetation has begun to re-establish over parts of the lease area in recent years. The extent of vegetative cover is shown in Figure 4.17.

Revegetation programs on sections of the MLMRC lease were undertaken as part of the requirements under the ER&MP section of the Continuation of Operations Act 1992. This program identified areas and tested methodology with the objective of developing specific revegetation techniques for the site using local species wherever possible. A program of soil testing was undertaken in 1994 on a 250m grid basis to determine the level of metal contamination either as a result of the deposition from smelter stack emissions or due to acid leaching. The survey collected soil samples and vegetation (where it existed), in the area between the mine infrastructure and the top of Philosophers Ridge, excluding the waste rock dumps, and the soil was tested for pH, macronutrients, including total nitrogen, total exchangeable bases, organic matter, soil depth, copper, zinc, magnesium, iron, aluminium and total sulphur.[Ref. Dawson, R. Personal Comm. Feb 1995] A series of trials were initiated to examine seed bed preparation methods and lime and nutrient applications as well as variations in establishment techniques and species. Plate 8 indicates the success of some of these trial areas.

The results of these trials show that:

i) both mechanical and minimum impact seedbed preparation and application methods are effective for some local colonising species,
ii) surface nutrient addition can improve growth rates but lime alone was not an effective treatment.

Sequences of aerial, as well as historical, photographs have been used to determine changes in vegetation as well as ground disturbances over a number of years on the lease. These have been summarised in the Gutteridge Haskins and Davey (GHD) Environmental Review of November 1994, in Section 5.6.2. The area impacted by smelter emissions extended well beyond the lease boundary over an area of approximately 45 square kilometres influenced by prevailing winds and topography. Approximately 12 square kilometres of this area was considered to have less than 1 percent vegetation cover.

Visual inspections on the western slopes of the lease area indicate the presence of isolated trees or small groups in the valleys where residual soil remains. The main natural recolonisers have been Restio *tet.*, Acacia *mucronata and A. melanoxylon*, and *Agrostis cappillaris.* Groups of Pinus radiata and black wattle - Acacia *mearnsii* - have been planted as trial plots in the late 1980's on the higher drainage valleys to Haulage Creek and sections of the slag dump. Soil collected from the area of Lake Burbury, now flooded, contained significant quantities of black wattle seed. Areas rehabilitated with this soil, such as that south of the hockey field, now feature prolific growth of black wattle.

Revegetation trials have been conducted on selected ridge crests where the ground has been less steep and rainfall scouring has been less severe.

The seed species utilised by MLMRC in the revegetation program is listed below in Table 4.5 with the quantity specified used over a restricted area of 250 ha.

Table 4.5
MLMRC revegetation seed mix

Species	Estimated Seed Required for 250 Ha
Acacia dealbata	10,300
Acacia melanoxylon	9,120
Acacia mucronata	25,010
Acacia verticillata	6,710
Blandfordia punicea	12,110
Diplarrena latifolia	6,670
Eucalyptus delegatensis	21,350
Eucalyptus nitida	32,670
Eucalyptus obliqua	21,350
Gahnia grandis	26,640
Gaultheria hispida	6,670
Leptospernum nitidum	1,570
Leptospernum scoparium	3,130
Leptospernum lanigerum	1,570
Leptospermum glaucescens	440
Melaleuca squamea	970
Melaleuca squarrosa	220
Telopea truncata	190

As the seed store indicates, the collection during 1993/94 programme concentrated on native tree and under storey species. These are fundamental to the succession processes of a native ecosystem restoration. The species collected also have a record of success in regeneration programs.

Some species, notably *Gahnia grandis and Gaultheria hispida,* have shown little or no regenerative capacity when their seed has been included in the broad scale seed mixes. Efforts in collection of these species have therefore been reduced (although not eliminated).

A botanical study of the Princess Creek tailings dam site has been carried out by Mr Andrew North (North, 1994). This work followed an earlier investigation to determine the botanical impacts of the area to be affected by the first stage tailings dam (North, 1994). It was reported that no species of conservation significance were recorded within the Stage 1 dam site, and that none of the plant communities described were of enough significance to find reason to oppose the proposal on botanical conservation grounds.

The vegetation of the dam site is typically scrubby moorland with patches of dense rainforest scrub where the topography offers some shelter from fire. The steeper valleys

downstream from the proposed dam site retain remnants of rainforest, although apart from some mature trees along the creek line, most is in the early post fire regeneration phase.

The area has had a history of disturbance from fire. Some areas are clearly burnt frequently. Only the more remote and isolated sites retain the less pyrogenic rainforest, and are not influenced by the cyclical fire patterns. Tree stumps of King Billy pine *(Athrotaxis sellaginoides)* near the proposed dam site give some indication of the nature of the vegetation prior to the current fire cycle phase.

The survey revealed a total of 134 plant species of which 17 are endemic to Tasmania. These consisted of 15 ferns, 38 monocotyledons, and 80 dicotyledons. A list of all plant species recorded is presented in Table 4.6

Only two species recorded are of conservation significance, *Centrolepis paludicola* and a sedge *(Carex polyantha).* This species was recorded along the banks of the Princess Creek between the upper and middle falls. Although widespread in Tasmania it is classified for its rare status (r2).

An unknown sedge *(Carex sp.)* was recorded on the old tramline close to the cutting. This species is not described in the Flora of Tasmania, and could not be matched to any plants held in the Tasmanian Herbarium (D. Morris pers. comm.). Due to the nature of the location, it is possibly an introduced species that currently is unrecorded for the state. Of the other Tasmanian endemics, all are widespread and common on the west coast.

Twenty plots were recorded, of which 17 were located within the main dam area.
They have been classified into five plant communities, mostly representing vegetation at different stages of succession from moorland to rainforest.

One week following the fieldwork undertaken for this project, most of the area of the dam site was burnt by bushfire. Changes to moorland and scrub communities is therefore likely with early successional species being favoured. The forest vegetation was apparently mostly unaffected by the fire.

The plant communities are described below:

COMMUNITY 1 - <u>Shrubby moorland</u>

Low conservation significance
Occupying the sloped ground, mainly characterised by patches of bare quartzite rock and gravels, the uneven topography and frequent fire regime has enabled this community to dominate much of the study area.

COMMUNITY 2 - <u>Twine rush moorland</u>

Low conservation significance
Occupying the valley floor where drainage is poor, slender twine rush *(Leptocarpis tenax)* dominates with a projected foliage cover of over 80 %. Buttongrass *(G. sphaceolata)* is a very small component in the vegetation.

Table 4.6

DICOTYLEDONS	
APIACEAE	
Actinotus bellidioides	
Hydrocotyle sibthorpioides	
e Oschatzia saxifraga	
ASTERACEAE	
Brachyscome spathulata	
Cassinia aculeata	
Craspedia glauca	
Gnaphalium sp.	
i Hypochaeris radicata	
Olearia floribunda	
Olearia peroonioides	
Olearia stellulata	
Ozothamnus rosmarinifolius	
CUNONIACEAE	
Bauera rubioides	
DILLENIACEAE	
Hibbertia prostrata	
DROSERACEAE	
Drosera auriculata	
Drosera binata	
EPACRIDACEAE	
Cyathodes juniperina	
Epacris impressa	
Epacris lanuginosa	
Epacris obtusifolia	
Monotoca glauca	
e Monotoca submutica var. submutica	
Sprengelia incarnata	1

Trochcarpa cunninghamii	
e Trochocarpa gunnii	
ERICACEAE	
e Gaultheria hispida	
ESCALLONIACEAE	
Anopterus glandulosus	
EUCRYPHIACEAE	
e Eucryphia lucida	
e Eucryphia milliganii	
FABACEAE	
Acacia melanoxylon	
Acacia mucronata	
i Cytiss scoparius	
Dillwynia glaberrima	
Oxylobium arborescens	
Pultenaea dentata	
FAGACEAE	
Nothofagus cunnighammii	
GOODENIACEAE	
Scaevola hookeri	
HALORAGACEAE	
Gonocarpus micranthus	
Gonocarpus tetragynus	
Myriophyllum amphibium	
LAMIACEAE	
Prunella vulgaris	
LOGANACEAE	
Mitrasacme pilosa	
MONIMIACEAE	
Atherosperma moschatum	
MYRTACEAE	
e Baeckea leptocaulis	
Leptospermum glaucescens	
Leptospermum lanigerum	
Leptospermum nitidum	
Leptospermum riparium	
Leptospermum scoparium	
Melaleuca squamea	
Melalueca squarrosa	
ONAGRACEAE	
Epilobium bilardierianum	
OXALLIDACEAE	
Oxallis magellanica	
PITTOSPORACEAE	
Billardiera longiflora	
Pittosporum bicolor	
POLYGALACEAE	
Comesperma retusum	
PROTEACEAE	
e Agastachys odorata	
Banksia marginata	
e Cenarrhenes nitida	

e Hakea epiglottis	
Telopaea truncata	
ROSACEAE	
i Rubus fruticosus	
RUBIACEAE	
Coprosma quadrifida	
RUTACEAE	
Boronia parviflora	
Eriostemon virgatus	
Phebalium squameum sub.squameum	
STYLIDIACEAE	
Stylidium graminifolium	
THYMELIACEAE	
Pimelea drupacea	
Pimelea linifolia ssp. linifolia	
VIOLACEAE	
Viola hederacea	
WINTERACEAE	
Tasmannia lanceolata	
MONOCOTYLEDONS	
CENTROLEPIDACEAE	
Centrolepis fascicularis	
e Centrolepis monogyna	
e Centrolepis paludicola	
CYPERACEAE	
Carex polyantha	
Eleocharis acuta	
Gahnia grandis	
Gymnoschoenus sphaceolata	
Isolepis cernua	
Lepidosperma filiforme	
Schoenus tenuissimus	
Tetraria capillaris	
IRIDACEAE	
Libertia pulchella	
Patersonia fragilis	
JUNCACEAE	
Juncus pallidus	
Juncus pauciflorus	
Juncus planifolius	
i Juncus squarrosus	
LILIACEAE	
Dianella tasmanica	
Drymophila cyanocarpa	
ORCHIDACEAE	
Thelymitra cyanea	
Thelymitra ixioides	
Thelymitra media	
Thelymitra megcalyptra	
POACEAE	
i Agrostis capillaris	

i Cortaderia richardii	
Danthonia laevis	
Danthonia penicillata	
e Ehrhata tasmanica	
Holcus lanatus	
RESTIONACEAE	
Calorophus elongatus	
Empodisma minus	
Leptocarpus tenax	
Lepyrodia tasmanica	
e Restio complanatus	
e Restio hookeri	
Restio tetraphyllus	
XYRIDACEAE	
e Xyris marginata	
e Xyris muelleri	
Xyris operculata	
GYMNOSPERMAE	
PHYLLOCLADACEAE	
Phyllocladus aspleniifolius	
PTERIDOPHYTA	
ASPIDIACEAE	
Polystichum proliferum	
BLECHNACEAE	
Blechnum fluviatale	
Blechnum minus	
Blechnum nudum	
Blechnum watsii	
DENNSTAEDTIACEAE	
Pteridium esculentum	
DICKSONIACEAE	
Dicksonia antarctica	
GLEICHENIACEAE	
Gleichenia dicarpa	
Gleichenia microphylla	
Sticherus tener	
HYMENOPHYLLACEAE	
Hymenophylum australe	
LYCOPODIACEAE	
Lycopodium laterale	
POLYPODACEAE	
Microsorum diversifolium	
SELAGINELLACEAE	
Selaginella uliginosa	
SCHIZAEACEAE	
Schizaea sp.	

COMMUNITY 3 - Riparian ferny sedge land

Unknown conservation significance
Occupying a river flat which periodically floods, near a track crossing of the upper reaches of Princess Creek, this site was the only location for a number of plant species recorded during the survey. It may have once been a wetland or sphagnum bog which has silted up. *Sphagnum* species are still present. As the vegetation type is widespread in the area, it is not unlikely that the pattern is repeated in other locations nearby.

COMMUNITY 4 -Tea tree/Sallow wattle closed scrub

Low conservation significance
Varying in canopy height between 4 and 10 metres, this community is in transition from moorland to rainforest. Species diversity varies from site to site, probably depending on frequency of fires and degree of isolation from more established forest.

Some plots retain a diversity of rainforest species. Much of this vegetation occupies slopes to the west of the dam site above the 250 m level.

COMMUNITY 5 - Nothofagus Cunninghamii callidendrous rainforest

Moderate - high conservation value
Occupying a small area close to the Princess Creek, below the first of three waterfalls, this community is protected against fire by steep slopes. Most of the trees are quite young, though there are some mature myrtles *(Nothofagus cunninghamii)* on the banks of the creek. It is likely that the vegetation has been mostly undisturbed since the cessation of mining early this century.

There are a number of sites along the four wheel drive track, that bisects the main dam site, where *Centrolepis paludicola* occurs. At all sites where species differentiation was made, the species is co-existing with the closely related *C. monogyza.* Many of the sites also feature a third species, *Centrolepis fasticulatus,* which can readily be distinguished in the field by distinct morphological characteristics. These locations are given in Figure 4.18.

Mr North reported that *C. paludicola* is reasonably well represented locally and there are good sized populations outside the area to be affected by the dam.

The riparian zone of Princess Creek is the site most weed infested, where the natural disturbances from periodic flooding favour their opportunist nature

Blackberries *(Rubus fruticosa)* and New Zealand toetoe *(Cortaderia richardii) in* particular, are established irregularly along the creek line. The site of the Princess Creek culvert, beneath the four wheel drive track, is notable for a number of weed species which would have been introduced with the fill that was put down here in the past. Species include toetoe *(C. richardii),* broom *(Cytisis scoparius),* flatweed *(Hypochaeris radicala), browntop (Agrostis capillaris),* Yorkshire fog *(Holcus latantus), and Juncus squarrosus.*

A weed control programme has been commenced at the tailings dam site to minimise potential for the spread of weeds during construction. A map of weed locations is presented in Figure 4.18. This will be used as a base for mapping weed control effectiveness over the future programme.

Most of the vegetation that occurs along the valley of Princess Creek proposed for the main tailings dam, is widespread in the area, and is made up of plant communities that are well represented statewide in the reserve system.

Some of the most significant vegetation recorded during the survey is located downstream of the proposed main dam site. This includes calidendrous rainforest - community 5, and the rare sedge *Carex polyantha.* These values in conjunction with the obvious aesthetic quality of the waterfalls and the historic and cultural values associated with the gold mine and tramway in the area, contribute to the significance of this Crown Land block. Mr North considered that the botanical values of the site would be threatened with change if there were to be a significant reduction to water flow rates through this section. He saw additional threats to the area caused by any major earthworks in the Botanical Garden Reserve. Consequently CMT do not intend to carry out any construction in the Reserve.

4.1.15 Fauna

Fauna numbers and diversity on the lease area has also been severely limited by the lack of vegetation cover, food and shelter. Introduced species including the European rabbit, feral cats and the black rat are present. Native animals including skinks, lizards, whip snakes, black jays, cockatoos, wombats and wallabies are becoming increasingly common as conditions on the lease improve. The rabbit population has at times had a significant impact on the revegetation trials and areas have needed to be fenced to prevent complete loss of transplanted trees and shrubs. The rabbits tend to shelter in and under loose rocks and in the waste rock dumps. Various control measures were trialed with only marginal success.

An overview of vertebrates likely to reside in the tailings dam area has been made by Mr Michael Driessen of Parks and Wildlife Service. The only rare or threatened species of vertebrates believed to have potential to occur in the study area are all birds, namely:

orange-bellied parrot, *Neophema chysogaster*
wedge tailed eagle, *Aqila audax fleayi*
swift parrot, *Lathamus discolor*, and
grey goshawk, *Accipiter novaehollandie*

Mr Driessen considered it unlikely that the conservation status of these species would be threatened by the proposed development.

A study of the cryptozoic freshwater invertebrates of the tailings dam area was carried out during November and December of 1994 by Associate Professor Allstair Richardson of the University of Tasmania (Richardson, 1994). Existing tracks were used as the basis of the sampling program. In order to put the fauna of the proposed development

into its local context, two sites were sampled in the catchment of Pearl Creek, just to the north of the Lyell Highway, adjacent to the site. Sampling sites were chosen to represent the range of vegetation types present in the area.

A total of 56 taxa were identified from the 10 Princess Creek sites and the 2 Pearl Creek sites. These included
Annelida: Oligochaeta (earthworms),
Mollusca: Gastropoda (native slugs) Cystopelta petterdi, (endodont snail)
Onychophora (velvet worms)
Diplopoda (millipedes)
Chilopoda (carnivorous centipedes)
Symphyla (millipede-like animals)
Aranea (spiders)
Opiliones (harvestmen)
Crustacea (landhoppers)

Two species of burrowing crayfish were found at the Princess Creek site. The commonest species was *Parastacoides tasmanicus tasmanicus*, which occurs in sedgeland, teatree swamps and along the edges of creeks. It was often absent, however, from cordrush flats. The other burrowing, crayfish was *Engaeus cisternarius*, which was found in gullies and under scrub or forest cover, where the soils were clayey.

Richardson reported that, in general, the fauna is what might be expected from a site on the west coast. Several expected species or groups are absent because their preferred habitat is missing, ie. large rotten logs. The fauna is undoubtedly a highly diminished subset of the original fauna of the site before European man arrived, when it would have supported the mosaic of rainforest and sedgelands typical of undisturbed parts of the west coast.

The cryptozoic invertebrate fauna of the Princess Creek catchment does not appear to differ significantly from that of Pearl Creek. A substantial proportion of the fauna is shared between the two.

The proposed tailings dam will force re-location of all the terrestrial invertebrates and burrowing crayfish within the inundated area but Richardson considered that this would not represent any significant loss of zoological value since:

- the area has already been highly degraded,
- no rare or endangered taxa were identified in the survey,
- the area does not differ substantially from the neighbouring catchment, and
- there is much comparable habitat, or habitat in better ecological condition, in the vicinity.

A survey of aquatic fauna of the Princess Creek has been carried out by Dr P Davies (Davies, 1995). No fish were found and Davies considered it unlikely that fish could survive in the creek as the presence of the highly polluted Queen River immediately downstream of the creek would act as an effective barrier to migration of fish. This migration would be required to complete their life cycles. Various invertebrates were found, including insects, crustaceans, snails, worms and nematodes. Fauna was found

to be similar to that recorded in other local streams and other streams of the central West Coast. None of the taxa identified are listed as rare, threatened or vulnerable.

Davies noted that the Princess Creek was one of only a few tributaries of the Queen River which have not been "massively disturbed" and it has been selected as one of three reference sites in the Queen River catchment, set up under the National River Health Program. However, Davies commented that the creek was significantly more disturbed than other catchments of similar size to the west and north west such as the Pearl Creek and Yolande River. The geology and geomorphology of the creek were not considered unusual and Davies concluded that the conservation values of the creek were moderate to low with only the relatively undisturbed nature of the catchment in the context of the overall Queen River being of note.

4.1.16 Meteorology

The lease area is situated at an altitude between approximately 170m and 750m above sea level and has a relatively high rainfall consistent with the exposure of the west coast of Tasmania to the influence of the 'Roaring Forties' wind pattern. Ground frosts and snowfalls are not uncommon in winter commensurate with a location at this altitude and the 40 Km distance from the west coast.

The following Table 4.7 gives the average monthly rainfall and temperature readings from information supplied by the Bureau of Meteorology for Queenstown. A rainfall intensity chart for the area is presented in Chart 4.1.

Table 4.7
Weather and Evaporation Data for Queenstown (Altitude 129m)

RAINFALL RESULTS FOR QUEENSTOWN FROM 1906 TO 1993 (mm)

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	mean total
MEAN	151.2	121.7	162.8	223.6	143.7	233.7	259.9	263.7	246.5	227.5	200.2	183.9	2517.1
MEDIAN	146	110.6	159.8	214.5	227.4	228.0	265.2	263.8	247.0	222.3	201.8	174.9	

AVERAGE MEAN DAILY TEMPERATURE FOR QUEENSTOWN FROM 1965 TO 1993 (o C)

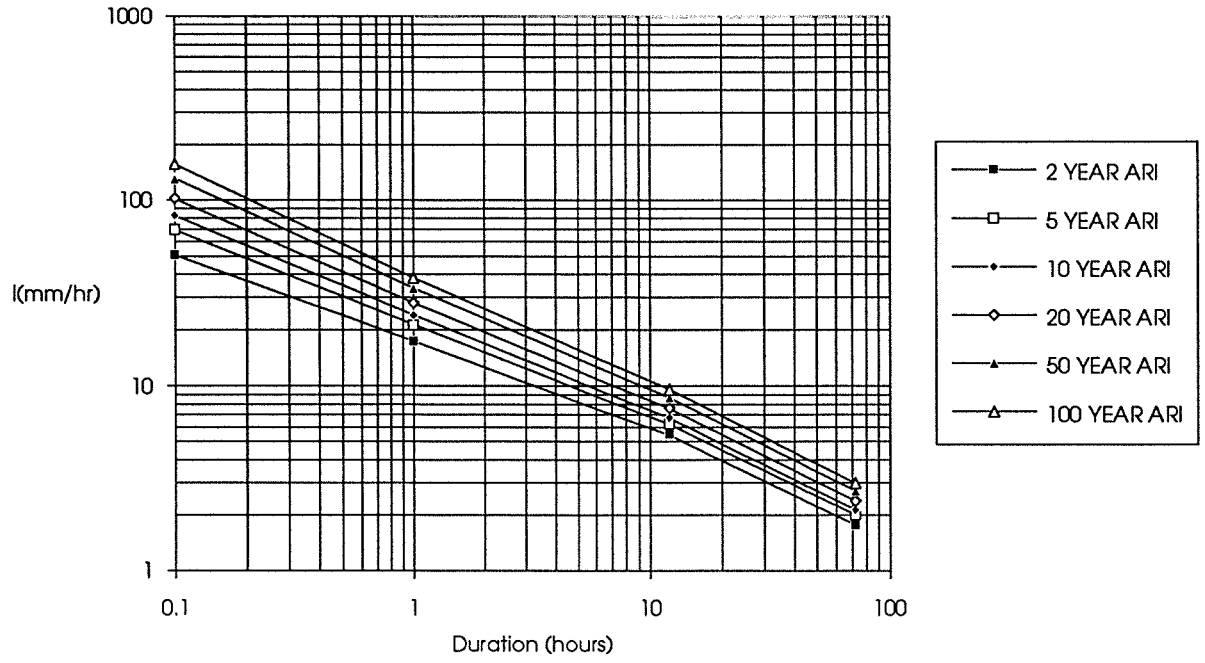
AV. MAX	21.1	22.0	19.1	16.6	14.5	12.3	11.6	12.5	13.6	15.9	17.6	19.3
AV. MIN.	8.3	8.5	7.7	6.4	4.4	2.6	2.3	3.1	4.2	5.0	6.4	7.8

MEAN DAILY PAN EVAPORATION FOR QUEENSTOWN (mm)

MEAN	3.5	3.5	2.3	1.3	0.9	0.8	0.7	1.1	1.4	2	2.7	3.1

There is a winter peak in rainfall readings and summer values in some years have been low. This has resulted in water shortages for the mine in the past and the necessity for the construction of holding dams and diversions near Lake Margaret and in the East and West Queen Rivers to provide adequate supplies of water for the mining operations and processing.

Chart 4.1 Rainfall Intensity Chart - Queenstown District
(from Australian Rainfall and Run-off)



note: I(mm/hr) denotes rainfall intensity

In addition a pipeline from Lake Margaret has been used in emergency conditions.

The main area of the lease is higher in elevation compared to the Queenstown weather monitoring site, is more exposed to the prevailing westerly winds, and would be expected to have a marginally higher rainfall and lower mean temperatures.

Evaporation rates are relatively low in comparison to the rainfall and water loss through evaporation is negligible.

4.1.17 Hydrology - surface and groundwater

The issue of hydrology and water quality is a crucial one for the future management of the site. The quality of the water coming off the lease is a direct result of past mining practices and impacts on the land from fire and timber harvesting. The CMT Act has specifically indemnified CMT from any responsibility for ongoing pollution caused by previous occupation or use of the leased land.

Consequently, in undertaking the integrated assessment of the CMT Project, SDAC, in setting the environmental objectives and conditions for the operation, must take into account the impact that existing polluted water will have on the operation of the mine. Studies (as discussed later) have shown that polluted water will continue to be generated from the leased land for hundreds of years.

4.1.17.1 Surface Waters

Limited long term stream flow information is available on the site streams with only three gauging sites covering the general area. These are located on the King River near Crotty (now defunct), the Queen River at Lynchford and on the Henty River at the Zeehan Road bridge. Data from these sites is summarised in Tables 4.8 and 4.9.

Table 4.8
Mean Stream Flow Data

Station	Period of record (yrs)	Catchment Area (Km^2)	Mean Flow cumecs	Mean Flow (L/sec/Km^2)	Average Rainfall	Average run off coeff.
King River at Crotty	67	449	32.93	73	3000	0.78
Henty at Zeehan Rd	29	116	9.282	80	3000	0.85
Queen River at Lynchford	8	52	5.418	104	3000 +	1.00 -

Table 4.9
Min / Max Stream Flow Data

Station	Max Flow ML/yr	Max Flow % Mean	Min Flow ML/yr	Min Flow % Mean	Max Flow cumecs	Max Flow % Mean	Min Flow cumecs	Min Flow % Mean
King River at Crotty	1527320	145%	586438	56%	1088	3300%	0.9	3%
Henty at Zeehan Rd	428800	136%	206900	66%	234.6	2530%	0.355	3.8%
Queen River at Lynchford					136.8	2530%	0.674	12.4%

A more detailed hydrological assessment has been carried out by the Hydro Electric Commission (HEC), to determine expected low flows and also flood flows to assist in the design of water management systems and dam spillways. This work utilised short term data from gauging sites on the Idaho and Comstock Creeks.

Of particular interest is the estimated 7 day minimum flows at 5.3 L/sec/Km^2 for a 2 year annual exceedance probability (AEP) to 2.5 L/sec/Km^2 for a 10 year AEP.

From both the above sources of information approximate flow parameters for the site streams has been developed, based on representative values as set out in Table 4.10.

Table 4.10
Regional Catchment Area - Proposed Typical Steam Flow Parameters

Average Rainfall	3000 mm / annum
Average Coeff Run off	0.9
Average Flow / Km^2	86 L/sec/Km^2
Maximum Annual Flow	140% mean
Minimum Annual Flow	60% mean
Maximum Flow (recorded)	2500% average
Minimum 7 day flow (2 yr AEP)	6% average
Minimum 7 day flow (10 yr AEP)	3% average

Approximate flow characteristics for the various catchments of interest have been evaluated using these Figures. The catchment areas are shown on Figure 4.19 and relevant flow predictions shown in Table 4.11.

4.1.17.2 Groundwater

Surface water hydrology is complicated somewhat due to discharges to surface watercourses from sub-surface flows from the following main discharge points:

- **North Lyell Tunnel** - drains water from the North Lyell, Cape Horn and Lyell Tharsis and the diverted Crown Lyell surface flow to Haulage Creek
- **West Lyell Tunnel** - drains inflow from the West Lyell open cut and upper levels of the Prince Lyell workings to Haulage Creek
- **Conveyor Tunnel** - drains mine water and settled solids pumped from the Level 17 Pump Station in the Prince Lyell workings. This includes introduced operational water as well as natural groundwater inflows. Drains to Haulage Creek.
- **Comstock Adit 7** - drains the lower levels of the Comstock Mine to Comstock Creek and Lake Burbury
- **Comstock Adit 5** - drains the upper levels of the Comstock Mine and open cut and flows via a diversion channel to the East Queen River

These areas are shown in Figure 4.7

Table 4.11.
Catchment Flow Estimates

Catchment No	Name	Area Km²	Average Flow ML/year	Max Year ML/year	Min Year ML/year	Min 7 day Flow AEP 10 yrs. L/sec
1	East Queen River	11.5	31050	43600	18700	29
2	West Queen River	10.9	29600	41400	17700	28
3	Haulage Creek	3.0	8140	11400	4880	8
4	Conglomerate Ck.	8.6	23300	32650	14000	22
5	Lower Queen River*	22.0	59700	83500	35800	57
	TOTAL QUEEN RIVER**	**56**	**151900**	**211491**	**90639**	**144**
6	Princess Creek Tailings Dam	10.4	28200	27972	16900	27
7	Upper Falls	0.38	1026	1436	616	0.75
8	Lower Falls	1.3	3510	4914	2106	3
9	Lower Princess	2	5400	7560	3240	5
	TOTAL PRINCESS CREEK	**14.12**	**38124**	**53374**	**22874**	**36**
10	Lyell Comstock Creek	18.6	50450	70600	30300	48
11	Idaho Creek	2.6	7050	9870	4200	607
12	White Creek	0.3	815	1140	490	0.75
13	Linda Creek above Idaho	2.0	542	7600	3250	5

*(above Princess, excluding catchments 1,2,3,4)

**(above Princess Creek)

To allow mining to proceed in the underground workings it is necessary to pump water from the lowest levels of the actively mined areas. CMT will achieve the necessary "mine dewatering" by continuing the operation of a major pump station on 17 level of the Prince Lyell Mine (220 m below sea level). Water collecting in lower levels will be pumped to 17 level prior to pumping to the surface.

Considerable work has been done to bring the pump and pipe system to a properly maintained condition and to properly assess the potential flow rates of mine dewatering from the 17 level pump station of the Prince Lyell Mine as this is the component for which CMT are required to take partial responsibility.

Recent work has comprised a detailed review of historical records and accurate measurement of flow using flow measuring weirs. A permanent flow monitoring system has been installed, with the assistance of HEC, which will automatically record mine dewatering flows. These will be reported monthly. HEC Enterprises Corporation have completed an initial hydrological analysis of this data which can be described in their Progress Report No. 1 (HEC, 1995).

The initial finding from flow monitoring has been that the MLMRC flow measuring equipment, previously relied on for "mine dewatering" flows, significantly underestimates

flow rates. Reported low flows of around 15 litres/second are likely to in fact be around 56 litres/second and average flows of 30 to 50 litres/second appear to be closer to 85 to 100 litres/second. This seems to correlate with other estimates of mine dewatering flow based on hydrological and theoretical pump performance calculations. Flow monitoring over April, May and June 1995 recorded an average discharge of 75 litres/second from the level 17 pump station, with a standard deviation of 14 litres/second. This includes a component of water introduced into the mine for operating procedures which would be expected to increase when full production is in progress.

Level 17 pump station mine water includes the component of "mud" which is currently lifted from the underground workings by a displacement system. During the year 1993/94 mud flow averaged 4 litres/second. This mud is discharged at the surface and becomes part of the overall "acid drainage" discharge.

Water pumped from the 17 level pump station includes;

a) Water falling as rain into the West Lyell Open Cut and the surrounding disturbed area, and being directed into the caved area of the Prince Lyell Mine. This water percolates through the mineralised rocks of the open cut and caved area and becomes rich in acid drainage contamination.
b) Ground water drawn from the surrounding country side. This water percolates through some mineralised areas but to a much lesser extent than a)
c) Process water pumped into the mine for use in mining operations such as drilling, wash down. This water is of reasonably good quality, being pumped from the upper reaches of the East Queen River. Typical process water usage is predicted to be around 18 litres/second at the start of production and likely to rise to 32 litres/second once full scale mining commences.

The HEC work has concluded that the proportion of ground water from remote areas is very small. Comparison of long term rainfall and total pump volumes suggest a contributing area of 55 to 65 Ha. This corresponds quite closely with the area of the West Lyell open cut and the cracked areas surrounding it. The HEC also found little correlation with rainfall in the short term and evidence that percolation of rainwater from the surface takes several weeks to reach the lower levels of the mine. However, recent monitoring of pump flows and water quality noted a particular correlation between mass flow of copper and heavy rain on 30th June 1995. It is likely that the correlation between rainfall and mine inflow is very complex and dependant on the degree of saturation of the cave area. Work is continuing to monitor inflows and determine the contribution from various sources, however the current best estimates of monthly mine dewatering flows from the 17 level pump station are still based on work by Signet Engineers, as presented in Table 4.12.

The cases shown include
Dewatered Mine - when no active mining is proceeding and no East Queen water is being introduced,
Operating Mine - when East Queen water is introduced

A diagrammatic representation of the mine dewatering flow contributions is presented in Figure 4.20

Table 4.12
Predicted Flow From Prince Lyell Mine Area

Dewatering Case	Outflow Point	Minimum Monthly Flow (L/s)	Average Monthly Flow (L/s)	Maximum Monthly Flow (L/s)
Dewatered Mine	17 Level Pump Station	22	57	170
Operating Mine	17 Level Pump Station	54	89	> 200

(based on Signet, 1995)

The effect of CMT's future mining operations at the Prince Lyell and Western Tharsis mines will be to remove further ore from levels below the previously mined areas. This will cause broken rock already in the caved areas to slump into the voids created and lead to further instability in the West Lyell open cut and surrounding area. Potentially this will increase the size of the catchment area collecting water and draining it to the mine.

Allowing for approximately 32 million tonnes of ore and waste rock to be mined over the next ten years the corresponding added volume to the surface depression is estimated at 10 million m^3 or approximately 20% of the current depression. Assuming the geometry of the surface remains relatively constant the area affected could increase by a similar figure. In reality the increase in catchment would tend to gradually increase to this figure over the operating period of the mine. However this effect would be offset by a set benefit at final closure, with much acid generating material pulled below the final water level as discussed by N.C. Clarke below.

The effect of mine closure on acid drainage is discussed later in section 4.1.18.

Groundwater conditions in the Princess Creek area have been reviewed by an experienced engineering geologist, Mr David Wilson of the HEC, to assess the potential for groundwater movement away from the site once tailings deposition commences. Results are described in the HECs "Princess Creek Tailings Dam - Geotechnical Report" (HEC, 1995) and discussed in a report on predicted dam seepage by Thompson & Brett Pty. Ltd. (T&B, 1995).

The groundwater table has been found to approximately mirror topographic features but less pronounced, with intersection of major streams. Thus the trend of groundwater flow is to follow surface drainage features.

There are several springs used by locals discharging at or near the foot of the hills immediately to the west of the town. The locations of a number of these has been established from local knowledge. Known springs are located at: Penghana (several hundred metres north of the Silver Hills Motel), one in Urquhart Street, and two in Henry Street. Locals report others in private property and several public springs are also located to the east of the town. The springs in Penghana and Henry Streets were located and examined. The Penghana spring appears possibly to be associated with Gordon Limestone which underlies the Siluro-Devonian sequence which in turn underlies

the tailings dam site (No. 1 and Main). However, the remainder of the springs are within the Silurian sandstones and not associated with limestone.

The Penghana site is considered by Wilson to be too far north to be affected by leachate from the tailings dam but the Urquhart / Henry Street sites are only 1 Km to the south east of the site. The possibility of leachate transmission to these latter sites will be difficult to preclude without further and more lengthy studies including the monitoring of groundwater in bores. Bores have been installed and a monitoring program set up as described in Section 5.

4.1.18 Water Quality and Acid Drainage

Water quality issues are, perhaps, the most critical issues facing CMT in its development of the Project and also the most difficult for SDAC to make its determinations on. SDAC has already advised CMT, on 10th March 1995, that the objective for the discharge from the Princess Creek Tailings Dam, the preferred dam site, should be to maintain water quality:

- "which will support a healthy (although not necessarily pristine) aquatic ecosystem" and
- "is aesthetically acceptable and suitable for secondary contact recreation"

In addition SDAC has advised that compliance with the ANZECC Guidelines for the protection of aquatic ecosystems should be adequate to achieve these objectives. However, the present water quality in the Princess Creek does not in itself satisfy these ANZECC Guidelines and it is considered that it will not be possible for the tailings dam discharge to meet these criteria. Furthermore there is considerable debate in scientific circles regarding the applicability of the ANZECC standards to Tasmanian waters which differ markedly from waters in other areas of Australia due to naturally low pH and high organic content.

The water quality typical of a pristine West Coast stream features low pH and a characteristic brown colour due to organic content. Water quality data from such a stream, the Murchison River (Koehnken, 1992), are listed in Table 4.13 and compared with Princess Creek, site of the proposed tailings dam.

Table 4.13
Water Quality
Murchison River and Princess Creek

Source	pH	Fe	Cu	Al	Zn	Mn	Hg	Pb	SO4
ANZECC (1992) Protection of aquatic ecosystems -Fresh Waters	6.5 -9.0	1	0.002 - 0.005	<0.005 (pH<6.5)	0.005 - 0.05		0.0001	0.001 - 0.005	-
Murchison River	5.5	0.2	0.0009	-	.03	<0.03	-	0.0047	<4
Princess Creek	4.4 - 7.2	0.24-0.6	0.007- 0.04	0.08- 28.0	<0.01	0.02- 0.03	<0.001	<.01	6-144

all values in ppm except pH

Even the relatively undisturbed Princess Creek shows signs of some influence from past mining, forestry and bushfire within the catchment, with elevated levels of iron, copper, manganese and sulphate compared to the Murchison.

However, the quality of the water run-off from the mine site lease area is far more strongly influenced by the following factors:

- the high rainfall on disturbed ground surfaces
- the lack of vegetation over significant areas of the lease
- the presence of sulphides in exposed soils and rock faces and in waste rock dumps, leading to the generation of acid drainage
- the discharge of contaminated water and sediment from underground as part of the mine dewatering.

The high rainfall on disturbed ground surfaces generates high peak flows resulting in erosion. The lack of vegetation prevents the normal retention of rainwater which evens out the peak flows. The presence of sulphides in waste rock, in broken ground and in underground workings exposed to air and moisture, leads to the generation of acid that leaches out metals.

The water quality of all streams flowing from the Mount Lyell lease has been monitored by MLMRC, and the Hydro Electric Commission since 1991. Monthly water quality monitoring has been carried out by CMT at selected sites since April 1995 with daily monitoring of Level 17 pump discharge from the Conveyor Tunnel over a similar period. The location of monitoring sites is shown on Figure 4.21.

A summary of median annual values from past testing is presented in Table 4.14 together with data from the CMT testing to date.

Clearly the streams originating on the lease area are highly contaminated and many would fail to meet the current Regulations of the EPA 1973 where these streams discharge beyond the Leased Land and constitute an effluent discharged from the premises. The contamination arises from acid drainage formed as described below. The acid drainage at Mount Lyell has been exacerbated by past mining practices.

Acid drainage is generated by the oxidation of the iron sulphide minerals pyrite and to a lesser extent other metal sulphides like chalcopyrite. During mining operations pyrite is exposed to air and water, and oxidises according to the following reactions (GHD, 1994):

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

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

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

The sulphide in the pyrite is oxidised to sulphate, releasing ferrous iron and acidity into the water. Subsequently, the dissolved ferrous iron undergoes oxidation to ferric iron, which then hydrolyses to form insoluble ferric hydroxide (ferrihydrite) releasing more acidity into the water.

Under abiotic conditions (without biological influence) the rate of reactions is controlled by the oxidation of ferrous iron. Below a pH of 5.5 the abiotic rate is negligible (half-life of many years). However, microbial catalysis by autotrophic iron bacteria such as *Thiobacillus ferroxidans* dramatically increases the rate of ferrous iron oxidation (GHD, 1994), and so acid waters with pH values of 2 to 3 can be rapidly produced. The common iron bacteria are microaerophiles, which need only low levels of oxygen to survive.

Table 4.14
Median Concentrations of Dissolved Species and Other Monitored Parameters

Station Ref. Fig. 4.21	Fe mg/L	Cu mg/L	Al mg/L	Zn mg/L	Mn mg/L	SO4 mg/L	pH	Cl mg/L	TDS mg/L	TSS mg/L	flow L/s
4	2.4	1.81	2.6	-	0.59	46	3.4	9	115	12	50
3a	5	0.86	2.1	1.8	1.2	43	3.5	10	80	16	406
3a (CCW)	**4.3**	**0.7**	**3.1**	**2.04**	**1.02**	**38**	**3.5**			**22**	**100**
5	800	71.5	490	6.4	40.7	5985	2.4	14	9460	12	54
5 (HCWL)	**680**	**90**	**360**	**7**	**34**	**5610**	**2.4**			**10**	**95**
6	227	7.6	61.5	53	36.75	1860	3.1	14	3210	64	4
7	294	49.3	62.5	4.8	21.2	1650	2.6	12	2810	12	56
8a	252	98.5	200	14.5	167	4120	2.9	13	7197	953	50
8a (CTW)	**802**	**265**	**38**	**30.5**	**340**	**9660**	**2.7**			**1061**	**75**
9a	440	90.9	211	8.4	88.4	3829	2.7	13	6075	350	227
10	0.17	0.04	0.55	0.01	0.05	315	9.1	59	696	314000	177
11	6	1.3	3.7	0.41	0.55	65	3.4	10	150	7	268
11 (EQWQ)	**8**	**1.3**	**4**	**0.39**	**0.43**	**65**	**3.2**			**12**	**399**
14	52	10.1	28	1.82	20.55	768	4.0	12	1320	8089	889
18	28	2.42	11.3	1.1	2.6	296	3.0	10	304	17	98.4
22	30	1.13	5.5	1.4	1.4	185	2.9	11	269	18	42
24	411	32.5	200	4.5	15.1	2170	2.5	9	4360	5	8
25	8	2.7	5.8	1.3	4.7	85	3.3	10	156	11	48
27	0.5	0.1	0.5	-	0.4	5	4.3	12	-	10	207
28[2]	1.1	0.44	0.8	0.1	0.6	20.5	4.7	11	71	308	52310
West Queen R.	0.3	0.04	0.5	-	0.04	4.5	5.6	11	43	1	10
QRQ	**51**	**20**	**36**	**2**	**20**	**740**	**3**			**66**	**1130**
PCDT	**0.43**	**<0.04**	**29**	**0.03**	**0.03**	**8**	**5.3**			**32**	**8**
HCCT	**60**	**4.25**	**120**	**4.5**	**25**	**2760**	**2.7**			**60**	**190**

bold figures are median of CMT results April, May and June 1995

Acid drainage has been a phenomenon of the area over geologic times as evidenced by the "copper clay" deposits on the site. These have been formed by neutralisation of acidic, copper laden drainage as it comes into contact with Gordon Limestone, with consequent precipitation of native copper. This process is believed to have been active since at least Tertiary times (about 1.8 million years ago).

The major sources of acid drainage on the lease are

- the waste rock dumps
- active mine dewatering
- groundwater from inactive mines, and
- run-off from exposed mineralised areas

These sources are shown diagrammatically in Figure 4.23.

Plates 5 and 6 depict acid drainage from inactive mine areas at Comstock and the North Lyell Tunnel, areas that will not currently be involved in CMT's operations.

The approximate contribution of acid drainage from the various areas of the site is summarised on Figure 4.22 in terms of mass loading of copper at median flows. This information has been derived from data in GHD, 1994, allowing for removal of tailings and adjusting the contribution from the 17 Level Pump station (Conveyor Tunnel) by a factor of 89/50 to allow for the higher actual pump output now believed appropriate. The figures derived are approximate, given the limited nature of available data, nevertheless they give some indication of the sources of acid drainage and show that the contribution to acid drainage from the Prince Lyell mine dewatering is not the only source of contamination.

Total estimated copper loadings leaving the lease are summarised in Table 4.15

The discrepancy between these figures highlights both the lack of reliable data, currently being rectified, and the variability of concentration of metals in the various streams. The mass flow calculations are very dependant on flow rate and reliable means of measuring flow are now being progressively introduced. The higher figures from recent monitoring may in fact be attributable to the effects of the recent extra ordinarily dry summer as discussed by N.C. Clarke below.

The current information can only be used to indicate that the total copper load leaving the lease is in the order of 2000 to 3000 Kg/day and the proportion from the level 17 pump station, representing predominantly water from the West Lyell Open Cut, is around 40 to 50%. Further long term monitoring will be necessary to get a more accurate picture of this situation.

Waste Rock Dumps

The Australian Nuclear Science and Technology Organisation (ANSTO) has been reviewing the nature of acid drainage generation from waste rock dumps on the site (ANSTO, 1994). This work has been based on monitoring of 9 boreholes in the main West Lyell waste rock dump and the flow of acid drainage from the dump. ANSTO conclude that:

- The majority of the dump has a high oxygen content
- There appear to be localised highly active acid drainage producing "pods" within the dump
- 13000 tonnes of SO_4 and 130 tonnes of Cu is generated from the dump annually
- acid drainage generation is predicted to continue at the current rate for up to 60 years or, more likely, taper off to a lower level after 20 years and continue for around 600 years

Two possible options for treatment were presented by ANSTO
i) treatment of the drainage water by chemical or biological methods,
ii) sealing of the dumps to prevent or minimise oxygen transport into the dumps.

Table 4.15
Estimated Total Copper Loads Leaving the Lease

a) from GHD summary of historical records

Station	No	Copper Loading Kg/day
East Queen	11	30
Lyell Comstock Ck	3a	175
Linda Creek	18	21
Haulage Creek above West Lyell tunnel	5	334
West Lyell Tunnel	6	3
North Lyell Tunnel	7	239
Conveyor Tunnel from 17 level pumps*	8a	760
Lower Haulage Creek	calculated from 9a-(8a+7+6+5)	447
Total Haulage Creek	9a	1783
Total		**2009**
% from 17 level pumps		**37%**

* calculated from GHD's 426 Kg/d times the ratio of current flow estimate of 89 L/s average compared to GHD's 50 L/s

b) from CMT monitoring April, May, June 1995

Station	No	Copper Loading Kg/day
East Queen	EQWQ	39
Lyell Comstock Ck	CCW	39
Linda Creek (use GHD)	18	21
Haulage Creek above West Lyell tunnel	HCWL	652
West Lyell and North Lyell Tunnel	HCCT-HCWL	328
Conveyor Tunnel from 17 level pumps	CTW	1537
Lower Haulage Creek	HCSD-CTW-HCCT	598
Total Haulage Creek	9a	1783
Total		**2886**

GHD (GHD, 1994) showed that one of the highest point sources of metal loadings into Haulage Creek was where it drains the West Lyell dumps (Station 5). It should be noted that some of the drainage from these dumps percolates downwards through joints and fractures in the bedrock, as well as through old mine adits, into the workings drained by the North Lyell and West Lyell tunnels, as well as into current mine workings and contaminates the general groundwater of the site.

Thus the metal loadings calculated by GHD probably underestimate the total loading derived from the waste dumps, part of which would report to the 17 level pump station within the mine.

Waste dumps from the Blow and West Lyell open-cut contribute acid drainage to the headwaters of Linda, White, Brown and Idaho Creeks. Metal loadings in these creeks are substantial (Stations 22, 24, and 25; Table 5.2), particularly in White Creek (Station 24), where the acid drainage from the Utah dumps enters at the head of the creek.

In an attempt to minimise the infiltration of water through the waste rock dumps, the surfaces of the larger dumps were levelled and topsoil from the King River valley was transported to the site and spread on the top. Growth of acacia species has occurred. However, there has been no significant reduction recorded in acid drainage from the base of the dumps as a result of the above procedure.

17 Level Pump Station

Water enters the current mine workings both by percolating down from the surface and as process water pumped into the mine from the East Queen River at Station 4. All rainwater that falls on the old West Lyell open-cut enters the Prince Lyell underground workings. As it seeps through the caved rock which separates the base of the open-cut from the active mine area it comes into contact with oxidised minerals and becomes contaminated.

Water accumulating in the actively mined areas is pumped to a treatment plant on the 18 Level. This comprises a system of settling tanks to separate solids from the water. An anionic flocculent is added to assist clarification. The clarified water is then pumped to a clear water dam at the same level from where it is drained to a pump station at 17 Level and pumped to the surface via the Conveyor Tunnel. The pump station features four Sultzer pumps with a theoretical combined capacity of around 600 L/sec. The settled solids are displaced to the Conveyor tunnel by water pressure using a purpose designed "mud displacement system".

Mine dewatering flow rates have been discussed previously in Section 4.1.17.

Mine water quality has been found to vary significantly. The results of several samples are presented in Table 4.16.

Table 4.16
Mine Water at Conveyor Tunnel
Water Quality (Total)

	SO4	Fe	Cu	Al	Mn	Ca	Mg	Cd	Co	Cl	Cond	pH	TSS
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L
1	4200	30	120	210	150	150	450			12		2.9	15000
2	1800	260	44									2.74	
3	8600	540	210	290	380							2.7	210
4	8200	10500	1400	2100	290							3.4	369000
5		470	130	160	170			0.05	3.4		5300	2.6	
6	5500	400	115	125	200					12	5200	2.6	90-220
7	4120	252	98.4	200	167					13		2.9	7187

1 - EGI 1993, includes sludge from mud displacement

2 - sampled 3/11/1994 from conveyor tunnel

3 - clear water dam 28/11/94
4 - mud pond 28/11/94 (estimated to be 6% of combined outflow)
5 - Signet Engineering , 1995
6 - Average 5 samples Feb 1995
7 - GHD, 1994, summary of Mount Lyell data

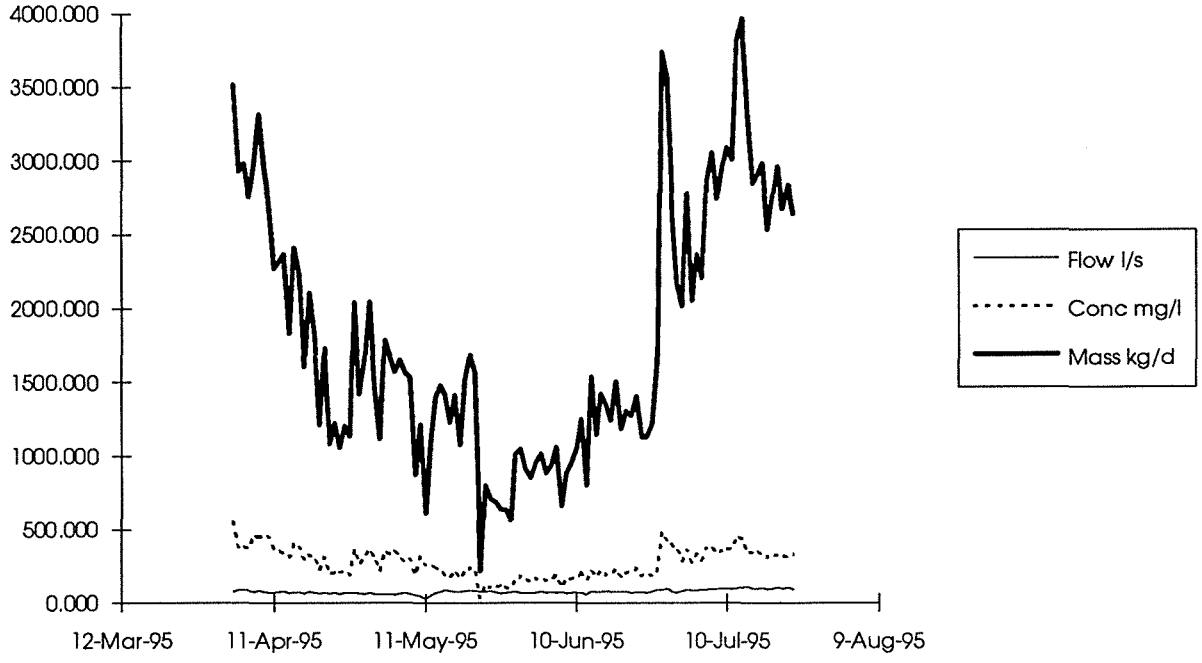
Daily Monitoring by CMT since April 1995 has shown an extreme variation in water quality from the pumps. Statistical information is presented in Table 4.17.

Table 4.17
Mine Water at Conveyor Tunnel
Water Quality (Filtered) from CMT Monitoring

	Flow l/s	pH	TSS	Fe	Mn	Zn	Cu	Cu mass kg/d	Pb	Al	Sulphate	Fluoride
average	75	2.66	1061	814	351	31.11	270	1801	<0.1	392	9493	45
mean	74	2.7	248	802	340	30.50	265	1537	<0.1	380	9660	44
sd	14	0.27	3125	238	116	8.48	102	875	<0.1	123	2578	11

The daily variability of these values is demonstrated in Chart 4.2.

Chart 4.2
Daily Variability of Flow and Copper Levels



The data has been discussed by Dr N C Clarke (Imtech, 1995) who suggests a close relationship between rainfall and mass loading. The high values in April occurred as rainfall increased following a prolonged dry period. Increased values in July followed an extremely heavy rainfall event on 30th June. Clarke suggests that oxidation is likely to

be greatest during dry periods with effluent concentration increasing as higher rainfall flushes oxidation products from the rock surfaces.

Clarke suggests that the limited data so far available from CMT's monitoring program is not yet as statistically valid as that reported by GHD (GHD, 1994) and that the mass loading estimates from that latter work are still the best estimate available.

Clarke also noted that difference between average dissolved copper concentrations measured before and after CMT's occupation of the site are not statistically significant and it is too early to make direct comparisons. CMT has not been involved in any works since taking over operation of the site that would be expected to significantly influence the acid drainage generation.

An immediate reduction in acid drainage and associated pollution will result from CMT's proposal to separate the "mud" from the 17 level discharge and put it through the mill. This allows extraction of economic metals and also removes a significant source of contamination from the remaining water. Sample 4 from Table 4.16 was taken from the mud settlement pond while Sample 3 from the clear water pond at the Level 17 pump station is likely to be most representative of the predicted water quality from dewatering of the mine once the mud is removed. A mass balance using these two samples suggests that the removal of the mud from the mine dewatering will immediately remove 99% of suspended solids, 47% of Fe, 25% of Cu and Al and a lesser amount of other components. The residue of the mud component after extraction of economic minerals would enter the tailings stream and be transported to the tailings dam. The solid component of the mud is estimated to be generated at an average rate of around 130 tonnes per day compared with the tailings production rate of 9600 t/day at full mill capacity.

GHD (GHD, 1994) predicted the effect of the cessation of mine dewatering on the acid drainage contribution from the Prince Lyell area. Flooding of the mine would take place to the level of the main decline portal at 11 Level, 200 metres above sea level. At this level the majority of the caved area of the Prince Lyell mine would be flooded and oxidation of sulphides in that area would be prevented. However, acid production would be expected to continue for many years due to dissolution of ferrihydrite. In addition, the majority of exposed sulphide material in the West Lyell open cut and the surrounding rock mass fractured by previous operations would remain above the water table as can be seen in Figure 4.20.

Clarke discusses this issue (Imtech 1995) and suggests that whilst it is virtually impossible to predict the effect of closure of the mine on acid drainage generation due to the many factors that influence bacterial oxidation. It is clear that acid drainage would not cease. On the other hand continued mining provides the opportunity to utilise the neutralising capacity of the tailings from the mill process to treat a large part of the acid drainage from the site. All of the mining proposed by CMT to date is below the water table. Continued caving may increase the area of fractured rock above the water table but this will be balanced by a downward movement of large volumes of the oxide rock currently above the water table which would be flooded if the mine were to close preventing the generation of acid in the future.

Under the CMT Act, CMT's liability for acid drainage is limited to that proportion resulting from their operations. The Company is indemnified from pollution resulting from past disturbance or occupation of the site. This indemnity includes acid drainage from the areas of the cave currently being dewatered. The acid drainage is generated due to exposure and fracture of the rock mass by previous occupiers.

Separation of this responsibility is very complex, however a method for assessing this has been developed by independent experts. Their report is attached as Appendix E.

CMT's future operation is likely to increase acid drainage in the cave as mining continues further underground. This increase in acid drainage will come from:

- increase in the area of catchment leading to additional water in flow
- increase in the extent of ground fracturing and exposure of fresh sulphides
- generation of acid drainage from operations involving introduction and use of surface water.

As discussed in Section 4.1.17 the first two items are estimated to marginally increase acid drainage during operations but this will be offset at final closure as described in this section. The third item is likely to be minimal as mining operations will take place in fresh areas of the mine and in rock whose sulphide content is predominantly chalcopyrite.

Acid Drainage from Abandoned Mines

The West Lyell tunnel collects surface seepage over a relatively limited area, which encompasses some of the West Lyell open-cut dumps, including the previous MLMRC garbage dump. The flow from this tunnel is relatively low, and the metal loadings relatively small (Station 6).

The North Lyell tunnel drains a larger area, also covered by some of the West Lyell open-cut dumps. However, it also receives, through a diversion, most of the surface drainage of the Crown Lyell - Lyell Tharsis and Cape Horn open-cuts. As a result drainage from the tunnel has high metal loading (GHD, 1994).

Underground drainage also occurs from adits along the east side of the Mount Lyell mine area. The Tharsis adit drains into Idaho Creek and has been closed with a concrete plug. The seal is not complete, and the adit continues to leak. The Iron Blow open-cut partially drains through an adit into Linda Creek. The total metal loads in Idaho Creek (Station 25) and in Linda Creek upstream of its junction with White Creek (Station 22) are relatively small compared to other sources, indicating that the underground drainage is contributing relatively little in the way of metal loading.

Comstock No 7 adit drains into Comstock Creek. Metal loadings in the creek are moderately high, particularly for zinc.

Water Quality in the Queen River

The prediction of water quality in the Queen River, following removal of tailings and water from dewatering of the Prince Lyell Mine is necessarily indicative only and is

presented as a guide to the potential short to medium term level of contamination. Essentially, the river will remain highly contaminated until the overall acid drainage situation is resolved.

Water quality in Queen River has been predicted by GHD (GHD, 1994) for the situation where tailings have been removed. The proportion of acid drainage contribution from the mine dewatering and other acid drainage sources was also predicted. This information can be combined to make a prediction of potential water quality in the Queen River at Queenstown following start up of the CMT operation as presented in Tables 4.19 and 4.20 These figures were adjusted from GHD work to allow for recent work showing higher mine dewatering flows, by factoring 17 level pump station flows by 178%.

Table 4.19

Mass Flow Components of acid drainage from Haulage Creek (Kg/day)

	Fe	Cu	Al	Zn	Mn	SO4	TDS	TSS
Haulage Creek	8630	1783	4183	165	1734	75078	119148	6885
17 level pump station	1940	758	1540	112	1280	31680	55260	6560
% mine dewatering of Haulage Ck*	23%	42%	37%	68%	75%	43%	46%	96%

all results kg/day

Table 4.20

Predicted Queen River Quality during CMT Operation

Based on Median Flows ex GHD except 17 level pump water

	Flow	Fe	Cu	Al	Zn	Mn	SO4	TDS	TSS	pH
Calculated ex tailings	712 L/s	114	24	55	2.3	23	999	1605	94	3.2
% mine dewatering	12%	23%	42%	37%	68%	75%	43%	46%	96%	
Predicted with mine water removed	623 L/s	88	16	35	1	6	570	870	4	<4

all results mg/L except L/s

These predictions have been based on GHD work as, as discussed in Section 4.1.18, this is believed to be the best long term statistical data.

These figures are presented as a guide to the level of contamination likely to persist in the Queen River for many years, but are not claimed as accurate, due to the lack of baseline data and the complexity of the physical and chemical processes involved.

Initial monitoring data available from DELM (King River-Macquarie Harbour Intensive Monitoring Program, unpublished results) covering the period 31 January to 22 February, 1995, gives average values for some quality parameters as shown in Table 4.21

Table 4.21
Queen River at Quality February 1995 Lynchford
Average mg/L

Fe	Cu	Al	Mn
15.6	11.9	24.2	16.7

These values are somewhat lower than those of the previous prediction. However, the latter figures result from sampling below the mouth of the Princess Creek and when the effect of dilution is taken into account the correlation is reasonable.

4.1.19 Visual Impact

Various views of the mine area are presented in Plates 2, 3 and 4, showing the current appearance of the Mill, the Prince Lyell Shaft area and the West Lyell open cut. Views of the Princess Creek Tailings Dam area are shown in Plates 9, 10 and 11.

An initial series of photographs of the site has been prepared as a basis for a photographic record of the site as described in Section 5.2.3.

CMT's activities over the next two years will create very few changes in the visual appearance of the main lease from off-site vantage points. The installation of a FAG mill near the Prince Lyell shaft and the possible removal of the overland conveyor will be the main changes.

Visual changes will occur at the tailings dam site as construction proceeds with the installation of diversion channels, dam embankments and access roads. These will initially be relatively visible in the mid to far distance from the Strahan Road due to the contrast between the currently blackened area from the recent fires and the exposed white quartzite rock. This contrast will diminish over the winter as vegetation re-establishes in the area. Clauses in the written contracts and personal contact with the operators have emphasised the need to keep disturbances to a minimum and rehabilitation of construction works will be carried out. Future changes will be the gradual development of a lake at the site as the dam level is raised. Beaches of tailings will be visible for part of the period between water level rises.

Revegetation of the mining lease would have the greatest influence on the visual impact of the site. Community attitudes to revegetation of the Mount Lyell site were canvassed in two reports, one by Hay (Hay 1994) and the other by Russell (Russell 1994)

In the recommendations contained within the Hay Report, commissioned by DELM, on community attitudes to revegetation, the following issues were highlighted,

- revegetation should not proceed without extensive consultation with the local community,
- consultation should be of a problem solving, rather than an investigatory nature,
- the consultation should be undertaken by a skilled third party not the Company,
- the legitimate cultural heritage of the bare hills should be acknowledged as a starting point,

- a ranking should be established of areas of greater and lesser importance and appropriate species rather than introduced species be encouraged in these areas,
- areas identified as of heritage, tourism, and firebreak importance should be devegetated manually as a trade-off for areas that are to be revegetated,
- there is strong opposition to the use of poisons to maintain the bare hills, but a recognition that manual clearance over a smaller area may be possible,
- a revegetation program should encourage the return of limited local forest cover
- the community is strongly opposed to the use of aerially applied fertiliser,
- local labour must be employed where at all possible,
- the elimination of rabbits should receive a higher priority,
- heritage assessment and community input should be included in any program of environmental works on the lease.

The report on landscape significance by Russell indicated that additional background studies were required to provide information on development sequences and cultural significance before the landscape significance could be assessed. A visual landscape analysis established that the previous MLMRC revegetation program, shown on Fig 4.24, did not affect the views to the "Gormy Hills" but would affect prominent views into the mine site from locations in and around Queenstown. A visual analysis to model landscape outcomes of revegetation options was proposed with the information used as an input to community discussion of options.

CMT does not have any immediate plans for revegetation and the issue will be canvassed with the community as outlined later in the EMP.

4.1.20 Other Operators on the Lease

As the CMT operational policy will be to utilise contractors for much of the operations of the mine there will be various independent operators on the leased land, utilising the facilities and infrastructure within the CMT operations. These operations will be required to comply with CMT's environmental policy and comply with the requirements outlined in the Environmental Handbook.

These operators currently include;

- Harback Earthmoving Pty Ltd, who operate a small conglomerate quarry behind the West Lyell open cut to produce crushed and screened material which historically has been sold both to the Mount Lyell operation and other users on the West Coast. Production is variable and dependent on local demand, but has amounted typically about 60,000 tonne per annum.

- Boral Concrete Pty Ltd, who operate a concrete batch plant located on the lease and who utilise several of the Mount Lyell operation sheds to keep their sands and gravel dry for concrete mixing. Concrete is supplied both to the local community and local industry and mines.

- West Coast Tours who provide guided bus tours and other tourism services. The tours include a bus route through the Lyell leases encompassing the Mill

Area, the mine tunnel yard area, the Prince Lyell shaft and the West Lyell open cut.

- Various local engineering companies who have been allowed to set up within various areas of the old Mount Lyell workshops including Setori Mechanical Services and TPW Electrical. These companies are all located in the area surrounding the warehouse, known as the CMT Industrial Estate.

Previous agreements with all of the above operators were generally informal. CMT has formalised agreements with these independent operators.

The licence currently issued to CMT by SDAC defines the "premises" as the boundary of the mining leases. Apart from the West Coast Tours, the above operations will be closed down or relocated to the area on the western edge of the lease as shown on Figure 3.2. This area, currently occupied by HEC buildings, private and government offices, private dwellings and the industrial area where buildings are owned by CMT but utilised by independent small businesses, will be marked out with surveyed permanent marker pegs to allow its excision from the "premises" for the purpose of the licence.

In addition to the above, various contractors and consultants involved with the development of the project, including National Mine Management, McCormick Civil Constructions, Stackpoole Drilling, Tasmanian Diamond Drilling, Direct Security, Thompson & Brett Pty Ltd and others, yet to be nominated, will be required to comply with CMT's environmental policy and meet the environmental standards set.

Contractual provisions relating to Contractors engaged on the site are discussed in Section 5.

4.2 PREPARATORY WORKS

4.2.1 Introduction

In order to meet the desired timetable of mine development, various works have been commenced. Some of these involve predominantly investigative works, essential for preliminary design and for the feasibility study, while others are works that are essential if the production start date is to be met.

The various items are discussed below;

4.2.2 Stage I Tailings Dam

The construction of an initial tailings storage, designed for zero discharge to Princess Creek, was commenced on 15th February 1995 with only essential earthworks being developed prior to overall project approval. The dam wall and associated roadworks were completed in July 1995 with only the pipeline route and site remediation remaining to be finished. This "Stage 1" dam comprises a small storage set up to cater for initial milling during late 1995 and early 1996, allowing time for detailed site investigations for the main dam to proceed during 1995 with construction of the main dam deferred until the summer of 1995/96.

The Stage 1 dam has been carefully designed to ensure zero discharge to the Princess Creek during its operating phase, in line with the perceived need for a conservative approach until a clearer picture of the potential water quality issues was determined.

A suitable site was identified at the northern end of the Princess Creek catchment, close to the airport, as shown in Fig 4.25. This proposal was described in detail (Thompson & Brett, 1994) in a DPEMP submitted to DELM in support of an application for a licence to operate the facility. This application was subsequently withdrawn when the CMT Act was amended allowing the company to proceed with preparatory works. A supplementary document (Thompson & Brett, 1995) provided further information sought by DELM on the project. Both these documents have been submitted to SDAC for its consideration but key points are summarised as follows.

The Stage 1 development comprises;

1 Construction of access and maintenance tracks for the site works and
2 Stage 1 Tailings Dam and appurtenant works
3 Access roads and survey tracks to and around the main dam site.

The Stage 1 Dam itself comprises a dam wall constructed across a narrow gorge on the upper reaches of Princess Creek approximately 1 kilometre south of the Queenstown aerodrome runway. The dam comprises an earth and rock fill structure 12 metres high and approximately 200 metres long. An auxiliary embankment approximately 4 metres high has been constructed at the eastern end of the storage.

The detailed justification for the dam site is discussed in section 4.3.4

Construction was undertaken in accordance with the DPEMP described above with strict compliance to environmental issues including;

- construction of silt traps
- flagging and avoidance of *Centrolepis paludicola* sites
- stockpiling and use of peat in rehabilitation

A report on environmental management during construction has been presented to SDAC (Thompson & Brett Pty. Ltd, 1995). Silt traps were effective in trapping silt from works areas and much of suspended solids noted in the Princess Creek during autumn and winter has been due to erosion of the fire effected areas of the valley and not associated with the dam construction.

4.2.3 Exploration Drilling

Contract exploration diamond drilling in the Prince Lyell and Western Tharsis deposits has been under way since July 1994 with a total of 13,000 m completed to July 1995. All drilling in the Prince Lyell deposit to date has been from underground drill pads with interception of the ore body between the 80 and 100 series (800 to 1000 m below ground level)

A geostatistical block model has been developed that estimates the quantity of ore in the 70, 80 and 90 series of the Prince Lyell deposit at over 35 million tonnes at a grade of 1.2% copper (using a 0.75% copper cut-of).

A similar geostatistical block model is now being prepared for the Western Tharsis ore body.

4.2.4 Decline Extensions

Contractors, National Mine Management, have been engaged to extend the access decline by 800m from -300RL (300 m below sea level) down to -400RL (400 m below sea level). A further 2,500m of level development at -300RL, -320RL and -340RL will also be provided to access the ore deposit. Construction will be in the hanging wall section of stable rock to the north of the Prince Lyell orebody to avoid possible future problems that might arise as a result of caving. To July 1995 the decline had been extended 460m to a depth of -345mRL and 1100m of tunnel had been completed.

4.2.5 Ore and Waste Rock Storage

Waste rock from the development above is trucked to the surface and from there the rock is transported to the waste rock dump at the end of the slag dump. Layers of waste rock are interspersed with layers of lime residue to minimise and neutralise acid drainage generated through air and water percolation. A detailed close out plan for this rock dump has been completed and forwarded to SDAC (Thompson & Brett, 1995). Further discussion of this dump is found at Section 5.2.9.2.

The location of these areas is shown on Figure 4.11

A surface ore stockpile will be located immediately adjacent to the shaft to allow balancing of feed to the FAG Mill.

4.2.6 Infrastructure

Preliminary works relating to the mine infrastructure comprise Care and Maintenance of the existing plant. This involves lubrication of equipment and short term running of parts that would be subject to deterioration if kept static. This applies particularly to the ball mills and the underground crusher which need to be turned over on a regular basis to avoid distress of bearings.

The underground infrastructure is being kept operational to allow current underground drilling and decline works to proceed. Items such as the shaft hoisting systems, ventilation systems and pump station are being operated on a regular basis.

Work has recommenced on repairing and upgrading of the crushing and flotation plant in anticipation of start up before the end of 1995. Work has focussed on repairing heavily corroded areas and safety matters as well as bringing standards up to current ergonomic requirements.

4.3 DEVELOPMENT DESCRIPTION & PRODUCTION PROCESSES

The format of this section has departed from the EMP guidelines provided by SDAC in an attempt to provide a logical flow of description of the operations from the mining through processing to waste disposal and product shipment. It is considered that all areas requiring description have been addressed.

4.3.1 Introduction

The initial focus of CMT's mining operation at Queenstown will be the Prince Lyell underground orebody below the level recently mined by MLMRC. Establishing an underground mine at Western Tharsis is CMT's second priority to be followed by a thorough assessment of the open cut potential at West Lyell.

CMT propose to introduce a sub-level caving method of mining to achieve a lower unit cost of production. The mining operations will be conducted by a contractor, with CMT providing overall supervision.

A plan of the overall operation is shown on Fig 4.25 highlighting the location of the mine area, the mill site, water sources and the tailings disposal site. More detailed plans and details of individual aspects of the operation are presented in context with descriptions following in this section of the EMP.

4.3.2 MINING OPERATIONS

4.3.2.1 General

A cross section of the proposed mining operation at Prince Lyell Mine is shown in Figure 4.26. At the present time the Prince decline access is being extended from the base of the 60 series workings to the base of the 70 series workings. This decline will serve the dual purpose of giving access to the orebody on the 320 and 340 levels for trial stope mining and metallurgical testwork as well as providing an exploration drilling platform on the 400 level (bottom of the 70 series) that is to be used for exploration drilling of the 100 and 110 series.

Development of the 70 series decline is scheduled for completion in September 1995, at which time trial stoping of the Prince orebody, utilising sub level stope mining techniques will commence on the 300, 320 and 340 levels. Production rates will increase from 100 tonnes per day to 3,000 tonnes per day between October 1995 and September 1996. Mining rates will eventually peak at 10,000 tonnes per day by the third year of operations with production from both the Prince Lyell and Western Tharsis orebodies.

In order to increase mine production levels from the previous historical level of 1.7mtpa to CMT's optimum throughput of 3.5 mtpa, a number of upgrades to the existing underground infrastructure are required. These can be summarised as follows:

i) upgrade of the shaft hoisting system by replacing the existing cage with a skip, which will be used in conjunction with the existing two skips.

ii) modify existing underground crushers by installing a fine material bypass prior to the primary crusher.

iii) either sink an extension of the Prince Lyell shaft from its present depth of 600 metres, to a new depth of 900 metres at the base of the 90 series or sink a new sub-vertical shaft close to the bottom of the existing shaft.

iv) install new pumping and crushing facilities at the base of the 90 series when the shaft sink has been completed.

v) extend the Prince decline from the base of the 70 series to the base of the 90 series.

vi) develop an access drive to the Western Tharsis deposit in order that mining can commence in 1997.

Sub-level caving has been selected as the preferred mining method for the re-opening of the mining operations. For the development of the sub-level caving method, the existing system utilising 100 metre mining levels will be changed to incorporate levels of 20 metres apart for the purpose of developing the orebody for extraction.

In the sublevel caving method of mining, development activities are commenced on the highest level to allow the progressive recovery of the ore from the highest to the lowest level. Ore is drawn from the highest operating level until such time as the caving waste material from higher up in the structure reduces grades to a predetermined cut off grade. Ore recovery activities then move to the next lowest level in the sequence. Further down the structure the levels are sequentially being developed, drilled and blasted in preparation for the ore recovery phase. A diagram of the method is presented in Figure 4.27

The sub-level caving method of mining to be introduced at Queenstown is expected to realise the following benefits:

- the top down mining sequence will allow minimal development time to achieve ore production at relatively low capital cost;
- high flexibility, allowing scaling up of the operation, and minimising exposure to a single critical path;
- a high degree of mechanisation and hence productivity to support lower unit operating costs; and
- better control of the stress environment which will maximise ore recovery and eliminate the need to leave pillars in situ.

Primary access will be by decline with cross-cut development from the decline to the level drives. Ore drives will then be established from the level drive. Additional stability will be provided by the use of non ferrous ground support such as fibre bolts and polymer mesh to minimise ore handling and crushing problems.

Ore drives are proposed on 14m centres, laid out in a longitudinal arrangement (ie. drives sub-perpendicular to the strike of the rock strata). Level spacing is also proposed at 20m intervals from floor to floor. This geometry, which will be verified by draw point modelling, offers a high stoping to development tonnage ratio and remains within the limits of current long hole drilling technology.

Long hole drill rigs will drill fans of up-holes 2.5m apart, inclined forward at 75° along the ore drives. Holes will be 89 mm diameter and between 15m and 35m in length. All holes will be double primed and charged with pumpable, water resistant explosive. One fan of holes will be fired in each blast and extraction will continue until the ore grade reaches cut off. A high level of draw point supervision is required to ensure that the broken ore is drawn down in sequence, and that excessive mineralised waste does not enter the draw points prior to the achievement of maximum ore recovery. Ore loading from the draw points will be achieved by 8 yard LHD loaders stockpiling and/or loading directly into trucks for haulage to the 240RL crusher station.

Preliminary economic evaluations have shown that it will be necessary to increase production levels above those achieved by MLMRC in order to gain sufficient economies of scale to enable the mine to remain profitable at low copper prices. It is envisaged that mining production rates of 1.5 mtpa will be achieved in 1996/1997, building up to 3.5 mtpa within 3 years.

Table 4.22 summarises the planned production levels over the next decade.

Table 4.22
Planned Production
1996-2004

MINING AREA	1996 (000,000t)	1997 (000,000t)	1998 (000,000t)	1999-2004 (000,000t)
Prince Lyell	1.5	2.5	2.5	2.5
Western Tharsis	-	-	1.0	1.0
TOTAL	1.5	2.5	3.5	3.5

4.3.2.2 Mine Access

Personnel and mine material access will be achieved via the Main Decline. This 5.5 x 4.7 metre decline extends from the surface at a gradient of ±l in 8 to the base of the 60 series at the -300m RL (300 m below sea level). Access to the Western Tharsis resource, when the operation is established, will be via the existing 14 level and a new 17 level access drive.

The Prince Lyell shaft is an existing 7.6 metre diameter concrete lined shaft which provides ore hoisting facilities from the 18 level in addition to providing a second means of personnel and material access via the 2.5 x 5.8 metre main cage.

The shaft is serviced by two 2,050 kW winders operating independently. There is potential to increase the shaft's capacity by introducing an extra skip replacing the man cage. The existing hoisting cycle and skip capacities will be capable of hoisting in excess of 2.3 mtpa. This facility, under CMT's proposed redevelopment program, will be upgraded to handle production up to 3.5 mtpa.

4.3.2.3 Mine Ventilation

The primary mine ventilation is an exhaust system drawing approximately 400 cubic metres per second of air. The main ventilation circuit relies on the exhaust of mine air via the Southern Exhaust Airway and the bratticed section of the Prince Lyell Shaft. Fresh air is drawn into the mine via the main decline and Prince Lyell Shaft.

The Southern Exhaust Airway located in relatively close proximity to the caved area as shown on Figure 4.26, is in a poor state of repair and is considered likely to be short circuiting air. It is proposed, therefore, to refurbish the shaft from +10RL to the -320RL level and recondition the existing fans.

Once the south exhaust is refurbished, the bratticed exhaust compartment on the Prince Lyell Shaft can revert to an intake airway which will significantly improve the intake air capabilities and possibly the corrosive environment in the shaft itself. This upgraded ventilation network will be more efficient to operate and will provide all regions with the required volumes of air. The upgraded network will result in a reduction in ventilation pressure drop across each region being mined, hence the main access and the drives

will be ventilated by the main circuit thus minimising auxiliary ventilation requirements. Level drives will be connected by a series of raises to effect adequate ventilation.

4.3.2.4 Mine Dewatering

Mine dewatering is of major importance due to the high annual rainfall averaging over 2,500 mm and the existence of the caved region of the mine. Mine water is directed to the main pumping station located between 17 and 18 levels.

Acidic water (pH 2 - 3) is pumped from the mine 24 hours per day. The design capacity of the station is about 600 litres/second to allow for high rainfall incidents. There are four pumps, with one standby, each rated at 750 kW, to pump clean water to the surface. On average 1 to 2 pumps are operational at any one time to pump water to the surface. The existing system could be automated to overcome operational difficulties.

Water from the 17 level pump station will continue to be pumped to the surface via the conveyor tunnel to a neutralisation system involving mixing with tailings prior to discharge. The number of pumps operated will depend on the inflow rate to the mine and the rate of use of fresh water for mining activities. Solids from the mine water treatment plant will be passed to the mill for treatment with the ore.

Under the CMT Act, CMT is responsible for treatment of discharges that are related to its new operations. A portion of the mine water that discharges from the conveyor tunnel is influenced by CMT activities such as underground decline development work, but much of the current drainage and adverse water quality results from pre-existing occupation and previous use of the leased land.

Estimates of pumped water flow from the mine have been revised following the installation of a measurement weir that specifically determines only the pumped mine water flow. The results show that previous estimates of volume discharges from this source were significantly underestimated. Yearly average flow rates are now estimated at close to 90 L/sec, with flows following periods of heavy rainfall of 196 L per second or greater over short periods.

Samples of pumped mine drainage water were collected on a daily basis over a 7 day time period and analysed for total and soluble components as well as pH, conductivity and trace constituents by ICP/MS techniques. The results of the analyses of these samples are shown in Table 4.23.

Since April 1995, daily samples from the Conveyor Tunnel discharge point of the 17 level Pump station have been analysed. A statistical summary of these results has been presented in Table 4.14 and the variation in daily levels has been demonstrated in Chart 4.2.

Table 4.23
Total and Filtered Mine Water Discharge Analysis Results
Results expressed as mg/L - except pH, Flow (L per second) and Conductivity (uS/cm)

Sample date	18-Feb-95		19-Feb-95		20-Feb-95		21-Feb-95		24-Feb-95	
Sample	**Total**	**Filtrate**	**Total**	**Filtrate**	**Total**	**Filtrate**	**Total**	**Filtrate**	**Total**	**Filtrate**
Flow	109		109		109		109		100	
pH	2.6		2.6		2.6		2.7		2.8	
Conductivity	5300		5200		5200		5200		5000	
TSS	220		170		120		140		90	
Iron	370	250	400	350	400	360	420	380	410	380
Manganese	200	200	190	190	190	190	200	200	200	200
Copper	119	118	110	112	114	112	114	114	117	115
Zinc	17	17	16	16	16	16	16	16	17	16
Lead	0.12	0.01	0.13	0.11	0.15	0.13	0.12	0.09	0.11	0.09
Aluminium	130	130	120	120	130	130	120	120	120	125
Sulphate		5000		5500		5000		5500		5500
Chloride	12		11		12		11		12	

4.3.2.5 Prince Lyell Shaft

MLMRC hoisted some 1.7 mtpa of crushed ore up the Prince Lyell Shaft utilising a twin skip automated system. The second winder was used to hoist men and materials.

CMT is proposing to upgrade the capacity of the existing ore skips from 9.8 tonnes to 14 tonnes. In addition it is proposed to convert the existing man riding/materials hoist to a rock hoist in order to achieve a total shaft capacity of 3.5 mtpa.

4.3.2.6 Underground Mine Development

Currently all mine access drives, crosscuts and the decline are positioned in the hanging wall with recent development now extending below the 60 series.

The main decline will initially be extended from its current position at 7,655m N, 3,415m E, 307m RL to the exploration drive at -400 RL. The ultimate positioning of the decline is to be determined by further analysis, taking into account the need to have it as permanent access and not subjected to deterioration by caving operations with the current dimensions of 5.5m x 5.0m being maintained.

In order to accelerate the initial development of the 70 series of stope blocks, the mining contractor has commenced the development of 800 metres of primary decline (between -300RL and -400RL) as well as the development of 2,500 metres of level development on the 300, 320 and 340 levels. Preliminary development commenced on the 15 January 1995, with access to the 400 level scheduled by November 1995. The same contractor National Mine Management has been awarded a full development and production contract for 3 years, subject to Project approval.

During the period March 1995 to December 1995, a large amount of repair and refurbishment work is required to be carried out on the crusher station and the Prince Lyell Shaft. Throughout this period it will therefore not be possible to hoist ore or waste through the shaft system. Waste from the 70 series decline development will be hauled by truck to the decline portal then to the waste dump located to the south of the treatment plant, next to the existing slag heap, (see Figure 4.28). Approximately 150,000 tonnes of waste will be dumped here during the 10 month period with an estimated 80,000 tonnes of this total already placed to the end of July. A further 120,000 tonnes will be placed at this dump to close the area out before a new waste rock dump is developed adjacent to the Prince Lyell Shaft. This will have capacity for dumping of the remainder of the estimated 1,000,000 tonnes of waste expected over the first 10 years. This matter is discussed in Section 5.

With development commenced on the 300 and 320 levels, copper/gold ores from this development will be stockpiled on surface prior to the planned commencement of treatment plant operations in about November 1995. Development ore will be trucked to the surface and placed in a stockpile at the concentrator and at the existing ore stockpile adjacent to the Prince Shaft.

It is anticipated that up to 110,000 tonnes of ore will be stockpiled between March and November 1995, after which ore will be delivered directly to the mill by conveyor. Drainage from the ore stockpiles is frequently monitored and has shown no acid mine generation.

4.3.2.7 Ongoing Development Programs

Further work will be undertaken to support the enlargement of underground mining activities to achieve a production rate of 3.5mtpa. This requires the installation of a second underground crusher and upgrading of the shaft hoisting capacity. In addition, studies will be commenced to determine the scheduling of the deepening of the Prince Lyell Shaft from -340mRL to -640mRL.

In addition, a geotechnical evaluation will be conducted as part of the feasibility study to demonstrate that stress components of the insitu rock will allow the proposed mining system to be undertaken as the depth of mining increases.

It is anticipated that the proposed mining procedures will assist in destressing the region being mined. Mining recovery is expected to increase once sub level caving is utilised with a lower cut-off grade of 0.75% Cu being implemented. The rate of vertical advance is expected to be maintained at close to previous rates once the annual tonnage output increases.

A drilling program is also planned to delineate material capable of excavation by open pit with the potential to define large volumes of low grade ore. These resources, when more accurately defined, will be included in plans to support metal production at or above the levels planned for 3.5mtpa of 1.45% Cu underground ore.

Rock mechanics investigations are currently being carried out in Australia and South Africa to determine if a block caving method of mining can be applied to the deeper

levels of Prince orebody below the 70 Series. If these tests prove successful, it may be possible to further reduce the mine operating costs over the next five years.

4.3.3 PROCESSING

4.3.3.1 Introduction

MLMRC operated a conventional comminution flotation and filtration plant at Queenstown to produce chalcopyrite and pyrite concentrates for export.

The current capacity of the integrated plant is 1.7mtpa with the throughput capacity of the system being limited by the current underground primary crushing facility. In June of 1994 the plant, whilst incurring significant down-time for mill maintenance, treated nearly 170,000 tonnes of ore and achieved a copper concentrate recovery figure of 92.8%. The current annualised throughput capacity of the systems downstream of the primary crushing has therefore been shown to be approximately 2.0 mtpa.

CMT propose enhancing the existing plant performance and reducing operating costs. The existing plant circuit will be modified and upgraded to the flowsheet of Figure 4.29. The improved circuit will initially target an integrated process with a production capacity in excess of 2.0 mtpa. Equipment will, however, be selected that allows for an approximate doubling of capacity as a second stage development.

4.3.3.2 Primary Crushing

At the existing underground crusher, the trucks tip ore directly into the 200 tonne capacity ore bin above the crusher. Ore is fed by a reciprocating feeder into the crusher and a rock breaker has been installed to assist with the breakage of oversized material. The 1500 x 1,200 mm Roxon BLM150 single toggle jaw crusher is powered by a 350 kW motor and provides a minus 150 mm feed to the plant.

In order to improve the availability and utilisation of the existing crusher it will be necessary to install a fine material undershoot which will feed minus 150 mm material directly onto the crushed ore conveyor. Once the fines bypass is installed the crusher will be able to achieve 2.0 mtpa. To achieve the 3.5mtpa production capacity another underground crusher will need to be installed.

Crushed ore is transported via three interlocked conveyor belts to a 1000 tonne ore bin located between 17 and 18 level. An apron feed directs ore to one of two strip loading flasks via a 1,500 mm wide conveyor belt. The flasks are interfaced with the 10 tonne skips which hoist ore to the surface. Ore is discharged through paramount feeders and is conveyed 1.2 kilometre to the primary ore stockpile.

4.3.3.3 Primary Ore Stockpile

In order to provide for a minimum of 24 hours live storage between the mine and the mill, an open 40,000 tonne stockpile will be provided adjacent to the Prince Lyell Shaft. Long shutdown periods for major maintenance on either shaft or mill would be covered by stockpiling ore at the shaft head, with reclaim by front end loader, or by bulldozing dead ore from the primary stockpile. Crushed ore is reclaimed from the stockpile by apron feeder to the stockpile reclaim conveyor feeding the mill transfer conveyor. Provision has been made to feed this belt by front end loader should the need arise. Lime is

added prior to discharge from the conveyor. The lime silo will be situated adjacent to the stockpile reclaim conveyor.

The ore is reclaimed from the mill feed bin by two variable speed vibrating feeders. The feeders will discharge to conveyors that will transport the ore to the two fully autogenous mills.

4.3.3.4 Autogenous Grinding Mill

Two fully autogenous grinding (FAG) mills (a mill capable of grinding ore using only the rock to rock action without use of introduced steel balls) will be installed in parallel about 15 months following start up. One will have an installed power of 7.3 MW and the other 4.4 MW. In the short term the existing crushing and grinding facilities will be used. The new mills will be located adjacent to the Prince Lyell shaft. Noise from the FAG mills is expected to increase noise from the shaft area only marginally.

Slurry from the mills will discharge onto a sizing screen for the removal of scats (oversize particles). The screen undersize material is then pumped to a cluster of cyclones in closed circuit with the mills.

The ore hardness has been recorded historically as varying substantially. The current operating work index, which has been calculated from installed power and actual mill throughput is 16.3 kW/t. Laboratory based bond work index of up to 18.2 kW/t have been recorded by the Julius Kruttschnitt Mineral Research Centre and this worse case data has been utilised for sizing the grinding circuit.

4.3.3.5 Slurry Pipeline

The proposed new FAG mills for the plant are situated 2 kilometres away from the main processing area. As the FAG mill site is elevated, pumps are not required to transfer the slurry. A 2 kilometre pipeline is proposed. This will discharge slurry to an agitated tank sized to retain the entire contents of the pipeline, when required, before pumping to the flotation tank.

4.3.3.6 Flotation

The copper flotation circuit is controlled at a pH of 10.7 by addition of lime slurry to the grinding circuit. Small supplementary lime additions are made to the regrind circuit and the cleaner cells. Reagent usage is as shown in Table 4.24.

Table 4.24 Reagent usage

CIRCUIT STAGE	REAGENT TYPE	g/t
Primary Collector	cyanamide ap5415	11
Scavenger Collector	shell st323	16
Frother	mibc or interfroth 56	30
pH Modifier	lime	1600

Total expected chemical usage is as follows:

30 - 35 tonnes per year di alkyl thionocarbamate (collector)
30 - 70 tonnes per year of sodium di-iso octylsulphosuccinate (filter aid)
40 - 90 tonnes per year di ester of an aromatic acid (frother)
800 - 4000 tonnes per year of hydrated lime
Safety data sheets are held for all reagents

Rougher and scavenger retention times are both approximately seven minutes. Clean tails and scavenger concentrate is reground in a 1.8m x 3.6m mill charge with 30 mm balls and closed with five 380 mm cyclones. The retreat and the scavenger tails are cyclone classified and the +38 micron material rescavenged and the concentrate also returned to the regrind mill. Cleaner concentrate will continue to be pumped to the 18m diameter thickener in preparation for filtering and the plant tailings will be pumped to the proposed tailings dam site as described elsewhere in the EMP.

Following a detailed study of the flotation circuit during the feasibility and the first year of operation at 1.5 mtpa, the flotation section will be redesigned and upgraded to handle in excess of 3.5 mtpa of throughput.

Copper recovery is significantly affected by fineness of grind, with a reduction of 1% in the +212 micron fraction resulting in an improvement of around 0.4% in recovery. Some ores show greater sensitivity .

4.3.3.7 Concentrate Handling

Copper concentrate is thickened to about 55% solids before filtering. The filter is an Eimeo Agidisc 8 disc 2.7m unit fitted with snap blow cake discharge and coupled to a Nash vacuum pump. Sulphosuccinate is used as a filter aid at the rate of 23g/t. The floor of the storage shed is electrically heated to assist in maintaining typical shipping moisture levels of 8.5%

The existing storage capacity for product is approximately 4,000t at Queenstown, 3,000t at the Melba Flats rail siding and 15 000t at Burnie.

4.3.3.8 Process Development Opportunities

Two major test work programs are being undertaken to support initial capital expenditure and to investigate the potential to enhance the performance of the existing plant. The programs are scheduled for completion prior to the recommissioning of the existing facility.

The first significant area of development is in the comminution section where autogenous grinding is highly attractive for the CMT operation and where significant savings over a conventional circuit can be realised by reductions in labour and grinding media costs, arguably for some increase in power consumption. Given the favourable power cost at Mount Lyell, there is an opportunity to make a number of operational changes to the circuit that will increase the overall recovery of the treatment plant.

In addition to direct operating cost savings the potential to further enhance plant performance by the introduction of the new unit process will be defined by using JK Simmet to build a model of the grinding circuit and evaluate the effects of changes. Actual plant data will be used as input for the model.

The purpose of the modelling is to enable evaluation of the following:

- The effect of throughput changes on the cyclone overflow size; whether the circuit could be modified to improve performance in flotation; and the optimum autogenous/ball circuit in the upgraded plant.
- The existing operation of the flotation circuit. The performance of the existing flotation circuit is in fact quite impressive in achieving around 93% recovery. However, this performance is achieved by complex flotation circuit with equipment dating back to the 1970's, utilising many small flotation cells (158 flotation cells in total). This test work will also include two separate work programs with both site-based and laboratory-based tests being undertaken.
- Determine if recovery or concentrate grade can be potentially improved;
- Determine if the same or better results could be achieved with a simpler circuit;
- Provide a database to allow for the future design of a new circuit utilising larger flotation cells;
- Determine the effect of increasing tonnage within the existing plant, or whether additional flotation capacity is required; and
- Determine whether the sensitivity of recovery to grind size is derived from the rougher or cleaner stages.

4.3.3.9 Future Development Opportunities

Further opportunities exist to investigate methods of enhancing the value of the operation. It is likely that these opportunities, which would coincide with a second stage of capital investment, would be most likely to be realised at higher levels of production than that at which the plant will be recommissioned.

The first area of specific interest is the potential to realise value from 'minor metals' recovery. The ore contains quantities of gold and silver which are recovered during concentrate smelting as well as a significant amount of cobalt which has never been

exploited. Based on historical data, the following are indicative values for the metals contained in 1.3% copper feed.

METAL	GRADE	UNIT
Copper	1.3	%
Gold	0.4	g/t
Cobalt	0.03	%
Silver	3.4	g/t

MLMRC recovered 62% of the gold from the copper concentrate. No revenue is received for the cobalt. It is apparent that the improved recovery of gold, and particularly the recovery of cobalt, have the potential to improve mine cash flow. It is noteworthy that at current prices the in situ value of cobalt in Prince Lyell ore is worth 3 times the value of gold in the ore (cobalt price on 26 October 1994 was US$26.50 per pound or US$58,300 per tonne) and 44% of the value of the copper content at a grade of 1.45%.

Mineralogical and metallurgical investigations will be necessary to demonstrate whether some or all of the minor metals can be recovered economically, by what process and at what capital and operating cost.

The second project opportunity requiring specific input relates to the potential for re-establishing downstream processing at the Queenstown site. It is not expected that on-site processing of concentrates could be commenced until at least several years after recommissioning of the primary facility. Hydrometallurgical processes could be operated at small scale, but smelting would probably only be economic at an ore treatment rate of at least 3.5mtpa.

CMT has examined five processes for on-site metal production:

The Cuprex process
The BHAS process
The Sirosmelt process
The Bio-Leach process
The Intec process

The viability of introducing on-site secondary processing at Queenstown will be the subject of a feasibility study. It is likely that such a mine will require the support of a largely Measured Resource to support a 15 year mine life.

4.3.4 TAILINGS

4.3.4.1 General

The discharge of tailings from the mine has been the source of many public complaints and significant environmental impact for more than half a century. The provision of an economic but environmentally responsible method of disposal of tailings is critical to the feasibility of the mine operation. Tailings dam proposals have been raised from time to time but have always been shown not to be financially viable.

The provision of a tailings dam is a requirement under the CMT Act and the Company has developed a proposal for tailings management which is considered to be feasible in response to this requirement.

4.3.4.2 Previous Tailings Dam Proposals

Regular reviews and reports on the feasibility of constructing a tailings dam were submitted by MLMRC to the Director of Environmental Control from 1973 with the introduction of the Environment Protection Act. Due to the fluctuating profitability of the mine and the political climate of the time the construction of a dam was not seen as a viable option.

The first available report (HEC, 1973) considered five possible sites for a tailings dam:

i) Comstock Valley
ii) Linda Valley
iii) Queen River Valley
iv) Upper Princess Creek area
v) Lower Princess Creek area

Construction methods and costings were based on a supplementary report prepared by the Hydro Electric Commission and were based on a 20 year tailings storage.

A downstream construction method using mine tailings for embankment construction was mooted as a possibility for the Comstock and upper Princess Creek proposals. A two stage hydro-cyclone was considered necessary to remove fines from the tailings to enable this construction technique to be used.

The report recommended that the Lower Princess Creek scheme be accepted in principle. The other sites were rejected on the basis of high cost of dam construction, high cost of pumping station construction and operation, distance from the concentrator plant and limited dam capacity.

Additional reports were submitted to the Director by MLMRC in 1975, 1979, and 1981 as part of the renewal application for a Ministerial Exemption for non compliance with the Environment Protection Act. The above reports were basically a revision of the cost estimates for the preferred option outlined in the June 1973 report.

A further report was submitted in June 1990 to the Director of Environmental Control (MLMRC, 1990), however, shortly after the submission of the above report the

Government was made aware of the likelihood of the closure of operations at the Mount Lyell mine by the parent company Renison within a five year time frame.

4.3.4.3 Nature of Tailings

The tailings comprise finely powdered rock material left over after the crushing of ore and extraction of the mineral fraction.

The physical properties have been tested initially in 1973 and again for the current project (HEC, 1973 and 1994). The results are summarised in Table 4.25.

Table 4.25
Tailings Grading

Grading Sieve Size (mm)	With Dispersant % Passing	Without Dispersant % Passing
0.6	100	100
0.3	97 - 100	100
0.15	79 - 93	93
0.075	56 - 73	73
0.033	47- 55	61
0.012	40	3
0.003	12	0

Liquid Limit	16%
Plastic Limit	12%
Plasticity Index	4
Linear Shrinkage	1
Specific Gravity	2.8
Estimated Permeability	10^{-8} to 10^{-9} m/sec

Consolidation tests on various fractions (HEC, 1973) suggest that the coarser fractions would settle close to the discharge point at a density of approximately 1460 Kg/m^3 and consolidate rapidly to a density of around 1525 Kg/m^3 at depths in excess of 5 metres. The finer fractions would settle at densities around 1125 Kg/m^3 increasing to 1270 Kg/m^3 at 3 metres and a maximum of 1360 Kg/m^3 below 20 metres. The test methods used to develop these values simulates the conditions more relevant to sub-aqueous disposal where tailings are discharged directly into water. It is expected that greater densities will be achieved if sub-aerial disposal where beaching is allowed to develop.

Mineralogically the tailings are made up of granular quartz and quartzose rock fragments, carbonate particles and many very fine needle shaped particles of mica (HEC, 1973).

Multi element scans of tailings in the King Delta (EGI, 1991) showed greater than average crustal abundance of sulphur, copper, selenium and silver.

A sulphur content of 5.5% was measured in fresh tailings below the water table on the King River Delta. Tailings exposed to oxygen have been shown to be readily oxidised with formation of a crust of oxidised material which tends to limit the oxygen penetration. Net Acid Generation (NAG) tests show that the material is reactive and likely to produce acid after a period of exposure and weathering. This has been confirmed by recent testing of waste rock from the mine development, likely to be representative of tailings chemistry (EGI, 1995). However, a comparison of the reactivity of various Tasmanian tailings (Dept. Mines, 1974) showed the Mount Lyell material to be far less reactive than that of some other Tasmanian mine tailings. This appears due to the mineralogy of the Mount Lyell material in which the sulphide content is Pyrite where at others the sulphide is the more reactive Pyrrhotite. This suggests that short term beaching of tailings can be tolerated as at other Tasmanian tailings dams.

4.3.4.4 Nature of Tailings Dam

Previous studies have considered concrete faced rockfill dams, spigotted tailings dams and geomembrane lined dams. None of these, particularly the former two, are considered ideal for the Mount Lyell material given current understanding of best practice for disposal areas.

The design parameters now believed most important for a tailings dam for reactive tailings are:

- The tailings should be permanently covered by water or otherwise separated from oxidising conditions.

- The dam should be capable of maintaining its function "in perpetuity".

The tailings dam will maintain a water cover over the tailings for two reasons.

a) This is considered to be, technically, the preferred method for control of sulphide oxidation.
b) In Tasmania, particularly the West Coast the maintenance of a water cover is technically feasible at a lower cost than other alternatives.

Soil cover to a dry tailings deposit can be effective provided it is properly carried out. However, proper soil coverage would require a three layer cap totalling at least 1 metre of soil. This would include a coarse sand capillary control layer, a clay barrier layer and an organic soil upper layer.

A total of around $3.5 \times 10^6 m^3$ of soil would be required for the dam abandonment at 15 years with the problems of access and placement of such a cover being virtually insurmountable.

Problems are seen with concrete faced rockfill dams and possibly geomembrane lined dams over extreme long term life times where repair and maintenance of relatively thin waterproof layers would be virtually impossible.

With spigotted tailings dam construction the tailings themselves are used to form the dam wall. Whilst economical in some circumstances, the phreatic line within this form of structure is lowered, resulting in potential oxidation of the dam construction materials. This has been the cause of relatively significant acid seepage from tailings dams in the past.

It is considered that the most suitable form of dam construction will be for a conventional earth and rockfill dam with a conservatively sized clay core. This would be designed essentially as a water storage, ignoring the inherent low permeability of the tailings themselves.

This dam type will be suitable for long term maintenance free life and ensure that all tailings are covered.

4.3.4.5 Tailings Storage Requirements

The most optimistic current estimates of tailings production are based on an early start of the existing mill and a staged increase in production to up to 3.5 million tonnes per year.

The initial 15 years of mine life could generate up to 47 million tonnes of tailings at the rates set out in Table 4.26

Table 4.26
Expected Annual Tailings Production

Year 1 1995-96	1 m tonnes
Year 2 1996-97	2.1 m tonnes
Years 3 to 15 1998 - 2010	3.325 m tonnes

Previous laboratory testing has suggested an average design density of 1330 Kg/m^3. This appears realistic and would require initial storage potential of 36 million cubic metres.

4.3.4.6 Tailings Storage Options

Clearly the discharge of tailings to the Queen river is not acceptable and is neither consistent with the principle of BPEM nor sustainable development. In-mine disposal has been seriously considered but at present there are no viable areas where tailings can be placed without compromising the current mining operation or the potential for future mining operations. Storage of tailings above active or potentially active mine areas is highly dangerous due to the risk of mud slides or mine flooding. Due to the limited nature of mineral exploration to date CMT is not in a position to declare any old workings exhausted and not likely to be mined. Furthermore most old workings other than the major open cut areas have very limited capacity for tailings disposal in view of the large production rate expected from the Prince Lyell mine. Nevertheless this option will be

reconsidered as future mining plans are developed. Disposal in a tailings dam is considered to be the only viable alternative at this stage, as is required by the CMT Act.

Previous studies over the last 20 years have reviewed a range of dam options some of which are clearly impractical in today's context where long term volumes are greater and technical detail of dam construction has changed. The locations of five possible dam sites are shown on Figure 4.30

Particular options which have been looked at include:

1. Linda Valley. This valley has sufficient capacity for the planned 15 years production, and scope for extension for around ten more years thereafter, but the need to divert a considerable length of highway plus power lines and, the visual impact of this site make it not viable. In addition any outflow would be into Lake Burbury with potential water quality implications. The storage also encroaches over potentially mineralised areas close to the current workings and could pose hazard to future mining.

2. Queen River. One scheme proposed a dam on the Queen River upstream of the King, however, the total storage potential is not sufficient for the proposed 15 year mine plan let alone any extension. Further complications with road and power line relocation were involved with flooding of the town golf course and sewage treatment plant.

3. Upper Princess Creek. This previously favoured scheme involved extensive embankments constructed by spigotting. Original costings were misleading as the costs of spigotting were not included. In addition the method is considered to be technically dubious and as a result has not been seriously considered.

4. Pearl Creek. The Pearl Creek area comprises a wide plateau containing a deeply cut valley. There is potential for significant storage but dams required would be major structures being both very high and also quite extensive in length.

Two areas with potential have been reviewed in more detail. These are the Comstock Valley and the Princess Creek (lower site).

The Comstock site in particular has been reviewed to assess the possibility of confining tailings disposal activity to the original lease area. The Comstock valley, whilst only partially on the lease has been suggested as being a preferable option on environmental grounds. The following discussion compares the Comstock site with the Princess Creek site.

Comstock

The Comstock Valley is located at the northern end of the Mount Lyell mineral field. The Lyell-Comstock Creek occupies the floor of the valley and drains into Lake Burbury. The catchment area is reasonably large. The Comstock site is shown in Figure 4.31.

Access to the valley from the CMT mill site is via a road following the East Queen River valley to a saddle at RL 385 before dropping into the Comstock Valley. A tailings pipeline would have an approximate length of 7 Km and a rise in elevation of 200

metres. The pipeline would be highly visible from the Lyell Highway by travellers on the road to Zeehan.

The valley is a well defined U-shaped feature running east-west and bounded by Mount Sedgwick to the north and Mount Lyell to the south. The Comstock Creek flows eastwards to Lake Burbury.

The floor of the valley is underlain by Quaternary sediments overlying the Owen Conglomerate of Ordovician age. The Owen Conglomerate in this area is composed of sandstones and conglomerates which are likely to be both porous and permeable. The Quaternary sediments are predominantly composed of glacial material and alluvial deposits. The glacial material consists of weathered, poorly consolidated outwash gravels of variable thickness. The Quaternary sediments would be both porous and permeable and would not form a suitable substrate on which to form any significant structures such as a dam wall. The stability of the glacial deposits is doubtful, particularly when water logged and would be a cause for concern in those steeper parts of the valley. A site inspection and a review of geological mapping suggests that clay deposit does not exist in this area.

Based on the surrounding geology, numerous faults will be expected below the glacial material, including the extension of the Great Lyell Fault.

The potential storage capacity of the valley depends on the actual location of the dam site, but the volume of earthworks necessary for dam construction increases significantly for dam sites towards the east of the valley. Current considerations have been based on a site approximately mid-way along the valley where a natural ridge in the valley floor would assist dam construction. At this site a dam 100 metres high, 1100 metres long and containing some 12 million cubic metres of earth and rock fill would provide a maximum storage capacity of 80 million cubic metres of tailings. This would be around 50% in excess of the current volume expected to be required to meet the current 15 year mine plan and hence would have little long term capacity. A slightly smaller dam to meet the requirements of the 15 year mine plan would have an estimated embankment volume of 10 million m^3. The estimated embankment cost alone for this structure would be around $60 million unless upstream construction methods were utilised. This would involve spigotting of tailings to produce a dam embankment constructed essentially of the tailings themselves. This type of structure relies on the outer zones of the tailings being well drained with increased risk of acidic seepage as discussed in Section 4.3.4.4.

Besides the obvious cost of construction of a dam of this size the technical feasibility is doubtful. The valley is blanketed by Pleistocene glacial moraine and underlain by Gordon Limestone. One drill hole in 1990 encountered 125 m of glacial material. This material would be potentially highly permeable and the scale of the foundation treatment necessary to seal the foundations against seepage would be massive, if in fact it was feasible at all. Extensive grouting of the morainal foundation material would be possibly the only way a dam could be contemplated at the site. This would involve a grout curtain some 80,000 m^2 in area and would possibly require special chemical grout materials for effective sealing. The cost of this work is considered likely to be in excess of $10 million and could not be guaranteed to successfully prevent significant seepage.

The outcrop of the Mount Lyell mineral field is terminated by the Quaternary sediments in the Comstock Valley. Economic mineralisation is known to the edge of the glacial deposits and exploration has been undertaken in this area and to the north along the Great Lyell Fault which brings into contact the mine sequence rocks and the overlying Owen Conglomerate. The presence of further economic deposits in the Comstock area within the strike continuation of the mineral field has not been fully evaluated. CMT has also been granted the adjoining exploration licence EL52/94. The proposed exploration strategy for EL52/94 is to assess the exposed geology for mineralisation and to test the area east of the Great Lyell Fault for repetitions of the mine sequence below the Owen Conglomerate.

In the northern part of the field, successful exploration may result in proposed mining developments being located below the level of any Comstock dam structure which would effectively prevent the development. For example, the existing Prince Lyell workings are well below the level of the Comstock Valley.

Mineral exploration in the area has detected pyrite veins within the limestone and a clay-sandstone unit beneath the limestone (Corbett, 1994). This latter is believed to be the host for the native copper-cuprite-chalcopyrite mineralisation of the "copper clays" currently being reviewed by CMT as a potential resource. In addition a significant base metal (zinc) mineralisation has been confirmed in the lower part of the limestone sequence in the Zeehan area which suggests a similar mineralisation could be found under the Queenstown lease limestones.

The foundations of the Comstock site thus have high potential for containing significant mineralisation and a major tailings deposit in the area could have significant impact on the feasibility of mineral extraction.

An additional potential problem seen at the Comstock site is the effect of a dam on the groundwater of the general area. The dam would result in a rise in groundwater levels with flooding of the Comstock No. 7 adit. This would allow water and tailings to enter the old workings and potentially the Great Lyell Fault together with other geological features of the mineralised Mount Read Volcanics of the area. Irrespective of any direct water flow connections, the effect of the increased water table could have a significant influence on current or future flow rates of mine dewatering and acid drainage potential from new or abandoned workings in the lease area.

The site is within the catchment of Lake Burbury and any increase in acid drainage or outflow from an extreme dam incident could result in a potentially significant effect on water quality in the lake. The lake currently exhibits a very high water quality and supports a growing trout fishery which is believed to be highly sensitive to acid drainage contamination. To date considerable expenditure has been committed to divert acid drainage sources from the catchment.

The vegetation in the Comstock valley comprises relatively undisturbed native vegetation including mature tree cover, particularly over the floor of the valley.

By way of comparison, the proposed Princess Creek site has the following advantages:

- no glacial material to compromise a dam structure or its long term integrity.
- a natural dam site.
- suitable construction materials.
- underlying geology composed of impervious rocks with no known structures present.
- underlying geology unprospective for minerals.

Recent communication with the HEC (letter dated 15/3/95) expresses a number of concerns relating to positioning a dam in the Comstock Valley. A transcript of this correspondence is available for reference.

"Proposals to construct a tailings dam for the Copper Mines of Tasmania project at Mount Lyell should be examined in regard to environmental threats to Lake Burbury.

The HEC would need assurance that the Comstock Valley option, outlined in your fax dated 13/3/95, posed no significant environmental risks as a result of leakage, spillage, deliberate water release or catastrophic failure.

Significant efforts have been made to divert acid, metal-rich waters from the Burbury catchment. In conjunction with the Inland Fisheries Commission, an extensive water quality monitoring program is also underway.

Lake Burbury is proving to be an outstanding fishing and recreational asset. Pollution of this resource via gradual or catastrophic releases from a Comstock Valley tailings dam could have serious economic consequences for the Queenstown community and the HEC. A Princess Creek tailings dam would pose no threat to Lake Burbury and, on the evidence available, would be the preferred option".

Princess Creek

The Princess Creek site is approximately the same distance from the mill but requires a rise in elevation of only 100 m allowing long term lower power costs for pumping tailings. The dam site allows a limited size dam of around 2 million m^3, for a potential storage of three times the current 15 year plan.

The foundations comprise Siluro-Devonian siltstones and sandstones with limited permeability allowing conventional dam construction.

For the current 15 year mine plan a dam embankment totalling 1,500,000 m^3 would be required with an estimated cost of around $10 million. This is nearly an order of magnitude less than the estimated cost of a similar dam at the Comstock site. This becomes particularly significant when put in context with the value of copper produced. The Princess Creek Dam capital cost, over the 15 year period, represents approximately $20 per tonne or around 1.5% of the expected minimum copper price on which the project feasibility is based. On the other hand the Comstock site capital cost represents around $150 per tonne or 10% of the possible copper price, clearly having a major impact on project feasibility.

Since identifying the site, a programme of geological investigation has been undertaken to sterilise the area and show it to contain no economic mineralisation. This has comprised diamond drilling of 3 holes at the dam sites, primarily for engineering purposes but also for assaying and analysis, compilation of past data and a detailed field geological survey including collection and analysis of over 80 stream sediment samples and samples from exposed quartz seams.

No zones of significant alteration or mineralisation were found (CMT, 1995).

The Princess Creek catchment has been subject to some small scale mining operations in the past, mainly in the upper catchment area or in the area well below the dam site. However no major disturbances or excavations have been undertaken that are considered to have any influence on groundwater.

Summary

A summary of the relative merits of the Comstock and Princess Creek sites is presented in Table 4.27.

Neither the Comstock site or any of the other alternatives reviewed are considered to be feasible alternatives to the Princess Creek from an economic or an environmental viewpoint.

Table 4.27
Comparison of Comstock and Princess Creek Dam Site

FEATURE	COMSTOCK	PRINCESS CREEK
Distance	7 Km	6 Km
Elevation	380 m	280 m
Max Dam Size height length	 100 m 1100 m	 70 m 400 m
Max Capacity	80 x 10^6 t	160 x 10^6 t
Foundations	glacial deposits and limestone posing significant engineering concern	siltstone and sandstone with normal engineering implications
Mineralisation	potential economic mineralisation	no economic potential - sterilised
Vegetation	good growth of native vegetation	frequently burned, little remaining significant vegetation
Effect on groundwater	potentially very significant, include possible acid drainage increase	believed limited significance and subject to study (stage 1 negligible)
Downstream considerations	Lake Burbury	Queen River via Princess Creek

4.3.4.7 Detail of the Overall Princess Creek Proposal

A preliminary overall plan of the Princess Creek Scheme is presented in Figure 4.32 showing the expected extent of water cover at the 15 years of operation at current planned production rates and also the potential maximum extent of the storage, being in excess of 60 years at the expected increased production level.

The scheme proposes a dam on the Princess Creek at the northern end of a relatively narrow gorge cut by the creek through the range of hills on the western side of the Queen River. This is some 500 metres above the Botanical Garden Reserve discussed in section 4.1. Tailings will be pumped to the dam, allowed to settle and decant water will be discharged into Princess Creek as described in more detail in the following section.

A diagram of the tailings discharge system is shown on Figure 4.33. Tailings will be passed through a new 25 m diameter thickener at the mill site following the flotation process. The overflow from this primary thickener will be recycled to the process water stream of the mill as discussed later in this section. The thickened tailings will pass to an agitated tank for mixing with 17 Level pump station water for neutralisation prior to passing to a 30 m thickener for excess water separation. Overflowing neutralised clear water from this thickener will be discharged to the Queen River. The thickened tailings would be pumped to the tailings dam at a solids content of around 50% by weight and a pH in excess of 6. Details of flow rates and water quality for these various discharges will be discussed in section 4.3.4.8.

The tailings pipeline will be laid above ground on a route leaving the northern end of the mill and crossing the West Queen River and the Lyell Highway approximately 50m north of the filter building, rising up a gully parallel to the highway and then following a route of lowest possible elevation across the elevated plateau to the north east of the Queenstown Airport. The pipe would skirt the eastern and southern boundaries of the airport site and traverse Howard Plains to the discharge area as shown on Figure 4.25. The tailings pipe will be laid around the northern edge of the tailings dam and will feature several discharge points, strategically placed to allow even spread of tailings to the dam.

Preliminary detail of the dam is shown in Figure 4.34. It will comprise a zoned earthfill dam with an initial height of 45m, giving a crest level of RL 220. This will be constructed over a two year period with the initial embankment constructed to RL 210. Normal water level will fluctuate between RL 215 and 216, on completion of Lift 1, depending on natural catchment inflow. This first lift will cater for the first 5 years of tailings storage, with three further lifts being contemplated during the current 15 year mine plan as follows

Lift	Date	Crest RL	Height (m)	Spillway Invert
1	1995/96	220	45	215
2	2000/01	228	53	222
3	2005/06	235	60	233
4	2010/11	238	63	235

The fourth lift would be intended to leave the dam in a suitable condition for abandonment if mine closure occurs after 15 years. If production continues the dam has the potential for further staged raising in 3 to 5 m increments, eventually reaching a height of 85m (crest RL 260).

The staged development of the dam is shown diagrammatically in Figures 4.35, 4.36, 4.37 and 4.38

The dam will initially have a breadth at the creek bed of 210m. With each raising the footprint will be extended in a downstream direction, so the final downstream toe location is expected to be 450m upstream of the northern boundary of the Botanical Gardens Reserve downstream.

For the first stage of the dam (to RL 220) the materials will consist of about 220,000m^3 of core material (silt or clay), 280,000m^3 of rockfill and 20,000m^3 of filter material. The rockfill, mainly sandstone with a small quantity of shale, is readily obtainable from within the impoundment area. For the filter zones it is intended to use slag currently stockpiled at the mine site. Site investigations have confirmed that adequate highly weathered shale will be available at the site for construction of a suitable clay core.

For each stage of the dam there will be a primary spillway designed to pass floods up to those with an annual exceedance probability of 1 in 100. This spillway will be comprise a concrete drop structure leading to an outlet pipe fitted with a valve. This valve will be capable of adjustment to vary the outflow from the dam. This will enable storage of water during high inflow periods for release during dry periods, thus allowing control of discharge water quality. In addition the control valve will allow emergency control of the outflow in the event of an environmental incident, such as an oil spill or excessive suspended solids content in the storage. The potential storage in the dam in the event of an incident will be in the order of several weeks which will allow for control measures to be introduced. Each stage of the dam will also feature a secondary spillway channel cut into the rock of the western abutment. This will be designed to cater for extreme flood events which exceed the capacity of the outlet tower.

The spillway channels, which are designed for maximum flows of between 20 and 50m^3/s, will discharge into natural gullies which rejoin Princess Creek a short distance below the dam. The natural gullies will be stripped of topsoil for a distance of approximately 50m downstream from the excavated channels to avoid erosion in the event of severe flood flows.

The reservoir will attenuate the normal fluctuations in flow in the creek but the extent of attenuation will be controllable by operation of a gated primary spillway. This is the subject of detailed design and hydrological work is being carried out by the HEC. The outflow system will be capable of management to suit environmental requirements Including

- Shut off of flow in the event of an environmental incident allowing corrective measures to be taken as outlined in Section 5.2.2.9.
- Control of outflow to simulate natural flow regimes

- Holding of flood flows for release during dry periods to even out water quality concentrations.

In extreme events, when the secondary spillway overflows, the discharge will approach that of the unregulated stream, but the storage capacity of the reservoir will reduce the peak flow. For the initial lake level of RL 215, the estimated peak outflow in the event of a "probable maximum precipitation" flood of critical duration is $45m^3/s$. Without the dam, the unregulated flow for a flood with an annual exceedance probability of 1 in 500 is estimated to be $63m^3/s$. This demonstrates the flood attenuating effect of the dam.

During construction the Princess Creek flow will be diverted through a concrete pipe at creek bed level. This will be sized in conjunction with a cofferdam incorporated into the upstream toe of the dam to pass flood flows. The sizing of the coffer dam and diversion will be subject to detailed design.

A silt trap will be created about 260m downstream of the ultimate toe of the dam. This will consist of a concrete weir creating a pond of about $1,500m^3$ capacity, giving a retention time of 1.5 hrs for median flow. This weir will also provide a monitoring position for the tailings dam.

Detailed design of the dam is currently being carried out by Thompson & Brett Pty Ltd. Detailed site investigations are currently in progress involving geological mapping, diamond drilling and test pit excavation. Geological input is being provided by Mr Ken Morrison with specialist engineering geological advice from Mr David Wilson of HEC. The dam design team is led by Mr David Brett, an experienced dam engineer and Mr Sergio Guidici, General Manager Consulting, of HECEC, has been engaged as a peer reviewer.

The tailings dam system proposed will be suitable for either;

- subaqueous discharge, where tailings are distributed directly beneath the water surface by pipe to a floating pontoon, or
- subaerial discharge where tailings are discharge to a beach with pondage of water minimised

The method currently proposed by CMT comprises a hybrid of the two methods with tailings being discharged from the bank of the pond away from the dam wall. Initially the majority of tailings would flow beneath the water surface but gradually a beach would develop below the discharge pipe. This beach would be expected to develop a slope of around 1% and would allow for a good separation of solids from the liquid stream and formation of a dense tailings deposit. The pondage water level would be progressively raised to inundate the beach discharge. Testing of the Mount Lyell tailings (EGI, 1991, 1995) has shown them to be less reactive than other Tasmanian tailings which have been successfully placed in beaches over limited periods without development of acid drainage. To limit the exposure time of tailings, the discharge system will feature a limited number of outlet points and a regular programme of discharge point changes to provide progressive covering of the beach with fresh material will be set up. In this way exposure time for any individual surface will be limited to a few weeks.

The development of a beach is preferred for practical reasons due to the better tailings density and more even distribution achievable compared to subaqueous methods. However the performance of the method will be closely monitored during the first few months of operation and conversion to subaqueous discharge methods can readily be adopted if oxidation of exposed tailings proves to be affecting release water quality.

The tailings discharge points and the resulting beach will be kept remote from the dam wall and water release point to ensure a large deep pondage at the dam. The discharge works will comprise two outlet levels, a lower controlled level and an upper uncontrolled level. Normal flow will pass via the lower outlet but this will be capable of shut off if water quality becomes unacceptable for discharge. At average inflow the rise in water level in the pond during the first lift is approximately 1 m in 20 days.

The controllable outlet also gives the potential for artificially varying outflow from the storage to give scope to store flood water for release during low flow periods to assist discharge water quality, or to manage the flow for other environmental reasons.

Detailed design of the dam is currently nearing completion. Control of seepage has been a major consideration and a seepage analysis has been carried out. The results have been reported to SDAC (CMT, 1995).

Surface rocks at the dam site have been found to be quite permeable but the deeper strata are reasonably competent. Accordingly the dam will feature a deep cut-off trench which will allow for removal of up to 20 m of permeable jointed rock and replacement with compacted clay. In addition the deeper foundation will be pressure grouted by injecting cement grout.

Not withstanding the above, the tailings themselves will further reduce the potential for any seepage, since the tailings have a relatively low permeability (10^{-8} m/sec) which will effectively seal the floor of the storage area.

Essentially the seepage analysis predicts that seepage will only be measurable at the dam wall and will represent less than 5% of the annual inflow to the storage during dry year flow. Total losses including evaporation have been predicted to account for only 6.5 to 14% of total dry year inflow. As a result the proposed minimum 2 m water cover to the tailings on abandonment will ensure that beaches will not become exposed.

Provision of a seepage collection and return system is a conservative design feature. Experience with early lifts will enable appropriate action to be taken, including dam design change and/or further grouting to reduce seepage.

The intention at abandonment will be that seepage should be of such limited flow rate that it can be incorporated into dam overflow without exceeding environmental discharge requirements to Princess Creek.

The dam has been designed with consideration of long term abandonment. This would be expected to comprise the maintenance of a permanent lake with a spillway provided in solid rock on the western abutment. The dam will feature conservative face slopes to provide a high factor of safety and the potential to support native vegetation.

The flooded area of each dam stage will be cleared of vegetation such that no dead trees will be left protruding from the water or tailings beach areas during any stage of operation.

The overall construction, management and rehabilitation of the scheme will take into account the historical and environmental values of the site, particularly the area downstream of the dam.

4.3.4.8 Stage 1 Dam

In view of the company's proposed start up programme and the sensitive nature of the tailings management system a small dam has been set up to cater for initial milling during late 1995 and early 1996. This enables detailed site investigations and design for the main dam to proceed during 1995 and allows environmental and technical approvals to be sought under the normal project approval mechanisms.

A suitable site was been identified at the northern end of the Princess Creek catchment, close to the airport. The site is of practical size for 6 months storage and, with diversion of an inflowing creek, has a very small excess catchment area which will limit stormwater inflow. Details of the proposal are presented in Figures 4.39, 4.40 and 4.41.

Other sites for the Stage 1 dam were considered but none were considered suitable, due mainly to the following factors:-

- The potential hazard of placing tailings over areas close to the mineralisation and potentially active mine areas.
- The difficulty of finding areas where significant storage can be achieved with modest earthworks due to the steep nature of the topography.

A major benefit of the Princess Creek Stage 1 Tailings Dam site is that it is within the long term disposal area and will thus:

- properly trial all aspects of dam construction, tailings delivery, handling and rehabilitation in this area.
- keep all tailings disposal in the one general area.

The Stage 1 development comprises

1 Construction of access and maintenance tracks for the site works and tailings/decant pipelines
2 Stage 1 Tailings Dam and appurtenant works
3 Access roads and survey tracks to and around the main dam site.
4 Laying of pipelines and setting up of pump systems.

The Stage 1 Dam itself comprises a dam wall constructed across a narrow gorge on the upper reaches of Princess Creek approximately 1 kilometre south of the aerodrome runway. The dam comprises an earth and rock fill structure 12 metres high and

approximately 200 metres long. An auxiliary embankment approximately 4 metres high is constructed at the eastern end of the storage.

Site investigations at the site of both dams comprised visual inspection and diamond drilling. The foundations comprise relatively hard siltstone with softer sandstone bands striking parallel to the dam axes and with sub-vertical dip to the east. Water testing has shown bedrock permeability to be low at the auxiliary wall with a measured permeability of 7 Lugeon units but testing at the main western wall showed around 10 times this value. Inspection of the core suggests that the permeable features are likely to be related to the softer sandstone beds with water flow confined to the sandstone. The potential for cross bedding flow is very limited due to the massive nature of the siltstone beds and with the subvertical nature of strata dip, the potential for seepage is considered minor. Thus, for the Stage 1 dam, pressure grouting of foundations was not considered necessary. Foundation preparation for the clay involved excavation of any jointed or fractured rock, high pressure water cleaning and detailed slush grouting of joints and bedding.

During construction the left abutment was found to be more fractured than originally thought and the design was modified to provide a clay facing to this area. A post-construction report for the Stage 1 dam is in preparation and will be submitted to TDR during August 1995.

Seepage is expected to be minimal, however a collection system will be provided with provision for pumping of any contaminated seepage back into the storage.

Siltstone available at a borrow area site within 750 metres of the site has been found suitable for core construction. Test results are summarised in Table 4.28.

Table 4.28
Siltstone Core - Material Properties

Grading	With Dispersant
Sieve Size (mm)	% Passing
2.36	100
0.6	90
0.3	87
0.15	85
0.075	84
0.033	71
0.012	50
0.003	12
0.0015	4

Liquid Limit	34%
Plastic Limit	28%
Plasticity Index	6
Linear Shrinkage	2
Specific Gravity	2.77
Max Dry Density (std)	1.57 t/m3 at 26% moisture content
Effective Stresses	cohesion 9 kPa friction angle 31 degrees
Estimated Permeability	10^{-8} m/sec

This material is an orange coloured clayey siltstone which breaks down readily under roller compaction. The compaction curve is relatively flat which indicates that the material will be practical to use over a range of moisture contents as will be expected given the potentially wet conditions likely to be encountered on site. This has now been confirmed by site experience.

Harder rock material is readily available on the site for use in upstream and downstream rockfill shells. This material will be relatively fine with expected upper size range around 150 mm. A filter zone for the core was subsequently not used due to the suitable grading of the downstream rockfill.

Batter slopes are conservatively set at 1 vertical in 1.5 horizontal for the rockfill. Stability analysis shows safety factors in the order of 1.6 for steady state conditions.

During operation all water from the Stage 1 dam storage will be returned to the mill and either used for process water or returned to the Queen River. Once the main Stage 2 dam is operational the water from Stage 1 will be allowed to spill into the main storage. A spillway will be cut in hard rock on the southern abutment of the dam. In the event of the main dam not proceeding, due to premature closure of the mine for some unforseen reason, the water return system will be kept operational until water quality stabilises to a level that discharge to the Princess Creek is environmentally acceptable.

The total inflow to the Stage 1 dam will be around 100,000 tonnes per month at approximately 50% solids. This equates to approximately 50 L/sec flow of slurry although instantaneous flow rate during production would be higher. The mixed slurry is expected to settle rapidly to around 60% solids with the release of around 13 L/sec of decant water depending on mine water handling strategy.

Rainwater run-off from the site would add to these flows. Average flow is estimated at 25 L/sec with typical wet weather flow at around 40 L/sec.

A 1:100 year storm could result in inflow of an average 250 L/sec over a 72 hour period, totalling 65000 m3 which would raise the water level in the dam by around 0.75 m towards the end period of tailings placement.

These flows are summarised in Table 4.29

Table 4.29
Flows to Stage 1 Dam (tailings only)

	Solids Rate t/a	Solids Content	Water Content t/a	Average Flow Rate L/s (solids SG 2.8)
Tailings Slurry	1,200,000	50%	1,200,000	50 @ sg 1.35
Settled Tailings	1,200,000	60%	800,000	39 @ sg 1.63*
Decant Water	0	0	400,000	13
Storm Water -average	0	0	0	25
Storm Water -typical wet	0	0	0	40
Storm Water - 1:100 yr	0	0	0	250

* allowing for sub-aerial beaching

With this level of inflow the dam has the capacity for in excess of 60 days storage without overflow. Maintaining a freeboard of 1m towards the end of the placement period allows a storage of approximately 90,000 m^3 giving around 20 days average capacity in the event of pump breakdown. The 1:100 AEP flood would raise the water level by an estimated 0.75 m.

The Stage 1 dam is designed to have zero discharge to the Princess Creek during use as a tailings storage. All water in the dam will be returned to the Queen River. The proposed return water pump arrangement would comprise a diesel operated 8" pump with a capacity of 150 L/sec. Storm run-off in excess of pump capacity would be temporarily stored by operating with a minimum freeboard of 1 metre allowing either

a) up to one week to arrange pump repair in the event of breakdown or
b) storage of a 1:100 year flood.

During initial operation the Stage 1 dam will be used as a prototype for the main dam. The pondage level will be controlled by pumping to simulate beach conditions expected

later. A detailed testing and evaluation programme will be carried out to confirm operating conditions for the main dam.

On termination of tailings storage the water level would be allowed to rise and discharge to the Stage 2 Dam. A nominal cover of 1 m of water would develop over the tailings. This is sufficient to prevent oxidation of the tailings and is adequate buffer against evaporation of the water cover during summer. The natural catchment of the dam is sufficient to maintain the water cover at full depth for most of the year.

Wetland plant species from the adjacent area will be transplanted to the edge of the dam and, based on experience at other Tasmanian dams are expected to spread around the dams perimeter.

The long term spillway will comprise an excavation in rock of sufficient size to pass the Probable Maximum Flood (PMF).

4.3.4.9 Pipelines

The pumping station for tailings transfer to the site will be located adjacent to the current tailings outlet on Haulage Creek. The pipe would run to a low point beside the Queen River, cross the river on an elevated bridge structure and pass under the Lyell Highway, up an adjacent gully and across the elevated plateau near the aerodrome and on to the dam site. The pipe will comprise a 300 mm diameter steel pipe and poly pipe laid on wooden sleepers at ground level. A second similar decant return pipe will be laid alongside. Both pipes will be capable of dual purpose usage for either tailings delivery or water return to allow flexibility of use. The pipeline route has been selected to provide a smooth vertical alignment providing minimum elevation. A high point on the ridge above the Mill allows fall in the pipe in both directions. This allows the pipe to be dewatered if necessary with discharge either to the dam or to a tailings holding sump at the low point beside the Queen River. The pipe route will be bunded, with emergency spill storage ponds located at strategic positions on the route to contain any spills from pipe burst. The pump system will feature an automatic shut down on loss of pressure at the pump or loss of flow at the dam to minimise the volume of spills.

The water return system for Stage 1 will comprise a diesel driven pump mounted on a floating pontoon. This will control the water level in the pond with the capacity to return all decant and natural run-off to the mill.

No return water system is proposed for further stages.

4.3.4.10 Access Roads

New roadways are necessary to provide access to the Stage 1 pipeline and dam and also to the main dam site and adjacent areas, initially to allow proper site investigation but eventually for construction, tailings pipe extension and long term access. The route of access roads has been selected to minimise environmental impact and to correspond to the location of long term access requirements. Road standard will be of suitable quality to allow heavy vehicle access with pavement width of 8 metres and properly constructed drainage. Batters will generally be cut to 0.5 to 1, in rock and flattened when

necessary to maintain stability. Fill batters will typically be 1.5 to 1. Earthworks are designed with rehabilitation procedures to suit.

4.3.4.11 Mine Site Water Balance

A flow diagram for the site water balance is presented in Figure 4.42 which shows average water flows for the 3.5 Mt/a operation.

Sources of water are

- Lake Margaret (an input to the West Queen Catchment): Water has been drawn from the Lake Margaret penstock during periods of major water shortfall from other sources. Water is pumped to the upper West Queen River. The pump capacity is 136 L/sec. With the recent shutdown of the Lower Lake Margaret Power Station the existing wood stave penstock has become unserviceable and a new pipe will need to be laid to the upper power station outlet.

- West Queen River: This is the main source of process water for the site with three dams on the upper sections of the River as shown on Fig 4.43. These comprise No 1 dam, which has limited storage capacity, No 2 Dam, with 160 ML storage, and No 3 Dam with 230 ML storage. Water is collected at No 1 dam and piped to the head tank above the mill. Water from the lower reaches of the West Queen is collected in the 1ML "Valley Pump" storage and pumped to the mill head tank. For the proposed redevelopment project two head tanks will be used. One will be dedicated for fresh water for use where very clean water is required. The other will be designated "process water" where a lower standard of water will suffice. In addition a further head tank will be provided at the Prince Lyell Shaft to allow West Queen water to be used for slurrying ore at the FAG Mill.

- East Queen River is the main source of water for the underground workings. Water is collected in a small storage dam on the upper East Queen and pumped by the "Cape Horn" pumps to two, 230 kL capacity tanks above the Prince Lyell Shaft. From these some water is pumped to the higher, 6ML "Utah" tank. Water is fed to both the Prince Lyell Portal and Prince Lyell Shaft from the Prince Lyell head tanks.

As a result of the water balance work it is not proposed to return water from the tailings dam apart from during Stage 1. Instead the Lake Margaret scheme will be maintained, though with control valves to regulate flow. This results in all decant water discharging to Princess Creek from the Princess Creek Stage 2 outlet.

As can be seen from Figure 4.42:

- The West Queen water is used to fill the Shaft and Mill head tanks from where it will be used for the various in-mill uses but particularly the slurry transport of ore through the FAG mill, secondary mill, flotation process and finally the tailings transfer. Overflow water from the tailings thickener will be returned to the Mill head tank for reuse. Underflow will be mixed with acid drainage prior to further thickening, using the existing "30m" thickener, and then pumped to the tailings dam. Neutralised

overflow will flow to the Queen River. Water pumped to the tailings dam will be typically 116.5 L/sec representing only 6% of total Queen River flow.

- East Queen water will be used in the underground workings for wash down, dust suppression, drill water and other uses and will then mix with ground water to become "mine water". This is pumped from the mine, and mixed with the tailings stream from the tailings thickener underflow as described above.

The proposed water management of the mining and milling operation includes a significant component of water recycling with a designated "process water" system being set up to allow this. The only water not being recycled is water from mine dewatering. This water is so rich in sulphates that recycling is not possible due to the severe scaling caused to pipework due to gypsum precipitation, and the affect of gypsum floc on the concentrating process. Nevertheless, as a result of various recycling operations within the plant the total water demand is no more for a 3.5 Mt/a plant than the MLMRC operation at 1.7 Mt/a.

During initial project evaluations the total recycling of mine water was considered. However, the sulphate content was found to preclude this for the reasons described above. Removal of the sulphate is technically difficult and prohibitively expensive. Dosing with high levels of calcium to precipitate gypsum, or pH and temperature control to precipitate jarosite, are possible options for sulphate reduction, but the procedure and degree of success is likely to be very chemistry specific. Apart from cost, these products pose disposal problems of their own, tending to scale discharge pipelines and potentially complicate tailings settlement behaviour if combined with tailings.

Analysis of water flows within the various parts of the water system has been carried out by Signet Engineering for various cases of mill throughput and dewatering flow from the 17 level pump station

Cases presented are

Case	Treatment Rate	Water Flow Rates
1	2 M tpa Treatment Rate, Stage 1 Dam,	mean dewatering flows
2	3.5 M tpa Treatment Rate, Stage 2 Dam,	minimum dewatering flows
3	3.5 M tpa Treatment Rate, Stage 2 Dam,	mean dewatering flows
4	3.5 M tpa Treatment Rate, Stage 2 Dam,	max dewatering flows

Values for mine dewatering and stream flows are based on information already presented in earlier sections

Results are summarised in Table 4.30

Table 4.30
Water Balance Results

Calculated flows		2 Mt/a average dewater	3.5 Mt/a minimum dewater	3.5 Mt/a average dewater*	3.5 Mt/a maximum dewater
E. Queen to Shaft Tank	W6	99.9	40.0	150.8	150.8
W. Queen to Mill Fresh	W9	30.5	10.1	10.1	10.1
Shaft Head Tank to FAG Mill	W10	67.9	118.8	118.8	118.8
Mine Water excess to neutralisation capacity	W1l	24.4	0.0	0.0	83.0
Mill Fresh to Process Water	W12	22.6	0.0	0.0	0.0
FAG Mill to Secondary Mill	W13	69.7	121.9	121.9	121.9
Process Water to Flotation	W16	49.7	86.9	86.9	86.9
Flotation Feed	W17	113.8	199.0	199.0	199.0
Concentrate Slurry to Thickener	W18	8.0	14.0	14.0	14.0
Flotation Plant Tailing	W20	155.4	271.8	271.8	271.8
Tailings Thickener U/F	W21	99.9	116.5	116.5	116.5
Discharge to Tailings Dam	W23	164.6	170.1	205.5	229.5
Treated Filtrate to Process Water	W24	7.2	8.9	8.9	8.9
Tailings Dam Decant to Valley Pumps	W25	0.0	0.0	0.0	0.0
Tailings Thickener Overflow	W26	58.4	160.5	160.5	160.5
Valley Pumps to Shaft Process Water	W28	0.0	110.8	0.0	0.0
Valley Pumps to Mill Process Water	W29	0.0	0.0	0.0	0.0
Process Water to Secondary Milling	W31	44.0	77.0	77.0	77.0
Concentrate Thickener O/F to Process Water	W32	5.5	9.5	9.5	9.5
E. Queen to Queen River	W33	889.1	0.0	838.2	24574
Tailings Dam Decant to Queen	W,34	142.1	0.0	0.0	0.0
Shaft Fresh to Shaft Process	W35	67.9	8.0	118.8	118.8
Total Flow to Queen	W36	1962	119.1	1780	48097
Water Retained in Tails Dam	W38	48.2	84.4	84.4	84.4
Tails Dam Decant Return	W39	142.1	0.0	0.0	0.0
Water to Flocculant for Thick	W40	2.9	5.1	5.1	5.1
Concentrate Thickener Underflow	W42	2.5	4.5	4.5	4.5
Acid drainage Neutralised by Tailings	W43	64.6	53.6	89.0	113.0
Valley Pump Station to Queen R	W44	906	119	942	23440
West Queen to Valley Pump Dam	W45	906	215	927	23425
Filtration Plant to Process Water	W46	12.7	18.5	18.5	18.5

* this case is depicted in Figure 4.42

4.3.4.12 Tailings Neutralisation Capacity

The tailings solids comprise essentially quartzose and carbonate rock particles with mica and between 5 and 10% pyrite.

CMT has initiated in-house routine NAG and ANC analyses of waste rock and ore from the mine. This will provide data to assist in investigations into both waste management and tailings neutralisation capacity. Work commenced in June 1995 and it is envisaged that a data base be set up from this work.

The net acid generation test (NAG) has shown that the sulphides in the tailings can form acid if exposed to oxidising conditions (EGI, 1994). However, the acid generation is effectively prevented where the tailings surface remains saturated. This has been confirmed in studies of tailings in the King River Delta (EGI, 1991) where tailings below the water table were found to be apparently "fresh" with high unoxidised sulphur content. Maintaining a water cover over tailings is the basis of various tailings disposal systems for acid drainage control in Tasmania and worldwide and is the planned method of operation at Princess Creek.

On the other hand, the Mount Lyell tailings have also been shown (EGI, 1994) to have a considerable acid neutralising capacity (ANC), due to the presence of carbonate and oxide minerals within the tailings solids. An initial ANC of 1.5 Kg $CaCO_3$/t and a longer term ANC of 13.3 Kg $CaCO_3$/t have been measured by the EGI in tests utilising an aggressive attack by a strong acid. Signet Engineering have more recently measured a neutralising capacity of 2.6 Kg $CaCO_3$/t in tests simulating realistic contact times with actual mine water.

Testing by EGI and Signet Engineering suggested that a lime equivalent of between 2.1 and 2.7 g/L was required to raise the pH of acid drainage to pH 6. Thus up to 1.0 Kg of tailings would be required to neutralise 1 litre of acid drainage. Subsequent testing by Graham Campbell & Associates reported by Imtech (Imtech, 1995) suggested the potential significant variation in ANC due to variations in ore mineralogy and degree of oxidation.

Mill production is due to commence in November 1995 with the recommissioning of the first mill stage. This will have a production capacity of around 230 t/hr but will initially be restricted to an average of 100,000 t/month as mine production develops. During early 1997 the mill capacity will be doubled to around 460 t/hr and production will continue to rise to a maximum of around 300,000 t/month, or 3,500,000 t/annum by mid to late 1997. The mill will be run on a batch, or "campaign" basis, with periods of shutdown, depending on ore availability and maintenance requirements. Particularly during the initial development period up to mid 1997 there will be periods of shutdown when no tailings will be produced. This could average 40% of the time during the first 6 months of operation. The staged increase in production and effective acid neutralisation capacity of the tailings is shown in Table 4.31.

The proportions of acid drainage that can be neutralised by tailings is shown in Table 4.32. Mine water flows referred to are pumping rates from 17 level during mine operations as previously described in Section 4.1.17. These data are based on mine water quality from MLMRC figures. Data on mine water quality, collected by CMT since April 1995, has cast some doubt on this data due to the apparently higher median acidity measured. However, as previously stated, the MLMRC data is still, statistically, the best long term data available.

It is now apparent that, at average mine dewatering rates, the tailings will not have sufficient capacity to neutralise all the mine water from the 17 level Pump Station until full production is reached by the end of 1997 and even then insufficient capacity will be available during infrequent, peak wet weather flows and possibly at other times as ore characteristics vary. Operational control should allow scope for utilisation of existing

pondage for temporary underground storage of mine water during short term mill shutdown and peak storm inflows. Additional pH adjustment may be required if all Pump Station output was to be treated.

During the mine establishment period between November 1995 and the end of 1997 a significant shortfall in neutralising capacity is available for the mine dewatering from 17 level pump station and significant operating costs would be involved in lime addition to fully neutralise the flow. The issue of relevant responsibility for all the acid drainage has been discussed previously. It is estimated that a lime equivalent of 2.6 Kg/L is required for 17 level dewatering neutralisation.

Table 4.31
Mill Production and Potential Acid drainage Neutralising Capacity

Period	Mill Production	Downtime (no tailings produced)	Acid Drainage Neutralisation Capacity when operating (L/s)
Nov 95 - May 96	1.2 Mt/a	40%	63 (230 t/hr)
May 96 - Dec 96	1.5 Mt/a	25%	63 (230 t/hr)
1997	2.5 Mt/a	25%	126 (460 t/hr)
1998 +	3.5 Mt/a	10%	126 (460 t/hr)

Table 4.32
Potential Acid drainage Neutralisation

Period	Proportion of acid drainage flow treated during mill operation			Overall proportion of acid drainage flow treated by tailings, allowing for Mill downtime		
	at minimum acid drainage discharge	at average acid drainage discharge	at maximum acid drainage discharge	at minimum acid drainage discharge	at average acid drainage discharge	at maximum acid drainage discharge
Nov 95 - May 96	100%	70%	<30%	60%	42%	<20%
May 96 - Dec 96	100%	70%	<30%	75%	52%	<22%
1997	100%	100%	<60%	75%	75%	<45%
1998 +	100%	100%	<60%	90%	90%	<54%

4.3.4.13 Proposed Management of Mine Dewatering

CMT believe that, under the CMT Act, it is legally responsible for only that component of acid drainage from the mine that is caused directly by its operation only, as discussed in Section 4.1.18.

Nevertheless, as the treatment of acid drainage using the available tailings is a responsible and relatively economic operation, it is CMT's long term plan to treat the pumped mine dewatering to the maximum practical extent once full production has been achieved subject to the conditions discussed later in this Section. However, the treatment of acid drainage with tailings does influence the quality of the final discharges of water from the plant as will be developed in Section 4.3.4.14. This may have an influence on the extent of acid drainage treatment that can be practically achieved.

CMT propose to continue operation of the existing underground pump station, at least in the short term. This comprises a treatment plant on 17 Level where solids are separated from the flow and raised to the surface via a "mud displacement" system using high pressure water rather than a pump. The clear water component is pumped to the surface from an underground pump station featuring 4 Sultzer pumps with a total capacity of 600 L/s. The mud component will be discharged directly to the mill for introduction to the ore stream and extraction of minerals. The clear fraction will be pumped to the tailings neutralisation circuit as shown on Figure 4.33.

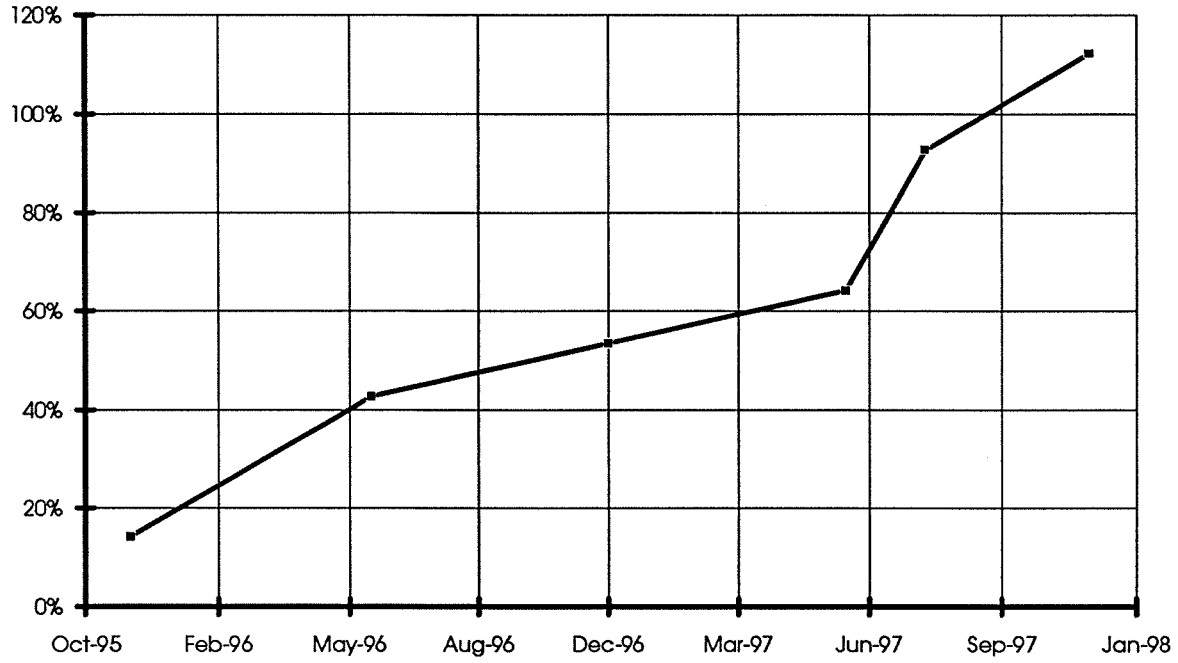
Figure 4.33 shows the proposed operation during initial mine development. Mine water would be pumped to a distribution system adjacent to the neutralising tank and only sufficient water drawn off that could be effectively neutralised by tailings production at the time. Excess mine water would be diverted to the Queen River. As previously described the mud from mine dewatering will be added to the mill in order to take advantage of its metal content and also to remove a significant source of metals from the tailings stream. Excess mud will be stored in a holding tank or pumped into the mine dewatering stream when the mill is not operating.

During the first 6 months of mine development, the proportion of mine dewatering that could be adequately neutralised by the tailings available would be limited to around 40%, with tailings being pumped to the Stage 1 tailings dam and all decant water returned to the Queen River.

Once the main Princess Creek Tailings Dam was ready, tailings would be diverted to the main dam and decant water would discharge to the Princess Creek. Initially the tailings volumes reporting to the dam will be very limited due to the limited production rate of the mill and expected gradual increase in availability of the mill as discussed in Section 4.3.4.12. Thus the dilution effect of the natural Princess Creek water will be significant. Mill production is expected to improve slightly due to increased efficiency over 1996 and most of 1997 with consequent slightly increased tailings discharge to the tailings dam. In late 1997 the mill capacity will be doubled and once the new mill is fully operational a significant increase in tailings discharge will result. At this latter stage the acid drainage neutralisation capacity is limited only by mill downtime except in extreme wet periods when mine dewatering reaches peak flow rates. The expected proportion of average 17

level pump station output able to be treated by contact with the tailings is shown in Chart 4.1.

Chart 4.1 Potential Tailings Neutralisation Capacity - Proportion of Average 17 Level Pump Station Output



The impact of this proposal on the water quality of Princess Creek is outlined in Section 4.3.4.14. and initial discussions on this have already been held with SDAC and their scientific advisers. As a result, SDAC has advised CMT that there is some doubt about appropriate levels of certain components in the discharge water due to the complexity of the water chemistry and its interaction with the receiving environment of Princess Creek. CMT has thus proposed that full implementation of the acid drainage treatment scheme, outlined above, will not take place until CMT is assured that the resulting water quality will be acceptable to achieve the objectives outlined for the Princess Creek. This will be achieved by taking advantage of the gradual increase in the levels of dissolved substances over the first two years of operation and by undertaking a program of chemical and biological monitoring of the actual performance of the scheme to confirm the desirability of proceeding to full treatment of Level 17 discharge by late 1997.

CMT's proposal to maximise treatment of Level 17 discharge is conditional upon the tailings treatment proposal described above being proven to be acceptable to the Government who will particularly need to take into account the effect of changes to water quality on Princess Creek due to treatment of acid drainage over and above CMT's liability. CMT is only liable for the proportion of the acid drainage from the Prince Lyell mine as previously discussed and as outlined in the CMT Act. Once the quantity of acid drainage to be treated by the tailings is identified, CMT should not become liable for any portion over and above their legal responsibility or suffer any financial burden for treating it.

4.3.4.14 Discharge Water Quality and Impact

The proposed mixing of tailings and acid drainage has been previously described. The tailings slurry alone comprises a mixture of fine grained minerals in an alkaline liquor containing a range of dissolved metallic salts, mostly at relatively low concentrations. The mineral content includes potentially acid neutralising carbonates together with potentially acid producing sulphides. However provided the tailings minerals are not allowed to oxidise, the acid generation capacity can be suppressed. The acid drainage on the other hand has percolated through oxidised rock material in the mine walls resulting in a liquor with low pH and high levels of dissolved metals.

The mixing of these two liquors results in neutralisation of the acid drainage. This has been shown by past study (EGI, 1991, internal Mount Lyell report) to result in precipitation of metals from the liquid. As pH rises, firstly iron at pH 3, then aluminium and copper, at around pH 4.2 to 4.5, are precipitated most likely as hydroxides or oxides.

The chemistry of the interaction between tailings solids, metal ions and cations and the latent acidity and alkalinity of the mixed solutions is very complex. Tests have been conducted on various blends of decant water from the tailings, acid drainage and natural catchment water to predict the resulting quality of water from

- the Tailing/Acid drainage Thickener
- the Stage 1 Dam, and
- the Future Main Dam

Initial testing looked at the tailings stream only. At discharge, the tailings water has a high pH and slightly elevated levels of sulphate and some metals. Changes of composition with time have been measured. The results are presented in Table 4.33 and show a tendency for decrease in pH (to around neutral levels), alkalinity and iron with the ageing and stabilisation of the mixture. Sulphate concentrations remain relatively constant.

Table 4.33 Composition of Tailings Decant Water Trials

Units : mg/litre except pH and conductivity (uS/cm).

RESULTS OF MOUNT LYELL TAILINGS SETTLING TESTS- ANALYSIS OF CLEAR DECANT WATER

TEST 1.

SAMPLED ON: 8 SEPT 1994. Initial pH 9.8 Analysis of supernatant after 17 days settling.

pH	6.1
Sulphate	330
Chloride	20
Sodium	12
Potassium	42
Calcium	140
Copper	0.006
Lead	0.03
Iron	0.05
Zinc	0.01
Magnesium	3.3

TEST 2. SAMPLED ON 5 OCT. 1994

	24 hrs	26 hrs	37 hrs	47 hrs	119 hrs	336 hrs	408 hrs
pH	10.3	10.2	10.1	9.8	7.8	6.2	7.3
Cond.	750	-	770	770	790	850	980
Sulphate		300	300	300	300	370	430
Calcium		120	120	120	130	130	170
Alkalinity		41	39	37	26	5	5
Iron		0.50	0.39	0.19	0.13	0.15	0.06
Copper		0.02	0.02	0.02	0.02	0.02	0.02
Aluminium	0.97				0.40		

A similar result was noted by Graeme Campbell & Associates (GCA) in more recent test work carried out using both 2 month old tailings and laboratory produced slurries of ground ore (GCA, 1995). The pH of tailings stored in airtight, sealed drums was found to have dropped from 10.0 - 10.5 to 6.8 -7.3 after 2 months. GCA suggested that this phenomenon related to a degree of sulphide oxidation, absorption of atmospheric CO_2 and a continuing consumption of OH^- ions at the surface of the oxide and silicate minerals. However only 0.2 to 0.3 kg $Ca(OH)_2$ per tonne lime demand was required to restore the pH to 10.3 compared to the 2 Kg/tonne required to adjust the pH of the original fresh ore.

Further tests have been carried out to evaluate the effect of adding mine discharge water in various proportions. Sample B of initial tests by Thompson & Brett, contained in the Stage 1 Tailings Dam DPEMP (T&B, 1994) reasonably closely mirrors the expected Stage 1 dam operation conditions.

Table 4.34 Mix Proportions - Acid drainage/Tailings/Catchment Water

Mix No	Acid drainage	Tailings Water	Catchment Water
Sample B	20%	54%	26%

The results of these tests are presented in Table 4.35

Table 4.35 Analysis Results - water mixes Thompson & Brett
units: mg/L except conductivity (uS/cm and pH)
Alkalinity as calcium carbonate equivalent.

Sample	pH	Cond	Cu	Fe	SO4	Alkalinity
Acid drainage	2.74	2060	44	260	1800	Nil
Tailings	9.2	1380	0.01	0.06	750	24
Princess R	4.7	60	0.02	0.12	<15	5
Mix B						
t=0	6.04	1080	0.22	0.69	630	13
t=12 hrs	6.95	1080	0.09	0.14	570	18
t=36 hrs	7.1	1120	0.03	0.03?	600	20
t=60 hrs	6.97	1130	0.02	0.1	750	23
t= 7 days	6.7	1250	0.02	0.12	630	18
t= 14 days	6.81	1560	0.02	0.18	900	20

GCA looked at various mixes which have been fully reported (GCA, 1995). The most representative results are described as follows

A	Full Production, average mine dewatering, average creek flow, manufactured tailings ground with lime.
B.	As above, manufactured tailings ground without lime.
C	As above, but with aged tailings, pH adjusted
D	Full Production, worst case, maximum mine dewatering, average creek flow, manufactured tailings ground without lime.
E	As above, but with aged tailings, pH adjusted

The approximate mix proportions, as shown in Table 4.36, were based on the water balance figures previously described in Section 4.3.4.11. Other cases are shown to demonstrate the reduced proportion of acid drainage in Stage 1.

Table 4.36

Case	Description	Tailings % Solids	Pumped Acid drainage % Mix	Tailings Liquor % Mix	Catchment Water % Mix
	Stage 1, Average	40	41	47	12
	Stage 1, Worst	40	34	62	4
	Stage 2, 2mtpa plant, average	50	3	4	93
	Stage 2, 2mtpa plant, worst	50	6	4	90
A,B,C	Full Production, Average	50	6	8	86
D,E	Full Production, Worst	50	11	7	82

Various water quality measurements were made on the mixed samples as summarised in Table 4.37

Table 4.37: Results of Tests on Mixtures of Tailings Slurry, Acid drainage and Princess-Creek Water, ex Graeme Campbell & Associates

Note: All results in mg/L, except for pH and EC (µS/cm).

WATER SAMPLE	pH	EC (µS/cm)	Cu		Fe		Mn		Cd		Al		Ni		Co		Zn	
			Tot.	Filt.	Tot.	Filt.	Tot.	Filt.	Tot.	Filt.	Tot.	Filt.	Tot.	Filt.	Tot.	Filt.	Tot.	Filt.
Mine Water	2.6	5,700	120	nm	280	nm	200	nm	0.052	nm	140	nm	0.60	nm	3.6	nm	17	nm
Creek Water	4.7	60	nm	0.004	nm	<0.05	nm	<0.05	nm	<0.001	nm	0.2	nm	<0.01	nm	<0.01	nm	<0.01
Tailings Water	8.8	3,300	nm	0.004	nm	<0.05	nm	0.05	nm	<0.001	nm	0.2	nm	<0.01	nm	<0.01	nm	<0.01
Test A (Stage 2: Average-Case [Ore Ground With Lime])																		
Decant	6.3	1,600	0.13	0.001	1.8	<0.05	7.4	55	0.001	0.002	0.6	<0.1	0.08	0.06	0.33	0.29	0.07	0.05
1-2 hours	6.4	530	0.46	0.004	2.9	<0.05	3.7	3.0	0.001	0.002	1.6	<0.1	<0.01	<0.01	<0.01	<0.01	0.04	<0.01
1 day	6.7	590	0.027	0.003	<0.05	<0.05	3.9	3.2	0.001	<0.001	0.3	<0.1	<0.01	<0.01	0.01	<0.01	0.04	<0.01
6 days	7.6	nm	0.07	0.005	0.15	<0.05	3.8	4.0	0.002	<0.001	0.2	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
9 days	7.3	890	0.03	0.007	0.20	<0.05	4.0	4.0	<0.001	<0.001	0.2	<0.1	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Test B (Stage 2: Average-Case [Ore Ground Without Lime])																		
Decant	5.8	4,500	0.060	0.030	27	2.4	83	70	0.003	0.002	1.2	0.6	0.16	0.15	0.74	0.71	0.62	0.58
1-2 hours	6.0	560	0.20	0.003	2.6	0.45	7.0	5.6	<0.001	0.001	1.2	0.1	0.01	<0.01	0.01	0.02	0.09	0.05
1 day	6.0	610	0.027	0.002	0.25	<0.05	7.0	6.0	0.002	<0.001	0.3	<0.1	0.02	<0.01	0.02	0.02	0.07	0.01
6 days	7.2	nm	0.05	0.006	0.15	<0.05	8.0	8.6	0.005	0.001	0.1	<0.1	0.02	<0.01	0.03	<0.01	0.03	0.03
9 days	6.8	860	0.08	0.007	0.20	<0.05	8.9	9.0	<0.001	<0.001	0.2	<0.1	0.03	<0.01	0.03	<0.01	0.01	0.02
Test C (Stage 2: Average-Case [Aged Tailings With Adjustment of Initial pH of Test Mixture])																		
Decant	6.9	3,500	nm	0.002	nm	0.25	nm	45	nm	<0.001	nm	0.1	nm	0.017	nm	0.07	nm	0.06
1-2 hrs	6.9	480	nm	0.011	nm	<0.05	nm	3.3	nm	<0.001	nm	<0.1	nm	0.006	nm	0.01	nm	0.02
1 day	6.6	670	nm	0.012	nm	<0.05	nm	3.4	nm	<0.001	nm	<0.1	nm	0.007	nm	0.01	nm	0.02
6 days	6.7	nm	nm	0.011	nm	<0.05	nm	5.0	nm	<0.001	nm	<0.1	nm	0.002	nm	0.02	nm	0.01
23 days	7.0	1,600	nm	0.08	nm	<0.05	nm	8.2	nm	<0.001	nm	<0.1	nm	<0.01	nm	0.03	nm	0.01
43 days	7.0	2,000	nm	0.013	nm	<0.05	nm	15	nm	<0.001	nm	<0.1	nm	<0.01	nm	0.06	nm	0.01
Test D (Stage 2: Worse-Case [Ore Ground Without Lime; Adjustment of Initial pH of Test Mixture])																		
Decant	6.0	5,000	0.11	0.003	3.8	1.4	96	77	0.001	0.001	0.6	<0.1	0.13	0.12	0.46	0.43	0.22	0.18
1-2 hours	6.2	680	0.52	0.002	3.1	<0.05	9.8	7.8	0.001	<0.001	1.7	<0.1	0.01	<0.01	0.04	0.04	0.10	0.05
1 day	6.3	760	0.020	0.003	<0.05	<0.05	11	8.7	0.002	<0.001	0.3	<0.1	0.02	<0.01	0.04	0.04	0.08	0.03
6 days	7.2	nm	0.03	0.006	0.10	<0.05	11	11	0.002	0.002	0.1	<0.1	0.01	0.01	0.03	0.03	<0.01	<0.01
9 days	6.8	1,100	0.03	0.006	0.10	<0.05	13	12	0.002	<0.001	0.2	<0.1	0.02	<0.01	0.03	0.04	0.01	0.03
Test E (Stage 2: Worse-Case [Aged Tailings With Adjustment of Initial pH of Test Mixture])																		
Decant	6.6	4,100	nm	<0.001	nm	0.65	nm	76	nm	0.006	nm	0.2	nm	0.09	nm	0.29	nm	0.17
1-2 hrs	6.3	420	nm	0.025	nm	<0.05	nm	4.0	nm	<0.001	nm	<0.1	nm	0.002	nm	0.02	nm	0.06
1 day	6.5	560	nm	0.020	nm	<0.05	nm	5.1	nm	<0.001	nm	<0.1	nm	0.007	nm	0.02	nm	0.04
6 days	6.6	nm	nm	0.017	nm	<0.05	nm	9.4	nm	<0.001	nm	<0.1	nm	0.008	nm	0.03	nm	0.03
23 days	6.7	1,900	nm	0.11	nm	<0.05	nm	19	nm	0.001	nm	<0.1	nm	0.03	nm	0.10	nm	0.05
43 days	6.4	3,300	nm	0.10	nm	<0.05	nm	36	nm	<0.001	nm	0.1	nm	0.02	nm	0.17	nm	0.14

Note: EC = Electrical Conductivity; Tot. = Total; Filt. = Filtrable; nm = not measured.

The testing by GCA using the aged tailings required pH adjustment with lime due to the age of the tailings. The pH of the fabricated slurries was also adjusted with lime to simulate the pH expected following the concentrating process.

GCA concluded that, provided the tailings/acid drainage mixtures remained at pH 6.5 or greater, most metals were effectively precipitated.

The predicted indicative concentrations of filterable-metal forms and sulphate at pH 6.5 suggested by GCA, assuming maximum acid drainage treatment, are

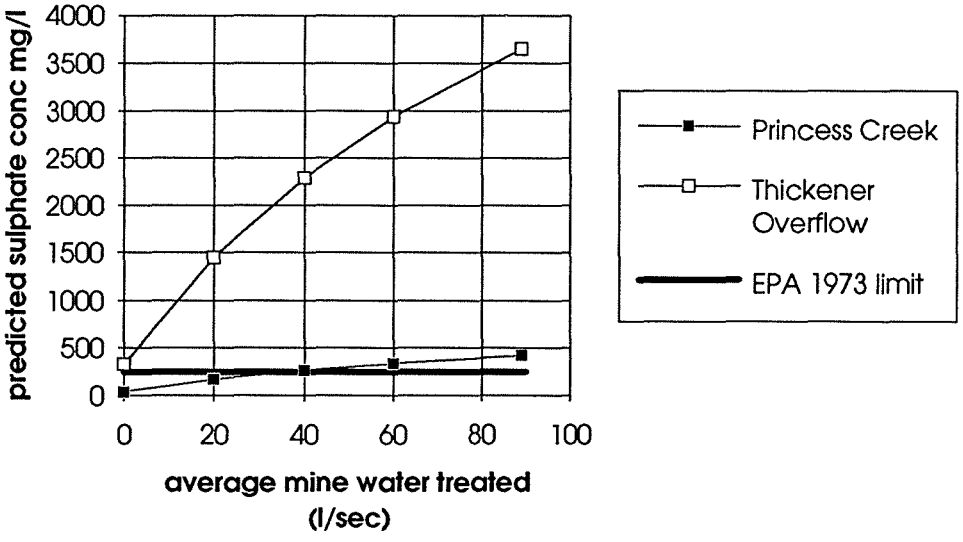
all results in mg/L

Location	Filt. Cu	Filt. Fe	Filt. Mn	Filt. Cd	Filt. Al	Filt. Ni	Filt. Co	Filt. Zn	SO_4
Thickener (to Queen R)	<0.03	<1	50 - 100	.002	<0.6	<0.15	<0.70	<0.20	<4000
Tailings Dam (to Princess Ck.)	0.02	0.10	5 - 20	.002	0.1	0.02	0.05	0.05	<400

Testing showed that metal levels could be reduced by neutralisation of mine dewatering by mixing with tailings. However sulphate levels were unaffected, other than by dilution.

Considering only the treatment of CMT generated acid drainage naturally results in reduced concentrations of sulphates. Chart 4.4 shows the predicted sulphate content in discharges to Princess Creek and Queen River for various flow rates of Level 17 pump station water.

Chart 4.4
Discharge Sulphate Content v's Acid drainage Treated



Close examination of the test results from both Thompson & Brett and GCA show a tendency for a decrease in pH and an increase conductivity, Mn and SO_4 after a period in excess of 30 days aging of the mixes. Campbell suggests this is due to a continuation of sulphide oxidation within the tailings due, most likely to the shallow nature of

submergence of the test specimens and not necessarily representative of actual conditions.

Table 4.38 provides a comparison of relevant ambient criteria including the ANZECC Water Quality Guidelines, Tasmanian Water Quality Regulations, the results derived from analysis of ambient water samples in Princess Creek, and the trial results of the supernatant tailings water. The predicted water quality for discharges from the tailings thickener and Princess Creek Dam are based on maximum treatment of acid drainage. Predicted water quality for these flows if CMT restricted treatment to its legal responsibility would be of higher standard. Water quality predictions for this case have been presented for comparison. These have been based on CMT's acceptance for responsibility for 20 litres/sec of acid drainage, believed to be the potential longer term component of water that could be attributable to their operations.

Chemical residuals in the discharge are expected to be undetectable. The copper promoter Di- Allyl Thionocarbamates is used in small amounts and is absorbed to the mineral particles thus remaining in the concentrate. Levels in tailings are normally undetectable and would tend to be retained in the solid component. Frother, an ester of an aromatic acid, does tend to remain in the tailings at levels of a few parts per million. This degrades to CO_2 and water and should be undetectable in return water.

Table 4.38
Comparisons of Ambient Criteria with Dam Supernatant Water

A Water Quality Standards

Units milligrams per litre (except pH)

Source	pH	Fe	Cu	Al	Zn	Mn	Hg	Pb	Ca	DOC	SO4	TSS
*ANZECC (1992) Protection of aquatic ecosystems - Fresh Waters**	*6.5 -9.0*	*1*	*0.002 - 0.005*	*<0.005 pH<6.5*	*0.005 - 0.05*	-	*0.0001*	*0.001 - 0.005*	-	-	-	*<10*
Tas. Regs. 1973 Env. Protection Act	-	*1 (+Mn)*	*1*	-	*5*	-	*0.002*	*0.05*	-	-	*250*	*30*

* not directly applicable to Tasmanian freshwaters due to various issues as discussed in the text

B Predicted Ambient Water Quality

Units milligrams per litre (except pH)

Source	pH	Fe	Cu	Al	Zn	Mn	Hg	Pb	Ca	DOC	SO4	TSS
East Queen	4	2.4	1.18	2.6	-	0.59	-	-	-	-	46	12
West Queen/ Princess Ck	4.4 - 7.2	.24 -0.6	0.007- .04	0.8-29	<0.01	<0.3	<0.001	<0.008	2	9	6 - 144	<44
Predicted Queen River	<4	92	17	40	1.6	19	<0.001	<0.008	-	-	775	46

C Predicted Discharged Water Quality

Units milligrams per litre (except pH)

Source	pH	Fe	Cu	Al	Zn	Mn	Hg	Pb	Ca	DOC	SO4	TSS
Typical Untreated Acid drainage	2.7	500	200	200	16	160 - 400	<0.001	0.12	150	0	4000 - 8000	200* - 15000
Primary Tailings Thickener overflow-recycled to process	11	0.5	0.02	0.6	0.01	0.05	<0.001	0.03	200	0	315	<30
Predicted Secondary Tailings Thickener Discharge - to Queen max acid drainage treatment	6.0 - 9.0	0.1	0.02	0.1	0.1	5 - 10	<0.001	0.01	180	0	4000	<30
Predicted Secondary Tailings Thickener Discharge - to Queen CMT acid drainage only	6.0 - 9.0	0.1	0.02	0.1	0.1	5 - 10	<0.001	0.01	180	0	1500	<30
Predicted Dam Decant - To Princess Creek** max acid drainage treatment	6.0 - 7.3	0.1	0.02	0.1	0.1	5 - 10	<0.001	0.01	20	10?	500	<10
Predicted Dam Decant - To Princess Creek** CMT acid drainage only	6.0 - 7.3	0.1	0.02	0.1	0.1	5 - 10	<0.001	0.01	20	10?	180	<10

* with "mud" removed
** at full production, dilution for 2mtpa plant approximately doubles

As can be seen in Table 4.38 it is believed that the predicted discharges from the Princess Creek tailings dam meets the current Tasmanian Regulations under the Environment Protection Act, 1973 if only the CMT generated acid drainage was treated. With maximum acid drainage treatment discharge from the dam and from the tailings thickener, would comply in all areas except for the levels of sulphate. The critical issue

to be determined is the effect of this discharge on the ecology of Princess Creek and whether the Government accepts this level of discharge and its possible effect on the objectives for Princess Creek as defined by SDAC.

A study of the effects of discharges to both the Princess Creek and the Queen River has been undertaken by Mr Peter Davies of Freshwater Systems Pty Ltd (Davies, 1995). The following is a summary of that report.

Mr Davies saw two ways in which the decant water from the proposed tailings dam on Princess Creek could affect its channel form or biota, namely by changes in water quantity (flow regime) and quality (chemistry).

Flows downstream of the Tailings Dam will be enhanced by a mean annual discharge of around 120 L/sec additional to the natural catchment yield averaging 765 L/s with a median of 200 L/s. The distribution of flows will thus change, with some enhancement of low flows (of the order of 50-80%). Similarly, the magnitude of median flows may also change depending on the manner in which the releases are controlled at the Dam. Overall, the effect of the Dam will be to reduce the incidence of moderate floods and enhance the discharge during dry periods, relative to the natural flow regime. Changes in the flow regime will not be sufficiently great as to result in any erosion or significant change in channel form. Alterations to flow may therefore, given that low toxicity and high water quality were maintained, have a beneficial effect by maintaining flows during dry conditions.

Water quality data available has been compared with current guideline threshold values proposed for the protection of aquatic ecosystems (ANZECC 1992). There is no ANZECC (1992) guideline value available for manganese or sulphate. Results of a literature search of aquatic ecotoxicological data on manganese and sulphate are presented in Table 4.39.

Table 4.39
Proposed threshold limits as 10% of 96 hr LC 50 (50% mortality) from various sources

Substance	Proposed Threshold
Manganese	3 mg/L
Sulphate	700 mg/L

Current levels of all analytes in Princess Creek are relatively low, with the exception of aluminium which is likely to be enhanced due to the relatively acid conditions of the naturally humic water.

Under low flow conditions, concentrations of Cu, Al and Zn will significantly exceed current guidelines for the protection of aquatic ecosystems (ANZECC 1992) or of toxic thresholds.

Davies suggests that the significance of these is markedly reduced when the impact of the presence of humic acids on the bioavailability of the metals is considered. He

reports that studies conducted by Sanger and Davies (Sanger 1993), Koehnken and Davies (Koehnken 1992) indicate that:

- a high degree of complexation occurs for Cu, Zn, Hg and Mn in humic waters typical of the west coast region;
- this complexation is due to binding with humic acids;
- the toxicological responses of fish both in laboratory and in field trials indicate that only the uncomplexed fraction of dissolved metals is toxic;
- that the bioavailability of these metals is reduced by up to 99% for Cu, 75% for Zn, 50 - 65% for Mn and would be high for Hg.

Davies proposes that ANZECC (1992) water quality guideline values are intended only to be indicative values (Davies, 1995) and are generally based on results of overseas studies of ecotoxicological responses assessed in non-humic waters. He suggests that it is widely recognised that the presence of significant concentrations of humic acids reduces the potential for metal toxicity and other effects on aquatic ecosystems, especially for 'hard' Lewis-acid type metals such as Hg and Cu. This has a significant impact on the manner in which ANZECC (1992) guidelines should be used in streams of western Tasmania (Koehnken 1992).

Davies has proposed revised threshold concentrations are shown in Table 4.40, compared to ambient and predicted Princess Creek concentrations. These allow a degree of complexing due to the influence of humic acids. However, the extent of availability of humic acids in the tailings dam is currently unknown and there is some doubt regarding the actual final concentrations. This is discussed in some detail later in this Section.

Predicted copper concentrations do not significantly exceed Davies revised threshold values, allowing for complexation.

Table 4.40. Revised threshold, current ambient and predicted metal concentrations for Princess Creek.

Metal	Concentrations in toxic equivalents*			
	Revised threshold conc.(ug/1)	Background conc. (ug/1)	Concentration at median Q (ug/1)	Concentration at low Q (ug/l)
Cu	40 - 100	9	20	80
Al	8	**300**	**100**	**400**
Zn	250**	< 10	100	**400**
Mn	5	-	5 - 10	**20 - 40**
Hg	0.5	< 2	**10**	**40**

(Figures in bold exceed threshold concentrations)

* Threshold values derived from ANZECC (1992) and for Mn have been increased by factors of 20 (Cu), 5 (Zn and Hg) or 1.67 (Mn and Al), see above. ** Threshold value based on 50 mg/l criterion for soft water with low complexing capacity of Hart (1982) cited in ANZECC (1992).

Aluminium concentrations predicted for Princess Creek markedly exceed ANZECC (1992) guideline values, even when complexation is taken unto account. However, current ambient levels are higher than predicted for the decant water. The relative abundance and diversity of macro invertebrates in Princess Creek suggest that Al toxicity is not a major problem and that changes due to decant water discharge are not likely to be an environmental concern.

Zinc and manganese concentrations predicted for Princess Creek exceed revised threshold concentrations under low flow (95 percentile) conditions. Zinc concentrations of 400 ug/l are toxically equivalent to 80 ug/l (after adjustment for 80% complexation). Such concentrations have been associated with toxicological effects on invertebrates (USEPA, 1987) but only over prolonged periods, but not with lethal toxic effects. The effects of such concentrations, occurring only during low flows, are unknown but are not likely to have a major impact on the stream ecosystem.

Manganese concentrations at low flow of 20 - 40 mg/l, equivalent to 12 - 24 mg/l when taking complexation into account, are likely to have short term effects on freshwater algae, but are unlikely to have effects on fish or invertebrates.

In view of the importance of complexation to Davies predictions a meeting of technical experts, required at the request of SDAC following submission of the draft EMP, took place on 2 April 1995. The purpose of the meeting was to attempt to resolve the issue of the potential discharge into the Princess Creek from the CMT tailings dam.

Scientific experts, representing both CMT and SDAC, provided advice to assist with the discussions on the interaction of tailings dam decant and the catchment water from Princess Creek. The outcome of the meeting was that:

the SDAC scientific subcommittee was of the opinion that the water quality predicted at the tailings dam outflow, once full production is reached and all water discharged from the Level 17 Pump Station is being treated, may have a detrimental effect on the ecology of the creek downstream of the dam. This is due to some doubt as to the actual complexing effect of humic acids in Princess Creek, once the dam is operational. There is insufficient evidence, at this stage, to evaluate the position either way.

Much of the data, required to make confident predictions or carry out possible modelling on the complexing capacity to confirm Dr Davies predictions, was judged to be either not available or insufficient at this time.

SDAC has already advised CMT that the objective for Princess Creek should be to maintain water:

- "which will support a healthy (although not necessarily pristine) aquatic ecosystem" and
- "is aesthetically acceptable and suitable for secondary contact recreation"

In addition SDAC has advised that compliance with the ANZECC Guidelines for the protection of aquatic ecosystems should be adequate to achieve these objectives. However, the present water quality in the Princess Creek does not in itself satisfy these ANZECC Guidelines and it is considered that it will not be possible for the tailings dam

discharge to meet these criteria. However it is considered that it will be possible to meet the standards of the EPA, 1973 for most parameters.

To resolve SDAC subcommittee's concerns as outlined above, it was agreed that additional study was required of the effect of the tailings dam discharge on the waters of Princess Creek. The treating of water from 17 Level pump station with the tailings is responsible for a significant proportion of contaminants in the dam discharge water. Water quality can thus be controlled to a certain extent by limiting the proportion of this water treated until further clarification of this issue is provided.

The staged increase in tailings discharge to the Princess Creek Tailings Dam and the predicted quality of discharge water at full production have been previously discussed in this Section. Table 4.41 shows the predicted water quality if no acid drainage was added to the tailings system. This suggests that, without the addition of level 17 water to the tailings, the discharge from the tailings dam can achieve water quality of a similar standard to that already existing in Princess Creek for most parameters. Sulphate and calcium are within the same order of magnitude. ANZECC Guidelines do not provide a sulphate figure for protection of aquatic ecosystems and the available literature does not indicate that a sulphate discharge of the level proposed would be likely to present a problem. The situation is likely to be similar for calcium. It is suggested that these levels of calcium and sulphate are unlikely to compromise the objective for Princess Creek as detailed by SDAC.

Table 4.41 Predicted Water Quality
Case A -No Acid drainage

Date	Average Tailings Water to Princess Creek Dam L/sec	Average Acid drainage to Tailings Pond L/s	Average Princess Creek Water to Dam Pond L/s	Cu	Al	Pb	SO4	Ca
Dec 95	0	0	895					
June 96	15	0	895	0.009	0.304	0.008	13.1	3.8
Dec 96	18	0	895	0.01	0.305	0.008	14.3	4.3
Jun 97	22	0	895	0.01	0.306	0.009	15.6	4.9
Aug 97	36	0	895	0.01	0.310	0.009	20.5	7.0
Dec 97	43	0	895	0.01	0.312	0.009	23.0	8.0

The long term objective of CMT is to utilise the tailings in the treatment of the maximum possible acid drainage from the level 17 pump station as described previously. Whilst at a minimum, CMT would treat all the acid drainage attributable to CMT's operations and for which it is liable, the more desirable objective, under BPEM, would be to treat the maximum quantity of level 17 water without compromising the ecology of Princess Creek. Table 4.42 shows that during the period of operation prior to increasing production to 3.5mta (ie until approximately June 1997), approximately 60% of the average discharge from Level 17 pump station can be treated without seriously affecting the discharge water quality from the dam. Again, sulphate and calcium levels are higher than the present levels in Princess Creek.

Table 4.42
Predicted Water Quality
Case B - up to 60% Acid drainage

Date	Average Tailings Water to Dam Pond L/sec	Average Acid drainage to Tailings Pond L/s	Average Princess Creek Water to Dam Pond L/s	Cu	Al	Pb	SO4	Ca
Dec-95	0	0	895					
Jun-96	7.5	7.5	895	0.009	0.300	0.008	43.61	4.345
Dec-96	9.0	9.0	895	0.009	0.300	0.008	52.34	5.018
Jun-97	11.0	11.0	895	0.009	0.300	0.008	61.01	5.686
Aug-97	25.2	10.8	895	0.009	0.304	0.008	64.93	8.691
Dec-97	32.4	10.6	895	0.010	0.306	0.008	66.85	10.15

It must be recognised that treatment of the level 17 water would be on the basis of treating the maximum possible water during production cycles at the mill and with no treatment of acid drainage when the mill was not operating, as already described in this EMP, since the mill will operate intermittently until the facilities are duplicated in line with the push to full production.

CMT would, during the period of operation of the Stage 1 dam, carry out a monitoring program to characterise the effect of the discharge quality on the waters of Princess Creek. This program would include the use of a pilot wetland system as a potential polishing mechanism for the tailings water. Once the results of this monitoring program are available the Government can make a decision on whether or not the anticipated discharge water quality is acceptable

While the long term impacts of tailings dam decant appeared to Dr Davies, to be minimal, subject to confirmation as described above, he saw that the short to medium term impacts of dam construction on the ecosystem and water quality of Princess Creek may be highly significant. Releases of large loads of sediment resulting from drilling, blasting and dam and road construction can have severe impacts on streams. He suggested that great care should be taken to avoid significant sediment inputs into Princess Creek during the construction phase of the Stage 2 dam.

Complete diversion of Tailings Dam decant out of Princess Creek would reduce flows by some 70 - 80% (over the range from median to 98 percentile low flows). Mr Davies suggested that, for maintenance of moderate to good in-stream habitat, some 30 - 50% of the mean annual flow should be maintained in a stream (Tennant 1976). In Princess Creek this represents some 230 - 380 l/s.

Removal of the tailings dam decant from the catchment would leave a significantly lower the flow range to one below that recommended using the Tennant method. Davies suggested this reduction in flow would have significant negative impacts on stream biota, especially under low flows.

Davies stated that the Queen River is in a seriously degraded state, resulting from discharge of mine tailings, acid drainage and raw sewage as well as enhanced sediment loads emanating from eroded slopes of the West Coast range. Previous sampling of the Queen River has revealed high loads of sediment and metals. Biological sampling has confirmed the absence of macro invertebrates, consistent with the highly toxic nature of the Queen River during the operations of the Mount Lyell Mining and Railway Company. Davies suggested that the ecological values of the Queen River have been degraded to a point unattained by any other Tasmanian surface water and the river is extreme need of remediation.

Even with the addition of some relatively clean acid drainage released after tailings thickening, Davies suggested that the Queen downstream of the East-West Queen junction will still have a pH < 4 and Cu concentrations in excess of 15 mg/l associated with a high sulphate concentration. These values indicate extremely toxic conditions. The predicted Cu concentrations in the Queen River will still be some 30 - 400 times the LC50 values for Australian freshwater species and some 3,000 - 7,500 times recommended threshold levels. These high Cu concentrations are the result of drainage from a range of sources including exposed ore, tailings dumps, drainage from old adits (eg. via the East Queen) etc. and are not the result of proposed Copper Mines of Tasmania operations. Some other contaminant concentrations will also be in toxic concentrations (Zn, Al,) but the toxicological effect of Cu will be overriding. It should also be noted that the efficacy of complexation by humic acids under the predicted conditions will be greatly reduced due to the low pH and high sulphate concentration (the above comparative calculations were made disregarding the effect of humic acid complexation).

Discharge of the relatively small volume of tailings decant into the Queen at the West-East Queen junction (approx. 90 L/s compared with the 520 L/s median flow) will marginally reduce the ambient copper concentration (eg. from around 20 to 15 mg/1).

Even the apparently high level of sulphate in the thickener discharge is insignificant when mixed with the Queen River, potentially raising the sulphate concentration at Queenstown from a level of around 775 mg/L, already over the threshold level, to around 1200 mg/L.

Discharge of Princess Creek water (containing Tailings Decant) into the lower Queen River, will reduce the Cu concentration by around 25% (eg. from around 15 to 11 mg/l), but the toxicity and pH of the lower Queen will still be extreme.

In summary, Davies suggested that Princess Creek has low to moderate conservation value. It contains no currently recognised or threatened aquatic taxa and its macro invertebrate fauna, although abundant and diverse, is common with other streams in the area.

Modifications to the flow regime in Princess Creek caused by tailings dam decant will not be significantly harmful to the stream, and can be manipulated to partially mimic natural flows, depending on the final operating procedures for the Dam.

It was Davies opinion that Tailings Dam decant water would not appear to adversely affect the water quality of Princess Creek, other than for moderately high zinc and manganese levels which may occur for short periods (5% of the time) during low flows. However, as outlined above, following discussions with SDAC, this position has been modified to take a more precautionary approach and confirmation of his predictions will occur during initial operations prior to the higher production levels being achieved.

Transfer of tailings dam decant flows out of the Princess Creek basin would have significant negative impacts on the biota of Princess Creek due to the major reduction in flows.

Discharges of Princess Creek (with tailings dam decant) and post-tailings thickening water into the Queen River will have some slight ameliorative impacts on current water quality, which will continue to be dominated by extreme acid and heavy metal contamination from other sources not directly associated with the operations of Copper Mines of Tasmania.

Predictions of water quality indicate that the Queen River will maintain a low pH and high levels of copper and other metals, which will continue to make aquatic life unsustainable.

Davies has proposed a monitoring program to be established in Princess Creek and in the Queen River with appropriately designed sampling frequencies for the assessment of changes in water quality and ecological health. The monitoring will conform to a BACIP(Before After Control Impact Policy) design so that stream ecological health assessment can be integrated within the larger framework of the current National River Health Program, which has established a network of reference and monitoring sites on the West Coast, and so that results of sampling conducted to date can also be incorporated.

Other potential sources of water quality reduction are from dam seepage and accidental tailings spillage.

The dam design has been specifically conservative with regard to seepage minimisation. Nevertheless a seepage collection system has been included to allow pump back of seepage should this be found to be significantly contaminated.

To minimise potential for accidental tailings spills the tailings pipeline has been designed to resist damage from vandalism and features control systems to minimise spills and to control any spills that may occur. Pumps will automatically shut down on loss of pressure or flow and check valves will be provided in the line to control backflow. The pipe vertical alignment allows dewatering to defined bunded areas. Pipes will feature quick action, "victaulic" joints which will allow easy pipe rotation to spread wear and routine inspections of pipe wall thickness using electronic measuring devises will be made to monitor corrosion and wear. Daily visual inspections of the pipe route will be included as routine operating procedures.

The discharge point of the tailings pipeline will be positioned so that all tailings will be able to be flooded by water on decommissioning of the tailings dam. In this way oxidation of the potentially acid producing materials will be prevented.

4.3.5 Concentrate Transport

The intended procedure for the transport of concentrate to the Burnie wharf is to transfer the material by road to Melba Flats where it will be loaded onto rail and delivered directly to the Burnie wharf.

Concentrate will be transferred from the processing area to a storage area by a short conveyor. The storage area is an enclosed shed, with concrete sided. Front end loaders will be utilised to arrange the concentrate in a manner to ensure maximum efficiency in loading trucks. Apart from ensuring all personnel obey health and safety regulations no additional environmental measures are considered necessary due to the procedures taking place in an enclosed area. The concentrate will have a moisture content of about 9% resulting in no anticipated dust problem.

The product will be loaded onto trucks and transported to Melba Flats for on-forwarding by rail. The likelihood of spillage from loaded trucks will be minimised by compliance with maximum permitted loadings and by particular attention to tailgate mechanisms to ensure spillage from faulty operation does not occur. Trucks will also be covered by tarpaulins.

The Melba Flats rail depot is owned and operated by the Emu Bay Rail Company and activities there will be the responsibility of that Company. However a brief description of the proposed activities is described below.

Trucks, carrying the concentrate from Queenstown, will tip into stockpile bins, located in a shed at Melba Flats. Front end loaders will load the rail wagons, which will be aligned adjacent to the bins for ready access, and each wagon muled into position for loading. All wagons are fitted with covers which remain in position until discharge takes place at the Burnie Wharf. As with the truck loading facility at Queenstown, apart from ensuring health and safety regulations are observed, no additional environmental measures are contemplated.

Following rail transport to the Burnie wharf, the concentrate will be discharged into the existing handling facilities, by rotating the railway wagons, and stockpiled by a conveyor system prior to being loaded onto a ship, also by conveyor, fed by front end loader. Ships will carry between 8,000 and 20,000 tonnes of concentrate, depending on the bulk carrier used. Approximately 18 ship movements per annum will be involved at full production.

From the commencement of the operation, concentrate will be produced in gradually increasing amounts to a peak of 188,000 tonnes annually by 1998. For road transport to Melba Flats semi-trailers with a 26 tonne nominal load will be used. The number of truck movements transporting concentrate annually, will be 7,230 per annum when peak production is achieved. For rail transport locomotives will tow approximately 20 wagons carrying an average of 40 tonnes each. This will be on a daily basis over 5 days per week, with each trip taking between 4.5 and 5 hours.

Over a 15 year mine production this usage equates to approximately 6 x10^5 equivalent standard axles per annum, an insignificant number compared with road pavement design criteria on roads of the status to be used for transport of concentrate, namely the Murchison Highway. It is noted that all roads forming the potential route for the transport of concentrate are existing State roads, with all registered vehicles having a right of usage.

All CMT transport operations will comply with the appropriate requirements of regulating Authorities

4.3.6 Hours of Work

The mine will operate 24 hours per day, seven days a week. These hours of work at CMT will be in accord with hours of work at all other GMA operations. Continuous shift workers in the underground mining and surface treatment operations will work an 8 day on, 4 day off roster cycle, comprising 12 hour working shifts. All other non-shift employees or contractors will work a 10 hour shift, 5 day week.

4.3.7 Occupational Health and Safety Issues

The Company strives to set the highest occupational health and safety standards, recognising that everyone involved with the operation must be responsive if high standards are to be achieved. To this end, the company policy prescribes contribution from all employees, both direct and indirect as highlighted by the Company Policies attached as Appendix G.

Site OH &S issues involve:
- working in dust environments
- working near noisy equipment
- chemical hazard within the site laboratory and the mill
- working with heavy equipment
- working in underground environments
- working with explosives

These issues are common in many industrial sites and the normal safety equipment and work practices are adequate to deal with them

Wearing of safety equipment including boots, hard hat, ear muffs and safety glasses is mandatory on the site.

4.3.8 Further Exploration

The potential to locate further economic mineralisation on lease 1M/95 is considered high due to the fact that, to date, limited systematic exploration has taken place away from the known deposits, particularly along strike within zones of known alteration, and at depth below current resources.

The further development of the economic potential of the lease relies on compiling all known information into a useable database. This is currently in progress and has already highlighted drilling targets in the West Lyell / North Lyell area.

It is also considered highly probable, considering the geological environment, that economic concentrations of gold, lead and zinc mineralisation are likely to be present.

Due to the nature of the topography and limited regional work completed on the lease, the discovery of "blind" deposits is considered possible. Geophysical techniques will be used to assist the exploration for these deposits.

CMT also plans to carry out drilling and exploration over their exploration lease EL 52/94 which abuts 1 M/95 to the east. This area is largely underlain by post Mount Reid Volcanics, Owen Conglomerates and younger rocks, including Gordon Limestone, with some limited outcrop of Mount Reid Volcanics.

The area is considered to have considerable prospectivity for:

- structural and replacement gold deposits, particularly associated with fault zones.
- base metals in the Gordon Limestone as evidenced by recent discovery of significant zinc mineralisation in the lower part of the unit near Zeehan.
- "copper clays" style mineralisation as previously discovered in lower members of the Gordon Limestone at Mount Lyell.

4.3.9 Stormwater Management

Stormwater drainage is a significant issue given the climate of the mine site. High rainfall events are common, with consequential erosion and damage to the site and its facilities. Problems with inadequate drainage provisions have, in the past, caused problems with crash out of roads due to siltation or inadequacy of culverts.

Most of the mine area drainage reports to Haulage Creek and the majority of drains are adequate to cope with stormwater flows. As only minor works are involved with plant upgrading, the existing system will not be significantly altered. The drainage system around the mill area has been studied by Gutteridge Haskins and Davey who have proposed a system of bunding and diversion to control contaminated water (GHD, 1995).

Any new works will feature culverts designed to pass stormwater flows with an AEP of 20 years.

Stormwater effects on the construction and operation of the tailings dam will be taken into consideration in the detailed design. A substantial silt trap is proposed for the Princess Creek downstream of the dam as has already been described. This will act as a silt trap driving construction and a polishing pond following construction.

The dam design will also feature a coffer dam and diversion pipe designed to pass a flood with an AEP of 200 years to limit the risk of dam overtopping during construction.

The dam spillway design has been discussed in section 4.3.4.7

4.3.10 The Mine Site Road System

The road system at the site includes numerous tracks which will not be used by the CMT operation.

The access route described in section 4.1.8 will be maintained by regular grading and addition of crushed gravel as necessary. Where necessary roads will be upgraded by installation of properly sized culverts. In particular, a section of failed embankment on the Cape Horn Road will be repaired.

New roads will be required on the tailings dam site to provide access and tailings pipe routes.

Minimal clearing of significant vegetation is required for the roads. However, where clearing is required the vegetation and peaty topsoil will be pulled back over batters to assist in erosion control and rehabilitation.

4.3.11 Energy Sources

The mill uses entirely electrical energy for its power source. Demand will build over the first few years to an estimated maximum of 32 MW. The HEC is able to supply this demand from the existing substation and no new works are necessary.

Underground operations will involve a considerable energy demand for excavation and transportation uses. An estimated 10,000 litres of diesel fuel will be used per week during peak operations.

Diesel will be delivered directly to underground fuelling depots.

As there is no need to return water from the tailings dam to the Mill, a major power supply will not need to be extended to this area. Nevertheless an electricity supply will be provided to the dam to allow lighting and control of miscellaneous equipment.

PART II ENVIRONMENTAL MANAGEMENT PLAN

5.0 INTRODUCTION

The role of the EMP is to provide a framework for Best Practice Environmental Management (BPEM) of CMT operations on the Leased Land as specified in the CMT Act. This section of the EMP describes how the operation will be managed to meet operational criteria and Regulations under respective legislation. The EMP includes a section on the Environmental Management System which is being put in place by CMT. A system such as this is not static and will constantly change as the operation seeks to improve its performance and to continually strive towards BPEM.

The "formulated position" in the CMT Act recognises the critical problem of environmental standard setting for the CMT operation in the context of a contaminated site where pre-existing pollution (such as acid drainage) also generates ongoing pollution.

Council's initial Draft Formulated Position is that there are two over-arching principles in respect of the environmental assessment criteria which should be applied to the CMT Project. These are -

1. In respect of environmental factors which are not affected by the pre-existing and on-going contamination and pollution caused by the previous occupation or use of the Leased Land, the environmental assessment criteria should be those which would otherwise be applied to the CMT Project if it were to be undertaken on another site not so affected.

2. In respect of environmental factors which are affected by the pre-existing and on-going contamination and pollution caused by the previous occupation or use of the Leased Land, the environmental assessment criteria should be varied from those which would otherwise be required by Best Practice Environmental Management to such extent as is necessary by reason of the agreement in Clause 5.1 of the Agreement that CMT is not responsible for any pre-existing and on-going contamination and Pollution caused by previous occupation or use of the Leased Land.

The EMP outlines the environmental policies, management processes, hazards, contingency plans and background information on site conditions, which will influence the manner in which acceptable environmental performance standards will be met.

5.1 ENVIRONMENTAL MANAGEMENT SYSTEM

Environmental issues have become a major concern for Australian business over the last decade. Increasingly corporations are focussing attention on their environmental performance and developing environmental policies and strategies which will contribute to sustainable development in a pro-active way. This involves going beyond immediate compliance standards, developing comprehensive environmental and auditing systems and seeking clear environmental objectives.

The Business Charter for Sustainable Development 1990 (International Chamber of Commerce), outlines 16 principles for environmental management which include:

- Corporate priority - environmental management is among the highest corporate priorities
- Process of improvement - continue to improve policies, programs and environmental performance
- Employee education - educate, train and motivate employees to carry out activities in an environmentally responsible manner
- Precautionary approach - modify the conduct of activities to prevent serious or irreversible environmental degradation
- Contractors and suppliers - promote adoption of the principles by contractors and suppliers
- Openness to concerns - foster openness and dialogue with employees and the public through responding to their concerns.

It is the objective of CMT to carry out its operations in line with these principles.

An environmental management system (EMS) is a quality assurance system which can be used to assess a company's environmental performance against defined performance targets. The application of a formalised EMS based on BS 7750 : 1992 or an equivalent Australian Standard form the basis of procedures that are being implemented by CMT. The EMS components are being inextricably interwoven into the Company's overall management system. All activities on the site have an effect on the environment and the EMS needs to be capable of dealing with this complexity. Components of the system include:

- organisational commitment
- an environmental policy at corporate level
- environmental impact assessment
- operational and emergency procedure
- responsibility and reporting structure
- the establishment of an environmental effects register
- clearly defined environmental goals
- an environmental management program with commitment from staff at all levels
- the development of an environmental manual and training program for all staff
- recording of relevant environmental data and information
- emission and performance monitoring and measurement
- auditing and reviews of performance
- community consultation program

CMT is in the early stages of development of its EMS. An EMS is a process which will constantly change and which will be regularly reviewed. Some components of the EMS have already been developed and implemented while others will be refined during the forthcoming months.

The EMS is critical to CMT operations. Mining at Mount Lyell has caused severe environmental degradation over 100 years. The community has become increasingly critical of these environmental effects and is calling for change. CMT recognises that change is necessary to take the Company and the Queenstown community into a prosperous era of mining in harmony with the environment. The EMS is one mechanism through which change will occur.

5.1.1 Organisational commitment

The Board of Gold Mines of Australia has nominated the Chairman to overview environmental responsibilities. CMT has made a fundamental commitment to ensuring that environmental issues are recognised as a responsibility of each member of its workforce by developing position descriptions for all employees which outline responsibilities in contributing to the achievement of CMT's Environmental Policy. A typical position description is provided at Appendix C. This commitment will ensure that all present and future employees recognise the high priority which will be given to environmental matters.

A schematic outlining CMT's Organisational Structure is shown on Figure 5.1. It is the responsibility of the Environmental Manager to ensure that all areas of the operation comply with the requirements of authorisations issued by SDAC and to keep the Board of GMA informed of the status of compliance with these. In addition it is the responsibility of the Environmental Manager to initiate, implement and promote procedures which will ensure that the operation of the mine conforms with BPEM under the CMT Act. The Environmental Manager reports directly to the Resident Mine Manager.

The Management Team ensures that environmental objectives and targets are achieved on the site. The Environmental Manager is consulted for input on all site works and contracts to ensure adequate recognition has been given to environmental issues.

5.1.2 Environmental Policy

An Environmental policy statement, for release to employees, has been issued by CMT and is reproduced at Appendix G to this document. This has been based on GMA's corporate Environmental Policy reproduced below:

"GOLD MINES OF AUSTRALIA LTD.

ENVIRONMENTAL POLICY

It is the Company's policy that, in all aspects of the Companies activities, it be recognised as a responsible Corporate citizen both locally and nationally.

The Company's objectives are:

- *to achieve the highest possible levels of productivity, quality and profitability.*

- *to provide a working environment for all employees consistent with sound management practices.*

- *to achieve cost effective environmental performance.*

- *to promote sound Environmental principles of the Mining Industry both locally and nationally with particular reference to the Youth of Australia.*

This Policy sets out the over-riding framework within which the Company and Subsidiaries will carry out business:

- *land which has been disturbed my mine operations is to be reinstated to a stable landform that is appropriate to the surrounding land fabric of the local region, suitable for the preparation of a subsequent land use, the maintenance requirements of which are commensurate with normal practices for that land use;*

- *assess and take into account the potential environmental impact of exploration and / or mine operations in an area prior to commencement of actual site work, emphasising avoidance of environmental impact in preference to rehabilitation, without compromising standards (E.I.S. stage);*

- *establish a Mining, Rehabilitation and Environmental Management Plan to document means of achieving environmental objectives and to provide a mechanism of reporting progress on an annual basis:*

  - *conduct exploration and / or mine operations with due regard to the protection of the environment including flora and fauna, and of sites of natural, cultural and historical significance.*

  - *avoid unnecessary long term disturbance to soil, waste and the land surface in general, and / or pollution of the environment resulting from inappropriate waste disposal or waste management practice;*

  - *minimise environmental impact on a daily basis of the Company's activities;*

  - *minimise and rehabilitate progressively any damage to vegetation, land surface, water systems or man-made improvements;*

  - *ensure that exploration and / or mine operations comply with all applicable State and Federal legislation and maintain an active self-monitoring programme for that purpose;*

- *establish a monthly reporting mechanism to advise the Board of the Environmental status of each operational site; and the Environmental Policy is being complied with.*

- *maintain a "best practice" approach to environmental management in all jurisdictions;*

- *designate a staff member to be accountable to the relevant Manager for all aspects of environmental planning and compliance with "best practice" of each operational site, and*

- *provide training to employees and contractors on environmentally acceptable practice.*

The Company will also actively seek to:

- *advance knowledge of the impact of exploration and / or mine operations on the environment and to minimise such impact as appropriate;*

- *work pro-actively with statutory agencies with a view to improving environmental standards;*

- *enhance communication and understanding with, and take into account the views of, environmental agencies and interest groups, land holders and local communities within areas of its operations, and the community at large.*

This Environmental Policy will also apply to Gold Mines of Australia Ltd. and to all its related subsidiaries. Each Manager is accountable for development and regular reviews of procedures and practices for their specific areas of responsibility, which will ensure that operations are conducted in a manner consistent with best environmental practice.

All contractors employed by Gold Mines of Australia Ltd. and it's related subsidiaries must carry out their business in accordance with the standards and requirements applicable, this will include the provision of full indemnity against any liabilities or claims arising out of or in the course of the work undertaken by those contactors."

5.1.3 Contractual Obligations

Each contract entered into for the provision of personnel services or contracts at the Mine includes standard contractual obligations developed by CMT. These cover standards of workmanship required and also the standard of behaviour expected with regard to occupational health and safety, human resource management and environmental protection. This latter is reproduced below;

"SPECIAL CONDITIONS OF CONTRACT

Note: These conditions apply to all contractors and their sub-contractors

ENVIRONMENTAL PROTECTION

1.0 General

1.1 The Contractor shall be aware of the criteria and conditions specified in the Environmental Management Plan for the site, the Company Policy on the Environment and the legal liabilities of the Contractor in relation to these matters.

1.2 The Contractor shall not cause, either wilfully or by neglect or ignorance, the emission of a pollutant from the lease area.

1.3 In the event of an emergency which may give rise to an unplanned emission of a pollutant from the premises, the contractor shall take all necessary steps to contain the emission and immediately advise the Site Superintendent of the occurrence. The Site Superintendent has an obligation to inform CMT's Environmental Manager who will inform DELM as required by CMT's Licence to Operate.

1.4 No introduced species are to be taken onto the site (including domestic pets).

1.5 No firearms are to be taken onto the site.

1.6 During the course of the contract, the Contractor shall keep the site clean and tidy to the satisfaction of the Site Superintendent. Surplus materials and site rubbish shall be removed progressively from the site where practicable.

2.0 Fire

2.1 Notwithstanding the requirements of the Environment Protection Act or the Environmental Commitments, the contractor shall ensure that;

1. *no open fires are lit on site, there will be no burning of cleared vegetation*
2. *every vehicle and large item of equipment is fitted with an appropriate fire extinguisher*
3. *fire breaks are constructed around areas and machinery from which there is a risk of fire escaping*
4. *all employees are instructed about the fire-sensitive nature of the surrounding environment and of the need to prevent the ignition and escape of wildfires.*

3.0 Vegetation

3.1 No vegetation is to be disturbed without prior consent of the Site Superintendent.

3.2 Any trees felled with permission of the Site Superintendent shall be salvaged to the requirements of the District Forester, West Coast.

3.3 No exotic species shall be introduced to the lease area.

4.0 Archaeology

Any site which is considered to be or has the potential to be an archaeological site, or have possible heritage significance, shall be reported to the Site Superintendent prior to commencement of any works within the vicinity. Historic mine workings will not be interfered with.

5.0 Land Management

5.1 No surface works which involves land clearing shall be undertaken by the Contractor without prior approval of the Site Superintendent. Where a limit to land clearing is specified, this shall not be exceeded without the approval of the Site Superintendent.

5.2 During any construction works which involves land disturbance, the Contractor shall stockpile topsoil separate to other overburden. The topsoil shall be used for rehabilitation of the site on completion of the works.

5.3 The Contractor shall ensure that all areas disturbed by their operation are rehabilitated according to the requirements of the Site Superintendent.

6.0 Liquid Emissions

6.1 All water generated by or used by the contractor's operation shall meet the quality standards as provided in authorisations issued by SDAC.

6.2 The Contractor shall take all reasonable steps to ensure that site run-off water is not contaminated by any process, facility or machinery used by the contractor. Where necessary, upstream cut off drains shall be constructed around a disturbed area to minimise flow.

6.3 All drilling fluid shall be treated to remove suspended solids, oil and grease prior to discharge to the environment.

7.0 Hazardous Materials

7.1 No hazardous materials (as defined by the Dangerous Goods Act 1976) shall be brought onto the site without the prior approval of the Site Superintendent.

7.2 The storage, handling and transport of hazardous materials shall be in compliance with the "Australian Code for Transport of Dangerous Goods by Road and Rail". The contractor shall submit a proposed procedure for management of hazardous materials on site in writing to the Site Superintendent at least one week prior to the intended arrival date of such goods.

7.3 All materials which have been contaminated by hazardous material shall be decontaminated and disposed of using the methods prescribed in the Environmental Management Plan and the Environmental Protection (Waste Disposal) Regulations 1974.

8.0 Solid Waste Management

8.1 All non-toxic waste (putrescible and inert) generated by the Contractor on site shall be disposed of by transport to and disposal at the Queenstown refuse disposal site. Prior to disposal, all wastes shall be securely stored on site to the approval of the Site Superintendent.

8.2 The contractor shall arrange for the removal from site and disposal of all hazardous wastes generated during their operation. This will be audited by CMT. Only a licensed waste disposal contractor approved by CMT shall be used for this purpose.

8.3 The contractor shall use only the transportable chemical toilets provided .

9.0 Noise

All construction equipment used by the Contractor shall comply with the Environment Protection (Noise) Regulations 1977.

10.0 Washdown of Mobile Equipment

It shall be the responsibility of the Contractor to ensure that mobile off-road plant will be washed before travelling to the site to minimise the spread of Phytophthora cinnamonii and introduced and noxious weeds.

11.0 Atmospheric Emissions

The Contractor shall take all reasonable steps to control emissions to atmosphere from their operation. Emissions shall be in compliance with the Environment Protection Act 1973 and it's regulations."

5.1.4 Targets of the EMS

The broad objectives of CMT in implementing the EMS are,

- to develop programs that will reduce the impact of CMT operations on the environment,
- to produce concentrate and products in the most cost effective, energy and resource efficient manner possible,
- to comply with all environmental Regulations and laws applicable to the Project, and
- to achieve recognition from the community that the environment and mining can operate in synergy.

CMT will seek to progressively reduce the environmental impacts of the operation in line with Best Practise Environmental Management (BPEM).

5.1.5 Operational Monitoring and Control

Monitoring of environmental effects will take place according to the framework set out in the EMP and according to the conditions set out in the environmental licence or permit. Additional in-house testing will be undertaken by CMT as part of the environmental management strategy.

Evaluation of effects of environmental management measures will be undertaken by plant personnel, supervisors and environmental personnel within the plant through the monitoring system and by recording and reporting on complaints and incidents. When any incident or malfunction occurs this will be reported to the Department of Environment and Land Management either by the Resident Mine Manager, the Environmental

Manager, or a designated responsible employee in accordance with the Conditions of Operation for the Licence.

The monitoring systems will highlight areas for gradual improvement which will allow the EMS to be continually improved to ensure that BPEM is achieved.

5.1.6 Procedures

Environmental procedures are to be documented in operational manuals. Written contractor agreements, memos and meetings must provide mechanisms to inform and to remind personnel of their responsibilities whilst on the site. All personnel on site are expected to accept environmental responsibility for their operational areas on an individual basis. The regular review of the EMP document and transfer of information through training programs, discussion and information relating to the contents of the document will provide personnel within CMT with a broad overview of improvements and issues outside their own working sphere.

5.1.7 Action Plans

Action plans to address significant issues identified from monitoring and reporting will be developed and incorporated into the Program of Environmental Works. The plans will be formulated to address problem areas. Action plans required to address minor issues can be initiated by the Environmental Manager or by the operational engineers and team leaders in consultation with the Environmental Manager. If the response required is minor in nature then orders will be issued directly to alter procedures through the appropriate channels to those concerned. If not, works orders will be issued for construction of equipment, or budget submissions will be prepared to initiate action plans and provide for forward works programs.

5.1.8 Records

Records of monitoring results, maintenance on environmental measuring equipment and internal checks of performance monitoring are the responsibility of the Environmental Manager. Summaries will be presented in reports to the Board and in the regular update of the EMP. Monitoring results will be forwarded to the Division of Environmental Management as required by the conditions of the licence to operate.

The Environmental Manager will ensure that an up to date record of relevant environmental legislation and regulations is maintained on the site. A central Registry of all environmental agreements and permits will be maintained. An additional register of complaints will be developed to ensure that all incidents are investigated.

5.1.9 Education, Training and Induction Programs

All employees, contractors and visitors will undertake an Induction Training Course that covers site operations, health, safety and environmental issues. A comprehensive induction program is being introduced to the site. An Environmental Handbook has been developed for use at the induction process and will be given to each employee. The

employee will be required to sign an undertaking that they have read and understood the requirements of the Handbook which will be updated and reissued each year. The content of the Handbook is reproduced at Appendix D.

Regular meetings and discussion groups are to be held with employees to update their safety and environmental knowledge. This will facilitate the maintenance of current BPEM as well as facilitating CMT environmental policy. Other process oriented training sessions include an environmental component where required.

5.1.10 Public Affairs and Information Programs

A key component of the EMS is the continuous involvement of the various stakeholders in a consultation program during all phases of the project. Stakeholders do not only include those with a direct commercial interest in the Project but also include the broader community of the West Coast and all levels of Government. Consultation and the dissemination of information about the Project has occurred since its inception.

The aim of the consultation program with the identified stakeholders is to:

1. Ensure the stakeholders are fully informed, by the Resident Mine Manager, of the Project Status and the likely impact that the project will have on individual stakeholder's interests.

2. Enable stakeholders to provide input to the various strategies being proposed for the Project.

3. Maximise the level of acceptance by stakeholders to the Project proposals.

To ensure that information reaches the broader community CMT has taken several initiatives. The Company has released two public information pamphlets to the local community describing its intentions in implementing the Mount Lyell Re-development Project and stressing the importance of the environmental issues. Information has also been published in the local newspapers and regular media briefings have been held. As the Project proceeds updates will be produced to keep the community informed of its status.

Copies of the Executive Summary of the EMP were provided in the local library and were letterboxed to each household in Queenstown and Strahan. The name and contact number of the Environmental Manager was provided so that anyone seeking further information could contact the Company. This publication created a general degree of interest throughout the town.

The first edition of the Staff Newsletter, Prospects, was produced in June with the intention that it should be published on a bi-monthly basis.

Promotions at various mining industry displays and other forums will be carried out and the Company has already taken part in several seminars.

An environmental mascot, to promote environmental issues within the Company, has been introduced to the site to very positive effect. The mascot, Platypus Pat, was developed with the assistance of the Chamber of Mines. The level of acceptance of Platypus Pat throughout the workforce has been very high and the mascot has been taken up by the Mine Tour operator as a promotion point.

CMT will continue with its program to inform the community and will ensure that it is receptive to input from all stakeholders.

5.2 ENVIRONMENTAL MANAGEMENT STRATEGIES

5.2.1 Construction Phase

A preliminary Construction Programme is presented on Figure 5.2, with an Environmental Control Plan presented on Figure 5.3.

This shows a continuing construction operation at the tailings dam site until completion of the Stage 2 Dam in April 1996 and substantial intensive construction phases at the mine and mill sites during late 1995 and continuing until late 1997 when full production will be reached.

5.2.1.1 Protection of Flora and Fauna

The protection of flora and fauna on the lease area and in the development phase will be undertaken through:

- suitable instruction of contractors
- fencing of sensitive areas
- a program of controlled elimination of exotic species and weeds
- a program of equipment inspection and cleaning before introduction to the leases

Monitoring of impacts and progress will be by site photography and on ground inspections of selected areas.

The sites of known habitation by the rare plant, *Centrolepis paludicola*, have been identified on site by flagging and contractors and their personnel made aware of the need to avoid works in these areas. The plant has become affectionately known on site as "Bruce".

A weed control programme has been commenced on the tailings dam site in an attempt to eradicate weeds in the areas were earthmoving will take place over coming months. Weeds are particularly visible and accessible following the bushfire of January 1995.

Contractors, Land Management and Rehabilitation Services have been engaged for this work and they have reported on weeds identified and the suggested programme of control. Main weed species are pampas, blackberry, broom and gorse. Spraying took place in February and May 1995 and follow up sprays are programmed for October 1995 and again in February 1996. In areas where eradication was not possible prior to earthworks commencing, weed infestations were identified and the areas selectively excavated and the soil disposed of by burial and covering with clean soil.

5.2.1.2 Archaeological, Cultural, Historical and Heritage Features

A commitment to the observance of heritage requirements is defined in the CMT Agreement and the Assumed Obligations on mine closure are listed in Schedule 2.

No development is planned in areas where archaeological artefacts have been identified and no Aboriginal issues have been identified that might affect the construction phase. Nevertheless, contractors will be advised to be alert for any signs of past habitation as noted in the standard contract conditions.

Many of the items listed in the Godden-Mackay Report are part of the infrastructure associated with ongoing activities at the mine. These items will be protected and maintained in line with commercial efficiency and production requirements. In some cases equipment and buildings will be updated, improved or removed and additional equipment will be purchased to replace existing or outdated items. Reference will be made to the Godden-Mackay Report listing and liaison with relevant officers within the MHC will be made, to determine if the sale, alteration or removal of special items is permitted. Should the Government wish buildings or equipment to be retained which are not the responsibility of CMT an agreement on their management will have to be reached.

Since CMT took over the site the remains of the smelter building have been demolished and removed with the permission of the MHC. The only other structure considered for removal from the site at some time in the future, is the overland conveyor, which will be replaced with a pipeline. Decision on the removal of the conveyor and any other structure or feature on the site will be made following consultation with the Mining Heritage Committee (MHC). If the conveyor is removed, the route will be cleaned up and the site restored.

Contrary to original expectations, no slag was removed from the slag dump in the construction of the Stage 1 tailings dam. Any future uses of slag for the Stage 2 Dam will not occur until discussions have taken place with the MHC.

The effect of development works, at the Prince Lyell Shaft and at the mill, is not expected to have any adverse impact on mining heritage. However, it is likely that the number of Magazine buildings on site will be reduced and only those buildings required for the Project works will be retained. A number of the buildings are considered a fire hazard. Prior to any removal permission will be sought from the MHC.

During construction of the Stage 1 Tailings Dam an adit was found which will be flooded on filling the dam. The find was reported to the MHC, inspected, surveyed, documented, and sealed. Other areas of mining activity have been identified in the area to be flooded by the Stage 2 Dam. These will also be reported and documented as directed by the MHC.

5.2.1.3 Minimisation of Impacts on Geological, Geomorphological and Soil Features

The works at the mine site involve little in the way of excavation or removal of soil or rock features. However, major earthmoving operations will be involved in construction of the tailings dams and access roads.

Geological studies have been carried out (Morrison, 1995) to determine a detailed knowledge of the site conditions and the effects of the works. The need to grout the dam

foundations was assessed by a drilling program and a report produced by the HEC. The report, Princess Creek Tailings Dam Seepage Analysis, by Thompson and Brett has been forwarded to SDAC.

Design and construction of earthworks will ensure that:

- stripping extent is minimised
- haul road construction is limited to the minimum necessary for practical construction
- embankments and batters are stable and properly rehabilitated. Batters will be laid back to stable slopes consistent with the geology and strength of the materials encountered.

Stripping of peat and soil at the tailings dam construction sites will occur as development continues. Specifications for the work allow for stockpile and reuse of this resource for rehabilitation of the construction works. In addition large quantities of this material is available in the areas to be inundated and a budget has been allocated to allow salvage and stockpiling of this resource for future use on the mine lease. Testing on the peat for Phytophthora has been carried out and it has been found to be suitable for rehabilitation on the mine site.

5.2.1.4 Protection, Maintenance, Removal of Special Features

The Botanical Garden Reserve immediately downstream of the Princess Creek Tailings Dam is a special feature of the site. Whilst only part of this area lies within the mining lease, CMT recognises the importance of the stream and of the vegetation of the area. The Company is conscious of its responsibilities to protect the area. Consequently the maximum practical attention has been given to ensuring that impact of construction works is minimised. Means to achieve this aim are listed below:

- Minimising of erosion and silt generation from upstream works as described in section 5.2.1.6
- Avoiding the location of any access roads within the area
- Banning of access to the area from the dam site
- Implementation of a weed control programme to avoid exacerbation of the existing weed problem within the Reserve

5.2.1.5 Recreational Land Uses

An area adjacent to the East Queen River but covered by the mining lease has historically been used as a hockey field by the Queenstown community and this will be allowed to continue.

Public access to the leases 1M/95 and 2M/95 has been relatively free in the past with dog walking over the site being common. This practice will cease in accordance with operating conditions and the responsibility for safety on the site.

Other recreational activities within the lease areas, particularly 5M/95, have included gold panning and four wheel drive trekking. These activities will not be allowed on the

lease or in the vicinity of the tailings dam areas under CMT management due to safety and environmental factors. Appropriate fencing and gates have been erected as required by the Mines Act.

The closure of the lease areas to these activities is not considered to be of significance due to the availability of many similar areas with easy access from the town.

5.2.1.6 Disturbance and Erosion Control

Ground disturbance from CMT operations within the main lease area during the first three years are anticipated to be minimal. The main areas where changes will occur are connected with the continued operation of the waste rock dump, construction of a new waste disposal area, the construction of a culvert for Haulage Creek and landscaping works in the area of the entrance gate where derelict structures will be removed and top soil placed. Minor ground disturbance will occur in future with the installation of the FAG mill and the provision of ore stockpiles. Significantly greater disturbance are involved with the construction of the Tailings Dams and associated access roads on lease 5M/95.

Erosion control has been implemented by use of current good practise as advised by Mr Tim Duckett (Land Management & Rehabilitation, 1995), a recognised expert in this field. He proposed;

- installation of sediment traps downstream of installed culverts on all minor stream crossings on access roads
- provision of cut-off drains above earthworks to divert water flows from exposed areas
- provision of localised silt traps immediately downstream of work sites. These will typically comprise peat bunds set across local drains to intercept and filter run-off
- provision of more significant silt traps downstream of general work areas. In particular larger peat walled silt traps have been constructed on the two tributaries of Princess Creek below the Stage 1 work sites and a major concrete weir is planned for construction above the top waterfall in the Botanical Gardens Reserve. This will become a major environmental monitoring point with permanent, continuous monitoring instrumentation, with possible associated automatic control of outlet flow, to be installed for measurement of flow, suspended solids, pH and conductivity. The weir will be constructed early in Stage 2 so as to act as a silt trap during construction. This will be backed up by temporary silt traps constructed from rock filled gabions.

It should be noted that some sediment has recently been observed in Princess Creek due to a natural landslide following the earlier fire and heavy rain in the area. Also general high sediment loads from the burnt areas has been noted. Advice from Duckett (Land Management & Rehabilitation, 1995) is that natural erosion from the catchment would be likely to increase significantly following loss of vegetation cover during the January bushfire. Despite the best efforts to control silt from the construction works, significant solids loss seems to have occurred from other areas.

Erosion as a result of historical activities on the mine site has been significant and the rapid change in stream water flow make the provision of effective erosion control

measures extremely difficult. The most effective long term solution is the revegetation of as much of the site as practicable.

Examples of proposed silt traps are presented in Figure 5.4

5.2.1.7 Water Pollution

Water pollution from erosion, as a result of construction activities, will be managed by the use of sediment traps and the minimisation of disturbance of the land surface as described in section 5.2.1.6.

The other significant source of potential pollution is from oil spillage. Contractual conditions require that contractors provide fully bunded fuel storages and this has been enforced at the Stage 1 Dam site. Small mobile fuel tanks are limited to 300 litres and vehicles carrying fuel must also carry absorbent materials designed for oil spill recovery.

Floating sock booms for oil spill isolation are to be available at all work areas, during construction, to allow rapid isolation of spills and allow time for absorbent materials to be brought to the area.

5.2.1.8 Air Pollution Including Dust

Minor amounts of dust will be generated, during periods of dry weather, as a result of construction activities. The chief sources will be due to road traffic movements and excavation. The effects will be limited to periods of prolonged dry weather and will not result in any off site effects since the location of main areas of activity are remote from public roads. Areas adjacent to the public road access points are constructed from quartzite gavel that generates minimal dust. If the generation of dust becomes a safety issue or has the potential to create off site effects then a water cart will be used to dampen the surfaces to minimise the dispersion.

5.2.1.9 Construction Phase Traffic Impacts

During the construction phase of the works traffic impacts will result from

- the general increase in traffic activity due to additional workers living in the town, and
- the transport of major items of plant and equipment from Burnie

The former is not likely to be significant as the Queenstown road infrastructure is well developed and suited to an historically larger town population.

Transport of larger items has not yet been quantified but certainly some large loads are expected that would require police escort and would potentially delay traffic for limited periods. However the road to be used between Burnie and Queenstown is of highway standard and designed for significant truck usage. As details of actual transport requirements become known the more significant loads will be planned in conjunction with Transport & Works and Tasmania Police to ensure that all statutory requirements are met and that the impact on other road users is minimised.

5.2.1.10 Construction Phase Fire Risk Management

A fire to the south-east of the airport occurred in December/January, prior to any activity on the proposed tailings dam area, that eliminated much of the vegetation on the plateau. Fortunately, there was very little impact on areas containing the identified rare plant species. The area had been burnt on a number of previous occasions and following quick response from the local fire authority damage was restricted to the plateau. The fire did not penetrate to the Queen River valley to any significant extent. The probability of a fire occurring again in this area over the next two years is extremely remote.

A Fire Management Plan for the CMT leases has been produced in consultation with the regional fire authority, the local council and DELM. The Plan will be upgraded as necessary and action implemented to reduce the risk of fire.

Construction activities on the mine site are not likely to impact on any vegetated areas at this time.

5.2.1.11 Visual Impacts During Construction Phases

Certain of the construction activities will be visible from public areas adjacent to the leases although works on the mine site will be relatively minor in context with the existing complex of structures, roads and the backdrop of previously disturbed areas.

At the Princess Creek dam site some of the construction works have been visible at the Stage 1 works although these have not been particularly obtrusive. Construction of an access track to the Princess Creek Stage 2 site has shown up due to the contrast of the exposed orange soil against the blackened burnt country around it. This impact will be reduced as the track work is completed, with rehabilitation of the batters and development of new growth of the vegetation.

Construction related visual impact will be minimised by:
- limiting of clearing and track construction,
- parking of vehicles out of site of public areas
- establishing sheds, fuel storages, portable toilets and the like away from public view

5.2.1.12 Construction Clean Up and Rehabilitation

Construction contracts include provision for progressive clean up and rehabilitation of construction sites. Non hazardous industrial waste generated during the construction period will be disposed on site within the new Waste Disposal Site to be developed. Other wastes will be the responsibility of Contractors to remove from the site to appropriate disposal sites.

Specified rehabilitation methods for earthworks comprise;

- stockpiling of cleared vegetation
- stockpiling of all topsoil and peat
- spreading of topsoil and peat over disturbed areas on completion, and
- spreading of cleared vegetation over topsoiled areas to provide protection from erosion and a source of seed for regrowth

Allowance has also been made in construction budgets to salvage and stockpile excess soil and peat from the construction sites for later potential use at the mine Leases.

5.2.2 WATER EMISSIONS & MANAGEMENT REGIMES

5.2.2.1 Introduction

Raw water is sourced from a number of nearby watercourses and from the Lake Margaret area in dry periods. A complete revision of the water use and recycling within the mine has been undertaken as part of the changes initiated by CMT. The mechanics of these changes are described in Section 4.3. The objectives of the changes are to provide a reliable water source of a quality commensurate with the ultimate end use and to feature a high proportion of recycling and reuse of process water. The management and mixing of water flows on the site are critical in determining the environmental performance of the operation and will be kept under review as a greater understanding of the interactions of acid drainage, tailings and solids is derived from monitoring data. As a result, the water used by CMT at full production is still of the order of that used by the previous operator at half that production rate.

5.2.2.2 Raw Water Sources and Quality

Sources of raw water to the mine have been described in Section 4.3. These are

- the West Queen River, supplemented from Lake Margaret during exceptional dry periods. This water, with low concentrations of dissolved solids, metals and sulphate is used for potable water throughout the site and process water for the Mill.

- the East Queen, at its diversion point at the East Queen Pump Station in the upper reaches of the stream, which is of similar quality. This water is pumped to head tanks at the Prince Lyell Shaft and to the Utah tanks as previously described.

5.2.2.3 Acid Drainage Sources and Quality

Under the Agreement with the Tasmanian Government, within the CMT Act, CMT is not responsible for pollution caused by past activities and is responsible only for acid drainage derived from its own activities. As discussed in Section 4.1.18 this comprises a proportion of water pumped from the Level 17 Pump Station and the mud displacement system.

CMT plan to feed the "mud" into the ore stream in order to remove excessive pollution and to extract minerals. This will immediately remove the majority of solid contamination and a major component of dissolved contamination from the current Level 17 discharge as described in Section 4.1.18. As tailings become available, a proportion of the Level 17 pump clear water will be neutralised by contact with the tailings stream as previously described in Section 4.1.18. It is the aim of CMT to maximise the neutralisation capacity of the tailings once full production of 3.5 mtpa is reached so that acid drainage over and above CMT's liabilities under the CMT Act is treated. The water from the Level 17 Pump Station is characterised by low pH and high levels of metallic and other contaminants. This issue is further discussed in Section 5.2.2.5

Other site water discharges to watercourses, relating to the historical use of the site, are not the responsibility of CMT under the provisions of the CMT Act.

5.2.2.4 Water Management

The proposed water management of the site has been described in Section 4.3.4

Water for use within the plant will be drawn from the East and West Queen rivers, with dry weather flow augmented from Lake Margaret. The East Queen source will not be sufficient to supply all underground uses and the future demand of the FAG mill so this supply will be augmented from the West Queen and recycled water from the Mill Process System.

The West Queen water will be drawn from:-

- the Dam 1 pipe, which allows water to gravitate to the Mill Head Tanks, and
- the Valley Pump Station, which picks up water from the lower reaches of the West Queen and pumps it to the same tanks.

There are two Mill Head Tanks, one of which will be designated for supply of direct West Queen water only. The other will be designated for "process" water and will be augmented with recycled water from various parts of the Mill.

The major source of recycled water will be the primary tailings thickener which will separate the tailings solids from the outflow from the Flotation plant. Water will also be returned from the concentrate thickener.

Thickened tailings will be mixed with acidic water from the 17 Level Pump Station prior to re-thickening and pumping to the tailings dam. The proportion of 17 Level Pump Station discharge to be treated will be subject to further investigation and agreement with Government, but, as a minimum, will account for the component of acid drainage generated by CMT.

After re-thickening of the tailings/acid drainage mixture the tailings are pumped to the dam in a slurry with a solids content of around 50%. The thickener overflow, effectively neutralised acid drainage, is discharged to the Queen River. This latter water is unsuitable for recycling due to a high sulphate content.

On reaching the tailings dam excess water will decant from the tailings slurry, leaving a denser deposit. An estimated 36% of tailings water will decant, become mixed with natural catchment water and overflow into Princess Creek once Stage 2 of the Dam is complete. During Stage 1 operation all decant water will be returned for reuse in the mill or discharge to the Queen River. This is discussed in Section 4.3.4.8.

Figure 4.42 presents a water balance during typical operating conditions for a 3.5 mtpa plant, expected to be operational by late 1997, assuming maximum treatment of Level 17 Pump Station discharge. For this case:

- draw off from the East and West Queen Rivers totalled 161 L/s, or around 8% of an average 1916 L/s combined river flow.
- 179 L/s is recycled from the tailings thickener and concentrator plant.
- around 110 L/sec water is pumped to the tailings dam as transport fluid
- an average of 89 L/s neutralised acid drainage is discharged to the Queen River via Haulage Creek
- the remaining excess process water overflows from the process water tank to the Queen River.
- 42L/s water from the tailings slurry will mix with an average 895L/s natural catchment water in the dam and overflow to the Princess Creek.

During dry periods the proportion of water drawn from the East and West Queen rivers increases. Information provided in Section 4.1.17 suggested 7 day minimum dry weather flows of 6% average with a 2 year AEP and 3% average for a 10 year AEP. Even during 2 year AEP conditions the total river flow would not be sufficient to keep the mine operating. Water storage in dams 1, 2 and 3 can be used in dry conditions with total capacity of around 400 ML or 28 days typical water demand.

In extreme dry weather the supply must be augmented with water from Lake Margaret. This will require construction of a new pipeline to replace the existing wood staved penstock which is in a state of disrepair. The operating policy for operation of the Lake Margaret supply is to maintain a minimum riparian outflow of water in both the East and West Queen equivalent to the 2 year AEP 7 day minimum flow. Flow will be monitored at Dam 1 and at the junction of both rivers with the Queen and appropriate controls of water draw off initiated to maintain the minimum flow levels specified.

Stormwater from the active operational areas of the mine and mill will be collected and handled appropriately through a system of diversions and bunds as recommended by Gutteridge Haskins & Davey (GHD, 1995). The effectiveness of this system, in conjunction with the hydrocarbon management plan described in Section 5.2.7.4, will be reviewed once operations commence. An option for construction of a silt/oil trap in Haulage Creek below the Mill, in a position where it can intercept the majority of Mill site run-off, will be reconsidered in the light of monitored performance of the drainage system. Other streams will be identified during detailed design and either diverted to the Mill Silt Trap or treated individually.

The waste rock and ore stockpiles feature stormwater run-off collection drains which will be monitored for water quality. If runoff from these areas is found to become contaminated, water will be diverted to the mine dewatering stream for neutralisation or provided with a local treatment facility.

As part of the mine redevelopment all existing components of the Water Management System will be thoroughly inspected, upgraded as necessary and subject to ongoing routine inspection and maintenance.

5.2.2.5 Water Emission Quality

a) Process Emissions

The expected quality of water emissions from the mine has been discussed in detail in Section 4.3.4.14. The predicted values of water quality parameters for discharges, once full production is achieved, are presented in Table 5.1 together with representative quality for raw waters. As can be seen the long term discharge to Princess Creek meets the requirements of the Environmental Protection Act, 1973, if only CMT's proportion of acid drainage is treated. With maximum treatment of acid drainage the level of sulphate is likely to exceed these limits. The quality of water discharging to the Queen river from the secondary thickener meets the requirements of the Environmental Protection Act, 1973, apart from sulphate. As discussed in section 4.3.4.14, the level of sulphate is not believed to be a significant environmental issue in either case and this position is to be confirmed by monitoring during early stages of the operation as discussed below. Neither the Queen River or the Princess Creek meet ANZECC guideline quality levels and these do not have any legislative status. CMT cannot meet ANZECC guideline levels due to, at least in part, the continuing pollution from past operations in the area and SDAC needs to take this into account in setting specific standards for the CMT operation.

SDAC has already advised CMT that the objective for Princess Creek should be to maintain water:

- "which will support a healthy (although not necessarily pristine) aquatic ecosystem" and
- "is aesthetically acceptable and suitable for secondary contact recreation"

To resolve remaining uncertainties regarding the ability of proposed discharges to achieve SDAC's stated requirements, as discussed in Section 4.3.4.14, CMT has proposed a detailed field monitoring program. During the period of operation of the Stage 1 dam, CMT will carry out a monitoring program to characterise the potential effect of the discharge quality on the waters of Princess Creek. Following this program, there will be sufficient information available to allow the Government to decide how much acid drainage generated at the Level 17 pump station will be permitted to be treated with the tailings.

The alternative, as discussed in Section 4.3.4.14, would be to continue to let all level 17 water, excluding mud, discharge into the Queen River.

b) Stormwater Emissions

The stormwater emissions from the sites where CMT have active operations, will be monitored and controlled to meet regulation levels of suspended solids and oil and grease levels. However, the pH and other water quality parameters are unknown at this stage and likely to be severely impacted by pre-existing pollution in the areas concerned.

Table 5.1 Summary of Water Quality Predictions

A Water Quality Standards

Units milligrams per litre (except pH)

Source	pH	Fe	Cu	Al	Zn	Mn	Hg	Pb	Ca	DOC	SO4	TSS
*ANZECC (1992) Protection of aquatic ecosystems -Fresh Waters**	*6.5 - 9.0*	*1*	*0.002 - 0.005*	*<0.005 pH<6.5*	*0.005 - 0.05*	-	*0.0001*	*0.001 - 0.005*	-	-	-	*<10*
Tas. Regs. 1973 Env. Protection Act	-	*1 (+Mn)*	*1*	-	*5*	-	*0.002*	*0.05*	-	-	*250*	*30*

* not directly applicable to Tasmanian freshwaters due to various issues as discussed in the text

B Predicted Ambient Water Quality

Units milligrams per litre (except pH)

Source	pH	Fe	Cu	Al	Zn	Mn	Hg	Pb	Ca	DOC	SO4	TSS
East Queen	4	2.4	1.18	2.6	-	0.59	-	-	-	-	46	12
West Queen/ Princess Ck	4.4 - 7.2	.24 - 0.6	0.007- .04	0.8-29	<0.01	<0.3	<0.001	<0.008	2	9	6 - 144	<44
Predicted Queen River	<4	92	17	40	1.6	19	<0.001	<0.008	-	-	775	46

C Predicted Discharged Water Quality

Units milligrams per litre (except pH)

Source	pH	Fe	Cu	Al	Zn	Mn	Hg	Pb	Ca	DOC	SO4	TSS
Typical Untreated Acid drainage	2.7	500	200	200	16	160 - 400	<0.001	0.12	150	0	4000 - 8000	200* - 15000
Primary Tailings Thickener overflow-recycled to process	11	0.5	0.02	0.6	0.01	0.05	<0.001	0.03	200	0	315	<30
Predicted Secondary Tailings Thickener Discharge - to Queen max acid drainage treatment	6.0 - 9.0	0.1	0.02	0.1	0.1	5 - 10	<0.001	0.01	180	0	4000	<30
Predicted Secondary Tailings Thickener Discharge - to Queen CMT acid drainage only	6.0 - 9.0	0.1	0.02	0.1	0.1	5 - 10	<0.001	0.01	180	0	1500	<30
Predicted Dam Decant - To Princess Creek** max acid drainage treatment	6.0 - 7.3	0.1	0.02	0.1	0.1	5 - 10	<0.001	0.01	20	10?	500	<10
Predicted Dam Decant - To Princess Creek** CMT acid drainage only	6.0 - 7.3	0.1	0.02	0.1	0.1	5 - 10	<0.001	0.01	20	10?	180	<10

* with "mud" removed

** at full production, dilution for 2mtpa plant approximately doubles

D Proposed Limits For Licence Conditions (allowing treatment of CMT component of mine dewatering)

Units milligrams per litre (except pH)

Source	pH	Fe	Cu	Zn	Mn	Hg	Pb	SO4	TSS
Process water overflow	6.0 - 9.0	1	1	5	15	0.002	0.05	250	30
Tailings Dam discharge	6.0 - 9.0	1	1	5	15	0.002	0.05	250	30
Thickener discharge	6.0 - 9.0	1	1	5	15	0.002	0.05	2000	30

E Suggested Limits For Operations Allowing Maximum Acid drainage Treatment

Units milligrams per litre (except pH)

Source	pH	Fe	Cu	Zn	Mn	Hg	Pb	SO4	TSS
Tailings Dam discharge	6.0 - 9.0	1	1	5	15	0.002	0.05	600	30
Thickener discharge	6.0 - 9.0	1	1	5	15	0.002	0.05	5000	30

5.2.2.6 Impact of Water Quality on Receiving Waters

The impact of discharges from the secondary tailings thickener to the Queen river and from the Princess Creek Tailings Dam to Princess Creek have been discussed in Section 4.3.4.14.

Discharge water from both the secondary tailings thickener and the tailings dam overflow are expected to meet regulations specified by the Environment Protection Act, 1973, except for sulphates, and, in the case of Princess Creek these will only be exceeded if the Government requests acid drainage treatment in excess of CMT's legal responsibility. In the case of the discharge to Princess Creek, studies have shown that the discharge level will not exceed toxic threshold limits (Davies, 1995). However, a monitoring program has been proposed to confirm this.

Discharge from the secondary thickener will feature a moderate to high sulphate level depending on the proportion of acid drainage treated. The receiving water of the Queen River below Haulage Creek is expected to continue to have high levels of sulphate even after proposed changes to the CMT mine dewatering system, with background levels predicted to exceed the toxic threshold limits for sulphate. The discharge from the secondary thickener will raise the concentration by up to approximately 50%, with maximum acid drainage treatment. However, the level of copper predicted to also remain in the Queen River from other sources will continue to be by far the greater source of toxicity to biological activity within the Queen river and aquatic life in the Queenstown reach of the river will continue to be unsustainable, irrespective of the secondary thickener discharge. The concentration of sulphate in the river is expected to drop to below toxic levels below Princess Creek.

5.2.2.7 Impact of Stream Flow Modification

Davies (Davies, 1995) suggested significant impact on aquatic life in the Princess Creek if flow above the Stage 2 Dam was diverted away from the creek. The current proposal does not divert water from the creek and there are no plans to use water from the main dam as process water due to the availability of more economical water from Lake Margaret.

The total flow in the creek at the dam will in fact be augmented by up to 42 L/s at full production, due to decant from the tailings. This represents 5% of average flow. The proportion of flow increases during low flow periods being 20% for mean flow and around 75% at extreme low flow. However, design of the dam outlet will feature a control valve as shown in Figure 5.5, which will allow throttling of the overflow to store flood water and allow its release during dry periods. This will allow maintenance of a more uniform discharge water quality. This will result in an increase in dry weather flow. Davies suggests that this will have a beneficial impact on aquatic life by reducing the stress on the creek during dry periods.

Flow in the West Queen river can be severely depleted during dry weather flow due to the extent of water removal. Flow in the East Queen is not affected to the same extent as the draw off point is in the upper reaches and the water from the lower reaches is not used due to acid drainage contamination. A minimum flow criteria is proposed for both

streams which will determine at what flow level water is introduced from the Lake Margaret system.

It is proposed that no water draw should result in any stream being dropped below its natural 7 day minimum level at annual exceedance probability (AEP) of 1 in 2 years. For the West Queen this would be 56 L/s over the lower reach between Dam 1 and the Junction with the East Queen. For the East Queen it would be approximately 20 L/s at the draw off weir.

Flow in the Queen river is expected to remain only marginally below natural flow conditions due to introduction of treated acid drainage from the secondary thickener which will be compensation for water removed from the catchment with the tailings.

5.2.2.8 Management of Flows and Water Quality

Testing of tailings/acid drainage to date has developed through a series of laboratory studies which have become more refined as the flows and water qualities in the system have become more defined. The work has been made more difficult due to lack of fresh tailings and some testing has been carried out using simulated tailings made up by grinding ore from the site. Current data is considered adequate for realistic predictions of water quality but further studies are proposed following recent discussions with SDAC as set out in Section 4.3.4.14.

These studies will include an intensive field testing programme set up when processing commences and tailings are discharged to the Stage 1 Dam. This will involve measurement of flow and water quality over the first 4 months of operation. A report on tailings behaviour will be released prior to commencement of discharge to the Stage 2 Dam. Modifications to the detailed procedures for tailings discharge, extent of beaching, timing of dam water level raising and any other issues arising, will be incorporated into Stage 2 Dam operation. Sub-aqueous discharge will be incorporated if found necessary.

Water quality monitoring points are to be set up at the following points:

- primary thickener inflow, overflow and underflow
- secondary thickener inflow, overflow* and underflow
- process water tank overflow*
- 17 level pump outflow
- Stage 1 tailings dam pond
- Stage 1 tailings dam decant return outlet*
- Princess Creek below Stage 2 Dam and proposed wetland/silt trap*
- Princess Creek at Queen

Those marked * will feature continuous monitoring of pH, suspended solids and conductivity and be provided with alarm systems to warn of exceedance of set levels as part of the mine control system.

A further program of study will involve the continued collection of base line water quality and biological data from Princess Creek over the period up to April 1996 when the first

discharge of effluent from the dam is expected. Water quality and monitoring of biological activity in the Creek will continue from this time with the specific aims of

- confirming predictions of water quality, and
- attempting to assess any indications of toxicological influences among the biota of the Creek

A detailed study program will be drawn up by CMT in consultation with SDAC and incorporated in an Environmental Control Plan for Water Emissions as shown in Figure 5.6

5.2.2.9 Risk Assessment of Control System Failure

Potential failures that could affect the water management system are discussed below:

Failure of power supply, equipment or componentry related to the mill side of the tailings system, the mine dewatering system or the tailings/acid drainage mixing system could result in potential for overflow of tailings and or of untreated acid drainage. A complete review of the drainage system around the processing area has been carried out by GHD. Details of the recommendations arising from this review are given in the GHD Report No. 4646 - 0200 provided for reference. This report makes recommendations on spillage containment to prevent contamination of stormwater. A contract has been let to effect the recommendations with an indicative cost of $195k.

The tailings transport system has been designed with provision for control during pipe breakage, pump shutdown or other mishap as follows:

- The pumps will be linked to flow and pressure switches which will detect breakage or loss of flow conditions which will automatically trigger alarms and stop pumps.
- The pipe route has been designed with spill collection drains to direct any spillage to collection basins at regular intervals.
- The pipe has been designed with a single high spot to allow drainage either to the dam or back to the mill in the event of a prolonged stoppage which could lead to setting up of tailings in the pipe.

The tailings dam is being designed in accordance with ANCOLD (Australian National Committee on Large Dams) guidelines. Stability will be based on conservative safety factors as recommended by ANCOLD for high hazard dams, including allowance for earthquake. Spillway design will cater for major floods with Annual Exceedance Probabilities in the order of $1:10^6$.

The outflow from the dam will be continuously electronically monitored with automated alarm and outlet valve control systems. In the event of water quality or flow exceeding set limits the outlet valve will be closed and alarms initiated at the mine control. The dam design allows storage of several weeks output, under normal operating flows, before overflow from the higher level auxiliary spillway as shown diagrammatically in Figure 5.5. The sort of event that could result in closure of this sort and the actions that could be taken to resolve the problem are set out in Table 5.2.

Table 5.2
Action in event of environmental incident at tailings dam

Event	Action (after closure of outlet valve)
high suspended solids	Allow settlement -if necessary distribute flocculant
high pH	review source, distribute lime
oil spill	initiate recovery

Further work on quantifying the risks of the various scenarios presented will be commissioned as discussed in Section 5.2.8

5.2.2.10 Water Monitoring

CMT will be monitoring aspects of mine dewatering discharges and tailings water in Princess Creek and the Queen River in the vicinity of the lease. A biological monitoring program will be set up to build on the data collected in background surveys and to monitor changes. Monitoring of water quality will be undertaken at the points specified in Table 5.5.

In addition a programme of groundwater monitoring will be set up to monitor changes in the groundwater regime in the vicinity of the Princess Creek Tailings Dam. This will comprise the establishment of monitoring boreholes in the ridge between the dam and the Queen River valley and the routine testing of known springs.

A routine inspection of all water control facilities will be undertaken to ensure proper operation of these systems

5.2.3 LAND MANAGEMENT

A Land Management Plan is presented in Figure 5.7

5.2.3.1 Impact on flora and fauna

The background reports on fauna and flora at the tailings dam site (North, 1994), have identified only one plant of special conservation significance on the lease, namely, *Centrolepis paludicola*. The sites which have been identified are shown on Figure 4.18. Protection measures initiated during dam construction works include marking and fencing the areas alongside the access track.

A rare sedge *Carex polyantha* was recorded along the banks of the Princess Creek below the tailings dam site as discussed in Section 4.1.14. The Botanical Garden Reserve area recorded the most significant vegetation of the survey carried out by Mr North. CMT do not intend to carry out any construction works in the Reserve and measures are being put in place during the construction of the tailings dam to minimise downstream impact on this area (Section 5.2.1.4).

Once the dam is fully flooded a small number of the areas where *Centrolepis paludicola* is currently found will be flooded. CMT has discussed the conservation status of this plant with the Parks and Wildlife Service and there appears to be doubt about whether *C. paludicola* is a distinct species in its own right. CMT has agreed to fund a research program to ascertain its specific taxonomy. If this study reveals that *C. paludicola* is not a distinct species its special conservation significance will be diminished. This work will not be carried out until the plant is in flower in January 1996. Once this work is completed CMT will discuss any necessary conservation measures with the Parks and Wildlife Service.

5.2.3.2 Weed control

Reduction of weed infestation is a vital part of revegetation and fire prevention programs. Management programs to limit weed and feral animal infestation of both the mine site and the dam site will be developed in conjunction with Landcare, the Department of Environment and Land Management, The West Coast Council and other appropriate bodies to ensure that re-infestation does not occur from off-site areas. MLMRC initiated a weed reduction program with some success and this program will be developed further under the CMT plan.

The Weed Eradication Strategy will encompass the Botanical Gardens Reserve area also. This area is already heavily infested with weeds and the proposed weed eradication measures will serve to protect the native vegetation in the area. The Strategy will include:

- development of a policy on control of weeds within the lease
- development of a machinery hygiene policy
- implementation of a long-term weed monitoring program
- liaison with the West Coast Weed Strategy Group

Measures to ensure that weeds are not spread as a result of work on the tailings dam area have already been undertaken with weeds on the site being sprayed prior to work commencing (Land Management & Rehab Services, 1995). The weed control program on the tailings dam site will continue throughout the course of the construction works.

Phytophthora has not presented a problem on the lease site to date. The harsh conditions and lack of soil cover coupled with the high metal loading present in dust and soils tends to preclude the transfer of the phytophthora by mud particles from infected sites. The situation will be kept under review as growth of vegetation on the lease proceeds. No Phytophthora has been detected at the tailings dam site which has been extensively used for 4-wheel driving in the past. Measures will be carried out to ensure that the potential for infestation to occur is minimised.

5.2.3.3 Fire Prevention

The licence issued under the Environment Protection Act 1973 for the CMT proposal and the preparatory works required CMT to prepare a Fire Management Plan by the 31 July 1995. This plan was formulated in consultation with the Tasmanian Fire Service, the local council and DELM.

The risk of fire spreading through vegetation on the main lease site is currently not great but is likely to increase as vegetation is regenerated on the site. A fire burnt out a considerable area round the airport and tailings dam site prior to construction of the Stage I dam. The Queenstown Volunteer Fire Brigade responded and cut firebreaks around the area to minimise the spread. CMT is required to make a Fire Service Contribution towards the operating costs of the State's fire brigades.

CMT as part of the underground rescue section has and will further develop firefighting crews that will be able to assist the local fire brigade in responding to off site fires, as well as being able respond to fires in areas where CMT is responsible for land management.

Management of flammable materials other than hydrocarbons will be in accordance with relevant regulations of the Mining Act, 1929, the Mines Inspection Act, 1968, the Dangerous Goods Act 1976 and the Industrial Safety and Welfare Act 1977.

A proposal by Dyno Wesfarmers to redevelop the ANFO station opposite the shaft is being considered by the underground contractor, National Mine Management, and CMT. This proposal would ensure that explosives will no longer be trucked by road to the site. A detonator magazine would be installed at the old bulk emulsion site which is currently fenced and has a concrete slab. Number 4 magazine would be repaired and fenced and would be used to store 30 tonnes of high explosives. All construction would be carried out in line with the most stringent standards.

This proposal post dates the Hazard Analysis Report. However, should it be decided to proceed the potential hazard of this development will be considered in the light of the Report and incorporated into the proposed Hazard Management Plan for the site. This

procedure will be followed for any other future development of a potentially hazardous nature.

5.2.3.4 Heritage Issues

Sites of heritage value are discussed in Section 4.1.6 and are shown on Figure 4.5.

The CMT Act designates heritage sites worthy of retention (the Identified Sites) at Annexure B to Schedule 5 of the Act. In addition the Godden-Mackay report identifies items of heritage significance. CMT is required to consult with the Crown and obtain approval before undertaking any activities which may affect the Identified Sites. The State Government will retain responsibility for the future management of these Sites. CMT intends to hold discussions with the State Government over the need to produce an engineering survey so that a pro-active program of protection can be initiated before any further degradation of the sites occurs.

5.2.3.5 Archaeological and Aboriginal Sites

Archaeological and Aboriginal sites are discussed in Section 4.1.5. Several surveys of the area have been carried out over a number of years and it has been a recommendation that formal archaeological surveys be conducted before any revegetation of the lease site occurs. The Parks and Wildlife Service has recently been awarded a National Estate Grant to carry out some preliminary work on Aboriginal sites.

CMT will liaise with the State Government on the outcome of the National Estate Grant work. CMT will support a full survey of the whole of the leased land, with the co-operation of Government Agencies and is prepared to discuss this matter with DELM. CMT's Environmental Policy includes the recognition and protection of items or areas of significance to Australian Heritage.

5.2.3.6 Protection of Special Interest Areas

The lease area has been severely impacted by previous land uses. The tailings dam area and even the Botanical Gardens Reserve have been impacted by bush fires and the activities of humankind. However, it is recognised that the Botanical Gardens Reserve is an area of special interest and will be protected from the mining activities proposed.

Tracks to the area have not been preserved and the area is infested with weeds. The weed eradication program described in Section 5.2.3.2 with contribute to the future protection of vegetation in the Reserve. In addition the botanical survey carried out by Mr Andrew North (North, 1994), identified a rare species of sedge, *Carex polyantha*, which he has recommended should be protected from impact not only from construction works but also from significant reduction in water flow rates which may arise from the operation of the tailings dam in the Princess Creek catchment.

Consequently, tailings dam discharge will be designed to even out Creek flows so that no extremely low flows will occur for long periods of time which may have a

consequential impact on the flora and fauna of the Reserve. This issue is discussed at Section 4.3.4.14.

5.2.3.7 Visual impact and landscape management

Very few changes in the visual appearance of the main lease from off-site vantage points will eventuate from CMT activities over the next two years. The installation of a FAG mill near the Prince Lyell shaft, minor changes to access roads within the mine area and the possible eventual removal of the overland conveyor will be the main changes. The current visual impact is severe due to the semi-derelict nature of much of the mill site and industrial precinct. It is proposed that new work will be neat and functional and likely only to highlight the degraded nature of the original structures to be left on site. The extent to which the visual appearance of the site can be improved by modification or removal of existing structures needs to be resolved through a process of discussion with appropriate authorities.

Visual changes will occur at the tailings dam site as construction proceeds and this aspect has been described earlier in the EMP. The most dramatic change in the visual appearance of the tailings dam area occurred with the destruction of most of the vegetation in the area by bushfire prior to the commencement of surveying or construction activity.

The visual appearance of the site has changed as diversion channels, the dam embankment and access roads were installed. These were initially very visible in the mid to far distance from the Strahan Road due to the contrast between the currently blackened area of the bushfire and the exposed white quartzite rock. However, rehabilitation of roads and embankments has ensured that the impact has been reduced. Minimisation of construction impacts has been discussed at Section 5.2.1.

As the tailings dam fills it is likely to be visible from coaches on the Lyell Highway. Exposed tailings beaches may be seen. With the regrowth of vegetation surrounding the dam the view will be obscured but it is intended to plant wetland species around the dam to minimise the visual appearance of the beaches. The wetland species may also assist in removing contaminants in the water column. This matter will be investigated by the Company. An area such as this, if properly managed, could provide a point of interest for visitors to the West Coast and an interpretation site on the Lyell Highway could be set up to illustrate Tasmania's mining heritage. Computer generated perspective views of the tailings dam site are presented in Figures 5.10, 5.11 and 5.12.

Figure 5.10 is a view from the air and gives an overall impression of the location of the dam and resulting pondage in relation to the Botanical Gardens Reserve and the Strahan Road. In fact the facility will be completely invisible from publicly accessible areas in the Queen River valley.

Figures 5.11 and 5.12 are views intended to simulate the view, at a bus height, from two view points along the Strahan Road (Table 5.3, View Points 5 and 6). These two view points are considered the only points where the pondage will be visible as from other sections of the road the view will be obscured by the topography.

Community attitudes to revegetation of the Mount Lyell site were canvassed in two reports one by Hay (Hay, 1994) and the other by Russell (Russell, 1994). These reports are discussed in Section 4.1.19. CMT recognises the cultural significance of the Mount Lyell landscape to the people of Queenstown but also recognises its environmental responsibilities. There is no doubt that the acid drainage problem occurring on the lease, with which both the Company and the community will have to contend, is unduly exacerbated by the exposed rock on the lease site. The scientific community are in agreement that revegetation of the lease will have the potential to ameliorate the present problem. Revegetation proposals previously presented by MLMRC are shown at Figure 4.24.

A photographic data-base has been set up to record the changes in visual appearance of the site during the CMT occupation. The vantage points chosen for photography are shown in Figure 5. 13 and described in Table 5.3. The first photographs are recorded at Appendix F. Repetition of the photographic series will be carried out six monthly in the first two years of operation and thereafter yearly.

Table 5.3 Photographic vantage Record Points

View Point No.	Location	Reason for selection
1	Lyell Highway at Gormanston	View of eastern side of lease
2	Tourist stop below Karlsons Gap	view of Howards Plains as backdrop to Queenstown
3	Lyell Highway opposite mine entrance	low level view of mine site, typical tourist stop point
4	High point on tailings access track	panorama of western side of Lease
5	Strahan Road opposite tailings dam 1 Km west of aerodrome	tourist view
6	similar to above 2 Km west of aerodrome	tourist view
7	hill in Princess Creek valley	overall panorama of dam site

5.2.3.8 Erosion Management and Rehabilitation

The project developments on the mine lease site described in earlier sections of this document will have minimal impact on surface land formations. Areas where additional stockpiles or equipment such as the FAG mill are to be placed are already cleared and levelled and the only alterations envisaged are the placement of shallow peripheral drains and the construction of small sediment traps to minimise transport of sediment. This has been described in Section 5.2.1.

Construction works at the dam site have been discussed earlier. Peat from the dam area has been and will be stripped and stockpiled for future use in rehabilitation works. Peat mounds are being use to prevent run-off from construction works and will assist in the revegetation of the tailings dam as discussed earlier.

The disturbed land in the vicinity of the tailings dam area will be rehabilitated with native vegetation. The tailings dam pond level will be raised to cover tailings. This will result in a lake between 2 and 20 metres in depth. Its end use may be for recreational purposes but this is an issue which will rely on the final water quality achieved. The general area will be suitable for passive recreation.

Area of existing erosion within CMT's Leases are the result of past disturbance as discussed in Section 4.1.13. CMT is indemnified from responsibility for remediation of these areas under the CMT Act. Consequently, CMT does not currently have any plans for erosion control outside the areas of the Leases effected by their operations other than the benefit of fire control which will apply to the entire Leased area. The main means of effective erosion control identified in Section 4.1.13 is revegetation. This issue has been discussed in Section 5.2.3.7.

5.2.4 ATMOSPHERIC EMISSION MANAGEMENT

5.2.4.1 Introduction

Emissions to the atmosphere are from the following sources:

- dust from transport movements on roads during periods of dry weather and ore crushing
- water vapour and traces of dust, hydrocarbons and explosive gases from mine ventilation
- trace quantities of organic compounds from the flotation section of the mill.

5.2.4.2 Road and Process Dusts

Dust from road surfaces is intermittent in nature and is controlled by the use of water carts. The high rainfall during most of the year prevents this being an off-site problem. Ore extracted from underground has a relatively high moisture content and the generation of dust during crushing and handling on site is not an issue unless the ore is stockpiled outside under very dry conditions. In addition crushing is to be confined to the underground crusher once the FAG mills are commissioned. The FAG mill operation for fine grinding involves addition of moisture. However, if dust generation does become a safety issue in any area then water sprays will be used for control.

Management Plan:- Monitor and initiate response as needed

5.2.4.3 Ventilation Shaft Emissions

Mine ventilation air quality is controlled by occupational health and safety and environmental standards which are set to values that would normally preclude any off-site effects arising from the discharge of these emissions at the surface. However, during blasting events, short term increases in particulate and volatile gas loadings occur. During the CMT operation this will be on a much reduced scale compared to that of MLMRC due to the smaller but more frequent blasting for the sub-level caving method proposed.

During colder periods of the year a water vapour plume is often visible at the exhaust points. These are located well within the mining lease and have no measurable impact at the boundary. Trucks used underground have water scrubbers on the exhaust systems to absorb fumes and minimise air quality degradation.

Proposed upgrades to the underground ventilation system as described in Section 4.3.2.3, will improve air quality and lessen the corrosion of exhaust structures. These changes will result in a reduction in concentration of emissions to the atmosphere.

No quantitative information is available on these emissions at this stage but if emissions become an issue revealed by the complaint response protocol, appropriate data will be collected and action taken where possible.

Management Plan:- Monitor and initiate response as needed

5.2.4.4 Organic Vapour Emissions

Trace quantities of the organic flotation agents used in the mill will be present in the atmosphere within the building, and will be discharged with the tailings. In the past when tailings were discharged to the Queen River and xanthates were used as a recovery agent for pyrite from the ore, these components were sometimes noticeable in Queenstown during periods of low wind velocity. The odour threshold concentration of these components in the atmosphere is in the low parts per million so small concentrations were noticeable. Xanthate will not be used as a flotation agent and the provision of a tailings dam will direct the residual reagents to an area where atmospheric dispersion will be considerably better.

Management Plan:- Monitor and initiate response as needed

5.2.4.5 Ozone Depleting Substances

All portable BCF fire extinguishers on site have been collected at a central point and will be used for fire fighting training or will be disposed of and replaced prior to December 1995. The fixed installation system underground is not required to be replaced at this time under the State legislation. However, this matter is being examined by CMT and recommendations for future underground fire control made. A phase out program will be prepared in accordance with all State Government requirements.

Management Plan: - Prepare phase out program

5.2.4.6 Monitoring of Emissions to the Atmosphere

Atmospheric emissions from the site are unlikely to give rise to significant environmental impact. At this stage, it is proposed that there are no atmospheric emissions that require on-going monitoring to demonstrate compliance with Legislation or to demonstrate that no impact is occurring. The situation will be kept under review and if issues develop as a result of process changes then a monitoring program will be initiated.

5.2.5 NOISE AND VIBRATION MANAGEMENT- MINIMISATION OF NOISE AND VIBRATION

5.2.5.1 General

Noise and vibration effects at the mine and surrounding areas have been an issue during the previous operations with MLMRC having an exemption for noise levels at a small residential area, particularly close to the Mill site. A general noise threshold of 45 dB(A) has been applied but the above area has been granted a level of 55 dB(A) in CMT's current licence.

Several preliminary noise surveys have been carried out by CMT to review noise levels from the very low level of activities currently being carried out on the site, in order to obtain an appreciation of the levels which may be generated during later operation. The location of monitoring points are shown in Figure 5.14.

At Site 1, to the south of the industrial estate and behind houses in Clarke Street, general background noise levels were measured at 40 - 50 dBA. Peak levels of 60 - 80dBA were registered due to truck traffic within the lease area, either delivering waste rock to the dump area or operating near the core shed.

At Site 2, at the Forestry Tasmania office background levels of 45 - 60 were recorded with peak levels due to lease vehicular traffic being noted up to 65 dBA.

At Site 3, the roadside parking bay opposite Clarke St., road traffic noise generally dominates over lease noise however, a peak of 55 dBA was recorded from forklift and truck operations within the lease.

A detailed noise survey was carried out by Pearu Terts in early May 1995. The noise survey report has been forwarded to DELM for assessment and to assist in recommendations to SDAC on noise conditions for the site. The report has been provided to SDAC for reference.

As outlined in Section 4.3, various changes proposed to the mining operations and the processing flowchart are expected to provide significant reduction in noise and vibration from the site, compared to the MLMRC operation. However, due to the closeness of the residential area, historically linked to the development of the mine, there may be difficulties in complying with stringent noise conditions on the operating licence.

The sub-level caving method of mine development allows for the use of considerably smaller quantities of explosives to be fired at any one time. The resultant ground vibration impacts will therefore be of an order of magnitude lower than during the MLMRC operations. In addition, as work progresses to deeper levels in the development of the Prince Lyell mine, shock wave disturbance and ground vibration impacts are expected to be diminished. Information from residents of Queenstown suggests that shock waves from previous operations could be felt on still nights in the town. However it is considered quite likely that, with the charge size proposed, this will no longer be the case. A blast vibration monitoring program will be initiated once production commences.

As previously discussed in Section 4.3, the FAG mill proposed for the Prince Shaft area will be a new source of noise but will be quieter than the existing ventilation fans. The FAG mill is not expected to significantly increase noise levels from that area.

Current plans are to transfer the crushed rock from the FAG mill at the mine head to the existing grinding plant by pipeline. This will avoid previous significant noise impacts caused by the operation of the conveyor and the dropping of ore into the surge bin at the end of the belt.

Waste rock transport by diesel truck will result in the generation of some noise as the material is dumped, spread and compacted. The current dump area is particularly close to the residential area but minimisation of noise, particularly at night, is being carried out by restricting dumping at the face of the dump, minimising dumping of waste rock at night and muffling the reversing beepers. This potential problem area will be removed when the new waste rock dump is established in the area above the Prince Lyell Shaft.

Operational times of most processing equipment on the site will be on a 24 hour basis 7 days per week. Site activity such as above ground maintenance work, road grading and cleanup and construction work will be predominantly during daylight hours, with only limited essential machine shop work undertaken on a shift basis.

Realistic and achievable noise levels should be set for the mine operation and provision of baseline data and information from the noise report by Pearu Terts should assist SDAC in setting these values.

5.2.5.2 Monitoring of Noise and Vibration Effects

Movement of trucks and materials transfer operations will be monitored on the site as changes are made to operational procedures that may have a noise impact beyond the boundary. A maximum limit of 55 dBA measured at residences opposite the Mill area applies to noise emissions from the lease. Standard noise monitoring locations have been set up by Pearu Terts to provide both baseline data and to monitor noise from the site as activity increases over the next two years.

Noise monitoring surveys will be carried out at these sites at six monthly intervals with the first repeat survey being undertaken following start up of operations. Ground vibration testing on a one off basis will be undertaken to confirm predictions that the limits will be readily met under the changed CMT blasting regime.

Management Plan:-

Noise emissions from current waste rock disposal site will be monitored to determine compliance. Evaluations will be made of the noise emissions from proposed equipment items such as the FAG mill, tailings pipeline pumps and the filter plant pumps to ensure that noise limits are met as part of the commissioning phase. If initial tests indicate that

compliance is not achieved then attenuation measures such as the construction of earth or slag bunding or concrete block enclosures will be undertaken.

Noise and ground vibration will be monitored as specified in Section 5.2.10 with a one off set of ground vibration measurements performed in a worst case scenario when a maximum quantity of explosives is to be detonated underground.

The standards to be aimed for are

- *noise levels of 45dB(A) overall and in a specified residential zone 55 dB(A)*
- *the goal for air blast overpressure is 115 dB (Lin Peak).*
- *the goal for ground vibration peak particle velocity is an average of 5 mm/sec, with the maximum value not to exceed 10 mm/sec.*

5.2.6 OFF LEASE MATERIALS HANDLING, TRANSPORT AND SHIPMENT

Details of off lease materials handling, transport, number and loading of vehicles and shipment has been discussed in Section 4.3.5. This also provided information on noise and traffic aspects.

The transport and handling of concentrates will be by contractors, whose contracts will contain provisions requiring proper environmental controls over their operations. Trucks will be covered with tarpaulins and all transfers and holding of concentrate will be carried out in covered, secure areas.

Contingency plans will be drawn up with transport contractors to provide quick response for clean up of any accidental spillage. This will include training of operators and include simulated emergency situations.

During the initial stage of the development, concentrates from the mine will be shipped to overseas smelters for secondary processing. EMP guidelines have requested a discussion of the issue of discharge of ballast water from ships transporting the concentrate.

Ballast water is taken on board ships in specifically designed holding tanks to stabilise the ship during ocean voyages and during cargo loading and unloading. The water is usually pumped on board at the previous port of cargo discharge and may take sediment and organisms into the ballast tanks that survive the journey to the next port.

As a result of the possible impact of ballast water introduction on the shellfish industry in Tasmania, research programs were commenced in the mid 1980's into the management, spread and identification of introduced species. These programs involved the State government, CSIRO and the University of Tasmania.

Introduced species in Tasmanian waters that are known to have come in ballast waters include the Japanese seaweed *Undaria,* the toxic dinoflagellate *Gymnodinium catenatum* and the northern Pacific Seastar *Asteria amurensis.* These species have already had a significant economic and ecological impact on the coastal environment and in particular:

- The seaweed *Undaria* has, in certain areas affected native seaweed species thus threatening traditional habitats of crayfish and abalone.

- The toxic dinoflagellate *Gymnodinium catenatum* has caused closure of shellfish farms in south east Tasmania.

- The northern Pacific Seastar *Asteria amurensis* is a voracious predator of shellfish and is a major threat to the industry, not least due to the alarming rate at which the species has multiplied.

Most introductions are thought to have come from the ballast water discharged by shipping from the northern Pacific area but there is an increasing concern about the

spread of these and other organisms from the movement of coastal shipping in Australian waters.

The problems caused by ballast water are being addressed at both National and State level through the Australian Ballast Water Management Advisory Council and other bodies. Recently a committee, chaired by Senator Nick Sherry, has been established to advise on the necessary legislation to enforce such guidelines, generally adopted by the shipping industry at present.

Precautions recommended by the Marine Environment Protection Committee to minimise the chances of survival of exotic species in ballast water tanks include the exchange of ballast water in tropical waters, chlorination of the tanks, treatment of ballast water by shore based facilities, regular cleanout and sterilisation of tanks and heating of ballast water to kill the organisms.

In practice all shipping coming into Australian waters should operate under Australian Quarantine Inspection Service (AQIS) guidelines, which currently are not mandatory but are generally complied with by the shipping companies. While safety of all shipping is the primary concern of any regulations, shipping is encouraged to discharge ballast water in mid ocean if tropical water exchange is not possible. Chlorination of ballast is not practical in most cases due to the large amount of chlorine necessary for the disinfection of "murky" ballast water. The generation of the large amount of heat needed for "kill-off" of the organisms is generally uneconomic.

The policy of the Company is to ensure that all shipping conforms with the current voluntary, and future mandatory, guidelines for the discharge and exchange of ballast water and contract documentation will enforce this policy.

Other transport issues involving delivery of raw materials to the site will involve limited vehicle movements, predicted as equivalent to 6 trucks per week, usually during daylight hours. In particular 1 fuel tanker and possibly 1 lime tanker per week would be involved. Most day to day deliveries would be by existing carriers and would have no additional environmental impact.

Management Plan -

- *Audit transport contractors to ensure environmental management procedures are implemented*
- *Draw up contingency plans dealing with notification procedures, materials handling, disposal of waste products and oil spill management.*

5.2.7 HAZARDOUS MATERIALS AND HYDROCARBON MANAGEMENT

5.2.7.1 Introduction

An Environmental Hazard Analysis for Leases 1M/95, 2M/95 and 5M/95 was carried out by GHD in July 1995 and has been provided to SDAC for information. Hazardous materials held on site include:

- explosives,
- hydrocarbons -diesel, oils and grease,
- reagents used in the flotation section of the ore processing circuit
- alkali and some residual acid.
- laboratory reagents

The Hazard Analysis Report provides a list of hazardous materials held on site at July 1995.

5.2.7.2 Storage and Management

Materials that present a hazard to the workforce or the environment will be contained or isolated according to the nature of the material and as required under the appropriate safety code such as the Dangerous Goods requirements. Quantities of hazardous materials used or stored on the site will be minimised in line with operational requirements. A central library of material safety data sheets (MSDSs) will be kept on site. This will ensure that full information of all hazardous materials is readily accessible. In addition a comprehensive software package database of information on hazardous materials has been purchased from Australian Health which will provide information on any chemical proposed to be brought on site.

The inventory of all designated hazardous materials will be continually updated and reviewed as part of the environmental audit process. Hazardous materials that are no longer used will be returned to the supplier or disposed of according to the appropriate regulations. Residual hazardous materials that cannot be returned will be disposed of via specialist contractors.

All known electrical equipment was believed checked for PCB content by MLMRC for disposal prior to 1991. However a recent audit has identified 26 PCB filled capacitors still in service on the site. These comprise 8 in the Main Substation, 12 in the Mill Substation, and 6 in the Southern Exhaust Switch room cubicles. Discussions will be held with representatives of the State Government to determine the appropriate action to be taken to replace these capacitors with PCB free alternatives when the need arises. All areas will be sealed and bunded to ensure that any potential leakage will not contaminate soil or waterways.

A review of the containers in which the materials specified are purchased will be undertaken as described in the Waste Management Section 5.2.9 . Bulk plastic reagent containers will be cleaned and returned to suppliers for refilling wherever this is possible.

5.2.7.3 Incident Response and Contingency Plans

Induction and training programs for employees will highlight the requirement to act responsibly and think of environmental as well as health safety and production consequences of actions on the lease. Additional backup training will be given to emergency response crews in environmental procedures and plans will be developed for specific areas of the operational sections of the mine in conjunction with the manager of that section and team leaders. The contingency plans will address issues such as spill control, fire, bunding, collection and recycling of spilt materials, waste oil capture and reclamation, radioactive sources, asbestos handling and disposal.

CMT currently operate 2 Mine Rescue Teams, each comprised of a minimum of 6 members, meeting on a fortnightly basis for a 6 hour training session. The training consists of all aspects of Mine Rescue skill requirements, including Surface and U/G Fire Fighting, closed and open circuit Breathing Apparatus, rescue from heights or depths, HAZCHEM response and advanced first aid and casualty handling. A Skills Acquisition and Training Program is being designed. The team maintains and operates a 6 x 6 fire tender, ambulance and general purpose rescue vehicle.

Preliminary Incident Response Plans have been drawn up by CMT but these will need further development as more detail of the actual project becomes clear. Extracts of current plans are outlined below:

EMERGENCY PROCEDURES

Employees are to familiarise themselves with the site emergency procedures in the event of earthquake, chemical spills, fire, accident or any other event deemed to be a threat to personnel or the environment.

UNDERGROUND FIRE

In case of Fire, personnel will proceed to nearest fresh air base and notify 555 emergency number.

The personnel on duty will activate the fire siren that is situated on the working levels.

The personnel on duty will don their w65 self rescuers and proceed through to the escape rises to fresh air bases, where they will stay until the Mine Rescue team arrives.

DAM SITE

In case of fire or accident, the personnel involved will contact the Emergency Services Department by radio. The Emergency Services Co-ordinator or designate will ascertain the level of response required, initiate Mine Rescue call out if necessary and proceed to the site. In case of an uncontrollable machine or vehicle fire, the Fire Tender will be mobilised with Mine Rescue Team members.

ACCIDENTS UNDERGROUND

(It is CMT's intention to have every employee on site undertake a St John Ambulance first aid ticket. Classes are conducted twice per week).

In the event of accident or injury underground, stay with the casualty if possible, and send some one to call the Emergency Services Officer by phone or radio. Do not move the casualty unless they are exposed to further danger. If there is no response from the ESO, dial 555, and calmly state your name, your exact location, your problem, the number of casualties and their names. The ESO will decide the level of response required, turn on the emergency light system (blue lights) and proceed to the casualty's position or the accident site. Should medical assistance on site be needed, the hospital will be contacted.

INDUCTIONS

Every new employee or contractor is taken through a Site Safety Induction Program, and a specific work area or department induction program according to the area or areas they will work in. The major aspects covered in the Site Induction include site specific and Government Safety Regulations, incident/accident reporting, personal protective equipment, hazardous chemicals on site and precautions necessary, traffic regulations, tagging and lockout, fire fighting, first aid and emergency response systems, environmental considerations, past site history and the future direction of CMT. Induction exams and checklists ensure all personnel are conversant with the operations. Future re-induction sessions are planned, which will test the effectiveness of the present system. The induction program is being designed to match the dynamic status of the operation.

HAZCHEM

In the event of spillage of hazardous chemicals, the Emergency Services Department will be notified which will then assess the level of response required. The spill will be contained or removed in conjunction with resource personnel, such as the Environmental Department. If further assistance is required, the appropriate authority will be contacted eg the Fire Brigade.

FIRE/ACCIDENTS ON THE SURFACE

Personnel are to contact the Emergency Services Department on the radio or phone 555. Upon assessing the problem, the Emergency Service Department may initiate a mine rescue call out and advise the person calling to evacuate the area as per the Emergency Procedure Manual.

5.2.7.4 Hydrocarbon Management Plan

A hydrocarbon management plan will be developed to:

- formulate procedures to minimise the risk to the environment of accidental spills and leakages that would result in contamination of waters or the ground,

- document storage and retention facilities and initiate improvements where required
- document emergency procedures in the event of a spill
- provide a listing of emergency equipment available and its location including absorbents and booms to collect and minimise the spread of a spill
- document and initiate cleanup and bioremediation in conjunction with DELM

Initiatives already undertaken involve the minimisation of diesel storage volumes and the removal of the petrol and diesel dispensing facility near the security gate. Currently minimal stocks of hydrocarbons are present on the site and this situation will remain until the development of the mine proceeds and the CMT workforce increases. Construction of facilities to comply with AS 1940 are in hand and tenders for construction of a new bowser dispensing facility will be let shortly.

Mechanisms will be developed for minimising loss of hydraulic and lubricating oils underground due to mechanical breakage problems. Documentation of usage and a record of the volume of lubricating oil returned for recycling will assist in determining the most significant loss pathways. All spills or leakages will be recorded in order to determine the magnitude of the losses that occur so that procedures can be developed to minimise these events.

A review of oil handling facilities underground is taking place and the results will be incorporated into the Hydrocarbon Management Plan. Immediately following termination of MLMRC operations in December 1994 oil and grease concentrations in the conveyor tunnel acid drainage discharge exceeded 50 mg/L. Results of the 14 February 1995 showed a value of less than 1 mg/L. Regular auditing of the acid drainage quality for oil and grease has indicated no significant loss of oil has occurred since that time.

The GHD Environmental Review (GHD, 1994) detailed a series of 13 significant historical hydrocarbon spills that had occurred over recent years on the lease. These have resulted in the contamination of soil, rock, timber and concrete in workshops, refuelling bays and at a number of other locations on the lease. Under the terms of the CMT Act, the Company is not responsible for clean-up and remediation of these sites.

However, due to leachate arising from some of these areas, CMT has removed approximately 100 tonnes of soil from around the old railway workshop and Number 4 crusher. This soil is being remediated by active composting at a Bio-pile operation at the old Open Cut Workshop site. The oil in the soil will breakdown over many months and will then be able to be used in rehabilitation works. Discussions will be held with DELM to formulate a priority listing of further areas to be cleaned up, excavated and bioremediated on the basis of cost compensation.

5.2.7.5 Transport, Transfer and Storage

Transport of hydrocarbons and other materials to the site is undertaken by private contractors that are registered and hold permits with the appropriate State Government authority for transportation of the goods. Responsibility for the safe passage of the goods to the site lies with the contractor. CMT may provide limited backup assistance, at the Resident Mine Managers discretion, in the event of a spillage or emergency in the vicinity of the lease. Storage areas for oils and greases will be located in bunded areas with provision for storm water separation.

Transfer of fuels and oils to and from storage on site will be undertaken in stores areas under supervision or to bunded storage tanks. Fuel and oils will be transported underground by tanker. As outlined above, future requirements for underground storage and transfer options will be investigated as a component of the Hydrocarbon Management Plan. Precautions in the form of lockable non-spill valves are being considered.

During the construction phase of the tailings dam and underground development only very limited quantities of fuel will be permitted.

5.2.7.6 Bunding and Stormwater Release

Adequate bunding of the main diesel supply tanks to AS 1940 is already in existence. Bunds have a locked outlet valve to allow release of clean stormwater only under responsible supervision. A complete review of lubricating oil and other hydrocarbon storage areas is being undertaken as part of the Hydrocarbon Management Plan. A proposal to construct a main diesel supply facility with storm water separation is being considered and as soon as it is finalised drawings will be forwarded to DELM for approval.

5.2.7.7 Collection and Recovery

Used and contaminated oils and other hydrocarbons are being collected in 200L drums from surface and underground workshops and decanted into the oil recycling tanks at the industrial estate, prior to collection by an approved recycling company.

It is proposed that used absorbent materials will have excess oil removed by mechanical means if appropriate facilities can be identified and it is cost effective. Oil contaminated wastes such as oil filters, rags and oil absorbent material used to clean up minor spillage, are being removed from site by specialist contractors and disposed of at a licensed disposal site.

5.2.8 PRELIMINARY HAZARD ANALYSIS AND RISK ASSESSMENT

5.2.8.1 Introduction

SDAC require that a hazard analysis and risk assessment be conducted for the proposed CMT operation to determine the likely consequences to people, wildlife and the environment, of a major occurrence such as explosion, fire, or chemical spill at the site. An Environmental Hazard Analysis: Leases 1M/95, 2M/95 and 5M/95 Report has been produced by GHD (GHD, 1995) and has been forwarded to SDAC for information. The Report identifies and quantifies all potentially hazardous materials held on site at the 31 July 1995, giving a description of the location and methods of storage, the safeguards in place to prevent spillage/leaks, and an assessment of the ramifications of loss of containment. Until final design plans are completed and the Project is commissioned a full hazard analysis for the Project cannot be completed.

Risk assessment is a process that combines an estimate of hazard potential with an estimate of the probability of loss of containment and applies judgement as to the resultant risk posed to the environment and the community.

The potential for any previously contained hazardous material to be released from containment and reach a target to cause serious harm or damage is a function of the following factors:

- its containment systems (ie primary packaging and secondary bunding or housing);
- its location relative to target components (environmental systems and people in the nearby community);
- the pathway/s from that location to the off-lease target components (eg through the air or via surface or underground waterways);
- the maximum amounts of released material that can reasonably be expected to actually interact with a part of the local environment or persons located off -lease; and
- the dose response relationship of the released materials entering the environment (and posing potential harm to ecological integrity) or persons (and causing significant health effects).

In Tasmania there are no statutory risk acceptability criteria and management of risk has hitherto been based upon a consensus between the facility operator and relevant Government agencies.

The GHD Report, has made judgements as to the potential for, as well as the seriousness and manageability, of accident events involving the more significant storages of hazardous substances on the lease as at July 1995.

Management guidelines and engineering programs initiated at the mine site are designed to minimise the potential to cause harm through the implementation of suitable

safety and environmental control procedures. Containment of hazardous materials and energy within well defined areas, including control measures such as spill collection systems, bunds, monitoring programs and buffer zones around industrial complexes, assist in reducing hazards to individuals and the environment.

5.2.8.2 Hazard Audit of Potentially Hazardous Materials

The GHD Report contains an inventory of Hazardous Materials at July 1995 held on site or expected to be held on site in the future.

The potential environmental hazards associated with the storage and processing of materials at the mine site are detailed below. The emphasis in this description is directed primarily to environmental issues although there is a very strong overlap with health and safety. Measures to reduce the risks are detailed below and should be read in conjunction with previous sections of the EMP describing the activities and areas concerned. Guidelines and documentation used in the preparation of this section are from the NSW Department of Planning Advisory Papers on Hazard Audits and Hazard Analysis, ICI Engineering Hazard Analysis Notes, and notes from the University of Sydney School of Risk Engineering.

a) Explosives

Explosives will be stored in two separate magazines located above ground and one underground. A future plan for the closure and demolition of all the surface magazines with exception of Number 4 Magazine is being considered, with the re-commissioning of the ANFO facility and a detonator store above ground with additional explosive storage underground. The revised mining methods described earlier in Section 4.3.2 means that more regular blasting using a steady transfer and positioning of explosives will occur. The previous use of large quantities of explosives over short time frames for massive blasting will no longer apply. This will assist in minimising the risks associated with the storage and transfer of explosives.

Explosives are presently transported and stored according to the safety requirements of Mineral Resources Tasmania with detonators and primers separated from other components such as cord, ANFO and Powergel, and the location of the secured storage areas remote from normal traffic and workplaces. Explosives are transported to the site from the main West Coast storage depot, currently near the Savage River Mine but soon to relocate to the Hellyer Mine, in 15 tonne lots. Quantities presently held at the mine site are kept to a minimum, thus limiting the risk associated with storage of larger quantities. A small tank unit is used to transport three tonne quantities underground.

The off-site environmental effects produced by a detonation at the explosives storage area would depend on the quantity and nature of materials that were stored at the time. A surface detonation of the main explosive mixture would result in a significant air pressure wave that may have some off-site effects including possible shattered windows at line of sight locations. Most of the largely unconfined blast effect would be directed vertically and placement of the magazines is such that the effects of the blast on outside structures and persons is minimised.

Explosion of the detonator storage would be sharp and limited to the immediate area. Mixed explosives can burn vigorously if an ignition source is present. Storage requirements under the mining regulations and operational procedures are designed to minimise this risk.

Localised environmental effects of a surface detonation would include a disturbance of the immediate area, the production of a crater in the ground and scattering of debris from the magazine. An underground explosion of the three tonne maximum quantities would only have a localised environmental effect as past practices have seen the firing of many hundreds of tonnes of explosives at once in controlled blasts.

In general the health and safety aspects of an accidental or premature explosion would tend to be far more significant than the off-site environmental effects.

b) Hazardous Chemicals and Reagents

A list of hazardous chemicals, the maximum quantities held, a hazard summary and the storage locations is presented in the GHD Report.

c) Diesel Fuel

Diesel fuel is used on site for above ground and underground transport vehicles.

Diesel oil presents a hazard to the environment if leakages occur resulting in soil or water contamination.

The diesel storage tank is an above ground steel cylindrical tank of 120kL capacity. Smaller tanks of 1000L capacity were temporarily located within an earth bund areas at the tailings dam construction site. The large tank at the mine site is surrounded by a concrete bund constructed according to the required Australian Standard AS1940. The tank is located off the main mine access route and any leakage from the bund would report to Haulage Creek via a stormwater drain. Plans for a new fuel dispensing area are being drawn up and the location of the new fuel depot is shown on Figure 4.10.

A discharge of diesel oil of any significant quantity to a water course would create a significant impact in Princess Creek or Haulage Creek and the Queen River. Clean-up and collection of the diesel would be difficult due to the rapid stream flows, presence of rocks, roots and snags and other vegetation along the river banks and in the channel. A significant spill would take some days to dissipate and this would occur as a result of evaporation of the lighter hydrocarbon components, river flushing, and biodegradation.

d) Fire

A fire through the vegetation at the tailings dam construction site, prior to any activity in the area resulted in the destruction of a considerable proportion of the vegetation on the plateau to the east and south of the airport. Following recent rains, run-off from the burnt area and small localised landslides have contributed to minor increases in the suspended solids load in Princess Creek.

The Fire Management Plan submitted as a condition of the environmental licence will assist in ensuring a rapid response to outbreaks of fire in the future and reducing the risks to the environment.

5.2.8.3 Comparative Risk Assessment

The possible scenarios outlined below have been drawn from the activities that CMT will continue to perform on the site as part of the ongoing extraction and ore processing, and the presence of new infrastructure associated with the tailings dam and pipelines.

Scenario 1

A significant surface or underground explosion whereby sections of earth or rock were physically disturbed could result in environmental implications under circumstances where drainage channels were disrupted or a fire occurred in an air inlet shaft. The health and safety aspects of these events would probably be of considerably greater concern than the environmental implications. This situation could arise in the unlikely event that an explosion resulted in a fire in close proximity to the air inlet shaft.

Prevention

Rigorous control of the handling, use and the minimisation of quantities of explosives are all oriented towards risk reduction. Inspections of the premises by officers from Resources and Energy (Mines) Division are carried out to ensure compliance with the relevant safety codes. The location of fresh air bases and the use of the self rescue apparatus forms an essential part of the training and induction program at the mine. The preventative measures outlined above are considered to lower the risk of a serious explosion to below reasonable limits.

Scenario 2

Pipe fractures involving any hazardous materials, oils and process streams within the flotation section of the plant.

Scenario 3

Services Failure. The failure of power or water to the site would result in the shutdown of all processes, materials transfers and activities on the site. Pumps cease operation if all or one of the electrical 3 phase supply circuits is interrupted.

Prevention and Containment (Scenarios 2 and 3)

A system of diversions and bunds will be developed around the mill site. A preliminary plan of works has been produced (GHD, 1995)A holding or spillage collection dam will be constructed to collect discharges that may overflow the normal reclaim systems within the concentrator building. The bunding within the concentrator building will also be upgraded to provide effective bunding and spill collection sumps with appropriate pumps for recovery.

Collection sumps or dams will be provided to collect tailings. If a power failure occurs over several minutes duration, the tailings in the pipeline may need to be drained to prevent settling and the blockage of the line. Provision will be made to drain the tailings into a sump for collection and return to the circuit. This sump will also act as a collection point in the event of a breakage in the line.

Scenario 4

Tailings system failure.

This has been previously discussed in Section 5.2.2.9. This aspect has been discussed in the GHD Report.

Scenario 5

Instrument Failure. If a level gauge falsely reports a tank as being full the flow ceases. If it reports as being empty and this is incorrect then a spill would result.

Prevention

A spill under these circumstances will report to internal bunding and a sump for recovery.

Scenario 6

Water storage tank failure. Two concrete water storage tanks of 250 kL capacity are located on a levelled area on the slope above and behind the Prince Lyell shaft, and the Utah Tank of 4,750 kL capacity is located on the crest of the ridge to the north of the West Lyell open-cut. Failure of any of the tanks would most likely occur as the result of a crack occurring in the concrete or a mechanical failure occurring in the pipework near the offtake point. This would result in a stream of water being discharged to nearby roadside or pad drainage. Some roadside and bank erosion would occur with the magnitude depending on the severity of the discharge. The run-off would report to Haulage creek and would cause an increase in sediment loading.

A catastrophic failure of any one of the tanks would cause a wave of water to descend down access roadways and embankments with vigorous scouring and erosive action. The water containing the elevated sediment load would report to Haulage Creek which would flood for a short period causing some additional bank scouring. Due to the distance of the tanks from the stream there would be a considerable levelling out of flow thus reducing the peak flood level that would occur. All tanks have been inspected and the Utah Tank was found to have minor cracks in the some of the walls and in the base.

Prevention / Containment

Regular inspections have and will continue to be made of the water storage tanks and the dams on the West Queen River. CMT is considering the feasibility of decommissioning the Utah Tank if suitable alternative procedures can be developed to

maintain water storage capacity. If the tank is required for service it will be drained and repaired.

Scenario 7

Sudden release of built up water and sediment from a blocked adit.

Within the underground adits and shafts a buildup of groundwater and sediment may occur in unused sections of the mine. On one occasion in 1987 a sudden rush of water occurred from the North Lyell tunnel which carried sediment and water out and through the mine site office area in a wave. The discharge caused a significant change in fine sediment loading and colour that was noticed as far as the mouth of the King River. With the maze of tunnels and lack of records and historical data about tunnel closures there is a remote possibility of a recurrence of this event.

5.2.8.4 Training, Safety Provisions and Warning Procedures

Induction courses are held for all employees and visitors to the site, including general site workers, contractors, and underground workers. Permission to undertake work on the lease is not granted until an induction course covering health, safety, mine safety and environmental regulations and rescue procedures has been completed. For underground workers the location of safe areas and fresh air bases as well as the use of the self rescue equipment emphasised. Environmental implications and responsibilities of individual workers also form part of the induction training process.

5.2.9 WASTE MANAGEMENT

5.2.9.1 Waste Management Strategy

A waste management strategy consistent with the current national and state based policies is being developed for the CMT Project. The goals of this strategy are to reduce potential environmental and health effects posed by waste generation and disposal. The disposal of wastes will only be considered where no other options for reuse or treatment are available. The principles of the strategy which will be applied to the operation are in order of preference:

- waste minimisation
- waste reuse/ recycling
- waste treatment
- waste disposal

In particular, the following waste management practices will be implemented and will form part of CMT's Waste Management Program for the Mount Lyell Project:

- Appropriate engineering treatments will be employed at the proposed waste disposal site for clean fill to minimise any potential adverse environmental effects from these areas and to ensure compliance with Regulatory requirements for such a facility.

- The volume of waste generated will be minimised through a purchasing policy which will minimise the volume of packaging by bulk purchase and provide materials in returnable containers.

- Recycling of materials will be encouraged at all levels of the operation from the office site through all of the operational areas. Appropriate recycling collection receptacles and a recycling station will be provided. All opportunities to recycle wastes generated on site will be investigated and pursued.

- Waste oil generated at the site will be collected for disposal or reuse off-site in an environmentally acceptable manner

Table 5.5 shows an overview of the waste management plan for all solid and liquid wastes identified as generated on the site. As new wastes are identified, their appropriate collection, storage and/or disposal will be incorporated into the Waste Management Strategy.

Table 5.5 Waste Management Plan

Waste Type	Minimise	Re-use/Recycle	Treatment/ Destruction	Current Disposal Sites	Comments
Solid Waste					
Putrescible		Compost	Compost	Municipal	Composting preferred
Biodegradable		Compost	Compost	Municipal	Composting preferred
Sewage sludge				Municipal	
Cans, containers	Bulk purchase	Collect for recycling	Place in bundles	Municipal	Recycling preferred
Packaging-paper, plastic	Bulk purchase	Recycle	Crush	Municipal	Recycling preferred
Wood pallets	Avoid damage	Return for reuse		Mine site	Recycling preferred
Scrap steel, wood		Separate, store in laydown area		Mine site	Recycling preferred
Drums	Bulk supply preferred	Return to supplier where possible	Ensure empty, crush at workshop	Mine site	Recycling preferred
Oil filters, absorbents, oil contaminated mats		Reuse absorbents		Off-site licensed disposal site	
Oil contaminated silts/ soils	Avoid spillage			Off-site licensed disposal site	
Tyres		Aim to recycle if market available		Mine site	Recycling preferred
Batteries		Aim to recycle if market available		Off-site licensed disposal site	Recycling preferred
Hazardous materials				Off-site licensed disposal site	
Liquid Waste					
Office or decline effluent			Septic tank/ STP		Connect to STP
Waste oil/ solvents		Collect for recycling. Keep drums, separate		No disposal on site	
Oil/ fuel contaminated			Interceptor trap, to silt sump	Off-site disposal	

Specific detail on each of the special areas of waste generation are given below.

A preliminary Waste Management Strategy and indicative timetable is provided at Figure 5.8.

5.2.9.2 Waste Rock

Waste rock is rock and fines material that has been removed from underground. It is lower in copper grade than the cut off value determined on economic grounds by the Company. Waste rock is currently being produced as a result of mine access development to the 70 series level. This material is transported from underground by truck and deposited on the southern side of the treatment plant as described in Section 4.3.2.6 and as shown in Figure 4.28. A Report on the Operation and Close Out of the existing waste rock dump at the Slag Heap has been prepared by Thompson and Brett and has been forwarded to SDAC for information.

The waste rock dump is presently being managed by placing lime solids between lifts to minimise the production of acid drainage. This is the practice previously carried out by the prior occupier of the lease. The use of lime in this way has only a short term benefit and CMT will explore and implement better long term practices for waste rock dumps. A new site for a more permanent waste rock dump has been identified and is shown on Figure 4.28. This site is believed to be more suitable for a long term stock pile of waste rock with a view to future rehabilitation and control of acid drainage.

Waste rock dumps are recognised as a significant source of acid drainage as discussed in Section 4.1.18. CMT has responsibility for waste rock dumps generated from their activities and will ensure that future management is in line with BPEM practices. These practices include, but are not be limited to:

- Characterisation of the waste rock to identify potentially acid forming and non-acid forming rock types. CMT has initiated routine NAG analysis on sub-economic material for the purposes of classifying high capacity and low capacity acid forming potential waste rock.

- Selective placement of these materials in the dumps to ensure that sulphide oxidation is minimised during placement and that acid generation is prevented from occurring. This may include addition of lime or limestone to the waste rock during placement to increase the lag period for effective management.

- Placement of compacted low permeability layers and or placement of an outer zone that will limit oxygen diffusion into the dump.

- Diversion of surface run-off to prevent infiltration of excess water.

- Leachate collection systems will be engineered so that seepage from the dump can be collected, regularly monitored and treated if necessary. The following parameters will be measured: flow, pH, SO4, Ca, Mg, Cu, Zn, Fe, Al and Mn.

It is unlikely that minimisation of waste rock generation will be feasible in the short term since it is directly related to the economics of ore production. However, the possibility exists for reprocessing some sections of the historical waste rock dumps in the future to recover residual copper. This may be economically viable by using conventional flotation

methods or, as has been suggested by some investigators, by treating the acid drainage stream from the base of the dumps. These options will be kept under review.

5.2.9.3 Tailings

The nature of tailings has been discussed in Section 4.3.4.3. The ground rock material contains pyrite and other trace metal sulphides as well as oxides, carbonates and silicates. The composition of the tailings varies according to the chemical and geological properties of the source rock which in turn varies from point to point within the ore deposit.

The tailings will be pumped to a tailings dam as described earlier for settling and long term storage under water. This process will stabilise the tailings in an oxygen reduced environment to minimise oxidation and acidification and release of the residual metals present.

The projected quantities of tailings to be produced over the next fifteen years are set out in Table 4.26 which has been reproduced below for reference.

Table 4.26
Expected Tailings Production

Year 1 1996	1.4 m tonnes
Year 2 1997	2.4 m tonnes
Years 3 to 15 1998 - 2010	3.3 m tonnes per annum

The construction of a tailings dam was a requirement under the CMT Act for the continued operation of the mine. The issue of tailings management has been extensively discussed in Part 4.3.4 of this EMP. CMT will ensure that tailings from the mine are handled with BPEM taking into consideration pre-existing contamination caused by previous use of the Leased Land.

5.2.9.4 Industrial Wastes

Industrial wastes generated on the site include drums, packing material, scrap steel, tyres, plastics, waste wood, and other solid materials of a non hazardous nature. The quantity and volume of waste material generated is expected to be significantly less than over the previous years due to the active minimisation of wastes as shown in Table 5.5. However, continued clean up of the site will result in additional scrap materials being collected for disposal.

A policy to purchase commodities for the plant in returnable or reusable containers will be developed and implemented. The purchase of reagents in 200L steel drums will be avoided thus removing the requirement to crush and dispose of these items although a contract to recycle these low return items is currently being negotiated. Historically, flotation agents and steel grinding balls have been received in steel drums thus presenting a disposal problem packaging. If recycling of the drums cannot be achieved,

they will be used for recycled oil which will be shipped from the site to an oil recycling depot.

Colour coded receiving bins for timber, steel, non-ferrous metals, miscellaneous plastics etc will be located at strategic locations round the site to provide for initial sorting of materials at the source. A recycling, sorting and holding area will be provided near to the disposal site to enable efficient recovery of reusable and recyclable materials. A recycling centre for materials will be established adjacent to the disposal site with materials being stockpiled here prior to being removed for onward recycling to appropriate outlets. Details of the program will be developed in the Waste Management Strategy for the site. Material for which there is no identifiable end use will have to be disposed of.

A new waste disposal site for clean fill has been identified and a Proposal for Development of Cape Horn Tip, prepared by Thompson and Brett, forwarded to the Director of Environmental Management, as required by the condition of the licence issued under the Environment Protection Act. The Proposal has been developed in accordance with the Code of Practice for Landfill Development and Operation - DELM 1995 (Draft).

The site is shown on Figure 4.12. The site has been designed to cater for at least the current 15 year mine plan. The volume of waste to be disposed of will depend on the success of the waste minimisation program. A preliminary assessment of volumes of materials to be disposed of, based on experience at other industrial sites, is 50 m^3 per week resulting in a total planning requirement of 40,000 m^3, comprising construction waste, drums, pallets, scrap metals, scrap tools, timber, pipes, dust collector bags, redundant equipment, plastics, paper, strapping, and assorted industrial waste yet to be determined in detail.

Progressive revegetation will be undertaken as the site is developed.

5.2.9.5 Hazardous Wastes

A survey will be conducted to determine the quantity and nature of asbestos containing materials remaining on the site, and a priority listing of actions to remove or contain the material will be made according to the extent of the risk posed pursuant to NHMRC guidelines. An Asbestos Register will be compiled which will document:-

- the location
- a description of the material
- the percentage of asbestos
- the removal date of the material.

An Asbestos Policy will be formulated that complies with National Health and Medical Research Council requirements, Worksafe Australia and the Department of Energy and Resources requirements. This information will be collected for areas of the lease currently being utilised by CMT.

Removed asbestos containing material will be packaged and disposed of in accordance with Australian Standards. It is the intention of CMT that all hazardous wastes will be removed from site and disposed of at appropriate licensed disposal sites with the approval of the relevant authorities. If this policy becomes difficult to implement in the future CMT will discuss the provision of a disposal facility with DELM.

The use of hazardous materials will be avoided as much as practicable on the site. Small quantities of alkali, acid or other hazardous materials no longer required will be made secure, and stored in a locked area and removed by a licensed waste contractor. The location of the previous hazardous chemical waste site used by MLMRC is shown on Figure 4.12.

5.2.9.6 Domestic and Putrescible Wastes

A program to implement recycling of clean domestic waste will be implemented as soon as feasible, as shown in Table 5.5. Aluminium cans, bottles and glass will be collected in appropriately marked bins and a contract for their removal negotiated. This may be done through local charity groups.

Putrescible wastes are being collected and deposited at the Queenstown municipal waste disposal site. In future, a composting operation to recover organic matter for revegetation will be developed. No on-site burning of wastes will be permitted. All office paper is currently being collected and recycled.

Septic tank solids and toilet pan wastes from underground will be removed by contractors and deposited in the Queenstown sewage treatment plant on the basis that the waste does not contain significant quantities of metals

Other items such as waste oil and non-ferrous metals are collected and transported off site by a licensed waste disposal contractor or recycling firm.

5.2.9.7 Sewage

The site currently has at least 13 septic tank systems with soakage pits in various states of repair. These sites are identified on Figure 5.9. The tanks are pumped out once or twice a year and the sludge deposited in at the Queenstown sewage treatment plant. Portable toilets are used underground and maintained under contract. A program to disband all systems on the lease with the sewage diverted to the Queenstown treatment system is being drawn up be and will be carried out with the agreement of the West Coast Council. Discussions with the Council have already taken place.

5.2.10 MONITORING AND REVIEW

5.2.10.0 Introduction

CMT recognises that the Leased Land is extensively polluted and contaminated due to past occupation and use and that this will continue to be an ongoing source of off site pollution. CMT also recognises that the extent and nature of this pollution has never been adequately studied over the last 100 years. Site conditions and inadequate records make a comprehensive environmental assessment of the current situation impossible.

Therefore, the Tasmanian Government has required (through the transferred licence for the preparatory works and SDAC Guidelines for this EMP) extensive monitoring, auditing and environmental reviews. More frequent monitoring and environmental studies are required as the Tasmanian Government has not remediated the Leased Land prior to the CMT project and they must now regulate a new operation. Inevitably, there will be some cumulative past and present pollution when CMT commences operations. Extensive monitoring will probably reveal short-term incidents of non-compliance by CMT due to the effect of past occupation and use. Strict environmental compliance will not always be achievable due predominantly to the levels of pre-existing contamination.

CMT monitoring results should be used to identify environmental problems to be rectified by CMT, or by the Tasmanian Government, and as a means of developing an environmental baseline for the Leased Land.

5.2.10.1 Monitoring

CMT is required as a condition of its operation to monitor environmental discharges associated with ongoing operational activities on the lease. The purpose of this monitoring is to audit compliance with the statutory Regulations applying to its operation. The data is submitted to DELM on a regular basis as required under the licence conditions issued under the EPA 1973. CMT proposes to carry out an amended monitoring program as detailed below. In addition, CMT will carry out additional monitoring programs outlined in this document to,

- optimise process control mechanism,
- audit performance in line with targets for the operation, and
- collect baseline data for the ambient environment which can be used to assess any future impact from CMT operations.

The monitoring program will provide information against which CMT can assess achievement of the targets of the EMS. The monitoring program is presented in Table 5.6. and 5.7. In addition to this program, monitoring in relation to CMT's legal responsibility will be required as set out in Appendix E.

Table 5.6
Water Monitoring Sites, Parameters, Collection and Reporting Frequency

Measurement Point	Sampling Parameter Frequency	Parameter	Reporting Frequency
DISCHARGES			
Conveyor Tunnel Discharge	Daily until adequate data base collected	pH, conductivity, TDS, NFR, sulphate, fluoride, total and filterable - Ca, Mg, Fe, Mn, Cu, Al, and Zn	within 1 month of receipt of results
Conveyor Tunnel Discharge	Monthly	Total Hg	within 1 month of receipt of results
Conveyor Tunnel Discharge	Continuous	Flow, Conductivity, pH	within 1 month of receipt of results
Secondary Thickener Overflow	Continuous for flow, pH, & conductivity weekly for other parameters until reviewed	pH, NFR, sulphate, fluoride, total and filterable Ca, Mg, Fe, Mn, Cu, Al, and Zn, oil and grease, cond, flow	3 Monthly
Secondary Thickener Underflow	Continuous for flow, pH & conductivity weekly for other parameters until reviewed	pH, NFR, sulphate, fluoride, alkalinity, total and filterable Ca, Mg, Fe, Mn, Cu, Al, and Zn, oil and grease, cond, flow	3 Monthly
Tailings Dam Discharge	Continuous for pH, SS and Cond. weekly for other parameters until reviewed	pH, NFR, sulphate, fluoride, alkalinity, total and filterable - Ca, Mg, Fe, Mn, Cu, Al, Pb and Zn, oil and grease, cond, flow	3 Monthly
Waste Dump Leachate Pits and Monitor Bores	Monthly	flow, pH, NFR, sulphate, fluoride, total and filterable Ca, Mg, Fe, Mn, Cu, Al, Pb and Zn.	3 Monthly
Haulage Creek Silt/Oil Trap Outlet	Continuous for pH, SS and Cond. weekly for other parameters until reviewed	pH, NFR, sulphate, fluoride, total and filterable Fe, Mn, Cu, Al, Pb and Zn, oil and grease, cond, flow	3 Monthly
AMBIENT			
Princess Creek Below Tailings Dam site	Monthly	pH, TDS, NFR, sulphate, fluoride, alkalinity, total Ca, Mg, Fe, Mn, Cu, Al, and Zn, oil and grease, flow	3 Monthly
Princess Creek	Quarterly until 1997 then Annually	Biological Survey	Annually
Haulage Creek above Shaft Waste Rock Dump	Monthly	pH, NFR, sulphate, fluoride, total and filterable Fe, Mn, Cu, Al, and Zn, oil and grease, flow	3 Monthly
Haulage Creek above West Lyell Tunnel	Monthly	pH, NFR, sulphate, fluoride, total and filterable Fe, Mn, Cu, Al, and Zn, oil and grease, flow	3 Monthly
West Lyell Tunnel	Monthly	pH, NFR, sulphate, fluoride, total and filterable Fe, Mn, Cu, Al, and Zn, oil and grease, flow	3 Monthly
North Lyell Tunnel	Monthly	pH, NFR, sulphate, fluoride, total and filterable Fe, Mn, Cu, Al, Pb and Zn, oil and grease, flow	3 Monthly
Haulage Ck at Slag Dump	Monthly	pH, NFR, sulphate, fluoride, total and filterable Fe, Mn, Cu, Al, Pb and Zn, oil and grease, flow	3 Monthly
BASELINE DATA			
Comstock Creek below workings	Monthly	pH, NFR, sulphate, fluoride, total and filterable Fe, Mn, Cu, Al, Pb and Zn, oil and grease, flow	3 Monthly
Acid drainage streams as required	Monthly	flow, pH, NFR, sulphate, fluoride, total and filterable Ca, Mg, Fe, Mn, Cu, Al, Pb and Zn.	3 Monthly
East Queen River above West Queen	Monthly	pH, NFR, sulphate, fluoride, total and filterable Fe, Mn, Cu, Al, Pb and Zn, oil and grease, flow	3 Monthly
AUDIT OPERATIONS			
Selected Mill Operations	as necessary to determine process performance	as necessary to determine process performance	3 Monthly
Groundwater Monitoring Bores at Tailings Dam	Monthly	flow, pH, NFR, sulphate, fluoride, total and filterable Ca, Mg, Fe, Mn, Cu, Al, Pb and Zn.	3 Monthly

Table 5.7
Noise and Vegetation Monitoring Programs

Measurement	Sampling Frequency	Parameter	Reporting Frequency
Noise Survey	baseline April 1995 Construction, Commissioning and thereafter at 6 Monthly	dB(A)	6 Monthly
Vegetation Survey	Annual	Photographic, Inspection	Annual

The State and Federal Governments are currently carrying out an intensive study of the mine site, the Queen and King Rivers and Macquarie Harbour under the Mount Lyell Remediation Research and Demonstration Program. CMT will co-operate with this study as far as practicable so that maximum benefit from all monitoring programs can be gained.

5.2.10.2 Audits

Environmental audits of CMT's operations will be undertaken on an annual basis involving GMA personnel when commercial production commences, with a team being selected from other GMA sites. A critical requirement of this audit will be to demonstrate that the criteria outlined in the Formulated Position are being achieved. A summary of the findings will be presented to DELM without prejudice. An independent environmental audit of CMT's operation will be undertaken within 2 years of mining operations commencing.

5.2.10.3 Programme of Environmental Works

Under the CMT Act the Company is required to prepare a Program of Environmental Works within two years of commencing operation. This program will be developed in consultation with the State Government.

5.2.10.4 EMP Review

This Environmental Management Plan will be reviewed within twelve months of commissioning of the Project when additional fine detail will be available concerning operational aspects of the mine, ore processing and stage one tailings dam performance will be available.

Future revisions of the EMP may also be required by the Director of Environmental Management if major changes occur in methods of extraction, processing and treatment occur that could have an impact on the environmental performance of the operation.

5.3 MISCELLANEOUS

5.3.1 Technical Panels and Industry Reviews

Technical panels will be set up within the GMA group to review progress, address technical issues and solve problems of overlapping interest including methods of environmental improvement of the site. Input from wide ranging areas of expertise both from within the Company and via bodies such as the Chamber of Mines and community groups will assist in ensuring that Best Practise Environmental Management is realised.

5.3.2 Research Projects

The State and Federal Governments have jointly funded a program to study and make recommendations on remediation measures which may be carried out to redress the environmental damage which has occurred as a result of past mining practices at Queenstown. This study, the Mount Lyell Remediation Research and Demonstration Program, has a broad range of programs covering the mine site itself, the Queen and King Rivers and Macquarie Harbour.

CMT has been invited to sit on the Steering Committee and has accepted this invitation. CMT is also represented on the Community Consultative Committee. CMT will support the study as the needs are recognised.

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THE MOUNT LYELL MINING FIELD
COMSTOCK
CAPE HORN
CAPE HORN HAULAGE DRIVE
NORTH LYELL
CROWN LYELL
LYELL THARSIS
NORTH LYELL TUNNEL
NO 1 SHAFT
ROYAL THARSIS
WEST LYELL OPEN CUT
PRINCE LYELL
CONCENTRATOR
SLAG DUMP
THE BLOW
Copper Mines of Tasmania
Mt Lyell Project EMP
The Mt Lyell Mining Field
Plate 1

Plate 2
Mill area
note: slag dump, Haulage Creek

Plate 3
Prince Lyell Shaft area
note: waste rock dumps, West Lyell open cut, Lake Burbury in background

Plate 4
West Lyell open cut

Plate 6
AMD from North Lyell Tunnel

Plate 5
AMD from Comstock No 5 Adit

Plate 7 Trial Revegetation Plots on Elevated Ridges Using Native Species.

Plate 8

Plate 9
Howards Plains from Lyell Highway
note: Aerodrome is visible,
pond will be visible in later stages

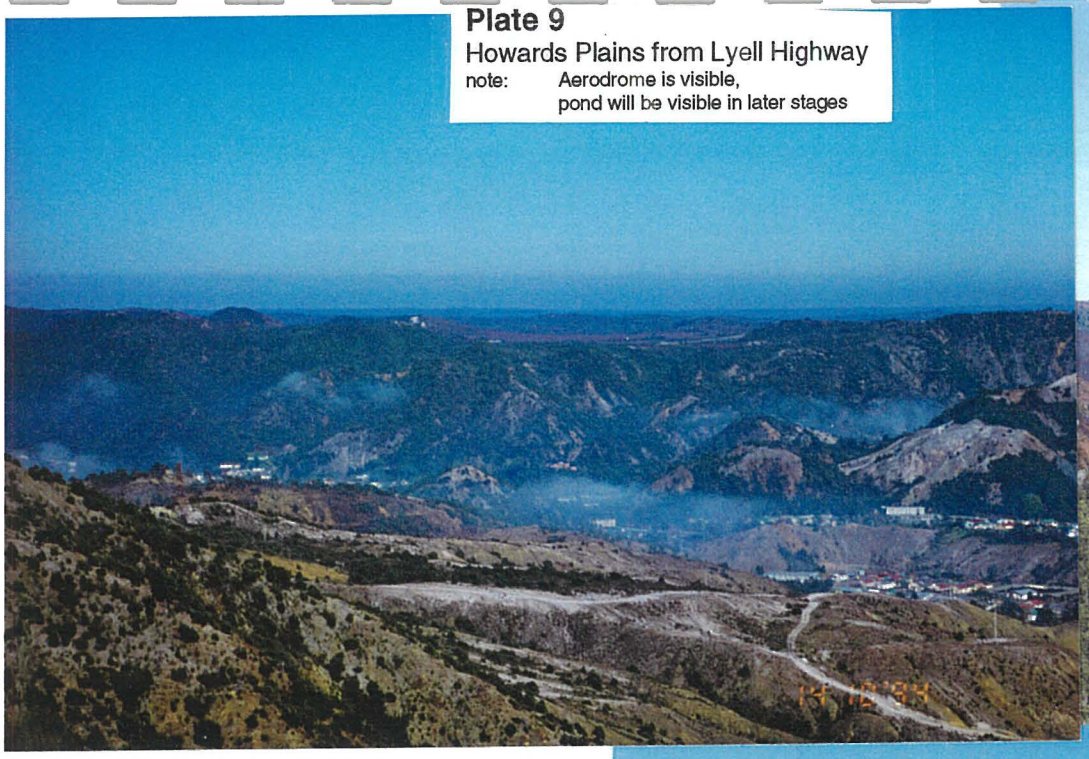
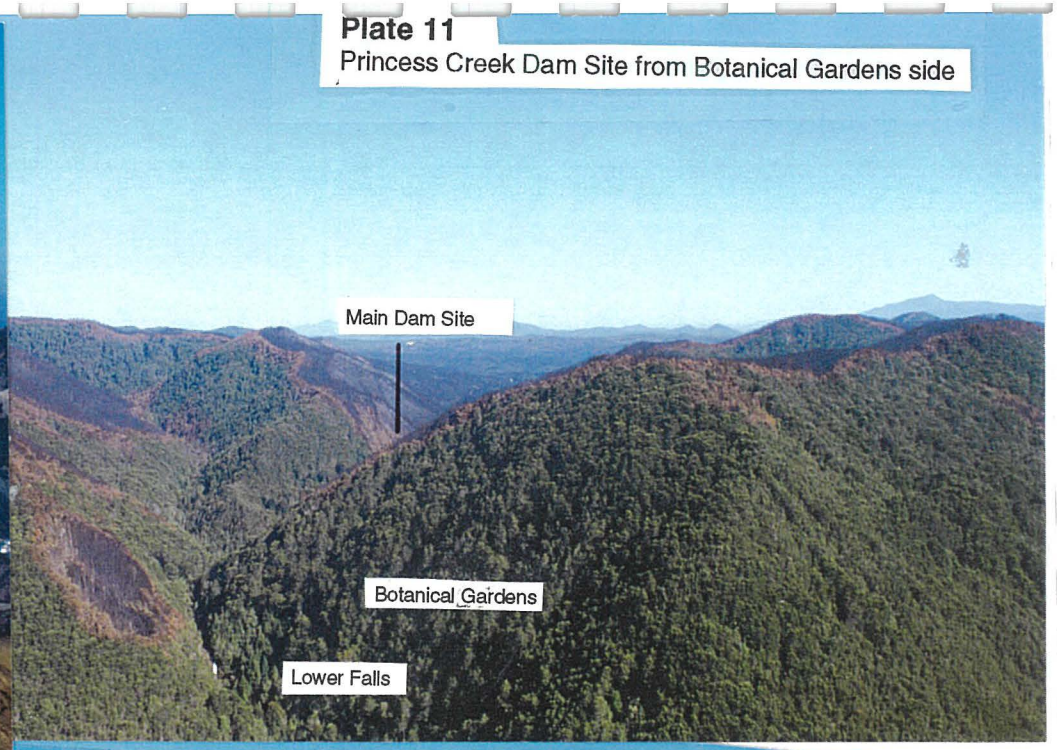


Plate 11
Princess Creek Dam Site from Botanical Gardens side



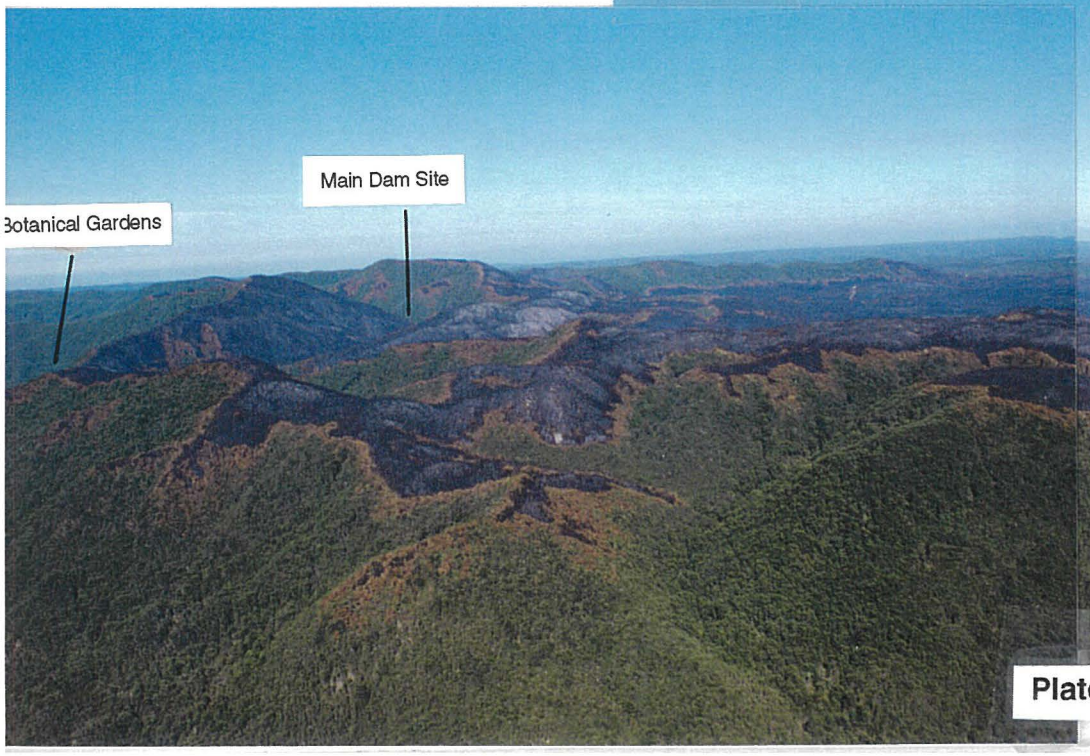
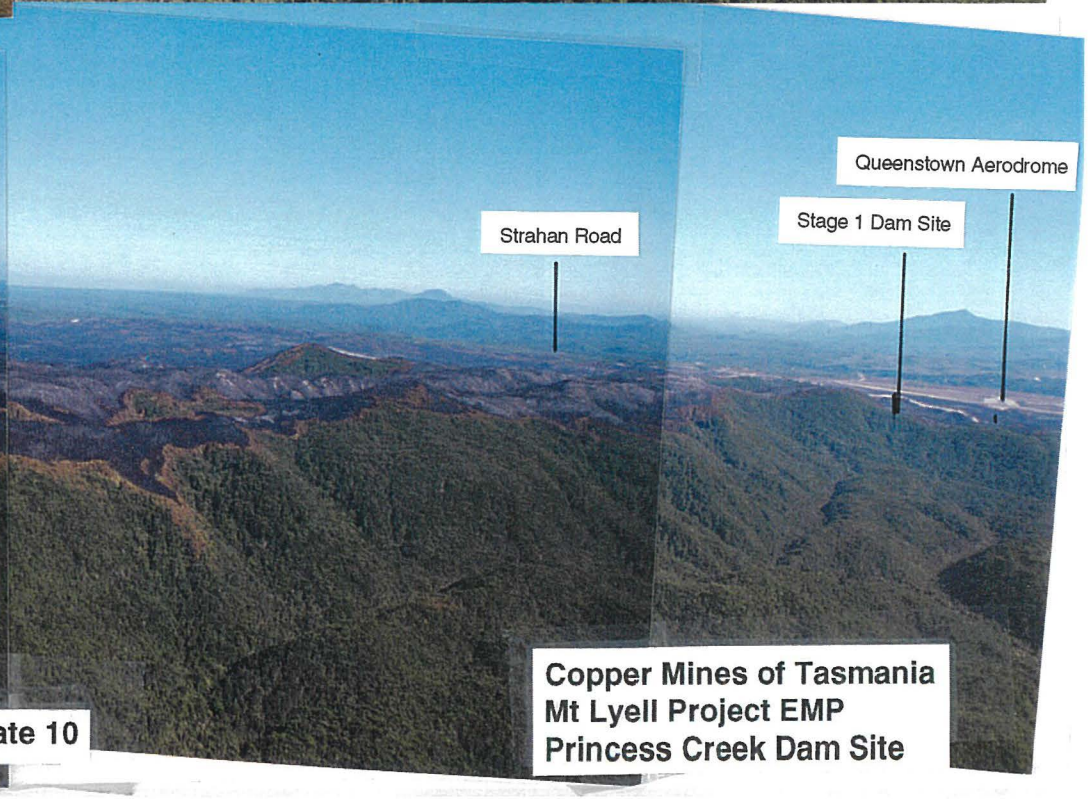


Plate 10



Copper Mines of Tasmania
Mt Lyell Project EMP
Princess Creek Dam Site

Plate 12
Upper Falls

Plate 13
Middle Falls

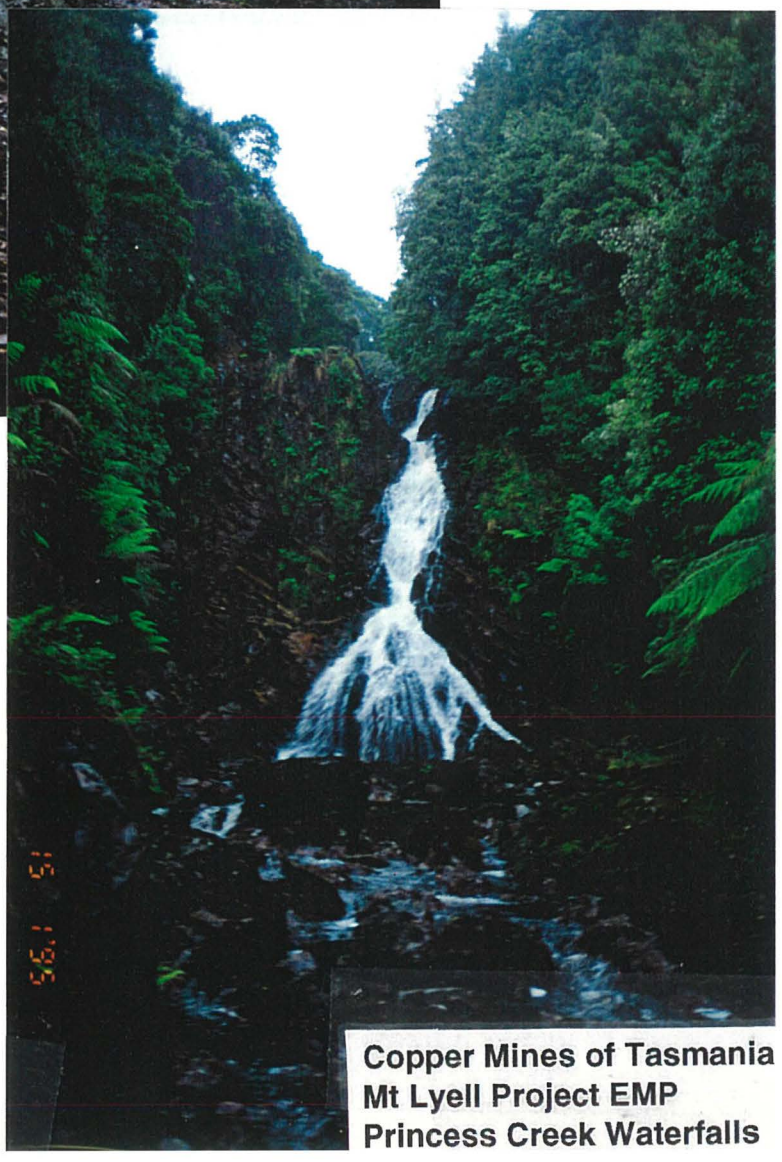
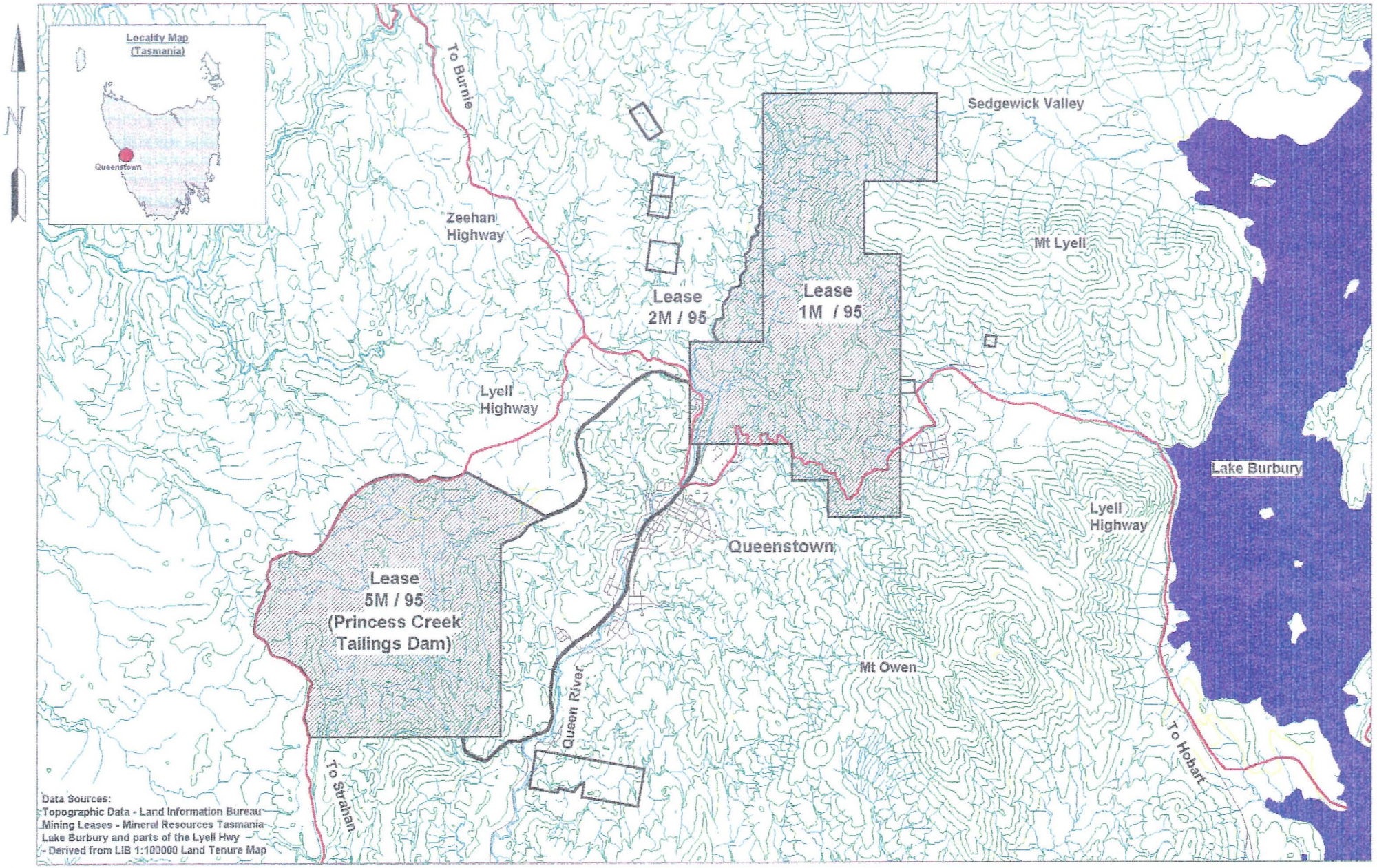
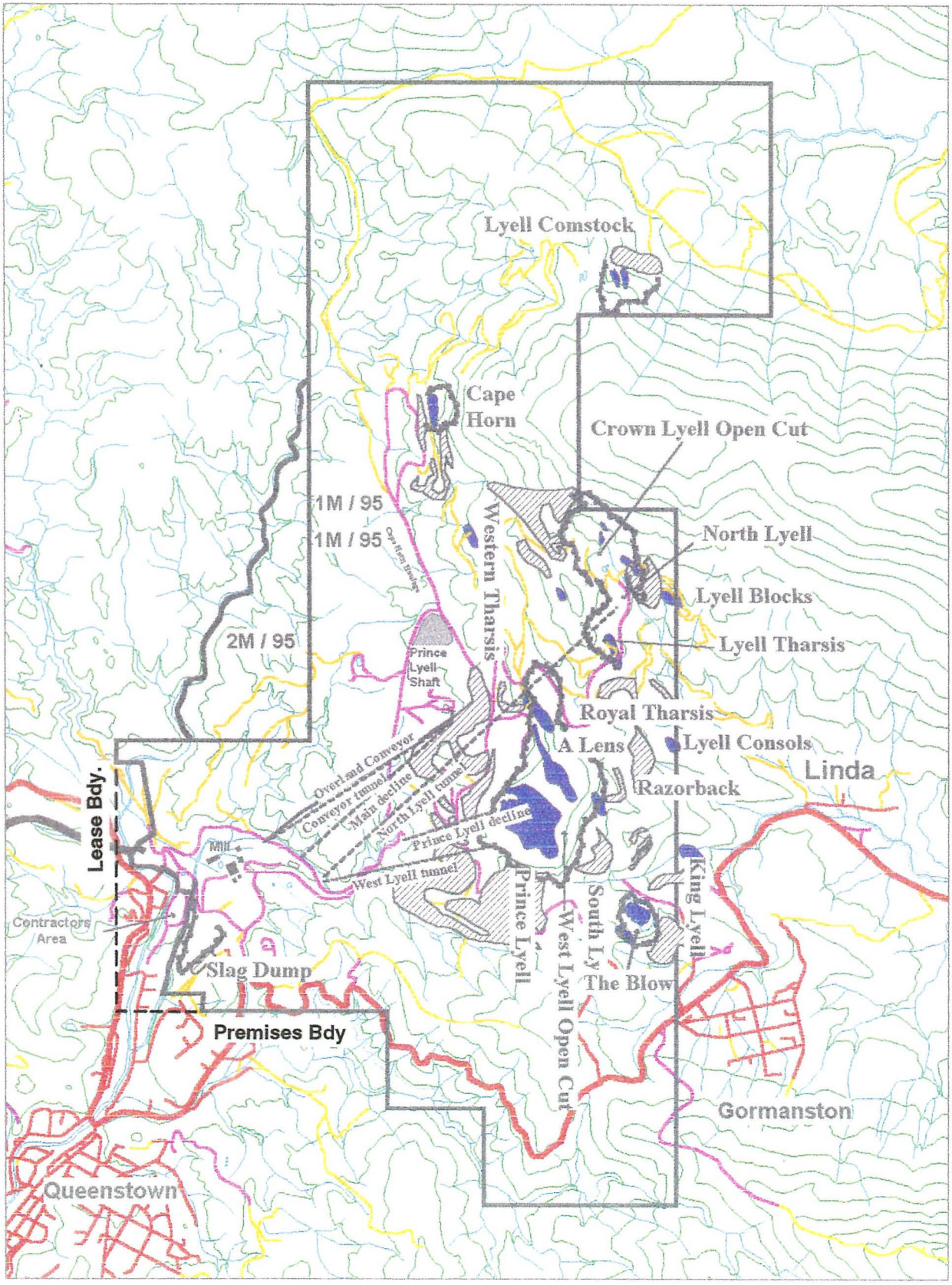


Plate 14
Lower Falls



Copper Mines of Tasmania
Mt Lyell Project EMP
Site Locality Plan

Figure 3.1



Excavated Areas

Fill Areas

Legend:

Public and Major Roads

Main Lease Roads

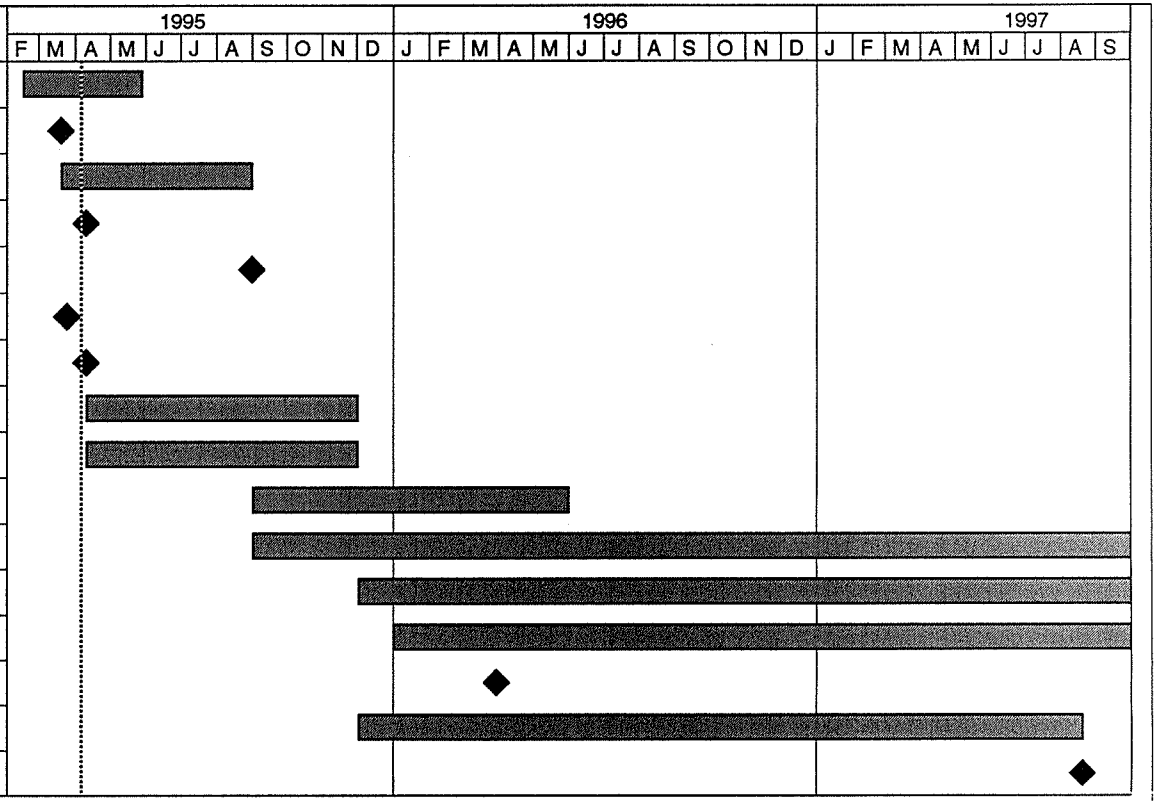
Tracks

Copper Mines of Tasmania
Mt Lyell Project EMP
Mine Site Plan

Scale: 1:30000

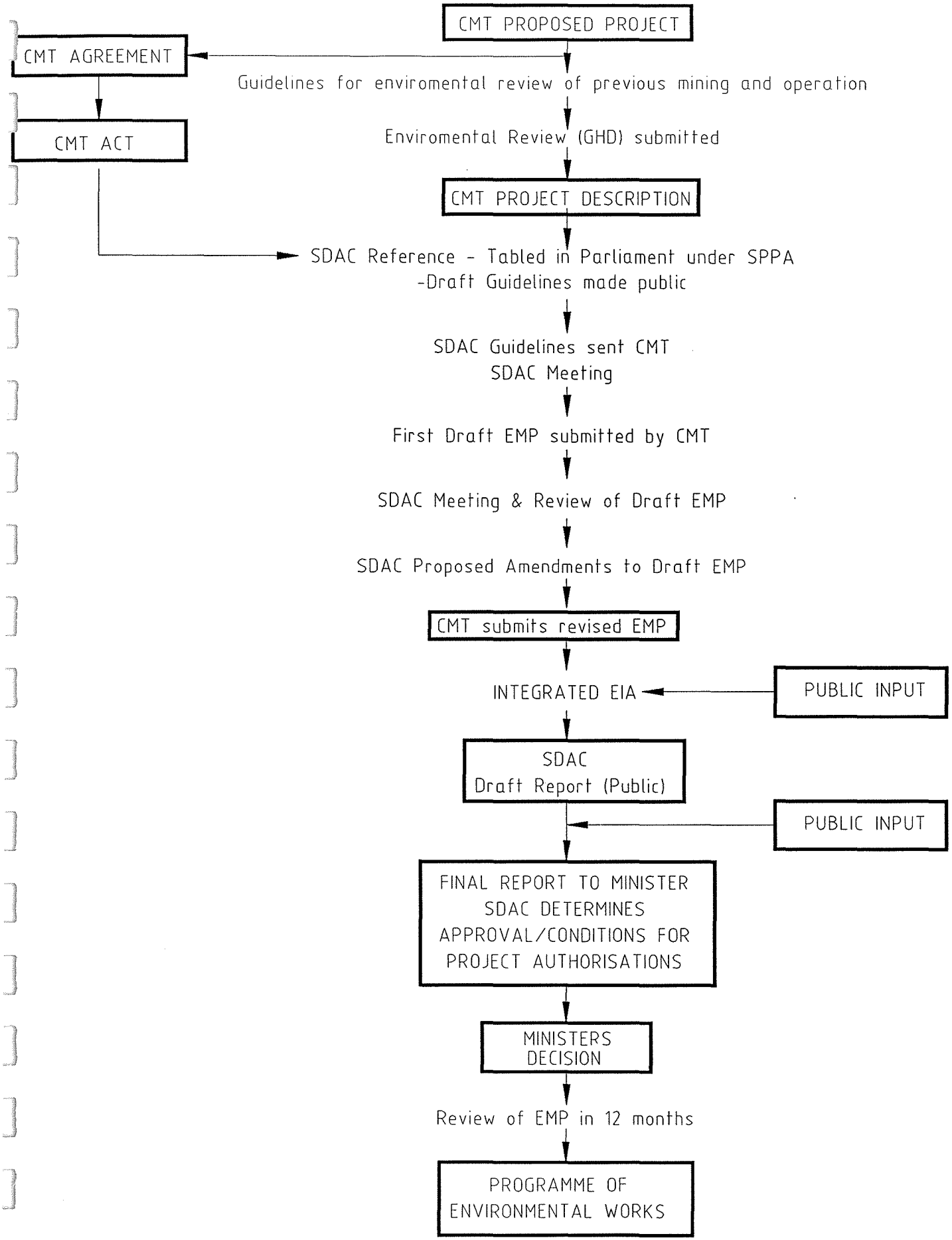
Figure 3.2

ID	Name	Duration	Scheduled Start
1	Stage 1 Earthworks	80d	15 Feb '95
2	Draft EMP to SDAC	0d	20 Mar '95
3	SDAC review	152d	20 Mar '95
4	SDAC preliminary indication	0d	10 Apr '95
5	SDAC Report to Gov't	0d	31 Aug '95
6	CMT feasibility complete	0d	25 Mar '95
7	GMA project commitment	0d	10 Apr '95
8	Mill Upgrade	229d	10 Apr '95
9	Tailings System	229d	10 Apr '95
10	Stage 2 Dam	274d	1 Sep '95
11	Mining	5000d	1 Sep '95
12	Processing	5000d	2 Dec '95
13	Concentrate to Burnie	5000d	1 Jan '96
14	First Concentrate shipment	0d	30 Mar '96
15	Mill Duplication	500d	2 Dec '95
16	Mill Output to 3.5 MTPA	0d	20 Aug '97



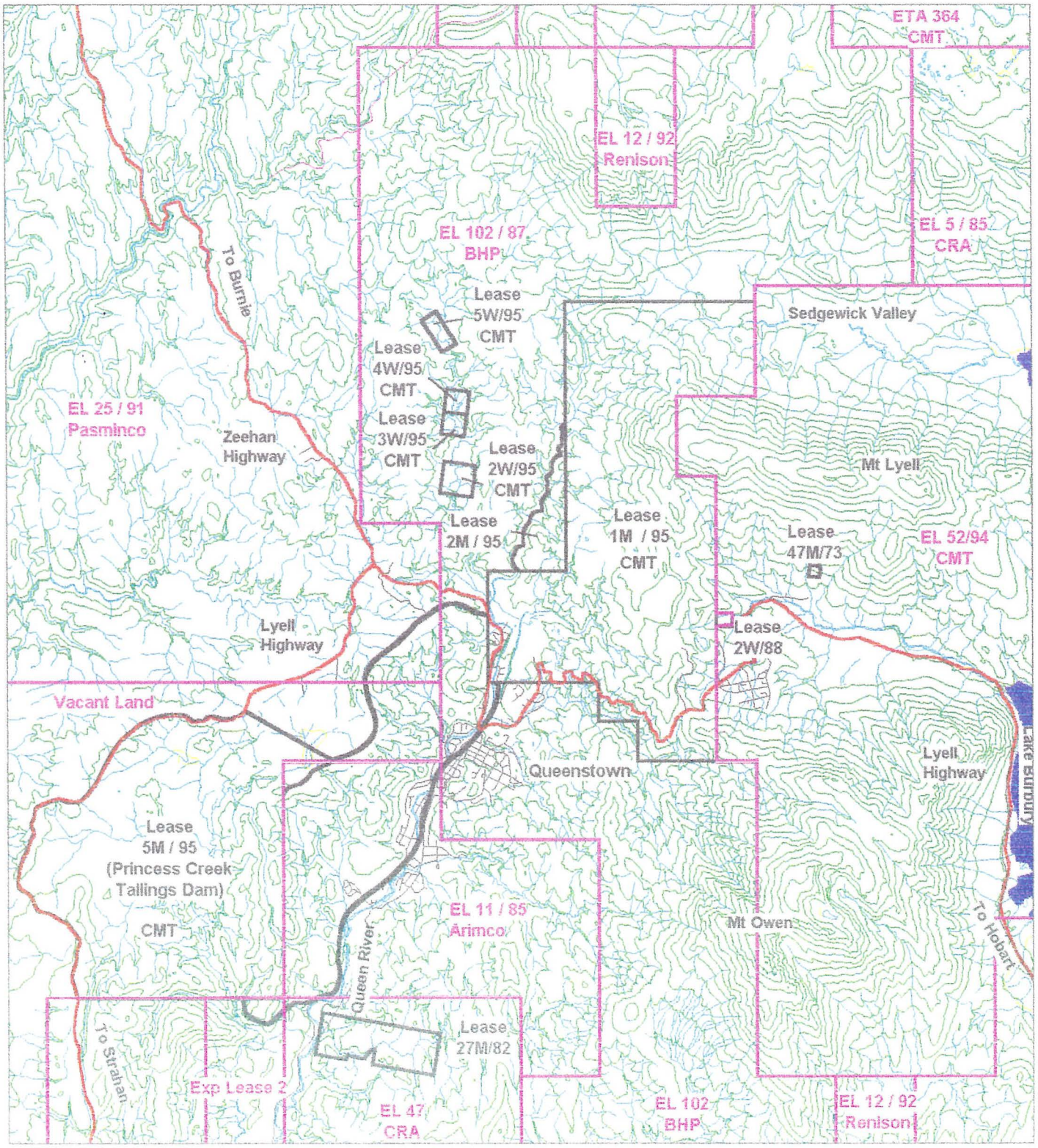
Copper Mines of Tasmania
Mt Lyell Project EMP
Project Program

Figure 3.3



Copper Mines of Tasmania
Mt Lyell Project EMP
Overview of the Integrated
Assesment & Project Approval Process

Figure 3.4

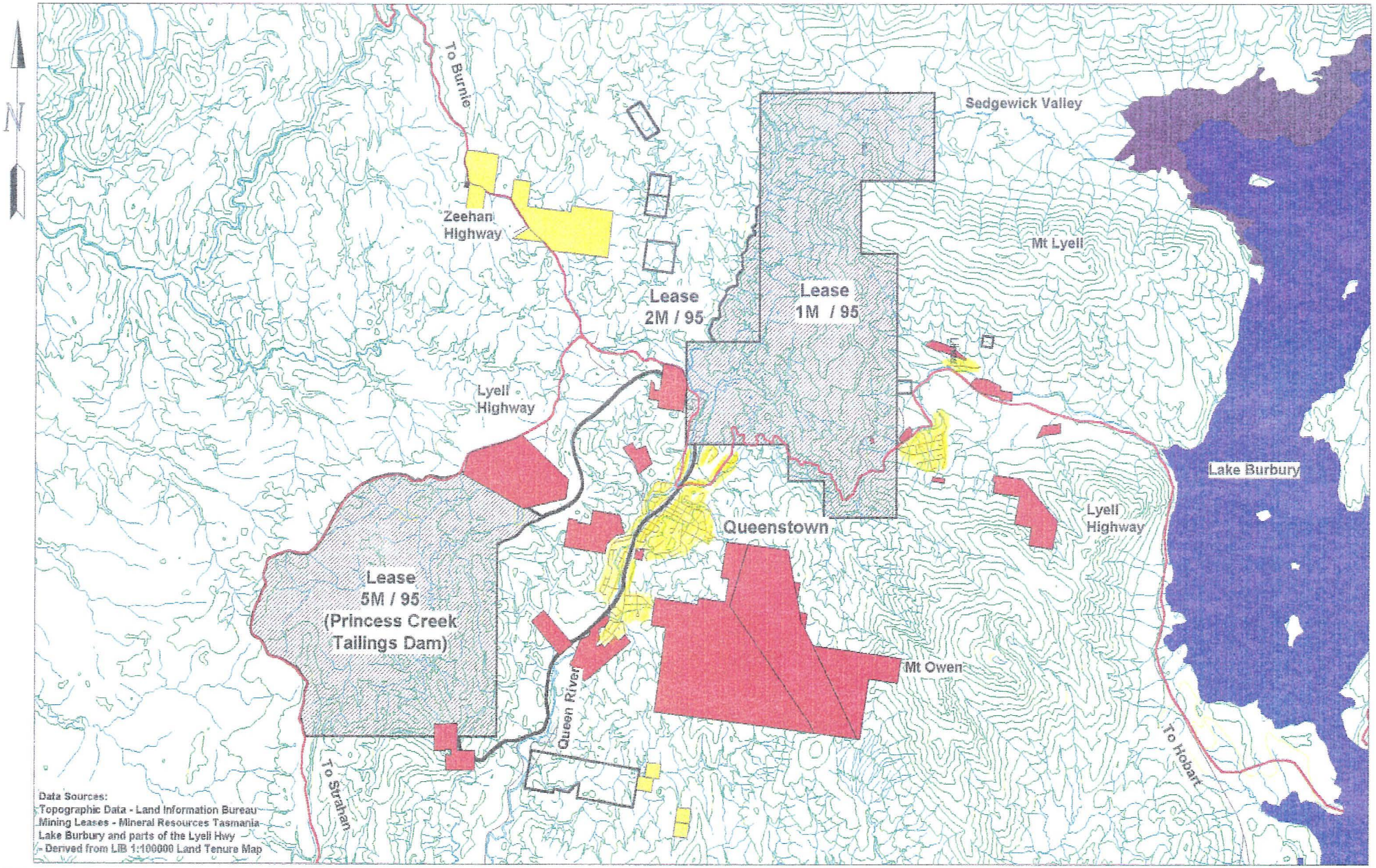


Data Sources:
Topographic Data - Land Information Bureau
Mining and Exploration Leases - Mineral Resources Tasmania
Lake Burbury and parts of the Lyell Hwy - Derived from LIB 1:100000 Land Tenure Map

Copper Mines of Tasmania
Mount Lyell Project EMP
SIte Plan
Mining and Exporation Leases

Scale 1:70000

Figure 4.1



Copper Mines of Tasmania
Mt Lyell Project EMP
Land Tenure

Figure 4.2

Queenstown Town Board
Queenstown, Oct 7 1901
Mount Lyell

Secretary for Lands Hobart

Dear Sir,

At last meeting of the town board a resolution was passed unanimously to apply to the Government for a reserve of a botanical area in the vicinity of "Princess Falls". The attached plan shows the location (viz 40 ac) of reserve asked for.

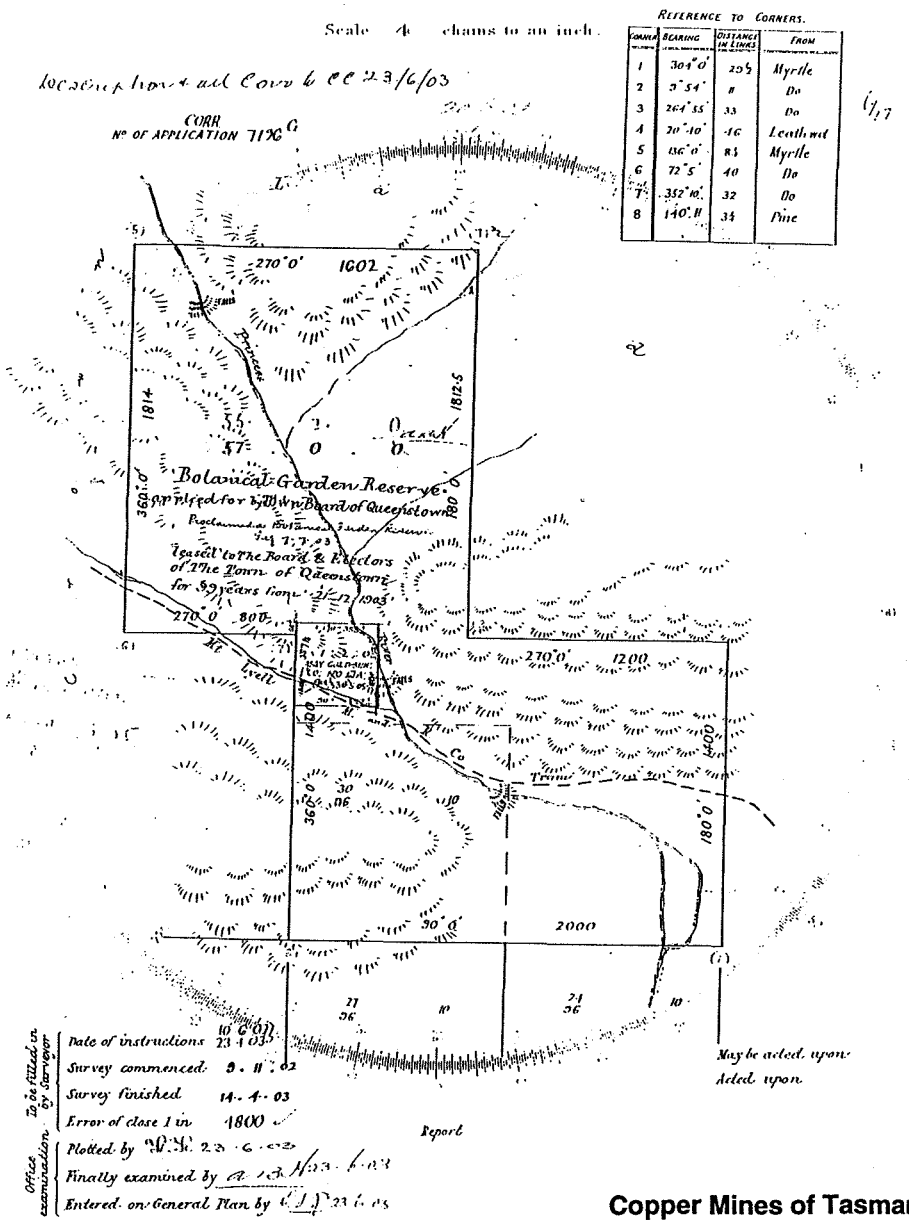
The Mt Lyell Co, have constructed a wooden tramway, from the Railway Line near Lynchford along the course of the Princess River for the purpose attaining firewood from the area west of the River. This tram passes along precipitous hillside to the river and crosses between two of the falls, making an easy means of access from the Railway Line. The scenery in the vicinity of the falls is most beautiful the ferns and native shrubs being untouched by fire or sulphur fumes and The Mt Lyell Co. (anticipating the desire for a Reserve here) have spared no effort to protect the green foliage when constructing their tramway and further have promised to leave intact all portions of the tramway which would be used by the Public in approaching the Reserve (proposed).

Should this application be favourably considered the Board would ask to have the Reserve vested In Trust so that proper control can be exercised in protecting the foliage from injury and in making improvements in the way of seats, paths etc.

In approaching the Government for this Reserve the Board are acting as the Representatives of the people of Queenstown, who, as you are aware are compelled to live in a fire swept, devastated valley devoid of any semblance of green foliage and to whom a small pleasure resort within easy reach of the town such as the proposed Reserve would prove, is a boon that the Board feel every confidence has only to be properly represented to you to be granted.

To prevent delay and to save if possible any destruction of the ferns and shrubs by the Public the Board would suggest that the Crown Lands Bailiff (Mr Wieton) be instructed to report and pending the arrangement of any local control, he be empowered to stop all wanton destruction of shrubs in the locality of the proposed reserve. The Board may state that (as already indicated) this request for a Reserve has the hearty sympathy of the General Manager of the Mt. Lyell Co.

Confidently awaiting your favourable reply
I am Sir
Yours faithfully
Fred Reid
Secretary



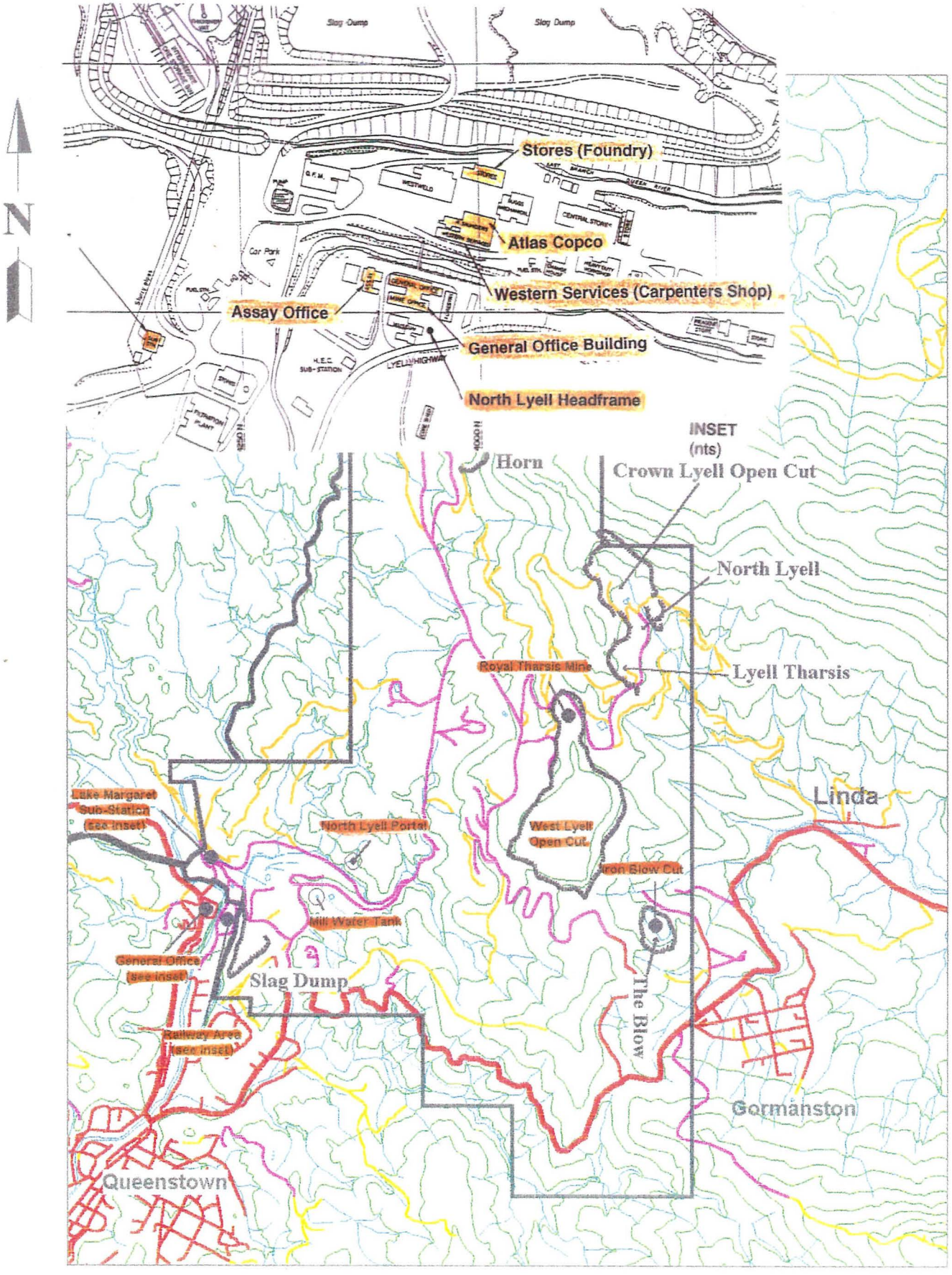
Copper Mines of Tasmania
Mt Lyell Project EMP
Botanical Garden Reserve

Figure 4.3

This map has been supplied under seperate cover due to the confidential nature of the information

Copper Mines of Tasmania
Mt Lyell Project EMP
Aboriginal Sites

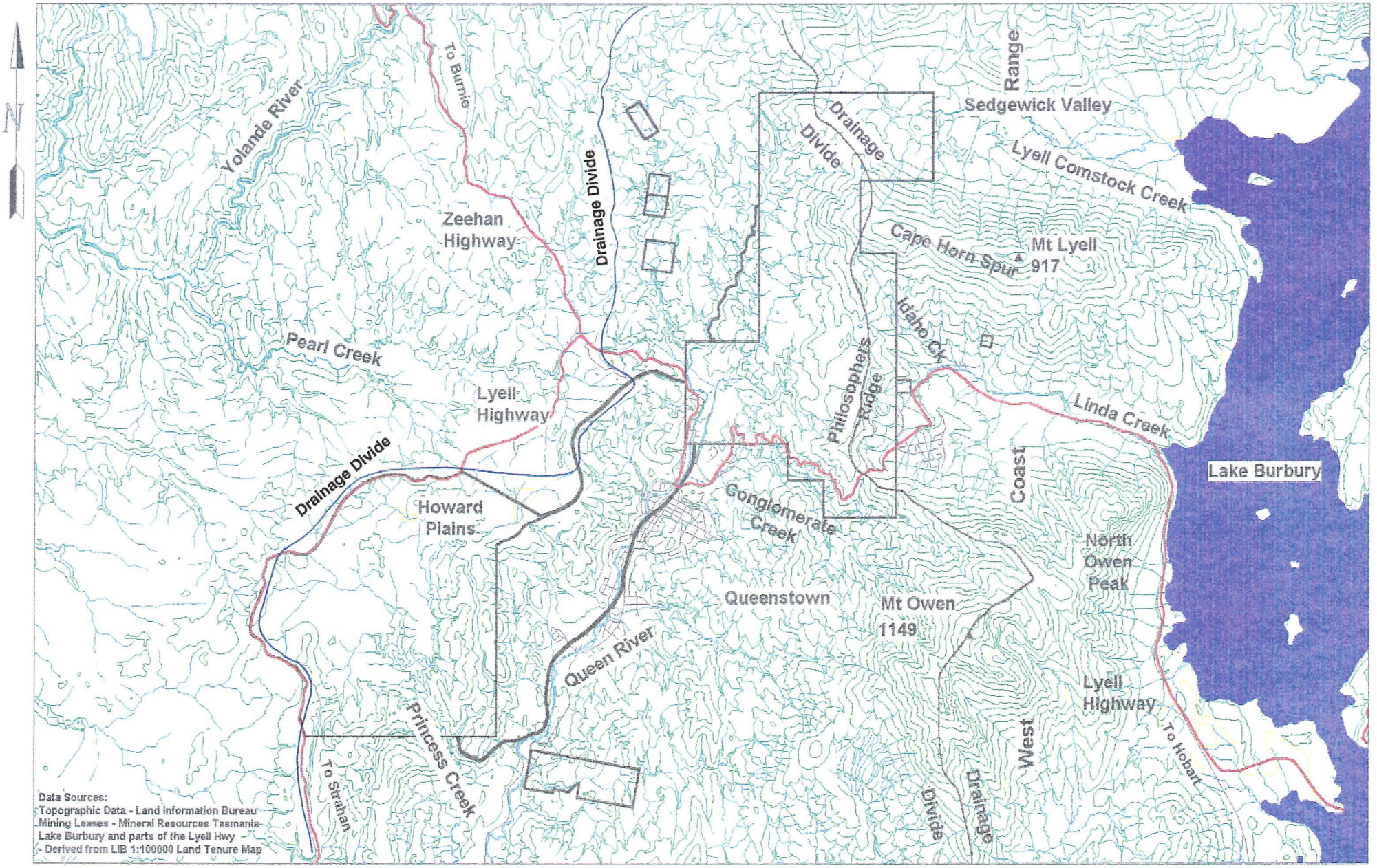
Figure 4.4



Copper Mines of Tasmania
Mt Lyell Project EMP
Areas of Very High Conservation Significance

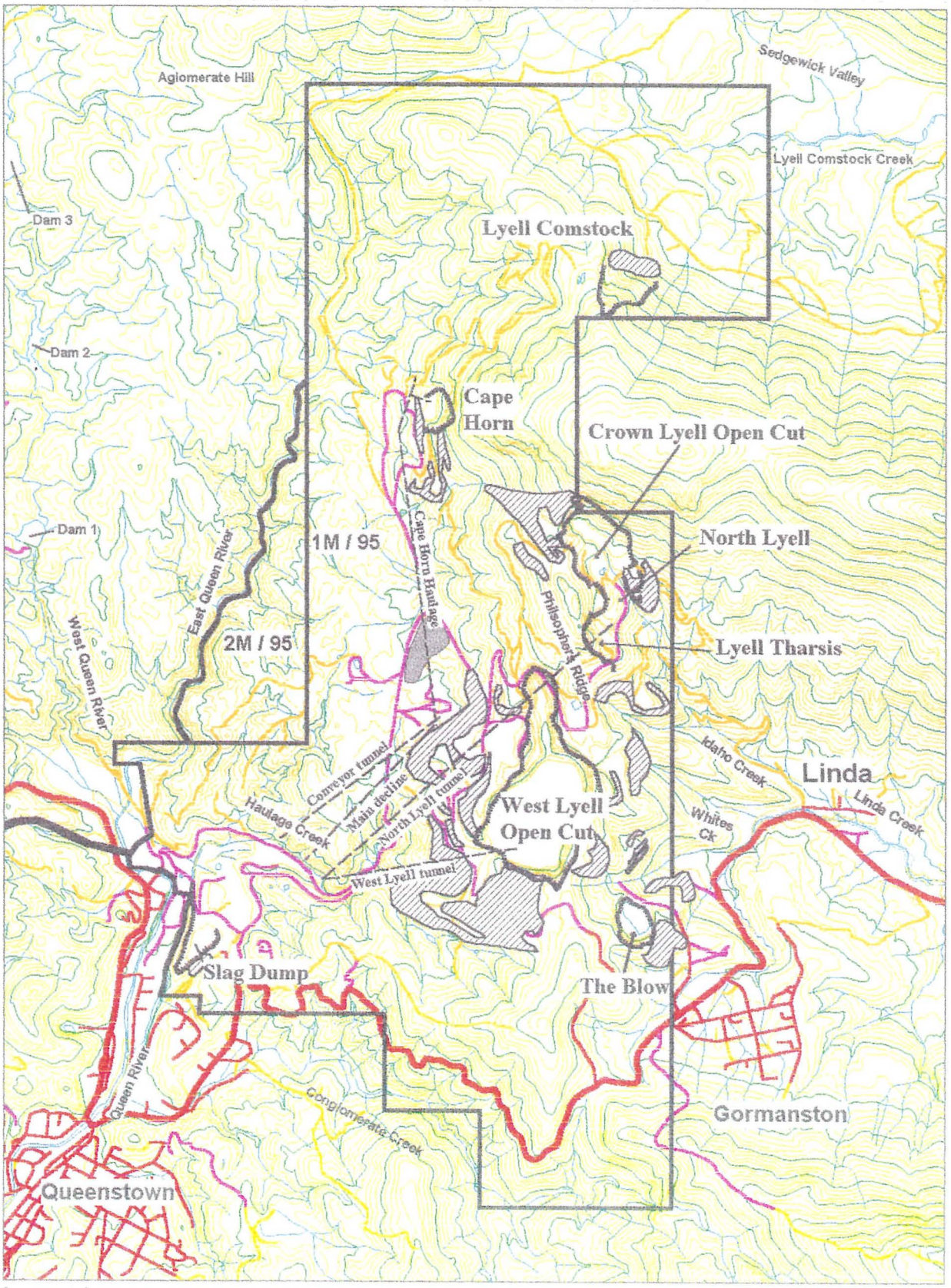
Scale: 1:30000

Figure 4.5



Copper Mines of Tasmania
Mt Lyell Project EMP
Topography and General Drainage

Figure 4.6



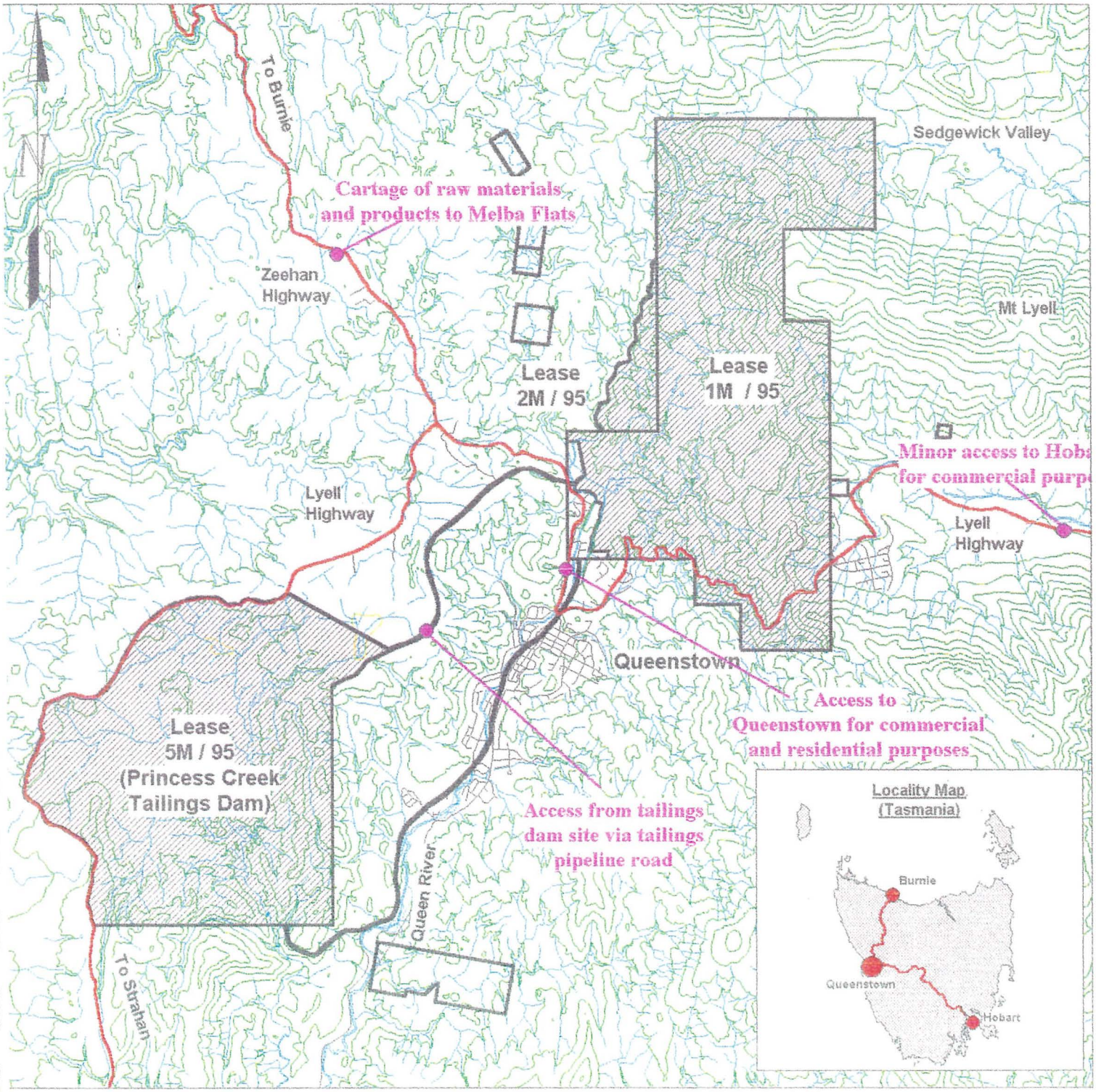
Legend:

- Public and Major Roads
- Main Lease Roads
- Tracks
- Excavated Areas
- Fill Areas
- Tunnels

Scale: 1:30000

Copper Mines of Tasmania
Mt Lyell Project
Mine Site Topography and Areas of Modification

Figure 4.7

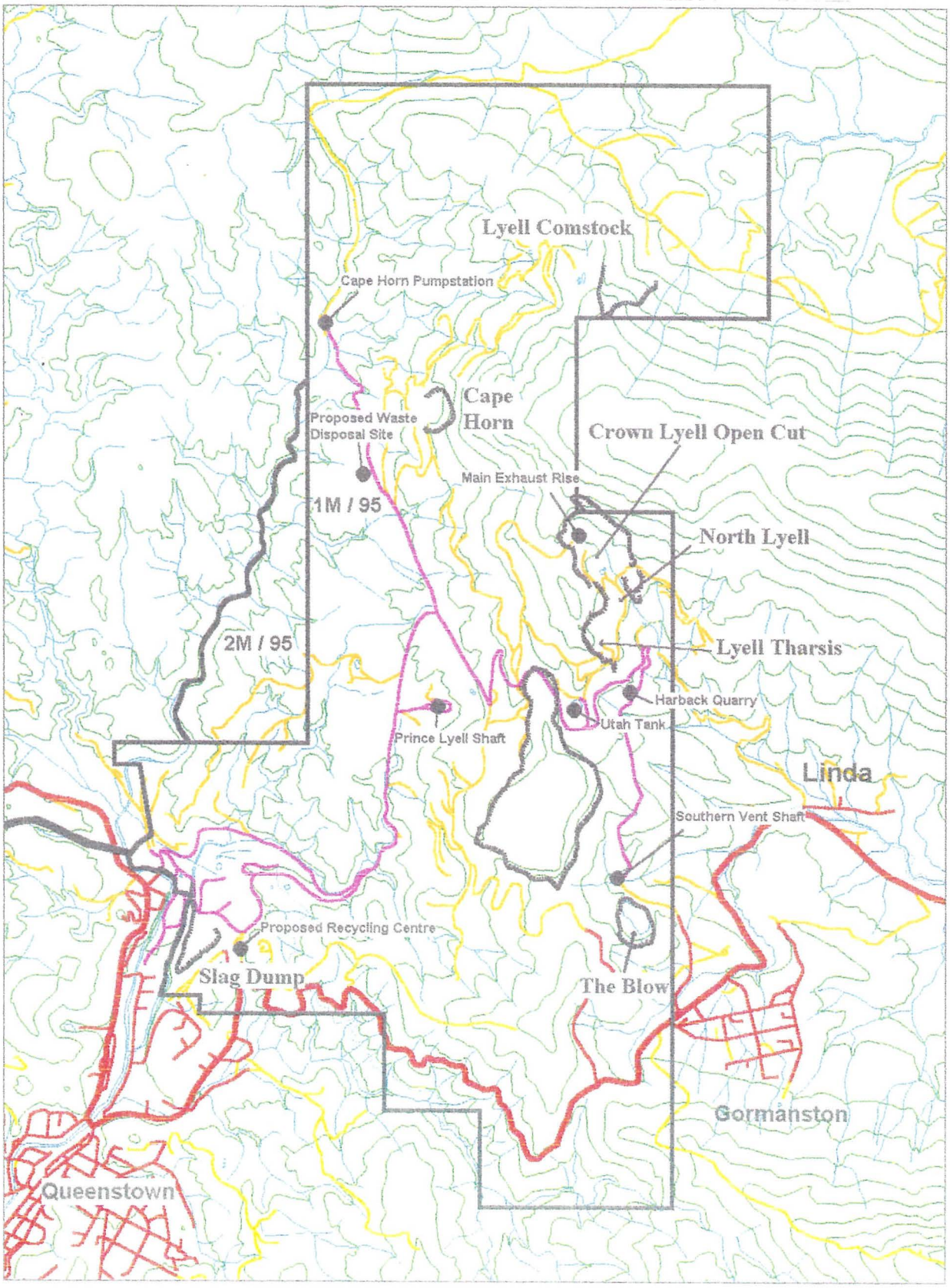


ata Sources:
opographic Data - Land Information Bureau
lining Leases - Mineral Resources Tasmania
ake Burbury and parts of the Lyell Hwy
Derived from LIB 1:100000 Land Tenure Map

Copper Mines of Tasmania
Mt Lyell Project EMP
Transport Routes - Outside Lease Areas

Scale 1:60000

Figure 4.8



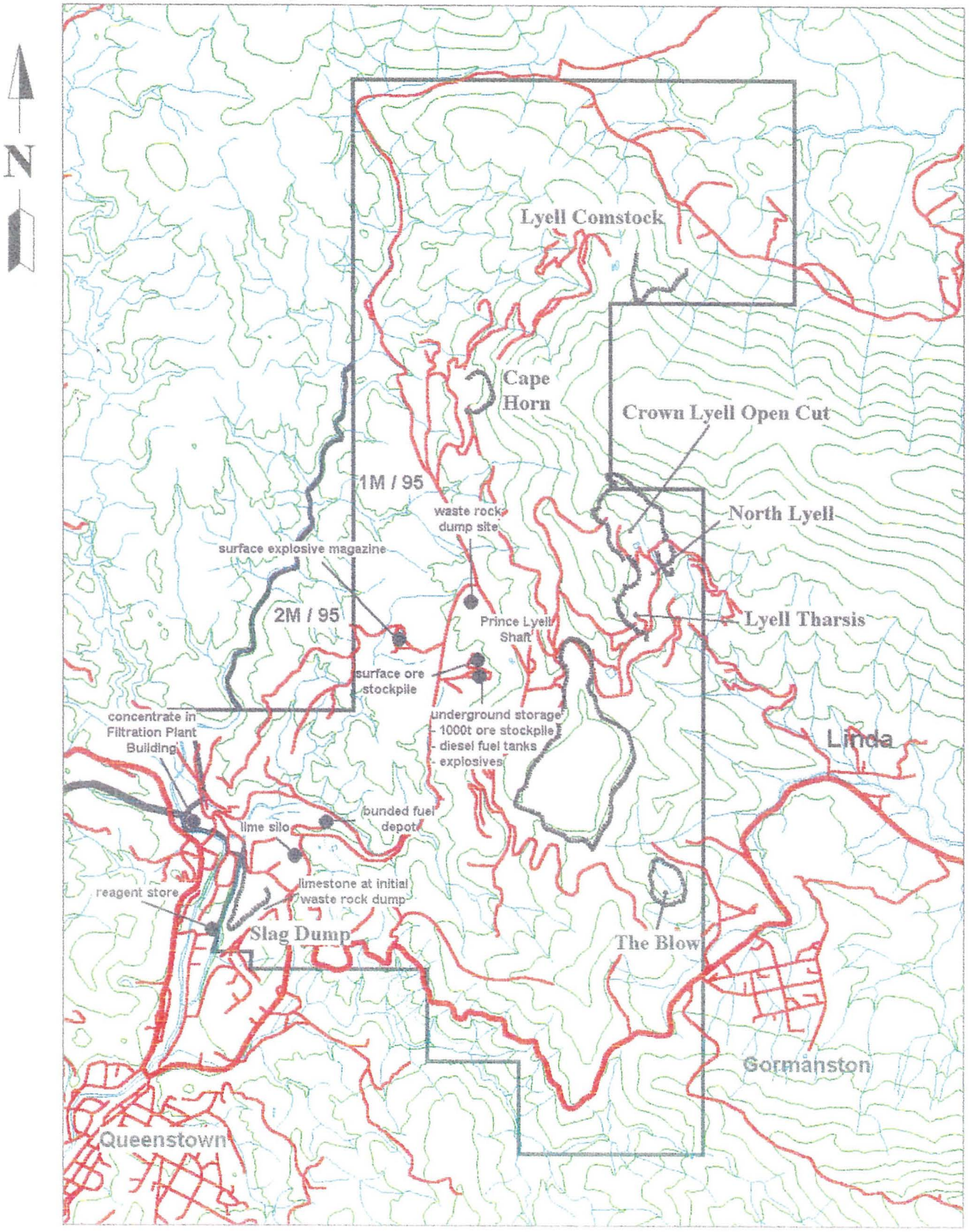
Legend:

- Public and Major Roads
- Existing Tracks
- Site Roads to be Maintained

Copper Mines of Tasmania
Mt Lyell Project EMP
On Lease Roads to be Used

Scale: 1:30000

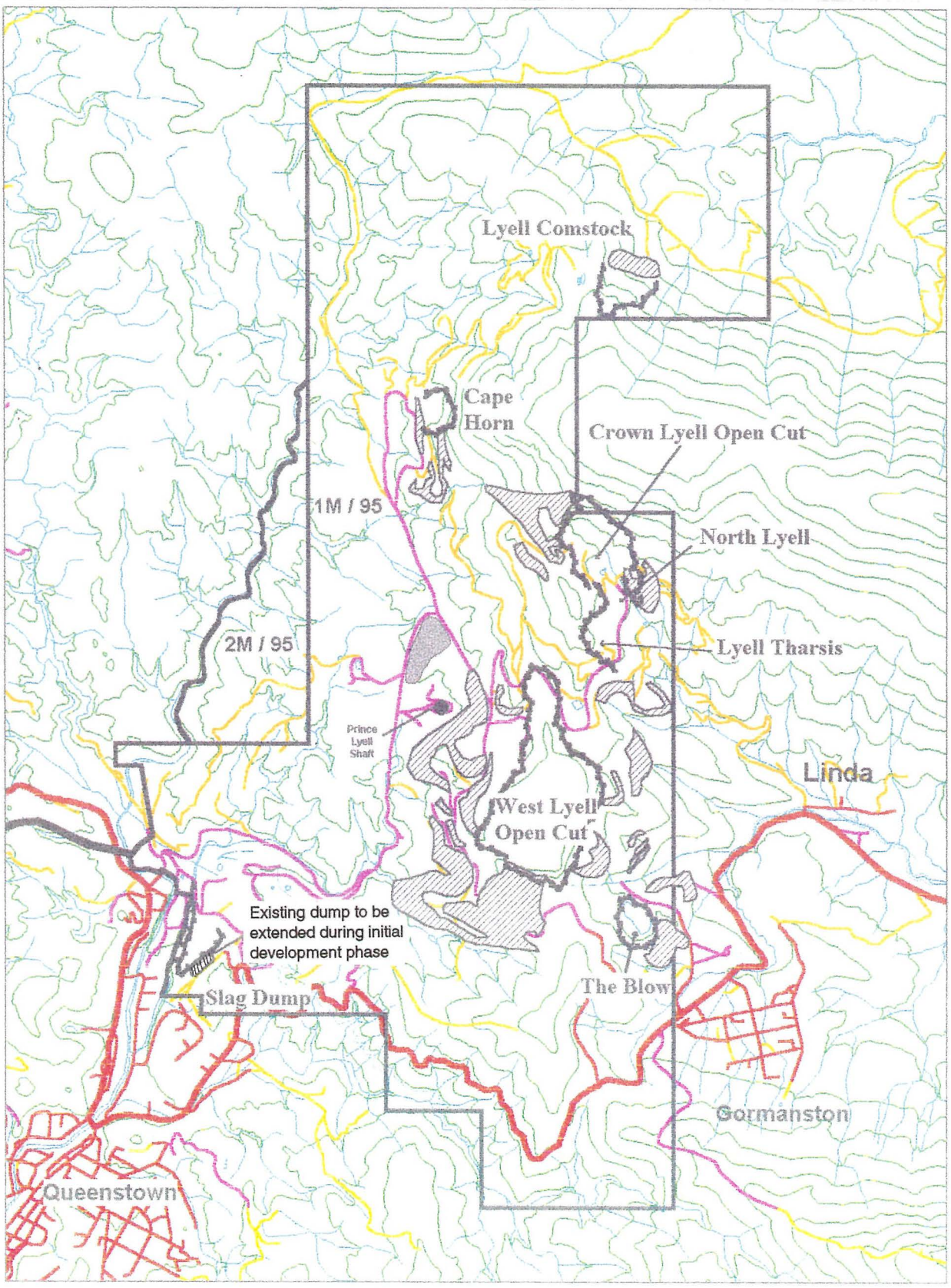
Figure 4.9



Copper Mines of Tasmania
Mt Lyell Project EMP
Materials Storage Areas

Scale: 1:30000

Figure 4.10



Legend:

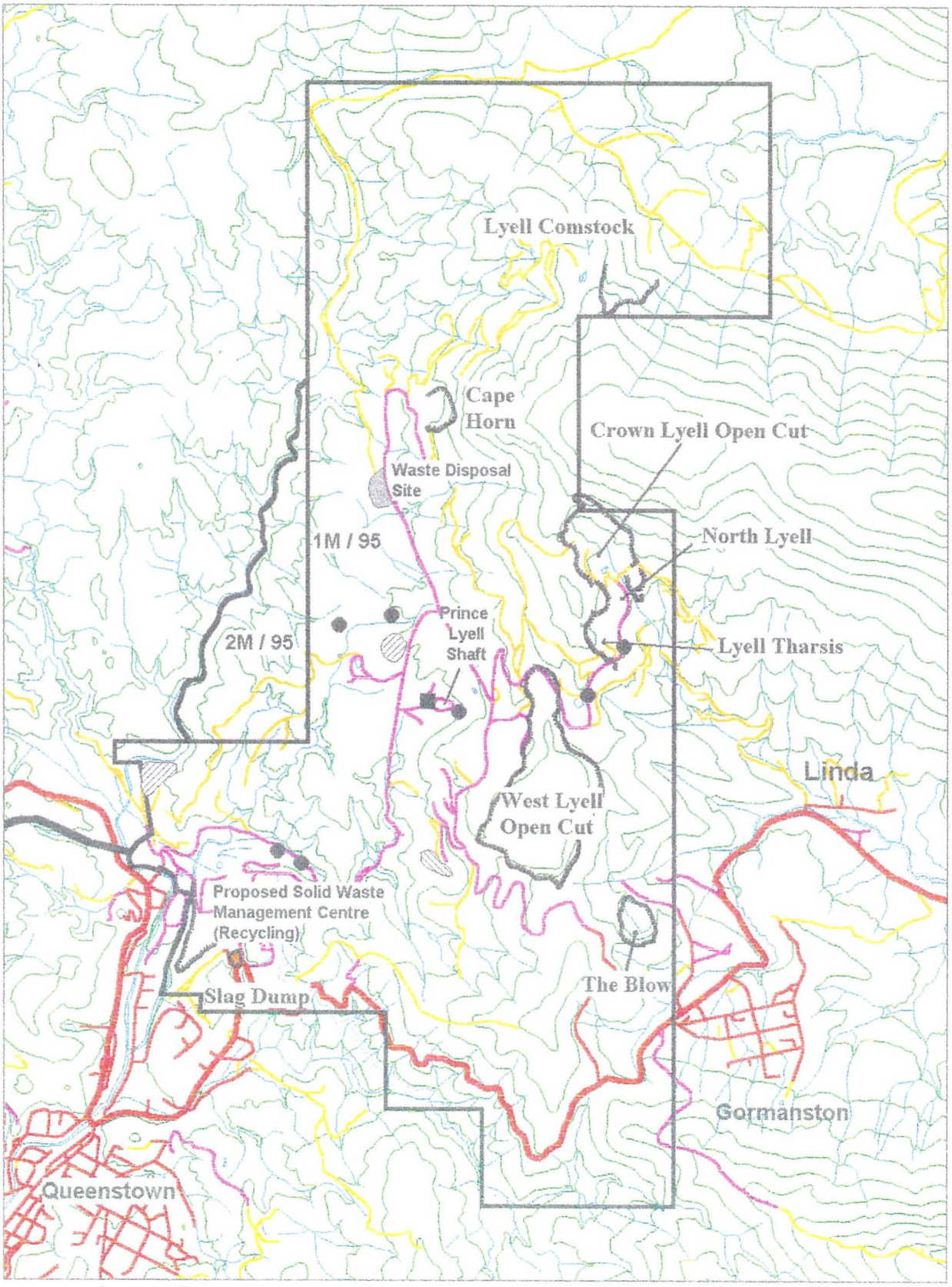
existing waste rock dump areas

proposed new waste rock dump - subject to detailed design

Copper Mines of Tasmania
Mt Lyell Project EMP
Waste Rock Dump Areas

Scale: 1:30000

Figure 4.11



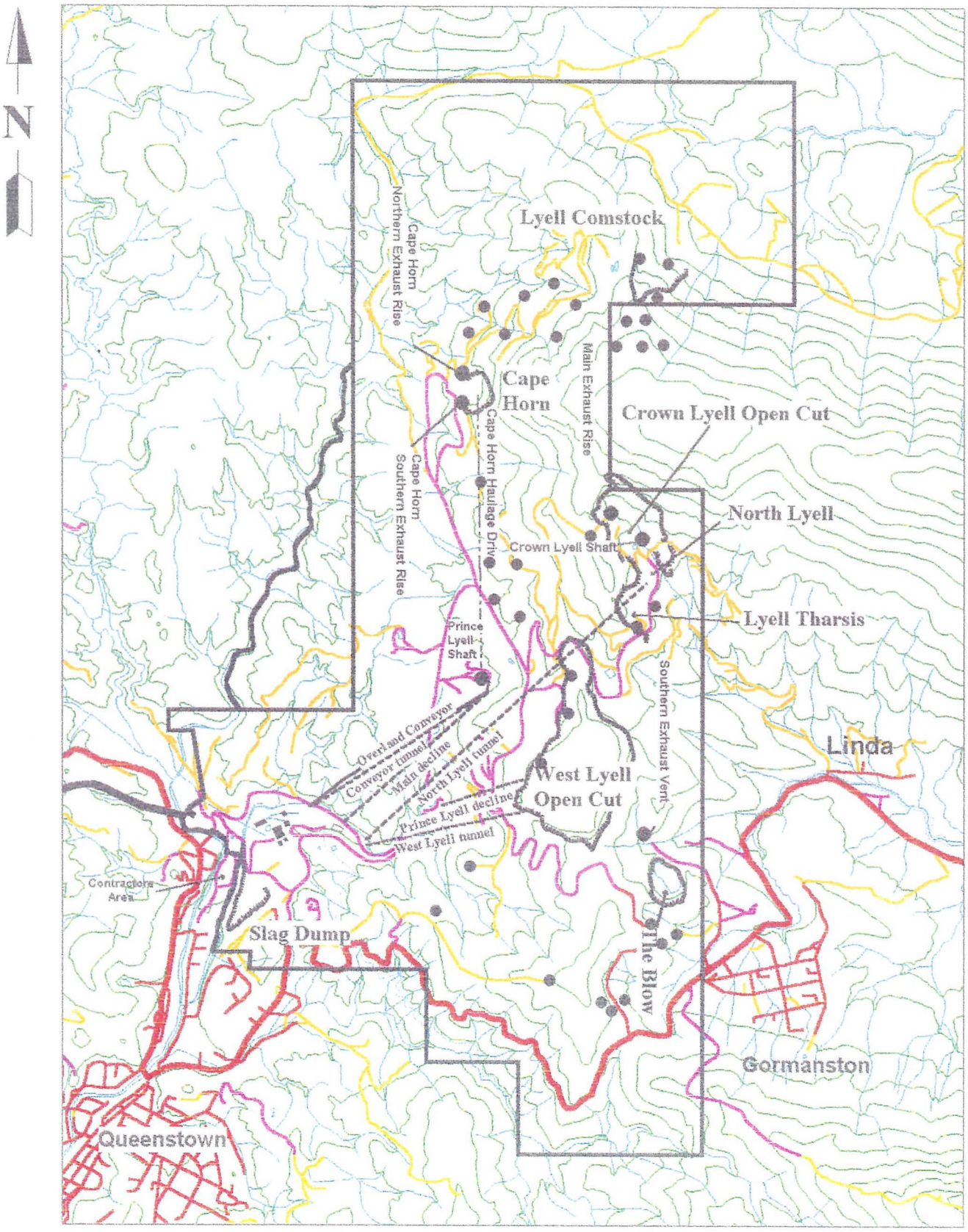
Legend:

- Previous MLMRC Disposal Sites
- Known Previous MLMRC Hydrocarbon Spills
- Previous MLMRC Hazardous Waste Disposal Site
- Proposed New Waste Disposal Site
- Proposed Solid Waste Management Centre

Copper Mines of Tasmania
Mt Lyell Project EMP
Waste Disposal Areas

Figure 4.12

Scale: 1:30000



Excavated Areas

Location of adit or shaft

Legend:

Public and Major Roads

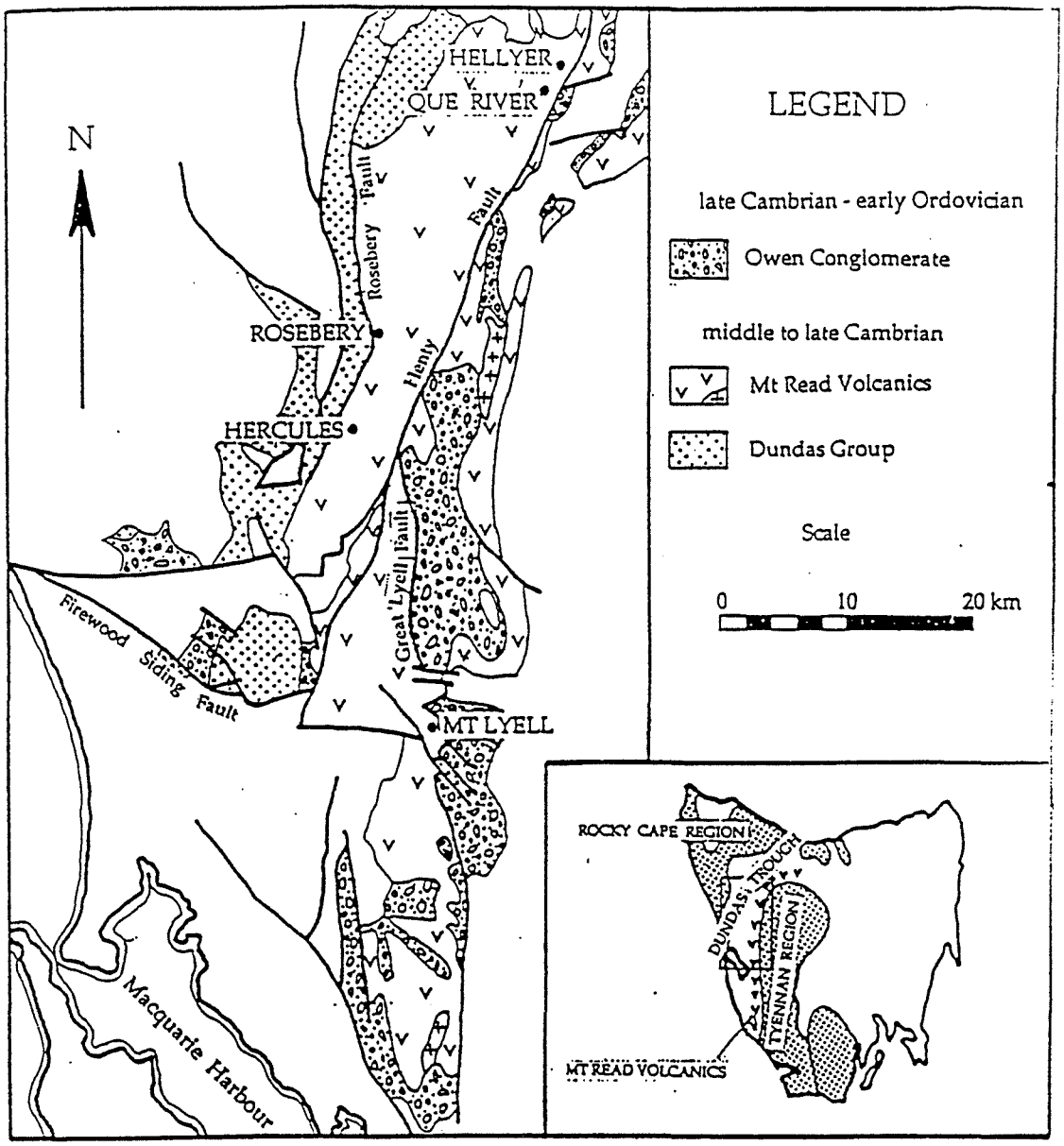
Main Lease Roads

Tracks

Copper Mines of Tasmania
Mt Lyell Project EMP
Location of Pits, Shafts and Adits

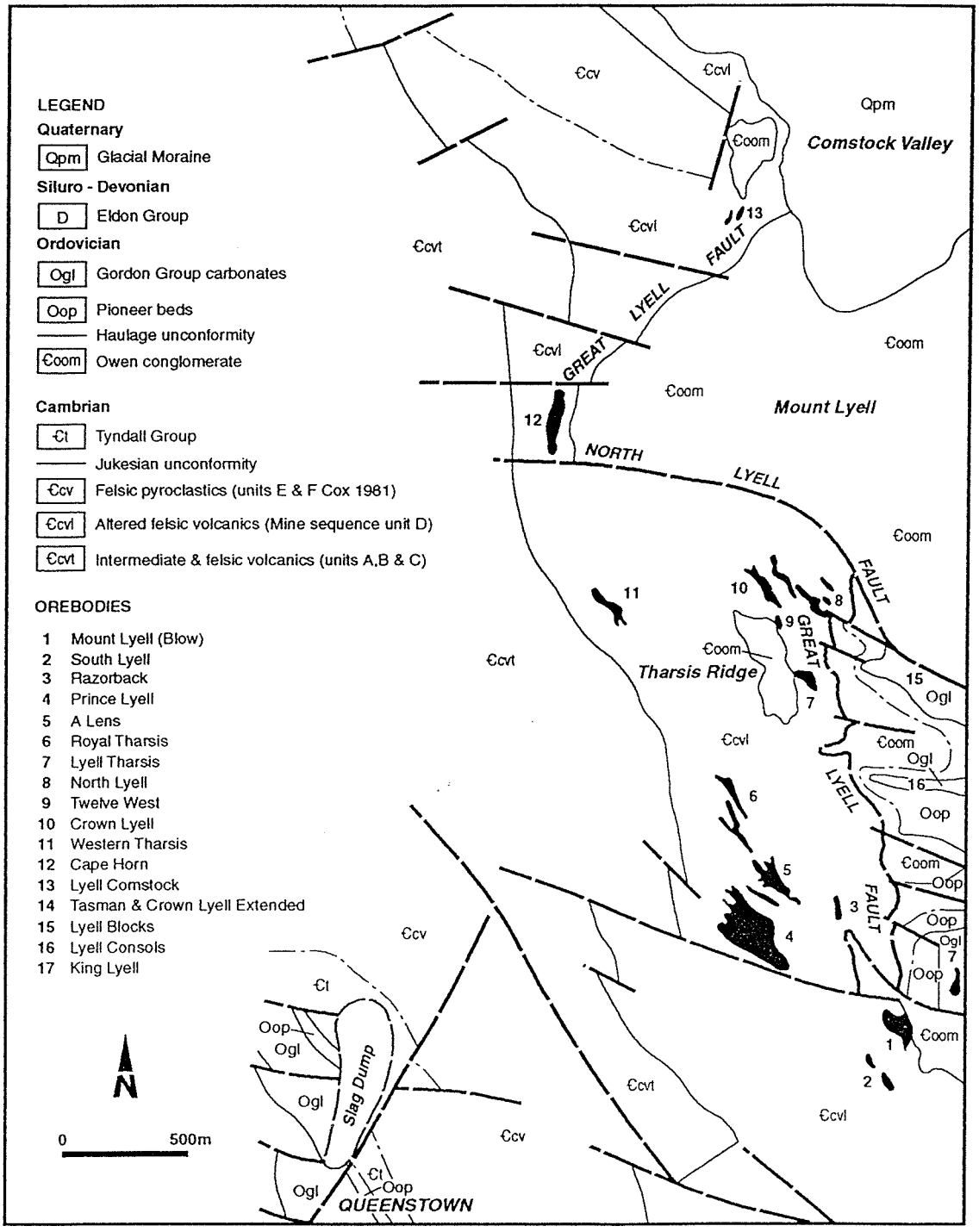
Scale: 1:30000

Figure 4.13



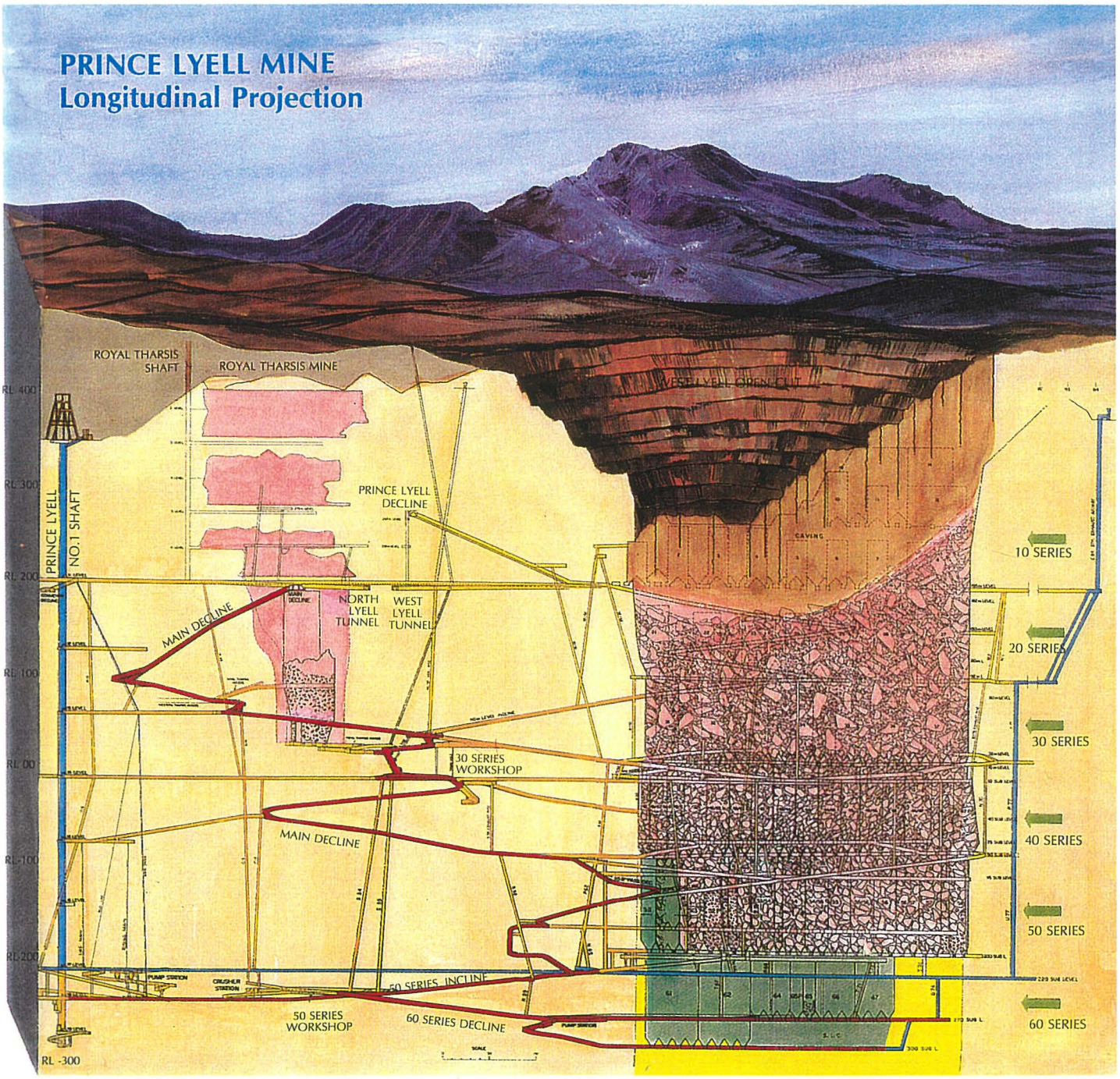
Copper Mines of Tasmania
Mt Lyell Project EMP
Regional Geology
(after Corbett & Salmon, 1989)

Figure 4.14



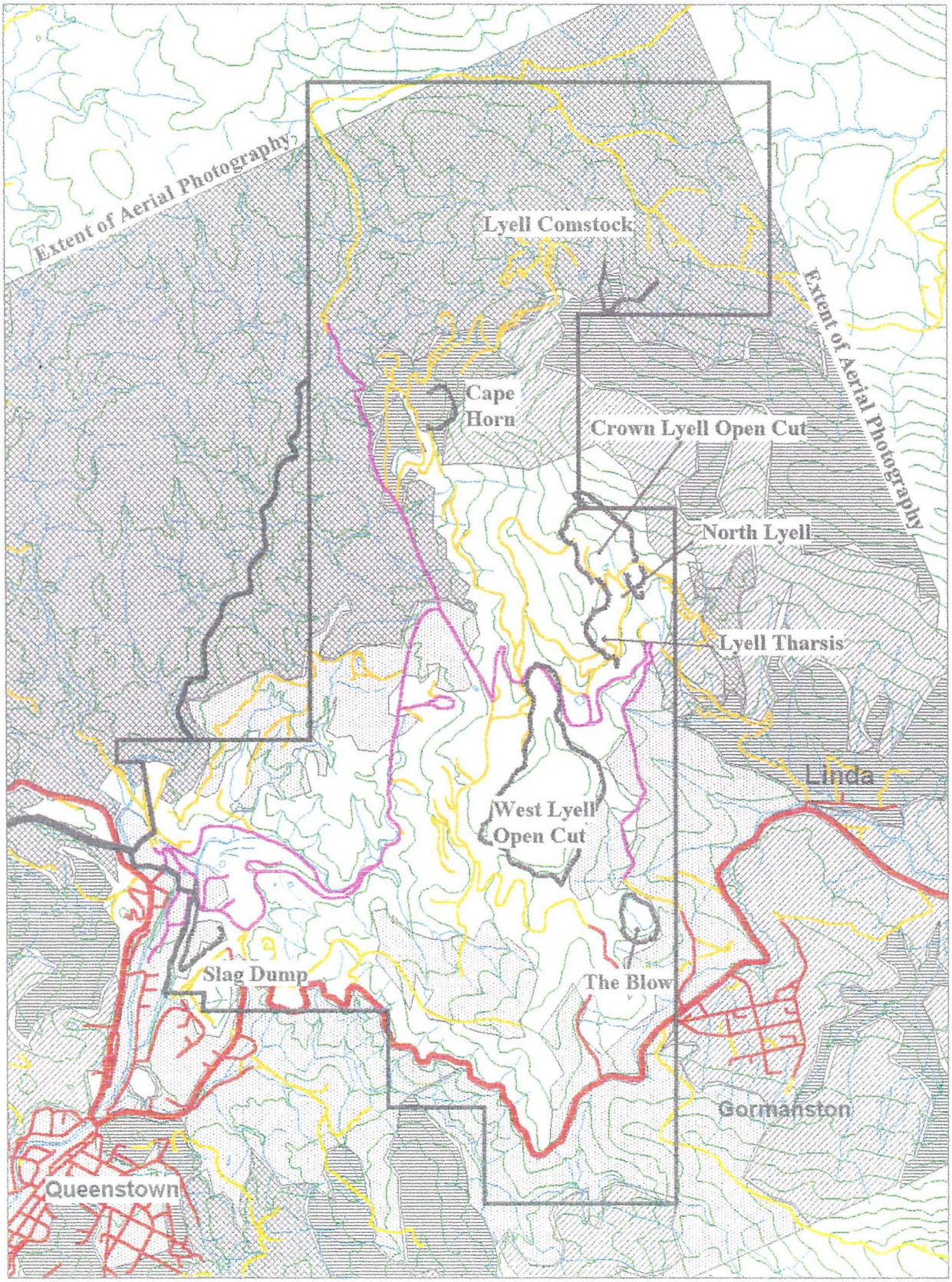
Copper Mines of Tasmania
Mt Lyell Project EMP
Project Geology

Figure 4.15



Copper Mines of Tasmania
Mt Lyell Project EMP
Prince Lyell Mine
Longitudinal Projection

Figure 4.16



Legend:

- Public and Major Roads
- Existing Tracks
- Site Roads to be Maintained

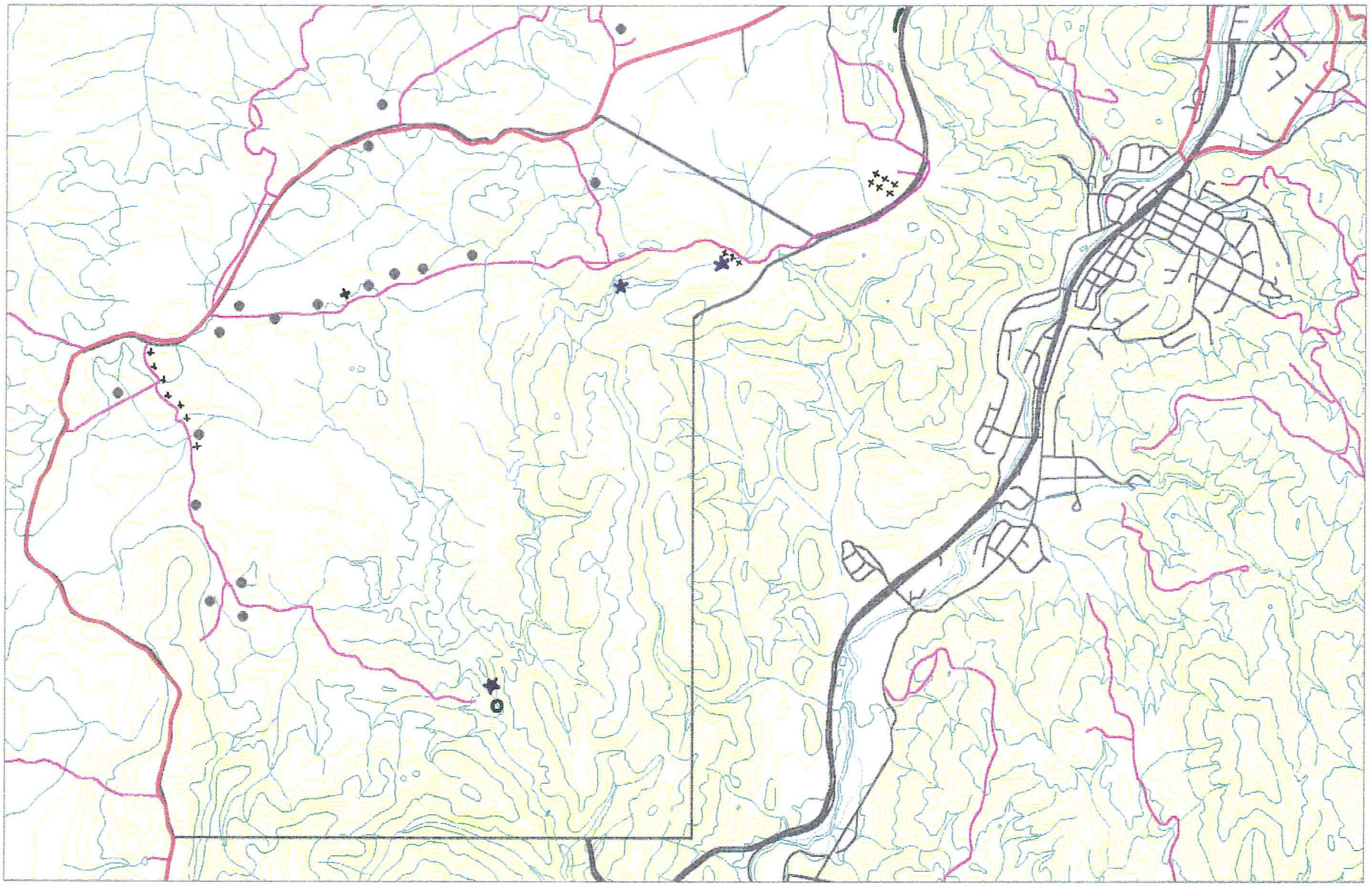
Vegetation Cover

- Dense 75 - 100% Cover
- 50 - 75% Cover
- 20 - 50% Cover
- Scattered <20% Cover
- 0 - 1% Cover

Copper Mines of Tasmania
Mt Lyell Project EMP
Vegetation - Mine

Scale: 1:30000

Figure 4.17



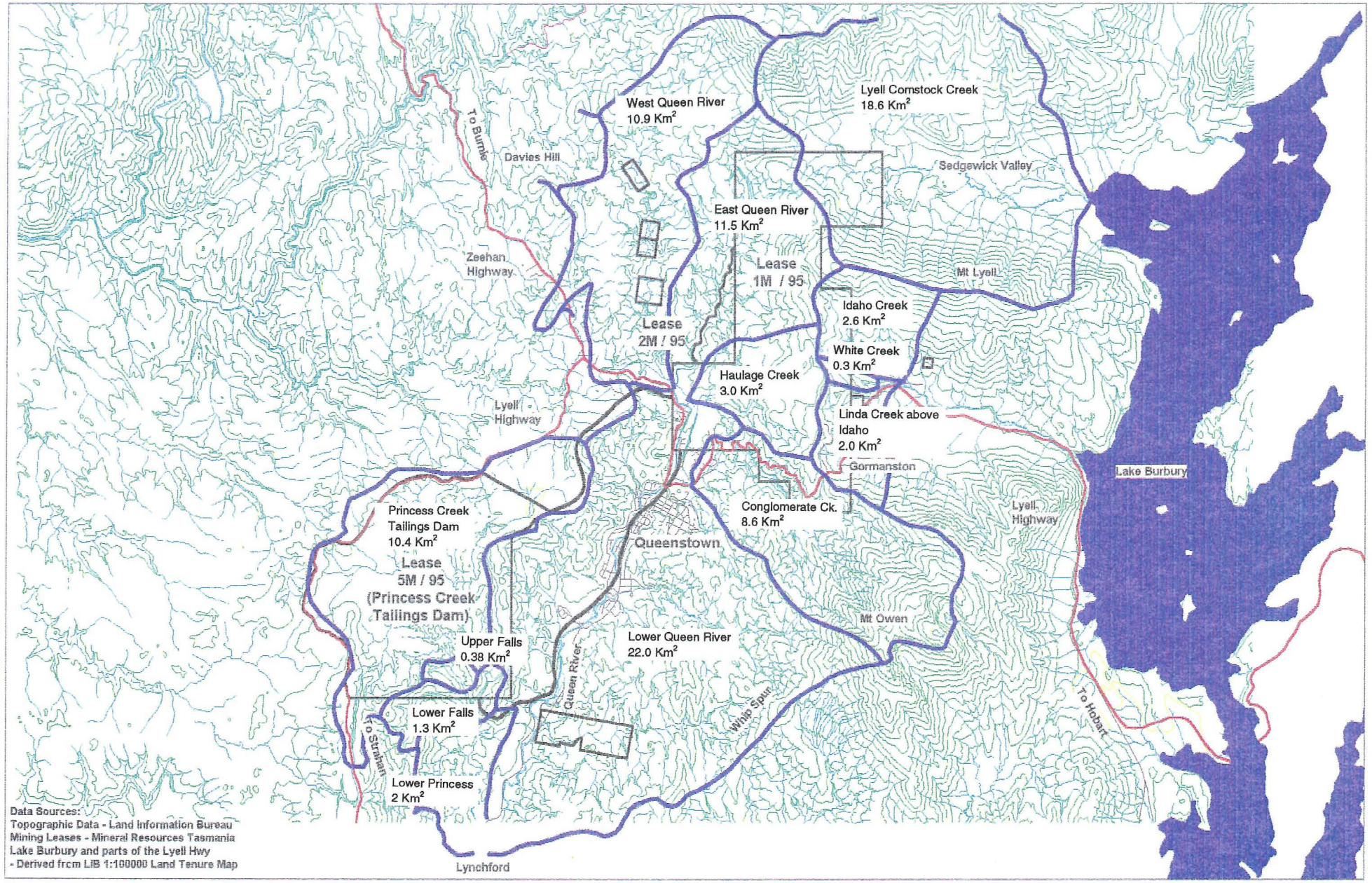
Legend

- *Centrolepis Paludicola* sites
- blackberries
- broom
- gorse
- pampas

Data Sources:
Topographic Data - Land Information Bureau
1:5000 and 1:25000 Scale Mapping

Copper Mines of Tasmania
Mt Lyell Project EMP
Vegetation - Dam Site

Figure 4.18

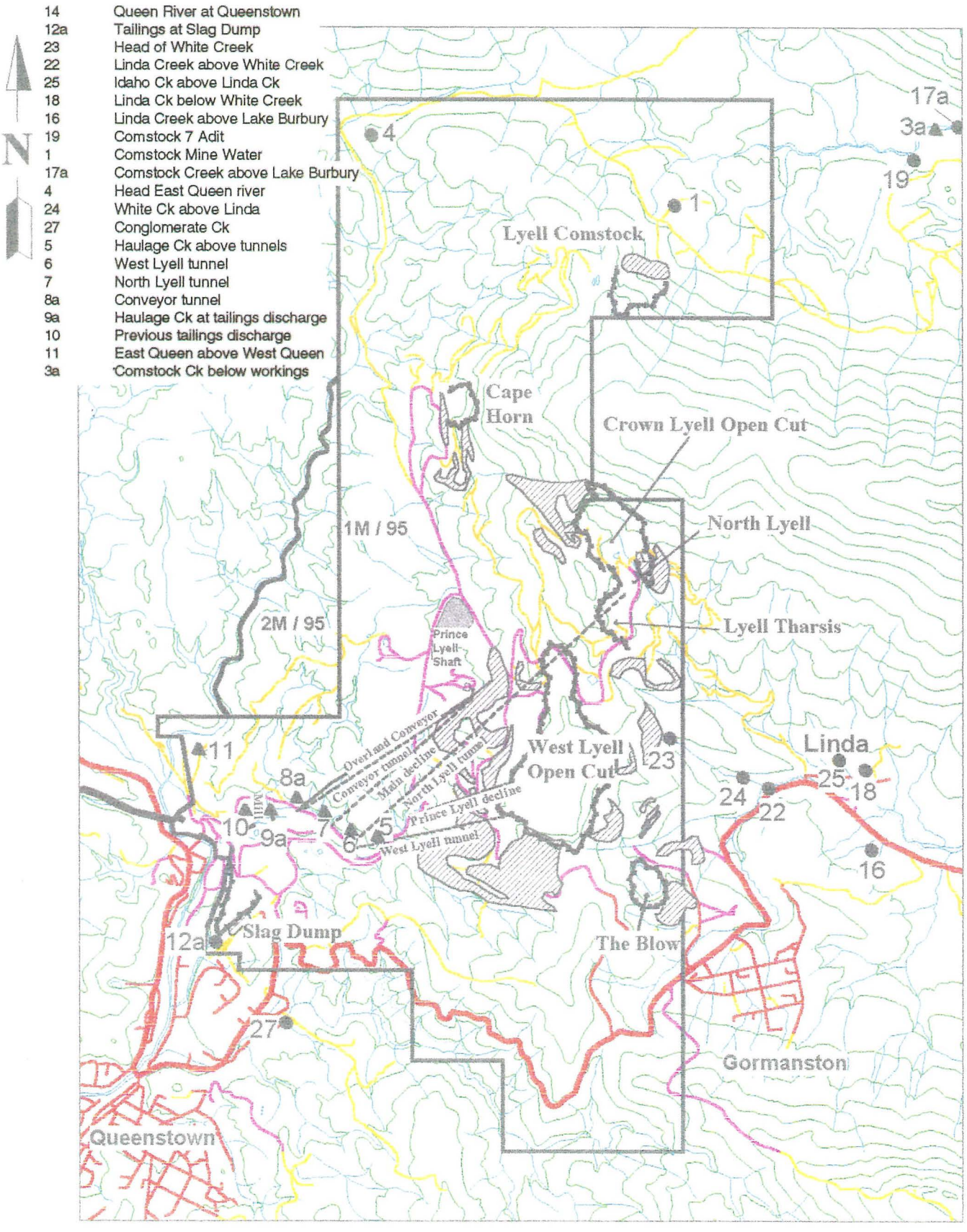


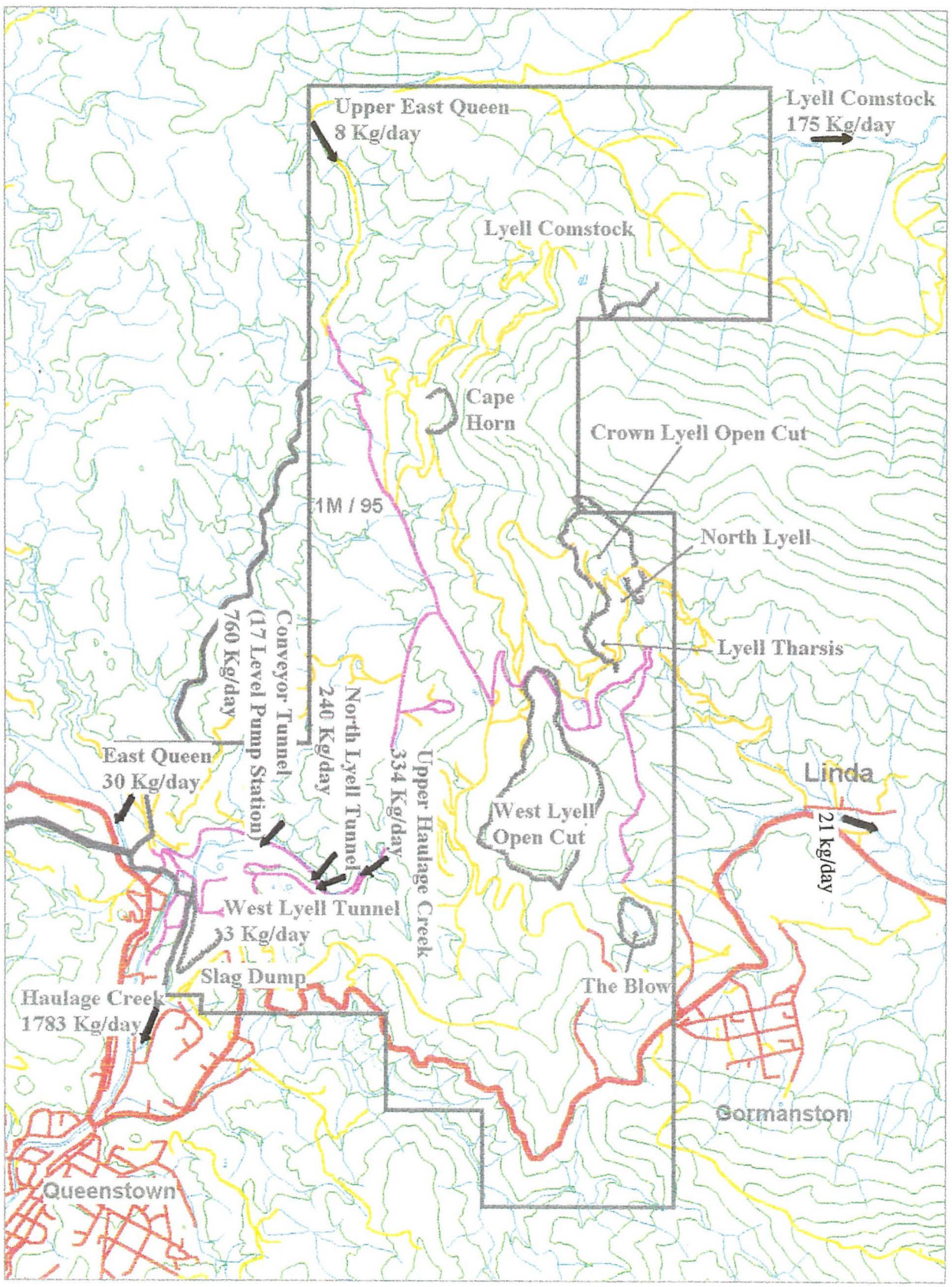
Copper Mines of Tasmania
Mt Lyell Project EMP
Drainage Catchment Areas

Figure 4.19

Copper Mines of Tasmania
Mt Lyell Project EMP
Prince Lyell Mine
Flow Contributions to Dewatering

Fig 4.20


14 Queen River at Queenstown
12a Tailings at Slag Dump
23 Head of White Creek
22 Linda Creek above White Creek
25 Idaho Ck above Linda Ck
18 Linda Ck below White Creek
16 Linda Creek above Lake Burbury
19 Comstock 7 Adit
1 Comstock Mine Water
17a Comstock Creek above Lake Burbury
4 Head East Queen river
24 White Ck above Linda
27 Conglomerate Ck
5 Haulage Ck above tunnels
6 West Lyell tunnel
7 North Lyell tunnel
8a Conveyor tunnel
9a Haulage Ck at tailings discharge
10 Previous tailings discharge
11 East Queen above West Queen
3a Comstock Ck below workings
N
Lyell Comstock
Cape Horn
Crown Lyell Open Cut
North Lyell
Lyell Tharsis
1M / 95
2M / 95
Prince Lyell Shaft
Overland Conveyor
Conveyor tunnel
Main decline
North Lyell tunnel
Prince Lyell decline
West Lyell tunnel
West Lyell Open Cut
Linda
Slag Dump
The Blow
Gormanston
Queenstown
Excavated Areas
Fill Areas
Legend:
Public and Major Roads
Main Lease Roads
Tracks
Copper Mines of Tasmania
Mt Lyell Project EMP
Flow Monitoring Sites
Scale: 1:30000
Figure 4.21



Legend:

- Public and Major Roads
- Existing Tracks
- Site Roads to be Maintained
- Cu Loading and source

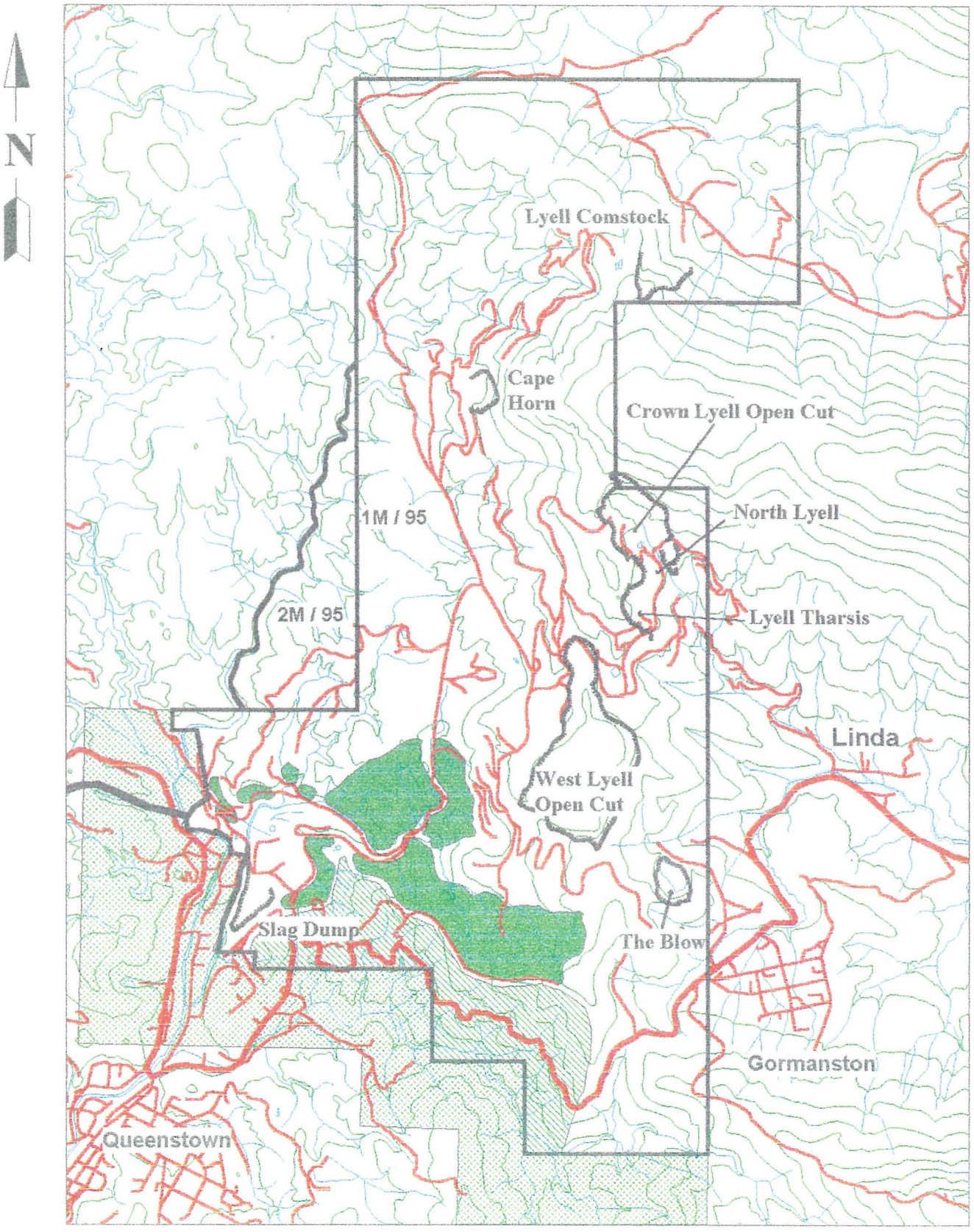
Copper Mines of Tasmania
Mt Lyell Project EMP
Mass Loads of Cu
Median Flows kg/day

Scale: 1:30000

Figure 4.22

Copper Mines of Tasmania
Mt Lyell Project EMP
Prince Lyell Mine
Contributions to AMD

Figure 4.23

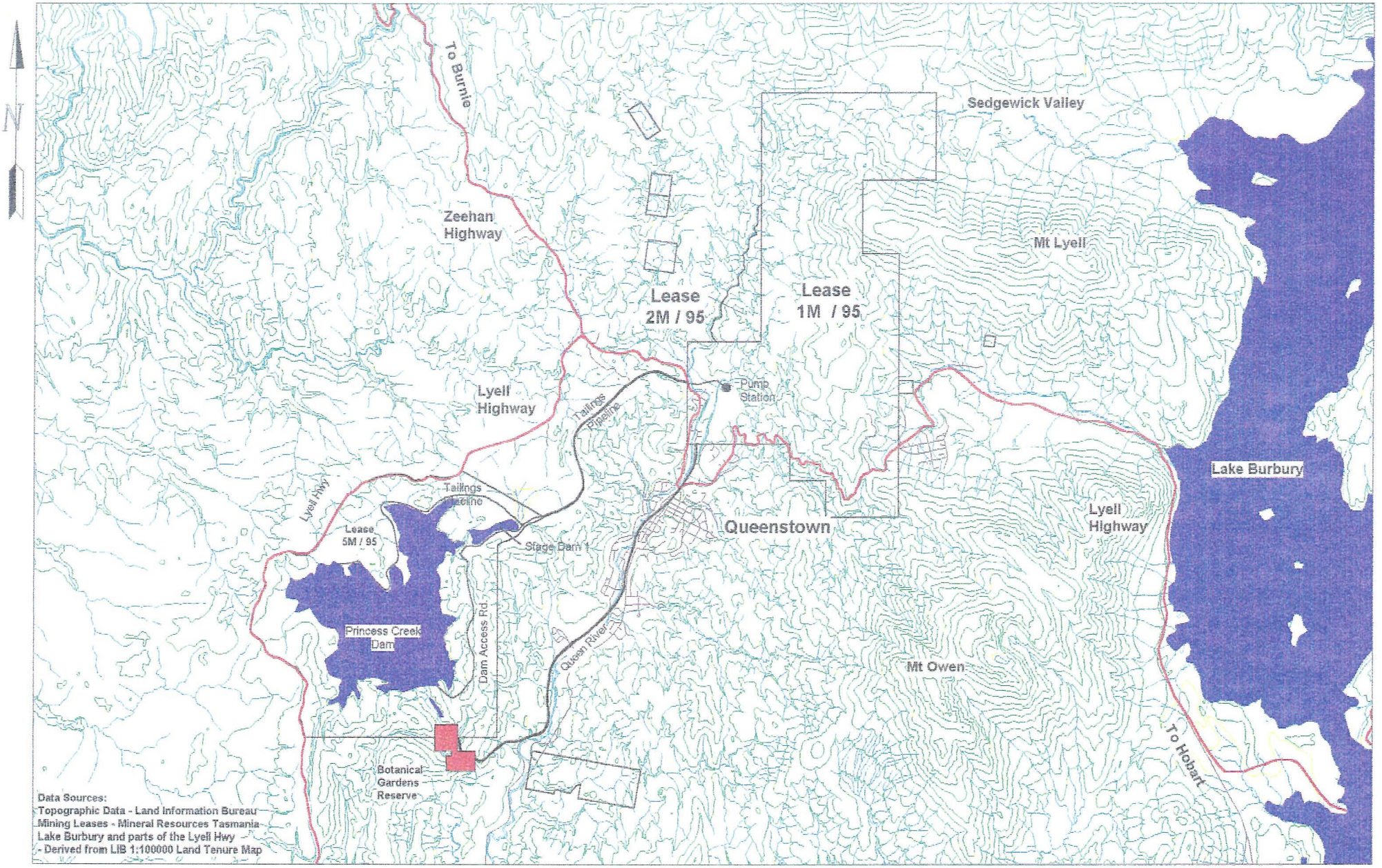


Areas that are to be Revegetated
Areas Outside the Lease NOT to be Revegetated
Areas on the Lease but Not to be Revegetated

Copper Mines of Tasmania
Mt Lyell Project EMP
Proposed Revegetation

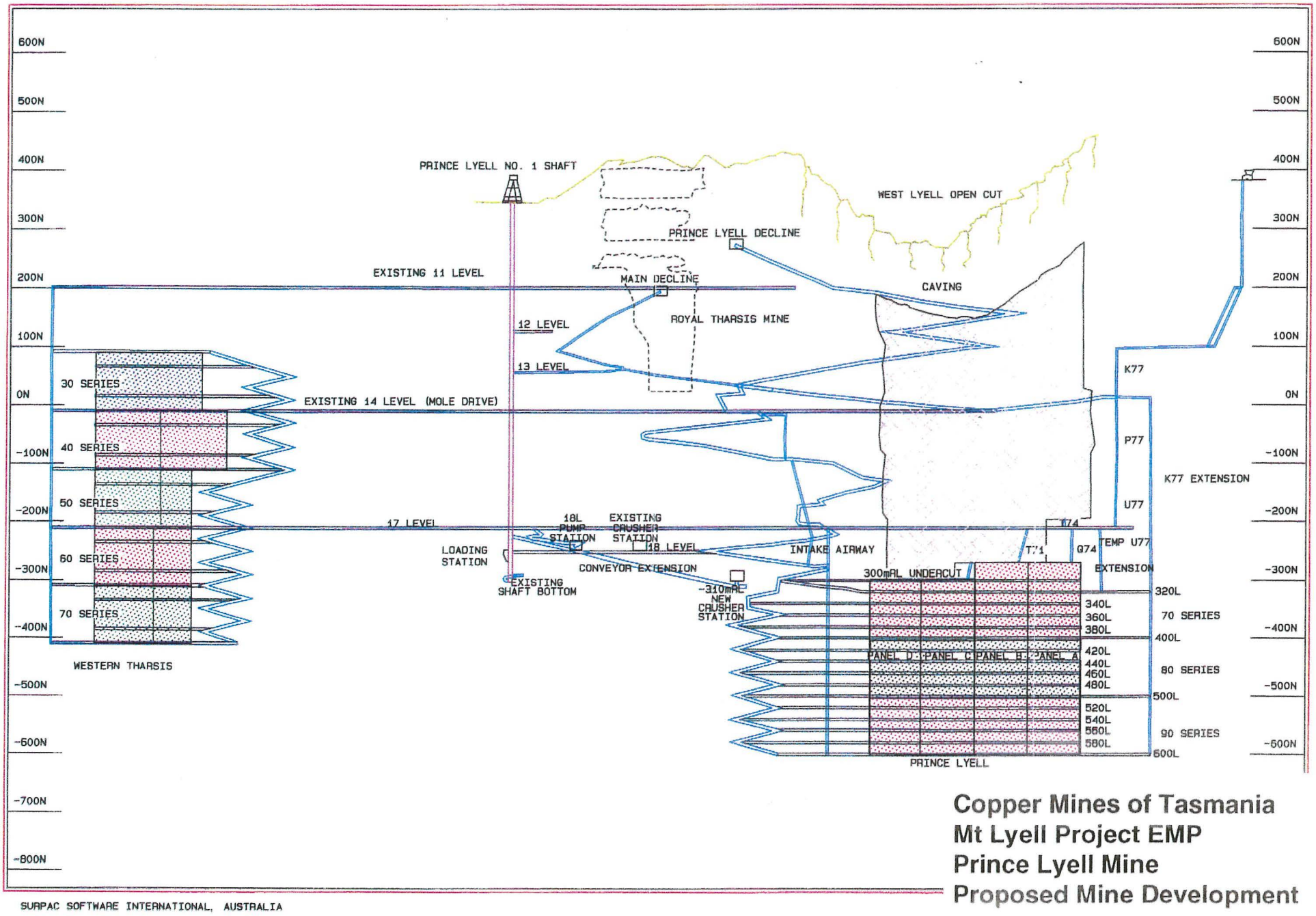
Scale: 1:30000

Figure 4.24



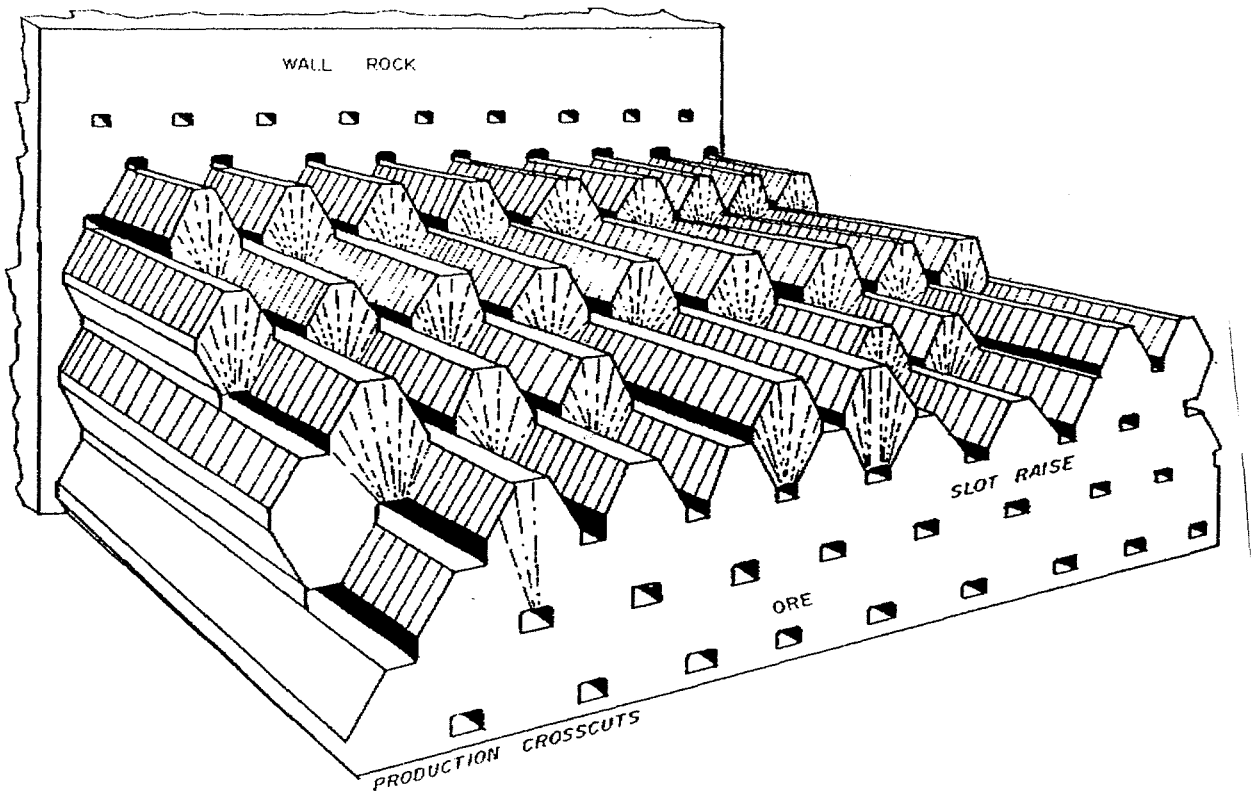
Copper Mines of Tasmania
Mt Lyell Project EMP
Tailings Management
Overall Plan

Figure 4.25

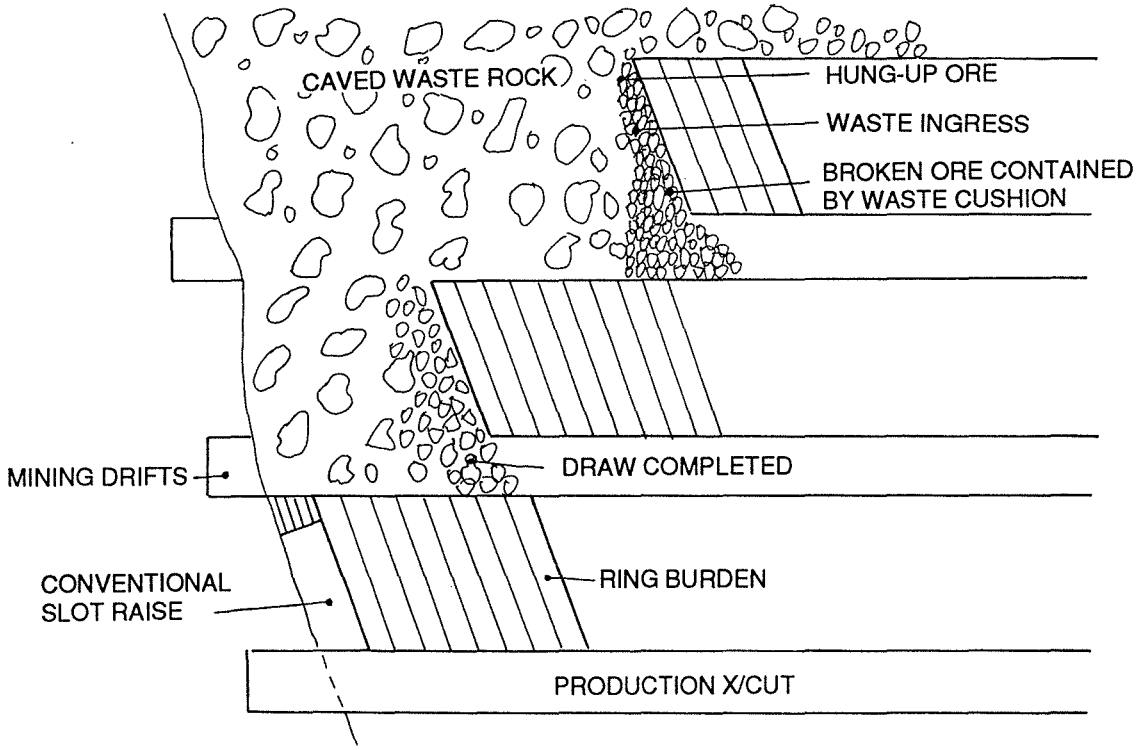


Copper Mines of Tasmania
Mt Lyell Project EMP
Prince Lyell Mine
Proposed Mine Development

Figure 4.26



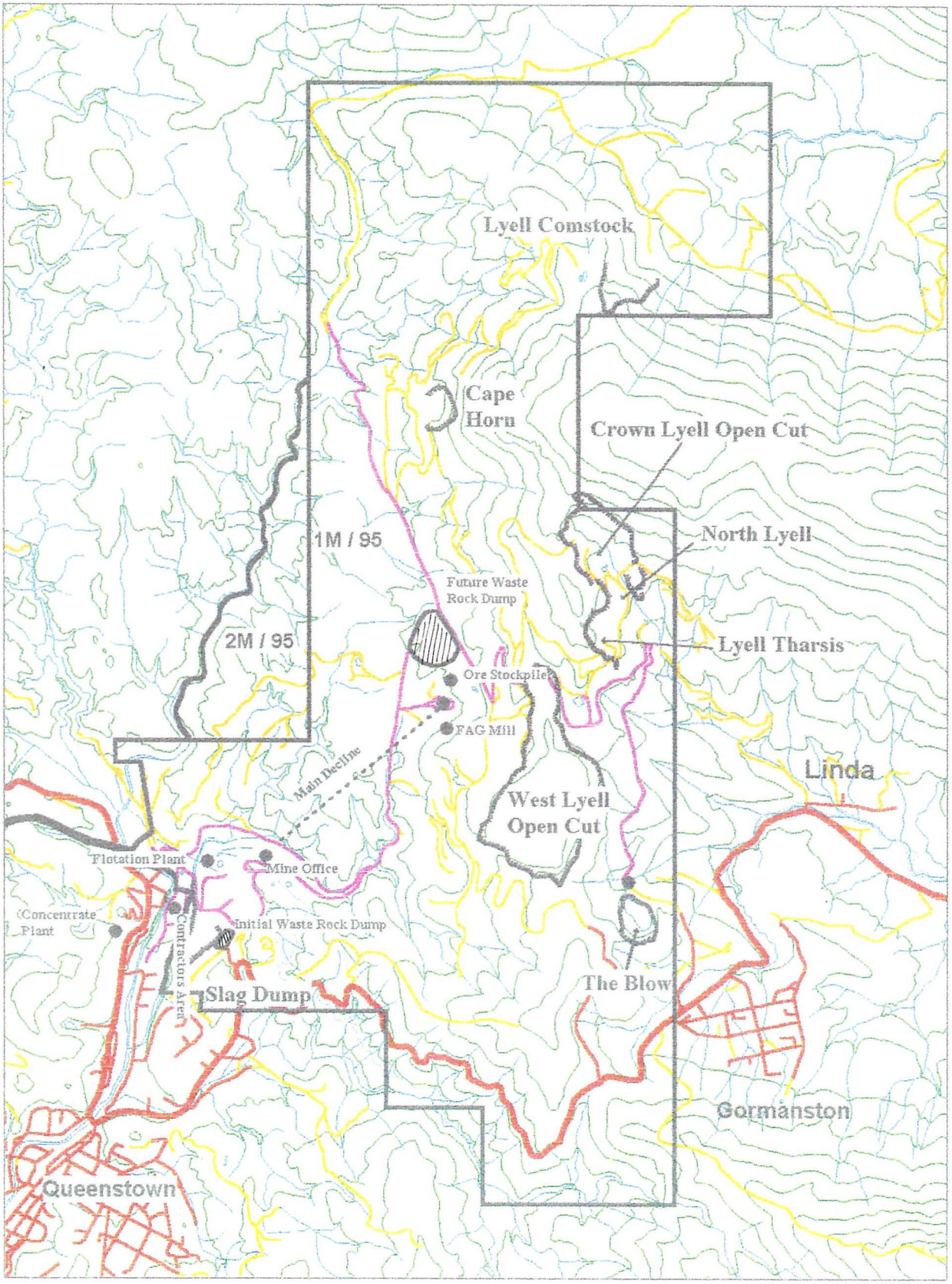
PERSPECTIVE VIEW



LONGITUDINAL SECTION

Copper Mines of Tasmania
Mt Lyell Project EMP
Sub Level Caving

Figure 4.27



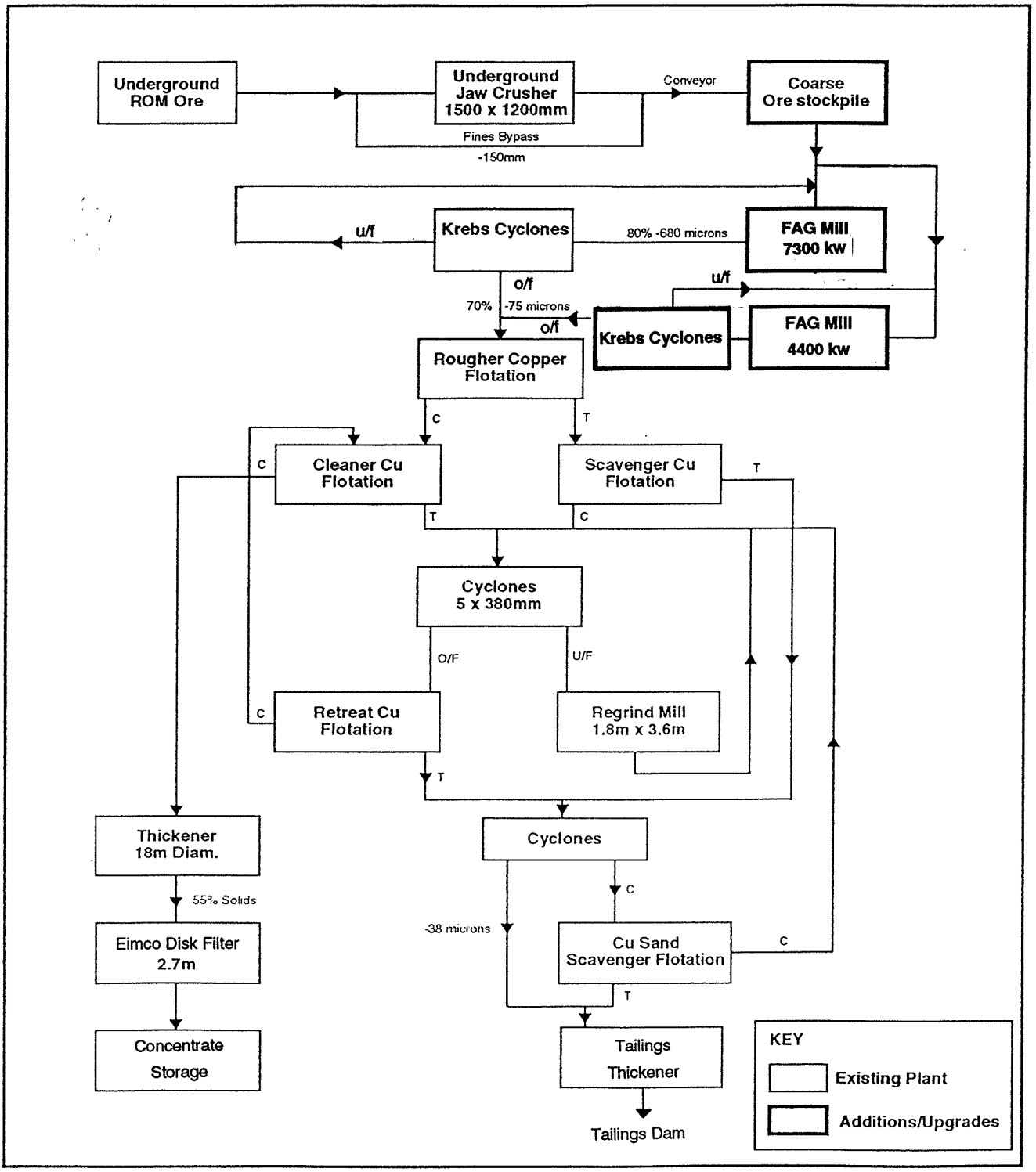
Legend:

- Public and Major Roads
- Existing Tracks
- Site Roads to be Maintained

Copper Mines of Tasmania
Mt Lyell Project EMP
Mine Site Surface Plan
CMT Operations

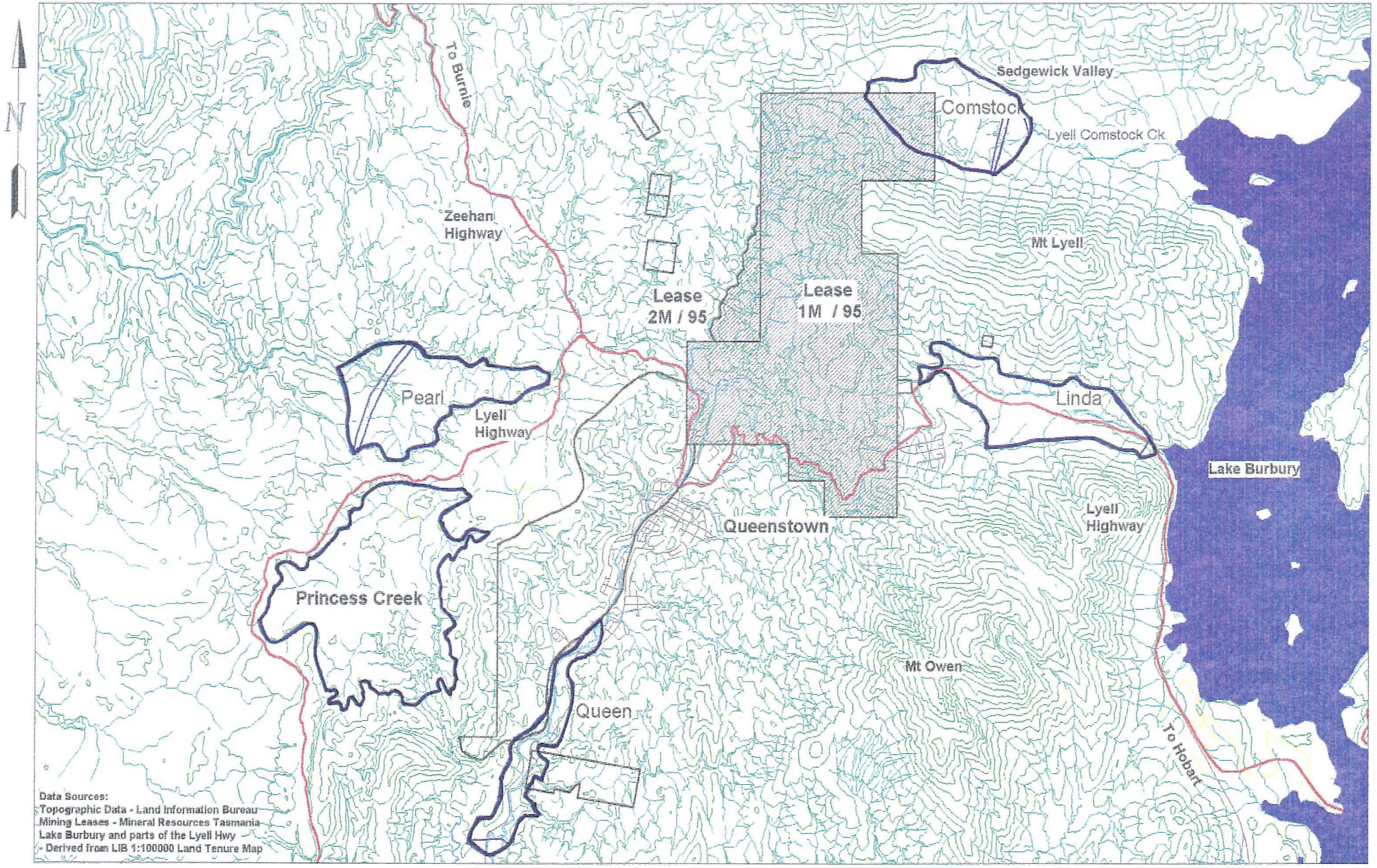
Scale: 1:30000

Figure 4.28



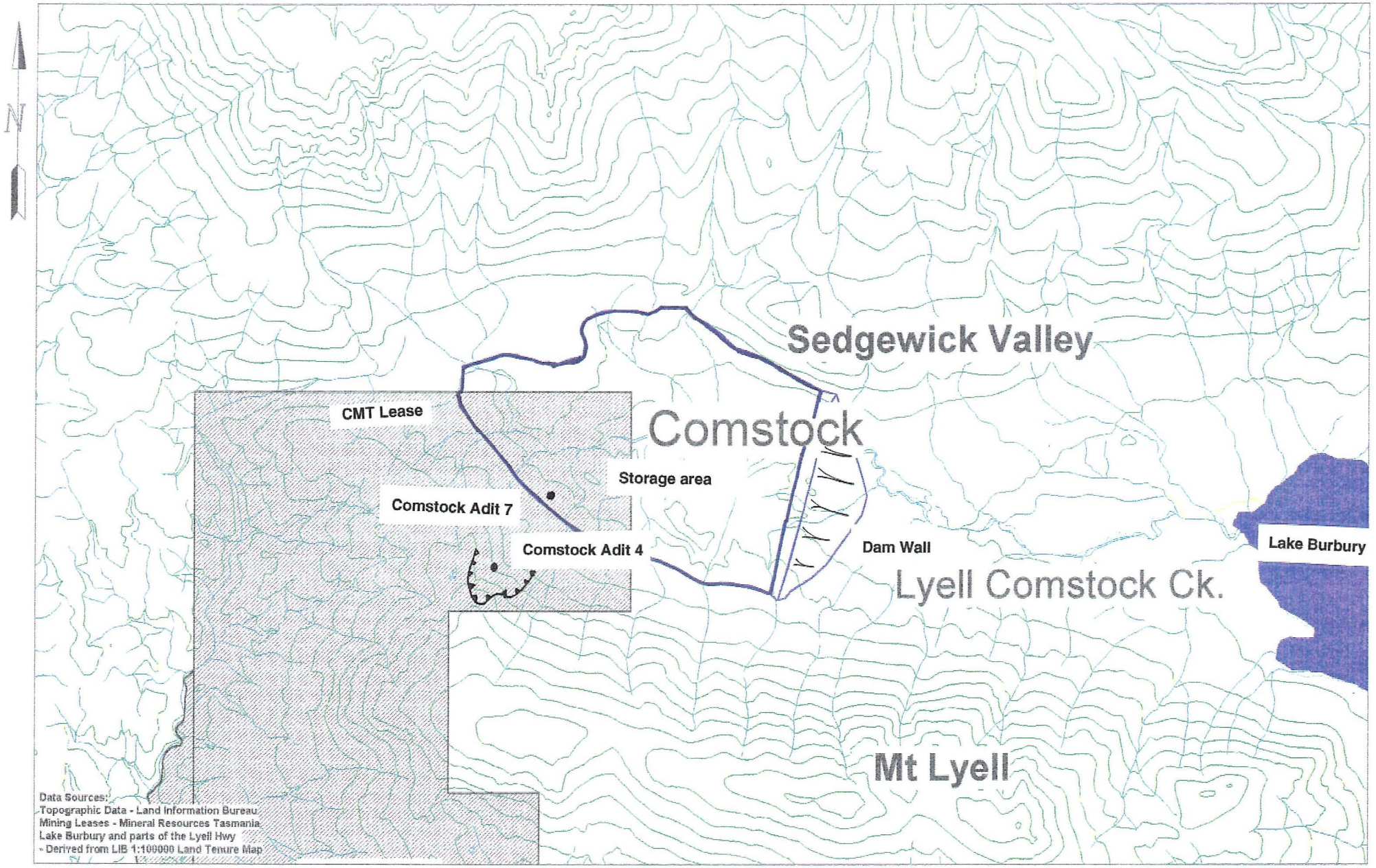
Copper Mines of Tasmania
Mt Lyell Project EMP
Prince Lyell Mine
Ore Processing Flow Sheet

Figure 4.29



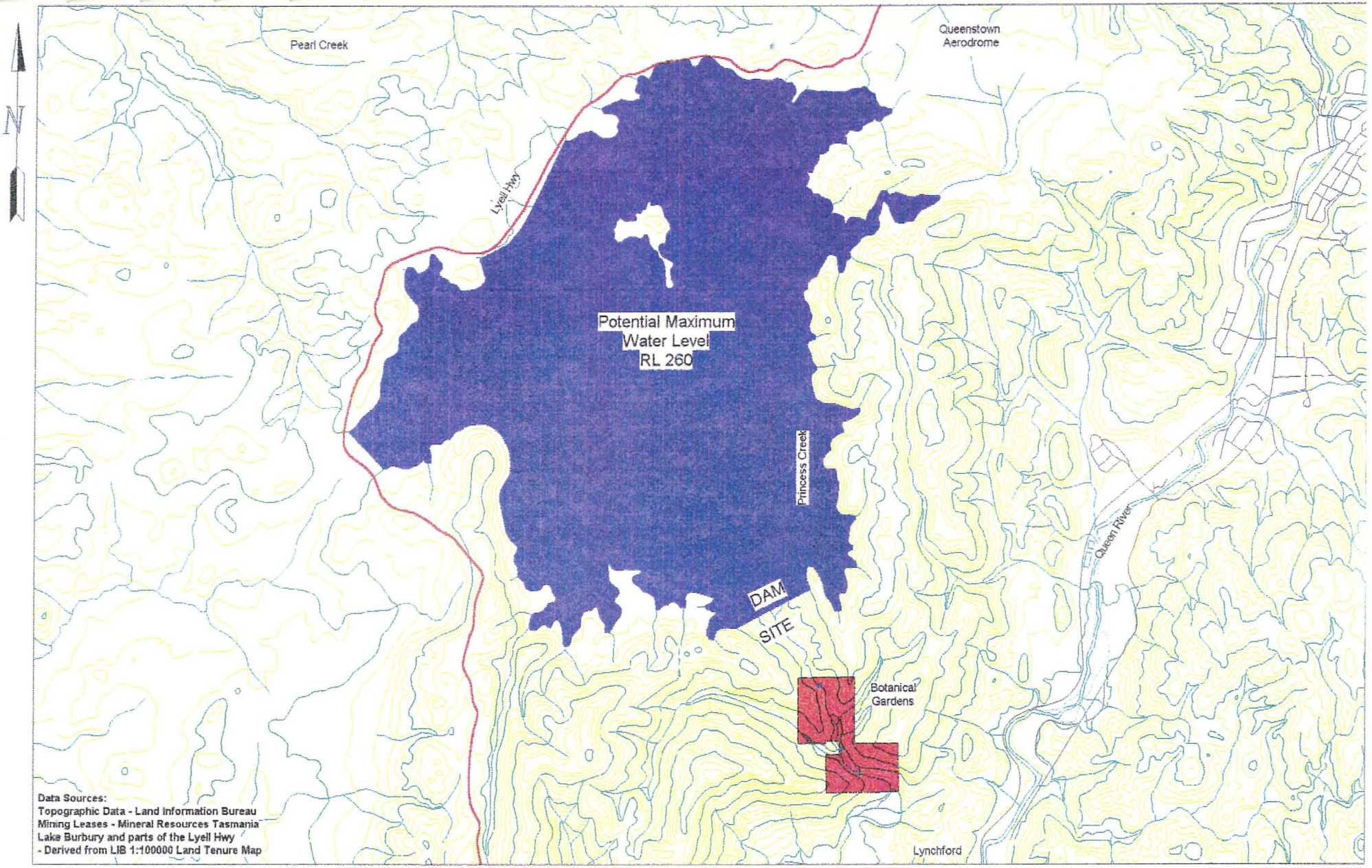
Copper Mines of Tasmania
Mt Lyell Project EMP
Alternative Tailings Dams Sites

Figure 4.30



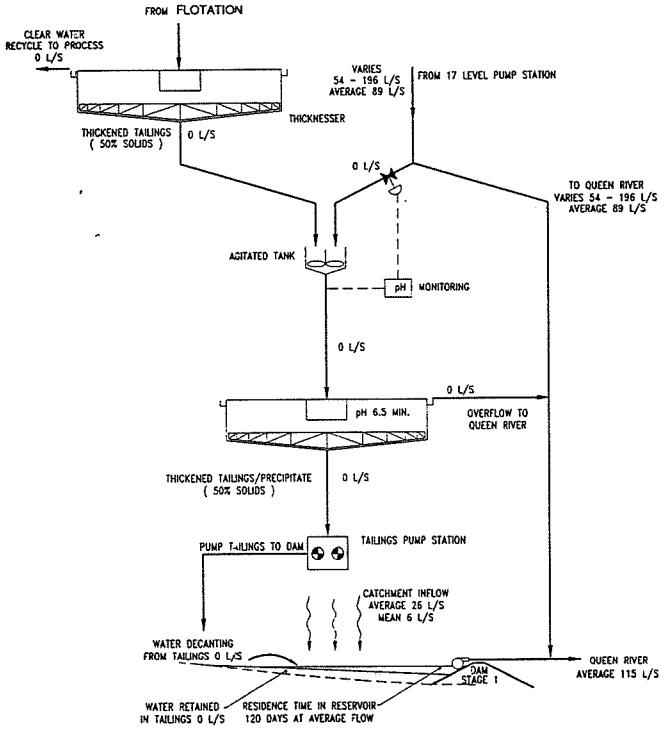
Copper Mines of Tasmania
Mt Lyell Project EMP
Comstock Dam Site

Figure 4.31

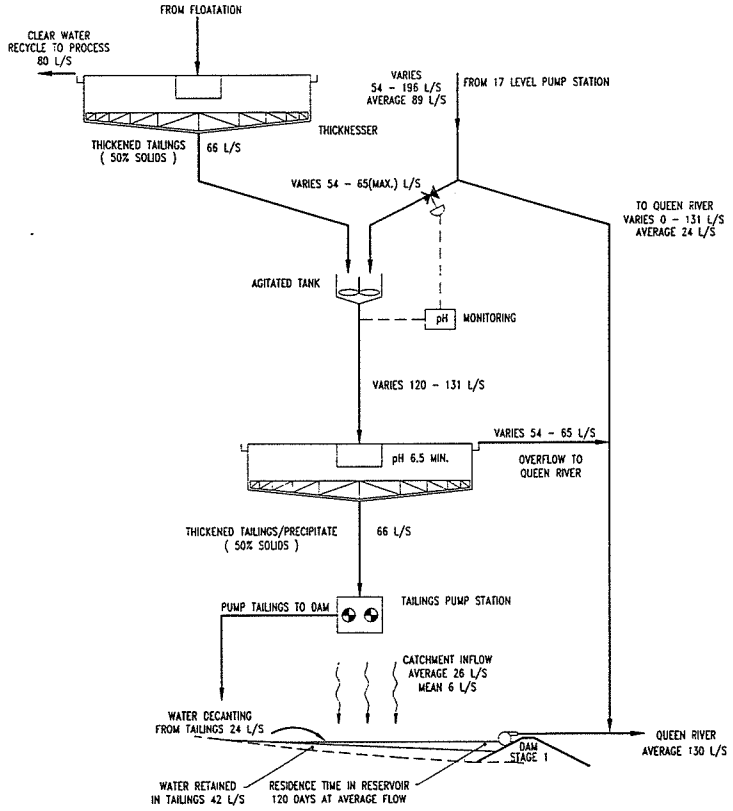


Copper Mines of Tasmania
Mt Lyell Project EMP
Princess Creek Dam Site

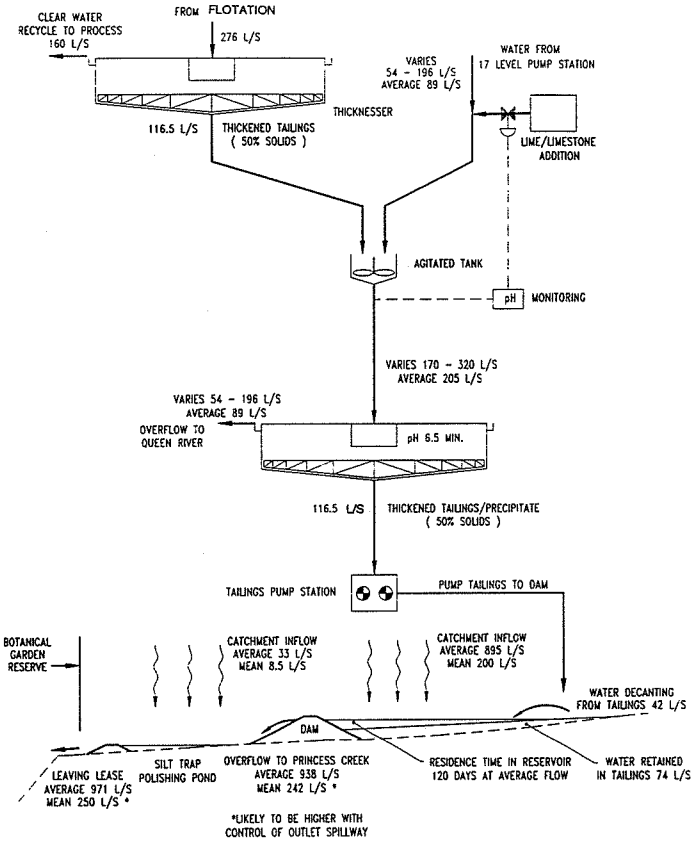
Figure 4.32



TAILINGS/MINE WATER MANAGEMENT
STAGE 1
MILL NOT OPERATING



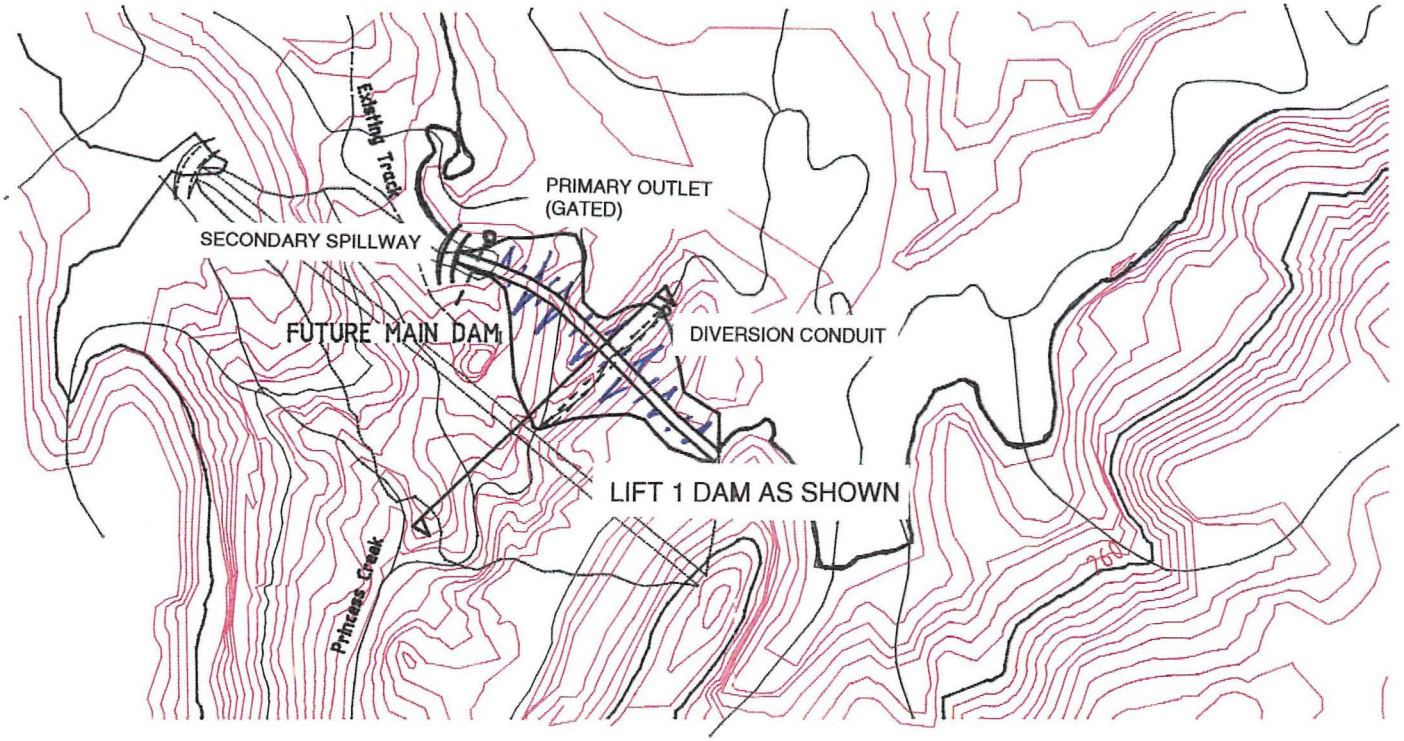
TAILINGS/MINE WATER MANAGEMENT
STAGE 1
MILL OPERATING



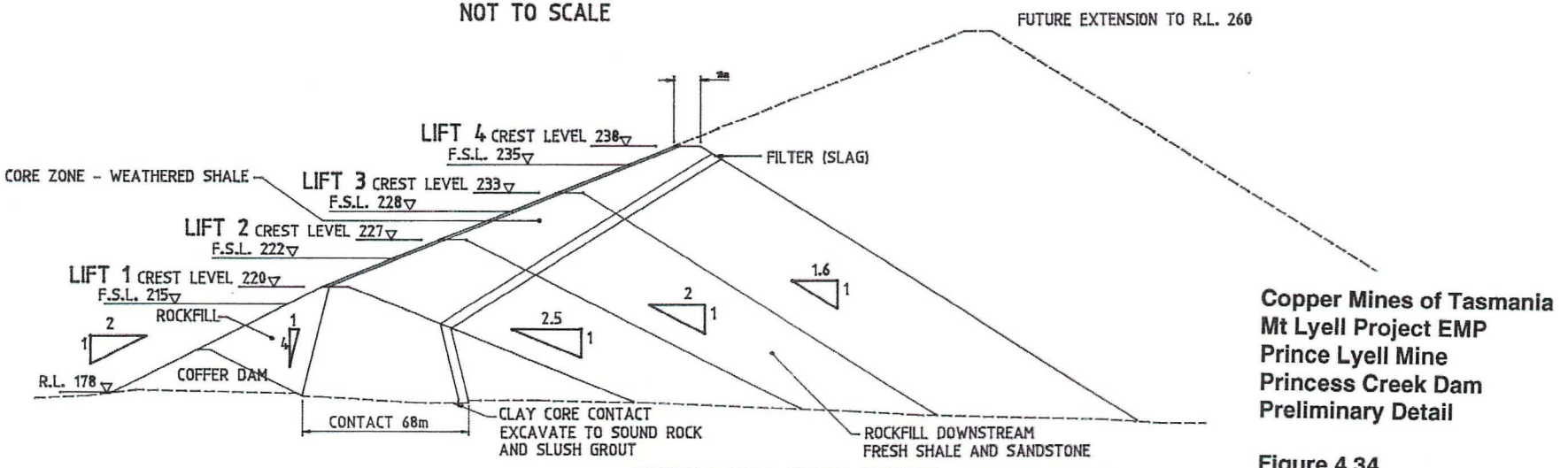
TAILINGS/MINE WATER MANAGEMENT
3.5 MTPA
MILL OPERATING

Copper Mines of Tasmania
Mt Lyell Project EMP
Prince Lyell Mine
Tailings / Mine Water Management

Figure 4.33



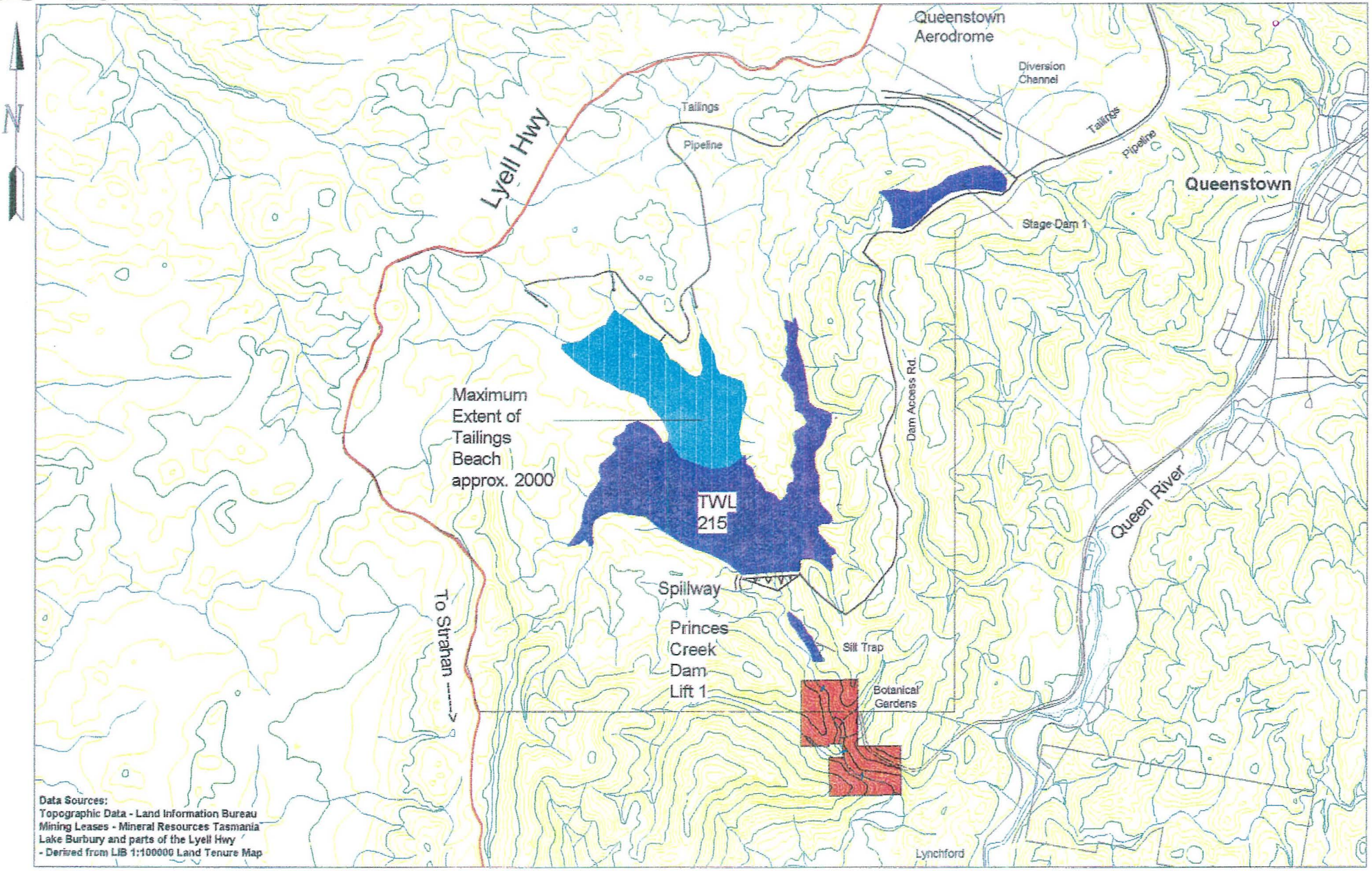
PLAN
NOT TO SCALE



TYPICAL DAM CROSS SECTION NOT TO SCALE

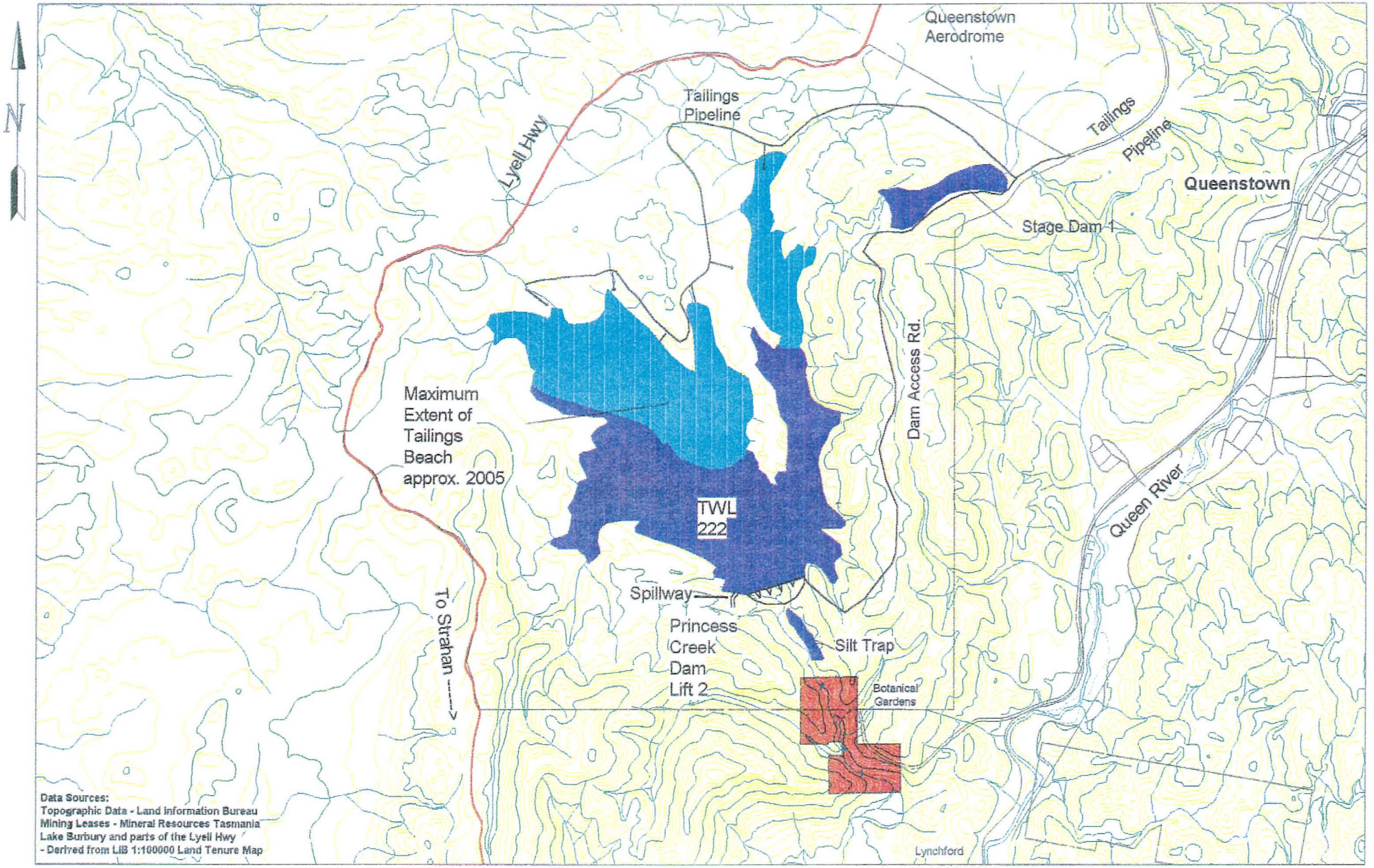
Copper Mines of Tasmania
Mt Lyell Project EMP
Prince Lyell Mine
Princess Creek Dam
Preliminary Detail

Figure 4.34



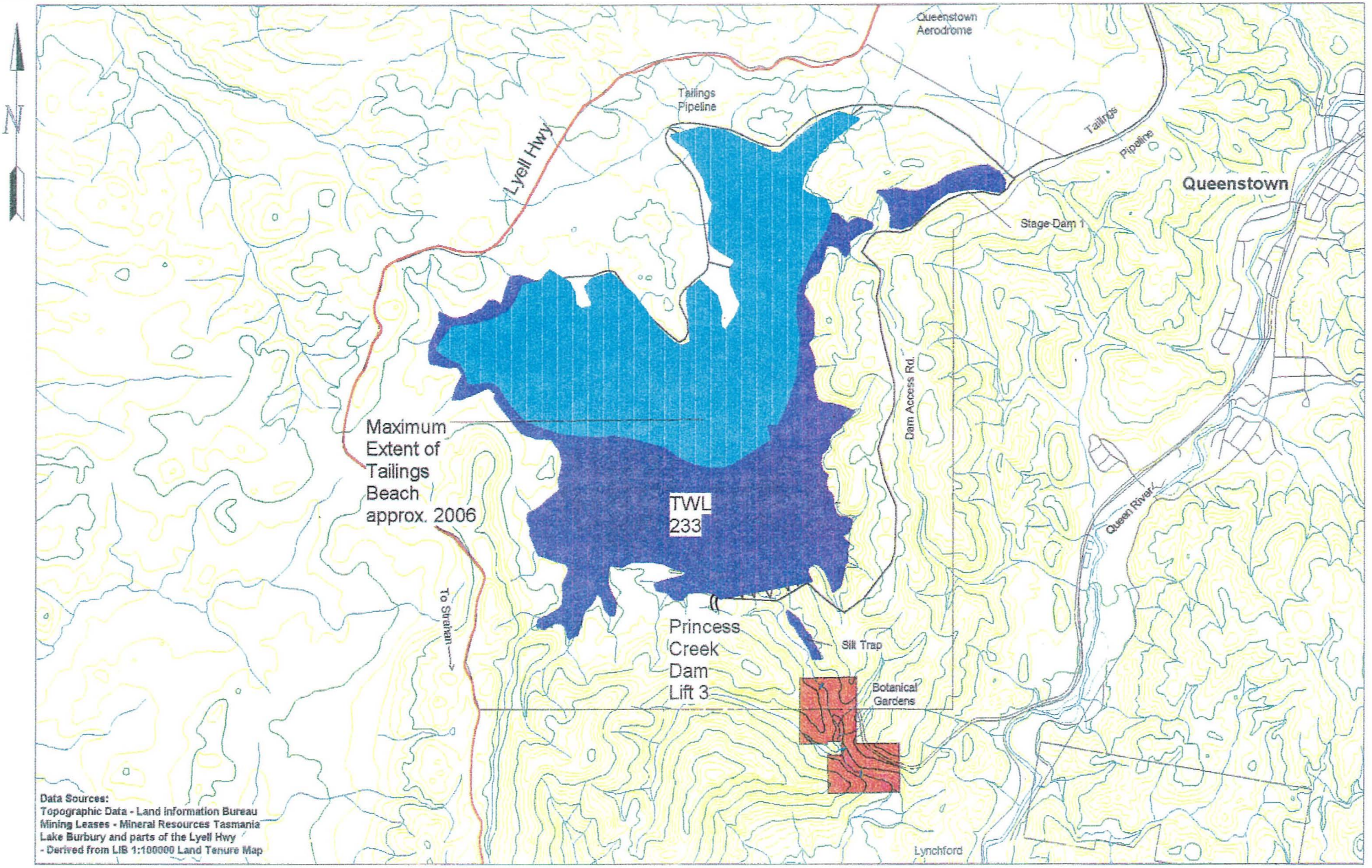
Copper Mines of Tasmania
Mt Lyell Project EMP
Princess Creek Dam
Plan - Lift 1 1995/96

Figure 4.35



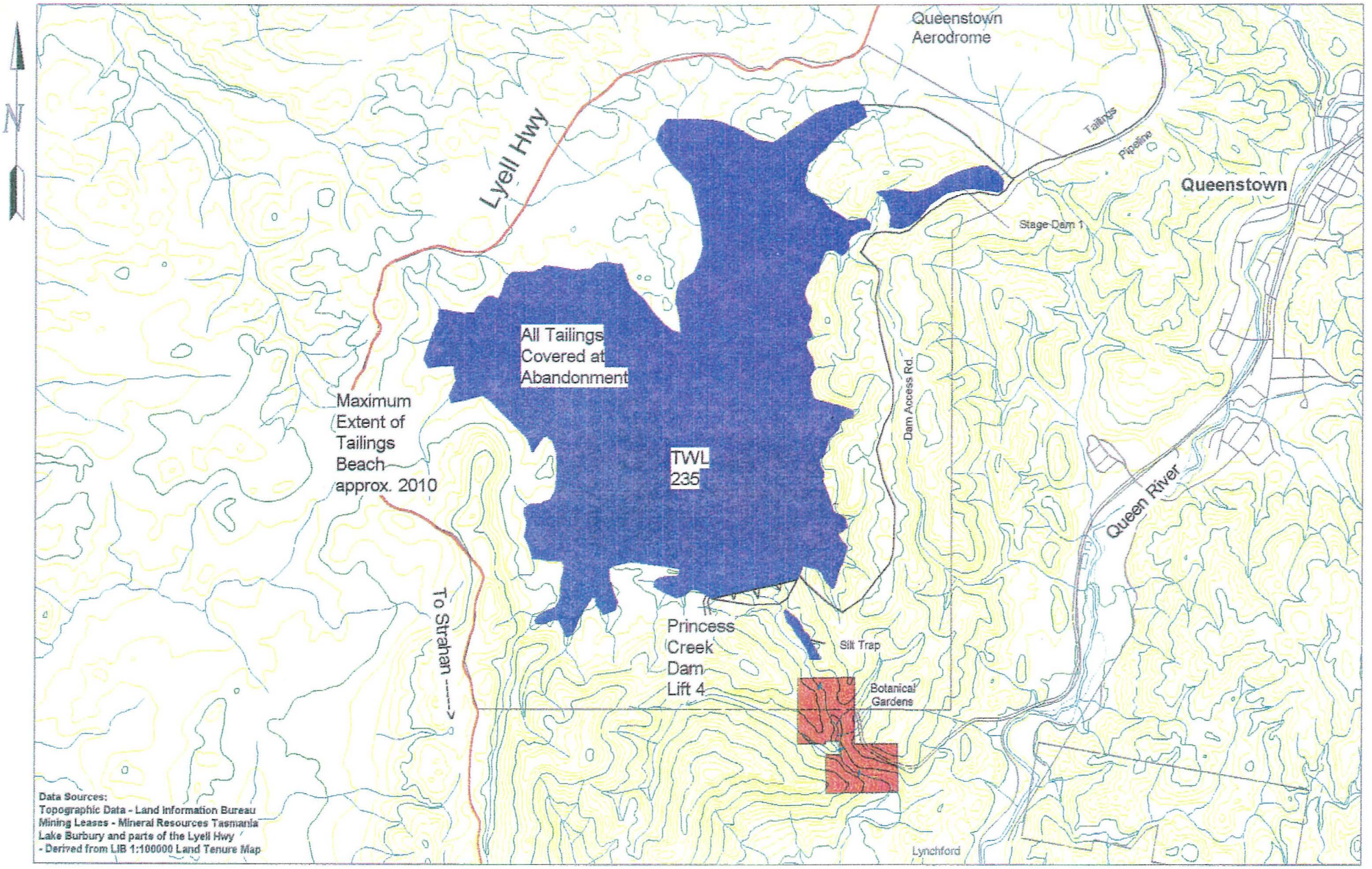
Copper Mines of Tasmania
Mt Lyell Project EMP
Princess Creek Dam
Plan - Lift 2 2000/01

Figure 4.36



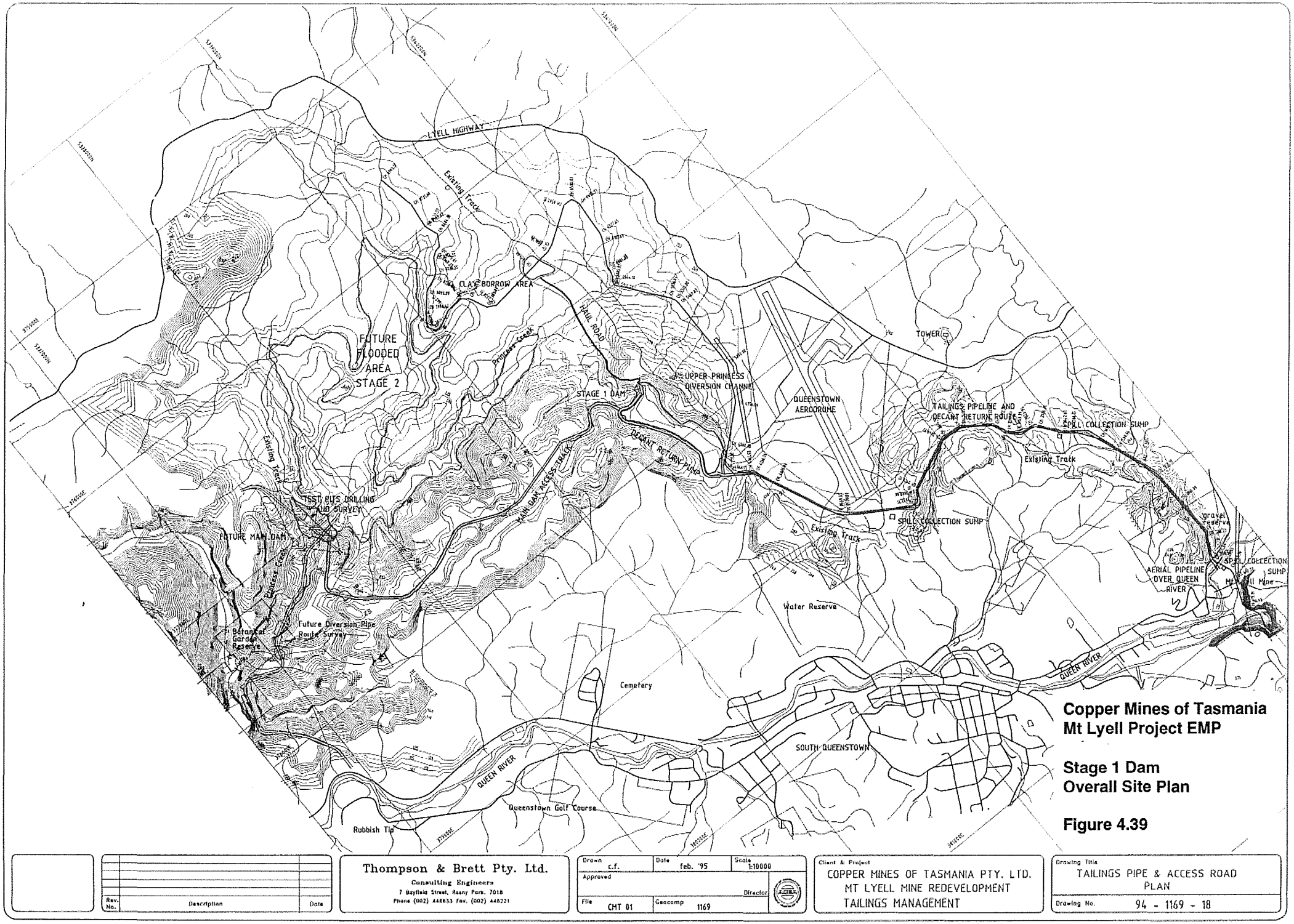
Copper Mines of Tasmania
Mt Lyell Project EMP
Princess Creek Dam
Plan - Lift 3 2005/06

Figure 4.37



Copper Mines of Tasmania
Mt Lyell Project EMP
Princess Creek Dam
Plan - Lift 4 2010

Figure 4.38



Copper Mines of Tasmania
Mt Lyell Project EMP

Stage 1 Dam
Overall Site Plan

Figure 4.39

Rev. No.	Description	Date

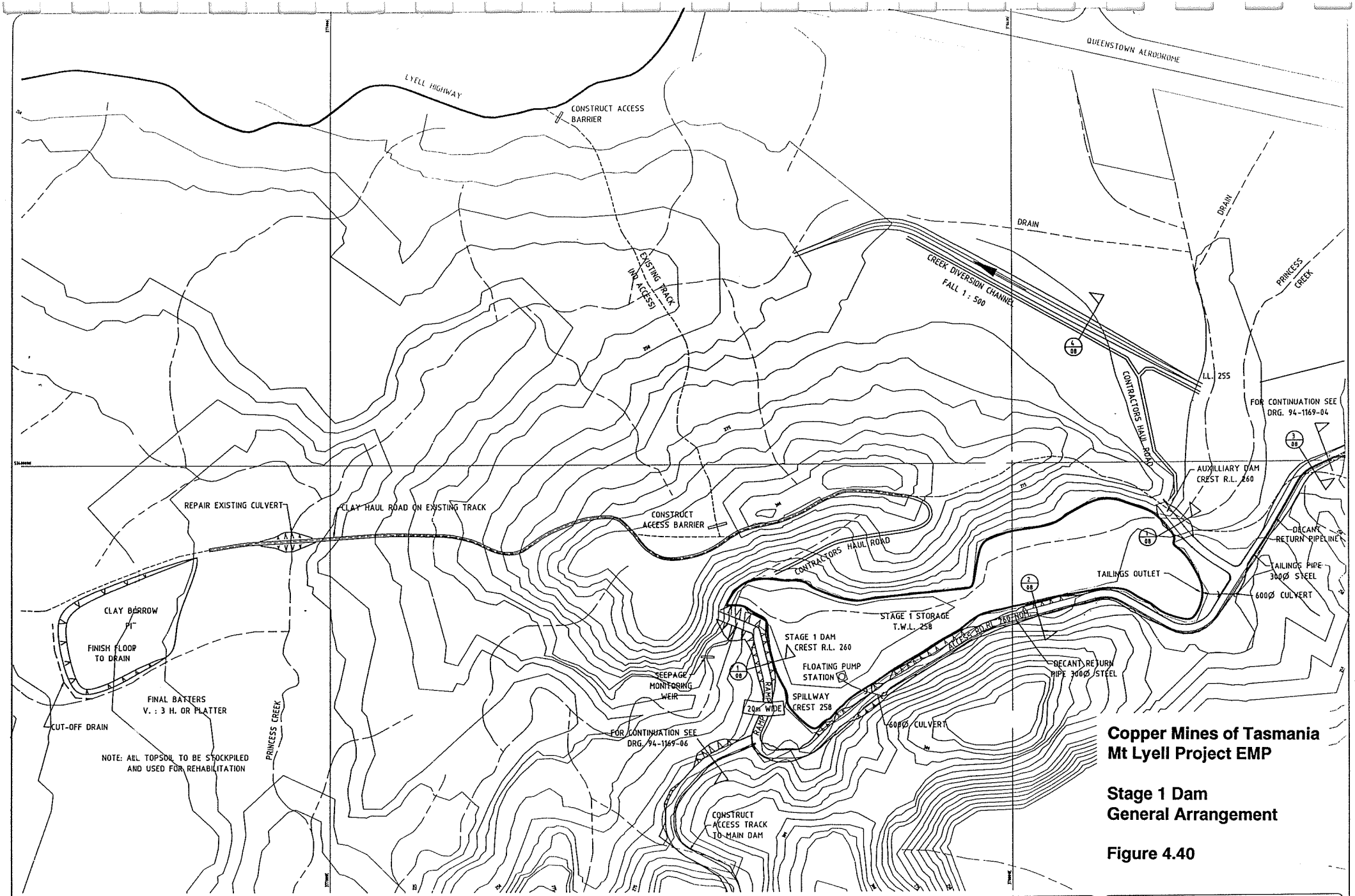
Thompson & Brett Pty. Ltd.
Consulting Engineers
7 Bayfield Street, Rosny Park. 7018
Phone (002) 448633 Fax. (002) 448221

Drawn c.f.	Date feb. '95	Scale 1:10000
Approved		Director
File CHT 01	Geocomp 1169	

Client & Project
COPPER MINES OF TASMANIA PTY. LTD.
MT LYELL MINE REDEVELOPMENT
TAILINGS MANAGEMENT

Drawing Title
TAILINGS PIPE & ACCESS ROAD PLAN

Drawing No. 94 - 1169 - 18



Copper Mines of Tasmania
Mt Lyell Project EMP

Stage 1 Dam
General Arrangement

Figure 4.40

Rev. No.	Description	Date

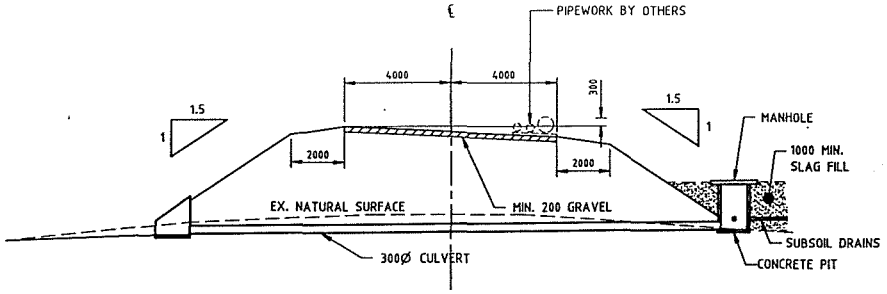
Thompson & Brett Pty. Ltd.
Consulting Engineers
7 Bayfield Street, Rosny Park. 7018
Phone (002) 446633 Fax. (002) 446221

Drawn B.W.	Date NOV. '94	Scale 1 : 2500	
Approved			Director
File CMT 01	Geocomp 1169		

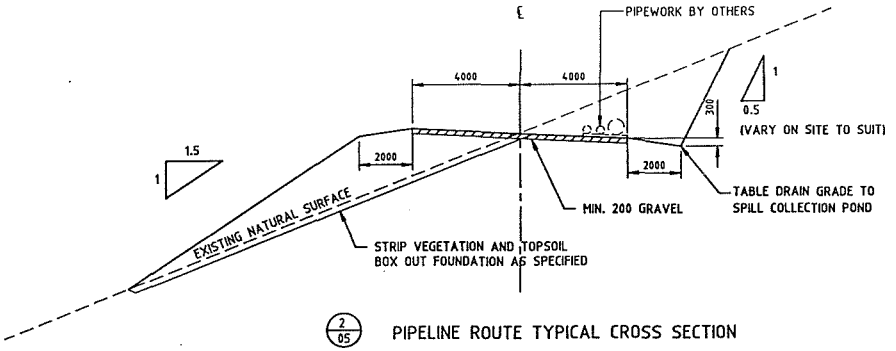
Client & Project
COPPER MINES OF TASMANIA PTY LTD
TAILINGS MANAGEMENT STAGE 1

Drawing Title
DETAIL PLAN - SH3

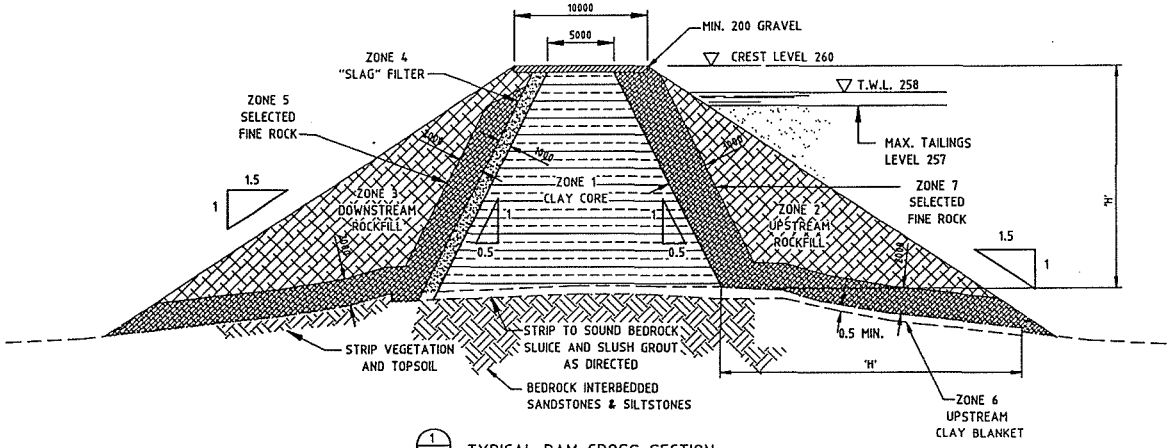
Drawing No. 94 - 1169 - 05



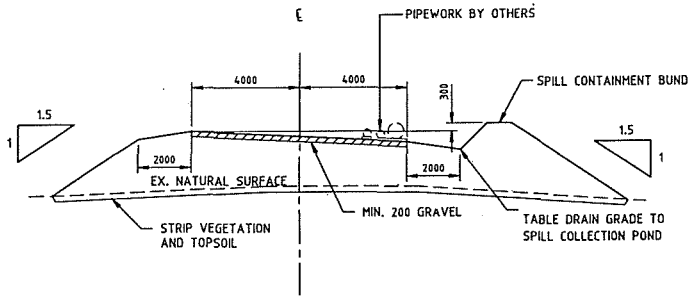
CROSS SECTION AT SPILL COLLECTION POND



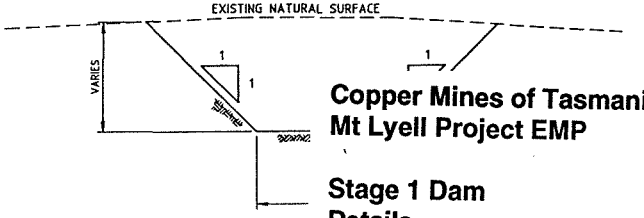
2/05 PIPELINE ROUTE TYPICAL CROSS SECTION



1/05 TYPICAL DAM CROSS SECTION



3/05 PIPELINE ROUTE DETAIL ON EMBANKMENT



4/05 DIVERSION CHANNEL

Copper Mines of Tasmania
Mt Lyell Project EMP

Stage 1 Dam Details

Figure 4.41

Rev. No.	Description	Date

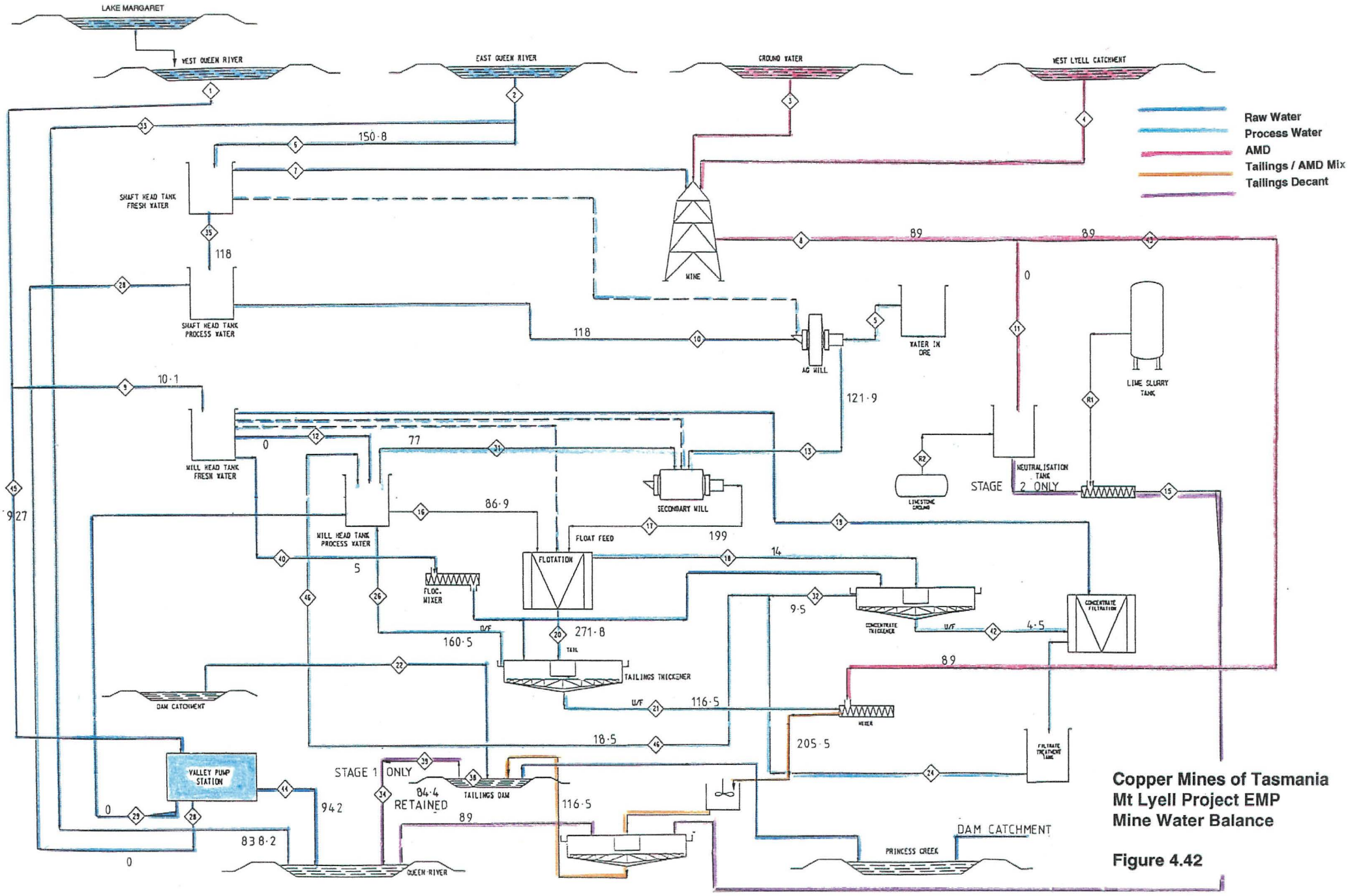
Thompson & Brett Pty. Ltd.
Consulting Engineers
7 Bayfield Street, Rosny Park, 7018
Phone (002) 446633 Fax. (002) 446221

Drawn B.W.	Date NOV. '94	Scale	
Approved		Director	
File CMT01	Geocomp 1169		

Client & Project
COPPER MINES OF TASMANIA PTY. LTD.
MT LYELL MINE REDEVELOPMENT
TAILINGS MANAGEMENT - STAGE 1

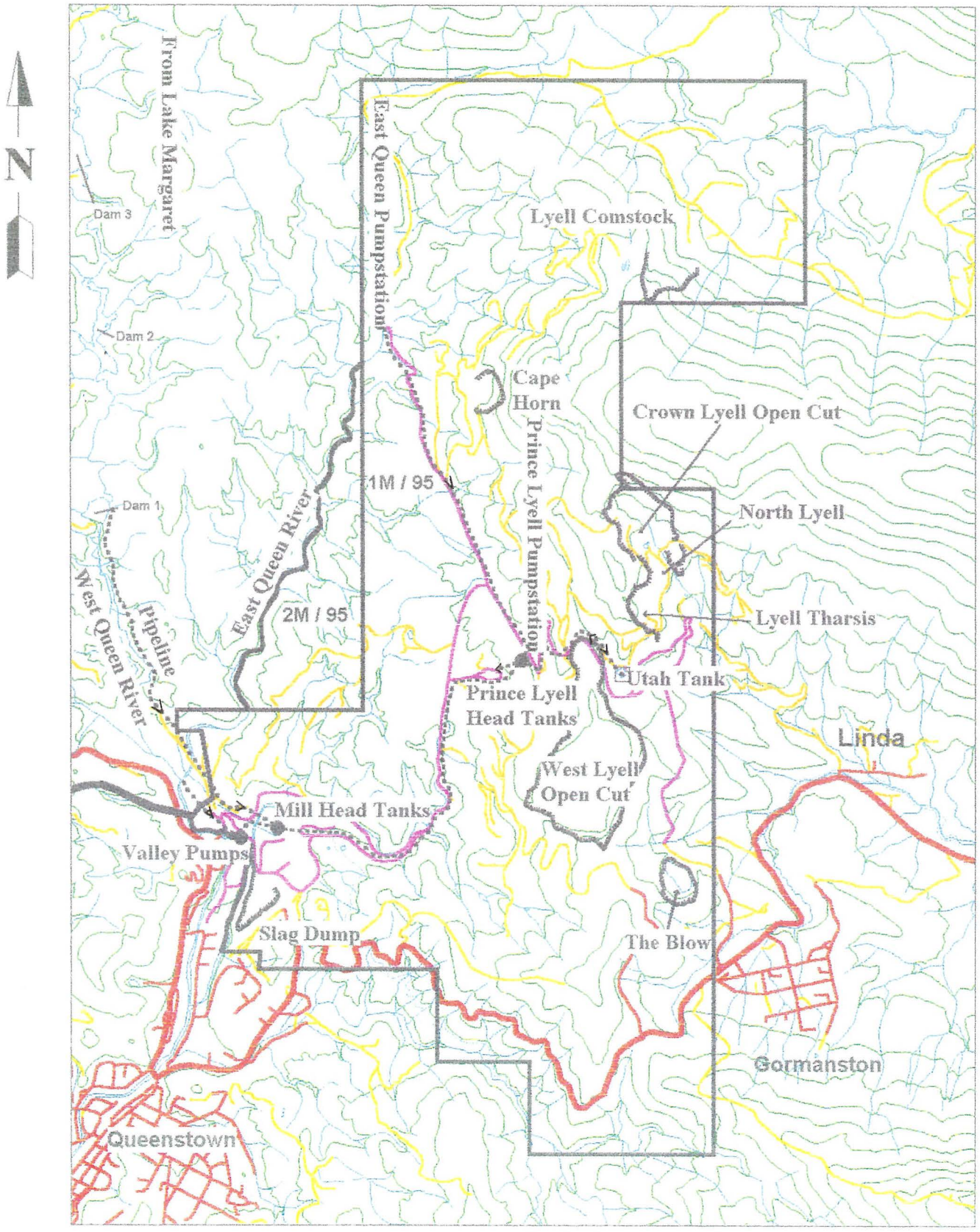
Drawing Title
EARTHWORKS DETAILS - SH1

Drawing No. 94 - 1169 - 08



Copper Mines of Tasmania
Mt Lyell Project EMP
Mine Water Balance

Figure 4.42



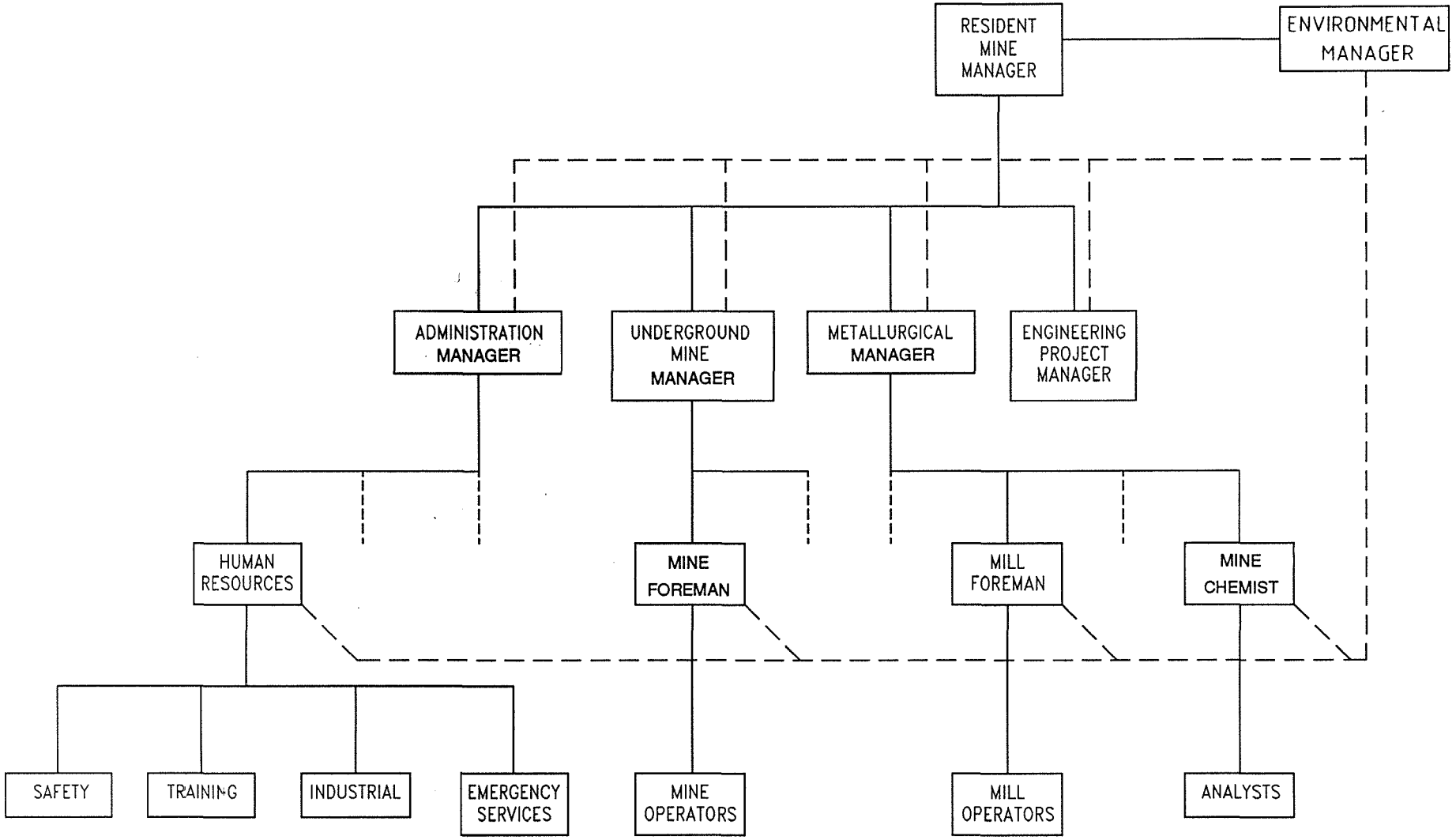
Legend:

- Public and Major Roads
- Existing Tracks
- Site Roads to be Maintained

Copper Mines of Tasmania
Mt Lyell Project EMP
Mine Water Supply

Scale: 1:30000

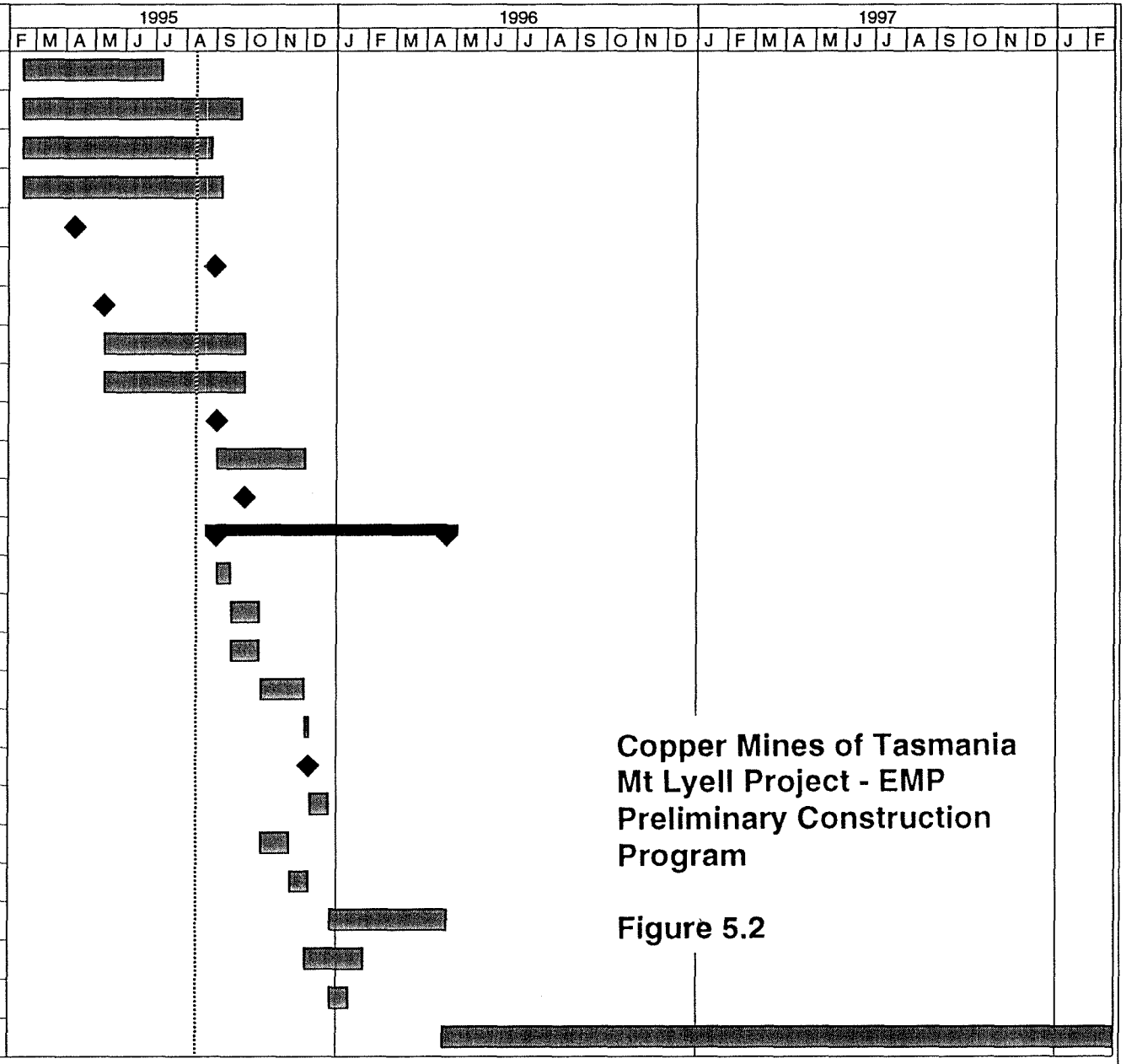
Figure 4.43



Copper Mines of Tasmania
Mt Lyell Project - EMP
Environmental Organisational Structure

Figure 5.1

ID	Name	Duration	Scheduled Start
1	Stage 1 Dam Earthworks	120d	15 Feb '95
2	Exploration Drilling	200d	15 Feb '95
3	Decline Extension	170d	15 Feb '95
4	Infrastructure Maintenance	180d	15 Feb '95
5	SDAC preliminary indication	0d	10 Apr '95
6	SDAC Report to Gov't	0d	30 Aug '95
7	GMA project commitment	0d	10 May '95
8	Initial Mill Upgrade	143d	10 May '95
9	Stage 1 Tailings Pumps and Piping	143d	10 May '95
10	Mining Commences	0d	1 Sep '95
11	Mill Commissioning	91d	1 Sep '95
12	Processing Commences	0d	30 Sep '95
13	Stage 2 Dam	235d	1 Sep '95
14	Construct Silt Traps	15d	1 Sep '95
15	Foundation Grouting	30d	16 Sep '95
16	Excavate for Diversion	30d	16 Sep '95
17	Construct Diversion Pipe	45d	16 Oct '95
18	Coffer dam	5d	30 Nov '95
19	Divert Creek	0d	4 Dec '95
20	Foundation Preparation	20d	5 Dec '95
21	Haul Roads	30d	16 Oct '95
22	Strip Borrow Areas	20d	15 Nov '95
23	Place Dam Embankment	120d	25 Dec '95
24	Construct Outlet Works	60d	30 Nov '95
25	Construct Wetlands	20d	25 Dec '95
26	Mill Duplication	500d	18 Apr '96



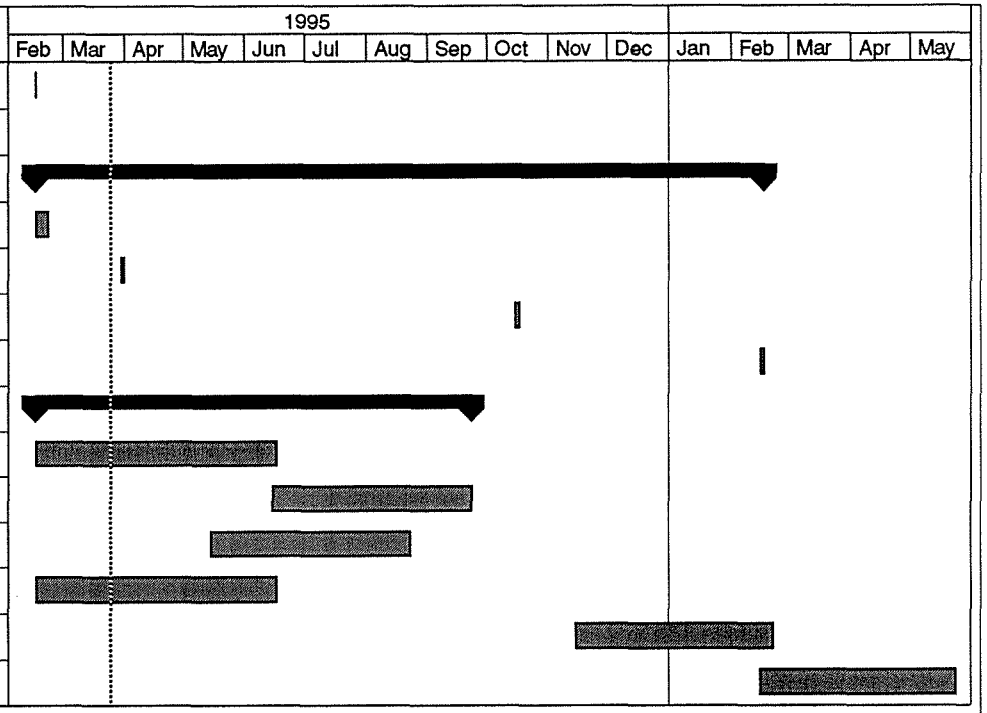
Copper Mines of Tasmania
Mt Lyell Project - EMP
Preliminary Construction Program

Figure 5.2

Project: Mt Lyell
Date: 10/8/95

Critical — Noncritical — Progress — Milestone — Summary — Rolled Up

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	CONSTRUCTION PHASE - ENVORONMENTAL WORKS	1d	15 Feb '95	15 Feb '95
2				
3	Weed Control Program	344d	15 Feb '95	17 Feb '96
4	Phase 1	5d	15 Feb '95	21 Feb '95
5	Phase 2	2d	30 Mar '95	31 Mar '95
6	Phase 3	3d	15 Oct '95	17 Oct '95
7	Phase 4	3d	15 Feb '96	17 Feb '96
8	Erosion Control	197d	15 Feb '95	23 Sep '95
9	Stage 1 Dam sediment traps	100d	15 Feb '95	17 Jun '95
10	MIne Site sediment traps	100d	15 Jun '95	23 Sep '95
11	Stage 2 Dam Silt Trap	100d	15 May '95	23 Aug '95
12	Rehabilitation Works - Stage 1 Dam	100d	15 Feb '95	17 Jun '95
13	Rehabilitation Works - Mill Development	100d	15 Nov '95	22 Feb '96
14	Rehabilitation Works - Stage 2 Dam	100d	15 Feb '96	24 May '96

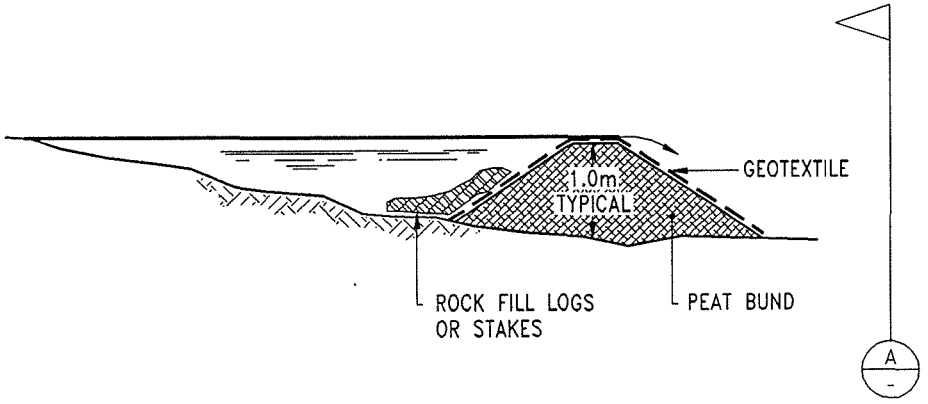


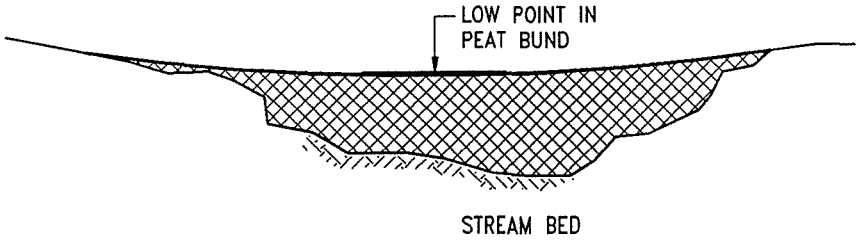
Copper Mines of Tasmania
Mt Lyell Project - EMP
Construction Phase -
Environmemtal Control Plan

Figure 5.3

Project: Mt Lyell
Date: 24/3/95

Critical
Noncritical
Progress
Milestone
Summary
Rolled Up



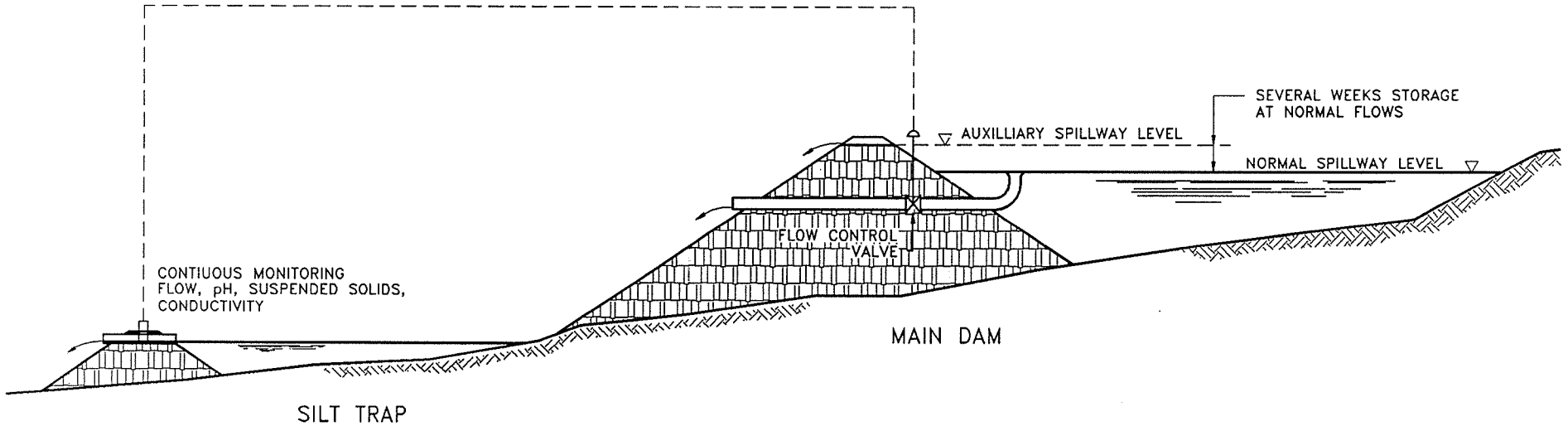


ELEVATION A

TYPICAL MINOR SILT TRAP

Copper Mines of Tasmania
Mt Lyell Project - EMP
Proposed Minor Silt Traps

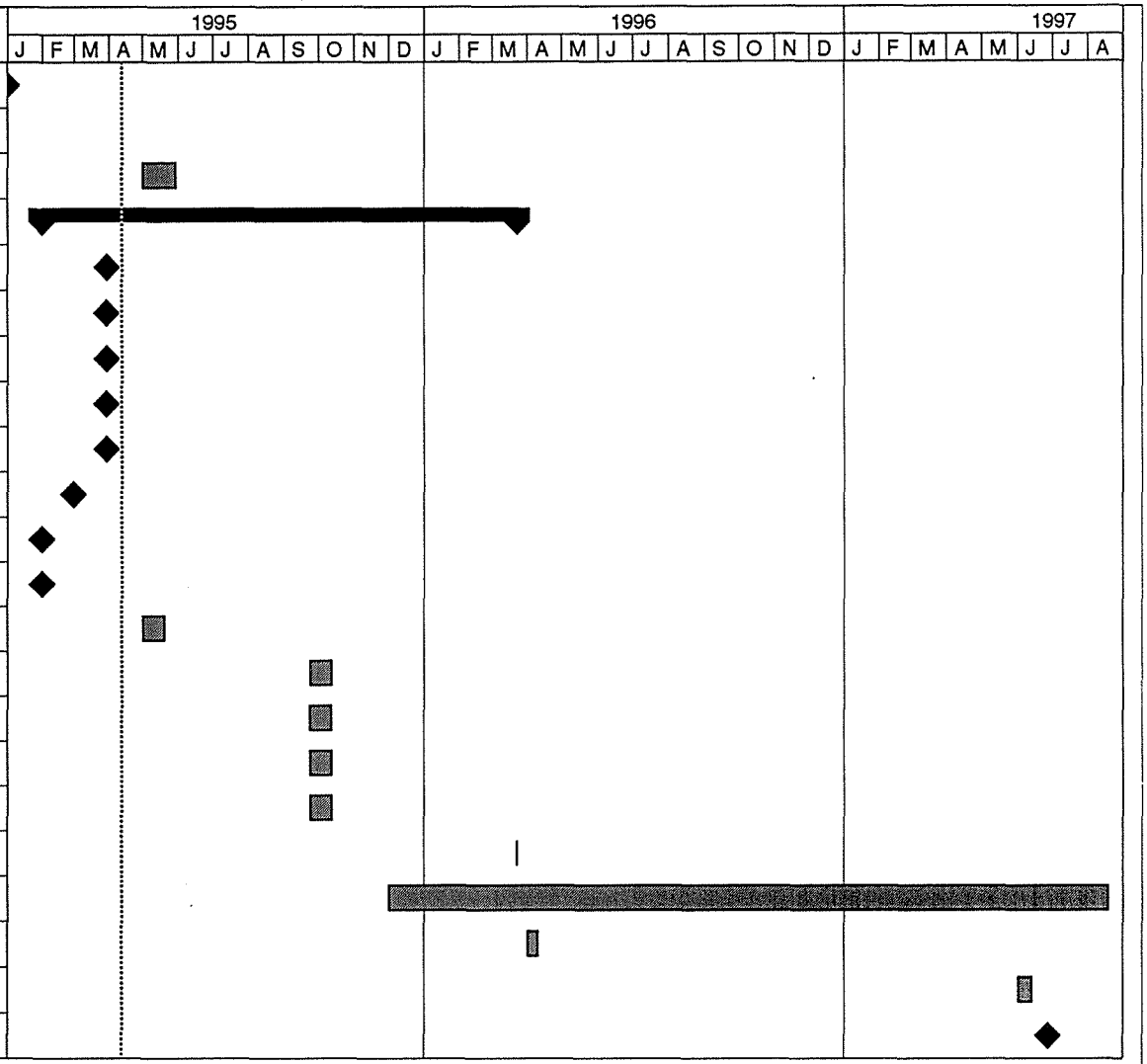
Figure 5.4



Copper Mines of Tasmania
Mt Lyell Project - EMP
Princess Creek Outlet Control

Figure 5.5

ID	Name	Duration	Scheduled Start
1	WATER EMISSION - ENVIRONMENTAL CONTROL PLAN	0d	1 Jan '95
2			
3	Prepare Detailed Monitoring/Testing Program	30d	1 May '95
4	Set up Monitoring Points	389d	1 Feb '95
5	Haulage Crk above West Lyell	0d	30 Mar '95
6	East Queen above West Queen	0d	30 Mar '95
7	Haulage Ck at Slag Dump	0d	30 Mar '95
8	Comstock below workings	0d	30 Mar '95
9	Queen River at Queenstown	0d	30 Mar '95
10	mine pumps	0d	1 Mar '95
11	Princess Creek at Queen	0d	1 Feb '95
12	Princess Creek at St 2 Dam - prel	0d	1 Feb '95
13	Princess Creek at St 2 Dam - permanent	20d	1 May '95
14	primary thickener	20d	23 Sep '95
15	secondary thickener	20d	23 Sep '95
16	process water tank	20d	23 Sep '95
17	Stage 1 Dam Pond	20d	23 Sep '95
18	Stage 2 Dam Outlet	1d	23 Mar '96
19	Monitoring	500d	1 Dec '95
20	Initial Tailings Behaviour Report	10d	1 Apr '96
21	Discharge Water Quality Report	10d	1 Jun '97
22	SDAC decision on AMD treatment	0d	27 Jun '97



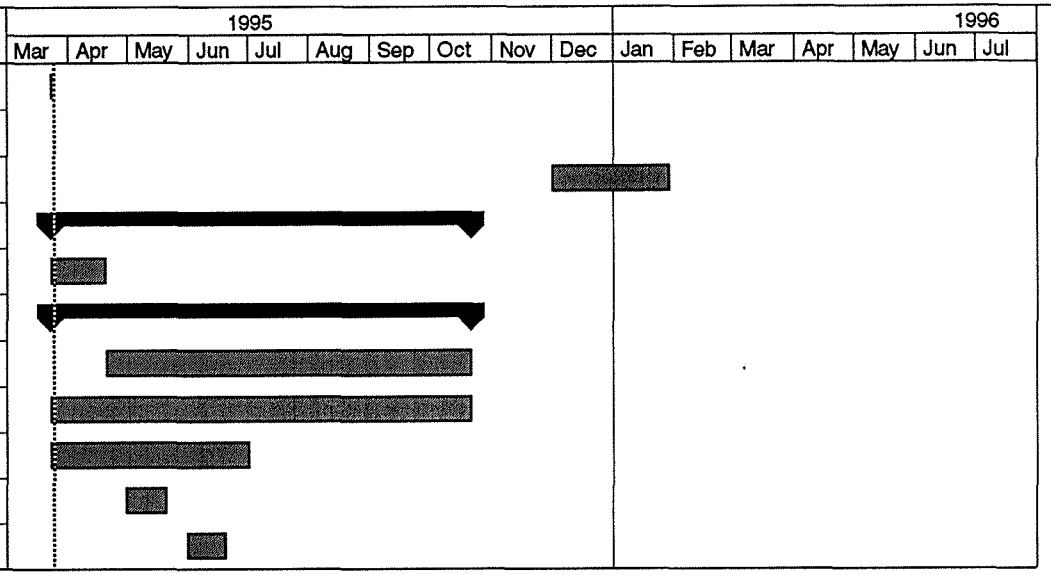
Copper Mines of Tasmania
Mt Lyell Project - EMP
Environmental Control Plan
Water Emissions

Figure 5.6

Project: Mt Lyell
Date: 11/4/95

Critical — Progress — Summary
Noncritical — Milestone — Rolled Up

ID	Name	Duration	Scheduled Start	Scheduled Finish
1	LAND MANAGEMENT PLAN	1d	23 Mar '95	23 Mar '95
2				
3	Flora Study - Centrolepis paludicola	60d	1 Dec '95	29 Jan '96
4	Weed Control	200d	23 Mar '95	21 Oct '95
5	Set Policy	20d	23 Mar '95	19 Apr '95
6	Carry out program	200d	23 Mar '95	21 Oct '95
7	mine site	180d	20 Apr '95	21 Oct '95
8	dam site	200d	23 Mar '95	21 Oct '95
9	Fire Management Plan	89d	23 Mar '95	1 Jul '95
10	Heritage Item Discussions	20d	30 Apr '95	20 May '95
11	Aboriginal Site Survey-discussions	20d	31 May '95	19 Jun '95



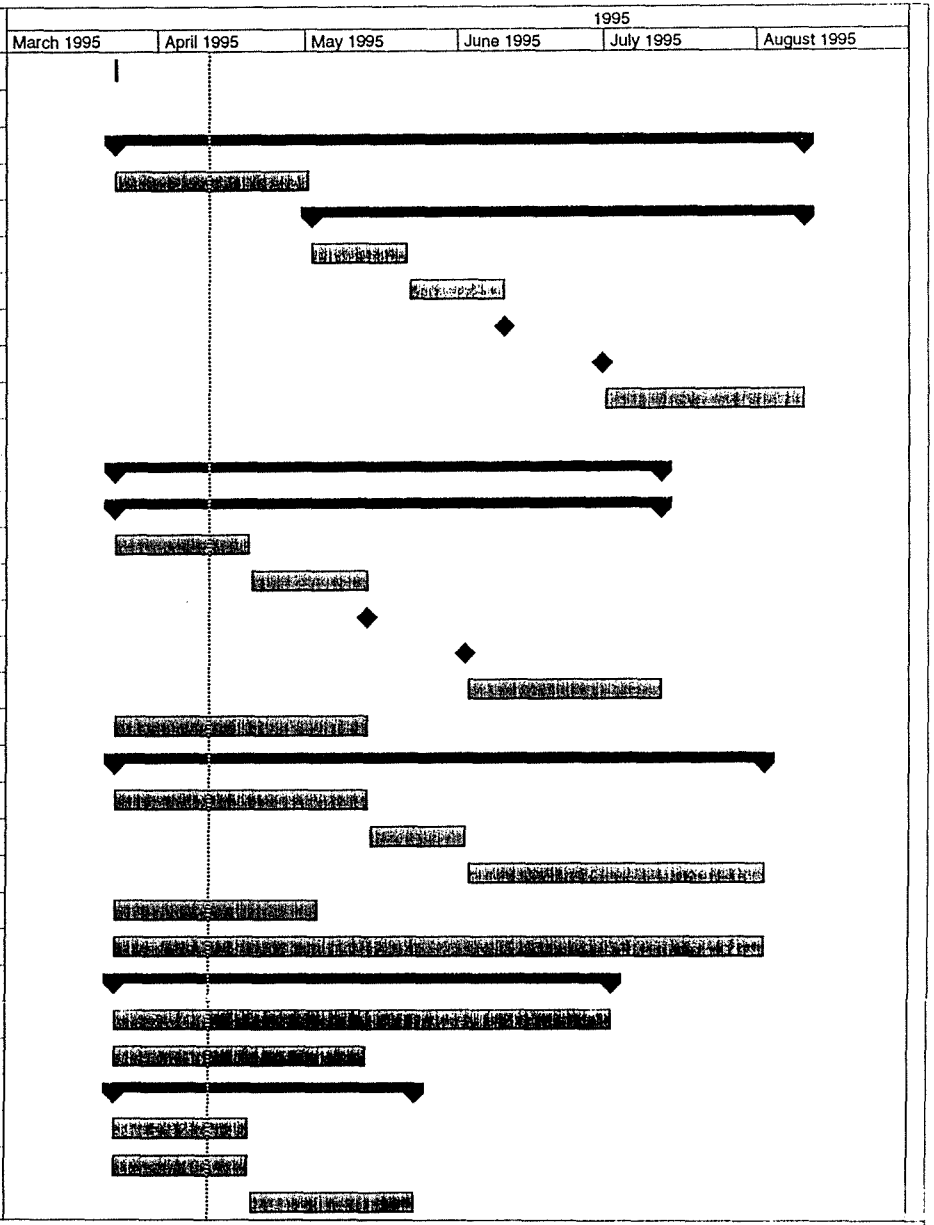
Copper Mines of Tasmania
Mt Lyell Project - EMP
Land Management Plan

Figure 5.7

Project:
Date: 24/3/95

Critical
Noncritical
Progress
Milestone
Summary
Rolled Up

ID	Name	Duration	Scheduled Start
1	WASTE MANAGEMENT STRATEGY	1d	23 Mar '95
2			
3	WASTE ROCK	128d	23 Mar '95
4	Investigation of best management strategy	28d	23 Mar '95
5	Rock Dump	100d	2 May '95
6	site investigations	20d	2 May '95
7	operation plan	20d	22 May '95
8	proposal to DELM	0d	10 Jun '95
9	approval	0d	30 Jun '95
10	construction	40d	1 Jul '95
11			
12	INDUSTRIAL WASTES	100d	23 Mar '95
13	Disposal Site	100d	23 Mar '95
14	site investigations	20d	23 Mar '95
15	operation plan	20d	20 Apr '95
16	proposal to DELM	0d	13 May '95
17	approval	0d	2 Jun '95
18	construction	40d	3 Jun '95
19	Recycling Station and Skips	40d	23 Mar '95
20	HAZARDOUS WASTES	120d	23 Mar '95
21	survey of asbestos	40d	23 Mar '95
22	asbestos policy	20d	14 May '95
23	asbestos removal	60d	3 Jun '95
24	discussion with DELM re PCB's	30d	23 Mar '95
25	staged replacement of PCB's	120d	23 Mar '95
26	HYDROCARBONS	90d	23 Mar '95
27	prepare hydrocarbon management plan	90d	23 Mar '95
28	discuss cleanup of MLMRC hydrocarbon spills	40d	23 Mar '95
29	DOMESTIC WASTE	50d	23 Mar '95
30	recycling program	20d	23 Mar '95
31	septic tank survey	20d	23 Mar '95
32	sewerage connection	30d	20 Apr '95

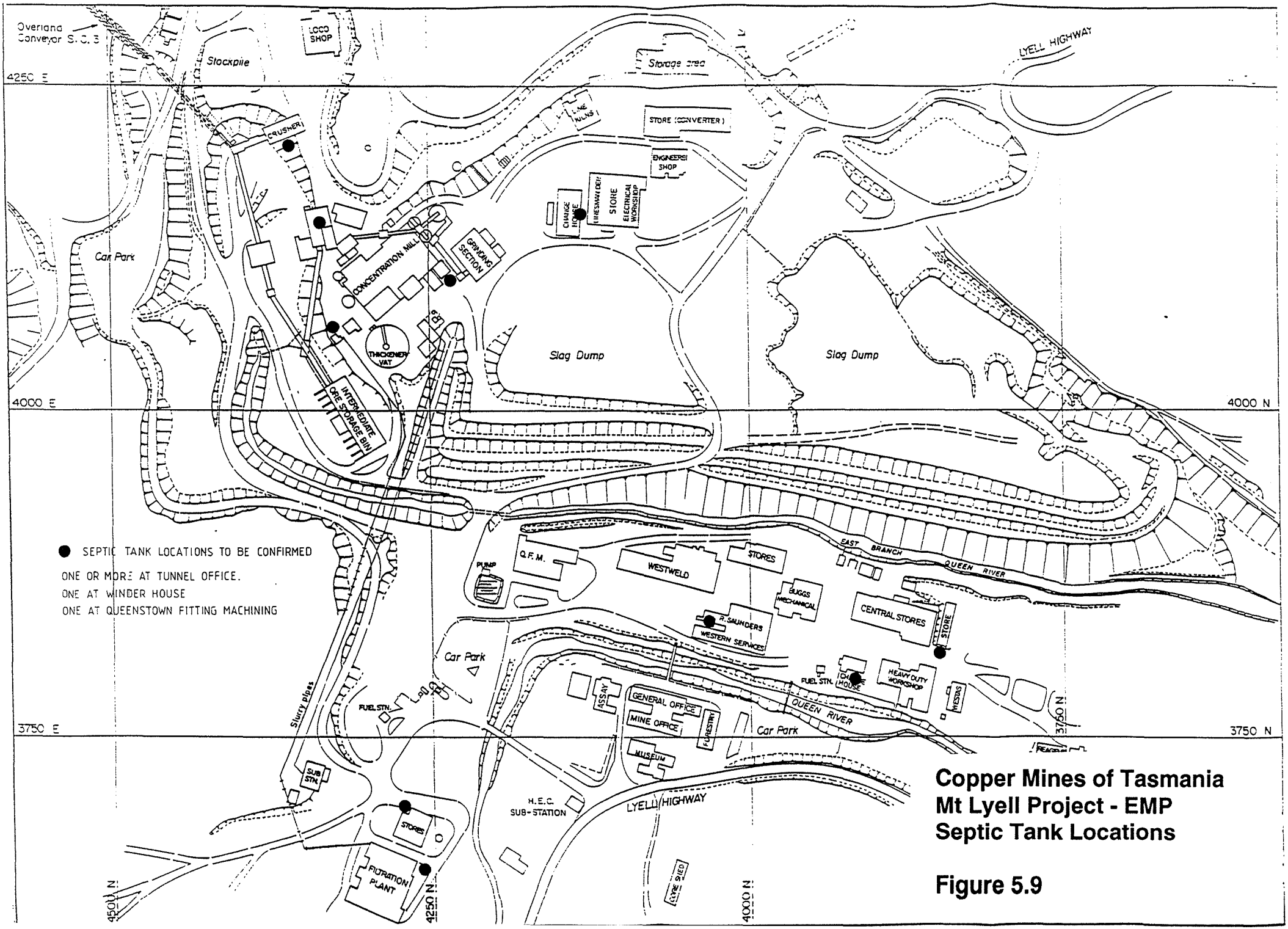


Project: Mt Lyell
Date: 11/4/95

Critical
Noncritical
Progress
Milestone
Summary
Rolled Up

Copper Mines of Tasmania
Mt Lyell Project - EMP
Waste Management Program

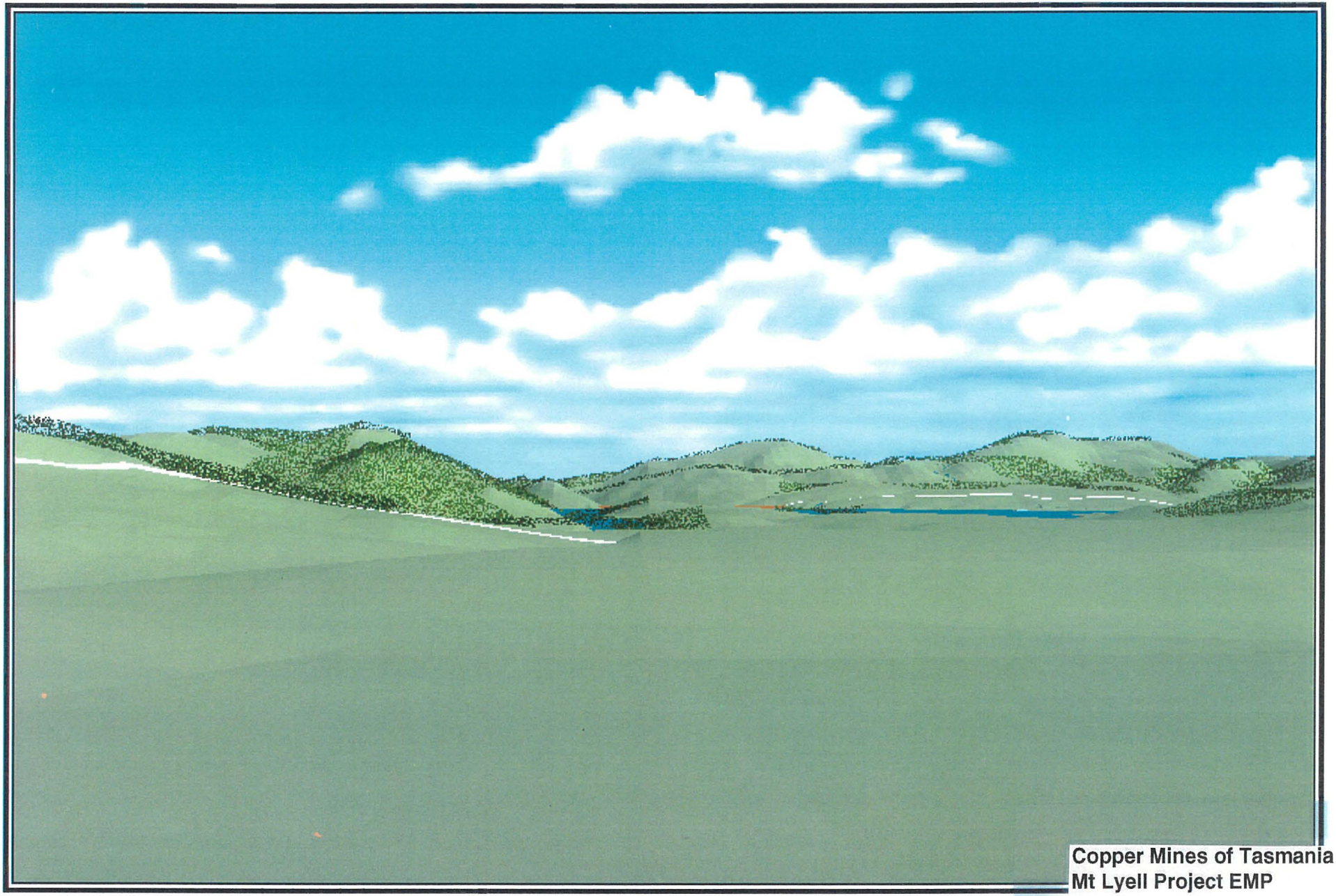
Figure 5.8


Overland Conveyor S.C.3
Stockpile
LOCO SHOP
Storage area
LYELL HIGHWAY
4250 E
CRUSHER
LIME KILNS
STORE (CONVERTER)
ENGINEERS SHOP
CHANGE HOUSE
TIMESMAN DEPT
STORE
ELECTRICAL WORKSHOP
Car Park
CONCENTRATION MILL
GRINDING SECTION
THICKENER VAT
Slag Dump
Slag Dump
4000 E
4000 N
INTERMEDIATE ORE STORAGE BIN
SEPTIC TANK LOCATIONS TO BE CONFIRMED
ONE OR MORE AT TUNNEL OFFICE.
ONE AT WINDER HOUSE
ONE AT QUEENSTOWN FITTING MACHINING
PUMP
Q.F.M.
WESTWELD
STORES
EAST BRANCH QUEEN RIVER
BUGGS MECHANICAL
CENTRAL STORES
STORE
R. SAUNDERS WESTERN SERVICES
Car Park
Slurry pipes
FUEL STN.
CHANGE HOUSE
HEAVY DUTY WORKSHOP
FUEL STN.
ASSAY
GENERAL OFFICE
MINE OFFICE
FLORISTRY
QUEEN RIVER
MESTAS
3750 E
3750 N
Car Park
MUSEUM
SUB STN.
H.E.C. SUB-STATION
LYELL HIGHWAY
STORES
FILTRATION PLANT
LIME SIED
4500 N
4250 N
4000 N
Copper Mines of Tasmania
Mt Lyell Project - EMP
Septic Tank Locations
Figure 5.9

Produced by the
Department of Environment and Land Management
Tasmania, April 10 1995

Copper Mines of Tasmania
Mt Lyell Project EMP
Simulated View
Princess Creek Tailings Dam
from above Queen River

Figure 5.10

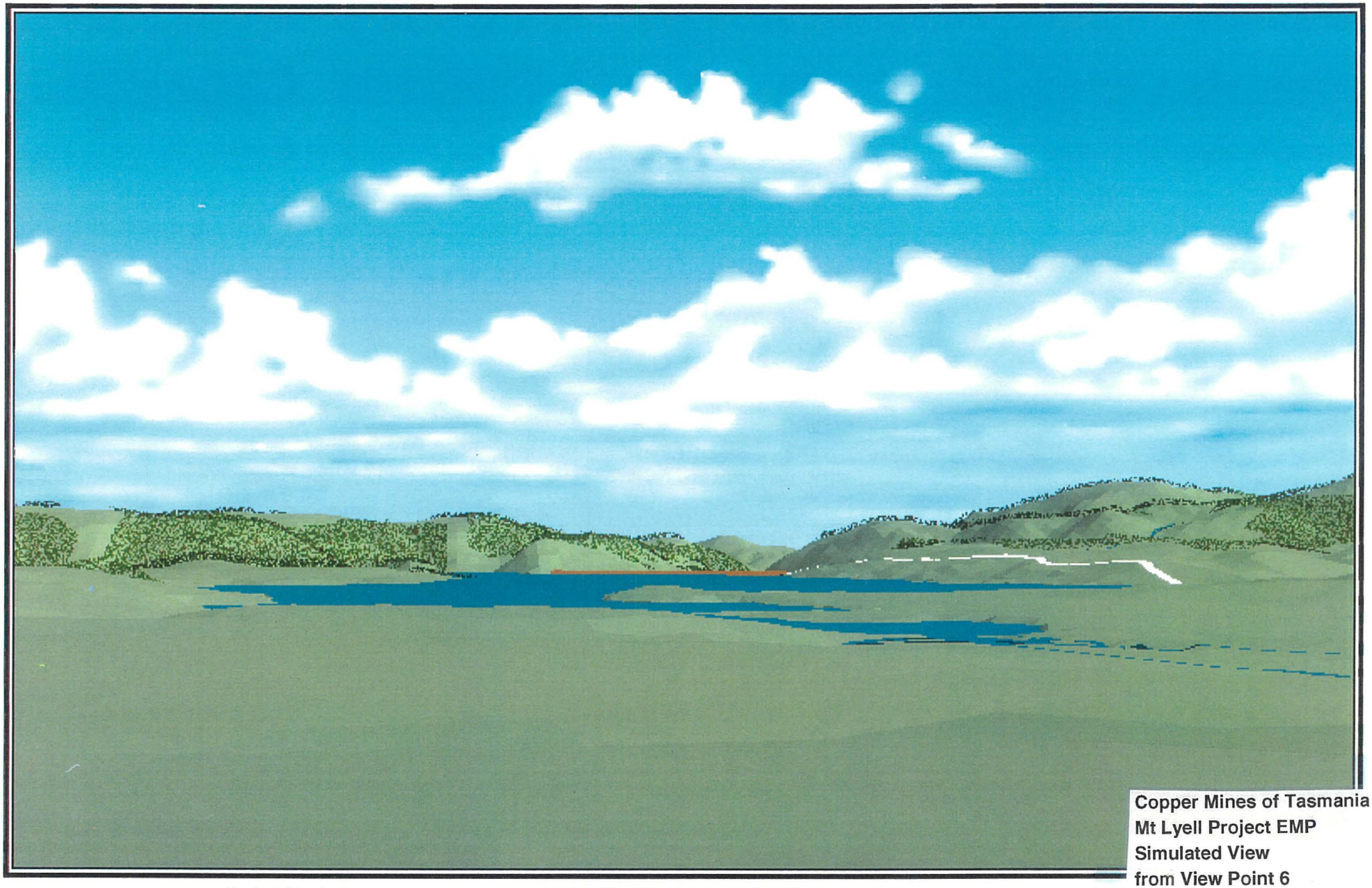


Produced by the
Department of Environment and Land Management
Tasmania, April 10 1995

PROPOSED TAILINGS DAM
215m TWL

Copper Mines of Tasmania
Mt Lyell Project EMP
Simulated View
from View Point 5

Figure 5.11

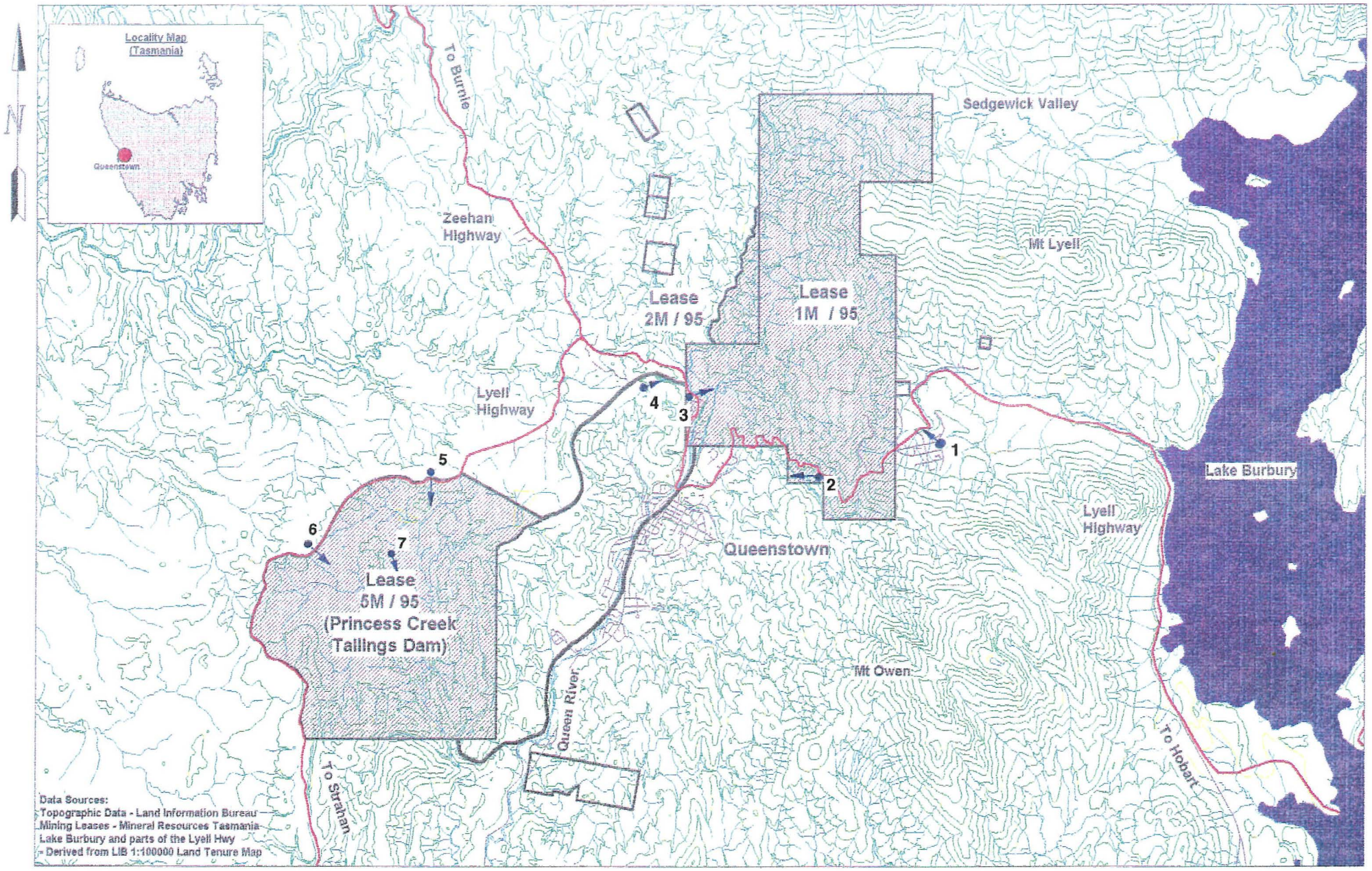


Produced by the
Department of Environment and Land Management
Tasmania, April 10 1995

PROPOSED TAILINGS DAM
215m TWL

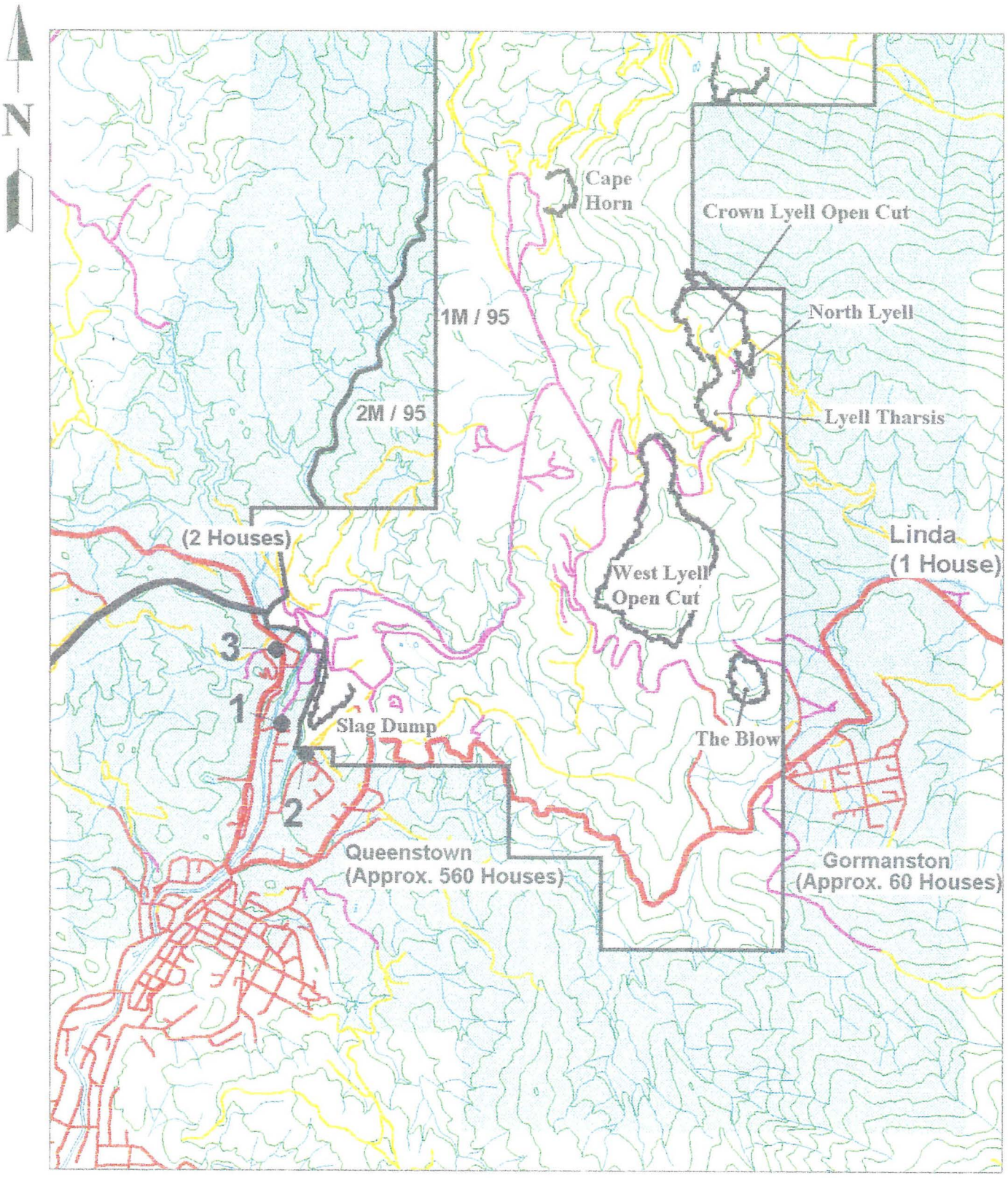
Copper Mines of Tasmania
Mt Lyell Project EMP
Simulated View
from View Point 6

Figure 5.12



Copper Mines of Tasmania
Mt Lyell Project EMP
Photographic View Points

Figure 5.13



Legend:

- Public and Major Roads
- Main Lease Roads
- Tracks
- 1 km Buffer

Copper Mines of Tasmania
Mt Lyell Project EMP
Noise Measurement Sites

Scale: 1:30000

Figure 5.14

APPENDIX A

GUIDELINES FOR EMP

GUIDELINES FOR AN ENVIRONMENTAL MANAGEMENT PLAN: COPPER MINES OF TASMANIA P/L

prepared by the

Sustainable Development Advisory Council

for Copper Mines of Tasmania Pty Ltd

March 1995

ISBN 0 7246 1709 4

INTRODUCTION

These Guidelines have been prepared to assist Copper Mines of Tasmania P/L (CMT) in preparing an Environmental Management Plan (EMP) as required by the *Copper Mines of Tasmania (Agreement) Act 1994l ('CMT Act')*.

The purpose of the EMP is to:

i) provide the Sustainable Development Advisory Council (SDAC) with sufficient information to be able to assess the likely environmental effects, and the adequacy of the proposed environmental management procedures, associated with the redevelopment and ongoing operation of the Mt Lyell copper mine as proposed by CMT. SDAC will undertake this assessment in accordance with the requirements of the State Policies and Projects Act 1993 (SPP Act), having regard to the CMT Act and to the Directions of the Minister for Environment and Land Management. (See Attachment 1)

ii) provide the community with an opportunity to be better informed about the nature and scope of the CMT Project and the wide range of environmental management and associated issues to be addressed in preparing for and operating a contemporary and large scale Tasmanian mining business.

iii) publicly identify the basis for and nature of the corporate commitment to sustainable development by GMA/CMT, should the CMT Project finally be approved by the Tasmanian Government. The EMP will set out CMT policies, practices and procedures for best practice environmental management to be followed in all mining and associated operations at Mt Lyell.

THE GUIDELINES

The following notes seek to ensure that matters which, in the opinion of the SDAC, are relevant and significant (as a minimum) are addressed and reported by CMT in preparing a draft EMP. In preparing the EMP, regard must be had to the CMT Agreement, the Minister's Directions and the CMT Project Description. (See Attachment 2)

These Guidelines were amended before being issued to CMT, taking into account comments received from agencies and individuals in response to a public advertisement placed in the media on 11 February 1995.

EMP general format and presentation style

As the EMP is to be a public document, it must be written in a manner which is clear and concise yet easily read and understood by the general public as well as operational staff. Necessary complex technical material should, wherever possible, be presented in graphical form to supplement the text; complex (particularly tabular/statistical technical information) may be best

presented as appendices, with appropriate summary/reference in the main body of text.

The guidelines set out below are intended to define the minimum scope of the EMP. It is desirable that the format of the EMP follow as closely as possible the format of the guidelines such that it may be readily ascertained that all aspects of the guidelines have been addressed. However, it is recognised that an alternative arrangement of subject material may sometimes improve the readability of the document. An outline or preliminary draft of the EMP should be discussed with SDAC to assist satisfactory completion of the final draft.

Reference citations (published and unpublished) must be appropriately shown throughout the text when relied upon. A comprehensive bibliographic listing detailing known relevant written, audio and visual resource materials would be of considerable assistance.

It is strongly recommended that each page be titled, numbered and dated (by way of header or footer).

A table of contents is required, showing text sections, maps, diagrams, tables, appendices etc. as appropriate.

A glossary of terms and abbreviations is to be included in the EMP.

1. PREAMBLE

This should explain the purpose of the EMP and its role in obtaining approval for the project from Government.

It should be made clear that in some aspects of environmental protection and rehabilitation of the site and downstream catchment, the responsibility is variously, the Company, the Government or is a shared responsibility.

2. EXECUTIVE SUMMARY

An executive summary of the EMP should be included.

3. INTRODUCTION

This should identify the proponent, (the incorporated body and its associates), and provide relevant background to the proposed project.

The rationale for the Mt Lyell redevelopment should be outlined together with the broad economic and social contexts and implications for the local/regional community, the State of Tasmania and nationally/internationally.

The timeframe and sequence for the CMT Project should be given. The likely timing of discrete stages of the redevelopment should be described, and factors likely to determine progress of any stage identified.

Specific current and anticipated future approvals that are or may be required for the redevelopment to proceed must be identified and discussed.

The initial and possible future product(s) and product uses must be identified and initial and future predicted/desired production rates outlined.

4. EXISTING ENVIRONMENT

This section should describe the existing lease area and surrounding environment and land uses. Where relevant, referral should be made to the detail in the Environmental Review prepared by Gutteridge Haskins and Davey, on behalf of Copper Mines of Tasmania, November 1994. As Acid Drainage is considered to be one of the most significant issues associated with this site, a full description of this issue must be given.

4.1 Site Description

The use of aerial photography, orthophotography and GIS technology may enhance the quality of information presented in this section. However, this section must include, as a minimum:

4.1.1 A locality map (1:25,000) showing:

details of the mine lease area

land tenure (public/private) of all land adjacent to the mine lease area, .

land zoning (Planning Scheme/Interim Order) of the area to be mined, and all adjacent land within 1000m of the lease boundary.

location of areas of high conservation value, or of scientific or special interest.

location of areas of archaeological significance. Where this information is sensitive or should not be publicly displayed in order to protect the sites so identified, this information should be provided separately and confidentially to the SDAC, and a comment should be included in the EMP to the effect that the information has been so provided.

location of areas of significant heritage and historical value.

topography and hydrology of the lease and any significant modifications to landform resulting from mining activity on the site.

access and cartage routes (existing and proposed) within the lease including conveyors, tracks, pipelines etc.

short and long term materials/products storage areas.

location of existing and proposed waste disposal and/or treatment areas.

location of any adits or excavations from historical mining activities.

4.1.2 Detailed descriptions should be provided of the following:

Minesite geology, geomorphology and topography.

Characterisation of the ore body and constituent minerals.

An assessment of the current erosion characteristics of the lease site together with an assessment of the future and ongoing erosion potential.

Flora, fauna and soils within the lease areas, including the distribution, composition and conservation status of:

- vegetation types, plant communities and associations;
- native endemic and exotic vascular and non-vascular plants and diseases;
- native and introduced mammals, birds, reptiles, and terrestrial invertebrates;
- species worthy of special consideration should be identified.

Relevant meteorological data.

A description of the hydrology and water quality of all surface waters on the lease site, and their relation to local and regional drainage systems. Details including interrelationships must also be provided of the hydrology, water quality and aquatic biology (including amphibians, fish, aquatic mammals and invertebrates and aquatic flora) of all surface waters off the lease site which may, potentially, be affected by mining and other associated activities. A similar description of hydrology, water quality and biology should also be presented for groundwater.

An assessment of the present visual impact associated with mining and associated activities from various viewfields in and around the lease areas, together with photographic representations from the respective viewfield sites.

4.2 Preparatory Works

Details must be provided of works that have been or are being undertaken, or proposed preparatory to the possible recommencement of mining operations. This must include, the proposed State 1 tailings dam, shaft and decline extensions, waste rock handling and temporary ore storage. The statutory authorities for such preparatory works must be detailed, including details of any approvals/licences to operate scheduled premises and mining leases.

A comprehensive analysis and discussion must be included of the various options that have been examined for the identification of potential sites for the establishment of the main (Stage 2) tailings dam. Full justification must be presented as to the reasons for CMT's preferred site, including dealing with matters beyond physical and hydraulic design and construction considerations (e.g. water chemistry; ecosystem and habitat impacts; contingency/emergency considerations deriving from process breakdowns or extreme natural events; community impacts).

4.3 Development Description and Production Processes

This section must provide a complete and detailed description of the CMT Project including all necessary associated infrastructure, mining operation and method, milling processes, and quantities and nature of all commercial and waste products produced.

The following must be included:

4.3.1 Detailed Plan

Detailed plan(s) (at least 1:5,000) of the mine area showing both existing and planned:

- pits, shafts, adits, and tailings dam disposal areas.
- historical mining activities, surface and underground.
- areas of proposed surface modification, disturbance and vegetation clearance.
- the location of all permanent and temporary stockpiles of raw material, overburden, topsoil concentrate etc.
- the location of all structures and items of equipment, and infrastructure within the lease shall be provided This shall include all surface, and where relevant subsurface, road and drainage works, crushing plant, flotation and concentrating plant, energy and water supply.
- land form modifications associated with the site through all stages of the development.
- identification of any residential premises existing or proposed within 1 kilometre of the lease boundary.

4.3.2 Description of the operation

A full description of the mining operation to be carried out must be given including:

- The major items of equipment being used and the method of operation.
- Details of energy sourcing, infrastructure, consumption and general management regime.
- Details of water consumption, source of supply, treatment facilities and management regime. This section should be cross-referenced with the description of the water regime associated with the tailings dams to be established for the project, including alterations to river flows as well as any underground water storage, treatment and management.
- A description of stormwater and other drainage structures, layout, how they function, and how they alter surface and underground drainage patterns.
- Outline of the condition and use of the roads impacted by the operational mine, and any upgrading, associated drainage, vegetation clearance/replanting and erosion protection works likely to be required.

- A description of how future mining operations will be integrated into the workings and landform left as a result of past and present mining activities.

- A description of the method of treatment of raw materials including the major items of plant and equipment used to produce concentrates. A step by step description of operations must be included e.g. method of extraction of raw materials, major processing stages, equipment used for processing, and the identification of all points at which solid, liquid or atmospheric emissions are generated and emitted.

- The full description of the nature and quantity of wastes generated by the mining operation and treatment process must be given, including all liquid, solid, and atmospheric industrial and hazardous waste emissions. An estimation of the quantities and quality of waste and mine water which will be produced as a result of mining and processing operations, must be given.

- The nature and quantities and geochemical characteristics of tailings and waste rock, and its potential for acid generation.

- An estimation of the life of the mining operation including ore reserves, and any potential for subsequent development with respect to other minerals should be given.

- A description of the quantities and nature of the concentrates produced, and the method of storage and transfer of concentrates from site must be given.

- Full and comprehensive details must be given of the *proposed preferred* mode of transport of raw materials to the site and products from the site to final shipment location. (Some discussion should be included of alternate modes of transport considered.) The transport routes, together with the number and frequency of truck and other land based transport vehicle movements must be given. Details should also be given of the port facilities for storage, loading and unloading of product at the port facility, and the frequency of associated shipping movements.

- The hours of operation (hours/day, days/week) for the mining and milling operation and any other associated activity.

- An outline of any activity or proposed activity which may be of interest or concern to employees, contractors or other relevant groups in regard to environment health and occupational safety.

- A description of any exploration programs on the mine lease must be given.

4.3.3 Assessment of Alternatives

This section should examine the environmental consequences of feasible alternatives to the project. The alternatives must include:

- The "no development option"

- Alternative mining and processing techniques

- Alternative waste treatment and disposal methods, particularly for tailings treatment and disposal and mine water management

5. ENVIRONMENTAL MANAGEMENT PLAN

This should describe how the facilities are managed and operated so as to meet satisfactory environmental performance standards. These may take the form of emission standards or requirements defined, where appropriate, by the Environment Protection Act, 1973 and associated Regulations, the Environmental Management and Pollution Control Act 1994 and associated policies, the legislative requirements of other agencies or authorities, and objectives agreed with the Sustainable Development Advisory Council.

Each significant environmental issue must be identified, the environmental performance standard clearly defined, and the method of achieving the required standard demonstrated. This may be by the use of specific pollution control equipment, or management prescriptions. Unsupported assertion that the standard will be achieved will not be considered adequate.

The environmental issues addressed in the management plan must include the following:

5.1 Environmental Management Systems

- Details of Company environmental policy objectives and supporting policy statements.
- Details of contractual obligations to be placed upon contractors to achieve the Company's environmental policy objectives.
- Details of the organisational structure and environmental responsibility and accountability within the organisation.
- Information, education, training and induction programs relating to environmental management for the project.

5.2 Environmental Management Strategies

It is noted that the CMT Act commits CMT to Best Practice Environmental Management.

5.2.1 Construction

A construction plan must be prepared which provides details of the timetable for the establishment of all major features to be associated with the mining and processing works. Measures to be implemented to ensure minimal environmental impact occurs during the construction period must be given including;

- protection of terrestrial and aquatic flora and fauna;
- protection, or where approved, relocation or destruction of archaeological, cultural, heritage or historical features;
- minimisation of impacts on geological, geomorphological and soil features;

- protection and maintenance of special features;
- recreational land uses;
- earth disturbance and erosion control;
- water pollution;
- air pollution including dust;
- traffic disturbance;
- fire risk management;
- visual impacts associated with disturbed areas;
- clean up and rehabilitation.

5.2.2 Water Emissions and Management Regime

The principal environmental issue relating to the Project is the control, treatment, re-use and disposal of process water and mine water, together with any associated impacts on aquatic environments.

Details must therefore be developed and provided of the water management regime for the entire lease site including the management of flows, treatment procedures and contingency measures to ensure that the environmental objectives and standards are maintained. This must also include details of the process, mine and wastewater discharges to the environment and the predicted impacts that will occur. The impacts must take into account the likely changes in receiving water quality and impacts on the aquatic environment. Areas of conservation significance in relation to aquatic flora and fauna must be identified together with approaches to be adopted to minimise or avoid adverse impacts to these.

A risk assessment of potential pollution of surface waters including the consequence of the breakdown or mass failure of any pollution control facility must be undertaken. A contingency response plan for addressing those consequences must be prepared.

Of concern in this regard also is the establishment of the tailings dams and the reduction in the flow regime of the particular water catchment. An assessment must therefore be made of the minimum flow regime requirements downstream of the tailings dams, and details must be given of how that minimum flow will be maintained.

Supportive information, based upon investigations and analyses of water and tailings chemistry, must be given. Details of any investigations to be undertaken to determine the nature and extent of process and mine water treatment, required in order to meet the effluent quality objectives, must be cited.

5.2.3 Land Management

Impact on flora and fauna

The impact of the development on any identified flora and fauna and their habitat of conservation significance must be discussed, including any measures to avoid or minimise such impacts. This should include consideration of the potential for the development to result in an increased weed infestation or spread of Phytophthora root rot fungus and other plant diseases.

Fire

The potential for the project and associated infrastructure and activities to result in an increased fire risk must be addressed.

A fire prevention and control plan must be developed in consultation with the appropriate local and state authorities.

Management of flammable and combustible materials on site other than those considered in the hydrocarbon management plan should be detailed.

Archaeology and Heritage

Measures to ensure the ongoing protection and maintenance of all significant archaeological, heritage and historical features must be given.

Features of Special or Scientific Interest

Measures to be undertaken to protect and maintain features of special or scientific interest (for example the Botanical Gardens Reserve) must be given.

Visual impact and landscape management

Measures to ensure that ongoing mining and other associated activities will not give rise to significant visual impacts must be given. Details must also be given of Company plans, such as rehabilitation works, which will give rise to changes in the visual appearance on the lease site as it currently stands. Where practicable, graphical representations or aids should be used to demonstrate the changes that will occur.

Erosion Management and Rehabilitation

Details must be provided of management plans to be implemented for the prevention and control of erosion on the lease site. This should include a program of works for the purposes of landscaping and contouring, landslip management, stormwater diversion and revegetation.

Details should also be provided of rehabilitation plans for above ground disturbed areas including:

- the likely end uses proposed for the lease sites, including the tailings dams.
- the changes in topography and landform associated with the sites at the completion of mining activities.

- any ongoing (post mining completion) drainage and runoff collection and treatment facilities.
- the proposed method of rehabilitation of disturbed areas, including contouring, the source and depth of topsoil, the plant species and planting techniques to be used and seed sources.
- the timing of all rehabilitation works.

It is noted that Section 4.1(j)(iii) of the CMT Act requires within 2 years of the re-commencement of mining operations, the preparation of a Program of Environmental Works to improve the environmental management of the Leased Land. However, this section of the EMP specifically refers to disturbance created by the CMT Project.

5.2.4 Atmospheric emissions

Atmospheric emissions from milling and mining operations and any Ozone depleting gases on site should be detailed and containment strategies outlined.

The potential for dust emissions from mining or crushing operations, and product transport should be reviewed, and mitigation procedures discussed.

5.2.5 Noise and Vibration associated with Mining Operations

The impact of noise and vibration must be critically evaluated in terms of all on-lease activities including:

- materials and vehicular transport movements,
- operation of all processing equipment,
- blasting regime and frequency.

An assessment must be made of the potential for impacts on the stability of surface and subsurface features located off the lease as a result of mining activities (such as blasting). Measures to be undertaken to minimise the potential for vibrational impacts must be given.

An assessment must be made of the noise emissions from all mining and processing activities and the likely noise levels that will result, and the potential impacts on residential and other public and recreational areas. Measures to ameliorate noise emissions to achieve satisfactory performance levels must be given.

5.2.6 Off-lease Materials Handling, Product Transport and Shipment

The impacts associated with the transport of materials and product must be addressed.

The methods to ensure minimal impacts associated with the loading and unloading of products for the purposes of land and marine shipment must be detailed, including noise, dust emissions, spillage, runoff from any proposed stockpiles and visual impact.

Other environmental issues associated with shipping the product must be considered, and in particular, the issue of ballast water discharge from contracted shipping vessels.

Transport of raw materials (such as fuel, equipment, spare parts, plant and machinery) to the site and ore concentrate and other products including wastes from the site must be addressed. This must include details of the proposed mode of transport and route, the frequency of transport movements and the likely impacts on residential areas and other areas of public access and use. The impacts considered should include, but not be limited to:

- noise
- dust
- material spillage
- road damage
- road access and safety

5.2.7 Hazardous materials and Hydrocarbon Management

The nature and quantities of all potentially hazardous materials to be held on the premises must be identified. The storage locations must be given, and safeguards incorporated to contain these materials and ensure clean-up of accidental spillage described. A contingency plan must be formulated to deal with spills.

A Hydrocarbon Management Plan for the leases should be detailed. This will include information on transport and storage options to and from the site. Other aspects to be considered include;

- bunding and covering of storage and distribution points.
- management of hydrocarbons in handling areas such as workshops and fuelling bays which ideally should be covered, bunded across exterior openings and/or graded towards a collection sump and oil water separator.
- provision of oil absorbent materials to be utilised in the event of spillage and a disposal strategy for used materials.
- details on recovery and collection of used hydrocarbons and strategies for recycling and disposal from site.
- a hazardous materials inventory detailing the nature of the material, its location on site, quantity stored and container description, usage and disposal.

5.2.8 Hazard Analysis/Risk Assessment

A preliminary hazard analysis and risk assessment must be carried out to determine the likely consequences to people, wildlife, water quality storm runoff and the environment generally, in the event of a major occurrence such as explosion, fire or chemical spillage. Generic guidelines for the conduct of such a study are attached as Annex 1 and have been provided by the Division of Environmental Management of the Department of Environment and Land Management.

Emergency control procedures, training and back-up facilities should also be described.

5.2.9 Waste management

A waste strategy must be developed for all mining, process, industrial and domestic wastes generated on the lease site. This must include full details of the quantities and nature of the various waste streams, the facilities for storage, treatment, re-use and disposal of the wastes, and all measures and management prescriptions undertaken to minimise the amount of waste generated.

Specific attention must be given to the following;

(i) Waste Rock

(ii) Tailings

(iii) Industrial and hazardous wastes

(iv) Domestic and putrescible wastes

(v) Sewage

5.2.10 Monitoring and review

A sampling and monitoring programme designed to monitor compliance with the objectives and predictions of the EMP must be presented. This must include :

- monitoring of process water, wastewater and mine waters and the respective receiving environment(s). This must include biological and chemical analyses of the receiving waters.
- monitoring of the progress of rehabilitation works and the erosion management plans.
- noise, vibration and dust monitoring on and off the lease site.
- waste disposal activities, including details of quantities and method of disposal, disposal site monitoring including bores, together with the effectiveness of the waste minimisation measures and re-use programs.
- an annual critical overview of the environmental performance of the site with respect to the objectives of the EMP.
- critical review of the EMP, comparing its predictions and management prescriptions with the actual performance of the development, after twelve months of operation, and at three yearly intervals thereafter.

5.2.11 Miscellaneous

Discussion is required of the following matters at appropriate locations in the EMP or as a supplement to the EMP:

- Development of written practice guidelines to be incorporated into every contract entered into which promotes and ensure compliance with CMT's EMP and furthers 'best practice environmental management'.
- Commitment to an external environmental audit in terms of *Environmental Management and Pollution Control Act, 1994.*
- Ongoing public affairs and information program.
- Establishment of panels of technical experts; peer industry reviews.
- Participation in research programs established by other parties (eg. Joint Commonwealth/State Study) to ameliorate existing environmental damage on the lease site.

ANNEX 1

GENERIC GUIDELINES FOR THE PREPARATION OF DOCUMENTATION TO SUPPORT AN APPLICATION FOR A LICENCE TO OPERATE A SCHEDULED PREMISES WHICH HAS MAJOR ACCIDENT HAZARD POTENTIAL

Whilst these guidelines cover the range of information likely to be required for land use safety assessment purposes, the exact extent of such information will be dependent upon the project's specific location, processes, materials and proposed safety management systems.

The Department of Environment and Land Management will determine the specific supporting information requirements on a case-by-case basis.

These guidelines are to be read by the proponent in conjunction with the overall guidelines for the preparation of an Development Proposal and Environmental Management Plan for a proposed development which - when operational - would pose, in the opinion of the consenting authority (Director of Environmental Control in this instance), the potential for significant offsite safety and environmental impacts.

All of the information provided by the proponent should be presented in a clear, uncluttered format, supported by maps, flowcharts, diagrams and other descriptive detail as appropriate.

The purpose of the information is to enable members of the public, the consent authority and other relevant government agencies to properly understand the environmental consequences of the proposed development and undertake an assessment based upon the information provided. This implies that all uncommon technical terms must be explained in plain English for the non-technical reader.

It may, in some cases, be necessary for the consent authority to commission a consultant industrial risk analyst to undertake a full technical review of the information provided by the proponent.

If such a review is required, the proponent must be in a position to provide all relevant technical, scientific, engineering and management information to the analyst.

Should information of a confidential commercial nature be involved in the review, that confidentiality will be preserved by the analyst and consent authority.

It is recognised that, at the earliest design stages of any industrial project, much of the detailed information that may be required for a fully quantified risk assessment may not be readily available. Furthermore, hazard and operability engineering studies on the engineering design and management systems probably will not have been completed at the time a licence decision is required by the proponent.

This can imply delays in making a licence decision until such information is available to the assessors.

It is the policy of this consenting authority to satisfy the public that it will not approve for operation an installation that has not been appropriately assessed for its offsite risk potential.

Thus a Licence to Operate Scheduled Premises under the Tasmanian Environment Protection Act 1973 will be subject to the proponent having first fully met all the guidelines for information in this area of impact assessment.

The risk acceptability criteria adopted by this consent authority are those currently in use by the New South Wales Department of Planning, Major Hazards Unit.

Should the findings of the assessment process indicate a need for risk reduction measures beyond those proposed by the developer, such measures shall be agreed and incorporated into the consolidated first edition of an Environmental Management Plan (EMP) for the premises.

The Approved EMP is the principle licence condition attached to the Licence to Operate Scheduled Premises under the Environment Protection Act 1973.

All Major Hazard Installations within Tasmania are subject to external hazard and environmental performance audit by State Government agencies at any time during their operational phase.

Such installations are further expected to formulate and drill emergency/disaster plans under the guidance of the State Emergency Service.

Such plans are required to be completed as part of the commissioning program for the premises and to be approved, in place and operational prior to full-scale operations at the site.

1. Background information for hazard analysis

- location of the proposed works: a detailed site layout map should be provided, complete with planned internal and adjacent roading, rail, port and other transportation infrastructure.

- storage and processing of hazardous materials: the layout, number, types (design and materials) and volumes of storage vessels for all hazardous materials to be stored on site. These details can be overlaid onto a base site layout plan.

The maximum likely static storage inventories of each such substance shall be depicted.

In addition, the maximum in-process inventories of hazardous materials (raw materials, intermediate products, by-products and final products) shall be given.

The waste streams (liquid, gaseous and solid waste stream routes and mass flows from all parts of the processing plant and storage areas) must be clearly depicted on a mass flow emission (to environment) chart.

The nature, types, storage and location of hazardous wastes shall be given.

2. Transportation of hazardous materials

The proponent should provide route maps for the transportation of hazardous materials to and from the proposed facilities.

The nature, numbers and capacities of road trucks/rail cars/marine vessels should be detailed in the submission.

Hours and days of transport operations should be given.

3. Preliminary risk assessment

A comprehensive identification of possible sources and causes of potentially hazardous events should be provided.

The likely consequences to Man and Nature offsite must be clearly explained for all explosion, fire, toxic releases to the environment.

The routes by which accidentally released materials may enter the food chain, and the human exposure paths for identified substances should be clearly defined.

4. Selection of credible accident events for further analysis

For the most credible accident events the proponent may be requested to undertake a full, quantified risk assessment for consequences outside the perimeter of the premises.

The proponent will need to demonstrate, through rigorous risk estimation techniques approved by the consent authority, the predicted risk (calculated number of occurrences per million per year) of human (individual and societal) fatality, injury, property damage and ecological damage (wild organism death, injury, ecosystem dysfunction, tainting of commercial stocks of organisms) caused through the accidental release of hazardous materials and energy.

All pertinent assumptions made in the preparation of such risk assessments must be clearly set out in the documentation.

Risk contour maps for the locality should be provided at a sufficient scale to enable the identification of individual houses.

NB: credible accident events are those, as determined by the consent authority and its advisors, to be included in the risk assessment study from a review of the proposed installations and activities; such events include fires, explosions and toxic gas releases which have the potential to significantly impact the environment surrounding the premises.

5. Risk management measures

The proponent will be required to demonstrate that it has designed and will put in place a comprehensive risk management and oversight system.

Components of this system, when fully operational, will be subject to audit by appropriate Government agencies, e.g. Tasmanian Development and Resources - Chemical Safety Branch, State Emergency Services and Environment and Land Management.

The system should pay particular attention to the containment of hazardous materials and energy within the perimeter fence line, and the measures to be put in place to prevent loss-of-containment events, and any cleanup and disposal measures in such events.

Further information details and clarification of requirements can be obtained through the Director of Environmental Management on Phone (002) 33 2770 or Fax (002) 23 3494.

APPENDIX B

CMT LICENCE TO OPERATE SCHEDULED PREMISES

TASMANIA

Dept of Environment and Land Management

Environment Protection Act 1973

LICENCE TO OPERATE
SCHEDULED PREMISES - CONDITIONS

Schedule of conditions under which the holder of Licence No. 3320 may operate the premises located at MT LYELL, QUEENSTOWN 7467.

Map Name: FRANKLIN (Tasmap 1:100000 Topographic Series)
Map Coordinates: 38303420
File Reference: 038196
Mining Lease(s): 1M/95, 2M/95

Dated this ...19th..... day of ..July..... 1995..

Frank Cattell
.....
(Director of Environmental Management)

This premises is scheduled under the Environment Protection Act 1973; Schedule 1, Part 8: Mines.

Licence No. 3320 is issued to COPPER MINES OF TASMANIA PTY LTD to operate the above premises for the purposes of a mine provided the quantities of material dealt with or used on the premises are in accordance with the following maximum quantities:

Limit on Materials Used, Produced or Processed in Respect of Schedule 1 Part 8
200000 Tonnes per Year of raw materials produced or processed.
(Annual licence and inspection fees are derived from this figure)

Other Limits on Materials Used, Produced or Processed

Quantity of Production	
(ex concrete batching plant)	1500 Cubic metres per year
(ex quarry)	60000 Tonnes per Year

The following conditions and definitions are attached to the Licence:
D1, D2, D3,
G1, G2, G3, G4, G5, G6, G7, G8,
R1, R2,
N1,
B1, B2,
M1, M2, M3, M4,
S1, S2, S3,
H1, H2, H3, H4.

TASMANIA

Dept of Environment and Land Management

Environment Protection Act 1973

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Dated this 19th day of July 1995

Frank Cattell
(Director of Environmental Management)

Definitions of Terms

D1 For the purpose of this licence the premises shall be defined as all that land, and structures there on, situated on mining lease numbers 1M/95 and 2M/95 and as delineated on the site plan which forms Attachment 1 to these conditions.

D2 For the purposes of this licence The Sustainable Development Advisory Council (SDAC) is defined as the body established by the State Policies and Project Act, 1993.

D3 For the purposes of this licence the "CMT Project" is defined in Schedule 1 of the Copper Mines of Tasmania Pty Ltd (Agreement) Act 1994.

General

G1 Other than as specifically provided for in the Copper Mines of Tasmania Pty Ltd (Agreement) Act, 1994 (as amended), the premises shall be operated in accordance with the requirements of the Environment Protection Act 1973 and Regulations thereunder. These conditions shall not be construed as an exemption from any of those requirements.

TASMANIA

Dept of Environment and Land Management

Environment Protection Act 1973

LICENCE TO OPERATE
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Dated this .....19th..... day of July..... 1995..

.....Frank Cattell.....
(Director of Environmental Management)

General (continued)

G2 Except as provided in subsection (2) of Section 29 of the Act, the licensee shall not without the prior approval in writing of the Director of Environmental Management;

(a) change any process used on the premises in any manner that might cause or substantially increase the emission of a pollutant or noise from the premises;

(b) construct, install, alter or remove

(i) any structure in, on or connected with the premises or

(ii) any furnace or other device that produces a pollutant on the premises,

in any manner that might cause or substantially increase the emission of a pollutant or noise from the premises;

(c) change the nature of the materials dealt with or used on the premises in any manner that might cause or substantially increase the emission of a pollutant or noise from the premises; or

(d) increase the quantity of materials dealt with or used on the premises so as to exceed an amount specified in that regard in this licence if that increase might cause or substantially increase the emission of a pollutant or noise from the premises.

TASMANIA

Dept of Environment and Land Management

Environment Protection Act 1973

LICENCE TO OPERATE
SCHEDULED PREMISES - CONDITIONS

Schedule of conditions under which the holder of Licence No. 3320 may operate the premises located at MT LYELL, QUEENSTOWN 7467.

Map Name: FRANKLIN (Tasmap 1:100000 Topographic Series)
Map Coordinates: 38303420
File Reference: 038196
Mining Lease(s): 1M/95, 2M/95

Dated this 19th day of July 1995.

Frank Cattell
(Director of Environmental Management)

General (continued)

G3 When any accident, breakdown or malfunction of equipment may or does result in the unplanned emission of a pollutant or noise from these premises which is different from, or in excess of, normal emissions from the premises, the licensee shall:

(a) Contact the Director of Environmental Management by telephone within 24 hours, (002) 33 6366 or fax (002) 23 3494

(b) Take all practicable action to contain the emission(s) and to minimise the adverse environmental effects of any pollutant or noise which is unavoidably emitted.

(c) The licensee shall, following any such incident report all events occurring during the unplanned emission episode(s) in writing (or by fax) within 5 working days of the cessation of the episode(s).

G4 Unless otherwise specified in the conditions attached to this licence, or otherwise approved in writing by the Director of Environmental Management, the premises shall be developed and operated as prescribed in Schedule 1 of the Agreement to the Copper Mines of Tasmania Pty Ltd (Agreement) Act 1994 (as amended), including the preparatory works defined by Section 3 of the Act (as amended), and as described in "Operation Strategy for the Re-Development of the Mount Lyell Copper/Gold Deposits by Copper Mines of Tasmania Pty Ltd", prepared by Gold Mines of Tasmania, December 1994.

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Dated this 19th day of July 1995..

Franke Cattell
(Director of Environmental Management)

General (continued)

G5 A copy of the conditions attached to this licence shall always be held on the premises. All persons, who at any time, may be responsible for the operation of the premises shall be familiar with the conditions attached to this licence.

The Licensee shall ensure that all personnel and contractors on site are aware of their responsibilities in regard to the licence conditions attached to this licence.

G6 The Licensee shall -

(a) Ensure no open burning of vegetation, rubbish or other matter occurs within the premises as defined in Condition D1 unless prescribed as part of a Fire Management Plan for the premises.

(b) Instruct employees on the fire sensitive nature of the surrounding vegetation communities and the fire control provisions of this licence.

(c) The licensee shall provide the SDAC with a copy of a Fire Management Plan developed for the premises which has been approved by the Director of Environmental Management by the 31 July 1995.

G7 The licensee may operate a quarry on the premises, defined by Condition D1. Material from the quarry may only be used on the lease area accept as otherwise agreed in writing by the Director of Environmental Management.

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Frank Cattell
(Director of Environmental Management)

General (continued)

G8 Unless otherwise approved by conditions attached to this licence, there shall be no commercial production on the premises, other than trials to develop or optimise processing methods, until the final decision regarding the CMT Project is made by the Government of Tasmania. Tailings and other process wastes generated during any such trials shall only be stored and/or disposed of in a manner approved in writing by the Director of Environmental Management.

Rehabilitation

R1 The Director of Environmental Management shall be notified of permanent cessation of operations within 30 days of such cessation.

R2 A rehabilitation plan for the premises, to include the Assumed Obligations under Schedule 2 of the Agreement to the Copper Mines of Tasmania Pty Ltd (Agreement) Act 1994, shall be prepared upon a decision by CMT not to proceed with the "CMT Project". This plan is to be provided to the Director of Environmental Management within 30 days of such a decision.

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Dated this .....19th..... day of .July..... 1995..

.....Frank Cattell.....
(Director of Environmental Management)

Noise Control

N1 Noise emissions from the premises shall be such that when measurements have been adjusted for environmental noise, the noise levels from operations on these premises shall not exceed an equivalent continuous A-weighted sound pressure level of 45dB(A) when measured at any residence in other occupation or ownership except for the small residential area located on the western side of the Lyell Highway opposite the Hydro Electric Commission substation. The noise level in this area shall not exceed an equivalent continuous A-weighted sound pressure level of 55dB(A). Environmental noise level measurements shall be taken in the presence of ambient noise normally existent in the area.

Where the combined level of the noise from the operations on the premises and the normal ambient noise exceeds the equivalent noise levels cited above, this condition shall not be considered to be breached unless the noise emissions from the premises are audible at the boundary of the premises.

The time interval over which the noise level is to be determined shall be 15 minutes.

All methods of measurement shall be in accordance with the relevant Australian Standards and the Tasmanian "Code of Practice for Sound Pressure Level Measurement".

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Dated this 19th day of July 1995.

Frank Coffey
(Director of Environmental Management)

Blasting

B1 Blasting shall be carried out in accordance with the regulations of Mineral Resources Tasmania.

B2 Airblast overpressure and ground vibration requirements shall not exceed the criteria recommended in the ANZECC document, "Technical Basis for Guidelines to Minimise Annoyances due to Blasting Overpressure and Ground Vibration, September 1990".

Monitoring

M1 The licensee shall measure and record the quantity of mine water discharged from the Prince Lyell mine via the Conveyor Tunnel on a continuous basis.

M2 Unless otherwise approved in writing by the Director of Environmental Management, a grab sample of the Prince Lyell mine water discharge shall be taken at the Conveyor Tunnel monitoring point in each 24 hour period and analysed for: pH, non-filterable residue, sulphate, fluoride, total and filterable iron, total and filterable manganese, total and filterable copper, total and filterable aluminium and total and filterable zinc.

A grab sample of the Prince Lyell mine water discharge shall also be taken at the Conveyor Tunnel monitoring point on a monthly basis and analysed for total mercury.

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Frank Cattell
(Director of Environmental Management)

Monitoring (continued)

M3 A grab sample shall be taken at monthly intervals from the following locations:

Haulage Creek above West Lyell
East Queen River above West Queen River
Haulage Creek at Slag Dump
Comstock Creek below Workings
Queen River at Queenstown
Princess Creek below the Tailings dam sites.

Grid References for the above sampling sites shall be submitted to the Director of Environmental Management for approval no later than 14 April 1995.

The samples shall be analysed for non filterable residue, pH, sulphate, fluoride, total and filterable iron, total and filterable managanese, total and filterable copper, total and filterable aluminium, total and filterable lead, total and filterable zinc, total and filterable mercury and total alkalinity. Total flow of the sampled stream shall be measured where feasible, or estimated, at the time of sampling.

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Frank Cattell
(Director of Environmental Management)

Monitoring (continued)

M4 All samples required to be obtained by these licence conditions shall be subject to the following:

(a) all samples shall be tested in a Government Laboratory, a N.A.T.A. registered laboratory or a laboratory approved by the Director of Environmental Management;

(b) all samples shall have been collected and analysed in accordance with the procedures specified in the codes of practice in the Act;

(c) all records of measurement taken relating to samples are to be retained by the licensee for at least two years after the date of measurement.

(d) Tests results of samples shall be forwarded to the Director of Environmental Management within one month of receipt of the results of analysis. Test results shall be accompanied by information on the date and time of sampling, the name of the person responsible for sampling, and presented in a format prescribed by the SDAC.

TASMANIA

Dept of Environment and Land Management

Environment Protection Act 1973

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Frank Cattell
(Director of Environmental Management)

Solid Waste Disposal

S1 Diversion drains and associated sediment settling dams are to be constructed at strategic locations within the premises, prior to the commencement of processing operations, to minimise the amount of sediment discharged beyond the boundary of the premises.

S2 No putrescible or domestic wastes shall be disposed of on site and may only be disposed of at a refuse disposal site licensed by the Director of Environmental Management and with the consent of the authority operating that facility.

S3 Unless otherwise approved in writing by the Director of Environmental Management, the licensee shall establish a waste disposal facility for non-biodegradable waste (excluding wasterock) at a suitable site within the lease area by the 31 July 1995. A full description of management procedures for the site will be forwarded to the Director of Environmental Management prior to commissioning.

Hazardous Substances

H1 Company policies, procedures and training are required to be in place to adequately deal with spilt or spent hydrocarbons, reagents and chemicals or any other hazardous substances requiring disposal. No environmentally dangerous or hazardous wastes (as defined in the Environment Protection (Waste Disposal) Regulations 1974) shall be disposed of at the refuse disposal site referred to in Condition S3.

TASMANIA

Dept of Environment and Land Management

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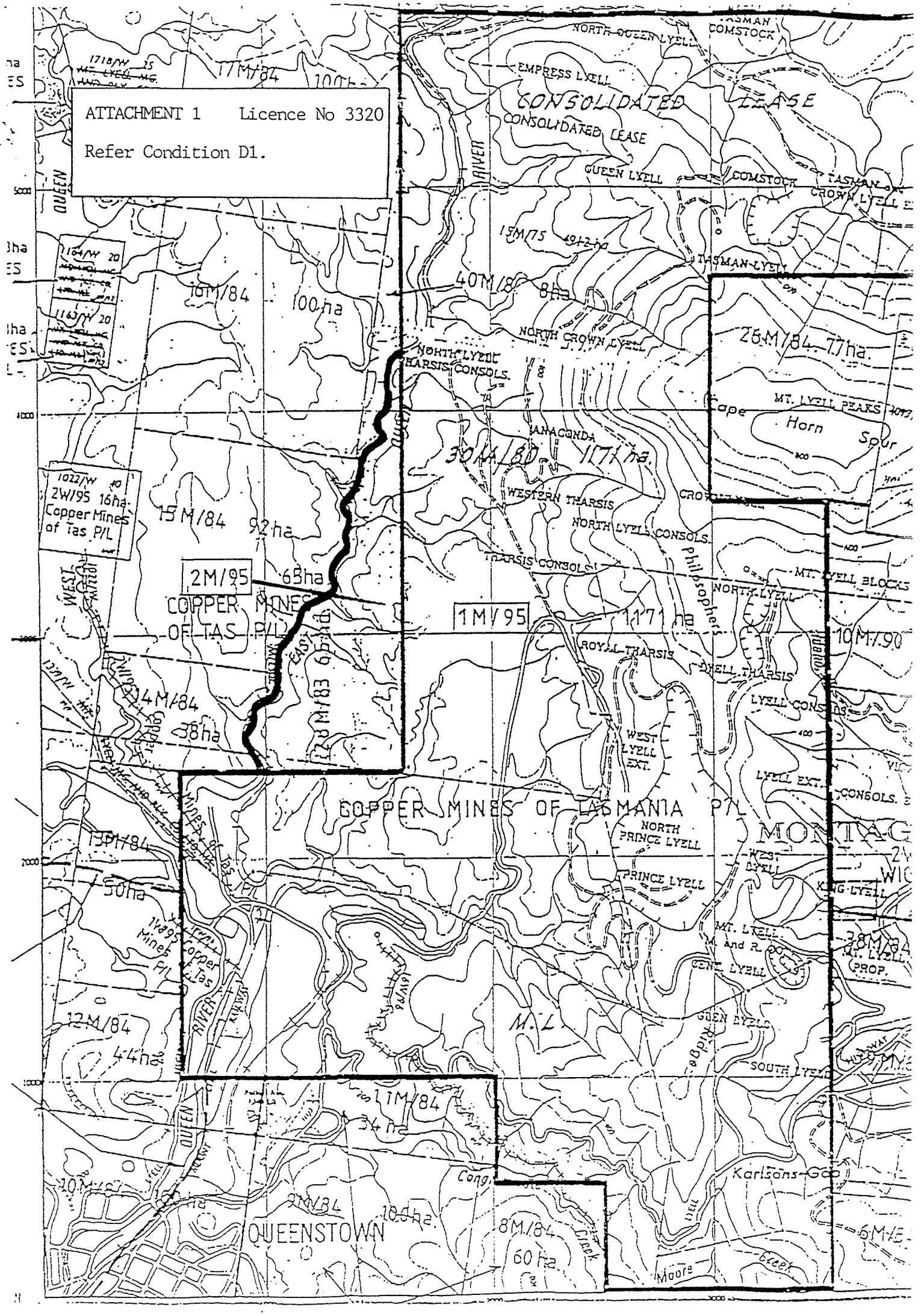
Frank Cattell
(Director of Environmental Management)

Hazardous Substances (continued)

H2 All above ground areas on the premises used for the storage of hydrocarbon products, whether containers, tanks, drums etc. shall be bunded. The bund shall form a containment capacity not less than 125% of the largest container held in the compound and be impervious to hydrocarbons. Any drain connection to the bund shall have a locked valve and only be operated under responsible supervision. This condition applies equally to the storage of unused and waste hydrocarbons.

H3 All areas on the premises used for the storage of Laboratory chemicals, mill reagents, and other hazardous chemicals or materials shall be bunded or graded to an adequate sump. The bund shall form a containment capacity not less than 125% of the largest container held in the compound. Any drain connection to the bund shall have a locked valve and only be operated under responsible supervision. Storage facilities for hazardous substances are required to be in compliance with the Australian Standard AS1940, or other relevant standards as approved in writing by the Director of Environmental Management.

H4 By 31 July 1995, all bowser type distribution points for hydrocarbons must be situated on an impermeable pad graded to an oil water separator. The fuel dispenser system must drain away from the fuel facility and from the vehicle. Where practicable distribution points should be roofed.


ATTACHMENT 1 Licence No 3320
Refer Condition D1.
CONSOLIDATED LEASE
CONSOLIDATED LEASE
COPPER MINES OF TAS P/L
2M/95
1M/95
COPPER MINES OF TASMANIA P/L
QUEENSTOWN
NORTH QUEEN LYELL
EMPRESS LYELL
QUEEN LYELL
COMSTOCK
TASMAN
CROWN LYELL
TASMAN-LYELL
NORTH CROWN LYELL
NORTH LYELL HARSIS CONSOLS.
MT. LYELL PEARS
Cape Horn Spur
JAMACONDA
WESTERN THARSIS
NORTH LYELL CONSOLS.
THARSIS CONSOLS
MT. LYELL BLOCKS
NORTH LYELL
ROYAL THARSIS
THELL THARSIS
LYELL CONSOLS
WEST LYELL EXT.
LYELL EXT.
CONSOLS.
NORTH PRINCE LYELL
PRINCE LYELL
WEST LYELL
KING LYELL
MT. LYELL M and R
CENT. LYELL
QUEEN LYELL
SOUTH LYELL
Karlsons Gap
Moore Creek
Phillpsopher
QUEEN RIVER
WEST QUEEN RIVER
26M/84 77ha.
40M/84 8ha
30M/84 177ha.
15M/84 92ha
2M/95 68ha
1M/95 177ha
10M/90
24M/84 38ha
13M/84 50ha
12M/84 44ha
1M/84 34ha
8M/84 60ha
1718/W 25
1164/W 20
1163/W 20
1022/W 20
2W/95 16ha. Copper Mines of Tas P/L
Mines of Tas P/L
Copper Tas

APPENDIX C

CMT POSITION DESCRIPTION

COPPER MINES TASMANIA
GOLD MINES OF AUSTRALIA LIMITED

POSITION DESCRIPTION

POSITION:	EXPLORATION TEAM MEMBER
TITLE:	**LEADING HAND FIELD ASSISTANT**
DEPARTMENT:	EXPLORATION
LEADER REPORTING TO:	MINE LEASE GEOLOGIST
ROSTER:	5 DAYS ON / 2 DAYS OFF
NUMBER OF POSITIONS:	1
DATE OF REVISION:	29 JUNE 1995

DEFINITION AND PRIMARY OBJECTIVES:

This position contributes to the overall performance of the Exploration Department by:

A. Being an active member of the Exploration team making contributions for the betterment of departmental operations and the effectiveness of its role.

B. Making contribution to the team effort by carrying out specific responsibilities as listed in this position description and adapted as the role develops.

C. Making contribution to the team culture by observing and maintaining team responsibilities as listed in this position description and adapted as the role develops.

KEY RESPONSIBILITIES:

A. Exploration Team Member

1. Contribute to a **productive team** by:

   * actively supporting the team leader (through the team forum) in formulating plans, decisions, procedures and actions to increase departmental efficiency
   * constantly promoting a "team" and co–operative approach within the Section
   * utilising and developing team attitudes and behaviours to ensure productive harmonious relations with other team members
   * cooperating through sharing resources, knowledge and ideas with other team members
   * openly raising matters relating to the betterment of team performance
   * taking responsibility to change personal behaviours as required by the team to effect more positive contribution

2. Contribute to improving the **service provided** by the Exploration team by:

* presenting and adopting suggestions to improve methods and performance
* dealing with other sections and departments in a friendly and "be of service" way
* improving personal skills by continuing with training and development

3. Contribute to achieving a positive and productive **employee relations** environment through:

* ensuring that information which is of interest to team members concerning your job or other exploration activities is conveyed either directly or through regular meetings
* dealing in a direct, honest, friendly and decent manner with those persons who may, from time to time, be assigned to work with or for you

B. Specific Responsibilities

1. Ensure efficient performance of the Field Assistants team through:

* leading, prioritising and assisting in the work of other field assistants
* monitoring and maintaining supplies of field and office consumables
* providing routine maintenance of records and statistics

2. Contribute to the **efficiency of Exploration** activities by participating in and ensuring the quality of the work done by others with respect to :

* collecting exploration drilling soil, rock and stream sediment samples
* recording of field data regarding sample location, quality and description
* assisting in data recording and input into databases and plans
* ensuring correct procedures for preparation and storage of samples
* assisting with surveying and establishing of field grids for sampling and drilling
* assisting with drill site and track preparation
* assisting with rehabilitation
* completing allocated tasks accurately and in a time urgent manner
* careful and accurate recording of information on a daily basis in the prescribed format
* carrying out regular preventive maintenance and checks of exploration equipment and vehicles
* assisting in various exploration activities as required

3. Contribute to the **cost-efficiency** of the operation through:

* monitoring and controlling usage of stores items
* minimising wastage
* ensuring that plant and equipment is operated efficiently and not subjected to damage and abuse
* ensuring field assistants are fully productive during shifts.

C. CMT Team Responsibilities

1. Contribute to achieving positive **interdepartmental relations** through:

* ensuring good communications and relations with technical, supervisory and other site personnel
* treating other departments as "clients" and displaying a "be of service" approach and attitude

2. Contribute to the effective **administration and management** of the Department through:

* ensuring compliance with Company administrative policies and procedures
* providing any support required to ensure the completion of work within the Section.

3. Contribute to a **safe and healthy work environment** by:

* taking a responsible attitude to personal safety and well being
* taking a responsible attitude to the safety and well being of others
* complying with safety rules and procedures
* actively promoting safety awareness
* ensuring compliance with safety rules and procedures and statutory requirements and obligations
* constantly monitoring field assistants work practices and procedures

4. Contribute to the **achievement of the company's Environmental policy** by:

* being familiar with the policy and its requirements
* ensuring activities that may affect the environment in any way comply with the company Environmental policy
* taking immediate steps to contain any possible adverse environmental effects of a job activity that goes astray and seeking immediate assistance from the Environmental Department
* taking an active role in reporting to the Environmental Department any issue observed anywhere on site that may adversely affect the environment if left unaddressed

5. Contribute to a **good public image** through:

* projecting a positive and friendly attitude in all dealings with suppliers and other people external to the company
* maintaining friendly and courteous relations with members of the community encountered through work activities

6. Provide **job procedures** by:

* becoming fully conversant with this job description and updating it when necessary

NB:
Updates should only be done to streamline work or to allow for a fundamental change of procedure. Any changes are to be in consultation with and authorised by the team leader.

APPENDIX D

ENVIRONMENTAL HANDBOOK

Copper Mines of Tasmania Pty Ltd

Environmental Handbook

July 1995

Copper Mines of Tasmania Pty Ltd

Environmental Handbook

1.0 INTRODUCTION

Mining at Mount Lyell has a history spanning over 100 years. Our recognition, both as a nation and as an industry, of the importance of environmental awareness and the potential for long term damage caused by poor environmental management, has become far more acute over this time. Unfortunately, early production practices lacked this recognition and resulted in considerable environmental impact on the leases which will take many generations to amend. Copper Mines of Tasmania (CMT) has now taken over the mining leases at Queenstown and is committed to Best Practice Environmental Management, through which the Company will create some environmental benefits.

This handbook describes CMT Environmental Policy, our statutory responsibilities and the responsibilities which **YOU** as an individual have to protect the environment. This handbook applies to everyone who comes on to the leases - employees, contractors, consultants, tourists and visitors.

The handbook also describes the site and gives some site history.

When you have read the handbook, please sign and date the section on the last page to show that you have read and understood the handbook. If you have any questions ask your Supervisor or talk to anyone in the Environmental Team.

2.0 HISTORY OF THE SITE

Gold mining started at the Iron Blow at Mount Lyell in 1893 and the Mount Lyell Mining and Railway Company Limited was formed in the same year. Copper in large quantities was discovered soon after and full scale production started at Mount Lyell in 1896. Production continued until December 1994 when the Mount Lyell Mining and Railway Company Limited closed and CMT took over the leases.

Although ore has been mined from many areas across the site, the main ore production areas have been the West Lyell Open Cut and the Prince Lyell Mine. Over the years Mount Lyell has produced over 100 million tonnes of copper ore and is the oldest copper mine in Australia.

Pyritic smelting of copper ore took place in the early part of this century and the fumes from the smelters and the harvesting of timber have played a major part in creating the "bare hills" for which Queenstown is famous. The first tailings dam at the operation was not built until CMT took over. Prior to this all tailings were pumped straight into the Queen River. These tailings have built a large delta at the mouth of the King River just as it enters Macquarie Harbour and can be seen on the River banks.

3.0 SITE DESCRIPTION

The Mount Lyell Mine is located north of Queenstown, about 40 kilometres inland from the West Coast of Tasmania, and at an altitude of between 170m and 750m above sea level. The annual rainfall is approximately 2.5m and the temperature varies, on average, from a high of 22°C in summer, to a low of 2°C in winter.

The CMT leases are shown on the Lease Map. The leases cover about 24 square kilometres which include the tailings dam area as well as the historical Mount Lyell mining leases.

These leases have been severely affected by past operations which have resulted in:

* significant changes to the landscape;
* soil of a generally poor quality;
* severe depletion of natural vegetation cover;
* modified storm water runoff characteristics, both quality and quantity;
* increased sediment deposits from the lease; and
* deterioration of water quality of the rivers leaving the lease, caused by acid drainage carrying high loads of dissolved metals.

Some vegetation has begun to re-establish over the lease area in recent years both naturally and as a result of revegetation work.

The vegetation in the area is mainly temperate rainforest in the valleys and slopes of the tailings dam area. Downstream of the tailings dam is a historical Botanical Reserve Area. There are at least two species of rare plants in the tailings dam area and in the Reserve area. The West Coast's delicate wilderness environment is prone to weeds which choke and take over the natural vegetation. Unfortunately, the denuded hills of Queenstown make it even easier for weeds to take hold. Both the mine site and the tailings dam area have been impacted by weeds. However, a weed eradication program is underway and it is important that everyone assists by reducing the opportunity for weed introduction as described later in this handbook.

However, the lease is home to many native as well as several introduced species. These include wallabies and possums together with cats and rabbits. No endangered animals have been identified on the leases.

4.0 CMT ENVIRONMENTAL POLICY

Protecting the environment and obeying environmental laws and regulations are top priorities with CMT. The Company is committed to setting the highest standards both in environmental management and in its mining operation.

The CMT Environmental Policy is outlined below and commits ALL employees to operating in a responsible way where the environment is concerned.

It is our Policy:

* To conduct business in compliance with environmental laws and regulations;

* To recognise and manage environmental risks in a cost effective manner that protects both the environment and our economic future;

* To place a high priority on environmental considerations in planning, constructing, operating, and closing facilities as well as in evaluating new business opportunities;

* To recognise and protect items or areas of significance to Australian Heritage;

* To actively promote employee involvement in implementing this policy throughout the Company;

* To place primary responsibility for compliance with environmental laws, regulations, and this Policy with operations management; and

To recognise achievement in effective implementation of this policy as a dimension of employee performance.

5.0 STATUTORY RESPONSIBILITIES

CMT is required under the law of Tasmania to obey all the Acts of Parliament which apply to the mining and exploration leases. The important laws for this site include environmental, and mining acts. In addition, a special Act has been written for CMT, called the Copper Mines of Tasmania Pty Ltd (Agreement) Act 1994 (the CMT Act).

The CMT Act describes the Agreement between CMT and the Government about how the CMT operation should be carried out. The CMT Act does not hold the Company responsible for past pollution, but it does require CMT to do specific things which include:

* build a tailings dam,
* use Best Practice Environmental Management,
* produce an Environmental Management Plan (EMP), and
* look after Heritage buildings and structures.

The EMP identifies some of the existing environmental impacts from past mining and outlines how the whole operation on the site and at the tailings dam will be managed. It details the standards set by the Government and describes how these will be met. The EMP has identified important areas to be considered and there are sections on:

* Land Management,
* Water Management,
* Waste Management,
* Hazard and Risk Assessment,
* Noise and atmospheric emissions,
* Conservation, and
* Revegetation.

The EMP describes CMT's environmental commitments in the redevelopment of the mining operation. CMT is in no doubt that these operation will result in an eventual improvement to the overall site and surrounding areas. These issues are described in the EMP in more detail. There is a copy in the Library and you can get more information and a booklet from the Environmental Team if you want to know more.

While the Company has programs in place to tackle all these environmental issues and it is the Company's responsibility to do so, it is up to YOU, as part of your day to day job, to make sure the environment is protected.

IT IS EVERYONE'S RESPONSIBILITY!

6.0 YOUR ENVIRONMENTAL RESPONSIBILITIES

All individuals on the CMT mining leases must obey the rules outlined in this section of the Handbook. Anyone who disregards these responsibilities will be subject to disciplinary action. It is your responsibility to contribute to the achievement of the Company's environmental policy by:

* being familiar with the Policy and its requirements,
* ensuring that all your activities on the site comply with the environmental Policy and the "rules" set out in the Handbook,
* taking immediate steps to contain any environmental incident,
* taking an active role in reporting any accidents or spillage you see, to your Supervisor or Environmental Team Member.

As you read this Handbook and carry out your work on site, be aware that looking after the environment is part of your job. Your job and the future of this Company depend upon CMT achieving a high environmental standard, so **take care in everything you do!**

6.1 Land management

CMT's policy is to carry out all exploration and mining activities with the highest regard to protecting the land. This means that, as part of your everyday work, you need to be aware of the effect that you can have on the land if it is not properly treated.

The rules are:

* Do not drive your vehicle off the tracks.

* Do not disturb any new areas of land without getting permission from the Environmental Manager.

* Do take care to prevent soil and sediment from getting into streams.

* Keep away from the flagged areas of the tailings dam where "Bruce" (a rare plant) is to be found.

* Do not dig sloping ground if it is raining so hard that the soil runs away.

* Wash the tyres of your vehicle when moving from the tailings dam lease to the mine site area.

* Ask the Environmental Team before you start work in a new area so that you know about any possible problems.

6.1.1 FIRE

No fires are permitted on the lease area unless they are approved in the fire management plan and a permit is issued. A Fire Management Plan for the Site is available and should be consulted before any fires are lit.

* No fire is to be left unattended whilst burning.

* Do not light a fire without a permit from the Environmental Manager.

Smoking is permitted on the lease except in the buildings. **PLEASE DISPOSE OF YOUR CIGARETTE BUTTS CAREFULLY AND ENSURE THEY ARE EXTINGUISHED FIRST!**

6.1.2 VEGETATION

The vegetation on the leases protects the soil from erosion by wind and rain.

Do not cut down or lop trees or disturb vegetation without permission. A permit from the Environmental Manager must be obtained before any trees can be removed.

Exploration must be carried out in line with the Exploration Code of Practice published by Industry, Safety and Mines. An outline of any clearing activities must be submitted to the Environmental Section prior to any new exploration being carried out. All clearing must be approved by the Environmental Manager.

Noxious weeds prevent native vegetation from thriving and are a particular problem on the CMT leases. A weed eradication program is being carried out. Do not bring or plant weeds on the leases. If you are unsure about plants check with the Environmental Team. Report any new weed growth to the Environmental Section.

6.2 Water management

You must take every effort to make sure that local streams and creeks are not polluted. Underground water must also be kept clean so do not dump any rubbish other than in a special tip area. Water courses are for clean water only. The rules are:

* Do not hose oil or grease into water ways.

* Do not put any rubbish into streams or creeks.

* Do not wash vehicles in streams or creeks.

* Only dump rubbish at the "Tip".

* Do not waste water - yes even in Queenstown! It costs money to pump clean water to the site and in summer the water supply runs very low.

6.3 Waste management

Waste management is an important part of every operation at CMT. Proper waste management is not only good for the environment but it saves the Company money and creates new jobs! Waste must be:

Avoided > Reduced > Reused > Recycled > Treated > Disposed of properly.

A plan is being put in place which needs the help of everyone on site. The key to remember is :

Dispose of waste only as a last resort!

The rules are:

* Order in bulk and insist that the supplier refills the container.

* Only order from suppliers who take packaging back.

* Recycle in the bins provided.

* Reuse or repair equipment rather than throw it away if it is more economical do so.

Table I shows you what you should do with your wastes. If you have any questions or suggestions please talk to the Environmental Team.

Table 1

Waste Type	Minimise	Re-use/Recycle	Treatment/ Destruction	Current Disposal Sites	Comments
Solid Waste					
Food scraps, plant material		Compost	Compost	Municipal	Composting preferred
Paper, cardboard		Compost	Compost	Municipal	Composting preferred
Sewage sludge				Municipal	
Cans, containers	Bulk purchase	Collect for recycling	Place in bundles	Municipal	Recycling preferred
Packaging-paper, plastic	Bulk purchase	Recycle	Crush	Municipal	Recycling preferred
Wood pallets	Avoid damage	Return for reuse		Mine site	Recycling preferred
Scrap steel, wood		Separate, store in laydown area		Mine site	Recycling preferred
	Bulk supply preferred	Return to supplier where possible	Ensure empty, crush at workshop	Mine site	Recycling preferred
Oil filters, absorbents, oil contaminated mats		Reuse absorbents		Off-site licensed disposal site	
Oil contaminated silts/ soils	Avoid spillage			Off-site licensed disposal site	
Tyres		Aim to recycle if market available		Mine site	Recycling preferred
Batteries		Aim to recycle if market available		Off-site licensed disposal site	Recycling preferred
Hazardous materials				Off-site licensed disposal site	
Liquid Waste					
Office or decline effluent			Septic tank/ STP		Connect to STP
Waste oil/ solvents		Collect for recycling. Keep drums, separate		No disposal on site	
Oil/ fuel contaminated			Interceptor trap. to silt sump	Off-site disposal	

6.4 Oil and fuel

Take care not to spill oil or fuel. If you do it must be contained and cleaned up by absorbing it with sawdust or the special oil absorbent materials provided by the Company. These special materials are expensive and should only be used when oil and water are mixed. Once used, these materials, or the sawdust, must be disposed of properly in the Oil Contaminated Waste Bins provided.

Any spillage must be reported to your supervisor.

Waste oil must also be collected and placed in the recycling tank so that it can be shipped off site for treatment.

6.5 Hazardous Materials Management

Hazardous materials are any materials which, when released to the environment, cause environmental damage or a risk to human health. Hazardous substances on the site include:

* explosives
* diesel, oils and greases,
* reagents used in the flotation section of the plant,
* laboratory reagents.

YOU need to be aware of the Material Safety Data Sheets (MSDSs) and Emergency Procedures which are in place for the handling of all Hazardous Materials. Generally you must:

* Act IMMEDIATELY to contain or clean up any spills. If the spill is large, get help.
* Notify your Supervisor immediately if the spill is large, and at the end of your shift if the spill is small.
* Dispose of contaminated materials only as detailed in the MSDS.
* Take action to stop future spills.

SUPERVISORS are responsible for:

* Ensuring staff are aware of the MSDS location;
* Placing MSDSs in view near the location of the hazardous substance;
* Making all staff in the area aware of the location of safety equipment;
* Keeping a record of all spills and clean-ups;
* Submitting these records to the Environmental Section monthly.

Never place yourself at risk in dealing with a spill of a hazardous substance.

Always wear appropriate protective clothing.

Always report spills to your supervisor.

Always consult the MSDS before cleaning up a spill.

6.6 Protection of Heritage

This site has a very long history. Aboriginal sites have been identified on the lease and European history dates back over a century. CMT is required by law to protect all Heritage found on the lease.

6.6.1 ABORIGINAL SITES

Any findings of Aboriginal Artefacts must be reported to the Environmental Manager as soon as possible. These sites must not be disturbed and artefacts must not be removed or destroyed.

6.6.2 EUROPEAN HISTORY

Many of the buildings and relics on the site are important heritage items. No building must be removed, destroyed, painted or altered without permission. A permit must be obtained from the Environmental Manager before any of these things can be done and planning well ahead is required since alterations to most of the heritage items will need Government approval.

6.7 Environmental Monitoring

The Environmental Section carries out an extensive monitoring program on the leases and a lot of time and effort is spent controlling the impact of our mining operation. Unless you have been given permission to do so, do not move or interfere with any of the monitoring equipment which you see on the site. You will see rain gauges, stream samplers, flow monitors, survey pegs, signs etc. If you notice any monitoring equipment that has been damaged or is obviously disturbed, report this as soon as possible to the Environmental Section so that it can be fixed.

UNDERTAKING

COPPER MINES OF TASMANIA - LEASES AND EXPLORATION AREAS

ENVIRONMENTAL HANDBOOK

I_____ of _____
(Full name - print) **(Address)**

acknowledge that I have read and understood the Environmental Handbook for the Copper Mines of Tasmania Mining and Exploration Leases. I, hereby, agree to abide by the environmental requirements contained therein at all times while I am employed on the project.

I understand that if I fail to comply with, or observe, any of the requirements contained within the Handbook, I may be required to leave the site immediately and not be permitted to re-enter the site, or I may be subject to disciplinary action.

Signed:_____ **Witness:**_____

Date:_____

Name of Employer:_____

Position:_____

APPENDIX E

CALCULATION OF CMT'S LEGAL RESPONSIBILITY FOR TREATMENT OF ACID MINE DRAINAGE

ATTACHMENT

Calculation of CMT's Legal Responsibility for Treatment of Acid Drainage for the Dewatered Mine Scenario

The following methodology is proposed for the calculation of the percentage of the copper loading that CMT is deemed responsible for generating.

It should be stressed that as mining proceeds, there will be continual changes to the magnitude of existing flows, and necessarily to the management of the drainage system. Thus whilst the overall methodology can be fixed, its actual application should be continually reviewed as mining progresses and flow regimes change.

An essential component of the methodology proposed is to prepare regular balances for copper mass flows in water underground. It is proposed that a balance be prepared each monthly period. If the total copper mass calculated from the individual flows within the mine differs by more than 15% relative from the total copper flow out of the conveyor tunnel, the difference should be investigated and if possible resolved. The difference should be calculated using the copper flow out of the conveyor tunnel as the base.

The methodology for sampling and evaluation of CMT's treatment quota should be continually reviewed and adjusted if necessary, in the light of results of the copper balances. An annual review would be conducted by two external experts appointed jointly by the Government and CMT.

The detailed methodology proposed initially follows:

1) Continue to divert flows from above 11 Level to the Cape Horn and North Lyell tunnels, insofar as that is possible. The CMT loading is then calculated as the annual average of the copper loading proportion in the Conveyor Tunnel flow as determined below.

2) As shown in Figure 2, there are a large number of individual flows of water into the Prince Lyell mine, which typically range from 0.1 to 5 Lps. The mine drainage system combines these flows into a relatively small number of large flows, of the order of 20 to 30 Lps each.

These large flows are directed to the settlers, where suspended solids are removed as "mine mud". The mud is transported via a mud displacement chamber, which uses water pressure from a tank at the surface to force the mud up a pipe, to the 11 Level Conveyor Tunnel and thence to the process plant where it will be treated by CMT.

The clean overflow from the settlers flows to the 18 Level Pump Station, which also pumps it to the 11 Level Conveyor Tunnel.

The individual large flows are now discussed. Reference should be made to Figure 2. It should be noted that in Figure 3, the abbreviations "Sub L." or "S" refer to "Sub-Level." In this context, the term "Sub" means below sea level, that is, a negative RL. In the discussion below, levels are expressed as negative RL's, if below sea level, to avoid confusion with use of the term "Sub-Level" meaning an intermediate level.

C) Water from the upper sections of the Main Decline, including a faulted area called the "Wet Sets" where there are groundwater inflows, flows by gravity to 13 Level, thence by a series of drain holes to 14 Level, 15 Level and finally to the 17 Level Mole Drive and the settlers.

It is possible to set up a V-notch weir and sampling station at the point where the water flows into the 17 Level drive. The flow rate of this stream requires continuous monitoring of flow and automatic sampling.

P) Water from the level at -90 RL, the base of the 40 Series of ore, is collected and flows by gravity to point "P" in the 17 Level Mole Drive. Point "P" is shown on a plan view of the -220 m RL level, in Figure 3.

Q) Water from the -200 m RL level, seen on Figure 2 at the base of the 50 Series of ore, flows by gravity to point "Q", shown on plan view in Figure 3.

R) Water from the -170 m RL level, also in the 50 Series of ore, flows by gravity to point "R", shown on Figure 3.

Flows "P", "Q" and "R" all combine and flow down the 17 Level Mole Drive, to the settlers. The Mole Drive is circular in cross section, so that the drainage is down the centre, which creates some difficulties for setting up sampling and measuring equipment. However, the base of the Drive is filled with fill and/or concrete, to form a flat trafficable surface. By cutting into this fill, it should be possible to set up a sampling and flow monitoring point. The flow rate of this stream requires continuous sampling and monitoring.

S) A pump station is situated on the -270 RL level. It receives water by gravity from the -270 RL hanging and footwall haulage and extraction drives, shown in Figure 4. The majority of this water in fact comes from above the -270 RL level, via a drain hole (marked "X" in Figure 4) from the -200 RL level which is 70 metres above, and a Vent Rise (marked "Y" in Figure 4) from the -220 RL level, which is 50 metres above.

The -270 RL pump station also receives water from the lowest pump station currently operating, on the -300 RL level. This pump station in turn receives water from two sources. One is from the -270 RL haulage drive, via the drain hole marked "Z" in Figure 4. This water therefore derives from above the -270 RL level and is not part of CMT's quota. The other source is water from between the -270 and -300 RL levels, and that exits from the bottom of the cave. A portion of the copper loading in this water is CMT's responsibility.

The drain hole that transports water from the -270 RL haulage drive down to the -300 RL level can be blocked, and the drainage re-organised so that all drainage from the -270 RL level flows by gravity to a point upstream of the -270 RL pump station. A continuous sampling and flow monitoring point should be installed here, shown as the point "V" in Figure 4.

The pumped flow from the -270 RL pump station at present enters the 17 Level Mole Drive upstream of flows "P", "Q" and "R". It should be diverted so that it enters downstream of these flows, thus avoiding contamination.

In approximately 6 months time, as mining operations below the -270 RL level continue, flows at the -270 RL level will greatly diminish, and continuous sampling and measurement at this point will cease.

3) The flow entering the -270 RL pump station is a mixture of flows from several levels. It will therefore also be necessary to take a sample every day of the flow coming from the drawpoints on the -270 RL level. This sample should be taken as close as possible to the drawpoints, so that it is as representative as possible of the water flowing through the cave at this level. However, the actual sampling points will have to be adjusted to reflect changes in flows, and safety considerations, as mining proceeds below this level.

4) The quantity of copper deemed to be generated by CMT's operations is calculated as follows:

Let:

V be flow volume, in Lps
C be the concentration of copper in the flow
M be the mass of copper in the flow

Let the following subscripts indicate the flow concerned:

a is the sample flow from the cave at the 270 level
pqr is the combined flow from streams P, Q and R (Figure 3)
c is the flow at point C on Figure 2
cv is the flow from the conveyor tunnel
v is the flow at point V in Figure 4
cmt is the mass of copper deemed to be generated by CMT.

Then:

270 is the flow sampled to represent the water in the cave at -270 RL.

Then:

$M_{cv} = M_{pqr} + M_c + M_v + M_{270} + M_{cmt}$

Thus:

$M_{cmt} = M_{cv} - M_{pqr} - M_c - M_v - M_{270}$

Where:

M_{270} is the mass of copper flowing in the caved material at the 270 level, and is given by:

$M_{270} = (V_{cv} - V_{pqr} - V_c - V_v)\ Ca$

5) The monthly results are averaged over a twelve month period to determine CMT's net copper loading liability.

APPENDIX F

VISUAL IMPACT - PHOTOGRAPHIC DATABASE

THOMPSON & BRETT PTY LTD CONSULTING ENGINEERS

COPPER MINES OF TASMANIA

Mt Lyell Mine Re-development
Visual Impact and Landscape Management

Photographic Database

Thompson & Brett Pty. Ltd.
7 Bayfield Street, Rosny Park 7018

COPPER MINES OF TASMANIA

MT LYELL MINE RE-DEVELOPMENT

VISUAL IMPACT AND LANDSCAPE MANAGEMENT

PHOTOGRAPHIC DATABASE

INTRODUCTION

This document presents an initial series of photographs to form a photographic record of the changes in visual appearance of the Mt Lyell site during the occupation and use by Copper Mines of Tasmania.

The photographic record follows the format outlined in the project Environmental Management Plan.

VIEW POINTS

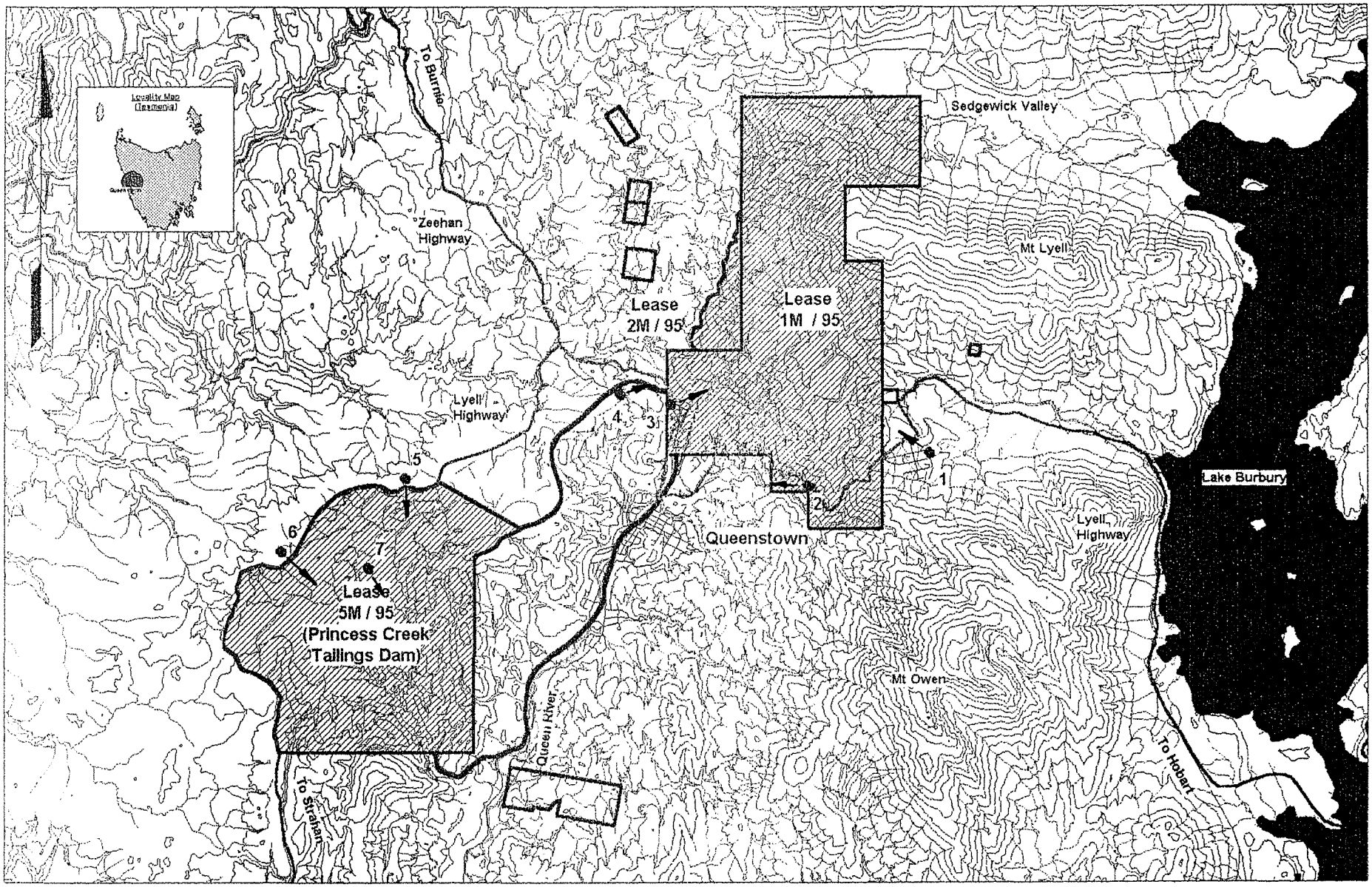
The photographic view points are presented on Figure 5.13, reproduced from the Environmental Management Plan.

DATE

This document is dated 27 June 1995.

PHOTOS FOR CMT EMP - Sites as per Figure 5.13 and Table 5.3 (pg. 144)

Plate No.	View Point No.	Location	Photo Ref. No.	Notes re Photos
Plate 1	1	Gormanston	CM15/54	Wide angle panorama - 12.05pm 6/6/95
Plate 2	2	Gormy Hills across to dams	CM15/51	Wide angle panorama - 11.55am 6/6/95
Plate 3	2	Gormy Hills across to dams	CM15/50	Normal lens view - 11.55am 6/6/95
Plate 4	3	Lyell Highway opposite Mine entrance	CM16/43	Wide angle panorama - 12.25pm 6/6/95
Plate 5	4	High Point near tailings access track	CM16/52	Wide angle panorama - 1.45pm 6/6/95
Plate 6	4	High Point near tailings access track	CM16/52	Short telephoto lens view - 1.45pm 6/6/95
Plate 7	5	Strahan Road opposite tailings dam west of airport	CM16/46	Photo taken from hill slightly to east of site on map because of vegetation. Wide angle panorama - 12.50pm 6/6/95
Plate 8	6	As above but 2Km west of aerodrome	CM16/48	Taken on hill above road. All this area is covered in burnt out sticks as seen in photo. There is no really good view from anywhere on this section of the road. Wide angle panorama - 1.15pm 6/6/95.
Plate 9	7	Hill in Princess Creek Valley	CM12/42	Wide angle panorama - 12.30pm 19/6/95.



Data Sources:
Topographic Data - Land Information Bureau
Mining Leases - Mineral Resources Tasmania
Lake Burbury and parts of the Lyell Hwy
- Derived from LIB 1:100000 Land Tenure Map

Scale 1:75000

Copper Mines of Tasmania
Mt Lyell Project EMP
Photographic View Points

Figure 5.13

Plate 1

Plate 2

Plate 3

Plate 4

Plate 5

Plate 6

Plate 7

Plate 8

Plate 9

APPENDIX G

CMT POLICY STATEMENTS

COPPER MINES OF TASMANIA

ENVIRONMENTAL POLICY

Copper Mines of Tasmania Pty Ltd strives to set the highest standards in environmental and heritage management. All employees at Mt Lyell must therefore be committed to operating in an environmentally responsible manner.

It is our policy:

- To conduct business in compliance with environmental laws and regulations;
- To recognise and manage environmental risks in a cost effective manner that protects both the environment and our economic future;
- To place a high priority on environmental considerations in planning, constructing, operating, and closing facilities as well as in evaluating new business opportunities;
- To recognise and protect items or areas of significance to Australian heritage;
- To actively promote employee involvement in implementing this policy throughout the Company;
- To place primary responsibility for compliance with environmental laws, regulations, and this policy with operations management; and
- To recognise achievement in effective implementation of this policy as a dimension of employee performance.

Hamish Bohannan
Resident Mine Manager

July 1, 1995

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COPPER MINES OF TASMANIA

OCCUPATIONAL HEALTH & SAFETY POLICY

The goal set by Copper Mines of Tasmania Pty Ltd is to become an exceptionally safe mining and mineral processing operation. To achieve this goal the company is committed to a continuing programme of ensuring that all reasonable precautions are taken to safeguard the health and welfare of all employees and contractors.

Management, in full consultation with employees, is responsible for formulation of this policy. However, it is the responsibility of ALL EMPLOYEES to support the policy and assist in its implementation.

For maximum effect in achieving our goal, your assistance in the following key areas will contribute significantly:

It is our policy that:

- Safety will play an integral part of all tasks, jobs and work practises performed;
- Plant and equipment shall be maintained in safe operating condition at all times;
- Hazards must be identified, reported and corrective action speedily taken to prevent injury or damage;
- Fire prevention will form part of the programme to ensure the safety of personnel and property;
- All employees must contribute to the security of the operation and report any malicious act which may injure persons or damage property;
- Accidents and incidents no matter how small must be reported and investigation must be prompt and be direct to prevent a recurrence;
- All employees must be involved and contribute to safety; and
- Concern for your own and your workmates' safety must be of paramount importance.

Hamish Bohannan
Resident Mine Manager

July 1, 1995

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COPPER MINES OF TASMANIA

HAZARDOUS SUBSTANCES & DANGEROUS GOODS POLICY

The objective of the Copper Mines of Tasmania Hazardous Substances & Dangerous Goods Policy is to evolve practices and adopt the National Code of Practice so as to minimise the risk of adverse health effects resulting from exposure to hazardous substances and dangerous goods in the workplace. It is aimed at developing attitudes that will support the active preservation and enhancement of our environment, for which we are each and severally responsible as individuals.

Hazardous substance and dangerous goods include oils, greases, solvents paints, acids, degreasers, adhesives, welding rods, gases, chemicals, chemical compounds, reagents, ore products, explosive, detonators, fume and vapours.

It is CMT's Policy to:

- Ensure that before hazardous substances and dangerous goods are brought to site, proper approval has been granted and the relevant Material Safety Data sheet for the goods are prepared and on site.
- Provide monitoring of hazardous substances and dangerous goods and control of exposures in the work place.
- Ensure that our workforce and visitors with potential exposure to hazardous substances or dangerous goods have access to information regarding control.
- Ensure all containers of hazardous substances and dangerous goods are adequately labelled and stored in advance with their Dangerous Goods Class.
- Maintain a register and site plan of all hazardous substances and dangerous goods used or produced in the work place.
- Ensure that the CMT Hazardous Substances and Dangerous Goods Register relates to substance and dangerous goods which:
    - are listed on the National Occupational Health & Safety Commission's *"List of Designated Hazardous Substances"*, or,
    - have been classified as hazardous by the manufacturer or importer in accordance with the National Occupational Health and Safety Commission's *"Approved Criteria for Classifying Hazardous Substances"*, or,
    - are listed in the Australian Dangerous Goods Code.

Hamish Bohannan
Resident Mine Manager
July 1, 1995

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COPPER MINES OF TASMANIA

AFFIRMATIVE ACTION POLICY

It is the desire of Copper Mines of Tasmania Pty Ltd to be an equal opportunity employer. In this regard it is our goal to ensure all employees are valued according to how well they perform their duties and their ability and enthusiasm to maintain company standards, rather than with regard to gender, age, race, marital status or other factors not relevant to the execution of this position.

Consistent with this, it is our policy:

- To not tolerate sexual harassment;
- To not discriminate on issues not relevant to job performance;
- To treat all employees on their merits for job performance;
- To energetically support all state and federal anti-discrimination requirements for employment;
- To treat all reports of discrimination seriously and investigate them properly, confidentially and impartially;
- To ensure that people reporting, or being witness to, grievances under this policy are not victimised in anyway;
- To take disciplinary action against anyone who discriminates against a co-worker. This may involve a warning, transfer, counselling, demotion or dismissal depending on circumstances.

Grievances regarding discrimination should be presented to the Affirmative Action Committee for due investigation, reporting and relevant action. Contact the committee via the mine reception.

Hamish Bohannan
Resident Mine Manager

July 1, 1995

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