Appendix A Mount Lyell Remediation Research and Demonstration Program

No	Title	Description	Leaders	Consultants
1	Characterisation of sources of acid drainage from the Mount Lyell lease and surrounds	Overview document detailing the current knowledge on the quantity and quality of effluent water from the lease site.	Mr John Johnston, DELM Dr Chris McQuade, ***oss***	Dr Chris McQuade, ***oss*** Mr John Johnston, DELM Ms Shelley Innes, DELM
2	Remediation options to reduce acid drainage from historical mining operations at Mount Lyell, western Tasmania	The identification of potential short and long term options for managing effluent water from the lease and recommendations for construction and operation of demonstration-evaluation trials.	Mr John Johnston, DELM	John Miedecke and Partners Pty Ltd incorporating Environmental Geochemistry International and ANSTO
2b	Estimation of water quality over time in the King and Queen Rivers, western Tasmania	The use of modelling to rank options for site remediation against their impacts on the water quality at several locations within the King River.	Dr David Klessa, ***eriss*** Dr Lois Koehnken, DELM	Dr David Klessa, ***eriss*** Dr Lois Koehnken, DELM Mr John Johnston, DELM
3	The construction and evaluation of remediation trials on the Mount Lyell mineral field	Construction and evaluation of some remediation options for the lease site as identified in project 2.	Mr John Johnston, DELM Ms Isobel Stanley, CMT	John Miedecke & Partners Pty Ltd Thompson & Brett Pty Ltd
4	Tailings and fluvial processes in the Queen and King Rivers	Assessment of the dynamics of tailings movement within the Queen and King Rivers.	Ms Helen Locher, DELM	Ms Helen Locher, DELM
5	Characterisation and impact assessment of mine tailings in the King River system and delta, western Tasmania	Quantification of the various types of tailings deposits distributed along the river banks and in the delta and the effects of different physico-chemical environments to which each are exposed. Determination of the potential for the tailings to be an ongoing source of metals.	Dr Lois Koehnken, DELM Dr Patrick McBride, ***oss***	Earth Systems Pty Ltd incorporating Monash University Earth Science Department
6	Remediation options for mine tailings in the King and Queen Rivers, western Tasmania	Identification of a range of options for alleviating environmental impacts arising from tailings deposits in the King River and Macquarie Harbour; listing environmental, aesthetic, economic and social attributes both positive and negative for each.	Mr Peter Waggitt, ***oss***	Hydro-Electric Commission in association with Coffey Partners International Pty Ltd
7	The impact of historical mining operations at Mount Lyell on the water quality and biological health of the King and Queen River catchments, western Tasmania	Undertaking of biological surveys of the fresh waters affected by acid drainage and the design of a long term monitoring program which would enable trends and patterns in biota and water quality to be assessed in relation to both remediation activities and other environmental conditions.	Dr Chris Humphrey, ***eriss***	Freshwater Systems Pty Ltd

9A	Toxicity assessment of waters from Macquarie Harbour, western Tasmania, using algae, invertebrates and fish	Estimation of the levels and forms of copper that can be tolerated in Macquarie Harbour waters without causing detriment to fish and other aquatic life.	Dr Patrick McBride, ***oss***	CSIRO Institute of Natural Resources and Environment
9B	Sub-lethal toxicity testing on *Oncorhynchus mykiss* (rainbow trout) in Macquarie Harbour, western Tasmania	Estimation of the levels and forms of copper which can be tolerated by farmed fish in Macquarie Harbour.	Mr Warren Jones, DELM Dr Simon Stanley, DPIF	Department of Primary Industry and Fisheries
10	The rehabilitation of derelict mining infrastructure along the Strahan foreshore, western Tasmania	Rehabilitation of the Macquarie Harbour foreshore between Strahan and the mouth of the King River from the environmental impacts of infrastructure or practises related to mining at Mount Lyell.	Mr Stewart Needham, ***oss*** Mr John Johnston, DELM	Community and government sponsored groups
12	The behaviour of copper in sediments and waters of Macquarie Harbour, western Tasmania	Quantification of the release of metals from the sediments and the conditions under which release will occur.	Dr Lois Koehnken, DELM Dr Patrick McBride, ***oss***	CSIRO Division of Coal and Energy Technology, Centre for Advanced Analytical Chemistry
13A	A pilot biological survey of Macquarie Harbour, western Tasmania	The carrying out of a pilot biological survey of Macquarie Harbour; and determinations of the concentrations and significance of trace metals in edible or potentially edible invertebrates or fish tissues.	Dr Patrick McBride, ***oss***	Water Ecoscience
13B	Monitoring of benthic invertebrates in Macquarie Harbour, western Tasmania	Carry out a baseline survey of invertebrates to assess the recovery of Macquarie Harbour.	Dr Patrick McBride, ***oss***	Mr Nick O'Connor, Water Ecoscience
14	Physical and chemical modelling of Macquarie Harbour, western Tasmania	Development of a hydraulic and chemical model to quantify the impacts of the inputs of the King River and sediments on the Harbour.	Dr Lois Koehnken, DELM Dr David Klessa, ***eriss***	Computational Fluid Dynamics Pty Ltd
15	Copper toxicity trials in mine effluent affected waters, western Tasmania	The use of 'whole effluent' toxicity testing techniques to estimate the effectiveness of various remediation scenarios in enabling the return of aquatic life to the Queen and King Rivers.	Dr Chris Humphrey, ***eriss*** Dr David Klessa, ***eriss***	Environmental Research Institute of the Supervising Scientist

CMT Copper Mines of Tasmania

DELM Department of Environment and Land Management (Tasmanian Government)

DPIF Department of Primary Industries and Fisheries (Tasmanian Government)

eriss Environmental Research Institute of the Supervising Scientist (Federal Government)

oss Office of the Supervising Scientist (Federal Government)

ANSTO Australian Nuclear Science and Technology Organisation

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Appendix B Full costings of remediation options

Table 1 Full costing associated with neutralisation scenarios (figures do not reflect cost offset provided by SX/EW recovery of copper) (all costs in $AUS)

	tailings only 70% of underground treated (45% total)	limestone & tailings 100% underground treated (65% total)	tailings, limestone & lime, 450 L/s, 99% all sources treated
Capital costs			
Neutralisation plant	$1 500 000	$4 000 000	$7 000 000
Holding pond			$1 000 000
Water diversion works			$1 000 000
Total capital	$1 500 000	$4 000 000	$9 500 000
Operating costs			
power	$60 000	$100 000	$150 000
flocculant	$126 000	$126 000	$126 000
maintenance spares	$45 000	$120 000	$183 000
pipe replacement	$20 000	$20 000	$100 000
maintenance manpower	$30 000	$150 000	$200 000
operators		$50 000	$200 000
grinding balls		$9 000	$19 000
limestone purchase		$284 000	$555 000
lime purchase			$500 000
contingency	$42 000	$130 000	$190 000
Total operating	$323 000	$989 000	$2 223 000
Life of plant		15 years	
Interest rate		5%	
Annual cost	$468 000	$1 374 000	$3 090 000
New present value, all costs	$4 853 000	$14 266 000	$32 069 000
Interest rate		10%	
Annual cost	$520 000	$1 515 000	$3 406 000
New present value, all costs	$3 957 000	$11 522 000	$25 905 000
Interest rate		15%	
Annual cost	$580 000	$1 673 000	$3 762 000
New present value, all costs	$3 389 000	$9 783 000	$21 996 000

Table 2 Pipeline costings ($AUS)

	Abt Railway route	Topographic route
Capital costs		
Preliminaries	$250 000	$250 000
Civil engineering	$2 637 000	$6 019 000
Pipeline	$11 130 000	$6 752 000
Bridge repairs	$3 080 000	$1 860 000
Ponds & pumps	$1 954 000	$1 952 000
Electrical & instrumentation	$400 000	$400 000
Engineering	$3 915 000	$2 720 000
Contingency	$3 505 000	$2 993 000
Land acquisition		
Pipeline diffuser	$1 000 000	$1 000 000
Environmental studies	$1 000 000	$1 000 000
Total Capital Costs	$28 870 000	$24 947 000
Operating Costs		
Personnel	$65 000	$65 000
Power	$394 000	$394 000
Maintenance		
year 1–10	$1 075 000	$918 000
year 11–20	$1 343 000	$1 147 000
year 21–30	$1 612 000	$1 377 000
Total operating costs		
year 1–10	$1 534 000	$1 377 000
year 11–20	$1 803 000	$1 606 000
year 21–30	$2 071 000	$1 836 000
Life of pipeline	30 years	
Interest rate	5%	
Annual cost	$3 565 000	$3 130 000
Net present value, all costs	$54 808 000	$48 114 000
Interest rate	10%	
Annual cost	$4 703 000	$4 114 000
Net present value, all costs	$44 338 000	$38 786 000
Interest rate	15%	
Annual cost	$6 002 000	$5 237 000
Net present value, all costs	$39 408 000	$34 386 000
Interest rate	12%	
Annual cost	$5 209 000	$4 552 000
Net present value, all costs	$41 960 000	$36 664 000

Table 3 Costing of SX/EW process ($AUS)

	100 L/s	200 L/s	232 L/s
Capital cost			
acid drainage	$260 000	$408 000	$449 000
solvent extraction	$1 160 000	$2 320 000	$2 555 000
tank farm	$370 000	$581 000	$639 000
electrowinning	$830 000	$830 000	$830 000
utilities	$140 000	$220 000	$242 000
Total capital	$2 760 000	$4 359 000	$4 715 000
Operating costs			
power	$54 000	$72 000	$75 000
labour	$174 000	$174 000	$174 000
organic reagents	$57 000	$112 000	$124 000
sulphuric acid	$16 000	$22 000	$24 000
maintenance	$55 000	$69 000	$71 000
cobalt sulphate	$5 000	$7 000	$7 000
laboratory analyses	$3 000	$3 000	$3 000
marketing	$31 000	$45 000	$47 000
overheads	$200 000	$200 000	$200 000
Total operating	$593 000	$703 000	$725 000
Revenue (copper sales @ 1.05/lb)	$1 271 000	$1 814 000	$1 915 000
Net income	$678 000	$1 111 000	$1 191 000
Life of plant		15 years	
Interest rate		5%	
Annual revenue	$412 000	$691 000	$736 000
NPV (positive asset value)	$4 280 000	$7 174 000	$7 642 000
Interest rate		10%	
Annual revenue	$315 000	$538 000	$571 000
NPV (positive asset value)	$2 399 000	$4 092 000	$4 340 000
Interest rate		15%	
Annual revenue	$206 000	$366 000	$384 000
NPV (positive asset value)	$1 206 000	$2 138 000	$2 246 000