MINERAL RESOURCES TASMANIA

STORYS CREEK ACID DRAINAGE REMEDIATION

ANOXIC LIMESTONE DRAIN DESIGN REPORT

JULY 2000

John Miedecke and Partners Pty Ltd • July 2000

CONTENTS

1.0 INTRODUCTION

The Storys Creek/Rossarden remediation project is a cooperative project between Mineral Resources Tasmania (MRT), the Department of the Primary Industry Water and Environment (DPIWE) and the Commonwealth Department of the Environment. The aim is to design and implement a remediation strategy for the Storys Creek and Rossarden abandoned mine sites to reduce acid and heavy metal discharge into the South Esk River system.

Mineral Resources Tasmania is supervising the acid drainage remediation works at the old abandoned mine workings at Storys Creek and Rossarden. The remediation works are being funded by the State Government though the Rehabilitation of Mining Lands Trust.

The aim is to design and implement a remediation strategy for the Storys Creek and Rossarden abandoned mine sites to reduce acid and heavy metal discharge into the South Esk River system.

Leachate from tailings materials both beside and within the creek bed and from the underground workings were identified the major sources of heavy metal contamination to the creek in a study commissioned by Mineral Resources Tasmania (MRT) in 1998 (John Miedecke and Partners Pty Ltd (JMP) 1998, 1999, 2000a).

As part of the remediation works, the construction of an anoxic limestone drain to generate alkalinity in waters draining into the underground workings is being considered.

This report details a design and costing for the work. Figure 1 shows the location.

2.0 ANOXIC LIMESTONE DRAIN TRIAL

2.1 Purpose

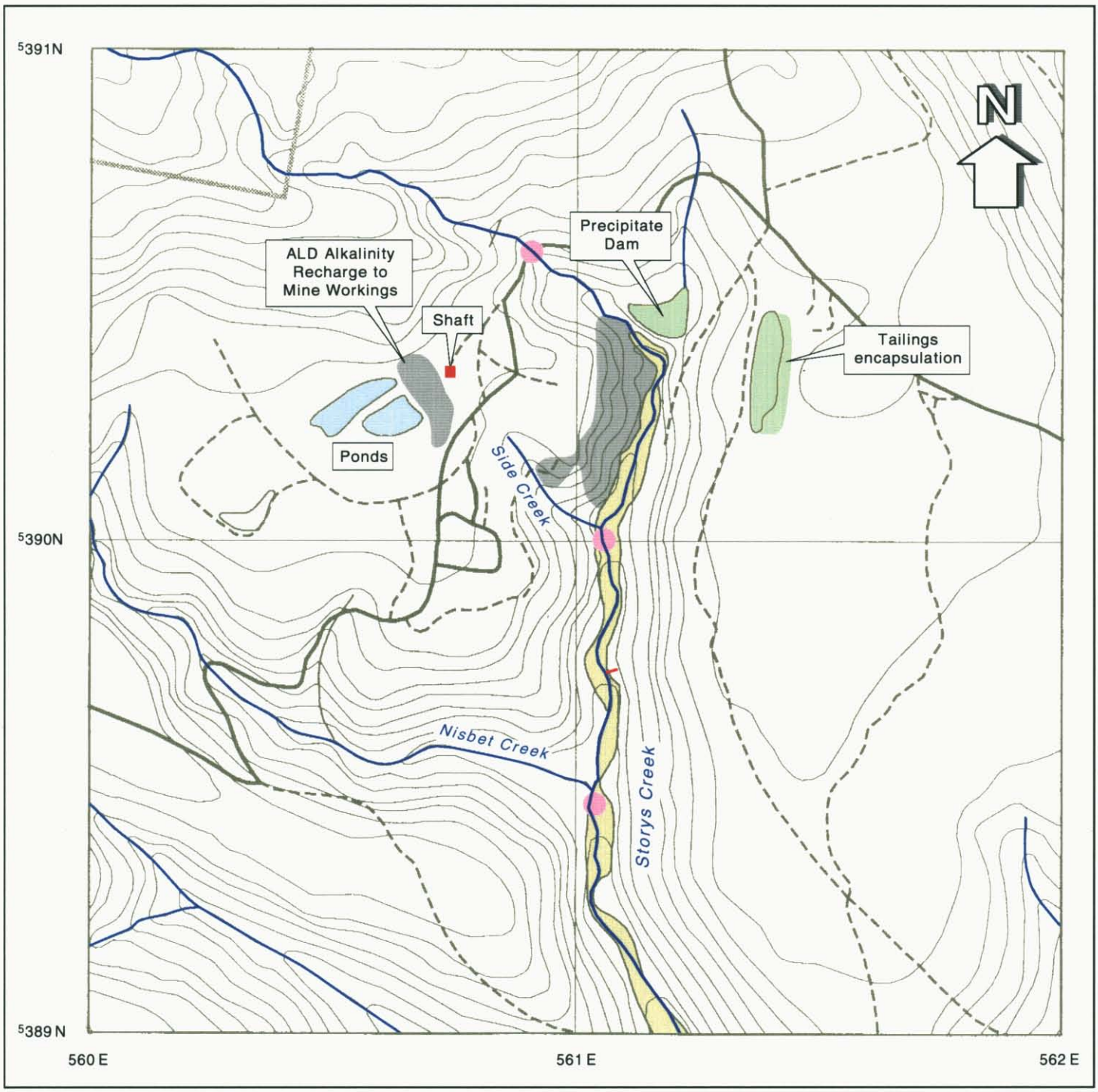
The use of anoxic drains to add alkalinity to uncontaminated surface waters have not previously been trailed. In the past, the use of ALDS has been restricted to treatment of acidic waters as it was not believed that they would be effective in generating significant alkalinity in "clean"waters.

A trial was designed to test if significant alkalinity could be generated and was constructed and operated from October 1998 to late 1999.

2.2 Trial Details

The drain was constructed up-slope from the main shaft and in an area which was saturated from leakage from the ponds constructed in the area for mine use (see Figure 1). The drain was excavated and filled with approximately 20 tonnes of limestone (size approximately 75-100mm), then a layer of hay and horse manure (stable waste), a polythene sheet, and then covered with topsoil.

The design was similar to designs for anoxic limestone drains which have been constructed in the United States, with a retention time of an estimated 16 hours (based on a 10% void area). The horse stable manure with the



1 grid space to 1km

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MINERAL RESOURCES TASMANIA	
Storys Creek Remediation Anoxic Drain Location Plan	
John Miedecke & Partners P/L	FIG 1

(July 2000)

polythene cap was designed to provide the seal so that inputs of atmospheric oxygen are minimised and the accumulation of CO2 within the ALD is maximised and therefore assists in alkalinity generation.

Water was directed to one end of the drain by a pipe, and samples collected at the outflow. Flow rates were controlled at approximately 4L per minute.

2.3 Results

The results are shown in Table 1. Alkalinity generation rates ranged from approximately 50 to 300mg/L. The variation is attributed to inflows of other waters in winter and rain events.

TABLE 1 TRIAL ANOXIC LIMESTONE DRAIN MONITORING RESULTS

PARAMETER (mg/l)						
SAMPLE DATE	Oct-98 Inflow	Outflow Oct-98	Nov-98	Dec-98	Apr-99	Jun-99
Notes			pipe blocked cleared to 4L/min		approx 4l/min	4L/min
pH L	5.8	7.2	7.1	5.3	6.7	6.5
Cond mS/cm L	23	604	673	235	345	120
						affected by other waters

2.4 Conclusions

The drain has proven very effective at generating alkalinity in clean waters and has application for alkalinity recharge. It is believed to be the first such application of such a design, which traditionally have only been believed to be effective in buffering acid drainage sources.

The results were reviewed by Dr Robert Hedin (Pennsylvania USA base consultant) who believes the results are very promising.

The most alkalinity he had seen consistently produced by ALDs (constructed for mine water) is 300-320 mg/L ($CaCO_3$) The current theory on ALD alkalinity generation is that it is largely controlled by high CO_2 in the influent mine water. Dr Hedin has done experimental anoxic limestone incubations of surface water (low CO_2) and found that, after 12 hours, alkalinity values were only 40-50 mg/L. The same devices and conditions produce 280-300 mg/L alkalinity with "fresh" CO_2-rich mine water.

Therefore, Dr Hedin believes that the organic cap on the ALD may be an important source of CO_2 and high alkalinity. He has recommended additional monitoring of influent and discharge pH (measured in the field) and the use a simple carbonate model to calculate CO_2 partial pressures, as well as Ca and Mg and concentrations. If CO_2 partial pressures are much higher at the effluent, it is suspected that the organic matter is playing more of a role than just acting as an oxygen barrier.

With respect to the life, the alkalinity generation rates indicate that the life of the drain would be approximately 20 years. The life of the anoxic layer which is the organic substrate in the system -- is not readily calculated. However, If data from the SAPS systems is indicative, the organic layer might be exhausted in 5-10 years.

3.0 ANOXIC LIMESTONE DRAIN

3.1 Purpose

A trial has shown that significant alkalinity can be generated and the details of a full scale ALD designed to generate the required alkalinity is discussed below.

3.2 Alkalinity Generation Rates

Table 2 shows the calculated pollutant loads in the Storys Creek and Aberfoyle Creek catchments.

As the mine drainage now very rarely exits in Side Creek through the old adits, the total acidity load in Storys Creek below Side Creek is believed to be indicative of the total loads including the mine drainage.

It is recognized that substantially higher loads will be experienced after rainfall events and in particular the initial "flush".

However, the data indicates that the total acidity load in the average flow conditions in Storys Creek below Side Creek will be in the vicinity of 69kg per day (expressed as CaCO3 equivalent).

3.3 ALD Design

Based on the findings of the trial and recommendations from Dr Hedin that flow rates could be doubled, an ALD with a capacity of 1100 tonnes of limestone, based on an alkalinity generation rate of 150mg/L would be sufficient to generate 86kg/day of alkalinity into the mine workings.

This ALD would have a design life of 25 years, with the organic component having a life of probably some 5 to 10 years.

The drain can be located up-slope from the main shaft and in an area which is saturated from leakage from the ponds (see Figure 2).

The drain would be excavated to a depth of approximately 2.5 m and filled with approximately 1100 tonnes of limestone (size approx 75-100mm). A layer of organic material - comprising manure/feedlot waste mixed with hay would be placed on the surface and capped with polythene and then covered with topsoil. Figure 3 shows the design layout. A pipeline would deliver water from the existing ponds at a rate of approximately 6L/second to the drain and an open channel would direct the alkaline water to the shaft.

Figure 2 shows the location plan.

3.4 Monitoring

Based on the findings of the trial and recommendations from Dr Hedin, additional water quality monitoring is recommended to confirm the

MINERAL RESOURCES TASMANIA	
Storys Creek Remediation ALD Design Plan	
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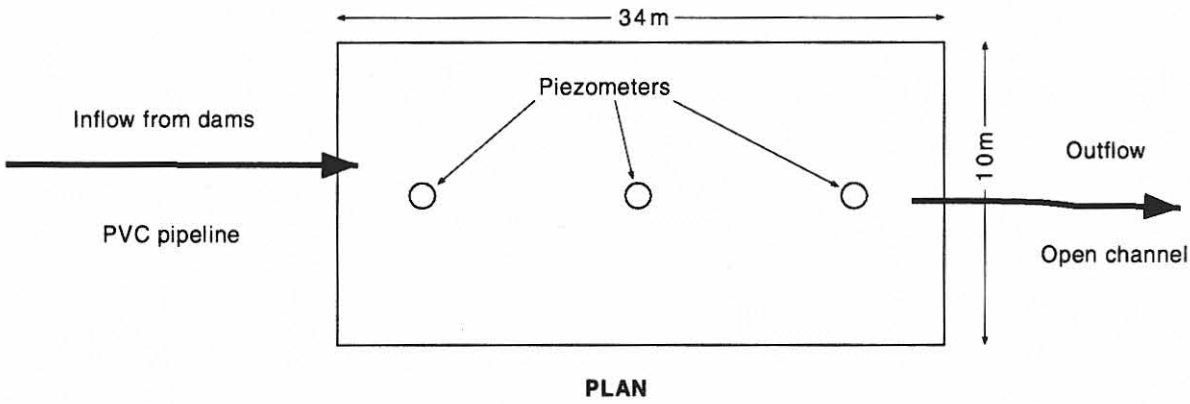
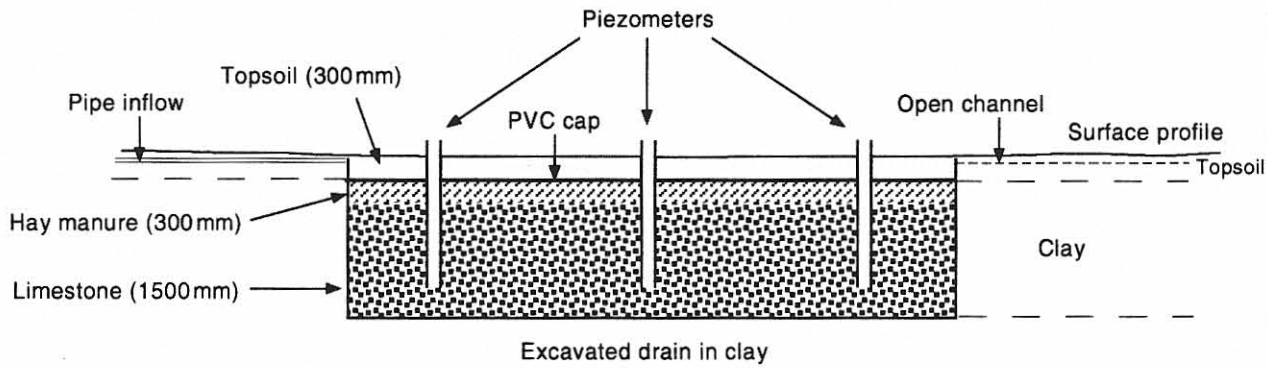


PLAN



SECTION

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MINERAL RESOURCES TASMANIA	
Storys Creek Remediation Anoxic Limestone Drain Design	
John Miedecke & Partners P/L	**FIG 3**

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Table 2 Acid Drainage and Metals Loads in Storys Creek
1097 data

LOCATION refer Hydro report PARAMETER SAMPLE DATE	1 SC ab M kg/day	2 SC b TD kg/day	3 SC b Side kg/day	4 SC b NC kg/day	5 SC b res kg/day	6 SC at Ros kg/day	7 SC a AC kg/day	8 SC b AC kg/day	9 SC a SE kg/day
FLOW L/sec	41	42	40	98	153	216	220	394	470
pH L	5.8	5.7	5.1	5.4	5.3	5.7	5.6	6.0	6.4
pH F	7.6	6.2	5.3	5.9	5.8	5.9	6.0	6.9	6.9
Acidity (CaCO3)	7.1	18.1	69.1	50.8	105.8	93.3	114.0	34.0	40.6
Alkalinity (CaCO3)	39.0	14.5	3.5	16.9	13.2	18.7	19.0	442.5	649.7
NFR (suspended solids)	3.5	39.9	17.3	59.3	79.3	56.0	19.0	34.0	40.6
Hardness (CaCO3)	24.8	61.7	127.9	271.0	356.9	242.6	323.1	1191.5	1705.5
SO4	1.9	79.8	207.4	338.7	475.9	485.2	361.2	919.1	1218.2
Metals									
Al T	0.4	2.5	6.9	8.5	11.9	11.2	7.6	13.6	12.2
Al F	0.4	0.4	3.5	3.4	5.3	5.6	3.8	3.4	4.1
Cd T	0.0	0.3	0.5	0.7	1.0	1.1	0.9	1.3	1.3
Cd F	0.0	0.3	0.5	0.7	1.0	1.1	0.9	1.2	1.2
Cr T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cr F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cu T	0.0	0.7	1.6	2.2	3.5	3.6	1.8	2.3	2.4
Cu F	0.0	0.3	1.5	1.9	3.1	3.2	1.5	1.5	1.2
Fe T	0.4	10.9	10.4	8.5	10.6	7.5	1.9	10.2	12.2
Fe F	0.4	0.4	6.9	2.5	5.3	3.7	1.9	3.4	4.1
Hg T	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hg F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mn T	0.4	0.7	2.1	5.1	5.3	5.6	3.8	10.2	8.1
Mn F	0.4	0.7	2.1	4.2	5.3	5.6	3.8	10.2	8.1
Ni T	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2
Ni F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pb T	0.0	0.0	0.0	0.1	0.7	0.0	0.0	0.0	0.0
Pb F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sb T	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2
Sb F	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2
Sn T	0.0	0.0	0.0	0.1	0.3	0.2	0.2	0.3	0.4
Sn F	0.0	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.4
Zn T	0.0	8.8	15.7	21.2	30.8	33.8	27.0	38.1	40.2
Zn F	0.0	8.3	15.4	20.6	30.1	33.0	26.2	35.1	36.4

mechanisms of alkalinity generation. This is being conducted on the existing trial which is still operating.

3.5 Costs

The estimate of costs for the construction of the full scale ALD is $ 70,000.

The cost breakdown is shown in Table 3.

TABLE 3 ESTIMATE OF COSTS

Item	**Cost $**
Establish	750
Excavate and prepare trench	2700
Limestone supply and place	42750
Manure mix supply and place	4050
Polythene capping	900
Pipework etc	200
Labour	1200
Supervision	2200
Profess	1760
Travel	440
Meals accom	750
Subtotal	57700
GST	5770
TOTAL	$63470
Contingency 10%	6347
Total	**$69817**

REFERENCES

Miedecke 1997; John Miedecke and Partners, 1997. Storys Creek/Rossarden Acid Drainage Remediation Study - Stage 1 Interim Report. September 1997.

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