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**DEVELOPMENT PROPOSAL**  
**AND**  
**ENVIRONMENTAL MANAGEMENT PLAN**  
**TO**  
**OPERATE A MINE**  
**AND**  
**BENEFICIATION PLANTS**  
**FOR**  
**THE PRODUCTION OF PIGMENT**  
**AT**  
**SAVAGE RIVER**  
**AND**  
**ON THE NORTH-WEST COAST**

RL 8802

March 1993

Savage Resources Limited

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**ENVIRONMENTAL MANAGEMENT PLAN**

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**AND**

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March 1993

Avage Resources Limited

## APPLICATION FOR A LICENCE TO OPERATE A SCHEDULED PREMISES

The following information has been prepared using guidelines furnished by the Department of Environment and Land Management, Division of Environmental Management.

The purpose of the Development Proposal and Environmental Management Plan (DP & EMP) is to provide the Director of Environmental Control with sufficient information for him to assess an application for a licence to operate a scheduled premises under the Environment Protection Act, 1973.

The management prescriptions set down in the DP & EMP form the basis of the conditions under which the licence to operate will be granted.

The document also fulfils the role of providing information about the proposal to other decision making authorities (e.g. Local Government) and the public, which has the opportunity to formally object to the issuing of the licence.

It is a statutory requirement of the Environment Protection Act 1973 that applications are advertised and a 30 day period is allowed for objections to be lodged. The Department of Environment and Land Management has required that this document should be placed on public display during the formal objection period so that the public may be aware of the development, proposed environment protection measures and likely residual impact and disturbance.

Readers are advised of their right to lodge a formal objection to the application for a licence during the statutory objection period. Objections must be lodged on the prescribed form which is available from the Department. Readers are also invited to submit comments on the proposal, including in support of it, to the Department of Environment and Land Management.

Objections or submissions should be sent to:

The Director of Environmental Control  
Department of Environment and Land Management  
GPO Box 1396P  
HOBART TAS 7001

Further information may be obtained from the Department by telephone on (002) 336 366.

The statutory objection period for this application closes on

## SUMMARY

This Development Proposal and Environmental Management Plan is submitted by Savage Resources Limited in support of a proposal to mine and beneficiate pigmentary grade iron oxide material (pigment).

This document is the culmination of five years investment in the exploration, development, research and marketing of Tasmanian pigment material and it details those aspects necessary for its commercialisation.

The development consists of the mining of the raw material from three deposits located approximately 5 kilometres south-west of the Savage River township, the beneficiation of this material within the confines of the Savage River Mines Lease area and the marketing/refining of the pigment at a location not far from the Port of Burnie.

There is no infrastructure requirement other than that available at the Savage River township and on the north-west coast of Tasmania.

The total ore resource is estimated to include some 350,000 combined tonnes of refined pigment consisting of yellow (ochre), brown (umber) and red colours. Annual pigment production is expected to be 10,000 tonnes although only 5,000 tonnes per annum is expected to be produced for the first two years of operation.

The mining operation is small in comparison to the size of the resource and the reserve of material is expected to support a mining operation well into the next century. The mining is to be seasonal and confined to the summer months. The mining of the material is by way of a number of shallow open pits each of which will not extend over an area greater than 0.75 hectares.

The beneficiation site is to be constructed adjacent to the Savage River Mine old tailings area. This process will be continuous, at first on a day time basis but later to include a 24 hour per day operation.

The solid tailing material from the beneficiation process will cap the existing barren, acidic and sulphide rich tailings of the Savage River Mine operation. The new tailings will be composed of clays and weathered materials and will have a good revegetation potential for the establishment of native species. The waste water will conform to all emission standards and will be discharged via pipework to Main Rivulet.

The Savage River Mines Rehabilitation Plan (1990) is in no way affected by this proposal.

The proposal utilises all Australian technology and the downstream value added implications remain in Tasmania. The Tasmanian pigment will be of a quality comparable or better than commercially available natural pigments.

Iron oxide pigments are characterised by their high chroma and are non-toxic and relatively inert. They have a wide use as colouring agents in paint, plastic, rubber, concrete and pharmaceutical applications. The Australian market for iron oxide pigment is approximately 10-12,000 tonnes of which imports account for some 8-10,000 tonnes.

It is envisaged that the high value of the iron oxide end product, the extensive shallow reserves, the comprehensive range of colours exhibited and the proximity of the deposits to existing infrastructure will result in a long standing industrial minerals development for the north-west coast of Tasmania.

## TABLE OF CONTENTS

	Page
<b>TABLE OF CONTENTS</b> .....	4
<b>TABLE OF FIGURES</b> .....	7
<b>TABLE OF APPENDICES</b> .....	8
<b>1. INTRODUCTION</b> .....	9
<b>1.1 Other Requirements</b> .....	10
<b>2. RESOURCE INFORMATION</b> .....	11
<b>2.1 Pigmentary Grade Iron Oxides - Savage River</b> .....	11
<b>2.1.1 Ore Resource Estimates</b> .....	12
<b>2.2 Iron Oxides - General</b> .....	14
<b>2.3 Production</b> .....	15
<b>2.4 Australian Market</b> .....	15
<b>2.5 World Markets</b> .....	15
<b>2.6 Prices</b> .....	15
<b>3. LAND CLASSIFICATION</b> .....	18
<b>3.1 Land and Mining Lease Tenure</b> .....	18
<b>3.2 Present Use and Ownership of Land</b> .....	18
<b>4. TECHNICAL STUDIES OF THE DEVELOPMENT SITE AREAS</b> .....	19
<b>4.1 Flora Information</b> .....	19
<b>4.1.1 Mine Site Area - HT Drillsite area</b> .....	19
<b>4.1.2 Mine Site Area - Bowry Creek Area</b> .....	19
<b>4.1.3 Beneficiation Site</b> .....	20
<b>4.2 Fauna Information</b> .....	20
<b>4.3 Soil Information</b> .....	20
<b>4.3.1 Mine Site Areas</b> .....	21
<b>4.3.2 Beneficiation Site</b> .....	21
<b>4.4 Geological Information</b> .....	21
<b>4.4.1 Mine Site Areas</b> .....	21
<b>4.4.2 Beneficiation Site</b> .....	22
<b>4.5 Groundwater Information</b> .....	23
<b>4.5.1 Mine Site Area - HT Drillsite area</b> .....	23
<b>4.5.2 Mine Site Area - Bowry Creek Umber Site</b> .....	23
<b>4.5.3 Beneficiation Site</b> .....	23
<b>5. DEVELOPMENT PROPOSAL</b> .....	24
<b>5.1 Access</b> .....	24
<b>5.1.1 Upgrading - Mine Access, HT Drillsite Area</b> .....	24
<b>5.1.2 Upgrading - Mine Access, Bowry Creek Umber Site</b> .....	25
<b>5.1.3 Beneficiation Site</b> .....	25
<b>5.2 Truck Movements</b> .....	25
<b>5.2.1 Bowry Creek Umber Material</b> .....	25

5.2.2	HT Ochre Material	25
5.2.3	Delivery to Burnie	26
5.3	Hours of Operations	26
5.4	Timber Salvage	26
5.5	Mining Operations	26
5.5.1	Mining Method	27
5.5.1.1	HT Ochre Site Mining Area 3/3	27
5.5.2	Machinery and Equipment to be Used	27
5.5.3	Quantities of Material to be Mined	27
5.5.4	Mining Infrastructure	28
5.6	Beneficiation Operations	28
5.6.1	Processing Method	28
5.6.2	Equipment List	29
5.6.2.1	Feed Preparation	29
5.6.2.2	Wet Processing	30
5.6.2.3	Drying, Milling and Bagging	30
5.6.3	Water Consumption and Use	30
5.6.4	Liquid, Solid and Atmospheric Wastes	30
5.6.4.1	Liquid waste	30
5.6.4.2	Solid Waste	31
5.6.4.3	Atmospheric Waste	31
5.6.5	Treatment and Disposal of Tailings	31
5.6.6	Storage	31
5.6.7	Beneficiation Infrastructure	31
5.7	Coastal Facility	31
6.	<b>ENVIRONMENTAL MANAGEMENT PLAN</b>	32
6.1	Source of Water for Processing	32
6.2	Waste Water Emissions	33
6.2.1	Beneficiation site	33
6.2.2	Mine Sites	34
6.2.3	Coastal Facility	35
6.3	Atmospheric Emissions	35
6.3.1	Beneficiation site	35
6.3.2	Mine Sites	36
6.3.3	Vehicles and Mining Machinery	36
6.3.4	Coastal Facility	36
6.4	Noise Emissions	36
6.4.1	Beneficiation site	36
6.4.2	Mine Site, Cartage Routes and Coastal Facility	36
6.5	Solid Waste Disposal	37
6.5.1	Beneficiation Site	37
6.6	Rehabilitation	38
6.6.1	Mine Site Areas	39
6.6.2	Access to Mine Sites	39
6.6.3	Beneficiation Site	39
6.6.4	Seed Collection, Planting/Application Time and Source of Top soil	41
6.7	Hazardous Materials	41
6.7.1	Beneficiation Site	41

6.7.2	Mine Sites	42
6.7.3	Coastal Facility	42
6.8	Fire	42
6.8.1	Beneficiation Site	42
6.8.2	Mine Site Areas	42
6.9	Visual Impact	42
6.9.1	Beneficiation Site	42
6.9.2	Mine Site Areas	43
6.9.3	Coastal Facility	43
6.10	Impact on Flora and Fauna	43
6.10.1	Beneficiation Site	43
6.10.2	Mine Site Area - HT Drillsite Area	43
6.10.3	Mine Site Area - Bowry Creek UMBER Site	43
6.11	Archaeology	43
6.12	Monitoring and Review	44

**TABLE OF FIGURES****SCALE**

1.	RL 8802 - CML 46M/90 Location Plan	1: 50,000
2.	HT Location Plan	1: 2,500
3.	Umber Location Plan	1: 1,000
4.	Pigment Project Tenure	1: 25,000
5.	HT Ochre Site with Preferred Sites	1: 10,000
6.	HT Ochre Site Detail	1: 2,000
7.	Umber Site with Preferred Site	1: 10,000
8.	Umber Site Detail	1: 2,000
9-13.	Preferred Site 3/3 Conceptual Mining Profiles	
14.	Conceptual Flow Diagram for Beneficiation Process	
15.	Conceptual Plant Layout for Beneficiation Process	
16.	Location of Beneficiation Plant	1: 5,000

**TABLE OF APPENDICES**

- APPENDIX 1** Environment Protection (Water Pollution) Regulations 1974  
Appendix to Schedule II
- APPENDIX 2** Environment Protection (Atmospheric Pollution) Regulations 1974  
Appendix to Part II of Schedule I
- APPENDIX 3** Native Species Seed Mix and Seedlings
- APPENDIX 4** Archaeological Survey Document
- APPENDIX 5** *A Supplementary report to the Development proposal and environmental management plan...*

## 1. INTRODUCTION

Savage Resources Limited (Savage) is an Australian owned public company listed on the Main Board of the Australian Stock Exchange (Sydney) with about 800 share holders. Savage is incorporated in Tasmania and has a significant number of Tasmanian shareholders.

Savage's principal project areas are located in the eastern seaboard states, western Queensland and Tasmania, and extend to include:

- mining, minerals processing and exploration; with interest in the metals, industrial minerals and coal sectors of the resources industry.

Savage has had a long association with Tasmania, in particular the mining areas of the west coast, through its acquisition of the exploration and mining tenements of the late Mr. Roy Hudson whose entrepreneurial skills contributed to the development of the joint venture known as Savage River Mines.

It is within one of these tenements that some 25 years of exploration commitment was rewarded with the discovery of a world class resource of variously coloured pigment material.

In comparison to the size of the resource so far identified the development proposal is small, sustainable well into the next century and ensures that all downstream value added remains firmly within Tasmania.

Savage has engaged the services of a number of Tasmanian and mainland research organisations and it is with the application of Australian-based technology that Savage will exploit and develop the resource.

This proposal will create a new industry for Tasmania and will provide a number of direct and indirect employment opportunities both on the north-west coast and within one of Tasmania's more isolated areas. Economic implications extend beyond the local community to benefit Australia by:

- reduction of Australian pigment industries' dependence upon overseas technology and product and,
- lower imports and increased exports and,
- development of research and technological patents to promote the export of Australian technology overseas.

The intrinsically small scale of the development proposal requires little additional infrastructure commitment to that already available. Research and support equipment employed for pigment production will require only moderate alterations to expand production from current pilot scale levels up to those quantities necessary for commercial operations.

The relative ease of plant construction and development start-up is reflected in the likely time frame outlined below, the start of which is dependent upon the issue of all necessary authorities:

0 - 6 months	site preparation, construction of plant, extraction and stockpile of material
7 -24 months	pigment production at between 1000 to 5000 tonnes per year
25-36 months	pigment production at between 5000 to 10,000 tonnes per year
37-60 months	pigment production in excess of 10,000 tonnes per year

*Table 1. Time frame for the Proposal*

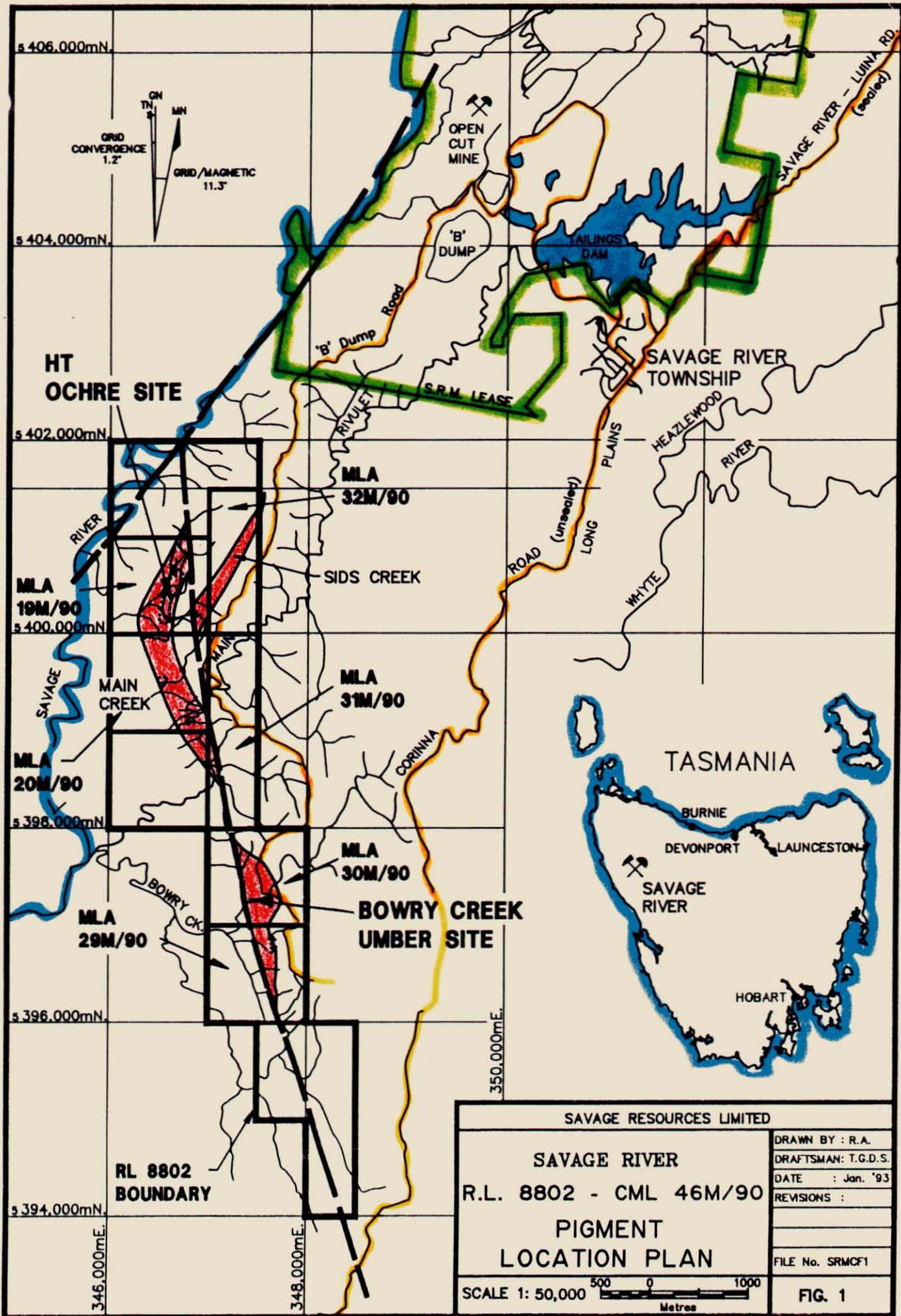
### 1.1 Other Requirements

Application for the issue of a Consolidated Mining Lease No. 46M/90 was lodged with the Department of State Development and Resources, Division of Mines on the 7 September 1990. The Department has informed Savage that the tenement will be granted upon the posting of an environmental bond.

On the 12 January 1993 the Council of the Shire of Waratah issued Savage with all planning approvals necessary to undertake the extraction and processing of material for pigment production. Planning approval is subject to the undertaking of a substantial commitment to the proposal within two years and the following clauses:

- that the operation is conducted in accordance with any lease issued by the Department of State Development and Resources.
- that the operation is conducted in compliance with the Licence to Operate a Scheduled Premises issued by the Department of Environment and Land Management and,
- that any erection of building must have approval under the Building Regulations 1978.

The commencement of any aspect of this proposal is dependent upon the submission of this DP & EMP and the grant of a Licence to Operate a Scheduled Premises.



SAVAGE RESOURCES LIMITED	
SAVAGE RIVER	
R.L. 8802 - CML 46M/90	
PIGMENT	
LOCATION PLAN	
SCALE 1: 50,000	500 0 1000 Metres
DRAWN BY : R.A.	REVISIONS :
DRAFTSMAN : T.G.D.S.	
DATE : Jan. '93	
FILE No. SRMCF1	
FIG. 1	

N.W. Coast Computer Aided Drafting Centre. Phone (004 354315)  
Fax. (004 354495)

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## 2. RESOURCE INFORMATION

The Main Creek pigment deposits, located between 3 and 5 kilometres south-west of the Savage River township in north-west Tasmania, were discovered in 1982.

The deposits contain pigmentary grade iron oxides, classifiable as yellow (ochre), brown (umber) and red (sienna), and conform to both the American and British Standards for "iron oxide pigment".

As pigments iron oxides have wide application in industry for their colouring properties.

### 2.1 Pigmentary Grade Iron Oxides - Savage River

Savage has spent the last ten years exploring and developing the commercial aspects of a variety of minerals in the Savage River area. It has been in the last five years that our attention has focussed on the exploration and development of the iron oxide material.

There are three contiguous deposits of pigment known as:

- Sids Creek Extended,
- Main Creek Deposit and,
- Bowry Creek Deposit.

The total area of these is approximately a little over 1 square kilometre (Fig. 1).

It occurs as both residual and transported material in a superficial deposit up to some tens of metres in thickness. Current observations indicate that the material is formed as a result of the weathering of the underlying magnesite rock.

Two areas are of particular interest to the pigment industry:

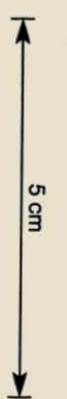
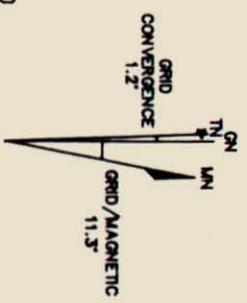
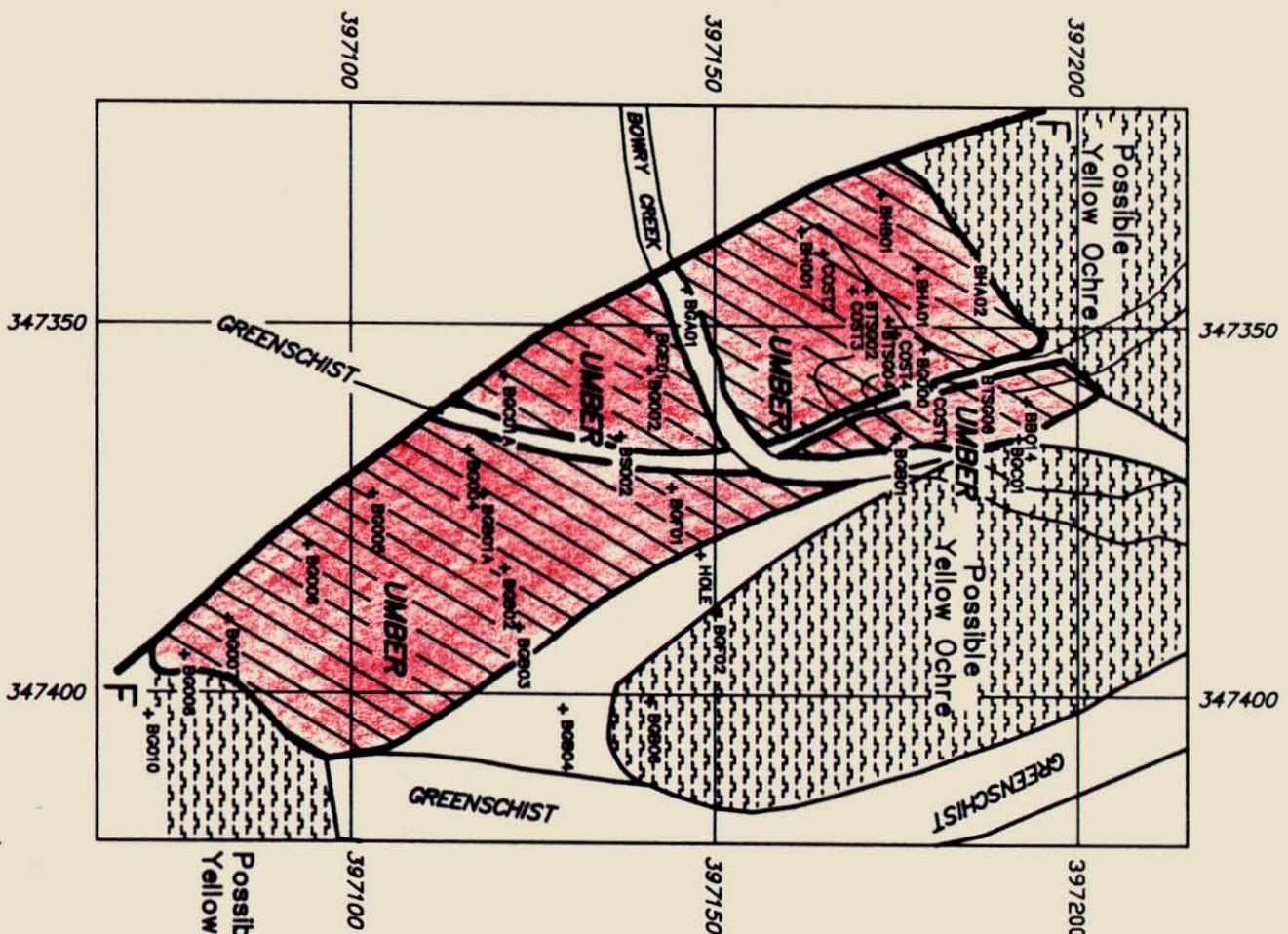
- the "yellow" ochres of the HT ochre site, within the Main Creek Deposit (Fig. 2) and,
- the "brown" umbers of the Bowry Creek umber site, within the Bowry Creek Deposit (Fig 3).

While exploration has not been confined to these two areas the majority of the sampling programme and all of the development work have been applied to the refinement and commercial potential of these "yellows" and "browns".

In-house research and laboratory testwork, together with the research efforts of several commercial and engineering establishments, has interpreted and presented many hundreds of samples to a database system.



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Savage Resources Limited	
Savage River	
R.L. 8802 - CML 46M/90	
Bowry Creek	
UMBER RESOURCE	
Scale 1:1,000	FIG. 3
Drawn by: R.A.	
Draftsman: T.G.D.S.	
Date: Jan. '93	
Revisions:	
File No. SRMCF3	

Samples have been subjected to scanning electron microscope work, total ferrous and selected non-ferrous geochemistry, XRD, particle size analysis, sub-micron sizing, microporosity as well as other proprietary testwork.

While the details of this are beyond the scope of this report it is appropriate to indicate that the refined pigments produced from Savage River are comparable to, or better than, commercially available natural pigments.

### 2.1.1 Ore Resource Estimates

The following resource information has been compiled from various press release statements given to The Australian Stock Exchange (Sydney) Board.

The ore resource estimates for the HT ochre and Bowry Creek umber sites have been derived using a computer database. The database is comprised of over 2000 data points, each of which is referenced to geotechnical and laboratory testwork to include:

- sample interval (location, depth, interval, etc),
- rock description (matrix, contaminants, rock type),
- colour (mass, dispersed and slip colours), and
- laboratory work (S.G., recovery factor, assay and colour aspects).

The ore resource estimate has been calculated using a Polygon Ore Reserve method. The algorithms use a 12 sided polygon whose radius is at most either 5, 10, 20, 30 or 40 metres. Two assumptions are necessary for the reserve estimate:

- a specific gravity of 1.24 g/cc for the material; based on field and laboratory examinations and,
- a pigment recovery factor which is variable and dependent upon the amount of contaminant material; in all cases the database recovery factor is lower than the laboratory testwork yield.

The ore resource estimates of recoverable or refined pigment have been reported in three ways:

- a total ore resource; the area of which is defined by the extremities of the drill hole information and,
- a preferred site resource; where the data density is sufficient to outline those areas within the above resource that have large quantities of near-surface ochre material and,
- a preferred site near-surface resource; the above resource is further refined to provide an estimate of the ochre material lying between 2.5 and 10 metres beneath the surface.

	Yellow	Brown	Red	TOTAL
measured	12,100	13,800	4,300	30,200
indicated	23,000	29,000	7,000	59,000
inferred	95,000	132,000	33,000	260,000
<b>TOTAL</b>	<b>130,100</b>	<b>174,800</b>	<b>44,300</b>	<b>349,200</b>

Table 2. Total ore resource for the HT ochre site

	Yellow	Brown	Red	TOTAL
measured	8,700	10,800	2,500	22,000
indicated	16,000	22,000	4,000	42,000
inferred	54,000	82,000	8,000	144,000
<b>TOTAL</b>	<b>78,700</b>	<b>114,800</b>	<b>14,500</b>	<b>208,000</b>

Table 3. Preferred site resource for the HT ochre site

	Yellow	Brown	Red	TOTAL
measured	6,100	6,000	1,600	13,700
indicated	10,900	12,500	2,400	25,800
inferred	39,500	45,000	7,000	91,500
<b>TOTAL</b>	<b>56,500</b>	<b>63,500</b>	<b>11,000</b>	<b>131,000</b>

Table 4. Preferred site near-surface resource for the HT ochre site

	Brown (umber)
measured	-
indicated	-
inferred	1800 tonnes per vertical metre of umber
<b>TOTAL</b>	<b>10,000 (assuming average thickness of 5.5 metres of umber material)</b>

Table 5. Preferred site near-surface resource for the Bowry Creek umber site

The life of the mining operations, based on the resource estimates known to date, are projected to continue well into the next century.

The mineral resource estimates quoted in this report conform to the "Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves, Report of the Joint Committee of the Australasian Institute of Mining and Metallurgy and Australian Mining Industry Council" of June 1988 and have been prepared under the direction of, and signed by, a "Competent Person".

## 2.2 Iron Oxides - General

Iron oxides have had application from the earliest times as fine coloured powders. In modern times they have wide application as colouring agents in paint, brick and tiles, wood stains, plastics, rubber, pet food, face powder and pharmaceutical capsules.

Iron oxides may be either natural-mineral pigments or synthetically produced pigments which are made from basic chemicals.

Iron oxide pigments are characterised by high chroma and excellent light fastness. They are non-toxic, non-bleeding and relatively inert. These characteristics, plus their relatively low cost, have contributed to making iron oxide second only to titanium dioxide (white pigment) as the most important inorganic pigment.

Iron oxides come in a variety of colours, the range being extended through calcination and blending. Haematite contributes a red colour; limonite yellow; and magnetite brown to black. Commercially the natural pigments show a gradation of shades from yellows (ochre), oranges (sienna) and reds (burnt sienna) through to dark browns (umber) and blacks.

Typical chemical composition (in percent) of natural iron oxide pigments is as follows:

	Ochre	Sienna	Umbre
Fe <sub>2</sub> O <sub>3</sub>	17-60	25-75	37-60
SiO <sub>2</sub>	35-50	10-35	16-35
Al <sub>2</sub> O <sub>3</sub>	10-40	10-20	3-13
MnO <sub>2</sub>	-	-	11-23
Loss on Ignition	10-12	15-20	10-15

Table 6. Typical Analysis of Commercial Iron Oxides

### 2.3 Production

World natural iron oxide production is difficult to estimate, but is of the order of 250,000 to 300,000 tonnes per annum principally from India, Spain and the United States. Of this approximately 60% is red, 30% is brown and 10% is yellow.

The principal synthetic iron oxide producers are Germany (Bayer), the United States (Pfizer and Harcros), Canada (Northern Pigments), China and Japan. Numerous other countries produce on a smaller basis.

### 2.4 Australian Market

The Australian market for iron oxide pigments is approximately 10-12,000 tonnes per annum of which imports account for approximately 8-10,000 tonnes. The principal producers are Tubemakers of Australia Limited (1,000 tpa) and Commercial Minerals Limited.

Australia has the highest per capita consumption of iron oxide pigments in the world. The major consumer of pigments in Australia is the construction industry which consumes approximately 80%.

Potential exists for markedly increased iron oxide consumption should "through pigmenting" of cement products such as roofing tiles commence.

### 2.5 World Markets

Generally, worldwide demand for iron oxides is strong, mainly as a result of the underpinning of the construction industry with demand resulting in lengthening delivery times. Construction demand has mainly resulted from the increasing popularity of concrete block pavers, a trend which is readily evident in Australia.

In the past synthetics have enjoyed higher prices than natural iron oxides due principally to their superior performance characteristics which are particularly required in the paint and coatings industries. However, while paints and coatings represent a large market sector, the sector has achieved only moderate growth.

In less high performance areas such as the construction industry, high quality natural pigments with good tinctorial strength can compete equally with synthetics but at a lower price.

### 2.6 Prices

The tables below and on the following page outline the quantity and value of imported iron oxides into Australia between 1989 and 1992 for the major exporting countries.

**Black Iron Oxides (Tonnes)**

ORIGIN	YEAR				VALUE A\$'000
	1989	1990	1991	1992	1992
GERMANY	3409	2343	2413	2280	3137
USA	335	132	2706	846	1255
CHINA	564		108	278	220
BELGIUM	52	224			
<b>TOTAL</b>	<b>4360</b>	<b>2699</b>	<b>5227</b>	<b>3404</b>	<b>4612</b>

**Brown Iron Oxides (Tonnes)**

ORIGIN	YEAR				VALUE A\$'000
	1989	1990	1991	1992	1992
GERMANY	498	8	29	129	292
USA	102	21	59	39	81
CHINA				29	31
BELGIUM	21				
UK	57	58	41	58	101
NETHERLANDS	16				
<b>TOTAL</b>	<b>694</b>	<b>87</b>	<b>129</b>	<b>255</b>	<b>523</b>

**Red Iron Oxides (Tonnes)**

ORIGIN	YEAR				VALUE A\$'000
	1989	1990	1991	1992	1992
GERMANY	2449	1423	148	1573	3054
USA	147	331	346	493	959
SPAIN	202	184	200	240	103
CHINA			189	284	272
MEXICO	162	97			
UK		104	129	75	141
ITALY				140	240
HONG KONG				109	97
<b>TOTAL</b>	<b>2960</b>	<b>2139</b>	<b>1012</b>	<b>2914</b>	<b>4866</b>

## Yellow Iron Oxides (Tonnes)

ORIGIN	YEAR				VALUE A\$'000
	1989	1990	1991	1992	1992
GERMANY	869	744	724	887	2095
CHINA	364	436	433	639	408
UK	267	209	218	253	406
BRAZIL	113	112	95	68	87
USA	34	74	37	107	266
HONG KONG				25	15
<b>TOTAL</b>	<b>1647</b>	<b>1575</b>	<b>1507</b>	<b>1979</b>	<b>3277</b>

<b>GRAND TOTAL ALL COLOURS</b>	<b>10212</b>	<b>6526</b>	<b>7879</b>	<b>8552</b>	<b>13278</b>
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*Table 7. Iron Oxides - Imports into Australia 1989 - 1992*

*Source: Australian Bureau of Statistics*

### 3. LAND CLASSIFICATION

#### 3.1 Land and Mining Lease Tenure

Land tenure classification of the land affected by the development proposal is given below (Figs. 4 and 4a):

Site	Tenement	Land Classification
Mine Area	ML 19M/90*	State Forest - Multiple Use Forest Land
	ML 20M/90*	State Forest - Multiple Use Forest Land
	ML 29M/90*	State Forest - Multiple Use Forest Land
	ML 30M/90*	State Forest - Multiple Use Forest Land
	ML 31M/90*	State Forest - Multiple Use Forest Land
	ML 32M/90*	State Forest - Multiple Use Forest Land
Beneficiation Area	SL's 1 - 12#	Crown Land - Deferred Forest Land
	ML 44M/66	Crown Land - Deferred Forest Land

Table 8. Land Tenure Classification

- \* On the 21 September 1990 these Mining Leases were surrendered conditional upon their replacement by Consolidated Mining Lease 46M/90 (CML 46M/90).
- # Savage River Mines holds a Licence to Operate a Scheduled Premises (Licence No. 3600) under the Environment Protection Act 1973, and a number of Special Leases for 30 years (from the 3 June 1966) under the Iron Ore (Savage River) Agreement Act 1965.

#### 3.2 Present Use and Ownership of Land

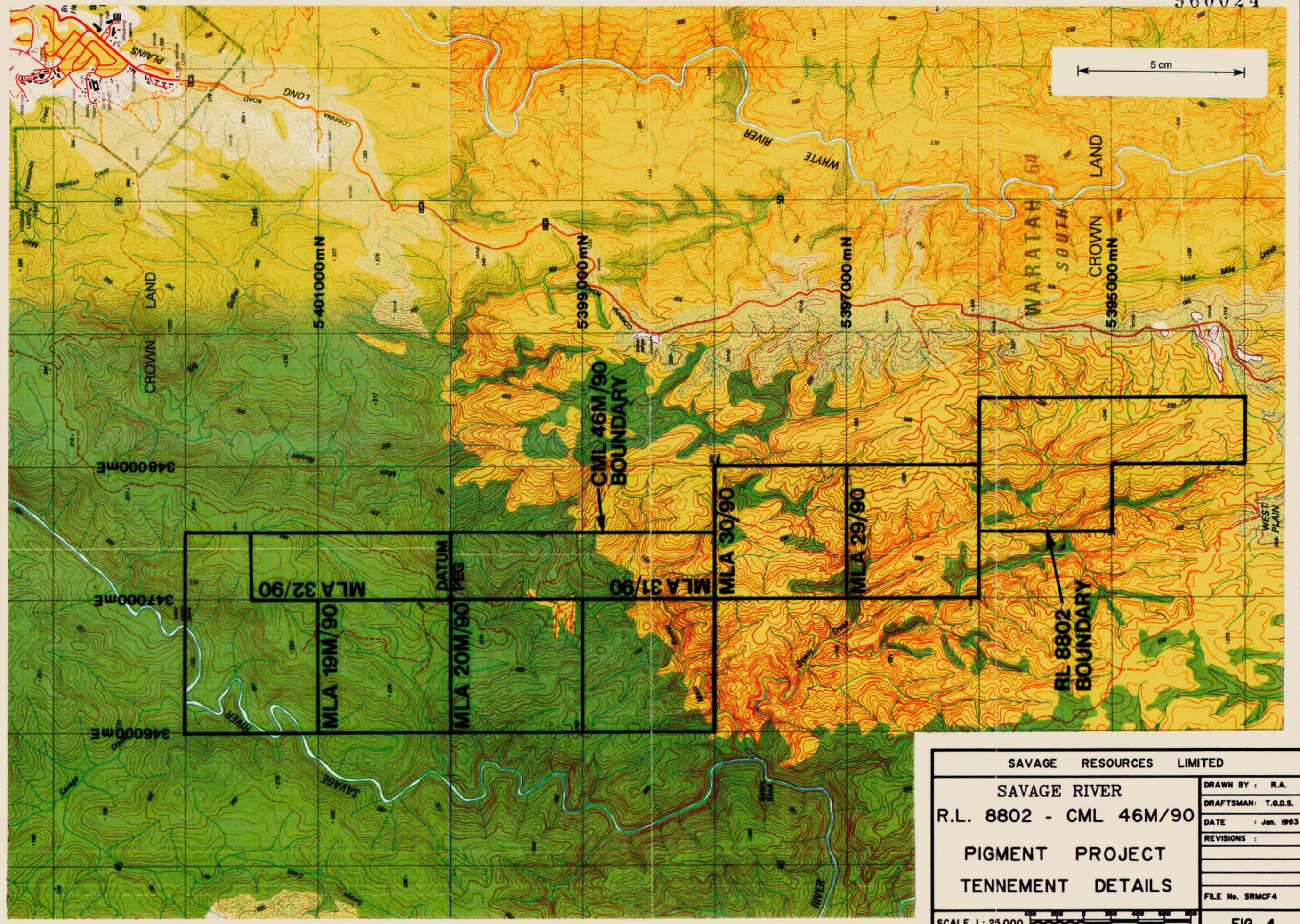
CML 46M/90 and SL's 10 - 12 are located within the traditional cutting areas of Corinna Sawmills.

There is no land use other than mining and forestry practices.

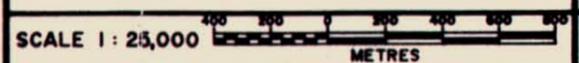
There is no ownership of land or private residences within one kilometre of:

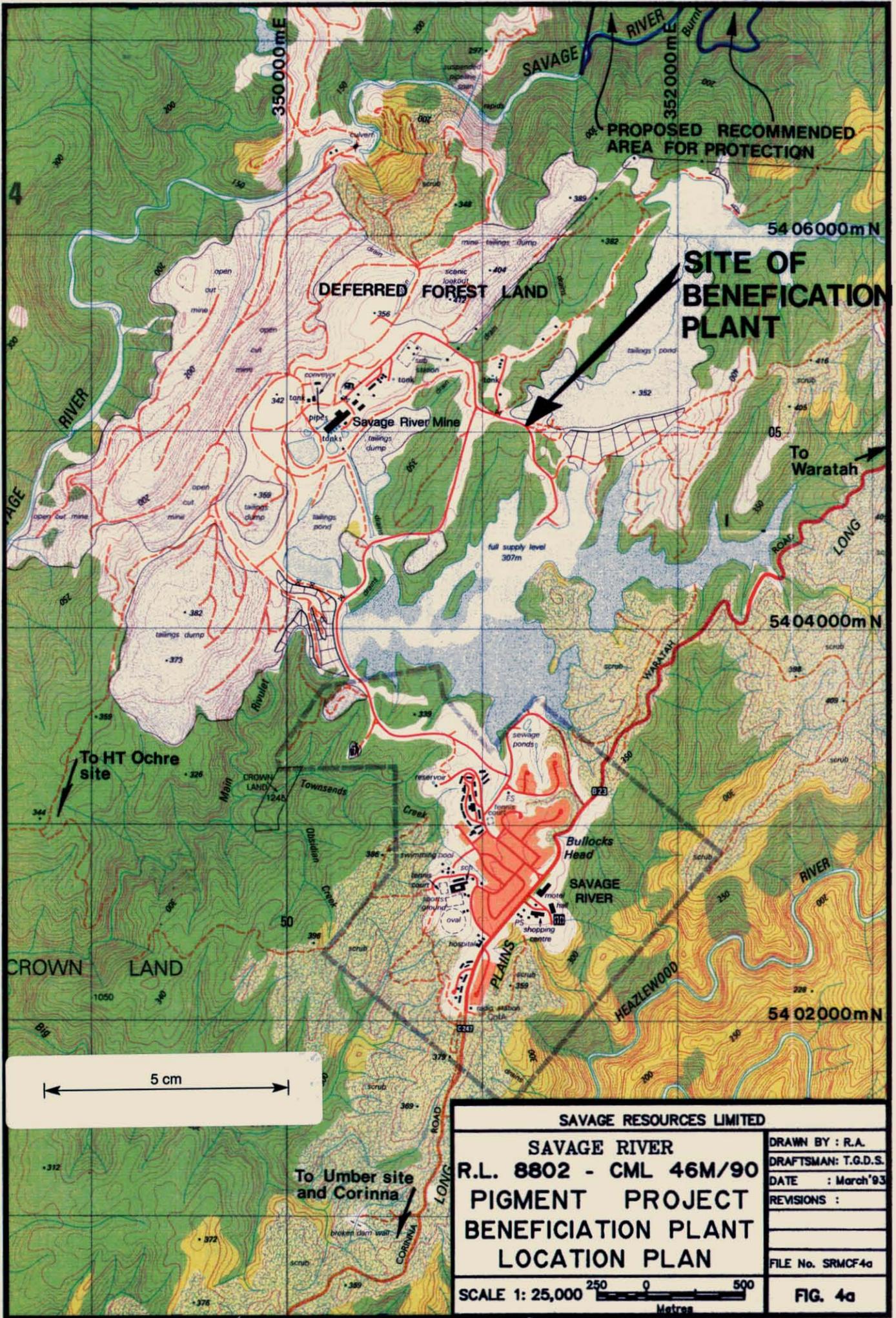
- the lease perimeter of CML 46M/90,
- the lease perimeters of SL's 10 - 12, and
- cartage route between mine site and beneficiation site.

5 cm



SAVAGE RESOURCES LIMITED	
SAVAGE RIVER R.L. 8802 - CML 46M/90	DRAWN BY : R.A.
PIGMENT PROJECT TENNEMENT DETAILS	DRAFTSMAN: T.G.D.S.
	DATE : Jan. 1993
	REVISIONS :
	FILE No. SRMCF4
SCALE 1 : 25,000	FIG. 4





5 cm

<b>SAVAGE RESOURCES LIMITED</b>	
<b>SAVAGE RIVER</b>	
<b>R.L. 8802 - CML 46M/90</b>	
<b>PIGMENT PROJECT</b>	
<b>BENEFICIATION PLANT</b>	
<b>LOCATION PLAN</b>	
SCALE 1: 25,000	250 0 500 Metres
DRAWN BY : R.A.	FILE No. SRMCF4a
DRAFTSMAN: T.G.D.S.	<b>FIG. 4a</b>
DATE : March '93	
REVISIONS :	

## 4. TECHNICAL STUDIES OF THE DEVELOPMENT SITE AREAS

### 4.1 Flora Information

The forests of the Savage River area fall into the closed forest category of cool temperate rainforest.

#### 4.1.1 Mine Site Area - HT Drillsite area

The forest shows a wide variation in both structure and floristic content although there is a major element comprising:

- |   |                            |                                   |
|---|----------------------------|-----------------------------------|
| - | Southern Beech or "myrtle" | <i>Nothofagus cunninghamii</i>    |
| - | Sassafras                  | <i>Arthrosperma moschatum</i>     |
| - | Leatherwood                | <i>Eucryphia lucida</i>           |
| - | Celery Top Pine            | <i>Phyllocladus asplenifolium</i> |

Other elements such as Horizontal (*Andopetalum biglandulosum*) combine with the major elements to produce a wide variety of forest communities.

The nature of the forest communities in the development areas are, to a degree, controlled by the underlying soil composition and can be categorised to include:

- good soils, well drained; forest of dominant canopy tree species forming a closed canopy with a clear under-storey ("park-like"). Often species poor and dominated by "Myrtle",
- sandy soils, well drained; forest of dominant canopy tree species forming an open canopy with moderate under-storey of shrub species development. Species poor and dominated by Celery Top Pine and,
- mixed soils, poorly drained; forest of dominant canopy tree species forming a dense closed canopy with dense under-storey species dominated by Horizontal.

#### 4.1.2 Mine Site Area - Bowry Creek Area

This mine site area lies within that part of the forest destroyed in the bush fires of March 1982.

The regrowth is essentially of moderate-sized pioneer species of dogwood (*Pomaderris apetala*), bracken fern (*Pteridium spp.*) and lance wood (*Phebalium squameum*), etc. Rainforest species typical of the area pre-March 1982 are emergent.

#### 4.1.3 Beneficiation Site

There is no vegetation on the surface of the old tailings dam.

There is some re-growth vegetation on:

- the dam embankment to the immediate south of the site and,
- along "finger-lines" which have been ripped for a short distance away from the embankment.

A thin veneer of essentially stunted varieties of the Tea-tree family (*Myrtaceae spp.*) rim the south-eastern area of the old tailings dam. This grades laterally into the heathland species dominated by button-grass (*Gymnoschoenus sphaerocephalus*).

#### 4.2 Fauna Information

Carnivorous marsupials found in this area include the Tasmanian Devil (*Sarcophilus harrisii*), the Tiger Cat (*Dasyurus maculatus*) and the Native Cat (*Dasyurus viverrinus*).

Numerous small mammals inhabit the forest, such as the Eastern Swamp Rat (*Rattus lutreolus*), Long-tailed Rat (*Pseudomys higginsii*) and the Black Rat (*Rattus rattus*).

A wide variety of herbivores also inhabit the rainforest and include the Potoroo (*Potopous apicalis*), Pademelon or Rufus Wallaby (*Thylogale billardierii*), Bennett's Wallaby (*Macropus rufogriseus*), Brushtail Possum (*Trichosurus vulpecula*), Ringtail Possum and Sugar Glider (*Petauridae spp.*) and Wombat (*Vombatus ursinus*).

Of the monotremes, Echidnas (*Tachyglossus aculeatus*) are fairly common and Platypus (*Ornithorhynchus anatinus*) may inhabit rainforest streams.

Reptiles in this area include such snakes as the Tiger (*Notechis ater*), Copperhead (*Austreleps superbis*) and Whip. There are a number of small lizards.

A wide variety of birds are also found including Black Cockatoos, Thornbills, Fantails, Robins and Green Rosellas.

#### 4.3 Soil Information

The soils are essentially Podzols (soils developed under a mixed forest in a cool to temperate moist climate) although any number of local Podzol variations exist dependent upon the topography, mass movement of the hill slope material and underlying bedrock.

#### 4.3.1 Mine Site Areas

The surface layer is always characterised by a thin root mat which is underlain by a layer of transported gravel wash with either organic, sand or clay matrix, the entire structure of which is complicated by mass movement. The average thickness is approximately 0.5 metres.

Disruption of the soil structure often continues into the underlying B horizon which displays an enrichment of predominantly iron oxide, or more rarely silica, and various alumina-silicates (clays). This layer can be up to 2 metres thick and in most cases imperceptibly grades into the underlying C horizon.

The C horizon is again often complicated by mass movement and is essentially an extension of the overlying B horizon to include predominantly iron oxides (the target mineral) and alumina-silicates (clays). Thickness's in excess of 30 metres are not uncommon.

#### 4.3.2 Beneficiation Site

The beneficiation site is to be confined to the stabilised south-eastern edge of Savage River Mines' old tailings dam which was abandoned in 1984. There is no soil structure or soil development within the tailings. The site area is underlain by various thickness's of graded (cyclone classified) tailings of relative coarse particle size with no associated organics.

The construction of the beneficiation plant will not disturb those areas revegetated by Savage River Mines as part of their rehabilitation programme.

In those undisturbed areas immediately surrounding and rimming the south-eastern area of the old tailings dam the soil classification is Peat.

The peat is underlain by a variable thickness of between 0.5 to 2 metres of angular quartz gravel which itself overlies relatively fresh C horizon material consisting of quartz-rich sediments.

### 4.4 Geological Information

#### 4.4.1 Mine Site Areas

The resource occurs within the geological rock unit termed "Bowry Formation" which is part of the Precambrian age sequence in the Arthur Lineament of north west Tasmania.

The Bowry Formation is a distinctive unit consisting mainly of greenschists which have been derived from the metamorphism of basic volcanics and quartz-free sediments.

Near the base of the Bowry Formation there is a zone of chemically deposited rocks including:

- the iron ore of the Savage River Mine, Long Plains South and Rocky River deposits and,
- the magnesite of Main Creek and Bowry Creek deposits.

It is the magnesite areas that contain the pigment deposits.

The magnesite contains some dolomite and is divided into discrete zones by a number of greenschist beds that make up approximately 10% of the magnesite bearing interval. The magnesite is steeply east dipping and, including the greenschist markers, is some 350 metres thick in total.

Current observations indicate that scattered occurrences of pigment subcrop over a strike distance of 2.5 kilometres in the Main Creek area and a strike length of some 2.0 kilometres at Bowry Creek.

It occurs as the matrix in the transported B soil profile (see Soils chapter) and as the weathered bedrock. The latter form is termed residual and is recognised by relict textures preserved from the original magnesite rock.

The residual material is often reworked as a result of erosion and redeposition and forms the matrix in a breccia type deposit, although often with the addition of only a few small foreign clasts.

The pigment material is not the only component of the transported B profile or weathered bedrock as it is often found to intimately occur with the weathering products of the interbedded greenschists. There is also an area of sand which overlies the magnesite, often with no residual or reworked pigment.

The auger drilling of the HT drillsite area very rarely bottomed in magnesite and it is believed that the ochre and greenschist phases often extend to depths exceeding 25 metres beneath ground surface.

#### 4.4.2 Beneficiation Site

While the geology of the beneficiation site is obscured by the recent activities of Savage River Mines it is known from nearby outcrops that the area is underlain by a rock unit termed the "Oonah Formation".

The Oonah Formation lies above the Bowry Formation and it is believed to be of a younger age. Its well bedded quartzitic sandstones and shales contrast markedly with the quartz poor greenschists of the Bowry Formation.

#### 4.5.1 Mine Site Area - HT Drillsite area

Groundwater movement developed in association with the presumed karst topography of the underlying magnesite rock is effectively concealed by the overlying superficial cover of iron oxide and alumina-silicate material and its inherent surface water regime.

The superficial cover contains a number of discrete aquifers which when breached flow with the hydraulic gradient along fractures, joints and geologic boundaries:

- erratic water seepage is associated with fractures and joint zones and are common beneath areas of generally higher ground,
- minor water flows, often short-lived and unpredictable, occur along the geologic boundaries and,
- water flows are always evident along the magnesite superficial cover contact.

The superficial cover profile beneath areas of high ground is invariably well drained and dry. Valley floors are often underlain by saturated cover material.

Auger drilling of the superficial cover did not intersect the water table.

#### 4.5.2 Mine Site Area - Bowry Creek Umber Site

No surface or ground water was encountered during geotechnical investigations at the Bowry Creek umber development site.

The ground is essentially free-draining to the Bowry Creek.

#### 4.5.3 Beneficiation Site

The hydrology of the area is dominated by the effects of the old tailings dam:

- water movement overflows the old tailings dam into the Savage River to the north of the site area and,
- seepage around the southern dam wall of the old tailings dam in the vicinity of the beneficiation site area drains south into the Main Creek tailings dam.

Table 10 lists a typical analysis of the water in the old tailings dam.

Table 11 lists a typical analysis of the water in the Main Creek tailing dam (Shepherds Lake). This water has been approved by the Inland Fisheries Commission for the stocking of trout.

## 5. DEVELOPMENT PROPOSAL

The pigment deposits are located between 3 and 5 kilometres south-west of the Savage River Township in north-west Tasmania.

The Savage River Township serves the Savage River iron ore mine which presently produces approximately 1.1 million tonnes of iron ore pellets per annum. The magnetite concentrate is carried by pipeline to Port Latta where there is a dedicated ship loading facility.

The Savage River Township is connected by sealed road to the West Coast highway and is 120 kilometres from Burnie. It has a population of about 450 people and a shopping centre, hotel, garage and a small hospital.

Housing is available in the Township.

### 5.1 Access

The deposits are accessed via the unsealed Corinna - Savage River road and exploration tracks, or, more directly, by the "B-dump" road (Fig. 4).

The beneficiation site is accessed via the sealed Savage River Mine link road and an internal Savage River Mine access road (Fig. 4a).

#### 5.1.1 Upgrading - Mine Access, HT Drillsite Area

The existing "B-dump" road is badly degraded but upon the cessation of forestry practises Savage intends to upgrade the road to provide all-year round access for both passenger vehicles and light trucks with dog-trailers.

This will provide the main access to the HT ochre site.

There will be no new construction other than that necessary for good road construction and maintenance (culverts, bridges, etc.), and all access roads will conform to those requirements set by the controlling Authority.

Basement, sub-base and topping materials will be taken from various stockpiles of material held within the Savage River Mine site area. Further topping material, made up of the fine quartz gravels found in the area, may be sourced from a nearby licensed gravel pit belonging to the Department of Construction.

Access off the Savage River Mine link road is at a point mutually agreeable to both Savage and the mine management and is so arranged to not interfere with either any mine practises or the rehabilitation work as laid down in the Savage River Mines Rehabilitation Plan, 1990.

### **5.1.2 Upgrading - Mine Access, Bowry Creek Umber Site**

The unsealed Corinna - Savage River road has already been upgraded to accommodate the movement of heavy trucks to and from the nearby Silica Mine and no further improvement to this road is necessary.

Access off this road to the Long Plains South magnetite deposit, some 500 metres to the south of the Bowry Creek umber deposit, is trafficable to light trucks for most of the year.

Only minor improvements to the road are necessary to provide all-year round access to Savage's mine site and this will be achieved in a manner similar to that detailed in the chapter above.

### **5.1.3 Beneficiation Site**

Access is provided by an unsealed road, which is serviceable year-round to passenger vehicles and trucks, off the Savage River Mine link road.

No construction is necessary other than general maintenance associated with the up-keep of unsealed roads.

## **5.2 Truck Movements**

It is expected that the majority of the pigment material will be extracted during the summer months. Upon its extraction this material will be trucked to the beneficiation site by contract hauliers using trucks and/or trucks and dog-trailers.

### **5.2.1 Bowry Creek Umber Material**

For the first two years of operations truck movements along the Corinna to Savage River road are not expected to exceed 4 round trips per day over one single summer month.

This is expected to rise to some 12 round trips per day over a period of some 6 weeks between December to April at the maximum production rate, within the time period of 36 to 60 months, of approximately 4000 tonnes of refined umber pigment.

### **5.2.2 HT Ochre Material**

The HT ochre material will not be transported along public roads apart from a 1500 metre stretch of the Savage River link road immediately adjacent to the Savage River operations.

For the first two years of operations truck movements between the mine site and beneficiation site are not expected to exceed 18 round trips per day over one single summer month.

This is expected to rise to some 24 round trips per day over a period of some 6 weeks between December to April at a maximum production rate of 8000 tonnes of refined ochre pigment.

### 5.2.3 Delivery to Burnie

A maximum of two trucks per week rising to six trucks per week will be sufficient to transport the refined pigment to the north-west coast. The material will be transported in bulk containers.

### 5.3 Hours of Operations

The extractive operations are expected to be confined to the summer months on a campaign basis. No operations except for essential plant maintenance will take place outside the hours of 6.00am to 6.00pm Monday to Saturday inclusive.

The beneficiation of the extracted material will initially be by one 8-hour day shift between the hours of 8.00am to 5.00pm. A continuous 24-hour per day system to include a day, afternoon and night shift system will be incorporated at a later stage.

### 5.4 Timber Salvage

During the construction of the access routes to the pigment deposits timber salvage will be conducted by Savage, or a nominated contractor, under the supervision of the Forestry Commission.

Savage will utilise, to the fullest extent practicable, that timber resource likely to be affected by mining operations.

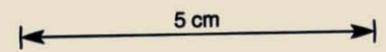
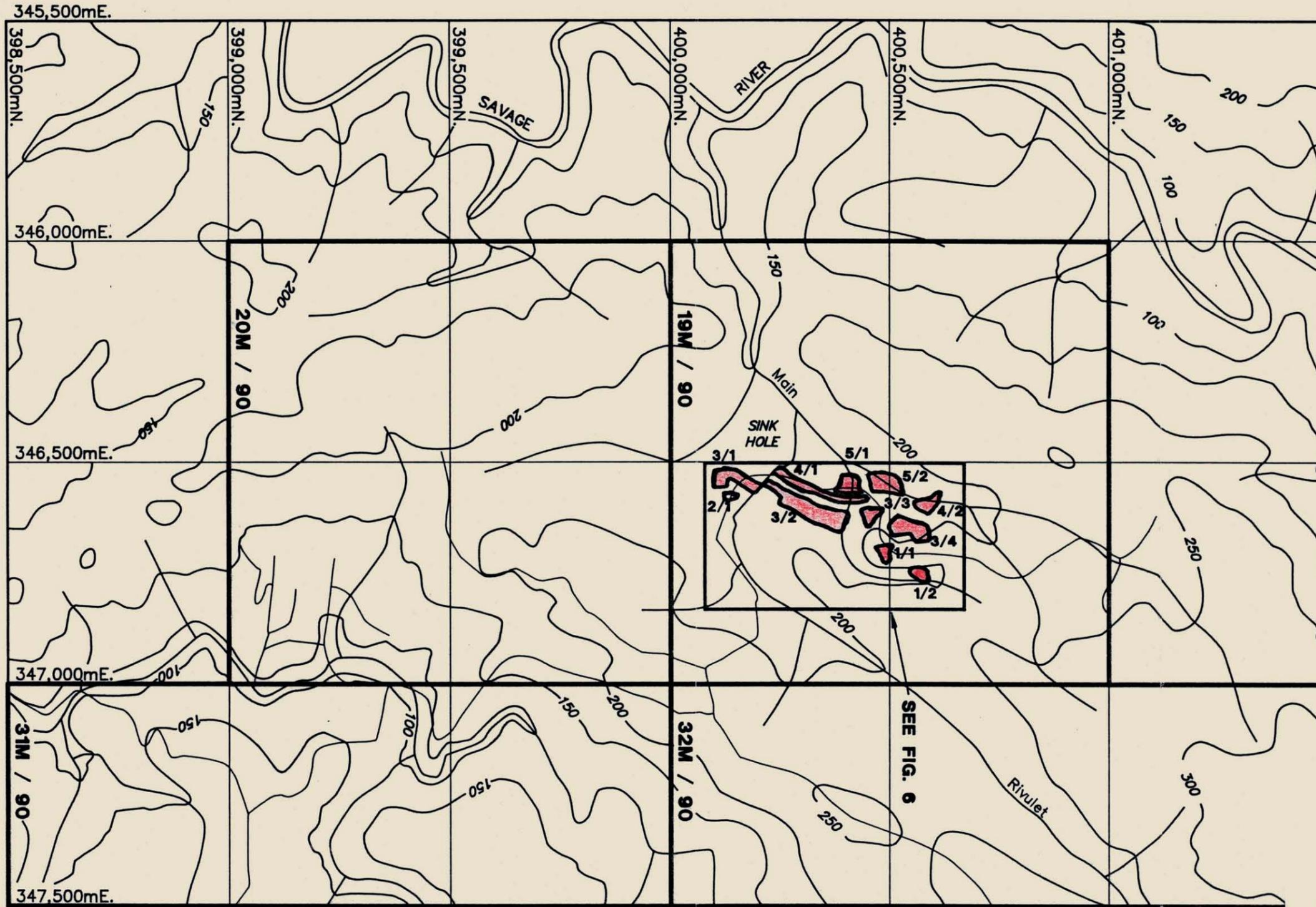
### 5.5 Mining Operations

Those areas where the data density is sufficient to outline large quantities of near surface material have been designated as preferred sites (refer ch. 2.1.1), and it is within either one or a combination of several of these sites that mining operations are expected to take place (Figs. 5 & 6, HT Ochre Site; Figs. 7 & 8 Bowry Creek Umber Site).

The open pit geometry is the result of the manipulation of the mining resource data with the mining slope and topography constraints, all of which is referenced to the 3D Lerchs Grossman optimum ultimate pit module.

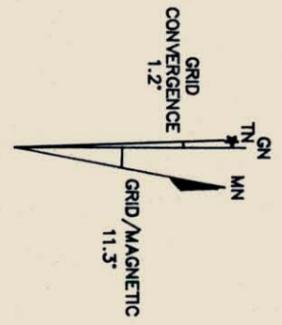
The extractive sequence has been determined by the need to provide a consistent blend of raw material to the beneficiation plant.

The pits have been designed to maximise the efficiencies of the extraction process using the Techbase Database Software Management System.

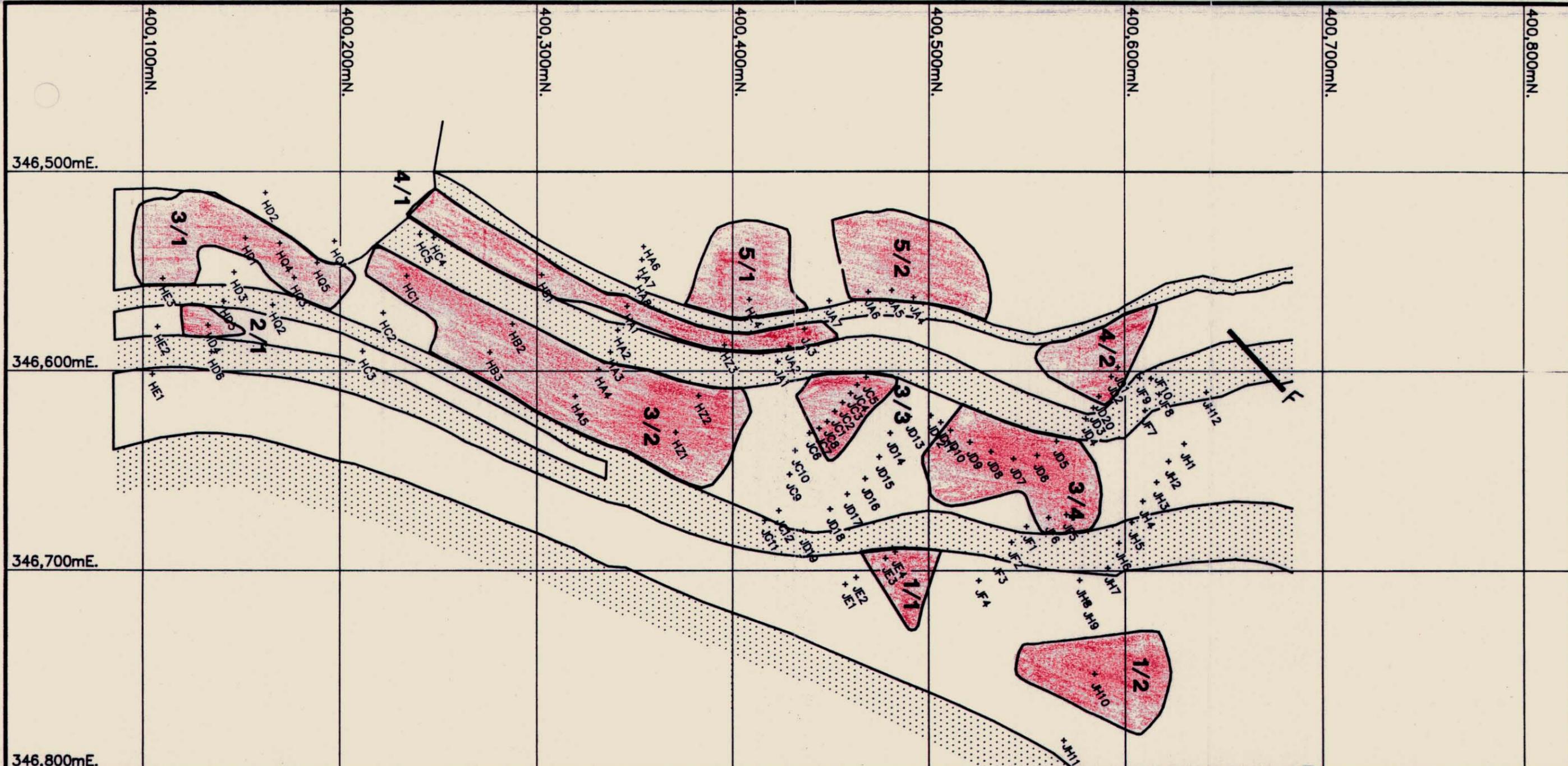


**LEGEND**

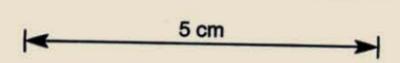
- ▽ 1/1 PREFERED SITE
- ~ 50m CONTOUR
- TRACK
- CREEK



SAVAGE RESOURCES LIMITED	
SAVAGE RIVER R.L. 8802 - CML 46M/90 MAIN CREEK HT OCHRE SITE LOCATION OF MINING LEASES WITH PREFERED SITES	
DRAWN BY : R.A.	DATE : JUNE '90
DRAFTSMAN: T.G.D.S.	
REVISIONS : R.A. Jan. 1993	
FILE No. SRMCF5	
SCALE 1 : 10,000	
<b>FIG. 5</b>	

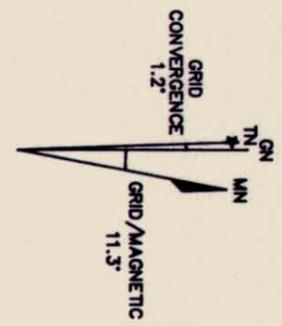


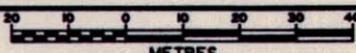
960035

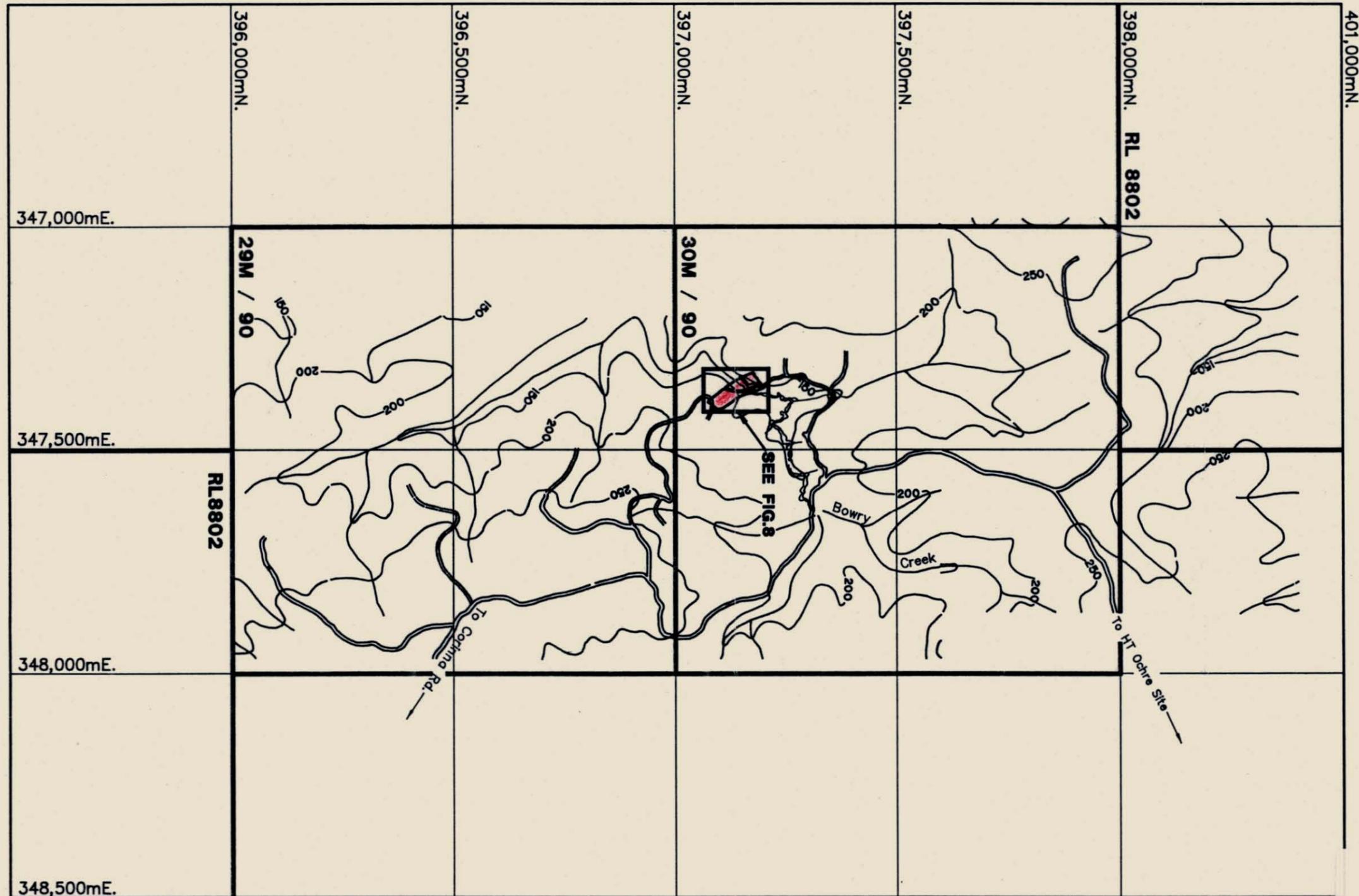


**LEGEND**

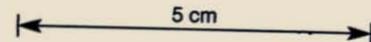
-  GREENSCHIST
-  POLY ESTIMATOR AREA
- 1/1** PREFERED SITE No.



SAVAGE RESOURCES LIMITED	
SAVAGE RIVER R.L. 8802 - CML 46M/90 MAIN CREEK HT OCHRE SITE POLY EST. AREA, 40m R PREFERED SITES	
DRAWN BY : R.A.	DATE : Jan. 1993
DRAFTSMAN: T.G.D.S.	
REVISIONS :	
FILE No. SRMCF6	
SCALE 1 : 2,000	
<b>FIG. 6</b>	

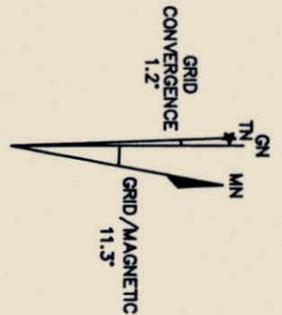


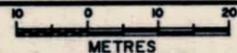
960036



**LEGEND**

-  PREFERRED SITES
-  50m CONTOUR
-  TRACK
-  CREEK



<b>SAVAGE RESOURCES LIMITED</b>	
<b>SAVAGE RIVER</b>	
<b>R.L. 8802 - CML 46M/90</b>	
<b>BOWRY CREEK UMBER SITE</b>	
<b>UMBER RESOURCE</b>	
<b>LOCATION OF MINING LEASES</b>	
<b>WITH PREFERRED SITES</b>	
SCALE 1 : 10,000	
DRAWN BY : R.A. DRAFTSMAN: T.G.D.S. DATE : Jan. 1993 REVISIONS : FILE No. SRMCF7	<b>FIG. 7</b>



### 5.5.1 Mining Method

There will be no mining other than that of the pigment material within the first five years of mining operations.

The mining operations are likely to be confined to the summer months on a campaign basis.

Progressive mining from the surface down will be by way of a number of mining benches. Material will be extracted from bench faces by track-mounted excavators and loaded to trucks. Bench widths not less than 5 metres will be sufficient for this purpose.

Pit slopes within predominantly fine-grained iron oxide material will not exceed 60 degrees although this figure will increase where pit benches are comprised of competent greenschist in order to minimise surface disturbance.

#### 5.5.1.1 HT Ochre Site Mining Area 3/3

The conceptual pit for the preferred area 3/3 provides an estimation of the final dimensions of one of the proposed mining operations.

An open cut pit excavated to a depth of 15 metres beneath the ground surface with pit slopes of 45 degrees is shown in Figures 9 to 13. The dimensions of the pit both north to south, west to east and north-west to south-east range between 75 and 80 metres.

A minimum of some 6500 tonnes of refined pigment is expected to be won from this pit, sufficient to sustain the proposed pigment production in its entirety for the first two years of operation.

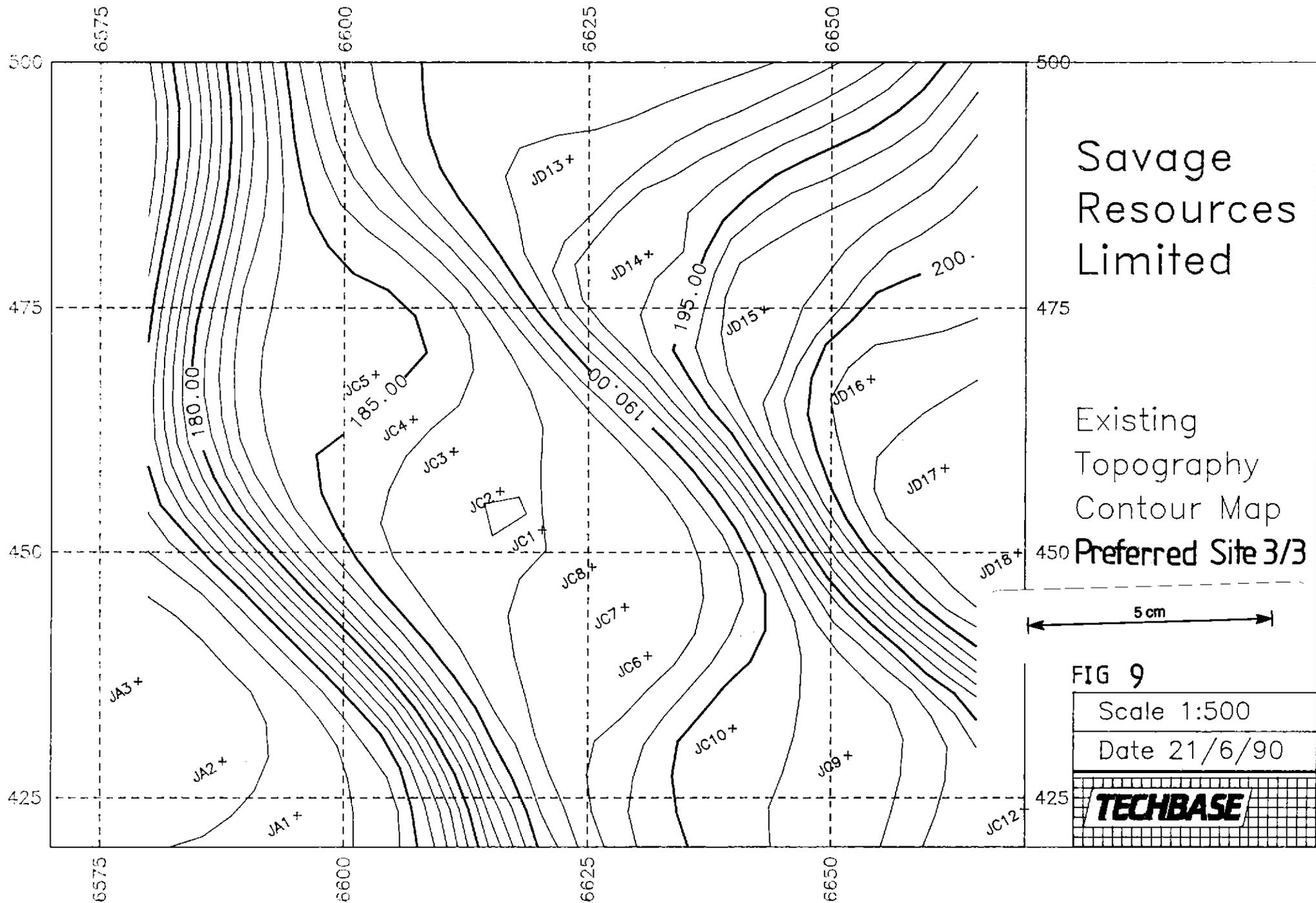
### 5.5.2 Machinery and Equipment to be Used

An earth moving contractor will provide all necessary equipment and personnel.

The material will be extracted by two track-mounted excavators, supported in part by a single bulldozer and trucked to the beneficiation site by 4 to 5 trucks.

### 5.5.3 Quantities of Material to be Mined

The pigment material is itself considered to be overburden to the underlying magnesite rock. Minor near surface clays and the occasional greenschist band are the only materials expected to be stockpiled as overburden material.



Savage  
Resources  
Limited

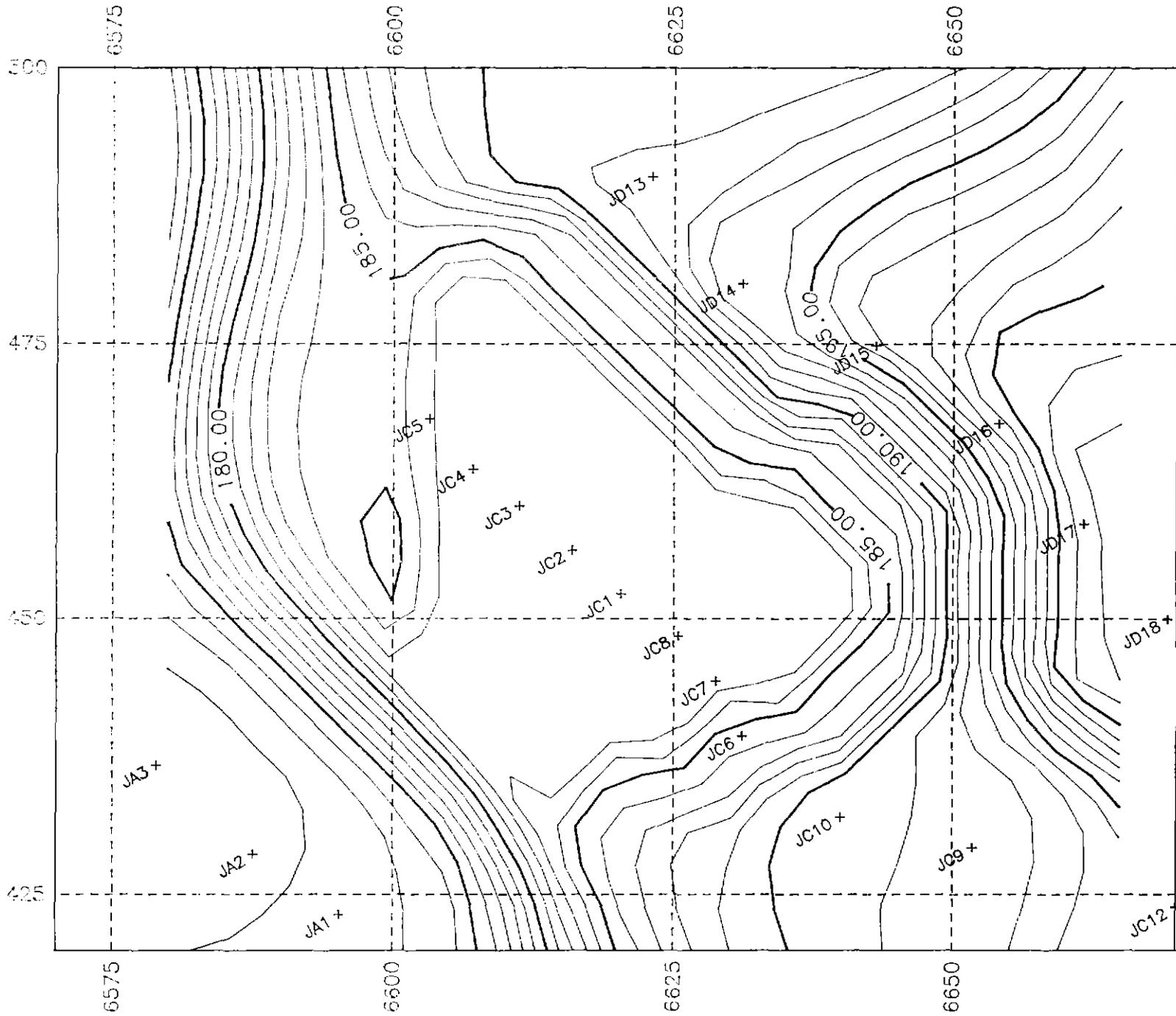
Existing  
Topography  
Contour Map  
Preferred Site 3/3

5 cm

FIG 9

Scale 1:500
Date 21/6/90
<b>TECHBASE</b>

960039



Savage  
Resources  
Limited

Conceptual  
Open Cut Pit  
Contour Map  
Preferred Site 3/3

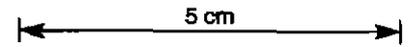
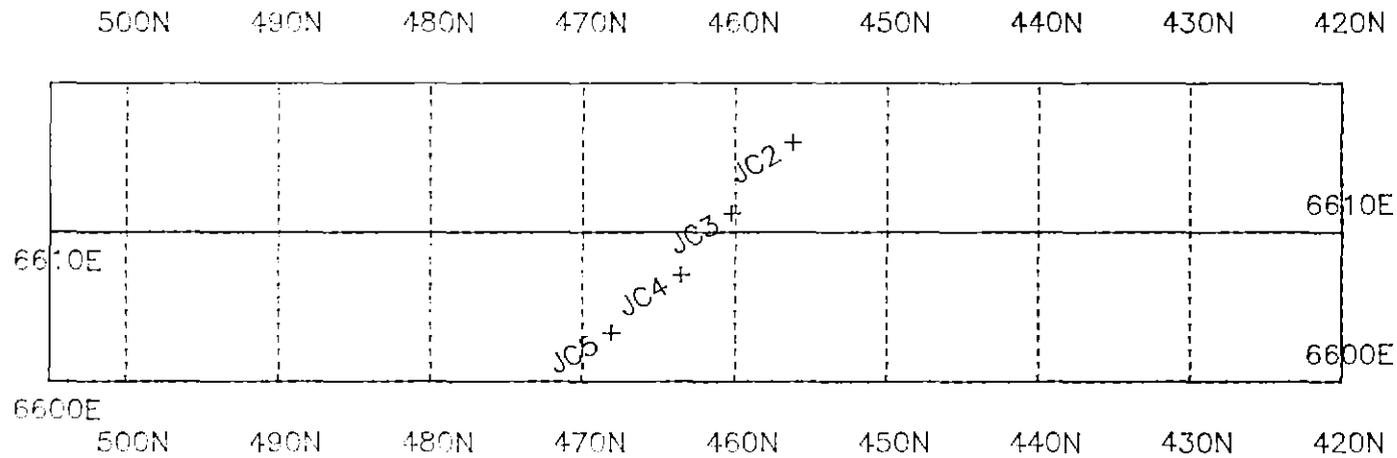


FIG 10

Scale 1:500  
Date 21/6/90



960040



5 cm

Savage  
Resources  
Limited

Preferred Site 3/3  
Section through  
Conceptual Pit  
North to South

Scale 1:500

Date 21/6/90

**TECHBASE**

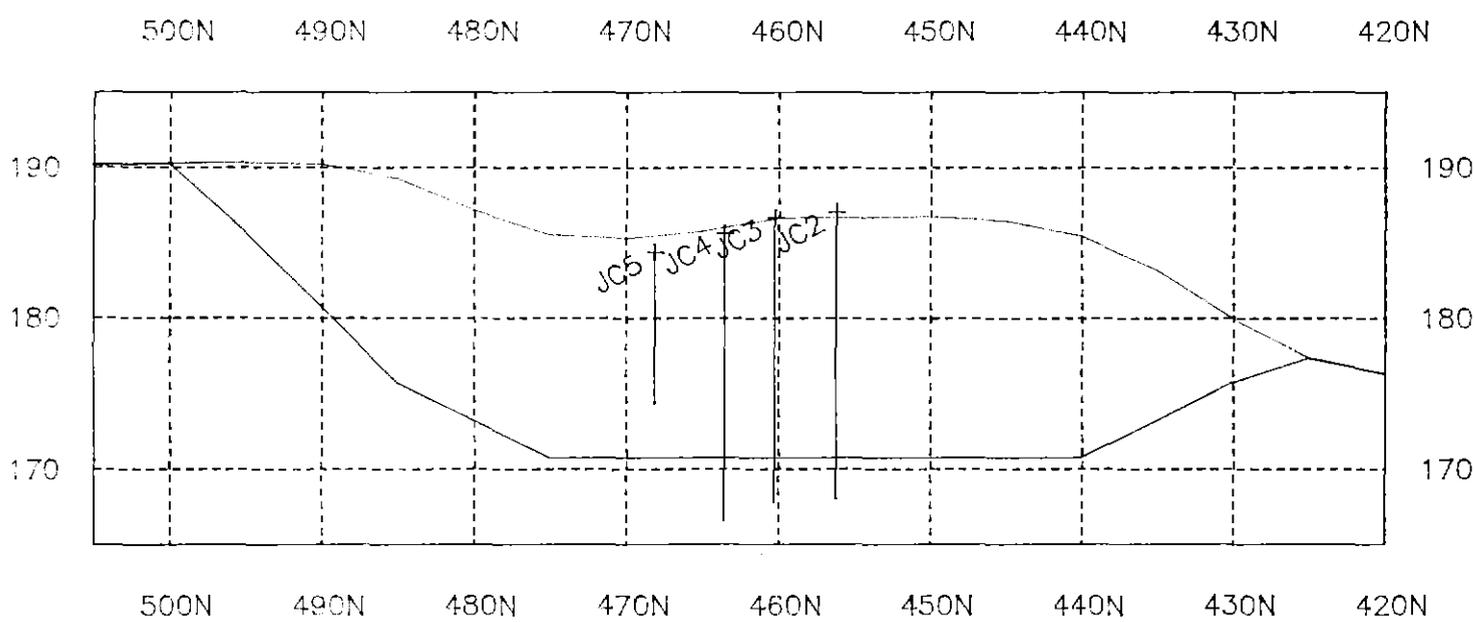
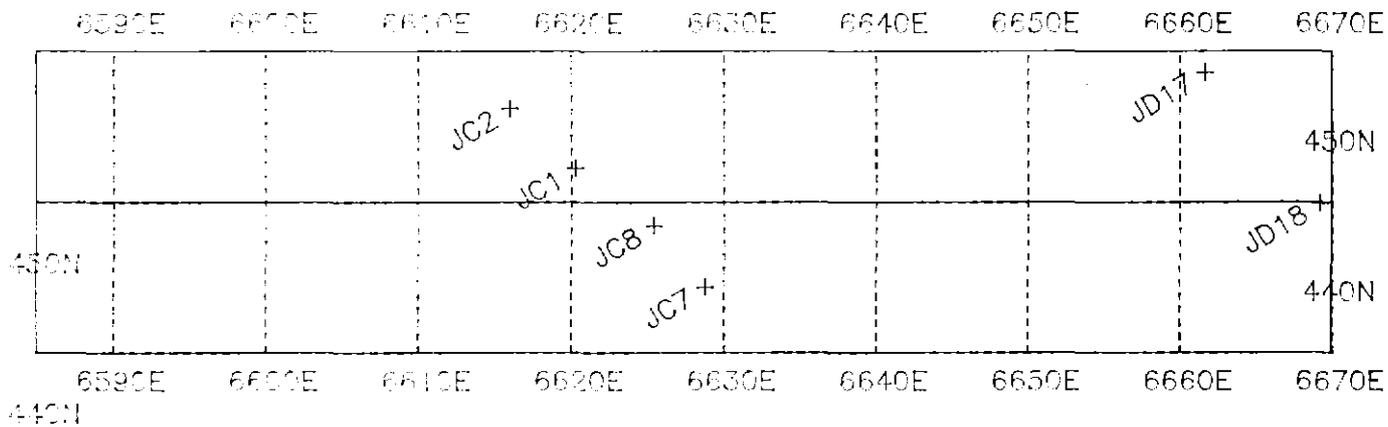
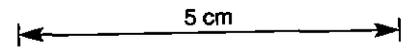


FIG 11

960041



Savage  
Resources  
Limited



Section through  
Conceptual Pit  
West to East  
Preferred Site 3/3

Scale 1:500

Date 21/6/90

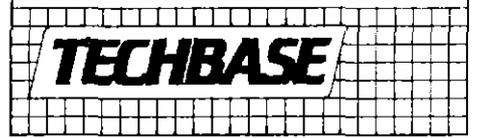
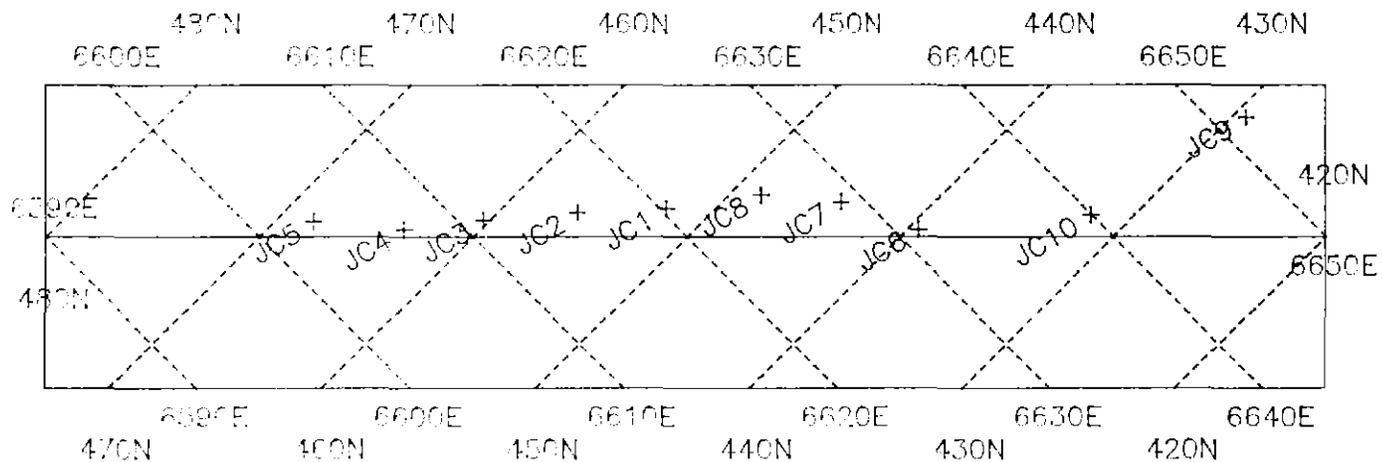


FIG 12

960042



5 cm

Savage Resources Limited

Preferred Site 3/3  
Section through  
Conceptual Pit  
NW to SE

Scale 1:500

Date 21/6/90

**TECHBASE**

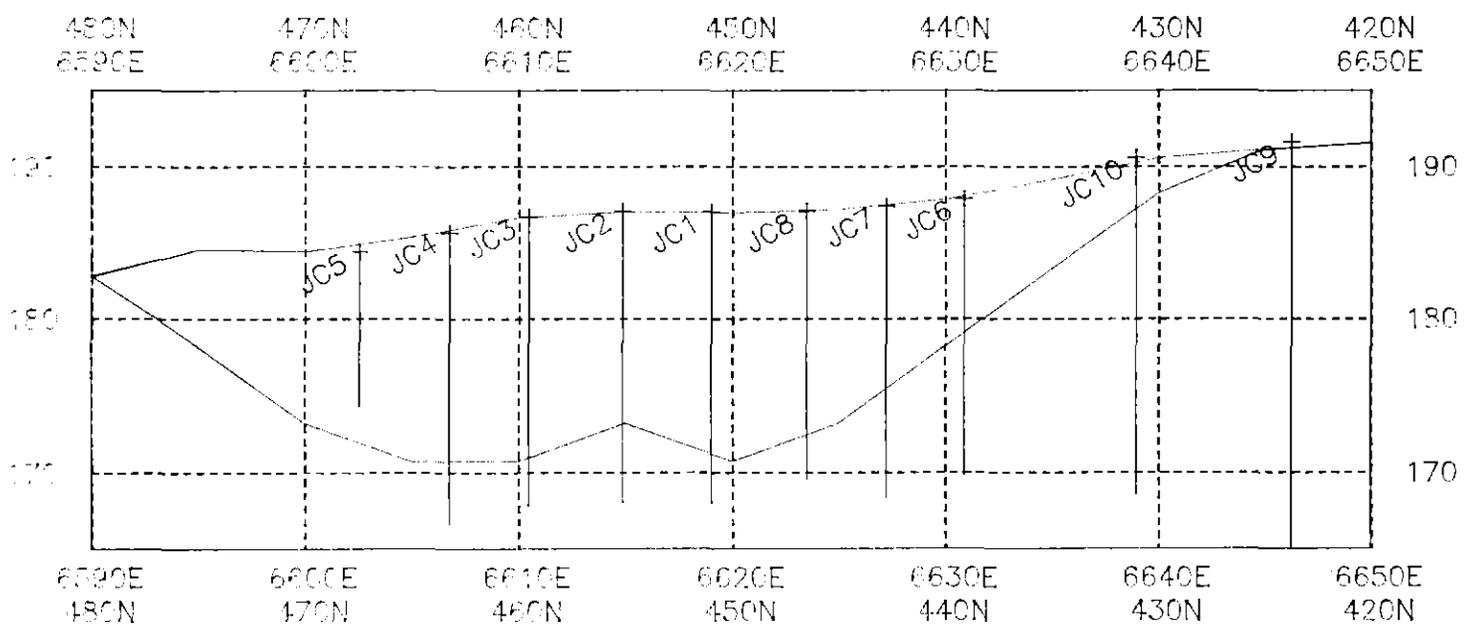


FIG 13

This material will be stockpiled in a neat and tidy manner. Any leaf-litter/topsoil will be carefully scraped away and contained within a separate heap for later rehabilitation purposes. All heaps will be battered and so maintained to reduce weathering and slump effects.

Based upon the timetable of events (Table 1, page 10) and assuming the conservative recovery factor of 40% the following material is expected to be extracted and carted to the beneficiation site.

Time (months)	MINING		PRODUCTION	
	Material (Tonnes)	Cumulative (Tonnes)	Pigment (Tonnes)	Cumulative (Tonnes)
0 - 6	0	0	0	0
7 - 12	5,000	5,000	2,000	2,000
13-24	12,500	17,500	5,000	7,000
25-36	25,000	42,500	10,000	17,000
37-48	30,000	72,000	12,000	29,000
49-60	35,000	107,500	14,000	43,000

Table 9. Quantities of Material to be Mined

#### 5.5.4 Mining Infrastructure

The intermittent nature of the mining operations will not require the erection of any service buildings at the mine site other than that necessary to provide support and shelter to the mining equipment.

#### 5.6 Beneficiation Operations

The beneficiation of the raw pigment material incorporates a number of processes which, if fully detailed, would not be easily understood by the general public. As such the process method described below is reported in general terms (Figs. 14 to 16).

##### 5.6.1 Processing Method

The basic method of beneficiation is one of selective flocculation using various chemical agents. The process can be divided into two stages:

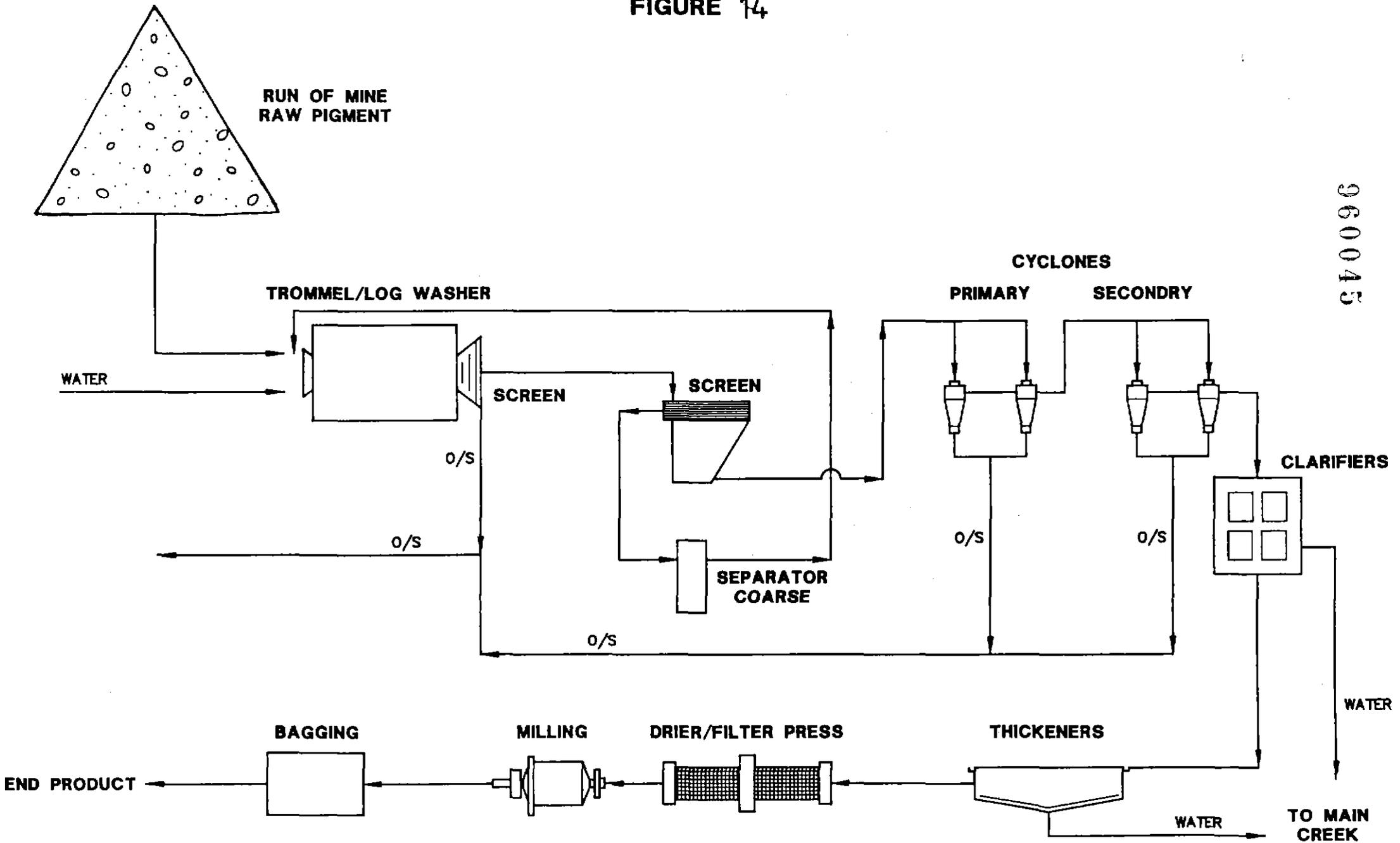
##### The Wet Process

- first the raw pigment material (run-of-mine) is blunged (dispersed) in an aqueous medium of known pH and density,
- the slurry is then passed through a series of screens and/or hydrocyclones which removes some of the gangue (unwanted) material to the discharge tailings area and the pigment material to a series of settling and mixing tanks,

# CONCEPTUAL BENEFICIATION FLOWSHEET

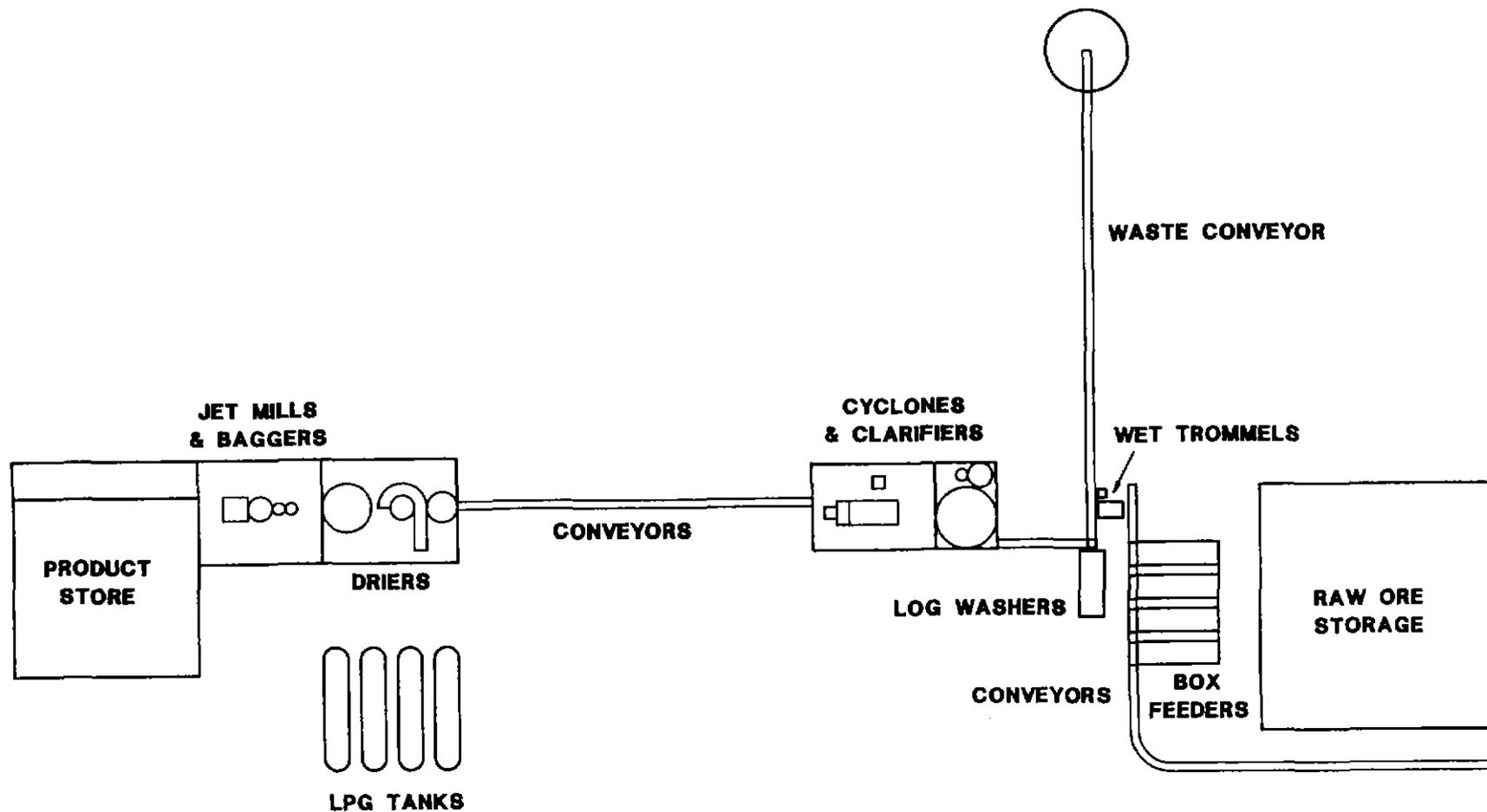
FIGURE 14

960045

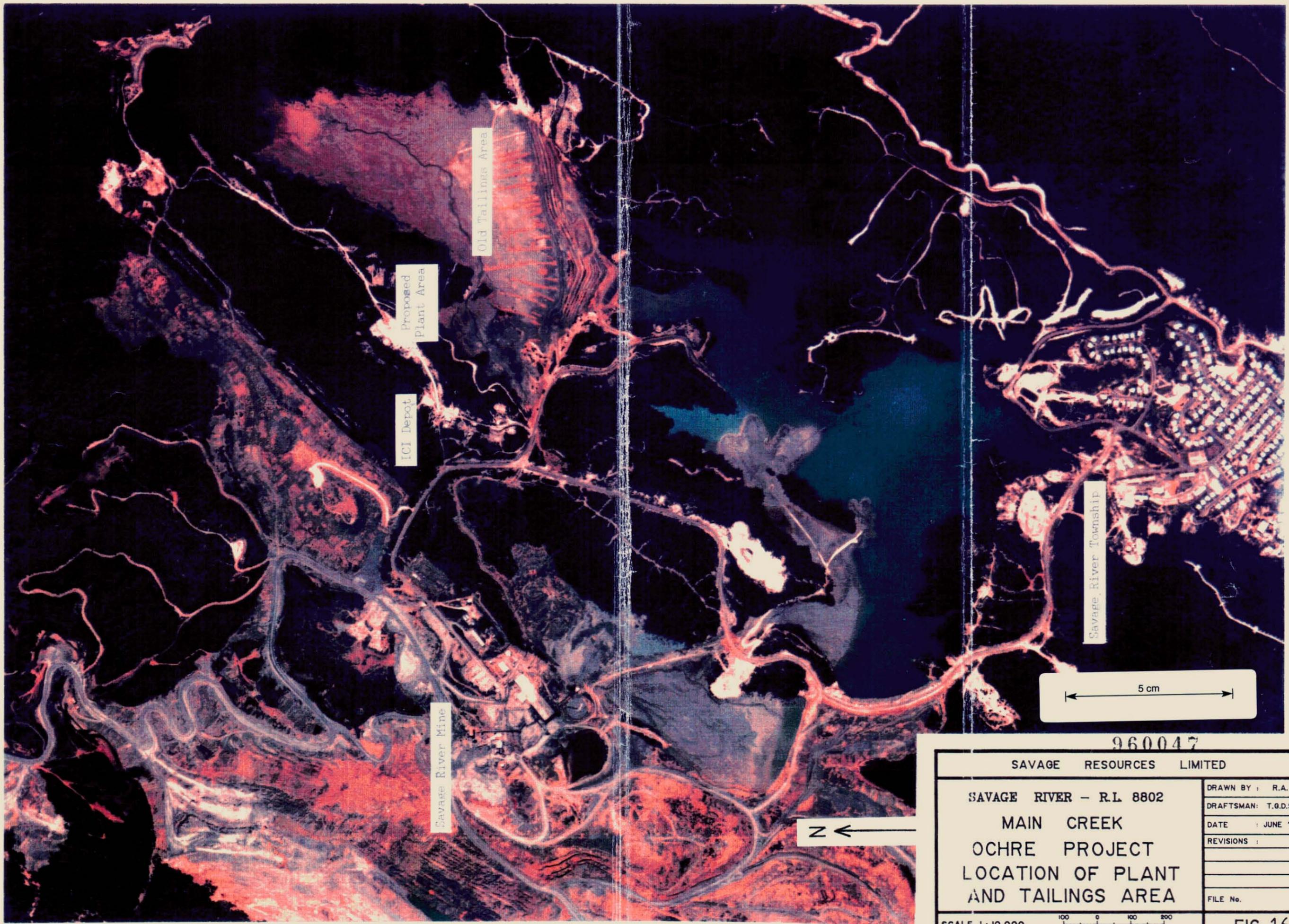


# CONCEPTUAL PLANT LAYOUT

## FIGURE 15



960046



Old Tailings Area

Proposed Plant Area

ICI Depot

Savage River Mine

Savage River Township

5 cm

← N

960047

SAVAGE RESOURCES LIMITED	
SAVAGE RIVER - R.L. 8802 MAIN CREEK OCHRE PROJECT LOCATION OF PLANT AND TAILINGS AREA	DRAWN BY : R.A. DRAFTSMAN: T.G.D.S. DATE : JUNE '90 REVISIONS : FILE No.
SCALE 1 : 10,000 100 0 100 200 METRES	<b>FIG. 16</b>

- after a combination of both agitation and settling of the slurry the pigment material is concentrated and refined by the removal of the remaining unwanted gangue and,
- the refined pigment material is removed from the tanks to the dry process while the gangue material reports to the tailing area.

This "wet" process is continuous with the input of raw pigment material being countered by the output of both gangue and refined pigment material. The following chemical agents are used:

1. Ammonia Solution at 25-30% strength.
2. Sulphuric Acid at 98% strength (AR Grade).

#### The Dry Process

- the wet refined pigment material is taken from the thickening tanks and dried, either by a combination of filtering and oven drying and/or direct spray drying and,
- the dried material is then disaggregated to its individual particle size, by conventional dry milling and grinding techniques, and bagged into bulker bags.

The dry process is contained within sealed equipment so as to both contain the entry of foreign material into the finished product and provide a dust free work environment.

The fuel used in the drying process may be either electricity or LP Gas or a combination of the two.

### 5.6.2 Equipment List

#### 5.6.2.1 Feed Preparation

Raw Material Base/Bins Concrete  
Front End Loader  
Box Feeder  
Conveyor  
Trommel  
Sump and Chemical Pumps  
Log Washer  
Instrumentation  
Chemical Store  
PLC Controller

### 5.6.2.2 Wet Processing

- Primary Cyclones
- Secondary Cyclone Feed/Sump
- Secondary Cyclones
- Cyclone ancillaries
- Waste, Effluent and Clarifier Sumps and Pumps Clarifier
- pH Instrumentation
- Chemical Pumps
- Filter Press
- Filter Cake Conveyor

### 5.6.2.3 Drying, Milling and Bagging

- Swirl Drier
- Drier Fuel Supply
- Bag House/Bin
- Jet Mill and Compressor
- Rotary Calciner
- Baghouse/Bin
- Bagging Unit
- Fork Lift
- Palletiser

### 5.6.3 Water Consumption and Use

Water will be used to disperse the run-of-mine material and is the carrier medium in most of the beneficiation stages.

It is estimated that approximately 1700 litres of water will be required per tonne of refined iron oxide pigment. This equates to a water requirement of between 17 and 24 megalitres per annum after 25 months of operation.

(As a comparison Savage River Mines pump approximately 23.5 megalitres per day from the Savage River. These pumps would provide all of Savage's annual water requirement in a little over 24 hours, or around 4 minutes of extra pumping per day throughout the year.)

### 5.6.4 Liquid, Solid and Atmospheric Wastes

#### 5.6.4.1 Liquid waste

Liquid waste will be a product of the wet processing and will amount to between 14 and 19.7 megalitres per annum after two years of operations.

## 6. ENVIRONMENTAL MANAGEMENT PLAN

### 6.1 Source of Water for Processing

Water will be drawn from two sources:

- the Savage River and,
- the existing Savage River Mines old tailings dam.

At full production the water requirement amounts to some 24 megalitres per annum, of which approximately 19.6 megalitres is returned.

The water will be drawn, for the most part, in unequal amounts from the two sources. The proportions are dependent upon the ability of the source(s) to provide clear water, the extremes of which are:

- at times of flooding and discolouration of the Savage River water will be primarily drawn from the old tailings dam and,
- at times of low water levels in the old tailings dam water will be sourced primarily from the Savage River.

The water quality of the source waters is given below:

source waters	Dissolved Solids	Suspended Solids	Fe	Mn	Cu	Cl	SO4	pH
Savage River	145	19	0.5	0.7	<0.1	14.9	49	6.2
Old Tailings Dam	217	10.5	3.2	0.39	0.45	19.2	102	3.1

*Table 10. Data from Savage River Mines Environmental Water Management Control, analyses in parts per million, data averaged over 45 months between Sept 1987 and May 1991.*

Water management procedure will provide Savage River water to the old tailings dam should the need arise to store water.

Savage River water will be taken off the existing water services provided by Savage River Mines. A short length of pipework will be constructed and buried between the ICI Depot and the proposed beneficiation site.

The acidity of the existing tailings water will not be detrimental to certain stages of the beneficiation process and therefore can be consumed and effectively neutralised.

#### **5.6.4.2 Solid Waste**

Solid waste will consist of a slightly alkaline friable mix of silica, silicates, iron oxides, greenschist, gibbsite, kaolinite and other neutral minerals and a small amount of organics from vegetable matter.

#### **5.6.4.3 Atmospheric Waste**

Atmospheric waste will by and large consist of water vapour from the drying process and a small amount of iron oxide dust from the loading operations.

#### **5.6.5 Treatment and Disposal of Tailings**

The tailings from this operation are particularly suitable for capping and overlaying the pyrite and sulphide type tailings of the Savage River Mine iron ore operation.

It is planned to spread the tailings of this operation over the older tailings of the existing iron ore operation. No specific treatment of the tailings will be needed.

Revegetation of the tailings is given in the rehabilitation chapter 6.6.3.

#### **5.6.6 Storage**

The intermittent nature of the mining operations and the necessity to stockpile approximately 2000 cubic metres of raw pigment material for the winter months will require the construction of suitable storage facilities along side the beneficiation plant.

#### **5.6.7 Beneficiation Infrastructure**

The beneficiation and storage plant will be constructed as a single unit of galvanised iron and timber fabrication with three phase power suitably connected to the local grid. Incorporated within the structure will be amenities, office accommodation and loading facilities.

Construction will be to the specification of the local Authority.

#### **5.7 Coastal Facility**

Further treatment of the refined pigment will be undertaken at a site located close to the Port of Burnie. This facility has yet to be chosen from the many industrial office/warehouse complexes currently standing empty.

The facility will house proprietary equipment which will be used both to extend the range of pigment colours and to prepare pigment to the specification of the particular end-user. Equipment to be used in part duplicates that listed under chapter 5.6.2.3 "drying, milling and bagging".

Materials to be stored will consist of both natural and synthetic iron oxides. An LP gas installation will be required.

## 6.2 Waste Water Emissions

The Environment Protection (Water Pollution) Regulations 1974 define the following emission standards into Inland Waters where the receiving water is at least 50 times greater than the flow of the emission:

- biochemical oxygen demand of the emission shall not exceed 40 milligrams per litre,
- the emission shall not be of such a nature as to reduce the oxygen content of the receiving waters below 50% of saturation,
- the non-filtrable residue of the emission shall not exceed 60 milligrams per litre,
- faecal coliforms in the emission shall not exceed 200 per 100 millilitre,
- total concentration in the emission of grease and oil (being grease or oil in stable dispersions) shall not exceed 10 milligrams per litre,
- the emission shall be visually free of grease, oil, solids, and unnatural discoloration and,
- the concentration in the emission of any restricted substance shall not exceed that specified in column II of the Appendix to the Schedule with respect to that substance (see Appendix 1).

### 6.2.1 Beneficiation site

The spent water issuing from the wet stage of the beneficiation route will total some 1400 litres per tonne of refined iron oxide pigment per annum, or, based on a 40% recovery of pigment from run-of-mine material, approximately 600 litres per tonne of run-of-mine material.

At full production this equates to some 19.6 megalitres per annum, or substantially less than 0.1 megalitres per day, all of which will be discharged by pipework from the plant site to Main Creek via the Savage River Mine tailings dam.

Water measurements taken at the Main Creek dam overflow weir between June 1990 and April 1991 (i.e. summer and winter flows) display a range of flows between 19 and 54 megalitres per day, with an average of 40 megalitres per day.

At no time then will the Main Creek receiving waters be less than 50 times greater than the flow of the emission.

The quality of the Main Creek overflow waters is as follows:

receiving water	Dissolved Solids	Suspended Solids	Fe	Mn	Cu	Cl	SO4	pH
Main Creek Overflow	691	15	0.15	0.12	<0.1	74.2	308	7.7

Table 11. Data from Savage River Mines Environmental Water Management Control, analyses in parts per million, data averaged over 45 months between Sept 1987 and May 1991.

The discharge will essentially be clear water at neutral pH, free of any discolouration, restricted contaminants and suspended solids. There will be no need for any treatment of the issuing water to ensure compliance with the emission standards.

In the unlikely event of an equipment malfunction the processing facility is capable of an immediate and total shut-down without discharge of any kind.

Stormwater from the site buildings and run-off from the site area will be channelled to the old tailings dam the volumes of which are dependent upon the rainfall received.

Domestic waste associated with the ablution facilities, etc. will be disposed of to the satisfaction of the Environmental Health Officer and the premises shall be kept in a clean and sanitary condition.

#### 6.2.2 Mine Sites

Water emission will be confined to the management and discharge of accumulated rain water and natural seepage within the mine areas, the volumes of which, for the most part, are dependent upon the rainfall.

The amount of water entering the mine areas will be minimised by:

- the construction of drainage channels around the mine areas so as to divert all natural water run-off away from the disturbed areas.

Those waters entering the mine areas will naturally drain to the lowest part of the mine-pit which will be so constructed to drain the active working areas and act as a sediment trap.

During times of inactivity at the mine sites any run-off water will be essentially clear; as the pigment material is sufficiently resistant to water erosion and no dispersion occurs. In this instance after suitable sedimentation of the particulate matter by natural sedimentation the super-natant (clear) water within the mine sump will be discharged to the nearest water course.

During mining periods some discolouration of the water within the mine areas will occur. Mine drainage will be so constructed to drain this water to a mine sump that will be designed to hold all mine run-off water. Release of this water, by pumping to a water course, will only occur after natural sedimentation has removed all colouration and particulate matter from the water.

In the unlikely event that a potential exists for a discharge of coloured water from the mining areas all mining will cease until such time as the waters are contained.

All haul roads and the main mine access road will be constructed from cobber reject material from the Savage River Mines operation to provide a surface free of potential contaminants. Correct construction will ensure suitable runoff of the rainwater to lateral drains.

### 6.2.3 Coastal Facility

There will be no waste water emission from the operations.

## 6.3 Atmospheric Emissions

The Environment Protection (Atmospheric Pollution) Regulations 1974 and the Environment Protection (Atmospheric Pollution) Amendment Regulations 1985 define the following emission standards for an installation that was in operation after 1 January 1975:

- the emission from any installation specified in the first column of the Appendix to this Part of this Schedule shall comply with all requirements specified in respect of that installation in the second column of that Appendix (see Appendix 2),
- the emission from any fuel-burning equipment shall not appear darker than shade 1 on the Ringelmann Chart,
- the concentration of soot in an emission from a boiler or furnace consuming oil or gas shall be such that when determined by the Bacharach filter paper method a blackening index of shade 3 is not exceeded and,
- the concentration of solid particles in the emission from plant used for the heating of metals or metal ores, other than cold blast foundry cupolas, shall not exceed 0.1 grams per cubic metre.

### 6.3.1 Beneficiation site

Emissions from the plant will mainly be water vapour from the drying processes and very minor amounts of iron oxide dust from loading operations.

Dust emissions will be minimised by careful design of loading facilities.

Water vapour emissions at full production will be equivalent to 1200 litres of water per day.

#### 6.3.2 Mine Sites

The damp nature of the in-situ iron oxide material will not create any significant dust emissions during the mining operations.

#### 6.3.3 Vehicles and Mining Machinery

The emissions into the atmosphere from the internal combustion engines used shall comply with such of the standards specified in Schedule II as are applicable.

#### 6.3.4 Coastal Facility

The handling of refined pigment material will be so designed to minimise the amount of iron oxide dust and no emission to the atmosphere is anticipated.

### 6.4 Noise Emissions

Reference is made to the Environment Protection (Noise) Regulations 1977.

#### 6.4.1 Beneficiation site

Noise from the plant at the site boundary will be kept below 60 dB(A) between the hours of 0700 and 1900 every day and will be kept below 50 dB(A) at other times.

Conformance with these self imposed limits will be by careful plant design and by tests of site in accordance with Australian Standards AS1259, AS1217, AS1469 and AS1081 and by subsequent provision of noise adsorbing barriers if necessary on offending plant.

It is not expected that extra provisions as this will be necessary.

#### 6.4.2 Mine Site, Cartage Routes and Coastal Facility

The mine site areas are a considerable distance from any general public amenity and consequently noise emissions from mining operations will be well within those standards of the Act.

The cartage route for the run-of-mine material from the HT ochre site area will be at all times greater than 1200 metres from the nearest residential building at the Savage River township. Any associated noise will not be distinguishable from the background levels associated with various activities at the Savage River Mine.

The cartage of the Bowry Creek umber material through the Savage River Township will make use of the Corinna to Waratah highway. Access to the beneficiation site will be by way of the alternative mine access route which effectively by-passes the residential areas of the township. The movement of trucks will be confined to the hours of 0800am to 0500pm.

Cartage of the refined pigment material to the coast and the activities confined to the coastal facility are unlikely to add significantly to existing noise levels.

## 6.5 Solid Waste Disposal

The Environment Protection (Waste Disposal) Regulations 1974 define the following controls:

- no open burning on a disposal site,
- no person shall deposit at any place any environmentally dangerous waste (Schedule I) and,
- no person shall deposit at any place hazardous wastes (Schedule II) in such quantities as are likely to give rise to an emission from that place of a liquid that:
  - (a) does not comply with the standards prescribed by the Environment Protection (Water Pollution) Regulations 1974; or
  - (b) would result in a contravention of those regulations.

### 6.5.1 Beneficiation Site

Solid waste emission will be confined to the beneficiation site and based on some very pessimistic recovery yields of 40% (which have always been surpassed during laboratory trials) the output of solid waste at the end of the fourth year of operations is anticipated to be at most 21,000 tonnes per annum.

Solid waste consists of a slightly alkaline friable mix of silica, silicates, iron oxides, greenschist, gibbsite, kaolinite, other neutral minerals, small amount of organics from vegetable matter and water.

The water component will be consistent to that discharged as waste water in chapter 6.2.1.. During the process of solid tailings consolidation and settling a proportion of the water will percolate out into the old tailings dam where it will be recycled back to the beneficiation process.

The solid waste material is suitable for overlaying and sealing the acidic sulphide tailings of the nearby iron ore operation. The slightly alkaline nature of the new tailings would neutralise and tend to prevent leaching from the surface of the acidic sulphide tailings.

The abundance of gibbsite, kaolinite, silica and other relatively neutral minerals in the tailings will form the basis of a good medium for vegetation growth.

It is planned to spread the tailings of this operation over the older exposed tailings of the existing iron ore operation.

## 6.6 Rehabilitation

The small scale of the proposed extractive operations will not have exhausted the defined resource within the scope of this report (i.e. the first five years of operations).

The following rehabilitation plan places considerable emphasis on the initial rehabilitation work to stabilise the disturbed areas prior to the commencement, at some later stage, of the final rehabilitation. Any reference to final end-use is given for completeness.

The objectives of the rehabilitation plan are:

- Environmental Stability; the stabilisation of the disturbed areas to prevent on-going erosion prior to final rehabilitation and,
- Environmental Development; the development of a surface profile and structure amenable to the development and promotion of ecological succession and equilibrium.

The areas of disturbance will be confined to those preferred site areas where extraction of the pigment material will take place. This is expected to disturb some 5 hectares of ground.

Little, if any, disturbance will result from the construction of the beneficiation plant.

Rehabilitation will commence when it is clear that the disturbed area, whether tailing, mine or that from access construction, will not be disturbed in the future, and it will primarily consist of:

- the re-contouring of the disturbed areas to provide a physically stable and non-eroding profile and,
- the re-seeding of these areas with native species in conjunction with, where possible, the promotion of natural colonisation to develop plant diversity.

### 6.6.1 Mine Site Areas

Mined out areas within the extractive operations will first be contour graded and battered and/or backfilled to minimise the slopes associated with open pit mining.

Battering and contouring will reduce the risk of erosion, maintain slope stability and reduce the effects of winter scouring by rainfall.

Grading of the pit walls to common drainage areas together with the construction of downslope water impoundments will provide suitable sedimentation basins for general site run-off before the water enters the local creek system.

Stockpiled soil (retained from the natural surface prior to mining) will be used to cover the terminal faces. This is expected to provide a rooting medium for successful vegetation establishment.

Planting schedules and species distribution will be similar to the seeding rates and seed mixes used at Savage River Mines in their rehabilitation programme (Appendix 3).

Where necessary because of poor site conditions, etc. the species rate and application rate may be expanded and aided with the judicious use of fertiliser. Seed application will be by hand broadcasting.

Mining will ultimately create a number of small depressions in those areas that are currently lying between the valley slopes.

### 6.6.2 Access to Mine Sites

While disturbance is expected to be minimal during access construction provision is made to provide rehabilitation.

Areas adjacent to culverts, drainage ditches and the like will be back-filled and planted with seeds and/or seedlings for rapid establishment and aesthetic considerations.

### 6.6.3 Beneficiation Site

The establishment of the plant and site area will, to a degree, complement the on-going rehabilitation of the Savage River Mines old tailings area. This will be further enhanced by the implementation of landscaping and some grassed areas immediately surrounding the beneficiation complex.

Tailings from Savage's operation will report to the surface of the old tailings area and cap the existing barren acidic and sulphide rich tailings. Tailing material will be so constructed to provide a stable, well-drained profile.

While the new tailings, composed of clays and weathered materials, have a good revegetation potential additional amounts of top-soil from the local Savage River Mine "A" dump will be added to the exposed surface material. This will provide a nutrient rich, well drained environment for future vegetation cover.

Hand broadcasting or mechanical hydro-seeding/mulching of a native species seed mix, similar to that for the mine areas, will be implemented.

At no stage will the issue of these new tailings bury or compromise in any way the present or future rehabilitation work of Savage River Mine which in the Savage River Mine Rehabilitation Plan (pages 10 & 11 and 17 & 18) states for this area:

#### .. "Old Tailings Dam

This tailings dam has been constructed using spigotted tailings for the dam wall. The coarser particles have accumulated near the wall while the fine have extended towards the northern embankment. This particle classification has produced a limited range of particle sizes, and makes the coarse tailings structureless and prone to erosion. The finer particles tend to have a high bulk density, low permeability and create surface crusts.

Both tailings types also with no organics, represent a hostile environment for plant growth, with an acid pH, saline and high levels of metals, at times possible toxic to plants.

The tailings embankment (mainly the south western section) is visible from the main road and classified as a priority area for rehabilitation. The SW abutment is also actively eroding.

#### Rehabilitation Treatment

Rehabilitation of this area has been proceeding on the basis of providing a tree screen on the dam wall.

The main embankment is to be further stabilised, based on the latest dam surveillance report, by providing drainage channels.

Revegetation is progressing well on the berms and it is proposed that every berm is similarly revegetated on the southern side of the embankment, with the objective of achieving full screening from the Corinna Road. Other areas will be subject to periodic review and with satisfactory growth every second berm may be revegetated.

The SW abutment and tailings surface will also be stabilised and revegetated, or in the case of the tailings surface flooded for wetland development.

Because the remainder of the dam surface is stable, has a low priority for rehabilitation, and water quality in the impoundments is sufficient for a trout fishery, this will be left in its current state.

The access road from the old rifle range in the south west corner will be closed off, as will access to the lake, past the ICI compound. Access to the lake for recreational purposes will be from the town side.

### Stability

..A final abandonment review of the three tailings dams has been submitted to the Department of Resources and Energy. This report (Savage River Mines Tailings Dams Abandonment Review, Thompson and Brett 1990) recommended the following minimum works be carried out by Savage River Mines;

No 1 (old) Dam            additional rockfill to saddle dam erosion protection rockfill to southern embankment.

In addition, the report recommends water quality from seepage and runoff be further improved and long term potential addressed by;

No 1 (old) Dam            developing wetlands in the SW corner and covering high areas with clays, monitoring and review of seepage from the southern embankment."

#### 6.6.4 Seed Collection, Planting/Application Time and Source of Top soil

Native seed will be either purchased from local commercial seed collectors or collected in the area.

Seed application will be in late Autumn and early Spring. Top soil will be taken from the Savage River Mine "A" dump area.

### 6.7 Hazardous Materials

#### 6.7.1 Beneficiation Site

Hazardous materials used and stored at the beneficiation site are confined to:

- ammonia solution (25-30%) and sulphuric acid (98% strength) and,
- LP gas.

Liquid chemicals will be stored in either lined steel containers which are recovered and re-used or dedicated on-site containers contained within safe compounds. Any leakage of the material will be contained by suitably constructed and drained impoundments.

All necessary safeguards including shower stations and protective clothing will be implemented to the standard required by the Authority.

#### 6.7.2 Mine Sites

Diesel fuels will be contained within approved mobile diesel storage tankers and stored on-site within areas specifically constructed to contain fuel and oil spillage.

#### 6.7.3 Coastal Facility

There will be no storage of hazardous materials other than LP gas.

### 6.8 Fire

#### 6.8.1 Beneficiation Site

The barren nature of the old tailings area is not expected to promote or develop a fire risk situation, however Savage intends to provide a suitable perimeter road around the site area that will also serve as a fire break.

#### 6.8.2 Mine Site Areas

During those fire danger periods specified by the Forestry Commission all mine plant will carry or have immediate access to the following equipment:

- fire extinguisher
- knapsack
- rake hose
- 200 litres of water.

All engine powered equipment will be fitted with fully maintained and effective mufflers and spark arresters.

### 6.9 Visual Impact

#### 6.9.1 Beneficiation Site

The plant complex will be fully enclosed in a timber/steel structure of a suitable aesthetic design and will be rendered outside with material finished in an earth-tone colour.

The site perimeter will be planted with suitable local tree varieties for both visual appeal and further noise abatement.

The site is not generally visible from either any major viewing spots or from the Corinna to Waratah highway.

The capping of the existing barren tailings area with new material which is capable of sustaining plant life will lessen the impact of the existing disturbance.

#### 6.9.2 Mine Site Areas

The sites are not visible from either any major viewing spots or from the Corinna to Waratah highway.

#### 6.9.3 Coastal Facility

An existing industrial/warehouse complex will be used.

### 6.10 Impact on Flora and Fauna

#### 6.10.1 Beneficiation Site

The plant will be sited on and immediately adjacent to the old tailings dump and will not interfere with the flora or fauna.

#### 6.10.2 Mine Site Area - HT Drillsite Area

Some clearing of the flora is necessary for the establishment of roadways and extractive operations. However the flora is that typical of the area and as such contains little to no conservation significance.

The initial mining phase may cause minor disorientation to the smaller land fauna present. This is alleviated in the medium term by:

- small scale of disturbance,
- mining restricted to day-light hours and,
- campaign mining provides considerable periods of non-mining activity.

#### 6.10.3 Mine Site Area - Bowry Creek Umber Site

The extractive operations will be confined to that area completely destroyed by the bush fires of March 1982. Any fauna disturbance will be as for the HT drillsite area.

### 6.11 Archaeology

The full archaeological survey report is reproduced in Appendix 4.

No Aboriginal or historic European archaeological sites were located during the survey.

It was concluded that:

- the pigment sources themselves had only been uncovered by the recent construction of tracks and,
- the consultant and Aboriginal representative were satisfied that the pigments or ochres could not have been exposed at any time in a way which would encourage Aboriginal people to exploit them.

#### 6.12 Monitoring and Review

Monitoring will be required to assess:

- compliance of the mining practices to those requirements laid down by the Department of State Development and Resources
- revegetation success and stability of the mining and tailings areas
- ensure that the water discharge is within the emission standards.

The rehabilitation and revegetation aspects of the proposal will be assessed in conjunction with the Department of Environment and Land Management and reviewed on an annual basis.

Mine and tailings areas require periodical inspection by the Department of State Development and Resources.

Monitoring of the water discharge will be performed by Savage and a Tasmanian Analytical Laboratory which is registered by the National Association of Testing Authority, Australia.

Savage will perform the collection of the issuing waters, at pre-determined times, the results of which will be provided to the Department of Environment and Land Management for their continued assessment. Visual inspection of the water quality will be performed on a daily basis and at those times that inspectors of any of the governing Authorities are on-site.

Visual inspection of the water quality will be performed on a daily basis and at those times that inspectors of any of the governing Authorities are on-site.

## APPENDIX 1

**Environment Protection (Water Pollution) Regulations 1974**  
**Appendix to Schedule II**

<b>Column I</b> <i>Restricted Substance</i>	<b>Column II</b> <i>Emission into Inland Waters</i> (milligrams per litre)
Arsenic	0.05
Barium	1.00
Boron	1.00
Cadmium	0.01
Chloride	250.00
Chromium hexavalent	0.05
Chromium trivalent	0.50
Copper	1.00
Cyanide	0.05
Fluoride	1.50
Iron and manganese (combined total filtrable)	1.00
Lead	0.05
Mercury	0.002
Methylene blue active subs.	0.50
Nitrogen (as ammonia)	0.50
Nitrogen (as nitrate or nitrite)	10.00
Pesticides:	
endrin, chlordane, toxaphane	
dieldrin	0.001
other organochlorides	0.01
organophosphates	0.05
carbamates	0.10
fluorinated hydrocarbons	0.001
substituted phenols and cresols	0.001
Phenolic compounds	0.001
Phosphorus	2.00
Selenium	0.02
Silver	0.10
Sulphate	250.00
Uranium	5.00
Weedicides	0.10
Zinc	5.00

*For the purposes of this Appendix, "weedicides" means any of the following substances:*

2,4-D (including salts and esters)  
2,4,5-T (including salts and esters)  
Phenyl ureas  
Triazines  
Amides  
Quaternary salts  
Dipyridyls  
Acrolein

***Environment Protection (Atmospheric Pollution) Regulations 1974***  
**Appendix to Part II of Schedule I**

***Sulphuric acid and sulphur trioxide***

3. Other installations - The concentration of sulphuric acid and sulphur trioxide shall not be such as to exceed the equivalent of 0.1 gram of sulphur trioxide per cubic metre.

***Fluorine***

2. Any other installation - The concentration of fluorine, hydrofluoric acid, and other inorganic fluorine compounds shall not be such as to exceed the equivalent of 0.05 grams of hydrofluoric acid per cubic metre.

***Chlorine***

Any installation - The concentration of chlorine shall not exceed 0.2 grams of chlorine per cubic metre.

***Hydrogen sulphide***

Any installation - The concentration of hydrogen sulphide shall not exceed 0.005 grams per cubic metre.

***Nitric acid and oxides of nitrogen***

Any installation - The concentration of nitric acid and oxides of nitrogen shall not be such as to exceed the equivalent of 1 gram of nitrogen dioxide per cubic metre.

***Heavy Metals***

Any installation - the combined total concentration of lead, arsenic, antimony, cadmium, mercury and the compounds thereof shall not be such that the total mass of those elements and compounds expressed in each case as the element exceeds 0.01 grams per cubic metre. The concentration of cadmium and any compounds thereof shall not be such that the total mass thereof, expressed as the element, exceeds 0.003 grams per cubic metre.

***Hydrogen chloride***

Any installation not being an installation for the manufacture of glazed terracotta tiles. - The concentration of hydrogen chloride shall not exceed 0.4 grams per cubic metre.

## APPENDIX 3

*Native Species Seed Mix and Seedlings***Native Species Seed Mix and Seedlings**

Seeding Rate: 2kg/ha

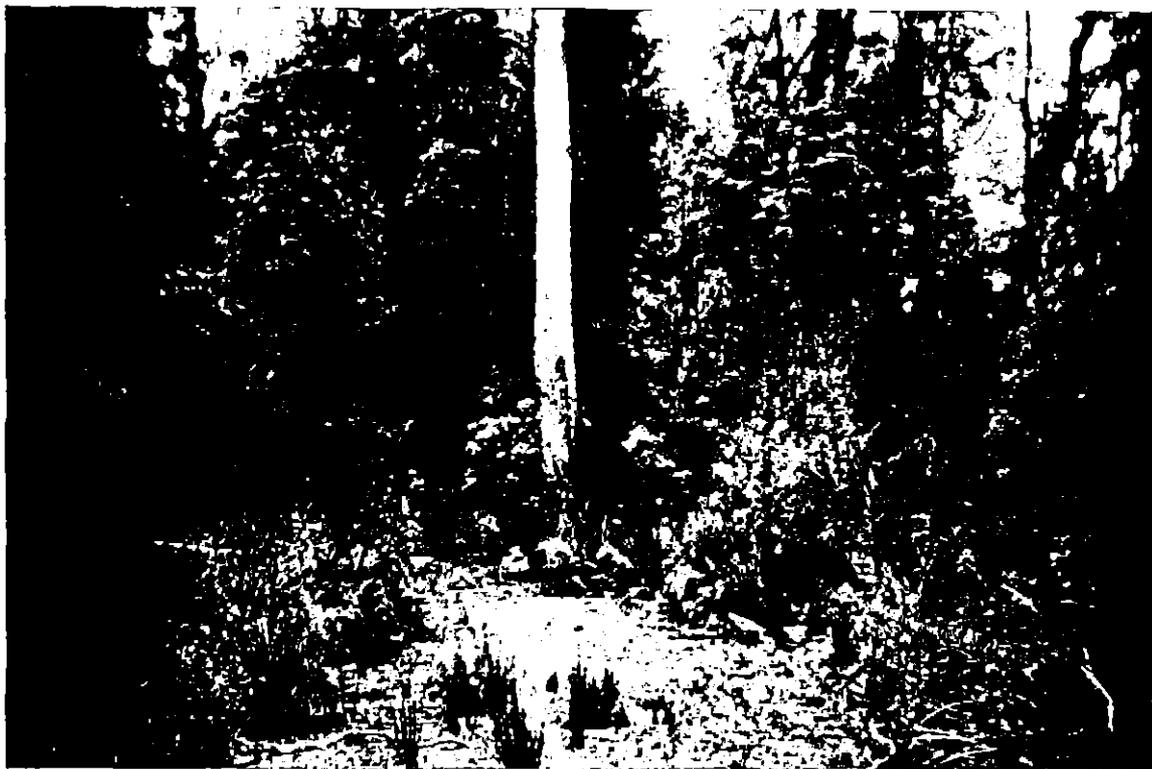
Acacia dealbata	(Silver Wattle)	0.2
Acacia melanoxylon	(Blackwood)	0.1
Acacia mucronata	(Native willow)	0.4
Acacia verticillata	(Prickly moe)	0.1
Eucalyptus brookerana		0.1
Eucalyptus nitida	(Smithton peppermint)	0.2
Gaultheria hispida	(Mountain snow berry)	0.1
Leptospermum glaucesceus		0.1
Leptospermum lanigerum	(Woolly tea tree)	0.1
Leptospermum nitidum		0.1
Leptospermum scoparium	(Manuka)	0.3
Melaleuca squamea	(Paperbark)	0.1
Melaleuca squarrosa	(Scented paperbark)	0.1
	<b>TOTAL</b>	<b>2.0</b>

**SEEDLINGS**

Acacia dealbata	(Silver Wattle)
Acacia mucronata	(Native willow)
Acacia verticillata	(Prickly moe)
Eucalyptus nitida	(Smithton peppermint)

*Archaeological Survey Document*  
by du Cros and Associates, Melbourne

**AN ARCHAEOLOGICAL SURVEY OF  
PROPOSED PIGMENT EXTRACTION AREAS,  
SAVAGE RIVER, NORTH-  
WESTERN TASMANIA**



Report to Savage Resources Limited

JANUARY 1993

Hilary du Cros

du Cros and Associates  
238 Ferrars Street South Melbourne VIC 3205

**ABSTRACT**

This report describes the survey work carried out to record Aboriginal and historic archaeological sites within the proposed pigment extraction areas in January, 1993 at Savage River, NW Tasmania.

No Aboriginal or European archaeological sites were located during the survey.

On the basis of this report, it was recommended that:

1. As no Aboriginal or historic archaeological sites were located in the survey area, there are no archaeological grounds for preventing the development subject to the above recommendation.

2. Copies of this report should be sent to:

Don Ranson  
Archaeologist  
Dept. of Parks, Wildlife  
and Heritage  
(Archaeology Branch)  
134 Macquarie Street  
Hobart TAS 7000

Steve Stanton  
Chairperson  
Tasmanian Aboriginal Land Council  
148 Elizabeth Street  
Hobart. TAS.7000

**ACKNOWLEDGEMENTS**

The consultant would like to thank the following people for their assistance:

Bob Annett and Leon Innes - Savage Resources Limited  
Rocky Sainty, Steve Stanton - Tasmanian Aboriginal Land Council  
Don Ranson - Department of Parks, Wildlife and Heritage

<b>List of Contents</b>	<b>Pages</b>
1. INTRODUCTION	1
1.1 The Brief	1
1.2 The Survey Area	2
1.3 Impact of the Development	2
1.4 Aboriginal Consultation	2
2. ENVIRONMENTAL CONTEXT	2
2.1 Geology and Topography	2
2.2 Vegetation	3
2.3 European Impact	3
3. PREVIOUS ARCHAEOLOGICAL WORK	3
4. HISTORICAL BACKGROUND	6
5. FIELD METHODS AND GROUND SURFACE VISIBILITY	8
6. SURVEY RESULTS	8
7. RECOMMENDATIONS	8
REFERENCES	10
APPENDIX 1 - The Brief	12
APPENDIX 2 - Glossary	13
APPENDIX 3 - Site Descriptions	14
<b>List of Figures</b>	
1. Location Map.	15
2. HT Survey Area	16
3. Detail of HT Survey area	17
4. Bowry Creek Survey Area	18

## ( 1. INTRODUCTION

Savage Resources Ltd is producing an Environmental Management Plan for the development of a pigment resource located south of Savage River in North-Western Tasmania (see Figure 1). This report documents the results of an archaeological survey for Aboriginal sites which will be part of the EMP.

The study area was considered by the Department of Parks, Wildlife and Heritage (DPWH) to have some potential for containing Aboriginal archaeological sites. Information regarding DPWH requirements for archaeological surveys was supplied to Savage Resources, Bob Annett, in May-June 1991.

### 1.1 The Brief

In the covering letter for the brief, priority has been given to the small areas where extraction is likely to occur (see Appendix 1). The brief itself is the standard DPWH one for conducting Aboriginal/historic site surveys and recordings. According to this brief, the main objectives of the study were:

- (a). To locate, document and interpret the Aboriginal and historic archaeological resources along the survey route through a systematic ground survey.
- (b). To assess the significance of the Aboriginal and historic archaeological sites identified.
- (c). To review and update site documentation, if any exists.
- (d). To place any archaeological remains located in a regional context, make predictions for site location and indicate areas of archaeological sensitivity.
- (e). To consult with the relevant Aboriginal people who have an interest in the survey area regarding its cultural heritage.

In the following report, the environmental, archaeological and historical background will be outlined for the survey area, as well as results and recommendations.

## 1.2 The Survey Area

The survey area lies within Savage Resource's six mining leases and focuses particularly on the HT and Bowry Creek sites (see Figures 2-4). However, pigment extraction is expected to occur within a small area of these areas. Access to each area is by 4WD track. Both survey areas are located in part of the Consolidated Mining Lease on crown land between Corinna Road and Savage River.

## 1.3 Impact of the Development

The extraction of the pigment would disturb any archaeological material (if present) contained within the area affected. The type of development proposed is a small open cut operation in both areas. This will be a series of pits with the largest measuring 500m x 100m in the HT area. The HT area will be accessed by improving the existing 4WD drive track to the north which connects it with the Savage River Mine. The Bowry Creek area will be accessed by the existing 4WD track which connects it with Corinna Road.

## 1.4 Aboriginal Consultation

Steve Stanton, Chairperson of the Tasmanian Aboriginal Land Council (TALC) was contacted before the commencement of the survey. The Council provided Rocky Sainty as their Aboriginal representative to assist the consultant on the survey. Mr Sainty will report to the Council on the results of the survey. As per standard policy, a copy of this report will be sent to the Council for comment.

## 2. ENVIRONMENTAL CONTEXT

### 2.1 Geology and Topography

One survey area includes rugged slopes and gullies overlooking Bowry Creek. The HT site has several small creeks running through it to the Savage River. These areas occur between about 150m and 200m above sea level. Bowry Creek is a tributary of Savage River which in turn flows into the Pieman River and into the sea. Both areas are part of the Savage River Land System which can be described as densely dissected hill country on Precambrian sedimentary rocks (Sharples 1992). Tertiary basalt also occurs at the north of the HT survey area. The pigments which are the subject of the proposed mine occur in a

( horizontal layer of weathered rock between vertical layers of magnesite and greenschist (Bob Annett, Pers. Comm.).

## 2.2 Vegetation

The survey area is principally mixed forest (rainforest and eucalypts) including Blackwoods, Myrtle Beech, Coachwood species. The undergrowth was less dense and included more grass and swampland species north of the HT area, where the canopy was more intact.

## 2.3 European Impact

Aboriginal people were not observed by Europeans as being present in the area, mainly because the area has received little in the way of attention since European settlement in Tasmania. This does not mean that they were not using or travelling through the area before and during the contact period.

Since European arrival in the area the main impact on the two survey areas have been from track construction and selective logging. Corinna Sawmills have been logging in the general area in recent years, but the tracks to the survey areas were constructed for prospecting in the 1960s. Either side of the survey area, are tangible reminders of the region's mining history as Corinna Road connected mine fields at Waratah and Corinna which were at their peak at the turn of the century (du Cros 1992).

## 3. PREVIOUS ARCHAEOLOGICAL WORK

No surveys have been conducted or archaeological sites recorded previously in the area. The majority of sites registered on the TASI and THASC Site Register for the North West are located far to the south or north of the survey area. Aboriginal sites are principally open artefact scatters or isolated artefact occurrences (Cosgrove and Hughes 1983, MacFarlane and Coates 1990, Richards 1992). Post-contact or historic sites are generally associated with sawmilling or mining.

Ingareth MacFarlane conducted a sample survey of the North-West. She located the Aboriginal archaeological sites which were closest to the survey area. This included a surface artefact scatter (TAS No. 4259) approximately 9 km away on Jaspers Hill and an isolated artefact (TAS No. 4761) 37 km to the north on the Pipeline track (TASI Site Register and MacFarlane n.d.). The latter site is the only one described in any

( detail in her report. It was located in an area of poor visibility due to disturbance by logging activity (MacFarlane n.d. 61).

Aboriginal spongolite quarry sites have also been recorded many kilometres to the north on Rebecca Creek (Cosgrove 1990, Richards 1992). Apart from these highly significant sites, very little has been recorded in this part of inland Tasmania. This is mainly because very little has been surveyed and archaeologists have had to contend with very poor ground surface visibility in the area that have been investigated.

To the south of the survey area, Cosgrove and Hughes (1983) note that ground surface visibility in the Henty River area was poor and that this limited the number of sites which were located.

MacFarlane and Coates (1990) located 83 open sites and 13 unoccupied caves/rockshelters during their Ling River power scheme area. The caves/shelters occurred in a limestone area. Of the open sites, 46 were artefact scatters and 37 were isolated artefacts. Three sites were re-recorded (TASI 2863-65) which were originally located by Cosgrove in 1985.

Two of the artefact scatters identified by MacFarlane and Coates (1990) were considered likely to contain sub-surface deposits (TASI 4592 and 4599). Over 70 of the sites had <10 artefacts and 6 sites had < 20 artefacts, while the largest site had < 60 artefacts. The sites varied in size from 0.22m<sup>2</sup> to 3,000m<sup>2</sup>. MacFarlane and Coates (1990:33) found that most (89%) were <310m<sup>2</sup> with the average being around 22m<sup>2</sup>. Densities in sites of similar size varied widely, but on average most artefact scatters were found to have <18 artefacts per m<sup>2</sup>.

Three valley regions were examined during the survey which differed in respect to topography and geomorphology and visibility conditions. The southern section yielded only three sites despite good visibility. Most sites occurred in the Central and Northern regions. MacFarlane and Coates feel this site choice reflects a preference by Aboriginal people for elevated ground (averaging 2m to 13m above the lowest ground in these valleys), for instance on the slopes or crests of rouche moutonnees or terraces running parallel to creeks (MacFarlane and Coates 1990:37). Only two sites were located on river banks level to the plain. MacFarlane and Coates hypothesise that:

Higher ground would have been selected as a locus for activities because it is better drained, has a view of the surrounding area, and is removed from the valleys where game tends to congregate. The particular types of raised

( landforms which have been selected for use are readily accessible from the plains. Gently sloping to moderate slopes link the sites to the plains (MacFarlane and Coates 1990:37).

Other spatial patterns were identified in terms of how sites clustered in the three regions. The northern section appears to have a more diffused pattern, in contrast to the central section where there is a low density of isolated large sites (or base camps). Three explanations may be forwarded:

1. Each pattern was established due to differing land use geographically.
2. Each pattern was established due to differing land use temporarily.
3. A number of factors are operating in site choice at any location.

MacFarlane and Coates (1990) suggest that the uniformity of suitable landform types placed little restriction on site choice. To test this they closely examined site contents. Integral to this was the assumption that a site with a large number of artefacts occurred in preferred site locations and that the smaller sites are not just smaller versions of the former. That the size of site may be linked to function or some other aspect of land use. Also, they posit that the smaller sites are the results of an opportunistic approach to reduction of raw materials involves selecting the raw materials expediently. They conclude "the sites identified in the King River Valley represent a range of stone working behaviours worthy of further detailed investigations (MacFarlane and Coates 1990:47)."

Pocock (1991) in following on from MacFarlane and Coates' work conducted some detailed investigations. She discovered that:

- 1). The materials in the open sites and cave sites of the King River Valley "were markedly different (Pocock 1991:204)".
- 2). The caves favour quartz and the open sites quartzite.
- 3). Darwin glass occurs in caves, but not in the open sites.
- 4). The date for Overhand Cave of 320 BP challenges the hypothesis that Darwin glass is always associated with the Pleistocene part of a site sequence.

Work conducted recently by Freslov in the area indicates that most of the open sites, particularly those clustered in the northern region

( of his adult life in the West country and came to be a respected mining consultant, geologist, draughtsperson and naturalist. His reports encouraged prospectors to work the area for copper and tin (du Cros 1991).

The tributaries of the Pieman River north-east of the Donaldson River attracted alluvial gold prospecting after 1879 (Tasmanian Year Book 1967, Blainey 1978). The areas of interest during the 1880's were Middleton's Creek where 500 men prospected and soon exhausted the richest section which was only about a kilometre long (Montgomery 1894, Whitham 1949). When this became unworkable prospectors and miners moved on to surrounding creeks and rivers including, Savage River, Fogarty's Creek (off Middletons Creek), and others up towards Mt Bischoff. Corinna, nearby on the Pieman River, was surveyed properly in 1882 and 30 blocks were mapped out to cope with the influx to the mineral fields (Julen 1987).

Montgomery, a Government geologist, reported on the gold prospecting and mining in the eastern zone in the early 1890's (Montgomery 1890, 1894). He observed that at least two main lines of nickel were being worked north of Heazlewood River and across Whyte River. The latter was also being worked for alluvial gold, as was the Castray River. He remarked on the potential for further mineral exploration in areas in typical nineteenth century style,

"The Great Western Range yet holds its treasures intact, but we may soon expect to hear of successful assaults on its fastnesses. The prospector - pioneer of the wildest wastes - is still pushing on... and into the dismal dens he lets light, till the beaten demons of the mine fly affrighted and yield him their long-guarded treasures (Montgomery 1890:18)."

Twelvetree's geological report on the Waratah/Corinna mineral fields describes the situation a few years later when more ore had been removed in response to favourable market prices (Twelvetrees 1900). As on the Balfour Mining Field, access was difficult, so returns had to exceed the cost of removing material. Marked on a sketch map of the Corinna-Waratah Mineral Field was a road that was being constructed to improve access (probably the current Corinna Road). Ore was then shipped from Waratah to Burnie by rail. Of these works, Magnet Silver-lead Mine was the most prosperous. A tramway was later built to link the mine with the railhead (Waller 1902). It cost £19,000 to build and allowed 1,000 tons of ore per month to be exported. The ore was sold to the Smelting Company of Australia and the Tasmanian Smelting Company (du Cros 1992).

- ( The Savage River Mining Company (a separate company to Savage Resources Ltd) began mining magnetite around 1968 and soon a thriving town developed centred on the open cut mine. The mine is now near the end of its operation and some houses in the town are gradually being sold off and moved (Bob Annett).

## 5. FIELD METHODS AND GROUND SURFACE VISIBILITY

The survey areas were surveyed on foot by Hilary du Cros, and Rocky Sainty (Tasmanian Aboriginal Land Council) with some assistance from Bob Annett (Savage Resources Ltd) on the 11th of January, 1993.

The ground surface visibility was restricted to tracks and cleared areas (0-10% per m<sup>2</sup>). There were some sections where slightly better visibility occurred under trees where the canopy was intact to the north of the survey areas.

The consultants surveyed tracks within the survey areas and sampled access tracks marked for improvement (see Figures 2-4).

## 6. SURVEY RESULTS

No Aboriginal or historic European archaeological sites were located during the survey. The HT survey area and associated track received the highest survey coverage as they offered the greatest ground surface visibility. Nevertheless no artefact scatters, isolated artefacts or remains of early mining/prospecting were encountered.

The pigment sources themselves had only been uncovered by the recent construction of tracks and prospecting by Savage Resources Ltd. Rocky Sainty and the consultant were satisfied that the pigments or ochres could not have been exposed at any time in a way which would encourage Aboriginal people to exploit them.

## 7. RECOMMENDATIONS

On the basis of this report, it is recommended that:

1. As no Aboriginal or historic archaeological sites were located in the survey area, there are no archaeological grounds for preventing the development subject to the above recommendation.

( 2. Copies of this report should be sent to:

Don Ranson  
Archaeologist  
Dept. of Parks, Wildlife  
and Heritage  
(Archaeology Branch)  
134 Macquarie Street  
Hobart TAS 7000

Steve Stanton  
Chairperson  
Tasmanian Aboriginal Land Council  
148 Elizabeth Street  
Hobart TAS 7000

## REFERENCES

- Binks, C.J. 1989 *Explorers of Western Tasmania*. Taswegia, Devonport.
- Cosgrove, R. 1990 The Archaeological Resources of Tasmanian Forests: past Aboriginal use of forested environments. *Occasional Paper No. 27*, Department of Parks, Wildlife and Heritage, Tasmania.
- Cosgrove, R. & Hughes, P. 1983 Anthony Power Development Scheme Phase 3 Archaeological Studies. Report to Natural Systems Research Pty Ltd, Hawthorn, Victoria.
- du Cros, H. 1991 An Archaeological Survey of the Moxon Saddle Diversion Channel, Western Tasmania. Report to the Hydro-Electric Commission Tasmania.
- 1992 Historic Heritage Resources in the North-West of Tasmania. A report to the Tasmanian Conservation Trust.
- Julen, H. 1987 *The Town that was Corinna*. Privately published.
- MacFarlane, I. n.d. North West Tasmania: A regional Aboriginal Archaeological Survey. Unfinished manuscript of final report, DPWH, Tasmania.
- MacFarlane, I. and Coates, I. 1990 King River Power Development Scheme. Aboriginal Archaeological Survey. Report to the Hydro-Electric Commission.
- Montgomery, A. 1890 Report on the state of the mining industry on the West Coast. *Old Series No. 79:15-19*.
- Pink, Kerry 1982 *The Story of the West Coast*. West Coast Memorial Pioneers Museum, Queenstown.
- Pocock, C. 1991 King River Power Development Archaeological Study Phase Two Aboriginal Sites Survey. Report to HEC.

- ( Richards, T. 1992 Aboriginal Archaeology of the North West. Report to the TCT.
- Scripps, L. 1990 *North-West Tasmania Historic Sites Inventory Project*. Report to Forestry Commission of Tasmania.
- Sharples, C. 1992 Geomorphology in the North West. Report to the TCT.
- Twelvetrees, W. 1900 Report on the mineral fields between Waratah and Corinna. *Old series No. 158*.
- Waller, R.F. 1902 *The Magnet Tramway, Geological Survey G.S. Report 1*; Tasmanian Department of Mines, Hobart: xxxiii.
- Whitman, c. 1949 *Western Tasmania. A Land of Beauty and Riches*. Davies Brother Ltd, Hobart.

**APPENDIX 1 - THE BRIEF**

**Savage  
Resources  
Limited**

Bob Annett  
PO Box 1179  
Ballarat Mail Centre VIC 3354

13 November 1992

Ms. Hilary La Gros

54 Brooke Street  
Albert Park VIC 3206

Dear Hilary,

Further to our telephone conversation of the 12 November I provide the following information for a proposed archaeological survey in the Savage River area of Tasmania's west coast. This survey is required by the Department of Environment and it will form part of an Environmental Management Plan for the development of a pigment resource located south of Savage River.

The survey was first proposed back in May-June of 1991 and I was given information as to the Department of Parks, Wildlife and Heritage requirements by Ms. Sue Kee. This consultancy brief remains the same and I enclose a draft copy that was provided by the Department.

Our area of interest lies within Savage's five mining leases and in particular at the HF site and the Bowry Creek site, see figures 1 to 3. Pigment extraction is expected to occur within a small part of these areas. Access to each area is by 4WD track.

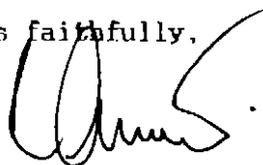
Priority is to be given to the small areas where extraction is likely to occur and if time permits to extend the survey to encompass the total area within the mining leases.

For your information a check of the Department's Tasmanian Aboriginal Site Index and the Tasmanian Archaeological Site Catalogue shows no archaeological sites in the area of interest, primarily because no archaeological survey has been undertaken.

Savage will provide a geologist throughout the duration of your field work. Savage has a large collection of plans, reports and the like and these will be provided if they are of value to your studies. Accommodation is available at the Savage River Motor Inn (004 46 1177).

I trust that I have provided sufficient information and I look forward to your itemised quote together with anticipated date of commencement.

Yours faithfully,



Robert W Annett  
Exploration Manager

encls.

cc Sydney

**DRAFT**  
**SAVAGE RIVER ARCHAEOLOGICAL STUDY**  
**ABORIGINAL/HISTORIC SITE SURVEY AND RECORDING**  
**CONSULTANCY BRIEF**

**1. Background**

Savage Resources Ltd is presently proposing to develop an area near Savage River, western Tasmania. The development will involve (area) in extent.

It is likely that the area contains Aboriginal open sites and possibly European sites.

**2. Study Area**

The study area is shown on the attached map (to be supplied).

**3. Objectives**

- (a) To locate, document and interpret the Aboriginal and historic archaeological resources of the study area through a systematic survey.
- (b) For Aboriginal sites to undertake an analysis of inter and intra-site variability including, but not limited to site location, site patterning, reduction sequences and raw materials type and sources.
- (c) To assess the significance of the Aboriginal and historic archaeological sites identified.
- (d) To identify areas of high archaeological potential within the study area and recommend any further research required.
- (e) To review and update existing site documentation.
- (f) To construct a model of Aboriginal settlement patterns based on archaeological and ethnohistorical evidence.
- (g) To consult with Aboriginal people with interest in the study area in order to obtain their views regarding the cultural heritage of the area.

## DRAFT

**4. Documentation**

The project officer will submit the following documentation :

- (a) Tasmanian Archaeological Site Index (TASI) forms and Tasmanian Historic Archaeological Site Cards (THASC) for all archaeological sites located and updated site record forms for all previously recorded sites inspected.
- (b) A photographic record in accordance with DPWH Guidelines of the sites located and/or inspected and their settings. Note that all photographs must be referenced in a photograph log book and, where appropriate, photographs are to include a scale and a blackboard showing the site's field name, the date and the recorder's initials.
- (c) Copies of other relevant documents including field notes, photograph log books, plans, aerial photographs and maps.
- (d) Annotated aerial photographs or mosaics showing in detail survey transects/routes carried out.
- (e) A Final Report (see item 5).

**5. Final Report**

The Final Report must conform to the Department of Parks, Wildlife and Heritage (Archaeology Section) Guidelines for the Production of Survey Reports.

Note that all figures, tables and references to sites recorded during the project must show TASI Site Register numbers and THASC, NOT field designations. TASI and THASC Site Register numbers will be allocated by the Archaeology Section on receipt of completed TASI and THASC site record cards and associated documentation.

The Final Report is preferred to be typed in MS Word suitable for use on a Macintosh computer.

**6. Restrictions and Requirements**

- (a) The project officer must not damage or interfere with archaeological sites beyond the requirements of the survey.
- (b) No excavations are to be carried out during the project.

## DRAFT

- (c) Augering or other forms of sub-surface sampling will be permitted only if appropriate consents are obtained.
- (d) The project officer will supervise any field assistants assigned to the project.
- (e) The project officer will undertake occasional public relations duties.
- (f) Savage Resources Ltd may produce further copies of the Final Report under the authorship of the project officer. The project officer may publish data obtained during the project, but may not publish the Final Report without the permission of the Exploration Manager, Savage Resources Ltd.
- (g) All costs associated with the project will be met by Savage Resources Ltd. The project officer must not incur costs without the prior approval of the Savage Resources Ltd.

**7. Timing and Reporting**

- (a) All site record cards, photographs and associated documentation must be submitted to the Department of Parks, Wildlife and Heritage Archaeology Section within (insert time) weeks from the starting date of the project.
- (b) A draft Final Report must be submitted to Savage Resources Ltd within (insert time) weeks before the finishing date of the project.
- (c) Savage Resources Ltd will return comments (prepared by DPWH) on the draft reports (insert time) working days after receipt of the draft reports.
- (d) The Final Report and all additional documentation shall be submitted to Savage Resources Ltd by the finishing date.

## APPENDIX 2 - GLOSSARY

### Aboriginal Site Types

**Artefact Scatter:** A surface scatter of stone artefacts which is defined as being the presence of three artefacts or more within a 50 metre radius of the first artefact located. Artefact scatters are often the only physical remains of places where Aborigines have camped, prepared and eaten meals and knapped stone material.

**Burial:** A burial site is usually a sub-surface pit containing human remains and sometimes associated artefacts.

**Contact Site:** A Contact site is one which shows evidence of Aboriginal experimentation with or use of European/Non-Aboriginal materials and ideas. This may include sites which are traditional, except for glass artefacts and other introduced materials; and sites with an historic context such as mission sites, and provisioning points.

**Isolated Artefact:** An isolated artefact is an occurrence which does not fulfil the minimum number of artefacts necessary to be an artefact scatter. It can be the result of an artefact being lost or discarded during travel or the only evidence of an artefact scatter obscured by poor ground visibility.

**Quarry:** An Aboriginal quarry site occurs where flakeable stone is exposed and can be extracted. The rock types which are most suitable for artefact manufacture e.g. spongolite. Ochre can also be quarried where it occurs in sufficient quantities close to the surface.

**APPENDIX 3 - SURVEY AREA DESCRIPTIONS****SURVEY AREA 1 - BOWRY CREEK**

Locations Examined: All areas with maximum visibility; tracks and bulldozed areas, the source of pigment at the extraction area.

Surface Visibility: 0% per m<sup>2</sup> in rainforest.

Nature of Disturbance: Selective logging, recent track construction, geological testing.

No. of Sites Recorded: None.

Areas of Archaeological Sensitivity: None.

**SURVEY AREA 2 - HT AREA**

Locations Examined: All areas with maximum visibility; tracks and bulldozed areas, the source of pigment in each the extraction area.

Surface Visibility: 0-10% per m<sup>2</sup> in rainforest.

Nature of Disturbance: Selective logging, recent track construction, geological testing.

No. of Sites Recorded: None.

Areas of Archaeological Sensitivity: None.

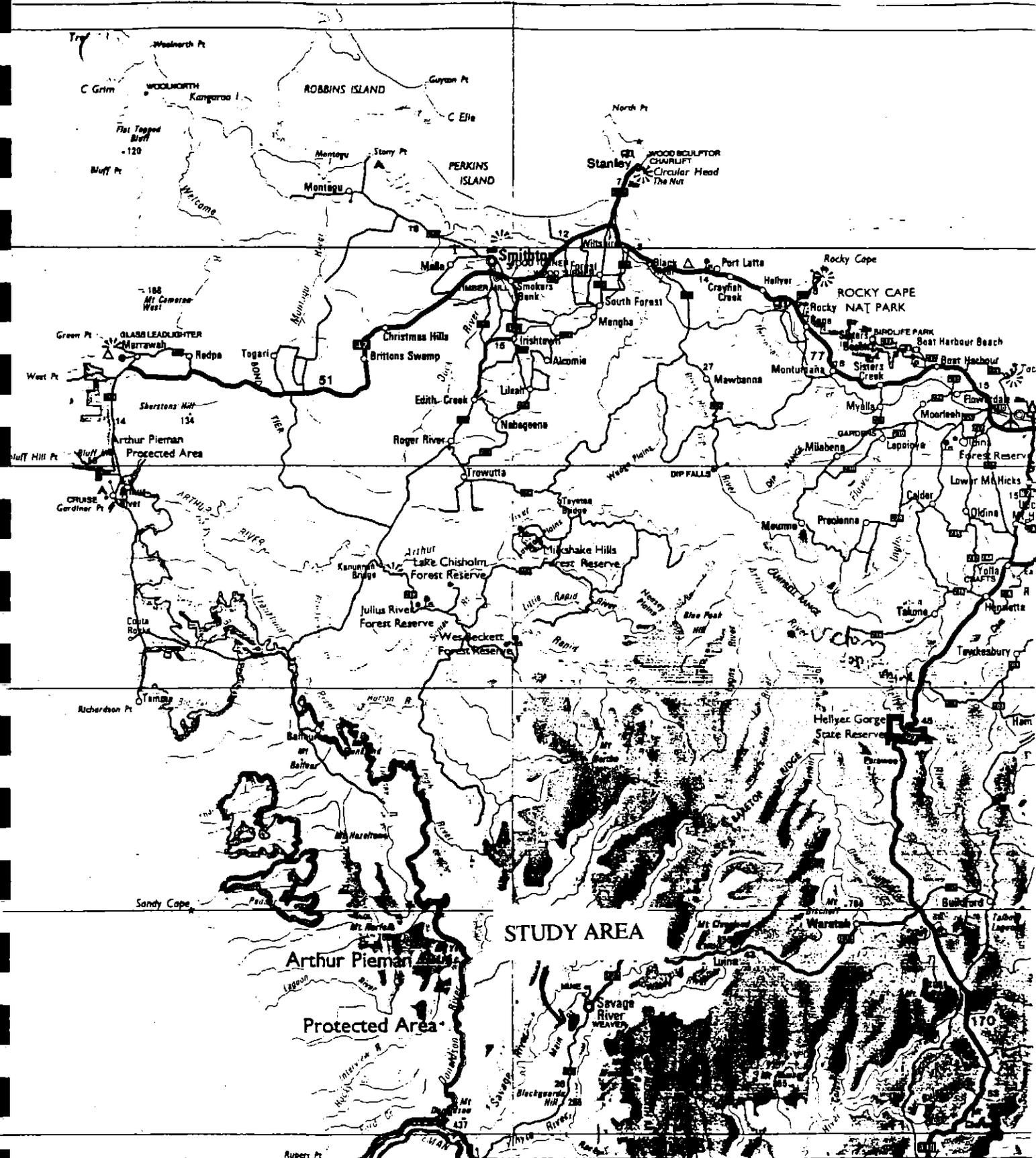


FIGURE 1. LOCALITY MAP

WARATAH 64

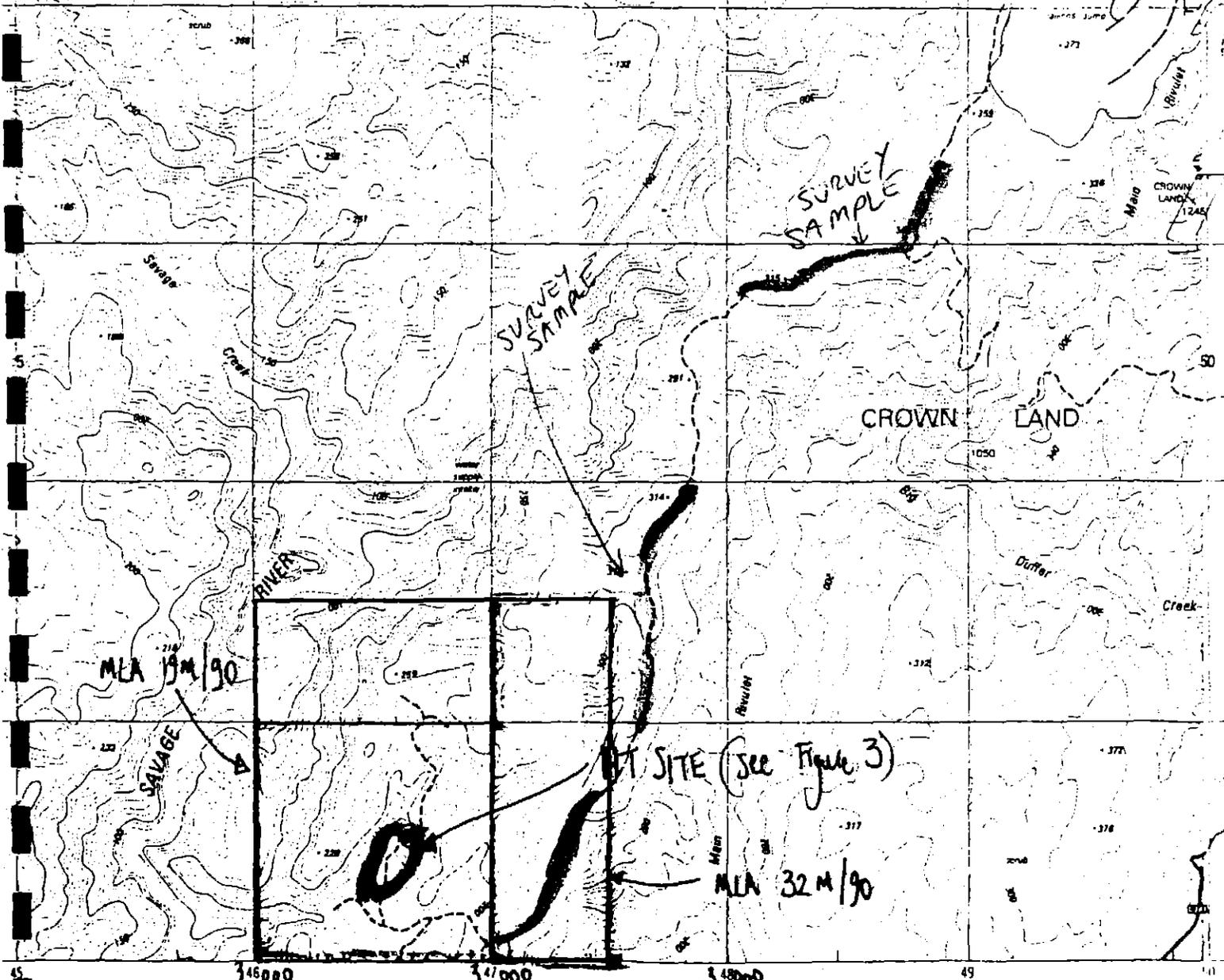
SOUTH

1:25,000 Series

"SAVAGE RIVER"

5 cm

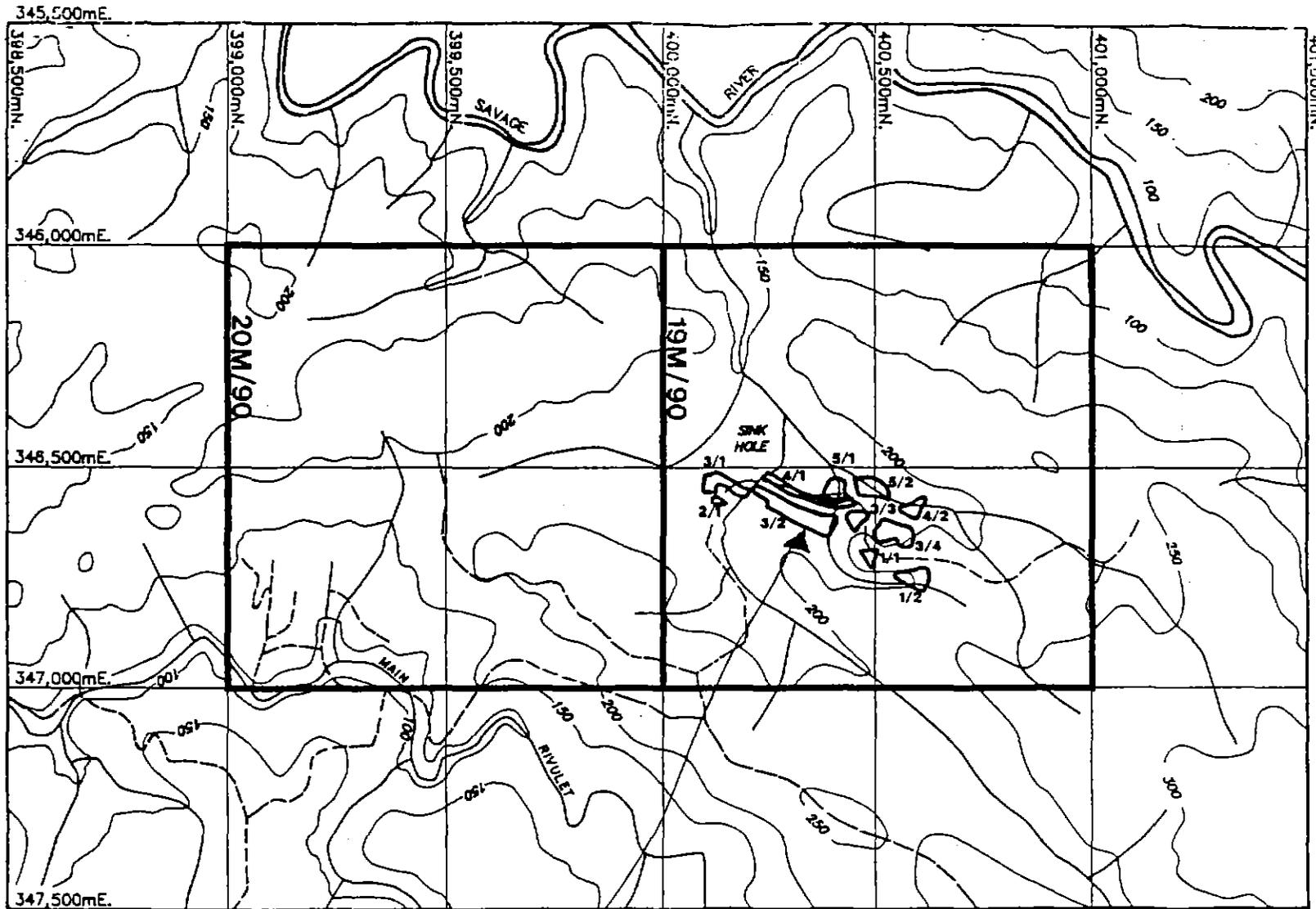
FIGURE 2. HT SURVEY AREA.  
MAP SCALE 1:25 000



residential area, Commercial buildings  
 Primary road with route number  
 Secondary road with route number



SCALE 1:25 000  
 1 millimetre on the map represents 250 metres



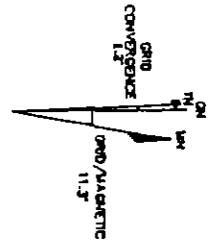
5 cm

AREA OF INTEREST.

FIGURE 3. DETAIL OF HT EXTRACTION AREAS SURVEYED

LEGEND

- ▽ 1/1 PREFERRED SITE
- ~ 50m CONTOUR
- TRACK
- CREEK



SAVAGE RESOURCES LIMITED	
SAVAGE RIVER - R.L. 8802	DRAWN BY: R.A.
MAIN CREEK	DRAFTSMAN: T.S.D.S.
OCHRE PROJECT	DATE: 1 JUNE '90
LOCATION OF MINING LEASES WITH PREFERRED SITES	REVISIONS:
SCALE 1:10,000	FILE:
METRES	FIG. 3

960091

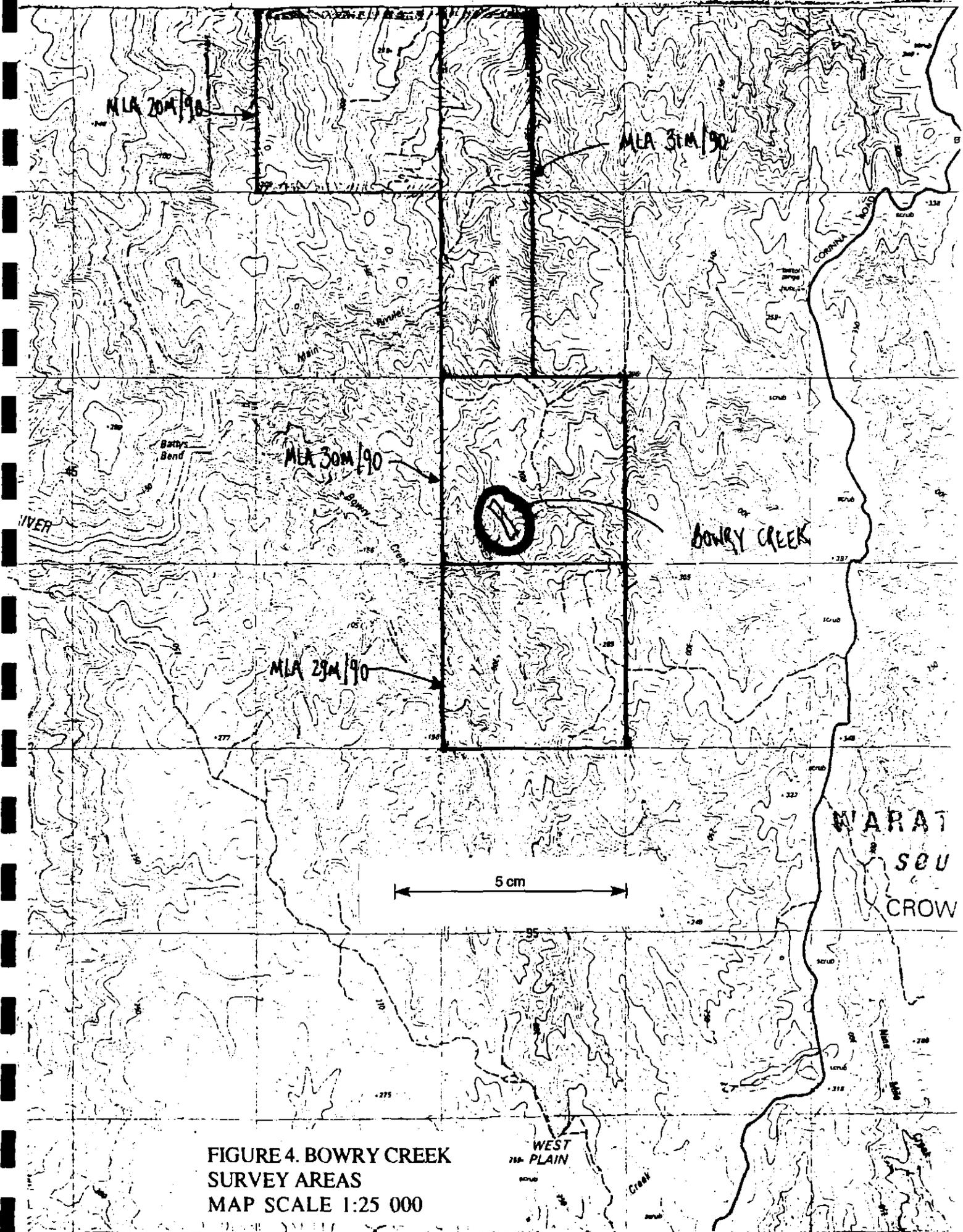


FIGURE 4. BOWRY CREEK  
SURVEY AREAS  
MAP SCALE 1:25 000

Appendix 5

A

SUPPLEMENTARY REPORT TO THE

DEVELOPMENT PROPOSAL

AND

ENVIRONMENTAL MANAGEMENT PLAN

TO

OPERATE A MINE AND BENEFICIATION PLANTS

FOR

THE PRODUCTION OF PIGMENT

AT

SAVAGE RIVER AND ON THE NW COAST

June 1993  
Savage Resources Limited

## 1. INTRODUCTION

This is a supplementary report to a Development Proposal and Environmental Management Plan ("DP&EMP") that was lodged with the Department of Environment and Land Management in early April 1993. The DP&EMP was advertised in the Advocate on Saturday 17 April and available for public comment until 17 May 1993.

This supplementary report has been prepared in response to a number of comments made by the Parks and Wildlife Service, the Forestry Commission and other interested parties.

The numerical value of the chapter reference number used in this report conforms with, and can be cross referenced to, those numbers used in the original DP&EMP.

#### 4. TECHNICAL STUDIES OF THE DEVELOPMENT SITE AREAS

##### 4.1 Flora Information

A botanical survey of the sites affected by the proposal was undertaken by the Tasmanian Herbarium on the 9th and 10th June 1993 (Appendix 5).

Consideration was given to the following:

- conservation significance of the sites,
- myrtle wilt,
- *Phytophthora cinnamomi*,
- weeds and,
- fire risk.

A copy of this report has been forwarded to the Forestry Commission (Senior Botanist - Mr Fred Duncan) for their evaluation.

It was concluded that the vegetation of the sites surveyed contain no species of vascular plants of high conservation significance. Given the scale of the proposed pigment operations no objection was raised on botanical grounds to the proposed works.

##### 4.1.1 Plant Diseases and Weeds

The few indicator species present showed none of the symptoms of dieback usually diagnostic of the presence of *Phytophthora cinnamomi* (Cinnamon Fungus).

To ensure the prevention of the spread of the Cinnamon Fungus the proponent will at all times implement strict hygiene measures to those standards set by the Forestry Commission and the Department of State Development and Resources (in compliance with the Mineral Exploration Code of Practice).

Limited access to the pigment sites may be required in order that the Cinnamon Fungus is not spread by other parties that use the tracks for other purposes.

In order that the spread of myrtle wilt is minimised it is intended that:

- there will be no unnecessary disturbance of myrtle forests,
- roads will be routed around rather than through myrtle forests where practicable and,

- damage to myrtle trees due to tree blazing, scarring by machinery, earth works, tree felling etc, on edges of forest clearings will be minimised.

No exotic weeds have been introduced to either of the rainforest sites. Some native opportunistic species, not otherwise present in the rainforest have established on the bare soil in disturbed situations but are not considered to be a problem.

#### 4.6 Karst Studies

A study was undertaken to investigate the impact of the proposal on karst hydrology. Following consultation with Parks and Wildlife Service officers the survey was undertaken by an independent consultant who has considerable knowledge of the area both as affects the pigment deposits and the karst features (Appendix 6).

Following a thorough search of the proposed mining sites no known surface karst features were found although some possible karst features occur in the surrounding area. Definite small scale karst features occur at a greater distance from the boundary but are so situated as to be outside such secondary impacts as siltation downstream of a disturbed area.

Stream flows in the area are essentially at surface, with only short underground sections in outcropping magnesite rock. The absence of stream sinks and risings on any larger scale indicates that integrated active caves systems are not present.

## 5. DEVELOPMENT PROPOSAL

### 5.1 Access

All new roading and upgrading will comply with the Forest Practices Code as a minimum.

### 5.2 Timber Salvage

The proponent will cooperate with the Forestry Commission to ensure that all merchantable timber, as determined by the Commission, will be salvaged during construction and be disposed of under the direction of the Commission to Crown sawmillers.

## 6. ENVIRONMENTAL MANAGEMENT PLAN

The following information is a supplement to the previously submitted information and as such **MUST** be read in conjunction with the original DP&EMP.

### 6.6 Rehabilitation

The area of disturbance due to mining operations will be confined at any one time to a total of 1 hectare. Rehabilitation will be progressive from the commencement of mining operations.

The proposed seeding/planting mix will be as determined by the Forestry Commission.

#### 6.6.1 Mine Site Areas

There will be no major alteration to the broad drainage pattern of the area as the proposed mining blocks are small and specifically situated on high ground to avoid drainage routes.

Minor modification to site specific drainage, that is intermittent down slope water seepage, will occur. This seepage will only be disturbed at the point immediately above the mining operations such that drainage will be routed around the mining practices. Good mining practice will ensure drainage routes remain stable at all times.

Current drainage of waters in the vicinity of the umber site to the Bowry Creek will not change. In the first five years of operations the mine drainage associated with proposed operations within the principal mining block 3/2 and potentially within 3/1, 4/1 and 5/1 of the HT area will flow to two small unnamed creeks which ultimately flow into the Savage River.

Topographical changes will in essence be confined to the creation of a number of small depressions within some of the proposed mining areas. These shallow topographical lows, no deeper than 20 metres beneath the original ground surface, will be small in area and confined to the existing valley slopes and higher ground.

Rehabilitation of these depressions has already been covered, however the top soil to be placed on the ripped berms, for the establishment of a

rooting medium for successful vegetation establishment, will be to a minimum depth of 250 mm. Rehabilitation will be in consultation with and under the direction of the governing authorities.

Revegetation of the disturbed areas will be undertaken in consultation with the Forestry Commission using species native to the site and using local provenances.

Final land use of the rehabilitated areas is a return to State Forest.

## 6.7 Hazardous Materials

The substances listed below will be stored in compliance with the following Australian Standards (AS):

AMMONIA - AS 2022  
(Class 2.3 Poisonous Gas, Sub Class 8 Corrosive)

SULPHURIC ACID - AS 3780.8  
(Class 8 Corrosive)

LPG - AS 1596 (Australian Gas AG 601)  
(Class 2.1 Flammable Gas)

### 6.7.1 Beneficiation Site

Hazardous chemicals used and stored at the beneficiation site are confined to:-

- 15,000 litres of ammonia solution (25-30% strength),
- 5000 litres of sulphuric acid (98% strength) and,
- 40 tonnes of LPG.

### 6.7.2 Mine Sites

Diesel fuel storage will be confined to not more than 5000 litres at any one time.

### 6.7.3 Coastal Facility

LPG gas storage will be no more than 40 tonnes at any one time.

## 6.8 Fire

The information provided in the DP&EMP more than adequately met the requirements laid down in the Fire Service Regulations 1981 (under the Fire Service Act 1979) detail of which is outlined in Appendix 7.

The intention is not to fight a forest fire with the implements at hand but to ensure that any spot fires which might arise from the mining activities are quickly contained and smothered.

The proponent will ensure that all activities conform to the Fire Service Regulations 1981.

## 6.10 Impact on Flora and Fauna

### 6.10.2 Mine Site Area - HT Drillsite Area

The proponent will ensure the development and effective management of the mining operation with minimal adverse impact to the environment.

Disturbance to the flora will be confined to:

- that veneer of flora that lies immediately marginal to the access roads and,
- the mining operations themselves.

Any such clearing of vegetation will be subject to and under the control of the Forestry Commission.

Disturbance will be confined to the short term. Rehabilitation, through the planting of native species using local provenances, will ensure minimal impact in the medium to long term.

### 6.10.3 Mine Site Area - Bowry Creek Umber Site

See above.

APPENDIX 5

Botanical Survey Document  
by Tasmanian Herbarium, Hobart

**BOTANICAL SURVEY  
OF SITES AFFECTED BY A  
PROPOSED PIGMENT MINING OPERATION  
AT SAVAGE RIVER**

Report prepared by the Tasmanian Herbarium  
for  
Savage Resources Limited

## Botanical Survey of Sites Affected by a Proposed Pigment Mining Operation at Savage River

### Introduction

Savage Resources Limited proposes to mine the natural pigments, ochre and umber, from two sites about five kilometres south-west of Savage River town in an area not previously mined.

The sites are in the West Coast high rainfall region. Average annual rainfall at Savage River is 1957mm; the wettest month is July with 241mm while February is the driest with 74mm. The mean maximum temperature in summer is 18°C and the mean minimum in winter is 4°C. Rainforest is the climax vegetation through almost all of this region except on poorly drained infertile soils where open or shrubby moorland occurs. However, fire-induced successional forests and mixed forests with eucalypts are widespread. The access track to the two mine sites passes through such forests. These were not, however, included in the survey. Part of the region was burnt in a wild fire in February 1982.

The two extraction sites were inspected and the floristic and structural components of the forest were recorded. Indicator species were examined for evidence of *Phytophthora cinnamomi* and trees of *Nothofagus cunninghamii* were examined for evidence of myrtle wilt. The access tracks to these sites have existed for at least ten years. The site of the proposed processing works, at the Savage River Mine's old tailings dam, was also inspected. This site has no botanical conservation significance.

Vascular plant nomenclature follows Buchanan *et al.* (1989) and Johnson (1991); community nomenclature follows Jarman *et al.* (1984).

Grid references cited are on the Pieman sheet 7914 (sites 1 and 2) and the Arthur River sheet 7915 (site 3) (1:100 000 series) or equivalent sheets in the 1:25 000 series.

## Surveyed sites

1. **Umbur site.** Located on Bowry Creek (grid reference 473 972), a tributary of Savage River, at 150m asl. The mining site is expected to occupy the gully bottom and lower slopes on both sides of the creek. The pigment-bearing ground overlies magnesite and is itself overlain by a clay soil about 1m in depth. Until recently the site carried thamnic rainforest but this was partially burnt in the wild fire of February 1982, leaving only a narrow strip along the creek. The slopes above the creek are now densely vegetated with regenerating rainforest species beneath scattered, still standing, mostly dead, tall trees. An area of about one hectare was surveyed.

### Vegetation

Forty-nine species of native vascular plants were recorded at this site and occurred in the unburnt and burnt forest as follows:

Taxa	Unburnt	Burnt
Angiospermae		
<i>Acacia melanoxylon</i> R.Br.	+	
<i>Acaena novae-zelandiae</i> Kirk	+	+
<i>Agrostis parviflora</i> R.Br.	+	
<i>Anodopetalum biglandulosum</i> A.Cunn. ex Hook.f.	+	+
<i>Anopterus glandulosus</i> Labill.	+	+
<i>Archeria eriocarpa</i> Hook.f.	+	
<i>Aristotelia peduncularis</i> (Labill.) Hook.f.	+	
<i>Atherosperma moschatum</i> Labill.	+	+
<i>Carex appressa</i> R.Br.	+	
<i>Cassinia aculeata</i> (Labill.) R.Br.		+
<i>Cenarrhenes nitida</i> Labill.	+	
<i>Clematis aristata</i> R.Br. ex DC.	+	
<i>Coprosma quadrifida</i> (Labill.) Robinson	+	+
<i>Cyathodes juniperina</i> (Forst.) Druce		+
<i>Eucryphia lucida</i> (Labill.) Baill.	+	+
<i>Gahnia grandis</i> (Labill.) S.T.Blake	+	+
<i>Galium australe</i> DC.	+	
<i>Gaultheria hispida</i> R.Br.		+
<i>Gnaphalium collinum</i> Labill.	+	
<i>Gonocarpus teucrioides</i> DC.	+	
<i>Hydrocotyle hirta</i> R.Br. ex A.Rich.	+	
<i>Juncus bassianus</i> L.Johnson	+	
<i>Juncus pauciflorus</i> R.Br.	+	
<i>Juncus planifolius</i> R.Br.		+
<i>Leptospermum lanigerum</i> (Aiton) Smith	+	+
<i>Leptospermum scoparium</i> Forst. & Forst.f.		+
<i>Libertia pulchella</i> Sprengel	+	
<i>Monotoca glauca</i> (Labill.) Druce		+
<i>Nothofagus cunninghamii</i> (Hook.) Oersted	+	+
<i>Pimelea cinerea</i> R.Br.	+	+
<i>Pittosporum bicolor</i> Hook.		+
<i>Pomaderris apetala</i> Labill.	+	+

<i>Schoenus maschalinus</i> Roemer & Schultes	+	
<i>Senecio gunnii</i> (Hook.f.) Belcher	+	
<i>Trochocarpa cunninghamii</i> (DC.) W.M.Curtis	+	
<i>Uncinia tenella</i> R.Br.	+	
Gymnospermae		
<i>Phyllocladus aspleniifolius</i> (Labill.) Hook.f. juveniles only	+	+
Pteridophyta		
<i>Blechnum watsii</i> Tind.	+	
<i>Dicksonia antarctica</i> Labill.	+	+
<i>Gleichenia microphylla</i> R.Br.		+
<i>Grammitis billardieri</i> Willd.	+	
<i>Histiopteris incisa</i> (Thunb.) J.Smith.	+	+
<i>Hymenophyllum australe</i> Willd.	+	
<i>Hypolepis rugosula</i> (Labill.) J.Smith	+	
<i>Microsorium diversifolium</i> (Willd.) Copel.	+	
<i>Polystichum proliferum</i> (R.Br.) C.Presl	+	
<i>Pteridium esculentum</i> (Forst.f.) Cockayne		+
<i>Rumohra adiantiformis</i> (Forst.f.) Ching	+	
<i>Sticherus tener</i> (R.Br.) Ching	+	+

Although the forest on a part of the site was burnt ten years ago, the whole comprises Thamnic Rainforest T1a (Jarman *et al.* 1984) in at least two successional stages. The unburnt forest is dominated by *Nothofagus cunninghamii* which with the subdominants, *Atherosperma moschatum* and *Eucryphia lucida*, form a broken canopy 20-25m high. Large trees of *Acacia melanoxylon* are scattered along the creek. The understorey is dominated by thickets of *Anodopetalum biglandulosum*, *Anopterus glandulosus* and *Dicksonia antarctica*. These species are also common in the burnt area having resprouted from old root stocks and fallen trees. The regrowth is now two to three metres in height. The dense growth of *Pteridium esculentum* here indicates that the site was not closed rainforest before the fire but probably included some open shrubby areas. Some species, especially *Carex appressa*, *Schoenus maschalinus*, *Juncus bassianus*, *Aristotelia peduncularis* and *Leptospermum lanigerum*, were confined to the creek banks. *Phyllocladus aspleniifolius* was recorded only as juveniles up to 1m in height growing at or near the road edge.

A prolific germination of *Nothofagus cunninghamii* had occurred during the last summer on the exposed mineral soil of the prospecting excavations; most seedlings were about 2cm high.

No introduced weeds were recorded but the native opportunistic plants present, such as *Cassinia aculeata*, have probably established only as a result of the soil disturbance along the access road and at the site.

2. HT (ochre) site. Located adjacent to another tributary of Savage River (grid reference 466 003) at 200m asl. The proposed mining area is an undulating, south-west facing, low-angled slope. The ochre overlies magnesite and produces deep clay soils with a shallow humus layer. Soils containing abundant quartzite fragments were also noted, especially on higher ground. The vegetation on this site was not affected by the 1982 wild fire and consists of relatively intact, mature rainforest. An area of about nine hectares was surveyed.

## Vegetation

Thirty-nine species of native vascular plants were recorded at this site:

### Angiospermae

*Acacia melanoxylon* R.Br.  
*Anodopetalum biglandulosum* A.Cunn. ex Hook.f.  
*Anopterus glandulosus* Labill.  
*Atherosperma moschatum* Labill.  
*Carex appressa* R.Br.  
*Cassinia aculeata* (Labill.) R.Br.  
*Cenarrhenes nitida* Labill.  
*Coprosma quadrifida* (Labill.) Robinson  
*Cyathodes juniperina* (Forst.) Druce  
*Dianella tasmanica* Hook.f.  
*Eucryphia lucida* (Labill.) Baill.  
*Gahnia grandis* (Labill.) S.T.Blake  
*Gnaphalium collinum* Labill.  
*Helichrysum dendroideum* Wakef.  
*Isolepis subtilissima* Boeck.  
*Juncus bassianus* L.Johnson  
*Juncus pauciflorus* R.Br.  
*Juncus planifolius* R.Br.  
*Leptospermum scoparium* Forst. & Forst.f.  
*Monotoca glauca* (Labill.) Druce  
*Nothofagus cunninghamii* (Hook.) Oersted  
*Phebalium squameum* (Labill.) Engl.  
*Pimelea cinerea* R.Br.  
*Pittosporum bicolor* Hook.  
*Pomaderris apetala* Labill.  
*Senecio gunnii* (Hook.f.) Belcher  
*Tasmania lanceolata* (Poiret) A.C.Smith  
*Trochocarpa cunninghamii* (DC.) W.M.Curtis

### Gymnospermae

*Phyllocladus aspleniifolius* (Labill.) Hook.f.

### Pteridophyta

*Blechnum wattsii* Tind.  
*Ctenopteris heterophylla* (Labill.) Tind.  
*Grammitis billardieri* Willd.  
*Histiopteris incisa* (Thunb.) J.Smith.  
*Hymenophyllum rarum* R.Br.  
*Hypolepis rugosula* (Labill.) J.Smith  
*Microsorium diversifolium* (Willd.) Copel.  
*Polystichum proliferum* (R.Br.) C.Presl  
*Rumohra adiantiformis* (Forst.f.) Ching  
*Sticherus tener* (R.Br.) Ching

The community is a good example of mature Tamnuc Rainforest T1a (Jarman *et al.* 1984). It is dominated by *Nothofagus cunninghamii* with stands of the codominant *Phyllocladus aspleniifolius* on areas of poorer soil, especially on higher ground away from the creek. *Atherosperma moschatum* and *Eucryphia lucida* are subdominant within an almost closed canopy 20-30m high. The shrubby understorey consists of

thickets of *Anodopetalum biglandulosum*, *Anopterus glandulosus* and *Trochocarpa cunninghamii*, the former being more common in areas where *Phyllocladus aspleniifolius* occurs. Near the creek and under canopy gaps, sufficient light reaches the forest floor to allow occasional plants of *Tasmannia lanceolata*, *Pomaderris apetala* and *Cyathodes juniperina* to establish. *Cassinia aculeata*, *Leptospermum scoparium*, *Isolepis subtilissima* and *Juncus planifolius* were recorded from the edges of the prospecting tracks, taking advantage of the disturbed soil and high light conditions.

Mosses, hepatics and lichens are abundant, particularly as epiphytes on standing *Nothofagus cunninghamii* trees and decaying logs.

No introduced weeds were recorded.

3. **Primary processing site.** Located at the edge of the Savage River Mine's old (disused) settling pond (grid reference 513 051). Almost all of this site has, in years past, been bulldozed clear of vegetation and soil. There is now a mosaic of open, almost bare rocky soil and a low, sparse regeneration of shrubby heathland species in the less disturbed situations.

The following taxa, listed in order of dominance, were recorded:

*Eucalyptus nitida* Hook.f.  
*Acacia mucronata* Willd. ex Wendl.f.  
*Leptospermum scoparium* Forst. & Forst.f.  
*Cassinia aculeata* (Labill.) R.Br.  
*Juncus pallidus* R.Br.  
*Sprengelia incarnata* Smith  
*Pteridium esculentum* (Forst.f.) Cockayne  
*Acaena novae-zelandiae* Kirk  
*Gonocarpus teucrioides* DC.  
*Oxylobium arborescens* R.Br.  
*Juncus planifolius* R.Br.  
*Agrostis capillaris* L.  
*Leptospermum glaucescens* S.Schauer  
*Bauera rubioides* Andrews  
*Gahnia grandis* (Labill.) S.T.Blake  
*Senecio gunnii* (Hook.f.) Belcher

This site has no conservation significance whatsoever.

### Conservation significance of sites 1 & 2

1. Taxa. The survey did not record any plant species that have been allocated a risk code in the system of Kirkpatrick *et al.* (1991).
2. Communities. Thamnic rainforest T1a is widely distributed in western and south-western Tasmania and is considered to be well represented in reserves (Jarman 1984).

### Other considerations

1. Myrtle wilt. A careful search at both forest sites found no evidence of myrtle wilt such as holes or frass of the *Platypus* beetle in *Nothofagus cunninghamii* trees (Packham 1990). No dead or dying limbs of *Nothofagus cunninghamii* other than those resulting from the fire or from damage by prospecting equipment, were seen.
2. *Phytophthora cinnamomi*. The few indicator species present, e.g. *Phyllocladus aspleniifolius*, *Anopterus glandulosus* and *Cenarrhenes nitida*, showed none of the symptoms of dieback usually diagnostic of the presence of this fungus (Podger *et al.* 1990). The relatively low temperatures and high rainfall do not favour the spread of *Phytophthora cinnamomi*.
3. Weeds. No exotic weeds have been introduced to either of the rainforest sites. Some native opportunist species, not otherwise present in the rainforest, have established on the bare soil in disturbed situations but are not considered to be a problem.
4. Fire risk. The vegetation at the umber site, especially the regrowth which includes *Leptospermum scoparium* and *Pteridium esculentum* on the slope above the proposed mine site, presents a potential fire hazard in very dry weather. Under normal conditions the vegetation at the ochre site is not likely to be a fire hazard.

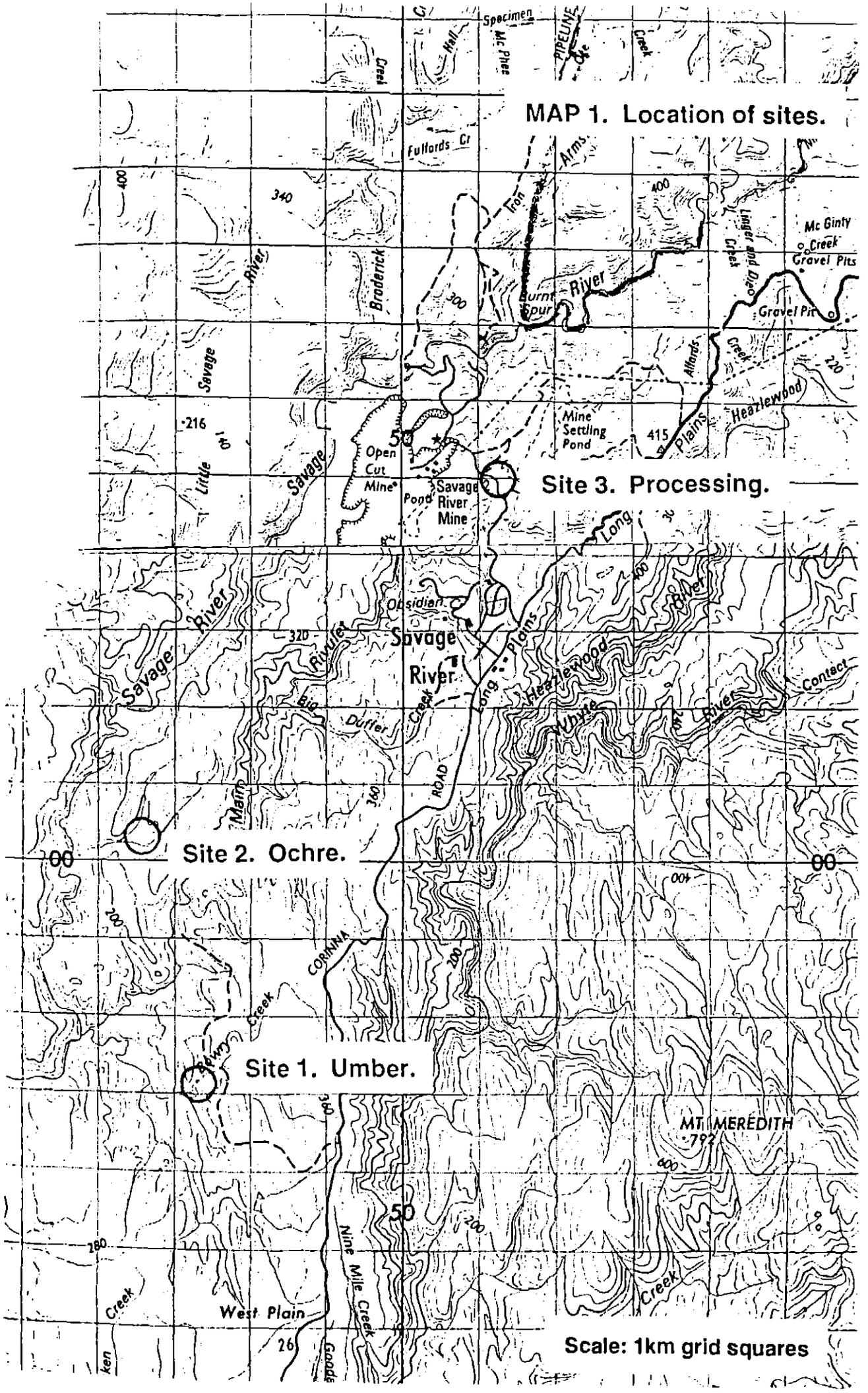
### Conclusions and recommendations

The vegetation of the sites surveyed contains no species of vascular plants of high conservation significance. Given the proposed scale of the pigment mining operations (see maps), no objection is raised on botanical grounds to the proposed works.

The Forestry Commission should be consulted regarding prevention measures against the possible introduction of myrtle wilt and *Phytophthora cinnamomi* into the area.

### References

- Buchanan, A.M., McGeary-Brown, A. & Orchard, A.E. (1989). A Census of the Vascular Plants of Tasmania. *Tasmanian Herbarium Occasional Publication 2*.
- Jarman, S.J., Brown, M.J. & Kantvilas, G. (1984). Rainforest in Tasmania. National Parks and Wildlife Service, Tasmania.
- Johnson, L.A.S. (1991). New Australian Taxa in *Juncus* (Juncaceae). In Banks, M.R. *et al.* (eds.) *Aspects of Tasmanian Botany*. Royal Society of Tasmania.
- Kirkpatrick, J.B., Gilfedder, L., Hickie, J. & Harris, S. (1991). Reservation and Conservation Status of Tasmanian Native Higher Plants. *Wildlife Division Scientific Report 91/2*.
- Packham, J.M. (1990). Myrtle Wilt. *Tasmanian NRCP Report No.2*.
- Podger, F., Palzer, C. & Wardlaw, T. (1990). A Guide to the Tasmanian Distribution of *Phytophthora cinnamomi* and its Effects on Native Vegetation. *Tasforests 2*(1): 13-20.



MAP 1. Location of sites.

Site 3. Processing.

Site 2. Ochre.

Site 1. Umber.

Scale: 1km grid squares

397,250mN.

# MAP 2. Umber site.

VEGETATION SURVEY

397,200mN.

POSSIBLE YELLOW OCHRE

397,150mN.

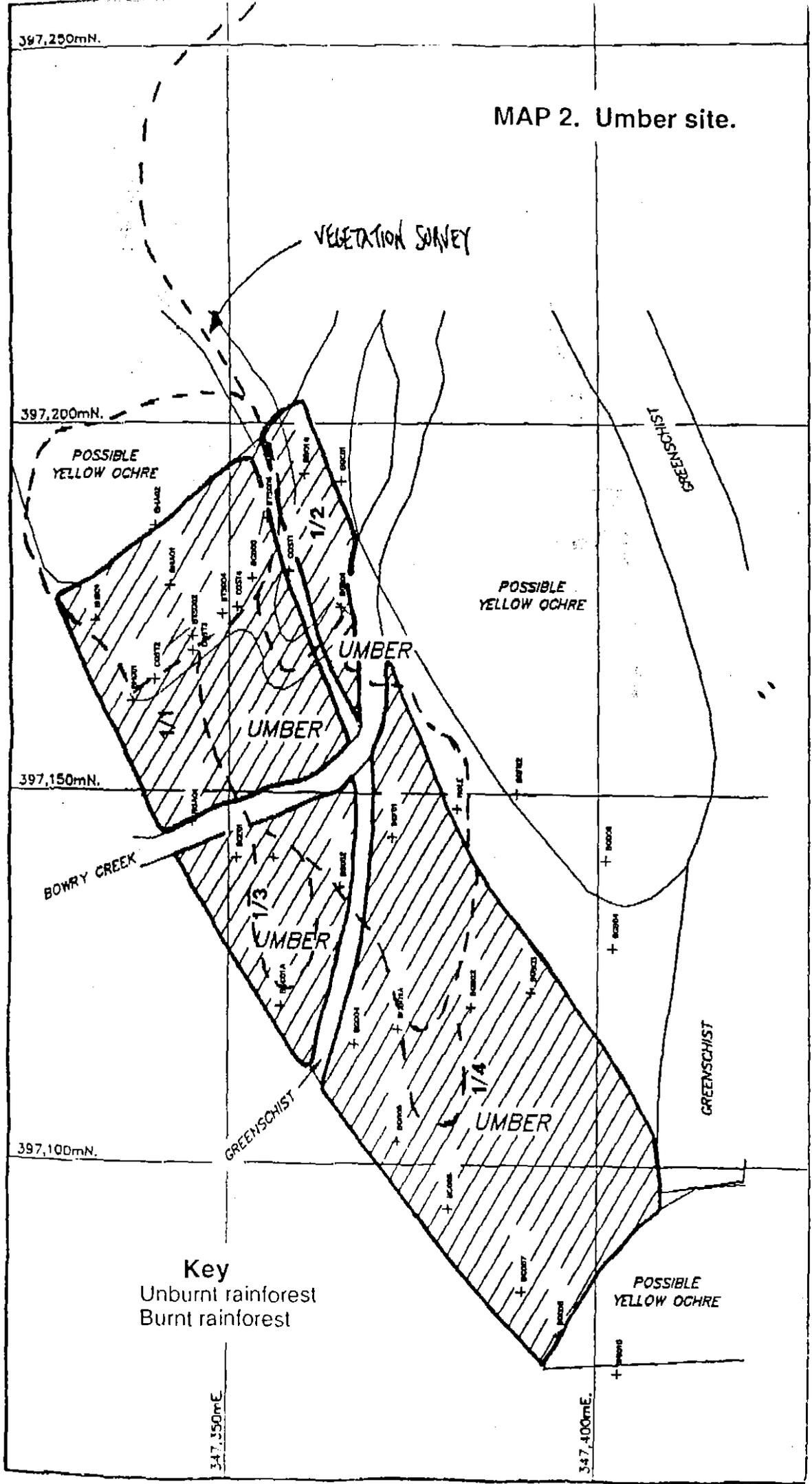
BOWRY CREEK

397,100mN.

**Key**  
 Unburnt rainforest  
 Burnt rainforest

347,350mE.

347,400mE.





APPENDIX 6

**Karst Survey Document**  
by C. H. C. Shannon, Launceston

C. H. C. Shannon  
Consultant  
319 Brisbane Street  
WEST LAUNCESTON TAS 7250

**KARST VALUES OF THE PROPOSED MINING SITES FOR OCHRE EXTRACTION  
AND THEIR ENVIRONS, SAVAGE RIVER, TASMANIA**

**SUMMARY.**

The proposed mining area has been thoroughly searched but has revealed no known surface karst features, although some possible karst features occur nearby. Definite karst features, very rare in that they are developed in magnesite rock, occur at a greater distance from the boundary and are so situated as to be outside such secondary impacts as siltation downstream of a disturbed area. Streamflows in the area are essentially at surface, with only short underground sections in outcropping magnesite rock. The absence of streamsinks and risings on any larger scale indicates that integrated active caves are not present.

**PROJECT AREAS UNDER EVALUATION.**

Two areas are under consideration for exploitation; the HT site in the vicinity of "Sids Creek", intended to utilise a deposit of yellow ochre, and the BT site on Bowry Creek, where an excavator trench supplemented by hand augering has brought in a resource of umber (a chocolate brown, usually manganese variety of ochre) to an inferred reserve status.

**KARST FEATURES OF THE PROPOSED MINING AREAS AND SURROUNDS.**

In terms of unequivocal surface karst features, neither the HT nor the BT area has any at all; that is there is not a doline, blind valley or cave entrance anywhere inside the dotted line (see attached plans). There are however two dubious karst features in close proximity to the HT site mining area:

- an intermittent shallow pond at 465002 which is explicable as a back-levee lagoon but may have been deepened through subsidence and so be partly a doline as well, and,
- a small doline on a sloping site at 466004, which lacks closure and may be a stump hole.

In the writers opinion the first is not a karst feature despite possessing topographic closure and the second is a karst feature despite lacking such closure.

Genuine karst features, albeit on a small scale, including

residual pinnacles with undercuts, short streamway caves and springs occur in some of the outcrops of magnesite rock associated with some incised streambeds in the Main Creek - Bowry Creek magnesite area generally. These features are of enhanced scientific interest in view of the extremely rare status of the magnesite karst; neither Sweeting's nor William's textbooks on karst, the most authoritative in English, appear to be cognisant of the existence of karst in magnesite rock.

But in terms of the proposed mining area all are outside the areas of proposed mining disturbance or downstream drainage from such areas. For the HT site the closest cluster of karsted outcrops is at about 464001 and for the BT site 473975. The karst outcrops of greatest significance with the most extensive caves (30m total passage length) are about 468989, more than one kilometre away from the HT site.

Karst caves on a larger scale are contra-indicated by the lack of sinking streams or risings other than on the subcutaneous scale. This despite an ideal potential for underground capture with Sid's Creek valley perched above Main Creek. Diamond drilling showed evidence of solution in the phreatic zone, notably a cavity at depth in hole MC28 DDH, which prompted abandonment of the hole. But it would appear that the great thickness of superficial deposits blocks development of major karst drainage at present.

#### KARSTIC NATURE OF THE OCHRE DEPOSITS AND ASSOCIATED MATERIALS.

The ochre deposit itself is karst related, in that the solution of the carbonate and the concentration of an insoluble residue has contributed largely to its origin. It appears from the drilling information that at the interface between ochre and magnesite rock there is a thin (c. 0.1m) permeable layer of silty disaggregated magnesite pug below some few metres of residual/replacement ochre, with well preserved relict texture from the original magnesite rock. This indicates that water circulation is basal to the cover materials in preference to deep penetration of the underlying carbonate body; in this respect the weathering process though solutional with a sharpish boundary layer has affinities rather to the solutional component of ordinary weathering rather than the full scale karst phenomenon. It is a partial karst only dominated by a deeply buried karren surface.

However, the typical section through ochre ore was found in drilling work supervised by the writer to comprise an alternation of the explicitly residual form of ochre, (in which relict textures of the original magnesite are clearly discernible in a gelatinous pug) with reworked ochre which included detrital clasts, and which graded into clay-matrix breccia. Rarely, swampy organics up to and including well preserved, flexible, peaty-lignitic plant remains were found. One common lithology encountered was a mud matrix breccia with up to pebble-sized clasts predominantly of fresh greenschist

hinting at a cold climate phase. An alternative cover material is a residual sand similar to the "silica flour" sand at Corinna. By analogy with the Corinna deposit this material would be older than the *N. asperus* zone sediments of the "Brown Plain Formation" which overlies the Corinna deposits. Some combination of ancient residual subsoil, cave fills, leached breccia pipes and sinkhole lake fills would seem to be present. These features would reflect past karst activity on a large scale that is now quiescent. The situation is not unlike the relation of a hydrothermal gold province to a Rotorua style thermal area.

#### CONSERVATION AND SCIENTIFIC VALUES.

The climatic and vegetation information potentially contained by the swampy organic deposits in particular may well rank with The Darwin Meteorite Crater and the Eugena cave/sinkhole deposits in value. The naturally exposed karst features though of very limited extent are rare because they are developed in magnesite rock. The springs associated with these outcrops may prove of most value in karst process studies. Mining down to magnesite bedrock can be anticipated to reveal an intricately sculptured solutional surface, also of value to karst studies.

#### GUIDES TO RESPONSIBLE CONDUCT OF A MINING OPERATION.

Care should be taken so that roads, waste dumps etc, are located so as to avoid the karst features in natural exposures of magnesite rock. These are sufficiently out of the way, and should pose no problem to practicable mining. The two doubtful dolines close to the mining area are considered expendable and no requirement should be imposed for their protection.

The mining of the area should be utilised so as to gain the information on the internal structure and origin of the deposit which might otherwise be difficult or impossible to obtain. Ideally effort should also be made to expose and collect plant fossil material from the peaty organic materials in boundary situations. The karren surface basal to the deposit is likely to be a natural rock sculpture of great interest and care should be taken to defend such a feature from a drab rehabilitation exercise particularly if it can be left well exposed above water after mining finishes.

Critical informative exposures which can be affordably left intact should be given at least the respect given such reference exposures in a normal mine, otherwise carefully recorded and sampled for posterity. This mine does appear to be a first-of-its-type which enhances still more the value of all reference sections.

#### WRITER'S EXPERIENCE.

The writer has an intimate knowledge of the area both as affects the ochre deposit and the karst features of the area.

Karst studies have been an enthusiastic private research interest since 1959, including writings on caves in all states of Australia, New Zealand and Papua New Guinea. He assisted in conservation campaigns for karst areas in Queensland in the sixties and seventies. He worked for Savage Resources and its predecessor Industrial and Mining Investigations, mostly at Savage River from late 1981 to 1992, and was responsible for the recognition of the ochre pigments in 1982, later developing the concept of residual/replacement iron oxide after magnesite first as a mapping tool and later as a potential commercial mineral. He has participated in all the drilling, costeaning, mapping, mechanical augering and hand augering to the project up until 1991. This involved walking all the tracks and creek beds in the area plus much off-tracks walking and observation.

*Harry Shannon*

C. H. C. SHANNON R. Sc.

21-6-93

## Comments on bibliography material.

The textbooks on karst are universally silent on the subject of karst in magnesite, which implies that no full scale karst features such as the naturally enterable stream caves, pinnacles and cave entrances grading to dolines or blind valleys of the Main Creek area had been brought to their authors' attention. There is a clear implication that such features in magnesite are exceedingly rare when such oddities as halite and gypsum karsts are recognized. This is not incompatible with a karst aquifer condition with or without surficial karren development on magnesite being commonplace; that is with karst phenomena not reaching the critical threshold where integrated underground drainage, and consequent modification of surface landforms has occurred. Karst geomorphology is primarily concerned with such fully developed landforms. The more limited solution phenomena are still properly to be noticed by competent geologists working on magnesite deposits per se or on aquifers.

Turner (1993) first tried the keyword approach, which yielded only 6 references juxtaposing magnesite with karst or cave; (none recognizing full scale karst as described above). By going into journal articles primarily concerned with world magnesite deposits, some 100+ articles with geomorphological notes in the introductory sections were found. One of these (Bodenlos 1954) contained a reference to surface-opening caves in NE Brazil - the only convincing example of full scale karst cited. It is possible that this area has since been mined away. Other references alluded to by Turner describe features compatible with the karst aquifer/surficial karren condition only. It is likely, considering the textbooks' viewpoint that most if not all the remaining references are to such limited karst development.

This can include sizable caverns without natural openings such as in the MC 28 borehole at Main Creek. In the body of this writers' report above he attempts to keep clear a distinction between the bulk of the area, in which there is karst aquifer and general solution etching of outcrops, and the specially significant creek outcrop areas, each less than a hectare in area where full development of karst occurs, and to which an obligation to give protection applies.

U

Harry Stramer 22-6-13

## Bibliography supplement.

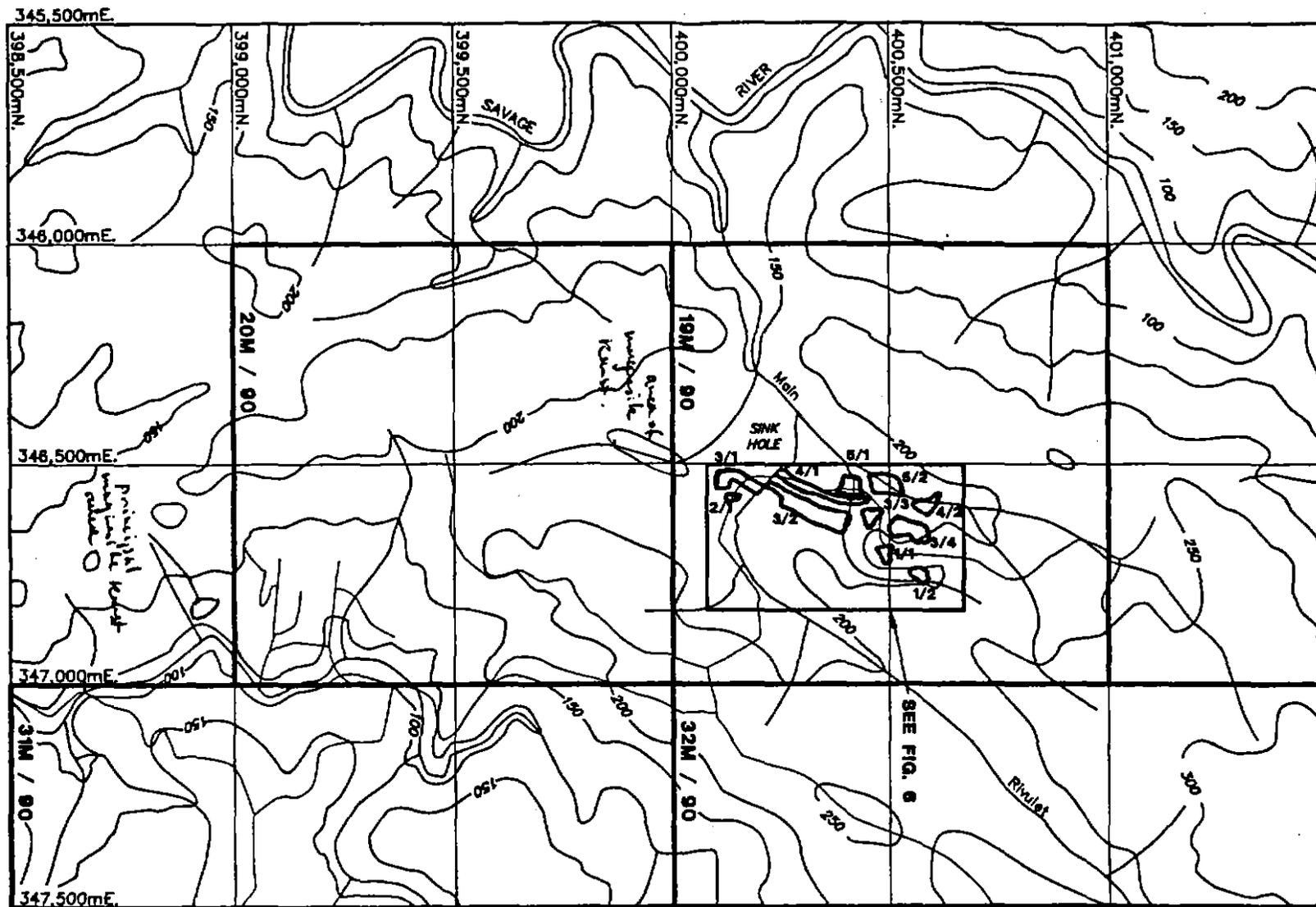
A.J. Bodenlos: Magnesite deposits in the Serra das Éguas, Brumado Bahia, Brazil. Bulletin United States Geological Survey 975-C (1954).

D.C. Ford and P.W. Williams: Karst Geomorphology and Hydrology. Unwin Hyman 1989 (BIP 1/93).

J.N. Jennings: Karst Geomorphology. Oxford; Blackwell 1985. (TU (L)).

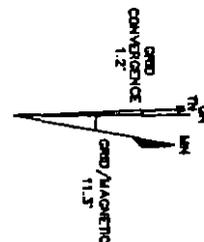
M.M. Sweeting: Karst Geomorphology. Stroudsburg, Pa; Hutchison Press c.1981.

N.J. Turner: Review: Geological/geomorphological aspects of the Wilderness Society's September 1992 proposal for a World Heritage Area in the North West Forests. Tasmania Department of State Development & Resources, Division of Mines Report 1993/4.



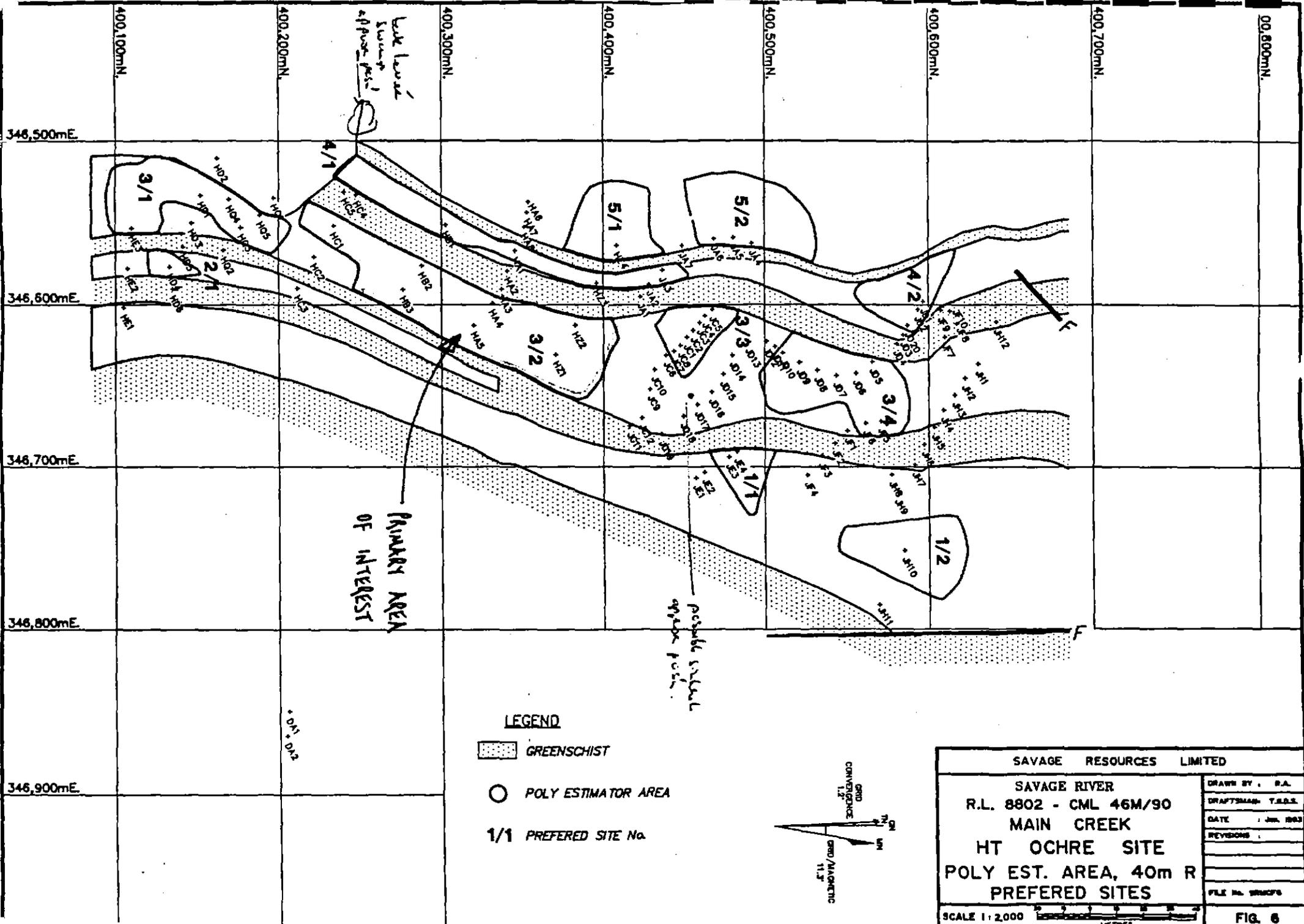
**LEGEND**

- PREFERRED SITE
- 50m CONTOUR
- TRACK
- CREEK

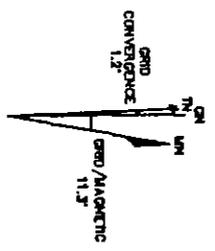


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<b>FIG. 5</b>													

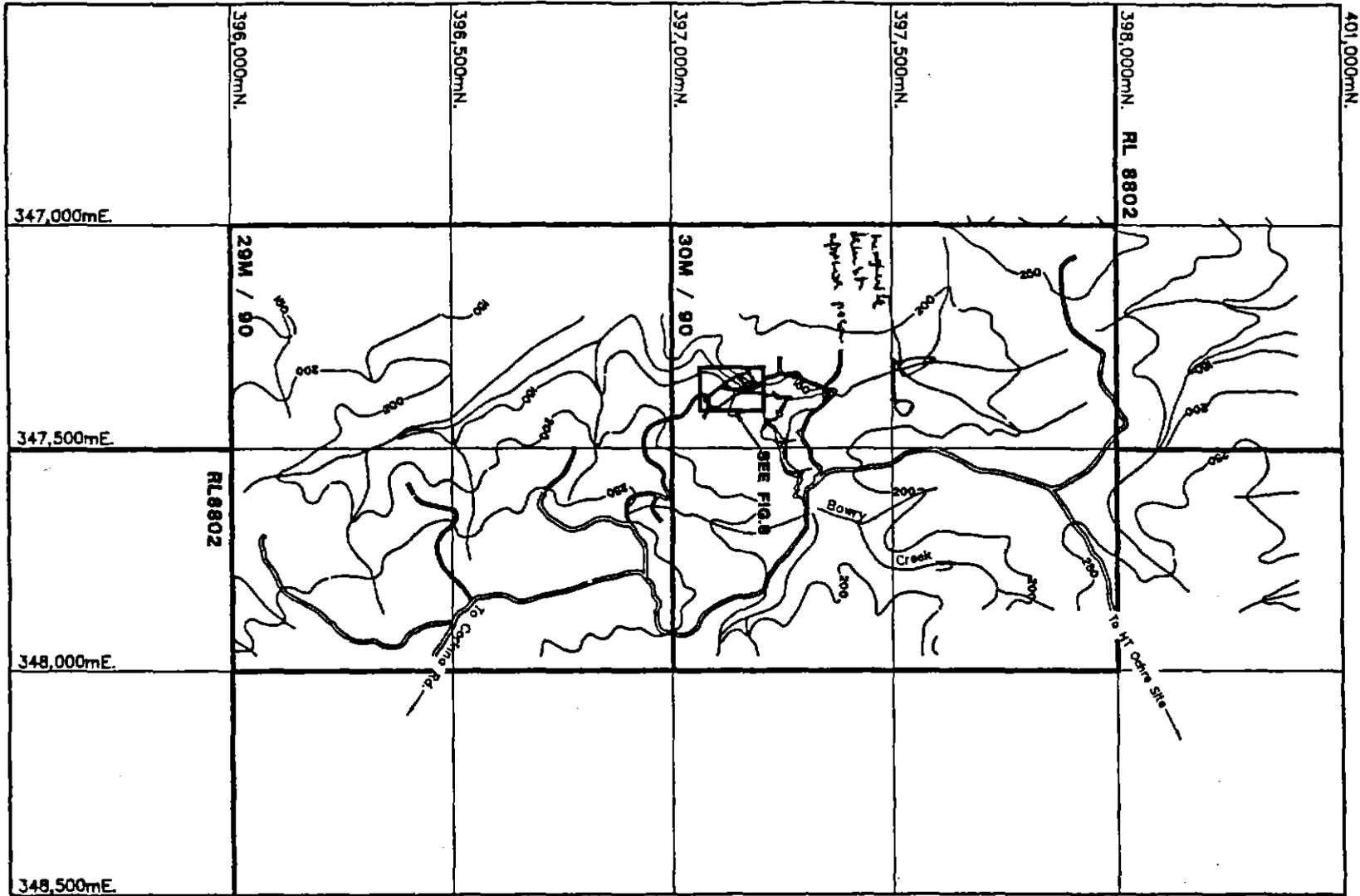
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- LEGEND**
- GREENSCHIST
  - POLY ESTIMATOR AREA
  - 1/1** PREFERRED SITE No.

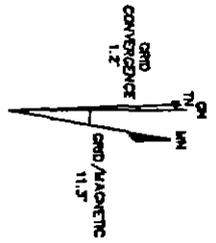


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FIG. 6							

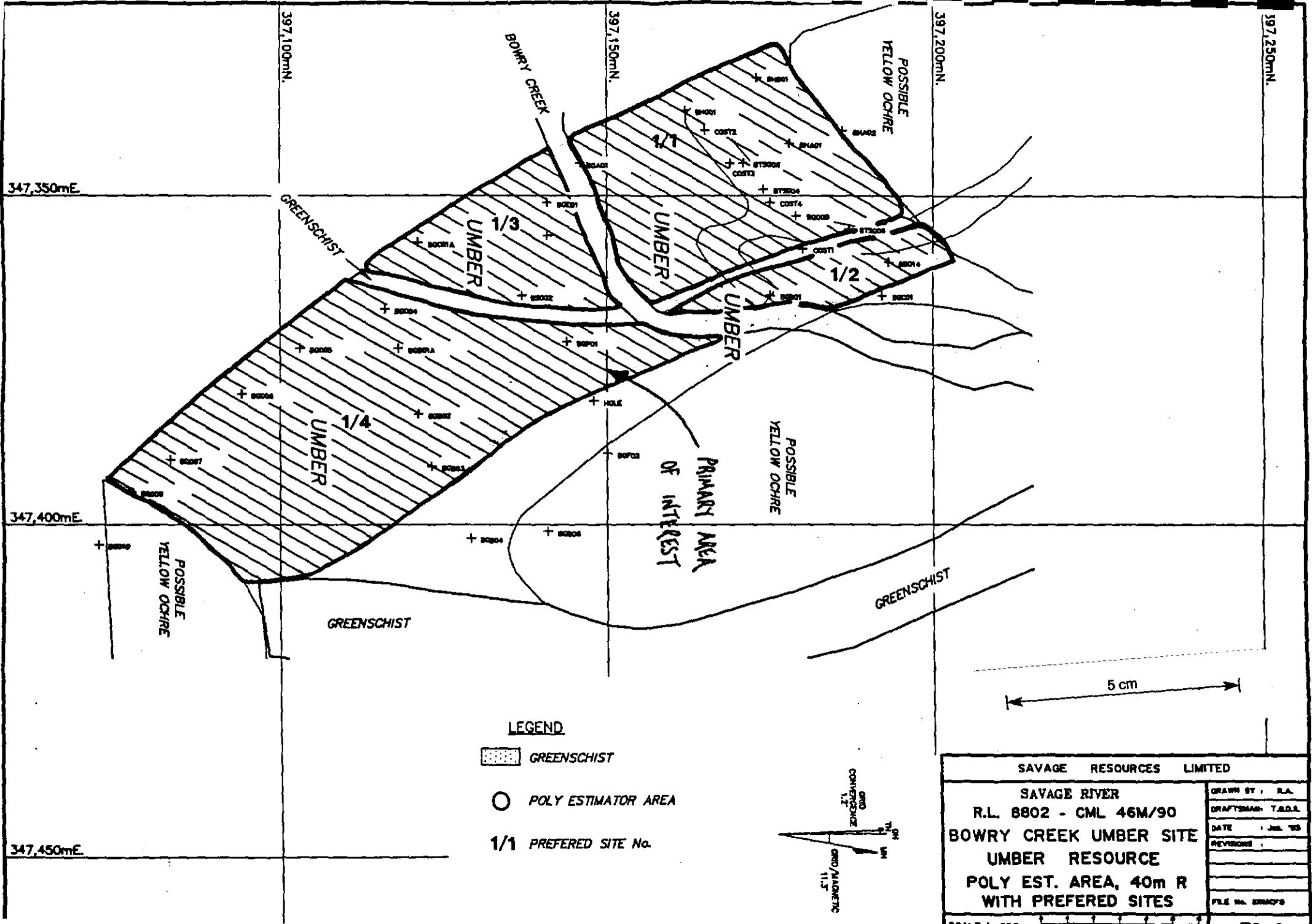


**LEGEND**

- ▽ PREFERRED SITES
- ~ 50m CONTOUR
- TRACK
- CREEK



SAVAGE RESOURCES LIMITED	
SAVAGE RIVER	
R.L. 8802 - CML 46M/90	
<b>BOWRY CREEK UMBER SITE</b>	
<b>UMBER RESOURCE</b>	
<b>LOCATION OF MINING LEASES</b>	
<b>WITH PREFERRED SITES</b>	
SCALE 1:10,000	
DRAWN BY: R.A. DRAFTER: T.A.G.S. DATE: Jan. 1983 REVISIONS: FILE NO. 8802/7	<b>FIG. 7</b>



960122

Extract from the Fire Service Regulations 1981  
under the Fire Service Act 1979

- 37 (1) The occupier of any premises used as a sawmill, log landing, or sawmill and log landing shall, during a fire permit period -
- (a) cause those premises to be equipped with the following fire-fighting tools:
- (i) one knapsack pump, having, to the satisfaction of the Commission, a capacity of not less than 10 litres and being in good operating condition and filled with water;
  - (ii) one slash hook;
  - (iii) one fire rake or grubbing hoe; and
  - (iv) a receptacle containing not less than 180 litres of water;
- (b) cause -
- (i) every chain saw used; and
  - (ii) every person using explosives, in or on those premises or elsewhere in connection with those premises to be provided with a knapsack pump, being a pump -
  - (iii) having, to the satisfaction of the Commission, a capacity of not less than 10 litres;
  - (iv) in good operating condition and filled with water; and
  - (v) kept within 100 metres of the place where the saw is, or the explosives are, being used; and
- (c) cause a firebreak to be made round those premises, being a firebreak that is -
- (i) sufficient to isolate the premises from the surrounding vegetation; and
  - (ii) cleared to the bare earth.