



## TABLE OF CONTENTS

### SUMMARY

### REPORT

- Tenement Information
- Previous Exploration
- Work Completed During the Report Period
  - Regional Survey
  - Specific Surveys
- Environmental Matters
  - Natural Forest
  - Proposed RAP
  - Land-Use Rezoning, Municipality of George Town
- Community Liaison
- Marketing
- Consultants

### LIST OF FIGURES

1. Map and Description of EL 10/90
2. Photocopy of part of 1 to 250,000 geological sheet 'Launceston' to show dolerite area covered by EL
3. Map of EL 10/90, at 1 to 100,000, to show potential quarry sites
4. Photo of cusped hinge of fold in dolerite
5. Photo of fold hinges in dolerite
6. Hansen's method to determine transport direction from folds
- 7, 8. The ship *Iron Prince* loading cement clinker at Bell Bay

APPENDIX 1

- details of  
expenditure.

## SUMMARY

The Exploration Licence has been in force for 11 months and the first year's program has been completed.

Four potential quarry sites have been recognised (Figure 3) and will be studied in more detail in Year 2.

It was a surprise to find that nearly all of the Jurassic dolerite sheet in the area is laminated and internally folded in a complex way. Folding in dolerite has not been recognised previously but is widespread in northern Tasmania from Low Head and Greens Beach to the Western Tiers. From the quarrying point of view the folding is both good and bad. For crushed rock used as aggregate it will increase the flakiness of the rock, but reduce the costs involved with explosives and crushing. No really satisfactory sites have yet been found for armour stone (massive blocks) or monumental stone because the laminar folded dolerite is so widespread, and because some rock contains zeolites.

A major constraint on the work emerged during the year when a large area was re-zoned for certain heavy industrial purposes but with exclusion of extractive industries (Municipality of George Town, Area 1 Planning Scheme 1985, Series 'X' Alteration). The opposition to quarrying disappeared when Tasmanian Hardrock explained that a quarry or quarries could be put in sites hidden from tourists. On the other hand a large part of the Licence Area was reserved as a Skyline Protection Zone which 'sterilised' several potential quarry sites.

Another constraint was that the best of the "hidden sites", in Williams Creek, was then included in a proposed Forestry Commission RAP in the Tippogoree Hills. That matter is unresolved and is being handled by the Department of Resources and Energy.

Other extensive work was done on matters connected with rock specifications, markets including the Third Runway at Sydney (decision still awaited), ship availability, ship costs, loading facilities, transport from quarry to ship, and liaison with representatives of local people and the media (newspapers, radio and TV).

## REPORT

### Tenement Information

Figure 1 provides a sketch map of the licence area and the grid co-ordinates of its boundaries.

It was designed to cover one of the numerous areas of Jurassic dolerite in northern Tasmania (Figure 2).

Figure 3 shows the licence area at a scale of 1 to 100,000, and four potential quarry sites that have been recognised. They will be studied in more detail, and studies of other parts of the licence area will continue also in relation to weathering, rock mineralogy and other factors affecting rock quality.

### Previous Exploration

Geological maps of the region have been published by the Geological Survey of Tasmania, now part of the Department of Resources and Energy. **Without those maps no project would have been started.**

The Bell Bay railway crosses the lease area by an unexpected route. The selection of the route must have been done by **one or more masterly geoscientists in the Geological Survey**. There are other more obvious routes in the topography, but they would have involved very costly cuttings through unweathered dolerite. The selected route also has major cuttings but they are all in soft weathered rock even though the surface is littered with unweathered dolerite boulders. Obviously a **large amount of superb geology was involved** in the selection of the route and resulted in the saving of large amounts of money, but I have only one small published report on the work.

*Flattery!*

No other earlier exploration of the licence area is known.

### Work Completed During the Report Period

#### Regional Survey

Before work started it was expected that nearly all the dolerite would be massive with columnar jointing. At the end of a year's work we had found that nearly all of the dolerite in the licence area is laminated and intensely folded. That was a complete surprise, because, so far as we know, folding had not been recognised in Jurassic dolerite in Tasmania (or Antarctica or Southern Africa). Yet laminar structure and folds in stacks separated by decollement surfaces are recognisable in most localities and can be photographed easily. Their importance in the present exploration is that they reduce the massiveness of the rock making it easier to quarry and to crush.

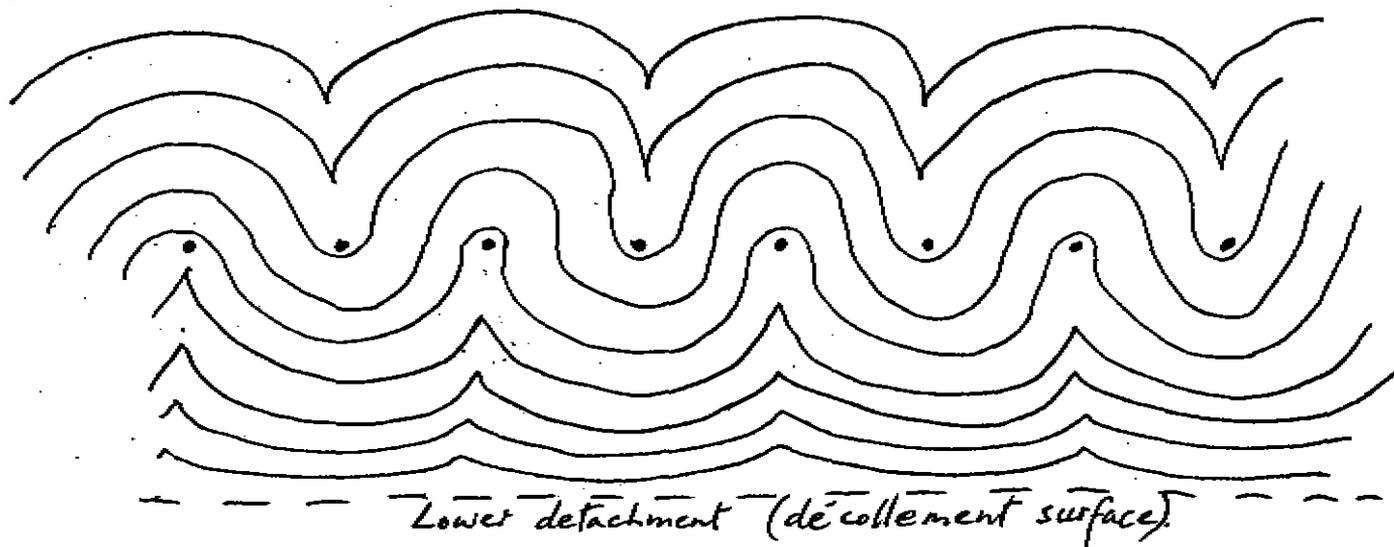
These structures are so widespread that it has been a problem to find areas of massive rock that could be worked for armour stone. One is immediately south of the Williams Creek bridge on the East Tamar Highway, but it is on the west side of the road in an area that cannot be worked for scenic reasons (Skyline Protection). Another is in a ridge between the East Tamar Highway, East Arm Road and Fourteen Mile Creek. It has been mapped as dolerite in the past, but microscopic examination shows that it contains about 18% of zeolite, alkali feldspar and albite so that it might be a Tertiary lava flow rather than a Jurassic dolerite. The problem will be resolved by further work in the coming year. The third known site is a quarry half-way up the hill climb to Mount George Scenic Lookout. It is unworkable because it is visible to tourists and houses are being built around it.

Another unexpected problem has been weathering. At the present stage of work the depths of weathering appear to vary erratically. One road cut can be quite fresh and its neighbour deeply

weathered. The reasons for this are being studied intensively. In part they seem to be connected with the complex Cainozoic history of the Tamar "Graben" and probable transfer faults crossing the graben obliquely. We have begun to recognise some of the problems and to see how they can be solved by further "broad" geological work in the coming year.

### Specific Surveys

Before work started it was anticipated that a lot of it would be the study of joint orientation and spacing. To our surprise jointing turned out to be of much lesser importance than the fabric of complexly folded laminar flow structures. The folds look 'innocent' at first and in many ways are like the concentric folds known as "Busk folds" that are studied by geology students.



In this type of folding layers are bent around centres. It is a geometrical necessity that interlimb angles change upwards and downwards in the stack. Consequently broad hinges occur alongside sharp cusped hinges (Figures 4 and 5). The stack also has to end upwards and downwards against detachment surfaces (décollements or faults). These faults can have strange geometries and can be hard to detect in some places and obvious in others. The sketch shows fold centres equally spaced along a horizontal straight line. The centres can be erratically spaced on non-horizontal bent lines and the geometries are then difficult to handle.

Some analysis has been done of the folds in the licence area but most of the results are utter confusion, so far. The little known work of Hansen on comparable folding in gneisses is being used at present (Figure 6).

In the meantime it is wise to comment only that the folds are mostly steeply plunging and have axial surfaces striking either northwest or northeast.

### Environmental Matters

#### i) 'Natural' Forest

Even where it looks original, we have found that the forest is sometimes a regrowth forest with old wire fences on long lines within it, and residual grass clearings. Much of the forest has been damaged by other human activity as can be seen clearly when it is viewed from George Town. Most of it is being cut over for firewood. Some areas are being subdivided and auctioned for large-block housing which could sterilise potential quarry sites of the future.

A plant list is being compiled by S.A. Harrington.

**ii) Proposed RAP**

A potentially major problem is that the best potential quarry site, in Williams Creek, is overlapped by a proposed Forestry Commission RAP (Recommended Area for Protection). The matter is being handled by the Department of Resources and Energy (letter dated 21 November 1990, file CAB 134.90:JH). This is a matter critical to incurring further expense on the potential Williams Creek quarry site and critical to negotiations with APPM for use of its ship-loading facilities.

**iii) Land Use Re-Zoning, Municipality of George Town**

A large part of EL 10/90 was affected by the "Area 1 Planning Scheme 1985, Series 'X' Alteration" of the Municipality of George Town. The Commissioner held a public hearing at George Town in October 1990 and at first there was opposition to Tasmanian Hardrock Pty. Ltd., which made a written submission. Indeed the Acting Commissioner stated at the beginning of the hearing that the Attorney-General had ruled that Tasmanian Hardrock would not be heard. The real reason for this was briefly and simply a fear of quarrying and mining. At the end of the hearing I was invited to speak briefly and to be examined by the Acting Commissioner, and the solicitors for the George Town Council and others. I answered questions and made explanations for over an hour. There was a fair hearing and at the end everyone relaxed and became friendly. On the following day two car loads of officers of the George Town Council and the Port of Launceston Authority were taken into the field, inspected possible quarry sites from the highway and expressed relief, apparently having believed that the granting of the EL meant that the whole of Mt George and the Tippogoree Hills would be one great quarry. There was visible relief when I indicated that sites, even for a 'super-quarry', could be completely concealed in hidden valleys, and relief was followed by co-operation and friendliness.

There was still strong concern however because a new catamaran service would be moving 400 tourists a day through George Town. There was a determination that a quarry should not be visible from the Tamar River or the East Tamar Highway. It was made clear that there would be no permit for any quarry that was visible. Consequently large parts of the EL had to be deleted from further consideration after some field work had been done on them. This situation affects one-third to one-half of the EL and hence has been given considerable space in this report. The matter will dominate further work on the licence area in the coming year (along with the RAP problem discussed earlier). The matter is not an old-style exploration matter but it is critical in the new-style exploration scene.

### **Community Liaison**

The George Town hearing was attended by many concerned local representatives, including reporters from newspapers, radio and television. They all got "stories" from me and used them fairly, and even better, for a week or more. I call on them regularly, and will have to continue to do so in the coming year. Such is new-style exploration.

### **Marketing**

The rock products industries in Sydney and elsewhere are very integrated laterally and vertically ("cartelised").

The Prospect quarries are nearly exhausted.

On 12 February 1991 the New South Wales Land and Environment Court brought down a decision that two new quarries could open at Mt Flora and Mt Misery (now "Compton Park")

which are 110 and 130 km from Sydney by the F5 Freeway. I attended hearings and studied all available documents. The successful applicants for the quarries were CSR Readymix and Amatek. They possibly have more problems and costs than Tasmanian Hardrock.

A decision on whether to proceed with the Third Runway at Sydney was to be made by July 1991. It is now stated that it will be made before the end of 1991. In a marketing situation the decision is critical. I am trying to find out what will be wanted by the Federal Airports Commission, and to let them know that superior rock will be available from Tasmania, competitively, and without putting more heavy trucks on the roads into Sydney.

These matters and others are time-consuming but important, and will be part of the program in the coming year.

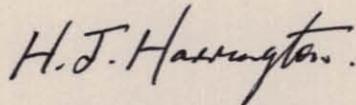
#### Consultants

Mr. Tim Minty gave advice on specifications and related matters.

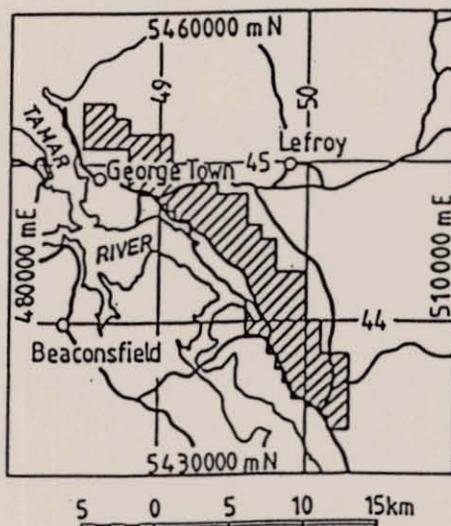
Dr. H. Hensel cut thin sections and did petrographic examinations.

Mr. Don Reed, formerly Pioneer's quarry manager in Britain, Spain and Israel is now a partner with Sinclair Knight & Partners. He visited the EL, gave quarry-engineering advice, and prepared preliminary costings and a general report.

Consultants will be engaged in a similar way in the coming year, if needed.



**H.J. HARRINGTON**  
**DIRECTOR**



**Fig. 1**  
Map & Description  
of EL 10/90

Locality and situation of land:

Commencing at the southeast corner at grid coordinates 503 000 metres E. 5 433 000 metres N. thence grid west to 501 500 metres E. grid north to 5 434 000 metres N. again grid west to 501 000 metres E. again grid north to 5 434 500 metres N. again grid west to 500 000 metres E. again grid north to 5 435 000 metres N. again grid west to 499 000 metres E. again grid north to 5 436 000 metres N. again grid west to 498 500 metres E. again grid north 5 437 000 metres N. again grid west to 498 000 metres E. again grid north to 5 438 000 metres N. again grid west 497 500 metres E. again grid north to 5 439 000 metres N. again grid west to 496 000 metres E. again grid north to the low water mark on the eastern bank of the Tamar River at approximate grid coordinates 496 000 metres E. 5 401 200 metres N. by that low water mark in a general northwesterly direction to its intersection with 492 000 metres E. again grid north to 5 446 500 metres N. again grid west to 491 000 metres E. again grid north to 5 447 000 metres N. again grid west to 490 500 metres E. again grid north to 5 447 500 metres N. again grid west to 490 000 metres E. again grid north to 5 448 000 metres N. again grid west to 489 000 metres E. again grid north to 5 448 500 metres N. again grid west to 488 000 metres E. again grid north to 5 451 000 metres N. again grid west to 485 000 metres E. again grid north to 5 454 000 metres N. grid east to 487 000 metres E. grid south to 5 453 000 metres N. again grid east to 488 000 metres E. aforesaid again grid south to 5 452 000 metres N. again grid east to 491 000 metres E. aforesaid again grid south to 5 449 000 metres N. again grid east to 494 000 metres E. again grid south to 5 448 000 metres N. aforesaid again grid east to 496 000 metres E. aforesaid again grid south to 5 446 000 metres N. again grid east to 497 000 metres E. again grid south to 5 445 000 metres N. again grid east to 498 000 metres E. aforesaid again grid south to 5 443 000 metres N. again grid east to 500 000 metres E. aforesaid again grid south to 5 440 000 metres N. again grid east to 501 000 metres E. aforesaid again grid south to 5 438 000 metres N. aforesaid again grid east to 503 000 metres E. aforesaid thence again grid south to the point of commencement.

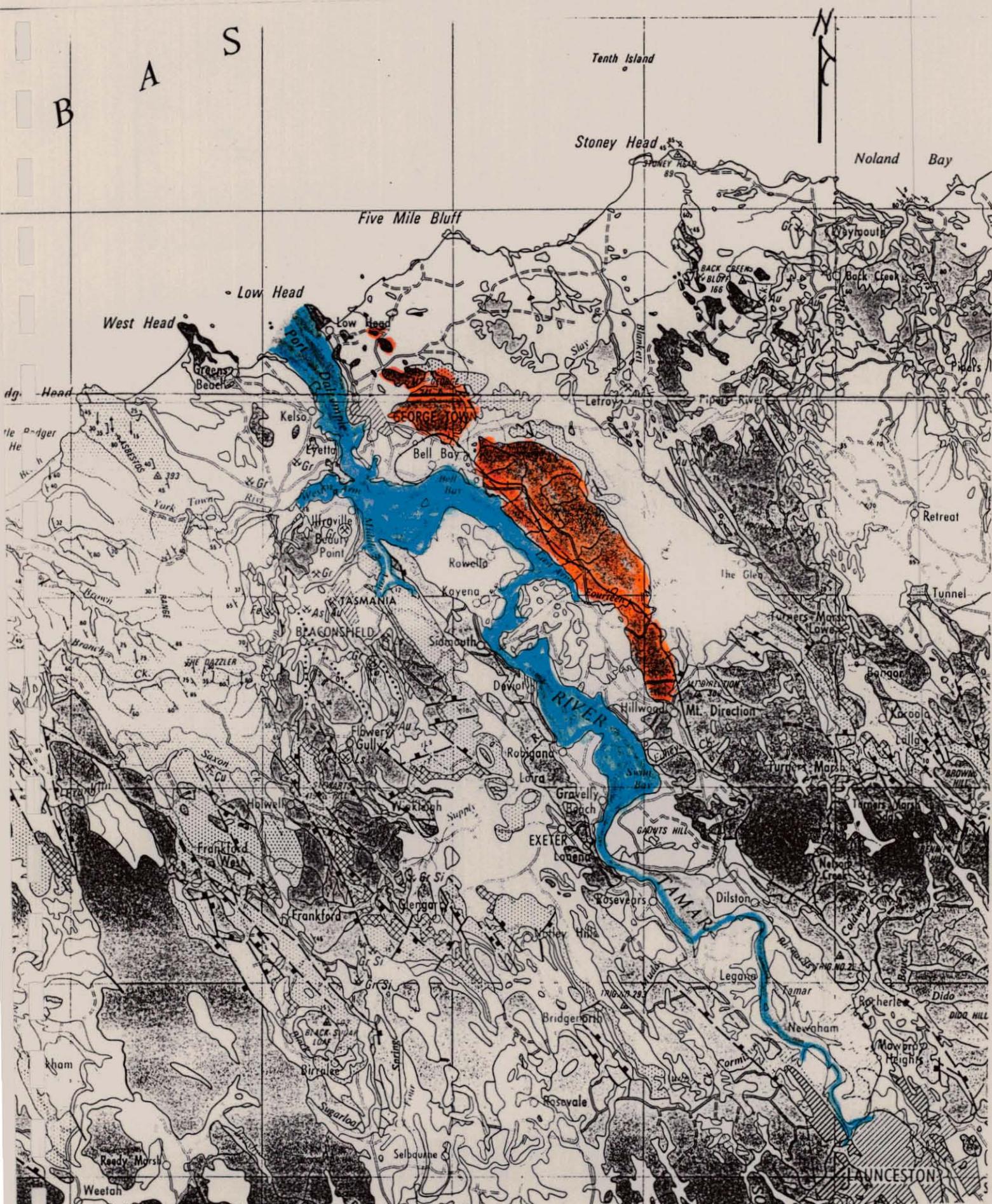


Fig.2. Photocopy of part of 1 to 250 000 Geological Sheet, 'Launceston'.

Blue : Tamar River  
 Orange : Dolerite areas covered for exploration by EL 10/90

5 cm

354009

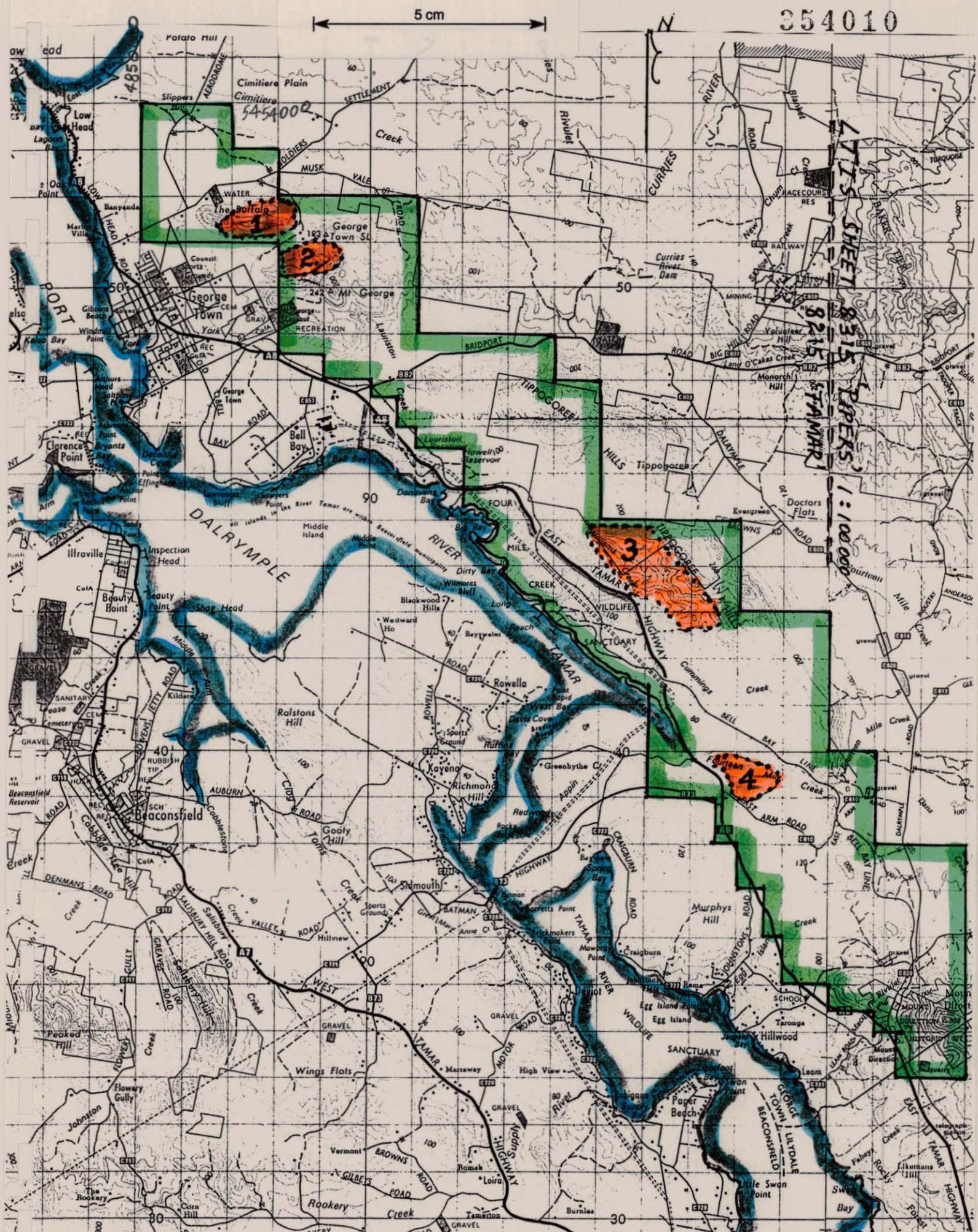


Fig. 3. Map of EL 10/90. Copy of parts of 1:100 000 sheets 'Tamar' and 'Pipers' (Land Tenure Index Series, sheets 8215 and 8315)

Blue : Shores of Tamar River  
 Green : Boundary of EL 10/90  
 Orange : Potential quarry sites; 1, Buffalo; 2, Lawrence; 3, Williams Creek; 4, East Arm Road



Fig. 4. Cuspate hinge of concentric fold in laminar-flow layers inside the dolerite sheet



Fig. 5. Fold-hinges in dolerite. These are typical folds in amplitude and wavelength for large parts of the sill, but not all of it. In the right-hand antiform, the interlimb angle decreases at the top of the photo forming a "text-book" example of a "Busk-fold".

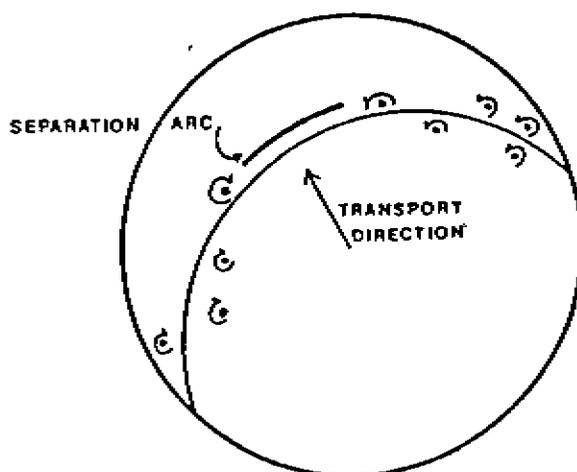


Fig. 6

Small scale folding alone frequently gives misleading transport directions because of intense local changes. When studied as a group, however, by Hansen's separation arc method, sets of minor folds also provide a guide to the transport direction (modified from Hansen, 1971).

(Hansen, E., 1971. *Strain Facies*. Springer-Verlag, Berlin, New York)

354013



Figs. 7, 8.

Goliath clinker, Bell Bay 25.5.90.  
The main wharves are not yet equipped for efficient loading and unloading of that kind of bulk cargo. A conveyor-belt loader



would be needed for crushed rock, and some other arrangement for armour stone blocks. Tippoogoree Hills in background.

**TASMANIAN HARDROCK PTY. LTD.**  
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Voice telephone: (044) 71 7949

16 September 1991

**For attention:** Mr. R. Hargreaves  
Mr. A. Reeves  
Mr. J.G. Oakes  
Mr. N.J. Turner  
Mr. D. Burgess

The Director,  
Division of Mines,  
Department of Resources and Energy,  
PO Box 56,  
**ROSNY PARK, TAS. 7018**

Dear Sir,

**EXPLORATION LICENCE 10/90 - BELL BAY**  
**RENEWAL APPLICATION**  
Your Ref. JGO 52.91 : AT  
TCR 91 - 3281

In reply to your letter of 21 August I send the following:

1. A list of expenditure. The company exists only for EL 10/90 and so all expenditure is directed to exploration of the EL.
2. A statement on the report by Tim Minty. On the telephone Mr. N.J. Turner said that there was certainly no need to send the publications that Mr. Minty had sent to me, but just a list of them. (A real report on test results for Tasmanian dolerite is now being prepared by the Division of Mines.)
3. The two reports by Dr. H.D. Hensel on the petrography of samples from Williams Creek and East Arm Road.
4. A copy of the report by Mr. Don Reed.  
In a note preceding it I have drawn attention to the serious RAP problem in Williams Creek. It would help a lot if the problem could be resolved.

The grid references for Figures 4 and 5 in the company's first annual report are:

Figure 4: 831535 on 1:25,000 Sheet Low Head 4845, edition 2  
Figure 5: 822545 on 1:25,000 Sheet Low Head 4845, edition 2.

The best-exposed of these folds in the dolerite are on the shore north and south of the Fairy Penguin Walkway near Low Head Lighthouse, and at all other headlands towards George Town. All of them are on reserves and are therefore outside EL 10/90, but identical structures can be seen at innumerable easily-accessible localities in the EL. They occur throughout the

MINES	
File Ref.	E.L. 10/90
19 SEP 1991	
Doc. Ref.	
Action Officer	Initials
REFER	TO
COVER SHEET	
16.9.91.	
Resubmit to	Date

German Town Potential Quarry Site east of George Town and west of the George Town Sugarloaf, between grid references 877503 and 888505. They occur also throughout the Williams Creek Potential Quarry Site, grid reference 948447 on the Bell Bay 1:25,000 Sheet 4844.

Further afield similar folding occurs at Greens Beach west of the mouth of the Tamar, and at many locations on "the tops" along the road from Poatina to Arthurs Lake. They look very similar at all those localities but broader more open folds in thicker laminae have been seen in cutting on the Bell Bay railway (987402 on the Bell Bay 1:25,000 sheet).

I look forward to a resolution of the RAP problem.

Yours faithfully,



**H.J. HARRINGTON**  
Director

## TASMANIAN HARDROCK PTY. LTD.

A.C.N. 009 499 807

## EXPENDITURE

Department of Resources and Energy	
Rental of Exploration Licence Area 10/90, 79 sq. km.	\$790.00
Issuing Fee for Licence	200.00
AMP General Insurance, Public Liability Policy for \$1 million	
First Payment	160.50
Second Payment	310.30
Commonwealth Bank Guarantee to Department of Resources and Energy	
Performance Guarantee and Private Land Deposit	
Payments \$40.00 half-yearly in advance	80.00
Maps and air photos from Tasmap and from the Mines Division, Department of Resources and Energy	655.00
Accountancy and secretarial, Hobart Office (CM & R Services)	2,201.00
Australian Securities Commission filing fee	230.00
Tasmanian Commissioner for Corporate Affairs, filing fee	185.00
Bank charges, Financial Institute Duty and Service Fees	66.21
Office consumables (office rent, nil)	662.50
Depreciation (computer, facsimile machine, copier, printer, desk, filing cabinet, etc. at rates laid down by Taxation Office)	2,132.64
Minor repairs and equipment items	448.47
Telephone	225.15
Rental of Post Office Box	70.00
Postage	151.00
Photocopying (Sydney and Canberra, no receipts could be obtained)	58.00
Rail freight	48.08
Films and processing	67.95
Typing	18.05
Field and Travel	
Tasmanian Ferry Services Ltd.	678.00
TT Line (Abel Tasman)	730.00
Ansett Airlines	313.00
Pioneer bus, Canberra - Sydney return	48.00
Taxis	42.00
Accommodation	
Mainly rent at Elphin Apartments, Launceston; Archers cottages, Launceston; some motels; (and a period in a free cottage in George Town)	5,717.37
Meals (mainly estimate, because receipts not easily obtained from normal cafeterias)	1,233.01
Toyota Landcruiser (Note 1 below)	
6980 km @ 86.74c	6,054.45
Salaries (Note 2 below)	
H.J. Harrington	65,000.00
S.A. Harrington	30,000.00
Consultants (Reports attached)	
Engineering Geology Specialists (Tim Minty)	297.00
H.D. Hensel (Petrology)	100.00
Don Reed & Associates (Sinclair Knight and Partners)	2,696.00
	<hr/>
TOTAL	\$121,668.68
	<hr/>

**Note 1: Landcruiser**

The Landcruiser for field work is owned by AGC and used by Tasmanian Hardrock by hire-purchase agreement for 5 years with a 'residual'. Fuel and maintenance are straightforward, but the reputable accountants' ways of handling hire-purchase payments, insurances, depreciation and 'residuals' are so complex to understand, at least by me, that I have used the straightforward cost per kilometre supplied by NRMA Head Office (National Road and Motorists Association). The NRMA determines a cost per kilometre for most of the common vehicles on Australian roads and supplies them to members, companies, accountants and vehicle pool managers. They are accepted for tax returns by the Taxation Office.

**Note 2: Salaries**

Salaries are included because the company exists only to handle EL 10/90 and we work full-time at it, venturing our own money. The salaries are real so far as an accountant is concerned, but are notional in the sense that all the funds for Tasmanian Hardrock are obtained from H.J. and S.A. Harrington as non-interest-bearing loans.

I have used salaries lower than those that would have been received by H.J. Harrington and S.A. Harrington had they stayed with DPIE-BMR and Canberra University respectively. I have **not** included labour on-costs (around 40% to 80% of salaries) and I have **not** included add-ons to salaries at ranks of SPRS and above, such as cars with fuel and maintenance, home telephones, flight club memberships, and expenses of office allowances.

**DPIE-BMR Salaries**

Secretary	— (not published)
Dep. Secretaries	— (not published)
SES 6 (Director)	— (not published)
SES 5, 4, 3, 2, 1 (Asst. Secs & Associate Directors)	— (not published)
Chief Research Scientists 3	\$95,706
Chief Research Scientists 2	\$87,222
Chief Research Scientists 1	\$80,474
SPRS	\$68,819 - \$75,473
Senior Officer, Grade B	\$53,403
Senior Officer, Grade A	\$45,546
Professional Officer 2 )	
Science 2 )	\$35,424 - \$39,589
Technical Officer 4 )	

## ATTACHMENT 1

## REPORT BY E.J. (Tim) MINTY

I asked Tim for a report on engineering test data on Tasmanian dolerite, and did not get it. I was sent copies of general published reports on quarries and the like. (Copies of these are not enclosed because on the telephone Dr. Turner said it would be sufficient to give a list of them).

Subsequently I had pleasant conversations with Mr. Minty in Melbourne but he did not seem interested in pursuing the matter of the engineering test data on Tasmanian dolerite. The reason was not clear but it seemed that it was because he was working for other companies. (The Division of Mines is now preparing a real report on the engineering test data on Tasmanian dolerite).

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RE: DOLERITES as AGGREGATE

To provide some engineering test data on soft and hard rocks used for roads and hard rocks used for concrete I have spent some time researching some of the papers written by myself and conference papers which may be relevant.

In 1963 I wrote a paper for the Royal Society of N.S.W. (Petrology in relation to road materials Part II) a copy of which is enclosed. You will probably be interested in TABLE 2 on page 61. (Appendix A).

Of course there is now a frantic interest in environmental impact studies that did not receive a mention in 1963 although that matter was not as neglected as some people would now have us believe. In fact, B.M. & G. planted trees right around Prospect Quarry in 1964 for visual as well as other reasons, including future noise abatement.

In 1977 a "Workshop on the Geology of Quarries" was arranged by the Australian Road Research Board. From A.R.R.B. (ARR No.80) papers I enclose four extracts:-

- (a) "Some comments on source rocks mined at Australian quarries" by the writer (Appendix B).
- (b) "Some comments on quarry evaluation" by G. Bell. (Appendix C).
- (c) "Some comments on quarry evaluation" by the writer. (Appendix D).
- (d) A case history of a Victorian quarry by .O.T. O'Flynn. (Appendix E).

The last paper, Appendix E, reflects the difficulties experienced by BORAL in establishing their Wollert Quarry in Melbourne.

- 2 -

While there is some data on quality of dolerite in the first of the conference papers abovementioned (Appendix B) some more up to date testing data is included as Appendices F & G which are extracts from a paper on "Aggregate durability", by Minty, Pratt & Brett, ARRB Vol. 10 Pr.3, 1980. The results are from D.M.R. N.S.W. Dolerite has better than average values for the three properties listed.

"Soft rocks" are defined in Appendix H.

On your next visit to Tasmania you may care to discuss these questions further. If so, my wife and I would be happy to have you stay overnight at "Wybalenna" as our guest.

There are some other documents which may be of interest to your new venture eg. Australian Standards AS 2758.1 and AS 2758.2.

So far the cost of collecting the data you have requested amounts to four hours in time plus postage and typing costs, all up less than three hundred dollars. We trust that this is what you required.

4297

Yours sincerely,



E.J. (TIM) MINTY  
Director

encl.

## ATTACHMENT 2

## REPORTS BY DR. H.D. HENSEL, CANBERRA

I am able to describe thin sections of rocks, but Dr. Hensel is especially competent. He was chosen to supervise quality control for the large-scale work involved in the quarrying and preparation of most of the rocks used in the New Parliament House, Canberra. A copy is attached of a Guide that he has written. He and I have had several written reports on specimens WC1 and EA1, because the dolerite in EL 10/90 is surprisingly uniform under a hand lens.

*discussions, but only two*

WC1: Williams Creek 1 is from potential quarry site 3 in Williams Creek, Figure 3 of the First Annual Report (grid reference, Bell Bay 1:25,000 Sheet 4844, ed. 2, 948447). It is reasonably characteristic of sites 1, 2 and 3, but not 4, in EL 10/90.

Further petrographic work on Site 3 is in abeyance until it is decided whether or not it will be declared an RAP (Recommended Area for Protection).

The rock is of excellent quality mechanically despite its 8% of interstitial alkali feldspar and 4% of smectite and hydrated iron oxide.

EA1: East Arm 1 is from potential quarry site 4, itself containing an old small quarry, in the angle between the East Tamar Highway and East Arm Road (GR, Beaconsfield 1:25,000 Sheet 4843, ed. 2, 979392). It has previously been mapped as Jurassic dolerite, but this rock is massive whereas all the adjoining dolerite has a folded laminar flow banding. Because of its massive character the East Arm rock is a potential source of armour stone, but in the field I suspected that it might be a Cainozoic basalt. Dr. Hensel's description, and personal examination of the slide, indicate that the rock could indeed be a basalt. It contains a notable amount of zeolite which might be reactive with cement, but might have little effect on its suitability for armour stone. It is on the site of an abandoned Cainozoic Tamar Valley which has a complex filling of boulder beds, sands and silts on a deeply weathered basement. Nearly all of this ancient valley is outside EL 10/90 except for the quarry beside East Arm Road.

**Macroscopic description of rock**

A massive, medium to dark greyish, fine- to medium-grained rock of basaltic appearance. Fractures are coated with a very thin film of iron oxide and hydrated iron oxide and there are two subparallel joints.

**Petrographic description of thin-section**

This is a medium-grained, reasonably homogeneous, very mildly altered, slightly weathered rock of basaltic composition. It consists mainly of small to quite large crystals of calcic pyroxene and abundant, relatively small crystals of plagioclase feldspar. In addition, there is a lesser amount of interstitial alkali feldspar, opaque minerals, and apatite. Minor hydrated iron oxide and smectite are the main secondary minerals.

The rock appears to have no structure. Its texture is basically intergranular although there are frequent subophitic intergrowths of calcic pyroxene and laths of plagioclase feldspar.

Typical maximum grainsize of the pyroxene is around 4mm with an average close to 2mm. The feldspar laths uncommonly exceed 1mm and generally fall into the range of 0.3 to 0.8mm.

The two minerals which comprise the bulk of the rock - plagioclase feldspar and calcic pyroxene - are essentially unaltered. Some of the opaque mineralogy is mildly affected by alteration and partial crusts of reasonably well crystalline goethite are not uncommon. In this rock there appears to be only one opaque oxide variety - probably a titaniferous magnetite.

Numerous interstitial areas are occupied by a murky, brownish mess consisting mainly of unresolvably fine-grained alkali feldspar. Other interstitial areas are partly to fully filled with either or both small yellowish rosettes and clusters of smectite flakes and poorly crystalline hydrated iron oxide.

**Mode of rock**

plagioclase feldspar	52%
alkali feldspar	8%
calcic pyroxene	35%
opaque minerals	1%
smectite	1%
hydrated iron oxide	3%
apatite	tr

**Name of rock**

Subalkaline (tholeiitic) dolerite

**Macroscopic description of rock**

A massive, medium to dark greyish, fine- to medium-grained rock of basaltic appearance. Fractures are coated with a very thin film of light brownish hydrated iron oxide.

**Petrographic description of thin-section**

This is a very mildly altered, slightly weathered rock of basaltic composition. It consists mainly of plagioclase feldspar and calcic pyroxene but there are also a number of primary minerals of minor occurrence including orthopyroxene, alkali feldspar, opaque minerals, and apatite. Surprisingly abundant zeolite, albite, minor amounts of hydrated iron oxide and smectite, and a trace of carbonate are the main secondary minerals.

The rock appears to have no structure but it is clearly heterogeneous compositionally and texturally. The texture of most of the rock is basically intergranular although there are a number of instances where the calcic pyroxene has a subophitic relationship with laths of plagioclase feldspar. In the relatively finer-grained parts of the rock this subophitic relationship dominates.

Typical maximum grain size of the pyroxene varies from 1mm in the finer-grained portions to about 3mm in the coarsest parts. The feldspar laths are roughly about half those dimensions, respectively.

The two minerals which comprise the bulk of the rock - plagioclase feldspar and calcic pyroxene - are mostly unaltered. The orthopyroxene is also unaltered even though it tends to appear rather messy and is usually at least partly surrounded by calcic pyroxene. Under high magnification it is possible to see the reason for the messiness - a substantial amount of exsolution (unmixing) of the two pyroxene types. The opaque mineralogy also seems unaffected by any alteration. On the basis of size and morphology it is highly likely that there are two varieties of oxides, the larger one being ilmenite and the smaller magnetite.

In view of the general freshness of the major minerals combined with its subalkaline chemical composition it is somewhat surprising to find such a large amount of zeolite in the rock. It occupies numerous interstices but also occurs in quite large and often elongate patches. The elongation might be a key to its formation suggesting that these patches constituted low- temperature fluid pathways formed in a tensional environment. There appear to be at least two varieties and positive identification is difficult. Another alteration mineral is smectite which forms little green rosettes and booklets mainly along grain boundaries in proximity to the zeolite. Also occurring in patches and as thin mantles around altered plagioclase feldspar crystals is some secondary albite.

Other interstitial areas are occupied by a murky, brownish mess consisting mainly of unresolvably fine-grained alkali feldspar.

## Mode of rock

plagioclase feldspar	47%
alkali feldspar	8%
albite	2%
zeolite	8%
calcic pyroxene	28%
orthopyroxene	4%
opaque minerals	3%
smectite	<1%
hydrated iron oxide	<1%
carbonate	tr
apatite	tr

## Name of rock

Subalkaline (tholeiitic) dolerite

Dr. H. D. Hensel  
(8th July, 1991)

## ATTACHMENT 3

**REPORT BY MR. DON REED OF DON REED & ASSOCIATES, OF  
SINCLAIR KNIGHT & PARTNERS**

Mr. Reed was recommended highly by the Secretary and President of the Institute of Quarrying and by a former President. He was formerly Manager of the British, Spanish and Israeli quarries of Pioneer International Ltd.

His report was based essentially on Potential Quarry Site 3 in Williams Creek, and was only a pre-feasibility study. Unfortunately the Williams Creek site became a proposed Forestry Commission RAP. In my opinion its vegetative cover is so degraded and abused that its value for RAP status is that there is nothing in it that could be milled. Nevertheless the RAP situation is such that until the problem is resolved no sensible company could invest more money in bulk sampling, feasibility studies and shore loading expenditure. The resolution of this problem is in the hands of the Department, and I am in a Catch 22 situation.

One of the reasons for asking Mr. Reed to concentrate on the Williams Creek site in his report was that the facilities for handling crushed rock at the PLA wharves are inadequate. Photos of the Iron Prince loading cement clinker were included in the First Annual Report as Figures 7 and 8 to show the problems. The crane in the background has since collapsed. The clinker had to be loaded by ship's gear.

The Williams Creek site is around 1.5 km from the APPM woodchip loading facility. When I first spoke to that company it was considering a quite large capital expenditure on a new fast jet-loader. After our discussions it decided to proceed (and the loader is now operational). The company was also prepared to look at spending \$1 to \$1.5 million on storage and loader facilities feeding-in to the jet loader, for the standard 25% R.O.F. (Don Reed's report, pages 6 and 7). They had in mind a number of their problems, including the Commonwealth Government's decision to phase out wood-chip exports by the year 2000. All these matters had been referred up to Company management by John Hogg, the APPM manager, before Don Reed's visit. I had also discussed them with senior PLA officers from Mr. Kippel downwards.

Parts of the discussions concerned whether it would be better to move rock from Williams Creek to the APPM loader by contract trucks or by a conveyor belt about 1.5 km long. The conveyor costs are set out by Don Reed in the table on page 7 of his report.

All these matters were being handled quietly because they are commercially sensitive, not so much in Tasmania as in the Sydney region. One Tasmanian trucking firm (Hazell Bros.) has declared itself to me as a determined competitor, using a Hobart quarry, and it declined an invitation to join in the Bell Bay venture.

9th November, 1990

Tasmanian Hardrock Pty Ltd  
G.P.O. Box 1412  
Canberra A.C.T. 2601

Attention: Mr Larry Harrington

**Preliminary Appraisal - Proposed Hardrock Quarry, Bell Bay, Tasmania**

Larry,

As requested I have prepared the following report as a summary of my impressions of the project derived from site visits and discussions with yourself on the 8th and 9th November, 1990. Included within the report are a number of considered project options, cost estimates and recommendations. It must be stressed that all comment is of a preliminary nature only and offered as a guideline to be considered during the preparation of a detailed feasibility study.

Comment is offered under the following headings :

**1. THE RESOURCE**

In offering comment on the resource size and quality reliance has been placed on your own professional assessment and conclusions. The resource appears to consist of a massive and high quality dolerite with excellent potential to produce the full spectrum of high quality quarry products. Information that will be required for any detailed assessment would include:

- surface geological mapping.
- petrological analysis of representative samples including comment on expected suitability for the production of the various quarry products.
- a full suite of laboratory test results to cover Material Density, Water Absorption, Sodium Sulphate Soundness, Los Angeles Abrasion, Wet/Dry Strength Variation, Aggregate Crushing Value, Polishing and Stripping Values, Alkali Reactivity, etc

Apart from site mapping and based on your summation of site geology, I would suggest that exploration can be restricted to 2-3 days percussion drilling and

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Mining and Quarry Consultants. 31 Illiliwa Street, Cremorne, NSW 2090.  
Telephone (02) 953 7710 Fax (02) 953 4989

sufficient trial blasting to open up a representative quarry face.

Indicative costs for the above (depending on local availability and costs) would be:

- site mapping	L.H.
- petrological analysis/description	L.H.
- full suite of lab tests (i.e. via Longmac, Arup, Boral or other)	\$1500-2000
- percussion drilling, 6 days including drilling for trial blast	\$5000-6000
- trial blast, explosives etc	\$2000-3000
- access track/stripping	<u>\$2000-3000</u>
Indicative Cost	<u>\$10000-14000</u>

Note that the indicative cost equates to diamond drilling in the order of 90 - 125 metres of core. Costs may be able to be reduced with the cooperation of governmental authorities (Viz. D.R.T., Div. Mines or other).

In general terms the resource was noted to be :

- well located 1 km from the East Tasman Highway, 1.2 kms from the Bell Bay rail track and approximately 2 kms from the intended port loading facility.
- easily accessed
- readily quarried in and environmentally effective manner.

## 2. THE ENVIRONMENT

As noted above the site is able to be developed in a manner that should avoid any significant objection on environmental grounds assuming that no unforeseen problems arise (viz, aboriginal artefacts, rare flora/fauna etc).

Whilst it appears that you are able to access significant quantities of necessary data (from Comalco, A.P.P.M., Forestry Commission, etc) it is critical that the final document is assembled by an experienced, reputable and well regarded environmental consultant. It is similarly critical that all aspects of quarry planning, production, materials handling as proposed within the E.I.S are cleared by an experienced quarry operator such as myself.

I would suggest that you discuss the E.I.S. compilation/presentation with myself once you have determined, from local authorities, exactly what is required. Dependent on the data input required, an E.I.S. can be expected to cost from \$10,000 - \$50,000.

### 3. MARKET RESEARCH

Market research and the ability to demonstrate real market opportunities will be the essential prerequisite to project justification assuming that quarry products can be delivered at competitive cost (refer comment below). I would suggest that research be conducted to identify real market opportunities before expenditure is committed to exploration or the Environmental Impact Study.

I cannot overstate the critical nature of professional market research to the successful preparation/presentation of bankable documents within the current economic climate. Potential investors and/or equity partners will insist on being convinced of real, demonstrable market opportunities.

You will need to clearly identify market targets, for example:

- Launceston - Bell Bay - Georgetown
- Other Tasmanian
- Melbourne
- Adelaide
- Sydney
- Other mainland coastal
- Asian and other markets

In assessing any of the above you will need to consider local supply and demand and nominate areas of recognised opportunity. Within the Sydney market I would look at market not tied up by Boral - C.S.R. - Pioneer (i.e. within the web of vertical integration, reciprocal deals, cross share holdings, etc). Such market can include:

- independent ready-mixed concrete producers
- independent asphalt producers
- the R.T.A. for asphalt and road materials
- the S.R.A. for ballast
- the P.W.D., M.S.B. and other government bodies
- major project markets including the Botany Bay Breakwater, the 3rd Mascot runway, the V.F.T. etc.
- independent resellers (i.e. selling to builders, drainers, garden suppliers, home builders, etc)
- Amatek if Mt Misery is not approved for extractive industry.
- possibly Hymix in the south
- major contractors such as Leightons, Theiss for project work, site mixed concrete etc
- others.

As discussed, the alternative to avoiding the Boral - C.S.R. - Pioneer oligopoly is to compete head on. ^Such a step would require the ability to produce or source independent cement and sands and to invest in a chain of pre mixed concrete batch plants, asphalt plants etc. The cost would run into the hundreds of millions and any new entrant would have to be prepared to endure a significant period of cost cutting (market war) as the existing "majors" fought to protect market share.

In assessing market opportunities in Sydney I would suggest that research be generally restricted to an area within 50 - 60 kms of the point of unloading. Note that my cost to carry out market research and prepare a realistic marketing strategy for the sale of quarry products into Sydney would probably cost in the order of \$4,000 - \$10,000 dependent on time spent with potential buyers.

#### 4. UNLOADING FACILITIES AND DISTRIBUTION STRATEGIES TO SERVICE IDENTIFIED MARKET

A number of factors are critical including:

- number and type of products to be unloaded/distributed
- size of vessel to be berthed
- unloading methodology (self unloading, grabs, bottom dump, Ro/Ro etc)
- availability of appropriate port facilities in proximity to identified market.
- quantities to be unloaded.
- storage for same.
- distribution of same.
- impact of the above on local environments, road systems, etc.

Project feasibility will depend on the ability to find suitable facilities to be operated at commercially viable costs. I have extensive specific information for Sydney and Brisbane and, as advised, am aware of 2 sites available in the near future within Botany Bay.

For budget purposes I have assumed a range of unloading, materials handling charges as follows:

\$2.50 p.t. x 1 m t.p.a.  
 \$3.00 p.t. x 0.5 m t.p.a.  
 \$4.00 p.t. x 0.25 m t.p.a.

## 5. SEA TRANSPORT

The type and size of vessels will depend on a number of factors including:

- volumes to be transported and segregation requirements (by product).
- the depth of water available for loading and unloading.
- loading/unloading facilities.
- cost consideration and, particularly, the relationship of unit cost to volume.
- vessel availability.
- manning and port requirements.

Although it won't be possible to define vessel requirements until many of the above listed variables are resolved it is necessary to know the options available and the approximate costs associated with each of the options. It is understood that you have received an indicative transport rate as low as \$13 per tonne to Sydney. I have excellent contacts within TNT who have extensive experience shipping to and from Tasmania.

For budget purposes I have assumed shipping rates of:

\$18 p.t. @ 1 m t.p.a.  
 \$20 p.t. @ 0.5 m t.p.a.  
 \$23 p.t. @ 0.25 m t.p.a.

*These rates were indicated by H. J. Harrington in discussion. It now appears that the real rate is \$9 or even less. (\$23 was a spot rate for general cargo but \$9 is realistic for bulk rock).*

## 6. SHIP LOADING - BELL BAY, TASMANIA

Time was spent on 8th November with Mr John Hogg, Tamar mill manager for A.P.P.M. Forest Products. The Tamar mill woodchip loading facility is located only some 2 kms from the proposed quarry site. The object of the visit was to confirm the viability of stockpiling quarry products on the A.P.P.M. site for loading onto seagoing vessels through the A.P.P.M. ship loading facility.

From the materials handling and engineering points of view, the above noted concept appears entirely feasible. As discussed, crushed aggregate products are able to be trucked or conveyed to the A.P.P.M. site where an area would need to be set aside to stockpile up to an estimated 50,000 tonnes at any one time. Cost savings of up to 75% per tonne are available from adopting the conveyor option as opposed to trucking. Material could be conveyed direct to stockpile.

The disadvantage of the conveyor option would be capital cost. The requirement would be for some 2 kms of conveyor and infrastructure including:

- loading bins
- bridge sections to cross rail and road.
- elevated sections at the stockpile end.
- a mobile head pulley arrangement to move from stockpile to stockpile.
- drives and power.
- conveyor enclosures.
- safety facilities.

As a ballpark figure I would estimate a capital cost in the order of \$2.0 m. Justification of such expenditure will depend heavily on the volume of material to be transported, that is, conveyor utilisation.

Although trucking is probably the preferred option until markets are established, considerable thought will have to be given as to how aggregate can be transferred from trucks to stockpiles. Trucking will be the only option for the transportation of armour rock which will require separate stockpiling and loading arrangements.

X Considerable time was given to discussing potential stockpile locations and materials handling facilities/alternatives. The preferred option would be to locate stockpiles adjacent to the section of the ship loader after the woodchip reclaim sections, and to use as much of the existing loader as possible. Essential components of the discussed system would include :

- aggregate stockpiles to be located over a sub-ground conveyor system.
- the sub ground conveyor (say 1000 - 1500 t.p.h. to be compatible with the main ship loader conveyor) to be installed within an Armco tunnel or similar structure.
- the conveyor to be fed by 2 - 3 feeders per stockpile via variable speed feeders.

John Hogg agreed to carry out costings on such a system with these to include :

- earthworks/drainage
- civils
- cost of Armco tunnel
- cost of feeders
- cost of conveyor structure, drivers and belting.

7

- cost of transfer bin
- electrics
- relocation of weightometer etc.

*A.P.M. (North Broken Hill Pathe  
volunteered to pay this capital  
cost (\$1-2 M) for an "essential"  
return of 25% p.a. (John Hogg  
says this was approved by his  
company).*

At the time of discussion an approximate cost of \$ 1.0 - 1.5 m seemed likely. John Hogg indicated that A.P.P.M. may look at supplying the capital for the conveyor system on a user pay basis. The fee to be charged would equate to a R.O.F. of 25% per annum. The 25% would be calculated after operational costs only and would exclude depreciation, interest and tax. Any cost per tonne to the quarry operator would then depend on volumes to be loaded.

The operation of the proposed system (at an estimated 1000 - 1500 t.p.h.) would require 1 man to supervise the conveyor system and "push in" stockpiles (via F.E.L. or dozer as required), in addition to 3 men on the actual ship loading duty. For budget purposes the running cost of loading was nominated by John Hogg at around \$1000 per hour (or \$1 per tonne at 1000 t.p.h.).

X An indicative cost of transporting material to A.P.P.M. and loading to seagoing vessel may be as follows : X

	at 250,000 t.p.a.	at 500,000 t.p.a.	at 1,000,000 t.p.a.
Transport conveyor			
* Finance Cost on \$2m Conveyor @ 16%	\$1.30 p.t.	\$0.64 p.t.	\$0.32 p.t.
* Operational Cost	\$0.30	\$0.30	\$0.30
* R.O.F.I. @ 25% after operat. costs before depreciation	\$2.20	\$1.20	\$0.70

<b>Loading conveyor</b>			
* Payment to A.P.P.M. to recoup \$1.5 m capex @ 25% after operational costs at \$1.00 p.t. plus \$1.00 p.t. margin	\$3.50	\$2.75	\$2.37
<b>SUB TOTALS</b>	<b>\$7.30</b>	<b>\$4.89</b>	<b>\$3.69</b>

## 7. SITE DEVELOPMENT/MINE PLANNING

Site development to include :

- slip lane to main road
- access roads to quarry site
- drainage/dam construction
- de-forestation
- earthworks/hardstand for plant and stockpile area
- stripping of quarry area
- fencing

Assume an all up budget of \$300-500,000 say, \$500,000 for initial site development after which costs will be operational

i.e.    \$2.00 p.t.    x    250,000  
           \$1.00 p.t.    x    500,000 t.p.a.  
           \$0.50 p.t.    x    1,000,000 t.p.a.

Detailed quarry planning should be carried out as part of the E.I.S. submission. A number of factors were noted including :

- massive reserves
- minimal overburden
- topography ideal for quarrying
- adequate site drainage
- extensive flat areas available for plant and stockpiles adjacent to quarry area.

Note that the preferred quarry orientation is approx. north - south for reasons relating to :

- orientation of observed jointing
- ready haul and access
- non visibility of quarry and haul roads from local road systems
- prevailing winds.

## 8. PRODUCTION - PLANT OPTIONS & OPERATIONAL COSTS

In selecting crushing and screening plant consideration needs to be given to :

- production requirement, short and long term
- production balance relative to market demand
- plant design / ability to produce quality product
- preferred hours of operation
- preferred plant capacity, short and long term
- mobile or fixed plant
- capital cost
- operational cost, particularly in relation to power requirements, manning, maintenance, consumables
- environmental factors
- accessibility for maintenance, housekeeping etc

In the absence of any guaranteed long term sale contracts, my recommended would be to initially employ suitable, mobile crushing and screening plant with an hourly production capacity of say 200 - 250 tonnes per hour dependent on production balance, thus production could be calculated as follows :

$$\begin{array}{l}
 \text{Say, } 225 \text{ t.p.h.} \times 8 \text{ hrs} \times 83\% \times 230 \text{ days} = 345,000 \text{ t.p.a.} \\
 \text{OR} \\
 225 \text{ t.p.h.} \times 10 \text{ hrs} \times 83\% \times 230 \text{ days} = 430,000 \text{ t.p.a.} \\
 \text{OR} \\
 225 \text{ t.p.h.} \times 12 \text{ hrs} \times 83\% \times 230 \text{ days} = 575,000 \text{ t.p.a.}
 \end{array}$$

Note that the 83% factor is applied as an industry norm and allows for plant downtime and less than 100% utilisation in terms of maintaining maximum throughput.

The installation of permanent crushing and screening plant should only be considered once a predetermined level of sales has been consolidated and quarry planning is able to determine a suitable long term site. Advantages of fixed over mobile plant are generally perceived to relate to long term plant stability and layout (less congested and more accessible for maintenance, housekeeping etc), materials handling (e.g. overhead bins or stockpile take-off conveyors rather than front end loaders) and environmental issues (e.g. cladding, dust suppression/extraction, noise abatement and so on).

The options on mobile plant are purchase or lease (new or second hand), hire, or a combination of both. Unless significant sales contracts are able to be signed during the feasibility stage of the project it is assumed that the hire of mobile plant would be the preferred first option as it minimises investment risk. Apart from the hiring of excavators, bulldozers, graders etc for earthworks described within Section 7 above, equipment/personnel to be hired/subcontracted, include as follows:

- drill and operator
- shotfiring contractor
- face loader and operator
- dump truck/s and driver/s
- primary, secondary and tertiary crushing/screening plant modules
- sales loader

The attached APPENDIX A provides an itemised estimate of operational costs for the production of 250,000 - 500,000 tonnes per annum using hired/subcontracted plant and equipment. In summary :

#### For 250,000 t.p.a.

- \* Rock to be quarried = 280,000 t.p.a. (at 10% waste).
- \* All plant and equipment to be hired including a temporary office and amenities.
- \* All mobile equipment (drill, loaders, dump truck/s) to be "wet hired", that is with hire cost including the operator, fuel, and other operating expenses (R & M consumables etc).
- \* The mobile crushing and screening modules to be "dry hired" with Tasmanian Aggregates providing; operators/fitters, power/fuel, consumables (manganese, screens etc) and so on.
- \* Full time company staff (excluding general management and marketing/sales staff) to total 5 persons in the first instance those being a quarry manager, foreman, accountant and two weighbridge clerks.
- \* The calculation of operational costs is detailed within APPENDIX A but totals \$2.1 million representing a unit operational cost of **\$8.40 per tonne**.
- \* It is stressed that calculations are of a preliminary nature only but conclusions are in line with experience elsewhere.

**FOR 500,000 t.p.a**

- \* costs detailed for the 250,000 t.p.a. model are essentially variable with only the 5 salaries remaining constant.
- \* Assuming hire costs to remain at the same rate with overall unit cost reduces to **\$7.80 per tonne.**
- \* Improved hire rates should be available in the case of permanent hire which would be required from the plant detailed to produce 500,000 t.p.a.
- \* Negotiation of better rates should lead to a reduction in the unit cost of production to something in the order of **\$6.50 - \$7.00 per tonnes**
- \* The cost of hiring equipment such as the loaders and dump truck becomes high enough to consider a combination of hire (of, say, crushing and screening plant) and purchase (of, say, loaders and dump trucks).

As the option of equipment purchase becomes increasingly viable a number of options are available, including :

**Purchase of second hand mobile plant**  
(including crushing and screening modules).

An indication of price would be as follows :

		\$
* Drill	150 -	250
* Face Loader (Cat 988 B or equivalent)	250 -	400,000
* Dump Truck (Cat 769 B/C or equivalent)	100 -	200,000
* Cr. & Screening Plant (El Jay/Cedar Rapids)	1,500 -	2,000,000
* 600 Kva Generator set (switch board)	120 -	150
* Sales Loader (Cat 966 D/E or equivalent)	125 -	200,000
* Indicative Total	2,225 -	3,200,000

**Say, \$2.7 million + or - 20%**

Note that figures provided are indicative only. Prices are principally determined by supply and demand at time of purchase. Quoted figures are generally "off the top of my head" with only brief reference to current second hand markets. Prices relate to quality second hand machines capable of doing the job.

**Purchase of New Mobile Plant**  
(including mobile crushing and screening plant)

An indication of prices would be as follows :

	\$
* Drill	400,000
* Face Loader (Cat 988 B or equivalent)	500,000
* Dump Truck (Cat 769 or equivalent)	450,000
* Cr. & Screening Plant (based on Nordberg Lokotrack "in pit" primary and El jay secondary & tertiary)	2,800,000
* 600 Kva Generator set (switch board)	200,000
* Sales Loader (Cat 966 D/E or equivalent)	<u>250,000</u>
* Indicative Total	4,650,000
PLUS	
* Office / Weighbridge	80,000
* Workshop / Tools etc (60' x 40')	60,000
* Amenities block	<u>35,000</u>
	<u>175,000</u>
 TOTAL COST	 4,825,000

Say, \$4.75 million + or - 10%

#### Purchase of New Mobile & Fixed Crushing & Screening Plant

I believe that this option becomes viable for a larger plant, say 500 t.p.h. and up once market is consolidated. A 500 t.p.h. plant involves different/additional capacity plant (both mobile and fixed) and would be estimated to cost in the vicinity of \$7 - 10 m.

Note that the unit cost of production (excluding finance and depreciation) would be expected to reduce with each of the above plant options. Reductions in the unit cost of production principally relate to ;

- processing through more cost efficient, state-of-the-art plant.
- increased volume as fixed costs are apportioned over a larger tonnage, although careful budgeting will reveal anomalies relating to overtime payments in particular.

#### 9. LANDED COST OF MATERIAL ON THE MAINLAND

As I understand the project this will be the key issue, that is, the cost to the consumer ex wharf in Sydney, Melbourne etc. With quarry costs able to be reduced and controlled as a function of capital expenditure and management, critical cost factors will be across the wharves (at both ends) and sea freight rates.

Based on the data and assumptions presented within this pre-feasibility report, the following "landed costs of aggregate" have been estimated.

For 250,000 t.p.a. production :

	Estimated cost per tonne	
Cost of site development (1 year only)	2.00	
Cost of production	8.40	
Transport to Wharf	3.80	
Shiploading	3.50	
Sea Freight	23.00	<i>Could be \$9</i>
Unloading / handling	4.00	
	44.70	<i>30.70</i>
OR Excluding site development after year 1	42.70	<i>28.70</i>

*for  
250,000t  
p.a.*

Note that the calculation is for crushed and screened aggregates, excluding any consideration of armour and other oversize product.

Note also that the figure is reduced to \$42.70 once year one site development costs are written off.

- X All costs are obviously critical with shipping and production costs paramount. The figures presented allow for interest payments and an acceptable return on funds on the only expenditure (viz. the 2 km conveyor to the Bell Bay/APPM Wharf). In the first instance Aust. Aggregates has the option of using road transport to wharf although tipping to stockpiles (50,000 tonnes) presents a problem. More detailed analysis may show that a saving of up to \$2.00 per tonne is feasible. As mentioned the cost of unloading is purely hypothetical with no off-loading facility yet identified/costed.

X Assuming that a landed cost of \$40 per tonne, or less, is attainable, the exercise may prove feasible in Sydney, at least where the Tasmanian dolerite would be competing with hardrock from the South and Central Coasts (and potentially ex Mts Flora/Misery in the Southern Highlands) with a transport component of up to \$20 per tonne into central Sydney for a delivered price of up to \$45 / tonne. X

It should be noted that the delivered prices ex Pioneer, C.S.R. and Boral reduce by approximately \$1.50 - 2.00 per tonne for every 10 kms from the C.B.D. (dependent on the location of the source quarry) and that existing prices contain a very considerable margin (estimated in the order of 50% of ex bin sales price). *|||| NB*

In contrast, the delivered price of the Tasmanian dolerite increases \$1.50 - 2.00 per 10 kms away from the port of off-loading, and contains no margin whatsoever, as calculated in this report. My "guesstimate" would be that Aust. aggregates have to find a way to deliver aggregates into Sydney at a landed cost of not more than \$30 per tonne to attain any significant market share. Whilst generating sufficient margin to meet internal return on fund criteria. *||| NB*

For 500,000 t.p.a. production

	Estimated Cost per tonne	
Site development (year 1 only)	2.00	
Cost of production, say	7.00	
Transport to wharf	2.14	
Shiploading	2.75	
Sea Freight	20.00	9
Unloading / handling	3.00	
	36.89	25.89
OR Excluding site development after year 1	34.89	23.89

Note that decreased shipping rates and off-loading charges assume that extra volume is via a common carrier / port, and this seems unlikely as market growth will most likely be attained through expanded geographic distribution rather than significantly increased market share within 1 city, viz. Sydney. *for Sydney t*  
*X*

## 10. CONCLUSIONS / RECOMMENDATIONS

The Resource appears excellent both in terms of quality and quantity. Not much attention has been paid within this report to the premiums which may be attached to the marketing of a superior quality aggregate on the Australian mainland and elsewhere. Likewise little attention has been paid to the potential economics of marketing armour and other specialist rock product. As stressed this document should be treated as a pre-feasibility and has been prepared principally to determine the emphasis that should be taken within any full feasibility study. Emphasis within this document has been placed on ascertaining the cost of landing the Bell Bay dolerite on the mainland. Calculations could be considered to be of the order of plus or minus 20% accurate on the basis of information provided.

In relation to the landed cost of aggregate on the mainland, the critical factors are the cost across the wharves and sea freight. Whilst production costs may be halved (to \$3.50 - 4.20 per tonne) such an achievement will require significant capital investment (and associated finance charges) and any reduction will still remain insignificant to a proportional percentage cost cut in sea freight and/or wharf handling charges. XX

Finally, and assuming that a way can be found to land aggregates on the mainland at a cost of around \$30 per tonne, market research is critical to determining project feasibility. The project would be ideal for a new entrant to the vertically integrated cement-quarry-concrete-asphalt industries. X X X X

Yours faithfully,

*Don Reed*

Don Reed

*P.P.*

*P.T.O*  
More Costing

14th November, 1990

## APPENDIX A

## OPERATION COSTS - TOTAL HIRE OPTION

For 250,000 produced  
= 280,000 quarried @ 10% waste/scalped

Costs estimated as

## 1. DRILLING

280,000 tonnes/	2.8	=	100,000 cu.m
@ say 3m x 3m x 15m pattern			
@ 30 holes per shot i.e. (3 rows x 10 holes)			
		=	3,645 cu m/shot
	x 2.8	=	10,200 tonnes
	say	=	10,000 tonnes/shot
Thus to produce			10,000 tonnes shot rock
drilling requirements		=	36 holes x 15m
		=	450m + stemming
	Say	=	490m
Therefore 10,000 tonnes shot rock			
490m drilled		=	20 tonnes/m. drilled
Therefore <u>280,000 t.p.a.</u>		=	14,000m to be drilled p.a.
	20		
@ say 20m drilled/hr including drill location			
		=	700 hours
	OR		
@ say 15m drilled/hr			
		=	933 hours
Say		=	820 hours
@ \$120 per hour "wet hire"		=	\$ 98,400 p.a.

## 2. BLASTING

Powder factor say 0.15 kgs/tonne			
Therefore 280,000 tonnes x 0.15			
		=	42,000 kg
		=	42 tonnes
@ \$600 / the Anfo		=	\$ 25,200
+ 33% for high explosives & initiation		=	\$ 33,500

2

Plus labour calculated at  
250,000 t.p.a. total

10,000 tonnes / shots = 28 shots  
 at say 6 hours x shotfirer & assistant / shot

Therefore 6 hrs (\$50/hr shotfirer + \$25/hr labourer)28 shots  
 = \$ 12,600 p.a.

plus blast monitoring (ground vibration, airblast o/pressure)  
 say \$1,000 x 7 shots (every 4th shot?)  
 = \$ 7,000

Total blasting cost = \$ 53,100  
 Say = \$ 55,000 p.a.

### 3. FACE LOADING

To load 280,000 t.p.a.  
 To produce 250,000 t.p.a.

Crushing hours at 225 t.p.h. other scalping

=  $\frac{250,000 \text{ tonnes p.a.}}{225 \text{ tonnes per 60 min hr}}$   
 OR  
 =  $\frac{250,000 \text{ t.p.a.}}{186 \text{ t.p.h. (50 min hr = 83%)}}$   
 = 1,345 crushing hours

Assume face loader hours = crusher hours  
 i.e. load dump trucks PLUS  
 feed plant from stock after dump trucks PLUS  
 clean up quarry PLUS  
 dump out scalps PLUS  
 stockpile as necessary PLUS  
 road maintenance etc

Assume a 980 or 988 or equivalent

= 1,345 hrs x \$170/hr wet hire  
 for long term contract  
 1345 x \$170 = \$228,650 per annum

#### 4. INTERNAL CARTAGE - DUMP TRUCKS

Two options are available i.e.

- 1) With mobile primary plant we can locate such plant up to say 50 m to the of the face (to avoid blasted fly rock) and feed with the F.E.L. at approx. 205 t.p.h. (i.e. 225 t.p.h. + 10% scalps x 83%)

thus for a Cat 988 @ 9,600 kgs per bucket load

$$\begin{aligned} \frac{205}{9.6} &= 21.4 \text{ cycles / 50 min hr} \\ &= 1 \text{ cycles / 2.4 min.} \end{aligned}$$

Whilst the work load is achievable it allows little time for other loader tasks such as maintaining a quarry floor, sorting the muck pile, loading out and so on.

- 2) A single, say, 35 tonne dump truck can be utilised on short haul to cart up to 7 cycles/hr.

Allow for the wet hire of 1 x 35 t dump truck to be used to feed the plant or dump out onto stockpiles (raw material and/or finished product) as required.

Thus wet hire of 1 x 35 t. dump truck @ \$120/hr

$$\text{i.e. } 1,345 \text{ hrs} \times \$120 = \$161,400$$

#### 5. CRUSHING AND SCREENING PLANT

The job requires primary, secondary and tertiary modules. Current hire rates would be in the order of \$6,500-7,000 per day for the 3 units, say \$5,500 per day or long term contract. Note that crushing and screening plant performance and configuration is critical and that the subcontractor would probably need to specifically purchase 1 or more of the 3 modules.

Assume a year round crushing day of an average 12 hours.

Therefore, 250,000 tonnes (after scalping)  
225 t.p.h. x 0.83 x 12 hours

$$\begin{aligned} &= 112 \text{ crushing days} \\ \text{at } \$5,500/\text{day} &= \$616,000 \\ \text{say} &= \$650,000 \text{ p.a.} \end{aligned}$$

Cost of power

Say, hire Of 600 Kva Generator Set @ \$1,000/day

$$\text{i.e. } \$1,000 \times 112 = \$112,000$$

PLUS

Cost of generator fuel

$$\begin{aligned} \text{Calculated at } 55 \text{ l/hr} \times 12 \text{ hrs} \times 112 \text{ days} \times 83\% \times \$0.775 \\ = \$48,000 \end{aligned}$$

PLUS

Cost of manganese, screen decks, etc

Calculated at 6% of capital cost p.a.

$$\begin{aligned} &= \$3,000,000 \times 0.06 \times 112/250 \text{ days} \\ &= \$56,000 \end{aligned}$$

PLUS

Cost of insurance against damage

$$\text{say } = \$2,000 \text{ p.a.}$$

$$\text{Total Crushing \& Screening Cost} = \$868,000$$

## 6. PLANT OPERATORS / FITTER

Plant operator on say \$20 per hr casual rate

$$\text{i.e. } \$20 \times 12 \text{ hrs} \times 112 \text{ days} = \$26,900 \text{ p.a.}$$

Note that this equates to a man on \$12 per hr plus overtime and on costs but this is not a full time job at 250,000 t.p.a.

Fitter/operator on say \$25 per hr casual rate

$$\text{i.e. } \$25 \times 12 \text{ hrs} \times 112 \text{ days} = \$33,600 \text{ p.a.}$$

Note that the fitter's hours would be flexible to include after hours maintenance.

$$\text{Total Cost} = \$60,500$$

## 7. SALES LOADER

Calculated at 112 days x 8 hrs x \$110/hr (966)

$$= \$98,560$$

## 8. ADMINISTRATION

Staff of 3 on flexible hours

i.e. Accountant (full time on say \$40,000 + car)

2 x Weighbridge/shipping clerks

(staggered shifts and full time on say \$25,000 + 33% on costs)

i.e.  $(\$40,000 \times 1.2 + 10,000) + (25,000 \times 2 \times 1.33)$

= \$124,500

Admin costs including advertising, bank costs, cleaning, consultants fees, bad debt provision, couriers, postage, printing and stationery, protective clothing, telephone, facsimiles, computers, photocopiers, etc estimated from similar operations

= \$ 60,000

Total Administration = \$184,500

## 9. FOREMAN / MANAGER SALARIES (Full Time)

Foreman is say,  $\$40,000 \times 1.2 + \text{M.V.}$

= \$ 60,000 X

manager is say,  $\$60,000 \times 1.2 + \text{M.V.} + \text{Bonus (unqualified here)}$

= \$ 84,000 X

Total Management Salaries = \$144,000

## 10. MISCELLANEOUS

including ; stripping, additional plant hire (grader, water cart) tools, laboratory equipment, casual labour hire, temporary office hire, etc.

estimated at 10% of above

i.e. Total of items 1) - 9) =

Drilling	\$ 98,400
Blasting	\$ 55,000
Face Loading	\$ 228,650
Cartage	\$ 161,400
Cr. & Scr.	\$ 868,000
Pl. Oper./Fitter	\$ 60,500
Sales Loading	\$ 98,560
Admin.	\$ 184,500
Foreman/Manager	\$ 144,000
Sub Total	\$1,899,010
+ 10%	\$2,088,910

6

Say,	\$2,100,000	
/250,000 t.p.a.	=	\$8.40 / tonne

**FOR 500,000 t.p.a.**

With the exception of salaries (5 men) all above calculated costs are essentially variable, thus for 500,00 t.p.a.

Drilling	\$ 196,800	
Blasting	\$ 110,000	
Face Loading	\$ 457,300	
Cartage	\$ 322,800	
Cr. & Scr.	\$1,736,000	
Pl. Oper./Fitter	\$ 121,000	
Sales Loading	\$ 197,120	
Admin.	\$ 244,500	
Foreman/Manager	\$ 144,000	
Sub Total	\$3,529,520	
+ 10%	\$3,882,472	
Say,	\$3,900,000	
/ 500,000 t.p.a.	=	\$7.80

At 500,000 t.p.a. hire would effectively be full time and hourly rates should come down 10 - 15% or more. As a result the unit rate could come down to \$6.50 - \$7.00 per tonne. On the other hand good second hand machines would be purchaseable in some areas (viz. sales loading in particular).