

Q 6 No 21

KING ISLAND PROJECT

T. R. Clarke

April, 1966

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RESEARCH CENTER

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President and Directors,
Mount Costigan Mines Limited,
30 The Driveway,
Ottawa 4, Ontario.

MICROFILMED

Gentlemen:

Herewith is my engineering assessment of your King Island Project to date March 15, 1966.

GENERAL

The figures quoted herein for financial requirements and operating costs are, at this stage, a "questimate" based on:

- (1) The borehole results received from the exploration drilling on the property along with the results of the previous work carried out by the Department of Mines.
- (2) The conclusions reached by Mr. J.E.F. Marshall, A.C.S.M., Mount Costigan Mines Consulting Metallurgist based on preliminary metallurgical studies on the available sands.
- (3) The costing of a preliminary flowsheet supplied by Mr. Marshall.
- (4) Investigation of sales contracts.
- (5) A study of available literature pertaining to the recovery of economic minerals from Australian beach sands.

The writer has not visited the site but has had at his disposal very adequate maps and photographs on which to base this preliminary engineering assessment.

PROPERTY

Mount Costigan Mines holds by options or directly, the licenses or permits on approximately 12,813 acres lying between the Sea Elephant River and the Fraser River and including the valley of the Fraser River some five miles inland and the off shore rights to a distance of 660 feet between the mouth of the Fraser River and Cowper Point.

Detailed exploration has been carried out on approximately sixty acres located between the Fraser River and the Sea Beach and extending from the mouth of the Fraser River to a point some 3500 feet north. This is in the vicinity of the townsite of Naracoopa.

This study deals with the development of the explored area only.

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ACCESS

The principal settlement on King Island is the Town of Currie located on the west coast of the island. Currie has adequate air service connecting with Melbourne, Australia, 155 miles to the north and Wynyard, Tasmania, 123 miles to the southeast. The settlement of Naracoopa, where the property is located, lies some 16 miles due east of Currie and is connected with it by a good road. Neither Currie nor Naracoopa have, at present, adequate harbour facilities for even medium tonnage vessels.

GEOLOGY (Naracoopa Area)

Folded mudstones and sandstones, possibly PreCambrian era, are visible in the bed of the Fraser River. These are overlain to the south of the river by Cambrian lavas which in turn are visible as bold cliffs extending many miles south from Naracoopa.

North of the Fraser River the bedrock is concealed by a sequence of dunes and beach sands paralleling the shore. These dunes probably range in age from early Pleistocene to Recent.

The oldest dunes are moderately consolidated quartz aeolianite and cover practically all the land area within a mile or two of the shoreline.

The second stage of dunes extends to one and a half miles inland from Sea Elephant Bay. They are slightly lower in elevation than stage one dunes.

Stage one and stage two dunes were truncated by stage three or the Lanherne dunes. The Lanherne dunes appear as a series of parallel ridges some six miles to the south. They rise twenty to thirty feet above sea level. It was the erosion of the Lanherne dunes that formed the narrow strip of unconsolidated beach sands. These beach sands were later uplifted. A number of ridges on the beach testify to several phases of beach development. They now form a distinctive raised beach in the Fraser River area (Milford Beach) that is some five feet above H.W.M. and 150 to 200 feet wide. This beach has produced the only tin mined to date in the area around the mouth of the Fraser River.

The present cycle is one of erosion of the Milford Beach during the northeasterly storms. This storm action brought about, in its earliest stages, a fourth set of dunes in the vicinity of Cowper Point. Now in turn these dunes are being eroded.

The present-day beach sands contain heavy minerals derived from the Milford Beach. Near the Fraser River the present beach sand is nearly black.

NATURE ORIGIN AND METALLIC MINERALS OF THE SANDS

There appears to be little definite information on the origin of the original sands. The Fraser River heavy minerals are presumed to be derived from the Fraser River catchment, an area of some twenty-five square miles. Gabbro outcrops in the southern part and could be the source of the ilmenite. Granite is said to have been reported in the western section of the basin.

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INDICATED RESERVES

To date, March 15, some 349 auger holes totalling approximately 5100 feet of drilling have been completed during the present exploration program. In addition, 24 holes totalling approximately 250 feet of drilling were completed under the direction of the Tasmanian Department of Mines.

The following chart shows the indicated tonnages and grades of the available sands calculated from the drill results. The average grades and tonnages were calculated by Mr. Sadlier-Brown, Mount Costigan Mines geologist and checked by Mr. G. C. Campbell of T. R. Clarke and Associates.

| BEACH | Drilled length | Average depth | Estimated tons | Rutile | Percent Zircon | Tin |
|-----------------|----------------|---------------|----------------|--------|----------------|------|
| Sea | 3600 | 8.5 | 119.226 | 4.1 | 4.5 | - |
| Milford | 3600 | 11.7 | 204,000 | 8.0 | 8.4 | - |
| " | 1050 | 11.3 | 87.320 | 8.0 | 8.4 | 0.01 |
| *Previous | 2250 | 9.5 | 91.850 | 13.9 | 12.5 | 0.05 |
| Sea and Milford | | | 493.396 | 8.2 | 8.2 | 0.02 |
| Lanherne | 2500 | 22.1 | 1.818.751 | 2.0 | 1.8 | - |
| Total | | | 2.312.147 | 3.3 | 3.2 | - |

* This previous drilling was carried out by the Department of Mines, Tasmania along the western edge of the Milford Beach against the Lanherne Beach and to the immediate west of the present drilling program.

All beaches are still open on the Northward extension. To date only about 60 acres of the company holdings of some 12,000 acres have been explored by systematic drilling. Reconnaissance exploration has been carried out on much of the remaining ground with encouraging results. Statistically it is interesting to note that the development program to date indicates a tonnage potential of approximately 40,000 tons of sands to the acre. It must also be noted that the remaining acreage to be explored will be largely of the Lanherne Beach type of deposit.

An estimate of the tin values are carried for part of the Milford Beach area. The tin occurs in pockets along the beach and does not have the same even distribution of the rutile and zircon minerals. The better grade material generally lies along the west of the Milford Beach within 1000 feet of the Fraser River.

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STATE OF THE PROJECT

Exploration drilling has been carried out on some sixty acres of the Company holdings and reconnaissance prospecting on a good part of the remaining ground. The results of this program indicate:

- (a) Sufficient tonnage and grade to warrant production planning.
- (b) Adequate grade and sufficient eventual potential to come within the economic range of other Australian operations.

Mr. J. E. F. Marshall has carried out preliminary metallurgical studies and

- (a) States that the economic minerals contained in the sands i.e., rutile, zircon and tin, are recoverable.
- (b) States that, with minor variations, the sands are amenable to standard beach sand milling practices and good recoveries may be expected.
- (c) Has provided a preliminary flowsheet on which to base an estimate of financial requirements and operating costs.

Investigations into sales markets have been carried out. These investigations indicate:

- (a) A good market for the products.
- (b) An indicated value of the products F.O.B. a plant on King Island.

It must be understood that the investigations to date, except for the exploration program, are of a preliminary nature and additional studies will be required before firm and final figures can be presented.

PRODUCTION PLANS

GENERAL

It is proposed to construct a dry milling plant capable of processing 84,000 tons of heavy mineral concentrate per year.

To supply the dry mill feed a mining and wet heavy mineral concentrating plant having a single shift capacity of 200,000 tons a year will be required. During the early years of the operation this plant will be used to mine the high grade sands of the Milford and Sea Beaches on a single shift basis. If field exploration fails to turn up additional high grade beaches then the plant will be operated on a two or three shift basis on the lower grade beaches in order to supply the necessary tonnage of heavy mineral concentrate to the dry mill.

Should it become necessary to operate on grades similar to the Lanherne Beach then additional mining and wet milling equipment must be added in order to

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supply sufficient feed to the dry plant.

It is again pointed out that exploration and drilling will be continued on the Milford, Sea and Lanherne Beaches. There is every reason to expect greatly increased tonnages both on the low grade Lanherne Beach and higher grade Milford and Sea Beaches.

However this assessment is based on the known reserve and for the purpose of the study cannot assume additional potential.

MINING

The Milford and Sea Beaches are wet, i.e., the water table is a matter of inches below the present surface. The present plan calls for mining the sands with an Acrow Jetlift Dredger, Series Eight, which is capable of delivering seventy-two tons of material per hour up to a distance of 1000 feet. The sands will be delivered to a wet milling plant to be located on top of the Lanherne Beach. Tailing disposal will be by gravity back to the dredge pond. Fresh water supply is available on the upper Fraser River.

MILLING

On the basis of his preliminary metallurgical tests, Mr. J.E.F. Marshall, A.C.S.M., Mineral Processing Consultant of Truro, Cornwall, England, has outlined a basic flowsheet for the recovery of the rutile and zircon mineral. Mr. Marshall calls for a wet milling circuit consisting of an attrition mill to wash and polish the sands followed by Humphrey Spirals. The Humphrey Spiral or Heavy Mineral concentrate will then be dried and treated in high tension and high intensity separators and pneumatic tables to separate rutile, zircon and tin concentrates. This proposed flowsheet follows normal milling practices for beach sands. Mr. Marshall advises that from the results of his preliminary tests he foresees no difficulties in following normal practice.

Mr. Marshall, other than to state that there is every reason to expect good recoveries, has not established as yet firm recovery figures. For the purpose of this study we are using a figure of 90% recovery of rutile and zircon and 70% recovery of tin.

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FINANCIAL REQUIREMENTSCAPITAL COSTS

| | <u>Buildings</u> | <u>Equipment</u> | <u>Total</u> |
|---|------------------|------------------|------------------------|
| Service Bldgs., Accommodations Vehicles, Tractors, Loaders | \$ 35,000 | \$ 55,000 | \$ 90,000 |
| <u>Mining Plant</u> | | | |
| Dredger, Pumps, Pipelines | 1,000 | 75,000 | 76,000 |
| <u>Wet Mill</u> | | | |
| Washers and Spiral Circuits | 7,500 | 122,500 | 130,000 |
| <u>Dry Mill</u> | | | |
| Separators, tables, bagging, handling, tailings | 15,000 | 210,000 | 225,000 |
| Power, Water Supply, Fire Protection, Distribution | 2,500 | 87,500 | ⁹ 90,000 |
| | \$ 61,000 | \$ 550,000 | \$ 611,000 |
| Contingency 10% | <u>66,100</u> | <u>55,000</u> | <u>61,100</u> |
| | \$ 67,100 | \$ 605,000 | \$ 672,100 |
| Engineering and Design Fees and Travel | | | 65,000 |
| Preproduction O/H and Expense | | | 75,000 |
| TOTAL CAPITAL COST | | | \$ 812,100 |
| Inventories | | | 25,000 |
| Working Capital | | | <u>75,000</u> |
| TOTAL FINANCIAL REQUIREMENT | | | <u>\$ 912,100</u> |

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OPERATING COSTS 200,000 tons a year

| | Number Persons | Cost per ton | | Total |
|-------------------|-------------------|--------------|--------------|--------------|
| | | Payroll | Supplies | |
| Admin. O/H | 4 | \$0.152 | \$0.110 | \$0.262 |
| Shops & Services | 7 | 0.246 | 0.135 | 0.381 |
| Dredges & Milling | 29 | 0.996 | 0.385 | 0.381 |
| Power | | | 0.165 | 0.165 |
| Development | | | 0.020 | 0.020 |
| Totals | 40 | 1.394 | 0.815 | 2.209 |

Cost per ton sands \$2.20

OPERATING COSTS 400,000 tons a year

Plant O/M

| | | | | |
|--------------------|-----------|--------------|--------------|--------------|
| Admin. | 4 | \$0.076 | \$0.059 | \$0.135 |
| Shops & Services | 8 | 0.139 | 0.075 | 0.214 |
| Dredging & Milling | 31 | 0.568 | 0.225 | 0.793 |
| Power | | | 0.139 | 0.139 |
| Development | | | 0.010 | 0.010 |
| Totals | 43 | 0.783 | 0.418 | 1.291 |

Cost per ton sands \$1.30

OPERATING COSTS 600,000 tons a year

Plant O/M

| | | | | |
|------------------|-----------|--------------|--------------|--------------|
| Admin. | 4 | 0.050 | 0.042 | 0.092 |
| Shops & Services | 9 | 0.103 | 0.055 | 0.158 |
| Dredge & Milling | 37 | 0.425 | 0.175 | 0.60 |
| Power | | | 0.128 | 0.128 |
| Totals | 50 | 0.578 | 0.340 | 0.988 |

Cost per ton sands \$0.99

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OPERATING COSTS - 1,200,000 tons a year

| | Number Persons | Cost per ton | | Total |
|-------------------|-------------------|--------------|----------|-------|
| | | Payroll | Supplies | |
| Plant O/M | | | | |
| Admin. | 6 | 0.036 | 0.024 | 0.060 |
| Shops & Services | 11 | 0.067 | 0.050 | 0.117 |
| Dredges & Milling | 46 | 0.267 | 0.135 | 0.372 |
| Power | | | 0.121 | 0.121 |
| Development | | | 0.010 | 0.010 |
| Totals | 63 | 0.370 | 0.340 | 0.710 |

Cost per ton sands \$0.710

METAL VALUE F.O.B. PLANT

Preliminary investigation of markets for rutile and zircon indicates a sale price of \$60.00 a ton for rutile and \$25.00 a ton for zircon F.O.B. the plant at King Island. The sale value for tin is placed at \$1.50 a pound at the plant.

RECOVERY VALUESSEA and MILFORD BEACHES

Available: 493.396 tons

Rutile 8.2%
Zircon 8.2%
Tin 0.02%

Rutile

Head 8.2% or 164 lbs. to the ton
Recovery 90% 147.6 lbs.

Value per lb. F.O.B. plant \$0.03

Value per ton \$4.43

Zircon

Head 8.2% or 164 lbs. to the ton
Recovery 90% 147.6 lbs.

Value per lb. F.O.B. plant \$0.0125

Value per ton \$1.85

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Tin

Head 0.02% or .4 lbs. to the ton
Recovery 70% .28 lbs.

Value per lb. F.O.B. plant \$1.50

Value per ton 0.42

Value per ton F.O.B. plant Sea & Milford Beach Sands

| | |
|--------|--------|
| Rutile | \$4.43 |
| Zircon | 1.85 |
| Tin | 0.42 |
| | <hr/> |
| Total | \$6.70 |
| | <hr/> |

LANHERNE BEACH

Rutile

Head 2.0% or 40 lbs.
Recovery 90% or 36 lbs.

Value per lb. F.O.B. plant \$0.03

Value per ton F.O.B. plant \$1.08

Zircon

Head 1.8% or 36 lbs.
Recovery 90% or 32.4 lbs.

Value per lb. F.O.B. plant \$0.0125

Value per ton F.O.B. plant 0.405

Value per ton F.O.B. plant Lanherne Beach sands

| | |
|--------|---------|
| Rutile | \$1.08 |
| Zircon | .405 |
| | <hr/> |
| Total | \$1.485 |

Use \$1.49

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OPERATING PROFIT - BEFORE TAXES

It is assumed that the Sea and Milford Beaches will be mined and milled at a rate of 200,000 tons per year. On this basis the generating profit contained in the present indicated reserves in the Sea and Milford Beaches is as follows:

| | |
|------------------------------|---------------------|
| Contained Value F.O.B. plant | \$6.70 per ton |
| Operating Costs | <u>2.20 per ton</u> |
| Estimated Operating Profit | \$4.50 per ton |

Estimated Operating Profit per year \$900,000.00

Estimated Operating Profit in Present Reserves \$2,220,300.00

Operating time at 200,000 tons a year

$\frac{493,396 \text{ tons}}{200,000}$ is 2.467 years.

The Lanherne Beach will be mined at a much higher rate than the Milford and Sea Beaches, likely in the range of 1,500,000 to 2,000,000 tons a year. However, for the purpose of this study it is proposed to keep the operation within the maximum range of size of the plant costed in this report, i.e., 600,000 tons a year. On this basis the operating profit contained in the present indicated reserves in the Lanherne Beach is

| | |
|------------------------------|---------------------|
| Contained Value F.O.B. plant | \$1.49 per ton |
| Operating Costs | <u>0.99 per ton</u> |
| Estimated Operating Profit | 0.50 per ton |

Estimated Operating Profit per year \$300,000.00

Estimated Operating Profit on Known Reserves \$909,300.00

Operating time at 600,000 tons a year

$\frac{1,818,751 \text{ tons}}{600,000}$ is 3.031 years.

OPERATING TIME AFTER TAXES

| | |
|-----------------------------|--------------------|
| Estimated Time of Operation | 2.467 years |
| | <u>3.031 years</u> |
| | 5.498 years |

Capital and Preproduction Expenditure

| | |
|------------------|--------------|
| Estimated | \$850,000.00 |
| Annual Write off | 156,420.00 |

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DEPLETION ALLOWANCE

20% of Operating Profit

TAXES

0 - \$12,500. is 32.5% or \$4,062.50
 \$12,501.- \$25,000. is 37.5% or \$4,687.50
 \$25,000. up is 42.5%

FIRST YEAR

| | | | |
|------------------------|-------------------|-------------------|-------------------|
| Gross Operating Profit | | \$900,000. | \$900,000. |
| Less Capital W.O. | \$156,420. | | |
| Less Depletion W.O. | <u>\$180,000.</u> | <u>\$336,420.</u> | |
| Taxable Income | | \$564,580. | |
| Taxes | | | <u>\$238,071.</u> |
| Net Income First Year | | | \$661,929. |
| Net Income Second Year | | | \$661,929. |

THIRD YEAR

| | | | |
|------------------------|-------------------|-------------------|-------------------|
| Gross Operating Profit | | \$580,200. | \$580,200. |
| Less Capital W.O. | \$156,420. | | |
| Less Depletion | <u>\$116,040.</u> | <u>\$272,460.</u> | |
| Taxable Income | | \$307,740. | |
| Taxes | | | <u>\$124,664.</u> |
| Net Income Third Year | | | \$455,536. |

FOURTH YEAR

| | | | |
|------------------------|-------------------|------------------|----------------------|
| Gross Operating Profit | | \$300,000. | \$300,000 |
| Less Capital W.O. | \$156,420. | | |
| Less Depletion | <u>\$ 60,000.</u> | <u>\$216,420</u> | |
| Taxable Income | | \$ 83,580. | |
| Taxes | | | <u>\$ 34,148.</u> |
| Net Income Fourth Year | | | \$265,852. |
| Net Income Fifth Year | | | \$265,852. <i>MI</i> |

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RECAP. NET INCOME

| Year | Gross Income | Taxes | Net Income | Accumulative Net Income |
|--------|-----------------|----------------|-----------------|-------------------------|
| 1 | \$900,000. | \$238,071. | \$661,929. | \$661,929. |
| 2 | 900,000. | 238,071. | 661,929. | 1,323,858. |
| 3 | 580,200. | 124,664. | 455,536. | 1,779,394. |
| 4 | 300,000. | 34,148. | 265,852. | 2,045,246. |
| 5 | <u>300,000.</u> | <u>34,148.</u> | <u>265,852.</u> | <u>2,311,098.</u> |
| Totals | 2,980,200. | 669,102. | 2,311,098 | 2,311,098. |

Estimated Profit End of Five Years \$2,311,098

SUMMARY AND CONCLUSIONS

There is sufficient indicated reserve in the exploration program to date to warrant an initial operation based on a dry milling plant capable of handling 84,000 tons of heavy mineral concentrate per year. The estimated capital cost of such a plant is \$850,000.00. The net operating profit from this plant based on the indicated ore reserve is \$2,311,098.00 over a period of five years.

The explored portion of the property to date (60 acres) represents a small percentage of the available acreage (12,000 acres). Preliminary reconnaissance prospecting indicates a good potential in the remaining acreage.

The proposed dry mill plant will be capable of processing 84,000 tons of heavy mineral concentrate per year with an estimated gross production of minerals worth \$900,000. per year F.O.B. the plant on King Island.

The proposed mining and wet milling plant would have a maximum capacity of 600,000 tons per year. Should it be necessary to operate in much lower grade sands entirely (Lanherne Beach) then the cost of doubling or even tripling the capacity of the mining and wet milling plant in order to supply adequate feed to the dry plant is not high. It is a characteristic of mining and concentrating beach sands that operating costs normally drop drastically as the tonnage handled is increased.

In actual operation, and providing further exploration is successful, it is possible to foresee the gross production from the dry plant being maintained in the range of \$800,000. a year.

A limited market research indicates a good demand for the products both at the present and in the foreseeable future.

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PRESENT PLANS

1. Continue exploration drilling on Sea and Milford Beaches.
2. Produce sample concentrates for further sales market assessment.
3. Continue equipment investigation for mining and milling plant.

Respectfully submitted,



T. R. Clarke & Associates,
T. R. Clarke, P.Eng., B.Eng.

OTTAWA
April 8, 1966.

Handwritten initials

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CERTIFICATE

I, Thomas Roy Clarke, residing at 128 Heddington Avenue, Toronto, Ontario certify that

(1) I am a graduate of McGill University and hold a Degree of Bachelor of Engineering in Mining.

(2) I am a registered Professional Engineer in the Province of Ontario and have practiced my profession for over thirty years.

(3) I have not visited the King Island project but have based my assessment on the exploration data available on the project to date; on the literature and reports available on the Australian beach sands operations; and on my experience in the mine operating field.

(4) I have no interest directly or indirectly in the properties or securities of Mount Costigan Mines Limited nor expect to receive any interest directly or indirectly in the properties or securities of the company.



T. R. Clarke, B.Eng., P. Eng.

Ottawa, Ontario
April 18, 1966.

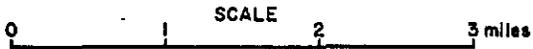
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MOUNT COSTIGAN MINES LIMITED

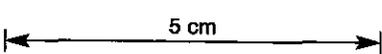
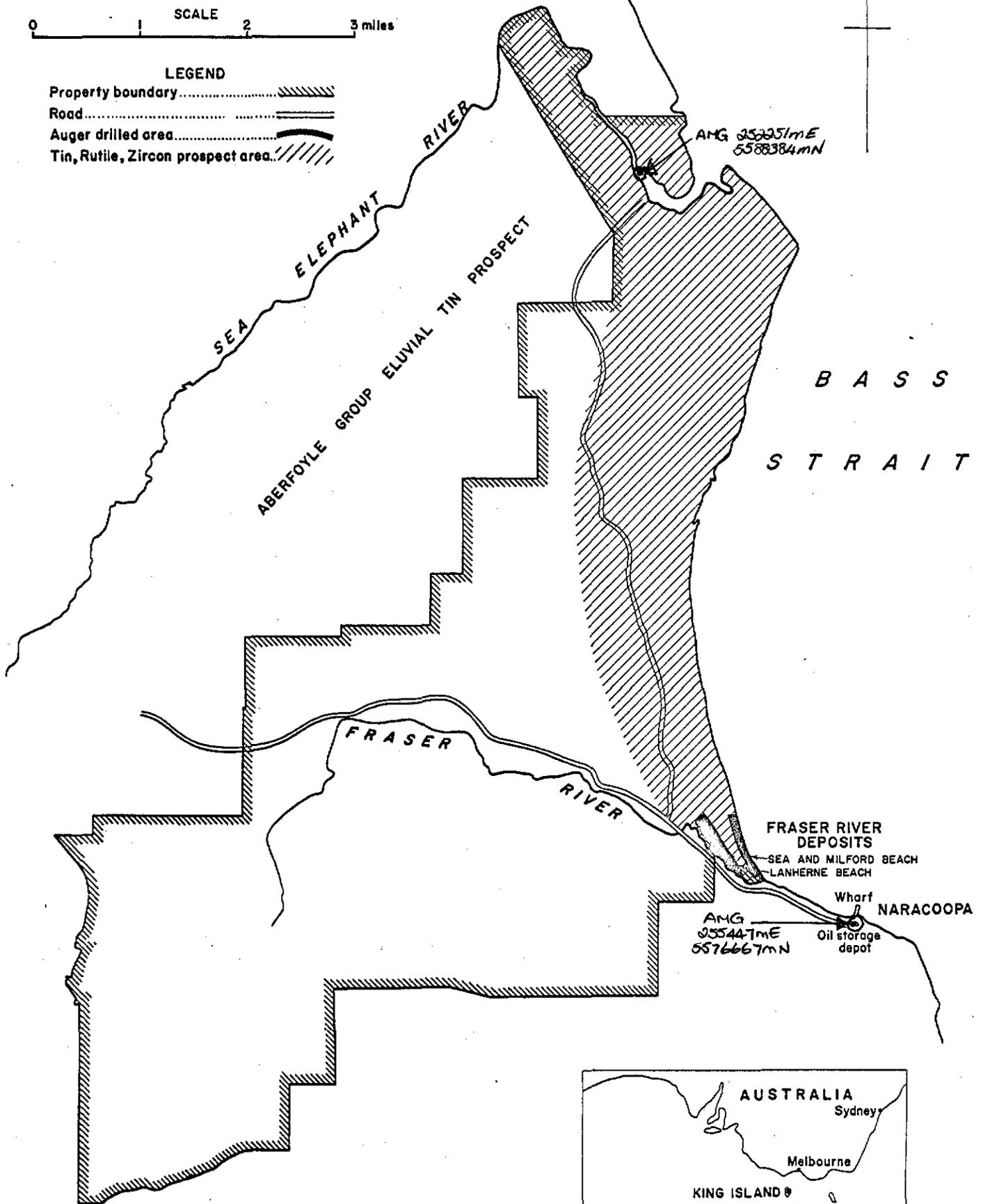
KING ISLAND - AUSTRALIA

TIN - RUTILE - ZIRCON

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- LEGEND**
- Property boundary.....
 - Road.....
 - Auger drilled area.....
 - Tin, Rutile, Zircon prospect area.....



AMG REFERENCE POINTS ADDED *nr 121*