Tasmania

Tasmanian Geological Survey Record 1998/05

Rock and gravel resources of King Island

by C. R. Calver

Summary

The known gravel resources on King Island are limited. Material for road works is currently sourced from two pits (Reekara and Pearshape) operated by the King Island Council, and from a mine overburden waste dump at Grassy. Concrete aggregate is sourced from beach shingle on the west coast.

The Reekara and Pearshape pits are known to have acid drainage problems. Mineral Resources Tasmania and the Department of Environment and Land Management have agreed that the Reekara pit should be closed immediately and rehabilitated, and that the Pearshape pit should be closed and rehabilitated within two years. Mining of the beach shingle, which is deleterious to the coastal environment, will also cease within two years. Thereafter concrete aggregate will need to be produced from hard rock.

Future supplies of road construction gravel may continue to be sourced from the Grassy dump, from a new site at Counsel Hill, and from one or two other small existing pits. For good quality road sealing material and concrete aggregate, it is recommended that sites in Precambrian amphibolite east of Pegarah, and in Tertiary basalt in the north of the island, be investigated.

INTRODUCTION

King Island's supplies of gravel for road construction and concrete aggregate have, for many years, been taken from beach shingle at widely scattered points along the west coast of the island, and from two inland gravel pits at Reekara in the north and Pearshape in the south of the island (fig. 4). A few other small pits have been in intermittent use. Material has also been taken from the mine waste dump on the coast at Grassy.

Shingle mining is regarded as environmentally unacceptable because of damage to beach and dune systems, and because it involves the removal of the natural barrier between the beach areas and pasture land. The resource is also becoming depleted (Bacon, 1987). Although extensively used in the past for road construction, this is the only material suitable for concrete aggregate currently available on the island. This resource was described in detail by Bacon (1987), from mapping and test-pitting by undertaken by V. M. Threader.

The Pearshape and Reekara pits, operated by the King Island Council for road construction, have acid drainage problems. Agreement between the Council, Environment Tasmania and MRT provides for a phasing out of shingle mining, and closure and rehabilitation of the Pearshape and Reekara pits in the near future.

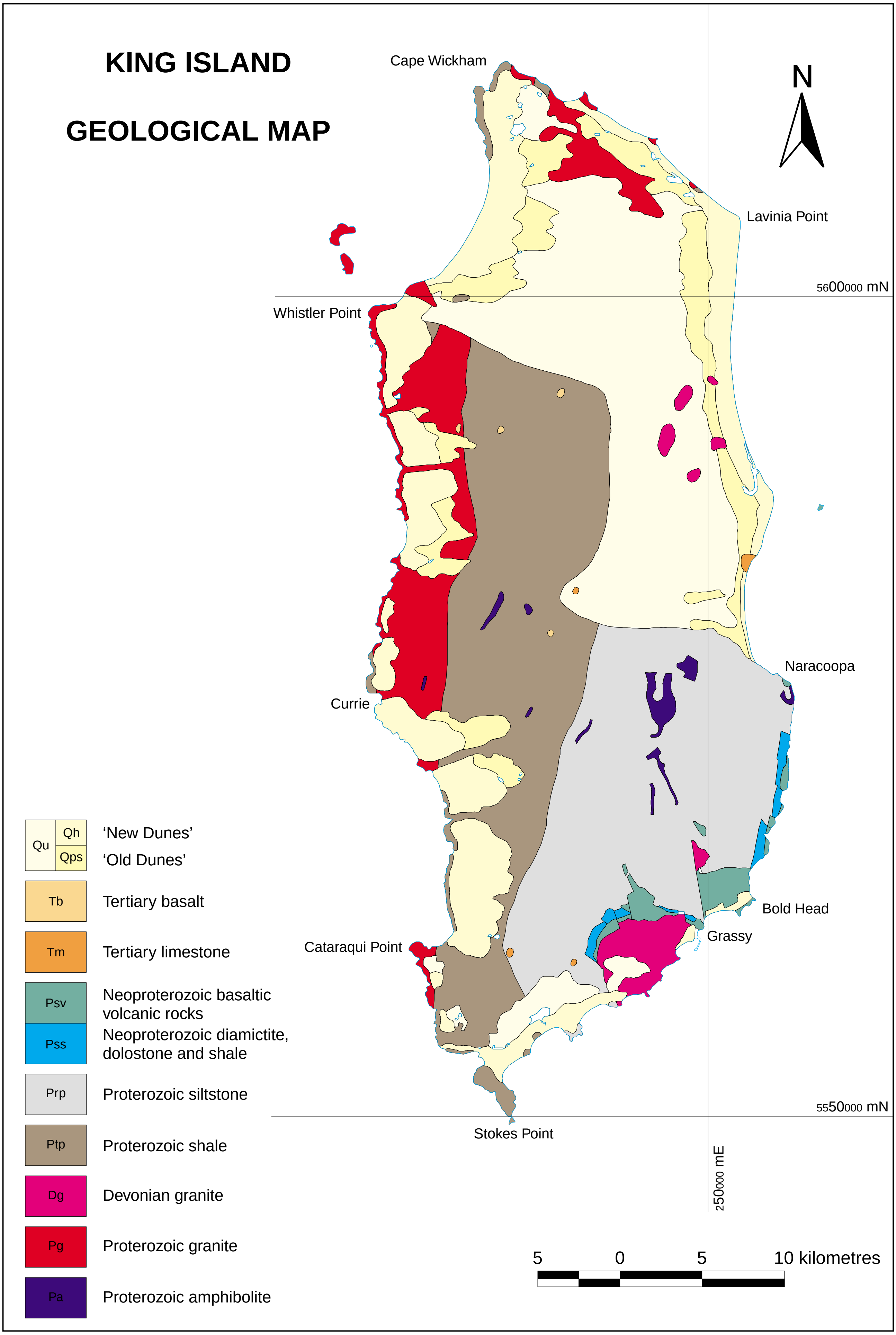
A substitute or substitutes for these pits needs to be capable of providing an annual total of around 40 000 tonnes of gravel and crushed stone for road construction. A new hard-rock source also needs to be located that is suitable for good quality road sealing material and concrete aggregate.

This report is a preliminary assessment of the existing and potential gravel and hard-rock resources of King Island. A brief description of the geology of the island is provided, followed by an inventory of the resources available on the current stone and gravel leases. Possible future sources are then discussed. Field work, to be undertaken in mid-June, will follow-up some of these possibilities.

On two recent visits Dr G. R. Green, J. Pemberton and W. L. Matthews located potential hard-rock sites at Counsel Hill and near Pegarah. A report from Dr Green is included as Appendix 1.

GEOLOGY

The current 1:250 000 scale geological map coverage of King Island (fig. 1) is based on previous work, mainly by Gresham (1972), Jennings (1959) and



KING ISLAND
GEOLOGICAL MAP
N
Cape Wickham
Lavinia Point
5600000 mN
Whistler Point
Naracoopa
Currie
Bold Head
Grassy
Cataraqui Point
5550000 mN
Stokes Point
250000 mE
5
0
5
10 kilometres
Qu
Qh
'New Dunes'
Qps
'Old Dunes'
Tb
Tertiary basalt
Tm
Tertiary limestone
Psv
Neoproterozoic basaltic volcanic rocks
Pss
Neoproterozoic diamictite, dolostone and shale
Prp
Proterozoic siltstone
Ptp
Proterozoic shale
Dg
Devonian granite
Pg
Proterozoic granite
Pa
Proterozoic amphibolite

Figure 1

Young and Mathison (1994). Bedrock geology is best known from coastal exposures, with much of the subdued relief of the interior of the island being covered by Pleistocene and Recent dune sand and other surficial deposits. A recent aeromagnetic and radiometric survey, with a 400 m line spacing, covers the island and provides useful supplementary information on the disposition of bedrock lithologies and some of the surficial deposits (fig. 2, 3).

Bedrock Geology

The western part of the island consists of Proterozoic metasedimentary rocks — dominantly quartz-muscovite schist and quartzite — intruded by granitic rocks dated at 760 Ma. The metasediments strike north-south and dip west, while the granitic bodies are regionally concordant. The granitic rocks consist of biotite granite and granodiorite, which in places are foliated, sheared or gneissic. Dykes of aplite, pegmatite and dolerite occur within the granite and schist near granite contacts (Gresham, 1972).

The eastern half of the island consists of relatively unmetamorphosed Proterozoic siltstone, shale and fine-grained quartzitic sandstone that has a regional north-south strike and an easterly dip. The nature of the contact between this sequence and the western, metamorphosed succession — whether a metamorphic transition, an unconformity, or a fault — is unknown. Pyrite is common to all rock types in the unmetamorphosed succession (Gresham, 1972; Young and Mathison, 1994). The unmetamorphosed rocks resemble parts of the Rocky Cape Group, in particular the Cowrie Siltstone, of northwest Tasmania.

Amphibolites locally occur within the Proterozoic successions. The largest amphibolite bodies, east of Pegarah, are associated with extensive development of lateritic ironstone (Gresham, 1972).

A narrow strip of country along the southeast coast consists of a Neoproterozoic sequence of diamictite, dolostone, shale and mafic volcanic rocks. These rocks dip east and overlie, with apparent conformity, the siltstone succession.

Mafic, syenitic and lamprophyric dykes intrude the southeastern coastal sequences. Three Devonian granite stocks — the Grassy, Bold Head, and Sea Elephant or Counsel Hill intrusions — also crop out along the east coast. The Grassy and Bold Head plutons intrude the Neoproterozoic sequence, and scheelite skarn mineralisation occurs in the contact metamorphic aureoles of these intrusions. Scheelite was mined between 1937 and 1990 from the Dolphin deposit at Grassy and the Bold Head deposit 3 km to the north.

Tertiary limestone crops out on the east coast north of Naracoopa and at isolated localities inland. The distribution of small sinkholes suggests that the limestone may underlie the coastal flats between Fraser River and Sea Elephant River, behind the sand dunes on the east coast (Jennings, 1959).

The geological map (fig. 1) shows a few small areas of Tertiary basalt in the north of the island. Several more occurrences, apparently intrusive plugs covered by surficial deposits, have been inferred from magnetic surveys (see later section).

The Total Magnetic Intensity map shows a complex pattern of anomalies, many of which have been numbered by Geopeko during mineral exploration in the 1970s (fig. 2). Nine subcircular anomalies are interpreted as Tertiary basalt plugs or pipes. The large anomaly trending north from the mouth of the Ettrick River (Anomaly 5) is thought to be due to a magnetite-bearing layer in the metamorphic succession (Brown, 1974*b*), or narrow dolerite dykes (Appendix 1). Other narrow north-south anomalies (e.g. anomaly 6, 17) are attributed to mafic dykes intruding the Proterozoic. The amphibolite bodies give only a subtle magnetic response.

Surficial deposits

A broad belt of vegetated sand dunes extends almost continuously around the coast, with the exception of the steep coast between Grassy and Naracoopa. The belt is widest (up to 4 km) behind the west coast. Two sets of dunes were recognised by Jennings (1959): the 'Old Dunes' and the 'New Dunes'.

The 'Old Dunes' occur as a discontinuous belt inland of the 'New Dunes', and as isolated occurrences in the northern interior of the island. They are of subdued relief, with their original morphology being somewhat altered by erosion. These dunes are thought to be of Pleistocene age, and the main occurrences are shown as Qps on the geological map (fig. 1) in the northern part of the island and as Qu in the southern half of the island. The 'Old Dunes' consist of leached, grey-white quartz sand, in places overlying dark brown hardpan (humus-bound sandrock). Although dominantly siliceous, they are of calcareous composition on the northern half of the west coast (north of Currie).

The 'New Dunes', of Holocene age, are shown as Qh on the map. They have been little modified by erosion and are commonly parabolic in form. Although mostly fixed by vegetation, active blowouts are common. On the west coast, the 'New Dunes' are dominantly calcareous in composition, ranging from unconsolidated creamy-yellow shell sand with a minor proportion of quartz, to typical aeolianite variably consolidated by secondary calcite. On the east coast, by contrast, the 'New Dunes' are mainly quartz sand, and these deposits are prospective for rutile and monazite.

In the central north of the island there are extensive flat plains underlain by estuarine/marine sediments (shelly sands), parts of which are covered by peaty

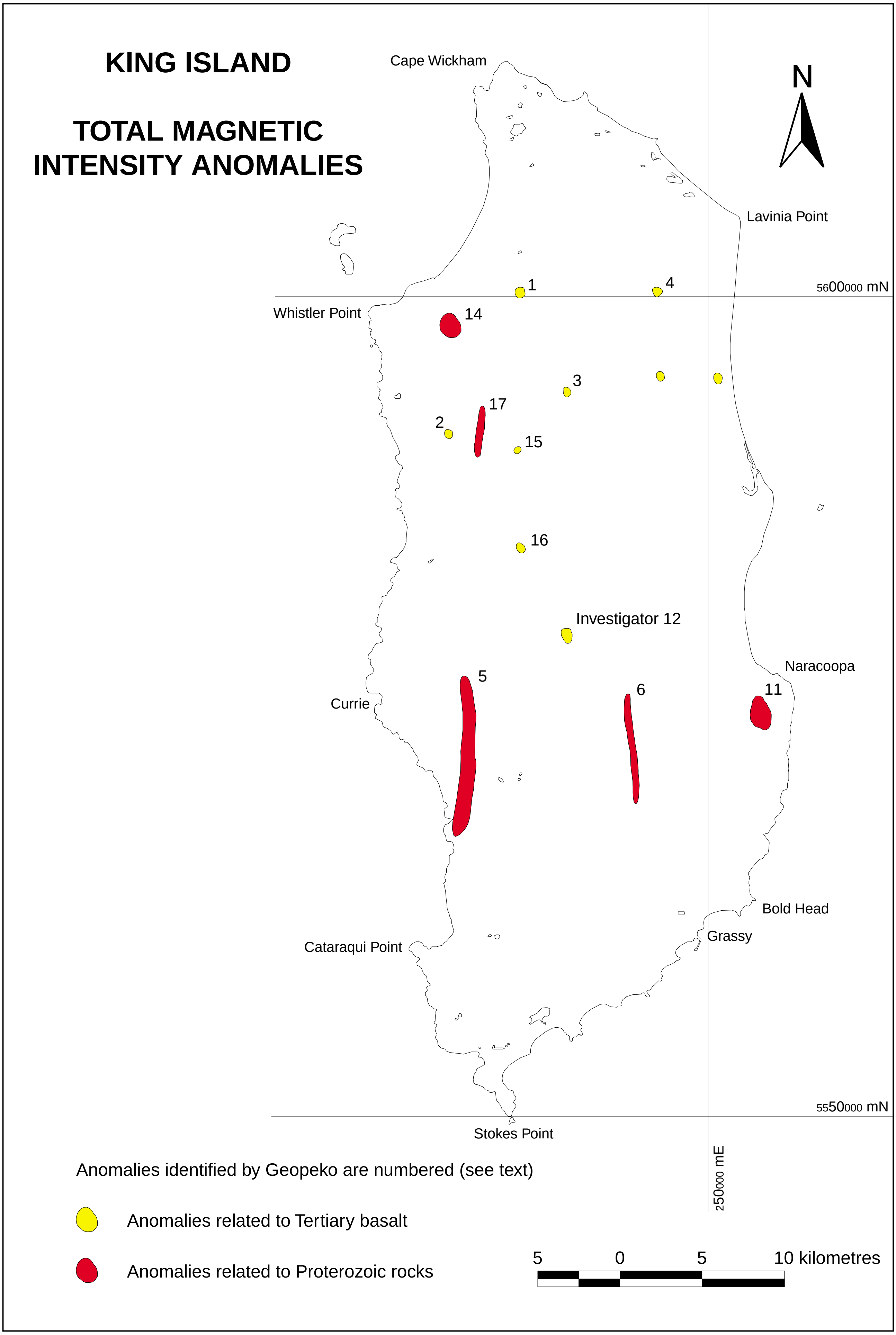

KING ISLAND
TOTAL MAGNETIC
INTENSITY ANOMALIES
Cape Wickham
N
Lavinia Point
5600000 mN
Whistler Point
1
4
14
3
17
2
15
16
Investigator 12
Naracoopa
5
6
11
Currie
Bold Head
Grassy
Cataraqui Point
5550000 mN
Stokes Point
250000 mE
Anomalies identified by Geopeko are numbered (see text)
Anomalies related to Tertiary basalt
Anomalies related to Proterozoic rocks
5
0
5
10 kilometres

Figure 2

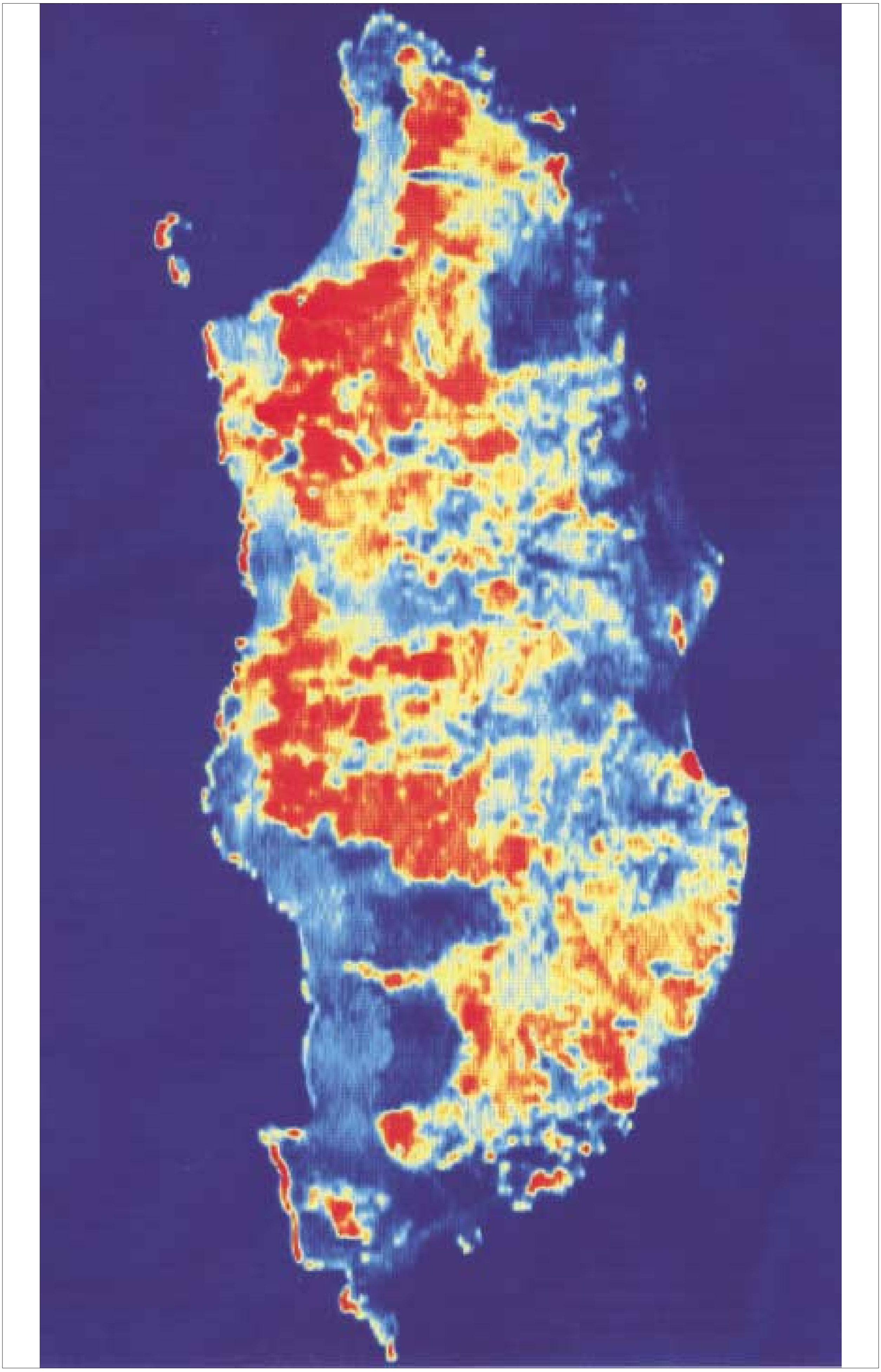


Figure 3. *Radiometric map of King Island (total counts)*

soils and clay of former shallow lakes and swamps such as Egg Lagoon. These sediments and swamp deposits are shown as Qu on the geological map. Pleistocene megafaunal remains have been found locally in the swamp deposits.

Wide vegetated shingle platforms and cobble ramparts occur on low rocky parts of the coast in many places. These occur on a raised marine terrace that is mostly less than 30 m wide (Bacon, 1987) and which extends up to about 5 m above high water mark. The shingle-covered terraces are widespread along the west coast between Whistler Point and Dripping Wells, and also occur at Seal Point and Red Hut Point in the southeast. The shingle banks show no signs of movement by modern wave action, and may have developed at a slightly higher (+2 m) sea level stand (Jennings, 1959). These deposits have been extensively quarried for road metal on the west coast over several decades. Test pits between Ettrick Rock and Whalebone Beach indicate that the deposits are mostly less than one metre thick (Bacon, 1987).

The radiometric map (fig. 3) shows, at a first approximation, areas of bedrock outcrop or with thin cover (high counts) versus areas with substantial surficial cover (low counts). The distribution of the sand dune belts on the west and northeast coasts is clearly delineated. South of Currie, two lobes of cover sediments extend far inland — further than is shown on the geological map — separated by the narrow valley of the Ettrick River which has eroded to bedrock along most of its course. The radiometric data may be useful in prospecting for hard-rock sites.

ROCK AND GRAVEL RESOURCES ON CURRENT OR RECENT OPERATIONS

Production of gravel and crushed stone is taking place, or has taken place in the recent past, from six locations on King Island over which mining leases have been registered (fig. 4). An additional seven sites are listed in the CONMAT (Construction Materials) database (Appendix 4). The CONMAT data were collected in 1980. These seven sites, for which no mining leases are current, are no longer in use.

There are also two small leases in the south (1164P/M and 1165P/M), both held by T. R. & P. Frerk for granite and limestone. There is no current production from these leases.

Sand and lime sand have been extracted from eight current or recent leases, all of which are small (<4 ha) except for 1636P/M (203 ha). The resource is plentiful (the widespread fixed Quaternary sand dunes) although environmental impacts need to be monitored. The sand resources will not be further discussed here.

1442P/M — Reekara (Municipality of King Island)

The quarry at Reekara, operated by the Council as a source of road gravel for the northern half of the island, is in weathered Proterozoic granite. Approximately 19 000 tonnes of gravel was produced in 1997. Water ponded in the quarry floor, presumably derived from groundwater discharge from sulphide-bearing granite and surface runoff, has a pH of 3.1 and high metals concentrations (Ezzy, 1998), and disposal of acid drainage is an ongoing problem.

Testing by the Department of Main Roads in 1977 on ‘spalls of medium-grained white granite’ from this pit showed that the material is suitable for base course and not susceptible to excess weathering, but the high abrasion (LA) loss may preclude its use as a sealing aggregate.

Reports of vegetation dieback along the edge of roads after times of high rainfall have been received by the Department of Environment and Land Management for some time (Ezzy, 1998). This suggests the material may be unsuitable for road gravel, quite apart from the acid drainage problems associated with the quarry.

In early 1998 MRT requested to the Council that no further production take place from this pit, because of the severe acid drainage problems.

1443P/M — Pearshape (Municipality of King Island)

The Pearshape quarry, about 16 km southeast of Currie, is operated by the Council. It is the principal source of gravel and crushed aggregate used by the Council in the construction and maintenance of roads in the southern part of the island.

The pit is situated in Proterozoic metasedimentary rocks, including pyritic black shale that appears to be the source of acidity in the drainage from the quarry. Water ponded in the southern part of the quarry has a pH of 2.0 to 2.5 (Ezzy, 1998). Environmental impacts attributed to the drainage, including death of stock on the neighbouring farm, are briefly detailed by Ezzy (1998).

Production returns to Mineral Resources Tasmania indicate that approximately 5000 tonnes of gravel and 16 000 tonnes of crushed stone were produced in 1997.

In early 1998 MRT requested that the Pearshape pit be closed and rehabilitated by December 1999.

1649P/M — Stricklands Road (D. & S. Helbig)

This site was pegged in 1997, but had previously been the source of gravel for King Island Airport. Production of 3500 tonnes of gravel was recorded at this site in the first quarter of 1998. The pit is in

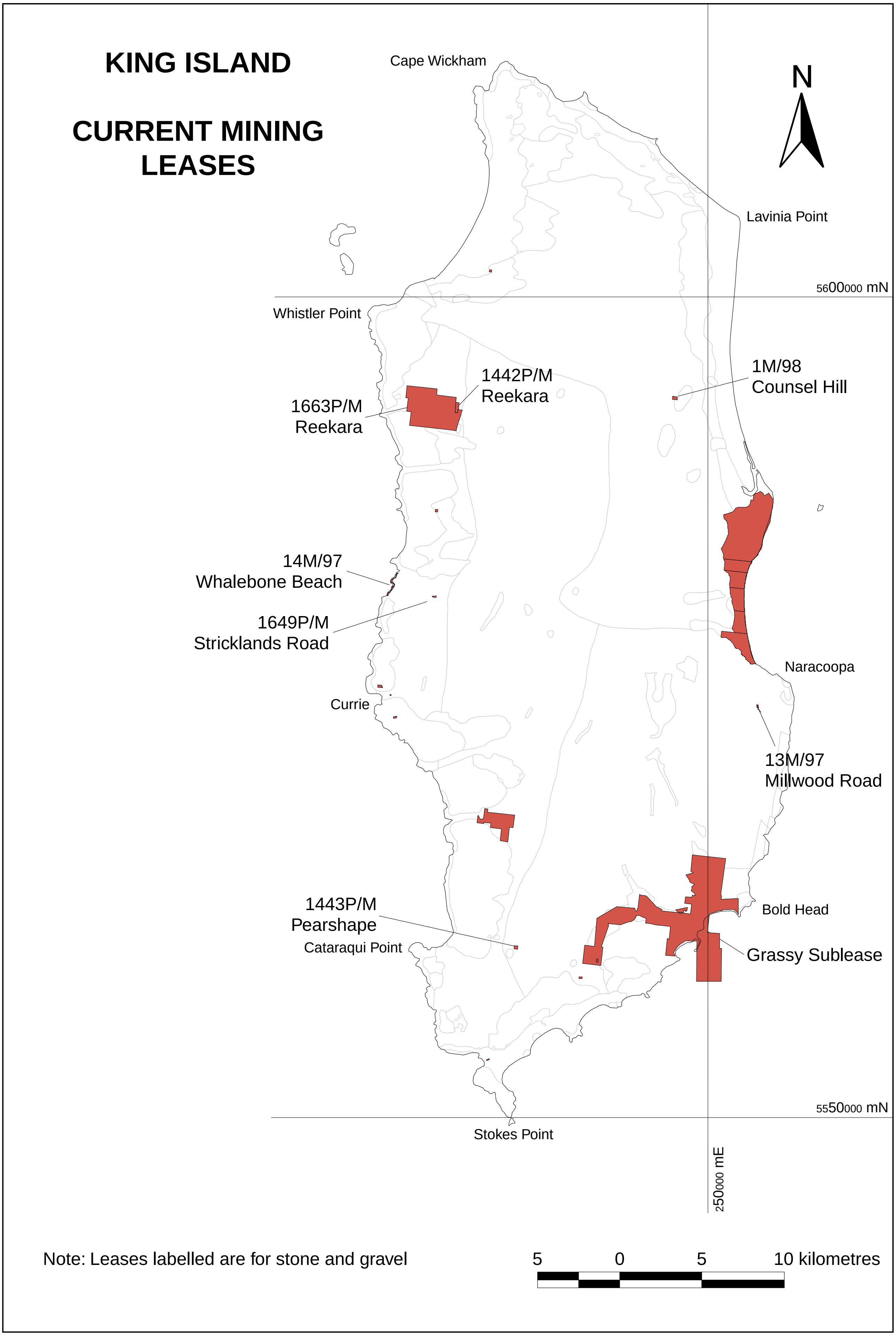

KING ISLAND
CURRENT MINING LEASES
Cape Wickham
N
Lavinia Point
5600000 mN
Whistler Point
1442P/M
Reekara
1M/98
Counsel Hill
1663P/M
Reekara
14M/97
Whalebone Beach
1649P/M
Stricklands Road
Naracoopa
Currie
13M/97
Millwood Road
1443P/M
Pearshape
Bold Head
Cataraqui Point
Grassy Sublease
5550000 mN
Stokes Point
250000 mE
Note: Leases labelled are for stone and gravel
5 0 5 10 kilometres

Figure 4

weathered granite, suitable for road construction. The resource is relatively small (20 000 m^3) and a ten-year life is envisaged by the operator.

1663P/M — Reekara (S. M. Cochrane)

This lease, under application, is sited immediately west of the existing Reekara pit. The applicant intends to access gravel (decomposed granite) through the construction of farm dams. It is likely that restrictions will be placed on the depth of excavation to preclude the development of excess acidity, as in the Reekara pit. Consequently the volume of material produced is unlikely to be large.

13M/97 — Millwood (D. & S. Helbig)

This small quarry is situated in Proterozoic siltstone. There appears to be no acid drainage problem (Ezzy, 1998). The quarry, operated by the King Island Council, has been an intermittent source of rock for some years, but the operation has only recently been subject to a mining lease application. No production returns have yet been received by MRT. Council records indicate that over 10 years of intermittent use (1986–1996) 5739 m^3 of rock were extracted. The material is clay rich, of poor quality as a hard-rock source, and is unsuitable for road base (R. Halfacre, personal communication 1998).

14M/97 — Whalebone Beach (D. & S. Helbig)

This lease is a narrow strip extending 1.5 km along the coast north and south of Whalebone Beach. The lease is based on littoral cobble and pebble gravels a few metres above high water mark. The beach shingle along this part of the coast occurs as a flat terrace a few metres above high water mark. The west coast shingle deposits, which were described and mapped in detail by Bacon (1987), are about one metre in thickness and overlie bedrock or clay. The inland side of the shingle is covered by dune sands in places.

These deposits have been exploited for road gravel for many decades, from a large number of places between Dripping Wells and Whistler Point. The resource is now substantially depleted due to piecemeal extraction over many years (Bacon, 1987). Operations have recently been limited to the Whalebone Beach area and formalised as a mining lease. Approval of the lease was conditional on progressive rehabilitation and closure of the operation by 2000.

This is the only source presently available that is considered suitable for concrete aggregate, with the possible exception of the Grassy mine waste rock (see below). In recent years MRT has pressed the Council and the operator of the lease to restrict the use of this limited resource to concrete aggregate because of the short supply of other suitable material on the island.

In the 1980s around 6000 cubic metres of shingle was extracted per year. The first production return to be received by MRT, for the first quarter of 1998, was for 196 tonnes of shingle.

Grassy Sea Dump

King Island Council have had a sub-lease arrangement with North Limited, the holders of the King Island Scheelite lease, for the extraction of beach gravel from two beaches on the coast near Grassy. About 1200 cubic metres are taken annually. This material is wave-washed rock derived from reclaimed and rehabilitated land made up of overburden waste from the nearby abandoned scheelite mine.

This resource has been crushed at Pearshape and mixed with lime sand, to stop sealed roads reacting with the road base material sourced from the Pearshape quarry (Ezzy, 1998).

The petrography of two rock samples from Grassy was recently assessed by Roger Townend & Associates to determine the rock's suitability for concrete aggregate. The samples — a fine-grained feldspar-quartz-biotite schist and a part-carbonated garnet pyroxene calcsilicate — were both regarded as suitable for concrete (fax from BFP Consultants Pty Ltd to King Island Council, 6 February 1998). However, a much wider variety of rock types, including hornfels, marble, garnet-rich skarn and metavolcanic rocks, some of which contain pyrrhotite, pyrite and other sulphide minerals, are exposed in the nearby open cut (e.g. Brown, 1990), and are presumably also represented in the waste dump. A more comprehensive assessment of this resource, and monitoring of the sulphide content of extracted material, probably needs to be undertaken if it is to be used in the manufacture of concrete aggregate.

CONMAT Site 05001 — Porky Creek

This site, on the south bank of Porky Creek next to North Road, is in weathered granite. A total production of 50 000 m^3 was estimated. The operation was recorded as abandoned in 1980 (Appendix 4).

CONMAT Sites 06001, 06002 and 06004 — Naracoopa

These sites are in Proterozoic siltstone just east and west of Naracoopa. Total production of 39 000 m^3 was estimated in 1980. They are presumably no longer in use.

CONMAT Site 06003 — Naracoopa

This site lies in Tertiary 'buckshot' (surficial lateritic deposits) in the forestry area west of Naracoopa. The deposit appeared to have been almost worked out by 1980.

CONMAT Site 09002 — Ettrick

This site was for coastal shingle extraction, which is now restricted to Whalebone Beach.

CONMAT Site 10001 — Yarra

This site, on the Millwood Road just north of Yarra Creek, was for Tertiary 'buckshot', and was evidently about to commence operations in 1980.

POTENTIAL FUTURE HARD ROCK AND GRAVEL SITES

The small size and subdued relief of the island means that there are no substantial deposits of fluvial gravel. The only significant natural gravel deposits appear to be the littoral cobble and shingle banks, the exploitation of which will shortly cease, and the residual 'gravels' of decomposed granite and Tertiary 'buckshot'. These residual gravels may be suitable for road base but not, in general, for road sealing or concrete aggregate. An additional hard-rock source or sources needs to be found, at least in order to supply good quality material for road sealing and concrete aggregate. Some possible sources are discussed below.

Pits currently operating at Millwood and Stricklands Road are too small to cater for current demand and may well encounter similar problems to the Pearshape and Reekara pits if greatly expanded.

Grassy mine

An expansion of the operation to utilise the mine waste at Grassy could conceivably satisfy much of the demand for road construction material, at least in the south of the island, once the Pearshape and Reekara pits are closed. Total reserves of waste rock at Grassy are very large, with some tens of millions of tonnes of overburden waste having been excavated from the scheelite mines and moved to the tailings dumps in the Grassy area. A more comprehensive program of testing, including abrasion testing and alkali reactivity, could be undertaken to assess the suitability of this material for road sealing and concrete aggregate manufacture.

The upper levels of the open cut itself are also worthy of consideration as a hard-rock resource (R. Halfacre, personal communication, 1998). It may be relatively easy to locate suitable volumes of unmineralised rock with the assistance of available large-scale maps of the mine. The presence of ready-made quarry faces should provide a significant cost saving over development of a completely new site.

Hornfels at Counsel Hill

Lease application 1M/98 has been registered by the King Island Council with the intention of assessing and exploiting this resource, which was initially recommended by G. R. Green (see Appendix 1). The potential size of the resource would be easily large enough to replace the supply from the Reekara pit.

Aggregate samples from Counsel Hill (Bicentennial Road) have been tested by BFP Geotechnical Mining and Geological Consultants in early 1998 (Appendix 3). They reported:

'Test results are encouraging. The strength of the rock is good and the size and shape of the aggregate can be improved as crushing and screening techniques are developed'.

Petrographic examination of aggregate from Bicentennial Road found that one component was not wholly satisfactory for concrete aggregate. Three rock types were present: metabasalt, meta-arkose and altered sericitic schist. While the metabasalt and meta-arkose appear suitable for concrete use, the schist is regarded as less satisfactory because of the abundance of secondary mica (fax from BFP Consultants Pty Ltd to Council, 6 February 1998; see Appendix 3).

This aggregate appears to have been a surficial, weathered sample (R. Halfacre, personal communication, 1998). Further testing should be undertaken on fresh, unweathered material.

Amphibolite, east of Pegarah

Proterozoic amphibolite near Pegarah Road may constitute a viable hard-rock resource. Young and Mathison (1994) provided the most recent map of these intrusions.

Outcrop south of the road, on 'Windermere', was located by G. R. Green and R. Halfacre in February 1996. There are 'knolls 500–1000 m southeast of the shed near the main road where there is good jointing in the rock and suitable topography for quarry development not too close to houses' (fax from GRG to Graham Conolly). This site is probably at about 247 000 mE, 5 574 000 mN but the precise location needs to be checked.

A thin section from a sample taken nearby shows a rock dominated by coarse (almost 10 mm) hornblende with subordinate plagioclase and minor hornblende-actinolite and FeTi oxides (A. Crawford, *in* Young and Mathison, 1994).

Tertiary basalt

Fresh Tertiary basalt is an ideal hard-rock source for road sealing and concrete aggregate. Although known outcrop of Tertiary basalt on King Island is very limited, a number of strong, circular magnetic anomalies were discovered during mineral exploration in the north of the island in the early 1970s, and most of these appear to be non-outcropping plugs of Tertiary olivine basalt (Brown, 1974*a-e*).

A total of nine subcircular magnetic anomalies were interpreted as basalt plugs (known as Anomalies 1, 2, 3, 4, 15, 16, Investigator 12, and two unnamed anomalies; fig. 2). All are positive anomalies except for 1 and 3, which are magnetic lows. Anomalies 2, 3, and 4 were proven to be olivine basalt by auger and percussion drilling.

An east-west ground magnetic profile and Gemco drilling across Anomaly 2 suggested that the basalt subcrop is about 375 m wide (Brown, 1974*c*). Percussion drilling on Anomaly 4, in what is now the Lavinia Nature Reserve, showed three metres of soil and clay underlain by 12 m of fresh basalt. The base of the basalt was not reached (Brown, 1974*e*). Percussion drilling on anomaly 1 failed to reach bedrock; the unconsolidated cover is here at least 104 m thick (Brown, 1974*a*).

In assessing these occurrences as possible quarry sites it is important to determine whether sufficient volume of fresh rock is present, and that the basalt bodies are not merely thin erosional flow remnants or very narrow pipes. The above-mentioned drilling results on anomalies 2 and 4 allow some optimism on this point. Further investigation might be best concentrated on Anomaly 2 and Investigator 12, which are the largest of the basalt anomalies and which are close to existing roads.

Anomaly 2 lies just east of the main North Road, about 1.5 km south of the Reekara pit. There is no outcrop at this site (Appendix 1). The proximity of the site (<1 km) to the Tatham Lagoon Wildlife Sanctuary would need to be taken into consideration in deciding whether to pursue the Anomaly 2 resource.

The Investigator 12 anomaly lies north of Adams Road at about 241 300 mE, 5 579 300 mN. Basalt outcrop is shown close to this site by Gresham (1972). The Investigator 12 site has better topography and probably better drainage than the Anomaly 2 site.

Basalt outcrop on Pegarah Road (Appendix 1) could also be investigated. According to G. R. Green, scattered float of basalt occurs on Pegarah Road around 346 700 mE, 347 900 mE, and 349 200 mE. There are large basalt floaters on a property on Robins Road at 347 800 mE, 5 570 000 mN. Tertiary sandstone with marine fossils occurs on Pegarah Road at 246 700 mE, 5 574 300 mN. This is presumably a sub-basaltic deposit, and indicates that the Tertiary basalt in the Pegarah Road area is likely to be thin and impersistent, consistent with the low response on the aeromagnetic map.

Ground magnetic surveys to determine the areal extent of the basalt at Investigator 12 and Anomaly 2, followed by shallow drilling, would effectively determine the volume available for quarrying.

Other possible rock types

A number of other rock units are prospective as hard-rock sources, but further field work would be necessary to properly assess these rocks.

Quartzite is present in the Proterozoic metamorphic rocks in the west of the island and in the Rocky Cape Group correlate in the east. If a sufficiently thick quartzite unit, uninterrupted by sulphidic layers, could be found it would be a potential source, but such a unit would be very difficult to find because of the generally poor rock exposure in the interior of the island.

Basaltic volcanic rocks of Neoproterozoic age, and contact-metamorphosed equivalents, occur inland of Bold Head and between Grassy and Mount Stanley. Where fresh, these rocks may be a good hard-rock source, but the presence of sulphides and asbestiform minerals (Appendix 1) would need to be monitored. The relatively strong relief and varied aspect in these areas mean that suitable quarry sites should be easily found.

Some of the granites may also be suitable, particularly the aplitic (fine-grained) and porphyritic varieties.

CONCLUSIONS

Once the Reekara and Pearshape pits and the coastal shingle mining operation are closed, an expanded operation based on the mine tailings dumps at Grassy could satisfy much of the demand for road construction materials, at least in the south of the island. More comprehensive testing on samples of aggregate from the Grassy dumps needs to be carried out to assess their suitability for concrete making. A hard-rock resource may also be available in the upper levels of the Grassy open cut, provided that suitable volumes of unmineralised rock can be found.

A new quarry could be opened at Counsel Hill if demand required. If further tests show that neither the Grassy nor the Counsel Hill rocks are satisfactory for concrete aggregate, a new hard-rock site could be sought in Tertiary basalt (particularly the ‘Investigator 12 or ‘Anomaly 2’ sites) or Precambrian amphibolite near Pegarah Road. Tertiary basalt is likely to provide the best quality concrete aggregate and road sealing material. Ground magnetics followed by shallow drilling would probably be required to prove the basalt resource.

Further work should also be carried out to assess the suitability of the Neoproterozoic basalt in the Grassy–Bold Head area, and of the granites.

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APPENDIX 1

Preliminary investigation into possible sources of hard aggregate suitable for use in concrete on King Island

G. R. Green

In response to a request from the King Island Council, possible sources of hard-rock aggregate suitable for use in concrete were inspected in early November 1995.

To guide the investigation, existing geological maps, mainly from previous exploration reports and Geological Survey of Tasmania compilations, and a 1:100 000 aeromagnetic image of the island prepared by Dr R. G. Richardson of Mineral Resources Tasmania, were used to interpret possible suitable rocks. Existing quarries on the island were also visited. The evaluation consisted of field inspections supported by brief petrographic examinations.

Important considerations in the evaluation include:

- lack of sulphide minerals, chert or strained quartz likely to cause acid reaction with cement;
- rock hardness; and
- lack of minerals with other undesirable properties (e.g. asbestiform minerals).

A number of localities were considered:

1. A magnetic high parallel to the west coast, thought possibly to be a hornfels. Field investigation showed this to be caused by dolerite dykes a few metres thick and too thin for a viable quarrying operation.

2. A mapped Cambrian spilite on the Mount Stanley Road, about one kilometre south of the Gentle Annie tower. This occurrence consisted of a few loose boulders in a paddock. There was insufficient evidence of whether a large to medium-scale quarry could be developed on the site and no guarantee of the quality of the material. The material was weathered and contained some needle-like, asbestiform tremolite-actinolite, a potentially hazardous material if crushed.

3. A weak aeromagnetic anomaly covering an area on Pegarah Road 3 km east of Pegarah and extending some 2.5 km to the north. This coincides with an area mapped as amphibolite by Geopeko in the 1980s. The amphibolite was present, but much of the area consisted of Tertiary basalt float. Basalt of this age would be ideal for aggregate purposes and is extensively used for aggregate on mainland Tasmania. The distribution of the basalt is patchy and it is likely to be thin. It occurs on Pegarah Road over about one kilometre as far east as a point just west of Sherstone Park. It is absent on Lancaster Road and Yarra Creek Road, but it occurs on Robins Road on Noel Philby's property and further to the west. The logs from old water bores are insufficiently definitive to give a better idea of its likely extent, and further drilling would be needed to determine whether there was sufficient thickness for a viable quarry. Any quarry would be in prime farm land. Other potential magnetic anomalies that might have been basalt related were not confirmed. One is at a point 2 km north of Fraser Road and 1.5 km west of Sea Elephant Road and was not visited because of lack of time. Another is a few hundred metres west of the North Road, about 500 metres north of Tathams Lagoon and 1.5 km south of the Reekara gravel pit. This site was visited. There is no outcrop and examination of a satellite image indicates that basalt, if present, is covered by an unknown thickness of older dune sand.

4. Hornfels in the metamorphic aureole of the Mount Counsel granite forms Counsel Hill and most of the subdued, semi-circular ridge of the Sea Elephant Hills. A roadcut on the Bicentennial Road some 200 metres south of Counsel Hill at about 248 000 mE, 5 693 700 mN offers the best potential for a quarry site. There would be no anticipated depth limitations for this material. Microscopic examination of the rock shows no stressed quartz or sulphides likely to cause acid reaction problems in concrete. The rock consists of biotite, muscovite and quartz, with some specimens containing minor feldspar, andalusite, tourmaline and possible cordierite (microscopic examination by Ralph Bottrill and Geoff Green, Mineral Resources Tasmania).

RECOMMENDATION

The site near Counsel Hill should be considered first. The material is quite fresh at the surface. Drilling would not be required to establish an adequate resource, but standard abrasion testing should be carried out. This material would be vastly superior to rock either from the Pearshape or Reekara quarries.

APPENDIX 2

Quarterly production statistics from King Island stone and gravel leases

1164P/M: T. R. & P. Frerk

Material	*Quarter*	*Production (tonnes)*
Granite, limestone		Nil

1165P/M: T. R. & P. Frerk

Material	*Quarter*	*Production (tonnes)*
Limestone, granite		Nil

1442P/M: Municipality of King Island

Material	*Quarter*	*Production (tonnes)*
Stone	97:4	7017.60
	97:3	405.40
	97:2	7984.90
	97:1	3685.6
	96:4	7377.15
	96:3	141.00
	96:2	6167.60
	96:1	4953.80
	95:4	6441.30
	95:3	3419.55

1443P/M:Municipality of King Island

Material	*Quarter*	*Production (tonnes)*	*Material*	*Production (tonnes)*
Gravel	97:4	869.55	Crushed stone	7397.55
	97:3	681.70		1800.30
	97:2	829.60		6082.60
	97:1	2461.60		1566.55
	96:4	715.70		838.10
	96:3	2753.15		1088.00
	96:2	1179.80		839.80
	96:1	11872.80		243.95
	95:4	4433.60		724.2
	95:3	2252.50		625.60

1649P/M: D. & S. Helbig

Material	*Quarter*	*Production (tonnes)*
Gravel	98:1	3500

13M/97

Nil Production

14M/97:

Material	*Quarter*	*Production (tonnes)*
Shingle	98:1	196

APPENDIX 3

Tests on aggregate samples from Counsel Hill and Grassy by BFP Consultants Pty Ltd

client	KING ISLAND COUNCIL			date tested	17/12/97
project	GRASSY			tested by	DLM
location	KING ISLAND				
Sample identification	Sample #2				
Sampled by	Client			Date received	12/12/97
Sample description	14 mm aggregate				
Test Description	AS1141	*Test methods*	*Results*	*Units*	*Remarks*
Misshapen particles		14	4	%	
Gradation finer than AS sieve	mm	11			
	26.5			%	
	19.0		100	%	
	13.2		88	%	
	9.5		2	%	
	6.7		0.4	%	
	4.75		-	%	
	2.36		-	%	
	1.18		-	%	
	0.075	12	-	%	

client	KING ISLAND COUNCIL			date tested	19/12/97
project	GRASSY			tested by	
location	KING ISLAND				
Sample identification	Sample #3			Sample No.	L97/877
Sampled by	Client			Date received	12/12/97
Sample description	14 mm aggregate				
Test Description	AS1141	*Item*	*Results*	*Units*	*Remarks*
Sect 22					
Wet/Dry Strength Variation		Wet Strength	360	kN	
		Dry Strength	398	kN	
		Fraction tested	-19 +9.5	mm	
		Cylinder size	150	mm	

client	KING ISLAND COUNCIL		date tested	17/12/97	
project	BICENTENNIAL ROAD		tested by	DLM	
location	KING ISLAND				
Sample identification	Sample #3				
Sampled by	Client		Date received	12/12/97	
Sample description	14 mm aggregate				
Test Description	AS1141	*Test methods*	*Results*	*Units*	*Remarks*
Misshapen particles		14	3	%	
Gradation finer than AS sieve	mm	11			
	26.5		100	%	
	19.0		99	%	
	13.2		81	%	
	9.5		1	%	
	6.7		1	%	
	4.75		0.5	%	
	2.36		0.4	%	
	1.18		-	%	
	0.075	12	-	%	

client	KING ISLAND COUNCIL		date tested	19/12/97	
project	BICENTENNIAL ROAD		tested by		
location	KING ISLAND				
Sample identification	Sample #3		Sample No.	L97/880	
Sampled by	Client		Date received	12/12/97	
Sample description	14 mm aggregate				
Test Description	AS1141	*Item*	*Results*	*Units*	*Remarks*
Sect 22					
Wet/Dry Strength Variation		Wet Strength	196	kN	
		Dry Strength	305	kN	
		Wet/dry strength variation	36	%	
		Fraction tested	-19 +9.5	mm	
		Cylinder size	150	mm	

Petrographic reports by BFP Consultants

SAMPLE GRASSY 1 197/876

Two rock samples:

A — dark fresh fine-grained biotite schist

B — coarse-grained veined garnetiferous calcsilicate rock.

Sample A

Quartz	30–40%
Feldspar	30–40%
Biotite	30–40%
Chlorite	1–2%
Muscovite	<1%
Ores	<1%

Sample B

Clinopyroxene	Major
Garnet	Major
Carbonate	Major
Clinoamphibole	Accessory
Ores	<1%

Vein

Quartz	Major
Carbonate	Major
Feldspar	Minor
Clinoamphibole	Accessory

Rock A is classified as a FELDSPAR QUARTZ BIOTITE SCHIST.

The rock is uniformly fine grained with typical sizes for all minerals around 0.1 mm. The largely fresh biotite forms a regular schistosity. The quartz feldspar component is as a finely granoblastic regular mosaic, with the feldspar untwinned. K feldspar was a major component as shown by staining. There are rare cross zones with chlorite/muscovite alteration.

Rock B is classified as a PART CARBONATED GARNET PYROXENE CALC SILICATE.

The texture consists dominantly of a fine-grained clinopyroxene that is partly replaced by carbonate, and of a coarse garnet blast also slightly carbonated. The section is crossed by a 2 mm vein of variable composition and fine veins of quartz carbonate (calcite).

Comment

Both rocks can be classified as suitable for concrete. The preferred fabric in the schist is of a fine non continuous scale.

SAMPLE BICENTENNIAL 197/880

Rock aggregate, thin sections (2)

Sample A

Plagioclase	65%+
Clinoamphibole	20–30%
Biotite	<5%
Ores	1–2%
Veins	
Clinopyroxene	Dominant
Quartz	Minor
Ores	Accessory

Sample B

Quartz	85%+
Plagioclase	5–10%
Biotite/chlorite	5%

Sample C

Sericite	60%
Quartz	10–20%
Biotite/chlorite	3–5%
Goethite	5–10%
Andalusite	1–5%
Tourmaline	<1%

About 20 chips were mounted, selected to represent the variation seen macroscopically.

Three main rock types were identified:

A METABASALT/METADOLERITE. This is a fresh fine to medium-grained former basic igneous rock now composed of granoblastic plagioclase, Ca amphibole, and minor biotite.

B This is a possible META SUB-ARKOSE. It is composed of a dominant quartzite texture with minor poorly twinned fresh feldspars and sporadic part chloritised biotite.

C This is a largely altered rock that was probably once an ANDALUSITE BLASTIC PELITIC SCHIST. The former andalusite and feldspars are largely altered to fine sericitic mica. Some of the chips also have much secondary goethite.

All three lithologies contained areas which are essentially oxides.

Comment

The metabasalt and meta-arkose are suitable for concrete use. The altered highly sericitic, and sometimes goethitic metasediments (C) are less satisfactory, because of the abundance of the secondary mica, that may include or lead to the formation of clays, undesirable in concrete.

APPENDIX 4

CONMAT sites

The following sites on King Island are recorded on the CONMAT (Construction Materials) database. This database has not been updated for some time.

CONMAT No./Locality:	**05001/Porky Creek**
AMG Co-ords:	232 200 mE, 5 582 800 mN
Annual production:	0
Total production:	50×10^3 m^3
Reserves:	$>10^9$ m^3
Operational status:	abandoned
Age/rock name:	Proterozoic granite
Extractability:	Bulldozer (D9)
Collector/Year:	V. M. Threader/1980
Uses:	Road sub-base, Road base-course, Road unsealed
Testing:	-
Quality:	Satisfactory

CONMAT No./Locality:	**05002/Reekara**
AMG Co-ords:	234 800 mE, 5 593 300 mN
Annual production:	0
Total production:	1000×10^3 m^3
Reserves:	$>10^9$ m^3
Operational status:	
Age/rock name:	Proterozoic granite
Extractability:	Bulldozer (D9)
Collector/Year:	V. M. Threader/1980
Uses:	Road sub-base, Road base-course, Road unsealed
Testing:	-
Quality:	Satisfactory

CONMAT No./Locality:	**06001/Naracoopa**
AMG Co-ords:	254 200 mE, 5 576 600 mN
Annual production:	0
Total production:	18×10^3 m^3
Reserves:	10 000–1 000 000 m^3
Operational status:	
Age/rock name:	Proterozoic siltstone
Extractability:	Bulldozer (D9)
Collector/Year:	V. M. Threader/1980
Uses:	Road sub-base, Road base-course, Road unsealed
Testing:	-
Quality:	Satisfactory

CONMAT No./Locality:	**06002/Naracoopa**
AMG Co-ords:	252 000 mE, 5 577 900 mN
Annual production:	0
Total production:	20×10^3 m^3
Reserves:	10 000–1 000 000 m^3
Operational status:	Occasional
Age/rock name:	Proterozoic siltstone
Extractability:	Bulldozer (D9)
Collector/Year:	V. M. Threader/1980
Uses:	Road sub-base, Road unsealed
Testing:	-
Quality:	Satisfactory

CONMAT No./Locality:	**06003/Naracoopa**
AMG Co-ords:	249 300 mE, 5 577 900 mN
Annual production:	0
Total production:	10×10^3 m^3
Reserves:	<1000 m^3
Operational status:	Occasional
Age/rock name:	Tertiary buckshot
Extractability:	Bulldozer (D9)
Collector/Year:	V. M. Threader/1980
Uses:	Road sub-base, Road base-course, Road unsealed
Testing:	-
Quality:	Satisfactory

CONMAT No./Locality:	**06004/Naracoopa**
AMG Co-ords:	254 200 mE, 5 576 600 mN
Annual production:	0
Total production:	1×10^3 m^3
Reserves:	1000–10 000 m^3
Operational Status:	
Age/rock name:	Proterozoic siltstone
Extractability:	Bulldozer (D9)
Collector/Year:	V. M. Threader/1980
Uses:	Road sub-base, Road base-course, Road unsealed
Testing:	-
Quality:	Satisfactory

CONMAT No./Locality:	**09001/Pearshape**
AMG Co-ords:	238 300 mE, 5 560 300 mN
Annual production:	0
Total production:	0 m^3
Reserves:	10 000–1 000 000 m^3
Operational status:	Occasional
Age/rock name:	Proterozoic slate
Extractability:	Bulldozer (D9)
Collector/Year:	V. M. Threader/1980
Uses:	Road sub-base, Road base-course, Road unsealed
Testing:	-
Quality:	Satisfactory

CONMAT No./Locality:	**09002/Ettrick**
AMG Co-ords:	234 200 mE, 5 567 000 mN
Annual production:	0
Total production:	10×10^3 m^3
Reserves:	1000–10 000 m^3
Operational status:	
Age/rock name:	Quaternary gravel
Extractability:	
Collector/Year:	V. M. Threader/1980
Uses:	-
Testing:	-
Quality:	-

CONMAT No./Locality:	**10001/Yarra**
AMG Co-ords:	251 500 mE, 5 568 000 mN
Annual production:	0
Total production:	0 m^3
Reserves:	
Operational status:	New
Age/rock name:	Tertiary buckshot
Extractability:	Bulldozer (D9)
Collector/Year:	V.M. Threader/1980
Uses:	Road sub-base, Road base-course, Road unsealed
Testing:	Grain size analysis, Atterberg limits
Quality:	Satisfactory