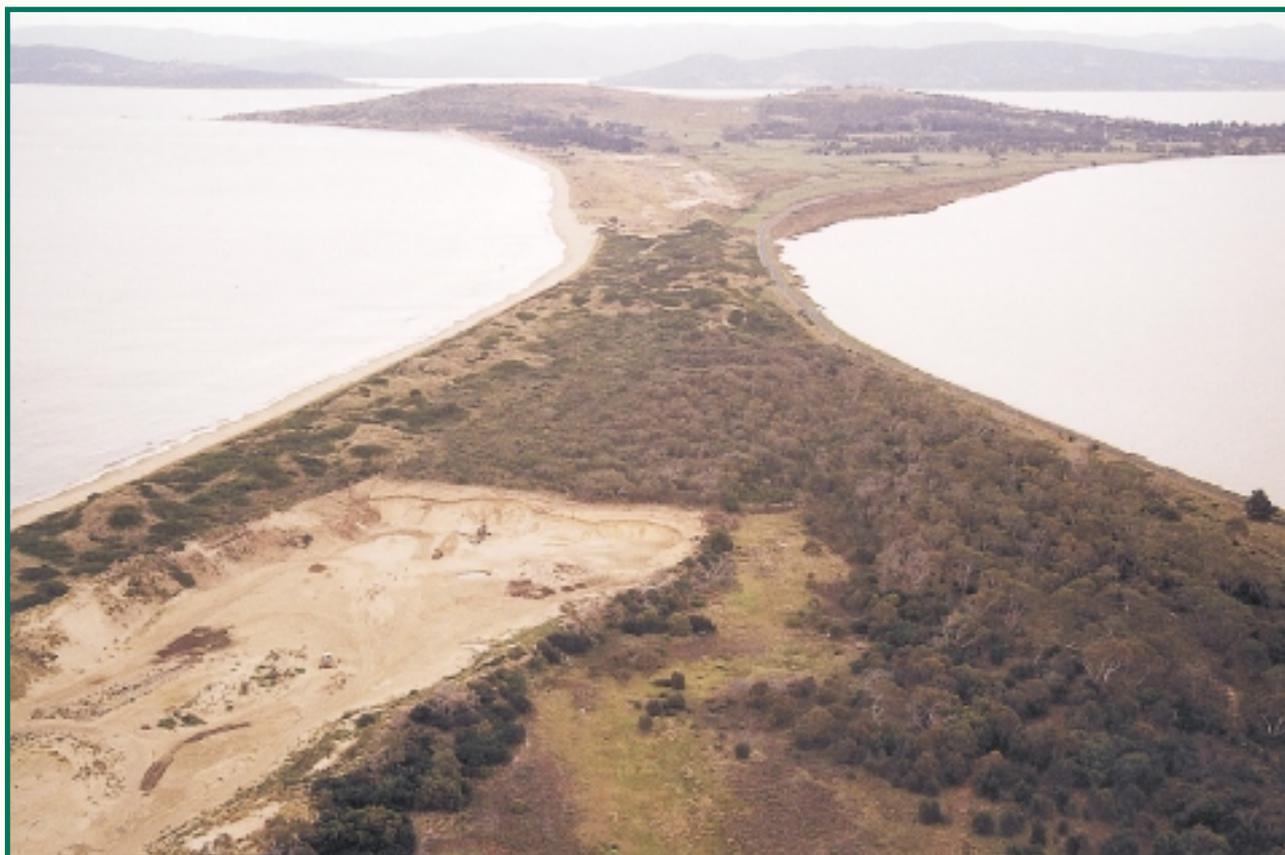


Tasmanian Geological Survey

Record 2000/03

**A review of socio-economic
and environmental issues
relating to the potential
extraction of sand in the
Hobart region**



MINERAL RESOURCES TASMANIA

A review of socio-economic and environmental issues relating to the potential extraction of sand in the Hobart region

by Jason Mills

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EXECUTIVE SUMMARY

This review investigates the reserves of sand that could be economically mined in Southern Tasmania, the potential benefits and disadvantages of mining at each deposit, and suggests how the supply of sand in the region can be sustained.

- Sand is essential for the manufacture of concrete and other pavement materials used in the building and construction industry.
- Only 29% of the sand resources identified in the Hobart Region by past studies are currently accessible to extractive industry.
- Dune sand is the most economical form of sand to mine and a supply shortfall is projected to occur within ten years unless resources outside existing operations can be mined.
- Significant resources close to Hobart have the potential to fill the expected shortfall in supply but access by extractive industries to the resources is currently limited or prohibited.
- Extended project lead times could be expected pursuant to support from the community, stakeholders and government for the development of each resource.
- If new resources cannot be developed the supply of dune sand from existing operations may be exhausted completely within 20 years.
- Once dune sand reserves are exhausted, sand-washing operations within the region will be unable to satisfy demand. It is likely that the importation of sand would be required to supplement sand produced by washing operations.
- All existing dune and washed sand reserves in the region operating under current permits will be effectively exhausted in approximately 30 years.
- Outlying sand resources may become viable as prices rise. To secure the future resource base, local government should consider potential sand resources when revising municipal planning schemes.

MINERAL RESOURCES TASMANIA
DISTRIBUTION OF QUATERNARY SAND AND EXISTING OPERATIONS
GREATER HOBART AREA

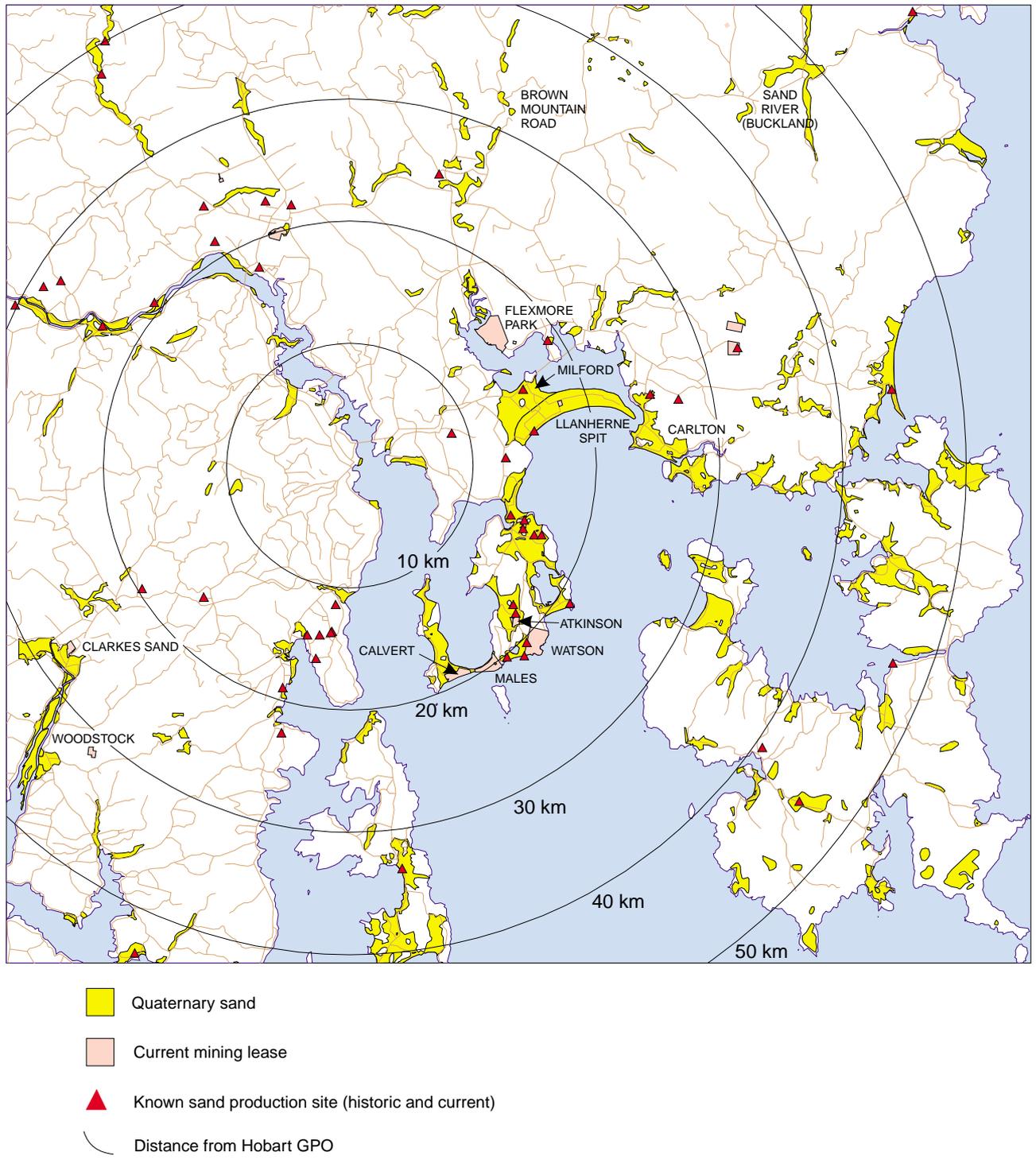


Figure 1

Part A: Supply of sand in the Hobart Region

Introduction

For some time there has been a question over the future supply of sand for the Hobart Region. Previous reports by Mineral Resources Tasmania on sand resources within the Hobart area include work by Threader (1974), Sloane and Weldon (1993), Matthews and Donaldson (1994), and most recently *A Study of Sand Resources in Southern Tasmania* by Duncan (1999).

Sharp sand, which is free from clay and other contaminants, is primarily used in the manufacture of concrete. Unless otherwise stated, the term 'sand' in this report refers to sharp sand of sufficient quality to manufacture concrete. Sharp sand is mined in the Hobart region from dune deposits at South Arm and from river deposits at Huonville and Penna (fig. 1). Because dune sand is economical to produce and of a consistent quality, mines in this material supply 85% of the Hobart sharp sand market.

Sand resources can be divided into three categories. The current supply comes from the *Mineable Reserves* on existing operations. As mineable reserves are depleted, *Accessible Resources* must be developed into new operations, and long-term supply must be provided by *Alternative Resources* that are presently uneconomic to develop, unavailable, or imported. In some parts of the world, where natural deposits are unavailable and the demand volume is large enough to defray costs, sand is 'manufactured'.

In order to develop a new resource, a lease must be issued from Mineral Resources Tasmania and a permit obtained under the *Land Use Planning And Approvals Act 1993*. A permit cannot currently be granted unless the resource is located in a Planning Scheme zone for which extractive industry is permitted or discretionary. Approximately 16% of the sand resources in the Hobart region are mineable reserves on existing operations, while an additional 13% of the resources are accessible outside these operations. Approximately 6% of the resources are not mineable

and the remaining 65% are in Planning Scheme zones which preclude mining.

Within this report Part A contains a discussion of the future supply of sand at a regional level. Existing operations and resources with potential for major operations are treated individually in Part B, while Part C examines the relative merits of each potential operation compared to the existing operations at South Arm.

Existing supply and demand

The life of a given sand reserve is determined by the rate at which the sand is consumed. If consumption is reduced, the life of the reserve will be extended. In the latter half of the 1990s, the demand for sand was depressed because of a slump in the building and construction industries. Reduced demand also resulted from the substitution of the coarse component of sand used to manufacture premixed concrete with crushing fines (termed 'crusher dust').

Building approvals declined by 48.2% in the Greater Hobart region from 1994/95 to 1997/98 with engineered construction also falling. The biggest fall was in 1998, correlating with a fall in sand production (fig. 2).

A recovery in the building industry occurred during 1999/2000, with the number of building approvals rising for nine months in succession to December 1999. The value of approvals in the Greater Hobart area was \$154.8 million in 1997/98. The increase in the number of building approvals has not yet translated into a recovery in sand production, although anecdotal evidence suggests demand has started to increase.

Construction statewide is forecast to improve over the next two years but not to the levels of the late 1980s and early 1990s, nor will the Hobart region necessarily follow the State trend. The adjusted production of sand from operations across the region, averaged over the eight years up to 1999, was 145 000 tonnes per annum.

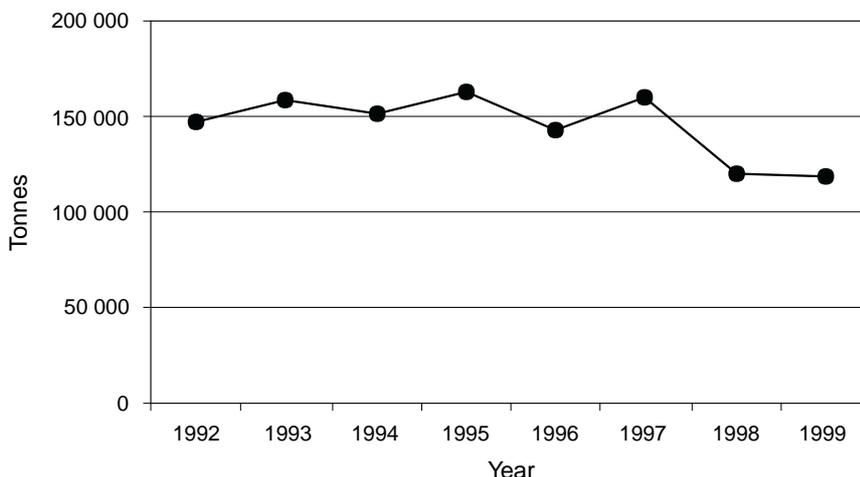


Figure 2
Concrete sand production
in the Hobart region

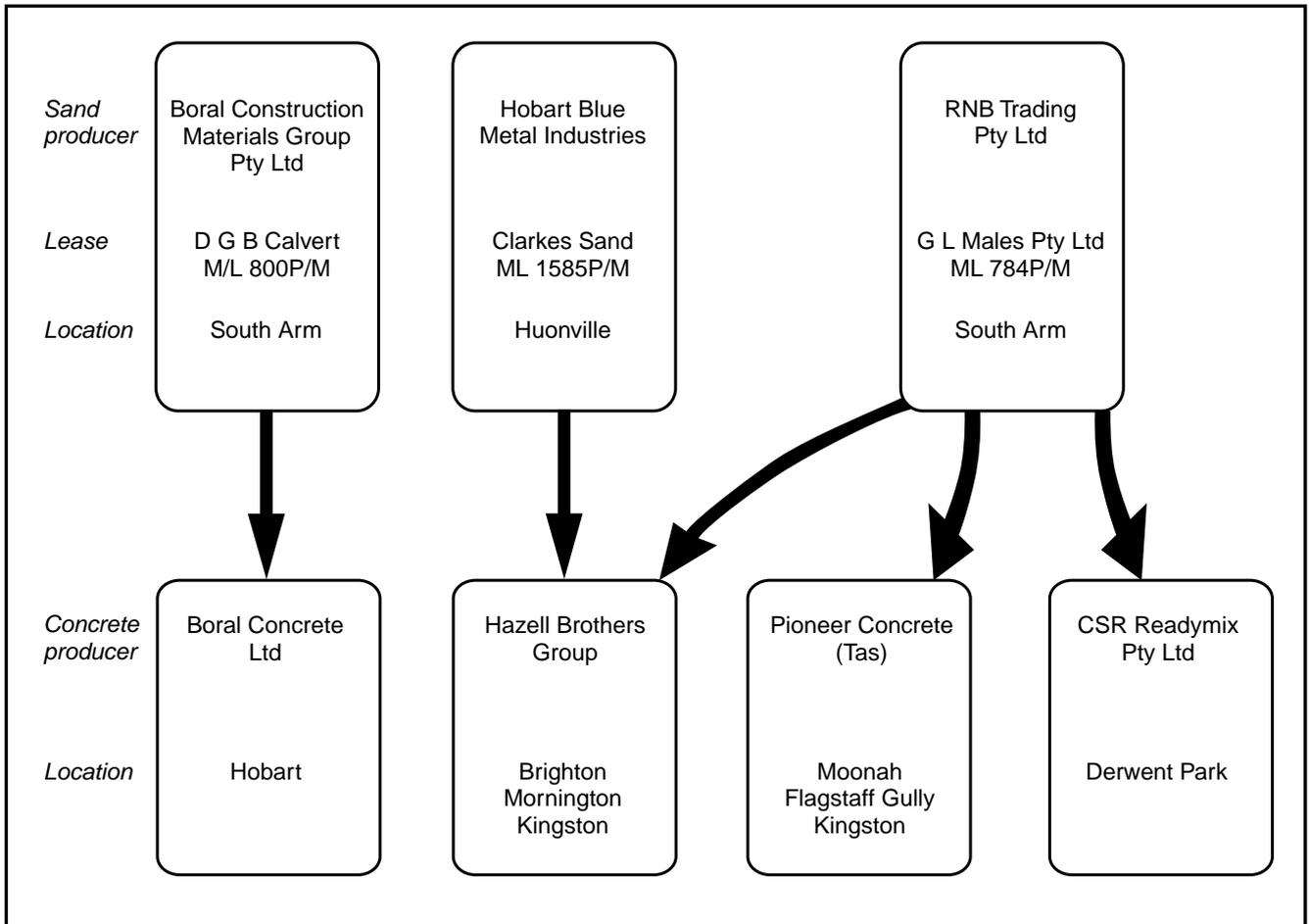


Figure 3

Major producers and end-users of sand in the Hobart region

Figure 3 shows how the supply of sand in the region is generated, and lists the customers that make up the bulk of the demand. Combined sand consumption reported by concrete producers is 60 000 tonnes per annum of the 120 000 tonnes of sand produced in 1999.

Mineable reserves

The dry sand reserves on existing leases, which can be mined, are estimated at six million tonnes. The total reserves on existing leases, including accessible wet sand reserves to three metres below the water table, are 7.8 million tonnes. The main factors governing regional supply are the life of individual reserves, particularly dune sand reserves, and the ability of operators to cover shortfalls when individual reserves are depleted, which is determined by maximum production rates. The major sand producer in the Hobart region could potentially exhaust its reserves of dune sand in 9.5 years.

The relative size of each sand reserve, and the production rate of each operation, is displayed graphically in Figures 4 and 5. The individual operations are discussed in Part B of this report.

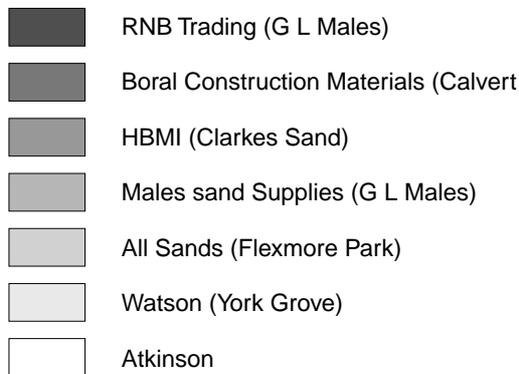
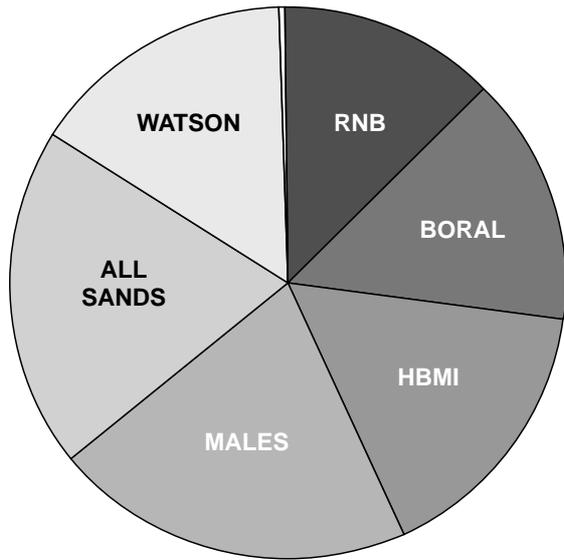
Figure 4 shows that the relative size of each reserve is similar whereas Figure 5 demonstrates that RNB Trading Pty Ltd (RNB Trading) has the largest share of

the market. Accordingly if that market share is maintained then the RNB Trading operation will be the first to close. Boral Construction Materials Group Pty Ltd (Boral) and RNB Trading dominate the market because their dune sand is cheap to produce, of consistent quality and they are licensed to produce large volumes. If either operation closed the other would control the market.

A forecast of production for the region is projected in Figure 6. The coloured units represent production from each operation. The thickness of each unit represents the production for that year and the area inside each unit represents the size of the reserve. The production units are stacked on each other to represent the summation of total production. When supply from existing operations cannot satisfy the demand, due to depletion of the reserve or production rate constraints, a shortfall is shown.

The forecast is projected using existing permit conditions and takes into account any mining constraints on production. Where a supply shortfall develops, the other operations will tend to increase production if it is possible or advantageous to do so. In developing the supply projection it was assumed that neither permit conditions nor existing operational constraints could be altered.

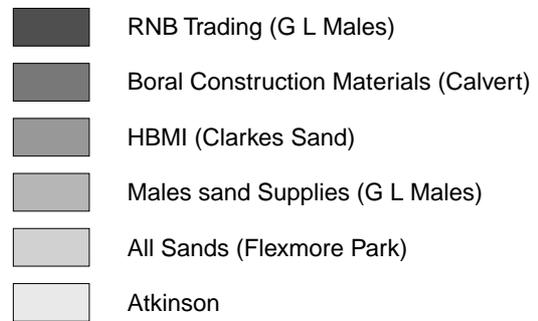
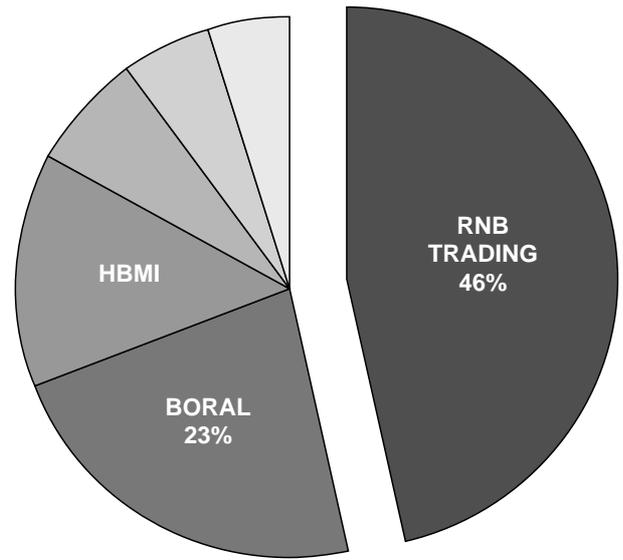
DISTRIBUTION OF MINEABLE RESERVES ON EXISTING LEASES



Expressed as a percentage of the mineable reserves in southern Tasmania

Figure 4

PRODUCTION ON EXISTING OPERATIONS



Expressed as a percentage of the southern Tasmanian market

Figure 5

Boral may not necessarily expand sand production from its lease (held under the name D. G. B. Calvert) to fill the supply shortfall created if the RNB Trading reserve was depleted. As a producer of concrete, Boral may continue to dedicate sand production to its own concrete plant, thus extending the life of the Calvert reserves. This argument is represented in Figure 6 by a question mark over production from the Calvert lease beyond 2010. Other operators may not be able to supply enough sand at consistent quality to offset the potential shortfall created.

Males Sand Supplies Pty Ltd (Males) operates a wet pit near the RNB Trading operation at South Arm. Production at this pit is limited by the plant capacity. The plant capacity is reliant upon the water supply, including the use of groundwater. The water holding capacity could be increased by deepening the existing wet pit.

The capacity of the HBMI (Clarkes Sand) operation at Huonville is limited by the treatment of clay slimes, which must be settled in a pond or filtered. Production

could be doubled before the capacity of existing settling ponds is exceeded and could be increased if additional dams were constructed or if filtering equipment was purchased. Increasing the capacity at Males Sand Supplies and HBMI is not currently justified.

Flexmore Park Pty Ltd (Flexmore Park) holds a lease, operated by All Sands Pty Ltd (All Sands) near Shark Point, which has the potential to replace some production from the South Arm operations. Only 5000 m³ of sand can be mined per annum under the existing permit. Extraction from Flexmore Park is currently an incidental operation complementing timber harvesting and cropping activities. Transport of sand from an expanded operation at Flexmore Park may be impeded by traffic constraints through Shark Point and Midway Point.

Kevin and Todd Watson (Watson) operate the 'York Grove' farm near Cape Contrariety on the South Arm peninsula. This area contains a sand resource with potential for large-scale development, although it may

SOUTHERN TASMANIA SAND SUPPLY — PROJECTED FORECAST

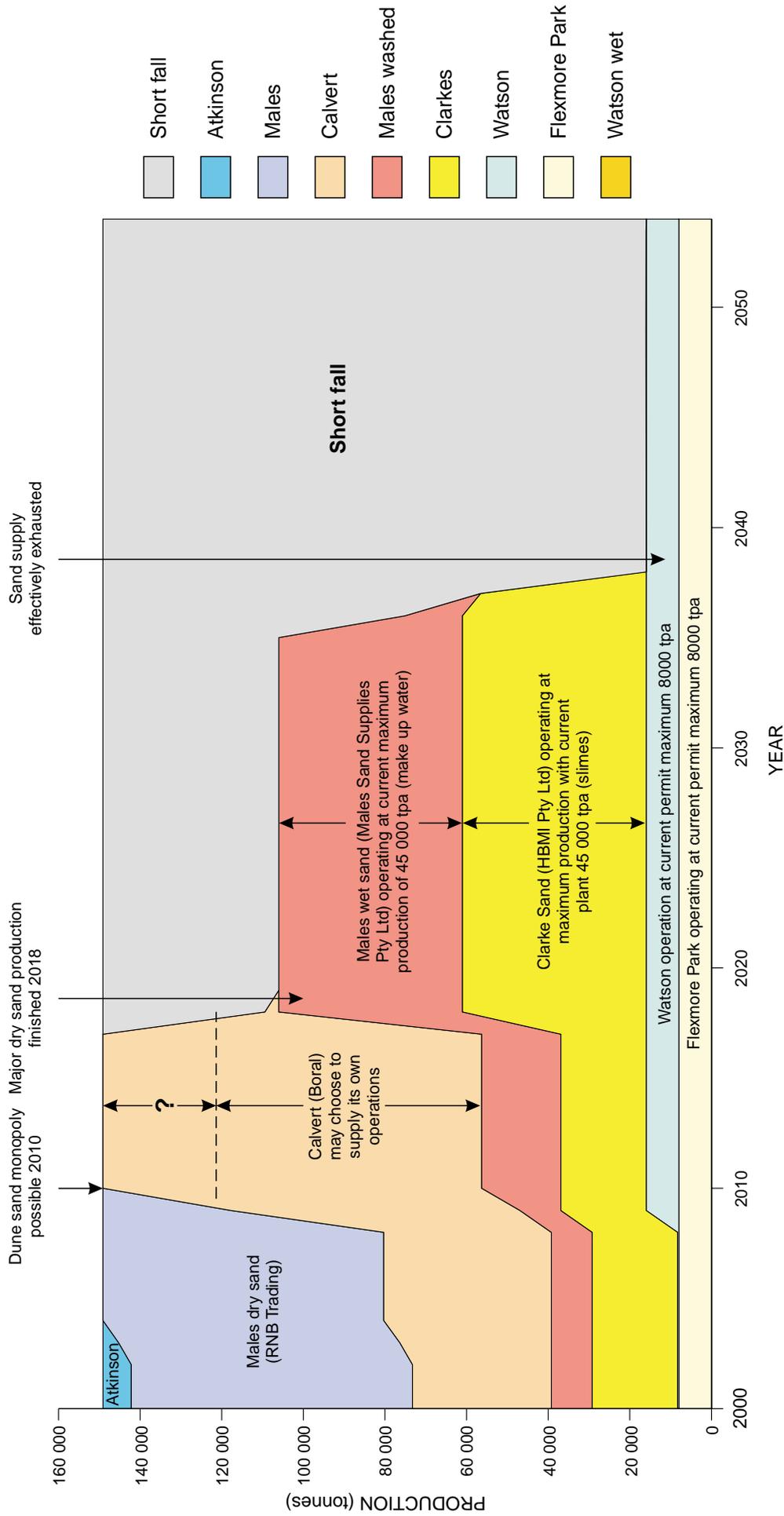


Figure 6

be difficult to obtain approval to increase production beyond the currently allowable 5000 m³. The operation may be constrained by environmental issues relating to the stability of the foreshore dune and the proximity of the resource to the South Arm State Recreation Area.

Accessible resources outside existing operations

With a shortfall of sand forecast within ten years, the potential to develop new operations must be considered. Outside existing reserves, only 13 % of the dry sand resources identified by Duncan (1999) are accessible to extractive industries. The accessible resources are also situated further away from the major users. Extraction of sand from these outlying resources may incur higher associated transport costs. The 36 million cubic metres of wet sand resources (below the water table) identified outside existing operations are also inaccessible. A breakdown of the resource accessibility is shown in Figures 7 and 8.

The accessible resource outside existing operations is three million cubic metres of dry sand, but transport distances, the size of the operation and poor sand quality tend to make these resources uneconomic. The South Arm operations, in comparison, are 35 km from

the Hobart GPO, are of consistent quality and are similar in size to the undeveloped accessible resources.

The accessible resources are shown on Figure 1. The Brown Mountain Road deposit is 40 km from the GPO, but it is a small deposit, with low potential for large-scale development. The Carlton Plains resource is 50 km from the GPO and is too fine grained for concrete production. The Buckland resource at Sand River is 70 km from the GPO, which would add around \$3.50 to the cost of each cubic metre of sand delivered compared to sand delivered from South Arm.

Alternative supplies

Inaccessible resources

A graphical representation of the relative size of the inaccessible resources is shown in Figure 9. The larger resources with potential for large operations are annotated in Figure 1. The Carlton resource has some potential, but it is finer grained than sand currently mined, further away than South Arm, and has been partially sterilised by residential development. Extraction of sand in the South Arm State Recreation

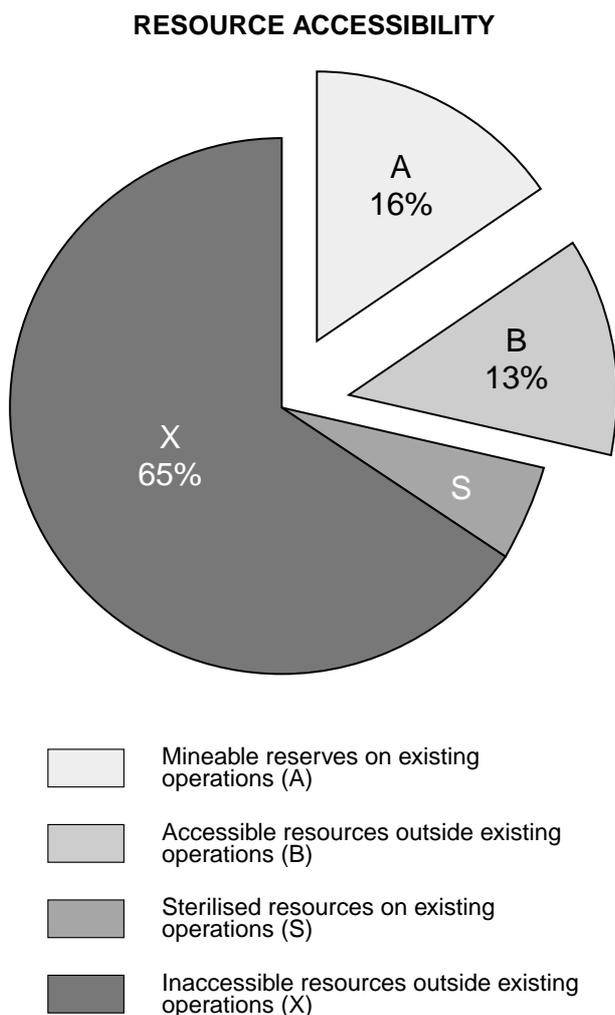


Figure 7

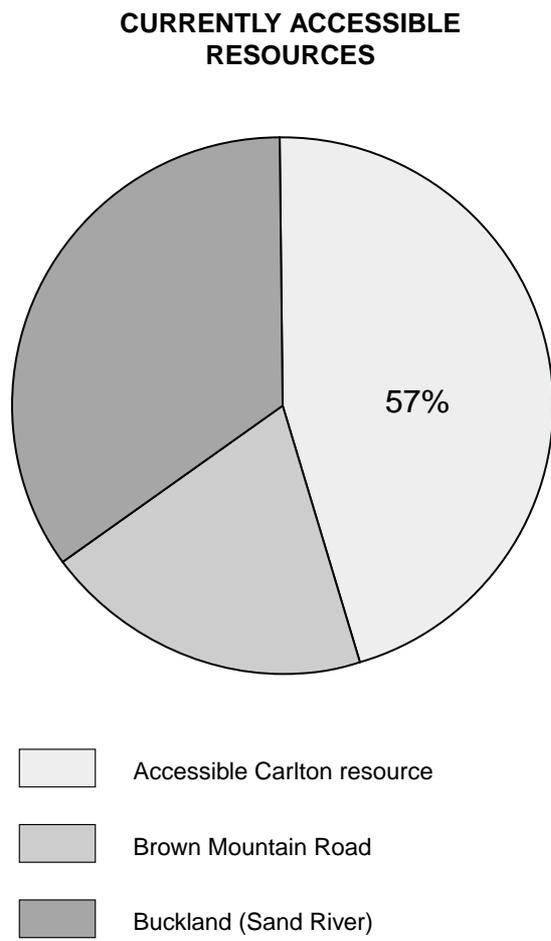


Figure 8

CURRENTLY INACCESSIBLE RESOURCES

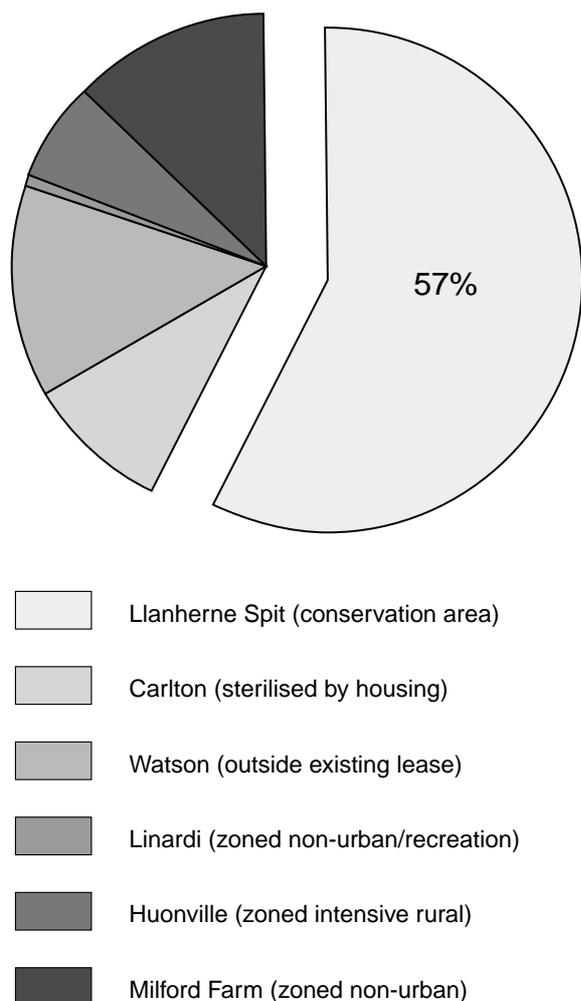


Figure 9

Area to the west of the current lease held by Watson, at York Grove, is unlikely to be approved.

The largest resource outside existing operations is the dune sand contained within the Llanherne Spit, near the suburb of Seven Mile Beach. The potential resource has been calculated within a boundary that excludes the beaches, fore dunes and other sensitive areas on the spit. Sand mined from within this core zone could supply the Hobart market for between 50 and 90 years. The Planning Scheme zone does not permit mining and the spit is currently a Conservation Area.

Milford Farm, which is located across the Tasman Highway from the Tasmania Golf Club, also contains a sand resource. The area is screened from traffic to some extent by open eucalypt forest. Some of the resource identified by Duncan (1999) is sterilised by the need for a screen or on land reserved by the Hobart Airport. The potential for large-scale development of the sand resource on Milford Farm is limited by existing and future agricultural development.

Smaller deposits such as Milford Farm have the potential to ease supply shortfalls if municipal Planning Schemes allow more discretion to approve

extractive industry in non-urban zones. These smaller deposits may be developed to supply the general sand market whilst allowing larger deposits to be developed solely for the construction industry and wholesale markets. This could further extend sharp sand resources.

Planning Schemes could potentially restrict development of sand resources in the Clarence, Sorell and Huon Valley Municipalities unless provision for extraction of sand is considered. Fragmentation of land for subdivision could also reduce or sterilise sand resources. Some of the resource previously identified at Carlton has already been sterilised by housing developments. To avoid further sterilisation of resources it is proposed that Planning Schemes recognise potential sand resources and that subdivision is excluded on sand resources.

Imported sand

Large resources of sand suitable for concrete occur in the Scottsdale area in northeast Tasmania. The sand from Scottsdale is coarse and well graded compared to dune sand, which is typically fine and poorly graded. Consequently sand imported from Scottsdale does not need to be blended with crusher dust to achieve concrete specifications. The product is also reported to reduce the amount of cement required to obtain a given strength. Production costs are generally low because the region hosts a number of large, deep deposits

Scottsdale sand is presently back loaded to Hobart by trucks after they deliver fertiliser. Rail freight of sand has also been trialled. Concrete plants situated near the rail network could potentially import sand by rail if road transport costs increased substantially. Importation of sand to the Hobart region has been limited to date but it could increase if sand shortfalls occurred or additional back-loading markets are secured.

Sand washing

Fat sand is a sand containing clay and is primarily used for mortar and loam. By virtue of location and abundance, the supply of fat sand and other sand and general sand is not likely to be affected in the foreseeable future. Sand containing up to 25% clay may be washed up to three times to produce sand amenable for concrete production (*Quarry magazine*, December 1999).

The fat sand component of the resources at Flexmore Park and Buckland could possibly be washed to produce sand for concrete production. Although more expensive to produce, and in the case of Buckland further away from the market, the use of fat sand resources could extend sharp sand supplies. Once existing sand washing operations are exhausted, the underlying fat sand at Flexmore Park (6.3 million m³) may be economical to treat in this way. Further test work would be required to assess this possibility.

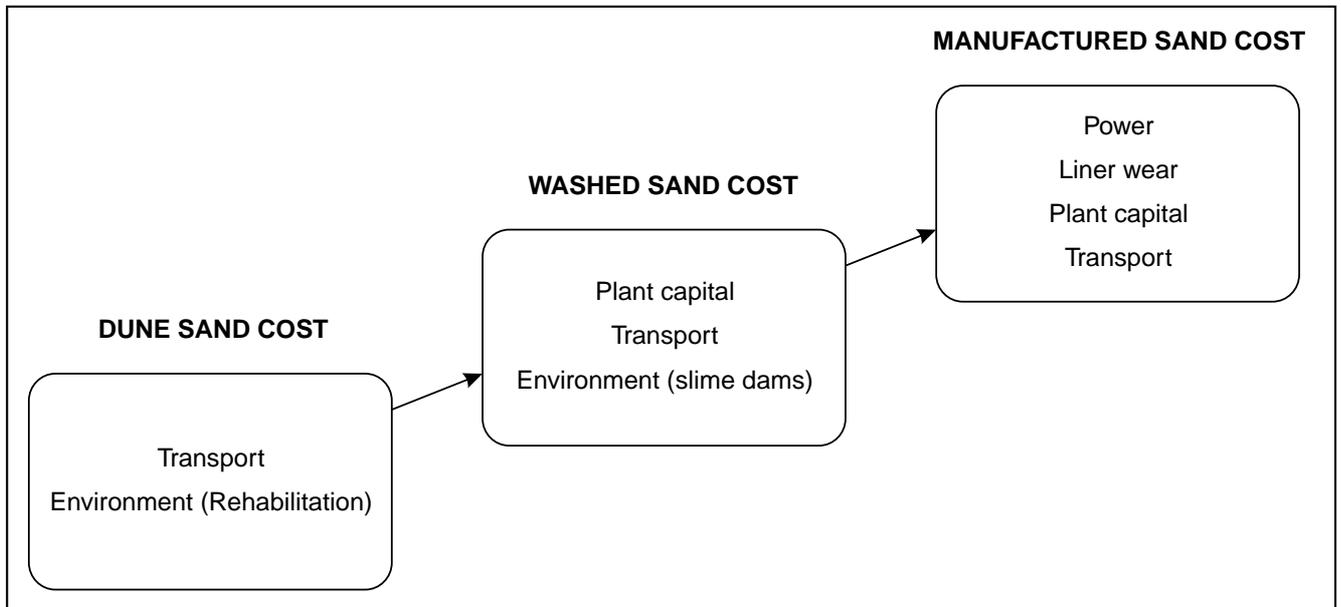


Figure 10

There are environmental and cost considerations for washed sand. The main problem is the disposal of the clay slimes which are separated from the final product. Washing the sand incurs additional costs and overheads. Historically, washed sand was blended with dune sand so that the fine aggregate produced complied with the specification for concrete but its use for blending has been largely substituted by crusher fines or 'dust'.

The Males wet pit operation at South Arm mainly supplies the brick paver market, where the size, colour and texture of washed sand is more suitable than crushed rock. Hobart Blue Metal Industries Pty Ltd (HBMI) sells sand from its lease, held under the name Clarkes Sand, to its parent company the Hazell Brothers Group to efficiently share overheads. Other washed sand products are marketed as foundry sand, propagating sand and general sand.

Crusher dust and manufactured sand

Hobart's concrete industry increasingly relies on fines produced by crushing stone to partly substitute for sand. Crusher dust may be considered as a raw by-product of stone crushing, while manufactured sand is more often a specific product from a dedicated crushing process. Coarse crusher dust is blended with fine dune sand to achieve a gradation of particle sizes suitable for the manufacture of concrete. Using crusher dust in the manufacture of concrete gives the product homogeneous colour and smooth finishing properties.

The major stone quarries presently have excess crushing capacity because of the depressed regional demand for stone. With additional capacity available, existing crushing circuits have been rearranged to produce fines suitable for the manufacture of concrete. In some cases, specialised equipment such as Barmac

crushers have been used to improve particle shape and sizing.

A telephone survey of the Hobart concrete plants highlighted a wide range of practices, with crusher dust being blended in proportions ranging from 110 kg dust per m³ concrete to 335 kg/m³. The sand usage is typically 600 kg/m³. The combined annual consumption of crusher dust is about 28 000 tonnes. If crusher dust was not used, coarse sand product from washing plants would be required. This conserves the existing natural sand resources.

Fine Crushed Rock (FCR) and crusher dust is also sought for road construction and blending to achieve size-grading specification of pavement materials. Consequently there is no excess production of crusher dust in the Hobart region. Some operators are already specifically crushing to produce fines. Because of the abundance of coarse sharp sand in northern Tasmania, there are stockpiles of crusher dust near Launceston which would be suitable for concrete if it was economic to transport and stockpile in Hobart.

The next step from crusher dust is to grind finer fractions of rock to produce a dedicated product stream of 'manufactured sand'. Manufactured sand can improve some concrete properties. Additional advantages, such as ease of finish, are attractive to slurry contractors and concrete fabricators. The Hobart market may not be large enough to justify large-scale production of manufactured sand. Typically manufactured sand plants elsewhere produce hundreds of thousands of tonnes of sand per annum, whereas the *total* Hobart sand production is less than 150 000 tonnes per year.

Typically crusher fines larger than 200 micrometres must be blended with dune sand from South Arm to achieve an acceptable sand specification. It is doubtful

whether sand produced by Lazenby at Sandford, which would require blended additions down to 150 µm, is economic to use in concrete. The Carlton resource is even poorer. The data quoted are not necessarily representative of each resource.

Conclusions

Building approvals in the Hobart region are currently increasing but long-term demand for construction materials such as dune sand will remain static unless there is growth in the construction and building industry.

Price increases and replacement of the market will occur within ten years as existing dune sand resources are depleted, based on individual reserve estimates. Outlying resources on the fringe of the Greater Hobart area cannot replace existing operations nor compete with imported sand.

Sand washing plants and wet-pit operations in the region cannot compete with dune sand operations but

can supply niche markets. The Hobart market is too small to justify large-scale manufacturing of sand but a combination of blending with crusher dust, imports and washed sand could supply the market if local dune sand resources are exhausted and prices rise.

Each sand consumer will choose a supply source or combination of sources based on their corporate structure. Companies with strong transport divisions may choose to import. Alternatively companies with local quarry activities may choose to blend or manufacture. Companies without major transport or crushing divisions may seek to increase their sand resource holdings.

Price increases can be minimised if access to resources close to Hobart can be secured. This would require land tenures to be modified to allow extractive industry. Approval for development of the next generation of resources will require lengthy public consultation and planning, which will reduce the window of time for effective action before shortfalls become apparent.

Part B: Current major operations and resources with major potential



Overview of the major South Arm operations

Current major operations

Males Dry Sand (RN B Trading Pty Ltd)

RNB Trading are the proprietors of the dry sand operations on the lease of G. L. Males at South Arm. Males Sand Supplies operates the wet sand operations on the same lease. The dry sand operations from the Males lease have accounted for 47% of total sharp sand production over the last eight years at an average of 65 947 tonnes per annum. Production for 1999 was 45 552 tonnes.

The resource runs east to west behind the Hope Beach foredune. The vegetation in the area is characterised by marram grass and regenerating coastal native vegetation. The operators are required to keep operations 100 metres inland from the high water mark. The accessible resource is approximately one million tonnes. The modal average of the particle size is +0.212 mm to +0.15 mm, with the proportion of fines (particles smaller than 0.075 mm) less than 0.1%.

The reserves on the lease are significantly reduced by permit conditions, which stipulate that the visual amenity, when viewed from South Arm Road, will be ensured. The 'western extension' to the Environmental Management Plan includes the mining of two large dune structures, which form the skyline when viewed from the road. The extension has not yet been approved by a change to the permit, so that portion of

the resource has not been included in the mineable reserve.

For a stable landform to be retained after mining, a final slope of less than 20° is assumed. This further reduces the effective face length as operations pinch out to the west. The mineable reserve as at December 1999 is estimated as 651 140 tonnes or 9.5 years at average rates of production.

Males Washed Sand (Males Sand Supplies Pty Ltd)

Males Sand Supplies Pty Ltd operates from the Males lease at South Arm. A coarse sand is produced by washing sand extracted from low dunes and wet pits. Production has reduced from about 15 000 tonnes per year to approximately 10 000 tonnes, although only 865 tonnes were reported as being produced in the 1999 production return. Males do not supply the ready mixed concrete market because the use of coarse sand in concrete manufacture has been substituted by crusher dust.

The economic cost of expanding and deepening the freshwater lake formed by operations will eventually determine the size of the mining reserve. The final shore must be separated from the toe of the slope formed by dry sand mining to ensure landform stability. If the economic depth of dredging is considered to be three metres, the mineable reserve is estimated as 1.694 million tonnes. The particle size is



RNB Trading's operation in the foreground with Boral's Calvert lease in the background

generally coarser and better graded than the dry pit product, with the modal average of particle size being +0.6 mm to +0.3 mm, with the proportion of fines less than 1.7%.

The plant currently only runs at 20% capacity and it is unlikely that the permitted maximum production of 120 000 tonnes per annum (combined production of RNB Trading and Males Sand Supplies) would be reached. The upper limit on production is estimated at 45 000 tonnes per year, based on the time it takes for the make-up water dam to recharge as water re-circulates back from sediment traps. Dredging the make-up water dam to three metres would increase the capacity of the dam and allow for higher production.

Based on past production, the operation could provide sand for 72 years. Once the dry sand operations were exhausted, production may increase, which could in turn reduce the reserve life considerably. The visual impact of the operation viewed from Goat Bluff and the integrity of the aquifer need to be considered when the Environmental Management Plan is reviewed. The final land use will be native bush surrounding a shallow wetland, formed as the Males Sand Supply wet sand operation progresses behind the dry sand operation. Good regrowth has become established on the old dry pit margins.

Calvert (Boral Construction Materials Group Pty Ltd)

The Calvert lease is operated by Boral, which produces sand for its concrete batch plant. Production from the Calvert lease accounts for 23% of total sand production. The mineable reserve is estimated at 1.16

million tonnes, which could supply the market for 34 years at average rates of production. The modal average of the particle size is +0.212 mm to +0.15 mm, with the proportion of fines less than 0.15%.

Production returns for 1999 show a drop in production to 20 397 tonnes for the year. Boral could potentially import sand using its truck fleet or rail freight to the Bridgewater Quarry.

Marram grass has been used to revegetate the back slope of the foredune. The back dune has been generally reduced in height by mining and is yet to be sloped back and revegetated. Mining is progressing eastwards, with the exposed face of an older operation to be excavated in the process. This will allow for rehabilitation of the eastern section during which mining will recommence westward beyond the middle section, which has already been rehabilitated.

Clarkes Sand (HBMI Pty Ltd)

HBMI Pty Ltd operates from the Clarkes sand operations in Huonville. The mineable reserve has been reduced to reflect some sterilisation of the resource by the construction of three dams on site, access roads and a riparian reserve along a stream to the west. There is up to six metres of clay overburden over sections of the resource and a wash plant operates on site. The mineable reserve is estimated as 1.27 million tonnes. Duncan (1999) indicates that the sand tends to be coarse and well graded, although there are also lenses of fine, well-sorted sand on site. The washed product has a modal average particle size of +0.3 mm, with no discernable fines.



Western end of the D. G. B. Calvert lease operated by Boral showing progressive rehabilitation



The HBMI sand washing plant, with the water reclaim supply dam in the foreground

Production for 1999 increased to 26 076 tonnes from the previous average of 20 913 tonnes per annum. Prior to 1995, when HBMI acquired the operation to supply its Kingston concrete plant, the plant was producing less than 5000 tonnes a year. Production is forecast to fall, with more material being purchased from RNB Trading to blend with crusher dust from the operator's Kingston Quarry for use in concrete production. The average production is therefore reasonable to use in forecasting future supply trends. The operation also

supplies a niche market for propagating sand and landscaping sales.

Although the permit allows for the extraction of up to 64 000 tonnes per annum, additional capital for equipment to de-water slimes would be needed for production beyond 45 000 tonnes a year. At average production rates, the sand reserves on site would be exhausted in 60 years.

Resources with potential for major operations

Llanherne Spit

Llanherne Spit contains over nine million cubic metres of sharp sand above the water table. Extraction of the wet sand resource is not considered here, as the sand below the water table hosts an excellent groundwater resource. The mineable reserve is estimated between 7 and 13.2 million tonnes of sand.

Duncan (1999) indicated that the modal average for the dry sand particles is +0.15 mm to +.212 mm, which is coarser than the underlying wet sand, but still finer than South Arm sand.

The reserve calculation is based on work by Threader (1974), who calculated a resource of 45 million cubic metres over an area of 500 hectares (Llanherne Spit covers 800 hectares). Threader assumed a foreshore reserve of 90 metres and included sand below the water table to a total depth below the surface of nine metres. When Cromer and Sloane (1976) drilled transects of the sand dunes at Llanherne Spit the average depth of dry sand was found to be 1.8 metres. Therefore dry sand is one-fifth of total resource (depth to water table divided by total depth) or nine million cubic metres.

Later work by K. C. Morrison in 1995 included re-drilling of transects B and C originally drilled by Cromer and Sloane, with an additional transect D to the east. The average depth to the water table was noted as 2.5 metres, lower than that recorded by Cromer and Sloane. There may be distortions in the

water table due to pumping from the aquifer to the golf course and transpiration from the pine plantation.

The depth of the water table is critical to the mineable reserve figure because the dry sand is relatively shallow. Dry sand mining is usually only permitted down to one metre above the water table to ensure enough cover to preserve the water table. For an area of 550 hectares (Multiple Land Use Zone, *Seven Mile Beach Protected Area Draft Management Plan 1996*), the mineable reserve is estimated to be between 4.4 million and 8.25 million cubic metres of sand after allowing for one metre of sand to be retained above the water table. The lower figure is based on an average depth to the excavation floor of 0.8 metres deep, with the higher figure based on a depth to the floor of 1.5 metres.

Depending on the permitted floor height, there may be sections of dry sand which are too shallow to mine economically. Further groundwater studies are required to determine the floor heights for any future excavation and to accommodate any rises in the water table associated with winter rains and vegetation clearing. Bores could be retained to monitor changes as mining proceeded.

The *Seven Mile Beach Protected Area Draft Management Plan 1996*, Section 3.2.6 – Sand Resources, raises the need to consider the sustainable use and management of all sand resources within the Hobart region before sand extraction can be considered within the Conservation Area. The draft plan lists consideration of the existing sand resources, availability of those resources, future needs of the region, supply alternatives, environmental and social consequences of mining each resource, and the regulation and



Llanherne Spit looking east, with the airport runway in the foreground



Flexmore Park sand pit looking south to the lease boundary at the far edge of the excavation

management of extraction as pre-requisites to allow inclusion of mining within the management framework. The relative merits of sand extraction at Llanherne Spit compared to South Arm are described in Part C.

Flexmore Park (All Sands Pty Ltd)

Flexmore Park is the largest single resource identified under an existing lease. The land is primarily used for agriculture, with a small sand mining operation and retail stockpile on the site. All of the resource should be accessible with the exception of 200 000 m³ which is covered by a landscape protection zone, leaving about 900 000 m³ available. The resource is also covered to some extent by a private timber plantation, which may affect production or sterilise portions of the reserve until the timber is harvested.

The production from the site is screened and retailed as several products. Fat sand underlies the sharp sand resource, separated by a clay hardpan. The operator separately mines both types of sand by benching down to the base of each horizon. It is estimated that 8000 tonnes of sharp sand and approximately 1200 tonnes of fat sand are produced each year.

More test work would be required to determine the suitability of the sand for concrete manufacture, although some concrete was manufactured with Flexmore Park sharp sand several years ago. The largest block tested by Duncan (1999) was block E. Duncan indicated that the assorted sharp sand had a modal average particle size of +0.212 mm with the proportion of fines quite variable between 0.3% (lower

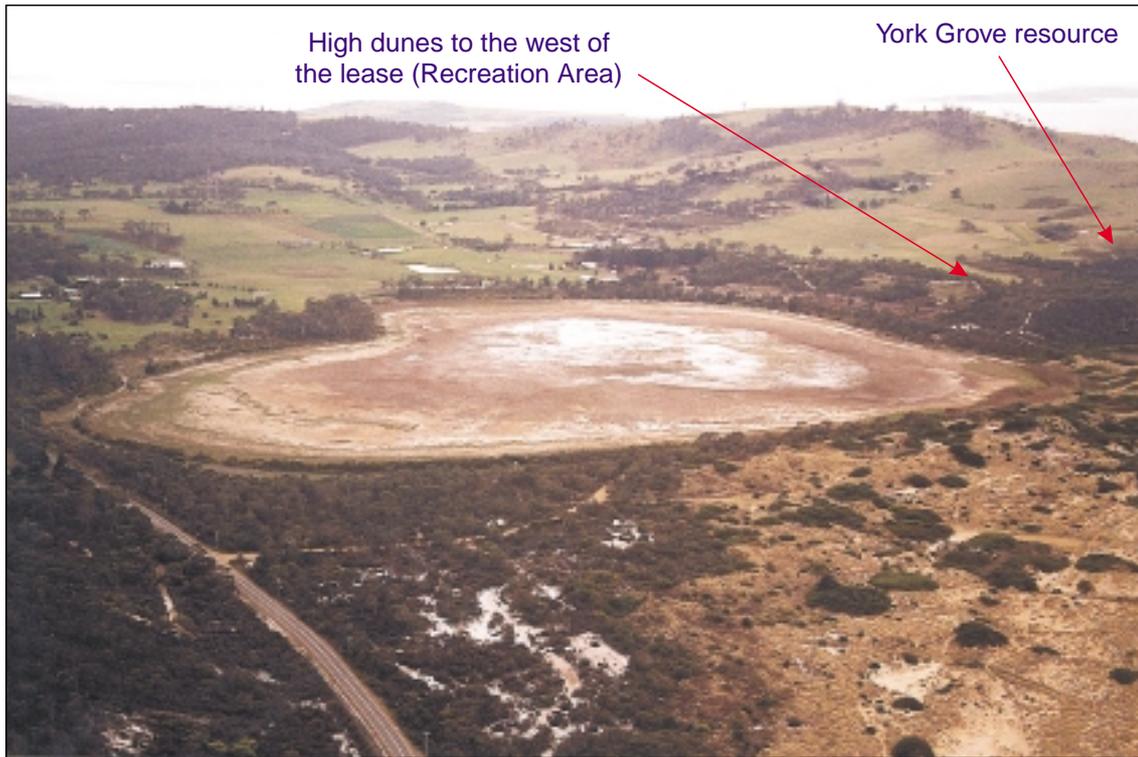
sand, block E) and 2.5%. Most of the sand in the existing pit had a fines content between 0.8 and 2.5%.

An Environmental Management Plan would need to be approved and a level 2 permit granted before the operation could be expanded. In the past there was public objection to increased traffic along Shark Point Road. There is approximately 1.5 km of unsealed access leading to Flexmore Park, part of which is adjacent to residences.

York Grove (K. and T. Watson)

The Watson's mine sand along the lee slope of foredunes on their 'York Grove' property, at the eastern end of Calverts Beach, South Arm. The permit is based on the development of a dam for stock with a maximum production of 5000 m³ (8000 tonnes) per year. At the permitted production rate the reserve will not be exhausted within 50 years. There is also a potential wet-pit resource. Duncan (1999) indicates that the resource is deep and marginally coarser than South Arm operations, with the modal average of the particle size being +0.3 mm to +0.212 mm.

The environmental sensitivity of the surrounding area is high. The lease is bounded by Calverts Beach to the south and the South Arm State Recreation Area to the west. The recreation area comprises Calverts Lagoon, which provides habitat for birds, and a bird watching vantage point situated on high dunes overlooking both the lagoon and the sand resource. Nearly all the sand resource is covered by native coastal plant species. The dunes to the west of the lease are up to 20 metres above sea level, and there is a risk of the dunes being undercut by the excavation unless the slopes are



Calverts Lagoon showing South Arm Highway and historical sand mining in the foreground and 'York Grove' farm to the far right

battered back to 20 degrees. The operation is not evident from main roads.

This resource is attractive because of the quality and depth of sand but there are environmental issues involving proximity to the adjacent lagoon and recreational areas. Management of the resource has been haphazard in the past due to its small scale and sporadic use. The resource could extend the life of existing South Arm operations if the environmental

issues can be resolved. The operator does not currently wish to expand the scope of operations.

The potential for expanding this operation raises the same issues as those affecting existing South Arm operations. The relative environmental and socio-economic arguments for its potential expansion have been included in Part C as an existing South Arm operation.

Part C: Comparison of socio-economic and environmental issues between South Arm operations and other potential resources

The potential worth of a sand resource is affected greatly by its quality, the associated transport costs, the ease with which it may be mined, and the potential effects an extractive operation may have on the local community and environment. A brief comparison of the issues relating to existing and potential operations is described in this section.

Continuation of mining at South Arm

Community attitudes towards sand mining

The continuation of sand mining at South Arm is reliant upon the continued tolerance by the local and broader communities of extractive industries on South Arm and heavy haulage along the road into Hobart. It is imperative that the operator's management practices are of the highest standard to maintain this relationship. South Arm has a history of extractive industries, but as the area disturbed by mining increases and the area develops, there is potential for community concern about sand mining.

Environmental and archaeological considerations

The continued operations at South Arm will tend to confine coastal disturbance from mining to existing operations. However, mining at South Arm requires the clearing of native vegetation, which has regenerated over decades after earlier cropping and grazing. *Ammophila arenaria* (marram grass) has been used to rehabilitate the fine sandy slopes exposed by mining in the past. The use of native species, such as *Myoporum insulare* (Boobyalla) to revegetate is encouraged and in older areas free from grazing, coastal species are returning.

The aquifers underlying the South Arm sand deposits are generally of a high quality. Creation of man-made lakes where wet pit mining is permitted may pose risks to the quality of the aquifers but there is limited data available. The lakes formed may offer recreational values as a land use after mining. The foredunes are subject to seasonal cutting and filling by the action of wind and waves. The Tasmanian Government acquired land along the neck to preclude mining at the narrowest point.

The archaeology of the South Arm neck is discussed in the Environmental Management Plans. To date no significant sites have been discovered.

Public amenity

An important consideration in discussing potential operations is the public amenity of each project. Public access, visual impact, noise, dust, traffic and recreational values are the main issues considered

when individual projects are subject to public hearing. Existing South Arm operations do not attract the level of public attention that a new project would receive. The Environmental Management Plans for South Arm are due for renewal. Provided that there is no change in the scale of operations, additional conditions to the current licenses could only be effected by the serving of an Environmental Protection Notice (EPN).

Public access at South Arm is limited by private land and the mining activities do not unduly affect access. The Crown purchased land near Goat Bluff to improve public access to the beach. Visual impact from vantage points will be only marginally affected by works within the Environmental Management Plans. Some of the calculated mineable reserves were reduced on the basis that dominant alterations to the skyline adjacent to South Arm Road have not been approved.

The main possibility of nuisance created by sand mining at South Arm is noise and nuisance from traffic along the haulage route. There are 1004 residences within 300 metres of the present haulage route from South Arm operations to the junction of the Tasman and South Arm Highways at Mornington. The main areas affected by South Arm sand haulage are Sandford, Lauderdale, Rokeby, Howrah and Mornington.

Socio-economic considerations

The economic value of mining to the community is a balance of the costs and benefits associated with mining, transporting and downstream processing of the sand and finally, construction prices which are passed on to the consumer over the life of the resource. South Arm operations will start closing within ten years if the average demand for sand is maintained, with approximately twenty years of total reserves left on existing operations at current production rates.

It is estimated that sand freight accounts for 3000 truck journeys from South Arm per year. Improvements have been made to the South Arm Highway over the last few years but maintenance costs from heavy vehicles are still significant. The cost to transport sand from South Arm is \$4.30 per tonne. Transport costs from both Llanherne Spit and Flexmore Park should be cheaper, with lower associated maintenance costs. There are no royalties generated by the South Arm operations, as the operations are on private land.

South Arm operations do not compete with other agricultural activities such as forestry or cropping, whereas Llanherne Spit and Flexmore Park support forestry activities, which may conflict with mining to some degree. Some grazing does co-exist with Boral's

operation, which may hinder the reintroduction of native species during rehabilitation.

Mining costs at South Arm are low because the dry sand is deeper, relative to deposits such as Llanherne Spit, and easier to excavate relative to resources such as Flexmore Park and Clarke's Sand, which contain shallower clay horizons. Deeper deposits, such as those at South Arm, also require less cleared area per cubic metre of sand extracted, so environmental impact, clearing and rehabilitation costs are all reduced for a given tonnage. After stripping the sand is simply screened at the face and loaded onto trucks from the stockpile.

The sand quality at South Arm is consistent and although the sand is poorly graded, blending practices are well established. Some isolated problems with shell grit have occurred at South Arm in the past.

Building costs could be expected to rise slightly due to increases in sand prices within the next ten years based on diminished supply if South Arm operations continue without major new operations commencing. The value of sand delivered to batch plants in the greater Hobart region annually is estimated at between \$1.3 and \$1.5 million, much of which comes from South Arm. Sand prices will rise, possibly by up to 50%, if large volumes of sand are imported to cover local supply shortfalls.

Potential resources — Llanherne Spit

Community attitudes towards sand mining

Community support for extractive industry at Llanherne will be influenced by the environmental performance of existing operations. Good practice and rehabilitation at South Arm should be promoted, and existing environmental liabilities corrected before proposals for mining at Llanherne Spit are presented. Individual operators that are not achieving an acceptable environmental standard may jeopardise other existing or future operations.

Should mining at Llanherne Spit be proposed, land tenure for the spit would need to be defined so that the beaches and foreshore are clearly excluded from any potential mining areas. The community has to be satisfied that any extractive industry will meet its expectations for the use of land at Llanherne. Ongoing consultation with the local and broader community would be part of the statutory process if changes to the municipal planning scheme and the Seven Mile Beach Protected Area Draft Management Plan are required.

If mining is allowed to proceed, each proposal would be subject to further public consultation, comment and objection during the application for mining tenements and licences. Presentation of the facts regarding supply of sand to the region should commence in the public arena to facilitate constructive debate and to

provide feedback, so that proposals can be developed, subject to public endorsement of the concept.

Environmental and archaeological considerations

The environmental values and issues at Llanherne Spit have been examined by publications such as the *City of Clarence Natural Assets Inventory* (Inspiring Place, 1999) and the *Seven Mile Beach Protected Area Draft Management Plan 1996* (Hepper Marriot, 1996).

The draft management plan excludes the discussion of mining on the spit but many of the issues are relevant to sand mining, allowing an examination of mining within the broader management framework. In particular the maps and chapters 3 (Management Issues), 4 (Management Vision), 5 (Management Strategies for Protecting Natural and Cultural Values) and 6 (Management Strategies for Sustaining Human Use) are pertinent to extractive activities. Mining could best be contained within the Multiple Use Zone (fig. 11), which comprises the core area of the spit.

Sand extraction may complement the clear-fall harvesting of pine from the plantations on the spit, but selective falling of saw log timber would be more problematical. Clear falling may be the best solution for removing non-commercial areas of pine trees located at the eastern end of the pine forest, which have started to colonise surrounding native communities.

In comparison, mining at South Arm requires the clearing of native coastal vegetation. The *Seven Mile Beach Protected Area Draft Management Plan 1996* states that "sand mining (in) substantially altered areas of the Protected Area (may be) less environmentally damaging than modification of native bush land in better condition on other sites ... e.g. on South Arm."

Llanherne Spit is the largest representative example of a mid-bay spit in southeastern Tasmania (Inspiring Place, 1999). Sub-parallel beach ridges characterise the geomorphology of the spit, in which the dry sand resource in the Multiple Use Zone is contained. A number of these structures could be preserved at the tip of the spit and along the fore dunes and back dunes, which are outside the Multiple Use Zone. In comparison, existing operations are extracting sand from regionally outstanding aeolian dune structures at South Arm, which host native flora and fauna communities.

Groundwater from a large freshwater aquifer of excellent quality is utilised by the golf courses. It is important that the integrity of the aquifer be preserved as a potential potable water supply for nearby communities. Increased monitoring prior to forestry harvest, post harvest and during mining would be required to identify changes in the water table and match the floor horizon of potential pits to the water table height.

Sites of aboriginal heritage occur on the spit, with known sites mainly confined to the shore of Five Mile

Beach. An archaeological survey would be required as part of any Environmental Management Plan. Some historical heritage values, such as the Lower Ferry Track, would also need to be considered in delimiting potential sand mining areas within the Multiple Land Use Zone.

Public amenity

The resource is relatively isolated from residential development. The potential transport route from Llanherne Spit, to a common point with the existing route at Mornington, passes within 300 metres of 51 residences. Land used for horse training at 'Patherton Park' is situated off Central Road, and covers a small portion of the Llanherne Spit resource. Public access beyond the day use areas is presently denied from March to November inclusive.

Mining of Llanherne Spit has the potential to create a dominant alteration when viewed from aircraft landing at and taking off from Hobart Airport. Because the dry sand horizon is shallow, it would be necessary to clear between 4 and 8 hectares per year to extract the same amount of dune sand from Llanherne Spit that is currently extracted from South Arm. Given that rehabilitation may take up to five years to establish, areas of up to 40 hectares could potentially be visible at any one time. To reduce this impact it would be preferable to limit clearing near the airport or use interim cover crops to reduce visibility until native vegetation is re-established.

The visual impact to residents and traffic would be minimal. Single Hill obstructs the view of Acton residents. A fringe of mature pine forest could be retained within a buffer zone between any potential mining zone and the shore of Five Mile Beach and Seven Mile Beach. The screen could eventually be removed after rehabilitation of mining zones was completed to reduce the generation of airborne seed by mature pines.

Socio-economic considerations

The size of the Llanherne resource potentially offers an economy of scale to the operators. Duncan (1999) indicated that the quality of the sand is similar to the South Arm dune sand deposits, although marginally finer overall. The royalties from mining the resource could generate up to \$8 million for the Crown over the life of the project whereas royalties at South Arm are currently paid to landowners.

The Llanherne Spit resource is closer to the Hobart GPO than South Arm (21 km versus 35 km) and it is near the Tasman Highway. A potential saving of \$1.40 per tonne of sand transported from Llanherne Spit could be made over sand transported from South Arm. The connecting road from Llanherne Spit to the Tasman Highway is 3.5 km long, while the South Arm connection to the Tasman Highway is 28 km. Diverting trucks from South Arm to Llanherne Spit could provide a saving in secondary road maintenance.

A pine plantation managed by Fletcher Challenge Paper (formerly ANM) has existed over the resource for decades and compartments adjacent to the Hobart Airport are approaching maturity. Negotiations are underway between Fletcher Challenge and the Parks and Wildlife Service as to the future of the unmanaged sections of forest to the east of the mature timber. The harvesting agreement for the western compartments expires in 2010. The eastern compartments may require another 15 years of thinning before saw logging operations could commence (fig. 12).

There may be non-commercial sections of the plantation that could be clear felled for extractive industry before saw log operations are finished. Clearing to extract sand in these areas may allow the wood to be pulped, generating revenue for the Parks and Wildlife Service and eradicating *Pinus radiata* in the process. Fletcher Challenge Paper and the Parks and Wildlife Service are the chief stakeholders.

Potential operations — Flexmore Park

Community attitudes toward sand mining

The potential to develop the Flexmore Park resource into a major operation is simplified by the fact that an operation already exists over the resource, with tenure being freehold. The main obstacle in increasing production may be nuisance emissions such as noise from trucks and dust from exposed excavations.

Environmental and archaeological considerations

As the area is under cultivated land, the major environmental issues may relate to ensuring that the water table along the fringe of the Pitt Water and the Coal River is not jeopardised. The Environmental Management Plan would need to ensure that there is no encroachment onto a Landscape Protection Zone along the upland fringe of the resource.

Public amenity

An increase in operations at Flexmore Park would result in 425 residents at Penna and Midway Point being affected by increased traffic. The quickest route for haulage trucks leaving Flexmore Park is past residences at Shark Point, Penna and Midway Point. An alternative route through Sorell may slightly reduce the number of residences affected.

Visual impact from residences would be low, although a background alteration could be discerned from Dulcot. Visual impact would be less than that caused by existing Shark Point sand extraction.

Socio-economic considerations

With the mineable reserve at Flexmore Park estimated to be 1.6 million tonnes, the resource can potentially compete with Llanherne Spit for scale of operations. The fat sand resource underneath the sharp sand surface would be exposed as the sharp sand was

extracted. Large exposed areas could tend to develop, because the market for fat sand is smaller than that for sharp sand. Ideally the fat sand surface could be replanted with trees or processed in a washing plant to minimise the unrehabilitated area.

The haulage distance from Flexmore Park to the Hobart GPO is 28 km, which may reduce haulage costs by \$0.70 per tonne compared to haulage from South Arm. Sand from Flexmore Park would have to become accepted in the market place. Testing would be required to establish its behavior and qualities within concrete and other pavement materials.

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Glossary

Batter	A slope created by excavating a series of benches or slopes
Bench	A platform created by excavating one face above another in a quarry
Crusher dust	Fines created as a result of crushing stone for aggregates
Concrete sand	Sand used in the manufacture of concrete, conforming to AS1141-1974
Dune sand	Sand deposited by aeolian (wind driven) processes
Fat sand	Naturally occurring sand containing a significant proportion of fines
Foundry sand	Coarse sand used in foundries for casting moulds
General sand	Sand used for general purposes
Manufactured sand	Sand specifically manufactured by a dedicated crushing circuit
Propagating sand	Coarse sand used to assist the propagation of plants
Reserve	A measured resource, which can be mined economically
Resource	The amount of material either measured or inferred in a deposit
Sharp sand	Naturally occurring sand free from clay and other fines
Toe	The base of an excavated face
Washed sand	Sand which is washed to remove the fines or clay content

[12 July 2000]

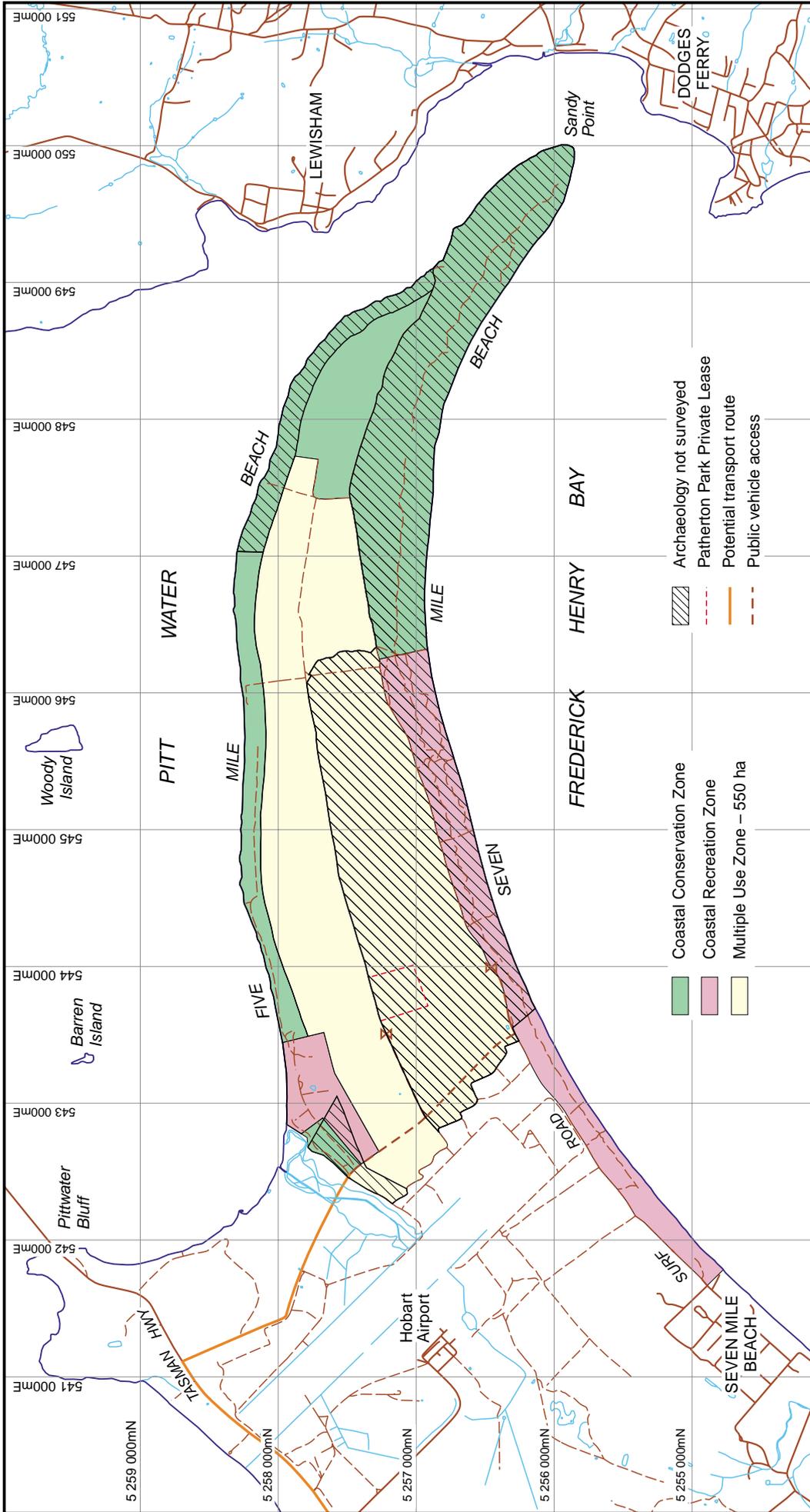


Figure 10. Composite Zoning Map, Seven Mile Beach Protected area

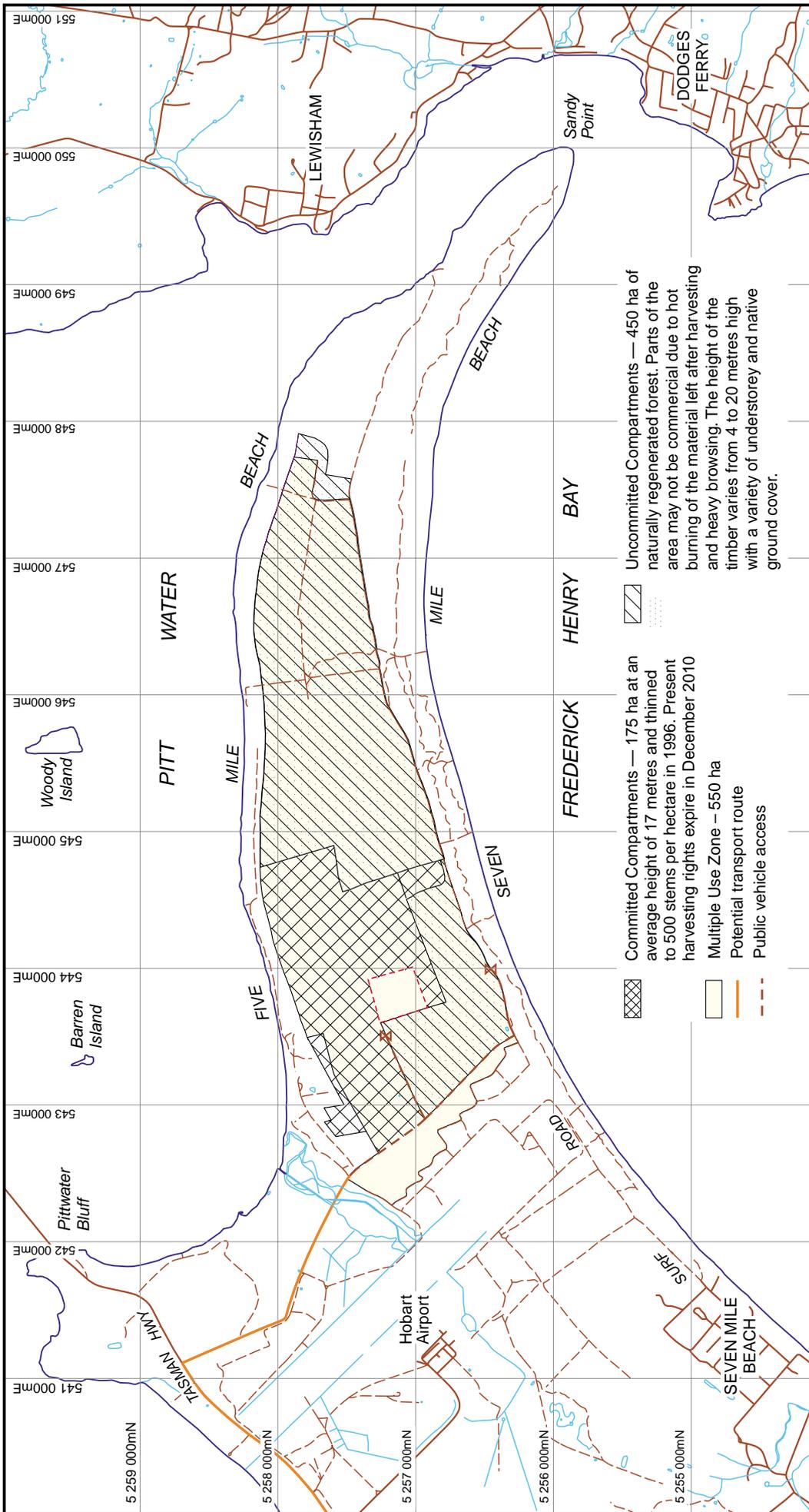


Figure 11. Commercial forestry operations, Seven Mile Beach Protected area