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NSW Offshore Sand Review

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More information

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GSNSW would like to acknowledge Geoscience Australia for providing spatial data for NSW sand bodies.

Front & Back Cover Image: Marine Aggregates (UK) – Capability & Portfolio 2014 (The Crown Estate)

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Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (August 2016). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the NSW Department of Trade and Investment, Regional Infrastructure and Services or the user’s independent advisor.
Executive Summary

A shortage in the supply of construction sand for the Sydney market has been predicted for many years. It is estimated that one million tonnes of construction sand is already imported from outside the Sydney Region per annum and demand for construction sand looks likely to continue with planned major infrastructure and building projects.

Resource depletion and increasing land use constraints surrounding alternative onshore sources have been one of the key drivers for companies to look at the marine aggregate option in the past however marine sand mining has been a highly contentious issue and is currently not permitted due to a long standing NSW Government position on offshore sand mining.

The inner continental shelf off the coast of NSW contains large volumes of sand, some of which could potentially supply the Sydney (and NSW) building and construction industry with high grade construction sand for use in concrete manufacture and for other industrial uses.

No new offshore exploration work has occurred since the early 1990s and to date the Cape Banks-Providential Head sand resource off Sydney’s coast is the best defined resource of offshore construction sand in State Waters (within 3 nautical miles of mean low water mark).

The marine aggregates industry is well established in many overseas countries. In the United Kingdom for example, marine aggregates make up a significant proportion of the total aggregates produced. Marine sand is delivered directly to large coastal urban areas where they are most needed reducing truck movements and associated environmental and social impacts.

Based on overseas experience the State’s known offshore sand deposits are at a water depth that is within reach using currently available technology. The economics of local offshore extraction are difficult to estimate however, costs for local beach replenishment projects and overseas examples indicate that they may be comparable to sand won from onshore operations.

In the past the environmental concerns regarding offshore sand mining have related mainly to the effects on marine life and beaches however some have argued that the impacts may be less than onshore alternatives if carried out appropriately.

A city the size of Sydney should not rely on only a small number of sand suppliers. The construction industry requires different types of construction sand for different uses and offshore sand deposits are one of a number of alternative sources that should be considered when planning for Sydney’s medium to long term supply of construction sand.

Further exploration is needed to evaluate the size, nature and economic viability of extracting the State’s offshore sand resources. If the decision is taken to re-commence exploration then a clarification of NSW Government’s policy/position regarding both exploration and mining in State Waters is required. Rigorous environmental assessment of the impacts of offshore exploration, community consultation and stakeholder engagement are essential prior to the commencement of exploration activities.

Considering the high cost and risk associated with offshore exploration and assessment of marine aggregate resources, allowing industry to conduct such exploration is the most effective route to understanding the viability of extracting these resources.
<table>
<thead>
<tr>
<th>Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glossary</td>
<td>3</td>
</tr>
<tr>
<td>Introduction</td>
<td>4</td>
</tr>
<tr>
<td>Background</td>
<td></td>
</tr>
<tr>
<td>Sydney's Onshore Sand Supply</td>
<td>4</td>
</tr>
<tr>
<td>Offshore Sand</td>
<td></td>
</tr>
<tr>
<td>Current Legal Situation</td>
<td>7</td>
</tr>
<tr>
<td>Sand Deposits of the NSW Inner Continental Shelf</td>
<td>10</td>
</tr>
<tr>
<td>Identified Sand Resources</td>
<td>12</td>
</tr>
<tr>
<td>International Marine Aggregate Industry</td>
<td>13</td>
</tr>
<tr>
<td>Economics of Offshore Extraction</td>
<td>14</td>
</tr>
<tr>
<td>Impacts and Constraints</td>
<td>15</td>
</tr>
<tr>
<td>Potential Benefits</td>
<td>15</td>
</tr>
<tr>
<td>Conclusion &amp; Recommendations</td>
<td>16</td>
</tr>
<tr>
<td>References</td>
<td>17</td>
</tr>
<tr>
<td>Websites</td>
<td>18</td>
</tr>
<tr>
<td>Tables</td>
<td></td>
</tr>
<tr>
<td>Table 1 - Australian Sand Imports by State</td>
<td>7</td>
</tr>
<tr>
<td>Table 2 - NSW Shelf Sand Bodies</td>
<td>12</td>
</tr>
<tr>
<td>Table 3 - Identified Marine Aggregate Resources</td>
<td>13</td>
</tr>
<tr>
<td>Figures</td>
<td></td>
</tr>
<tr>
<td>Figure 1 - Sydney Region Major Quarries Location Map</td>
<td>6</td>
</tr>
<tr>
<td>Figure 2 - Marine Aggregate Titles Location Map</td>
<td>9</td>
</tr>
<tr>
<td>Figure 3 - NSW Shelf Sand Bodies Location Map</td>
<td>11</td>
</tr>
<tr>
<td>Appendices</td>
<td></td>
</tr>
<tr>
<td>Appendix 1 - NSW and Interstate Sand Dredging Examples</td>
<td>19</td>
</tr>
<tr>
<td>Appendix 2 - NSW Shelf Sand Bodies</td>
<td>20</td>
</tr>
</tbody>
</table>
Glossary

**Aggregate:** A mixture of sand, gravel, crushed rock or other bulk minerals used in construction and civil engineering.

**Bathymetry (Bathymetric):** The study of the underwater depth of the ocean floor.

**Beach Replenishment:** The process of placing new sediment onto beaches to replace sediment lost through erosion.

**Capital Dredging:** The act of removing sediment from an area of seabed as part of an engineering or navigational project, usually for a port development or approach channel.

**Construction Sand** (also known as **fine aggregate**): Sediment with a particle diameter between 0.063-2mm on the Wentworth Scale.

**Grab Sampling:** A survey method that employs a mechanical grab system used to acquire a sample of the sediment (up to 3 kilograms in weight) from the seafloor.

**Grain Size:** The size of individual particles (or grains) in a sediment or sedimentary rock.

**Gravel** (also known as **coarse aggregate**): Sediment with a particle diameter between 2-64mm on the Wentworth Scale.

**Marine Aggregate:** Sand and gravel extracted from the seabed for use in construction or beach nourishment projects.

**Regressive Sand Deposits:** Sand deposits created when sea level falls (marine regression).

**Resource:** Is a concentration or occurrence of solid material of economic interest in or on the Earth’s crust in such a form, grade (or quality), and quantity that there are reasonable prospects for eventual economic extraction.

**Seismic Survey:** A type of geophysical survey designed to investigate the structure of the earth by determination of the time interval that elapses between the initiation of a seismic wave at a shot point and the arrival of the reflected or refracted impulse at one or more detectors.

**Side-Scan Sonar Survey:** A method of creating an image of the sea floor whereby a sonar device emits a pulse down towards the seafloor across a wide angle perpendicular to the path of the sensor which is towed from surface vessel. The intensity of the acoustic reflections from the seafloor of the fan-shaped beam is recorded as series slices.

**Vibracore:** Equipment designed to acquire a core sample up to 0.6 metres in length and 76 millimetres in diameter through the seafloor for the purposes of determining the thickness of aggregate resource deposits.
Introduction

The Geological Survey of New South Wales (GSNSW) has undertaken an ‘audit’ of offshore marine (sand) aggregate resources in NSW Waters and evaluated the feasibility and accessibility of extracting those resources, to inform the development of NSW Government policy/position on offshore sand exploration and mining.

A key driver for the study has been the predicted shortfall in the supply of construction sand for the Sydney market caused by the depletion of currently approved sand operations and increasing land use constraints surrounding onshore sand resources within and outside the Sydney region.

To better synthesise all available information a three month desktop study has been completed and the report prepared contains:

- Background information regarding Sydney’s current sand supply and the present legal situation relating to offshore sand exploration and mining.
- A description and location of potential offshore sand resources (from previous studies) including maps showing the location of the sand bodies and a table setting out the available information for each location.
- The general economics of marine sand extraction using local information where available and international examples.
- Recommendations in relation to NSW Government’s policy/position on offshore sand exploration and mining.

Consultation during the preparation of this report included Geoscience Australia (GA), Cement Concrete and Aggregates Australia (CCAA), British Geological Survey (BGS), British Marine Aggregate Producers Association (BMAPA), Sydney Coastal Councils Group (SCCG), current title holders and applicants.

Several onshore sand operations were visited to gain a better understanding of the types of sand being extracted, economics of extraction and an appreciation of the issues facing onshore operations.

Spatial data was supplied by GA (sand bodies) and the Department of Primary Industries (Marine Protected Areas).

This report is confidential and should be used for internal purposes only.

Background

Sydney’s Onshore Sand Supply

A shortage in the supply of construction sand for the Sydney market has been predicted for many years as access to local onshore resources of construction sand has become increasingly difficult through resource depletion and increasing land use constraints surrounding potential alternative sources.

Strong demand for construction sand is expected to continue. Recommendations by Infrastructure NSW, set out in the State Infrastructure Strategy Update 2014, include projects and programs valued at $18.9 billion and the construction of new housing, schools, hospitals and roads associated with planned population growth will require long term secure sources of construction sand.

The last major study into the supply and demand for construction sand in the Sydney region commenced in October 2000 and was completed May 2001. Data for the study, which included sand production and markets supplied, was collected via a questionnaire sent to construction sand producers. It is unclear from the report the number of suppliers that were surveyed and how many responded.
It was estimated (from the data collected during the study) that the Sydney region consumed approximately 7 million tonnes (Mt) of construction sand annually (Plenmunne & Whitehouse, 2001) and that the region imported between 900,000 tonnes (t) and 1 Mt of sand from outside the region. It was predicted that this amount would increase significantly if new local sources were not developed. The study also estimated that Sydney would require in the order of 137 Mt of construction sand over the medium term (20 years) and 291 Mt over the long term (40 years) to meet predicted demand.

Sydney’s main sources of construction sand have traditionally been Kurnell (fine-medium grained coastal dune sand) and Penrith Lakes (medium-coarse grained riverine sand). In 2012-2013 Kurnell produced over 900,000 t of construction sand, while it is estimated Penrith Lakes produced approximately 1.4 Mt of sand (out of 3.4 Mt of unprocessed material extracted).

Penrith Lakes is due to cease production this year and uncertainty still surrounds the remaining resources at Kurnell. The closure of Kurnell has been predicted as far back as the 1990s. The most recent review in 2011 indicated that Kurnell may have resources for a further 10 years. Price rises are inevitable as resources deplete and a recent anecdotal comment suggests that both Kurnell and Penrith Lakes have been increasing prices several times each year.

In addition to Kurnell and Penrith Lakes, Sydney’s major sources of construction sand currently include:

- Friable sandstone deposits at Maroota (The Hills LGA), Newnes (Lithgow LGA), Calga/Somersby (Gosford LGA) and Green Valley (Wingecarribee LGA).
- Flood plain and river terrace deposits at Maroota (The Hills LGA).
- Dune deposits at Stockton-Williamtown (Port Stephens LGA) and Dunmore (Shellharbour LGA).
- Manufactured sand produced by large hard rock quarries near Marulan (Goulburn-Mulwaree LGA), Dunmore/Albion Park and Bass Point (Shellharbour LGA) and Somersby (Gosford LGA).

Figure 1 illustrates the major sand suppliers within and outside the Sydney region and indicates the distances from the Sydney CBD.

In the short term demand for construction sand can be met by increasing production from existing sources (above) however many of these are located outside the Sydney region. For example, Macka’s Sand & Soil (Mackas) have a large sand resource (approximately 154 Mt) at Stockton and supply approximately 1 Mt of material to NSW, with about half going to the Sydney market. Mackas could potentially double its production if necessary.

Sand is a high bulk-low unit cost commodity preferably sourced close to market to minimise transport costs. Transporting sand from outside the region significantly adds to its cost. Advice from Cement Concrete and Aggregates Australia (CCAA) indicates that the current price for onshore construction sand is around $20/t. Production costs quoted by several operators range from $4/tonne (for dune sand) up to $20/t for sand produced from friable sandstone. Transport costs can add an additional $8/t (from Kurnell – 8km from the CBD) up to $28/t (for sand moved from Stockton, 180km from the CBD).

Increasing truck movements across the region has environmental and social consequences, including increased air and noise pollution and traffic congestion. Sydney Marine Sands Pty Limited (SMS) anticipates that an additional 226,000 truck movements per year are to be expected in the event of Kurnell and Penrith Lake’s closing.

Increasing the use of rail and sea are alternatives to road transport. Mackas, whose current truck movements are around 200/day are intending to commence barging sand from Kooragang Island (at Newcastle) at a rate of around 1000 t/day.
New projects and proposed expansions to existing operations (both within and outside the Sydney region) face considerable hurdles in obtaining development consent, for example, continued community opposition has put at risk a major expansion of Rocla Pty Limited’s Calga Sand Quarry, north of Sydney. The project application for the southern extension of the quarry was initially lodged with the Department of Planning in September 2006 and conditional approval was granted in December 2013. At the time of writing, the project was still pending a Land and Environment Court decision, despite receiving approval.

Fine crushed aggregate or ‘manufactured sand’ can be used as a replacement for medium to coarse grained natural sand. Large quarries in the Marulan, Shellharbour and Somersby areas extracting hard rock aggregate produce an undetermined amount of manufactured sand from their ‘crusher fines’. Quarries cannot meet market demand relying solely on manufactured sand however, the CCAA (2008) estimate that quarries are replacing between 30-50% of the natural sand market with manufactured sand to meet demand.

There has been a proposal for transporting sand from even further afield as a recent (February 2014) newspaper article in Tasmania’s Examiner Newspaper suggests. A new sand mine is being planned in Bridport on Tasmania’s north east coast, with the intention of shipping 450,000 t of sand to Sydney each year, increasing to 1.5 Mt per year in future years.

NSW imports small quantities of sand from overseas as Table 1 from the Australian Bureau of Statistics indicates. A big jump in 2011 has seen NSW overtake Queensland to become the largest importer of sand from overseas.

<table>
<thead>
<tr>
<th>Table 1 - Australian Sand Imports by State (from Global Trade Atlas)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>All States</td>
</tr>
<tr>
<td>New South Wales</td>
</tr>
<tr>
<td>Queensland</td>
</tr>
<tr>
<td>Western Australia</td>
</tr>
<tr>
<td>Victoria</td>
</tr>
<tr>
<td>South Australia</td>
</tr>
<tr>
<td>Tasmania</td>
</tr>
<tr>
<td>Northern Territory</td>
</tr>
</tbody>
</table>

**Offshore Sand**

**Current Legal Situation**

The current legal situation regarding offshore sand mining is complex. Seafloor exploration and mining in Australia is governed by both State and Commonwealth legislation. State legislation covers waters within three nautical miles of the mean low water mark (State Waters). Commonwealth legislation governs water beyond the three nautical mile limit (Commonwealth Waters) to the edge of the Australian Territorial Waters.

Exploration and mining titles in State Waters can be issued under the *Offshore Minerals Act 1999*. Royalties are set at 4% of the landed value of the mineral under the *Offshore Minerals Regulation 2013*. Exploration and mining activities in Commonwealth Waters are covered by the *Commonwealth Offshore Minerals Act 1994* (which is jointly administered by NSW and Commonwealth Governments).
The entire State Waters are covered by a reserve block (deemed under the *Offshore Minerals Act 1999*) prohibiting the granting of mining leases. It is unclear if this also precludes offshore exploration activities and further investigation is required. If this were the situation then areas would need to ‘opened-up’ before exploration licences could be granted.

**Marine Protected Areas**

There are currently six marine parks and 12 aquatic reserves in NSW regulated under the *Marine Estate Management Act 2014* and the *Marine Estate Management Regulation 2009* (refer Appendix 2). Management of the marine estate has been under review in recent years by the NSW government via the *Independent Scientific Audit of Marine Parks 2012* resulting in initiatives to achieve longer term planning outcomes for the estate.

Marine parks cover 34% of State Waters (more than 345,000 hectares) and lie adjacent to one third of NSW’s coastline. Aquatic reserves cover around 2000 hectares. There is a general prohibition of mining in marine parks and aquatic reserves.

**Planning Legislation**

*State Environmental Planning Policy (Major Development) 2005* provides that all of the coastal waters of NSW are defined to be an environmentally sensitive area of State significance and the Minister for Planning is the approval authority for all developments.

*State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* applies to the coastal waters of NSW and provides that extractive industries may be carried out with consent in any part of the coastal waters of the State that is not in an environmental conservation zone.

**NSW Government Position**

Opposition to sand exploration and mining dates back to the early 1990s when Metromix Pty. Ltd. (Metromix) undertook an extensive environmental impact assessment for a proposal to extract sand at Cape Banks-Providential Head area off the coast at Sydney. The proposal did not proceed as the (then) Greiner government announced it would not approve offshore sand mining.

In March 2003, in a media release, Bob Carr, the (then) Premier of NSW expressed the NSW Governments opposition to offshore sand mining. This long standing embargo on offshore sand mining is (reportedly) still in force. To date there is no ‘active’ written policy regarding offshore exploration and mining for minerals (and coal) in State Waters.

Although offshore sand mining is currently not permitted in State Waters sand dredging in rivers and estuaries is common and has been periodically carried out in NSW and most other Australian States. Sand is primarily dredged to keep boating and shipping channels open and for local beach replenishment and coastal protection projects. Appendix 1 contains a list of some examples from NSW (and other Australian States).

**Marine Aggregate Titles**

In the late 1970s exploration licence EL1194 (refer Figure 2) was granted to a consortium of companies to explore within the entrance to Broken Bay north of Sydney. A mining lease application was subsequently lodged however was refused when a reserve was placed over Broken Bay preventing extraction.

From 1988-1990 five exploration licences (EL3217, 3218, 3219, 3220, 3221) in State Waters were granted to various companies (including Metromix) under the *Mining Act 1973* to explore over parts of the inner continental shelf between Nowra and Swansea (refer Figure 2). These titles remain in force subject to renewal (pending since 1994) and cannot be repealed under the *Mining Act 1992*. In the early 1990s Metromix lodged mining lease applications as part of its Cape Banks-Providential Head proposal however the applications were subsequently refused.
Since 2003 Sydney Marine Sands Pty Limited (SMS) has lodged applications for four exploration licences in Commonwealth Waters. All applications have been unsuccessful. There is one current offshore licence application (MELA10) by SMS under the Commonwealth Offshore Minerals Act 1994. This exploration licence application covers about 150 km² of outer shelf sands in Commonwealth waters (refer Figure 2) and is currently being considered by NSW Trade & Investment.

**Sand Deposits of the NSW Inner Continental Shelf**

The inner continental shelf off the NSW coast contains large volumes of sand, some of which could potentially supply the Sydney (and NSW) construction industry with high quality construction sand for use in concrete manufacture and for other industrial uses.

The inner continental shelf occupies a zone along the entire NSW seaboard, in water depths that typically range from 20-60m. The inner shelf extends from 1-15 km offshore and covers an area of approximately 8000 km². The inner continental shelf is predominantly covered by sand with minor proportions of gravel and small areas of bedrock reef (Roy, 2001).

Roy (2001) recognised three main types of inner shelf sand deposits:

- **Inner shelf sand sheets** are thin (<1.5m), laterally extensive (covering approximately 70% of the inner shelf) and contain sand that tends to be coarser making them suitable for beach nourishment (Whitehouse, 2007).
- **Thick shelf sand bodies (SSB)** are less common, cover smaller areas and because of their thickness can contain large quantities of sand (Whitehouse, 2007).
- **Tabular, regressive shelf barriers** contain sand with similar characteristics to SSBs however due to their smaller size, are potentially a much less important source of sand (Whitehouse, 2007).

**Shell Sand Bodies**

SSBs are linear, shore parallel deposits typically associated with headlands. SSBs typically range from 20-30m thick, 5-40km in length and vary from 2-4km in width. They are predominantly situated less than 5km offshore (Whitehouse, 2007).

SSBs consist of fine-medium grained, moderately to well sorted quartz sand with disseminated heavy minerals (mainly rutile and zircon), moderate (10-15%) biogenic carbonate (shells) and usually <1% mud (Roy, 2001). The sand is well suited to concrete manufacture and industrial applications including glass manufacture (Whitehouse, 2007).

Table 2 below lists some of the major SSBs for which data is currently available and Figure 3 shows the location of the major SSBs (refer to Appendix 2 for more detailed maps of the SSBs). The total volume of sand in the SSBs listed in the table is 7.75 km³. This is equivalent to approximately 12,000 Mt of sand (assuming a dry density of sand to be 1.6 kg/m³).

**Previous Studies**

Scientific field studies relating to sand deposits on the inner continental shelf date back to the early 1970s. These studies have been carried out by various government agencies, universities and industry. Many of the scientific studies were completed by Dr Peter Roy (formerly of the GSNSW) with others during the 1980s and 1990s.

GA has collected a large amount of scientific data relating to offshore marine environments much of the data is available for download from their MARine Sediment (MARS) database. As part of the Wealth from the Oceans National Flagship Project, the CSIRO in conjunction with GA and State Geological Surveys produced a map of Australian Offshore Mineral Locations in 2006.
Figure 3 - NSW Shelf Sand Bodies Location Map

Legend
- **Shelf Sand Bodies (SSB)**
- **Other Sand Bodies**
- **Continental Shelf (approx.)**

(Location of SSB & other sand bodies supplied by Geoscience Australia)
Exploration field work by Metromix (and others) in the late 1980s and early 1990s included various bathymetric, seismic and side-scan sonar surveys, sediment sampling and vibrocoring drilling. Work by SMS to support their exploration licence application in Commonwealth Waters (MELA10) included a compilation of surface sediment samples contained in GA’s MARS database.

The GSNSW has been involved with more recent key studies relating to offshore minerals and construction sand including the last major review of construction sand supply and demand in the Sydney Region (Pienmunne and Whitehouse, 2001), an evaluation of mineral resources on the NSW intercontinental shelf (Whitehouse, 2007) and a desktop study by the GSNSW’s Minerals Systems group to inform a potential review of offshore mining in 2014.

### Table 2 – NSW Shelf Sand Bodies (for which sub-surface data is available)

(from Roy, 2001)

<table>
<thead>
<tr>
<th>SSB Name</th>
<th>Sand Volume (km³)</th>
<th>Maximum Thickness (m)</th>
<th>Water Depth Range (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Byron-Ballina*</td>
<td>1.65</td>
<td>31</td>
<td>18-53</td>
</tr>
<tr>
<td>Hat Head</td>
<td>0.35</td>
<td>38</td>
<td>25-60</td>
</tr>
<tr>
<td>Cape Hawke-Sugarloaf Point*</td>
<td>1.09</td>
<td>38</td>
<td>25-65</td>
</tr>
<tr>
<td>Port Stephens-Morna Point*</td>
<td>0.80</td>
<td>47</td>
<td>32-76</td>
</tr>
<tr>
<td>Sydney</td>
<td>0.82</td>
<td>30</td>
<td>25-75</td>
</tr>
<tr>
<td>Bass Point</td>
<td>0.08</td>
<td>21</td>
<td>30-65</td>
</tr>
<tr>
<td>Jervis Bay*</td>
<td>1.12</td>
<td>45</td>
<td>40-85</td>
</tr>
<tr>
<td>Warden Head</td>
<td>0.03</td>
<td>11</td>
<td>20-55</td>
</tr>
<tr>
<td>Montague Island*</td>
<td>1.60</td>
<td>48</td>
<td>50-110</td>
</tr>
<tr>
<td>Green Cape</td>
<td>0.21</td>
<td>20</td>
<td>55-80</td>
</tr>
</tbody>
</table>

* Affected by Marine Protected Areas (refer Appendix 2)

### Identified Sand Resources

Although there is a large amount of scientific information available relating to marine sediments generally, very little exploration has occurred to allow evaluation of many of the sand bodies on the inner continental shelf of NSW.

Offshore exploration for construction sand first took place in the Sydney area in the late 1970s when a consortium of companies defined a potential resource of approximately 21 Mt within the entrance to Broken Bay (refer Figure 2). An environmental impact statement was developed however extraction did not occur as mining was subsequently prohibited in Broken Bay.

In the early 1990s, Ready Mixed Industries Pty Limited (now Metromix) defined potential resources as a result of exploration carried out at Bass Point and Black Head (off the coast from Nowra) of 10 Mt and 15 Mt respectively (refer Figure 2). Ready Mixed also identified a large potential resource of approximately 2800 Mt in a zone off the coast from Norah Head (in the south) to Swansea (in the north).
In 1993 R.W Corkery Limited (on behalf of Metromix) developed a proposal to extract a sand resource of approximately 100 Mt from the Cape Banks-Providential Head area (part of the Sydney SSB), 0.5 km to 2.5 km off the coast from Botany Bay and the Royal National Park, refer Figure 2). It was estimated that the Sydney SSB contains in excess of 1200Mt of sand, however the proposal involved sand extraction to a maximum depth of only 5 metres. The sand was considered suitable for concrete aggregate and a variety of other industrial uses. Other sand bodies were not considered as part of the proposal.

Table 3 provides a summary of the identified offshore sand resources close to Sydney. A total of just under 3000 Mt of sand has been defined from sand bodies located on the inner continental shelf from Black Head in the south to Swansea in the north. The resources occur as sand sheets and SSBs and consist of fine to coarse grained sand in water depths ranging from of 25m to 75m.

To date, the Cape Banks-Providential Head sand resource outlined in the Metromix (1993) proposal is the best defined resource of offshore construction sand close to Sydney. Exploration would need to re-commence to define additional resources and to allow further economic evaluation.

<table>
<thead>
<tr>
<th>Deposit</th>
<th>Identified Resources (million tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cape Banks</td>
<td>57</td>
</tr>
<tr>
<td>Providential Head</td>
<td>55</td>
</tr>
<tr>
<td>Broken Bay</td>
<td>21</td>
</tr>
<tr>
<td>Norah Head-Swansea</td>
<td>2800</td>
</tr>
<tr>
<td>Bass Point</td>
<td>10</td>
</tr>
<tr>
<td>Black Head</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,958</strong></td>
</tr>
</tbody>
</table>

**Table 3 - Identified Marine Aggregate Resources (close to the Sydney Region)** *(from Pienmunne & Whitehouse 2001 & Ready Mixed Industries, 1990)*

**International Marine Aggregate Industry**

The marine aggregate (sand and gravel) industry is well established in many countries. Offshore extraction occurs in the United Kingdom (UK), Europe (Belgium, Denmark, France, Germany, Netherlands, Poland and Portugal), Japan, South Korea and China. The United States offshore extraction industry is largely focused on beach replenishment. A large amount of information is publicly available (particularly relating to the industry in the UK).

**United Kingdom**

The UK has one of the world’s largest and most developed marine aggregate industries (The Crown Estate, 2014). According to the British Marine Aggregate Producers Association (BMAPA), the UK produced around 16 million tonnes of marine aggregate in 2010 which accounted for approximately 20% of the sand and gravel requirements for England and Wales. Regionally the industry is even more important, in London for example, over 90% of sand and gravel supplies are contributed by marine aggregates (The Crown Estate, 2014). The United Kingdom also exports marine aggregate to neighbouring European countries.
A BGS report into the strategic importance of the marine aggregate industry to the UK (Highley et al., 2007) cite one of the greatest benefits of using marine aggregates is the ability to deliver large volumes of material close to the point of final demand (large urban areas) reducing truck movements which has associated environmental benefits including reduced traffic congestion and a reduction in air and noise pollution.

In the UK, vessel capacity ranges from 1,200 tonnes to 10,000 tonnes and the capacity of a capital dredger can be up to 60,000 tonnes. A typical dredger will deliver the equivalent of 250, 20-tonne lorry loads (5,000 tonnes of material). The production cycle (return trip to port) in the UK varies between 12 hours and 48 hours, depending upon the type of resource being dredged, its location relative to the wharf being supplied and tide times (BMAPA, pers. comm.).

Aggregates are extracted from 70 production dredging licences located around the coast (including the English Channel and Thames Estuary). There are 11 companies involved in the production of marine aggregates in the UK. The industry is highly capital intensive, operating 28 dredgers with a replacement value of approximately 1 billion pounds (Highley et al., 2007).

The industry directly employs 600 staff on the dredging vessels, a further 600 on the wharves and an estimated 500 additional jobs related to the primary delivery of marine sand and gravel (Highley et al., 2007).

Most dredging takes place in coastal waters less than 25km offshore and in water depths of between 18-35m. The technology of the dredging fleet means that the maximum depth that resources can be directly worked is approximately 50m and thus water depth is a controlling factor on resources that can be currently extracted (Highley et al., 2007).

**Asia**

Japan is the world's largest producer of offshore aggregates. Japan's onshore aggregate industry is experiencing increasingly stringent environmental regulations, which makes offshore extraction of sand and gravel appealing. Between 20 and 25 per cent of Japan's supplies of natural aggregate comes from marine sources (Eamey, 2002).

Offshore sand mining is well established and implemented in South Korea. The total share of sand from land sources in 2002 was about 50%, while offshore sand was 27.7% (up from 15.3% in 1992) and 17.3% from river sources (down from 46.7% in 1992), (Cho, 2005).

Marine aggregates are abundant on the northern shelf of the East China Sea. Most of them are directly exposed in the Yangtze Shoal and the linear sand ridge system at water depths of 25–55m and 60–120m respectively. A preliminary feasibility analysis suggests that the Yangtze Shoal is suitable for dredging with the present technology and under the current economic conditions (Qin et al., 2015).

**Economics of Offshore Sand Extraction**

Cost of production for offshore marine aggregate is difficult to estimate as it is dependent on the economies of scale – both in terms of the production volumes, and also the distance between the production licence being dredged and the market being supplied.

As there is no marine aggregate industry in NSW, local estimates are based on dredging for beach nourishment and can vary significantly. The SCCG website estimates that the total unit cost for a beach nourishment campaign in Sydney is approximately $20 per cubic metre in shallow waters (total costs range from $25-$30 per cubic metre including impact assessment and consultation).

Moses and Ling (2010) from the Land and Property Management Authority estimated that the cost of disposing of dredged sand or using it for beach re-nourishment would be $13/m3. Costs include dredge and load barges, delivery to stockpile and unloading, loading and transporting offsite and final shaping to surrounding beach profile during re-nourishment. They estimated a range of indicative costs, dependant on the size of the project, to be from $10/m3 up to $20/m3.
The BGS have previously (2007) used an estimate for the selling price of marine aggregate of £6/tonne (approx. $12/tonne) ex-ship (i.e. delivered to the wharf) and £12/tonne (approx. $24/tonne) ex-wharf (processed and sold through the gate of the wharf i.e. no onward transport costs added). The value for materials dredged for fill and beach nourishment is much less, estimates by the BGS are around £1-3 per tonne (BGS, pers. comm.).

Prices for marine aggregate in the UK do not include VAT (national tax), but do include a royalty. Once the product is sold to the end user, it also incurs a further tax (called the Aggregates Levy), which currently stands at £2/tonne.

According to Pugh (2008) European prices for marine aggregate in general would be expected to be about 30% lower than in the UK. The cost of desalted marine sand in China is about 70% of land-won sand in the coastal Yangtze economic region (Qin et al., 2015).

Impacts and Constraints

There is a high level of uncertainty regarding the environmental impacts of seafloor activity (Littleboy & Boughen, 2007). A Sydney Morning Herald newspaper article in November 2005 reported that the Colong Foundation (an environmental lobby group) called for a comparison between the environmental impacts of mining ocean sand and the impacts of land-based options.

The environmental impacts associated with offshore sand extraction appear to relate specifically to sediment disturbance (the sediment plume associated with extraction) mobilisation, transport and redistribution (particularly in the short-term) and impacts on the marine ecology and biodiversity (particularly those organisms living in or near the sea floor) and alteration to the sea floor bathymetry.

A number of mitigation methods have been proposed including the use of silt curtains, diffusers to rapidly disperse fine sediments, anti-turbidity overflow systems (returning sediment overflow directly back to the sea floor), restricting the hours of operation to reduce impacts on recreational fishing and diving and recognising buffers zones around shipwrecks.

There have also been issues raised relating to the potential impacts on beaches by the removal of sand from long-shore drift replenishment, however according to the SCCG group, offshore sand bodies are no longer connected to Sydney’s ocean beaches by littoral drift and therefore this may not be an issue.

Issues identified in the Metromix proposal (1993) that need to be addressed include possible impacts to commercial fishing, recreational fishing and diving, the location of scientific research areas, the presence of shipwrecks (refer Appendix 2) close to the proposal area and the impacts to migrating sea life (whales).

Other potential constraints could include the location of commercial shipping lanes, military areas/zones and the routes of underwater cables.

Potential Benefits

Large offshore sand resources conveniently located close to the Sydney market could take advantage of economies of scale, help stabilise prices and have other economic benefits including providing royalty revenue to the State.

Marine aggregates landed in Sydney (and other major NSW ports) for distribution by rail or road could have potential environmental benefits including reduced truck movements, traffic congestion, fuel use, greenhouse gas emissions and road infrastructure maintenance. Metromix (1993) estimated that potentially 300 million fewer truck-kilometres would be travelled over a 50 year period if the Cape Banks proposal was approved.

Seasearch Exploration Associates in a submission to a review of the NSW Planning System in 2001 suggested that offshore sand extraction may also lead to reduced social and financial loss of residential property amenity and values compared to terrestrial mining close to residential areas.
Other beneficial spin-offs to the establishment of a marine aggregate industry include the economic feasibility of coastal erosion protection and maintenance projects such as beach nourishment which may increase in the future with possible rising sea levels due to climate change.

**Conclusions and Recommendations**

Large deposits of sand occur on the inner continental shelf off the NSW coast. They represent a major potential source of construction sand for the Sydney (and NSW) market where access to onshore sand resources is becoming increasingly difficult due to resource depletion and increasing land use constraints.

A large amount of scientific information is available regarding marine sediments (including sand) however little information (the Cape Banks-Providential Head area being the exception) is available regarding the quality and size of the State’s offshore sand resources.

Due to a long standing Government position prohibiting offshore sand mining, no new information is available with the last exploration work having been carried out over twenty years ago. Further exploration would enable a more accurate determination of the extent of the States offshore sand resources and viability of extracting them.

Considering the high cost and risk associated with offshore exploration and assessment of marine aggregate resources, allowing industry to conduct such exploration is the most effective route to understanding the viability of extracting these resources.

Based on overseas experience and currently available information NSW’s identified offshore sand resources are at a depth that could be extracted using current technology. The economics of extraction are difficult to estimate, however using overseas examples and local information from dredging and beach nourishment projects, it appears that the cost of extraction may be comparable to onshore extraction.

The building and construction industry requires different types of construction sand for different uses and accordingly Sydney needs a range of sand suppliers. Offshore sand could potentially provide an alternative long term source of high quality construction sand and should be considered when planning for Sydney’s medium to long term sand requirements.

It is recommended that:

- Exploration should re-commence subject to rigorous environmental assessment of the impacts of offshore exploration. Community and stakeholder engagement should occur prior to the commencement of exploration activities.

- Clarification of the NSW Government’s policy/position regarding both offshore exploration and mining is required and a comprehensive legislative (approval) framework should be developed.
References


Useful Websites

British Marine Aggregates Producers Association - http://www.bmapa.org/
Cement Concrete & Aggregates Australia – http://www.concrete.net.au/
International Council for the Exploration of the Sea - http://www.ices.dk/community/groups/Pages/WGEXT.aspx
The British Geological Survey - http://www.bgs.ac.uk/mineralsuk/
Appendix 1 – Australian Sand Dredging Examples

NSW

- Shoalhaven River - Shoalhaven Sands Pty. Ltd. recently had a proposal approved to expand its coarse river sand dredging operation on the north and western side of Pig Island in the Shoalhaven River near Nowra.

- Tweed River - Action Sands Pty. Ltd. has been dredging sand from the Tweed River in northern NSW since 1992 and is currently seeking approval to extend its Dodd Island operation for a further 10 years. The company sells sand locally, for use in concrete, fill and soil products (loam).

- Tweed River - Entrance Sand Bypassing project in NSW involves the extraction and transport of specific offshore sand sources for beach nourishment.

- Port of Newcastle - Maintenance dredging of the Port of Newcastle is undertaken 12 hours per day, seven days per week (at times of intense sediment fill, the dredge will operate 24 hours per day) and has been in operation since 1991. The dredging is carried out in order to maintain channel depth and operational berths.

- Port of Newcastle - State significant infrastructure proposal by the Port of Newcastle to dredge the south arm of the Hunter River for a planned port expansion.

- Kurnell - Dredging at Kurnell wharf previously undertaken in the 1950s and at the sub-berth in 1969. More recently dredging was completed in Q4 of 2014, extracting around 153,000m$^3$ of sediment.

- Shoal Bay - 33,000 cubic metres of clean, coarse sand was dredged from the high sand shoals in the entrance to Port Stephens and used to replenish the beach.

- Jimmy's Beach - Dredging of the 29,000m$^3$ of sand from the Corrie Channel has also provided sand for beach replenishment.

- Port Macquarie - In 2007, 17,000m$^3$ of sand was pumped from Port Macquarie to Town Beach to rebuild the local dune system.

- Park Beach, Coffs Harbour - Beach replenishment has taken place on Park Beach (2009) with the removal of up to 40,000 cubic metres of sand from the entry to the inner harbour.

- Lady Robinson Beach has previously been replenished with around 300,000 cubic metres of sand.

- Swansea Channel - Dredging of the Swansea Channel involves the removal of up to 100,000 cubic metres of sand from the channel and is used to rehabilitate nearby dunes.

- Terranora Inlet, Tweed Heads - Has approximately 18,000m$^3$ of sand dredged from the navigation channel and placed on the adjacent foreshore (2008).

- Ettalong Channel - The mouth of Ettalong channel is dredged to improve navigation, dredge spoils have potential for beach nourishment.

Interstate

- Moreton Bay, Queensland - Approximately 15 million cubic metres were dredged from the Middle Banks area of Moreton Bay for the construction of Brisbane Airport.

- Hallet Cove, South Australia - In the 1990s sand was dredged from south of Hallet Cove.

- Cockburn Sound, Western Australia - Cockburn Cement (Adelaide Brighton) has been extracting shell sand for cement from the large banks (Success Bank and Owen Anchorage) just offshore as well as dredging navigation channels for shipping.
Appendix 2 – NSW Shelf Sand Bodies (cont.)
Appendix 2 – NSW Shelf Sand Bodies (cont.)

NSW Shelf Sand Bodies (Far North)

Legend
- Shelf Sand Bodies (SSB)
- Other Sand Bodies
- NSW State Waters (3nm limit)
- NSW Ports
- Shipwrecks
- NSW Aquatic Reserves
- NSW Marine Parks
- Commonwealth Marine Reserves
- Continental Shelf (approx.)