The sand and gravel dredging industry plays a major role in supplying high-quality construction aggregates into the UK. The main markets lie in south-east England, including London, in South Wales and south-west England, and in north-east and north-west England. A total of 14.1 million tonnes of marine aggregates were landed in England and Wales in 2001. In addition, marine dredging also supplies the construction industries of the Netherlands, Belgium and northern France, with almost 7 million tonnes supplied to these countries in 2001. The third main market for marine sand and gravel is UK beach replenishment and infill. Annual tonnages for this purpose vary according to specific contract demand; for example, in 1996 a total of 7.2 million tonnes were used whereas in 2001 the figure was 1.6 million tonnes.

Notwithstanding the clear benefits which society derives from construction aggregates, marine dredging, in common with other extractive industries, leads to environmental impacts. This article examines how the British Marine Aggregate Producers Association (BMAPA) is identifying, investigating and mitigating these impacts. It introduces some examples of recent progress in establishing best practice for more sustainable management, in keeping with the Government’s desire to see greater efforts in marine stewardship from relevant stakeholders.

MARINE STEWARDSHIP AND MARINE AGGREGATES

In May 2002 the Department for Environment, Food and Rural Affairs (DEFRA) launched the Government’s first marine stewardship report, ‘Safeguarding our Seas’ (DEFRA, 2002), which set out an approach to counter marine environmental problems including declining fish stocks and biodiversity. The report recognizes the vital role marine resources play in the national economy (i.e. oil and gas, fisheries, wind power and aggregates) and explains the benefits of implementing sustainable management and research, both present and future.

In relation to marine aggregates, the report sets out the current precautionary approach to permitting dredging and lists several ways in which good practice in aggregate extraction will protect the marine environment. BMAPA accepts these approaches and believes that the industry is already acting responsibly with regard to environmental impacts. According to DEFRA (2002), promoting marine stewardship through good practice in aggregate extraction can be achieved in the following ways:

— the careful location of new dredging areas
— considering new applications for dredging permissions in relation to the findings of a full environmental impact assessment (EIA)
— minimizing the overall impact of dredging by reducing the risk of cumulative impacts from multiple dredging operations and other human activities
— minimizing the area dredged at any one time and minimizing the total area permitted for dredging
— controlling dredging operations through the use of legally enforceable conditions attached to dredging permissions
— requiring operators to monitor, as appropriate, the environmental impacts of their activities during and on completion of dredging.

These points are referred to in turn below to explain how...
BMAPA is currently managing marine dredging.

The careful location of new dredging areas: All dredging areas are selected with reference to high-resolution geological surveys and EIAs. These are conducted by survey specialists and independent consultants and scientists.

Considering new applications for dredging permissions in relation to the findings of a full EIA: Since 1993 all applications have required an EIA, the scope of which is determined in each case by consultation with stakeholders.

Minimizing the overall impact of dredging by reducing the risk of cumulative impacts from multiple dredging operations and other human activities: Dredging in existing licences is commonly considered within the scope of new applications as a cumulative impact assessment within an environmental statement.

Minimizing the area dredged at any one time and minimizing the total area permitted for dredging: Many licences are zoned to restrict the area available for dredging and 90% of all aggregate dredging in UK offshore waters in 2001 took place from an area of only 13km². Each year the area dredged and licensed is reviewed and reported in a joint BMAPA and Crown Estate initiative.

Controlling dredging operations through the use of legally enforceable conditions attached to dredging permissions: Aggregate dredgers already carry a Crown Estate electronic monitoring system (EMS) on board which records digitally the location of the vessel and whether or not it is dredging. This monitors and ensures that dredging is only taking place when and where it is permitted. In addition, the Government (Office of the Deputy Prime Minister, ODPM) will soon introduce a statutory licensing procedure with the implementation of the Environmental Impact assessment and Habitats (Extraction of Minerals by Marine Dredging) Regulations. Existing Crown Estate dredging licences already have conditions attached by the ODPM and failure to comply could result in the licence being suspended or withdrawn.

Requiring operators to monitor, as appropriate, the environmental impacts of their activities during and on completion of dredging: Several types of monitoring are already undertaken, including pre- and post-dredging bathymetry, resource assessment, benthic biological surveys, fishery assessments, beach profiling and aerial photography. These are underpinned by regular data interpretation and reviews. In addition, the industry contributes to research both in kind through data provision and directly with funding for specialist projects.

BMAPA therefore believes that much is already being done to promote marine stewardship within the industry to the standards expected by the Government. The next section of this article illustrates the good practice outlined above with reference to examples of advances in marine stewardship at an industry level.

**PUTTING MARINE STEWARDSHIP THEORY INTO PRACTICE**

**Research**

**Marine ecology**

A key topic in relation to aggregate dredging and the marine environment is how fast and to what extent marine life in dredging areas recovers after extraction has permanently ceased. In 2000 BMAPA commissioned a research project to investigate this issue, the aim being to provide information to assist with licence applications around the UK. The study was entitled ‘The impact of marine aggregate dredging and overboard screening on benthic biological resources in the central North Sea’ and was carried out by a leading scientific consultancy, Marine Ecological Surveys Ltd (Newell et al 2002).

New data was collected from a licensed dredging area in the central North Sea in the form of grab samples from within and beyond the dredged seabed. The samples were analysed for their marine life content in terms of biomass, species diversity and abundance. Dredging records were collated together with sedimentological data to provide accurate information on physical (as opposed to biological) changes both before and during dredging. The report has just ➤
been published and, in summary, concluded the following:
— no impact of dredging was detected on species variety or population density
— dredging had a major impact on biomass within the dredged area and a smaller but still significant effect immediately beyond the dredged area
— the zone of lower biomass extends between 500m and 4,000m beyond the dredged area depending on the seabed sediment transport and tidal residual direction
— beyond the zone of suppressed biomass, the biomass of benthic macrofauna is locally high relative to the remainder of the survey area. This is thought to arise from locally high levels of organic matter settled out from the dispersing dredger sediment plume
— the seabed where dredging has ceased for about one year supported a similar biomass to that in undredged control areas, suggesting recolonization was largely complete within a year of dredging ceasing
— these results are considered representative of gravelly sand deposits in shallow marine environments where waves and tides influence biological development. This is the case in most of the existing dredging licence areas off the coast of Eastern England and in some areas off southern England
— the results cannot be applied uncritically to deeper-water sites where rates of natural sediment movement may be lower or where mobile seabed sands are absent. These are more stable seabed environments and the associated benthic communities may be less well adapted to natural or man-induced changes.

Other research on recolonization rates following dredging (Kenny et al, 1998) indicated similar rates for opportunistic or quick-colonizing species but over three years for slower-growing species. This research took place as a one-off experiment on an area of seabed off north Norfolk, which was intensively dredged over a limited period of time. Further work may be necessary should dredging take place in deeper water in the future.

BMAPA believes that the results of Newell et al will provide reassurance to stakeholders concerned about the possibility that many dredged areas will be left as lifeless marine deserts after extraction. This is clearly not the case from the work in the central North Sea, on one of the most heavily dredged offshore licences. It is also hoped that the results will assist in the progress of new licence applications to replace depleted reserves.

Archaeology
Consideration of marine archaeology for marine dredging operations has advanced in recent years. Two main issues are considered here: the potential existence of prehistoric landscapes and artefacts within dredging areas; and maritime artefacts — shipwrecks and other post-Mesolithic debris.

The potential existence of prehistoric landscapes and artefacts within dredging areas: During the glacial episodes of the Quaternary Period global sea levels fell by over 100m exposing large tracts of the UK continental shelf as dry land. It was during these cold, periglacial phases that most of the present-day marine sand and gravel deposits were formed. 

The 2,400-tonne capacity dredger City of Chichester steaming in the English Channel. The vessel is 72m long and 15m wide with a draught of up to 5.2m. It is designed to enter small, tidally restricted wharves on the south coast of England and delivers two cargoes a day, one on each high tide.
Marine Aggregates

Safeguarding our seas

The British Marine Aggregate Producers Association (BMAPA) and The Wildlife Trusts have recently announced a new allied approach to dredging and marine biodiversity. The move, made in response to a new Department for Environment, Food and Rural Affairs (DEFRA) initiative entitled ‘Safeguarding our Seas’, means that together BMAPA and The Wildlife Trusts will look at dredging in ways that have the least impact upon the biodiversity of the seas.

Commenting on the new approach, BMAPA chairman Barry Dennett described marine stewardship as ‘one of the most important issues that the marine environment has faced in recent years’. ‘It is about knowledge of the sea, what we need from it and what it needs from us,’ he said. ‘BMAPA has made a commitment to The Wildlife Trusts to look at this issue together, so we can share our knowledge to get the best for the marine environment. We will draw on each other’s strengths and expertise to develop our awareness and sustainable use of the marine environment.’

Simon Lyster, director general of The Wildlife Trusts, added: ‘The more knowledge we have about the marine environment, the better we can conserve it as a resource for the future. By working with BMAPA we will be able to find out more about marine habitats and use this knowledge together to protect and enhance our seas.’

BMAPA says future discussions will cover all aspects of the marine environment applicable to dredging and make a significant contribution to DEFRA’s marine stewardship initiative. ‘Safeguarding our Seas: A Strategy for the Conservation and Sustainable Development of our Marine Environment’ (ref: PB6187), priced £20.00, is available from DEFRA Publications, Admail 6000, London SW1A 2XX; tel: (08459) 556000. The report can also be accessed through the website: www.defra.gov.uk/environment/marine/

as gravel-bed river deposits. At the same time, human occupation of the exposed land surface was likely during the Palaeolithic and early Mesolithic periods. With the amelioration of global climate at the end of the Pleistocene, sea levels rose to submerge the UK continental shelf. Research into marine Palaeolithic and early Mesolithic archaeology therefore accompanies dredging licence applications to assess the site-specific potential for finds (such as stone tools) from these periods. Maritime artefacts — shipwrecks and other post-Mesolithic debris: With the submergence of the continental shelf to approximately the present level around 7,000 years ago, archaeological interest lies in the potential for maritime artefacts. Reference is made to industry survey data and existing public records to determine whether wreckage of archaeological interest exists within dredging areas. Items of interest range from early wooden craft to more modern charted or uncharted wrecks of either ships or aircraft. If debris is located a dredging exclusion zone is implemented and further surveys by a remotely operated vehicle or divers may be undertaken to identify the debris. Debris from the two world wars is sometimes discovered, most recently the remains of a US Air Force bomber in a dredging licence off Great Yarmouth.

Arisinfrom this research are initiatives to safeguard and report on any finds located. To this end, BMAPA has this year funded the drafting of a Technical Guidance Note in conjunction with the charity Wessex Archaeology, the Royal Commission for Historic Monuments in England (RCHME) and the Government competent authority for archaeology, English Heritage. This is the first of its kind in the marine environment and will assist with the assessment, mitigation and monitoring of any effects of dredging on maritime archaeology, as well as documenting best practice for dredging companies, consultants, curators and regulators. A new industry-wide code of practice sets out that archaeological finds on dredgers or at wharves must be reported to a specialist archaeological contact for a decision on whether to retain the find for further analysis. If necessary, dredging exclusion zones are implemented to ensure no further debris is disturbed.

In keeping with effective marine stewardship, the code of practice will ensure that archaeological issues are always considered both before and during dredging operations. These developments build upon the broader Joint Nautical Archaeology Policy Committee Code of Practice for Sea Bed Developers, 1995.

Data collection and provision

BMAPA members routinely collect large amounts of marine bathymetric, geological, ecological, fisheries and archaeological data as part of their resource assessments and environmental impact assessments to support dredging licence renewals and new applications. The information is made available to stakeholders through the consultation phases of the licensing procedure and increasingly through the Internet. Much of this information, which is undoubtedly of use in wider environmental management, would never have been obtained without the marine aggregates industry. Industry data and interpretative reports are, for example, provided to the Hydrographic Office, the British Geological Survey, English Nature, the Centre for Environment, Fisheries and Aquaculture Science (CEFAS) and the Marine Life Information Network (MarLIN) for their own use in updating public information and in undertaking research and development.

The seabed area dredged and licensed

BMAPA recognizes that the area dredged and area licensed are key indicators in assessing marine stewardship performance. In association with the Crown Estate, the industry annually reports on the area of seabed licensed and dredged off the UK. This is an ongoing initiative to
review existing production licences, recording the relinquishment of areas no longer containing viable deposits of sand and gravel together with the issue of new licences. The annual report also provides information on the extent and intensity of dredging operations derived from the Crown Estate’s EMS records for the year in question.

The aim is to eliminate all non-productive seabed from Crown Estate licences and to keep the area dredged to a minimum while meeting market requirements. The beneficial effect for marine stewardship is in limiting the environmental impact and avoiding disruption to other marine users. BMAPA is also minimizing the area available for dredging at any one time through both mandatory and voluntary zoning plans which restrict the area of seabed that can be dredged at any one time within a given licence area.

The Crown Estate and BMAPA initiative is now in its fifth year and since 1998 the area licensed has fallen from 1,662 km² to 1,413 km². With increasingly accurate dredging, the area dredged has fallen by a third from 258 km² in 1998 to 173 km² in 2001. Furthermore, in 2001 90% of all dredging intensity was recorded within an even smaller area of only 13 km².

BMAPA members are continuing to survey their licence areas to assess remaining resources and to continue to relinquish areas of seabed no longer containing viable reserves of sand and gravel. Details of the latest area dredged review, ‘The Area Involved — 4th Annual Report’, can be obtained at www.bmapa.org or by contacting the address at the end of this article.

FUTURE DEVELOPMENTS

Nature conservation and dredging

BMAPA recognizes the need to develop its responsibility for marine stewardship and is entering into dialogue with The Wildlife Trusts to discuss what further action could be taken to research and conserve marine habitats and biodiversity while also extracting marine aggregates.

More research

A number of other research projects to which BMAPA has contributed data and/or funding will soon be published, including a southern North Sea sediment transport study by HR Wallingford and a DEFRA-commissioned investigation into the cumulative effects of dredging, carried out by CEFAS. Additional research into the rehabilitation of dredged areas has been commissioned by ODPM to CEFAS. All will have a bearing on the way marine aggregate dredging is managed in the future.

BMAPA and English Heritage/RCHME are jointly sponsoring two research projects on marine archaeology, the first examining the potential for Palaeolithic and Mesolithic finds within sand and gravel deposits. The investigation is using analogues from terrestrial sediments to assist in recognizing the nature of such evidence offshore. The second project is based on GIS and will characterize marine archaeological potential on the inner continental shelf from the Isle of Wight to the Humber. Output will be in the form of charts depicting geology, known Palaeolithic or Mesolithic finds and more recent maritime casualties. As a result, a broad regional appreciation of archaeological context for dredging areas will be gained for dredging companies and regulators alike.

Further opportunities for marine research are arising from the aggregates levy sustainability fund. Several consultancies are pursuing funding for project proposals and the outcome will be known in the near future.

Regional environmental assessment

BMAPA members are also involved in a major initiative to support new dredging licence applications in the eastern English Channel. Ten applications have been made from six companies to dredge in water depths of between 35 m and 60 m close to and bordering on the median line between English and French waters. Given the scale of interest and the fact that the region has never been dredged for aggregates before, a regional environmental assessment (REA) is under way, commissioned by the companies under the name of the East Channel Association.
Marine Aggregates

New coastal forum

BMAPA, in conjunction with the Standing Conference on the Problems Associated with the Coastline (SCOPAC), recently initiated a coastal forum for the south coast of England. The aim of the forum was to develop an environment in which an open exchange of ideas and information on coastal issues could take place between coastal authorities and the marine aggregates industry.

Representatives from the South Downs and South East coastal groups and members of BMAPA attended the forum, which covered a wide range of issues including coastal monitoring, dredging licence applications and beach replenishment.

The forum was the first of its kind to take place in the UK and followed the recommendations of research into coastal processes and impact at the coastline carried out by the coastal group at University College London.

The author of this research, Dr Richard Simons, was invited to chair the forum. After the event he praised the constructive atmosphere of the meeting and held it up as a positive guide to future relations between all groups with an interest in the coastline.

As issues to be taken forward, Dr Simons highlighted the sustainability of aggregate supply for beach replenishment, the provision and availability of monitoring information, and the wider involvement of coastal groups in industry developments.

Robin McInnes, chairman of the SCOPAC Officers Working Group, commented: ‘There was a very positive response from those attending the forum on the important subject of the need for marine aggregate dredging. I shall be recommending to all SCOPAC members that the forum meets on a regular basis.’

Mark Russell, BMAPA development manager, concluded: ‘Marine aggregates are an important source of construction material along the south coast of England, and a major source of sand and gravel for ongoing beach replenishment works. This forum provided an opportunity to improve communication and data exchange at a technical level, which in turn will allow a better understanding of current issues.’

Over the next six months BMAPA will be looking to extend the coastal forum approach to other regions where marine aggregates dredging takes place.

CONCLUSIONS

Marine aggregates provide high-quality materials for all forms of concrete-based construction. They also provide a means of restoring eroded beaches and defending low-lying coastal landscapes from marine flooding. They are supplied in large volumes by ship into the centre of coastal and estuarine urban areas without the need for road transport. They can reduce the pressure to quarry land where planning constraints exist and there are sufficient volumes of marine sands and gravels to last for many decades to come, provided permission is given, where appropriate, to extract them.

Nevertheless, BMAPA understands that there are environmental impacts associated with dredging and is acting to mitigate these on both existing sites and through research for new licences. This paper demonstrates that the industry is prepared to embrace the principles of marine stewardship, to liaise with other stakeholders, and to take seriously the responsibility of working in the marine environment in a sustainable manner.

This article was written on behalf of the British Marine Aggregate Producers Association (BMAPA), 156 Buckingham Palace Road, London SW1W 9TR.

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Marine aggregate survey operations at dawn in the eastern English Channel. The equipment shown is a 3m-long vibrocorer used to sample coarse-grained seabed sediments. BMAPA members routinely carry out such surveys together with geophysical, biological and archaeological surveys to assess resources and marine environmental aspects.