



Artificial reefs have been defined as “any material purposely placed in the marine environment to influence physical, biological, or socio-economic processes related to living marine organisms”. Up to 40 countries around the world have constructed artificial reefs. Objectives for the deployment of artificial reefs include the enhancement of recreational and commercial fishing, coastal protection and mitigation of habitat loss and damage.

The New South Wales Department of Primary Industries (DPI) manages recreational fishing in ocean waters off NSW out to 200 nautical miles under the *Fisheries Management Act 1994* (FM Act). A primary objective of the FM Act is “to conserve, develop and share the fishery resources of the State for the benefit of present and future generations”. Further objects under the Act include promoting “ecologically sustainable development, including the conservation of biological diversity” and promoting “quality recreational fishing opportunities”. DPI aims to improve recreational fishing opportunities in NSW through the development of offshore artificial reefs.

In 2004, DPI began investigations into artificial reefs in coastal estuaries, progressing earlier work done by the Department in the 1970’s. Using design specific concrete artificial reef units developed in the United States known as ‘Reef Balls’, a number of small artificial reefs were deployed in Lake Macquarie Botany Bay and St. Georges Basin between December 2005 and February 2007 (Figure 1). In each estuary, six individual artificial reefs were created with an associated long term monitoring program to evaluate the effectiveness of the reefs. Preliminary results indicate that the artificial habitats have been successful in maintaining an increase in fish abundance and diversity, accompanied by extensive marine plant growth on the surface of the Reef Balls units. The reefs have also been a success in terms of enhancing recreational fishing opportunities.



Figure 1: St Georges Basin artificial reef constructed from Reef Balls (image: DPI)

Eight months after construction, catch abundance, catch diversity, and catch rates of recreational species on the artificial reefs were found to be as good as or better than control sites (naturally occurring reefs) within

Lake Macquarie. This pilot estuarine artificial reefs project has provided the necessary monitoring and management experience required for the investigation of the potential implementation of large artificial reefs in NSW coastal waters.

The material used in reef construction is a major consideration which will ultimately determine the success of the artificial structures. DPI staff visited South Korea and Japan in September 2007 to investigate artificial reef technology currently in use from two of the world's largest artificial reef manufactures and users. This study allowed DPI to conduct manufacture and design inspections of a number of artificial reef designs and also participate in 'in-situ' artificial reef inspections. The visit to South Korea was hosted by Dr Chang Gil Kim from the *Korean National Fisheries Research and Development Institute* (NFRDI). Mr Kim's extensive experience in artificial reef design and management and was engaged by DPI to produce a report to aid with the selection of a suitable artificial reef design and configuration options for the NSW coast. It was recommended that from the target species identified and the oceanographic conditions experienced along the NSW coast that an octagonal two storied steel artificial reef unit would be most suitable.



Figure 2: An octagonal two storied steel reef being lowered into position off Cheju Island, Republic of Korea (Image: Woochang Construction Co., Ltd).

The design is owned by the Woochang Construction Co., Ltd located on Cheju Island, South Korea. Four units are proposed to be deployed off each of the three proposed locations; Newcastle, Sydney and Wollongong; 12 in total (see Appendix 3 & 4 proposed site locations and artificial reef unit dimensions and proposed group configurations).

Each artificial reef unit will be constructed on land, transported to the proposed site by barge and lowered onto the sea floor via crane. Each artificial reef unit would sit directly on the seabed and would not require additional anchorage other than the weight of the unit itself. It is estimated that an area of seabed of 1.2km² would be required off Newcastle, Sydney and Wollongong for each artificial reef group.

Primary Objectives of the Proposed DPI Offshore Artificial Reefs Project are:

- Undertake an environmental assessment of the proposed deployment of offshore artificial reefs to examine biological, biophysical, economic, social and environmental impacts that may arise from their deployment;
- Investigate statutory obligations for the deployment of artificial reefs in NSW coastal waters;
- Investigate suitable and effective artificial reef designs for NSW coastal environmental conditions;
- Deploy artificial reefs in 3 metropolitan zones in NSW, namely Newcastle, Sydney and Wollongong to enhance recreational fishing opportunities by providing additional fishing locations;
- Implement a long-term management and monitoring program to assess the effectiveness and impacts of the artificial reefs over time.