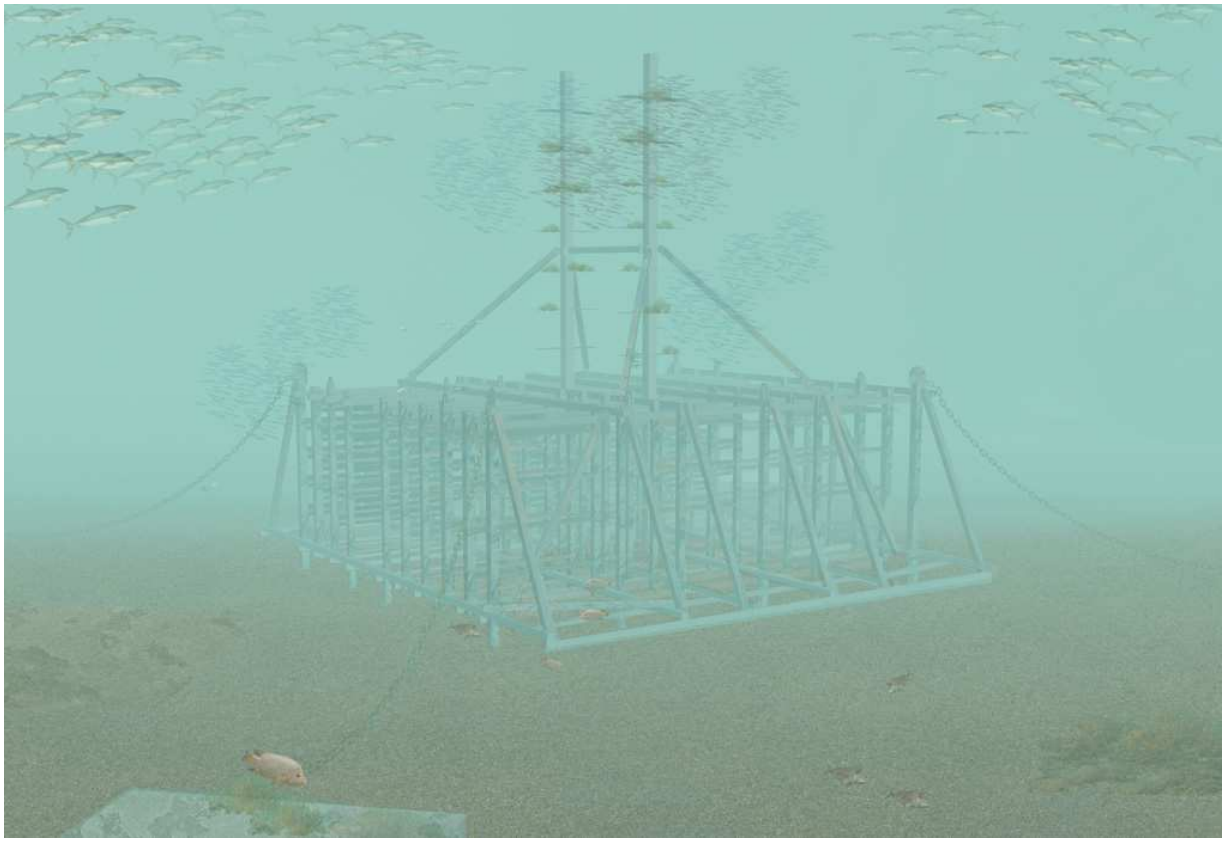
NSW GOVERNMENT Primary Industries

Environmental Management and Monitoring Plan (EMMP)

Sydney Offshore Artificial Reef



Offshore Artificial Reef Project (08_0095) **September 2011 (V3)**

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AMENDMENT SCHEDULE		
DATE	**REVISION NO.**	**AMENDMENT**
August 11	1	For review and approval
September 11	2	Reviewed as per DSEWPC comments received 15 Sept
September 11	3	Reviewed as per DSEWPC comments received 22 Sept

1 Introduction

1.1 Background

NSW Department of Primary Industries aims to improve recreational fishing opportunities in NSW through the development of offshore artificial reefs (OARs) in the vicinity of Newcastle, Sydney and Wollongong.

This Environmental Management and Monitoring Plan (EMMP) document aims to consolidate the mitigation and management measures that DPI is committed to implementing to minimise potential impacts of the proposal on the environment.

State and Commonwealth approval was received for the deployment of up to four individual 'OAR units' off Sydney, Newcastle and Wollongong (twelve in total – four per site). As per approval conditions, only one OAR of up to four individual OAR units will initially be constructed off Sydney (refer section 2.2 OAR location) and monitored in detail for a minimum of 3 years to enable monitoring and assessment of the success of the reef before proceeding with the other locations. This EMMP has therefore been compiled for the Sydney location only.

1.2 EMMP Outline

The Department of Primary Industries is responsible for the OAR operation, including management, monitoring and maintenance operations. The predicted effectiveness of the proposed management strategy/mitigation measures has been assessed on the following basis:

- High = the management strategy/impact mitigation measures should effectively reduce the magnitude of the potential impact to an extent where no discernable impact on ambient environmental conditions should be evident.
- Moderate = the impact is still likely to occur but the observed magnitude of the impact should be substantially smaller than if the management strategy or mitigation measure was not implemented.
- Low = the impact is still likely to occur.
- Uncertain = there is insufficient information available to predict with any certainty how effective the management strategy/impact mitigation measure will be in reducing the magnitude of the impact.

Terms referred to throughout the EMS are defined below:

'DPI' – refers to the NSW Government Department of Primary Industries (the project proponent and principal);

'OAR Management Area' – refers to the area within a 500m radius around the OAR unit including the area bounded by the Artificial Reef Crown Reserve detailed in Section 3.1 and Figure 1.

'Monitoring Plan'– refers to the Monitoring Plan outlined in Table 1. Background information and further detail of the Monitoring Plan are provided in the Artificial Reefs Monitoring Program (ARMP) and can also be obtained in Section 11.2 of the EA/draft PER document;

'User Guidelines' – refers to the OAR User Education and Awareness Guidelines outlined in Section 3.9. These guidelines aim to provide information important for OAR user groups to ensure minimal environmental impact and promote safety within the management area;

'OMMT' – refers to the OAR Management and Monitoring Team that consists of the following DPI personnel: Manager Fisheries Enhancement; Manager Recreational Fisheries Programs; Senior Research Scientist and Senior Fisheries Management Officer.

'DSEWPC' - Commonwealth Department of Sustainability, Environment, Water, Population and Communities (formally DEWHA).

'Reserve' – the DPI Offshore Artificial Reefs (Crown) Reserve, Gazetted 16 September 2011

2 OAR Installation

2.1 OAR Design

The OAR unit design is 12 m x 15 m x 12 m (height x length x width) with the bulk of the internal structure in the lower 4 m of the structure, giving it a low centre of gravity for increased stability (Fig. 1). The OAR unit is manufactured from square hollow sections (SHS) and rectangular hollow sections (RHS) and plates, and will weigh approximately 42 tonnes (dry weight). Four concrete anchor bocks will be connected to each corner to ensure OAR stability. The OAR unit has design certification to withstand a 1/100 year storm event (a wave height of approximately 18 m – H^{Max}) and will have an operational lifespan of 30 years.

2.2 OAR Location (Geographical Coordinates)

Up to a maximum of four individual OAR units are approved for deployment on the Sydney artificial reef reserve. Only one unit will be deployed in the 2011/12 financial year. However, up to three additional OAR units may be deployed at the Sydney artificial reef site during the course of the three year trial. However, this is dependent on funding availability for additional OAR unit construction and deployment in subsequent financial years.

Based on the outcomes of the Environmental Assessment/draft Public Environment Report (EA/draft PER), the location for the first OAR unit on the Sydney artificial reef reserve is as follows:

- The first deployment site is the southern most approved Sydney OAR unit location;
- Approximately 1.2 km from The Gap and 1.9 km south-east of South Head at a depth of 38 m (LAT) (Fig. 2);
- Latitude - 33°50.797'S; Longitude - 151°17.988'E

2.3 OAR Placement

2.3.1 Contractor

Tenders for construction and deployment of the Sydney OAR closed on 01 June 2011. Waterway Constructions Pty Ltd in joint venture with Haejoo Pty Ltd was selected as the preferred tenderer. The contract for the fabrication, construction, transport and deployment of the first trial OAR unit was executed in July 2011.

2.3.2 Assembly of the OAR unit, loadout and transportation

The steel component segments of the OAR unit have been prefabricated and test assembled in a steel workshop based in Scone (Hunter Valley, NSW). Completed modules are transported by road to Sydney (White Bay), where assembly is completed, load-out and sea-fastening of the unit and associated mooring blocks to the deck of the Kochi barge is completed onsite at White Bay.

The steel skeletal structure and concrete blocks are lifted onto the deck of the Kochi from the wharf edge using the Kochi's crane. The OAR unit and mooring blocks are then sea-fastened and readied for transport to the Sydney artificial reef site. A combination of 1.0 m of sea and swell; a maximum of 10 knots wind when lifting at sea is required for safe deployment of the OAR unit(s).

DPI will be notified no less than *36 hours* in advance of commencing transport of the OAR unit to the deployment site by barge. The installation works are not to interfere with any seagoing vessels unless agreed in advance with the Harbour Master. A detailed Marine Traffic Management Plan (MTMP) has been developed and approved by the Sydney Harbour Master as per conditions of 'Permission for Disturbance of the Bed of a Special Port Area' under Clause 67 of the *Management of Waters and Waterside Lands Regulations* received by DPI from the Harbour Master - Sydney Ports.

Other relevant approvals/permits required (obtained by deployment contractor – Waterway Constructions Pty Ltd) include:

- Towing permit from NSW Maritime to transport the OAR;
- Aquatic licence from NSW Maritime for exclusive use of the waters for the purposes of sinking and/or monitoring the structure;

- Authorisation under Section 13 of the *Maritime Services Act 1935* for buoys associated with the OAR (exclusion zone).

Once on site with the Kochi barge, the steel structure will be lowered in two steps; the OAR unit will be lowered keeping the upper spreader beam and two slings above deck level at all times. Using two slings guided by the side of the barge prevents twisting of the structure during lowering. Slings will be added to the initial arrangement of rigging to reach the desired depth. To lengthen the slings, the OAR unit will be secured to bollards on the barge deck using the initial rigging set up and attach the additional slings needed to reach the bottom level.

2.3.3 Ensuring accurate OAR placement

To ensure correct positioning of the artificial reef a combination of GPS, compass and Remotely Operated Underwater Vehicle (ROV) devices will be used. To ensure the barge remains in the correct location, four anchors will be deployed. Using two slings resting along side of the barge will control the orientation. After the structure has been lowered, the ROV will be used to confirm the orientation, if it is correct the diver will un-do the shackles to release the slings free. The same procedure will be used to lower the concrete anchor blocks initially. They will then be connected to the steel skeletal frame and repositioned to the correct location. Waterway Constructions Pty Ltd will provide a formal certificate to the DPI verifying the exact GPS coordinates of the works once deployment has been completed.

2.3.4 OAR deployment timing and exclusion zone establishment

Timing is weather dependent and the crew of the Kochi barge and associated tug services (managed by Polaris Pty Ltd) will be available according to the following proposed schedule:

OAR Unit 1 (October 2011)

30 September 2011 – completion of unit assembly and final inspection;

05 October / 06 October 2011 – completion of load-out and sea-fastening to the Kochi barge; establishment of exclusion zone;

07 October 2011 – transport to the site ; 4-point anchoring of the Kochi barge;

08 October 2011- deployment of the OAR unit;

08 October 2011 / 09 October 2011 – deployment of the 4 x mooring blocks

10 October – completion of OAR unit/mooring block attachment; confirm location and build;

11 October – disassembly of deployment site and exclusion zone; transfer Kochi barge and associated deployment equipment to White Bay.

The Kochi barge will be towed by the tugs 'Leveret' and 'Fern Bay' owned by Polaris Marine Pty Ltd and based in Rozelle Bay, Sydney.

Exclusion zone: the exclusion zone will be deployed prior to the arrival of the Kochi barge and will be in force between 07 – 10 October; the zone will be marked by temporary buoys (special mark – yellow and lit with yellow flashing light 1/5 seconds) and will cover an area of 300 m x 300 m. No unauthorised persons/boats/watercraft will be allowed to enter this exclusion zones. Enforcement will be conducted by NSW DPI (Fisheries) compliance personnel and vessels throughout the deployment of the unit and associate mooring blocks.

The position of the exclusion zone marks shall be as follows:

Exclusion Mark 1 33 50.734'S 151 18.166'E

Exclusion Mark 2 33 50.951'S 151 18.063'E

Exclusion Mark 3 33 50.858'S 151 17.806'E

Exclusion Mark 4 33 50.647'S 151 17.910'E

2.3.5 Cetacean Interaction Procedures

If at any times in the course of placement and operations activities an incident occurs involving Cetaceans, work will cease until marine life has moved on from the work area. In addition:

- The incident will be immediately reported to the DSEWPC in writing if deemed necessary;
- When towing the Kochi barge or operating any other vessels, the *Environment Protection and Biodiversity Conservation Regulations 2000* Part 8.05 Other craft — adult cetaceans shall apply:

    1. This regulation applies: (a) to a person who is operating a vessel that is not a prohibited vessel; and (b) in relation to cetaceans other than calves. Note Regulation 8.06 contains special provisions for calves.
    2. Within the caution zone (caution zone, for a cetacean, means an area around the cetacean with a radius of: (a) for a dolphin — 150 metres; and (b) for a whale — 300 metres.)for a cetacean to which this regulation applies, the person must:
        - Operate the vessel at a constant speed of less than 6 knots and minimise noise;
        - Make sure the vessel does not drift or approach closer to the cetacean than: (i) for a dolphin — 50 metres; or (ii) for a whale — 100 metres;

- If the cetacean shows signs of being disturbed, immediately withdraw the vessel from the caution zone at a constant speed of less than 6 knots;
- If there is more than 1 person on the vessel, post a lookout for cetaceans;
- subject to paragraph (b), approach the cetacean only: (i) from the rear, no closer than 30 degrees to its observed direction of travel; or (ii) by positioning the vessel ahead of the cetacean at more than 30 degrees from its observed direction of travel;
- Make sure the vessel does not restrict the path of the cetacean;
- Make sure the vessel is not used to pursue the cetacean.

Note: The Offshore Artificial Reef Education and Awareness User Guide provides more detail on how the public may assist in reporting an potential interactions with cetaceans during to operation phase of the OAR.

2.3.6 Waste Inspection

The artificial reef unit will be 'sand-blasted' to remove all foreign material (e.g. paint, oils, welding slag etc) prior to transport to White Bay for assembly. Following the completion of assembly, a final inspection will be carried out by Haejoo Pty Ltd to ensure no foreign material remains on the unit and a written report will be provided to NSW DPI confirming the unit's readiness for deployment. Following assembly at the White Bay site, the OAR unit will be inspected by DPI personnel and a representative from Worley Parsons Services Pty Ltd (design contractor).

3 Management and Environmental Monitoring

3.1 Management Area

An OAR Management Area is the area within a 500 m radius of the unit. In addition, a Crown Reserve has been established under the *Crown Lands Act 1989* around the Sydney OAR site consisting of an area which is 1000 m by 400 m, which includes a buffer zone of 200 m around each reef unit (Fig 2).

It is important to note that the boundaries of the Crown Reserve are not intended as an 'exclusion zone' but an area considered appropriate to manage the potential issues described in this management plan.

3.2 Environmental Performance Monitoring

In order to better understand how the installation of OARs will impact upon significant components of the marine environment and evaluate their overall effectiveness in relation to the project objectives, an environmental monitoring strategy has been developed. This aims to address a number of the potential impacts identified in the EA/draft PER by implementing an adaptive management approach. The following section refers to the monitoring plan presented in Table 1 of this document. As best practise, all objectives outlined in the Monitoring Plan (Table 1) would be met and appropriate monitoring carried out.

3.3 Scope, Duration and Time Frames for Monitoring

In order to better understand how the installation of OARs will impact upon significant components of the marine environment and evaluate their overall effectiveness in relation to the project objectives, an artificial reef monitoring strategy has been developed. In compliance with recommendations outlined in the EA/draft PER, DPI is committed to carry out intensive environmental monitoring over a minimum period of three years. However, ongoing surveillance environmental monitoring will be carried out by the Department on an annual basis for an additional period of 7 years (10 years in total - or as otherwise agreed to by consenting authorities).

The monitoring plan is consistent with the EA/draft PER which prioritised objectives as:

- Priority One (monitoring objectives strongly recommended), and
- Priority Two (objectives to be addressed given the available resources**).

***Although priority 2 monitoring objectives are resource dependent, DPI confirms that colonisation of the OAR unit(s) including any colonisation by invasive marine pests; sampling of sediments within a 10m radius of the unit(s) to determine changes in heavy metals, sediment characteristics, and; swath mapping (or equivalent) to investigate scouring and sedimentation in the vicinity of the unit(s) will be undertaken.*

3.3.1 Priority One Monitoring Objectives

Biological

- Investigate movements of high priority species within the direct study area.
- Assess effectiveness in terms of catch rates, species composition and fish stocks.
- Investigate occurrence of threatened/protected and migratory species on the OARs.

Physical

- Assess structural integrity.

- Remove fouled gear and debris.

Socio-Economic

- Assess effectiveness in terms of popularity with recreational fishing groups and OAR related expenditure.

3.3.2 Priority Two Monitoring Objectives

Biological

- Assess influence of OARs on benthic assemblages (soft sediments) including potential halo effects.
- Assess influence of OARs on benthic assemblages of proximal natural reefs (benthos).
- Document colonisation of the reef structures by macroinvertebrates including pest species.

Physical

- Assess influence of OARs on sediment characteristics.
- Assess concentrations of heavy metals in adjacent sediments to OARs.
- Assess water quality.

Socio-Economic

- Identify issues of conflict between user groups.

Priority One monitoring objectives are fully funded by a current Departmental Trust Funded project (Offshore Artificial Reef Monitoring Program). Funding for Priority Two objectives is conditional on the success of a current ARC linkage grant application submitted by NSW DPI and the University of NSW (UNSW).

3.4 Procedures and Protocol for Sampling and Analysis

3.4.1 Identification of Parameters to Monitor

Monitoring parameters have been determined by assessment of information needed to meet requirements identified by Priority One and Priority Two monitoring objectives.

3.4.2 Proposed Methodology (Priority One Objectives)

Priority One objectives relate to the species composition and residency times of the fish community associated with the OAR, particularly in relation to how this differs to the fish assemblage associated with natural (control) reefs in the immediate vicinity. Additional priorities include an assessment of the level of interaction between

threatened species and the OAR, structural integrity of the OAR, and the popularity of the OAR with recreational fishing groups.

The experimental design to address Priority One objectives incorporates a Before-After-Control-Impact (BACI) design to assess relative rates of recruitment and species composition between the OAR and naturally occurring reefs (control locations) over time. The following methods will be used;

- Baited stereo videography (BRUVS) to obtain detailed size frequency information of species associated with the OAR.
- The use of "flash memory" underwater video (UV) designed for extended deployments suitable for detecting low occurrence events that may be important in the assessment of offshore structures.
- Underwater visual surveys (UVC) conducted by divers and coordinated with the deployment of UV will provide a census of numbers of fish at each location and a means of assessing the structural integrity of the OAR.
- Photographic surveys to record physical change on the sea floor (sedimentation and scouring), growth of macroalgal and any structural changes associated with the OAR.
- Acoustic tagging technology in association with ATTAMS array to determine movement patterns of species associated with offshore artificial structures.

Monthly sampling utilising BRUV and UVC will be used to monitor changes in the assemblage structure of fish populations associated with the OAR and control locations. Stereo video observations will be analysed to obtain measures of diversity and relative abundance which will form the basis of comparisons over time in relation to the artificial structure and comparisons between locations (artificial and natural). Accurate length estimates can also be derived from the stereo video observations enabling further comparisons in the size structure of species between locations and over time. Analysis will be carried out using multivariate repeated measures analysis (PERMANOVA Primer statistical package).

Stereo BRUV and UVC will also be used in conjunction with ultrasonic telemetry to determine levels of interaction between threatened species and marine mammals and the OAR. Ultrasonic tags will be implanted in fish residing on the OAR and at control locations. Listening stations will be deployed at the OAR and control locations to assess fish residency times and rates of movement between adjacent natural reef and the OAR sites. Structural integrity will be assessed by regular visual and photographic inspections of the OAR. Assessment of popularity including catch rates associated with recreational anglers will be assessed using charter log book data.

3.4.3 Proposed Methodology (Priority 2: Objectives)

Priority two objectives incorporate the assessment of benthic assemblages (soft sediments) including concentration of heavy metals, potential 'halo' effects around the OAR and an examination of the macroinvertebrate communities (including invasive and pest species) associated with the OAR. Additional priorities examine the potential for patterns of water movement associated with the OAR to affect local levels of productivity.

Priority two objectives will be assessed using the following methods;

- Benthic grab samples to determine changes in composition of soft sediment around the OAR
- Benthic 'feeding plates' to examine potential differences in the interaction between the fish assemblage and macrobenthic community between locations
- Video and photographic surveys to assess benthic diversity.
- Acoustic current meter (ADCP) to assess influence of the OAR on water movement
- Pelagic BRUVS to assess species assemblages in the ocean around the OAR
- Plankton nets and optical plankton counts to assess water quality and plankton biomass around the OAR

Benthic grab samples and Baited Remote Underwater Video (BRUV) imagery will be made at sites near (<100 m) and far (>1 km) from the OAR, the video imagery will be examined for evidence of sand disturbance by grazing fish. Material retrieved from the grab samples will be analysed to determine a range of metal concentrations (cobalt, chromium, copper, iron, manganese, nickel, lead, zinc) to determine if proximity of the OAR has an effect metal concentration.

The benthic grazing plates will be deployed inside fish-exclusion cages and none-cage controls at the OAR and control locations to assess the grazing of benthic assemblages by fish. Video observations will also be used to document differences in the benthic communities between OAR and control locations and any differences in the types of species feeding off the plates in each location and provide logical candidates for comparison of fish condition between locations.

The fine-scale (10 m) flow disturbance around the OAR and natural reef will be determined with repeat transects using intensive deployments with an 'Iver2' autonomous underwater vehicle. A second vessel will make GPS guided conductivity temperature depth (CTD) casts providing vertical profiles of phytoplankton and nitrate. Sampling will be carried out over at least 10 days each summer over the three year study period. Zooplankton will be collected in a 20 cm diameter, 100 micron mesh nets at 30 m depth. Plankton abundance will be

measured in the laboratory with a Laser Optical Plankton Counter. Baitfish abundance will be compared between OAR and the two natural reefs using a pelagic Baited Remote Underwater Video (BRUV).

Feeding plates will be deployed on the OAR and naturally occurring reefs. The plates will be photographed, analysed and replaced every 6 months. Photographs will be analysed to reveal the density and growth of species, such as barnacles and tunicates. Potential predators will be excluded by cages covering the plates. Prior to removal the plates will be uncovered for a 24 hour period.

The sediment particle size distribution (PSD), concentrations of heavy metals and water quality was surveyed as part of the PEA. Concentrations of heavy metals within the sediments were well below the ANZECC interim sediment quality guidelines (ISQG) provide a baseline for future assessment. Post deployment sampling will require benthic grab samples to be taken at sites near (<100 m) and far (>1 km) from the OAR. Material retrieved from the grab samples will be analysed to determine a range of metal concentrations (cobalt, chromium, copper, iron, manganese, nickel, lead, zinc) to determine if proximity of the OAR has had an effect on metal concentration.

3.5 Consideration of the effectiveness of the OAR

Effectiveness of the OAR will be considered based on information from observation and analysis of fish community data collected during Priority One sampling. Comparison of assemblage structure (diversity, species richness and relative abundance) collected by a combination of BRUVS and UVC observations between OAR and control locations will be used to assess any differences between the OAR and natural reefs in the immediate area. This information will be complemented by movement data (ultrasonic telemetry) of fish tagged on the OAR and on control reefs. Analysis of this information will provide a more detailed picture of movement patterns and residency times of selected species between the OAR, naturally occurring reefs and the broader marine environment.

3.6 Movement of identified high priority species within the direct study area and potential impact to threatened species

The Preliminary Environmental Assessment (PEA) identified the entrapment or injury of threatened species or mammals as a “low risk”. Known distribution patterns of threatened species and marine mammals were considered in OAR site selection as part of the initial constraints mapping exercise. In addition, the OAR has incorporated design features (large internal void spacing, open ended design platform) to minimise the potential for entrapment of any species likely to encounter the structure.

Detection and movement patterns of high priority species will be carried out via combination of BRUVS, UVC and ultrasonic telemetry. High priority species moving regularly within the immediate vicinity of the study area will be detected by video (BRUVS) and diver based (UVC) observations. High priority species moving within the direct study area less frequently may be observed by camera systems designed to operate over longer periods (days) and specifically designed to detect less frequent encounters of rare or high priority species.

Issues and contingency measures relating to possible interaction of threatened species and marine mammals are outlined in Table 2 and relate to existing monitoring (BRUV and UVC) and the removal of debris from the structure. Assessment of the level of interaction of threatened species and marine mammals with the OAR will be carried out using information gained from UV camera, repeated BRUV and UVC observations and supported by ultrasonic telemetry. Interactions will be recorded and reported to the Department's threatened species unit in accordance with Departmental protocols.

3.7 Concentration of heavy metals in the sediments and hydrology within a 10m radius of the OAR(s)

Artificial reefs made from steel in the marine environment will corrode over time, potentially affecting adjacent sediments. Many organisms take up contaminants from surrounding waters, sediment, or their food, which accumulate and persist within their tissues for long periods of time or are transferred to consumers higher up the food chain i.e. bioaccumulation. Where these organisms also function as habitat (eg seagrass), there is potential for accumulated contaminants to negatively affect associated epifauna.

Design specifications calculate that the OAR structure would corrode at a rate of 0.01 mm per year over the expected 30 year design life. It is therefore likely this will result in the leaching of iron oxide over time and potentially elevated iron levels within sediments adjacent to the reef. Iron is not however, considered a significant contaminant in the sea (and even at elevated levels, would be unlikely to have adverse effects on infaunal assemblages). Any leachate is likely to be quickly dispersed and diluted and any potential impacts would be of relatively small-scale and localised. Providing Australian Standard guidelines are met, contamination from leachate is not likely to have a significant impact on sediments or water. Management and mitigation strategies are outlined in Table 3. Scouring and sedimentation will be assessed by visual inspection by divers and annual swath acoustic mapping (or equivalent) to visually explore trends and document rates of sedimentation and scouring in the immediate vicinity of the OAR unit(s).

Hydrology around the OAR including a synoptic current field over the Sydney Shelf will be monitored by three oceanographic moorings of the Integrated Marine Observing System, located at the 60, 100 and 140 m isobaths. There will also be two conventional ADCP current meters deployed 2 km north and south of the OAR.

Autonomous underwater vehicles (IVER2) will be used to record fine scale currents upstream and downstream of the OAR as well as over two adjacent natural reefs, on flood and ebb tides.

3.8 The structure of the fish assemblage at the OAR and potential impacts of the OAR on proximal natural reefs

Artificial reefs by definition will undergo a period of succession as fish and epibenthic communities colonise the reef. The rate of recruitment of fish communities to artificial structure is known to vary according to the proximity to natural reef and the types of species present. The structure of fish assemblages associated with OAR will be examined using a combination of stereo BRUVS, UVC and UV observations. Analysis of this data will enable an assessment of assemblage characteristics (species diversity, richness, size structure and abundance) how this varies over the life of the study period and provide a comparison with fish and benthic assemblages associated with naturally occurring reef systems.

Ecological impacts of artificial reefs on surrounding ecology are not well understood and it is possible that artificial reefs may affect the structure of nearby natural reef assemblages. The effect on adjacent natural reef is likely to be dependent on factors such as distance from the artificial reef and the type of fish found on the artificial reef that are also likely to forage on adjacent natural reef. Hence, overlap of predators, competitors or grazers from the artificial reef could lead to over-grazed or altered natural reef habitat or feeding halos.

The structure of assemblages on natural reef habitat is largely dependent on larval settlement and recruitment that in turn depends on current and dispersal patterns. It is possible that the artificial reef structures could also alter or interrupt dispersal patterns by:

- providing alternative settlement substratum for recruits that could otherwise occur on natural rocky reef;
- increasing predation of planktivorous fishes on artificial reefs;
- providing a link between otherwise separate populations, or facilitating recruitment of invasive pest species; and
- altering local hydrology.

The extent of impact on neighbouring natural reef may also depend on the size of the natural reef with impacts likely to be greater for a smaller neighbouring reef than a larger one. Any change in rocky reef assemblages as a result of the proposal would occur over a relatively long time period and would therefore require a suitably long period of monitoring to detect changes.

Potential impacts of the OAR on existing fish communities are addressed by the before after control impact (BACI) nature of the experimental design. In compliance with the guidelines set down by the EA, natural reef control locations will be monitored monthly for at least 6 months prior to the deployment of the OAR. Monitoring

will continue at these locations using a combination of both BRUV and UVC for the entire sampling period (3 years). Analysis of this data will provide the information used to asses the nature and degree of any impact the OAR has had on nearby natural reef systems. Management strategies and measures relating to mitigating negative effects are listed in Table 5

3.9 OAR User Education and Awareness Guidelines

User guidelines have been produced to form the basis of the OAR education campaign. The guidelines would provide information important for OAR user groups to ensure minimal environmental impact and promote safety within the OAR Management Area. These OAR User Education and Awareness Guidelines are available via the DPI website (www.fisheries.nsw.gov.au) and in print for distribution to relevant recreational fishing associations and clubs. A copy of the OAR User Education and Awareness Guidelines is attached in Appendix 1.

4 Contingency Measures

4.1 Environmental emergency, incident or non-compliance contact and response

If at any time during the deployment or operation of the OAR as specified in the EA/draft PER and/or the EMMP, an environmental risk/incident occurs involving Threatened, Protected and/or Migratory Species or matters of National Environmental Significance (NES), DPI will immediately implement measures to mitigate the risk or the impact. The situation will be reported in writing within 24 hours to the DSEWPC (and any other relevant Government Agency or Authority), with a full report detailing:

i) the environmental incident that occurred and/or 'non-compliance' detected;

ii) the mitigation measurers taken, and;

iii) The success of these measures in addressing the environmental incident that occurred and/or 'non-compliance' detected and any additional measures that are proposed to be taken.

The following emergency contacts will be utilised:

1) Manager Fisheries Enhancement – DPI
   Ph: (02) 9527 8475 (office hours); 0438 042 278 (24hrs/7days)

Responsible for coordinating emergency response and notification to relevant Agencies (e.g. NPWS, DPI, NSW Maritime) in the event of an environmental emergency occurring in the vicinity of the OAR site.

Other relevant emergency contacts include:

i) DPI Fisheries-related matters – Ph: 1300 550 474 (Recreational Fisheries Management, Threatened Species Unit)

ii) ORRCA Whale and Dolphin Rescue - Ph: (02) 9415 3333

iii) Fisheries Watch - for reporting illegal fishing – Ph: 1800 043 536

iv) For ALL other emergencies (NSW Police, Maritime, Fire, Ambulance) – Ph: *000*

4.1.1 Decommissioning

The nominal operational lifespan of the OAR units is estimated to be 30 years. It is likely, however, that the structures would remain operational for longer than this. The current design does not allow for removal of the structures intact at the end of the 30 year lifespan as it is uncertain whether they would be structurally sound enough to be lifted from the seabed and transported to a disposal site. Whether the units are removed intact or dismantled would depend on the outcome of structural inspections prior to removal. The following options for decommissioning would be considered:

- Option A – Provided the structures are verified to be structurally sound for removal, the units would be lifted intact by crane to a barge and transported to a waterside location, where the units would be cleaned, dismantled and disposed of at an appropriate land-based facility.
- Option B – If it is not feasible for the units to be removed intact, then the units would be dismantled by commercial divers in-situ, sections craned onto a barge and transported to a waterside facility where the pieces would be cleaned and disposed of at an appropriate land-based facility.
- Option C – Structures would remain in-situ on the sea-bed and be allowed to gradually break-down over time. Monitoring of the structures would continue.

These options would provide a contingency for decommissioning at any stage during the operational life of the OAR if required, although the option of removing the units intact is unlikely to be feasible towards the end of the operational lifespan. In the event that unacceptable impacts to the environment were detected during monitoring of the first (Sydney) deployment then 'Option A' would be the most likely method of decommissioning. In the event that removal of the OAR structures or partial removal is required, a decommissioning plan will be submitted to SEWPC and the NSW Department of Planning for approval. It is likely that the main impact of removing the structures (options A or B) would be a significant loss of attached flora and fauna and a loss of fish habitat, however, the overall environmental impact would depend on which option for decommissioning was considered

most appropriate and the length of time the units had been in place. Removal of the units (Options A or B) would therefore be subject to a separate environmental assessment for their removal.

4.2 OAR Inspections – modifications, repair, fouled gear and marine debris removal

Design specifications for the OAR were based on Australian standards for similar offshore structures with a thirty year design life. The model for the stability assessment was based on the following parameters:

- water depth of 38 m;
- a 100 year average recurrence interval (ARI) design wave (H^{max}) in the primary wave direction (19.6 m);
- a 100 year ARI design wave period (Tmax) of 14 seconds;
- a minimum Factor of Safety (FOS) of 1.15 for overturning; and
- load increase associated with marine growth.

Structural integrity of the OAR would be assessed by regular (bi annual) inspections. The following items would be monitored and recorded during the inspections:

- unit location;
- unit orientation;
- all main structural members (i.e. ensure that structural members are intact and not loose);
- any severe corrosion; and
- Thickness of marine growth on random steel sections at the top and base of each unit.

Following the monitoring inspections, the findings would be compared with the design documentation and previous studies to determine if there has been a significant change in the structure. If any significant changes occur, a structural engineer would be engaged to determine the best remediation options. More regular inspections of the structures and removal of any entangled debris or fishing gear (potentially harmful to marine animals) would be carried out during biological aspects of the monitoring program. Monitoring strategy, performance indicators and mitigation measures are listed in Table 6.

4.3 Review of OAR management area regulation

The establishment of the DPI Artificial Reefs Reserve (Crown Reserve) under the *Crown Lands Act 1989* allows the Reserve Trust Board (made up of a minimum of 3 current DPI employees) to manage all current and proposed activities within the reserve boundaries (1000 m x 400 m, including a buffer zone of 200 m around each reef unit). The Reserve has been Gazetted with the express purpose of recreational fishing and

Government purposes (i.e. Research and Management). If increased regulation of the Reserve (Management Area) and its users is required, DPI, as the Reserve Trust will have the mechanism to implement a wide range of management responses, including but not limited to fishing activities as stipulated under the *Fisheries Management Act (1994)* and *Fisheries Management (General) Regulation (2010)*.

There are provisions under the *Fisheries Management Act 1994* to make changes to current fishing arrangements including a range of input and output controls to address interaction and sustainability issues. This also includes provision to implement spatial, temporal and gear related fishing closures if required.

Complaints and issues in relation to the OAR, its operation and management can be made directly to DPI via email or post using the contact details listed below:

Address:
NSW DPI Offshore Artificial Reefs

Manager Fisheries Enhancement
PO Box 21
Cronulla NSW 2230

Email:
fisheries.FADs@industry.nsw.gov.au

All complaints will be registered by the Manager Fisheries Enhancement and escalated for review and response (if required) by the Manager Recreational Fisheries Programs, the Director Recreational and Indigenous Fisheries and the DPI Executive to ensure the issue is adequately assessed and accordingly responded to through existing NSW Government Departmental correspondence procedures.

4.4 Invasive Marine Pests

The OAR structures will be monitored for the colonisation of marine pests. In the event that invasive (introduced) marine pests are identified on the OAR unit(s), the extent of marine pest incursions would be assessed in terms of area, species type and abundance. The potential for further spread of identified marine pests will be assessed. Requirements for removal of marine pests (according to NIMPIS) would depend on the extent and nature of the incursion but is likely to involve manual removal by divers in the first instance. Details of management contingencies to minimise/prevent colonisation of marine pests on the OAR structures and minimise/prevent the spread of marine pests are listed in Table 7.

4.5 EMMP review

Review of the EMMP will be conducted annually from the date of approval and is the responsibility of the OAR Management and Monitoring Team. Issues relating to the operation and implementation of the EMMP will be collated by the DPI Manager Fisheries Enhancement for review and reporting and approval.

The Manager Fisheries Enhancement is responsible for:

i) submission to SEWPC (within 4 weeks of the review being conducted) the draft reviewed EMMP;

ii) reporting in writing to the OAR Management and Monitoring Team (OMMT) the outcome of the EMMP review process.

5 Project Reporting

In addition to regular quarterly updates on the DPI - Artificial Reefs webpage (www.fisheries.nsw.gov.au), an OAR Annual Environmental Management Report (AEMR)** will be made available on the DPI website. However, one-off reports detailing the following will also be produced by DPI.

5.1 Reporting within 5 days of OAR deployment

Within 5 days of the first OARs deployment, DPI will provide a report that:

i) Details the date and time of the placement of the Sydney OAR unit;

ii) Confirms that within 24 hours of the Sydney OAR deployment, DPI:

   a. confirmed that the highest point of the OAR is no less than 20 m below sea level (LAT) and verified by an independent observer;

   b. confirmed the measures used to verify that the OAR unit is upright and stable including a discussion on the placement detailing any problems that arose and how they were rectified;

iii) the final position of each OAR unit (confirmation of the placement site to two decimal places of a minute, plus horizontal datum, in latitude and longitude format);

iv) the estimated maximum depth over the Sydney OAR unit (LAT), and the date and time of the observation;

v) Details of inspection dive and any items removed or hazards rectified;

vi) Proof of written notification to the Australian Hydrographic Office items i, iii and iv.

5.2 Annual Environmental Management Report (AEMR)

The OAR - AEMR issued annually thereafter (for a period of up to 10 years or as agreed by relevant consenting authority[s]) may include, but no be limited to the following:

i) identify the standards and performance measures of the project;

ii) describe all works carried out over the previous 12 months;

iii) include a summary of complaints and make a comparison to previous years;

iv) include records of maintenance checks and activities;

v) provide a summary of post deployment monitoring activities and preliminary results;

vi) Identify 'non-compliance' and/or environmental incidents recorded or responded to in the previous year; including those that specifically involved threatened and/or migratory species (including signings and/or incidental captures, and;

vii) Describe what actions were, or are being undertaken to ensure compliance.

5.3 Final Reporting

Within 6 months after the end of the third year of OAR operation, DPI will submit a final report summarising the key findings from, and limitations and improvements to, all monitoring programs undertaken during the Sydney OAR trial phase. This report is to be used to provide recommendations for the subsequent OAR placements along the NSW coast.

** Ongoing surveillance environmental monitoring will be carried out by the Department on an annual basis for a period of up to 10 years (or as otherwise agreed to by consenting authorities).

6 Key Personnel

The DPI OAR Management and Monitoring Team (OMMT) consist of the following DPI personnel:

6.1 DPI Manager Fisheries Enhancement

The DPI Manager Fisheries Enhancement (Mr Heath Folpp) is responsible for the pre-installation approvals process, construction management and post deployment management of the OAR consistent with plans and procedures set out in the EMMP. The Manager Fisheries Enhancement is the primary contact for the project

(project complaints and environmental emergencies) and will be responsible for the recording and response to queries, issues and/or complaints by the general public, stakeholders and other Government Agencies (State and Commonwealth). The Manager Fisheries Enhancement is accountable for all project related reporting responsibilities and is a member of the DPI commercial dive team that will conduct monthly in-situ inspections of the OAR as part of the monitoring requirements of the project as detailed in this EMMP. The Manager Fisheries Enhancement will report monthly to the Manager Recreational Fisheries Programs and quarterly to the Ministers Advisory Committee on Recreational Fishing (ACoRF) and the Recreational Fishing Saltwater Trust Expenditure Committee (RFSTEC) and to other Agencies and Stakeholder groups where required.

6.2 DPI Manager Recreational Fisheries Programs

The DPI Manager Recreational Fisheries Programs (Mr Bryan van der Walt) manages the NSW recreational fisheries programs and is directly responsible for overseeing the management of the OAR project. The Manager Recreational Fisheries Programs primary role is to ensure proper Government protocol and procedures are adhered to and that all obligations stipulated under State and Commonwealth approval conditions are met. In addition, the Manager Recreational Fisheries Programs is responsible for project reporting to the Director, Recreational and Indigenous Fisheries and the DPI Executive.

6.3 DPI Senior Research Scientist

The DPI Senior Research Scientist (Dr Michael Lowry) is the principal investigator accountable for responsibilities associated with the OAR environmental monitoring. The Senior Research Scientist is required to report annually to the Manager Fisheries Enhancement on the progress of the OAR monitoring and is a member of the DPI commercial dive team that will be conducting in-situ inspections of the OAR as part of the monitoring requirements. The Senior Research Scientist is responsible for the analysis and write-up of peer reviewed Departmental reports and scientific journal manuscripts submitted for external publication.

6.4 DPI Senior Fisheries Management Officer

The DPI Senior Fisheries Management Officer (Mr Marcus Gregson) role is as a member of the DPI commercial dive team and will perform monthly in-situ inspections of the OAR. The Senior Fisheries Management Officer is also responsible for the maintenance of project related equipment (vessel and diving related equipment) and is the dedicated vessel Master (Coxswain) of the DPI Management vessel FV Dorado II.

7 References

Cardno Lawson Treloar (2009). Artificial Reefs: Construction. Environmental Impact Assessment. Prepared for NSW Department of Primary Industries. Report No.2569.

Fabi, G. Sala, A. (2002). An assessment of biomass and diel activity of fish at an artificial reef (Adriatic Sea) using a stationary hydroacoustic technique. ICES Journal of Marine Science, 59: 411-420.

Stanley, D. Wilson, C. (1998). Spatial variation in fish density at three petroleum platforms as measured with dual beam hydroacoustics. Gulf of Mexico Science, 1998(1) 73-82.

Worley Parsons (2009). Offshore Artificial Reefs Draft Construction Methodology. Worley Parsons, North Sydney. NSW.

8 Figures

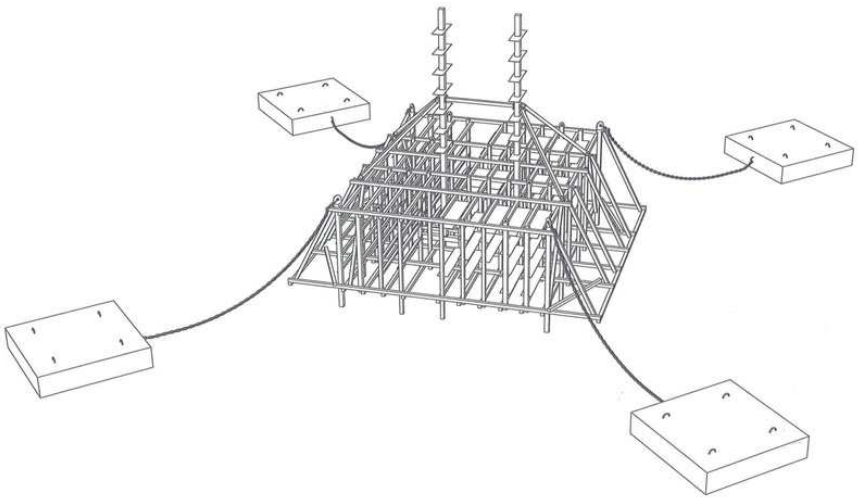

Figure 1: OAR design completed and design-certified by WorleyParsons Services Pty Ltd in January 2010.

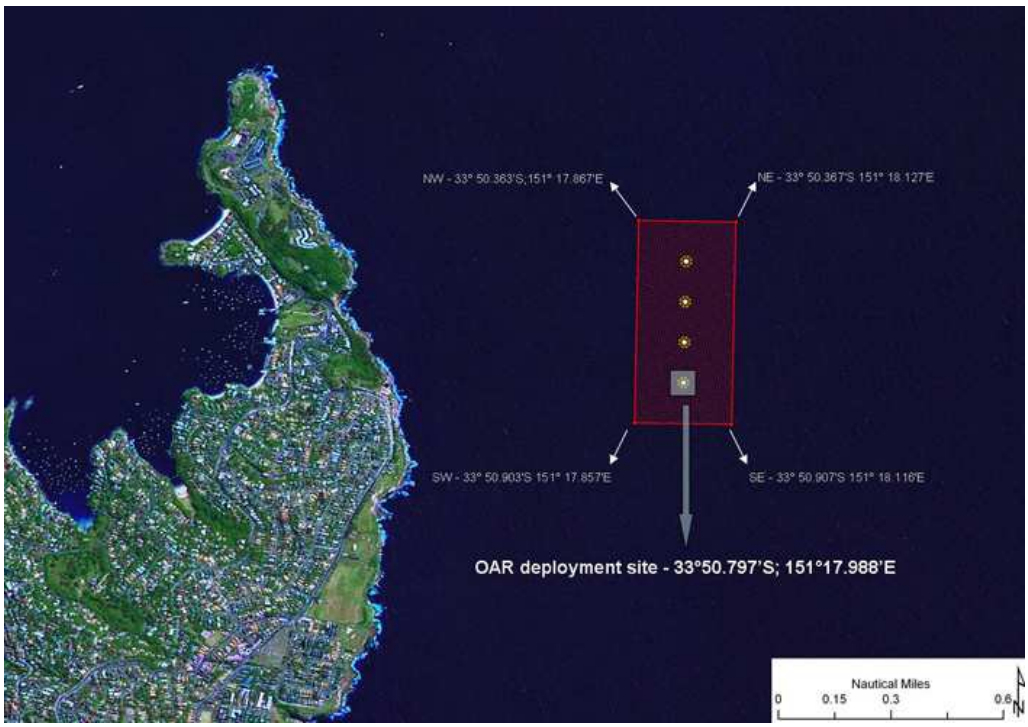

Figure 2: Location of the Sydney OAR trial site and Crown Reserve boundaries (GPS coordinates are given in WGS84).

9 Tables

Table 1: Offshore Artificial Reefs – Monitoring Program.

Factor to Monitor	Objectives	Monitoring Program	Location	Method	Review Period	Management Procedures	
						A. Impact not detected	**B.** Negative impact detected and/ or failure to meet objectives
A. Biological							
A.1 Macrobenthos	**A.1.1** Assess influence of OARs on benthic assemblages (soft sediments) including potential halo effects.	A or C*	Impact sites (soft sediment habitat adjacent to OARs) and control sites	Benthic grab deployed by boat	Annual	■Continue monitoring	■Determine acceptable level of impact in consultation with DSEWPC in context with other cumulative impacts
	A.1.2 Assess influence of OARs on benthic assemblages of proximal natural reefs (benthos)	A*	OAR sites, proximal natural reef sites (impact sites), and reference natural reef sites (controls)	Photo video quadrats	Annual	■Continue monitoring	■Determine acceptable level of impact in consultation with DSEWPC**:** ■Continue monitoring ■Consider temporary closure and/or further monitoring ■Limit to seasonal operation ■Removal of structures
	A.1.3 Document colonisation of the reef structures by macroinvertebrates including pest species	D*	OAR Structures only	Photo video quadrats and visual diver inspections	As for monitoring period	■Continue monitoring	■Verify species identification ■Determine threat of pest species if observed in consultation with DSEWPC: ■Continue monitoring ■Removal of pest species according to appropriate NIMPIS method

Continued

Table 1: continued

Factor to Monitor	Objectives	Monitoring Program	Location	Method	Review Period	Management Procedures	
						A. Impact not detected	**B.** Negative impact detected and/ or failure to meet objectives
A. Biological							
A.2 Fish	**A.2.1** Investigate movements of high priority species within the wider study area	A or C*	OAR sites, proximal natural reef sites (impact sites), and reference natural reef sites (controls)	BRUVS, biotelemetry and visual diver census	Annual	■Continue monitoring	■Determine acceptable level of impact in consultation with DSEWPC: ■Continue monitoring ■Consider temporary closure and/or further monitoring ■Limit to seasonal operation ■Removal of structures
	A.2.2 Assess effectiveness in terms of catch rates, species composition and fish stocks	A or C*	OAR wider study area	Stereo-videography, BRUVS and/or visual diver surveys, on-site surveys and/or charter boat log book data	Annual	■Continue monitoring	■Determine acceptable level of impact in consultation with DSEWPC: ■Continue monitoring ■Consider temporary closure and/or further monitoring ■Limit to seasonal operation ■Removal of structures
A.3 Threatened/ protected and migratory species	Investigate occurrence of threatened and/or protected species on the OAR	C and F*	OAR sites	BRUVS or stereo-videography, visual diver census and/or listening stations if feasible	As for the monitoring period and on an 'ad hoc' basis	■Continue monitoring	■Determine acceptable level of impact in consultation with DSEWPC: ■Continue monitoring ■Consider temporary closure and/or further monitoring ■Limit to seasonal operation ■Removal of structures

Continued

Table 1: continued

Factor to Monitor	Objectives	Monitoring Program	Location	Method	Review Period	Management Procedures	
						A. Impact not detected	**B.** Negative impact detected and/ or failure to meet objectives
B. Physical							
B.1 Sediments	**B.1.1** Assess the influence of OARs on sediment characteristics (sediment particle size composition)	A or C*	Impact sites (soft sediment habitat adjacent to OARs) and control sites (Note that control sites should be of similar particle size composition and depth to impact sites	Benthic grab deployed by boat	Annual	■Continue monitoring	■Determine acceptable level of impact in consultation with DSEWPC in context with other cumulative impacts
	B.1.2 Assess concentrations of heavy metals in adjacent sediments	B*	Impact sites (soft sediment habitat adjacent to OARs) and control sites (Note that control sites should be of similar particle size composition and depth to impact sites	Benthic grab deployed by boat	Annual	■Continue monitoring and compare against ANZECC guidelines.	■Determine acceptable level of impact in consultation with DSEWPC in context with other cumulative impacts
B.2 Water Quality	Assess water quality	A*	Impact and control sites	Water quality probe	Annual	■Continue monitoring and compare against ANZECC guidelines	■Determine acceptable level of impact in consultation with DSEWPC in context with other cumulative impacts

Continued

Table 1: continued

Factor to Monitor	Objectives	Monitoring Program	Location	Method	Review Period	Management Procedures	
						A. Impact not detected	**B.** Negative impact detected and/ or failure to meet objectives
B.3 OAR Structure	**B.3.1** Assess structural integrity	E*	OAR units only	Diver survey	Every two years	■Continue monitoring	■Consider need for maintenance
	B.3.2 Remove fouled gear and debris	E*	OAR Structures only	Diver survey	Every two years	■Continue monitoring	■Continue monitoring and/or; ■Removal of entangled fishing gear and debris
C. Social and Economic							
C.1 Recreational and Commercial fishermen	**C.1.1** Assess effectiveness in terms of popularity with recreational fishing groups and calculate relative expenditure related to OAR usage and whether this leads to a net increase at the regional level	E*	N/a	Stakeholder questionaires	Annual	■Continue monitoring until project objectives are met	■Analyse feedback from user groups against project objectives**:** ■Implement necessary changes ■Consider temporary closure and/or further monitoring ■Limit to seasonal operation ■Removal of structures
	C.1.2. Identify issues of conflict between user groups (e.g. from crowding)	F*	N/a	Mechanism for incident reporting	Annually and on an 'ad hoc' basis	■Continue monitoring	■Analyse feedback from user groups against project objectives: ■Continue monitoring or; ■Resolve issues within a forum between user groups

Continued

Table 1: continued

Monitoring Program					
A*	B*	C*	D*	E*	F*
Pre-deployment	Pre-deployment	Pre-deployment	Pre-deployment	Pre-deployment	Pre-deployment
winter x1 summer x1	x1	winter x2 summer x2	N/A	N/A	N/A
Post-deployment	Post-deployment	Post-deployment	Post-deployment	Post-deployment	Post-deployment
3 months 6 months 12 months Every year thereafter (winter x1 and summer x1) for a minimum of 3 years	12 months Every year thereafter (x1) for a minimum 3 years	3 months 6 months 12 months Every year thereafter (winter x2 and summer x2) for a minimum of 3 years. Note this option allows temporal seasonal comparisons.	3 months 6 months 12 months Every year thereafter (winter x1 and summer x1) for a minimum of 3 years	12 months Every 1-2 years thereafter	Continuous mechanism for feedback e.g. reporting incidents or remote data transfer

Table 2: Monitoring strategy relating to management of Threatened and Migratory Species interactions with the OAR

Issue/s:	Potential for negative impacts on threatened, protected and migratory species known or likely to occur within the wider study area. This includes direct impacts of the proposal (e.g. incidental capture) and/or indirect impacts related to an increase in recreational boating activity (e.g. gross pollution or boat strike).
Aim:	Minimise potential negative impacts on threatened or protected species related to the proposal.
Management Strategy:	Implementation of a Monitoring Plan.
Monitoring:	Monitoring would be used to assess the occurrence of threatened species on OARs and to remove fouled fishing gear or debris hooked on the OARs to prevent injury or entanglement of threatened/protected species. A multi-method monitoring approach would be used that would include the use of ultrasonic telemetry and stereo-videography. Ultrasonic telemetry data would be analysed using conventional univariate and multivariate statistical software packages. Data would be used for determining the presence/absence of threatened species and could also be used to record movements of grey nurse sharks if they have already been tagged for research purposes. Stereo video data would be analysed as it is collected, on a 3, 6 and 12 month basis (as a minimum). Collection of ultrasonic telemetry would be continuous but analysis would be dependent on the availability of the data following downloads from the receivers (likely to be every 3 – 6 months). If a threatened species was considered at risk then mitigative action would be taken and advice sought from NSW DPI Aquatic Ecosystems Unit and relevant authorities e.g. Office of Environment and Heritage/Department of Sustainability, Environment, Water, Population and Communities to determine the most appropriate course of action.
Performance Indicators:	Records of reported sightings/incidental capture and monitoring data would be reviewed.
Mitigation:	Temporary closure (e.g. if a large cetacean was considered at risk from boating disturbance), seasonal closure or removal of structures in extreme circumstances.
Effectiveness:	High.

Table 3: Monitoring strategy relating contamination of sediments adjacent to OAR

Issue/s:	Potential contamination of sediments adjacent to OARs.
Aim:	Minimise contamination of leachates and ensure levels are within acceptable ANZECC/ARMCANZ

	guidelines for marine sediments.
Management Strategy:	It would be ensured that structures are built according to Australian Standards for minimum corrosion rates.
Performance Indicators:	Concentrations of heavy metals (particularly iron). If contaminants exceed recommended ANZECC/ARMCANZ guidelines for marine sediments then mitigative action would be considered. Assessment of observations carried out on diver surveys.
Mitigation:	Provided the structures are built to meet Australian Standards for corrosion rates, there are no relevant impact mitigation measures that can be implemented to further reduce potential impacts during operation. If monitoring identified severe impacts i.e. levels exceeding ANZECC/ARMCANZ guidelines, then removal of the structures would be considered.
Effectiveness:	High.

Table 4: Monitoring strategy relating to impacts associated with OAR on soft sediment (macroinvertebrate) assemblages

Issue/s:	Change to soft sediment assemblages
Aim:	Assess influence of OARs on soft sediment assemblages and identify potential halo effects (potentially occurring from increased predation on soft sediments).
Management Strategy:	Implementation of Monitoring plan (Benthic Surveys)
Performance Indicators:	Change in macroinvertebrate abundance and diversity (and sediment grain size) at OAR (impact) relative to control sites. If significant negative impacts are detected i.e. significant reductions in abundance/diversity of macrofauna then appropriate mitigative action would be taken.
Mitigation:	Temporary/seasonal closures.
Effectiveness:	Moderate.

Table 5: Monitoring strategy relating to potential impacts from OAR associated with proximal natural reef

Issue/s:	Change to proximal natural reef.
Aim:	Minimise and monitor movements of fish from existing natural reefs to OARs (i.e. draw down effects) and associated changes to epibenthos of natural reefs.
Management Strategy:	Final OAR locations would be a minimum of 500 m from existing natural reef. Where possible, maximum separation from natural reef has been achieved. Implementation of a Monitoring Plan (BRUVS and diver surveys)
Performance Indicators:	If negative impacts are detected (e.g. a significant reduction in abundance and diversity of fish species at natural reefs attributed to the OARs) then mitigative action would be taken.

Mitigation:	Temporary or seasonal closure; removal of structures.
Effectiveness:	High.

Table 6: Monitoring strategy relating to stability and structural integrity of the OAR

Issue/s:	Stability and Structural Integrity.
Aim:	Ensure the long-term structural integrity, functionality and stability of the units within the 30 year design life.
Management Strategy:	A design engineer would be required to verify section sizes and plate dimensions and to optimise the design for habitat complexity where feasible. The certification of the final design would be the responsibility of the appointed contractor. The units would be inspected for unforseen stresses, movement from deployment location, orientation, corrosion and thickness of marine growth. Following monitoring inspections, the findings would be compared with the design documentation and previous studies to determine if there has been a significant change in the structure.
Monitoring:	Diver observations and photographic survey
Performance Indicators:	Corrosion rate, stresses, extent of movement from deployment location and rate of marine growth.
Mitigation:	Maintenance or remediation works to be investigated by a structural maritime engineer.
Effectiveness:	Moderate.

Table 7: Monitoring strategy relating to invasive marine pests

Issue/s:	Colonisation of OAR structures by marine pests. Potential for spread of marine pests via recreational boating.
Aim:	Minimise/prevent colonisation of marine pests on the OAR structures and minimise/prevent the spread of marine pests.
Management Strategy:	▪ OAR user groups would be informed of boating guidelines to minimise the spread of marine pests ▪ Implementation of a Monitoring Plan.
Monitoring:	OAR structures would be monitored for the colonisation of marine pests (Table 1 – A.1.3).
Performance Indicators:	The extent of marine pest incursions would be assessed in terms of area, species type and abundance. Mitigative action would be undertaken according to NIMPIS guidelines.
Mitigation:	Requirements for removal of marine pests (according to NIMPIS) would depend on the extent and nature of the incursion but is likely to involve manual removal by divers in the first instance.
Effectiveness:	Moderate.

Appendix 1

INSERT OAR User Education and Awareness Guidelines

NSW GOVERNMENT Primary Industries

Appendix 2

WATERWAY CONSTRUCTIONS

Offshore Artificial Reef Project
Conforming
Tender Programme No.2

Date: Mon 18/07/11
Page 1 of 1

ID	Task Name	Duration	Start	Finish
1	Tender Closing Date	0 days	Wed 1/06/11	Wed 1/06/11
2	Tender Evaluation	16 days	Wed 1/06/11	Fri 24/06/11
3	Notification of Preferred Tenderers	0 days	Fri 24/06/11	Fri 24/06/11
4	Contract Signing	0 days	Wed 20/07/11	Wed 20/07/11
5	**Offsite & Submissions**	**85 days**	**Wed 20/07/11**	**Wed 23/11/11**
6	DPI to issue Approved for Construction Drawings	0 days	Wed 20/07/11	Wed 20/07/11
7	Develop and Submit CEMP to DPI	4 wks	Wed 20/07/11	Wed 17/08/11
9	Submit Marine Traffic Plan to DPI	4 wks	Wed 20/07/11	Wed 17/08/11
11	DPI to prepare and submit EMMP	4 wks	Wed 20/07/11	Wed 17/08/11
14	Anchor Block Mix Design Submission	0 days	Tue 2/08/11	Tue 2/08/11
8	Approval of CEMP by Director General	0 days	Wed 24/08/11	Wed 24/08/11
10	Approval of Marine Traffic Plan	0 days	Wed 7/09/11	Wed 7/09/11
12	Approval of EEMP	0 days	Wed 7/09/11	Wed 7/09/11
15	Confirm Proposed Location & seabed profile	0 days	Thu 29/09/11	Thu 29/09/11
16	Detailed Loadout Submissions (Section 5 of Technical Spec)	0 days	Wed 26/10/11	Wed 26/10/11
13	Advise DPI of deployment	0 days	Wed 23/11/11	Wed 23/11/11
17	**Fabrication & Procurement**	**84 days**	**Wed 20/07/11**	**Mon 21/11/11**
19	Fabrication drawings	1 wk	Wed 20/07/11	Tue 26/07/11
18	FRP Anchor Blocks	12 days	Thu 18/08/11	Fri 2/09/11
20	Approval of Fabrication drawings	14 days	Wed 27/07/11	Tue 16/08/11
21	Procure Steelwork	12 wks	Tue 9/08/11	Mon 7/11/11
22	Transport to Wharf and prepare for deployment	10 days	Tue 8/11/11	Mon 21/11/11
23	**Deployment**	**46 days**	**Wed 28/09/11**	**Wed 7/12/11**
24	Seabed survey	2 days	Wed 28/09/11	Thu 29/09/11
25	Establish exclusion zone & temporary Nav Aids	4 days	Tue 22/11/11	Fri 25/11/11
26				
27	Tow to site, Lay barge anchors	1 day	Mon 28/11/11	Mon 28/11/11
28	Deploy OAR	1 day	Tue 29/11/11	Tue 29/11/11
29	Deploy concrete block anchors	3 days	Wed 30/11/11	Fri 2/12/11
30	Confirm As Built position and depth of water	1 day	Wed 7/12/11	Wed 7/12/11