Department of Primary Industries

Fisheries and Aquaculture Management

Long Term Management Plan - Batemans offshore artificial reef

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Long term management plan

The NSW Department of Primary Industries (DPI) is responsible for the operation, including management, monitoring and maintenance of the Batemans offshore artificial reef (OAR). This long-term management plan has been developed to provide clear direction on the implementation of environmental management best practices during the construction/installation, and operation of the reef.

This plan has been developed as part of the environmental assessment (EA) process and DPI is committed to carrying out the mitigation measures outlined in this plan and the EA. Assessment of ecological, biological and socio-economic impacts have been considered and are summarised in this plan.

1 Introduction

DPI aims to improve recreational fishing opportunities in NSW through the development of offshore artificial reefs in offshore locations. DPI manages recreational fishing in ocean waters off NSW under the *Fisheries Management Act 1994 (FM Act)* and the Offshore Constitutional Settlement. The 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 objectives under the Act include promoting 'ecologically sustainable development, including the conservation of biological diversity' and promoting 'quality recreational fishing opportunities'. The deployment of artificial reefs as a fisheries enhancement tool is consistent with these objectives.

The Batemans region is also afforded an additional layer of environmental protection under the *Marine Estate Management Act 2014*. The objectives of the Act are to:
(a) provide for the management of the marine estate of New South Wales consistent with the principles of ecologically sustainable development in a manner that—
(i) promotes a biologically diverse, healthy and productive marine estate, and
(ii) facilitates—
• economic opportunities for the people of New South Wales, including opportunities for regional communities, and
• the cultural, social and recreational use of the marine estate, and
• the maintenance of ecosystem integrity, and
• the use of the marine estate for scientific research and education,
(b) to promote the co-ordination of the exercise, by public authorities, of functions in relation to the marine estate,
(c) to provide for the declaration and management of a comprehensive system of marine parks and aquatic reserves.
The deployment of artificial reefs as a fisheries enhancement tool is consistent with these objectives. The Batemans Marine Park was declared in 2006 and extends from Bawley Point to Wallaga Lake. The proposal will require a permit under the *Marine Estate Management Regulation 2017*.

Recreational fishing is an important leisure activity for approximately 12% of the NSW population (approximately 849,000 people over the age of 15) and provides significant social

and economic benefits, with an estimated $3.42 billion generated in economic activity in NSW each year creating approximately 14,000 full-time equivalent jobs.

In NSW, approximately 22% of the total fishing effort takes place between the shoreline and 5 km offshore. The creation of new, high quality fishing areas through the deployment of offshore artificial reefs will enhance fishing opportunity by creating high relief, complex fish habitats. Artificial reefs provide additional fishing locations and an alternative to heavily fished natural reefs. They also have the potential to increase the abundance and productivity of some demersal and reef species found there.

This proposal is considered an 'activity' under Part 5 of the *NSW Environmental Planning and Assessment Act 1979 (EP&A Act)*. The deployment of the offshore artificial reef structure requires a licence under Section 34 of the *Crown Lands Act 1989*, given the proposed deployment site is located in State waters (within 3 nautical miles) on unzoned land. Construction of artificial reefs is regulated under the Commonwealth *Environment Protection (Sea Dumping) Act 1981 (EP (SD) Act)*.

The assessment of impacts identified components of the marine environment and potential impacts/issues related to those components that require further investigation and potential monitoring. The potential risks identified can be minimised or removed to an acceptable level of risk through implementation of the Long-Term Management Plan (LTMP). This plan aims to consolidate the mitigation and management measures that the DPI is committed to implementing.

1.1 Project planning

DPI has been responsible for the preparation of all documentation, stakeholder consultation, risk analysis, constraints identification and specialist flora and fauna investigations. DPI has coordinated a team of highly qualified environmental consultants who have extensive experience in oceanography and coastal processes of the NSW coast, cultural heritage and hydroacoustic surveying (Figure 1) to provide further expertise when required.

DPI reviewed relevant planning and legislative requirements, provided detail for requirements of artificial reef design and planning and provided an overview of the construction and deployment process. In addition, DPI developed a monitoring plan and procedures to assess potential impacts relating to threatened species, pest species, fishing related marine debris and the monitoring of effects of scouring and deposition in the vicinity of the reef post deployment and its impact on the structural integrity of the reefs.

DPI engaged the services of:

- Umwelt Pty Ltd to investigate the cultural significance of the site and potential impacts on Aboriginal heritage and to undertake consultation.
- The Manly Hydraulics Laboratory (Public Works) to provide expertise in coastal processes including wave behaviour and sediment movement and circulation.
- Total Hydrographic Pty Ltd to complete the acoustic survey of habitats in the vicinity of the proposed reef location.

The technical reports prepared by these consultants are summarised within this document.

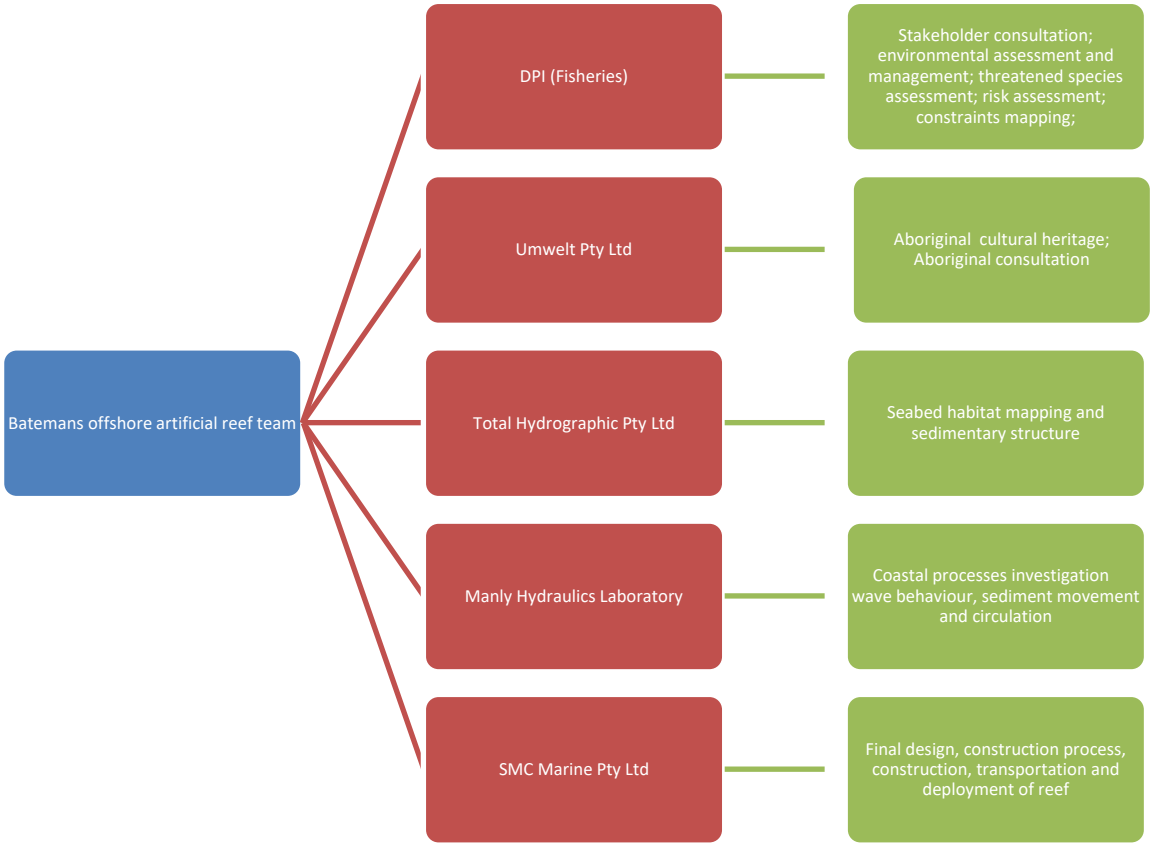


Figure 1 Batemans offshore artificial reef project team

1.2 Consultation with relevant Commonwealth, State and Local Government agencies and interested non-government organisations

Initial site selection for offshore artificial reef projects are a result of early preliminary consultation and constraints mapping which is summarised within this LTMP. Previous reef projects have shown early consultation and constraints mapping dramatically reduces the number of stakeholders negatively impacted by the project from inception. As a result, formal consultation periods often reveal relatively few (if any) objections. The feedback received is generally from recreational fishers who are eager to see the project move forward.

For example, the Batemans Marine Park presents a high-level constraint for site selection. The Marine Parks artificial reef policy provides for artificial reefs within general use zones (Figure 2). Additionally, the Marine Park further reduces user conflict and adversely impacted stakeholders by excluding commercial trawling within the park. This higher-level constraint provides suitable areas for further stakeholder consultation and constraints mapping with a significantly reduced potential for stakeholder impact. Having significantly reduced the number of affected stakeholders prior to the formal consultation period, DPI with advice from recreational fishing representatives local to the region, defined the initial proposed site for formal public consultation and further constraints analysis. Consultation resulted in no objections from the major stakeholder groups. All active commercial fishing businesses and

fishers who have fished in the greater region received information on the proposal and did not respond.

Consultation was carried out by, email, phone calls and through stakeholder consultation meetings. Fisheries enhancement and the proposed offshore artificial reef were also included as agenda items as part of regular stakeholder meetings (e.g. the Recreational Fishing NSW Advisory Council (RFNSW) and the Recreational Fishing Saltwater Trust Expenditure Committee (RFSTEC)). In addition, consultation relating to the Aboriginal Cultural Heritage Due Diligence Assessment was carried out by Umwelt Pty Ltd and outcomes of this consultation were summarised in the corresponding report.

DPI staff gave a presentation on the Batemans offshore artificial reef during a fishing habitat information night hosted by Local Land Services (LLS). The information session was aimed at fishers in the region and widely advertised by LLS, local newspapers and local fishing associations. Feedback from the night was generally positive with discussions held around reef location, constraints and safe access.

Additionally, a webpage specifically relating to the proposed Batemans offshore artificial reef was launched at the beginning of the consultation period on the DPI Fisheries webpage. The website was used to provide updates on the progress of the proposal and information regarding the environmental assessment, and an email address (fisheries.enhancement@dpi.nsw.gov.au) was provided as an additional avenue for community feedback.

Stakeholder consultation email letters were distributed by DPI between 19 February 2020 and 31 March 2020 (Table 1). The consultation letters provided the context for the proposed Batemans offshore artificial reef, a brief history of artificial reef deployment in NSW and set out the environmental assessment process currently being conducted by DPI in regard to the proposal. The letters contained DPI contact details and invited comment on the proposal; the objective being to provide an opportunity for community stakeholders to provide any comments on the Batemans artificial reef proposal.

Table 1 DPI stakeholder consultation letter distribution summary

Group	Number
Aboriginal stakeholder groups (plus additional 46 groups consulted with by Umwelt Pty Ltd)	5
Recreational fishing stakeholders (including line and spear fishing clubs, recreational fishing associations and charter operators in the South Coast and Far South Coast regions)	67
Commercial fishing stakeholders (including fishing business owners, nominated fishers, professional associations and fishermen's co-operatives)	42
Conservation	6
Diving (retailers, charters)	6
Statutory authorities (including local, state and federal government)	20
Recreational licence agents and fishing tackle outlets	13
Universities	2
Businesses/voluntary organisations	2
Total	163

Media coverage of the project has been conducted since 18 March 2018 when the Premier announced funding for an offshore artificial reef in the Batemans region. Since this time

several updates on the status of the Batemans project have been included in broader community consultation including Newscast (DPI's online information bulletin for recreational fishers with >500,000 subscribers), and social media and media announcements.

Responses from the statutory and non-statutory groups consulted were received via telephone, email and from the stakeholder consultation meetings. The proposal was well-received in terms of the location, design of the reef and the processes used in selecting these, with no objections raised through the consultation process.

2 Project goals and objectives

2.1 Goals for the activity

The proposed goals for the activity are as follows:

1) To enhance recreational fishing opportunities through cost-effective reef deployment which complements other existing DPI programs; and
2) To ensure the consistent production and deployment of appropriate quality reefs.

3 Risk assessment

3.1 Introduction

A workshop to review previous risk analyses assessing the impacts of artificial reefs was held on 11 December 2020, attended by DPI representatives who have expertise in artificial reef assessment, monitoring, design and construction. The aim of the workshop was to review existing potential issues/hazards associated with the proposed Batemans offshore artificial reef and identify any new potential hazards. The risk assessment workshop assessed the likelihood of occurrence of such hazards and the consequence to key receptors if these hazards eventuated.

Risk analysis undertaken by DPI and industry professionals for the past eight offshore artificial reefs considered potential impacts relating to coastal processes and oceanography, ecosystem processes, contamination, fisheries (commercial and recreational) and interference with existing coastal infrastructure, obstructions and exclusion zones.

The risk analysis workshop in December 2020 assessed if risks required alteration or if new mitigative tools were required for the Batemans artificial reef based on updated information gained from reef monitoring and post installation operations by DPI. Combined with the constraints mapping process and the coastal processes, SWATH (acoustic) mapping and Aboriginal heritage consultant advice, the review sought to minimise or eliminate a number of potential risks associated with existing infrastructure, obstructions and exclusion zones (such as deep-water ocean outfalls, port restrictions, spoil grounds and historical shipwrecks), threatened species by avoiding critical habitats and marine protected areas.

The risk assessment focusses on issues identified through the risk analysis workshop, during consultation and identified for consideration through both State and Commonwealth legislation.

3.2 Methods

Environmental or ecological risk assessment has become an important means for identifying the likelihood and relative consequence of potential hazards associated with human activities. It is also now being widely advocated as beneficial for fisheries management [1]. The following risk assessment was based on the principles of Australian Standards for Risk Management 4360:2004 and Fletcher [1].

Typically, assessment of risk entails the identification of a potential hazard (i.e. some aspect of the activity that could affect the environment), a judgement of the likelihood that the hazard has of occurring and a judgement of the consequence of that hazard, if it did result from the proposed activity. Frequently, scientists and managers also consider those aspects of the environment that might be subject to the hazard; such aspects are often referred to as receptors.

Key points that need to be recognised in relation to the general risk assessment:

- The risk assessment benefited greatly from the initial site selection and constraints mapping which resulted in avoidance of major biological constraints, such as areas of natural reef and areas of conservation significance, navigational hazards and exclusion zones.
- The risk assessment was undertaken at a generic level.
- Risk is often scale-dependent; therefore, the risks were assessed using scales where they were thought to have the greatest potential impact. To reduce the subjectivity of this analysis, the scale on which each of the risks was assessed is listed in the risk assessment table.
- The risk analysis methodology deals mainly with impacts on the environment. However, the methodology has also been used to analyse relevant health and safety issues.
- The risk analysis is based on the proposed reef design.

The risk matrix (Table 2) gives the rationale for scoring probability/likelihood of a hazard occurring and of the consequence if the hazard eventuated. Scores of likelihood and consequence may then be combined into a matrix to provide a subjective judgement of significance. Based on this, each hazard/risk is identified as being of very low, low, medium or high significance. The result of the risk assessment does not mean that the project should not proceed, i.e. if the level of risk is high, but rather that the issue may need greater or less effort in management/mitigation or that further research on the receiving environment is required. Note that health and safety impacts are assessed on a different scale to environmental impacts.

Table 2 Risk analysis matrix

Likelihood			
A	Almost certain	Is expected to occur as a result of the project under most circumstances	>1 / month
B	Likely	Will probably occur as a result of the project in most circumstances	>1 / year
C	Possible	Could occur and has occurred in similar circumstances	1–10 years
D	Unlikely	Could occur as a result of the project but is not expected	10 – 100 years
E	Rare	Could occur only in exceptional circumstances	<1/100 years
Consequence (Environmental)			
1	Catastrophic	Widespread extreme impact beyond the deployment area; limited prospect of full recovery	
2	Major	Substantial impact/serious harm within the immediate deployment area; limited prospect of full recovery	
3	Moderate	Serious/significant impact; recovery longer than 3 years	
4	Minor	Localised harm; recovery measurable within 1-3 years	
5	Minimal	No impact on the baseline environment; minimal or no mitigative actions required	
Consequence (Health and Safety)			
1	Catastrophic	Single or multiple fatalities	
2	Major	Catastrophic illness or injury	
3	Moderate	Extensive/major injury	
4	Minor	Minor injury e.g. medical treatment required	
5	Minimal	No medical treatment required	

Scale	
Sub – Local	30 m radius from the reef modules
Local	400 m x 400 m (16 HA)
Intermediate	0 – 3 km
Large	3 – 10 km
Regional	> 10 km

			Likelihood				
			A	B	C	D	E
			Almost certain	Likely	Possible	Unlikely	Rare
Consequence	1	Catastrophic	A1	B1	C1		
	2	Major	A2	B2	C2	D2	E2
	3	Moderate	A3	B3	C3	D3	E3
	4	Minor	A4	B4	C4	D4	E4
	5	Minimal	A5	B5	C5	D5	E5

H	High Risk	Risk is significant and requires significant cost-effective measures for risk reduction and/or management.

M	Moderate Risk	Routine and cost effective measures required to reduce and/or manage risk. Risk may be acceptable.
	Low Risk	Risk can be managed by routine procedures and/or no further measures to manage the risk are required.
	Very Low Risk	Risk is accepted, no further measures to manage the risk are required.

4 Batemans offshore artificial reef management area

The proposed artificial reef management area is situated approximately 3 km south east of Broulee Island and about 5 km east-northeast of Moruya River entrance within State waters. Depth within the reef management area ranges from 40 – 45 m in depth (LAT) providing a minimum vessel clearance depth of 28 m. The size of the management area is a 400 x 400 m square with the centre point of the reef located at 35° 53.153′ S, 150° 12.166″ S (WGS84) (Figure 2). The corner point co-ordinates for the reef management area will be situated at;

NW	35° 53.042′ S, 150° 12.037′ E
SW	35° 53.258′ S, 150° 12.029′ E
NE	35° 53.048′ S, 150° 12.303′ E
SE	35° 53.264′ S, 150° 12.295′ E

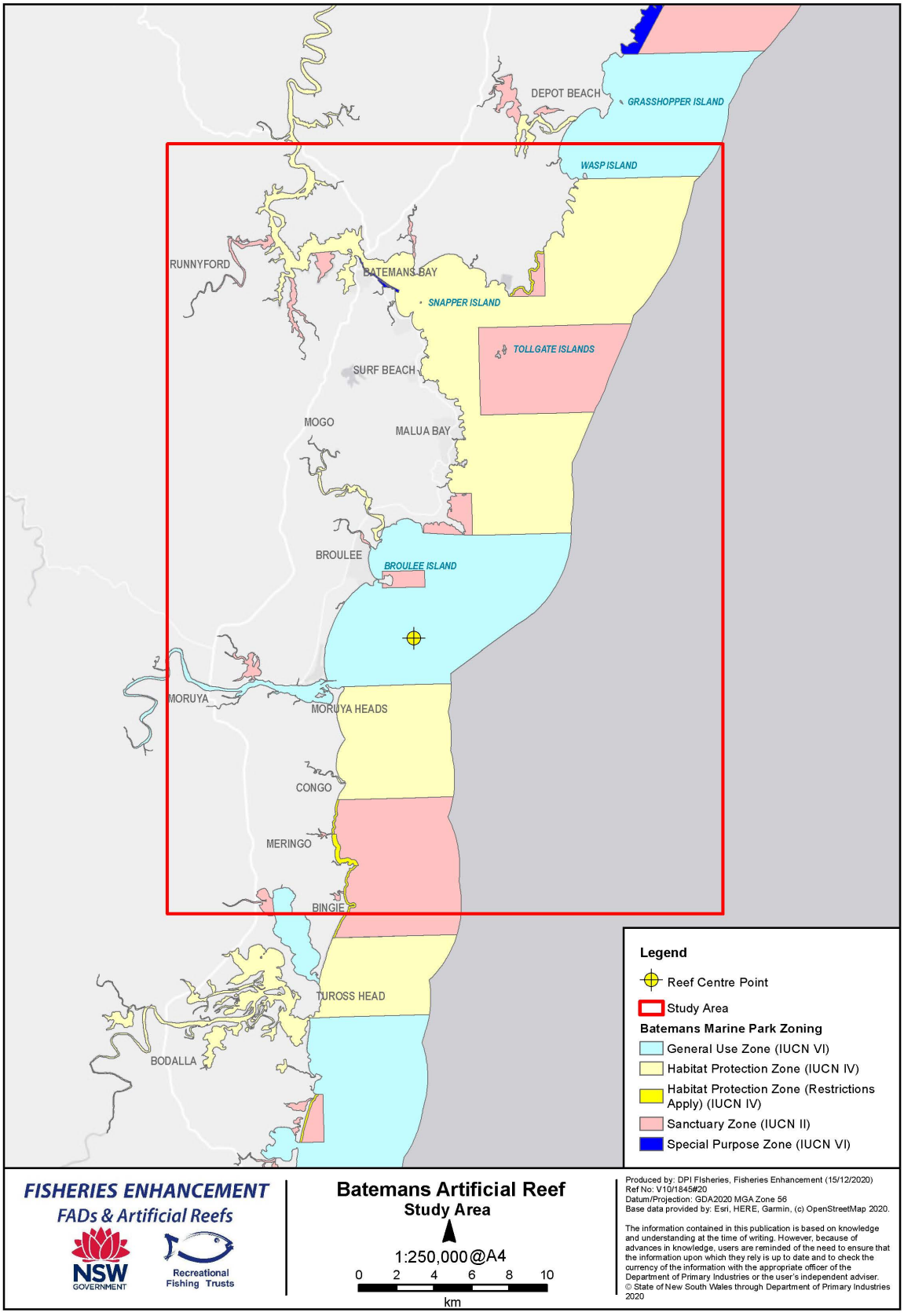


Figure 2 General location for proposed deployment of the reef within Batemans Marine park zoning plan

4.1 Socioeconomic considerations

Almost 80% of fishing effort in NSW occurs in saltwater (estuarine, inshore and offshore waters). The Mid South and South Coast Fishing zones account for over a quarter of the fishing effort in NSW (26%) ([2]). It is anticipated that the offshore artificial reef will have a high visitation rate based on the fact that it will be based adjacent to the highest fishing effort region (Mid South Coast – 22%) and with a large proportion of seasonal tourism-based interstate fishing effort from Victoria.

The southern NSW region provides a wide variety of fishing locations across a number of different types of aquatic habitats, including open ocean, ocean beaches, rocky headlands, rivers, coastal embayment's and freshwater streams.

Trip expenditures by anglers are classified as being either directly attributable to fishing (tackle, bait/berley etc.), indirectly attributed (accommodation, travel, boat fuel and hire), and other expenses (eating out, other entertainment, food and drinks etc.). Total recreational fishing expenditure is estimated to be in excess of $130,000,000 annually accounting for 6% of the total NSW spend. Given the small relative population to other coastal region, this represents a significant spent and economic contribution that recreational fishing makes to these local economies ([3]).

A recent social return on investment study on previously installed artificial reefs in NSW found social returns of 8.8% in Port Macquarie and 9% on the Southern Sydney reef over the 30 year life of the reef using conservative assumptions (unpublished). Given expenditures by anglers in the Batemans region, DPI anticipates similar or greater social return on this investment to the economy.

It is estimated that approximately 2460 hours of fisher effort were expended on the Sydney offshore artificial reef during the 2013/14 survey year, equating to a higher levels of recreational usage intensity than many natural NSW estuarine systems (Figure 3 [4]).

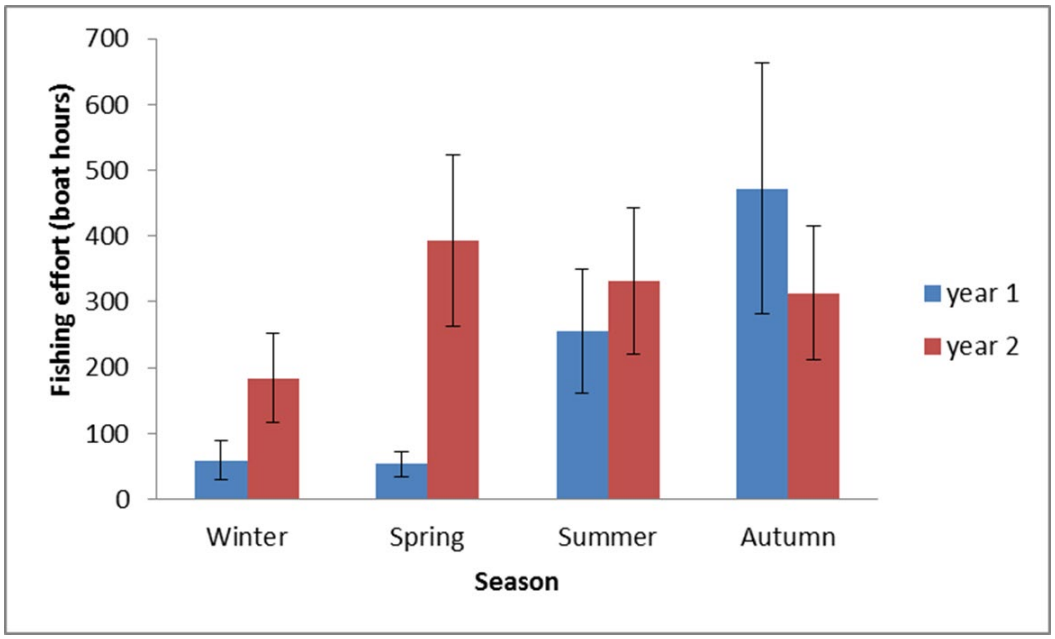


Figure 3 Average (± SE) fishing effort at the OAR site per season for the two sampling years (year 1 is June 2012- May 2013; year 2 is June 2013- May 2014)

The location and accessibility of the Batemans offshore artificial reef is expected to deliver similar direct social and broader economic benefits by providing increased recreational fishing opportunities in the region. The following have been identified as beneficiaries of the reef:

- recreational fishers who have an interest in healthy fish stocks and a quality marine environment;
- tourism and charter operators who base their businesses around the quality of the fishing experience and the abundance of fish;
- tackle and boating industry that depend on having sustainable fish resources in the Batemans region; and

4.2 Environmental considerations

The South East Corner Bioregion is located in the southeast corner of NSW with a total area of 2,707,639 hectares that extends into Victoria. The NSW portion of the bioregion is in two parts; the main body of the bioregion. The bioregion includes the towns of Batemans Bay, Moruya, Narooma, Bermagui, Bega, Merimbula and Eden, most of the bioregion's population living in the towns along the coast. The Clyde, Deua, Moruya, Buckenbowra, Brogo, Wadbilliga, Towamba, Genoa and Tuross Rivers traverse the bioregion with the main catchments being the Clyde, Deua, Tuross, Bega, Towamba and Genoa catchments. The bioregion is dominated by a temperate climate, characterised by warm summers and no dry season. The coastline is a mixture of rocky cliffs and small sand barriers built across the mouths of most streams. Unlike the north coast, only one phase of barrier development is apparent and soils formed in the dunes are podsol profiles but these only have minimal profile development. Sediments in the estuaries are mainly sand.

A detailed investigation of existing information and database searches relating to the study area has shown that there are several critical constraints which required further consideration to identify a suitable reef location. These included the preferred depth requirements, proximity to reef substratum and marine protected areas.

Reef siting and design should incorporate a variety of biological, economic, and physical sciences and engineering factors ([5]). Size, relief, complexity, location and biological factors can all influence assemblages of fishes on artificial reefs ([6]). Biological principles that should be considered include habitat limitation ([7]), habitat complexity ([8], [9]) and refuge from predators ([10]). Physical principles deal with the size of the reef structure ([11]) and the strength and stability of the reef materials. Reef size and its influence on species abundance is an ongoing debate. Where biomass has been reported in association with large artificial reefs, it may be composed of large but few individuals ([12]). Conversely, greater densities of fish on smaller artificial reefs have also been reported ([6]). The vertical relief, relative to water depth of an artificial reef, can also influence abundance and diversity. In temperate waters, diversity has been shown to be greater on low-relief artificial structures than on natural structures ([13]). Conversely, a study of high-relief reefs found greater diversity on natural reefs than on artificial reefs ([14]). Psychological, social and economic aspects of human behaviour are also important when considering reef design, taking into account the requirements of possible end user groups ([15], [16], [17]).

The area of seafloor identified as the potential OAR deployment site lies approximately 5 km north east of the Moruya river entrance, 4.3 km offshore from Bengello Beach situated between Broulee Island and Moruya Heads. Patchy low relief subtidal reefs lie approximately 1 km in both north and southerly directions of the reef management area (Figure 4). Both subtidal reefs break during heavy swells. The hydroacoustic survey and follow up camera surveys did not confirm the presence of hard reef within the surveyed area. The closest known reef identified through LIDAR imagery is 940 m to the north of the proposed reef location (Figure 6).

Total Hydrographic Pty Ltd was commissioned to provide a survey to look in detail at the seafloor within the vicinity of the proposed reef deployment site. The survey used a multibeam echo-sounder (MBES) to determine bathymetry, backscatter and MBES derivative surfaces (i.e. aspect, slope) that define the seafloor characteristics of the Batemans reef site.

The aim of the surveys was to conduct a multibeam survey across the proposed reef deployment area, approximately a 2.5 x 2.5 km survey patch, to provide bathymetry, backscatter, slope and aspect data.

The survey resulted in a description of the physical characteristics of the sea floor within the proposed reef deployment area, highlighting the presence of suitable substrata for the artificial reef. Swath acoustic mapping results illustrated a 2.8 km onshore-offshore depth gradient consistent with sediment substrata represented by intermittent increases in depth ranging from 30 m in the north western corner through to 50 m in the south eastern corner of the survey area (Figure 5). The bathymetry indicates that the seafloor is predominantly unconsolidated sediments with the presences of shallow gutters and some slight ridges. Video transects were conducted across the survey area to validate the data presented in this report.

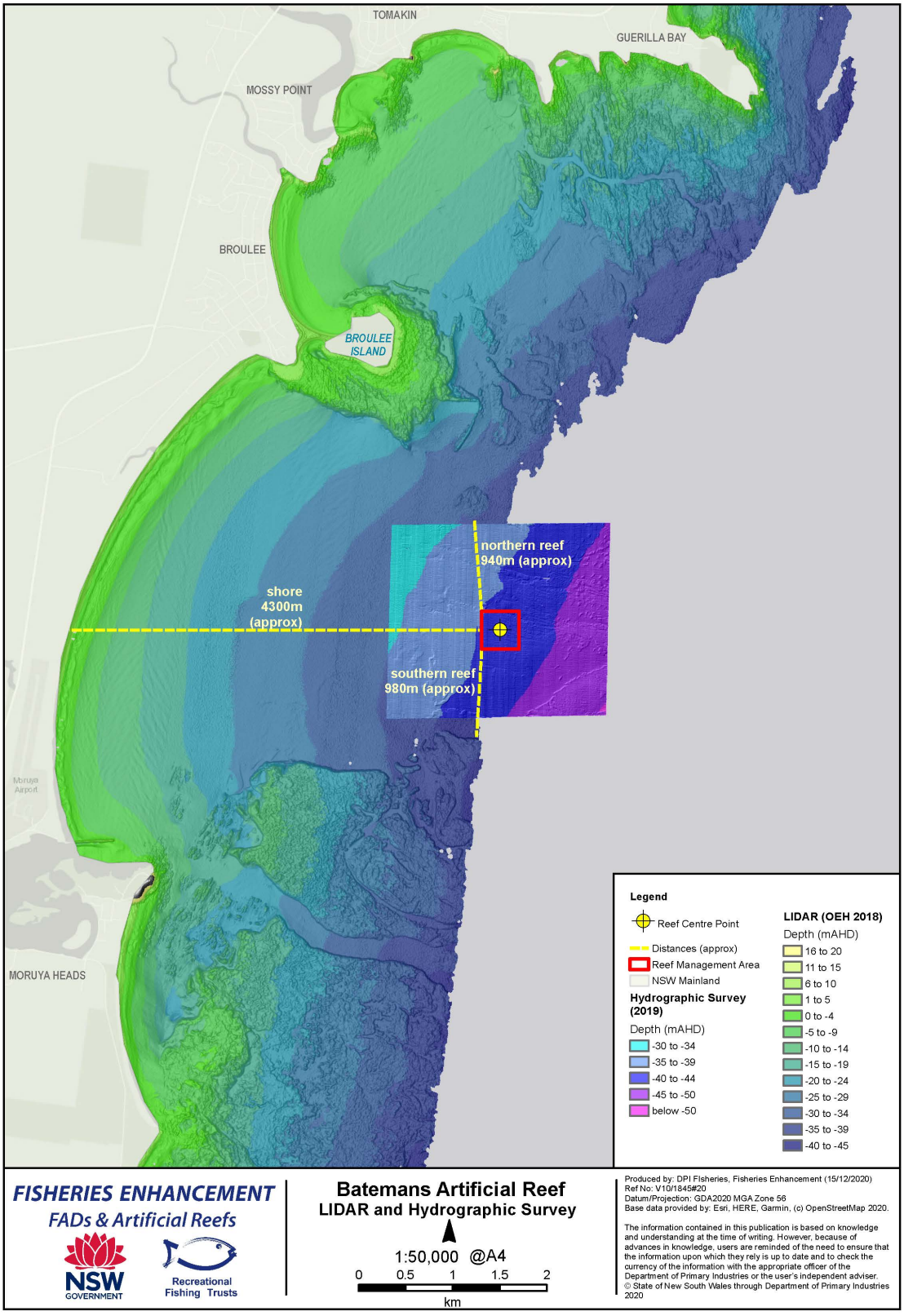


Figure 4 LIDAR reflectance imagery displaying presence of natural reef and distance from proposed artificial reef site and nearest mainland beach

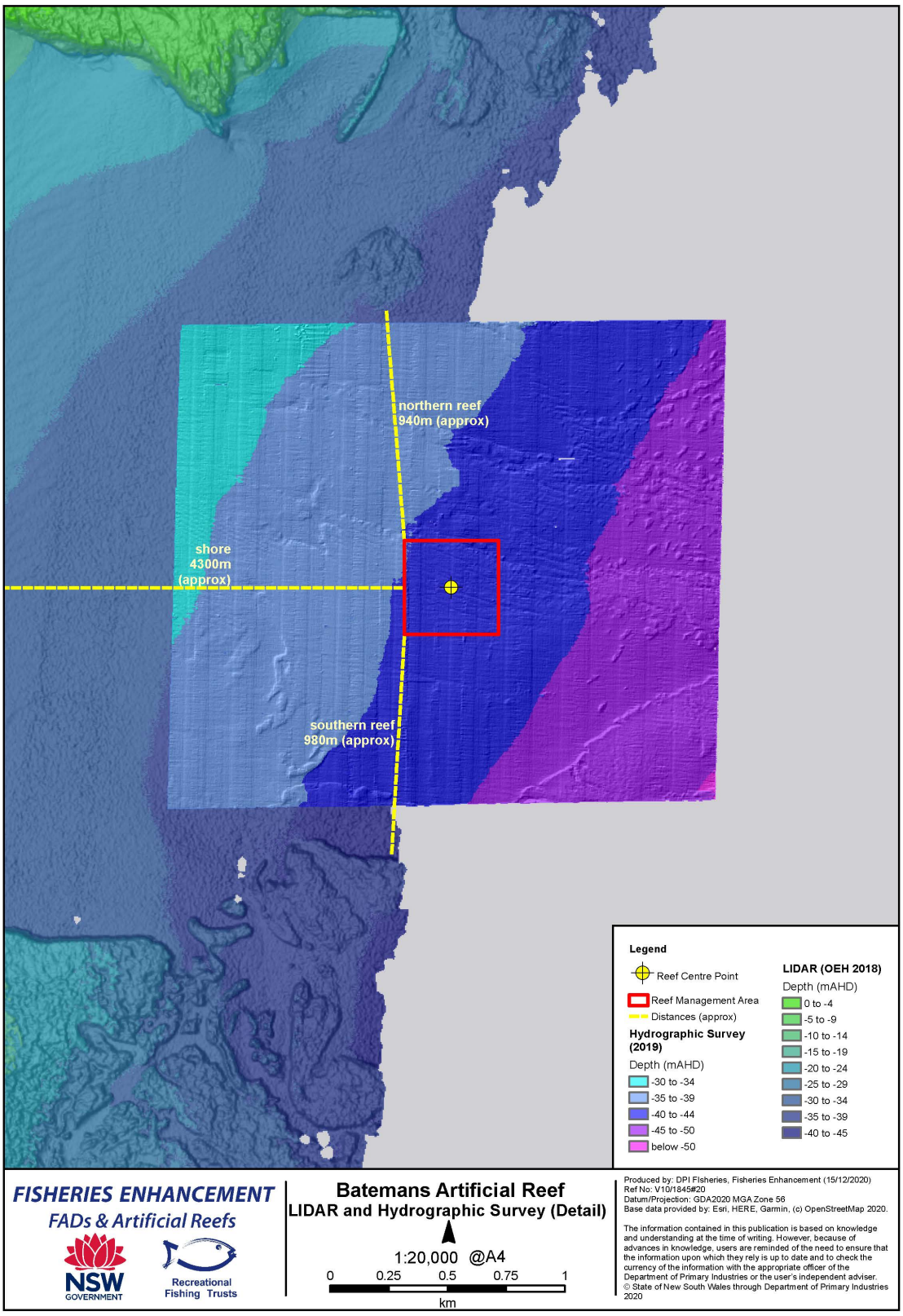


Figure 5 Colour gradient model depicting the depth contours (m) over the survey area and distance to nearest confirmed low profile reef.

4.3 Biological considerations

Soft sediment and rocky reef assemblages

Offshore artificial reefs are considered to be most effective when placed in bare, sandy, 'habitat limited' environments. Selection of reef sites has therefore focussed on areas known or likely to consist of sandy substratum away from areas of naturally occurring reef. In NSW a few common groups make up the fish fauna of sandy areas ([18]). The elasmobranchs are often represented by Urolophid and Rhinobatid rays. There may also be many small planktivorous fishes. Other common and commercially important groups are the flatheads (Platycephalidae), which are voracious predators and whiting (Sillaginidae), which are benthic feeders. The flatheads and whiting were present across the proposed reef deployment area by site video surveys conducted by DPI.

Offshore artificial reefs are likely to be most effective if habitat is a limiting factor for population growth. Subtidal rocky reefs harbour fishes that depend on this habitat for food, shelter and/or spawning sites at some stage during their lives. Many species are affected by the topography of the reef and are more abundant in areas of greater physical complexity. Some reef fishes may be very active, including wrasses and leatherjackets, and can traverse large areas of reef. There are also many less mobile, reef associated species, which spend most of their time on or near the bottom and cryptic species that remain within caves, overhangs and crevices.

Fish surveys were conducted by DPI on the proposed offshore artificial reef deployment site and control sites representative of natural reef of a similar depth found nearby to the reef deployment area using baited remote underwater video (BRUV) units and tow cameras. Results from these surveys indicated that the natural rocky reef supported a fish community that was different to the community identified on the proposed reef deployment site. In total, 21 fish species were identified on the natural reef site and 9 species on the proposed artificial reef site.

The natural reef exhibited a greater number of reef associated species including commercially and/or recreationally important Grey Morwong (*Nemadactylus douglasii)*, Red Morwong (*Cheildactylus fuscus*), Silver Trevally (*Pseudocaranx georgianus*), Blackspot Pigfish (*Bodianus unimaculatus*), Redfish (*Centroberyx affinis*) and four species of Leatherjacket. The proposed artificial reef site showed a greater dominance of soft sediment associated species such as Flatheads (*Platycephalus spp.*), Eastern School Whiting (*Sillago flindersi*) and Shovelnose Rays (*Aptychotrema* spp.).

The results of BRUV surveys conducted by DPI were consistent with other similar surveys and artificial reef sites prior to reef construction. They further support the hypothesis that the new offshore artificial reef will provide the building blocks for a reef habitat for a wide variety of reef associated fish species.

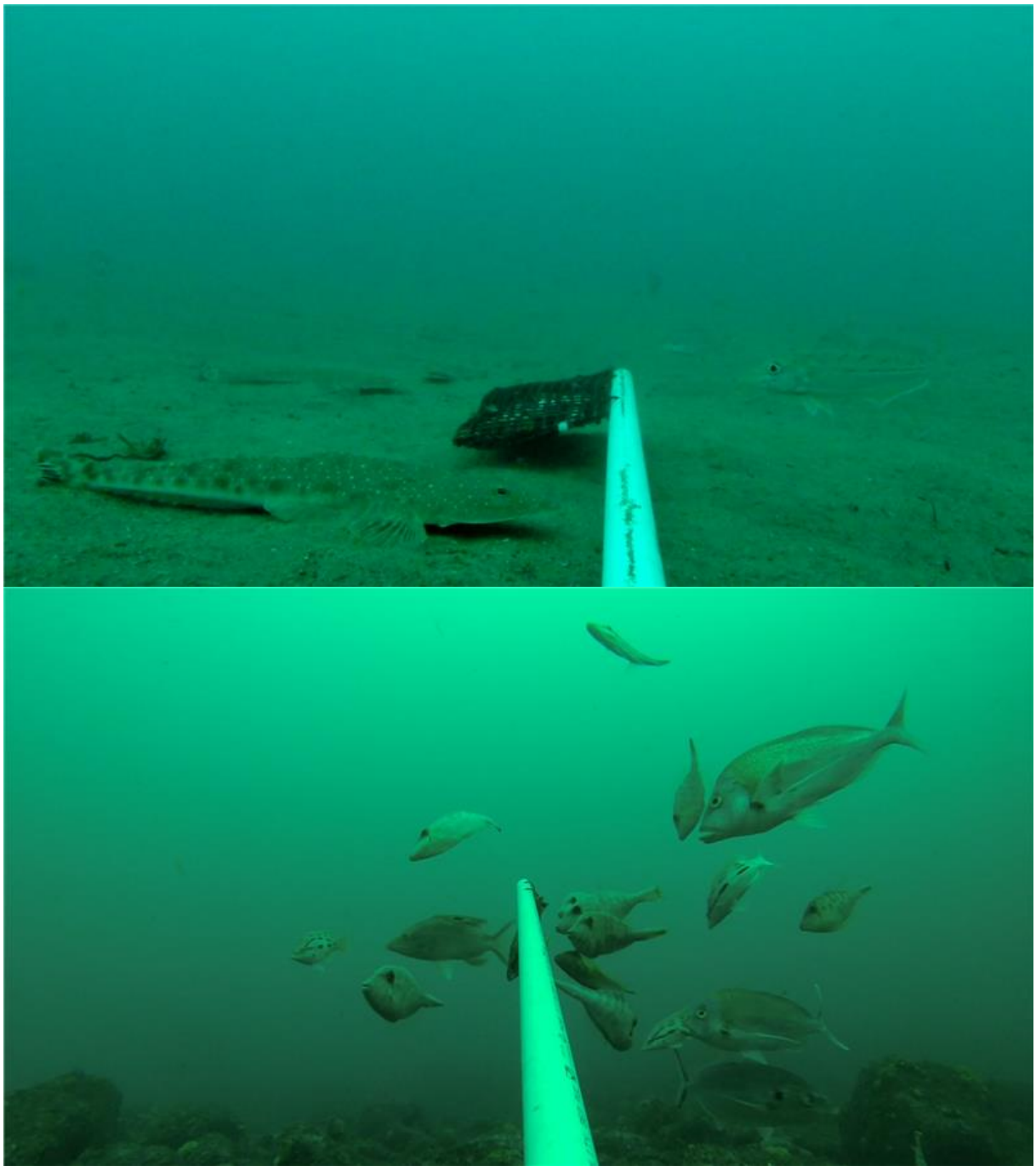


Figure 6 A still image from the baited remote underwater video (BRUV) deployment on the proposed offshore artificial reef site (top) and the natural rocky reef site located north of the reef deployment site in the same depth range (bottom)

Threatened and protected species, populations and endangered ecological communities

Threatened and protected species, populations and endangered ecological communities listed under relevant schedules of the Commonwealth *Environment Protection and Biodiversity Conservation Act*, the NSW *Biodiversity Conservation Act* and the NSW *Fisheries Management Act* were identified within a 50 km radius of the proposed deployment site using the EPBC Act Protected Matters Reporting Tool ([35]), the Bionet Database ([36]) and

the Atlas of Living Australia, as well as literature relevant to the Batemans area in September 2020. A list of all threatened and protected species, populations and endangered ecological communities that have previously been recorded within the search areas are provided (Table 3). It is important to note that data in the searches comes from a number of different sources, may contain errors and omissions and should therefore be treated as indicative only.

Results of the database searches revealed 26 species of fish (including seahorses, pipefish and ghost pipefish), 32 species of marine mammal (including whales, dolphins and seals) and 5 species of marine reptiles (turtles) (Table 3).

Only threatened species (from the initial search) that were known or considered likely to occur in the wider study area (based on general species distribution databases) and/or known to utilise habitat in the study area, were considered for further Assessment of Significance. Overall, 3 species of fish, 3 species of marine turtle, 4 species of cetacean and 2 pinnipeds were assessed according to EES and DPI threatened species assessment guidelines ([19], [20]). A total of 7 species of fish, 5 species of marine turtle, 11 species of cetacean and 1 pinniped were assessed individually under the EPBC Act.

Searches for seabirds likely to forage offshore and in the proposed reef deployment area were also carried out. Intertidal and wading birds, such as sandpipers, curlews and plovers, were excluded from the assessment as they are unlikely to be affected by the proposal. A total of 61 bird species were identified comprising of seabirds and birds of prey. The main groups of seabirds that were found to occur in the study region included albatrosses, petrels, shearwaters, terns, skuas, prions, gulls and gannets.

New South Wales and Commonwealth registers of critical habitats were also searched within and beyond the study region. The nearest Greynurse Shark critical habitat location is the Tollgate Islands over 15 km north-north-west of the proposed Batemans offshore artificial reef site (Figure 2). The Tollgate Islands are afforded the highest level of protection under the *Marine Estate Management Act* 2014 and are zoned sanctuary within the Batemans Marine Park zoning plan with no fishing permitted within that zone.

A threatening process is something that threatens, or could potentially threaten, the survival or evolutionary development of a species, population or ecological community [21]. Key Threatening Processes (KTPs) identified as being potentially relevant to the proposal are entanglement or ingestion of anthropogenic debris in marine and estuarine environments (TSC Act); injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris (EPBC Act); and hook and line fishing in areas important for the survival of threatened fish species (FM Act).

The risk assessment considered that the incidental capture of sea birds was very unlikely on the offshore artificial reef. From experience from the Sydney, Shoalhaven, Port Macquarie, Southern Sydney, Merimbula, Newcastle, Wollongong and Tweed offshore artificial reefs, zero reports of interactions with sea birds have been reported. For this reason, no direct mitigation measure is considered to be required. If increased interactions with sea birds is reported and verified by DPI, an appropriate management response including but not limited to restrictions on some fishing practices (i.e. floating of surface baits) may be considered.

The artificial reef may potentially increase the risk of lost fishing gear and harmful marine debris entering the marine environment in the vicinity of the proposed reef. Threatened species including seabirds can ingest or become entangled in marine debris, such as plastics.

In order to reduce this potential impact on seabirds, education using the reef user guidelines and existing DPI education programs would be provided on the potential impacts of harmful marine debris on marine life and the responsible disposal of litter and discarded fishing gear.

Following deployment of the reef, it is proposed for any incidents, recorded or reported interactions with threatened or protected fish species to be reported to the DPI Threatened Species Unit for further assessment as detailed in this plan. Incidents involving threatened and/or protected species include:

- Reports from reef users of incidental capture;
- Visual identification reports from reef users;
- Interaction with any of the DPI monitoring protocols including baited remote video, unbaited video drops, ROV or acoustic interactions of tagged animals with the acoustic receiver attached to the reef;
- Any interaction that involves the death of a threatened or protected seabird, mammal or reptile species will be immediately reported to the NSW Environment, Energy and Science (EES). The DPI will also provide education on threatened and protected species' identification, best practice for returning incidentally captured fish, minimising risks to seabirds and boating restrictions in the vicinity of large cetaceans. This educational information will be published as part the Batemans offshore artificial reef 'User Guidelines'.

Table 3 Threatened and protected species in the Batemans area

Class	Scientific Name	Common name	Status under BC/ FM Act	Status under EPBC Act
Aves	*Accipiter fasciatus*	Brown Goshawk		LM
Aves	*Ardenna carneipes = Puffinus carneipes*	Flesh-footed Shearwater, Fleshy-footed Shearwater	V	LM, M
Aves	*Ardenna grisea = Puffinus griseus*	Sooty Shearwater		LM, M
Aves	*Ardenna pacifica = Puffinus pacificus*	Wedge-tailed Shearwater		LM, M
Aves	*Ardenna tenuirostris = Puffinus tenuirostris*	Short-tailed Shearwater		LM, M
Aves	*Catharacta skua*	Great Skua		LM
Aves	*Chlidonias hybrida*	Whiskered Tern		LM, M
Aves	*Chlidonias leucopterus*	White-winged Tern, White-winged Black Tern		LM, M
Aves	*Diomedea antipodensis*	Antipodean Albatross	V	V, LM, M
Aves	*Diomedea antipodensis gibsoni*	Gibson's Albatross	V	V, LM, M
Aves	*Diomedea epomophora (sensu stricto)*	Southern Royal Albatross		V, LM, M
Aves	*Diomedea exulans (sensu lato)*	Wandering Albatross	E	V, LM, M

Class	Scientific Name	Common name	Status under BC/ FM Act	Status under EPBC Act
Aves	*Diomedea sanfordi*	Northern Royal Albatross		E, LM, M
Aves	*Eudyptes pachyrhynchus*	Fiordland Penguin		LM
Aves	*Eudyptula minor*	Little Penguin		LM
Aves	*Falco cenchroides*	Nankeen Kestrel		LM
Aves	*Falco hypoleucos*	Grey Falcon	E	V
Aves	*Falco subniger*	Black Falcon	V	
Aves	*Fregetta grallaria grallaria*	White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian)	V	V
Aves	*Fregetta tropica*	Black-bellied Storm-Petrel		LM
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V	LM
Aves	*Haliastur sphenurus*	Whistling Kite		LM
Aves	*Hamirostra melanosternon*	Black-breasted Buzzard	V	
Aves	*Hydroprogne caspia*	Caspian Tern		LM, M
Aves	*Larus dominicanus*	Kelp Gull		LM
Aves	*Larus novaehollandiae = Chroicocephalus novaehollandiae*	Silver Gull		LM
Aves	*Larus pacificus*	Pacific Gull		LM
Aves	*Lophoictinia isura*	Square-tailed Kite	V	
Aves	*Macronectes giganteus*	Southern Giant-Petrel	E	E, LM, M
Aves	*Macronectes halli*	Northern Giant-Petrel	V	V, LM, M
Aves	*Morus serrator*	Australasian Gannet		LM
Aves	*Onychoprion fuscata*	Sooty Tern	V	LM
Aves	*Pachyptila desolata*	Antarctic Prion		LM
Aves	*Pachyptila turtur*	Fairy Prion		LM
Aves	*Pachyptila turtur subantarctica*	Fairy Prion (southern)		V
Aves	*Pandion cristatus = haliaetus*	Eastern Osprey	V	LM, M
Aves	*Pelecanoides urinatrix*	Common Diving-Petrel		LM
Aves	*Pelecanus conspicillatus*	Australian Pelican		LM

Class	Scientific Name	Common name	Status under BC/ FM Act	Status under EPBC Act
Aves	*Pelagodroma marina*	White-faced Storm-Petrel		LM
Aves	*Phoebetria fusca*	Sooty Albatross	V	V, LM, M
Aves	*Pterodroma leucoptera leucoptera*	Gould's Petrel	V	E, LM
Aves	*Pterodroma macroptera*	Great-winged Petrel		LM
Aves	*Pterodroma neglecta neglecta*	Kermadec Petrel (Western)	V	V
Aves	*Puffinus assimilis*	Little Shearwater	V	LM
Aves	*Puffinus gavia*	Fluttering Shearwater		LM
Aves	*Stercorarius parasiticus*	Arctic Jaegar, Arctic Skua		LM, M
Aves	*Stercorarius pomarinus*	Pomarine Jaegar, Pomarine Skua		LM, M
Aves	*Sterna hirundo*	Common Tern		LM, M
Aves	*Sterna paradisaea*	Arctic Tern		LM
Aves	*Sterna striata*	White-fronted Tern		LM
Aves	*Sternula albifrons = Sterna albifrons*	Little Tern	E	LM, M
Aves	*Sternula nereis nereis*	Australian Fairy Tern		V
Aves	*Thalassarche bulleri*	Buller's Albatross, Pacific Albatross		V
Aves	*Thalassarche cauta*	Shy Albatross, Tasmanian Shy Albatross	V	V, LM, M
Aves	*Thalassarche chlororhynchos bassi*	Atlantic Yellow-nosed Albatross		LM, M
Aves	*Thalassarche eremita*	Chatham Albatross		E, LM, M
Aves	*Thalassarche impavida*	Campbell Albatross, Campbell Black-browed Albatross		V, LM, M
Aves	*Thalassarche melanophris*	Black-browed Albatross	V	V, LM, M
Aves	*Thalassarche salvini*	Salvin's Albatross		V, LM, M
Aves	*Thalassarche steadi*	White-capped Albatross		V, LM, M
Aves	*Thalasseus bergii = Sterna bergii*	Crested Tern		LM
Mammalia	*Arctocephalus forsteri*	New Zealand Fur-seal, Long-nosed Fur-seal	V	
Mammalia	*Arctocephalus pusillus doriferus*	Australian Fur-seal, Australo-African Fur-seal	V	LM

Class	Scientific Name	Common name	Status under BC/ FM Act	Status under EPBC Act
Mammalia	*Balaenoptera acutorostrata*	Minke Whale		Cet
Mammalia	*Balaenoptera bonaerensis*	Dark Shoulder Minke Whale		Cet, M
Mammalia	*Balaenoptera borealis*	Sei Whale		V, Cet, M
Mammalia	*Balaenoptera edeni*	Bryde's Whale		Cet, M
Mammalia	*Balaenoptera musculus*	Blue Whale	E	E, Cet, M
Mammalia	*Balaenoptera physalus*	Fin Whale		V, Cet, M
Mammalia	*Berardius arnuxii*	Arnoux's Beaked Whale		Cet
Mammalia	*Caperea marginata*	Pygmy Right Whale		Cet, M
Mammalia	*Delphinus delphis*	Common Dolphin, Short-beaked Common Dolphin		Cet
Mammalia	*Eubalaena australis*	Southern Right Whale	E	E, Cet, M
Mammalia	*Globicephala macrorhynchus*	Short Finned Pilot Whale		Cet
Mammalia	*Globicephala melas*	Long Finned Pilot Whale		Cet
Mammalia	*Grampus griseus*	Risso's Dolphin, Grampus		Cet
Mammalia	*Hydrurga leptonyx*	Leopard Seal		LM
Mammalia	*Kogia breviceps*	Pygmy Sperm Whale		Cet
Mammalia	*Kogia simus*	Dwarf Sperm Whale		Cet
Mammalia	*Lagenorhynchus obscurus*	Dusky Dolphin		Cet, M
Mammalia	*Lissodelphis peronii*	Southern Right Whale Dolphin		Cet
Mammalia	*Megaptera novaeangliae*	Humpback Whale	V	V, Cet, M
Mammalia	*Mesoplodon densirostris*	Blainvilles Beaked Whale, Dense-beaked Whale		Cet
Mammalia	*Mesoplodon grayi*	Gray's Beaked Whale		Cet
Mammalia	*Mesoplodon hectori*	Hector's Beaked Whale		Cet
Mammalia	*Mesoplodon layardii*	Strap toothed Beaked Whale, Layards Beaked Whale		Cet
Mammalia	*Mesoplodon mirus*	True's Beaked Whale		Cet
Mammalia	*Mirounga leonina*	Southern Elephant Seal		V, LM
Mammalia	*Orcinus orca*	Killer Whale, Orca		Cet, M

Class	Scientific Name	Common name	Status under BC/ FM Act	Status under EPBC Act
Mammalia	*Physeter macrocephalus*	Sperm Whale	V	Cet, M
Mammalia	*Tursiops aduncus*	Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin		Cet
Mammalia	*Tursiops truncatus*	Bottlenose Dolphin		Cet
Mammalia	*Ziphius cavirostris*	Cviers Beaked Whale, Goose Beaked Whale		Cet
Pisces	*Acentronura tentaculata*	Shortpouch Pygmy Pipehorse	P	LM
Pisces	*Carcharias taurus (east coast population)*	Greynurse Shark (east coast population)	CE	CE
Pisces	*Carcharodon carcharias*	Great White Shark	V	V, M
Pisces	*Cosmocampus howensis*	Lord Howe Pipefish	P	LM
Pisces	*Epinephelus daemelii*	Black Rockcod, Black Cod, Saddled Rockcod	V	V
Pisces	*Heraldia nocturna*	Upside-down Pipefish, Eastern Upside-down Pipefish	P	LM
Pisces	*Hippichthys breviceps = Hippocampus breviceps*	Short-head Seahorse	P	LM
Pisces	*Hippocampus abdominalis*	Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse	P	LM
Pisces	*Histiogamphelus briggsii*	Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish	P	LM
Pisces	*Isurus oxyrinchus*	Shortfin Mako, Mako Shark		M
Pisces	*Kimblaeus bassensis*	Trawl Pipefish, Bass Strait Pipefish	P	LM
Pisces	*Lamna nasus*	Porbeagle, Mackerel Shark		M
Pisces	*Lissocampus runa*	Javelin Pipefish	P	LM
Pisces	*Manta birostris*	Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray		M
Pisces	*Maroubra perserrata*	Sawtooth Pipefish	P	LM
Pisces	*Notiocampus ruber*	Red Pipefish	P	LM
Pisces	*Phyllopteryx taeniolatus*	Weedy Seadragon	P	LM
Pisces	*Rhincodon typus*	Whale Shark		V, M

Class	Scientific Name	Common name	Status under BC/ FM Act	Status under EPBC Act
Pisces	*Solegnathus spinosissimus*	Spiny Pipehorse, Australian Spiny Pipehorse	P	LM
Pisces	*Solenostomus cyanopterus*	Robust Ghostpipefish, Blue-finned Ghost Pipefish,	P	LM
Pisces	*Stigmatopora argus*	Spotted Pipefish, Gulf Pipefish, Peacock Pipefish	P	LM
Pisces	*Stigmatopora nigra*	Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish	P	LM
Pisces	*Syngnathoides biaculeatus*	Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish	P	LM
Pisces	*Urocampus carinirostris*	Hairy Pipefish	P	LM
Pisces	*Vanacampus margaritifer*	Mother-of-pearl Pipefish	P	LM
Pisces	*Vanacampus phillipi*	Port Phillip Pipefish	P	LM
Reptilia	*Caretta caretta*	Loggerhead Turtle	E	E, LM, M
Reptilia	*Chelonia mydas*	Green Turtle	V	V, LM, M
Reptilia	*Dermochelys coriacea*	Leatherback Turtle, Leathery Turtle, Luth	E	E, LM, M
Reptilia	*Eretmochelys imbricata*	Hawksbill Turtle		V, LM, M
Reptilia	*Natator depressus*	Flatback Turtle		V, M, LM

PE = presumed extinct, CE = critically endangered, E = endangered, V = vulnerable, CD= conservation dependent, M = migratory, LM = listed marine, Cet = cetacean and P = protected (FM Act). Note: All native birds, reptiles, amphibians and mammals in NSW are protected by the NSW National Parks and Wildlife Act (NP&W Act).

5 Module design, reef configuration and construction

5.1 Preparation of materials

Similar to the Sydney offshore artificial reef, the modules will be constructed of new Australian standard structural steel components which will be raw, unpainted and ungalvanized (Figure 7). No substances from Annex 1 or 2 (under schedule 1 of the *Sea Dumping Act*) will be used in the fabrication of reef modules.

Figure 7 Sydney offshore artificial reef, 2011 (Image courtesy of Hae Joo)

5.2 Reef design and construction

The two steel tower modules are identical in design, with weights of 46 tonne, footprints of 12.8 x 12.8 m and heights of 11.7 m (Figure 8).

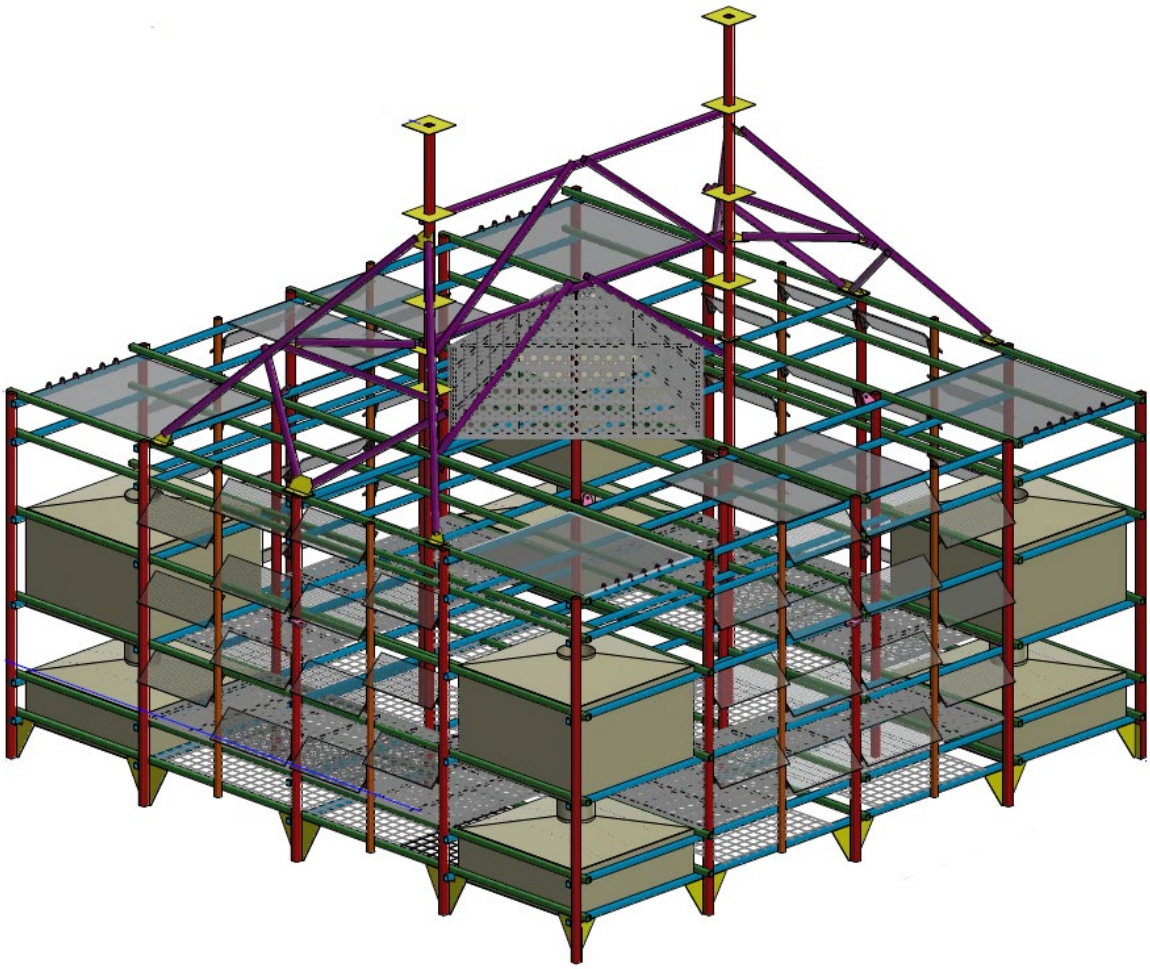


Figure 8 Steel tower module

The reefs are of a modular design, allowing safe and efficient fabrication, transport, and assembly. The structural steel welded sections are bolted together. Once assembled all critical joints are welded.

Assembly and welding of materials will be completed at SMC Marine, Sydney Ports Secure Area, White Bay, Rozelle. Qualified and experienced tradesmen shall conduct the fabrication work in accordance with SMC's standard weld operation procedures and job specifications.

The reef body provides a stable base, areas of shelter for the fish, surfaces for algae growth, current flow diversion via angled panels, and features of interest for selected fish species.

Buoyancy chambers are mounted in the four corners of the reef body (Figure 8). These chambers enable the reef to float during marine transport. Once in location for sinking, the chambers are opened, venting all air and allowing the reefs to sink to the sea floor.

The design has been checked for the assembly, launch, tow and installation load cases which are the most onerous design conditions.

The following design features and criteria have been included in the design:

- Complexity and structural integrity are achieved by using large structural members.
- Large permeable base allowing for benthic foraging and minimising disturbance of soft sediments during deployment.

- Tall profile to attract pelagic fish.
- Open skeletal structure that is ideal for mobile sand substrate environment.
- Steel thickness great enough to allow for corrosion.
- Structural complexity of steel beams and plates for a greater variety of habitats.

5.3 Reef Deployment site

Following the review of existing information and mapping of key characteristics of the study area and surrounds, constraints analysis identified a potential offshore artificial reef deployment area to the south of Batemans Bay. This is the area where, based on existing information, reef deployment would be suitable and unlikely to conflict with the physical, biological and regulatory constraints investigated. The analysis was limited to using the information available and was subject to revision once further data or field investigations of the seabed and consultation had been undertaken.

The corner point co-ordinates (GDA2020) for the 400 x 400 m reef management area are situated at:

NW	35° 53.042′ S, 150° 12.037′ E
SW	35° 53.258′ S, 150° 12.029′ E
NE	35° 53.048′ S, 150° 12.303′ E
SE	35° 53.264′ S, 150° 12.295′ E

5.3.1 Map of deployment site

The location of the proposed Batemans offshore artificial reef deployment site is shown in Figure 9. The deployment site falls within the waters displayed in Australian Hydrographic Chart AU436150, Batemans Bay to Jervis Bay.

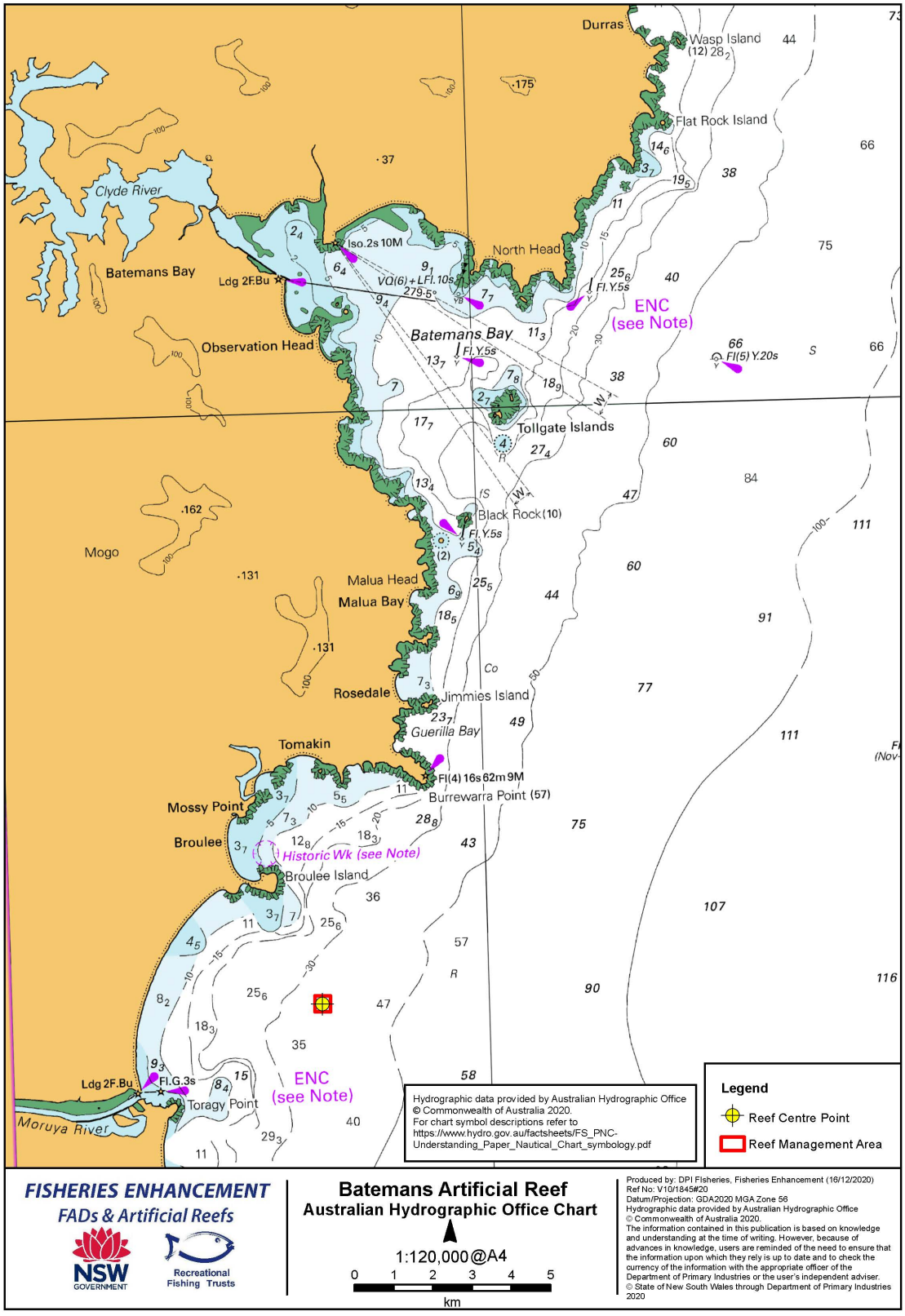


Figure 9 Reef management area shown on Australian Hydrographic Office Chart AU436150

5.3.2 **Photographs and/or video of the proposed site prior to deployment**

Drop camera and tow video surveys were conducted by DPI on 29 September 2020 at the proposed reef centre point (35° 53.153' S, 150° 12.166' E) and a control site representative of natural reef found to the north of the reef deployment area (35° 51.177' S, 150° 13.877' E) using tow camera and baited remote underwater video (BRUV) units. Results from these initial surveys indicated that the natural rocky reef supported a fish community that was different to the community identified on the proposed reef deployment site.

The site specific surveys conducted by DPI consistently supported the hypothesis that it is expected that the new offshore artificial reef would support a wide variety of reef associated fish species. However, the community is likely to be made up of a larger number of species with greater diversity as the structure would likely provide ample space for both sand and reef associated species.

Figure 10 A still image of the substrate from tow camera video at the proposed offshore artificial reef site. (Image: DPI – September 2020)

5.3.3 **Geographical position (latitude and longitude)**

Table 4 , Figure 11 and Figure 12 describe the geographical arrangement of the reef layout within the reef management area. On the day of deployment, accurate localised currents will be measured on site to ensure the modules align with the prevailing EAC influence to maximise fishers' drift across the reef modules. The modules will be placed approximately 80 m apart (Figure 12), 40 m either side of the reef centre point) to maximise biological value between modules.

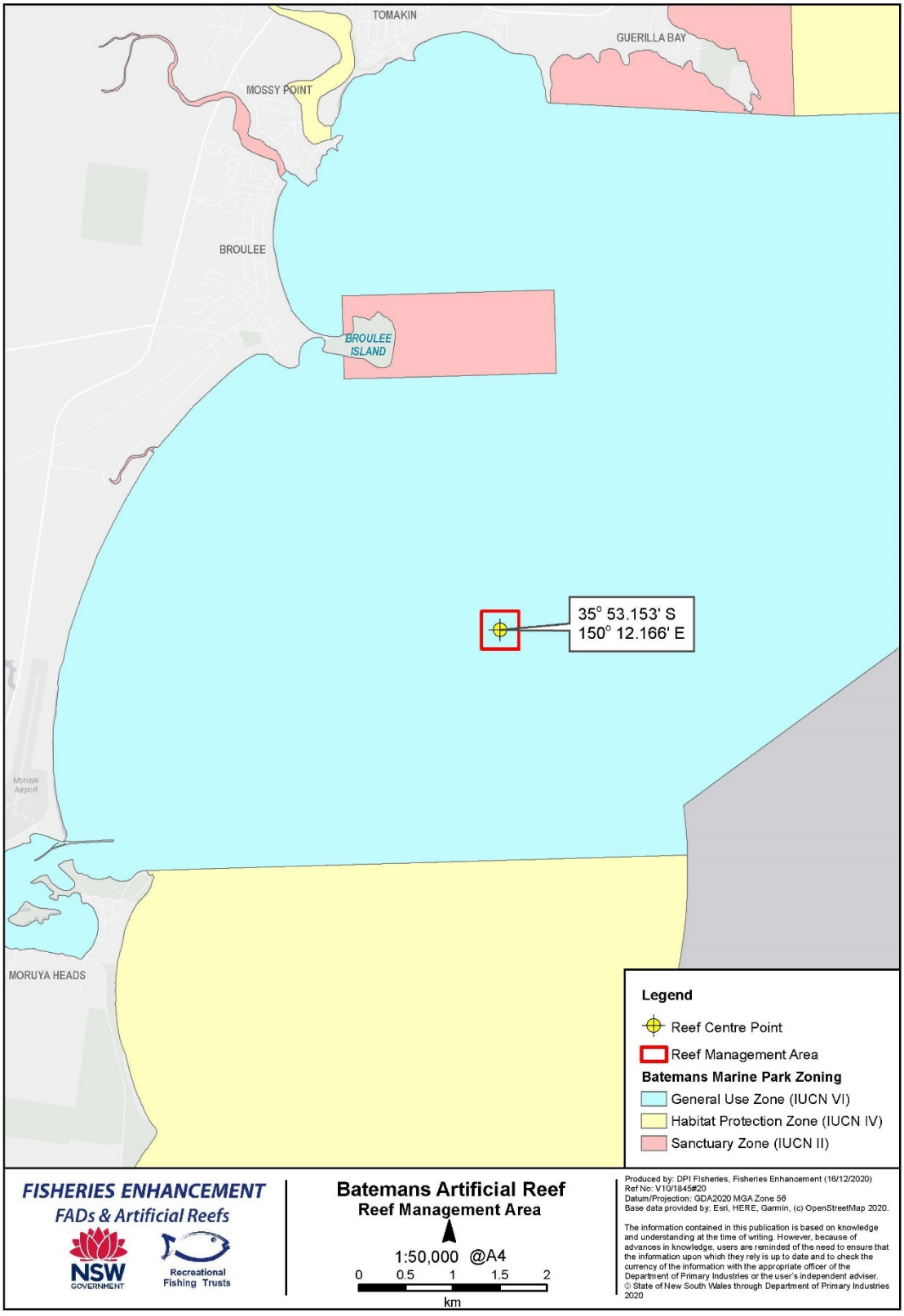


Figure 11 Reef centre point within Batemans Marine Park general use zone

Table 4 Approximate geographical position of each reef module

1	35° 53′ 7.800′′S	150° 12′ 9.961′′E	35° 53.130′S	150° 12.166′E	35.885500°S	150.202767°E
2	35° 53′ 10.381′′S	150° 12′ 9.961′′E	35° 53.173S′	150° 12.166′E	35.886217°S	150.202767°E

*Coordinates are presented in Datum WGS84

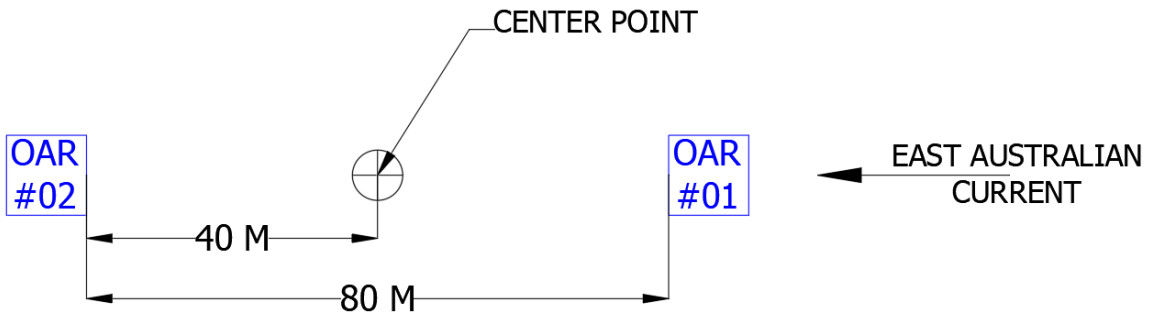


Figure 12 Reef module arrangement

5.3.5 Depth of water over the reef

Suitable depth is important to avoid creating a navigational hazard and for the stability of the modules (in terms of ability to withstand certain hydrodynamic forces), accessibility to recreational fishers (via boat) and would also influence the type of fish which would aggregate around the structure. Clearance depth over the artificial reef post deployment would be no less than 28 m (LAT). This would be confirmed post reef deployment.

5.3.6 Distance from nearest land

The Batemans offshore artificial reef management area is to be located within State waters approximately 4.3 km offshore from Bengello Beach and 2.7 km from Broulee Island (Figure 5).

5.3.7 Biological characteristics

The proposed deployment site consists of unconsolidated soft sediments. Reefs designed for the purpose of recreational fishing enhancement should be placed an appropriate distance away from existing reefs in order to create new habitats and create an opportunity to increase local productivity, rather than adding to existing reef habitat (typically a nominated distance of no less than 0.5 km). Natural reef habitats, habitats unique within an area, or locations known to support diverse benthic/epibenthic communities should therefore be avoided. Areas of conservation significance and habitats critical to the survival of a particular species are generally protected under NSW legislation and reefs designed for recreational fishing may not be compatible with the objectives of the protected area. Information on the occurrence and distribution of threatened species is generally sparse and may be limited to predictions based on presence of suitable habitat and/or records of a species occurring at nearby locations. It is especially difficult to predict where highly mobile individuals (such as fish or migratory marine mammals) occur due to their itinerant nature.

The proposed artificial reef deployment site has been chosen approximately 940 m south of the nearest natural reef to reduce the effect of 'draw-down' (that is individuals readily moving from the natural reef onto the artificial reef). Open sand/sediment expanses present a perceived impassable barrier to many demersal reef associated fish species. Biological considerations are discussed in further detail in section 4.3.

5.3.8 Characteristics of the sea bottom at the site, and impact of material on biota at the placement site or other areas potentially affected by the creation of the artificial reef

Swath acoustic mapping results illustrated a 2.5 km onshore-offshore depth gradient consistent with sediment substrata, represented by intermittent increases in depth from 30 m to 50 m (Figure 5). This indicates that the seafloor consists predominantly of unconsolidated sediments with the presences of gutters and some slight ridges, as evidenced by camera surveys.

Impacts on soft sediment assemblages

Offshore artificial reefs are considered to be most effective when placed in bare, sandy, 'rocky-reef habitat limited' environments. Selection of reef sites has therefore focussed on areas known or likely to consist of sandy substratum away from areas of naturally occurring reef. Soft sediment habitats can support extremely diverse macrofaunal assemblages.

Initial deployment of the OAR units would cause localised disturbance and re-suspension of sandy sediment in the area where the units are installed which may result in mobile macroinvertebrates being temporarily displaced. If the base of the modules were impermeable, a large proportion of animals living within the direct footprint of where individual modules are placed would also be lost through smothering. This would be a total area of ~328m2, however the base of the modules for the Batemans offshore artificial reef are permeable to the sea floor, minimising the impact and leaving the sediment open to benthic foraging for the life of the reef. Once colonised, the habitat will continue to support a wide variety of marine organisms and provide greater habitat heterogeneity allowing a potentially diverse assemblage to establish.

Soft-bottom habitats adjacent to artificial reefs would be partially affected by current patterns and some minor scouring and deposition which may consequently affect grain size. It is possible that species numbers and/or diversity in sandy habitat adjacent to the reefs may decrease as a result of increased predation by benthic and demersal fish or decapods attracted to and/or growing on the reef, feeding in the adjacent sandy habitat. This effect is known as a 'feeding halo'. Halo effects of reefs may be confined to areas very close to a reef (within a few metres) or extend over a much larger area and may depend on the size of the reef and/or the trophic structure of fish occupying it. Furthermore, the habitat will continue to support a wide variety of marine organisms found living on or over soft sandy substrata. Increased predation on benthos is therefore not considered to have a significant impact within the wider study area.

Table 5. Risk assessment of soft sediment assemblages considered in the reef assessment

Environmental Aspect	Scale	Risk description	Risk Level	Mitigative measure	Treatment type	Risk Level
Flora and fauna						
Benthos	Sub-Local	Direct loss of habitat	A4	Careful selection of habitat type for deployment location. Swath mapping to confirm presence of reef habitat to provide adequate buffer. Efficient design of footprint to minimise loss of sedimentary habitat.	Accept	A4
Benthos	Sub-Local	Change to benthic fauna from changes to sedimentary characteristics	C4	Accept	Accept	C4

Benthos	Sub-Local	Changes to infaunal assemblages	B4	Accept	Accept	B4
Benthos	Sub-Local	Increased predation by fishes from the OAR on benthos	A4	Accept	Accept	A4

Impacts on adjacent rocky reef assemblages

It is considered likely that initial increases in fish numbers would be a result of attraction and aggregation, but that over time (once the reef has become established), the reefs would contribute to overall production. 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. As a precautionary measure, maximum separation of the offshore artificial reef units from existing natural reef was aimed for as part of the constraints mapping in order to minimise potential draw-down effects. Natural reef areas with a 500 m buffer are represented in Figure 13. The convenience and likely popularity of the offshore artificial reefs could attract more recreational fishers, increase participation and length of time fishing and thus increase fishing effort rather than simply redistributing it. However, it is much more likely that fishing effort would not increase as a result of the deployment of the reef. Rather, it would merely transfer from other areas as access to the reef would be limited to boat-based fishers. This transfer of fishing effort could result in an increase in fishing pressure on a localised scale but would in turn potentially offer some relief to other areas that would have previously been fished. Therefore, an increase in fishing effort is not considered to have a significant impact within the wider study area. In summary, the site-specific surveys conducted by DPI supported the hypothesis that it is expected that the new offshore artificial reef will support a wide variety of reef associated fish species. However, the community is likely to be made up of a larger number of species with greater diversity as the structure will likely provide ample space for both sand and reef associated species.

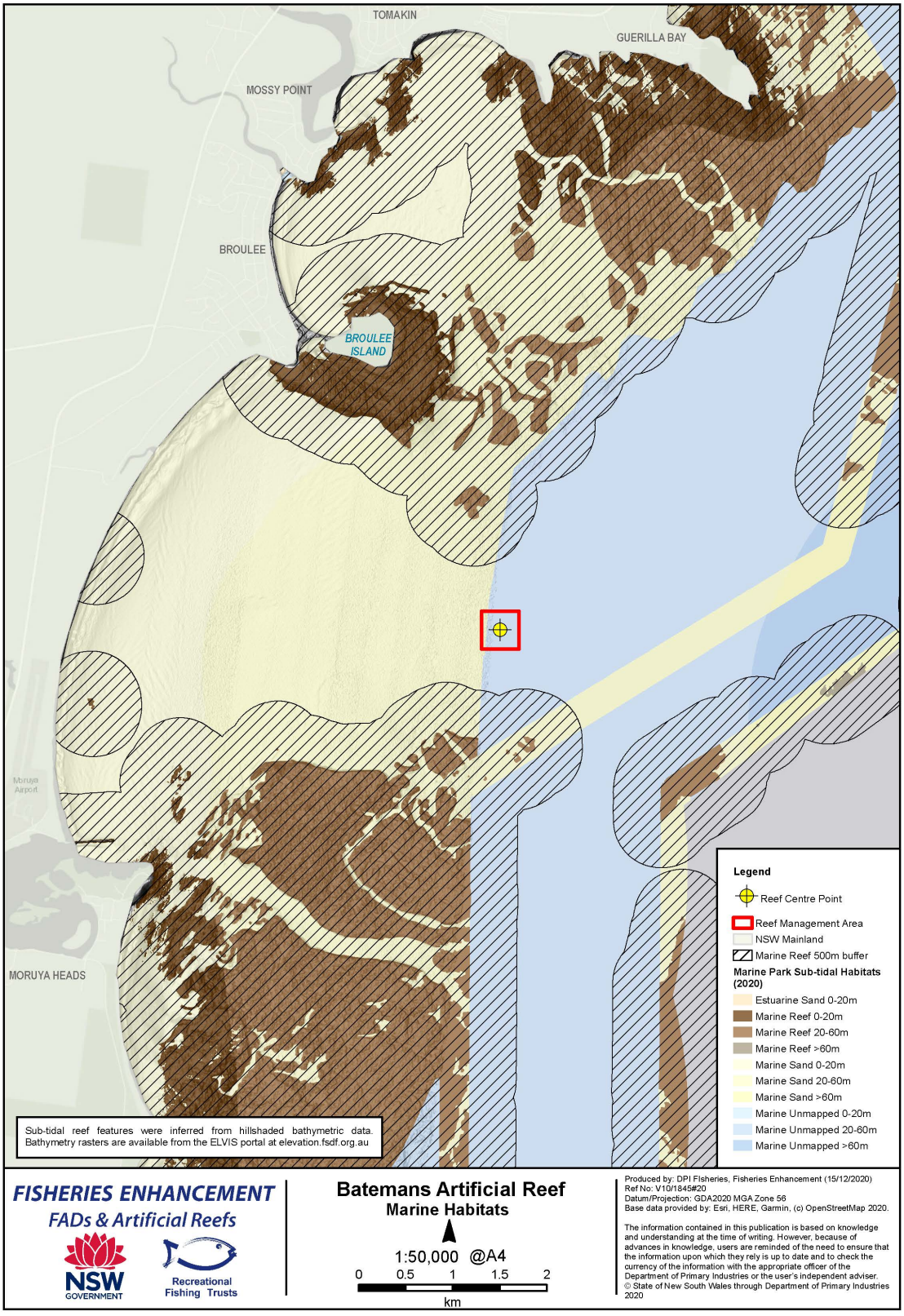


Figure 13 Natural reef mapped with a 500 m buffer zone

Table 6. Risk assessment of rocky reef assemblages considered in the reef assessment

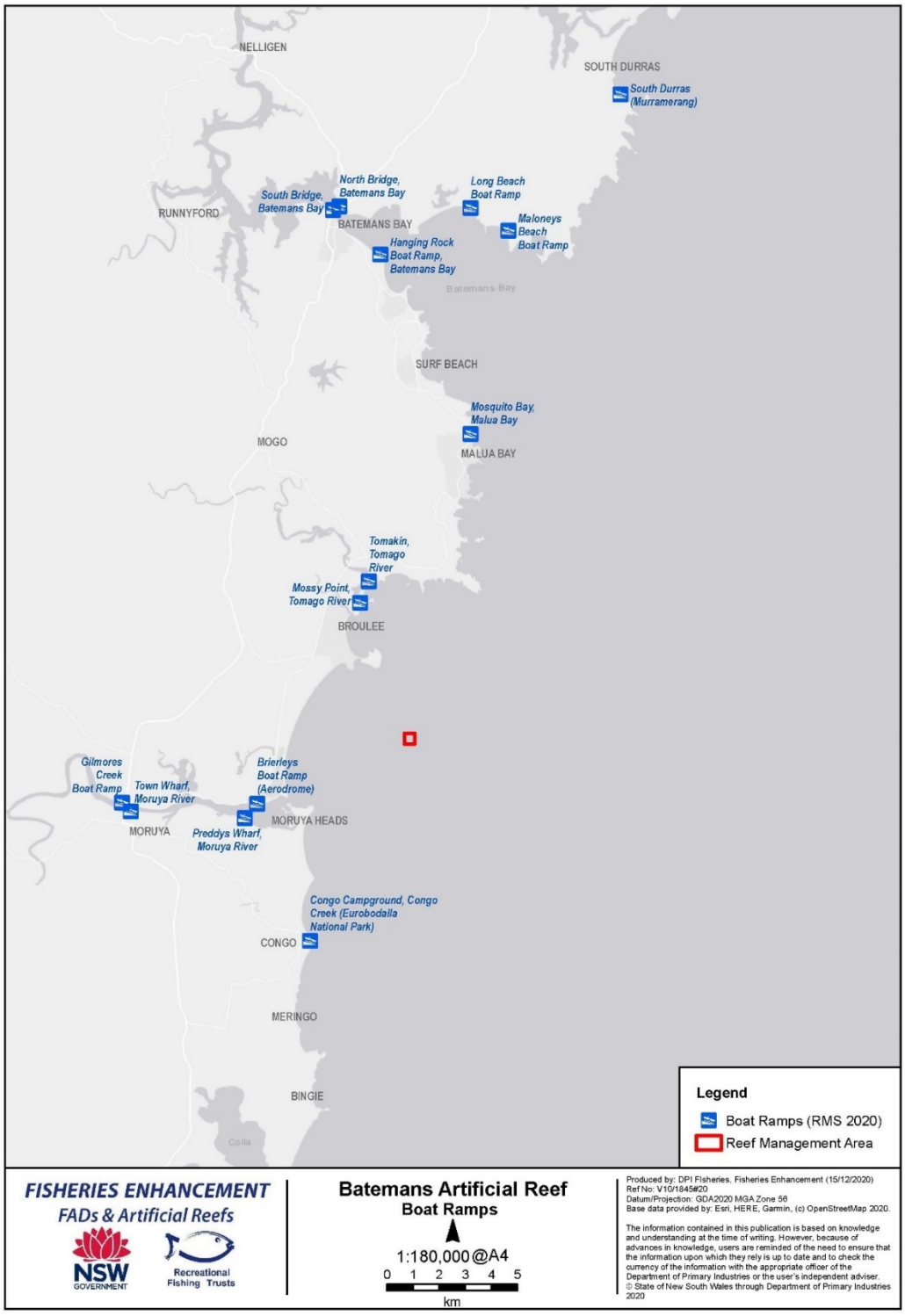
Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Flora and Fauna						
Proximal natural reef	Intermediate	Drawdown effects – reduction in abundance/diversity of reef assemblages	C3	Careful selection of habitat type for deployment location. Swath mapping to confirm presence of reef habitat. Careful site selection to provide adequate buffer from natural reef.	Reduce likelihood	D3
Proximal natural reef	Local	Changes to demersal assemblages	A4	Careful selection of habitat type for deployment location.	Accept	A4
Proximal natural reef	Local	Changes to plankton assemblages	A4	Careful selection of habitat type for deployment location.	Accept	A4
Proximal natural reef	Local	Changes to pelagic assemblages	A4	Careful selection of habitat type for deployment location.	Accept	A4
Proximal natural reef	Intermediate	Changes to epibenthic assemblages	B5	Careful selection of habitat type for deployment location. Swath mapping to confirm presence of reef habitat. Careful site selection to provide adequate buffer from natural reef.	Reduce likelihood	C5
Proximal natural reef	Intermediate	Increased fishing effort leading to increased fish mortality	C3	Existing bag and size limits and surveillance. Utilise additional input controls as appropriate - broad understanding on angler habits.	Reduce consequence	C4

5.3.9 Relation of proposed site to features of importance for amenity, navigation, or exploitation of cultural, historic or scientific interest, fishing, endangered, rare or migratory species or sensitive habitats (such as coral reefs or seagrass beds)

There are numerous boat ramps and amenities in the Batemans region with 14 public boat ramps known to Roads and Maritime Services within 25 km by water of the proposed offshore artificial reef site (Table 7 and Table 14). It is anticipated that the majority of boaters will use ramps from within Moruya River, Mossy Point or ramps within Batemans Bay to access the artificial reef.

Table 7. Boat ramps and facilities within 25 km of the proposed Batemans offshore artificial reef site

NAME	WATERWAY	ACCESS	CONSTRUCTION	CONDITION	NO. LANES	NO. TRAILER SPACES	FEE PAYABLE	LIGHTING	WASTE BINS	FISH CLEAN	PONTOON	BBQ	TOILETS
North Bridge, Batemans Bay	Clyde River	All times	Concrete	Fair	2	11-20	N	Y	Y	Y	N	N	Y
South Bridge, Batemans Bay	Clyde River	All times	Concrete	Good	2	21-50	N	Y	N	Y	N	N	Y
Hanging Rock Boat Ramp	Clyde River	All times	Concrete	Good	3	51+	N	Y	Y	Y	Y	N	Y
Mosquito Bay, Malua Bay	Tasman Sea	All times	Concrete	Good	2	0-10	N	Y	Y	Y	N	N	Y
Mossy Point, Tomago River	Tomago River	All times	Concrete	Good	2	21-50	N	Y	Y	Y	Y	N	Y
South Durras (Murramerang)	Durras Lake	Shallow at times	Sand	Fair	-	0-10	N	N	N	N	N	N	N
Maloneys Beach Boat Ramp	Batemans Bay	Shallow at times	Sand	Fair	-	11-20	N	N	N	N	N	Y	Y
Long Beach Boat Ramp	Batemans Bay	Shallow at times	Sand	Fair	-	0-10	N	N	N	N	N	N	N
Tomakin, Tomago River	Tomago River	Shallow at times	Concrete	Good	1	11-20	N	N	N	Y	N	N	Y
Brieleys Boat Ramp (Aerodrome)	Moruya River	Shallow at times	Concrete	Fair	2	0-10	N	N	N	Y	N	N	Y
Preddys Wharf, Moruya	Moruya River	All times	Concrete	Good	2	11-20	N	Y	Y	Y	Y	N	Y
Town Wharf	Moruya River	Shallow at times	Concrete	Good	1	11-20	N	Y	Y	Y	Y	N	Y
Gilmores Creek Boat Ramp	Moruya River	Shallow at times	Sand	Poor	-	0-10	N	N	N	N	N	N	N
Congo Campground	Congo Creek	Shallow at times	Sand	Poor	1	0-10	N	N	N	N	N	N	N



5.3.9.1 Navigation

Figure 14 Boat ramps in the Batemans region that may be used to access the artificial reef

The proposed artificial reef has the potential to impinge on recreational and commercial vessel operations. The potential impacts of the proposed fishing reef on navigation and vessels are listed below and considered within Table 9.

Clearance

There is a potential risk that vessels transiting over the offshore artificial reef may be damaged or damage the reef structures if their hull or propeller comes into contact with the structures. However, this would be mitigated by ensuring sufficient clearance at all tides and in high wave conditions. Adequate safe vessel clearance will be provided with a minimum of 28 m clearance from the uppermost part of the offshore artificial reef at Lowest Astronomical Tide (LAT) ensured for the proposed Batemans offshore artificial reef.

Anchoring in the vicinity of the reefs would be strongly advised against. Target user groups would be informed about general boating rules in the vicinity of the reefs and recommended against anchoring in the area.

The potential impact of a vessel striking the reef has been prevented by ensuring suitable clearance from the upper part of the structures. It is not possible to completely remove the risk of anchor fouling/loss on the structures as the actions of recreational boat operators are difficult to control.

Table 8. Risks and mitigation associated with clearance

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Navigation and Safety	Local	Clearance	D4	Sufficient clearance between the upper part of the reef and transiting vessels in severe weather conditions and under Lowest Astronomical Tide (LAT) would be ensured through constraints mapping process and swath mapping. Appropriate site selection, consultation and mapping on navigation charts.	Reduce Likelihood	E4

Increased vessel traffic

It is possible that there would be an increase or aggregation of small fishing vessels in the vicinity of the proposed offshore artificial reef locations which could increase the risk of collision or boating accidents.

A code of conduct and guidelines would be published to promote awareness of boating safety within the reef area and minimise navigational hazards such as anchor fouling and collisions. Recreational fishing vessels should give way to movement of commercial vessels and all other normal RMS boating rules and regulations apply.

The location of the artificial reef would not be marked with a buoy and light, because such markers can become a navigation hazard to small boats.

Table 9. Risks and mitigation associated with increased vessel traffic

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Navigation and safety	Local	Increased vessel traffic	A4	Accept	Accept	A4
Navigation and safety	Local	Collision from crowding	C3	Observe boating regulations. Spread effort through reef design/layout. Education.	Reduce likelihood	D3

5.3.9.2 Exploitation of cultural, historic or scientific interest

Conflict with areas of spiritual significance/dreamings

As discussed within DPI's Indigenous Fisheries Strategy and Implementation Plan – December 2002, Aboriginal people have strong cultural connections with the ocean and coast. Fishing has represented an integral part of their cultural and economic lives for thousands of years. Fishing has been an important source of food, a basis for trade and an important part of cultural and ceremonial life and the act of fishing is itself an important cultural practice and a key part of the cultural identity of Aboriginal fishing communities ([22]).

The project area falls within the traditional lands of the Yuin people (also *Coast Murring*). The Yuin, as a broad group, occupied territory from Cape Howe to the Shoalhaven River and inland to the Great Dividing Range.

Roberts ([24]) notes the ongoing importance of fishing to Aboriginal communities throughout New South Wales, stating that fishing represents a cultural (as opposed to purely subsistence/recreational) activity that 'became a crucial means of survival when other traditional practices were undermined by colonisation' and has remained a largely accessible activity as compared to land-based activities. It is also noted that fishing remains an important activity for Aboriginal people today, despite the changes that have occurred in the environment and regulatory requirements over the intervening period.

It is widely accepted that Aboriginal people have inhabited the Australian landscape for the past 60,000 years. During that time, variations in climatic conditions would have exposed and inundated low lying areas, such as the East Coast of Australia. Prior to 7,000-8,000 years ago there was substantial variation in sea level changing the location of the active coastline. As the sea level gradually rose, land was inundated. Whilst the project area may have been exposed prior to 7,000 years ago and would have been part of a landscape utilised by Aboriginal people, when sea levels rose to around current levels the project area and any archaeological record of human occupation that may have been present were subject to inundation. Over the subsequent 1000s of years, the project area has been subject to ongoing deposition of sand and other materials. The seafloor within the proposed reef deployment area offshore from Bengello beach is currently 42 m underwater, and is flat, sandy, with no significant rock outcrops or features.

It is considered that if any Aboriginal objects remain at the project site due to its use prior to inundation, they are likely to have been buried by coastal processes and will not be impacted by the project.

Though no formal correspondence was received from any of the Aboriginal parties consulted with by Umwelt Pty Ltd, the outcomes of consultation directly from DPI staff with the local Aboriginal Land Councils and consultation from previous directly comparable projects (i.e.

Merimbula offshore artificial reef) have demonstrated that relevant Aboriginal stakeholders (including the South Coast People Native Title Claimants) are generally supportive of the artificial reefs program.

Table 10. Risks and mitigation associated with conflict with areas of spiritual significance/dreaming's

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Heritage	Intermediate	Impacts on submerged Aboriginal deposits	C4	Appropriate site selection identified through consultation and Aboriginal cultural heritage due diligence assessment.	Reduce likelihood	E4
Heritage	Intermediate	Conflict with areas of spiritual significance/dreamings	C4	Appropriate site selection identified through consultation and Aboriginal cultural heritage due diligence assessment.	Reduce likelihood	E4

Historic shipwrecks

A desktop review of shipwrecks known or potentially occurring in the potential deployment region was carried out in December 2020 from the NSW Historic Shipwrecks Database ([25]) (Table 11 and Figure 15 Shipwrecks within the greater study areaFigure 15).

Several historic shipwrecks have been confirmed within the boundaries considered in the constraint's analysis. A total of 8 shipwrecks have been confirmed or believed to be present within the greater study area. The closest known shipwrecks to the proposed artificial reef site are the John Penn, a steamer screw wrecked near Burrewarra Head in 1879, the Rover, a schooner wrecked in Broulee Bay in 1841 and an unidentified dredge year unknown; all located between 4 and 5 km to the north west of the reef site.

Unfound wrecked vessels from within the Batemans area pose a potential deployment concern for the offshore artificial reef as the placement of the reef must not impede upon a historical shipwreck. It is possible that unidentified wrecks or debris could occur on the seabed throughout the area. The multibeam survey carried out by Total Hydrographic provided full coverage information on the nature of the seabed in the proposed reef deployment area. The survey did not identify any anomalies requiring further investigation. A follow up camera survey of the site confirmed the hydroacoustic survey's findings.

Table 11. Submerged shipwrecks known to occur within the Batemans region

Shipwreck	Vessel type	Year wrecked	Wreck location	Latitude	Longitude
Darra	Punt	1906	Clyde River, Buckenboura Junction	-35.69436	150.13021
Dureenbee	Steamer screw	1942	Batemans Bay, north head	-35.72019	150.28304
John Penn	Steamer screw	1879	Broulee Bay, near Burrewarra Head	-35.85214	150.18333
Kameruka	Steamer screw	1897	Moruya, Pedro Reef	-35.93534	150.16265
Monaro	Steamer screw	1879	Moruya, 7mls sth of, at Bingie Bingie Point	-36.01489	150.16678
Rover	Schooner	1841	Broulee Bay	-35.84356	150.18514
Unidentified	Unknown	-	Malabar Creek, north of Moruya River	-35.90231	150.10704
Unidentified	Dredge	-	Broulee Bay	-35.84256	150.19821

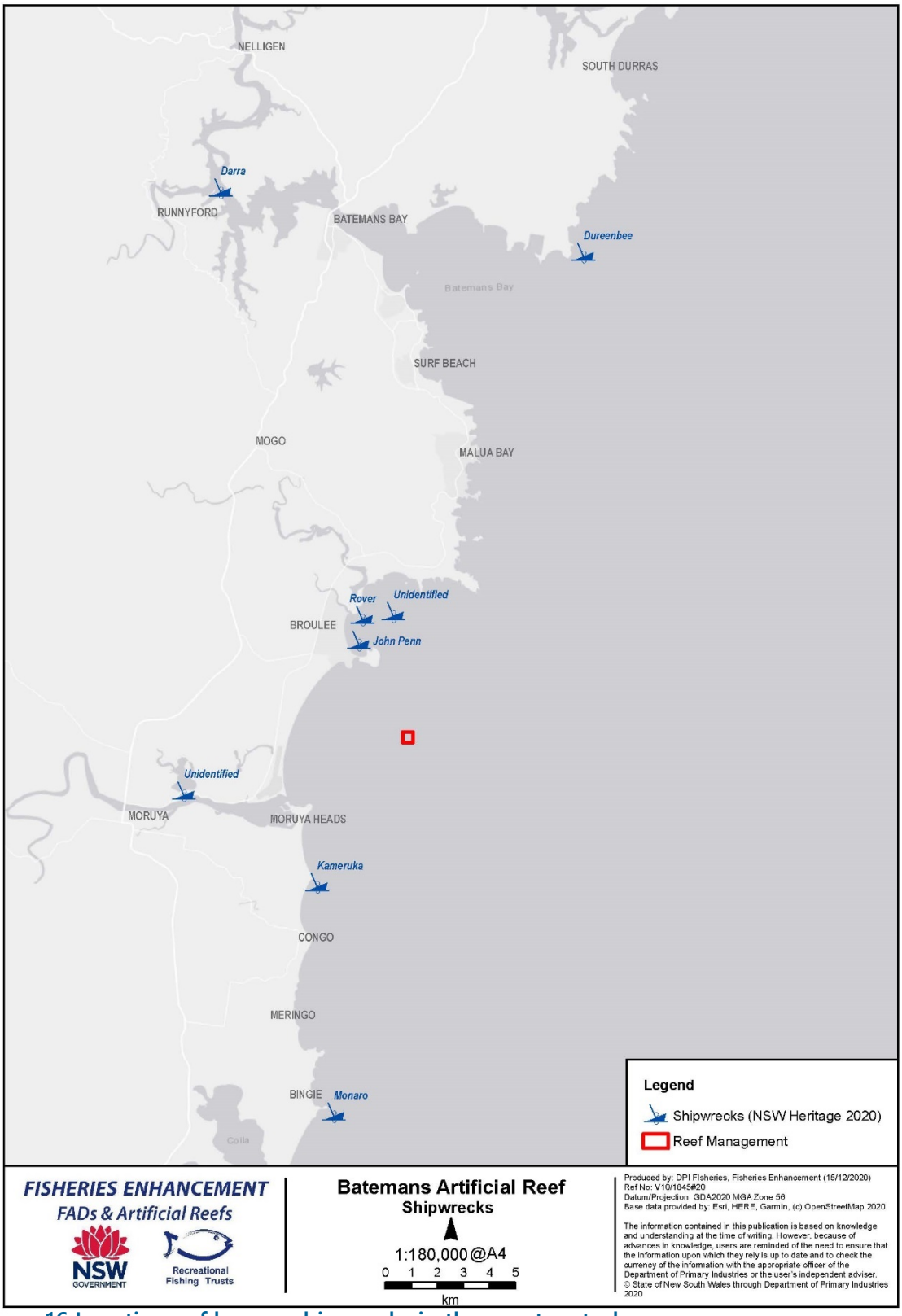


Figure 16 Locations of known shipwrecks in the greater study area

Figure 15 Shipwrecks within the greater study area

5.3.9.3 Fishing

Loss of commercial fishing ground

Commercial trawling is prohibited within the Batemans Marine Park eliminating impacts to this industry. Commercial fisheries likely to be affected by the proposal include the Ocean Trap and Line fisheries. Based on the footprints of offshore artificial reefs built to date in NSW, a maximum loss of up to 328 m^2 of fishing ground is expected. Given the area of similar habitat in the area, this loss is considered to be minimal. This assessment is based on receiving no objections from the commercial fishing sector during the consultation period. Loss of fishing area within the proposed study region is not considered to be a significant issue due to careful site selection with the reef to be located within a Marine Park which extends from Bawley Point to Wallaga Lake (Figure 2).

Table 12. Risks and mitigation associated with loss of commercial fishing grounds

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Recreational and commercial fishing	Local	Loss of commercial fishing ground		Consultation with commercial operators and careful site selection to avoid important areas.	Reduce consequence and likelihood	D4

Conflict between other user groups

Recreational fishing involves a variety of user groups, including sportfishers, gamefishers, spearfishers and charter boat fishing. The proposed offshore artificial reefs are aimed at all recreational fishers. Some overlap between user groups is therefore likely and the potential for conflict would be addressed through suitable management, including a code of practice for all users which is provided as part of the user guidelines for offshore artificial reefs.

In order to minimise potential conflict between user groups, consultation between sectors would be undertaken to resolve any issues of conflict (or similar).

Table 13. Risks and mitigation associated with conflict between user groups

Recreational and commercial fishing	Local	Conflict between other user groups	B4	Education, consultation and adaptive management by implementing controls where applicable. Establish a complaints register to monitor conflict.	Reduce likelihood	C4

Risk offshore artificial reef does not achieve goals

The overall effectiveness and success of the reefs can be assessed only by monitoring of user satisfaction, structural integrity and impacts of the reef on the surrounding environment. If the proposal were shown not to meet its objectives and/or to have significant adverse

impacts on significant components of the marine environment, then appropriate mitigative action would be taken and deployment of future reefs would need to be considered.

For example, if the community is identified to be mono-specific in terms of species richness following the deployment of the reef with a clear dominance of a small suite of species including aggregation of a threatened or protected species, input controls such as gear or seasonal restrictions may require implementation. Depending on the species in question, restrictions may include the exclusion of bottom fishing with live bait and wire trace (aimed at reducing the likelihood of incidental capture of threatened species such as the Greynurse Shark (*C. taurus*) or the temporary closure of the reef during peak spawning periods in-line with key target species (e.g. early winter for inshore Snapper – *Pagrus auratus*).

Periodic inspections over the design life of the reef will be implemented to investigate structural integrity of the reef and to identify any potentially detrimental issues related to the stability of the modules. Inspections will look for any obvious physical damage either from anchor damage or wave action from significant storm events. The first storm event inspection will take place within 6 weeks after the first 1/20 ARI event and 1/50 ARI inspections will take place thereafter. If any of these impacts are identified, further investigations by the reef manufacturer (during the defects liability period) or by an appropriately qualified engineer would be used to identify a suitable mitigative response. Responses may include reef repositioning in the event of module movement.

Angler satisfaction is directly related to the useability and accessibility of the reef and the resultant fish community which takes up residence on the structures. Considerable attention has been applied to the site selection process of the reef to ensure it is located in an area where there is strong support for the reef initiative and where stakeholders (e.g. recreational fishers) can safely access the reef from suitable boating infrastructure (e.g. boat ramps) and where natural reef is limiting. Documenting the development of the fish community and dissemination of these results through meetings, online media (DPI website), social media (Facebook) and popular press (including newspaper and fishing magazines) will ensure stakeholders are well informed as to the development of the reef. Angler satisfaction will be directly related to visitation rates and usage.

Table 14. Risks and mitigation associated with the offshore artificial reef not achieving its goals

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Recreational and commercial fishing	N/A	Risk offshore artificial reef does not achieve goals	D1	Implementation of a monitoring plan, stakeholder feedback	Reduce likelihood and consequence	E4

Gear hook-up

Potential safety issues which could occur as a result of recreational or commercial fishing in the direct study area include, but are not limited to, gear hook-up and collision. The risk of gear hook-up is considered relatively likely, particularly for recreational fishing gear, and could result in detrimental impacts to species vulnerable to entanglement or injury from fishing line and hooks. Vessels may foul their anchors on the offshore artificial reef. This may cause loss of the anchor and anchor line, and possible damage to the reef. In some

circumstances, the loss of an anchor may cause consequential impacts on safety such as a disabled vessel drifting towards the coast.

Commercial trawling is excluded in the area. Additionally, fishers will be provided with a chart describing the exact location of each of the reef modules, including DGPS coordinates. However, a potential risk remains of gear hook-up on the reef units, which could result in damage to the reef, fishing vessel and safety implications for the vessel. The Australian Hydrographic Office will be notified of the final offshore artificial reef locations, so that a 'Notice to Mariners' can be issued, and the official hydrographic charts can be amended. NSW Maritime will also be notified of the final reef location so that relevant publications and maps are amended to show the location of the offshore artificial reef.

Provided commercial fishing businesses which operate in the region are made aware of the fishing reef location, follow a code of conduct and that structures are marked on the relevant AUS Chart, this potential risk is considered to be low.

Table 15. Risks and mitigation associated with gear hook-up

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Commercial Fishing	Local	Gear hook-up (commercial)	C2	Consultation, education, notice to mariners. Reef to be marked on nautical charts and NSW Maritime notified for inclusion in relevant publications. Commercial operators to be consulted and notified of final position.	Reduce likelihood	D2
Recreational Fishing	Local	Gear hook-up (recreational)	A4	Education (user guidelines), monitor, hydrographic charts. Removal of debris when required.	Reduce consequence	A5

Impacts on commercial fish stocks

It is considered highly unlikely that the proposed offshore artificial reef would contribute to a reduction in commercially fished populations in the wider area. It is possible that species most vulnerable to fishing mortality could be affected within the direct reef deployment area, but this is unlikely to have impacts at a population level. The positive impacts on secondary production of the Sydney offshore artificial reef have been demonstrated by ecological modelling ([31]).

Table 16. Risks and mitigation associated with impacts on commercial fish stocks

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Recreational and Commercial Fishing	Regional	Impacts on commercial fish stocks	E5	Accept	Accept	E5

Injury from boat strike or drowning (spearfishing)

Given the depth range it is not anticipated that freedivers and spearfishers will utilise the Batemans artificial reef. The majority of spearfishers in the area frequent the many headlands in appropriate zones of the Marine Park. There is however, a risk that spearfishers/freedivers would attempt to dive to depths beyond their limits.

The activity of SCUBA diving in the vicinity of the offshore artificial reef is strongly discouraged in the User Guidelines and code of conduct because of the potential safety risks and conflict with recreational and commercial fishing activities.

Safety issues including, but not limited to, the risk of gear fouling and risks to spearfishers cannot be mitigated but can be managed through education. The User Guidelines would aim to provide the best possible information to inform different user groups on best practice and safety within the reef area.

Table 17. Risks and mitigation associated with injury or drowning (spearfishing)

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Navigation and safety	Local	Injury or drowning (spearfishing)	C1	Monitoring usage, education and awareness strategies.	Accept	C1

5.3.10 **Invasive marine pests and diseases**

There is potential for the spread of marine pests or diseases during the project with the key vector/pathway being the transport of vessels or equipment between ports. In particular vessel ballast water and biofouling of hulls or vessel niche areas, and the movement of vessels or infrastructure from other locations (with different risk profiles), can present translocation risk. In addition, the reef modules will be newly constructed and free from any pests and disease. There is a possibility of transferring larvae or aquatic pathogens/disease agents between ports in ballast water, however this can be mitigated by exchanging ballast water at sea or by using a ballast water treatment system if available.

The proposed reef structures could provide a substratum or habitat suitable for invasive marine pests (also referred to as 'introduced', 'alien' or 'non-indigenous' species). Invasive marine pests are defined as organisms (usually transported by humans) which successfully establish themselves and then overcome or displace otherwise intact, pre-existing native ecosystems ([32]). Although there is evidence that many exotic species establish populations more easily on artificial structures [33], the risk of increased potential for pest and disease issues associated with installation of the offshore artificial reef is considered to be small due

to the isolated location of the structures in the open ocean rather than in estuarine environments as noted by the aforementioned study. Similarly, the risk to threatened species from invasive marine pests associated with the reef is considered very small.

Comparison of video observations over a three-month period following deployment of the Sydney OAR showed that the majority of the structure had been covered by encrusting organisms, including serpulid polychaetes, barnacles, filamentous algae, bryozoans and hydroids. No introduced marine pests were observed ([34]). Likewise no marine pests have been observed on the subsequent eight artificial reefs installed by DPI between Merimbula and Tweed Heads.

Ships' ballast water is a major vector for introduced species. Fouling of ships' hulls, aquaculture, the aquarium industry and bait industries are also potential vectors. Major ports and estuaries are potential hotspots for invasive species. Whilst the proposed artificial reef site is potentially at risk from colonisation by invasive marine pests, the scale of the potential impact is small and would be unlikely to have any significant impact on the marine environment.

The reef structures will be monitored for colonisation by marine pests. In the event that invasive (introduced) marine pests are identified on the structures, the extent of the pest incursions will be defined noting affected area, species type, abundance and potential for further spread. Requirements for removal of marine pests (according to Biosecurity NSW) would depend on the extent and nature of the incursion but is likely to involve manual removal by divers in the first instance.

Table 18. Risks and mitigation associated with invasive marine pests

Environmental Aspect	Scale	Risk description	Risk Level	Mitigative measure	Treatment type	Risk Level
Invasive marine pests and diseases	Regional	Spread of invasive marine pests or aquatic disease agents during transport and installation	C3	Ensure equipment and vessels used during transport and installations are clear of all biofouling before making way to Batemans reef site. Release and exchange ballast water or other storage/water tanks (if used) from vessel/s at sea, or treat using a ballast water treatment system, prior to movement between regions between ports of different biosecurity risk. Move directly to and from the port or berth and the work site to reduce the uptake of any marine pest or disease agent.	Reduce likelihood	D3
Invasive Marine Pests	Local	Colonisation by invasive (noxious) marine pests	C3	Follow Biosecurity NSW advice if marine pests are identified.	Reduce consequence	C4

5.3.11 **Endangered, rare or migratory species**

Threatened and protected species, populations and endangered ecological communities

A list of all threatened and protected species, populations and endangered ecological communities that have previously been recorded within the search areas are provided in Table 3. It is important to note that data in the searches comes from a number of different sources, may contain errors and omissions and should therefore be treated as indicative only.

Only threatened species (from the initial search) that were known or considered likely to occur in the wider Batemans region (based on general species distribution databases) and/or known to utilise habitat in the area, were considered for further Assessment of Significance. These species were assessed according to EES and DPI threatened species assessment guidelines ([19, 20]). It should be noted that this does not include 'protected' or 'conservation dependent' species, which do not require an Assessment of Significance. All seabirds were assessed collectively.

Assessments of significance (State)

Overall, 3 species of fish, 3 species of marine turtle, 4 species of cetacean and 2 pinnipeds were assessed according to EES and DPI threatened species assessment guidelines.

Fish

The proposal was not considered to have a significant impact on any of the species identified in Table 3, hence Species Impact Statements (SIS) were not required.

Management of fishing related activities in NSW includes the implementation of a range of bag and size limits aimed at ensuring fisheries resources are managed in a consistent and sustainable manner state-wide. Current Fisheries regulations make provisions for the exclusion of the harming or taking of protected or threatened species. Proper management of these regulations by compliance activities in the far South Coast region will ensure these regulations are adhered to by fishers. It is therefore unlikely that the artificial reef would pose an inflated threat to listed threatened and protected species.

Fish species considered most at risk from fishing related activities such as incidental capture including the Great White Shark (*Carcharodon carcharias*) and Greynurse Shark (*C. taurus*) are highly migratory and the transient nature of these species means that although they may pass in the vicinity of the reef they are unlikely to remain on the reef long enough to be vulnerable to the potential fishing related impacts identified. The reporting register for threatened and protected species provided to the DPI Threatened Species Unit will ensure assessment of numbers of threatened species are evaluated independently outside of the DPI Fisheries and Aquaculture Management group. In addition, any serious incidents involving threatened and protected seabird, mammal or reptile species will be reported to the NSW Environment, Energy and Science (EES).

The Greynurse Shark is known to aggregate at discrete locations within the South Coast area. The nearest aggregation area to the study area is the Tollgate Islands, 15 km north-north-west of the proposed artificial reef deployment site (Figure 2). The Tollgate Islands are afforded the highest level of protection under the *Marine Estate Management Act* 2014 and are zoned sanctuary within the Batemans Marine Park zoning plan with no fishing is permitted in this zone. Given the distance from known aggregation areas, the proposal would not directly affect Greynurse Shark habitat. It is, however, possible that individuals could

occasionally forage within the direct reef area. Although this species is most frequently sighted in or near sand-bottomed gutters or rocky caves, Greynurse Sharks are migratory along the NSW coast and may occasionally forage outside of aggregation sites over open sandy habitat ([37]). This considered, it is possible that individual Greynurse Shark could be at risk of incidental capture as a result of the proposal. Even if the sharks are returned to the water, capture related injuries can lead to early mortality due to infection and/or by affecting feeding efficiency. It is unlikely that potential impacts associated with the reef would affect the life cycle of a viable local population to such an extent that the species is placed at the risk of extinction. Furthermore, providing that fishing activities in the direct reef area are properly managed and monitored, potential risks would be minimised or addressed before they become problematic.

There were no official records available for Scalloped Hammerhead Shark (*Sphyrna lewini*) or Great Hammerhead Shark (*S. mokarran*) south of Sydney. It is possible that the artificial reef site could represent foraging habitat for these species on occasions, however, based on an absence of records south of Sydney, it is considered highly unlikely that the artificial reef would disrupt the species' life cycle or place any local population at risk of extinction.

The Black Rockcod (*Epinephelus daemelii*) inhabits coastal and estuarine rocky reefs throughout the NSW coastline. While adult Black Rockcod are territorial and unlikely to utilise the new artificial reef habitat, the pelagic dispersal of eggs and larvae may lead to juveniles recruiting on the reef structures and there is a subsequent risk of incidental capture of individuals. However, it is considered unlikely that the potential impacts associated with the artificial reef would affect a viable population to the extent that it would be placed at risk of extinction.

The Offshore Artificial Reef User Guide contains information on how to identify and report sightings of threatened or protected species and how to properly release unwanted fish species safely and with as little impact on the individual as possible.

Marine Turtles

For the species identified, the proposal was not considered to have a significant impact such that a Species Impact Statement (SIS) would be required. This was mainly due to the transient nature of these species and absence of important nesting, mating or feeding areas within the wider study area.

Cetaceans

The proposal was not considered to have a significant impact on any species of cetacean, such that a SIS would be required. This was mainly due to the transient nature of the species and the absence of important nesting, mating, feeding or resting areas within the wider study area.

Pinnipeds

Although seals forage within the study area, the proposal was not considered to have a significant impact such that a SIS would be necessary. It is considered highly unlikely that the artificial reef would disrupt the species' life cycle or place any local population at risk of extinction.

Seabirds

The proposal was not considered to have a significant impact on any species of seabird, such that a SIS would be necessary.

Matters of national environmental significance (Commonwealth legislation)

Listed Threatened and Protected Species

Overall, 7 species of fish, 5 species of marine turtle, 11 species of cetacean and 1 pinniped were assessed individually under the EPBC Act. Note that threatened species assessed under the EPBC Act include only those listed as 'extinct in the wild', 'critically endangered', 'endangered', 'vulnerable' or 'migratory'.

Note that a species may be classed as both a 'cetacean' and a 'migratory species' in addition to its protected status, e.g. the Southern Right Whale (*Eubalaena australis*) which is listed as 'endangered' but is also protected as a 'migratory cetacean'.

Only threatened species that were known or considered likely to occur in the wider study area (on the basis of their geographical distributions) and/or known to utilise habitat in the study area, were considered for further impact assessment. I was concluded that provided the artificial reef is properly managed, monitored and mitigation measures implemented, the artificial reef proposal is unlikely to have any detrimental impacts on listed threatened and protected species.

No critically endangered or endangered ecological communities are known to occur within the proposed study area.

The Commonwealth Marine Area

The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters. The Commonwealth marine area stretches from 3–200 nautical miles from the coast.

The proposed Batemans artificial reef is proposed to be located within State waters (Figure 2).

Key threatening processes

The following Key Threatening Processes (KTPs) have been identified as potentially relevant to the proposal:

- Entanglement or ingestion of anthropogenic debris in marine and estuarine environments (BC Act); and
- Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris (EPBC Act).
- Hook and line fishing in areas important for the survival of threatened fish species (FM Act).

Entanglement or Ingestion of Anthropogenic Debris in Marine and Estuarine Environments (BC Act)

The NSW Scientific Committee has declared entanglement in or ingestion of anthropogenic debris in marine and estuarine environments to be a 'key threatening process' in NSW. Marine debris is mostly comprised of fishing gear, packaging materials, convenience items and raw plastics. The major sources of marine debris are from ship waste, recreational activities, aquaculture industry and both urban and rural discharges into rivers, estuaries and

coastal areas ([38]). Marine debris, particularly plastics, can become entangled around or be ingested by marine animals. This can lead to a number of lethal or detrimental impacts such as:

- strangulation;
- increased drag;
- potential poisoning by polychlorinated biphenyls (PCBs);
- blockage and/or perforation of an individual's digestive system;
- wounds caused by line or net and subsequent infection; and
- gastric impaction by plastic bodies.

Even sub-lethal effects of entanglement or ingestion of marine debris may reduce an individual's fitness and ability to successfully reproduce, catch prey and avoid predation. Records kept by the NSW National Parks & Wildlife Service and Taronga Zoo databases show that entanglement in monofilament line, presence of hooks in the mouth and/or gut, net/line wounds and gastric impaction of plastic bodies are the main reasons for injury or mortality in marine wildlife ([39]).

A number of threatened marine species (including marine turtles, seals and cetaceans) and a number of marine birds have been found to have ingested or become entangled in marine debris.

Injury and Fatality to Vertebrate Marine Life Caused by Ingestion Of, or Entanglement In, Harmful Marine Debris (EPBC Act)

This KTP is similar to the above KTP, but applies to vertebrate marine life protected under Commonwealth legislation ([39]). Department of the Environment has developed a Threat Abatement Plan to address the impacts of this KTP ([40]).

Hook and Line Fishing in Areas Important for the Survival of Threatened Fish Species (FM Act)

Hook and line fishing refers to the use of a combination of lines and hooks for catching fish, including lines composed of microfilament, wire and cord, with attached lures, hooks and jigs. Hand-lines, set lines, rod and reel fishing, trolling, lure fishing and fly fishing are all included in the activities identified as a key threatening process. This definition includes catch and release, not just the 'taking' of fish ([41]). Areas that are used for feeding and breeding are considered important for the survival of a threatened species and with the exception of Greynurse Shark, such areas are poorly defined, if at all, for the majority of threatened species considered in these assessments. Following identification, some of these areas may be declared as critical habitat, such as the Greynurse Shark aggregation sites along the NSW coast. The Greynurse Shark and Black Rockcod are considered particularly vulnerable to this KTP ([41]). Even when accidentally captured, hooks caught in fishes' mouths can result in damage that can impact on feeding behaviour and success. The effects of fish hooks can be more serious over a longer time if retained in the mouth, throat and stomach of fishes and sharks, and ultimately can lead to death ([41]). It is recognised that listing all hook and line fishing throughout NSW waters as a KTP would be unpractical and unwarranted. However, where known aggregation sites, spawning areas, important juvenile habitats and feeding areas are concerned, activities that could kill or adversely affect threatened fish species should be considered a threatening process and managed accordingly. A threat abatement plan is yet to be developed for this KTP.

The majority of impacts identified are relevant to threatened or protected species only if they were to move and/or recruit into the direct study area. Threatened or protected species, populations or endangered ecological communities that are most likely to be affected by the deployment of the reef are those that would compete directly with the target fish or crustaceans for the same food or the newly created habitat. Following deployment of the reef, it is proposed for any incidents, recorded or reported interactions with threatened or protected species to be reported to the DPI Threatened Species Unit for further assessment as detailed in this plan. A series of trigger points relating to threatened species has been established as part of the environmental management of the reef. As such, if aggregation of any given threatened species or a key non-threatened species within the reef area increases by an amount deemed 'of concern' by the DPI Threatened Species Unit, this may require a modification to the management of the reef. These measures are deemed to potentially reduce the consequences of an aggregation of threatened species from a moderate risk to a low risk.

The DPI will also provide education on threatened and protected species' identification, best practice for returning incidentally captured fish, minimising risks to seabirds and boating restrictions in the vicinity of large cetaceans. This educational information will be published as part the offshore artificial reef 'User Guidelines'.

Table 19. Risk assessment of threatened and protected species considered in the risk assessment

Environmental Aspect	Scale	Risk Description	Risk Level	Mitigative Measure	Treatment Type	Risk Level
Threatened and Protected Species						
Fish	Local	Incidental capture	C3	Reporting and education. Angler education on best practice and fish release guidelines. Report incidences. Monitor and manage/regulate as appropriate (seasonal closures/gear types etc.).	Accept	C3
	Local	Aggregation of threatened or protected species	C2	Reporting trigger points. Utilising input controls as required.	Reduce likelihood and consequence	D3
	Regional	Interruption of movement corridors (e.g. GNS)	C4	Reporting trigger points. Utilising input controls as required.	Accept	C4
	Sub-Local	Loss of habitat	E3	Careful selection of habitat type for deployment location.	Accept	E3
Marine Turtles	Local	Incidental capture/entanglement from marine debris	C3	Reporting and education	Accept	C3

	Local	Increased risk of boat strike	C3	Education	Accept	C3
	Intermediate	Increased risk of acoustic disturbance	C4	Accept	Accept	C4
	Large	Interruption of movement corridors	E5	Accept	Accept	E5
	Intermediate	Loss of habitat	E4	Accept	Accept	E4
Cetaceans	Local	Increased risk of boat strike	C3	Education regarding acceptable approach distances to cetaceans via national guidelines for whale and dolphin watching. Reporting and education of existing regulations.	Reduce likelihood	D3
	Intermediate	Increased risk of acoustic disturbance from boat traffic	C4	Follow national guidelines for whale and dolphin watching.	Accept	C4
	Large	Interruption of movement corridors	D5	Accept	Accept	D5
Pinnipeds and Sirenians	Sub-Local	Incidental capture/entanglement from marine debris	C3	Report marine debris and remove as per Long Term Management Plan	Reduce likelihood	D3
	Local	Boat strike (sirenians only)	E3	Accept	Accept	E3
	Intermediate	Increased risk of acoustic disturbance from boat traffic	D4	Accept	Accept	D4
	Large	Interruption of movement corridors	E5	Accept	Accept	E5
Seabirds	Local	Incidental capture	D3	Reporting and education. Encourage reporting to WIRES.	Accept	D3
KTPs	Intermediate	Harm from marine debris and pollution (KTPs)	C3	Monitor for fouled gear and remove as necessary. Monitoring, reporting and education, adaptive management.	Reduce consequence	D3

5.3.12 **Areas of conservation significance**

Nature reserves are areas of predominantly untouched land in a natural condition and are considered to have high conservation value. Their primary purpose is to protect and conserve outstanding, unique or representative ecosystems, native plant and animal species or natural phenomena ([42]). Nature reserves are generally terrestrial, but there are some with associated marine components.

National parks are areas of land protected due to their unspoilt landscapes, outstanding or representative ecosystems, native plants and animals, and places of natural or cultural significance. National parks provide opportunities for public nature appreciation, well-being, enjoyment and scientific research in addition to their role in conservation [43].

Aquatic reserves are marine areas managed to conserve marine biodiversity and support marine science, recreation and education. The type of fishing activities that are allowed in an aquatic reserve depend on the biodiversity values of the individual reserve. All aquatic reserves provide for boating, SCUBA diving, snorkelling and swimming. Fishing is permitted in some aquatic reserves as long as bait is not collected. In other aquatic reserves, however, fishing is prohibited in all or part of the reserve to help conserve all types of marine life in that area.

Marine Parks are areas set aside to conserve biodiversity and ecosystem integrity. Marine Parks in NSW have spatial management zones which manage fishing and other activities to zoned areas within the park. Fishing is permitted within general use zones of the Batemans Marine Park. NSW DPI also has a policy in place to provide for the installation of artificial reefs within general use zones.

Historic sites or heritage places are areas of cultural significance which protect and promote cultural heritage values [44]. They may be an area of significance to Aboriginal culture, include areas associated with a person or event in history, or include areas containing a building, place, feature, or landscape of cultural significance.

For the purpose of this assessment, areas of conservation significance include areas declared as critical habitats under the NSW FM and BC Acts and Marine Protected Areas (which include Marine Parks, Aquatic Reserves and Nature Reserves). With the exception of the proposed site residing within the boundaries of Batemans Marine Park (see section 1) and the Greynurse Shark critical habitat at discussed in sections 4.3 and 5.3.11, no other areas of conservation significance are present within the study area.

5.3.13 **Ocean waves and currents**

Water movements in the proposed offshore artificial reef deployment area may be caused by a variety of physical processes, including:

- tides;
- winds;
- density flows;
- coastal trapped waves;
- East Australian Current; and
- nearshore wave processes.

Measured wave data collected from the waverider buoy at Batemans Bay (Figure 17) shows the significant wave height vs wave direction rose. The wave rose shows that the dominant wave direction is from the south to south-east sector. This direction is dominant both in terms of the highest wave heights and the longest wave periods originating from the south-south-east direction.

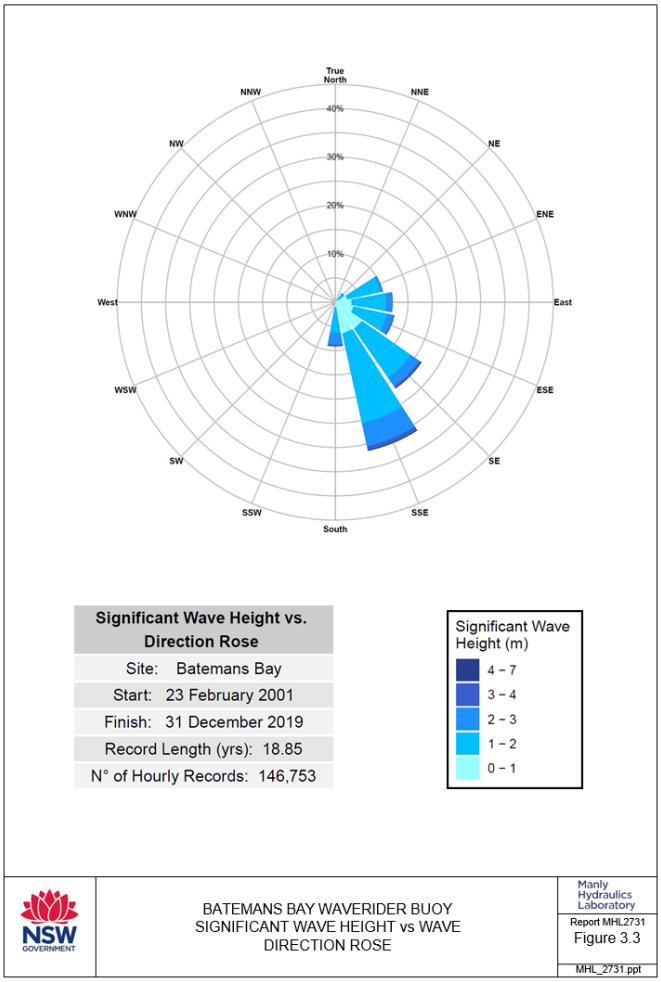


Figure 17 Wave rose of Batemans Bay offshore wave dataset

Storm events with a return interval of 100 years are expected to produce a significant wave height offshore of Batemans of 7.8 m (Hs) (Table 20). This parameter is to be taken into consideration as a primary design specification for the reef and its modules. The highest maximum significant wave height recorded at the Batemans Bay buoy is 7.19 m. This storm event occurred on 31 August 1996 when the Waverider buoy recorded an individual maximum wave height (Hmax) of 10.1 m. At this time, the Waverider buoy was an earlier non-directional model and hence no definitive wave direction information is available.

Table 20 Batemans Bay Waverider buoy extreme wave analysis results. Source: MHL 2020

ARI (yr)	Extreme Wave Analysis Results per Durations									
	1 hour		3 hours		6 hours		12 hours		24 hours	
	Hsig (m)	CI (±m)	Hsig (m)	CI (±m)	Hsig (m)	CI (±m)	Hsig (m)	CI (±m)	Hsig (m)	CI (±m)
1	4.9	0.2	4.5	0.2	4.3	0.1	4.0	0.1	3.4	0.1
2	5.4	0.2	4.9	0.2	4.7	0.2	4.3	0.2	3.7	0.2
5	5.9	0.3	5.4	0.2	5.1	0.2	4.8	0.2	4.1	0.2
10	6.4	0.3	5.8	0.3	5.5	0.3	5.1	0.3	4.4	0.3
20	6.8	0.3	6.2	0.3	5.8	0.3	5.4	0.3	4.6	0.3
50	7.4	0.4	6.7	0.4	6.2	0.4	5.8	0.4	5.0	0.4
100	7.8	0.4	7.0	0.4	6.6	0.4	6.1	0.4	5.2	0.5

Table 21. Risks and mitigation associated with inshore wave climate and change to beach erosion/deposition

Environmental Aspect	Scale	Risk Description	Initial Risk Level	Mitigative Measure	reatment Type	Residual Risk Level
Nearshore coastal	Large	Inshore wave climate	C3	Detailed coastal processes assessment to be undertaken. Avoid placement where there is risk of impacts to coastal processes.	Reduce likelihood and consequence	E5
Nearshore coastal	Large	Change to beach erosion/deposition	C3	Detailed coastal processes assessment to be undertaken. Avoid placement where there is risk of impacts to coastal processes.	Reduce likelihood and consequence	E5

Sediment transport is caused by the water particle motions of waves and currents that lead to a shear stress on the seabed sediment particles. Generally, sediment motion commences when the seabed shear stress exceeds a threshold value, which depends on particle size and density. At shoreline locations, sediment transport may be alongshore and/or onshore/offshore. Where waves break obliquely to the shoreline, a longshore current may cause longshore transport. Offshore transport normally occurs during a storm, with a longer-term onshore transport following storm abatement. The majority of sediment transport along the NSW coast is inshore from the depths under consideration in the current artificial reef proposal. During storms with relatively large waves, beach sand moves offshore to form bars.

This process typically occurs over a period of hours to days. When extended periods of calmer waves occur, the material held in these bars migrates onshore to re-build the beach. Depending on the magnitude of the preceding storm, this beach building process can occur over a time scale of days to years.

The primary driving mechanism for currents outside the Bengello Beach embayment are large scale (100 to 300 km) deep ocean eddies that are generated by the separation of the East Australian Current (EAC) from the coastline. Cyclonic (clockwise current movement) eddies are characterised by cold, dense cores with a depressed surface level relative to the surrounding waters while anticyclonic eddies have warm, elevated cores. Cyclonic eddies tend to increase stratification at the core (and vice-versa for anti-cyclonic eddies), however this phenomena is probably not a factor at the coast, which is generally at the extremity of such eddies, and interactions of the current with the coastline dominate. The EAC typically runs at 0.1 to 0.6 m/s and can also be affected by local winds that seasonally create upwelling of deep nutrient rich colder waters onto the coast.

The relative scale and influence of local catchment flows, tidal currents, wind, storm waves and the EAC on the proposed artificial reef deployment site can only be determined by careful measurement of the relevant physical parameters and modelling with an appropriate hydrodynamic and water quality model that has been adequately validated with these data.

For the purposes of this coastal processes investigation results from the Integrated Marine Observing System (IMOS) project have been reviewed. IMOS is one of the national research infrastructure capabilities currently supported under the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS). Since 2006, IMOS has been routinely operating a wide range of observing equipment throughout Australia's coastal and open oceans including a network of current meters at different depths in various locations.

Figure 18 displays an example of the IMOS sea current and sea surface temperature charts corresponding to the BMP070 deployment site which is located north of Montague Island near Narooma in a water depth of 70 m. This monitoring station, which has been collecting continuous currents data through the full water column since 2015, indicates maximum southbound currents of approximately 1 m/s. The BMP070 site is located approximately 40 km south of the proposed artificial reef location and it is considered that ocean currents would be off a similar magnitude at the two locations.

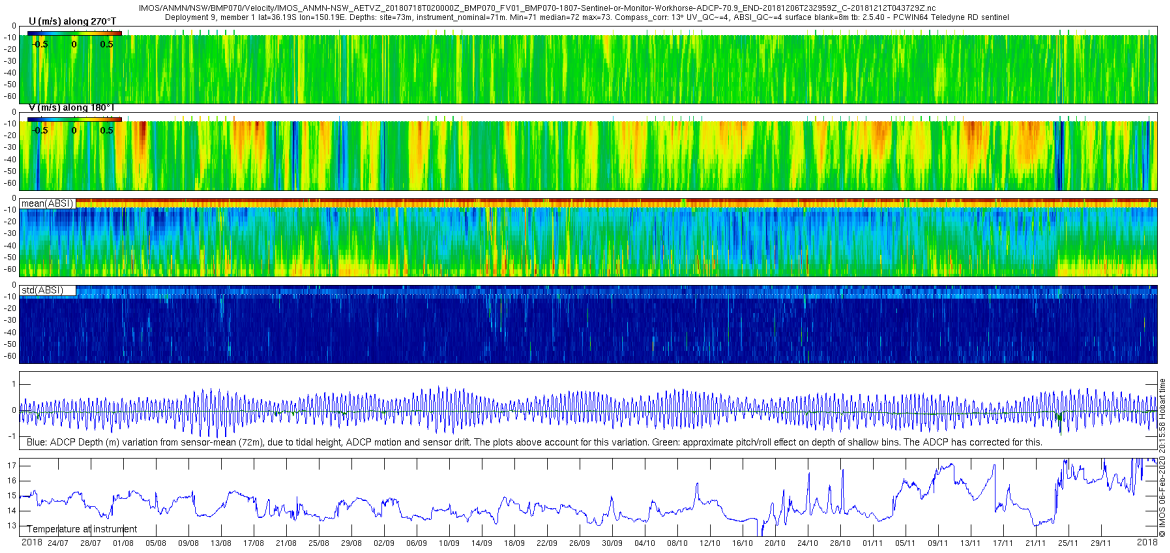


Figure 18 Example of ocean current and sea temperature for the IMOS BMP070 station Source: IMOS Data Portal

Another data source for ocean current and sea surface temperature for the Tasman Sea off the NSW south coast is daily regional charts available for download from the IMOS data portal. The charts are based on numerical modelling with dense data integration to provide ocean currents and surface temperatures across the Tasman Sea. It should be noted that landward boundaries are difficult areas for these types of numerical models to accurately characterise and they are truncated to approximately 10 km off the coast. Nevertheless, the charts are valuable, allowing an assessment of the ocean currents and sea surface temperatures offshore from the NSW south coast. The IMOS South Tasman Sea current and sea surface temperature charts presented in Figure 19 indicate low south surface currents offshore from the Batemans Bay coastline during the major June 2016 storm event. The sea surface temperature on the IMOS charts also show a large eddy of warmer water that appears to have separated from a tongue of EAC waters well offshore from Jervis Bay.

The East Australia Current (EAC) is a body of warm Coral Sea water that flows down the east Australian coast usually offshore from the continental shelf. From time to time eddies break free from the EAC, travelling south, sometimes as far as Tasmania. Although it is known that these eddies sometimes encroach upon the continental shelf and effect nearshore currents, the precise nature of this effect is unknown.

The literature review undertaken for this investigation suggested that no numerical modelling of currents in the vicinity of the proposed location of the Batemans artificial reef has been undertaken. However, previous field investigations can provide some information about the magnitude of currents off the Batemans Bay to Moruya coastline. During field data collection for the investigation of the Batemans Bay ocean outfall by MHL in 1988, local currents were measured ranged from 0.04 m/s to 0.11 m/s in a shallow area close to the shoreline. Similar results when obtained during a field campaign for another outfall near Tomakin, where currents of 0.04 m/s to 0.13 m/s were recorded by MHL in 2008. In 2018 MHL also found the same magnitude of surface currents near the shoreline.

As discussed previously, based on current meter measurements by the IMOS program, ocean currents in the deeper waters off Narooma at the BMP070 mooring site typically range from 0.4 to 0.6 m/s with maximum velocities of up to 1 m/s. However, in the shallower waters in

the vicinity of the proposed artificial reef location, it is expected that the currents would be less, typically in the range of 0.2 to 0.5 m/s. It is considered that the faster current velocities in the order of 1 m/s observed at IMOS BMP070 mooring location near Narooma would not be as great in the shallower water depths at the artificial reef location.

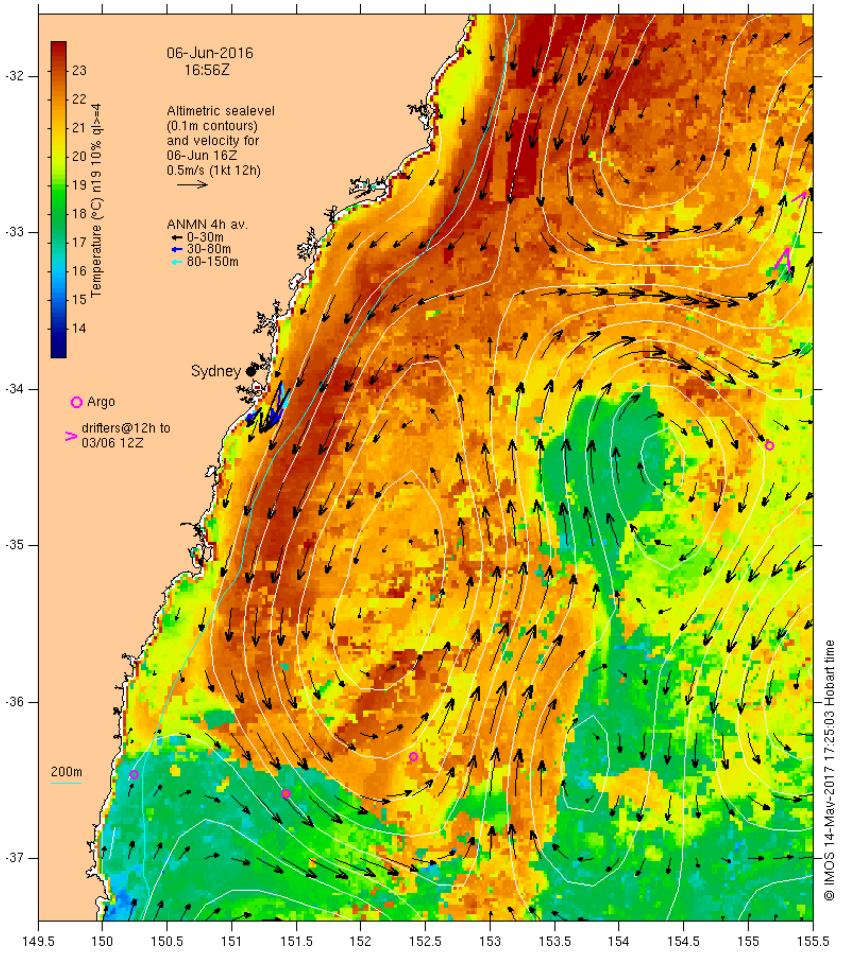


Figure 19 Tasman Sea currents and sea temperatures for 6 June 2016

Table 22. Risks and mitigation associated with local currents and sediment transport causing local scouring/deposition around units

Environmental Aspect	Scale	Risk Description	Initial Risk Level	Mitigative Measure	Treatment Type	Residual Risk Level
Local seabed	Sub-Local	Local scouring/deposition around units	B3	Detailed coastal processes assessment to be undertaken. Avoid placement where there is risk of impacts to coastal processes. Consider alternative module arrangement options to further reduce this risk.	Reduce consequence	B5

The coastal processes report (Technical report B) concluded that the proposed installation of an offshore artificial reef comprised of steel towers is considered unlikely to have any significant detrimental impacts on coastal processes at either the immediate deployment site or within the Bengello Beach embayment more broadly.

The coastal processes investigation conducted by MHL identified the following results:

- The proposed reef installation is expected to have little to no impact on the wave climate at the site or within the bay more broadly, with no subsequent expected impact on coastal processes or sediment transport at the nearby shoreline and beaches.
- The proposed reef installation is expected to have a negligible impact on currents near Bengello Beach, with only minor localised impacts expected to occur in the immediate vicinity of the base of the reef structures.

MHL also prepared conservative values for oceanographic forces relevant to reef stability. These values formed reef module design constraints and were included in the scope of requirements for the reef design and are shown in Table 23.

Table 23 - Oceanographic parameters for reef modules design constraints

Design Parameter	Design Value	Comments
Waves		
Significant Wave Height (Hsig)	6.9 m	Equivalent deepwater Hsig = 7.8 m. Equates to a 100 - year ARI for a storm duration of 1 hour
Maximum Wave Height (m)	12.0 m	Expected maximum wave height associated with a 6.7 m significant wave height
Wave Period (TP1)	12.3 s	Typical wave period during major storm event
Wavelength	203 m	Wavelength for 12.3 s wave period in 42 m water depth
Currents		
Wave Orbital Current Velocity	1.4 m/s	Orbital current velocity at seabed 42 m water depth
East Australian Current Velocity	0.7 m/s	Maximum East Australian Current velocities at IMOS Narooma 70 m depth mooring 1 m/s. Lower velocities expected at artificial reef depth of 45 m.
Combined current velocity	2.1 m/s	Combined conservative moderate storm waves orbital velocity and East Australian Current

5.3.14 **Recreational vessels**

Table 24 Risks and mitigation associated with vessel - fauna interactions

Environmental Aspect	Scale	Risk Description	Initial Risk Level	Mitigative Measure	Treatment Type	Residual Risk Level
Vessel / Fauna impact	Sub-Local	Vessel strike while fishing the reef	E4	Vessels anchored, drifting or trolling at idle speed. Education through guidelines Approach distances for whale and dolphin watching	Accept	E4
Vessel / Fauna impact	Intermediate	Vessel strike while transiting to and from the reef	C3	Education regarding acceptable approach distances to cetaceans via national guidelines for whale and dolphin watching. Reporting and education of existing regulations. No greater risk considered than any other marine based vessel activity.	Accept	C3
Noise disturbance to marine fauna	Intermediate	Increased risk of acoustic disturbance from boat traffic	C4	Follow national guidelines for whale and dolphin watching.	Accept	C4

5.3.15 **Recreational divers**

Table 25 Risks and mitigation associated with a failure to observe DPI position on diver access

Environmental Aspect	Scale	Risk Description	Initial Risk Level	Mitigative Measure	Treatment Type	Residual Risk Level
Human safety	Sub-Local	Diver use access and entrapment	C1	NSW DPI does not support diving on artificial reefs. Education. Depth of the project site is 42m exceeding “advanced open water diver certification” Diving depth ranges for recreational diving over 30m require specialist/technical training.	Reduce likelihood and consequence	D3

5.3.16 **Summary of the reasons for selection of proposed site**

A detailed investigation of existing information and database searches relating to the study area has shown that there are several critical constraints which would preclude the deployment of an offshore artificial reef at depths of 30-50 m over a large proportion of the study area offshore of the Batemans region. These included the Batemans Marine Park zoning plan, the preferred depth requirements and proximity to natural reef substratum.

Following the review of existing information and mapping of key characteristics of the study area and surrounds, constraints analysis identified a potential artificial reef deployment area offshore of Bengello Beach between Broulee Island and Moruya Heads (Figure 20 Potential deployment area identified through constraints analysisFigure 20). This is the area where, based on existing information, reef deployment would be suitable and unlikely to conflict with the physical, biological and regulatory constraints investigated. The analysis was limited to using the information available and was subject to revision once further data or field investigations of the seabed and consultation had been undertaken.

A desktop review of known historic ship wrecks in the region revealed wrecks in the vicinity of Broulee Island but not in the bay area between Broulee Island and Moruya Heads. There were no active mining or exploration tenements, ocean outfalls, critical infrastructure or areas of conservation significance identified within the potential deployment area. A swath acoustic survey of the potential deployment area was completed and bathymetry and habitat type determined. A 500 m buffer was applied from the natural reef. Additional investigations including an Aboriginal cultural heritage due diligence assessment and a coastal processes study further confirmed the suitability of the potential deployment area.

Depths of 40 to 60 m were considered for the project. A suitable reef management area was identified covering depths of 40-44 metres with a centre point depth of 42 m located approximately 4.3 km offshore from Bengello Beach (Figure 20). This depth range was preferable for tower style reef designs that aim to maximise vertical relief and attract pelagic species, while still providing for safe vessel clearance (>28 m) above the structures. This location is also accessible to boat-based fishing from Moruya Heads, Mossy Point and numerous ramps within Batemans Bay. Notification letters were sent to relevant stakeholders, no objections or concerns were raised.

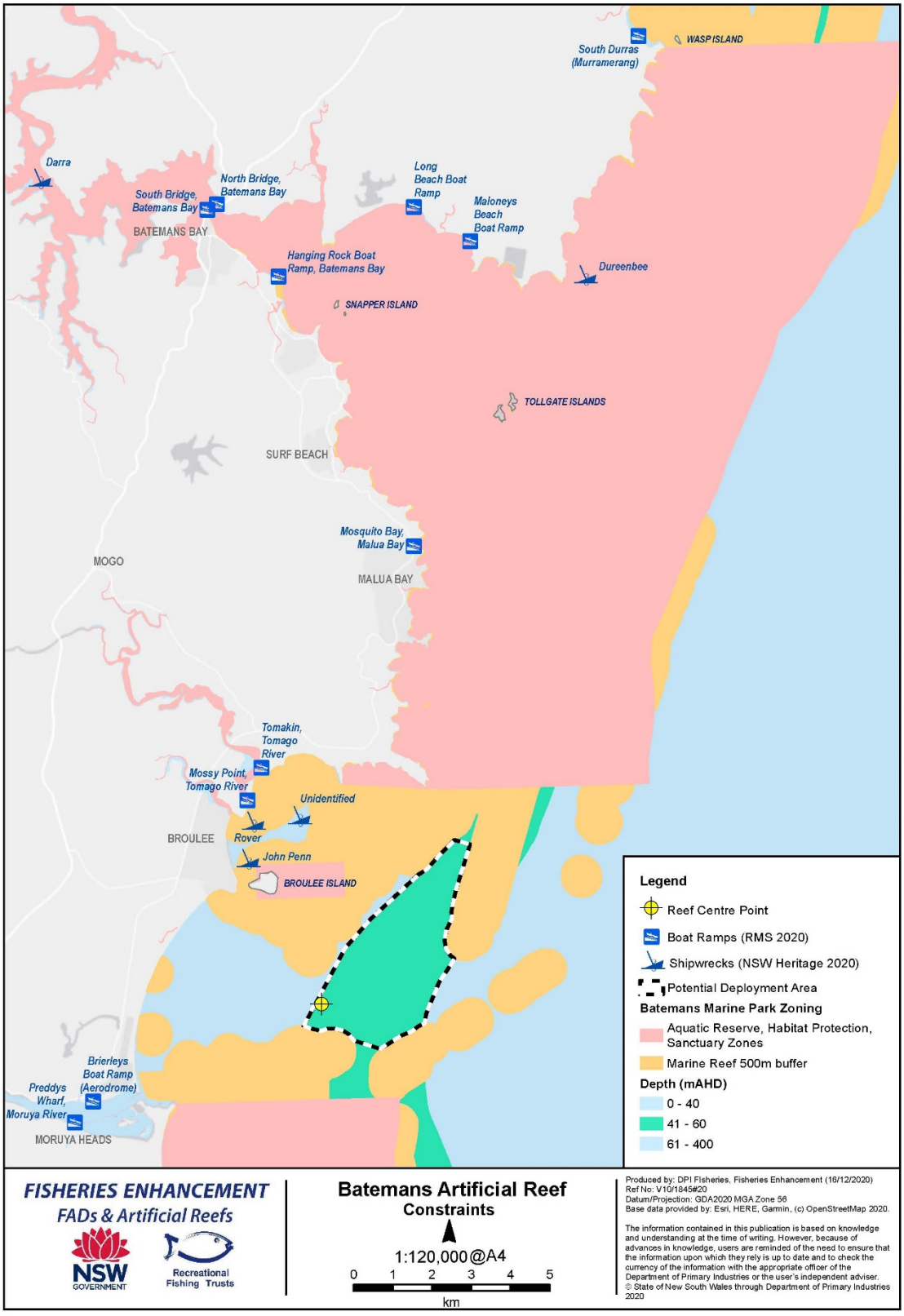


Figure 20 Potential deployment area identified through constraints analysis

6 Scope, duration and timeframes for monitoring

This section describes monitoring commitments related to the Batemans offshore artificial reef that are designed to provide information that will lead to continuous improvements in the way the reef is managed, and future reefs deployed. Development of a monitoring strategy to meet objectives requires a time frame that is consistent with the rate of recruitment to the artificial reef system and the ecological factors which drive this process.

Previous work associated with both estuarine and offshore reef systems has indicated that the fish communities remain dynamic over the first 2-3-year period post deployment. A five-year monitoring program will provide an adequate time frame to understand longer term trends in the nature of the fish assemblages associated with artificial reef systems (including interactions with threatened and protected species), physical forces acting on the structural integrity and stability of the reef.

The duration of the initial detailed monitoring at annual intervals for 5 years was considered sufficient based on the results of past and existing artificial reef research projects undertaken by the DPI. More intensive monitoring programs for DPI's previous eight reefs have informed the move to an annual monitoring program for 5 years with the option to consider 5 yearly surveys thereafter.

6.1 Monitoring objectives

The monitoring objectives outlined in this LTMP address the existing requirements of the *Environment Protection (Sea Dumping) Act 1981* for the Batemans offshore artificial reef. In compliance with recommendations outlined in previous permits and this document, DPI is committed to carry out the monitoring objectives listed in Table 23.

Table 26 Monitoring objectives, methodology and timeframes

Monitoring objective	Short description of monitoring description and expected outcome	Timeframes
• Confirm fish assemblages, the colonisation of the reef & community development • Assess reef performance and popularity with recreational fishing groups	BRUVs and unbaited ROV cameras will be deployed on the reef. This would allow the reporting of fish and benthic assemblages and the documentation of the development of the fish and benthic communities. Assessment of the artificial reef performance and public response, including catch rates associated with recreational anglers will include collation of anecdotal reports including Facebook. Reviews of charter operator log book data, feedback from local fishing clubs and trends in data collected from DPI's Integrated Monitoring Program (IMP) on fishing effort and demographics of recreational fishers will be used if available.	Annually for 5 years, then once every 5 years thereafter

• Occurrence of threatened/protected & migratory species within the reef management area	Any threatened species observed during surveys, inspections or from general public reports will be incorporated into the DPI Threatened Species Unit's database. Education and mechanisms to report sightings or interactions will be available to reef users in the "User guidelines" covering boat strike, incidental capture & acoustic disturbance will be available to users for best practice.	Annually for 5 years, then once every 5 years thereafter
• Reef structural integrity & stability • Accumulation of marine debris • Presence of invasive species	ROV camera surveys would be conducted; these surveys will allow a visual inspection of the reef to document reef stability and structural integrity, corrosion, investigate seabed/sediment characteristics including any scouring. These surveys would also; • Report on the level of gear or debris hook up; if there is a build-up of marine debris on the reef structures which poses an entanglement hazard, DPI will contract commercial divers to remove the debris. User guidelines will specify anchoring is not recommended within the reef management area to encourage best practice for users. • Report on any colonisation of marine pests, and ensure data including images or video are available for interpretation by subject matter experts (i.e. Biosecurity NSW)	Annually for 5 years, then once every 5 years thereafter
Storm event stability and structural integrity	As requested by DAWE during the finalisation of the LTMP for the Tweed project, DPI is committed to completing an inspection within 6 weeks of the first significant storm event defined as 1/20 year ARI. Post storm inspections thereafter will be undertaken for 1/50 year ARI events.	Within 6 weeks of the first 1/20 year ARI event. Within 6 weeks of 1/50 year ARI events thereafter.
Review user guidelines	User guidelines, DPI engagement with fishing clubs, social media & DPI webpages to promote best practice catch & release and provide user groups with informed sizes and bag limits. User guidelines to promote best practice, personal responsibility and safety within the management area. NSW DPI does not recommend SCUBA diving on the reef.	

BRUV = baited remote underwater video, ROV = remotely operated vehicle

6.2 Monitoring timeframes

Environmental monitoring programs outline procedures to monitor potential changes in significant components of the marine environment and assess the structural integrity of the reef infrastructure, marine fauna interactions and environmental impacts (Table 23). The preliminary 5 year timeframe for annual surveys was selected based on the results from the previous NSW offshore artificial reef surveys. Previous work associated with both estuarine and offshore reef systems has indicated that the fish communities remain dynamic over the first 2-3 year period post deployment. A 5 year monitoring program will provide an adequate time frame to understand longer term trends in the nature of the fish assemblages associated with artificial reef systems (including interactions with threatened and protected species), physical forces acting on the structural integrity and stability of the reef. It is proposed to

review monitoring timeframes 5 years post reef installation based on these results from monitoring conducted and consider moving to 5 yearly surveys.

6.2.1 **Structural integrity and stability monitoring**

The structural integrity and stability monitoring will be used to undertake inspections of the reef infrastructure. Evidence of faults, damage, and excessive debris build-up will be the focus of the inspections which will be followed by appropriate maintenance. An inspection will be particularly important after the first significant wave event defined as a 1/20 year ARI. Subsequent post storm inspections will be completed within 6 weeks following storms of a 1/50 year ARI magnitude. Routine visual inspections will be undertaken every 12 months for 5 years (then reviewed) with a minimum inspection period of every 5 years for the remainder of the reef design life or following severe storm events defined as a 1/50 year ARI event.

The inspection checklist includes:

- Date and type of observation conducted (diver vs. camera);
- Location and description of faults identified including: significant scouring or sedimentation; module damage including cracks, splits, breakages and the location (GPS coordinates) of the module;
- A list of proposed actions to be undertaken (if any).

The structural integrity and stability monitoring will assess the effectiveness and suitability of the module design, such as whether it adequately withstands the sea conditions offshore of the Batemans coastline as designed.

An intense East Coast low hit the NSW coast between April 20-23 2015 which produced gale force winds (>45 knots) and huge seas, with the most extreme effects felt along the Hunter-Sydney coast with strong winds, flooding rains and massive seas. The largest wave recorded at 3 pm on 21 April was 15 m, approximately the height of a five-story building. The waves also exceeded 6 m for 30 hours, the longest duration of such high waves since 1987. Post storm inspections (Figure 21) of both the Sydney and Shoalhaven artificial reefs were carried out in May 2015 in line with inspection conditions of respective sea dumping permits (SD2008/882 & SD2014/2842). DPI used surface deployed cameras to undertake the inspections. No damage was identified to either the single large Sydney reef unit or any of the 20 multiple modules which form the Shoalhaven reef. In addition, no significant scour or deposition was identified in the vicinity of either reef [45].

Figure 21 Inspections of the Sydney (upper image - 7 May 2015) and Shoalhaven (lower image - 18 May 2015) OARs following an intense east coast low that produced waves up to 15 m (Hmax)

6.3 Performance monitoring and review

6.3.1 **Performance indicators**

Performance indicators provide the most appropriate indication of whether the offshore artificial reef is meeting its objectives. A number of monitoring programs and existing DPI programs are to be used in conjunction with each other to gather information to measure performance indicators.

Key performance indicators (KPI) used to demonstrate whether the project meets its primary objective "to enhance recreational fishing opportunities" will be a comparison of species density and richness pre and post deployment. This KPI will be measured during scheduled monitoring (see Table 26). Should species density and richness represent a decline 10 years post deployment, decommissioning options will be assessed and implemented.

6.3.2 **External drivers**

External drivers are factors that are known to potentially impact on the performance of the reef but which are outside of the control of DPI (e.g. environmental conditions, social changes etc.). Any external influences that may contribute to a trigger being breached will be identified during monitoring of the reef and, if necessary, referred to any relevant managing agency for action. A number of external influences may contribute to trigger points being reached. For example, the NSW Environment, Energy and Science (EES) administer interactions with marine mammals under the *NSW National Parks and Wildlife Regulation (2009)* and the *NSW National Parks and Wildlife Amendment (Marine Mammals) Regulation 2006*, introduced to protect marine mammals such as whales and dolphins while allowing people to appreciate them in the wild. These existing regulations specify the distances of approach and interaction with marine mammals. If interactions between reef users and cetaceans, pinnipeds, etc. were found to increase significantly post installation of the reef, then in addition to the DPI Threatened Species Unit (TSU) being notified of these interactions, the NSW EES would also be independently briefed. Management actions would require a combined approach from both the DPI and EES to ensure a consistent method to address the issue. A passive approach such as increased education and an awareness campaign coordinated between the two agencies may suffice. However, if impacts continue to escalate, increased monitoring and compliance patrols combined with temporal exclusions zones may require consideration.

Build-up of marine debris identified during the monitoring of the reef to be as a result of purposeful dumping of material on or adjacent to the reef site is another external influence. If increased marine debris is entering the marine environment in the vicinity of the proposed artificial reef which is of a deliberate nature (i.e. intentional dumping of waste from vessels) then the NSW Roads and Maritime Services (RMS) would be notified and action taken under the *Marine Pollution Regulation 2006*. As current Fisheries Management Regulations do not manage this activity, an appropriate management response would be for DPI to administer a combined on-water operations with the RMS Boating Safety Officers (BSOs) to target offenders and enforce these regulations.

6.3.3 **Trigger points**

Trigger points specify when a performance indicator has reached a level that suggests there is a problem with the activity and a review is required. Table 27 establishes the performance indicators and trigger points that will be used to measure effect of mitigation measures. No numbers for interactions with threatened species have been defined; instead a threshold for 'of concern' will be implemented. The reasoning behind this is that the types of threatened species and degree to which they are threatened is highly variable in regard to the operation of the reef. This has been determined in consultation with the DPI TSU.

By not defining a set point/number at which management measures would be imposed upon the operation of the reef, it allows the TSU to assess not only numbers of interactions with threatened species on the reef, but other aspects of threatened species management which may be relevant such as:

- the level of the threat that is or has occurred;
- the type of interaction;
- the frequency of the interactions;

- the season that the interaction is occurring (breeding/calving);
- any potential change in the threatened status;
- how much harm as a result of the interaction was occurring;
- sightings vs. hookings/entanglements; and
- if the species is recovering and numbers are increasing.

Without imposing numbers/thresholds on the interactions with threatened species the LTMP is more fluid and is more in line with current impact assessment that is being undertaken. Numbers are not used when assessing the level of impact on matters of National Environmental Significance but rather the process relies on professional judgement.

Reporting to and involvement of the DPI TSU (which is independent of DPI Recreational Fisheries Management) allows for an independent judgement of these levels of interaction. Also any significant interaction such as mortality would immediately be reported to the TSU.

If the level of interaction was to become 'of concern', potential management measures which could be imposed upon the reefs may include gear restrictions, closed seasons, fishing times, a restricted fishery and restrictions on the type of fishing. DPI as an agency would need to come up with an appropriate management response in relation to the interaction. Again, as the threshold is not quantifiable due to so many variables, it is important to deal with the interactions appropriately as they arise based on professional judgement.

Harm from Marine Debris: The proposal is likely to result in the concentration of, and increase in, recreational fishing activity in the direct reef area. This potentially increases the risk of lost fishing gear and harmful marine debris entering the marine environment in the vicinity of the proposed recreational fishing reefs. Threatened marine species, particularly marine turtles, pinnipeds, small cetaceans and seabirds, can ingest or become entangled in marine debris, such as plastics. Potential harm to marine animals from build-up of marine debris such as lost fishing tackle, anchor lines and other pollution is being monitored quarterly each year over the first 3 years post reef installation.

A commitment has been made by DPI that periodic inspection of marine debris will be maintained on the reef for its design life. The ongoing regularity of inspections will be based on a needs basis following a review of the scheduled quarterly monitoring over each of first 5 years. Annual debris removal has been scheduled over 5 years (i.e. the first debris removal will be conducted within 12 months of the reef being installed and annually thereafter for a period of up to 5 years, if required). This is deemed to be an appropriate management response and mitigative measure based on the unknown level of build-up. If an obvious entanglement hazard is identified outside scheduled maintenance and debris removal (including but not limited to free floating rope (discarded anchor lines)), removal by contracted commercial divers will be facilitated as soon as practical.

In order to further reduce the impact of this KTP, education using the reef user guidelines and existing DPI education programs would be provided on the potential impacts of harmful marine debris on marine life and the responsible disposal of litter and discarded fishing gear.

Invasive Marine Pests: The proposed reef structures could provide a substratum or habitat suitable for invasive marine pests (also referred to as ‘introduced’, ‘alien’ or ‘non-indigenous’ species). Although there is evidence that many exotic species establish populations more easily on artificial structures, the risk of increased potential for disease associated with biota

at the artificial reefs is considered to be extremely small due to their isolation in the open ocean rather than in estuarine environments. Similarly, the risk to threatened species from invasive marine pests associated with the reef is considered very small.

Invasive marine pest species including the Japanese and yellowfin gobies and New Zealand screw shell are generally associated with soft or unconsolidated sediments in bays and estuaries and would be unlikely to occur offshore. Therefore, they are unlikely to be of concern, primarily due to the location of the proposed Batemans offshore artificial reef. CSIRO modelling of the potential range of NZ screwshell (based on temperature tolerance) indicates it is very unlikely to survive north of Merimbula in southern NSW.

Whilst the proposed reef site is potentially at risk from colonisation by invasive marine pests, the scale of the potential impact is small and would be unlikely to have any significant impact on the marine environment. Depending on the species identified a variety of management responses may be required. In the first instance, reef user groups would be informed of boating guidelines to minimise the spread of marine pests and a revised monitoring plan would need to be implemented in order to better document the extent of the incursion. Requirements for removal of marine pests (according to National Introduced Marine Pest Information System - NIMPIS) would depend on the extent and nature of the incursion but is likely to involve manual removal by divers in the first instance. This would be facilitated by the DPI upon advice from the DPI Biosecurity Unit.

Table 27. Trigger points

Incidental capture of threatened species		
Risk description	Trigger point	Justification/comments
Incidental capture from recreational fishing gear could potentially affect threatened fish, pinnipeds and seabirds that forage in the surface waters	Increases of incidental capture of threatened species or key non threatened species within reef area increases by an amount deemed 'of concern' by the DPI Threatened Species Unit (TSU) following reporting of the incident as specified in the project reporting section.	Increased incidences of capture of threatened species or key non threatened species within the reef area may indicate a change in species interactions or species interactions with the reef. This may require a modification to the management of the reef.
Data required	Availability/monitoring programs	
Incidences of threatened species capture within the reef area	Information on threatened species or key non threatened species is available from DPI and other government agencies (e.g. EES) and through the Bionet database as well as through the ROV and BRUV surveys and through the angler advisory campaigns. This information would be sent to the DPI TSU for review.	

Aggregation of threatened or protected species		
Risk description	Trigger point	Justification/comments
Aggregation of threatened or protected species	Aggregation of threatened species or key non threatened species within reef area increases by an amount deemed 'of concern' by the DPI TSU.	Increased aggregations of threatened species or key non threatened species within the reef area may indicate a change in species interactions. This may require a modification to the management of the reef.
Data required	Availability/monitoring programs	
Information on the residency of threatened and	Information on threatened species or key non threatened species is available from DPI and	

protected species within the reef area.	other government agencies (e.g. EES) and through the Bionet database as well as through the ROV and BRUV surveys, DPI acoustic telemetry programs and through the angler advisory campaigns. This information would be sent to the DPI TSU for review.	

Alteration/interruption of movement corridors		
Risk Description	Trigger point	Justification/comments
Cetaceans and some species of fish, such as the Greynurse Shark, that undertake migrations along the NSW coastline, could alter their migratory behaviour in response to the presence of the offshore artificial reefs.	Movement corridors of threatened species or key non threatened species within reef area alters by an amount deemed 'of concern' by the DPI TSU or other relevant government agency.	Changes in movement patterns and corridors of threatened species or key non threatened species within the reef area may indicate a change in species interactions and behavioural patterns. This may require a modification to the management of the reef.
Data required	Availability/monitoring programs	
Information on the migration routes and patterns of threatened and protected species within the reef area.	Information on threatened species or key non threatened species is available from DPI and other government agencies (e.g. EES) and through the Bionet database as well as through the ROV and BRUV surveys, DPI acoustic telemetry programs and through the angler advisory campaigns. This information would be sent to the DPI TSU for review.	

Harm from marine debris and pollution (KTPs) / Gear hook up		
Risk Description	Trigger point	Justification/comments
Increased risk of lost fishing gear and harmful marine debris entering the marine environment in the vicinity of the proposed offshore artificial reefs.	Debris build up on the reef by an amount that the DPI Recreational Fisheries Unit believes is 'of concern'	Ongoing build-up of marine debris on the reef may require a modification to the management of the reef.
Data required	Availability/monitoring programs	
ROV inspection of the reef to assess the debris build up.	Annual reef monitoring and observance program and other DPI research projects/programs operating within the reef area.	

Invasive Marine Pests		
Risk Description	Trigger point	Justification/comments
The proposed reef structures could provide a substratum or habitat suitable for invasive marine pests (also referred to as'	An incidence of a novel disease or pest within the reef area	Pests and diseases can pose significant risks to the environment. This indicator ensures that the reef and its management are appropriately responding to pest and disease issues. There are potential external drivers in

introduced', 'alien' or 'non-indigenous' species).		this trigger point such as the introduction of pests and diseases through other aquatic or land-based activities
Data required	Availability/monitoring programs	
Ongoing monitoring of the reef area, pests and records of responses to pest or disease incursions	Disease and pest notification procedures (in line with DAWE) and DPI Biosecurity	

7 Environmental management

The following provides an overview of the proposed environmental management developed to provide guidelines for the operation of the offshore artificial reef.

7.1 Environmental reporting

Environmental reporting requirements for the Batemans offshore artificial reef will include the following:

- Colonisation and community development;
- Inspections of reef infrastructure, structural integrity and stability (conducted annually);
- Observations of marine fauna interactions (from the Marine Fauna Interaction Register);
- Threatened species interactions

A report will be provided to the Department of Agriculture Water and Environment within 30 days of each scheduled monitoring activity which identifies the extent of species colonisation and presence of invasive species.

Checklists will be maintained by DPI for environmental inspections and environmental audits.

7.1.1 **Logs and registers**

A number of registers will be maintained by DPI as part of the operation of the reef. A summary of the matters within the registers will be included in environmental management reports. The registers will include but are not limited to the following:

Complaints register

A complaints register will be maintained by DPI. The register will list information such as the following for each complaint:

- Date;
- Person/s receiving the complaint;
- Name, address and contact phone number of person/s making the complaint;
- Specific details of the nature of the complaint; and
- Action undertaken in response to the complaint.

Marine fauna interaction register

The marine fauna interaction register will list information such as the following:

- Date;
- Time;

- Fauna species (if known);
- Number of individuals;
- Approximate size;
- Nature of interaction;
- Description of displayed behaviour;
- Management issue; and
- Management actions.

Interactions between recreational vessels and listed threatened species including pinnipeds, cetaceans, turtles and sharks will be reported to the Department of Agriculture Water and Environment within 24hrs.

7.1.2 Offshore artificial reef user education and awareness guidelines

Offshore artificial reef user education and awareness guidelines have been produced to form the basis of the offshore artificial reefs advisory/education. The guidelines provide information important for user groups to ensure minimal environmental impact and promote safety within the reef management area.

These guidelines are available via the DPI website and in print as required for distribution to relevant recreational fishing associations and clubs.

7.1.3 Inspection timing

Five scheduled inspections will be conducted over the first 5 years post reef installation to document the accumulation of any fishing or non-fishing related marine debris. The first inspection and debris removal (if required) will be conducted within 12 months of the reef's installation and annually thereafter for a period of up to 5 years.

At the conclusion of this initial 5 year assessment period, the results will be used to identify a suitable level of assessment required to identify and respond to marine debris accumulation. For example if debris build-up remains consistent over the first 5 years, annual removal and inspections may be required to be maintained. However, if limited debris is recorded with a trend towards a reduction in debris, inspections may be further reduced and align with structural integrity monitoring every 5 years for the remaining design life of the reef.

7.1.4 Inspection

A combination of remotely operated vehicle (ROV) and baited remote underwater video (BRUV) will be used to provide an ongoing debris log. This log will be maintained by DPI and will include the following detail:

- date
- type of material identified (e.g. fishing line (mono or braid), anchor line, trap or net);
- approximate amount seen (length and diameter of lines) and distance the material extends (i) vertically; and, (ii) laterally from the reef;
- location of the debris (including GPS coordinates (where possible) and reef patch group);
- proposed removal methods (diver, barge/winch, other);
- threat presented by the debris.

7.1.5 Debris removal triggers

If the build-up of marine debris on the reef structures is identified to pose an entanglement hazard or if 'free floating' lines (i.e. tethered to the reef which extend into the upper water column above the structures) are identified this removal strategy will be implemented. Although commercial fishing is not expected to be undertaken on the reef, in the event of a net or fish trap being identified on the reef a team will immediately be mobilised to assess and remove the objects(s) in question.

Marine debris generated from recreational fishing identified through scheduled monitoring will be removed at least once every 12 months.

7.1.6 Debris removal

If the amount of material identified can be safely removed by divers using a single knife only, a commercial dive team (2815.1 qualified in accordance with minimum standards set by AS/NZ2299.1 Commercial Diving Standard) may be used to remove the hazard (note: special permission from the DPI – Fisheries NSW Occupational Diving Officer will be required).

If the hazard poses an entanglement or entrapment hazard to divers, DPI will contract an external commercial diving contractor with surface-supply capacity (as per AS/NZ2299.1) to complete the removal.

If the hazard cannot be safely retrieved by divers (e.g. commercial trawl net or large commercial fish trap), suitably experienced and qualified salvage contractors are to be sought by DPI to provide salvage advice.

Significant entanglement hazards which pose an immediate threat to marine mammals are to be reported to the NSW Environment, Energy and Science (EES) under the *NSW National Parks and Wildlife Regulation (2009)*.

7.2 Contingency measures

In addition to the circumstances outlined above, the Deputy Director General DPI Fisheries NSW may order a review and/or make a modification to the offshore artificial reef in circumstances declared by the Minister as requiring contingency action, or upon the recommendation of DPI staff.

These circumstances may include (but are not limited to) food safety events, environmental events, and results of monitoring programs or unpredictable changes on or around the reef over time. Notwithstanding the above, the Deputy Director General DPI Fisheries NSW may also make amendments to the operation of the offshore artificial reef that the Deputy Director General DPI Fisheries NSW considers to be minor in nature at any time.

Any alteration to the design, placement or operation of the modules in accordance with section 7.2 will also require written approval from the Department of Agriculture Water and Environment in accordance with the sea dumping permit conditions.

7.3 Emergency contacts and response

If at any time during the deployment or operation of the reef an environmental risk/incident occurs, the DPI will immediately implement measures to mitigate the risk or the impact. The

situation will be reported in writing within 24 hours to Department of Agriculture, Water and the Environment (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 measures 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.

Emergency contacts:

DPI Fisheries Manager (Fisheries Enhancement)

Ph: (02) 4476 0822 (office hrs), 1300 550 474 (24hrs)

Email: fisheries.enhancement@dpi.nsw.gov.au

Other relevant emergency contacts include:

i) ORRCA Whale and Dolphin Rescue – Ph: (02) 9415 3333

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

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

7.4 Decommissioning

Whether the units are removed intact or dismantled at the end of the life of the Sea Dumping Permit 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 method of removal of the units would be subject to a government tender process to ensure the most contemporary methods for removal were employed at the time. The reef would then be 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 reef 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 are detected during routine monitoring, or the 10 year KPI (section 6.3.1) is not achieved, option B would be the most likely decommissioning plan to be implemented. A report outlining the project shortcomings would also be submitted to DAWE along with details and outcomes of the decommissioning tender process.

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 of their removal.

7.5 Project reporting

Updates on the Batemans offshore artificial reef will be placed on the DPI offshore artificial reefs webpage (www.dpi.nsw.gov.au/fishing), via social media (e.g. Facebook) and will be reported as required to other statutory agencies and departments.

7.5.1 **Post installation**

GPS co ordinates of each module will be provided to DAWE within 24 hours of deployment.

Within 21 working days from completion of the reef installation, the DPI will provide a report to DAWE that:

- details the date and time of the placement of the Batemans artificial reef;
- confirmation of the placement site boundaries to two decimal places of a minute (WGS84);
- the estimated maximum depth over the Batemans reef units (LAT), and the date and time of the observation; and confirmed that the highest point of the reef is no less than 20 m below sea level (LAT);
- details of inspections and any items removed or hazards rectified;
- proof of written notification to the Australian Hydrographic Office and NSW Maritime.

A report can be provided to relevant consenting authority(s) as requested addressing, but not limited to the following:

- identify the standards and performance measures of the project;
- describe all works carried out over the previous 12 months;
- a summary of complaints and a comparison to previous years;
- records of maintenance checks and activities;
- a summary of post deployment monitoring activities and preliminary results;
- '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 sightings and/or incidental captures)

7.5.2 **Project objectives**

10 years post deployment, the DPI will provide a report to DAWE that:

- Provides a comparison of pre and post species density and richness at the site.
- Provides a percentage coverage of biomass attached to the structure that directly contributes to fish habitat.

- Provides detail on any impacts to the environment that are detected during routine monitoring.
- Provides detail on any project shortcomings along with details and outcomes of the decommissioning tender process should it be implemented.

7.6 Long term management plan review

Review of this plan will be conducted as required from the date of approval and is the responsibility of the DPI Recreational Fisheries Management team. Issues relating to the operation and implementation of the plan will be collated by the DPI Senior Fisheries Manager (Fisheries Enhancement) for review and reporting and approval.

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