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MEMORANDUM

ATTN:	John Eyres	**CC:**	Laurie Caporn
ORGANISATION:	Department of Fisheries	**FROM:**	Michelle Bejder and Gabrielle Cummins
PROJECT NO:	1051_009	**DATE:**	7/10/2015
SUBJECT:	Potential adverse interactions between the Mid-west Aquaculture Development Zone and marine mammals and turtles		

A. This document

Risks associated with the Department of Fisheries (DoF) proposal to establish the Mid-west Aquaculture Development Zone (MWADZ) were assessed based on the outcomes of environmental modelling and desk-top assessments. Desktop assessments have examined the potential for adverse interactions between the proposal and key marine fauna, including sea-birds, sharks and rays, and fin-fish and invertebrates (see BMT Oceanica 2015a). This desk-top assessment summarises the potential for adverse interactions between the MWADZ and marine mammals and turtles. It is designed to feed into the broader PER, and addresses the following specific objectives:

1. Identify and assess the values and significance of marine mammals (including the Australian sea lion) and turtles within the strategic proposal area and immediate adjacent area and describe these values in a local, regional and State context
2. Identify critical windows of environmental sensitivity for marine mammals and turtles in the strategic proposal area and immediate adjacent area
3. Describe the presence of marine mammals and turtles in the proximity of the strategic proposal area, documenting any known uses of the area (e.g. foraging, migrating, calving and nursing)
4. Identify the construction and operational elements of the proposal that may affect marine mammals and turtles
5. Briefly describe and assess the potential direct and indirect impacts that may result from the construction and operation of the proposal to marine mammals and turtles
6. Briefly summarize (high level) potential mitigation and management measures for adverse impacts on marine mammals and turtles.

The document focuses particularly on objectives 1 to 5. Objective six is addressed briefly in Section 5. For a more detailed overview, the reader is directed to the Environmental Monitoring and Management Plan (EMMP) for the MWADZ proposal, which is published separately (see BMT Oceanica 2015b).

B. Site description

B.1 Relevant legislation

The MWADZ lies in Western Australian (WA) State waters within three nautical miles of the mainland, and is therefore regulated under the Wildlife Conservation Act 1950. It is also bound by Australian Commonwealth Matters of National Environmental Significance (MNES) listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

B.1.1 Commonwealth

The EPBC Act requires approval from the Commonwealth Minister for the Environment for any action that has, will have or is likely to have a significant impact on any of the following MNES:

- World Heritage properties
- National Heritage places
- Ramsar wetlands of international importance
- Nationally threatened species (animal and plant) and ecological communities
- Migratory species protected under international agreements
- The Commonwealth marine environment
- The Great Barrier Reef Marine Park
- Nuclear actions
- Water resources, in relation to coal seam gas and large coal mining developments.

B.1.2 State

The WA State legislation for marine fauna protection is the Wildlife Conservation Act 1950, which lists threatened native plants and animal species in need of special protection based on the threat of extinction or rare occurrence.

This assessment considered the potential for impacts in the context of both State and Commonwealth regulatory frameworks.

C. Key species and their likelihood of occurrence

C.1 Marine mammals

The EPBC Act Protected Matters Search Tool (DoE 2014a) identified 31 cetacean and two pinniped species with the potential to occur within <50 km of the MWADZ (DoE 2014a; Appendix A). The following sections describe species that are most likely to be encountered, as well as three species listed as Endangered or Vulnerable under the EPBC Act and the Wildlife Conservation Act (Table C.1).

Table C.1 EPBC Act threatened marine mammal species potentially occurring within 50 km of the MWADZ, including Wildlife Conservation Act status

Scientific Name	Common Name	EPBC Act Status	Wildlife Conservation Act Status
Balaenoptera musculus	Blue whale and pygmy blue whale	Endangered Cetacean Migratory	Endangered
Eubalaena australis	Southern right whale	Endangered Cetacean Migratory	Vulnerable
Megaptera novaeangliae	Humpback whale	Vulnerable Cetacean Migratory	Vulnerable
Neophoca cinerea	Australian sea lion	Vulnerable Marine	Other protected fauna
Balaenoptera edeni	Bryde's whale	Cetacean Migratory	Not listed
Orcinus orca	Killer whale	Cetacean Migratory	Not listed
Tursiops aduncus	Indo-Pacific bottlenose dolphin	Cetacean	Not listed
Tursiops truncatus s. str.	Bottlenose dolphin	Cetacean	Not listed
Dugong dugon	Dugong	Marine Migratory	Other protected fauna

Source: EPBC Act Protected Matters Search Tool (DoE 2014a) and Wildlife Conservation (Specially Protected Fauna) notice 2014

C.1.1 Blue and pygmy blue whales

Two sub-species of blue whales are known to occur in Australian waters: the southern (or 'true') blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*B. musculus brevicauda*). These two subspecies differ based on distribution, morphology, acoustics and genetics (Attard et al. 2012). Both migrate seasonally between their feeding grounds at high latitudes in the Austral summer and their breeding grounds at low latitudes in the Austral winter. As a general distributional trend, southern blue whales are found south of 60°S and pygmy blue whales are generally found north of 55°S (DEWHA 2008). Since 1994, relatively high numbers of blue whales have been observed between October–December in Geographe Bay, a shallow embayment in south-west WA, which may be a transitory corridor and/or migratory resting area (Salgado Kent et al. 2011, DSEWPaC 2012a). Surveys in 2003 recorded more than 100 sightings in Geographe Bay (Burton 2003).

Blue whales are documented in deeper waters off the Perth coast and near the edge of the continental shelf in 500–1000 m water depth (McCauley & Jenner 2010, McCauley et al. 2001). The only known areas of significance to blue whales are feeding areas around the southern continental shelf, notably the Perth Canyon, WA, and the Bonney Upwelling and adjacent upwelling areas of South Australia and Victoria (Jenner & Jenner 2004). In the Perth Canyon, up to 40 blue whales have been sighted in a single aerial survey. During vessel surveys, 211 unique individuals have been photo-identified over six years (2000–2005). Of these, one whale was sighted over four separate seasons, one whale over three seasons and 11 whales over two seasons (Jenner & Jenner 2004). Limited satellite tagging data revealed that blue whales have probable foraging patterns not only over the Canyon, but also over the upper shelf slope to its north and south as well. While their Australian distribution is widespread, blue whales are commonly found in deep, oceanic waters, and they are unlikely to be sighted in significant numbers in the MWADZ proposal area (Table C.3) (but see some examples below).

Pygmy blue whales have been recorded in similar areas to the blue whales about 40–100 km offshore (Double et al. 2012). Perth Canyon is the only recognised feeding area for the species in WA (DoE 2014b; McCauley & Jenner 2010) and is more than 350 km south of the MWADZ proposal area. Passive acoustic data documented the north-bound migration of pygmy blue whales as they left the Perth Canyon and travelled up the WA coastline, passing Exmouth Gulf between April and August and continuing into Indonesian waters (McCauley & Jenner 2010). The pygmy blue whale south-bound migration begins from October to late December along the 500–1000 m depth contour on the edge of the slope (McCauley & Jenner 2010). During baseline investigations for the Oakajee Deepwater Port Project, blue whales were observed during aerial surveys near Geraldton and the Abrolhos Islands on four out of thirty three aerial surveys in the period November 2008 to January 2010 (Oceanica 2010).

Satellite-tracking data recorded a similar pygmy blue whale migratory pattern, with a north-bound migration off Exmouth and the Montebello Islands between June and August, and south-bound migration passing through the same areas from October to January, with a peak in late November to early December (Double et al. 2012). The satellite-tagged pygmy blue whales were recorded in the offshore areas of the Abrolhos Islands, providing evidence of migration near the MWADZ proposal area (Table C.3).

C.1.2 Southern right whales

Distributed between 30°S and 60°S, southern right whales (*Eubalaena australis*) have been recorded in coastal waters of all Australian states. They migrate from high-latitude feeding grounds in summer to warm, low-latitude coastal locations in winter (May through to November) between Sydney and Perth, as well as Tasmania (Bannister et al. 1996). The population is

suggested to be growing, and rare sightings were recorded in northern waters, such as Shark Bay and the North West Cape (Bannister et al. 1996). In Australia, important calving areas in WA are at Doubtful Island Bay and east of Israelite Bay (on the south coast of WA). However, there are no critical habitats recognised in the waters around the Abrolhos Islands. Therefore, any sightings of southern right whales from the MWADZ proposal area will be rare and infrequent (Table C.3).

C.1.3 Humpback whales

Humpback whales (*Megaptera novaeangliae*) migrate along the WA coastline between their summer feeding grounds (south of 55°S) and winter breeding grounds of Camden Sound in north-west WA (DoE 2014b, Jenner et al. 2001), located approximately 1,700 km north-east of the MWADZ. The Abrolhos Islands are recognised as a significant habitat during humpback whale migration (DoE 2014c). Humpback whales have been documented to use the sheltered waters adjacent to the Abrolhos Islands to opportunistically rest during their southern migration to the Antarctic feeding grounds (DoE 2014c, DEWHA 2007).

Fishermen have reported sightings of northbound humpback whales around the Abrolhos Islands between May and June, however the peak northbound migration is early to mid July (Jenner et al. 2001). Humpback whales migrate south along the WA coastline after the breeding and calving period. The peak southern migration period which incorporates a corridor through the proposal area is in late September (Jenner et al. 2001) (Table C.3).

C.1.4 Australian sea lions

The Australian sea lion (*Neophoca cinerea*) is endemic to Australia, with a distribution extending from the Abrolhos Islands, Western Australia to the Pages in South Australia (Campbell 2005; DSEWPaC 2013a). Their main breeding rookies comprise offshore islands (Campbell 2005), with beaches and rocky shores used as year-round haul-out areas (Orsini et al. 2006). The Abrolhos population is small and at the northern limit of the species range.

The Australian sea lion is listed as Vulnerable under the EPBC Act based on primary threats such as fatal capture as fishery bycatch and entanglement with marine debris (Hesp et al. 2012). Secondary threats include interactions with aquaculture operations (DSEWPAC 2013a). The Recovery Plan for the Australian sea lion describes the conservation requirements for the species across its range and identified actions to ensure its long-term viability in nature as well as the parties that will undertake those actions (DSEWPaC 2013b).

There are 28 large known breeding sites for Australian sea lions in WA including two at the Abrolhos Islands (here, the Easter Group is referred to as one breeding site and the Pelsaert Group is referred to as one breeding site however there are separate islands within these sites) and 48 sites in South Australia (Goldsworthy et al. 2009, Shaughnessy et al. 2011, DSEWPaC 2013b). The overall estimated abundance of Australian sea lions in WA is much lower (~2000 individuals) than in South Australia (~12 700 individuals) (Goldsworthy et al. 2009).

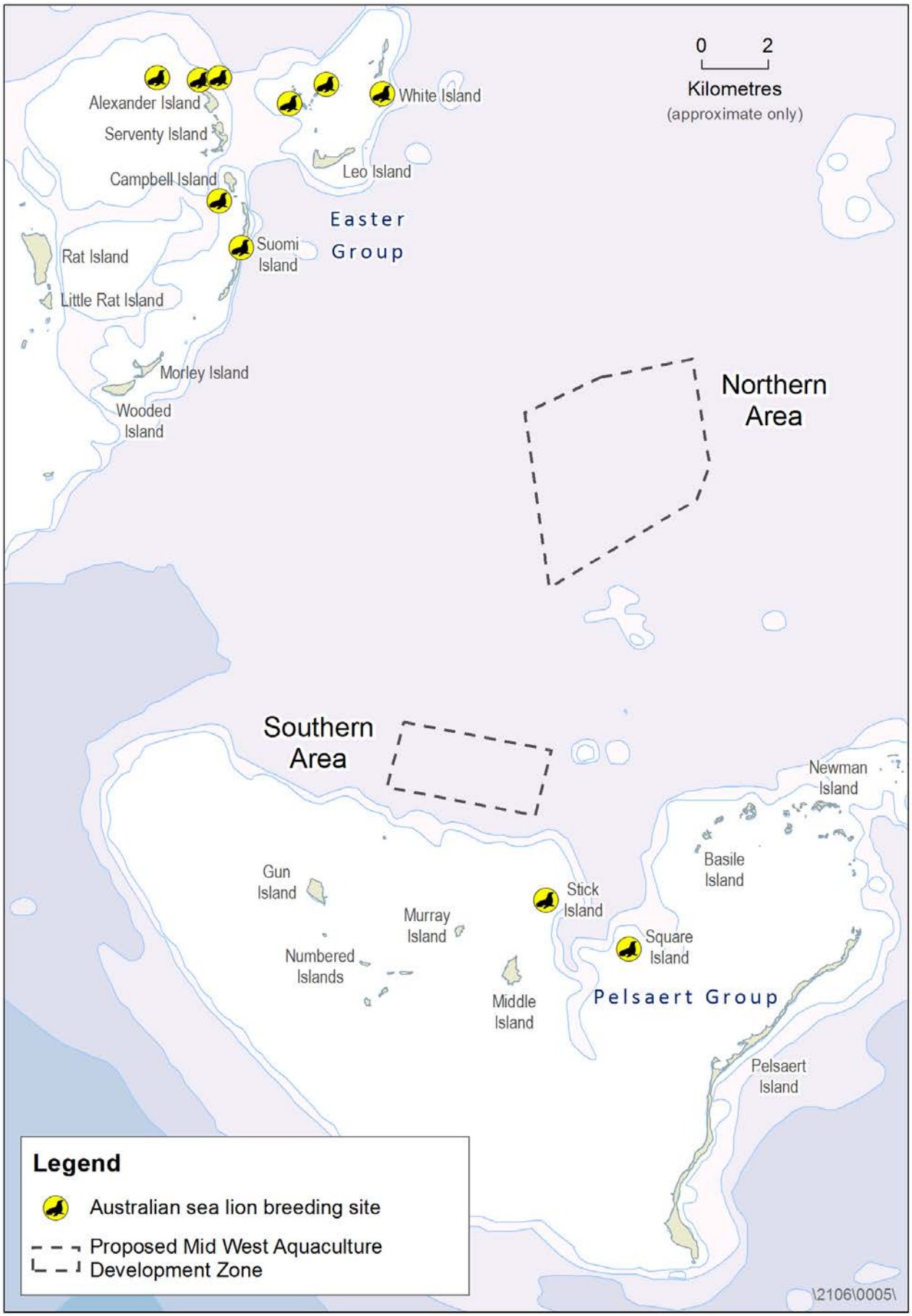
The Abrolhos Islands population, which is a small and closed population, is highly vulnerable, especially to increased mortality from anthropogenic causes (Campbell 2008). Scientific data suggest that there are approximately 14,780 Australian sea lions, and the most recent pup counts from Kangaroo Island, South Australia, indicated a general decline of 0.54–0.67% per year between 1985 and 2010 (Goldsworthy et al. 2011). Population estimates are based on pup numbers to infer the overall population size.

Australian sea lions have a characteristically slow rate of maturation and low fecundity, with females having asynchronous breeding seasons between colonies and producing only one pup every 18 months. Female Australian sea lions have a high rate of natal site fidelity (or natal philopatry), thus supporting their restricted home range as well as limited gene flow with other regions (Campbell 2005). As a result, some breeding colonies or clusters of breeding colonies are unique populations, and recolonisation of extinct breeding colonies is unlikely. In contrast, male Australian sea lions have foraging ranges that extend up to 60 km from their birth colonies, with some males ranging more than 180 km (Hamer et al. 2011).

Historical population abundances at the Abrolhos Islands ranged from 300–580 sea lions, while recent surveys described severely reduced population estimates (76–96 sea lions), most likely resulting from historical harvesting (Campbell 2005, DSEWPaC 2013a). Unlike other harvested pinniped species, Australian sea lion populations have not recovered, and there is evidence that some small populations are still in decline.

In the Easter Group of the Abrolhos Islands, young pups and breeding activity has been recorded on Alexander Island, Serventy Island, Campbell Island, Gilbert Island, Helm Island, Stokes Island White Island and Suomi Island (Figure C.1) (Gales et al. 1994, Campbell 2005). In the Pelsaert Group, adults and pups have been observed made at Stick Island and Square Island (Figure C.1), however, when observed, numbers have been restricted to ~3-7 individuals (Campbell 2005). In 2004, 17 sea lion pups were recorded at breeding areas within the Easter Group, and two pups were recorded on the Pelsaert Group. There was some speculation that islands in the Pelsaert Group are predominantly used as haul-out sites with only occasional pupping events (DSEWPaC 2013a).

Recent telemetry data from tagged Australian sea lions recorded foraging ranges with a broad use of coastal shelf waters, including coastal areas to the shelf's edge (Campbell 2008). Foraging behaviour varied among different Australian sea lion populations and different cohorts within each population. From all WA populations studied, sea lions generally displayed strong foraging site fidelity, and the Abrolhos Islands population had the smallest foraging range observed (Campbell 2008). Females and juveniles had small foraging ranges (<10 km), and foraging trips comprised travel within the Abrolhos Islands. As benthic foragers, Australian sea lions may dive up to 90 m to target prey species, such as cephalopods, crustaceans and fish (Campbell 2005). Interactions between Australian sea lions and the MWADZ are considered likely (Table C.3).



Source: Combined observation from DPaW 2015 and Campbell 2005

Figure C.1 Australian sea lion breeding sites in the Easter and Pelsaert Groups, Abrolhos Islands

C.1.5 Bryde's whale

The Bryde's Whale (*B. edeni*) is distributed throughout tropical and warm temperate waters, between 40˚N and 40˚S, in both oceanic and inshore waters (DoE 2014b). With the exception of the Northern Territory, Bryde's whales were recorded in all Australian states, although no feeding or breeding areas have been identified (DoE 2014b). Observations of Bryde's whales have been documented at the Abrolhos Islands indicating this area may be important for this rarely sighted species (DEWHA 2008). However, sighting frequency, habitat use and abundance of Bryde's whales at the Abrolhos Islands are not known (Bannister et al. 1996, DEWHA 2008). Large numbers of Bryde's whales are not expected to be encountered in the nearshore waters of the MWADZ proposal area. Although, it remains possible that Bryde's whale may visit the MWADZ proposal area (Table C.3).

C.1.6 Killer whale

Killer whales are a cosmopolitan species that generally occurs in offshore, pelagic areas from the equator to polar regions (Bannister et al. 1996). In Australia, killer whales have been sighted from all states on the continental slope and shelf, and near seal colonies and humpback whale resting areas. Sightings were frequently recorded from Tasmania, South Australia and Victoria, with a possible key locality at Macquarie Island (Bannister et al. 1996). Recent scientific evidence documented killer whale attacks targeting humpback whales off Ningaloo Reef, WA (Pitman et al. 2015), confirming their presence in coastal areas.

In other areas, mammal-eating killer whales are capable of rapid, long distance movements (approximately 1,000 km) into mid-latitudes, suggesting their capability to intercept and hunt humpback whales during their migration movements (Pitman et al. 2015). However, it is considered unlikely that killer whales will visit the MWADZ proposal area (Table C.3).

C.1.7 Bottlenose dolphins

Two subspecies of bottlenose dolphins are likely to occur within the MWADZ proposal area: the Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) and the common bottlenose dolphin (*T. truncatus*; DSEWPaC 2012a). Indo-Pacific bottlenose dolphins are observed between the continental shelf and the coastline (<200 m water depth) in reef, sandy and seagrass habitats (DSEWPaC 2012a). In both estuarine and coastal habitats in the southwest region of Australia, resident Indo-Pacific bottlenose populations have been surveyed for over 20 years and on a year-round basis. Scientific evidence confirmed both long-term residency and short-term associations with coastal, non-resident dolphins (Finn 2005; Chabanne et al. 2012). Therefore, as Indo-Pacific bottlenose dolphins are known to occur throughout the Abrolhos Islands, it is likely that they will be encountered in the MWADZ proposal area (Table C.3).

Common bottlenose dolphin distribution is not well documented in Australia, although records exist from Queensland, New South Wales, Tasmania, South Australia and south-western WA (DoE 2014b). Sightings are documented from both offshore (waters deeper than 30 m) and coastal waters, and in a variety of habitats: mud, sand, seagrasses, mangroves and reefs (Hale et al. 2000, DoE 2014b). Common bottlenose dolphins are often sighted in association with other cetacean species, including pilot whales, white-sided dolphins, spotted dolphins, rough-toothed dolphins, humpback whales and Southern right whales. During the Oakajee Deepwater Port baseline surveys, common bottlenose dolphins formed ~26% of the observations, the majority of which were located <15 km from shore (Oceanica 2010). Based on this assessment, common bottlenose dolphins are likely to be encountered within the MWADZ proposal area (Table C.3).

C.1.8 Dugongs

A significant proportion of the world's dugongs are found in north Australian waters from Shark Bay, WA, to Moreton Bay, Queensland (Marsh et al. 1994; Marsh et al. 2002). Specific areas supporting dugongs in WA include: Shark Bay; Ningaloo Marine Park; Exmouth Gulf; Pilbara Coastal and offshore regions (Exmouth Gulf to De Grey River); Eighty Mile Beach; and Kimberley Coast Region (Marsh et al. 2002). Dugongs are herbivores and use fresh water to varying degrees, although they also frequent coastal waters, estuarine creeks and streams, and travel upstream for several kilometres (Lawler et al. 2002). Feeding aggregations occur in wide, shallow protected bays, wide, shallow mangrove channels and in the lee of large inshore islands (Heinsohn et al. 1979). They are generally distributed around areas of deep-water seagrasses.

Although not commonly sighted south of Shark Bay, dugongs are highly migratory and undertake long distance movements (>100 km) over several days, possibly in search of seagrass beds or warmer water (DoE 2014b). During baseline investigations for the Oakajee Deepwater Port Project, aerial surveys of the mid-west region were undertaken near the Abrolhos Islands. The results included observations of individual dugongs at Horrocks, ~45 km north of Geraldton (Oceanica 2010). Therefore, there is a rare likelihood of encountering dugongs within the MWADZ proposal area (Table C.3).

C.2 Likelihood of marine mammals within the zone

The likelihood of marine mammals occurring within the MWADZ proposal area is outlined in Table C.3, with likelihood definitions prescribed from Fletcher 2014 (Table C.2).

Table C.2 Likelihood definitions

Level	Descriptor
Remote	Never heard of, but not impossible
Rare	May occur in exceptional circumstances
Unlikely	Uncommon, but has been known to occur elsewhere
Possible	Some evidence to suggest this is possible here
Occasional	May occur
Likely	It is expected to occur

Source: Fletcher 2014

Table C.3 Likelihood of marine mammal occurrences within the proposal area

Common name	Likelihood in MWADZ proposal area	Occurrence period
Blue whale	Unlikely	November–May
Pygmy blue whale	Occasional	June–August; October–January
Southern right whale	Possible	May–November
Humpback whale	Likely	July–November
Australian sea lion	Likely	All year
Bryde's whale	Possible	Unknown
Killer whale	Unlikely	Unknown
Indo-Pacific bottlenose dolphin	Likely	All year
Common bottlenose dolphin	Likely	All year
Dugong	Rare	All year

C.3 Marine turtles

The EPBC Act Protected Matters Search Tool (DoE 2014a) identified four marine turtle species (Table C.4) that are likely to occur within 50 km of the MWADZ proposal area (DoE 2014a). All

four species are listed as Threatened and Migratory under the EPBC Act and the WA Wildlife Conservation Act 1950. As nesting is not known to occur in the Abrolhos Islands, the following sections describe the likelihood that adult marine turtles will occur within the MWADZ.

Table C.4 Protected marine turtles relevant to the proposal

Scientific name	Common name	EPBC Act status	Wildlife Conservation Act status
Caretta caretta	Loggerhead turtle	Endangered, Marine, Migratory	Endangered
Dermochelys coriacea	Leatherback turtle	Endangered, Marine, Migratory	Vulnerable
Chelonia mydas	Green turtle	Vulnerable, Marine, Migratory	Vulnerable
Natator depressus	Flatback turtle	Vulnerable, Marine, Migratory	Vulnerable

C.3.1 Loggerhead turtles

Loggerhead turtles are widely distributed throughout tropical, subtropical and temperate waters, preferring the waters of coral and rocky reefs, seagrass beds and muddy bays (DoE 2014b). This species feeds primarily on benthic invertebrates, foraging from the nearshore zone to water depths of approximately 50–60 m (DoE 2014b). The WA stock is known to forage and nest primarily in north-west WA, from Shark Bay to the Pilbara Region (DoE 2014b). In the south-west of WA, resident loggerhead turtles are commonly observed foraging in waters from Rottnest Island to Geographe Bay (DEWHA 2008). Based on their foraging habitats and prey species preferences, adult loggerhead turtles may prefer the coastal waters of the MWADZ proposal area. Loggerhead turtles are not reported to be resident in the Abrolhos Islands, however reproductive adults may be encountered migrating through the region (DSEWPaC 2012b). Therefore, it is possible that the loggerhead turtle may visit the MWADZ proposal area (Table C.5).

C.3.2 Leatherback turtles

The leatherback turtle is found in tropical, subtropical and temperate waters throughout the world, and has been observed foraging in all Australian waters (DoE 2014b). Primarily in pelagic and coastal waters of all Australian states, leatherback turtles feed on marine invertebrates (such as jellyfish and tunicates), most commonly in areas of upwelling or convergence where primary productivity is high (DoE 2014b). Leatherback turtles are most commonly observed foraging in the mid- to south-west WA regions (DEWHA 2008). There are records of leatherback turtles being entangled in crayfish pot ropes at the Abrolhos Islands; therefore, it is likely this species may visit the MWADZ proposal area (Table C.5).

C.3.3 Green turtles

Green turtles are found in tropical and subtropical waters globally. WA supports one of the largest green turtle populations in the world, with ~20,000 turtles comprising three genetically distinct stocks from the north-west WA (DoE 2014b). Resident green turtles primarily feed on seagrass and algae in shallow benthic environments and regularly feed around the Abrolhos Islands reefs, which is recognised as an important foraging area (DEWHA 2008). In WA, telemetry data documented green turtles feeding up to 200–1000 km away from nesting beaches (DoE 2014b). Green turtles have been observed at the reefs of the Abrolhos Islands (DEWHA 2008). Moreover, the Abrolhos Islands and surrounding waters have been documented by the Commonwealth Government as a regionally important foraging area for the green turtle (DEWHA 2008). Therefore, green turtles are likely to occur within the MWADZ proposal area (Table C.5).

C.3.4 Flatback turtles

Flatback turtles are endemic to subtropical and tropical waters of Australia, Papua New Guinea and Irian Jaya, with nesting activity confined to Australia (Limpus 2007, DoE 2014b). They are

commonly found in turbid water over soft-bottom habitats in shallow, nearshore waters (DoE 2014b). Without a pelagic phase or global distribution, flatback turtles will mature and remain in shallow coastal waters that are close to their natal beaches (DSEWPaC 2012b). However, flatback turtles are not expected to occur in the mid-west region or south of Exmouth, WA (Limpus 2007). Therefore, their likelihood of occurrence in the MWADZ proposal area is remote (Table C.5).

C.4 Likelihood of marine turtles within MWADZ proposal area

The likelihood of marine turtles occurring within the MWADZ proposal area is outlined in Table C.5, with likelihood definitions prescribed from Fletcher 2014 (Table C.2).

Table C.5 Likelihood of marine turtle occurrences within the proposal area

Common name	Occurrence in proposal area
Loggerhead turtle	Possible
Leatherback turtle	Likely
Green turtle	Likely
Flatback turtle	Remote

Source: Fletcher 2014

D. Potential for adverse interactions

D.1 Marine mammals and turtles

The following section briefly describes the potential environmental impacts that may occur to marine mammals and turtles within the MWADZ proposal area. This information is based on a literature review of the best available scientific data. Potential environmental impacts on marine mammals and turtles may result from the following aspects of the proposed aquaculture cages:

- physical presence of the aquaculture cages;
- vessel movements; and
- artificial light.

The potential environmental impacts that may result from these aspects are described in the following sections.

D.1.1 Physical presence of aquaculture cages

The physical presence of aquaculture farms could attract larger marine predators by concentrating fish within the sheltered water, and thereby alter the natural marine environment of MWADZ proposal area. Potentially adverse impacts on local, marine mammal populations may include:

- changes in natural feeding behaviour as a result of higher fish density;
- serious injury or mortality due to aquaculture structures and/or poor mitigation methods
- inadvertent secondary effects on target species or other species due to aquaculture structures and/or mitigation methods
- habitat changes; and
- changes to marine fauna distribution and migration patterns.

In Australia, the history of marine mammal predation on fish farms spans more than 25 years, with pinniped species being the most vulnerable to potential impacts (Pemberton et al. 1991, Kemper et al. 2003). Pinniped predation most commonly involves fur seals and sea lions, but with rare interactions of leopard and elephant seals (Kemper et al. 2003). Fish stock in marine

aquaculture is likely to act as an attractant to pinnipeds, which may develop complex predation techniques, depending on predator and prey species and ranging from damaging nets and cages to entering enclosed structures and feeding on fish inside (Kemper et al. 2003). By altering their natural foraging behaviours, attempts to predate on fish within marine aquaculture cages may occur all year round with seasonal or daily patterns and result in serious injury and mortality to pinnipeds (Vilata et al. 2010).

Cetaceans may be attracted to fish farms to feed on fish inside the cages and other fish attracted to the marine farms (Diaz Lopez et al. 2005, Wursig & Gailey 2002). Noise may be an issue particularly during installation of the anchoring system for aquaculture sea-cages (DoF 2009). However, anchoring and relocation is expected to be infrequent and could be timed not to coincide with migratory pathways for sensitive species. Any impacts from noise are expected to be short-term and infrequent (DoF 2009) and therefore negligible.

Seals and sea lions have been entangled in cage nets, anchor lines and anti-predator nets. Entanglements generally result from large mesh sizes (>15 cm), unrepaired holes, open bottom nets and loose or baggy nets (Kemper et al. 2003).

Pinniped interactions are estimated to increase up to 10 times when fish farms are located within 30 km from significant haul-out sites. At Port Lincoln, South Australia, tuna feedlots were located within 25 km to the second-largest, Australian sea lion breeding colony at Dangerous Reef, resulting in a high level of pinniped interaction and predation (Kemper et al. 2003).

Recent analyses revealed that WA sea lion populations are extremely vulnerable to any additional level of mortality, the impacts of which may include reduced survival rates and population decline, which could lead to an increased extinction risk for the species (Campbell 2008). Habitat degradation and interactions with aquaculture operations were identified as significant factors contributing to the lack of recovery for the species (DSEWPaC 2013a, b). Therefore, any threat of incidental mortality, may significantly affect the population of Australian sea lions in the proposal area.

Dolphins and whales have a history of adverse interactions with marine fish farms. In the Mediterranean Sea, common bottlenose dolphins forage opportunistically around fish cages (Lopez & Shirai 2007). There has also been a high rate of incidental dolphin captures within loose, anti-predator nets with large mesh sizes (>15 cm), leading to entanglement and fatality (Kemper et al. 2003). To potentially mitigate entanglements a net mesh size of 6 cm is recommended (Schotte & Pemberton 2002). Furthermore, a an ecosystem-based model evaluating bottlenose dolphin interactions in the Mediterranean Sea, concluded that highly productive waters around open sea-cages altered the foraging strategies of bottlenose dolphins (Piroddi et al. 2011). In Australia, non-fatal and fatal entanglements in anti-predator nets with mesh sizes >15 cm have been documented (Kemper et al. 2003).

Aquaculture farms have occasionally recorded adverse impacts to large baleen whales, with a humpback whale trapped within an aquaculture cage in Port Lincoln, and an unidentified whale collision with a salmon cage and possible entanglement with its anchoring lines (Pemberton et al. 1991, Kemper et al. 2003). Between 1982 and 2010, five humpback whales were entangled in WA aquaculture gear for abalone, pearl and mussel (Groom & Coughran 2012).

The presence of the MWADZ is expected to lead to localised nutrient enrichment of the waters near the sea-cages, and organic enrichment of sediments beneath the sea-cages. Nutrient enrichment has been identified as a management concern for marine turtles and dugongs (DSEWPaC 2012b), and inputs of organic materials may alter light levels and lead to algal

blooms (Bouwan et al. 2013). Risks associated with key water column contaminants, dissolved inorganic nitrogen (DIN) and suspended particles were examined as part of the broader EIA for this proposal (NMT Oceanica 2015a). DIN was examined the context of algal growth potential, nutrient enrichment and shading.

Based on the results of modelling, concentrations of DIN down-current of the sea-cages were predicted to increase with biomass and increasing stocking density. However, the plumes dissipated rapidly, with concentrations returning to levels consistent with a high level of ecological protection inside the southern MWADZ boundary, and within 2.3 km of the northern MWADZ boundary. Despite large inputs of DIN to the system, none of the scenarios resulted in significant changes to the chlorophyll-a concentrations in the broader project area. Similar results were obtained with respect to light and water column dissolved oxygen levels. The extent of light reduction (or shading) is largely associated with the extent of particles in the water, a proportion of which is phytoplankton. Although the proposal presents conditions under which phytoplankton may flourish, thus also increasing light attenuation, none of the modelled scenarios predicted changes in chlorophyll-a concentrations and calculated light and dissolved oxygen conditions were not affected.

A small proportion on the MWADZ will be occupied by sea-cages and associated infrastructure, including support vessels, anchor lines and anchors on/in the seabed. Marine mammals and turtles may temporarily be disturbed by infrastructure or their movements may be disrupted as they attempt to avoid contact with the infrastructure.

D.1.2 Vessel movements

The proposal will be serviced by a number of small vessels. The vessels will be used for routine operations, such as maintenance, feeding and harvesting. The use of service vessels may lead to injuries and mortalities through collisions and/or changes in behaviour disturbance from noise) impact marine mammals and turtles, particularly when operating at speeds. The risk of collision increases when vessels travel at speeds greater than 15 knots (Vanderlaan & Taggart 2007). Generally, dolphin species avoid moving vessels, although large whales and turtles may not respond to approaching vessels depending on their activity at the time.

Behavioural disturbance may include avoidance, swimming speed changes, evasive dives, breathing changes and aggression (DEH 2006). Within the species range, vessel collisions have incidentally injured or killed dugongs while feeding in shallow inshore waters. Dugongs are known to habituate to vessel traffic and disturbance, thereby increasing the likelihood for collisions and injuries (DSEWPaC 2012c). While dugongs are unlikely to be encountered within the MWADZ proposal area, management measures to reduce the likelihood of adverse impacts may include restrictions on approach distance and speed limits, as per the Australian National Guidelines for Whale and Dolphin Watching 2005 (DEH 2006).

D.1.3 Artificial light

For safety and operational reasons, the aquaculture cages may require lighting at night. Artificial lighting may cause adverse environmental impacts to marine fauna by disrupting their natural behaviour through disorientation, attraction or avoidance (EPA 2010). While nesting is not known to occur at the Abrolhos Islands, adult female turtles are known to avoid nesting at beaches with artificial light, and any hatchlings depend on natural light to navigate to the open sea and risk dehydration and predation if misguided by artificial light.

E. Potential mitigation and management measures

Potential mitigation and management measures are summarised below based on a comprehensive review of literature undertaken during the EIA process. Further, more detailed recommendations are provided in the MWADZ EMMP (BMT Oceanica 2015).

Experience gained in Australia and in other parts of the world has resulted in significant advances in knowledge of aquaculture environmental management, including in the development of methods for both minimising risks and managing residual risks. Examples of the mitigation and management measures are provided in Table E.1. The management strategies listed here are proactive management strategies to be employed during routine operations, and/or incorporated into the aquaculture infrastructure.

Table E.1 Summary of project aspects, potential environmental impacts and possible management measures

Project Aspect	Potential Environmental Impact	Possible Management Measures
Aquaculture cage	Feeding behaviour change Serious injury or mortality Habitat change	Anti-predator nets (mesh size <15 cm) Constant maintenance and monitoring Controlled feeding regimes to minimise waste and prompt removal of dead stock Use of semi-rigid or well tensioned net material Adequate distance from known fauna habitats High walled sea-cages to prevent pinniped access
Aquaculture activities	The availability of supplementary food (stock feed) may change feeding behaviour Noise associated with the installation of cages may cause behavioural disturbances	Controlled feeding regimes – to minimise feed waste Prompt removal of dead stock Noise levels at all times will be within Environment Protection (Noise) Regulations thresholds and it is preferential to install the cages outside of humpback whale southern migratory months (given humpback whales are the only “likely” migratory cetacean)
Vessel movements	Serious injury or mortality Behavioural disturbance	Do not approach within 100 m of a whale and 50 m of a dolphin Do not approach calves or pods with calves Move at slow speed (<15 knots) Avoid sudden/repeated changes in direction Avoid sudden/excessive noise Allow fauna to move in against the shore
Lighting disturbance	Behavioural disturbance through: • disorientation • attraction • avoidance of important habitats	Reduce intensity of artificial light Use long-wavelength lights
Environmental quality	Toxicity Regional eutrophication	Water quality monitoring Sediment quality monitoring

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Australian Government

Department of the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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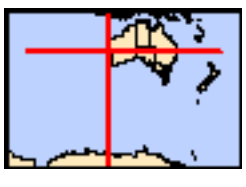

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	27
Listed Migratory Species:	37

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	63
Whales and Other Cetaceans:	31
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	2

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	10
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	3
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	4

Details

Matters of National Environmental Significance

National Heritage Properties [Resource Information]

Name	State	Status
Historic		
Batavia Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos	WA	Listed place

Commonwealth Marine Areas [Resource Information]

Approval may be required for a proposed activity that is likely to have a significant impact on the environment in a Commonwealth Marine Area, when the action is outside the Commonwealth Marine Area, or the environment anywhere when the action is taken within the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to a Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
South-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Diomedea epomophora epomophora		
Southern Royal Albatross [25996]	Vulnerable	Species or species habitat may occur within area
Diomedea epomophora sanfordi		
Northern Royal Albatross [82331]	Endangered	Species or species habitat may occur within area
Diomedea exulans amsterdamensis		
Amsterdam Albatross [82330]	Endangered	Species or species habitat may occur within area
Diomedea exulans exulans		
Tristan Albatross [82337]	Endangered	Species or species habitat may occur within

Name	Status	Type of Presence
		area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Turnix varius scintillans Painted Button-quail (Houtman Abrolhos) [82451]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Breeding known to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias		
Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Breeding known to occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto)		
Southern Royal Albatross [1072]	Vulnerable*	Species or species habitat may occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered*	Species or species habitat may occur within area
Macronectes giganteus		
Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli		
Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus pacificus		
Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Sterna anaethetus		
Bridled Tern [814]		Breeding known to occur within area
Sterna caspia		
Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii		
Roseate Tern [817]		Breeding known to occur within area
Thalassarche carteri		
Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may

Name	Threatened	Type of Presence
		occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus		
Sperm Whale [59]		Species or species habitat may occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Anous stolidus		
Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Catharacta skua		
Great Skua [59472]		Species or species habitat may occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena		
Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto)		
Southern Royal Albatross [1072]	Vulnerable*	Species or species habitat may occur within area
Diomedea exulans (sensu lato)		
Wandering Albatross [1073]	Vulnerable	Species or species habitat may occur within area
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered*	Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding likely to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus assimilis Little Shearwater [59363]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Puffinus huttoni Hutton's Shearwater [1025]		Foraging, feeding or related behaviour known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area

Name	Threatened	Type of Presence
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Breeding known to occur within area
Reptiles		
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat may occur within area

Name	Status	Type of Presence
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Commonwealth Reserves Marine	[Resource Information]
Name	Label
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	Special Purpose Zone (IUCN VI)

Extra Information

Places on the RNE	[Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Houtman Abrolhos Islands Reserve	WA	Registered
Houtman Abrolhos Marine Area	WA	Registered
Historic		
Batavia Shipwreck	WA	Registered
Ben Ledi Shipwreck	WA	Registered
Hadda Shipwreck	WA	Registered
Marten Shipwreck	WA	Registered
Ocean Queeen Shipwreck	WA	Registered
Ruins of Huts on West Wallabi Island	WA	Registered
Windsor Shipwreck	WA	Registered
Zeewijk Shipwreck	WA	Registered

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Mammals		
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Plants		
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 90-120m depth	South-west
Commonwealth marine environment surrounding	South-west
Western demersal slope and associated fish	South-west
Western rock lobster	South-west

Coordinates

-28.66667 113.85

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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