



Technical Appendix C6

Protected Marine Species

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GORGON DEVELOPMENT ON BARROW ISLAND

TECHNICAL REPORT

PROTECTED MARINE SPECIES

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1 Introduction

ChevronTexaco Australia Pty Ltd (ChevronTexaco) and its joint-venture partners, Shell Development Australia and Mobil Australia Resources Company (Gorgon JointVenturers) propose to develop a gas processing facility on Barrow Island. A description of the proposal is contained within the main report.

In order to assist with the assessment of the environmental implications of this venture, ChevronTexaco engaged RPS Bowman Bishaw Gorham to conduct a literature review of protected marine species occurring within the proposed development area. This report describes the results of the literature review, combined with opportunistic field observations recorded as part of the marine ecological surveys. This information was used in the environmental risk assessment for the proposed development, as described in Chapter 11 of the main report.

2 Methodology

Methods used for this report include:

- desktop review of the available literature on marine species
- liaison with APPEA, Department of Environment and Heritage, Department of Conservation and Land Management, Department of Fisheries, Department of Industry and Resources and the Department of Environment (Western Australia)
- liaison with research personnel (independent researchers, universities and the Western Australian Museum)
- review of existing in-house information and previous surveys undertaken in the region by Bowman Bishaw Gorham, including the North West Shelf Environmental Resource Atlas (Bowman Bishaw Gorham 1995)
- opportunistic observations collected during field surveys for the Gorgon Development.

Field surveys investigating intertidal and marine ecology and assessing the conservation significance of areas pertaining to the Gorgon Development were undertaken during August 2002, January 2003 and January 2004. The surveys included investigations of the supratidal, intertidal and marine areas on the east and west coasts, at locations likely to be affected by the development and operation of the proposed marine facilities. During these field surveys the presence of larger protected marine species was noted.

The marine facilities and operations of the Gorgon development on Barrow Island that will potentially impact marine species include:

- the Gorgon gas field development and pipeline to Barrow Island (west coast)
- materials offloading jetty, dredged channel and product loading facilities (east coast)
- dredged spoil disposal
- domestic gas pipeline route (east coast).

This report comprises a review of the available information describing protected marine species found in the Barrow Island area. Discussion of these species' habitat, behaviour and diet is also incorporated in the review.

The ecology, occurrence, and conservation status of seabirds and shorebirds is addressed separately (refer Appendix C3).

3 Regional Marine Environment

The Rowley Shelf is a large sedimentary shelf in the West Pilbara, mainly in the geological province known as the Carnarvon Basin. Barrow Island, the Montebello Islands and the Lowendal Islands are the most offshore of the southern Rowley Shelf islands. These islands are separated from the inner part of the Rowley Shelf by the Flinders Fault and collectively form the Barrow-Montebello Complex (Wilson et al. 1994). The Barrow Island system emerges as a north-tending promontory extension of the Rowley Shelf. This island system comprises Trealla limestone, flanked and veneered by Pleistocene and Holocene sediment deposits (LeProvost et al. 1987).

Offshore tropical open waters are typically nutrient-impooverished and therefore generally support limited marine life. Inshore tropical waters typically support more developed communities with large species diversity. Marine environments around Barrow Island include a mix of limestone pavements, reefs and sands and support a diverse faunal assemblage. The Western Australian Museum has identified 500 species of reef fish on northern Ningaloo Reef and the Muiron Islands, over 600 species at the Rowley Shoals, 457 species at the Montebello Islands and 335 species from the Dampier Archipelago (Hutchins 1994; Allen 1998). Barrow Island waters are expected to support a similar suite of fishes to those found at the Montebello Islands.

Soft sediment habitats generally support limited vertebrate species but include a diverse assemblage of burrowing and crawling invertebrate infauna. Fine sediments generally accumulate in low energy areas and these generally support more diverse and abundant infaunal assemblages.

4 Marine Reserves and Conservation Parks

The purpose of marine reserves is to ensure that representative marine habitats and ecosystems are preserved within an environmentally robust management framework. The marine environments associated with the Barrow, Lowendal and Montebello Islands are proposed to become a marine conservation area and be included within such a management framework. The proposal for the Montebello/Barrow Island marine conservation reserves includes separate marine parks incorporating all of the Montebello Islands, Biggada Reef and Bandicoot Bay at Barrow Island and a marine management area, including the remainder of Barrow Island and the Lowendal Islands.

All of the islands in the region are either nature reserves or conservation parks. Barrow Island is a Class A nature reserve. Reserve boundaries extend to the low water mark, therefore all fauna and flora in the intertidal zones on Barrow Island are protected within the Class A nature reserve. The following terrestrial reserves are located within 50 km of Barrow Island: Boodie Double Middle Islands Nature Reserve, Great Sandy Island Nature Reserve, Lowendal Nature Reserve and Montebello Islands Conservation Park.

All marine conservation reserves in Western Australia extend to a depth of 200 m below the seabed. The airspace above a reserve is not height limited (EPA 2003). In terms of the operation of the Western Australian *Conservation and Land Management Act 1984* (CALM Act), the airspace above terrestrial national parks and reserves is not explicitly considered to be a part of those reserves (EPA 2003).

Under the CALM Act and the New Horizons policy (Government of Western Australia 1997) there are classes of marine conservation reserves in which petroleum drilling and production are

not permitted and there are terrestrial areas which are not available for exploration and production activities (EPA 2003).

5 Protected Marine Species

5.1 Legislation and International Conventions

5.1.1 Environment Protection and Biodiversity Conservation Act 1999

Fauna designated as threatened or migratory under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) are protected by that act. A number of marine species in Commonwealth waters are listed as protected marine species. Species are also protected from activities outside of these areas that are likely to affect critical populations in Commonwealth waters.

The EPBC Act has very specific ‘triggers’, related to defined matters considered to have National Environmental Significance (NES). Under the EPBC Act, a proponent is required to refer to the Department of Environment and Heritage for assessment, on behalf of the Commonwealth Minister for Environment and Heritage (under Part 9 of the Act), any action that is likely to significantly impact a matter of NES.

Of the seven NES matters identified within the EPBC Act that trigger the Commonwealth assessment and approvals regime, three are of particular relevance to the proposed Gorgon development. These matters are:

- listed threatened species
- listed migratory species
- Commonwealth marine areas.

The distributions of threatened or migratory marine fauna that may be affected by offshore activity are restricted and frequently have seasonal variations. Listed migratory species cover a broad range of species with different life cycles and population sizes. Consequently, what is an ecologically significant proportion of the population varies for each species, and therefore each circumstance needs to be evaluated. Appropriate planning can often be applied to reduce the likelihood of activities causing significant environmental impacts, as defined by the EPBC Act.

Factors considered include whether the species is endangered; whether the activities would be in a migratory path adjacent to a feeding, breeding or resting area; whether calves or pregnant females may be affected and whether significant numbers (relative to the species or populations) of the species may be affected.

5.1.2 Wildlife Conservation Act 1950

All native vertebrates are protected under the Western Australian *Wildlife Conservation Act 1950*. All species are wholly protected throughout Western Australia at all times.

5.1.3 Fish Resources Management Act 1994

The Western Australian *Fish Resources Management Act 1994* (the FRM Act) and the *Fish Resources Management Regulations 1995* aim to conserve, develop and share the fish resources of the state for the benefit of present and future generations. The Act and Regulations aim to conserve fish

and protect their environment. To that end, some fish species of particular conservation concern are protected within the Act and Regulations.

5.1.4 International Conventions

(IUCN) – Red List of Threatened Species

The IUCN Red List of Threatened Species (IUCN Red List) provides taxonomic, conservation status and distribution information on taxa that have been evaluated using the IUCN Red List Categories and Criteria. The main purpose of the IUCN Red List is to catalogue and highlight those taxa facing a higher risk of global extinction (those listed as Critically Endangered, Endangered and Vulnerable) and this system is designed to determine the relative risk of extinction. The IUCN Red List also includes information on taxa that cannot be evaluated because of insufficient information (Data Deficient) and on taxa that are either close to meeting the threatened thresholds, or that would be threatened, were it not for an ongoing taxon-specific conservation programme (Near Threatened).

Bonn Convention

The Bonn Convention provides a framework for the conservation and management of migratory species (including waterfowl and other wetland species) and promotion of measures for their conservation including habitat conservation. Conservation of these habitats is one of the principle actions taken for endangered species as listed under the Bonn Convention and for species or groups of species which are the subject of Agreements under the Bonn Convention.

CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement aimed at ensuring that international trade in specimens of wild animals and plants does not threaten their survival.

5.2 Listed Marine Species

A list of protected marine fauna that may occur within the study area is provided in Table 5-1. These include:

- fish – 37 species
- mammals (cetaceans, whales, dolphins and dugong) - 45 species
- reptiles – 20 species.

The likely occurrence of these animals in the Barrow Island area, in particular their use of areas that will potentially be influenced by the proposed development, is described in Section 6.

Table 5-1 - Protected Fish, Mammals and Reptiles (and their Conservation Status) Possibly Occurring in the Vicinity of Barrow Island

Common Name	Scientific Name	Conservation Status				CITES ⁶
		Commonwealth ¹	State ^{2,3}	IUCN ⁴	Bonn Convention ⁵	
Fish						
Grey nurse shark	<i>Carcharias taurus</i>	V	S1 ²	V		
Great white shark	<i>Carcharodon carcharias</i>	V	S1 ² , S2 ³	V		III
Whale shark	<i>Rhincodon typus</i>	V	S2 ³	V	II	
Beady pipefish, steep-nosed pipefish	<i>Hippichthys penicillatus</i>	L				(II)
Bend stick pipefish, short-tailed pipefish	<i>Trachyrhamphus bicaracatus</i>	L				(II)
Blue-finned ghost pipefish, robust ghost pipefish	<i>Solenostomus cyanopterus</i>	L				(II)
Braun's pughead pipefish, pug-headed pipefish	<i>Bulbonaricus brauni</i>	L				(II)
Brook's pipefish	<i>Halicampus brocki</i>	L				(II)
Cleaner pipefish, Janss' pipefish	<i>Doryrhamphus janssi</i>	L				(II)
Double-ended pipehorse/ pipefish, alligator pipefish	<i>Syngnathoides biaculeatus</i>	L		DD		(II)
Flagtail pipefish, negros pipefish	<i>Doryrhamphus negrosensis</i>	L				(II)
Flat-face seahorse	<i>Hippocampus planifrons</i>	L		V		II
Glittering pipefish	<i>Halicampus nitidus</i>	L				(II)
Helen's pygmy pipefish	<i>Acentronura larsonae</i>	L				(II)
Indonesian pipefish, Gunther's pipehorse	<i>Solegnathus lettiensis</i>	L		V		(II)
Ladder pipefish	<i>Festucallex scalaris</i>	L				(II)
Leafy seadragon	<i>Phycodurus eques</i>		S2 ³	DD		(II)
Long-nosed pipefish, straight stick pipefish	<i>Trachyrhamphus longirostris</i>	L				(II)
Many-banded or banded pipefish	<i>Doryrhamphus multiamulatus</i>	L		DD		(II)
Mud pipefish, Gray's pipefish	<i>Halicampus greyi</i>	L				(II)
Muiron Island pipefish	<i>Cheoichthys latispinosus</i>	L				(II)

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Common Name	Scientific Name	Conservation Status				IUCN ⁴	Bonn Convention ⁵	CITES ⁶
		Commonwealth ¹	State ^{2,3}					
Pacific short-bodied pipefish, short-bodied pipefish	<i>Choerichthys brachysoma</i>	L					(II)	
Pig-snouted pipefish	<i>Choerichthys suttus</i>	L					(II)	
Pipehorse, Hardwicke's pipefish, pallid seahorse	<i>Solegnathus hardwickii</i>	L			V		(II)	
Potato cod	<i>Epinephelus tukala</i>		S2 ³					
Queensland groper	<i>Epinephelus lanceolatus</i>		S2 ³					
Ribboned seadragon, ribboned pipefish	<i>Haliichthys taeniophorus</i>	L					(II)	
Ringed pipefish	<i>Doryrhamphus dactylophorus</i>	L					(II)	
Rock pipefish	<i>Phoxocampus belcheri</i>	L					(II)	
Spiny seahorse	<i>Hippocampus histrix</i>	L			DD		II	
Spiny-snout pipefish	<i>Halicampus spinirostris</i>	L					(II)	
Spotted seahorse, yellow seahorse	<i>Hippocampus kuda</i>	L			V		II	
Three-keel pipefish	<i>Campichthys tricarinatus</i>	L					(II)	
Tidepool pipefish	<i>Micrognathus micronotopterus</i>	L					(II)	
Tiger pipefish	<i>Filicampus tigris</i>	L					(II)	
Western spiny seahorse, narrow-bellied seahorse	<i>Hippocampus angustus</i>	L			DD		II	
Weedy seadragon	<i>Phyllopteryx taeniolatus</i>				DD		(II)	
Mammals: Dugong								
Dugong	<i>Dugong dugon</i>	V	S4 ²		V	II		
Mammals: Baleen Whales								
Southern right whale	<i>Eubalaena australis</i>	E (C)	S1 ²		LR	I	I	
Blue whale	<i>Balaenoptera musculus</i>	E (C)	S1 ²		E		I	
Pygmy blue whale	<i>Balaenoptera musculus brevicauda</i>	(C)			E	II	I	
Bryde's whale	<i>Balaenoptera edeni</i>	(C)			DD	II	I	

Common Name	Scientific Name	Conservation Status				IUCN ⁴	Bonn Convention ⁵	CITES ⁶
		Commonwealth ¹	State ^{2,3}					
Fin whale	<i>Balaenoptera physalus</i>	V (C)	S1 ²		E	II	I	
Humpback whale	<i>Megaptera novaeangliae</i>	V (C)	S1 ²		V	I	I	
Minke whale	<i>Balaenoptera acutorostrata</i>	(C)			LR		I	
Sei whale	<i>Balaenoptera borealis</i>	V (C)	S1 ²		E	II	I	
Mammals: Beaked and Toothed Whales								
Andrews' beaked whale	<i>Mesoplodon houndmani</i>	(C)			DD		II	
Arnoux's beaked whale	<i>Berardius arnuxii</i>	(C)			DD		I	
Strap-toothed beaked whale	<i>Mesoplodon layardii</i>	(C)			DD		II	
Blainville's beaked whale	<i>Mesoplodon densirostris</i>	(C)			DD		II	
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	(C)			DD		II	
Dwarf sperm whale	<i>Kogia simus</i>	(C)			DD			
Ginkgo-toothed beaked whale	<i>Ziphius cavirostris</i>	(C)			DD		II	
Gray's beaked whale	<i>Mesoplodon grayi</i>	(C)			DD		II	
Hector's beaked whale	<i>Mesoplodon hectori</i>	(C)			DD		II	
Longman's beaked whale	<i>Mesoplodon pacificus</i>	(C)			DD		II	
Melon-headed whale	<i>Peponocephala electra</i>	(C)			DD		II	
Pygmy sperm whale	<i>Kogia breviceps</i>	(C)			DD			
Shepherd's beaked whale	<i>Tasmacetus shepherdi</i>	(C)			DD		II	
Southern bottlenose whale	<i>Hyperoodon planifrons</i>	(C)			DD		I	
Sperm whale	<i>Physeter macrocephalus</i>	(C)			DD	I	I	
True's beaked whale	<i>Mesoplodon mirus</i>	(C)			DD		II	
Mammals: Dolphins								
Killer whale	<i>Orcinus orca</i>	(C)			DD	II	II	
False killer whale	<i>Pseudorca crassidens</i>	(C)			DD		II	

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Common Name	Scientific Name	Conservation Status				IUCN ⁴	Bonn Convention ⁵	CITES ⁶
		Commonwealth ¹	State ^{2,3}					
Long-finned pilot whale	<i>Globicephala melas</i>	(C)			DD	II	II	
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	(C)			DD		II	
Pygmy killer whale	<i>Feresa attenuata</i>	(C)			DD		II	
Bottlenose dolphin	<i>Tursiops truncatus s. str.</i>	(C)			DD	II	II	
Common dolphin	<i>Delphinus delphis</i>	(C)			DD	II	II	
Dusky dolphin	<i>Lagenorhynchus obscurus</i>	(C)			DD	II	II	
Fraser's dolphin	<i>Lagenodelphis hosei</i>	(C)			DD	II	II	
Indo-Pacific humpbacked dolphin	<i>Sousa chinensis</i>	(C)			DD		I	
Irrawaddy dolphin	<i>Orcaella brevirostris</i>	(C)			DD	II	II	
Pantropical spotted dolphin	<i>Stenella attenuata</i>	(C)			DD	II	II	
Risso's dolphin	<i>Grampus griseus</i>	(C)			DD	II	II	
Rough-toothed dolphin	<i>Steno bredanensis</i>	(C)			DD		II	
Southern right whale dolphin	<i>Lissodelphis peronii</i>	(C)			DD		II	
Spinner dolphin	<i>Stenella longirostris</i>	(C)			DD	II	II	
Spotted bottlenose dolphin	<i>Tursiops aduncus</i>	(C)			DD	II		
Spotted dolphin	<i>Stella attenuata</i>	(C)			DD			
Striped dolphin	<i>Stenella coeruleoalba</i>	(C)			DD	II	II	
Reptiles								
Loggerhead turtle	<i>Caretta caretta</i>	E	S1 ²		E	I & II	I	
Flatback turtle	<i>Natator depressus</i>	V	S1 ²		DD	II	I	
Green turtle	<i>Chelonia mydas</i>	V	S1 ²		E	I & II	I	
Hawksbill turtle	<i>Eretmochelys imbricata</i>	V	S1 ²		CE	I & II	I	
Leathery turtle, leatherback turtle	<i>Dermochelys coriacea</i>	V	S1 ²		CE	I & II	I	
Olive ridley turtle	<i>Lepidochelys olivacea</i>	E	S1 ²		E	I & II	I	

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Common Name	Scientific Name	Conservation Status				
		Commonwealth ¹	State ^{2,3}	IUCN ⁴	Bonn Convention ⁵	CITES ⁶
Horned seasnake	<i>Acalyptophis peronii</i>	L				
Short-nosed seasnake	<i>Aipysurus apraefrontalis</i>	L				
Dubois' seasnake	<i>Aipysurus daboisii</i>	L				
Spine-tailed seasnake	<i>Aipysurus eydouxii</i>	L				
Olive seasnake	<i>Aipysurus laevis</i>	L				
Stokes' seasnake	<i>Astrotia stokesii</i>	L				
Spectacled seasnake	<i>Diasteira kingii</i>	L				
Olive-headed seasnake	<i>Diasteira major</i>	L				
Turtle-headed seasnake	<i>Emydocephalus annulatus</i>	L				
North-western mangrove seasnake	<i>Ephalophis greyi</i>	L				
Fine-spined seasnake	<i>Hydrophis ezelukoni</i>	L				
Elegant seasnake	<i>Hydrophis elegans</i>	L				
Seasnake	<i>Hydrophis ornatus</i>	L				
Yellow-bellied seasnake	<i>Pelamis platurus</i>	L				

¹Commonwealth – Environment Protection and Biodiversity Conservation Act 1999

CE – Critically Endangered (NES), E – Endangered (NES), V – Vulnerable (NES), L – Listed, (C) – Cetacean, M – Migratory, MM – Migratory Marine – (NES – Matters of National Environmental Significance)

² State - Wildlife Conservation Act 1950

S1 – Schedule 1, fauna that are rare or likely to become extinct, S2 – Schedule 2, fauna presumed to be extinct, S4 – Schedule 4, other specially protected fauna

³ State - Fish Resources Management Act, 1994

Listed in Fish Resources Management Regulation, 1995, Schedule 2, Part 2, totally protected fish

⁴ International Union for the Conservation of Nature and Natural Resources (IUCN) – Red List of Threatened Species: CE – Critically Endangered, E – Endangered, V – Vulnerable, LR – Lower Risk – classified as either conservation dependent (CD) or near threatened (NT), DD – Data Deficient –insufficient knowledge to determine threatened status.

⁵Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention): I – Appendix I, Endangered Migratory Species, II – Appendix II, Migratory Species.

⁶Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES 2000): I - Appendix I, species threatened with extinction. II - Appendix II, includes species not necessarily threatened with extinction, but in which trade must be controlled to avoid utilisation incompatible with their survival. III - Appendix III includes all species which any Party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the cooperation of other Parties in the control of trade. Parentheses indicates the species are proposed for listing at the time of writing this report.

6 Occurrence of Protected Marine Species near Barrow Island

6.1 Fish

6.1.1 Conservation Significance and Protection Status

Some species of fish known to occur around Barrow Island are afforded protection under the EPBC Act and are specially protected under Schedule 1, Division 5 (Fish) of the Wildlife Conservation Act as animals that are rare or likely to become extinct.

Large fish of the family Serranidae, commonly termed grouper or cod, are considered vulnerable to exploitation. All potato cod (*Epinephelus tukula*) are protected under the FRM Act, as are all serranids greater than 1200mm in total length or 30kg in weight.

Fish in the family Syngnathidae include seahorses, pipefish, pipehorses and seadragons. All syngnathids and solenostomids (ghost pipefish) are listed as marine species under Part 13, s248 of the EPBC Act and are protected in Commonwealth waters (NSW Fisheries 2003a). The entire genus of *Hippocampus* (seahorses) is listed under Appendix II of CITES to improve the management of international trade. Consideration is currently being given to listing the entire family of Syngnathids under Appendix II of CITES (NSW Fisheries 2003b).

The weedy seadragon (*Phyllopteryx taeniolatus*) and the leafy seadragon (*Phycodurus eques*) are both protected under the *Commonwealth Fisheries Administration Act 1991* (FA Act) and are listed on the IUCN Red List of Threatened Animals due to the lack of information on the species. The leafy seadragon is also protected under the FRM Act.

6.1.2 Sharks

Protected species of sharks that may occur near Barrow Island include grey nurse sharks, great white sharks and whale sharks.

Grey nurse sharks (*Carcharias taurus*) are regionally widespread and are relatively common on Ningaloo Reef and presumably also in the waters surrounding Barrow Island. The grey nurse shark was listed in August 2000 as Vulnerable under the EPBC Act. This species is also protected under the Wildlife Conservation Act, Schedule 1 and listed on the IUCN Red List of Threatened Animals as Vulnerable worldwide. Their life-history and reproductive strategies, such as their preference for inshore rocky reef habitats and their tendency to aggregate, make them particularly vulnerable to human-induced pressures (NSW Fisheries 2002).

The great white shark (*Carcharodon carcharias*) is protected under the EPBC Act, where it is listed as Vulnerable. It is also protected under the Wildlife Conservation Act, under Schedule 1, and is assessed as Vulnerable by the IUCN. Great white sharks have a global distribution and are thought to have local populations that show some evidence of migratory behaviour. This species is thought to have a low reproductive rate and the estimated Australian population is fewer than 10 000 mature individuals (CITES). These sharks are protected from commercial fishing in Western Australian waters.

A great white shark was observed in Exmouth Gulf in 2003, so they may also occasionally visit the Barrow Island area. It is highly unlikely that any great white sharks will be vulnerable to impact by the proposed development.

Whale sharks (*Rhincodon typus*) migrate to the Ningaloo Reef each year between January and August. Whale sharks have also been observed ranging from Shark Bay to the Dampier Archipelago and would certainly occur, at times, in the area of the proposed development. The migration destinations of the whale sharks encountered on Ningaloo reef are the subject of ongoing research, but details of life history are presently very limited.

6.1.3 Seadragons

Two species of seadragon occur in Australia, the 'common' or weedy seadragon (*Pyllopteryx taeniolatus*) and the leafy seadragon (*Phycodurus eques*). Both are protected under the FA Act and are listed on the International Red List of Threatened Animals, primarily due to the lack of information on these species. Both are distinguished by leafy appendages or seaweed like camouflage and by having a stiff, non-prehensile tail.

Both the leafy seadragon and the weedy seadragon inhabit rocky reefs, seaweed beds, seagrass meadows and structures colonised by seaweed. Leafy seadragons are often found living in *Sargassum* seaweed, which is mimicked by the animal's leaf-like appendages. The seadragons' diet mainly consists of sea lice, mysid shrimps and other small crustaceans. They generally occur individually or in small groups.

Seadragons are found in shallow coastal waters to 50 m depth, but usually occur in water between four and ten metres deep. Seadragons are thought to settle in shallow water as juveniles and move into slightly deeper water with age.

Seadragons can be caught as bycatch in trawling nets and are widely sought in the aquarium fish trade and for traditional Chinese medicines. They are also at risk from loss of habitat due to degradation of seagrass meadows and seaweed beds.

Both the leafy seadragon and the weedy seadragon have been recorded from Geraldton and unconfirmed sightings have been made in Shark Bay and near Onslow. It is thus possible that one or both species occur at Barrow Island, presumably in association with the extensive *Sargassum* beds that occur in the region.

6.1.4 Pipefish

Pipefish are widespread throughout the Pilbara region in both offshore and nearshore habitats. Little is known of the distribution and breeding seasons of the individual species that may occur around Barrow Island, however, it is likely that several could occur within the development area. Only two pipefish species have been recorded from Barrow Island (Western Australian Museum unpublished data 2004) and these have also been recorded during scientific studies of other Pilbara locales.

Protected pipefish that may occur at Barrow Island occupy habitats that are regionally widespread.

6.2 Reptiles

Reptiles have successfully adapted to the marine environment and three of four reptilian orders have marine representatives. These are the Chelonia (sea turtles), the Squamata (sea snakes) and the Crocodylia (crocodiles). The study area does not support crocodiles, however, it does contain diverse and abundant populations of sea turtles and sea snakes.

6.2.1 Sea turtles

Six of the world's seven species of marine turtle frequent the Pilbara region, but only four are confirmed as breeding in the area (Marine Turtle Newsletter 1993). All sea turtles are protected under Schedule 1 of the Wildlife Conservation Act, by the Bonn Convention and the EPBC Act. All marine turtle species occurring in Australian waters are protected by CITES. Five of the seven turtle species are listed as endangered on the IUCN Red List. The Bonn Convention gives all Indo-Pacific turtles a priority for conservation (Pendoley 1997).

Of the six species of sea turtles occurring in the region (green, flatback, hawksbill, loggerhead, leatherback and olive ridley), three species (green, flatback and hawksbill) are known to nest on Barrow Island beaches (Prince 1990). Leatherback turtles (*Dermochelys coriacea*) are the most globally widespread of sea turtles, but possibly the least abundant. They do not nest on Barrow Island, however, they would occur as infrequent visitors, most commonly in deeper offshore waters.

Green turtles (*Chelonia mydas*) are the most abundant sea turtle species in Pilbara waters, nesting on most sandy beaches in the region. The most important Western Australian green turtle nesting beaches are considered to be at the Lacapède Islands (refer Appendix C7: Sea Turtles), with other major nesting beaches being located at North West Cape, the Muiron Islands, Serrurier Island and on islands of the Dampier Archipelago (Prince 1990)., Barrow Island is also of regional significance for green turtle nesting, with large numbers utilizing all Barrow Island west coast beaches.

Adult green turtles feed on algae and thus feed in relatively shallow waters. They are always common in inshore Barrow Island waters, particularly along the west coast and in Bandicoot Bay. Green turtles are known to undertake widespread migrations, but the routes of Barrow Island animals are largely undetermined. Green turtles from other locations are known to migrate between Indonesia, Queensland, Northern Territory and Western Australia (Environment Australia 2000a).

Flatback turtles (*Natator depressus*) nest in moderate numbers on east coast beaches of Barrow Island. They are also known to nest on Ashburton, Thevenard and Airlie Islands, which are at the southern limit of nesting activity. Flatback turtles feed in offshore waters, mostly on soft-bodied prey such as sea cucumbers, soft corals and jellyfish (Environment Australia 2000b). They are therefore generally only found close to Barrow Island when adults are nesting and when hatchlings are coming off the beaches.

Loggerhead turtles (*Caretta caretta*) have a more temperate distribution than green, hawksbill and flatback turtles, with the islands of the Dampier Archipelago being the northern limit for nesting in Western Australia. Major nesting areas occur on the Muiron Islands and the islands within Shark Bay (Environment Australia 2001b). Occasional nesting may also occur on Barrow Island beaches. Loggerhead turtles feed mainly on large molluscs, but eat other benthic invertebrates such as holothurians. They have been observed in the waters around Barrow Island.

Leatherback turtles are the largest of the world's sea turtles and have the greatest worldwide distribution (Environment Australia 2001a). They are, however, uncommon throughout their range and rarely breed in Australia. Olive ridley turtles (*Lepidochelys olivacea*) in Australian waters are only known to nest in the far north, predominantly in the Northern Territory and Cape York regions. Neither leatherback nor olive ridley turtles have been reported from the study area, but are expected to be occasional visitors, particularly in offshore waters.

Appendix H describes in detail the sea turtle research that has been undertaken on Barrow Island.

6.2.2 Sea Snakes

Sea snakes are protected under the EPBC Act. Sea snakes are widespread throughout the Pilbara region in offshore and nearshore habitats. Storr et al. (1986) estimated that nine genera and 22 species of sea snakes occur in Western Australian waters.

Sea snakes are very common in shallow waters around Barrow Island, in offshore waters west of the island and in inshore waters between Barrow Island and the mainland. The sea snake assemblage appears to be both species-rich and abundant in the proposed development area.

6.3 Mammals - Cetaceans

6.3.1 Protection Status

Following the recommendations of the Frost Inquiry into Whales and Whaling in 1978, the Australian Parliament passed the *Whale Protection Act 1980* (Whale Protection Act). This Act provided for the preservation, conservation and protection of all cetaceans in Commonwealth waters (3-200 nautical miles from the coast). Complementary legislation in Australian States and Territories protects all cetaceans in coastal waters (less than three nautical miles from the coast). The EPBC Act designates all Australian waters as an Australian Whale Sanctuary. The Act also provides for the addition of coastal waters to the Sanctuary if a state or territory agrees and prohibits Australian citizens from killing, capturing and interfering with cetaceans anywhere in the world.

Australia was one of the 15 original countries that signed the International Convention for the Regulation of Whaling (ICRW) in 1946. The International Whaling Commission (IWC) was established under the ICRW to regulate whaling and conserve whale stocks. In recent years it has concentrated on strategies to manage and allow recovery of whale populations. Australia has promoted a strong conservation position in the IWC since whaling ended in 1978 (DEH 2004).

In addition to protection under the EPBC Act, humpback whales (*Megaptera novaeangliae*), which are common in the Barrow Island region, are specially protected under Schedule 1 of the Wildlife Conservation Act as animals that are rare or likely to become extinct.

6.3.2 Regional Occurrence

The Australian cetacean fauna is diverse, with 43 of the 79 species recognised worldwide (54 per cent) having been recorded in Australian Commonwealth waters (Bannister et al. 1996). This list includes 26 species of whale and 17 species of dolphin.

Five of the whale species found in Australian waters are considered threatened and are listed as endangered or vulnerable under the EPBC Act. In addition, a number of whale and dolphin species are migratory (visiting Australia for only part of the year or having populations that straddle international borders) and are listed under the Bonn Convention. Two of these threatened species, the blue whale (*Balaenoptera musculus*) and humpback whale (*M. novaeangliae*) are listed on the Department of Environment and Heritage (DEH) website as occurring in the Barrow Island region.

The known feeding, breeding and resting areas of blue whales and humpback whales and the times when whales are believed to be present in these areas are summarised in Table 6-1.

Blue and humpback whales undertake extensive annual migrations from Antarctic waters into the tropics. Extensive studies of humpback migrations have identified prime migration routes, resting and calving areas (Jenner et al. 2001), but these are variable from year-to-year. There is a lesser understanding of the occurrence, population and migratory characteristics of blue whales in Western Australian waters. However, in broad terms, the period in which whales are likely to migrate through the region extends from April/May through to November.

The main mating season for the blue whale extends over four to five months during the winter, from early April to late August, with peak conceptions occurring in late May and early June. The mean date for calving for the blue whale in the southern hemisphere is about mid-April (Gambell 1979).

Pygmy blue whales are a subspecies of the true blue whale, in that they are slightly smaller (growing to 25 m compared to 30 m). They are confined largely to the tropical regions of the Indian Ocean, southern Australian waters and east to New Zealand. Recent studies suggest they target smaller, more localised and ephemeral aggregations of several species of krill, rather than the vast swarms of the Antarctic krill (*Euphausia superba*) found near the Antarctic ice edge (WA Blue Whale Study Group 2002). Differentiation between blue and pygmy blue whales is difficult. The bulk of these whales occurring in tropical Western Australian waters are thought to be of the pygmy blue whale sub-species.

Humpback whales are the most common of the migratory and threatened whales occurring in the Barrow Island region. They migrate from the Southern Ocean into the Kimberley tropics each year to mate and calve, before returning to their Antarctic feeding grounds. Present estimates place the population of humpback whales migrating along the west coast of Australia at 3000–4000, many of which are expected to move through the western-most parts of the study area each year.

Migrating humpback whales generally pass through the Pilbara region seaward of the shallow islands, including Barrow Island. The northern migration follows a more offshore route than the southern migration, and is broadly centered on the 200 m bathymetric contour. Humpback whales appear to migrate south in a much more dispersed manner than when traveling north, with whales more often moving and resting in shallow inshore waters.

Whales are seldom reported from the area between Barrow Island and the mainland, possibly due to the extensive shoals and strong currents found in that area (Jenner et al. 2001). Sightings of whales from 1991 to 1996, recorded by the crews of rig tenders, seismic vessels and platform personnel and reported to the Centre for Whale Research, show whales migrating as far offshore as the 1000 m isobath or approximately 50 nm west of the islands. The humpback migratory route in the vicinity of Barrow Island is shown in Chapter 11 (Figure 11.4) of the main EIS/ERMP reports.

Table 6-1 - Summary of Endangered Whale Species that Occur in the Barrow Island Region and their Known Aggregation Areas and Migratory Paths (Assessed for Western Australian Waters only and Interpreted from the Department of Environment and Heritage website 2004).

Protection Status	Species found in Western Australian Waters	Recognised Aggregation Areas (Breeding and Resting Areas) for Western Australia	Migration Season (assessed for Western Australian Waters only)
Listed critically endangered or endangered species and a listed migratory species	Blue whale (<i>B. musculus</i>)	Rottneest	Nov –Dec (N/A to north West Australia).
Listed vulnerable species and a listed migratory species	Humpback whale (<i>M. novaeangliae</i>)	King Sound, Broome Shark Bay, Carnarvon North West Cape, Ningaloo, Perth Flinders Bay, Cape Leeuwin.	Mid July –Mid September (mid west WA coast) Late July – early August and late August – early September; (north west coast)

A number of other whale species occur off the north Western Australian coast and may occur in the survey area, at least on occasion. Whales reported from the region include the sei (*Balaenoptera borealis*), fin (*B. physalus*), minke (*B. acutorostrata*), and Brydes (*B. edeni*) whales, with sperm (*Physeter macrocephalus*) and melon headed (*Peponocephala electra*) whales possible, as surmised by their distribution range (Baker 1990). Attachment 1 provides other cetaceans in Australian waters listed as Threatened and/or Migratory Species under the EPBC Act.

Southern right whales were occasionally caught from the Norwegian Bay Whaling station prior to them becoming protected (Bridgewater 1990). These are a southern species occasionally observed in Perth waters, and those caught off the Ningaloo Reef would presumably have been rare visitors. Southern right whales were hunted to near extinction in Australian waters and, although recovering, the population is still very low. It is highly unlikely they ever occur near Barrow Island.

The bottle-nosed dolphin (*Tursiops truncatus*) and the Indo-Pacific humpbacked dolphin (*Sousa chinensis*) have resident populations within the shallow waters of the inner Rowley Shelf, including Barrow Island. Although less well understood, a number of deep water dolphins occur off the north Western Australian coast and may also occur in the survey area, at least on occasion. Spinner (*Stenella longirostris*) and striped (*Stenella coeruleoalba*) dolphins are common offshore tropical species (Swan et al. 1994) and are expected to be relatively common in the offshore waters of Barrow Island. Less common inhabitants may include the common (*Delphinus delphis*), Risso's (*Grampus griseus*), spotted (*Stella attenuata*) and rough-toothed (*Steno bredanensis*) dolphins, with three of the latter being stranded on Barrow Island in 1971 (Baker 1990). Attachment 1 contains a summary of the dolphin species listed under the EPBC Act as migratory species.

Killer (*Orcinus orca*) and false killer whales (*Pseudorca crassidens*) are large members of the dolphin family and are known in the area from sightings in 1971 and from strandings on Barrow Island in 1970 (Butler 1975). The pygmy killer whale (*Feresa attenuate*) could occur as a rare visitor to the area.

6.4 Mammals – Dugongs

The Dugong (*Dugong dugon*) is the only member of the family Dugongidae and joins the northern hemisphere manatees as the only living representatives of the order Sireniidae. Dugong occur in the temperate shallow waters of the Indian and Pacific oceans, but are most abundant in the marine waters of northern Australia.

Dugong are provided special protection under Schedule Four, other specially protected fauna, Division One (mammals) of the Wildlife Conservation Act and are listed as threatened (Vulnerable) under the EPBC Act.

Dugong are known to occur around the islands of the North West Shelf (Prince 2001), although not in the large concentrations seen further south in Exmouth Gulf or Shark Bay (Prince 1986). Dugong typically occur in shallow, warm waters that support the *Halodule* and *Halophila* seagrasses on which they feed.

Feeding animals generally occur over seagrass meadows at depths of five to ten metres. They are the only wholly herbivorous marine mammal and their seasonal movements and feeding grounds are little understood. Dugong are sensitive to temperatures below approximately 20°C and tend to be found in warmer waters in winter.

Dugong were not observed in the proposed development area during any of the three field surveys (August 2002, January 2003 and January 2004), but were observed in March 2004 at Varanus Island and over Barrow Shoals (Fitzpatrick, J. 2004. Personal communication). Dugong have been previously observed off the east coast of Barrow Island, at the Lowendal Islands to the northeast and at a number of other islands of the region (Prince 2001).

Dugong are likely to pass through and possibly feed on seagrass around Barrow Island. However, the sparse nature of the seagrasses, combined with the presence of large food reserves to the north and south, means that Barrow Island waters are unlikely to be of major significance for breeding or feeding activities of this species. Dugong are believed to calve predominantly in August to September and produce one calf every three to seven years (Swan et al. 1994). The dugong is a long-lived mammal with a lifespan of 50–60 years and a minimum pre-reproductive period of 9–10 years for both sexes (Swan et al. 1994). Individual animals are likely to be disturbed by noise and shipping activity, however, population level effects are unlikely.

7 Conclusion

More than one hundred protected marine species have been identified as occurring, or likely to occur, in the waters surrounding Barrow Island.

7.1 Fish and Invertebrates

Protected fish and invertebrate species are known, or likely, to occur in both the nearshore and offshore waters surrounding Barrow Island. The habitats which they occupy are generally widespread throughout the Pilbara region. There are no known features in the proposed development area or surrounds to suggest that significant concentrations would be expected to occur.

7.2 Cetaceans

Humpback whales generally are likely to rest occasionally around Flacourt Bay and Double Island (sighted on occasions) and pass through the region seaward of Barrow Island on their annual migration between the Southern Ocean and the Kimberley. Their northern migration is broadly centered on the 200 m bathymetric contour, and they are likely to pass through the area around the Gorgon gas field.

The southern migration of adults and calves tends to be more inshore and some use inshore areas such as the area near Flacourt Bay and Double Island to rest. Other whales and deep water dolphins that occur off the northwestern Australian coast that may occur in the survey area tend to have widely dispersed populations and there are no known features in the survey area or surrounds that suggest that significant concentrations would be expected within the development area.

7.3 Reptiles

Barrow Island is an important feeding and nesting area for sea turtles, primarily flatback turtles on the east coast and green turtles on the west coast.

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Attachment 1 - Other Cetaceans in Australian Waters Listed as Threatened and/or Migratory Species under the EPBC Act.

Listed vulnerable species	Sei whale (<i>Balaenoptera borealis</i>)
	Fin whale (<i>Balaenoptera physalus</i>)
Listed migratory species	Spectacled porpoise (<i>Phocoena diotropica</i>)
	Indo-Pacific humpback dolphin (<i>Sousa chinensis</i>)
	Dusky dolphin (<i>Lagenorhynchus obscurus</i>)
	Indian Ocean bottlenose dolphin (<i>Tursiops aduncus</i>)
	Pantropical spotted dolphin (<i>Stenella ttenuate</i>)
	Spinner dolphin (<i>Stenella longirostris</i>)
	Fraser's dolphin (<i>Lagenodelphis hosei</i>)
	Irrawaddy dolphin (<i>Orcaella brevirostris</i>)