MANAGEMENT PLAN FOR THE NINGALOO MARINE PARK AND MUIRON ISLANDS MARINE MANAGEMENT AREA

2005 - 2015

Management Plan Number 52

Vision

The marine flora and fauna, habitats, sediment, and water quality of the Ningaloo Marine Park and the Muiron Islands Marine Management Area will be in the same or better condition in 2015 than in the year 2005 and the reserves' cultural and Indigenous heritage values will be fully protected from adverse human impacts. The marine conservation reserves will be considered to be important ecological and social assets by the local, national and international community.

Cover photographs courtesy of Western Australian Tourism Commission (background, inset top and inset middle) and Geoff Taylor, Lochman Transparencies (inset bottom)

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LIST OF ACRONYMS

AIMS	Australian Institute of Marine Science
ANZECC	Australian and New Zealand Environment and Conservation Council
CALM	Conservation and Land Management
CCPAC	Coral Coast Parks Advisory Committee
DEH	Department of Environment and Heritage
DoE	Department of Environment
DoF	Department of Fisheries
DoIR	Department of Industry Resources
DOLI	Department of Land Information
DPI	Department for Planning and Infrastructure
EPA	Environmental Protection Authority
H	High priority management strategy
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IUCN	The World Conservation Union
KMS	Key management strategies
KPI	Key performance indicators
L	Lower priority management strategy
LGA	Local Government Authority
M	Medium priority management strategy
MPRA	Marine Parks and Reserves Authority
MPRSWG	Marine Parks and Reserves Selection Working Group
NRSMPA	National Representative System of Marine Protected Areas
NSDO	Ningaloo Sustainable Development Office
WAFIC	Western Australian Fishing Industry Council
WAMM	WA Maritime Museum
WATC	Western Australian Tourism Commission

EXECUTIVE SUMMARY

Ningaloo, a marine conservation icon

The *Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area* 2005 – 2015 (this document) was formally approved by the Minister for the Environment on 7 January 2005. It was produced on behalf of the Marine Parks and Reserves Authority (MPRA), by the Department of Conservation and Land Management (CALM).

The Ningaloo Marine Park was originally gazetted in 1987 and on 30 November 2004 the Park boundary was amended to include the whole of the Ningaloo Reef in the Marine Park. The Muiron Islands Marine Management Area, Western Australia's first marine management area, was also gazetted on 30 November 2004. Unless otherwise stated, the management objectives, strategies and targets documented in this management plan are applicable to both the Marine Park and Marine Management Area.

This plan was developed over a period of five years and included extensive consultation with all stakeholders, government agencies and the broader community including the formal release of a draft/indicative management plan on 26 July 2004 for public comment in accordance with the *Conservation and Land Management Act 1984*. This plan replaces the original management plan approved for the Park in 1989 and directs management of these two reserves for a ten-year period from 2005 to 2015.

The Ningaloo Marine Park and Muiron Islands Marine Management Area are located off the North West Cape of Western Australia, approximately 1200 km north of Perth, and cover areas of approximately 263,343 ha and 28,616 ha respectively. Ningaloo Reef is the largest fringing coral reef in Australia. Temperate and tropical currents converge in the Ningaloo region resulting in highly diverse marine life including spectacular coral reefs, abundant fishes and species with special conservation significance such as turtles, whale sharks, dugongs, whales and dolphins. The region has diverse marine communities including mangroves, algae and filter-feeding communities and has high water quality. These values contribute to the Ningaloo Marine Park being regarded as the State's premier marine conservation icon. The Muiron Islands Marine Management Area is also important, containing a very diverse marine environment, with coral reefs, filter-feeding communities and macroalgal beds. In addition the Islands are important seabird and green turtle nesting areas.

The Ningaloo area has very high social significance. As well as a wealth of Aboriginal history in the area associated with extended occupation, the area is very important for a variety of recreational pursuits and for nature-based tourism that centres on the reserve's natural attractions. Due to the close proximity of the reef to the shore, visitors can enjoy a wide variety of nature-based tourism activities without the need for lengthy boat trips. Seasonal aggregations of whale sharks, manta rays, sea turtles and whales, as well as the annual mass spawning of coral provide unique opportunities for visitors to observe marine fauna and key biological processes within the reserves. Approximately 200,000 people visited Ningaloo in 2004 and participated in a range of nature-based activities including wildlife viewing, boating, fishing, diving, snorkelling, and a variety of coastal uses. The tourism industry generates significant income for the region with the whale shark industry being a major contributor. The remoteness, wilderness and seascape values are also important intrinsic aspects of the area that are valued by the community. The 'Ningaloo experience' is a cherished part of Western Australia's coastal heritage.

This plan outlines a suite of management strategies to protect the special marine plants and animals found in the region, as well as to ensure there is opportunity for sustainable recreational and commercial uses. The major thrust of management of the reserves will include:

- Implementation of a zoning scheme for the Park that includes sanctuary zones that are representative of the Park's marine habitats, flora and fauna, comprising 34 per cent of the Park. This will provide a high degree of protection for representative areas throughout the Park.
- Implementation of a zoning scheme for the marine management area that includes conservation areas that provide a high level of protection to representative marine habitats in the marine management area.
- Implementation of comprehensive research and monitoring programs to improve the understanding of the marine environment and to assess the impacts of human activities.
- Implementation of comprehensive education and information programs to support the management of the reserves.

- Development of detailed recreational management plans and implementation of management strategies throughout the Park to facilitate the sustainable management of recreational activities.
- Close integration of management of the adjoining coastal lands and the Park.
- Close cooperation with other agencies, particularly the Department of Fisheries, in achieving integrated management of the marine environment in this area.

The implementation of this management plan will be regularly reviewed by CALM and audited by the MPRA every three years to ensure the management objectives are being met, and to ensure that the management regime for the reserves is still appropriate to meet these objectives.

1 INTRODUCTION

The coastal environment of Western Australia extends from latitudes 14° to 35° South and ranges from the warm, tropical waters off the Kimberley coast to the cool, temperate waters of the Great Australian Bight. The coastline is over 13,500 kilometres in length and comprises about 40 per cent of the continental coastline of Australia. A unique feature of the coastal waters of Western Australia is the presence of a poleward, shelf-edge flow of tropical water, the Leeuwin Current, which flows down the Western Australian coastline. The current flows year round but is stronger and closer to shore during autumn and winter due to the absence of the opposing southerly wind stress and associated nearshore northward flowing Capes and Ningaloo currents that occur during the late spring and summer months (Pearce & Pattiaratchi, 1999; Taylor & Pearce, 1999).

The Leeuwin Current has a major influence on the biogeography of the State's marine flora and fauna and is responsible for the occurrence of tropical biota at latitudes where these species are not typically found (Pearce & Walker, 1991). Three major biogeographic zones occur: a *tropical* zone north of North West Cape; a *temperate* zone east of Cape Leeuwin; and a *biological overlap* zone in between. Other major influences on the marine environment of Western Australia are the regular occurrence of severe tropical storms (ie. cyclones), particularly off the north-west coastline, the low level of freshwater and sediment input to most of the nearshore waters of the State and the high wave energy of the west and south coasts.

The above natural characteristics and influences combine to produce a diversity of marine ecosystems and habitats unrivalled in the other states and territories of Australia. Much of the marine biodiversity of Western Australia is poorly described, particularly along the west and south coasts where many endemic species are likely to occur. The conservation of Western Australia's marine biodiversity is not only important from an intrinsic point of view but also as the fundamental basis of major recreational, tourism, fishing and, potentially, pharmaceutical industries.

The conservation significance of the Ningaloo Reef was recognised in the 1960s by the Western Australian branch of the Australian Marine Sciences Association that recommended the reef be established as a marine reserve. The Ningaloo Reef, stretching over 300 km from North West Cape to Red Bluff, is located in the Ningaloo Marine Bioregion and is the largest fringing coral reef in Australia. It is one of the State's premier marine conservation icons. The area is also important from a social perspective and the 'Ningaloo experience' is a cherished part of Western Australia's coastal heritage. In the 1950s and 1960s commercial whaling, turtle hunting and fishing operations were based in the region. In the 1970s and 1980s, fishing was the main reason people came to the area. Over the past decade a major shift to more passive, nature-based activities has occurred (Wood & Dowling, 2002) although recreational fishing is still a popular pursuit. This trend is expected to continue.

The waters of the Ningaloo Marine Park and the terrestrial component of the Park (a 40 m strip above the high water mark adjacent to the pastoral stations) extending approximately 260 km from Bundegi to Amherst Point and incorporating about 90% of the Ningaloo Reef were originally gazetted in 1987. The *Ningaloo Marine Park (State Waters) Management Plan 1989 - 1999* (CALM, 1989) was approved in 1989 and the Park was designated A class in 1990. The contiguous Ningaloo Marine Park (Commonwealth Waters) was declared in 1987 under Commonwealth legislation with boundary amendments in 1992.

Section 54 of the CALM Act requires the MPRA to review management plans for lands and waters vested in the MPRA, as soon as possible after the ten-year management plan period. Review of the management plan began in 2000 and included consideration of extending the Park southwards to incorporate the full extent of the Ningaloo Reef, as well as the waters surrounding the Muiron and Sunday islands. Both of these areas were highlighted in the Marine Parks and Reserves Selection Working Group (1994) report as potential marine conservation reserves. A revised draft management plan for the Park and indicative management plans for the proposed extension and Marine Management Area were released for public comment on 26 July 2004. A final management plan was approved by the Minister for the Environment on the 7 January 2005.

This management plan provides a detailed description of the ecological and social values of the Ningaloo Reef and the Muiron and Sunday islands, and outlines management objectives, strategies and targets. The goal of this plan is to facilitate the conservation of marine biodiversity of this area and to ensure opportunities for nature appreciation, a wide range of recreational and commercial activities, research and education are maintained and managed within an ecologically sustainable framework. The plan also provides mechanisms for the local community to participate actively in the on-going planning and management of the reserves.

The plan should not be viewed in isolation but as an integral part of a suite of complementary management practices that occur within and adjacent to the reserves. The integrated and complementary management of the reserves requires continuity with other existing management programs, plans and planning processes These include fisheries regulations, marine fauna protection, pollution control, management of adjacent coastal lands and environmental impact assessment, as well as maritime transport and safety measures. The review of the management plan for the Ningaloo Marine Park and consideration of the southern extension and Muiron Islands Marine Management Area has considered other existing management arrangements in the region including the plan of management for Ningaloo Marine Park (Commonwealth Waters), the review of the *Cape Range National Park Management Plan,* the *Gascoyne Aquaculture Development Plan*, *Fisheries Environmental Management Plan for the Gascoyne Region*, and the *Gascoyne Recreational Fishing Strategy*.

Also considered during the review of the Ningaloo Marine Park Management Plan and consideration of the southern extension and Muiron Islands Marine Management Area was the *Ningaloo coast regional strategy Carnarvon to Exmouth* (Western Australian Planning Commission, 2004) prepared by the Department for Planning and Infrastructure (DPI) on behalf of the Western Australian Planning Commission, in consultation with CALM and other key stakeholders, and DPI's Statement of Planning Policy No 9.3 Ningaloo Coast. These documents seek to ensure that the future management of coastal development protects the ecological and social values of the coast while enabling development of the region as a nature-based tourism destination. Nomination of the North West Cape/Ningaloo area for World Heritage listing is also under consideration by Government.

It should be noted that many marine species are not permanently resident in the reserves and move through or in and out of the reserves during different stages of their lifecycles. Conservation of these organisms may be supported through management on a larger spatial scale, or through national and international treaties governing protection of specific species (eg. turtles) or processes. Water quality within the reserves may also be affected by activities outside the reserves. It is therefore critical that the environmental management objectives of the environment external to and within the reserves are compatible. Many of the strategies of the plan reflect this inter-dependence and the plan provides a framework to achieve the necessary integration and close cooperation that is needed between statutory management and regulatory agencies to achieve the conservation and sustainable management objectives outlined in the plan.

State marine reserves are vested in the MPRA and CALM is the primary manager of these reserves. The Department of Environment and Heritage (DEH) is responsible for the management of Ningaloo Marine Park (Commonwealth Waters). The Western Australian Department of Fisheries (DoF) is responsible for management of recreational and commercial fishing in the reserves. The Ningaloo Marine Park (Commonwealth waters) is managed under a Memorandum of Understanding between CALM, DoF and DEH.

Unless otherwise stated:

- Ningaloo Marine Park (State Waters) will hereafter be referred to as 'the Park';
- the Muiron Islands Marine Management Area will hereafter be referred to as the 'Marine Management Area';
- where the plan refers to both the Park and the Marine Management Area, they will be referred to as 'the reserves'
- the vision, strategic objectives, values, management objectives, strategies and targets will apply to both the Park and the Marine Management Area; and
- *Management plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 - 2015* (this document) will hereafter be referred to as 'the plan'.

2 MANAGEMENT CONTEXT

2.1 National and International Context

At a national level, the conservation of marine biodiversity, maintenance of ecosystem integrity and the sustainable use of marine resources are addressed by the Inter-governmental Agreement on the Environment. This is implemented through actions developed under national strategies such as the *National Strategy for Ecologically Sustainable Development* (Commonwealth of Australia, 1992), the *National Strategy for the Conservation of Australia's Biological Diversity* (Commonwealth of Australia, 1996a), *Australia's Oceans Policy* (Commonwealth of Australia, 1998), and the *Strategic Plan of Action for the National Representative System of Marine Protected Areas: A Guide for Action by Australian Governments* (ANZECC TFMPA, 1999).

The Ningaloo Marine Park and Muiron Islands Marine Management Area are part of the National Representative System of Marine Protected Areas (NRSMPA). The NRSMPA is being developed cooperatively by the Commonwealth, State and Northern Territory governments responsible for the conservation, protection and management of the marine environment (ANZECC TFPMA, 1998a). The primary goal of the NRSMPA is to build a national system of marine protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems and to protect Australia's biological diversity at all levels. The marine protected areas will be:

- *Comprehensive* – include the full range of ecosystems at an appropriate scale within and across the bioregions;
- *Adequate* – include the required level of reservation to ensure the ecological viability and integrity of populations, species and communities; and
- *Representative* – include marine protected areas that are representative of the marine fauna and flora of each bioregion.

The development of an NRSMPA helps fulfil Australia's international responsibilities and obligations as a signatory to the Convention on Biological Diversity, to provide a means of meeting obligations under the Convention on Migratory Species (Bonn Convention) and to satisfy responsibilities under bilateral agreements for migratory birds with Japan and China. In addition, it supports the World Conservation Union (IUCN) World Commission on Protected Areas Program in promoting the establishment and management of a global representative system of marine protected areas (ANZECC TFPMA, 1998b).

Ningaloo Marine Park (Commonwealth Waters)

The Commonwealth waters adjacent to the Ningaloo Marine Park (State Waters) were declared a marine park on 7 May 1987 by proclamation under the Commonwealth *National Parks and Wildlife Conservation Act 1975* with amendments to include the second stage of the marine park by proclamation.

The Ningaloo Marine Park (Commonwealth Waters) covers an area of 258,500 ha and is managed by the DEH under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An MOU is in place between CALM, DoF and DEH to facilitate collaborative management of the State and Commonwealth waters.

This plan relates specifically to the State waters of the Ningaloo Marine Park and the Muiron Islands Marine Management Area, which are reserved under the CALM Act. However, the management strategies for the State and Commonwealth waters will need to be compatible and complementary, to ensure that the conservation values of this unique environment are managed appropriately. The current management plan for the Ningaloo Marine Park (Commonwealth Waters) was approved in 2002 and provides for Commonwealth waters to be managed as an IUCN Category II Reserve (National Park) according to the Australian IUCN reserve management principles set out in the *Environment Protection and Biodiversity Conservation Regulations* 2000. In 2004, two areas where added to the Commonwealth Marine Park, that were previously not included due to the presence of petroleum tenements.

2.2 State

In 1984, the then new CALM Act provided powers to establish marine conservation reserves and seven marine conservation reserves were created between 1987 and 1990. In June 1994, the Minister for the Environment released a report entitled *A Representative Marine Reserve System for Western Australia* that identified about 70 areas in the coastal waters of Western Australia that were worthy of consideration for marine reservation under the CALM Act. In November 1994, the State Government released a policy on marine conservation that

foreshadowed changes to the marine reserve provisions of the CALM Act (Government of Western Australia, 1994). In 1997, legislative changes were made to the CALM Act relating to how marine conservation reserves were to be established, vested and managed. These changes revised statutory consultative protocols for the establishment of marine reserves, provided clear guidance for commercial activities in marine reserves, and established the MPRA. A State Government policy position released in June 1998 (Government of Western Australia, 1998a) provided further policy guidance in respect to the establishment and management of marine conservation reserves.

2.3 Legislative Framework

Marine conservation reserves are vested in the MPRA under the CALM Act and CALM is responsible for their management. The CALM Act and the *Wildlife Conservation Act 1950* (WC Act) and associated regulations provide legislative protection for flora and fauna within the reserves. The DoF is responsible for the management and regulation of recreational and commercial fishing, aquaculture and pearling in CALM Act marine conservation reserves in accordance with the *Fish Resources Management Act 1994* (FRM Act) and the *Pearling Act 1990*. The *Fishing and Related Industries Compensation (Marine Reserves) Act 1997* provides the mechanism by which the holder of a DoF authorisation for commercial fishing, aquaculture, pearling or fish processing operations (as outlined in Schedule One of the *Fisheries and Related Industries Compensation (Marine Reserves) Regulations* 1998) may seek compensation if the commercial value of the authorisation is shown to be diminished by the establishment of a marine nature reserve, or an exclusion zone in a marine park or marine management area.

The *Marine Act 1983* and *Navigable Waters Regulations*, administered by DPI, regulate boating in State waters and apply within marine conservation reserves. In addition, any development that may have a significant impact on the environment in or adjacent to a marine conservation reserve, is assessed in accordance with the *Environmental Protection Act 1986* (EP Act) by the Environmental Protection Authority (EPA). The Department of Environment (DoE) is responsible for pollution control in the marine environment.

The reserves lie within State territorial waters. Waters seaward of this limit and extending to the 200 nautical mile limit fall under the jurisdiction of the Commonwealth Government. The Park includes a 40 m strip of land adjacent to pastoral leases to the southern limit of the Park. The Muiron Islands are classified as Class C nature reserves vested in the Conservation Commission of Western Australia and the Shire of Exmouth and are managed for the purpose of recreation and conservation of flora and fauna. Management strategies for the reserves have been developed to ensure integrated management of the marine and adjacent terrestrial environments.

2.4 Responsibilities of Authorities and Government Agencies

CALM is primarily responsible for the management of marine conservation reserves, including the implementation of management plans. CALM collaborates closely with the DoF, which also has significant management responsibilities in marine conservation reserves. CALM also consults with other organisations (eg. Conservation Commission of Western Australia, local government authorities) that have responsibilities in the surrounding waters and coastal areas, to ensure the various regulatory and management practices are complementary. In some cases Memoranda of Understanding (MoU) are developed to facilitate cooperation and promote operational efficiency.

The MPRA plays an important role in the development of marine policy and management plans and in auditing the management of marine conservation reserves vested in the MPRA. The audit function is an important role to ensure that CALM's management of marine conservation reserves is meeting stated objectives and targets. The management plan provides the principal framework by which the MPRA will carry out this function.

The authorities and agencies with statutory responsibilities in the reserves are listed in Table 1.

Table 1: Authorities and agencies with responsibilities in the Ningaloo Marine Park and the Muiron Islands Marine Management Area

Marine Parks and Reserves Authority	• vested body for the marine conservation reserves; • provides policy advice to the Minister for the Environment; and • audits management plan implementation by CALM.
Department of Conservation and Land Management	• manages marine conservation reserves vested in the MPRA. This includes the: a) preparation of management plans; b) implementation of the management plan; c) coordination with other agencies and stakeholders; d) implementation of education and public participation programs; e) implementation of research and monitoring programs; f) coordination of management intervention programs; g) management of recreation (non-fisheries) and nature-based tourism; and h) lead role in enforcement (non-fisheries issues); • ensures integrated management of marine conservation reserves with adjoining mainland and island conservation reserves; and • is signatory to the MOU with Department of Environment and Heritage (Commonwealth) and DoF in regard to the day to day management of the Ningaloo Marine Park (Commonwealth Waters).
Department of Fisheries	• manages and regulates commercial and recreational fishing, aquaculture and pearling in all State waters including marine conservation reserves; • lead role in enforcement of fisheries legislation within the marine conservation reserves; and • is signatory to the MOU with DEH (Commonwealth) and CALM in regard to the day to day management of the Ningaloo Marine Park (Commonwealth Waters).
Department for Planning and Infrastructure	• responsible for all boating regulations including licensing, safety standards, vessel navigation, marker buoys, moorings, jetties and support facilities such as navigation marks, navigation charts and harbour facilities (NB mooring controls can be delegated to other agencies); • chairs and supports the State Coordinating Committee which provides the mechanism to coordinate the management of marine pollution incidents; and • responsible for management of vessel navigation and in the development and management of support facilities.
Department of Environment	• assists the EPA in the process of assessing development proposals that may significantly affect the marine environment, including inside marine conservation reserves; and • administers pollution control legislation.
Environmental Protection Authority	• assesses proposals that may significantly affect the marine environment, including inside marine conservation reserves.
Western Australian Maritime Museum	• protects pre-1900 shipwrecks and artefacts under the *Marine Archaeology Act 1973*. Shipwrecks over 75 years old are declared and protected under the Commonwealth *Historic Shipwrecks Act 1976*.
Department of Industry and Resources	• administers legislation that controls mineral and petroleum exploration and development; and • regulates petroleum industry operations.
Department of Environment and Heritage (Commonwealth)	• manages the Ningaloo Marine Park (Commonwealth Waters); and • is signatory to the MOU with CALM and DoF in regard to the day to day management of the Ningaloo Marine Park (Commonwealth Waters).
Shire of Exmouth	• joint management of Jurabi and Bundegi coastal parks and Muiron Islands

3 MANAGEMENT FRAMEWORK

3.1 'Best Practice' Management Model

The conservation of marine biodiversity and sustainable management of human activities in the marine environment of Western Australia are achieved through a number of complementary mechanisms that include marine conservation reserves, fisheries regulations, marine fauna management, pollution control, environmental impact assessments of development proposals, and maritime safety regulations. The management of the reserves employs both specific (Section 7) and generic strategies (Sections 8 & 9) to ensure human usage of the marine environment is managed sustainably.

The content of this section is based on the best practice principles outlined in the report entitled *Best Practice in Performance Reporting in Natural Resource Management* (ANZECC, 1997). The model is also broadly consistent with the performance assessment framework in the *Strategic Plan of Action for the National Representative System of Marine Protected Areas: A Guide for Action by Australian Governments* (ANZECC TFMPA, 1999). The objectives, strategies, performance measures and management targets outlined in Section 7 reflect an outcome-based "best practice" approach from which the effectiveness of management can be better assessed. This model has been adopted by the MPRA to facilitate better conservation and management outcomes and a more objective and effective approach to auditing CALM management.

Ecological and Social Values

The conservation of marine biodiversity, the promotion of public education, public participation, research and nature appreciation through recreation and tourism opportunities and the management of human uses are the major objectives for the reserves. These generic terms need to be defined operationally to be useful in a management context. This is achieved by identifying the key ecological and social values of the reserves and setting management objectives, strategies and targets in relation to these values.

Ecological values are the intrinsic physical, chemical, geological and biological characteristics of an area. For convenience, the major ecological values are listed individually in this plan. However, in reality the marine environments of the reserves are a structurally and functionally complex array of relationships between the plants and animals interacting with their physical environment.

The ecological values should (where appropriate) include:

- species and communities that have special conservation status (eg. loggerhead turtles, dugong);
- key species endemic to the reserves;
- key structural components of the ecosystem (eg. coral, macro-algae and mangrove communities);
- exploited species and communities (eg. whale sharks, manta rays and targeted fish populations); and
- key physical-chemical components of the ecosystem (eg. water and sediment quality and geomorphology).

Social values are the major cultural, aesthetic, recreational and economic attributes of the area.

Management Objectives

Management objectives identify **what** the primary aims of management are and reflect the statutory responsibilities of the CALM Act. Objectives have been developed for all of the ecological and social values of the reserves. Where a significant pressure/s on an ecological value has been identified, the management objective addresses the specific pressure/s. When there is not an obvious existing pressure or threat, the management objective provides broader direction to management in relation to protecting the value from the most likely future pressures. Management objectives for social values address, where appropriate, the effect of the activity on the other values of the reserves and the complementary interests of other statutory management arrangements or activities that exist in the reserves.

Management Strategies

Management strategies provide specific direction on **how** the management objective/s for each value might be achieved. All strategies outlined in this plan have been defined as high (**H**), medium (**M**) or lower (**L**) priority to provide an indication of their relative importance. The (**H**) strategies considered to be critical to achieving the long-term objectives of the reserves are also designated as *key management strategies* (**H – KMS**). These strategies also form part of the performance assessment of reserve management by the MPRA, particularly during the initial years of implementing the management plan for the reserves (see Section 10 – Performance Assessment). It should be noted that management priorities are likely to alter in response to changes in usage

patterns or to new knowledge acquired during the life of the management plan.

Performance Measures
Performance measures are **indicators of management effectiveness** in achieving the objectives and targets of the reserves. They are developed for all of the ecological values, plus those social values that are non-activity based and have intrinsic societal worth (eg. seascapes, wilderness). Performance measures should be quantitative, representative and, where possible, simple and cost-effective. Performance measures for indirect (eg. nutrient enrichment impacts on coral reef communities) and direct (eg. anchoring impacts on coral reef communities) impacts should focus on surrogate (eg. changes in phytoplankton biomass and species composition) and direct (eg. changes in biodiversity and coral cover) measures of the value respectively. Performance measures for some social values have not been developed due to inadequate existing information. These will be developed during the early phase of the implementation of this plan.

It should be noted that all performance measures are indicative only and will be reviewed and, if appropriate, revised during the development of monitoring programs for the reserves.

In regard to those social values that have the potential to negatively impact on the ecological values of the reserves (eg. coastal use, recreational fishing), a different approach to performance assessment is required. This has been termed *reporting,* and incorporates information on the status and level of the human activity. This information is important in monitoring human activities to assist in determining trends in use, and to assist in assessing impacts of these uses on the ecological values of the reserves.

Management Targets
Management targets represent the desired **end points of management**. Targets should be measurable, time bound and expressed spatially. Ecological targets are set as either the "natural state" or some acceptable departure from the "natural state". The long-term target provides a specific benchmark to assess the success or otherwise of management action within the life of the management plan. A short-term target is sometimes established to provide a benchmark for management to achieve within a specified time period and, in most cases, is a step to achieving the long-term target. The quantitative short and long-term targets will be developed early in the life of the plan, in consultation with stakeholders where required. The targets for recreational fishing, commercial fishing, nature-based tourism, water sports, coastal use, scientific research, education and the hydrocarbon exploration and production industry are process-based and are generally stated as "*Implementation of management strategies within agreed timeframes*". This ensures that strategies for the social values are implemented in accordance with the management objectives.

Key Performance Indicators
Key performance indicators (KPIs) are a **measure of the overall effectiveness** of management in relation to the strategic objectives for the reserves. Key performance indicators relate specifically to the management targets for key ecological and social values and reflect the highest conservation (from biodiversity and ecosystem integrity perspectives) and management (social) priorities of the MPRA, CALM and the community. KPIs are a key element of the MPRA audit process (Section 10).

3.2 Determining Management Priorities

Ningaloo Reef is the largest fringing reef in Australia. Temperate and tropical currents converge in the Ningaloo region resulting in highly diverse marine life including spectacular coral reefs, abundant fishes and species with special conservation significance such as turtles, whale sharks, dugongs, whales and dolphins. The region has diverse marine communities including mangroves, algae and filter-feeding communities and has high water quality. All these values contribute to Ningaloo being regarded as one of the State's premier marine conservation icons, worthy of protection.

The management of the Ningaloo Marine Park and the Muiron Islands Marine Management Area aims to conserve the marine biodiversity of the reserves, while maintaining opportunities for people to appreciate and enjoy the reserves and for the local community to benefit from visitors attracted to the area, where these activities are compatible with maintaining the values of the reserves. While marine conservation reserves reflect a pro-active and precautionary approach to conserving marine biodiversity, an important step in determining management priorities is to undertake a risk assessment by considering the likelihood of existing and potential pressures affecting the ecological and social values and their associated ecological and social consequences.

The relative level of risk posed by existing and/or potential pressures on values can be assessed by considering the following factors:

- the *biological intensity* of the pressure - pressures that impact lower trophic levels (ie. primary producers such as coral and mangrove communities) are often of greater concern than pressures on higher trophic levels;
- the *temporal* scale of the pressure - ongoing pressures are generally of greater management concern than pressures that are short-lived;
- the *spatial* scale of the pressure - pressures that occur over a greater spatial extent are often of greater management concern than localised pressures;
- the *social consequence* - acknowledges that different pressures have different social and political consequences. A high socio-economic/political consequence is often of greater management concern; and
- the *probability* of a pressure occurring within the timeframe of the management plan.

The natural attributes and the major uses of the Ningaloo region are well known. However, the short-term and long-term cumulative ecological effects of pressures are not fully understood. For the purposes of developing management priorities, pressures on the values are confined to current pressures and pressures likely to occur during the life of the management plan and considered to be manageable within a marine conservation reserve context. By definition, this excludes global pressures such as climate change. The potential impact of these global pressures is however considered in the development of the strategies for the management of the reserves. The vision and strategic objectives of the plan (Section 3) provide the longer term (>ten years) direction for management of the reserves.

4 REGIONAL PERSPECTIVE

4.1 Biogeographical Setting

The Ningaloo Marine Park straddles two bioregions, these being the Ningaloo Bioregion and the Pilbara Nearshore Bioregion while the Muiron and Sunday Islands 15 km north of North West Cape, lie in the Pilbara Offshore Bioregion (IMCRA, 1997). The Ningaloo Bioregion is characterised by interrupted fringing reefs in the south and continuous offshore reefs in the north. The Pilbara Nearshore Bioregion covers the nearshore area to 10 m depth, with habitats characterised by intertidal mudflat, sandflat and fringing coral reef environments. The Pilbara Offshore Bioregion covers the areas seaward of the 10 m depth contour, characterised by a series of limestone islands of which the Muiron and Sunday islands represent the westerly most examples. Because of the range of substrate types and oceanographic conditions, the structural variety of the bioregions within which the reserves are located create exceptional habitat diversity and high species richness. There is a progression in the gradient of representation of species throughout the reserves with tropical species predominating in the north to increasing representation of temperate species in the south.

4.2 Geology and Geomorphology

The Ningaloo Reef is the largest fringing coral reef in Australia and is over 300 km in length, forming a discontinuous barrier enclosing a lagoon. The lagoon varies in width from 200 m to about 7 km, with an average of about 2.5 km. Gaps regularly intercept the main reef line providing for a series of individual elongated reef segments. The lagoonal areas backing the reef are interspersed with occasional patch reefs and nearshore platform reefs. At the extreme northern end of the Park (north of Jurabi Point) the barrier reef becomes discontinuous and eventually disappears. From here around the tip of the peninsula to Bundegi Reef there are intertidal shoreline reefs and some offshore banks. The southern end of the reef is closer to shore and less continuous and becomes a shoreline fringing reef at Red Bluff.

The Park is located on the northern extremity of the Dirk Hartog Shelf (Carrigy & Fairbridge, 1954) and can be broadly described as having the following geomorphic features:

- an inner continental shelf section;
- a reef slope seaward of the reef crest, (characterised by a steep slope in the north of Ningaloo Reef shifting to a gentle slope south of Point Edgar);
- a reef flat (less than 150 m wide) which consists of a discontinuous basement platform of Pleistocene marine or aolian (windblown) sediments or older tertiary limestone bedrock (Collins *et al.*, 2003);
- a gradually sloping back reef which may be several hundred metres wide with either an abrupt shoreward edge or a gentle gradation into the lagoon;
- a lagoonal area landward of the reef, which varies in width throughout the reserves but has an average depth of 2-4 m, characterised by coarse calcareous sands in the shallows and fine calcareous sand and silt in the deeper basins and gutters; and
- a shoreline characterised by either sandy beach, rocky benches or low limestone cliffs, sometimes with a sloping beach rock platform or a narrow fringing reef.

The Muiron Islands are a continuation of the Cape Range Peninsula and are low dome-shaped, limestone islands separated by a deep navigable channel. The western shores of the islands are characterised by limestone cliffs fronted by sandy beaches and intertidal rock platforms beyond which the seafloor slopes away to the shelf edge some 30 km seaward. Eastern shores comprise sandy beaches backed by low dunes. They have gently sloping sand with patch reefs and coral bommies, eventually levelling out to muddy soft substrates.

The varied geomorphology of the reserves has resulted in a high habitat and species diversity. The continental shelf in the Park is narrower that at any other location in Australia, resulting in deep oceanic waters close to the Reef.

4.3 Climate

The climate is arid with an annual evaporation of about 2700 mm, far exceeding the annual rainfall along the coast of between 200-300 mm. Rainfall can occur in summer and winter, with summer rainfall from cyclones being irregular but sometimes heavy. Lighter more regular falls occur in winter with June the wettest month of the year. The proximity of the reef system to shore is in part the result of the region's characteristically arid climate with low average annual rainfall and extremely low levels of run-off. Although arid, there is considerable variation in the climate both within the region and from year to year.

The daytime air temperature on the western side of Cape Range Peninsula in winter ranges between the low to high 20°Cs. In summer, average daytime temperatures range from the low 20°Cs to low 30°Cs. On the eastern side of the Cape temperatures vary more widely. An average minimum of 23°C occurs in January and 14°C in July, with average maximum of 37°C and 24°C respectively.

The dominant wind conditions throughout most of the year are the south-east trade winds. On the western coast of the Cape the winds are predominantly from the south-west with velocities ranging from 1-3 m/sec to over 10 m/sec with a sea breeze developing in the late morning. Brisk breezes from the south occur around 70% of afternoons. Cyclonic winds although infrequent may be severe, exceeding speeds of 150 km/hr. Winds during Cyclone Vance (1998) were recorded in excess of 250 km/hr.

4.4 Oceanography

Water movement in the reef system is dominated by both wave pumping over the reef crest and direct wind-driven circulation, with tides serving to modulate the general circulation patterns throughout (D'Adamo & Simpson, 2001). Wave pumping causes oceanic water to flow into the lagoon over the reef crest and fan out laterally within the lagoon proper. Prevailing winds (generally from the south-south-west) cause regular vertical mixing throughout the system and drive relatively strong nearshore currents northwards. Flushing of lagoonal waters to the ocean occurs mainly in confined currents via gaps in the reef. Once in the ocean, flushed lagoonal waters are then entrained in either the southward flowing Leeuwin Current (strongest in autumn/winter) or northward flowing Ningaloo Current (strongest in spring/summer). This process is locally complicated by the structure of the mainland at Point Cloates, which disrupts nearshore lagoonal water movement leading to the formation of eddy currents running counterclockwise to the south of the headland, thereby disrupting linear water movement along the reef. This process may be a contributory factor in determining the dispersal of larvae within the lagoon and could account for the higher number of temperate species to the south of Point Cloates and tropical species to the north (D'Adamo & Simpson, 2001).

The water movement associated with the northern sector of the Park and the Muiron and Sunday islands is more strongly influenced by the tidal flow of water in and out of Exmouth Gulf.

The reef is located just north of the west coast's major tidal transition zone, which is centred around Carnarvon and which separates the South Western Australian tidal zone (diurnal and micro-tidal) and the North Western tidal zone (semi-diurnal and macro-tidal). The tides in the area are mixed, predominantly semi-diurnal and with a maximum range at springs of about 2 m. Changes in meteorological conditions (such as strong offshore or onshore winds, changes in barometric pressure and cyclones) can also affect water levels (D'Adamo & Simpson, 2001).

The deepwater wave climate off the North West Cape is dominated by perennial long period south-west swell, having a mean annual height of about 1.5 m and seasonally being slightly larger in winter than in summer. Wind-driven waves have a mean annual height of about 1.2 m and seasonally are significantly larger in summer than in winter. The total waves (combined sea and swell) off the North West Cape are significantly more severe than those experienced anywhere else along the North West Shelf. The total waves have a mean annual height of about 2 m (with little seasonal variation) and will regularly reach 3.5 – 4.0 m in the winter months and 3 m in the summer months (due to non-cyclonic conditions). The predominant wave direction is from the south-west throughout the year (D'Adamo & Simpson, 2001).

Studies of water temperature within the lagoons and in an outer reef channel location over a six-month period showed water temperatures in the lagoon ranged from a minimum of 17.8°C in August (mean in August 20.5°C) to a maximum of 29.8°C in December (mean in December 25.6°C). Mean water temperature in the channel in August was 24.1°C. Salinities in the Park are generally close to oceanic values (approximately 35 parts per thousand). There are subtle differences in salinities within the lagoonal waters, as well as between lagoonal and offshore waters. This is due to local evaporation and the presence of occasionally varying regional currents (ie. the Leeuwin and Ningaloo currents) (D'Adamo & Simpson, 2001).

4.5 Ecology

The scientific understanding of the ecological values of the Ningaloo Reef has increased significantly since the Ningaloo Marine Park was established. For convenience, the ecological values are treated individually in this plan. However, like most coral reefs, the Ningaloo Reef is a complex ecosystem with high species diversity. Most of the reef lies within the tropical belt of the Indo-Pacific Faunal Region with the Tropic of Capricorn crossing the southern end of the Park. The majority of species occurring in the Park are widespread throughout

this vast region. The Ningaloo Reef is at the southern (latitudinal) edge of the Region. Within the southern end of the Park, the Western Australian Overlap zone begins, ie. a biogeographic transitional zone between the tropical fauna and the highly endemic temperate fauna of the Southern Australian Faunal Region. Large proportions of the tropical species are at the southern limit of their geographic range within the reserves. Conversely, a few temperate Southern Australian or endemic West Coast species are at the northern limit of their range within the reserves (eg. the Western Rock lobster, *Panulirus cygnus*).

The North West Cape represents an abrupt change in the marine fauna of Western Australia due to the sudden change in marine habitats. The marine fauna of the Ningaloo Marine Park is an outlier of the Indo-West Pacific 'oceanic' coral reef group. It is physically isolated from other similar habitats further north in the turbid waters of the North West shelf, but has a degree of connection with southward flowing ocean currents (eg. the Leeuwin Current), which may provide genetic continuity for marine organisms. The marine fauna and flora of the Muiron Islands is in some cases similar to the Ningaloo Reef. However the intertidal rock platforms on the western shores are of particular interest as this habitat type is a feature of a different biogeographic zone (west coast south of Cape Cuvier) which is uncommon in the tropics.

The physical structure of the Ningaloo Reef lagoon system is less varied than that of other major coral reef systems such as the Great Barrier Reef. It has, however, comparable species richness (diversity) to the flora and fauna found at similar latitudes on the Great Barrier Reef. The reserves are characterised by a cross shelf representation of habitats from intertidal reef environments, lagoonal and fringing coral reef communities and out to the offshore oceanic environments of the continental shelf. This diversity of habitats provides for an extensive range of marine species, including over 200 species of coral, 600 species of mollusc and 500 species of fish in the Park alone. The Muiron and Sunday Islands contribute further to this diversity and are considered " … *one of the most diverse – geologically and faunistically speaking – regions in WA*" (Hutchins *et al.,* 1996).

The reserves also have very high marine wildlife values being important for whale sharks, turtles, dugongs, sharks and manta rays. Whale sharks can grow to a length of 12 m and predictable aggregations of whale sharks occur outside the reef from March – May/June every year and a significant nature-based tourism industry has developed around this event. The foreshores and nearshore reefs of the Ningaloo coast and Muiron/Sunday islands also provide important aggregation and nesting areas for turtle populations, including the loggerhead (*Caretta caretta*), green (*Chelonia mydas*), flatback (*Natator depressus*) and hawksbill (*Eretmochelys imbricata*) turtles. Shark aggregations are seasonally reported and manta rays are commonly found in the area.

4.6 Social Setting

The uses of the reserves include indigenous and maritime heritage, commercial and recreational usage, aesthetic and cultural values, science and education. There is a wealth of Aboriginal history in the region associated with the extended occupation of the region. All Aboriginal sites, registered or otherwise, are protected under the *Aboriginal Heritage Act 1972*. There is also an extensive maritime history in the region associated with early explorers and the trading activities that prevailed along the coast following early European settlement.

The reserves represent a very important area for nature-based tourism activities and usage has been shown to have shifted from extractive activities towards non-extractive nature-based activities (Wood & Dowling 2002). The appeal of the area for visitors includes spectacular coral reefs, a wide variety of large marine fauna, the remote and wild nature of the land and seascapes and the rich maritime heritage. The area's varying accessibility, via roads and tracks, satisfies a variety of recreation and tourism interests from basic bush camping to established accommodation and facilities at development nodes and population centres. A strategy to plan and regulate coastal development along the Ningaloo coast has been undertaken with the formulation of the *Ningaloo coast regional strategy Carnarvon to Exmouth* (Western Australian Planning Commission, 2004). The strategy determined the most appropriate development along the Ningaloo coast based on the natural carrying capacity and preferred human use of the area and takes account of the potential impacts of development options on the marine environment. This process sought input from the public as to the importance of 'seascape' and 'wilderness' values as part of the visitor experience to the area.

Recreational fishing is a popular activity in the area and the number of fishers is expected to increase during the life of the plan. Recreational fishers target a variety of species, the most highly regarded being emperor *(Lethrinidae),* seaperch *(Lutjanidae)* and cod *(Serranidae)* species. However, a variety of several other finfish and mollusc species is also caught. Recreational fishers employ a variety of methods including line, spear, net fishing and hand collection (Sumner *et al.,* 2002).

Commercial fishing activity in Ningaloo Marine Park (State waters) is limited to the waters of the general use

zone north of Tantabiddi Creek and south of Point Maud The unclassified waters of the Muiron Islands Marine Management area are also open to commercial fishing in accordance with the FRM Act.

The waters surrounding the Muiron and Sunday Islands are highly prospective for hydrocarbons and exploration is anticipated to increase in this region over the next decade. Government policy prohibits drilling for petroleum and production within Ningaloo Marine Park but not within the Muiron Islands Marine Management Area.

5 DEFINITION OF AREA AND RESERVE TENURE

The Ningaloo Marine Park and the Muiron Islands Marine Management Area are located off the north-west coast of Western Australia, approximately 1200 km north of Perth, and cover areas of approximately 263,343 ha and 28,616 ha respectively.

The amended boundary of the Ningaloo Marine Park (State Waters) was gazetted as a Class A reserve on 30 November 2004. The Park includes a terrestrial component (a 40 m coastal strip adjacent to the pastoral stations) which was gazetted on 3 July 1987. The boundary of the Ningaloo Marine Park extends from Bundegi just north of the town of Exmouth, south to Red Bluff, encompassing the entire Ningaloo Reef and offshore waters, out to the State territorial limit (Figure 1). The boundary of the Muiron Islands Marine Management Area shown in Figure 1 is contiguous with the north-eastern boundary of the Park. The landward boundary of the reserves is defined as high water mark, except:

- adjacent to any pastoral lease where the boundary is defined as 40 m above the high water mark;
- adjacent to the Ministry of Defence land (Location 44) at the northern tip of North West Cape where the boundary is defined as the low water mark;
- at the navy pier at Point Murat where the boundary excludes the area that is surrounding the pier owned by the Department of Defence; and
- between Red Bluff and Amherst Point where the boundary is the low water mark.

The CALM Act (Section 6 (6)) states that a marine park, marine nature reserve or marine management area "…*includes:*

a) the airspace above such waters or land;
b) in the case of waters, the sea-bed or other land beneath such waters and the subsoil below the sea-bed or other land to a depth of 200 m; and
c) in the case of land other than waters, the subsoil below such land to a depth of 200 m."

Pastoral leases, including Ningaloo, Cardabia, Warroora, Gnaraloo and Quobba stations are the major land tenure adjacent to the Park. In the northern area of the Park the adjacent tenure includes Cape Range National Park (vested in the Conservation Commission of Western Australia) and the Jurabi and Bundegi coastal reserves (jointly vested in the Shire of Exmouth and Executive Director of CALM). The Department of Defence controls lands at Location 44 on North West Cape and Location 97, located directly south of Cape Range National Park. The gazetted townsites of Coral Bay and Mauds Landing adjoin the Park (Figure 2).

In respect to the Marine Management Area, the Muiron Islands are jointly vested in the Conservation Commission of Western Australia and the Shire of Exmouth for the purposes of conservation, and Sunday Island is unallocated crown land. The terrestrial reserves include all land to the high water mark (Figure 2).

The CALM Act (Section 13B (1)) states that a marine park is established *"… for the purpose of allowing only that level of recreational and commercial activity which is consistent with the proper conservation and restoration of the natural environment, the protection of indigenous flora and fauna and the preservation of any feature of archaeological, historic or scientific interest."*

The CALM Act (Section 13C (1)(2)) states that a marine management area is established *"… for the purpose of managing and protecting the marine environment so that it may be used for conservation, recreational, scientific and commercial purposes. Commercial purposes include:*

a) aquaculture, commercial fishing and pearling activity;
b) mining, within the meaning of the Mining Act 1978;
c) seismic surveys and exploratory drilling for petroleum; and
d) production of petroleum, and associated activities."

It is proposed that the State Government liaise with the Commonwealth in regard to an amendment to the boundary of the Ministry of Defence land (Location 44). This reserve extends to the low water mark and includes significant areas of intertidal reefs that are an important ecological component of the marine ecosystem. It is recommended that the intertidal component be removed from Location 44 and added to the Park (see strategies in Section 8.1).

The area added to the Park in 2004 between Amherst Point and Red Bluff was gazetted to low water mark. The intertidal could not be included (as previously proposed) given the requirements of the *Native Title Act 1994*. It is proposed that when the requirements are met, the intertidal area will be added to the Park.

There at two port areas, Point Cloates and Point Maud within the Marine Park which are vested with the Minister for Planning and Infrastructure under the *Marine and Harbours Act 1981*. CALM and DPI are reviewing the need for these port areas with a view to addressing this overlap.

As the reserves are Class A reserves, the amendment of the purpose and boundaries of the reserves requires the tabling of an order in both Houses of Parliament. Either House can resolve to disallow an order and, consequently, Class A vesting provides high security of tenure. By contrast, the zoning scheme and the management plan can be amended through a formal public consultation process and do not require Parliamentary consideration. This provides the flexibility to respond to changing management priorities and community aspirations, as well as new information on the values and uses of the area. The CALM Act allows for the plan to be amended once several requirements are met. These requirements include the release of the proposed changes for public comment for a minimum two-month submission period and approval of the changes by the Minister for the Environment following consultation with the Minister for Agriculture, Forestry and Fisheries and the Minister for State Development.

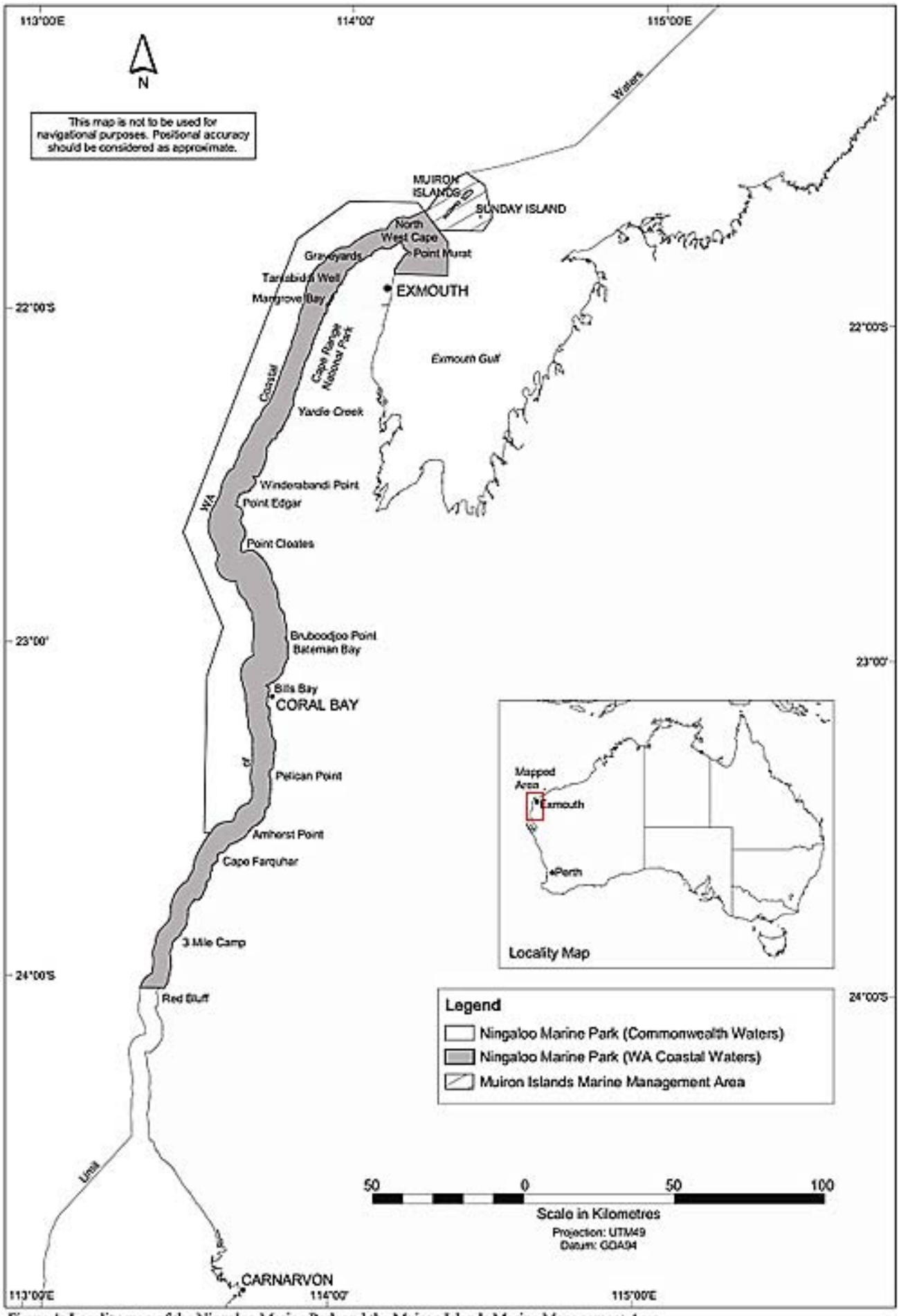

Figure 1: Locality map of the Ningaloo Marine Park and the Muiron Islands Marine Management Area

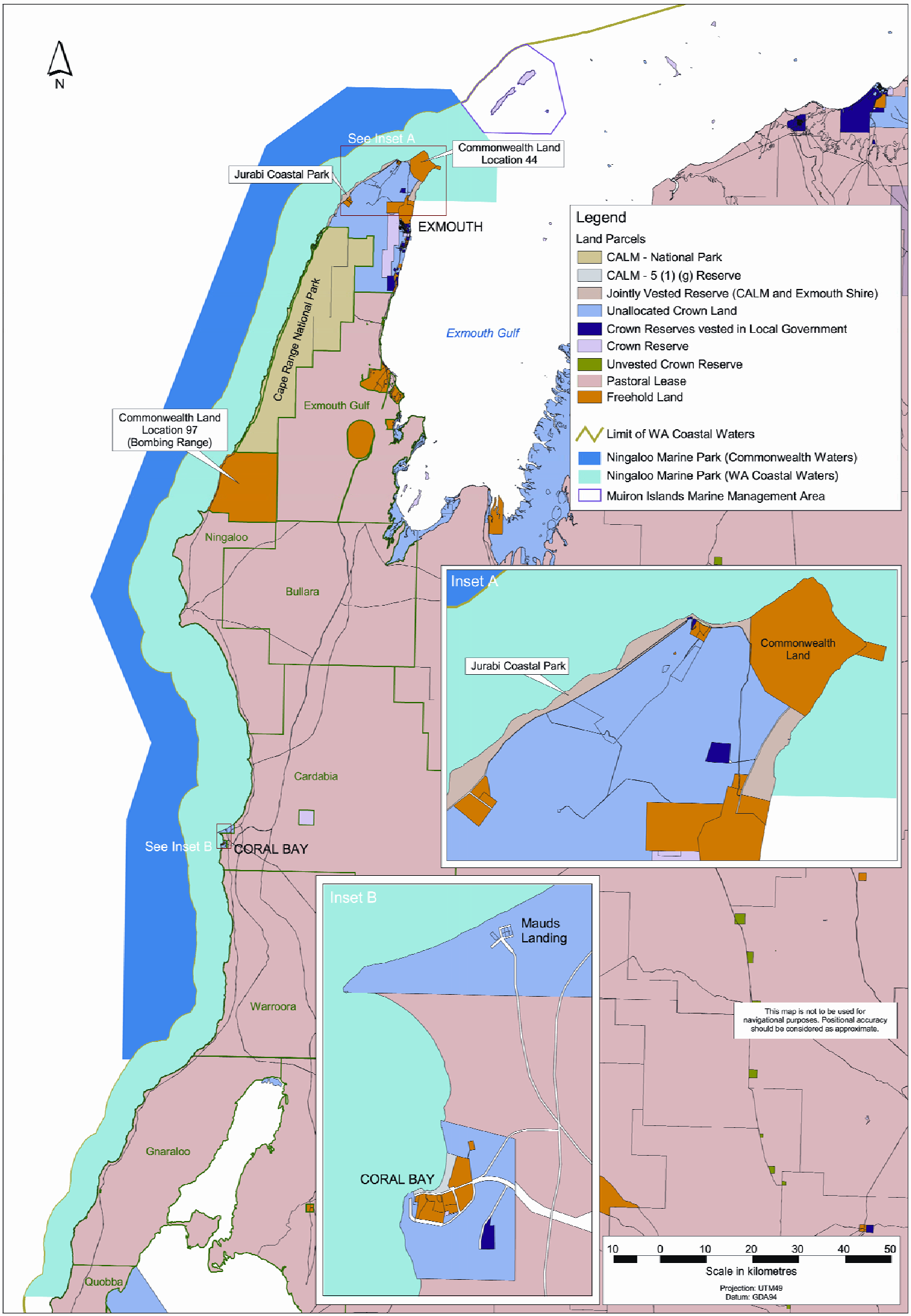

Figure 2: Tenure map of the Ningaloo Marine Park and the Muiron Islands Marine Management Area

6 VISION AND STRATEGIC OBJECTIVES

6.1 Vision

The Ningaloo Reef and associated coral reef communities are of local, national and international significance. As Australia's largest fringing coral reef ecosystem, which contains dugongs and endangered species such as turtles, as well as the world-renowned whale shark aggregations, this area is Western Australia's premier marine conservation icon. The conservation significance of the reef was formally acknowledged by the Western Australian Government in 1987 with the initial declaration of the Ningaloo Marine Park and the extension of the Park in 2004. The vision statement broadly reflects these natural values and the aspirations of the local and wider community with regard to the conservation, use and management of the Ningaloo Reef and the Muiron and Sunday islands.

Vision Statement

The marine flora and fauna, habitats, sediment, and water quality of the Ningaloo Marine Park and the Muiron Islands Marine Management Area will be in the same or better condition in 2015 than in 2005 and the reserves' cultural and Indigenous heritage values will be fully protected from adverse human impacts. The marine conservation reserves will be considered to be important ecological and social assets by the local, national and international community.

6.2 Strategic Objectives

The Government has a policy of establishing a comprehensive, adequate and representative system of marine conservation reserves in Western Australia, based on the principles of multiple use. The objectives of the marine conservation reserve system are:

- to preserve representative as well as special ecosystems in the marine environment; and
- to put a formal management framework in place to ensure the various uses of marine conservation reserves are managed in an equitable, integrated and sustainable manner.

Within the context of Government policy and the CALM Act, the strategic objectives for the reserves are:

Conservation

- to maintain the marine biodiversity of the reserves;
- to maintain ecological processes and life support systems (ie. key ecosystem structure and function);

Science and Education

- to promote education, nature appreciation (through recreation and tourism opportunities) and scientific research in the reserves;

Public Participation

- to promote community involvement in the management of the reserves;

Recreational Uses

- to facilitate, manage, and where appropriate, assist in the management of recreational activities in the reserves within an equitable and ecologically sustainable framework; and

Commercial Uses

- to facilitate manage, and where appropriate, assist in the management of commercial activities in the reserves within an equitable and ecologically sustainable framework.

The strategic objectives of the reserves cannot be achieved in isolation from other statutory and non-statutory management measures both within and external to the reserves. Thus the management of the reserves must be seen as part of a complementary suite of management practices, including fisheries management, marine fauna management, pollution control, environmental impact assessment, maritime transport and safety measures as well as community cooperation and participation.

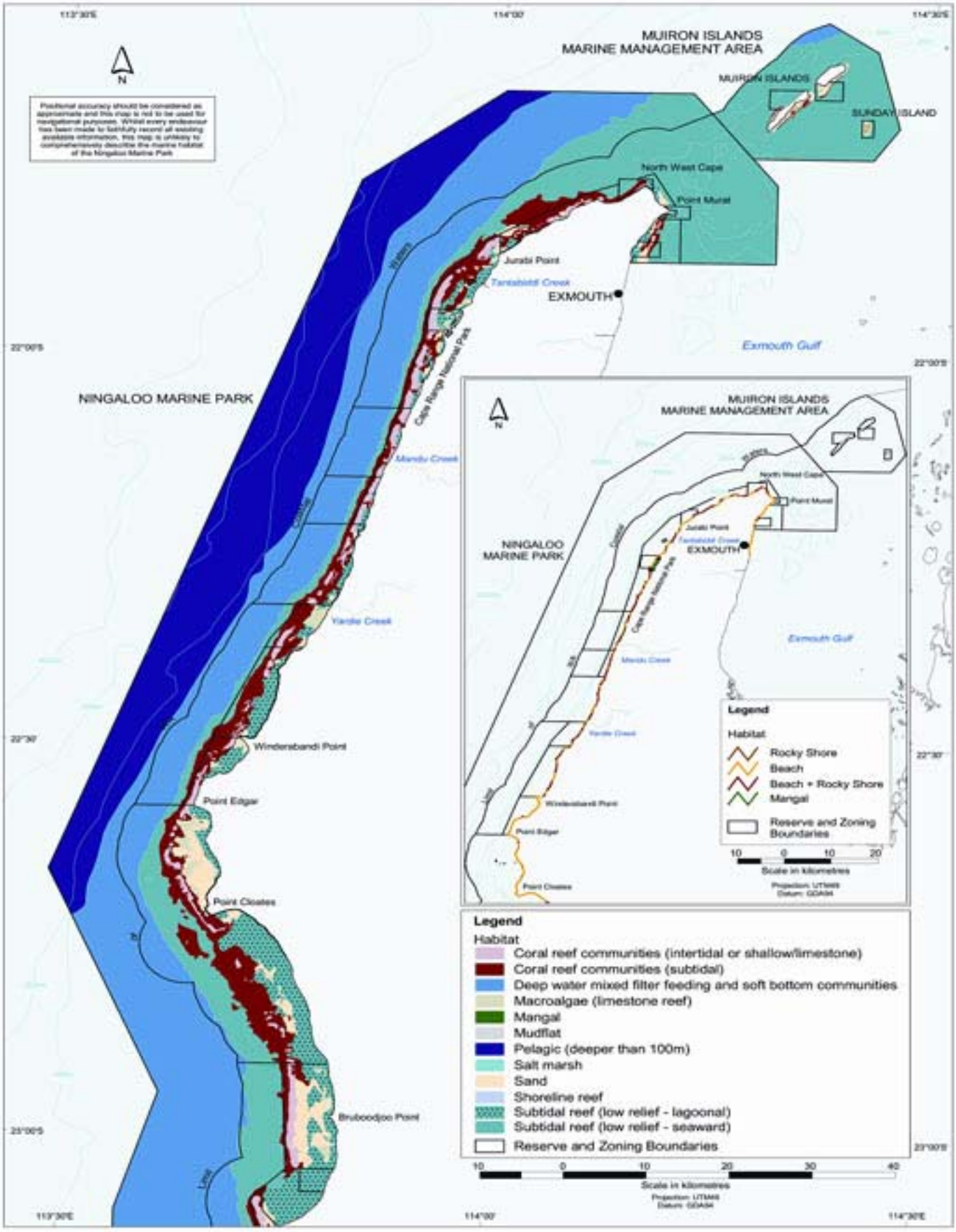

Figure 3: Major marine habitats and coastal structure of the Ningaloo Marine Park north of Point Cloates

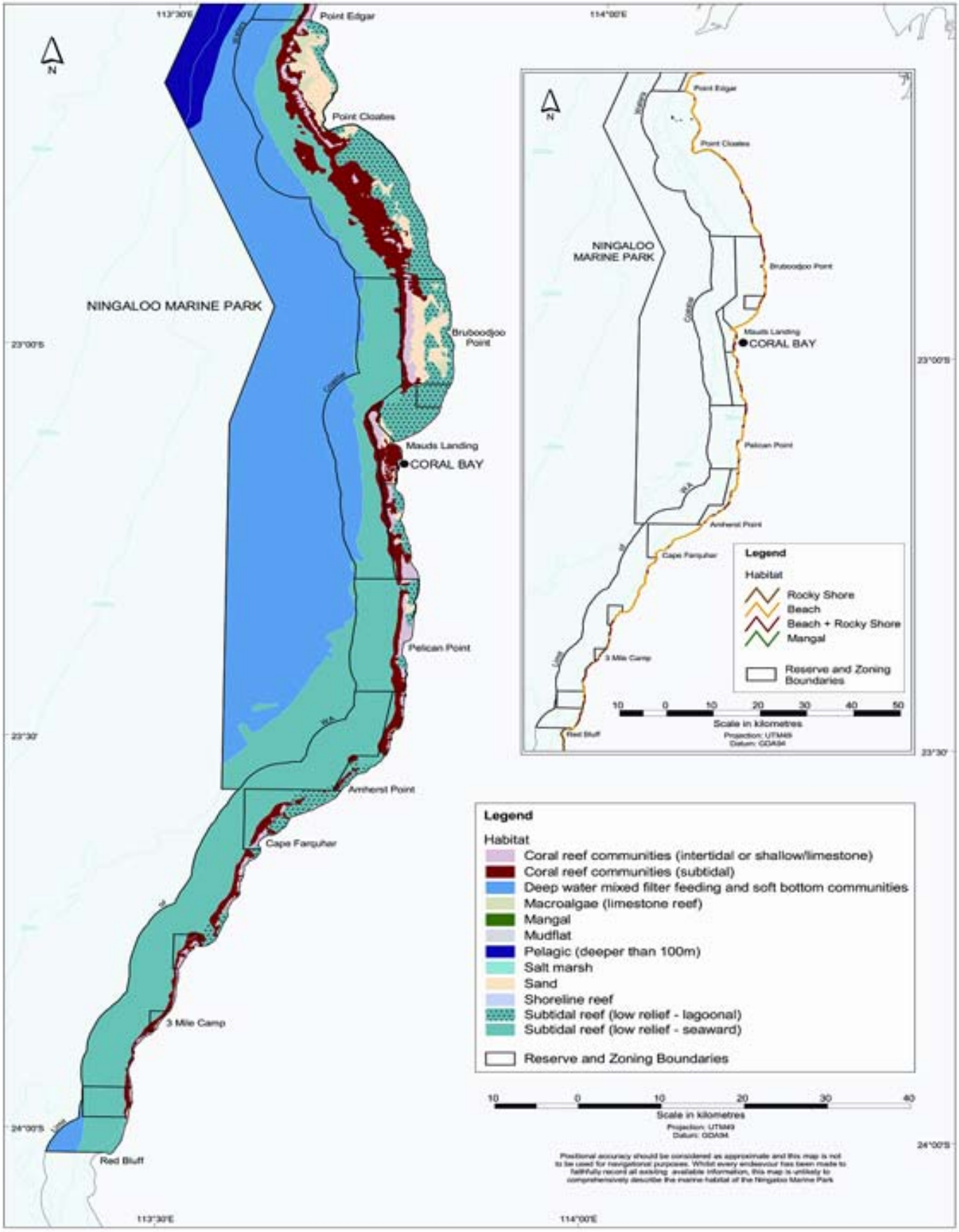

Figure 4: Major marine habitats and coastal structure of the Ningaloo Marine Park south of Point Cloates

7 MANAGEMENT OF ECOLOGICAL AND SOCIAL VALUES

7.1 Ecological Values

Ecological values are the intrinsic physical, chemical, geological and biological characteristics of an area. Ningaloo Reef, the largest fringing reef in Australia is renowned for its wealth of ecological values, including high diversity of corals, fishes and molluscs, an abundance of large marine fauna such as whale sharks, manta rays, sharks, turtles, whales, dugong and dolphins, and high water quality. This management plan aims to conserve these ecological values.

As well as being one of the State's marine conservation icons, the abundant wildlife and pristine nature of the Ningaloo environment form the basis on which visitors come to the area to enjoy the 'Ningaloo experience'. The area also supports a growing nature-based tourism sector. These uses are discussed in Section 7.2 Social Values. Conservation of the ecological values not only ensures protection of the Ningaloo environment but also ensures protection of the 'Ningaloo experience' and the tourism industry.

7.1.1 *Geomorphology*

Ecological value	**Geomorphology:** *The reserves are characterised by a diverse range of seabed and coastal geomorphology located within Australia's largest fringing coral reef.*

Background	The Ningaloo Reef is the largest fringing barrier reef in Australia, stretching for over 300 km. It forms a discontinuous barrier enclosing a lagoon that varies in width from 200 m to over 7 km. At the extreme northern end of the Park, from just north of Jurabi Point the barrier reef becomes discontinuous and eventually disappears. From here around the tip of the peninsula to Bundegi Reef there are intertidal shoreline reefs and some offshore banks. In the southern extent of the Park, the reef is closer to shore and less continuous until it becomes a shoreline fringing reef at Red Bluff. The major marine geomorphological features of the reserves are a gently sloping submarine shelf, underlain by Pleistocene limestone with a veneer of marine sediments and interrupting this shelf, a fringing barrier reef system (MPRSWG, 1994). The Park is located on the northern extremity of the Dirk Hartog Shelf (Carrigy & Fairbridge, 1954) and can be broadly described as having the following geomorphic features: • an inner continental shelf section; • a reef slope seaward of the reef crest (characterised by a steep slope in the north of Ningaloo Reef shifting to a gentle slope south of Point Edgar); • a reef flat (less than 150 m wide) which consists of a discontinuous basement platform of Pleistocene marine or aolian (windblown) sediments or older tertiary limestone bedrock (Collins *et al.,* 2003); • a gradually sloping back reef which may be several hundred metres wide with either an abrupt shoreward edge or a gentle gradation into the lagoon; and • a lagoonal area landward of the reef, which varies in width throughout the reserves but has an average depth of 2-4 m, characterised by coarse calcareous sand. The morphology of the reef environments and their location has a critical relationship with the oceanography within and surrounding the reserves. The complex intertidal and subtidal geomorphology of the reserves plays a significant role in the variety of marine habitat types and correspondingly high species diversity. The Park's landward boundary extends to 40 m above the high water mark adjacent to pastoral leases. The coastline of the reserves is characterised by Pleistocene limestone overlain in some areas by geologically recent and unconsolidated Holocene dunes. These dune systems are very fragile and vegetation cover is critical to maintain stability. Recreational camping and four-wheel-drive (4WD) tour use and activities, as well as grazing livestock and feral animals have had a detrimental effect on some of these fragile dune environments. Management of this value includes ensuring that proposals for development within the reserves, such as marinas and resorts that have the potential to disturb the geomorphology of the reserves, are appropriately assessed in accordance with the EP Act, implementation of educational initiatives to increase awareness of the importance of geomorphology, and research that focuses

	on increasing our understanding of the geomorphology and its relationship to the reef system
Current status	The subtidal and intertidal geomorphology of the reserves is generally in an undisturbed condition. The dune systems along the 40 m coastal strip adjacent to pastoral stations, are severely disturbed at intensively used locations.
Existing and potential uses and/or pressures	• Recreational use of coastal landforms (camping, 4WD, walking). • Commercial use of coastal landforms (tourism, including infrastructure). • Commercial use of the marine environment (trawling). • Coastal infrastructure (marinas, boat facilities, groynes). • Unrestricted foreshore grazing and trampling by feral and domestic animals. • Navigation requirements (channels and markers). • Installation of telecommunication cables or petrochemical pipelines.
Current major pressure/s	Commercial and recreational use of coastal landforms.
Management objective/s	To ensure commercial and recreational access and use do not degrade coastal landforms within the reserves.
Strategies	1. Ensure effective management of commercial and recreational access and use of coastal landforms adjacent to the reserves through liaison with coastal land managers (CALM, DPI, LGAs, pastoralists) **(H-KMS)**. 2. Prohibit commercial and recreational use of coastal features within the reserves where these activities are likely to result in degradation of coastal landforms (CALM) **(H-KMS)**. 3. Educate users of the reserves about the ecological importance of the reserves' geomorphology, particularly the fragile coastal landforms (CALM) **(H-KMS)**. 4. Undertake research to map and classify the seabed geomorphology of the reserves, with a particular emphasis on the deeper (>20 m) areas and reserve areas of Exmouth Gulf. (CALM) **(H)**. 5. Ensure coastal and offshore development activities do not have significant impacts on the geomorphology of the reserves, through the provision of advice to the EPA regarding environmental assessment of proposals (CALM) **(M)**. 6. Develop a rehabilitation strategy for the 40 m strip above the high tide mark within the Park (CALM, LGA, NSDO, Pastoralists) **(M)**. 7. Undertake research to improve knowledge of the coastal groundwater system and its relationship to the reef system (CALM) **(M)**. 8. Undertake research to investigate the morphology and growth history of the reef system and identify the importance of reef growth characteristics for the maintenance of reef biodiversity (CALM) **(L)**.

Performance measure/s	1. Area of seabed disturbance (ha). 2. Area of coastal degradation (ha).	**Desired trend/s**	1. Negative. 2. Negative.
Short-term target/s	To be developed as required.		
Long-term target/s	**Ningaloo Marine Park –** 1. No change of seabed structural complexity as a result of human activity in the Park. 2. No change in coastal landform structure (in the coastal strip to 40 m above the high water mark) as a result of human activity in the Park except for approved development sites (ie. carparks, roads, campsites). **Muiron Islands Marine Management Area –** 1. *Conservation areas* - no change except in areas approved by the appropriate government regulatory authority. The cumulative area of change is not to exceed 1% of the total area of these zones. 2. *Unzoned areas*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[§] Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.2 Sediment quality

Ecological value	**Sediment quality**: *The sediment quality of the reserves is high and generally undisturbed, and is essential to the maintenance of a healthy ecosystem.*

Background	The sediments of the Ningaloo Marine Park and the Muiron Islands Marine Management Area are generally characterised by calcareous sands in the shallow lagoon and by calcareous fine sands and silts in the deeper offshore waters. The sediments in the protected Exmouth Gulf areas of the reserves are significantly finer than on the western side of North West Cape. Little information is available on the sediment quality of the reserves, however due to the low level of industrial and coastal development, the absence of significant catchment related inputs, and the relatively low level of boating activity, it is likely the sediments of the reserves are in an undisturbed condition. Some localised contamination of sediments was recorded in a 1995 study adjacent to the Coral Bay townsite (Simpson & Field 1995). While heavy metal and organic contaminant surveys found the sediments of Bills Bay to be relatively pristine, concentrations of arsenic, chromium, iron, manganese and zinc were found to be considerably higher at two Maud's Landing control sites than most comparable sites. This is possibly due to historical activities at Maud's Landing. Tri-butyl tin (TBT) concentrations from anti-fouling paints from boat hulls were extremely high at several sites in Coral Bay, these sites coinciding with mooring areas for large boats (Simpson & Field 1995). Concentrations of over 10 µg TBT/kg in sediments are considered to be unacceptable given the extreme toxicity of TBT to a range of marine fauna and flora (Simpson & Field 1995). Management for sediment quality includes research to increase our understanding of contaminant distribution in mooring and anchoring areas and characterising the condition of surficial sediments. Management will also focus on working with stakeholders to promote use of products that minimise impacts on marine biota. Development and infrastructure proposals that have the potential to impact on sediment quality in the State are subject to assessment under the EP Act. The EPA can set conditions for sediment quality, which are subsequently regulated by the DoE and the DoIR.
Current status	The sediment quality is generally in an undisturbed condition, apart from localised and low level contamination in some relatively high boat use areas (eg. southern Bills Bay).
Existing and potential uses and/or pressures	• Contaminants from drilling fluids and cuttings (Marine Management Area). • Sediments from drill cuttings (Marine Management Area). • Nutrient inputs. • Toxicant inputs. • Litter.
Current major pressure/s	None.
Management objective/s	To ensure that the sediment quality of the reserves is maintained at a level which supports and maintains the area's ecological and social values.
Strategies	1. Undertake contaminant sediment surveys in designated mooring and anchoring areas and at appropriate control sites, particularly in relation to hydrocarbons, antifouling paint contamination and other toxicants as appropriate (CALM) **(M)**. 2. Undertake research to characterise the surficial sediments of the shallow waters (<20 m) of the reserves (CALM) (**M**). 3. In relation to petroleum exploration operations in the Marine Management Area, minimise impacts on sediments by encouraging, where possible, the use of products that have the least amount of impact on the marine biota (DoE/EPA, DoIR, CALM) **(L).**

Performance measure/s	1. Metals and metalloids. 2. Organic compounds.	**Desired trend/s**	1. Constant or negative. 2. Constant or negative.
Short-term target/s	To be developed as required.		
Long-term target/s	**Ningaloo Marine Park -** No change in sediment quality of the Park waters from 'background'$^{\Omega}$ levels, as per the environmental quality management framework referred to in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000), as a result of		

	human activities in the Park. **Muiron Islands Marine Management Area -** 1. *Conservation areas* – no change from 'background'[Ω] levels except in areas approved by the appropriate government regulatory authority. The area not meeting ANZECC guidelines is not to exceed 1% of these zones. 2. *Unzoned areas*[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.

[Ω] *background* conditions are determined from an appropriate unimpacted reference site, as per the environmental quality management framework referred to in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000).

[§] Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.3 Water quality (KPI)

Ecological value	**Water quality***: The water quality of the marine reserves is high due to low terrestrial runoff and limited coastal development, and is essential to the maintenance of healthy marine and foreshore ecosystems.*

Background	Nearshore water movements and mixing patterns within the Ningaloo Marine Park are primarily driven by wave action forcing water over the reef tract and into the lagoon. Prevailing winds and tide drive the water northward within the lagoon until it is expelled back outside the reef tract through the intermittent reef gaps. A portion of the water is then pumped back over the reef while the majority joins the prevailing offshore current. Local offshore water movement is dominated by the southerly flowing Leeuwin Current (prevailing in autumn and winter) and its interaction with the northerly flowing Ningaloo Current adjacent to the reef (prevailing in spring and summer). The northward movement of the Ningaloo Current is interrupted at Point Cloates (the Park's most westerly terrestrial point, located centrally on the Park's coastline) where a counter current may direct some of the water offshore and southward creating a zone of upwelling adjacent to the reef. Due to the strong water movements through the area, combined with low human usage, water quality throughout the reserves is generally high. Major inputs from anthropogenic sources are limited to the two relatively large population centres adjacent to the reserves at Coral Bay and Exmouth. Properties in Coral Bay have historically used septic tanks or open evaporation ponds for their sewage disposal. Elevated concentrations of inorganic nitrogen and faecal coliforms in samples from shoreline wells adjacent to Bills Bay were attributed to leaching from these systems (Simpson & Field, 1995). The State Government has completed the installation of an evaporative sewage system 4 km from the town to accommodate a population of approximately 4000 people. Sewage treatment for the town of Exmouth is addressed by means of a series of open evaporative ponds, which are located 500 m from the ocean and 10 km from the Park boundary. Given the distance from the northern boundary, it is that pathogens or nutrient loading from these facilities would affect the water quality in the reserves. An additional sewage outfall services approximately 15-20 people at the Point Murat naval jetty. Monitoring around this site has shown no evidence of contamination from sewage (Cary & Grubba, 2000a). Petroleum and shipping industry activities adjacent to the reserves have the potential, if not managed appropriately, to have negative impacts on the water quality of the reserves. Exploration and production by the petroleum industry can result in produced formation water (water with hydrocarbon contamination) and discharge of toxic drilling fluids, while the transfer of oil to vessels also carries the risk of accidental spillage. Proposed petroleum exploration and development in the Exmouth sub-basin at the Stybarrow and Enfield projects to the north-west of the Park has the capacity to impact the Park if a spillage occurs. Ningaloo Reef also lies near the westernmost point of Australia and closest to the edge of the continental shelf. There is extensive shipping activity close to the Park and this activity raises concerns in regard to the potential impact on the Ningaloo Reef if a shipping accident should occur. Other vessels transiting or conducting commercial and recreational activities within and adjacent to the Park may also negatively impact the water quality through the discharge of bilge water, accidental fuel and oil spills and the leaching of toxins from antifouling coatings. These input are likely to have greatest impact at locations where there is a high level of boating activity. While the risk of introduced marine pests from ballast water is low given that commercial shipping does not access the area, there is a small possibility of marine pests being introduced to the reserves on the hulls of fishing or pleasure craft arriving from other areas. Inputs to the marine environment from the land are limited due to the low level of development. The low rainfall characteristic of the area limits the runoff from the adjacent land and so limits the nutrient and suspended material input into the waters of the reserves. Sewage discharge from vessels has the potential to increase nutrient levels and to cause health problems for direct contact recreational activities due to elevated bacterial levels. The impact of sewage discharge from vessels will vary considerably from place to place and seasonally as a consequence of environmental parameters (eg. water circulation) and human usage patterns (eg. number of vessels). A statewide Strategy for Management of Sewage Discharge from Vessels

	into the Marine Environment was adopted by the Government in 2004. This strategy details a framework for the implementation of controls of sewage discharge through designation of high risk areas where discharge is prohibited or where only treated sewage can be discharged from vessels. In the reserves, the following sewage discharge scheme is recommended to be applied, however during the life of the management plan, may be amended if considered necessary: • All waters of the Park will be 'Zone 1' (no discharge areas) except for waters in general use zones from 500 m seaward of the reef front, which are Zone 3 (open discharge areas). • All waters of the Muiron Islands Marine Management Area will be 'Zone 1' (no discharge areas), except for unzoned areas greater than 500 m from the coast that are Zone 3 (open discharge areas). Management includes gaining a better understanding of the processes that contribute to high water quality and development of predictive models and response strategies in the event of an oil spill or shipping accident. With increased recreation and commercial vessel use within the reserves it is important to educate users of the reserves about the correct procedure for sullage disposal from vessels, in accordance with the DPI Sewage Policy. Development and infrastructure proposals with a potential impact on water quality in the State are subjected to assessment under EPA guidelines. The EPA also sets conditions for water quality, which are regulated by DoE and DoIR.
Current status	The water quality in the reserves is, generally, in an undisturbed condition.
Existing and potential uses and/or pressures	• Toxicant inputs from the accidental spillage of fuel and oils. • Antifouling paints used on boat hulls. • Oil spills from passing ships. • Nutrient and pathogen inputs from sewage discharge from vessels. • Litter from commercial and recreational boating/fishing activities.
Current major pressure/s	None.
Management objective/s	To ensure that the water quality of the reserves is maintained at a level which supports and maintains the areas ecological and social values.
Strategies	1. Establish and maintain a pollutant inputs database for the reserves (CALM) **(H)**. 2. Develop an appropriate understanding and predictive capacity of the circulation and mixing of the reserves' waters, particularly in relation to key ecological processes (eg nutrient supply and productivity, recruitment, connectivity) (CALM) **(H)**. 3. Map the ecological and social values of the reserves that are highly sensitive to oil spills and ensure this information is accessible to the State Committee for Combating Marine Oil Pollution (CALM, DPI) **(H)**. 4. Inform users of restrictions on sewage discharge from vessels and incorporate these restrictions in licence conditions for charter operators (CALM, DPI) **(H)**. 5. Undertake water quality surveys in appropriate control sites and in areas of the reserves that are, or have been, exposed to contaminant inputs (CALM) **(M)**. 6. Investigate the option for the listing of Ningaloo Reef with the International Maritime Organisation as a 'Particularly Sensitive Sea Area' to minimise risks associated with shipping (CALM, DoE) **(M)**. 7. Undertake a baseline litter survey in areas of historical and current high use (CALM) **(M)**.

Performance measure/s	1. Nutrients: Chlorophyll *a* and inorganic nitrogen (N) conc. in seawater. 2. Toxicants: conc. in seawater. 3. Pathogens: Faecal coliforms conc. in seawater. 4. Litter: Mass (kg) of litter at selected monitoring sites.	**Desired trend/s**	1. Constant or negative. 2. Constant or negative. 3. Constant or negative. 4. Negative.
Short-term target/s (KPI)	To be developed as required.		
Long-term target (KPI)	**Ningaloo Marine Park -** No change in water quality of all of the Park waters from 'background'$^{\Omega}$ levels, as per the environmental quality management framework referred to in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000), as a result of		

	human activities in the Park. **Muiron Islands Marine Management Area -** 1. <u>*Conservation areas*</u> – no change from 'background'[Ω] levels as a result of human activity in the Marine Management Area. 2. <u>*Unzoned areas*</u>[§] - maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.

[Ω] *background* conditions are determined from an appropriate unimpacted reference site, as per the environmental quality management framework referred to in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ, 2000).

[§] Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.4 Coral reef communities (KPI)

Ecological value	**Coral reef communities***: A diverse range of species rich coral communities occurs in the reserves.*

Background	Ningaloo Reef is the largest fringing barrier coral reef, and the second largest coral reef system, in Australia. The most diverse coral communities in the reserves are in the relatively clear water, high energy environment of the fringing barrier reef and low energy lagoonal areas to the west of North West Cape. The reserves are characterised by a high diversity of hard corals with at least 217 species representing 54 genera of hermatypic (reef building) corals recorded to date (Veron & Marsh, 1988). All 15 families of hermatypic corals are represented in the reserves; however, species diversity and community structure vary with environmental conditions such as exposure to wave action, currents, depth and water clarity. Corals are the most important reef building organisms within the reserves, and provide food, settlement substrate and shelter for a wide variety of other marine flora and fauna. Coral communities are also important for protection of coastlines through accumulation and cementation of sediments and dissipation of wave energy. Although broad habitat mapping of coral communities has been completed, information is limited on detailed distribution of species throughout the reserves. Natural events that impact on coral communities include cyclones, extreme low tide events, anoxic conditions resulting from coral spawning, bleaching and predation by the gastropod, *Drupella cornus.* In 2001 the DoF imposed a prohibition on recreational collection of coral that will remain in place until such time as the Minister for Agriculture, Forestry and Fisheries has endorsed a long-term management strategy for this activity. Commercial and recreational take of live coral (for aquarium use), 'live' rock and 'live' sand is prohibited in the Park and the Marine Management Area. Development proposals that have potential to impact on coral reef communities may be referred the DoE/EPA if appropriate, for consideration and formal environmental impact assessment. Any development proposals will be considered in light of the management targets for filter feeding communities and other ecological values. In 2005, the coral communities in the reserves were in a good condition with some localised impact from human activities. The major human pressure on coral communities in the reserves is the damage associated with trampling of shoreline communities, vessel collisions and indiscriminant anchoring/mooring. Impacts from these activities are generally localised and mostly occur in heavily used areas within the reserves. Southern Bills Bay, in particular, is an area where localised damage to coral communities has occurred from recreational and commercial vessels. Research by Westera (2003) has provided evidence that current levels of fishing in some parts of Ningaloo Marine Park may be causing undesirable changes to the coral reef communities in the Park. Given the key ecological role of coral reef communities in the Park, management strategies focus on protecting representative and adequate areas in sanctuary zones, increasing knowledge of the distribution of coral reef communities in the Park and understanding the impacts of human activities, particularly fishing, and natural influences on these communities. Monitoring will be undertaken at sites most likely to have localised disturbance. Implementation of anchoring restrictions and/or installation of moorings will also be considered to avoid coral damage. Development of recreation/mooring site plans for the reserves will provide direction on areas suitable for provision of moorings and areas suitable for anchoring.
Current status	The coral communities are, generally, in an undisturbed condition, with some localised disturbance from inappropriate anchoring and mooring activities (eg. in southern Bills Bay).
Existing and potential uses and/or pressures	• Vessels colliding with shallow coral communities. • Anchor damage and inappropriate moorings. • Trophic effects caused by fishing. • Litter. • Direct impacts by recreation use (trampling, diving). • Pollution events (shipping, oil/gas industry). •

Current major pressure/s	Localised direct damage associated with reef walking, anchoring and boating activities.
Management objective/s	To ensure the diversity and abundance of coral reef communities in the reserves are not significantly impacted by human activities within the reserves.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Assess the nature, level and potential impacts of human activities, and recreational fishing in particular, on coral communities within the reserves (CALM, DoF) **(H-KMS)**. 3. Undertake research to develop a cost-effective monitoring protocol to estimate annual coral reef fish recruitment within the reserves and investigate the implications for coral reef resilience and connectivity (CALM) **(H-KMS)**. 4. Undertake research and monitoring to assess the ecosystem effects of recreational fishing on coral reef communities (ie. trophic cascades) (CALM, DoF) **(H-KMS)**. 5. Undertake research to develop a cost-effective monitoring protocol to estimate annual coral recruitment within the reserves and investigate the implications for coral reef resilience and connectivity (CALM). **(H-KMS)**. 6. Educate users of the reserves about the ecological importance of coral reef communities and the potential detrimental effects of indiscriminate reef walking, collecting, anchoring and boating activities on coral reef communities (CALM) **(H)**. 7. Implement a Mooring Plan, including the establishment and maintenance of public and private moorings, for the reserves in line with the MPRA/CALM Mooring Policy (CALM) **(H)**. 8. Undertake research to characterise the coral species and distribution within the reserves with a particular emphasis on the seaward deeper water community abundance and key functional groups of coral populations (CALM) **(H)**. 9. Monitor the distribution and abundance of *Drupella cornus* in the reserves at least every three years (CALM) **(H)**. 10. Undertake research to develop a cost-effective protocol to monitor *Drupella cornus* population trends in the reserves (CALM) **(H)**. 11. Undertake research on the distribution and abundance of key predators of *Drupella cornus* (CALM) **(H)**. 12. Undertake research to assess the potential impacts of climate change on Ningaloo Marine Park over the next 50 years, with particular emphasis on the coral reef communities (CALM) **(H)**. 13. Monitor the recovery of the coral reef communities in Bills Bay every three years (CALM) **(H)**. 14. Monitor coral communities in areas at most risk of mooring and anchoring damage and review the effectiveness of anchoring restrictions in preventing coral damage (CALM) **(M)**.

Performance measure/s	1. Diversity. 2. Biomass	**Desired trend/s**	1. Constant or positive. 2. Constant or positive
Short-term target/s (KPI)	To be developed as required.		
Long-term target/s (KPI)	**Ningaloo Marine Park –** 1. No loss of coral diversity as a result of human activity in the Park. 2. No loss[Ø] of living coral biomass as a result of human activity in the Park. **Muiron Islands Marine Management Area –** 1. No loss of coral diversity as a result of human activity in the Marine Management Area. 2. The abundance[Ø] targets for coral reef communities will be as noted below: i. *Conservation areas* – no change as a result of human activity in the Marine Management Area. ii. *Unzoned areas*[§] – maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[Ø] In this context a loss or change in "*abundance" or "biomass"* excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

§ Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.5 Filter feeding communities (other than coral reefs)

Ecological value	**Filter feeding communities (other than coral reefs)**: *A diverse range of filter feeding communities exists in the reserves between 20-200 m in depth.*

Background	Filter feeding communities are defined here as those communities comprising species such as sponges, tunicates and cnidarians other than hermatypic corals. Filter feeding communities, often referred to as "sponge gardens", are generally located in areas that have strong water currents and hard substratum. Well-developed communities occur in the northern part of Exmouth Gulf around North West Cape and the Muiron and Sunday islands (A. Heyward, pers. comm.). A survey of the filter feeding communities adjacent to North West Cape (Bancroft, 2003) found that the greatest density and diversity of filter feeding communities occurred in the waters adjacent to Point Murat. Surveys by the Australian Institute of Marine Science during 2004 in depths between 20 – 200 m have recorded extensive areas of filter feeding communities in the reserves. Development proposals that have potential to impact on filter feeding communities may be referred to the DoE/EPA if appropriate, for consideration and formal environmental impact assessment. Any development proposals will be considered in light of the management targets for filter feeding communities and other ecological values. The major (most diverse and abundant) known filter feeding communities are not under significant threat. Trawling is only permitted in the general use zone of the reserves where it overlaps with the Exmouth Gulf Managed Prawn Trawl Fishery. Trawling activities may occasionally infringe on the edges of some areas of these filter feeding communities. Identification of these areas would assist negotiations with the Exmouth Prawn Fishery to minimise the impacts on these communities from trawling activity. Other commercial fishing activities (including specimen invertebrate and shell collection) have the potential to impact on filter feeding communities through targeting particular species. In 2005 the filter feeding communities within the reserves were considered to be largely undisturbed but understanding of these communities is limited. Management will thus focus on increasing our understanding of the extent and diversity of filter feeding communities within the reserves and implementing appropriate protection based on this improved understanding.
Current status	Filter feeding communities, generally, are presumed to be in an undisturbed condition except for those areas of the reserves in Exmouth Gulf that are subject to trawling activities.
Existing and potential uses and/or pressures	• Trawling. • Anchoring. • Specimen invertebrate and shell collecting.
Current major pressures	None.
Management objective/s	To ensure that important filter feeding communities are not significantly impacted by human activities in the reserves.
Strategies	1. See ZONING strategies (Section 8.1.1)(CALM) **(H-KMS).** 2. Undertake research to characterise the distribution and abundance of filter feeding communities in the reserves, particularly in the deeper offshore waters and in areas subject to trawling activities (CALM) **(H-KMS)**. 3. If mapping shows overlap of filter feeding communities with trawling, liaise with the DoF and the trawling industry to have these areas protected. (CALM, DoF) **(H-KMS)**. 4. Undertake further research with the aim of developing cost-effective monitoring protocols to determine the 'health' of filter-feeding communities (CALM) **(M)**.

Performance measure/s	1. Diversity. 2. Abundance.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s	To be developed as required.		
Long-term target/s	**Ningaloo Marine Park –** 1. No loss of filter feeding community diversity as a result of human activity in the Park. 2. No loss[Ø] of living filter feeding community biomass as a result of human activity in the		

	Park. **Muiron Islands Marine Management Area –** 1. No loss of filter feeding community diversity as a result of human activity in the Marine Management Area. 2. The abundance[Ø] targets for filter feeding communities will be as noted below: i. *Conservation areas* – no change as a result of human activity in the Marine Management Area. ii. *Unzoned areas*[§] – maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.

[Ø] In this context a loss or change in "*abundance" or "biomass"* excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

[§] Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.6 Shoreline intertidal reef communities

Ecological value	**Shoreline intertidal reef communities:** *Shoreline intertidal reef communities are widely distributed throughout the reserves.*

Background	Shoreline intertidal reefs are a prominent feature along the coastline of the Ningaloo Marine Park and the islands of the Muiron Islands Marine Management Area. These reefs contribute significantly to biological diversity of the reserves. Intertidal reef communities are significantly affected by tidal and wave action and support diverse assemblages of organisms that are resistant to desiccation. Larger fish and other marine animals come in to feed on reef platforms when the tide is high. The abundance of invertebrate life on these shoreline intertidal reefs also provides a valuable food source for shorebirds. Development proposals that have potential to impact on shoreline intertidal reef communities may be referred to the DoE/EPA if appropriate, for consideration and formal environmental impact assessment. Any development proposals will be considered in light of the management targets for filter feeding communities and other ecological values. The intrinsic biological attributes and accessibility of shoreline intertidal reefs often attract a variety of recreational uses (eg. collecting, fishing, reef-walking) as well as providing a range of educational and scientific opportunities. This accessibility and relatively high use also make these reefs among the most vulnerable habitats to human degradation. Reef-walking and recreational fishing, for example, can result in physical disturbance to the reef platforms through trampling. Similarly recreational bait collecting activities have the potential to deplete local invertebrate populations (eg. octopus). These pressures are generally greatest on mainland shoreline intertidal reefs due to the ease of access. The less accessible intertidal reefs around the Muiron/Sunday islands are generally less impacted. Anecdotal evidence suggests that there has been historical stripping of reefs for shells in the north of the Park in the 1960s and 1970s associated with the ease of access from the adjacent naval facility. It is recommended (see Section 5) that the intertidal reefs included in Defence land be incorporated into the Park. The inclusion of the extensive reef flat in the north of Lighthouse Bay into the Lighthouse Sanctuary Zone provides increased protection to these reefs. Generally the shoreline intertidal reef communities in the reserves are in good condition. There are some areas with localised disturbances in highly accessible recreational areas. Management of these communities in the reserves will focus on the use of spatial controls to provide for areas of no impact in which monitoring can be undertaken and management of conflicting uses, research to improve our understanding of shoreline community diversity and the impacts of humans on them, and education of users of the reserves about the importance of this value.
Current status	The shoreline intertidal reef communities are, generally, in an undisturbed condition, with some localised areas of degradation resulting from trampling and historical recreational collection.
Existing and potential uses and/or pressures	• Trampling. • Pollution events (shipping, oil/gas industry). • Recreational collecting/fishing.
Current major pressure/s	Localised degradation associated with trampling and recreational collecting activities.
Management objective/s	To ensure the diversity and abundance of shoreline intertidal reef communities in the reserves are not significantly impacted by trampling and recreational collecting within the reserves.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Assess the nature, level and potential impacts of human activities on shoreline intertidal reef communities within the reserves (CALM) **(H-KMS)**. 3. If appropriate, limit access to intertidal areas under pressure from human activities (CALM) **(H-KMS)**. 4. Educate users of the reserves about the ecological importance of shoreline intertidal reef communities and the potential detrimental effects of indiscriminate reef walking and collecting for bait and ornamental uses (CALM) **(H-KMS)**. 5. Monitor shoreline intertidal reef communities in areas at most risk of degradation from human activities such as trampling (CALM) **(H)**.

	6. Undertake research to characterise the flora and fauna on representative shoreline intertidal reef communities within the reserves (CALM) **(H)**.

Performance measure/s	1. Diversity. 2. Biomass.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s	To be developed as required.		
Long-term target	**Ningaloo Marine Park -** 1. No loss of shoreline intertidal reef community diversity as a result of human activity in the Park. 2. No loss[Ø] of shoreline intertidal reef community abundance as a result of human activity in the Park. **Muiron Islands Marine Management Area –** 1. No loss of shoreline intertidal reef community diversity as a result of human activity in the Marine Management Area. 2. The abundance[Ø] targets for shoreline intertidal reef communities will be as noted below: i. *Conservation areas* – no change as a result of human activity in the Marine Management Area. ii. *Unzoned areas*[§] – maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.		

[Ø] In this context a loss or change in "*abundance" or "biomass"* excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

[§] Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.7 Soft sediment communities

Ecological value	**Soft sediment communities:** *Soft sediment communities occur in the deeper offshore waters and shallow lagoonal environments of the reserves.*

Background	Soft sediment communities within the reserves exist in the low energy depositional environments found in the deeper offshore waters of the west coast and in the more protected environments of Exmouth Gulf. Although typically bare of vegetation, soft sediment communities are characterised by a surface film of micro-organisms that are a rich source of food for the high diversity of invertebrates found there. These invertebrates are found both living on the surface and burrowing into the substrate, where their burrowing activities facilitate aeration through the turnover of sediment. The existence of healthy soft sediment communities also assists to stabilise the substrate. Where a stable substrate is not maintained, higher levels of turbidity may result and lead to smothering of adjacent areas. The abundance of invertebrate life found on soft sediment communities also provides a valuable food source for resident and transient invertebrate and invertebrate fauna. Soft sediment communities are extremely important from a biodiversity conservation perspective because of the high diversity of infauna and epifauna (particularly invertebrates) found in these habitats. Development proposals that have potential to impact on soft sediment communities may be referred to the DoE/EPA if appropriate, for consideration and formal environmental impact assessment. Any development proposals will be considered in light of the management targets for filter feeding communities and other ecological values. Soft sediment communities are sensitive to physical disturbance and where disturbance of these habitats occurs, stability of substrates is affected. Trawling has occurred over a long period in a small area of the Park and Marine Management Area in Exmouth Gulf. The effects, if any, on soft sediment communities are not known. Management of soft sediment communities includes undertaking research to better characterise these communities and to assess the level of human impact on soft sediment communities.
Current status	The soft sediment communities in the reserves are mostly undisturbed. Significant disturbance to areas in Exmouth Gulf that are subject to trawling.
Existing and potential uses and/or pressures	• Trawling. • Petroleum drilling (Muiron Islands).
Current major pressure/s	None.
Management objective/s	To ensure the species diversity and biomass of soft sediment communities within the reserves are not significantly impacted by human activities in the Park.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Undertake research to better characterise the flora, fauna and distribution of soft sediment communities within the reserves, particularly in the deeper offshore waters of the Park and in Exmouth Gulf (CALM) **(H)**. 3. Assess the nature, level and potential impacts of human activities on soft sediment communities within the reserves and if appropriate, implement management activities to minimise these impacts (CALM, DoF) **(M)**.

Performance measure/s	1. Diversity. 2. Biomass.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s	To be developed as required.		
Long-term target/s	**Ningaloo Marine Park -** 1. No loss of soft sediment community diversity as a result of human activity in the Park. 2. No loss[Ø] of soft sediment community abundance as a result of human activity in the Park. **Muiron Island Marine Management Area –** 1. No loss of soft sediment community diversity as a result of human activity in the Marine		

	Management Area. 2. The abundance[Ø] targets for soft sediment communities will be as noted below: i. *Conservation areas* – no change as a result of human activity in the Marine Management Area. ii. *Unzoned areas*[§] – maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.

[Ø] In this context a loss or change in "abundance" or "biomass" excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

[§] Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.8 Macroalgal and seagrass communities

Ecological Value	**Macroalgal and seagrass communities**: *Macroalgal and seagrass communities are patchily distributed but are important primary producers within the reserves.*

Background	Macroalgal meadows in the reserves are generally found on the shallow limestone lagoonal platforms and occupy about 2200 ha. Macroalgal beds play an important role in primary production and provide important habitat for vertebrate and invertebrate fauna. No comprehensive surveys of macroalgal diversity and abundance have been undertaken in the reserves although macroalgal communities within the Park have been broadly described (Bancroft & Davidson, 2001). The dominant genera are *Sargassum, Padina, Dictyota* and *Hydroclathrus (*McCook *et al.*, 1995). Seagrass species are generally patchily distributed within the reserves and are not a major component or a major primary producer. No comprehensive survey of seagrass diversity and abundance has been undertaken. However, the biogeography of several species such as *Cymodocea angustrata, Cymodocea serrulate, Halodule uninervis, Haliphola ovalis, Haliphola spinulosa, Syringodium isoetifolium,* and *Thalassodendron ciliatum* suggest that these species are likely to occur in the reserves. It is also highly likely that some temperate species have their northernmost limit in the reserves. No major pressures on these communities have been identified. However macroalgal and seagrass communities are susceptible to impact through inappropriate anchoring and mooring or propeller scars. They can also be negatively impacted through pollution events such as oil spill and increases in nutrient concentrations, for example through leaching from septic tanks or from uncontrolled sewage disposal from vessels. Given the ability of macroalgal and seagrass communities in the reserves to recover from human impact where water quality and substrate are maintained, as well as the lack of current pressure on these communities, management aims to gain further knowledge of these communities, including the important role of herbivory in these systems, and raise awareness of their importance. Management controls for macroalgal and seagrass communities emphasise maintenance of areas free of human impact for monitoring as well as areas that provide insurance against impacts in the future. Development proposals that may impact on macroalgal and seagrass communities may be referred for environmental impact assessment by the DoE/EPA.
Current status	The macroalgal and seagrass communities within the reserves are, generally, in an undisturbed condition.
Existing and potential uses and/or pressures	• Boating activities (anchoring, moorings, propeller scour). • Pollution events (shipping, oil/gas industry). • Nutrient inputs.
Current major pressure/s	None.
Management objective/s	To ensure seagrass and macroalgal communities are not disturbed as a result of human activities in the reserves.

Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Undertake research to characterise the level and nature of herbivory in the reserves and use this information to assist in the development of a monitoring protocol for this key process (CALM) **(H-KMS)**. 3. Undertake research to better characterise the diversity, distribution and abundance of seagrass and macroalgal communities within the reserves (CALM, DoF) **(H)**. 4. Educate users of the important ecological role of seagrass and macroalgal communities and the potential impacts of human activities, particularly vessel mooring, and nutrient and pollution inputs on these communities (CALM) **(M)**.

Performance measures/s	1. Above ground biomass (areal extent and density) of perennial seagrass meadows and macroalgal communities. 2. Diversity	**Desired trend/s**	1. Constant. 2. Constant.

Short-term target/s	To be developed as required.
Long-term target/s	**Ningaloo Marine Park–** 1. No loss of macroalgae/ seagrass community diversity as a result of human activity in the Park. 2. No loss[Ø] of macroalgae/ seagrass biomass as a result of human activity in the Park. **Muiron Islands Marine Management Area –** 1. No loss of macroalgae/seagrass community diversity as a result of human activity in the Marine Management Area. 2. The abundance[Ø] targets for macroalgae/seagrass community will be as noted below: i. *Conservation areas* – no change as a result of human activities in the Marine Management Area. ii. *Unzoned areas*[§] – maintained in a natural state, except for areas where some level of acceptable change is approved by the appropriate government regulatory authority.

[Ø] In this context a loss or change in "abundance" or "biomass" excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

[§] Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.9 Mangrove communities (including mudflats) (KPI)

Ecological value	**Mangrove communities (including mudflats):** *Limited mangrove communities occur in the northern half of the Ningaloo Marine Park.*

Background	Three species of mangroves have been identified within the Park. The dominant species is the white mangrove (*Avicennia marina*), with the red mangrove (*Rhizophora stylosa*) and the ribbed-orange fruit mangrove (*Bruguiera exaristata*) existing in limited numbers (May *et al.*, 1983). While the area of mangal is less than 0.1% (33.4 ha) of the Park area, they represent a unique community within the Ningaloo Reef system. The largest mangrove community (approximately 31 ha) found within Mangrove Bay is characterised by established trees to 5 m in height. Established mangrove stands can also be found associated with the Park's tidal creek systems including a well developed mangal within Yardie Creek. Mangrove communities have been highlighted as 'unexpectedly important' for reef fish communities, increasing the importance of the protection of the discrete stands (Mumby *et al.*, 2004). While not as extensive as other benthic communities in the reserves, the intertidal mudflat communities associated with mangroves are extremely important from a biodiversity conservation perspective as they support a high diversity of infauna, particularly molluscs. Although typically bare of vegetation, other than mangrove trees, these areas are covered with a surface film of microorganisms that are a rich source of food for many invertebrate species. These invertebrates inhabit the sediment surface or burrow into the substrate, where their activities regularly turn over the sediment. The abundance of invertebrate life found on intertidal sand/mudflat communities provides a valuable food source for resident and migratory shorebirds. Mangroves are protected throughout the State under the WC Act. Development proposals that have potential to impact on mangrove communities may be referred the DoE/EPA if appropriate, for consideration and formal environmental impact assessment. Any development proposals will be considered in light of the management targets for filter feeding communities and other ecological values. Generally the mangrove communities and intertidal mudflats are in an undisturbed condition. However, localised disturbance (eg. trampling) has occurred in some areas where mangroves are associated with recreational nodes and activities such as mudcrabbing. Mangroves are particularly vulnerable to oil pollution and these areas should be given a high priority for protection in the event of an oil spill (see water quality Section 7.1.3). Anecdotal accounts indicate that groundwater outflow and extraction for the town of Exmouth may be impacting hydrological regimes and causing mangrove die-off at Bundegi. Where recreational use of these areas is impacting on these mangroves, appropriate education of users and, if necessary, restrictions on vehicle and pedestrian access should be implemented to reduce impacts. Given that physical disturbance, plus extraction of a major component of the community are the most significant threats to mangrove communities, management arrangements include protecting these communities in sanctuary zones. This will alleviate pressure on the mangrove communities from mud-crabbing activity and, given that mud-crabs are also found outside mangrove areas, it will still allow opportunities to take mud-crabs from the reserves. Management of mangrove communities also includes undertaking research to better characterise these communities and to assess the level of human impact on them.
Current status	The mangrove communities are generally in good condition with some localised disturbance in high use areas.
Existing and potential uses and/or pressures	• Physical disturbance (eg. trampling). • Pollution events (shipping, oil/gas industry). • Mud crabbing. • Groundwater extraction.
Current major pressure/s	Physical disturbance (eg. trampling).
Management objective/s	To ensure the species diversity and abundance of mangrove communities within the Park are not significantly impacted by trampling.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Educate users of the important ecological role of mangrove communities and intertidal

	mudflats and the potential impacts of human activities, particularly trampling, on these communities (CALM) **(H)**. 3. Undertake research to characterise the flora and fauna of the mangals and mudflats within the Park (CALM) **(H)**. 4. Investigate impacts of groundwater extraction on mangrove communities in the Park (CALM, Water Corporation) **(M)**.

Performance measure/s	1. Diversity. 2. Abundance.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s	To be developed as required.		
Long-term target/s	1. No loss of mangrove diversity as a result of human activity in the Park. 2. No loss[Ø] of mangrove biomass as a result of human activity in the Park.		

[Ø] In this context a loss or change in "abundance" or "biomass" excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

[§] Quantitative targets for geomorphology, water quality, sediment quality and marine habitats in the unzoned areas of the Marine Management Area will be developed in consultation with stakeholders early in the life of this management plan. This process will include additional habitat mapping to define the extent of marine habitats more accurately.

7.1.10 Coastal biological communities (KPI)

Ecological value	**Coastal biological communities:** *A range of coastal communities occurs along the terrestrial portion of the Park.*

Background	The coastal biological communities adjacent to the Park are typified by fragile Holocene dunal environments and hard coastal limestone platform. Arid perennial shrubs dominate the vegetation of the coastal communities. The dominant species represent a small number of families, namely *Acacia, Eremophila, Cassia, Atriplex, Triodia* and *Eucalyptus* (SMEC Australia, 2000). The coastal biological communities are important as they protect dunes from erosion and are an integral part of the seascape value of the Park. Coastal communities are relatively robust to natural forms of biological and physical disturbance (ie. fire, wind, salinity and drought). However, unmanaged access by commercial and recreational vehicles, establishment of camping sites (with resulting collection of firewood and uncontrolled fires), introduction of exotic plants and animals and, grazing and movement of livestock have resulted in significant degradation of coastal vegetation adjacent to the Park. This degradation can lead to erosion of the fore-dune system and so it is essential that human impacts be minimised in the coastal communities adjacent to the Park. Since the establishment of the Ningaloo Marine Park, it has been recognised that more intensive management of the coast is required to ensure that recreational use does not degrade the coastal communities. The future vesting and management of the coast was considered through the *Ningaloo coast regional strategy Carnarvon to Exmouth* (Western Australian Planning Commission, 2004) which outlines the Government's commitment to the Ningaloo coast being managed as public lands for conservation and recreation purposes. It also recommends excision of the coastal parts of the pastoral leases adjacent to the Marine Park and vesting of these areas in the Conservation Commission of Western Australia. This strategy outlines the Government's view on the most appropriate level of development given the ecological and social values and the most appropriate locations for nodes of development based on environmental factors. Management of the coastal lands in the Park will be undertaken in conjunction with the adjacent land managers and consistent with the *Ningaloo coast regional strategy Carnarvon to Exmouth.* (Western Australian Planning Commission, 2004) This will provide for continued access to and along the coast, but will require consolidation and management of access tracks and camping grounds to reduce the damage to coastal communities and allow degraded areas to recover. Management of coastal communities will also include undertaking research to better characterise these communities and to assess the level of human impact on them.
Current status	The coastal biological communities within the Park adjacent to pastoral leases are generally in poor condition with extensive areas of degradation caused by recreational use of the coast and grazing.
Existing and potential uses and/or pressures	• Commercial coastal activities. • Unrestricted recreational coastal activities (camping/vehicle access). • Firewood collection. • Grazing by feral and domestic animals. • Introduced species (exotic plants/ferals). • Fire.
Current major pressure/s	Physical disturbance (eg. grazing, camping and 4WD access).
Management objective/s	To ensure that the species diversity and abundance of coastal biological communities within the Park are not significantly impacted by physical disturbances associated with grazing, trampling and 4WD access.
Strategies	1. Assess the nature, level and potential impacts of human activities on coastal biological communities within the Park (CALM) **(H)**. 2. Manage the 40 m coastal strip of the Ningaloo Marine Park in collaboration with adjoining managers and consistent with the outcomes of the *Ningaloo coast regional strategy Carnarvon to Exmouth* (CALM, DPI, Pastoralists) **(H)**. 3. Where appropriate, designate camping areas within the Park (CALM, DPI) **(M)**. 4. Initiate research programs to characterise the flora and fauna of representative coastal areas within the Park in relation to determining the management targets (CALM) (**M**)

	5. Determine the impact of built structures and their associated use, within the 40m strip, on the coastal biological communities and remove if necessary (CALM) **(L)**.

Performance measure/s	1. Diversity of terrestrial flora and fauna. 2. Abundance (area of vegetation cover and density).	**Desired trend/s**	1. Constant. 2. Constant or positive.
Short-term target/s	To be developed within three years of gazettal of the plan.		
Long-term target/s	1. No further loss of coastal biological community diversity as a result of human activity in the Park. 2. No further loss[Ø] of coastal biological community biomass as a result of human activity in the Park apart from areas where development has been approved by an appropriate authority.		

[Ø]In this context a loss or change in "abundance" or "biomass" excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

7.1.11 Seabirds, shorebirds and migratory waders

Ecological value	**Seabirds, shorebirds and migratory waders:** *A variety of resident seabirds, shorebirds and migratory wader species occur in the reserves.*

Background	A total of 144 bird species has been recorded on North West Cape, of which one-third are seabirds, shorebirds and waders, both resident and migratory (May *et al.*, 1983). There are approximately 33 species of seabirds found in the Park, 13 of which are resident and the other 20 are migratory birds or occasional visitors (CALM Seabird Database). The main rookeries in the Ningaloo Marine Park are found at Mangrove Bay, Mangrove Point, Point Maud, the Mildura wreck site and Fraser Island. In addition, the Muiron and Sunday islands provide isolated rookeries. Eight species of seabird are known to breed in the reserves, these being the caspian tern (*Sterna caspia*), crested tern (*Sterna bergii*), roseate tern (*Sterna dougallii*), fairy tern (*Sterna nereis*), beach stone curlew (*Esacus neglectus*), pied cormorant (*Phalacrocorax varius*), osprey (*Pandion haliaetus*) and white bellied sea eagle (*Haliaeetus leucogaster*) (CALM Seabird Breeding Islands Database and Johnstone, 1980). The Mangrove Bay area is known to support a high diversity of bird species including eight species at their southern limit in Western Australia (May *et al*, 1983). Thirteen of the migratory birds and their habitats are protected under bilateral agreements between Australia and the Governments of Japan and China (Cary & Grubba, 2000b). Australia has an international obligation to protect these species and all birds are fully protected under the WC Act. Levels of use of the coast in the reserves vary considerably. In terms of recreational vehicle and 4WD usage, there is a high level of use around Coral Bay and Point Billy (adjacent to Ningaloo Station) and low use adjacent to Cape Range National Park where driving on the beach is prohibited. Given this varied level of usage and the management strategies that have been put in place, there are no current major pressures on seabirds, shorebirds and migratory waders in the reserves. Additional management of seabirds, shorebirds and migratory waders in the Park will include implementation of spatial controls to provide protection to seabird nesting and roosting areas and increased education and awareness with shoreline users. Management of seabirds, shorebirds and migratory waders also includes undertaking research to better characterise these communities and to assess the level of human impact on them.
Current status	The resident seabird and migratory bird populations are probably stable in the marine conservation reserve, based on the current low level of threat to these populations, however population information is limited.
Existing and potential uses and/or pressures	• Loss or degradation of critical habitat. • Disturbance by human activities (boating/walking/vehicles). • Predation by introduced pests. • Entanglements. • Pollution events (shipping, oil/gas industry).
Current major pressure/s	None.
Management objective/s	To ensure the species diversity and abundance of seabird, shorebird and migratory bird species in the reserves are not significantly impacted by human activity.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Undertake research to characterise bird distribution and abundance in the reserves (CALM) **(H)**. 3. Monitor the impact of vehicles on birds in the Park and introduce restrictions where appropriate to protect important coastal areas (CALM) **(M)**. 4. Educate users of the reserves about the ecological significance of nesting, feeding and roosting sites for resident and migratory bird species within the reserves (CALM) **(M)**.

Performance measure/s	1. Diversity. 2. Abundance.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
Short-term target/s	To be developed as required.		

Long-term target/s	1. No loss of seabird, shorebird and migratory wader diversity as a result of human activity in the reserves. 2. No loss of seabird, shorebird and migratory wader abundance as a result of human activity in the reserves.

7.1.12 Finfish (KPI)

Ecological value	**Finfish:** *A rich finfish fauna, characterised by a diversity of tropical, sub-tropical and warm temperate species occurs in the reserves.*

Background	A total of 500 finfish species from 234 genera and 86 families have been recorded within the Ningaloo Marine Park (see Allen, 1980; May *et al*., 1983; Hutchins, 1994) while 393 species have been recorded at study sites at the Muiron Islands (Hutchins *et al.,* 1996). This rich diversity of finfish species is an important value of the reserves. A large number of the fish species found in the area have reproductive modes that rely on dispersal of eggs and larvae in the water column. It is therefore likely that recruitment for these species is supplemented from elsewhere, such as from the north-west (ie. the Dampier Archipelago and Montebello Islands) via the Leeuwin Current and from the south (ie. Shark Bay and Abrolhos Islands) via the Ningaloo Current. It is also highly likely that the Ningaloo Reef is an important source of recruits for other areas along the Western Australia coast. A small percentage of the fish species found within the reserves are important to commercial and recreational fishers. These include emperors (*Lethrinidae*), Spanish mackerel (*Scoberomorus commerson*), red emperor (*Lutjanus sebae*), coral trout (*Plectropomus* spp.), snappers (*Lutjanus* spp.), and golden trevally (*Gnathanodon speciocus*). Recreational and commercial fishing activities are discussed in Sections 7.2.8 and 7.2.11 respectively. Under the FRM Act, the DoF is responsible for the management of the recreational and commercial take of finfish species in the reserves. The potato cod (*Epinephelus tukula*) is protected under the FRM Act. The current major pressure on finfish in the reserves is from recreational fishing and to a lesser extent commercial fishing. A major recreational activity in the region is fishing from the beach or from boats, by both local residents and tourists. Recreational fishing occurs throughout the reserves (except existing sanctuary zones in the Marine Park), with the major nodes of high activity located in the vicinity of boat ramps. Other pressures on finfish include incidental extraction of non-target species, fish feeding and physical disturbance of important habitats. Finfish biodiversity will be conserved through a representative system of sanctuary zones (see Section 8.1.2), individual species protection, sustainable recreation and commercial fishing management strategies, relevant research, monitoring and education strategies. The establishment of representative and adequate sanctuary zones throughout the Park and conservation areas in the Marine Management Area will provide areas where fish populations are not impacted by fishing activities (see Section 8.1.2). Research strategies focus on improving our understanding of fish communities within the reserves, with an emphasis on aspects such as reproduction and recruitment. Another key strategy will be to determine those large iconic finfish species (such as cods) that should be fully protected and then achieve this throughout the reserves using appropriate legislation. This decision would be based on a number of factors including species distribution, abundance, life history and an assessment of the ecological and social importance of the species in the context of the reserves. For those species for which extraction is considered appropriate, DoF will manage these on a sustainable basis in areas open to fishing in the reserves. The management of recreational and commercial fishing is covered in detail in Sections 7.2.8 and 7.2.11.
Current status	Non-targeted species are believed to be in a largely undisturbed condition; however, there is localised reduction in the abundance of some target species in the recreation and general use zones of the Park and possibly in parts of the Marine Management Area.
Existing and potential uses and/or pressures	• Commercial fishing. • Charter boat fishing. • Recreational fishing. • Incidental commercial, charter boat and recreational extraction of non-target species. • Physical disturbance of important finfish habitats. • Trophic interactions. • Fish feeding.
Current major pressure/s	Commercial and recreational fishing of target species.

Management objective/s	To ensure the species distribution and abundance of finfish species are not unacceptably impacted by recreational and commercial fishing in the reserves.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Undertake research to better characterise finfish diversity and abundance in the reserves (DoF, CALM) **(H-KMS)**. 3. Undertake research to support the development of management targets for commercially and recreationally targeted finfish species (DoF, CALM) **(H-KMS)**. 4. Identify finfish species that require protection from recreational or commercial fishing in the reserves and provide the necessary legislative protection to achieve this (DoF, CALM) **(H-KMS)**. 5. Undertake research to identify aggregation and spawning sites and times for key finfish species (CALM, DoF) **(H)**. 6. Undertake research, with the aim of developing a cost-effective monitoring protocol, to estimate annual recruitment of key targeted fish species in the reserves (CALM, DoF) **(H)**. 7. Undertake research on pelagic fishes to examine benthic-pelagic coupling (CALM) **(H)**. 8. Quantify the level and significance of by-catch for recreational and commercial fishing activities in the reserves (DoF, CALM) **(M)**. 9. Where necessary and in accordance with DoF By-catch Action Plans, seek to implement measures to progressively reduce the by-catch of finfish species in the reserves (DoF, CALM) **(M)**.

Performance measure/s	1. Diversity. 2. Abundance.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive.
	No loss[Ø] of finfish species abundance in the *sanctuary zones* in the Park and *conservation areas* in the Marine Management Area as a result of human activity within the reserves.		
Long-term target/s (KPI)	1. No loss of finfish diversity as a result of human activity in the reserves. 2. No loss[Ø] of protected finfish species abundance as a result of human activities in the reserves. 3. Abundance and size composition of finfish species in sanctuary zones and conservation areas to be at natural* levels. 4. Management targets for abundance of target finfish species in all other areas to be determined by the DoF in consultation with CALM and stakeholders.		

[Ø]In this context a loss or change in 'abundance' or 'biomass' excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

* 'Natural' in this context refers to the abundance that would occur in areas that are undisturbed and/or unexploited by human activities.

7.1.13 Invertebrates

Ecological value	**Invertebrates** *: The high invertebrate faunal diversity of the reserves is poorly described, particularly in deeper waters but is comprised of tropical, sub-tropical and warm temperate species.*

Background	Marine invertebrates are those animals without a backbone and include animals such as rock lobster, squid, cuttlefish, abalone, sponges, corals, jellyfishes and anemones. Corals are covered in Section 7.1.4 and sponges in Section 7.1.5. There is a high diversity and abundance of invertebrate species, attributed to the range of habitats in the reserves. The invertebrate fauna exhibits a gradient of tropical and temperate species related to the influence of the southerly flowing Leeuwin Current and the northerly flowing Ningaloo Current adjacent to the coast. Over 600 species of mollusc have been identified in the reserves (CALM, 1989). This level of diversity is thought to be generally consistent throughout the reserves, with approximately 5% of these species believed to be endemic to the region. Perhaps the best known mollusc from the reserves is the corallivorous snail *Drupella cornus.* Populations of this species in the reserves have historically caused widespread depletion of coral cover though present populations are relatively low. Several explanations for the cause of the population explosions include the depletion of finfish species that feed on the molluscs and natural fluctuations in population structure. Over 90 species of echinoderms including seastars, sea urchins and sea cucumbers have been found in the area (Western Australian Museum, 1998). Coral reef environments naturally contain a high density and diversity of polychaete worm species. Studies on the Great Barrier Reef have found as many as 1441 worms from 103 species living in and on a 3 kg coral head (Storrie & Morrison, 1998) and it is likely that the reserves have a similar diversity. Polychaetes play an important role in the reef ecosystem, and are often spectacular snorkelling and diving attractions due to their colour and form (eg. the Christmas Tree Worm- *Spirobranchus* spp.). Under the Wildlife Conservation (Fauna of the Ningaloo Marine Park) Notice 1992, all invertebrates are protected, with the exception of octopus, squid, cuttlefish, prawns, shrimps, scampi, rock lobster, bugs, crabs and oysters. Several invertebrate species are targeted by commercial and recreational fishers within the reserves. The permitted commercial and recreational take of these species is managed under the FRM Act by DoF. Given the easy access to and high level of use of intertidal areas, there may need to be a review of the take of certain invertebrate species (eg. octopus) during the life of the management plan. There are no current major pressures on the invertebrate communities of the reserves. Trawling or net fishing in the reserves is limited and therefore threats to invertebrates, in terms of inclusion in by-catch from these activities, are limited to the areas of operation. Commercial fishing for aquaria and shell species is permitted in the general use zone (north of Tantabiddi creek and south of Point Maud) of the Park and in unzoned zones of the Marine Management Area. Recreational shell collection, with the exception of oysters, is not permitted in the reserves. Commercial fishing for prawns is permitted in the general use zone of the Park (within Exmouth Gulf) and this activity will continue in the unzoned area of the Marine Management Area. There is anecdotal evidence of decreases in shell and lobster populations in the reserves and further investigation may be warranted. Due to the lack of knowledge of the invertebrate communities in the reserves, research is necessary to improve our understanding of patterns of invertebrate diversity and abundance within the reserves and assist in the development of management targets for this ecological value.
Current status	Non-target invertebrate species are believed to be in an undisturbed condition in the reserves. However there is likely to be a significant reduction in the abundance of key target species (eg. lobsters, octopus, mollusc species) due to current and historical fishing and collecting.
Existing and potential uses and/or pressures	• Recreational fishing of target species. • Commercial fishing of target species. • Introduction of pests from ballast water and on hulls of visiting vessels.

Current major pressures	None.
Management objective/s	To gain an understanding of the invertebrate diversity and abundance throughout the reserves to facilitate long-term management.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Undertake research programs to characterise invertebrate diversity, distribution and abundance in the reserves and to support the development of management targets for commercial and recreational target invertebrate species (CALM, DoF) **(H-KMS)**. 3. Identify targeted invertebrate species that require protection from recreational or commercial fishing in the reserves (DoF, CALM) **(H-KMS)**. 4. Review the existing legislation protection for invertebrate species under the WC Act and the FRM Act and amend these notices as necessary for the extended Park and the Marine Management Area (CALM, DoF) **(H-KMS)**. 5. Determine management targets for targeted invertebrate species (DoF, CALM) **(H-KMS)**. 6. Quantify the level and significance of by-catch for recreational and commercial fishing activities in the reserves and, if necessary and in accordance with DoF By-catch Action Plans, implement measures to progressively reduce the by-catch of invertebrate species in the reserves (DoF, CALM) **(M)**.

Performance measure/s	1. Diversity. 2. Abundance.	**Desired trend/s**	3. Constant or positive. 4. Constant or positive.
Short-term target/s	No loss[Ø] of invertebrate species abundance in the *sanctuary zones* in the Park and *conservation areas* in the Marine Management Area as a result of human activity within the reserves.		
Long-term target/s	1. No loss of invertebrate species diversity as a result of human activity in the reserves. 2. No loss[Ø] of protected invertebrate species abundance as a result of human activities in the reserves. 3. Abundance and size composition of invertebrate species in sanctuary zones and conservation areas to be at natural* levels. 4. Management targets for abundance of target invertebrate species in all other areas to be determined in consultation with the DoF and peak bodies.		

[Ø]In this context a loss or change in 'abundance' or 'biomass' excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

* 'Natural' in this context refers to the abundance that would occur in areas that are undisturbed and/or unexploited by human activities.

7.1.14 Sharks and rays

Ecological value	**Sharks and rays:** *The lagoon and offshore waters of the Ningaloo Reef and Muiron/Sunday islands have diverse and abundant shark and ray populations.*

Background	The Ningaloo Reef and waters surrounding the Muiron/Sunday islands have diverse and abundant shark and ray populations including the whale shark (*Rhincodon typus*), tiger shark (*Galeocerdo cuvier*), hammerhead (*Sphyrna* spp.), grey reef shark (*Carcharhinus amblyrhynchos*), white-tip reef shark (*Triaenodon obesus*), black-tip reef shark (*Carcharhinus melanopterus*), tawny nurse shark (*Nebrius ferrugineus*), manta ray (*Manta birostris*), blue spotted maskray (*Dasyatis kuhlii*), white spotted eagle ray (*Aeotobatus narinari*), giant stingray (*Plesiobatis daviesi*) and the cowtail stingray (*Pastinachus seplen*). The whale shark and manta ray are treated as specific ecological values and their management is detailed in sections 7.1.15 and 7.1.16 respectively. Aggregations of the black tip reef shark (*Carcharhinus melanopterus*) and grey reef sharks (*Carcharhinus amblyrhynchos*) have been reported at several locations in Ningaloo Marine Park including Pelican Point, Bundegi Sanctuary Zone, Mangrove Bay and Bills Bay. The best known of these is the aggregation associated with Bills Bay, which was first reported 75 years ago. At this site up to 100 sharks have been witnessed displaying 'following behaviour' in water depths as shallow as 0.5 m. Following preliminary investigations of the area, Norman (undated) suggested that the area is a nursery for juvenile sharks. Additional studies are planned to determine if this type of aggregation occurs at other locations within the reserves. Aggregations recorded in other locations of the reserves have so far represented fewer individuals. Under the FRM Act, the DoF is responsible for the management of the recreational and commercial take of shark and ray species. Shark and ray catch is managed through a wide range of management tools, including size and bag limits, gear restrictions, licences and closed seasons. Although commercial shark fishing is not permitted within the Gascoyne region, sharks are caught as by-catch in several other commercial fisheries (ie. trawling, wetline, longline industries) in and adjacent to the reserves. There is also pressure associated with recreational fishing on sharks within the reserves. In addition, disturbance of shark and ray areas could potentially affect these species. Management of sharks and rays in the reserves will comprise research to better characterise shark and ray diversity and abundance and aggregation sites. Additional research is required to identify fishing impacts on shark and ray populations.
Current status	Diversity and abundance of shark and ray numbers in the reserves and adjacent waters are probably stable based on the current low level of threat to these populations, however population information is limited.
Existing and potential uses and/or pressures	• Recreational fishing. • Disturbance of aggregation sites. • Commercial fishing by-catch (trawling, wetlining).
Current major pressure/s	Commercial and recreational fishing.
Management objective/s	To ensure that shark diversity and abundance are not significantly impacted by recreational and commercial fishing activities in the reserves.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Undertake research to characterise shark/ray diversity and abundance in the reserves and support the development of management targets for shark and ray species (CALM, DoF) **(H-KMS)**. 3. Identify shark species that require protection from recreational or commercial fishing in the reserves and provide the necessary legislative protection to achieve this (DoF, CALM) **(H-KMS)**. 4. Determine management targets for shark species that can be fished in the reserves (DoF, CALM) **(H-KMS)**. 5. Undertake research to better document shark/ray movement patterns and aggregations within the reserves (CALM, DoF) **(H)**. 6. Quantify the level and significance of shark/ray by-catch for recreational and commercial

	fishing activities in the reserves and, if necessary and in accordance with DoF By-catch Action Plans, implement measures to reduce progressively the by-catch of shark/ray species in the reserves (DoF, CALM) **(M)**.

Performance measure/s	1. Numbers of individuals at known aggregation areas. 2. Diversity. 3. Abundance.	**Desired trend/s**	1. Constant or positive. 2. Constant or positive. 3. Constant or positive.
Short-term target/s	No loss[Ø] of shark/ray species abundance in the *sanctuary zones* in the Park and in the *conservation areas* in the Marine Management Area as a result of human activity within the reserves.		
Long-term target/s	1. No loss of shark/ray diversity as a result of human activity in the reserves. 2. No loss[Ø] of protected shark/ray species abundance as a result of human activities in the reserves. 3. Abundance and size composition of shark and ray species in sanctuary zones and conservation areas to be at natural* levels. 4. Management targets for abundance of shark/ray species in all other areas to be determined in consultation with the DoF and peak bodies.		

[Ø]In this context a loss or change in 'abundance' or 'biomass' excludes losses of a minor, transient or accidental nature. This qualification does not apply to seabirds, marine reptiles and marine mammals where minor or transient losses would be unacceptable (but does not apply to losses due to accidents).

* 'Natural' in this context refers to the abundance that would occur in areas that are undisturbed and/or unexploited by human activities.

7.1.15 Whale sharks

Ecological value	**Whale sharks:** *The waters of the reserves are host to one of the world's largest predictable whale shark aggregations.*

Background	The reserve waters seaward of the reef crest play host to one of the world's largest known predictable aggregations of whale sharks (*Rhincodon typus)* from March through to June each year. Whale sharks are the world's largest living fish (specimens of over 12 m in length having been recorded) and are pelagic filter feeders of plankton and smaller nektonic (free-swimming) species. Whale sharks are thought to be distributed throughout the world's warm-temperate and tropical regions, but appear to be seasonally attracted to Ningaloo due to the upwelling of nutrient rich waters from the deep ocean, located less than 10 km from the reef crest. The size of the whale shark population visiting the Park each year is thought to be in the order of several hundred individuals, with the majority of animals being immature male specimens between three to nine metres in length (Taylor, 1996). A nature-based tourism industry based on interactive trips to snorkel with whale sharks has developed with 15 licensed operators in the reserves, which is worth $12 million annually to the region. The majority of interactions occur in two areas of Ningaloo Marine Park, these being seaward of the reef crest from Tantabiddi to Point Edgar in the northern area of Ningaloo Marine Park and to the north-west of Point Maud in the central area of the Park. In Western Australian waters, whale sharks are protected under the WC Act and are threatened species declared to be *vulnerable* under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.* Whale sharks are also listed in Appendix 2 of the Bonn Convention 2000 as a migratory species that will be the subject of a conservation-based management agreement between signatories to the Convention. International conservation status is unclear- the whale shark is listed as having an 'indeterminate' status on the World Conservation Union's *Red List of Threatened Animals*. This category applies to animals that are known to be 'endangered', 'vulnerable' or 'rare', but there is insufficient information available to say which of these three categories is appropriate. A Closed Season Notice for whale sharks establishes an interaction code of conduct for vessels and swimmers, while the broader management of the species in the Park is covered by the *Whale Shark Interaction Management Program No. 27* (Colman, 1997). Disturbance to the whale shark population in the reserve waters may potentially result from inappropriate interactive activities, boat noise or collisions. There have been some indications of possible boat contacts with whale sharks such as antifouling paint marks on sharks and damage to fins possibly resulting from propeller contact. The current incidence of entanglement of whale sharks in fishing gear or litter is considered to be low. In 2005 there was no evidence to suggest that human activities are demonstrably affecting whale shark aggregations in the reserves. If significant impact due to whale shark interaction becomes apparent, non-interaction areas (eg. in the area adjacent to Point Cloates) may be considered to provide refuge areas free of disturbance. The management of the whale shark interaction industry will continue to focus on education, working collaboratively with commercial operators, and conducting research and monitoring of the annual aggregations of whale sharks and the impact of nature-based tourism activities on them.
Current status	Seasonal whale shark numbers vary widely from year to year.
Existing and potential uses and/or pressures	• Boating activities (collision, harassment, noise). • Commercial whale shark interaction tours.
Current major pressure/s	None.
Management objective/s	To ensure whale sharks migrating through the reserves are not disturbed by boating and interaction activities.
Strategies	1. Continue to implement the *Whaleshark Interaction Management Program No 27* with a particular emphasis on: • ensuring continued industry compliance with the code of conduct and licence conditions; • maintaining close liaison with the industry through regular meetings of the Industry/

	CALM committee; • ensuring effective administration of the industry by CALM; and • promoting and facilitating research programs by external organisations where appropriate (CALM) **(H-KMS)**. 2. Review, and where necessary update, the Wildlife Management Program for Whale Sharks (CALM) **(M)**. 3. Continue research on the local and regional migratory patterns of whale sharks (CALM) **(M)**. 4. Continue biological and oceanographic research to establish the relationship of spatial and temporal patterns in biophysical variables (eg. temperature, nutrients, zooplankton) important to whale shark aggregation and migration (CALM) **(M).** 5. Continue to monitor the behavioural response of whale sharks to nature-based tourism activities (CALM) **(M)**.

Performance measure/s	1. Reported animal-boat collisions/year*. 2. Number of recorded whale shark sightings per season (March-May) relative to search effort. * as a proportion of population	**Desired trend/s**	1. Negative. 2. Constant or positive.
Short-term target/s	To be developed as required.		
Long-term target/s	No loss of whale shark abundance as a result of human activity in the reserves. [Ø]		

[Ø] This does not apply to losses due to accidents.

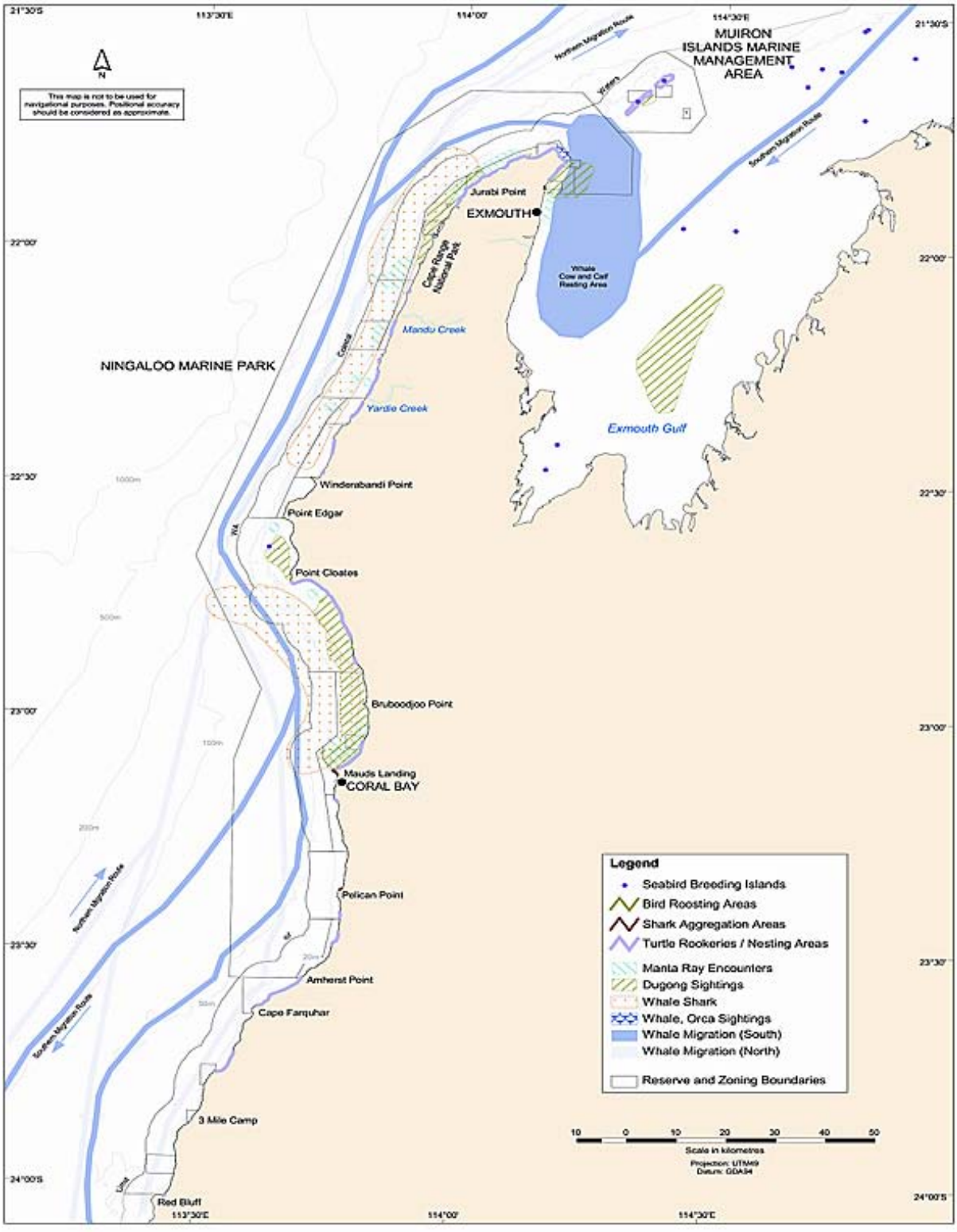

Figure 5: Wildlife associated with the Ningaloo Marine Park and the Muiron Islands Marine Management Area

7.1.16 Manta rays

Ecological value	**Manta rays:** *Manta rays are common and aggregations can be found in various locations within the reserves.*

Background	Manta rays (*Manta birostris*) are distributed throughout the tropical waters of the world and can be found along the Western Australian coastline in waters north of Rottnest Island. Manta rays are common throughout the reserves, but are known to aggregate in specific locations within the lagoon and on the reef front. Manta rays are one of the largest living fish species with recorded specimens having a disc width of over 6 m and a weight of over 2 tons (Allen & Swainston, 1988). Manta rays are the largest filter feeder inhabiting the Park lagoon, and therefore play a significant role in the lagoonal food web. In Australia, this species is considered to be at low risk in terms of its conservation status (Pagonoski *et al.,* 2002). Nature-based tourism relating to manta ray interaction has increased. Interactive tours were originally coupled with other nature-based tourism activities (ie. whale shark interactions). Increased predictability of aggregations in Coral Bay has led to a growing interest in this nature-based tourism activity. Manta rays are protected under the FRM Act and targeted fishing of the species is prohibited. Concern over increased numbers of operators interacting with manta rays in addition to anecdotal evidence of changes in behaviour of manta rays have led to the development of a code of conduct in consultation with operators at Coral Bay. Operators in Coral Bay voluntarily apply the code of conduct to all manta ray interaction tours. In the life of this management plan, it may be necessary to broaden the code of conduct to include the entire area of the reserves. In 2005 there was no demonstrated effect of tourist interactions on the behaviour of manta rays although anecdotal evidence cited incidents where behaviour was affected. Management of manta rays in the reserves will focus on research into the impact of interactions with manta rays and the effectiveness of the code of conduct.
Current status	The manta ray population in the reserves is probably in an undisturbed state.
Existing and potential uses and/or pressures	• Disturbance by commercial activities. • Disturbance by recreational activities. • Boating activities (collision, noise).
Current major pressure/s	Localised commercial tourism in southern Bateman's Bay.
Management objective/s	To ensure that manta rays in the reserves are not significantly disturbed by interactive tours or recreational boat users or snorkelers.
Strategies	1. Undertake research on the general ecology of manta rays with the aim to determine potential impacts of human interaction on manta ray populations (CALM) **(H)**. 2. Develop a code of conduct for manta ray interaction in the reserves if required (CALM) **(H)**. 3. Undertake community education programs, compliance monitoring and liaison with commercial operators to ensure interaction activities do not significantly impact on manta rays (CALM) **(M)**. 4. Consider licensing of manta ray interaction at Coral Bay if significant disturbance of local manta ray populations is detected (CALM) **(M)**.

Performance measure/s	Abundance.	**Desired trend/s**	Constant or increasing.
Short-term target/s	To be developed as required.		
Long-term target/s	No loss of manta ray abundance as a result of human activity in the reserves. [Ø]		

[Ø] This does not apply to losses due to accidents.

7.1.17 Whales and dolphins

Ecological value	**Whales and dolphins:** *A diverse range of whale and dolphin species has been recorded in the reserves*

Background	A total of 13 species of toothed whale and dolphin and seven species of baleen whale have been recorded from the State and Commonwealth Marine Park waters. These species are: <u>Toothed whales and dolphins</u> Sperm whale *(Physeter macrocephalus)* Pygmy sperm whale *(Kogia breviceps)* Killer whale *(Orcinus orca)* Pygmy killer whale *(Feresa attenuatta)* False killer whale *(Pseudorca crassidens)* Short-finned pilot whale *(Globicephala macrorhychus)* Melon-headed whale *(Peponocephala electra)* Bottlenose dolphin *(Tursiops truncatus)* Indo-Pacific humpback dolphin *(Sousa chinensis)* Common dolphin *(Delphinus delphis)* Risso's dolphin *(Grampus griseus)* Striped dolphin *(Stenella coeruleoalba)* Spinner dolphin *(Stenella longirostris)* <u>Baleen whales</u> Blue whale (*Balaenoptera musculus)* Humpback whale *(Megaptera novaeangliae)* Minke whale *(Balaenoptera acutorostrata)* Bryde's whale *(Balaenoptera edeni)* Sei whale *(Balaenoptera borealis)* Fin whale *(Balaenoptera physalus)* Southern right whale *(Eubalaena australis)* (Tucker, 1991) The humpback whale passes through the reserves (Figure 5) during the annual migration north to the warm tropical waters off the Pilbara and Kimberley coasts in June and July. Exmouth Gulf, particularly the deeper north-westerly reaches, is used as a resting area for female humpback whales and their young calves during their southerly migration to feeding grounds in Antarctica for the summer months (Jenner & Jenner, 2000.). Between 1913 and 1957, these migrating and resting whales were hunted using factory ships and processed at onshore facilities in Norwegian Bay. The increased predictability of whale sightings is supporting a growing nature-based wildlife interaction industry during the southerly migration. Common and Indo-Pacific humpback dolphins are regularly seen in reserve waters with the latter regularly sighted around Tantabiddi Lagoon. Whales and dolphins are fully protected under the WC Act. Five of the seven species of baleen whale are threatened species listed as specially protected under the WC Act due to over-exploitation during the whaling era. The blue whale and southern right whale are threatened species listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the fin whale, sei whale and humpback whale are threatened species listed as endangered under this Act. A code of conduct for interactions has been developed to protect the whales from adverse human disturbance. Given the presence of whales in the Gulf and the established charter industry in Exmouth, it is highly likely that a whale watching industry will develop during the life of the plan. Charter operators who undertake this activity would require the appropriate wildlife interaction licence. In 2005 there were no demonstrated negative impacts of tourist interactions on the behaviour or presence of resident or transitory whales and/or dolphins associated with the reserves. Due to the lack of identified threats to whale and dolphin populations in the reserves, management will focus on development of a code of conduct which will enable management of any increase in tourist interaction, research to increase our understanding the importance of the area to these populations and the impacts of nature-based tourism on cetacean behaviour, and maintenance of

	records of entanglements or stranding of whales and dolphins.
Current status	Whale and dolphin populations are generally in an undisturbed state in the reserves. However, historical harvesting of humpback whales along the Western Australian coast (including Ningaloo) has contributed to an overall reduction in the abundance of this species along the Ningaloo coastline. The abundance of this species is now increasing.
Existing and potential uses and/or pressures	• Boating activities (collisions, harassment, noise). • Commercial whale interaction tours.
Current major pressure/s	None.
Management objective/s	To ensure whales and dolphins in the reserves are not significantly disturbed by commercial whale interaction tours.
Strategies	1. Ensure whale and dolphin interaction activities do not significantly impact on these species, through education programs, liaison with charter operators and compliance monitoring (CALM) **(H)**. 2. Monitor the behavioural response of whales to nature-based activities such as whale watching and determine the need to review existing management controls in the event of future expansion of the whale watching industry (CALM) **(M)**. 3. Undertake research to improve understanding of the importance of the region to whale demographics and ecology (CALM) **(M)**. 4. Maintain records of the incidence of entanglement, boat collisions and stranding of whale and dolphin species (CALM, WAFIC) **(L)**.

Performance measure/s	1. Diversity. 2. Abundance	**Desired trend/s**	1. Constant. 2. Constant or positive.
Short-term target/s	To be developed as required.		
Long-term target/s	1. No loss of whale and dolphin diversity as a result of human activity in the reserves. 2. No loss of whale and dolphin abundance as a result of human activity in the reserves. [Ø]		

[Ø] This does not apply to losses due to accidents.

7.1.18 Turtles (KPI)

Ecological value	**Turtles:** *Several species of sea turtles aggregate and nest in the reserves.*

Background	Australia is one of the few countries in the world still to have relatively large turtle populations and the foreshores of the Ningaloo coast and Muiron/Sunday islands provide an important habitat and relatively undisturbed nesting areas for these populations. Four species of marine turtle have been recorded from the reserves, these being the loggerhead (*Caretta caretta*), green (*Chelonia mydas*), flatback (*Natator depressus*) and hawksbill (*Eretmochelys imbricata*) turtles. There are also records of occasional foraging by leatherback turtles and olive ridley turtles along the Ningaloo Coast. The majority of nesting turtles in the reserves are green or loggerhead turtles, with hawksbills also nesting to a lesser extent. Green and loggerhead turtles regularly use the sandy beaches in the reserves for nesting in December to March each year. Green turtles tend to nest in higher proportions in the northern areas of the reserves while loggerheads tend to favour the sandy beaches of the southern areas of the reserves (Waayers, 2003). The hawksbill turtle population is significant as the populations in Western Australia represent the largest remaining population in the Indian Ocean. There have been occasional records of nesting by flatback turtles on the Jurabi Coast and Muiron Islands. Seasonal aggregations of turtles occur in the protected lagoon environments of the reserves and specific locations, such as Graveyards in the northern section of Ningaloo Reef, have been identified as important sites for mating aggregations. As the population numbers of marine turtles are declining worldwide due to direct and indirect impacts, the Ningaloo coast and islands off the Pilbara coast, which provide areas relatively free of human impact, will increase in significance in terms of their value to turtle populations. Loggerhead, leatherback, green, hawksbill and flatback turtles are threatened species declared to be specially protected under the WC Act. The loggerhead is listed as an endangered species on the IUCN Red List while the green, flatback and hawksbill turtles are listed as vulnerable. All species of turtle are also protected under the Commonwealth EPBC Act. The *Recovery Plan for Marine Turtles in Australi*a prepared by Environment Australia presents national actions and recovery criteria with the objective '*to reduce detrimental impacts on Australian populations of marine turtles and hence promote their recovery in the wild*'. (Commonwealth of Australia, 2003). Potential disturbance to turtle populations in the reserves is mainly from disturbance to nesting habitat (ie. vehicle access to nesting beaches), as well as disturbance of the females during nesting activity. Foxes provide one of the major disturbances to the populations, through predation on egg clutches from nests on the beaches. Information on the incidence of boat strikes is currently unavailable; however, due to the localised high use of lagoonal areas (such as southern Bills Bay), the threat to mature adults from boat collision needs to be determined. The risk of entanglement in trawling nets in the adjacent waters of Exmouth Gulf has been reduced through the adoption of turtle exclusion devices (TEDS) in nets used in the fishery. Other incidences of entanglement in fishing gear and litter in the Park are considered low. Turtle hunting occurred in the Park until 1973 (including the take of eggs) and there are historical reports of tens of thousands of turtles being taken. Anecdotal advice suggests that indigenous hunting in the region is minimal. This is because the Baiyungu will generally only catch turtles for large family occasions and this may occur only once or twice a year. Any concerns regarding the activity will be managed through liaison with the Coral Coast Park Council. Several management strategies are used to protect turtle aggregations and nesting populations including seasonal controls on tourist activities associated with nesting beaches and aggregation sites, regulation of lighting incorporated in existing and future coastal development, fox baiting and management of vehicle access to nesting beaches. Research and monitoring strategies focus on understanding trends in turtle populations, the significance of specific sites to turtles, and the impact of pressures such as indigenous hunting.
Current status	Unknown but current populations (particularly green turtles) are likely to be significantly lower than pre-1950 levels.

Existing and potential uses and/or pressures	• Commercial fishing by-catch. • Boating activities (collision, harassment, noise). • Nesting disturbance by commercial interactions. • Nesting disturbances by recreational activities (lights, vehicles, inappropriate intervention). • Predation of nests by foxes. • Coastal infrastructure (marinas, boating facilities, groynes). • Indigenous hunting (green turtles only). • Entanglement in discarded fishing line.
Current major pressure/s	1. Predation of nests by foxes. 2. Disturbance by recreational and commercial interaction.
Management objective/s	To ensure turtles in the reserves are not significantly disturbed by foxes or recreational activities on beaches (ie. vehicles, walkers).
Strategies	1. Continue the fox control program to reduce animal predation on nests both in the reserves and on adjacent land (CALM) **(H-KMS)**. 2. Determine the location and relative significance of turtle aggregation sites and rookeries within the reserves (CALM) **(H-KMS)**. 3. Ensure interaction activities do not impact on turtles, through education and compliance programs, liaison with charter operators and appropriate licensing (CALM) **(H-KMS)**. 4. Continue turtle monitoring programs within the reserves (CALM) **(H-KMS)**. 5. Evaluate the effectiveness of turtle monitoring programs within the reserves and implement revised/modified turtle monitoring programs as required (CALM) **(H-KMS)**. 6. Continue to implement public education programs through the Jurabi Turtle Centre (CALM, Exmouth Shire) **(H)**. 7. Undertake research to determine the status and trends of the turtle populations in the reserves in relation to historical populations (CALM) **(H)**. 8. Maintain records of the incidence of by-catch of turtle species within and adjacent to the Park (CALM, DoF) **(H)**. 9. In partnership with the Coral Coast Park Council, undertake research to determine the extent and level of indigenous hunting and ensure that this is sustainable (CALM, Coral Coast Park Council) **(H)**.

Performance measure/s	1. Number of nesting turtles. 2. Number of nests disturbed by feral animals or human use.	**Desired trend/s**	1. Constant or positive. 2. Negative.
Short-term target/s (KPI)	1. No loss of turtle diversity as a result of human activity in the reserves. 2. No loss of turtle abundance as a result of human activity[#] [Ø] in the reserves.		
Long-term target/s (KPI)	To be developed following determination of historical trend in turtle populations.		

[#] Sustainable indigenous take of turtle is permitted.
[Ø] This does not apply to losses due to accidents.

7.1.19 Dugong

Ecological value	**Dugong:** *The dugong inhabits the sheltered lagoonal areas of the reserves.*

Background	The dugong (*Dugong dugon*) occurs throughout the tropical and subtropical Indo-West Pacific but has been reduced to relict populations separated by large areas in which it is extinct or close to extinction. In the reserves, dugongs are frequently sighted in the shallow protected lagoonal environments though not in the comparatively large or dense concentrations seen in Exmouth Gulf or Shark Bay (Prince, 1986). Current knowledge of the size, distribution and migratory habits of dugong populations in the region is limited; however, dugong numbers in Ningaloo Marine Park are considered to be in the order of around 1000 individuals (Preen & Marsh, 1997). The seagrass beds around the sandy lagoonal areas of the Park provide a valuable food source for these animals. A similar number can be found in Exmouth Gulf. However, given the susceptibility of seagrass to storm events, which can damage seagrass meadows, the numbers of dugongs present at any one time can vary from very few to several thousand, dependent on the status of their main food source. The importance of the Marine Management Area to dugongs is undocumented, however the seagrass *H. spinulosa* may occasionally bloom in abundance in this area and be a food source for dugongs. Dugongs are fully protected under the WC Act, under which it is an offence to disturb or approach within 100 m of these animals. Indigenous hunting of the species is still permitted although it is not considered to be a common activity within the reserves. In 2005 there were no established nature-based tourism activities associated with dugongs. Due to the low level of recreational and commercial tourism interaction, there are considered to be no current major pressures on dugong populations in the reserves. Management of dugongs in the reserves focuses on undertaking further research to determine the importance of the area for dugongs and educating reserve users about dugongs.
Current status	Unknown but the lack of major pressures suggests that the population is likely to be relatively undisturbed.
Existing and potential uses and/or pressures	• Boating activities (collision, harassment, noise). • Loss or degradation of critical habitat. • Indigenous hunting.
Current major pressure/s	None.
Management objective/s	To ensure dugong in the reserves are not significantly disturbed by human activity.
Strategies	1. Maintain records of the incidence of boat collisions with dugong (CALM) **(M)**. 2. Undertake research to better understand dugong population, distribution and habitat requirements in the reserves and the adjacent areas in Exmouth Gulf and determine the current status of the dugong population in relation to historical levels (CALM) **(M)**. 3. In partnership with the Coral Coast Park Council undertake research to determine the extent and the level of indigenous hunting that is sustainable (CALM, Coral Coast Park Council) **(H)**.

Performance measure/s	Numbers of individuals within the reserves.	**Desired trend/s**	Constant or positive.
Short-term target/s	To be developed as required		
Long-term target/s	No loss of dugong abundance as a result of human activity[#] [Ø] in the reserves.		

[#] Sustainable indigenous take of dugong is permitted.
[Ø] This does not apply to losses due to accidents.

7.2 Social Values

The Ningaloo region has a strong cultural heritage, including an Indigenous heritage associated with a long Aboriginal occupation and, a maritime heritage associated with the early European explorers of our coastline. The area is visited and enjoyed by over 200,000 people a year, for whom the 'Ningaloo experience' is a uniquely rewarding personal experience. There is a wealth of nature appreciation, recreation and nature-based tourism opportunities in the area that are increasingly important to the regional economy. Striking the right balance between protecting the environment for future generations and facilitating and managing the rapidly increasing recreational and commercial activities of the area, is the primary purpose of this plan.

Social values are the major cultural, aesthetic, recreational and economic attributes of the area.

7.2.1 Indigenous heritage

Social value	**Indigenous heritage**: *The area has significant Indigenous heritage value associated with historical and current use by indigenous people.*

Background	Ningaloo Reef and the adjacent foreshore have a long history of occupancy by Aboriginal communities. The foreshore and hinterland of North West Cape contain numerous Aboriginal sites such as burial grounds, middens and fish traps that provide a historical account of the early habitation of the area and a tangible part of the culture of local Aboriginal groups. The earliest Aboriginal groups to inhabit the peninsula were the Jinigudira and the Baiyungu people. The Jinigudira inhabited most of the land adjacent to the reef and northern cape, while the Baiyungu inhabited the southern areas of foreshore adjacent to the reef. The archaeological record of the Cape Range Peninsula is significant in that it provides the earliest confirmed record of Pleistocene marine resource use in Australia. Aboriginal habitation of the North West Cape and Exmouth is thought to have commenced at least 32,000 years (with some reports of 38,000 years before present and continues up to the present (Western Australian Planning Commission, 2004). Although the majority of local Aboriginal people live in towns such as Carnarvon and Onslow, individuals and families retain strong ties to particular sites. The Jinigudira and the Baiyungu still maintain and associate with the North West Cape and are recognised as the traditional owners of these lands (Gnulli Park Council, pers. comm.). Cardabia pastoral station surrounding Coral Bay is owned and managed by the Baiyungu community. Despite disruptions to traditional life, Aboriginal people seek to retain social, religious and personal bonds with their traditional lands. Current Aboriginal usage of the area includes camping and fishing, as well as limited hunting of turtle and dugong. Aboriginal heritage is protected under the *Aboriginal Heritage Act 1972* and traditional hunting of turtle and dugong is permitted in accordance with the WC Act. The Gnulli Native Title claim is the only native title claim over the North West Cape area currently awaiting mediation in the Federal Court. The Gnulli Working Group is represented by the Yamatji Land and Sea Council (Yamatji Marlpa Barna Baba Maaja Aboriginal Corporation). Marine management issues in regard to Aboriginal heritage in the reserves include potential human impacts on historical sites (eg. physical disturbance, litter), access for hunting and cultural activities, and the involvement of Aboriginal people in the management of the reserve. Under traditional law, Aboriginal people are responsible for, and obliged to protect, preserve and manage areas, sites and objects of Aboriginal significance associated with their country. In traditional terms, management includes protection and preservation of physical sites and objects as well as the traditional knowledge pertaining to them. A fundamental dimension of cultural knowledge to Aboriginal people today is the "meaning" of the land as it reveals the record of creation and the history of human activity. These responsibilities and obligations are of continuing importance to Aboriginal people, particularly with respect to teaching cultural heritage to the young. Management strategies include increasing the level of knowledge regarding the significance of Aboriginal heritage in the area and the involvement of Aboriginal people in the management of the reserves. The Coral Coast Park Council has been formed comprising representatives from

	the Gnulli Working Group, Baiyungu traditional owners and CALM to facilitate Aboriginal involvement in management of the Ningaloo Marine Park and the Cape Range National Park. Management of Indigenous heritage values in the reserves will seek to ensure that existing heritage sites in the reserves are protected from loss or degradation, and traditional activities are sustainable and maintained in collaboration with local indigenous groups.
Requirements	• Access for traditional hunting, significant sites and cultural activities. • Protection of Indigenous heritage sites.
Management objective/s	1. To involve the local Aboriginal community in the management of the reserves. 2. To protect Indigenous heritage sites in the reserves.
Strategies	1. Through the Coral Coast Park Council, encourage indigenous participation in the management of the reserves (CALM, Coral Coast Park Council) **(H)**. 2. Develop, in collaboration with the local Aboriginal community, an understanding of the significance of the area to Aboriginal people (CALM, Coral Coast Park Council) **(M)**. 3. Identify, in collaboration with the local Aboriginal community, the significance of Indigenous heritage sites in the reserves (CALM, Coral Coast Park Council) **(M)**. 4. Develop, in collaboration with the local Aboriginal community, protocols and a monitoring program for traditional hunting in the reserves (CALM, Coral Coast Park Council) **(M)**. 5. Educate users of the reserves about the Indigenous heritage value of the reserves (CALM, Coral Coast Park Council) **(M)**.

Performance measure/s	To be developed as required in consultation with Department of Indigenous Affairs.	**Desired trend/s**	To be developed as required in consultation with Department of Indigenous Affairs.
Short-term target/s	To be developed as required.		
Long-term target/s	Maintenance of Indigenous heritage values, as identified by the Department of Indigenous Affairs.		

7.2.2 Maritime heritage

Social value	**Maritime heritage:** *Significant maritime heritage sites including numerous historic shipwrecks, the Vlamingh Head lighthouse and the whaling station in Norwegian Bay.*

Background	The Ningaloo area has an extensive maritime history, relating to the provision of navigation aids (such as lighthouses) for passing vessel traffic and the whaling trade. Numerous shipwrecks have also resulted from the number of vessels plying the coast of Western Australia. Shipwrecks are of great interest to many visitors to the reserves since they provide a tangible link with the history of the reserves in a dynamic environment. Submerged wrecks can also provide spectacular dive sites that combine a historical and natural experience due to the array of marine life that accumulates on and around the wrecks. The remains of a whaling factory at Norwegian Bay provide a glimpse of the thriving industry that existed from 1913 until whaling became economically unviable and the station closed in 1957. The structures and equipment left on site have since become derelict with wind blown items scattered over a large area. Management of the area now faces the problems associated with a degrading site, including the risk of asbestos contamination on and around the site associated with the lagging of pipes and building materials. The lighthouse at Vlamingh Head represents one of the area's most visual human landmarks. The lighthouse was decommissioned in 1967 after 55 years of operation. The light was one of the main navigation aids as ships travelled from Asia and western ports down the west coast of Australia. Another lighthouse was constructed on Ningaloo Station. Pre-1900 shipwrecks are protected under the *Maritime Archaeology Act 1973* (State legislation) and the *Historic Shipwrecks Act 1976* (Commonwealth legislation). The WA Maritime Museum has statutory responsibility for management of these wrecks. While some of the wrecks in the region pre-date European settlement such as the *Rapid*, others relate to pioneer industries, such as pearling, whaling and coastal trade. In 2004, the wreck of the *Correio Da Azia*, a Portuguese sailing ship which went aground on Ningaloo Reef in November 1816 while travelling from Lisbon to Macau, was discovered in the Park. This is the only known Portuguese wreck on the Australian coast and is an important part of Western Australia's pre-colonial history. In regard to European history/maritime heritage, the goal of reserve management is to prevent significant human impacts on important historic sites through the education of reserve users and ensuring that such sites do not pose any threat to public safety.
Requirements	Not applicable.
Management objective/s	That, in collaboration with the WA Maritime Museum, human activities do not significantly impact historic sites in the reserves.
Strategies	1. Undertake a risk assessment of potentially hazardous maritime sites (eg. whaling stations and Maud Jetty) to establish threats to public safety (WAMM, CALM) **(H)**. 2. Ensure reserve users are aware of the relevant regulations under the *Maritime Archaeology Act 1973* (WAMM, CALM) **(M)**. 3. Distribute educational material relevant to conserving historic sites in the reserves to users (WAMM, CALM) **(M)**. 4. Develop a cost-effective monitoring strategy for the maritime heritage sites within the reserves in cooperation with the maritime museum. (CALM, WAMM) **(M)**.

Performance measure/s	To be developed as required by Western Australian Maritime Museum.	**Desired trend/s**	To be developed as required by Western Australian Maritime Museum.
Short-term target/s	To be developed as required.		
Long-term target/s	Maintenance of maritime heritage values, as identified by the WA Maritime Museum.		

7.2.3 Seascapes (KPI)

Social value	**Seascapes**: *Panoramic vistas of turquoise lagoon waters, reefs, beaches, breaking surf and the blue open ocean beyond the reef line are major attractions of the reserves.*

Background	Panoramic vistas of turquoise lagoon waters, offshore islands, reefs, beaches, breaking surf and the blue open ocean beyond the reef line are major aesthetic attractions of the reserves. These attributes can be appreciated from the shoreline of the reserves, from the ocean or from high vantage and lookout points along the coastal roads and hinterland. The popularity of both natural and artificial lookouts indicates that the seascapes of the reserves are a prized natural value of the area and are important both socially and economically. Inappropriate structures along the coastline, on the islands and in the surrounding waters have the potential to degrade the aesthetic values of the reserves. Coastal developments and maritime infrastructure projects must therefore be planned with careful consideration of this issue. Management of the seascapes of the reserves will concentrate on ensuring that areas of high seascape values are identified and protected. Developments and activities that have potential to impact on this value should be suitably assessed and where possible, these impacts should be minimised.
Requirements	Generally uninterrupted coastal vistas.
Management objective/s	To identify designated seascapes of the reserves and seek to minimise degradation of seascapes by coastal developments, island structures or marine infrastructure within the reserves.
Strategies	1. Identify and determine the key characteristics and spatial extent of the major seascapes of the reserves (CALM, LGA) **(H-KMS)**. 2. Develop performance measures and management targets for designated seascapes (CALM, LGA) **(H-KMS)**. 3. Provide formal advice to the DPI, EPA and LGAs in relation to ensuring development proposals inside and outside the reserves do not unnecessarily impact on the designated seascapes of the reserves (CALM, MPRA) **(L)**. 4. Ensure potential developers are informed of relevant management objectives and targets of the reserves in relation to seascape values (CALM, LGA) **(L)**. 5. Investigate the removal of existing inappropriate structures that impact on seascape values (ie. coastal shacks or abandoned development) (CALM) **(L)**.

Performance measure/s	To be developed.	**Desired trend/s**	To be developed.
Short-term target/s (KPI)	To be developed as required.		
Long-term target/s (KPI)	Maintenance of amenity values of designated seascapes in the reserves.*		

* Seascape value for the reserves will be determined by the MPRA/CALM, in consultation with the CCPAC and key stakeholders, via public consultation processes and will be cognisant of other planning processes such as for the Cape Range National Park Management Plan, the Ningaloo coast regional strategy Carnarvon to Exmouth (Western Australian Planning Commission, 2004) and the World Heritage nomination process.

7.2.4 'Wilderness' (KPI)

Social value	**'Wilderness':** *Areas of secluded coastline and remote coastal waters offer opportunities for remote experiences that are integral to the Ningaloo experience.*

Background	The reserves are remote from the major Western Australian population centres and the Park extends along 300 km of coastline. Visitation levels to the reserves have been relatively low due to their distance from Perth, limited or difficult road access to the coast, and few visitor facilities. However as the values of Ningaloo Reef become better known, visitor numbers have increased and are expected to continue to increase at >5% per annum. This trend is likely to create a demand for a higher level of facilities and better access, which may be in conflict with maintaining the natural setting considered characteristic of the area. The *Ningaloo coast regional strategy Carnarvon to Exmouth* (Western Australian Planning Commission, 2004), released by the DPI determines the appropriate level and location of development along the Ningaloo coast. The Muiron and Sunday islands are visited by boat with most visitors coming from Exmouth for day trips. Limited camping on the islands is permitted. For most visitors, the combination of the natural setting, isolation, few people, and absence of infrastructure provide the essential elements of a 'wilderness' experience. However, there will be variations among visitors as to specifically what constitutes 'wilderness', and a point at which visitation and infrastructure have significantly impacted on an individual's 'wilderness' experience. Perceptions of wilderness will also vary between cultural groups and may vary over time. Consequently, targets to express what 'wilderness' means need to be determined, but must also remain flexible to be able to respond to changes in visitor perceptions over time. Through the *Ningaloo coast regional strategy Carnarvon to Exmouth* (Western Australian Planning Commission, 2004), the appropriate level of access and use of the coastal environment has been determined. The Strategy includes a Coastal Tourism Framework with the objective of considering environmental and other relevant factors in order to facilitate planned sustainable tourism along the Ningaloo Coast. The framework highlights two types of coastal sector on the Ningaloo Coast, these being remote and semi-remote. This will directly affect the future use of the marine reserves. In considering future access, the notion of having some areas of no development, or a low level of development, is being considered to ensure that the 'wilderness' value is maintained in some areas. CALM's policy "Identification and Management of Wilderness and Surrounding Areas" guides the identification, designation and management of 'wilderness' and surrounding areas on land managed by CALM. Given that visitor perceptions of 'wilderness' will vary over time and will depend on the visitor profile, the targets set to maintain this value will require ongoing review and input from users. There will always need to be a balance between maintaining wilderness values while not unnecessarily, or inequitably, restricting public access to the reserves. Key management issues will be the standard of coastal access, level of visitor facilities and infrastructure, possible maximum visitor numbers at some sites, marine infrastructure (eg. boat ramps and moorings) and suitability of activities which may degrade wilderness experiences.
Requirements	• Limited access to remote secluded areas of the foreshore. • Uninterrupted seascapes. • Limited numbers of visitors. • Low level of facilities/infrastructure (ie. a natural setting).
Management objective/s	To identify designated 'wilderness' areas of the reserves and manage the waters and adjacent coast so that these values are maintained.
Strategies	1. Identify and determine the key characteristics and spatial extent of the major 'wilderness' areas of the reserves (CALM, NSDO, LGA) **(H-KMS)**. 2. Undertake research to characterise 'wilderness' areas of the reserves and develop performance measures and management targets for designated 'wilderness' areas (CALM, NSDO, LGA) **(H-KMS)**. 3. Ensure relevant management objectives and targets of the reserves in relation to 'wilderness' values are considered in the assessment of proposals for coastal and marine developments (CALM, MPRA, LGA, DPI/NSDO, EPA) **(M)**.

Performance measure/s	To be developed.	**Desired trend/s**	To be developed.
Short-term target/s (KPI)	To designate wilderness areas and develop guidelines for the maintenance of these values within three years.		
Long-term target/s (KPI	Maintenance of amenity values of designated wilderness areas in the reserves.*		

* Wilderness value for the reserves will be determined by the MPRA/CALM, in consultation with the CCPAC and key stakeholders, via public consultation processes and will be cognisant of other planning processes such as for the Cape Range National Park Management Plan, the Ningaloo coast regional strategy Carnarvon to Exmouth (Western Australian Planning Commission, 2004) and the World Heritage Area process.

7.2.5 Water sports

Social value	**Water sports:** *The pristine nature and diversity of the natural environment of the Ningaloo Reef and the Muiron and Sunday islands provide recreational opportunities for swimming, boating, snorkelling, scuba diving, free-diving, surfing, and other water sports.*

Background	Due to their warm climate, pristine reef habitat adjacent to the shore, spectacular coastal views and possibilities for interaction with a wide range of marine fauna, the reserves provide a wide variety of recreational opportunities. Recreational boating, diving, snorkelling and wildlife observation (eg. whale sharks, humpback whales, dolphins, manta rays and turtles) can be experienced within the reserves. Research has shown that there has been an increase in the pursuit of non-extractive nature-based recreational activities (Wood & Dowling 2002). The sheltered waters of the reserves are also used for a variety of on-water activities such as surfing, windsurfing, sea kayaking and yachting. Whales, dolphins, dugongs, turtles, seabirds and whale sharks are fully protected under the WC Act and it is an offence to disturb these animals. A code of conduct has been developed to guide interaction with some species, however such codes may also need to be developed for other wildlife interactions, including minimum approach distances, maximum boat speeds and use of lights in the vicinity of wildlife. DPI is responsible for all boating regulations including licensing, safety standards, marker buoys, moorings and jetties. Mooring controls can be delegated to other management agencies and at Coral Bay, these controls have been delegated to CALM under the *Shipping and Pilotage Act 1967*. Moorings can also be managed under the CALM Regulations. Further increases in on-water activities have the potential to impact negatively on the ecological values of the reserves through an increase in the disposal of effluent and rubbish, disturbance, and inappropriate anchoring/vessel movement in sensitive habitats. The reserves cover a very large area and the use of this area for water-based activities is growing and changing. As these uses increase, there may be conflicts among these activities, or they may have impacts on the environment that trigger a need for management intervention. It is therefore not sensible to be highly prescriptive in this plan given that uses and areas of use will be changing over the life of the management plan. The goal of marine reserve management in relation to water sports is to manage recreational use in the reserves in a manner that is consistent with maintaining the values, to maintain the values of the reserve important to water sports and to that ensure water sports are carried out in an equitable manner. Where water sports are in conflict with other users or where they impact on the ecological values of the reserves during the life of the plan, management response would be, in liaison with DPI and major users, to determine appropriate management restrictions and controls and implement these. A recreation masterplan will be developed for the area. This will address finer scale issues of user conflict and impacts of certain water sport activities in the reserves. In some areas of intense SCUBA diving and snorkelling activity, localised damage to corals may occur as a result of walking on corals, fin damage and uncontrolled anchoring. Shallow water areas such as Oyster Stacks are particularly susceptible. Where localised damage occurs, appropriate management controls will be implemented. Water sports are permitted in all areas of the reserves, except in sanctuary zones if the activity is shown to be incompatible with the purpose of the sanctuary zone. The Coral Bay Boating Strategy introduced some restrictions on boating access to the Maud Sanctuary Zone that include access for recreational boating.
Requirements	• High water quality. • Equity of access to appropriate areas within the reserves. • Separation of incompatible recreational activities.
Management objective/s	1. To ensure water sports are managed in a manner that is consistent with maintaining the ecological and social values of the reserves. 2. To maintain the ecological and passive social values of the reserves that are important to recreational water sports. 3. To manage recreational activities in a manner that minimises conflict between reserve users.

Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Maintain a database of the nature, spatial and temporal patterns of all existing uses in the reserves (CALM) **(H-KMS)**. 3. Assess the nature, level, spatial and temporal patterns and potential impacts of water sports in the reserves (CALM) **(H-KMS)**. 4. Develop a recreation and tourism masterplan for the reserves (CALM) **(H-KMS)**. 5. Review, every three years, recreation and tourism use of the reserves (including shore-based activities) and where conflicts are identified between user groups and types of activities, develop appropriate strategies to address these conflicts (CALM, DPI) **(H)**. 6. Use regulations to separate incompatible activities, as appropriate (CALM, DPI) **(M)**. 7. In collaboration with user groups, develop *Codes of Conduct* and education programs to minimise environmental impacts of recreational activities, particularly water sports, as appropriate (CALM, DPI, WATC) **(M)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes.

7.2.6 Marine nature-based tourism

Social value	**Marine nature-based tourism***: An unspoilt natural environment and easy access ensure significant opportunity for a variety of marine nature-based tourism activities.*

Background	Ningaloo Reef and the Muiron/Sunday islands offer a wide variety of wildlife in a very natural setting of land and seascapes that presents a major drawcard for the region's nature-based tourism. Annual visitor numbers to the Gascoyne region are approximately 270,000 with an annual expenditure of approximately $149 million (Gascoyne Development Commission, 2003). Of this, $127 million is spent per year by visitors to the Ningaloo Marine Park and Cape Range National Park (Western Australian Tourism Commission, 2002). The whale shark watching industry contributes significantly to this total, being worth $12 million per year. A 2004 survey indicated that 48% of visitors to the Park are from Western Australia, with the remainder coming from other States (12%) and overseas (39%) (Carlsen & Wood, 2004). To cater for the large tourism interest in the region, an increasing number of operators that provide a range of nature-based tourism experiences have established themselves either permanently or seasonally in population centres associated with Ningaloo Reef. In 2004 there were 86 licensed commercial tourism operators undertaking activities in Ningaloo Marine Park. In 2004, three recreational diving outlets operated from Exmouth, while numerous other operators offered vessels for charter for activities such as snorkelling and diving. In Coral Bay in 2004, only one outlet offered diving while several other operators provided snorkelling and diving as part of a charter vessel service. Glass bottom vessels offering a marine viewing experience for tourists located at Bundegi, Tantabiddi and Coral Bay provided an alternative to the in-water experience provided by the diving and snorkelling tourism operators. In 2005 there were fifteen whale shark interaction licences granted in the Park. Three of these are held by operators working from Coral Bay, while the rest of the licences are allocated to Exmouth-based operators who operate out of Tantabiddi. The Exmouth operators have also incorporated a manta ray tourism opportunity while, in Coral Bay, this interactive activity has developed as a separate nature-based tourism experience. Numerous land-based commercial operators offer nature-based tourism in the marine and coastal environments of the Park by accessing locations further from the population centres. It is important to manage competing pressure from local and state-wide operators. Additionally, a large number of the operators in the region provides seasonal nature-based tourism services during the winter months such as surfing and sea kayaking operations. The seasonal influx of tourism operators has highlighted the need for greater management of competing and conflicting tourism activities in the region. The development of a sea kayaking trail for the Ningaloo coast is one such attempt to manage increasing numbers of commercial operators, ensuring that competing tourism operators are able to be managed through allocation of camping sites along the coast that require pre-booking and separate users. Commercial ATV (all terrain vehicle) tours have been licensed to operate in the Park and there have been proposals to undertake commercial jet ski operations in the Park. These types of activities have the potential to be highly intrusive to other users of the Park and if not regulated properly, can be a risk to public safety and/or cause environmental damage. A recreation masterplan for the area will be developed that will address the issues of user conflict and ecological impacts of certain activities in the reserves. The acceptability of these commercial operations will continue to be assessed in light of the recreational masterplan and on environmental, equity and safety criteria. If applications for these activities continue to increase, it may be necessary for the MPRA to develop a policy position on these types of activities during the life of the management plan. Nature-based tourism activities have the potential to make an important contribution to protecting the region's ecosystems by fostering a greater understanding and appreciation of the environment. However, unless carefully managed, visitation has the potential to cause environmental damage, particularly as the numbers of visitors continue to increase. This includes increases in litter, impacts on fish stocks due to fishing, damage to marine environments through indiscriminate anchoring, disturbance of coastal and island landforms

	through trampling, and disturbance to seabirds, marine mammals and nesting turtles. Human interactions with large marine fauna are controlled through the WC Act. In the reserves all commercial tour operations require a licence under the CALM Act. The Coral Bay Boating Strategy introduced some restrictions on boating access to the Maud Sanctuary Zone that includes access for commercial tourism. The goals of reserve management in relation to nature-based tourism are to manage tourism activities in the reserves in a manner that is consistent with maintaining the reserves' values, to maintain the values of the reserves on which the nature-based tourism industry depends, and assist in maintaining a viable nature-based industry in the reserves. Non-extractive tourism activities will be permitted in all zones of the Park subject to environmental assessment. However, in sanctuary zones and conservation areas there may be restrictions on activities that are shown to be incompatible with the zone. Extractive tourism activities (ie. charter fishing) are permitted in accordance with the permitted uses in various management zones (see Tables 4 & 6). Appropriate ecological baselines will be established against which impacts of these activities can be assessed.
Requirements	• Clean beaches. • High water quality. • Healthy benthic communities. • High aesthetic quality of the marine environment. • Abundance of charismatic megafauna • Provision of 'undisturbed' areas for nature appreciation. • Equitable access to the natural values of the reserves.
Management objective/s	1. To ensure that marine nature-based tourism activities are managed in a manner that is consistent with maintaining the ecological and social values of the reserves. 2. To maintain the ecological and passive social values of the reserves that are important to the tourism industry. 3. Cooperate with the industry to maintain a viable tourism industry in the reserves.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Assess the nature, level and potential environmental impacts of commercial tourism operations within the reserves (CALM) **(H)**. 3. Maintain a database of the nature, spatial and temporal patterns and potential environmental impacts of commercial tourism operations within the reserves (CALM) **(H)**. 4. Undertake research to establish appropriate baselines in the Park adjacent to existing and proposed tourism nodes identified in the *Ningaloo coast regional strategy Carnarvon to Exmouth* (CALM) **(H)**. 5. Continue to license appropriate commercial tourism operations within the reserves with appropriate conditions including a requirement to report on their activities as part of the Park's audit process (CALM) **(H)**. 6. Ensure equitable access for marine tourism within appropriate zones in the reserves (CALM) **(H)**. 7. Develop *Codes of Practice* for commercial marine tourism operations in the reserves including: • performance measures; • desired trends; • short-term and long-term management targets; and • monitoring and reporting requirements (CALM, WATC) **(H)**. 7. Develop detailed site plans in areas of intense recreation and tourism use, in consultation with the major users (CALM) **(H)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes.

7.2.7 Coastal use

Social value	**Coastal use:** *Recreational use of headlands, dunes and long white beaches for walking, swimming, surfing and fishing is a major value of the reserves.*

Background	The nearshore waters, foreshore and coastal hinterland of the reserves provide a wide variety of recreational opportunities for visitors, including walking, camping, swimming, surfing, sea kayaking, kite surfing and fishing. The 300 km coastline of the Marine Park has a relatively small number of visitors undertaking a variety of different uses at varying levels of intensity. The intensity of use varies from most heavily used areas at Coral Bay to restricted access on the Muiron and Sunday islands. Although activities in coastal areas of the reserves are spread over a large area, significant localised degradation of coastal communities has occurred at nodes of high intensity use. As visitor numbers to the reserves increase, there is the possibility of further environmental degradation and conflicts, particularly on the more popular foreshore areas or adjacent to marine access points. Degradation occurs through littering, trampling of sensitive habitat, inappropriate disposal of human waste and damage to coastal communities by 4WD vehicles. The marine reserves planning process has been undertaken cognisant of the *Ningaloo coast regional strategy Carnarvon to Exmouth* (Western Australian Planning Commission, 2004) to ensure appropriate integration of marine and terrestrial management. The reserves' management is also complementary to management arrangements in the *Cape Range National Park Management Plan*. Camping occurs in the Ningaloo Marine Park, Cape Range National Park and on pastoral leases. Camping in the Cape Range National Park is managed through the *Cape Range National Park Management Plan* under the CALM Act. Visitors also camp on pastoral leases and this has led to some degradation of the coastal environment. In regard to camping in the marine reserves, this management plan supports the recommendations in the *Ningaloo coast regional strategy Carnarvon to Exmouth* (Western Australian Planning Commission, 2004) which suggests site specific camping nodes based on a range of environmental and social parameters. Coastal camping nodes are proposed at The Lagoon, Horse Paddock, Stevens Camp, Maggies, Fourteen Mile Beach, Jane Bay Camp, Lefroy Bay and Doddy's Camp. These recommendations are also consistent with strategies in the *Cape Range National Park Management Plan*. A recreation masterplan for the area will address the issues of user conflict and ecological impacts of recreational activities in the reserves. Licensing for various commercial operations will be based on the recommendations of the masterplan. Management objectives for the foreshore of the reserves will seek to ensure that high use areas are managed to limit any degradation of the ecological values and prevent conflict between coastal users, in consultation with the Ningaloo Sustainable Development Office. Management in low use areas will seek to ensure that impacts on the more remote areas of the reserve foreshore are minimised and the reserves' wilderness value is protected.
Requirements	• Vehicle access, boat launching facilities. • Facilities, eg. roads, toilets and walkways. • Control of beach activities, eg. recreational vehicle use and dogs. • Clean beaches.
Management objective/s	1. To ensure that coastal uses are managed in a manner that is consistent with maintenance of the reserves' values. 2. To maintain the ecological values of the reserves that are important for coastal use. 3. To ensure management of the coastal portion of the Park is integrated with the management of adjacent coastal lands.
Strategies	1. Undertake an education program to promote environmentally sensitive use of the coastal areas of the reserves (CALM) **(H)**. 2. Manage the recreational activities in the 40 m coastal strip of the Park to be consistent with the management targets for geomorphology and coastal biological communities as outlined in this plan (CALM) **(H)**. 3. Undertake research to map the coastal geomorphology of the Park (CALM) **(H)**. 4. Liaise with coastal land managers to limit access to coastal areas of the reserves where significant environmental or social impacts cannot be avoided (CALM, DPI/NSDO, LGA, Pastoralists) **(H)**.

	5. Identify coastal areas of the reserves that are environmentally sensitive and prohibit access by vehicles and for camping (CALM, DPI/NSDO, LGA, Pastoralists) **(H)**. 6. Identify coastal areas of the reserves that are degraded and, where appropriate, undertake rehabilitation programs (CALM) **(H)**.
Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes.

7.2.8 Recreational fishing

Social value	**Recreational fishing:** *A diverse range of quality recreational fishing opportunities for local and visiting fishers targeting a variety of marine finfish and invertebrates.*

Background	The waters of Ningaloo Reef and the Muiron/Sunday islands support an abundance of prized table fish, and the reef is considered a premier fishing location. The fringing reef provides sheltered waters that are accessible to small recreational vessels and extensive opportunities exist for beach fishing. Recreational fishing is largely concentrated around major settlements at Coral Bay and Exmouth and boat ramps at Tantabiddi and Bundegi (Sumner *et al.*, 2002). Data collected in a 1998-99 survey showed that the species most commonly caught by recreational fishermen in the Park were spangled emperor (*Lethrinus nebulosus*), golden trevally (*Gnathanodon speciosus*), sweetlip emperor (*Lethrinus miniatus*), blue lined emperor (*Lethrinus laticaudis*), chinaman cod (*Epinephelus rivulatus*), squid (*Cephalopodidiae spp*) and yellow tailed emperor (*Lethrinus atkinsoni*) (Sumner *et al.*, 2002). There is a significant take of these species, with an estimated 60 tonnes of spangled emperor extracted from the Park in 1998-99 (Sumner *et al.*, 2002). Recreational fishing effort is expected to increase with increases in population and visitation to the area. Recreational fishing effort, as estimated for 1998/99, is shown in Figure 6. Recreational fishing is managed to achieve sustainability under the FRM Act by DoF through a variety of management tools. These tools include bag and size limits, gear restrictions, seasonal restrictions and licensing. Some species, such as the potato cod (*Epinephelus tukula*), are protected from fishing within all State coastal waters, including the reserves. In 1992, specific daily bag limits and a possession limit were introduced for the Ningaloo Marine Park. These park-specific limits have been replaced with regional bag and possession limits as outlined in the Recreational Fishing Guide – Gascoyne Region (DoF, 2003). In respect to the reserves, the regulations have lowered species bag limits and increased minimum size limits for some species, while increasing the overall possession limit from 17 kg to 20 kg per fisher. It is unlikely that these changes will significantly reduce the overall fish take from the reserves given that the possession limit has increased, few fishers catch above the reduced bag limits and there is likely to be a gradual increase in the fishing population as detailed in the *Five year management strategy for recreational fishing in the Gascoyne region of Western Australia* (DoF, 2001). While the practice of catch and release fishing is increasing in the State, the main issues in regard to recreational fishing in the reserves relate to over-exploitation of target species and associated impacts on ecological values through littering, trampling of sensitive habitat, damage to coastal communities by 4WD vehicles and ecological 'flow on' effects resulting from the removal of larger predatory fish. Research by Westera (2003) found evidence of these 'flow on' effects or 'trophic cascades' within the recreation zone adjacent to the Mandu Sanctuary zone. Given the higher level of recreational fishing effort in the northern areas of the Park, similar trophic cascade effects may also be occurring in northern areas. The establishment of 'no-take' zones within the reserves provides research and monitoring opportunities through which the impacts of recreational fishing on the values of the reserves can be assessed.
Requirements	• High water quality. • Maintenance of target species habitat. • Equitable access to fishing grounds within the reserves in appropriate zones. • Maintenance of recreational fish stocks in the reserves.
Management objective/s	1. To ensure that, in collaboration with the DoF, recreational fishing in the reserves is managed in a manner that is consistent with maintaining the reserves' values. 2. To maintain the ecological values of the reserves that are important to recreational fishing. 3. Cooperate with the DoF in maintaining quality recreational fishing opportunities in the reserves.

Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Undertake an educational program to ensure recreational fishers are aware of zoning

	restrictions and regulations, which apply to their activities within the reserves (CALM, DoF) **(H-KMS)**. 3. Undertake joint surveillance and enforcement programs until with the DoF to ensure compliance with zone restrictions and fishing regulations (CALM, DoF) **(H-KMS)**. 4. Continue to undertake research and monitoring of the ecological effects of recreational fishing in the reserves and review management controls as appropriate (CALM, DoF) **(H-KMS)**. 5. Undertake research to support the development of management targets for recreationally targeted finfish species (DoF, CALM) **(H-KMS).** 6. Formulate performance measures and targets for key recreational species that will ensure ecologically sustainable recreational fishing in the reserves (CALM, DoF) **(H)**. 7. Monitor the abundance of selected target finfish species to assess effectiveness of management strategies, with a particular emphasis on the effectiveness of sanctuary zones, including where feasible the use of community monitoring programs for these data (CALM, DoF) **(H)**. 8. Monitor and report on recreational fishing catch/effort within the reserves (DoF, CALM) **(H)**. 9. Implement a community monitoring program for key target fish species in the reserves (CALM, DoF, LGA) **(H)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes.

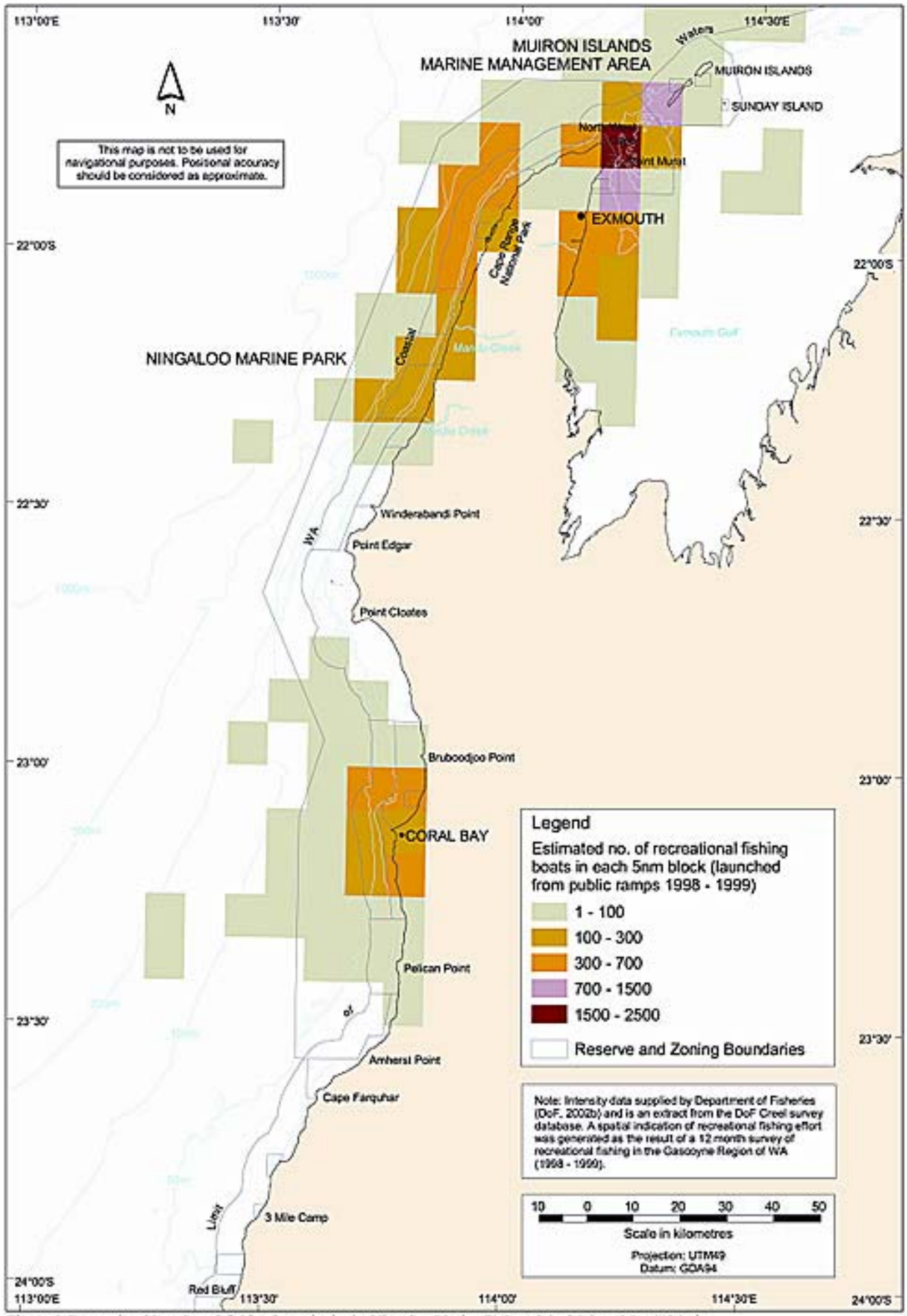

Figure 6: Recreational boat based fishing intensity in the Ningaloo Marine Park and the Muiron Islands Marine Management Area

7.2.9 Scientific research

Social value	**Scientific research**: *A largely undisturbed coral reef environment together with shallow clear and protected waters provide unique opportunities for scientific studies.*

Background	The reserves provide unique opportunities for scientific research. The environment is largely undisturbed; the reef is accessible and the lagoon is protected and shallow. The islands and habitats in the Marine Management Area also provide ample opportunity for research. As the largest fringing coral reef in Australia and lying at the intersection of three IMCRA meso-scaled bioregions (Ningaloo, Pilbara inshore and Pilbara offshore regions), the reserves are representative of an important and unusual juncture in marine biodiversity. These regions coincide with the transition zone between waters dominated by temperate species found in the south and tropical species found in the north. The reef also lies on the narrowest strip of continental shelf in Australia with waters over 1000 m in depth lying within 20 km of the mainland. The flora and fauna found on the reef is also of great scientific significance, and the coral assemblages in particular are of interest to the scientific community due to the relatively low amount of coral bleaching found on the reef during global coral bleaching events. The offshore waters of the reef are also the location of one of the largest and most predictable seasonal aggregations of whale sharks globally. A good understanding of how the ecology of the reserves functions and knowledge about the cumulative long-term impact of recreational and commercial activities on the ecological values of the reserves are a fundamental requirement for effective management. In addition such studies enhance the general understanding of the functioning of arid zone and subtropical coral reef ecosystems, thereby providing broader benefits. Research programs should, ideally, be designed to fill key gaps in existing knowledge. However, any increase in knowledge is ultimately useful so all legitimate research projects will be encouraged. All research within the reserves requires the appropriate research permits and/or approvals (ie CALM Act, WC Act, FRM Act, EPBC Act and/or *WA Animal Welfare Act 2003*) as relevant to the research proposal. Scientific research is permitted in all areas of the reserves, subject to the appropriate permit.
Requirements	1. Access to representative sites free of major human influences as 'control sites'. 2. Access to representative sites covering the range of major human activities in the reserves as 'impact' sites. 3. Equitable access to the reserves for ecological and social research opportunities in appropriate zones.
Management objective/s	1. To promote the use of the reserves for social and ecological research. 2. To ensure ecological and social research is ethical and ecologically sustainable. 3. To maintain the ecological values of the reserves that are important for scientific research.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Identify and communicate high priority scientific and social research projects relevant to the management of the reserves to appropriate research organisations (CALM) **(H-KMS)**. 3. Facilitate scientific and social research in the reserves by research, academic and educational institutions by providing financial and logistical assistance where possible (CALM, DoF) **(H)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes.

7.2.10 Education

Social value	**Education**: *Easy access and the close proximity of the reef to Ningaloo shoreline provide unique opportunities for education about the marine environment.*

Background	Easy access and the proximity of the reef to the shoreline provide excellent opportunities for community education about the marine environment. The reserves are used by local schools and by Perth-based universities and schools for educational purposes. There is, however, great potential for this use to be increased. Public education about the marine environment, through active participation, greatly assists management. The desired outcome of public education is to increase public awareness and understanding of conservation and management issues in the Park and of the marine environment in general. In a local sense, this increased understanding helps develop a real sense of community ownership, which subsequently leads to better protection of the ecological and social values of the reserves. Non-extractive educational activities will be permitted in all zones of the reserves.
Requirements	1. Access to sites free of major human influences. 2. Access to sites covering the range of major human activities in the reserves.
Management objective/s	To promote the use of the reserves for marine education opportunities.
Strategies	1. See ZONING strategies (Section 8.1.1) (CALM) **(H-KMS)**. 2. Maintain the Milyering Visitor Centre, CALM Exmouth District Office, Coral Bay Information Hut and the Jurabi Turtle Centre as key locations for marine education (CALM) **(H-KMS)**. 3. Develop and routinely distribute to the local community and visitors a range of education materials about the reserve values and management (CALM, DoF) **(H)**. 4. Provide talks and briefings about the reserve values, uses and management to local and visiting groups (CALM) **(M)**. 5. Support local schools who wish to develop a marine education program relating to the reserves (CALM, schools) **(M)**. 6. Provide support, where possible, to institutions using the reserves for educational purposes (CALM) **(L)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes.

7.2.11 Commercial fishing

Social value	**Commercial fishing**: *A number of commercial fisheries operate in the reserves.*
Background	Commercial fishing in the reserves include wetline fisheries, a demersal line fishery, a mackerel fishery, the Exmouth Gulf Prawn Managed Fishery (EGPMF), the Shark Bay snapper fishery and the marine aquarium and specimen shell fisheries. The EGPMF operates in a small part of the general use zone of Ningaloo Marine Park in Exmouth Gulf and in part of the Muiron Islands Marine Management Area. Both of these areas are at the northern extent of the Exmouth Gulf trawl grounds. The demersal wetline fishers (wetline and mackerel) are licensed to fish in the Park in the general use zone south of Point Maud and north of Tantabiddi Creek and in the unzoned areas of the Marine Management Area. However, the majority of fishing in these two fisheries is conducted outside the reserves. Five wetline vessels operate regularly from Coral Bay and four from Exmouth. Additional vessels visit the area on a seasonal basis. Commercial fishing in the Commonwealth waters of the Park was prohibited in 2002. Commercial marine aquarium and specimen shell collecting has historically not been permitted in the Ningaloo Marine Park. However, given that other types of commercial fishing can occur in general use zones (apart from the area between Point Maud and Tantabiddi Creek), commercial marine aquarium and specimen shell collecting is permitted in the same parts of the general use zone. This provision is subject to this activity being demonstrated to be ecologically sustainable by 2009. Commercial marine aquarium and specimen shell fishing is also permitted in the unzoned areas of the Marine Management Area. This activity is not permitted in sanctuary zones, recreation zones, conservation zones or the general use zone between Point Maud and Tantabiddi Creek. Collection of live coral, 'live' rock and 'live' sand is not permitted throughout the reserves. In 2005 there were no aquaculture operations or proposals for aquaculture in the Ningaloo Marine Park. In addition, the *Gascoyne Aquaculture Development Plan* (Department of Fisheries, 1996) indicates that the potential for aquaculture development in the Park for a range of species is low. Future proposals for aquaculture in the Park could only be undertaken in general use ones and would be assessed according to the *Gascoyne Aquaculture Development Plan* and relevant environmental approvals. The DoF manages commercial fishing in Western Australian in accordance with the *Fish Resources Management Act 1994*. Management strategies include limitations on fishing gear, temporal and spatial closures, limits to the number of licences issued and the monitoring of catch and effort levels. Where the establishment of a marine nature reserve or exclusion zone in a reserve is claimed to have reduced the commercial value of a fishing licence, the licensee may be eligible for compensation under the *Fishing and Related Industries Compensation (Marine Reserves) Act 1997*. Potential habitat damage, impacts on stocks and equitable access are the major considerations in regard to commercial fishing in the reserves. However, given the current low level of wetline fishing and the types of gear used, the potential for impacts other than on the fish stocks, from these activities is low. Prawn trawling in Exmouth Gulf has occurred in the same area for over four decades. Although current practices are mostly confined to areas of unvegetated, fine and silty sediments, it needs to be confirmed that trawling activities are not encroaching on the filter feeding communities in the reserves in the north of Exmouth Gulf. This issue needs to be addressed in liaison with the industry and the DoF. The Coral Bay Boating Strategy introduced some restrictions on boating access to the Maud Sanctuary Zone that include access for commercial fishers. The primary role of management within the reserves in relation to commercial fishing is, in liaison with DoF, to ensure that commercial fishing activities are ecologically sustainable and help maintain the natural values (eg. high water and sediment quality) of the reserves on which the industry depends. In addition, the creation of no-take areas within the reserves will provide opportunities through which the impacts of commercial fishing on the values of the reserves can be assessed. Commercial fishing in the Park is not permitted in sanctuary and recreation zones and in the general use zone north of Point Maud and south of Tantabiddi creek, and is

	prohibited within the conservation areas of the Muiron Islands Marine Management Area. Sustainable commercial fishing activities are permitted in the unzoned area of the Marine Management Area and the general use zone of the Park as outlined in Tables 4 and 6.
Requirements	1. High water quality. 2. Maintenance of key habitat (eg. nursery grounds, areas of high primary productivity). 3. Equitable access to fishing grounds (in appropriate areas). 4. Maintenance of target fish stocks.
Management objective/s	1. To ensure that, in collaboration with the industry and DoF, commercial fishing activities in the reserves are managed in a manner consistent with maintaining the values of the reserves. 2. To maintain the ecological values of the reserves that are important to commercial fisheries. 3. Cooperate with the industry and DoF in facilitating a viable commercial fishing industry in the reserves.
Strategies	1. Undertake research to support the development of management targets for commercially targeted finfish species (DoF, CALM) **(H-KMS)**. 2. Monitor and report on commercial fishing catch/effort within the reserves (DoF) **(L)**. 3. DoF to review and report to the MPRA on the sustainability of commercial aquarium and specimen shell collection in the reserves within three years (DoF) **(H)**. 4. Assess the levels and effects of commercial fishing, particularly the marine aquarium fishery, in the reserves and review the effectiveness of existing management controls (DoF, CALM) **(M)**. 5. Undertake an education program to ensure commercial fishers are aware of the zoning scheme and any restrictions which may apply to their operations (DoF, CALM) **(M)**. 6. Ensure DoF liaises with the MPRA and CALM in regard to any changes to existing fisheries management arrangements within the reserves (DoF) **(L)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes.

7.2.12 Petroleum development

Social value	**Petroleum development:** *The area around the Muiron and Sunday islands is highly prospective for hydrocarbons.*

Background	Western Australia's petroleum industry began more than 40 years ago and today the industry is worth $16 billion per annum and fulfils 53% of the State's energy production needs, making it the State's most valuable commodity. Several exploration permits are dispersed throughout the Marine Management Area and these areas are considered to be highly prospective. There are proposed petroleum exploration and development projects in the Exmouth sub-basin at the Stybarrow and Enfield projects to the north-west of the Park. Drilling for petroleum exploration or production in Ningaloo Marine Park is not permitted. Seismic exploration is permissible in the Park subject to EPA assessment. There are active exploration permits operated by Lansvale Oil and Gas Pty Ltd and Victoria Petroleum Pty Ltd that overlap the Park (see Figure 7), however only seismic exploration could be permitted in the Park. The area surrounding the Muiron and Sunday islands is prospective for petroleum and there have previously been drilling operations conducted in the area. The Muiron Islands Marine Management Area does not preclude future petroleum exploration and development in either the conservation areas or unzoned areas. Any exploration or production activities would be subject to environmental assessment as detailed below. The DoIR is responsible for managing petroleum activities in State waters and is responsible for the assessment, evaluation and approval of petroleum operation proposals in Western Australia (Department of Minerals and Energy, 2000). This is effected via the legislative framework of the *Petroleum Act 1967*, *Petroleum (Submerged Lands) Act 1967* and the *Petroleum (Submerged Lands) Act 1982* that control marine based petroleum operations and the *Petroleum Pipelines Act 1969* which governs the construction, operation and maintenance of petroleum pipelines. Petroleum proposals may also be subject to assessment by the DoE/EPA under the EP Act and where proposals may impact on matters of national environmental significance, under the Commonwealth EPBC Act, by DEH. The standard approvals process for the petroleum industry, which includes referral of petroleum development proposals to a variety of bodies, continues to apply in the reserves. The MPRA is advised of any petroleum development proposal in the marine conservation reserves as part of this standard process. Any advice the MPRA provides will generally relate to whether the proposal is consistent with the management plan (ie. targets for the ecological values and management objectives for the social values). The primary role of reserve management in relation to hydrocarbon exploration will be to ensure that the reserve values are not impacted by any petroleum activities, in liaison with DoIR and the DoE/EPA.
Requirements	Equitable access to areas of the marine reserves within appropriate zones subject to environmental assessment.
Management objective/s	To ensure that, in collaboration with the petroleum industry, DoIR, and the EPA, petroleum industry activities in the reserves are managed in a manner that is consistent with maintaining the values of the reserves.
Strategies	1. Provide formal advice to EPA and DoIR in relation to the environmental assessment of petroleum activities in the reserves (MPRA, CALM) **(M)**. 2. Ensure the licence conditions of approved petroleum industry projects include: • appropriate environmental performance measures; • desired trends; • short-term and long-term management targets; and • monitoring and reporting requirements (CALM, DoIR, EPA) **(M)**. 3. Ensure other uses of the reserves do not unnecessarily restrict future petroleum industry opportunities in appropriate zones in the reserves (CALM) **(L)**.

Reporting	To be developed.
Target/s	Implementation of management strategies within agreed timeframes.

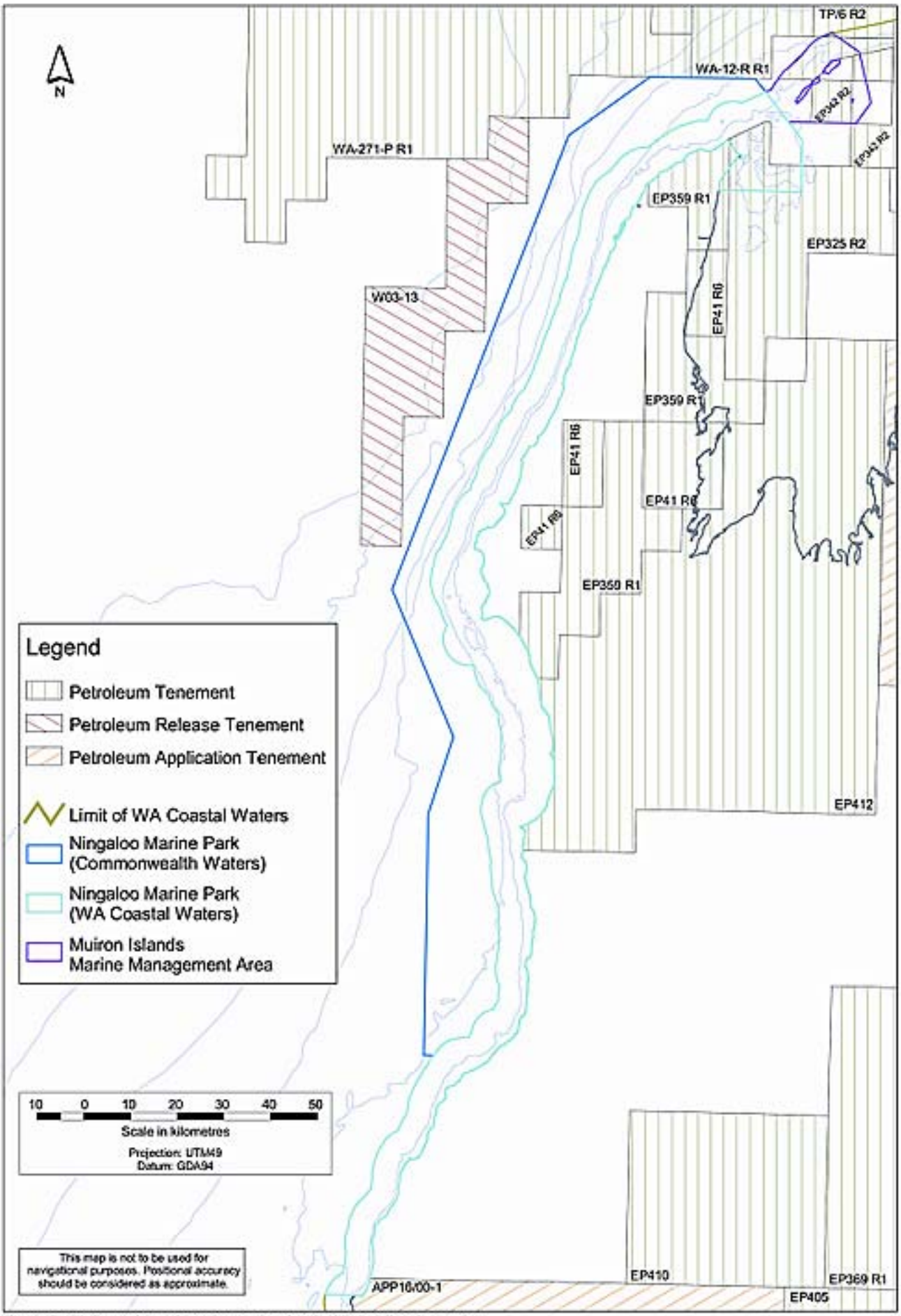

Figure 7: Mining and petroleum leases associated with the Ningaloo region

8 GENERIC MANAGEMENT STRATEGIES

The management objectives, strategies and targets outlined in Section 7 provide the framework for the development of specific management actions designed to conserve the ecological values and manage the social values of the reserves. These actions can be categorised into one or more of the following seven generic management strategies:

- the development of an appropriate administrative framework;
- education and interpretation;
- surveillance and enforcement;
- research;
- monitoring;
- public participation; and
- direct management intervention.

8.1 Development of an Administrative Framework

The development of an appropriate administrative framework is essential to ensure the reserves are managed effectively over the long term. The administrative framework includes statutory considerations such as the development of a management plan including reserve purpose, class, boundaries, and a suitable zoning scheme and appropriate regulations as well as human, financial and infrastructure/plant resources.

For administrative purposes within CALM, Western Australia is divided into regions, which are divided into districts. The Ningaloo Marine Park and the Muiron Islands Marine Management Area are located within the Exmouth District of the Pilbara Region, and the day to day operational management of the reserves is the responsibility of the District Manager and staff based in Exmouth. The District staff are supported by the Marine Conservation Branch, which has a central role in providing strategic guidance and assistance to Regional and District offices throughout the State with respect to marine conservation. A number of other specialist branches provide support in relation to areas such as enforcement, wildlife interaction management and licensing of nature-based tourism operations.

The implementation of the zoning scheme is an important strategy for the conservation of marine biodiversity and the management of human use in marine conservation reserves. The zoning scheme may also assist in separating conflicting uses and provide priority for specific activities such as commercial and recreational uses, scientific study and nature appreciation. The partial or total restriction of extractive activities in representative habitats is a key strategy in the long-term maintenance of marine biodiversity values of marine conservation reserves. In the Ningaloo Marine Park, the establishment and maintenance of sanctuary zones in which extractive activities are not permitted has and will continue to play a key role in the protection of representative areas of important habitat such as mangrove communities, coral reef communities, macroalgal and seagrass communities and soft bottom communities. In the Marine Management Area, conservation areas, which are also no-take areas, will perform a similar function. These zones also provide areas where natural processes can be studied free of significant human influence, thereby providing the opportunity to improve the understanding of the key ecological processes and to obtain critical baseline data to compare against areas where extractive activities are permitted and/or where environmental impacts may be occurring.

Zoning is a flexible management tool that can accommodate evolving use of the reserves during the period of the management plan. The nature and extent of zoning should be considered within the context of the other generic management strategies of education and interpretation, surveillance and enforcement, research, monitoring, public participation and direct management intervention (Sections 8.2 – 8.7). Section 62 of the CALM Act provides for classification of zones in any category of marine conservation reserve necessary to give effect to the objects of the CALM Act. In marine management areas, zones *may* be created to give effect to the management of the reserve. However, this is not a requirement. In contrast Section 13B(2) of the CALM Act *requires* that marine parks be zoned as one or a combination of specific management zones. These are sanctuary, recreation, general use and special purpose zones.

The CALM Act allows for the plan to be amended once several requirements are met. These requirements include the release of the proposed changes for public comment for a minimum two-month submission period and approval of the changes by the Minister for the Environment following consultation with the Minister for Agriculture, Forestry and Fisheries and the Minister for State Development.

8.1.1 Zoning scheme for Ningaloo Marine Park

The development of the zoning scheme for the Park and the Marine Management Area was based on a number of key principles. These principles included:

- that the zoning scheme should include adequate and representative sanctuary zones for the primary purpose of marine biodiversity conservation;
- that the zoning scheme should include adequate and representative sanctuary zones for the purpose of providing ecological "insurance" via increased resilience to natural and human disturbance;
- that the zoning scheme should provide areas free of significant human impact for research and monitoring, nature appreciation via recreation and tourism opportunities and for public education;
- operational principles from the Great Barrier Reef Marine Park Authority's Representative Areas Program on the design of no-take areas, including -
    - ❖ having, where possible, no-take areas for which 10 km is the minimum dimension (for coastal bioregions);
    - ❖ having larger versus smaller no-take areas;
    - ❖ having sufficient replication
    - ❖ having only whole reefs in no take areas; and
    - ❖ including biophysically special/unique places (eg. spawning areas);
- the application of the precautionary principle which, in this case, means that a lack of scientific certainty about the location, size or number of no-take areas should not prevent the establishment of no-take areas;
- that zoning is one in a suite of management mechanisms for the reserves;
- that the zoning scheme should be simple for users to understand and therefore to comply with any restriction; and
- that, where possible, the placement of zones to achieve the management objectives should be done so as to minimise impacts on the existing social values.

The zoning scheme comprises:

- sanctuary zones totalling approximately 88,365 ha, which represents 34% of the Park;
- recreation zones totalling approximately 36,460 ha, which represents 14% of the Park; and
- special purpose (benthic protection) zones totalling approximately 5,488 ha, which represents 2% of the Park;
- special purpose (shore-based activities) zones totalling approximately 687 ha of the coastline, which represents <0.3% of the coastline of the Park; and
- general use zone totalling approximately 132,343 ha, which represents 50% of the Park.

The zoning scheme for the Ningaloo Marine Park is shown in Table 2 and Figure 8. The activities permitted in each zone of the Park are outlined in Table 4.

Table 2: Areas and percentages of zone types in Ningaloo Marine Park

ZONE	Size (ha)	Percentage of Park
Sanctuary Zone	88,365	34%
General Use Zone	132,343	50%
Recreation Zone	36,460	14%
Special purpose (benthic protection) zone	5,488	2%
Special purpose (shore-based activities) zone	687	<0.3%
TOTAL	**263,343 ha**	**100%***

NB: The Marine Park also includes the 40 m strip of land between High Water Mark and pastoral leases, and Fraser Island, which are Crown reserves with the purpose of marine park and vested in the MPRA. The Crown reserves have a total area of 56 4ha and are unzoned.
** Rounding causes the total to be 100.3%*

Sanctuary zones

Sanctuary zones in marine parks provide for the maintenance of environmental values and are managed for nature conservation by excluding human activities that are likely to affect the environment adversely. The primary purpose of sanctuary zones is for the protection and conservation of marine biodiversity. They are used to provide the highest level of protection for vulnerable or specially protected species, and to protect representative habitats from human disturbance so that marine life can be seen and studied in an undisturbed state. These zones also provide the opportunity to improve understanding of the key ecological processes of the Marine Park and to obtain critical comparative data with areas of the Park where extractive activities are permitted and/or where environmental impacts may be occurring. These zones will also provide other ecological benefits such as refugia for exploited species, replenishment areas, education and nature appreciation sites (via passive recreation and tourism opportunities), ecological 'insurance' and resilience against the failure of the adaptive management approach adopted for the rest of the Park, and enhanced resilience to natural and human-induced disturbance.

Specified passive recreational activities consistent with maintaining environmental values may be permitted, but extractive activities, including fishing and traditional fishing and hunting are not. Commercial tourism operations (such as for nature-based tours) will be considered where they do not conflict with other uses and are regulated under the CALM Act.

All extractive activities are excluded from sanctuary zones. Passive nature-based tourism, some recreational activities, boating and approved scientific research are permitted. The activities permitted in sanctuary zones are detailed in Table 4.

There are 18 sanctuary zones in the Park. The detailed location of each sanctuary zone is shown in Figures 9-12 and areas in Table 3.

Table 3: Names and areas of sanctuary zones in the Ningaloo Marine Park

Sanctuary Zones	Area (ha)
Bundegi Sanctuary Zone	696
Murat Sanctuary Zone	490
Lighthouse Bay Sanctuary Zone	763
Jurabi Sanctuary Zone	754
Tantabiddi Sanctuary Zone	50
Mangrove Sanctuary zone	1,135
Lakeside Sanctuary Zone	8
Mandu Sanctuary Zone	1,349
Osprey Sanctuary Zone	9,513
Winderabandi Sanctuary Zone	5,526
Cloates Sanctuary Zone	44,752
Bateman Sanctuary Zone	1,111
Maud Sanctuary Zone	2,151
Pelican Sanctuary Zone	10,864
Cape Farquhar Sanctuary Zone	5,326
Gnaraloo Bay Sanctuary Zone	1,021
3 Mile Sanctuary Zone	395
Turtles Sanctuary Zone	2,461
TOTAL	**88,365**

Recreation zones

Recreation zones have the primary purpose of providing opportunities for recreational activities, including fishing, for visitors and for commercial tourism operators, where these activities are compatible with the maintenance of the values of the zone. Petroleum drilling and production, commercial fishing, pearling and aquaculture are not permitted in recreation zones. The locations and the activities permitted in the recreation zones are shown in Figure 8 and in Table 4 respectively.

Recreation zones in marine parks provide for conservation and recreation, including recreational fishing where this is compatible with the conservation values. Commercial fishing, pearling and aquaculture are not permitted in these zones.

The lagoon environment of the Park north of Amherst Point, excluding sanctuary zones, is classified as recreation zone. The seaward boundaries of the recreation zones within the Park are broadly defined as either:

- an area from the high water mark to 100 m seaward of the reef crest surf zone; or
- an area 1,000 m offshore from the high water mark where there is no visible reef crest surf zone.

Special purpose (benthic protection) zone

The area seaward of the Mandu Sanctuary Zone has been classified as a special purpose (benthic protection) zone. This zone has the priority purpose of conservation of benthic habitat. Trolling by recreational fishers is permitted in this zone, however all other extractive activities are not. The location and the activities permitted in the special purpose (benthic protection) zone are shown in Figure 8 and in Table 4 respectively.

Special purpose (shore-based activities) zone

Special purpose zones in marine parks are managed for a particular priority purpose or use, such as a seasonal event (eg. wildlife breeding, whale watching) or a particular type of commercial activity (eg. pearling). Uses that are incompatible with the specified priority purpose are not allowed in these zones.

Many areas of the coastline have been classified as special purpose (shore-based activities) zones. These zones are adjacent to sanctuary zones (in which case the landward boundary of the sanctuary zone has been placed 100 m offshore) to allow recreational shore-based angling to continue. Special purpose (shore-based activities) zones are located adjacent to Murat, Lighthouse, Jurabi, Osprey, Winderabandi, Cloates, Maud and Pelican sanctuary zones.

The locations and the activities permitted in the special purpose (shore-based activities) zones are shown in Figure 8 and in Table 4 respectively.

General use zones

General use zones in marine parks are those areas of the marine park not included in sanctuary, special purpose or recreation zones. Conservation of natural values is still the priority of general use zones, but activities such as sustainable commercial and recreational fishing, aquaculture, pearling and petroleum exploration and production may be permitted provided they do not compromise the ecological values of the marine park.

All areas not zoned as sanctuary or recreation zones are classified as general use zones. The location of the general use zones is shown in Figure 8 and the permitted activities are shown in Table 4.

Implementation of the zoning scheme requires notices under the CALM Act and the FRM Act. The FRM Act orders will in some cases be defined in a way to facilitate compliance. This will happen for the seaward boundaries of Cloates, Osprey, and Pelican sanctuary zones and the Mandu Special Purpose (Benthic Protection) zone. These zones extend to the limit of State Coastal Waters, which is difficult to define on the water. To facilitate compliance and simplicity for users, the FRM Act orders will be a series of coordinates and straight lines approximating the coastal waters boundary. In addition to this, where sanctuary zones adjoin the coast south of Amherst Point, the FRM Act orders will use the high water mark to facilitate compliance with the sanctuary zones.

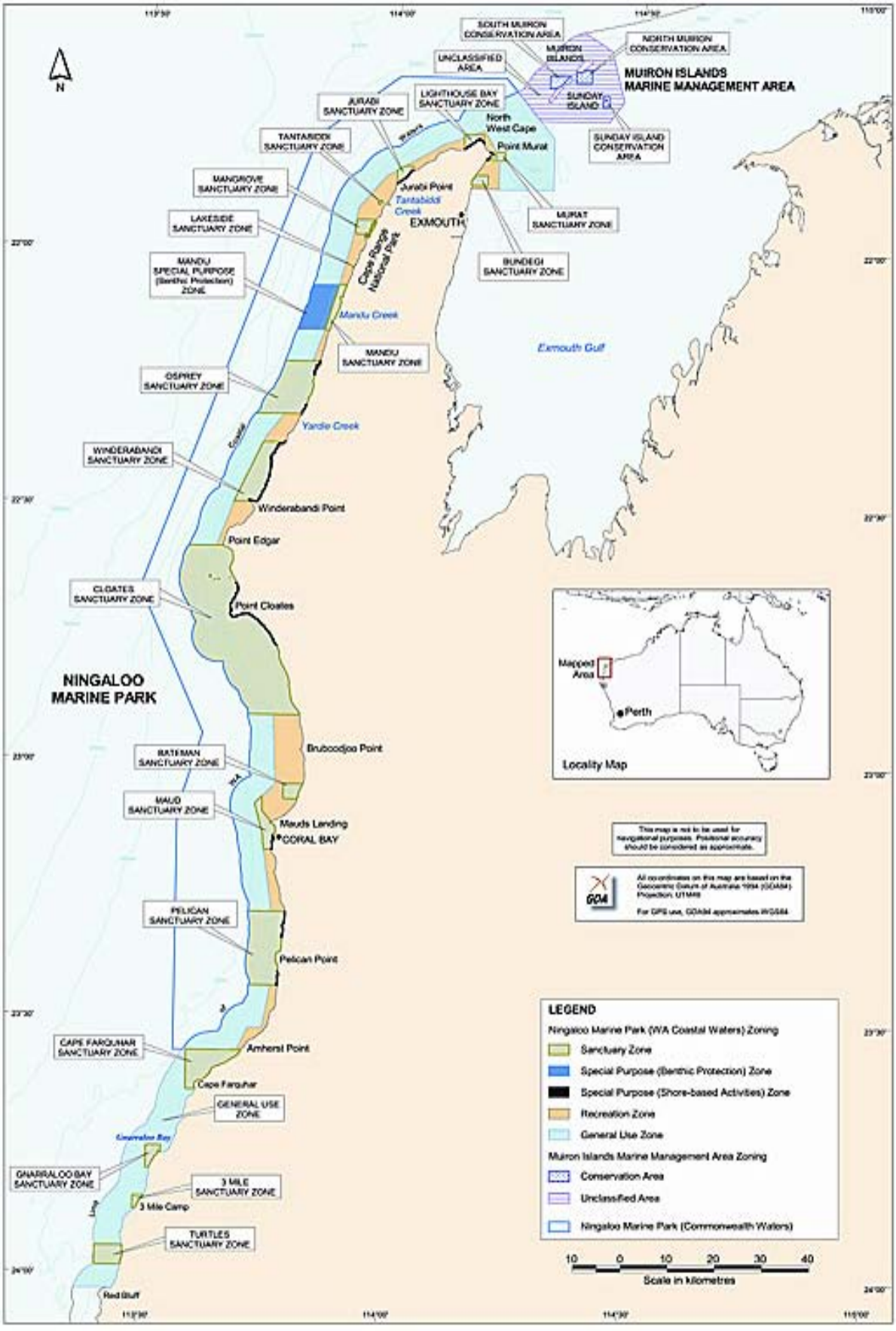

Figure 8: Zoning scheme for the Ningaloo Marine Park and the Muiron Islands Marine Management Area

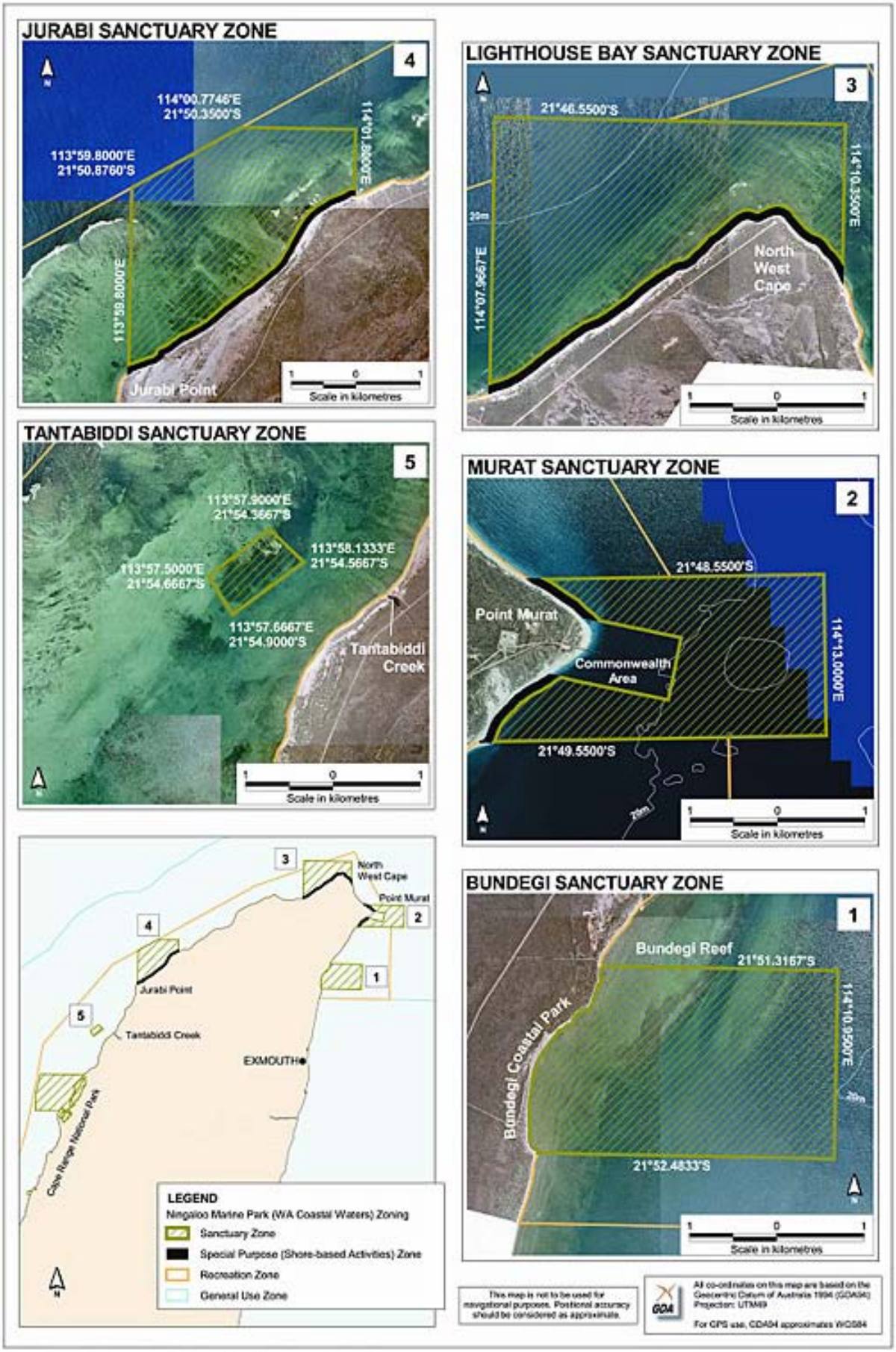

Figure 9: Sanctuary zones 1-5 in the Ningaloo Marine Park

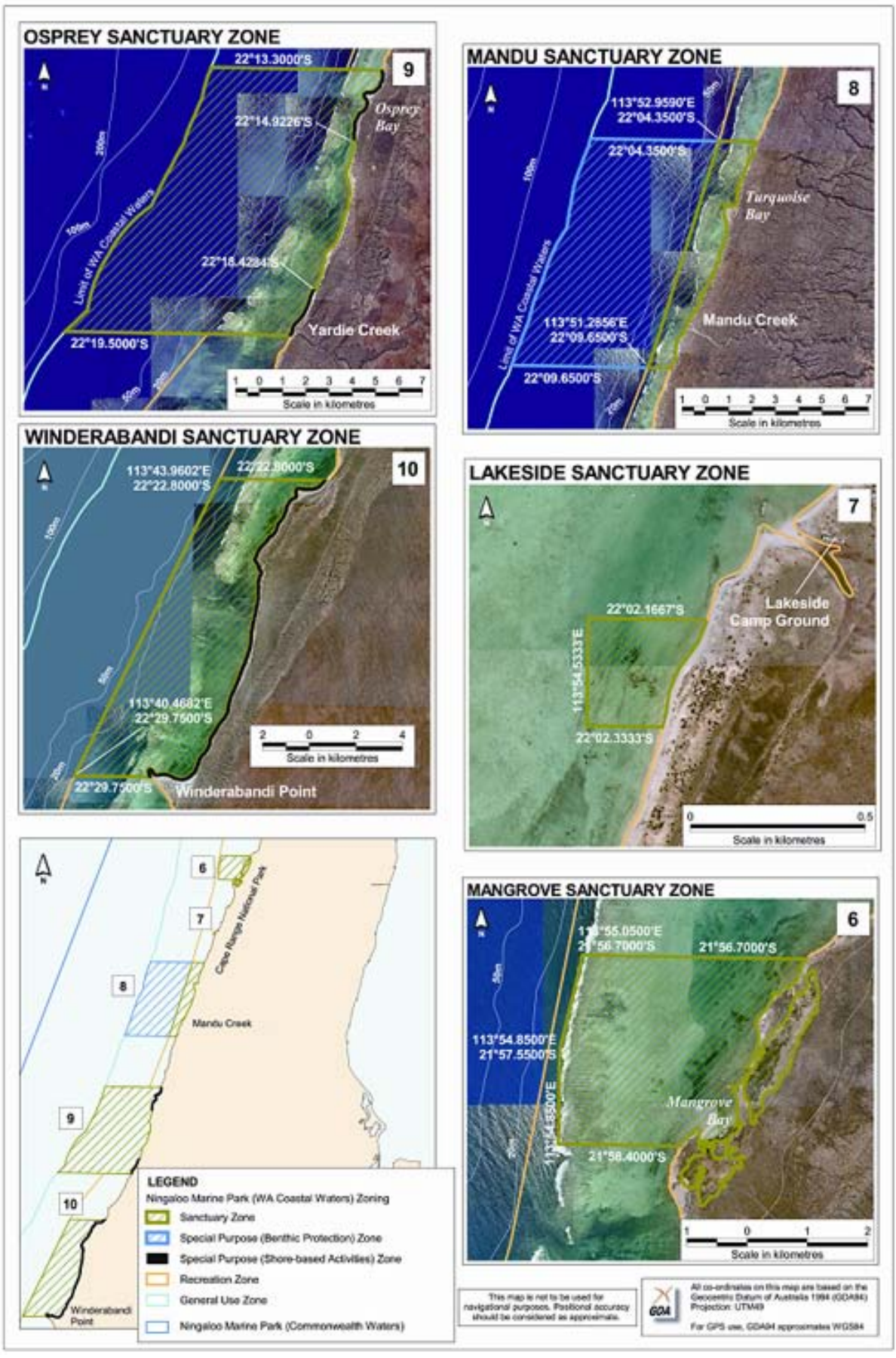

Figure 10: Sanctuary zones 6-10 in the Ningaloo Marine Park

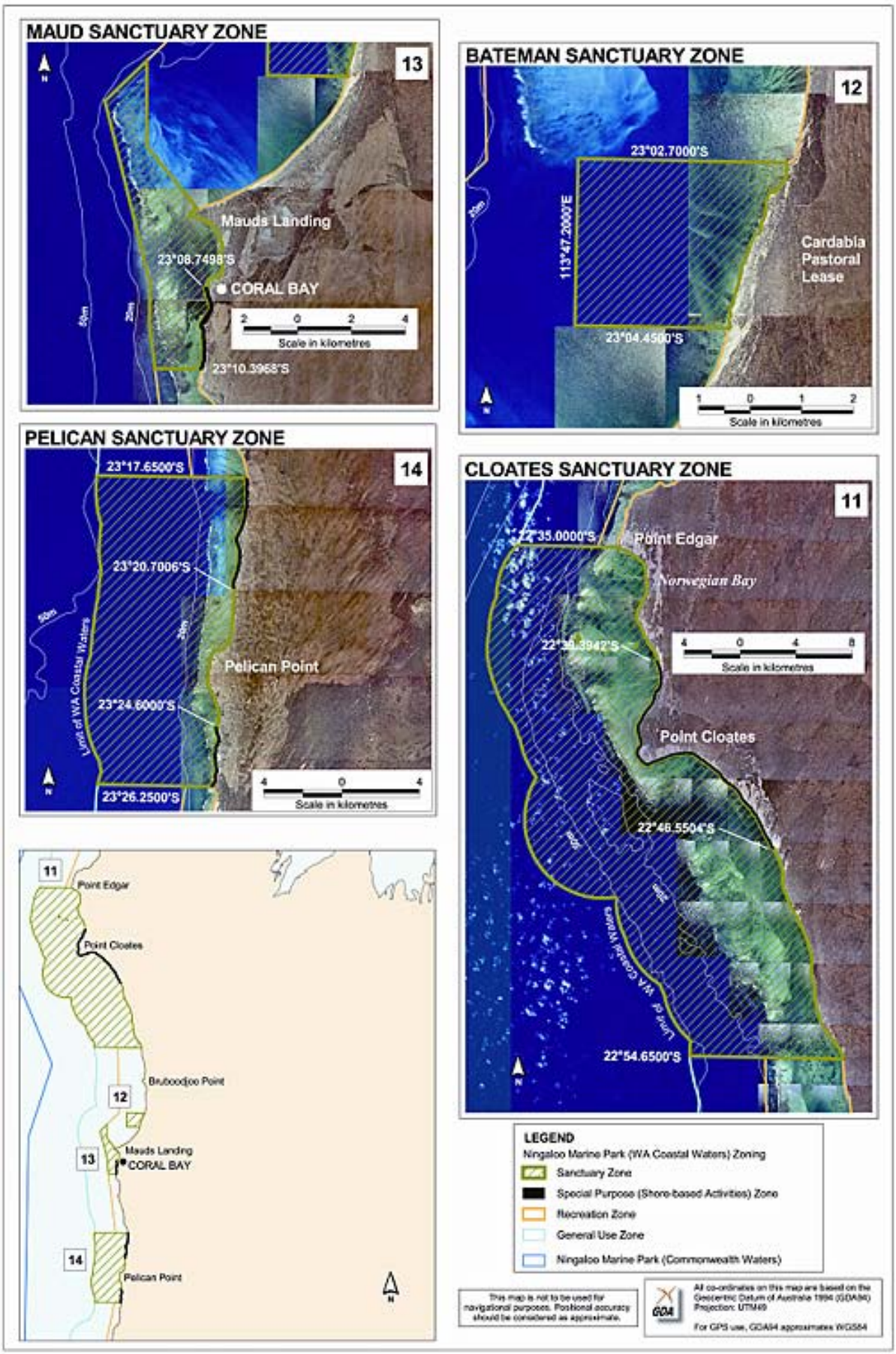

Figure 11: Sanctuary zones 11-14 in the Ningaloo Marine Park

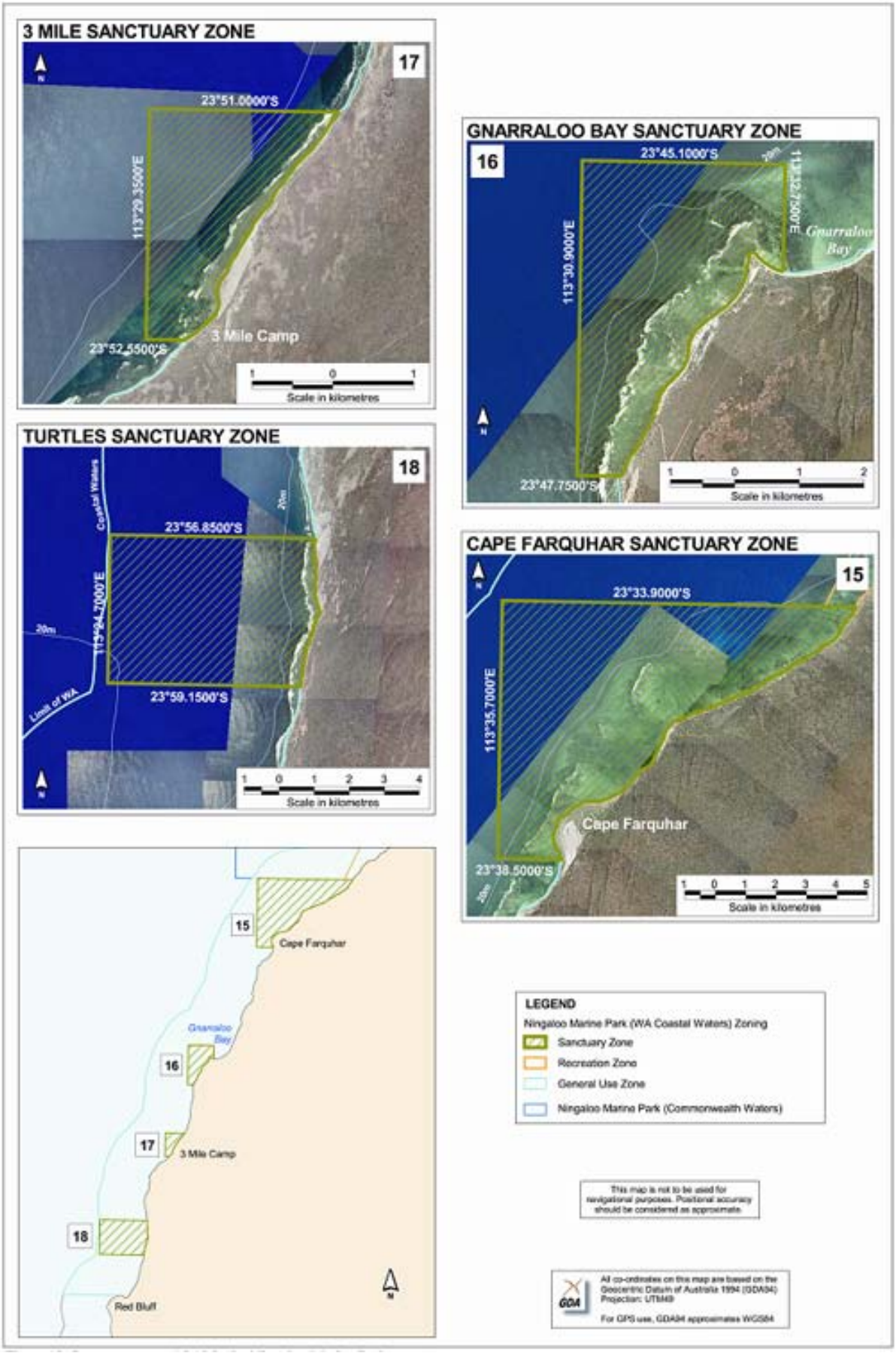

Figure 12: Sanctuary zones 15–18 in the Ningaloo Marine Park

Table 4: Uses permitted in each zone of the Ningaloo Marine Park

Activity	General use zone	Recreation zone	Special purpose (shore-based activities) zone	Special purpose (benthic protection) zone	Sanctuary zone
COMMERCIAL					
Commercial trawling [b e]	Yes/Limited [1]	No	No	No	No
Commercial beche de mer fishing	No	No	No	No	No
Commercial long line fishing	No	No	No	No	No
Commercial aquarium and specimen shell collecting [b e]	Yes/Limited [2, 3]	No	No	No	No
Commercial collecting of coral, 'live' sand and 'live' rock [b e]	No	No	No	No	No
Commercial wet lining [b e]	Yes/Limited [3]	No	No	No	No
Commercial rock lobster fishing	No	No	No	No	No
Commercial mud crabbing	No	No	No	No	No
Commercial beach seine	No	No	No	No	No
Commercial trap fishing	No	No	No	No	No
Pearling [be]	Yes	No	No	No	No
Aquaculture [b e]	Assess	No	No	No	No
Mineral & petroleum exploration (seismic) [d]	Assess	Assess	Assess	Assess	Assess
Petroleum drilling & mineral development	No	No	No	No	No
Petroleum pipelines [d]	Assess	No	No	No	No
Charter vessels - fishing [b e g]	Yes	Yes	No	Trolling by recreational fishers only	No
Charter vessels - other [c e g]	Yes	Yes	Yes	Yes	Yes
RECREATIONAL					
Boating (motor & non-motorised) [a g]	Yes	Yes	Yes	Yes	Yes
Surface water sports [a f g]	Yes	Yes	Yes	Yes	Yes
Recreational rock lobster fishing [b e]	Yes	Yes	No	No	No
Recreational line fishing [b]	Yes	Yes	Beach- Yes Boat- No	Trolling by recreational fishers only	No
Recreational netting (shore–based) [b e]	Yes/Limited [5]	Yes/Limited [5]	Yes/Limited [5]	No	No
Recreation netting – throw net [b]	Yes	Yes	Yes	No	No
Spearfishing [b]	Yes/Limited [4]	Yes/Limited [4]	No	No	No
Recreational collecting [b]	No	No	No	No	No
Recreational collecting of coral, 'live rock and 'live' sand	No	No	No	No	No
Recreational mudcrabbing	Yes	Yes	No	No	No
Diving and snorkelling	Yes	Yes	Yes	Yes	Yes
Wildlife interaction [c]	Yes	Yes	Yes	Yes	Yes
OTHER ACTIVITIES					
Proposals for marine infrastructure (eg. moorings) [a d e]	Assess	Assess	Assess	Assess	Assess
Research [e]	Yes	Yes	Yes	Yes	Yes
Dredging and dredge spoil dumping [d]	Assess	No	No	No	No

KEY:

a	Subject to the *Western Australian Marine Act 1982.*
b	Subject to the FRM Act and/or *Pearling Act 1990*.
c	Subject to the CALM Act and WC Act.
d	Subject to the EP Act.
e	Licence required from CALM and/or DoF and/or DoE/EPA and/or DoIR.
f	Activities permitted unless activity is shown to be incompatible with the specified primary purpose of the zone.
g	Boating and associated activities (eg anchoring) may be restricted in specific areas where there is a clear need for such restrictions.
Assess	Activity will be permitted if assessed to be sustainable by relevant agencies.
Limited	1. Trawling is permitted only in the general use zone of the Park east of North West Cape. 2. Permitted in the general use zone of the Park (apart from the area between Point Maud and Tantabiddi Creek) subject to this activity being demonstrated to be ecologically sustainable by 2009. 3. Commercial fishing is not permitted in the general use zone of the Park between Tantabiddi Creek and Point Maud. 4. Spearfishing is not permitted in the Park between Tantabiddi Creek and Winderabandi Point. 5. Recreational shore-based netting is permitted only at designated beaches at Neds Camp/Mesa, Winderabandi Point, Bruboodjoo and 14 Mile Beach (Warroora Station).

8.1.2 Zones in the Muiron Island Marine Management Area

The Muiron Islands Marine Management Area covers an area of 28,616 ha. Classified areas or zones can be established in marine management areas under section 62 of the CALM Act. Three conservation areas (similar to sanctuary zones) have been established in the Muiron Islands Marine Management Area, with a total area of approximately 1,929 ha, or 7% of the Marine Management Area. The remaining area (26,687 or 93% of the total area) is unclassified and will be managed for multiple use. It provides for recreational and commercial activities to occur, as long as they are compatible with the overall maintenance of the ecological and social values. The 'zoning' for the Muiron Islands Marine Management Area is shown in Figures 8 and 13.

Conservation (flora/fauna protection) areas

Three conservation (flora/fauna protection) areas of have been established in the Muiron Islands Marine Management Area. They are located at the north-east corner of South Muiron Island, the south-east corner of North Muiron Island and surrounding Sunday Island. These areas provide protection of representative of seaward and landward coral reef and deeper water habitats on the eastern and western sides of the islands. The locations of the conservation (flora/fauna protection) areas are shown in Figure 13 and the names and areas shown in Table 5.

All fishing activities are excluded from the conservation (flora/fauna protection) areas and passive nature-based tourism, some recreational activities, boating and approved scientific (non-destructive) research are permitted. Petroleum exploration and development proposals will be subject to assessment.

The permitted activities in all parts of the Marine Management Area are shown in Table 6.

Table 5: Names and areas of conservation areas in the Muiron Islands Marine Management Area

Conservation (Flora/Fauna Protection) Areas	Area (ha)
North Muiron Conservation (Flora/Fauna Protection) Area	828
South Muiron Conservation (Flora/Fauna Protection) Area	784
Sunday Island Conservation (Flora/Fauna Protection) Area	317

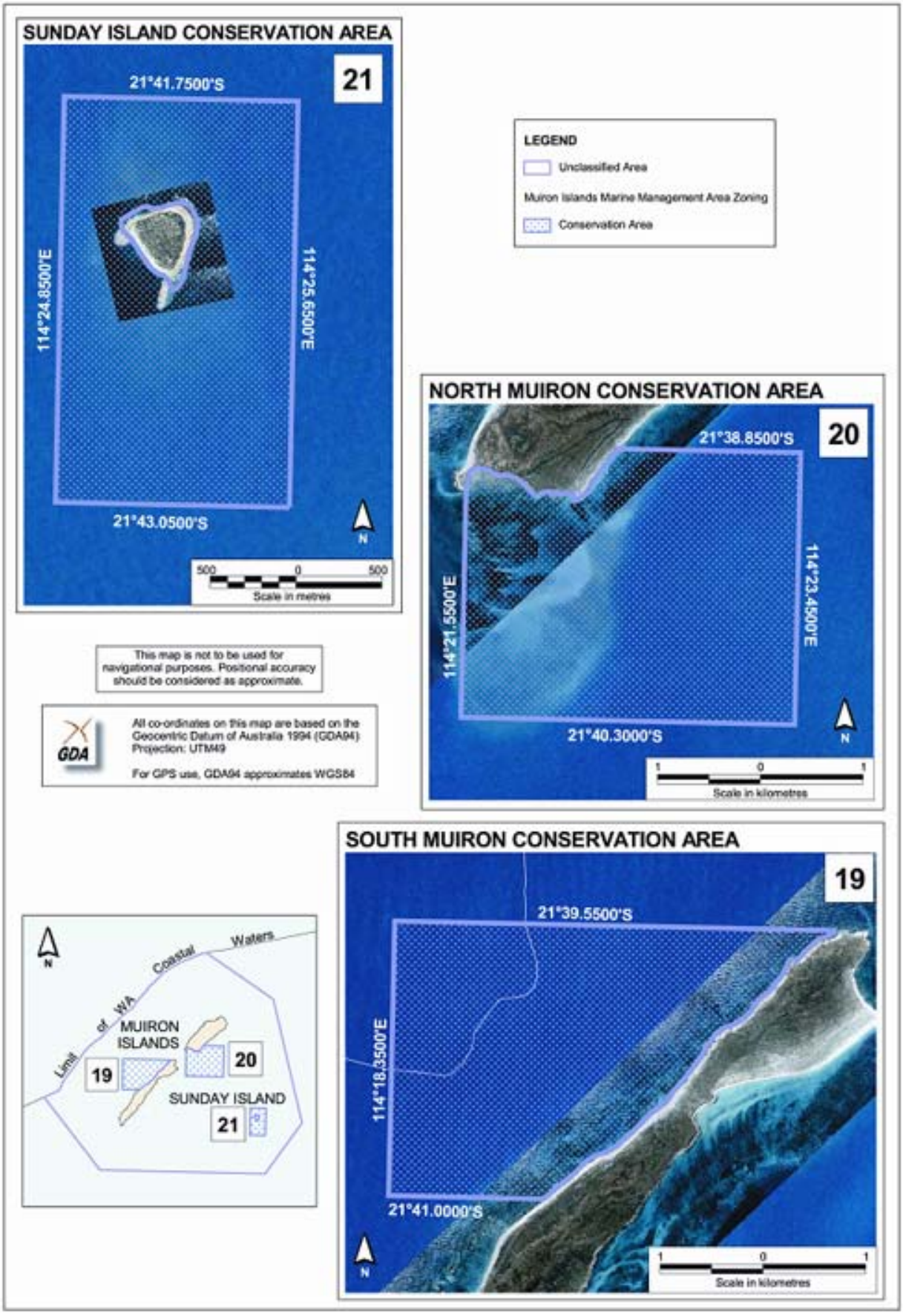

Figure 13: Conservation areas in the Muiron Islands Marine Management Area

Table 6: Uses permitted in each 'zone' of the Muiron Islands Marine Management Area

Activity	*Unzoned area*	*Conservation Area*
COMMERCIAL		
Commercial trawling [b e]	Yes	No
Commercial aquarium and specimen shell collecting [b e h]	Yes	No
Commercial collecting of coral, 'live' rock and 'live' sand [b e]	No	No
Commercial beche de mer fishing	No	No
Commercial wet lining [b e]	Yes	No
Commercial long line fishing	No	No
Commercial mud crabbing	No	No
Commercial trap fishing	No	No
Commercial beach seine	No	No
Commercial rock lobster fishing	No	No
Pearling [b e]	Assess	No
Aquaculture [b e]	Assess	No
Mineral & petroleum exploration (seismic) [d]	Assess	Assess
Petroleum drilling & mineral development [d]	Assess	Assess
Petroleum pipelines [d]	Assess	Assess
Charter vessel - fishing [b e g]	Yes	No
Charter vessel - other [c e g]	Yes	Yes
RECREATIONAL		
Boating (motor & non-motorised) [a g]	Yes	Yes
Surface water sports [a f g]	Yes	Yes
Recreational rock lobster fishing [b e]	Yes	No
Recreational line fishing [b]	Yes	No
Recreational netting -shore based [b e]	Yes	No
Recreational netting – throw net [b]	Yes	No
Recreational mudcrabbing	Yes	No
Spearfishing [b]	Yes	No
Recreational aquarium and specimen shell collecting [b]	Yes	No
Recreational coral, 'live' rock and 'live' sand collecting	No	No
Diving and snorkelling	Yes	Yes
Wildlife interaction [c]	Yes	Yes
OTHER ACTIVITIES		
Proposals for marine infrastructure (eg. moorings) [a d e]	Assess	Assess
Research [e]	Yes	Yes
Dredging and dredge spoil dumping [d]	Assess	Assess

KEY:

a	Subject to the *Western Australian Marine Act 1982.*
b	Subject to the FRM Act and *Pearling Act 1990*.
c	Subject to the CALM Act and WC Act.
d	Subject to the EP Act.
e	Licence required from CALM and/or DoF and/or DoE/EPA and/or DoIR.
f	Activities permitted unless activity is shown to be incompatible with the specified primary purpose of the zone.
g	Boating and associated activities (eg. anchoring) may be restricted in specific areas where there is a clear need for such restrictions.
h	Subject to this activity being demonstrated to be ecologically sustainable by 2009.
Assess	Activity will be permitted if assessed to be sustainable by relevant agencies.

Summary of Generic Administration Objectives, Strategies and Targets

Management objective/s	To implement the statutory administrative framework for the Ningaloo Marine Park and the Muiron Islands Marine Management Area.
Strategies	1. Gazette appropriate notices under the CALM Act, WC Act and FRM Act to implement the zoning schemes for the reserves within one year of gazettal of the reserves (CALM, DoF) **(H-KMS)**. 2. Use appropriate legislative mechanisms to implement the mooring plan for the reserves (CALM, DPI) **(H-KMS)**. 3. Install zone markers and signage within a year of gazettal of the reserves (CALM) **(H)**. 4. Undertake site planning for recreational and commercial activities in the reserves, at an appropriate level of detail for the level of current and projected future (to 2015) use. (CALM, DPI) **(H)**. 5. Undertake annual inspections and maintenance of the infrastructure of the reserves, particularly zone markers and signage (CALM) **(H)**. 6. Develop an Indigenous Land Use Agreement with Native Title claimants in respect to the vesting of the intertidal area south of Amherst Point as marine park (CALM) **(M)**. 7. Liaise with the Department of Defence for the amendment of the boundary of Location 44 from low to high water mark to enable this intertidal area to be included into the Park (CALM) **(M)**. 8. Amend the Ningaloo Marine Park boundary when agreements have been obtained from the Native Title claimants and the Department of Defence for the above tenure changes (CALM, DOLI) **(M)**.
Target	Implementation of management strategies within agreed timeframes.

8.2 Education and Interpretation

Developing community support for the reserves is critical to the effective implementation of the management plan. The level of voluntary public compliance in relation to management controls in the reserves will be directly related to the level of understanding of the purposes of the reserves and zones, and the reasons for regulating activities in the reserves. Increased understanding will foster a sense of community ownership and acceptance of the need for restrictions, which will subsequently lead to better protection of the ecological and social values of the reserves. Education programs will raise awareness of the outcomes of the review of previous management of Ningaloo Marine Park, the creation of the Marine Management Area and new restrictions on recreational and commercial activities as a result of the implementation of the zoning scheme, and other management arrangements.

A summary of the generic education and interpretation objectives, strategies and targets is outlined below.

Summary of Generic Education and Interpretation Objectives, Strategies and Targets

Management objective/s	To enhance community understanding of, and support for, the reserves through education and interpretation programs.
Strategies	1. Develop and progressively implement an integrated education and interpretation program to ensure reserve users are aware of and understand the values of the reserves, the purposes of the management zones and regulations and the reasons for these controls (CALM, DoF) **(H-KMS)**. 2. Maintain the Milyering Visitor Centre and Jurabi Turtle Centre as a primary education resource for visitors to Ningaloo Marine Park (CALM, Exmouth Shire) **(H-KMS)**. 3. Encourage and assist the tourism industry to provide educational courses/ materials to their staff and customers to foster the community stewardship of the reserves (CALM) **(H)**.
Target	1. Implementation of management strategies within agreed timeframes. 2. 50% of visitors aware of the reserves, their values and of management restrictions within three years of release of the management plan. 3. 90% of visitors aware of the reserves, their values and of management restrictions within ten years of the release of the management plan

8.3 Surveillance and Enforcement

This plan details a range of strategies relating to the management of particular human activities within the reserves. The effectiveness of these strategies will be dependent on the extent to which the users of the reserves abide by these restrictions. The education program is critical to achieving a high level of voluntary compliance as in most cases users will abide by controls where they are clearly aware of what they are and why they have been implemented. There will, however, always be a need to monitor the level of compliance, and where users continue to undertake illegal activities, take action to stop inappropriate behaviour. Surveillance and enforcement of sanctuary zones and conservation areas is of particular importance because of their key role in marine biodiversity conservation. An appropriate level of 'on water' presence by CALM and DoF staff will be necessary within the reserves.

Implementation of the zoning scheme requires notices under the CALM Act and the FRM Act. The FRM Act orders will in some cases be defined in a way to facilitate compliance. This will happen for the seaward boundaries of Cloates, Osprey, and Pelican sanctuary zones and the Mandu Special Purpose (Benthic Protection) zone. These zones extend to the limit of State Coastal Waters, which is difficult to define on the water. To facilitate compliance and simplicity for users, the FRM Act orders will be a series of coordinates and straight lines approximating the coastal waters boundary. In addition to this, where sanctuary zones adjoin the coast south of Amherst Point, the FRM Act orders will use the high water mark to facilitate compliance of the sanctuary zones.

A summary of generic surveillance and enforcement objectives, strategies and targets is outlined below.

Summary of Generic Surveillance and Enforcement Objectives, Strategies and Targets

Management objective/s	Maximise public compliance of regulations related to the ongoing management of the reserves.
Strategies	1. Develop and implement a surveillance and enforcement program, in collaboration with DoF, to ensure an adequate level of compliance with Park regulations with a particular focus on sanctuary zone restrictions (CALM, DoF) **(H-KMS)**. 2. Facilitate cross authorisation of government enforcement officers as appropriate (CALM, DoF, DPI) **(H-KMS)**. 3. Develop and implement procedures to ensure coordination between government agencies to maximise efficiency and effectiveness of surveillance and enforcement activities (CALM, DoF, DPI) **(H-KMS)**. 4. Develop and implement education programs that promote voluntary compliance and peer enforcement of reserve regulations (CALM, DoF) **(H-KMS)**. 5. Consider appointing honorary rangers to assist CALM in surveillance and enforcement (CALM) **(M)**.
Target	Implementation of management strategies within agreed timeframes.

8.4 Research

Ecological and social research is a key strategy critical for the effective management of marine conservation reserves. Research provides key information on the ecological and social environment, an improved understanding of what is "natural" as a benchmark for monitoring programs, and facilitates a better understanding of the short and long-term impacts of human activities. Research programs should, ideally, be designed to fill key gaps in current knowledge of most use to management. However, any increase in knowledge is beneficial. Specific research strategies are detailed for ecological and social values and are outlined in Section 7. Scientific research as a value of the reserves is described in Section 7.2.9. A summary of the generic research objectives, strategies and targets is outlined below.

Summary of Generic Research Objectives, Strategies and Targets

Management objective/s	1. To obtain an appropriate understanding of the biodiversity and key ecological and social processes within the reserves. 2. To promote ecological and social research in the reserves that improves knowledge of the reserves and the technical basis for management decisions.
Strategies	1. Develop and progressively implement a coordinated and prioritised research program into key values and processes in the reserves (CALM) **(H-KMS)**. 2. Communicate high priority ecological and social research projects to appropriate research organisations (CALM) **(H-KMS)**. 3. Undertake research on marine fauna and flora to support the development and monitoring of cost-effective reef health indicators (CALM) **(H-KMS)**.

	4. Undertake research to determine the effectiveness of the zoning scheme for biodiversity conservation and in relation to the principles of comprehensiveness, adequacy and representativeness, with a particular emphasis on sanctuary zones (CALM) **(H-KMS)**. 5. Undertake research to determine the effectiveness of the zoning scheme for integrated management of targeted fish stocks in the marine reserves, with a particular emphasis on sanctuary zones. (CALM) **(H-KMS)**. 6. Develop and maintain a database of historical and current research in the reserves (CALM) **(H)**. 7. Facilitate ecological and social research in the reserves conducted by research, academic and educational institutions, by providing financial and logistical assistance (where possible) (CALM, DoF) **(H)**. 8. Investigate the applicability and benefits of implementing a management strategy evaluation approach to support performance assessment and adaptive management (CALM) **(H)**. 9. Undertake research into the history of exploited marine animal populations in the reserves (CALM, DoF) **(M)**.
Target	Implementation of management strategies within agreed timeframes.

8.5 Monitoring

Monitoring is a critical strategy for measuring the effectiveness of management action in marine conservation reserves. Monitoring programs should also ensure the early detection of detrimental changes and provide the trigger for management action to ameliorate potential impacts before they lead to undesirable changes in the values of the reserves. Where changes have occurred and remediation measures have been implemented, a monitoring program should determine the rate of recovery of an affected area or value.

Specific monitoring strategies are detailed for each ecological and social value and are outlined in Section 7 and scientific research as a value of the reserves is outlined in Section 7.2.9. A summary of the generic monitoring objectives, strategies and targets is outlined below.

Summary of Generic Monitoring Objectives, Strategies and Targets

Management objective/s	1. To determine the status and trends in the condition of, and threats to, the ecological values and the effectiveness of management responses in the reserves. 2. To provide the necessary information for the MPRA and CALM audit function. 3. To promote ecological and social monitoring in the reserves that can detect changes to the ecological values and aid management decisions.
Strategies	1. Develop and progressively implement an integrated and prioritised ecological and social monitoring program for the reserves with a particular emphasis on MPRA and CALM audit requirements (CALM, DoF) **(H - KMS).** 2. Implement a long-term monitoring program, commencing with baseline studies, to assess the effectiveness of the sanctuary zoning scheme (CALM) **(H-KMS)**. 3. Ensure that proponents of development proposals or commercial activities with the potential to impact on the reserves' values conduct appropriate compliance monitoring programs (CALM) **(H)**. 4. Encourage Commonwealth marine research agencies to establish and maintain long-term reference sites to better understand natural variability and key ecological processes (eg. recruitment, herbivory etc) in the reserves (CALM) **(H)**.
Target	Implementation of management strategies within agreed timeframes.

8.6 Public Participation

Developing community support for the reserves is critical to the effective implementation of this management plan. The level of public compliance in relation to management controls in the reserves will be related directly to the level of understanding of the values of the reserves and the reasons for regulation of activities in the reserves. Community input into the management of the reserves will be through ongoing involvement of the Coral Coast Parks Advisory Committee (CCPAC), Coral Coast Park Council, and the Whale Shark Management Advisory Committee with the local CALM office. In this way, issues raised relating to the reserves' management, administration, zoning, conflicts of usage and any other management-related issues during the life of the management plan can be discussed within a forum of community members. Community monitoring programs and 'schools' programs will also be established to promote community involvement. A summary of the generic public participation objectives, strategies and targets is outlined below.

Summary of Generic Public Participation Objectives, Strategies and Targets

Management objective/s	To promote on-going community participation in the management of the reserves.
Strategies	1. Develop a public participation strategy within one year of gazettal (CALM) **(H-KMS)**. 2. Support the CCPAC to facilitate community input into the ongoing management of the reserves (CALM) **(H-KMS)**. 3. Provide assistance to key stakeholders groups (including Whaleshark Operators Association and Coral Coast Park Council) to facilitate community input into the ongoing management of the reserves (CALM) **(H - KMS)**. 4. Encourage community and local industry involvement in reserve management (including education and monitoring activities) monitoring programs (CALM**) (H-KMS)**. • Implement a schools program to foster involvement in reserve management (CALM) **(H-KMS)**. 5. Investigate and implement, if appropriate, honorary marine park officers (CALM) **(M)**.
Target	Implementation of management strategies within agreed timeframes.

8.7 Direct Management Intervention

Direct management intervention strategies generally relate to two types of management action – reactive (ie. restorative) and proactive (ie. preventative) measures.

Although the majority of the waters of the reserves are in relatively pristine condition, there are areas that have suffered localised disturbance from human use. Research by Westera (2003) suggests that there are impacts on recreationally targeted finfish populations. In addition, indiscriminate mooring and anchoring has impacted some areas of the reserves. Other impacts include, for example, damage to coastal vegetation due to unregulated access by Park users. Such localised disturbances may negatively affect the ecological and social values of the area. Management response in this case would include identifying areas that have been disturbed and evaluating what rehabilitation measures should be undertaken. Decisions as to whether it would be appropriate to rehabilitate an area would be based on the ability of an area to recover naturally (eg. recovery of finfish stocks if no further fishing pressure is applied and with no management intervention), the current level of disturbance of the area, ecosystem effects of not carrying out rehabilitation, aesthetic considerations, and the cost of rehabilitation.

Human use of the reserves is projected to increase rapidly over the next ten years. Increases in visitor numbers will require additional facilities (eg. moorings, dive trails) to be provided, to protect the ecological values from human disturbance and enhance visitor experiences.

Although some areas of the reserves are relatively accessible to the public, much of the reserves are remote and specialised equipment is required to access some areas (eg. boat, 4WD). In addition, shallow submerged reefs, strong winds and currents combined with the unpredictable nature of the marine environment make the area hazardous to all but experienced visitors. An ongoing visitor risk assessment should be undertaken to identify potential hazards and management measures to minimise these. A summary of the generic direct management intervention objectives, strategies and targets is outlined below.

Summary of Generic Direct Management Intervention Objectives, Strategies and Targets

Management objective/s	1. To identify and, where appropriate, implement reactive management measures to address existing environmental impacts within the reserves. 2. To identify and, where appropriate, implement proactive (ie. preventative) management measures to address potential environmental impacts within the reserves. 3. To identify risks to public safety and, where appropriate, take reasonable actions to minimise these risks in the reserves.
Strategies	1. Undertake biannual assessment to identify areas of existing human impact in the reserves, assess rehabilitation options and, where appropriate, implement these measures (CALM) **(H)**. 2. Undertake a biannual risk assessment of human use patterns and trends in the reserves, and where changes in use have potential to cause environmental impacts, assess preventative options, and where appropriate, implement these measures

	(CALM) **(H)**. 3. Undertake a biannual assessment of visitor risk in the reserves and, where necessary, implement appropriate measures to minimise visitor risk (CALM) **(H)**.
Target	Implementation of management strategies within agreed timeframes.

9 DEVELOPMENT PROPOSALS WITHIN THE RESERVES

All development proposals within the reserves are subject to the environmental impact assessment requirements of the EP Act and consideration by CALM in the context of the approved management plan. During the life of the plan, there may be proposals for the installation and construction of marine infrastructure associated with petroleum industry facilities (ie. pipelines) and tourism operations, and potential infrastructure to support public recreation. This could involve major development such as jetties, or minor works such as the installation of moorings, or the deployment of fish aggregating devices or navigation markers. The nature of the development will determine the appropriate level of assessment. Any assessment should review the proposal in terms of its potential impacts on the reserves' ecological and social values and whether it is consistent with the ecological targets of the reserves.

In relation to petroleum activities that are permitted in the marine conservation reserves, there are agreed assessment procedures and protocols that are set out in an MOU between the EPA and DoIR. The MPRA has endorsed the approach outlined in the MOU. The MPRA will be informed of all proposals submitted within the reserves, although the EPA/DoIR will be the primary mechanism for environmental assessment and approvals. There will not be a duplicated approval process undertaken by the MPRA for petroleum operations. It should be noted that under this arrangement, the MPRA and CALM would still provide input and advice to the EPA on proposals when requested.

During the life of the plan, a boating facility will be developed by DPI near Coral Bay, which will assist to alleviate anchoring damage in the Park. Development of this facility is subject to the appropriate environmental approvals. The Mooring Policy (Policy Statement No. 59) (CALM & MPRA 2002) for marine conservation reserves aims to (i) minimise the detrimental impacts of uncontrolled mooring and anchoring; (ii) enhance user safety, access and equity in relation to moorings; and (iii) provide a framework to accommodate present and future mooring usage patterns. A key component of the policy is that all marine conservation reserves will become mooring control areas and that a broad mooring plan will be developed for each reserve.

As part of the Coral Bay Boating Strategy, the entire Maud Sanctuary Zone was designated as a mooring control area in August 2001 for the protection of the ecological values of the sanctuary zone and the social values associated with recreational activities and public safety. This has put in place pro-active measures to manage moorings and other marine activities in Coral Bay. Two additional areas, at Bundegi and Tantabiddi, have been identified as requiring similar site plans in order to manage increases in boat use in these areas. The Bundegi area encompasses a sandy lagoon within an intertidal reef on the eastern side of North West Cape. The Tantabiddi area is located within the lagoon environment adjacent to the Tantabiddi boat ramp providing protected waters for commercial and recreational vessels. Detailed assessment of these existing high use mooring and anchoring areas will enable the accurate determination of the capacity for moorings at these locations to determine appropriate controls.

While there are no broad-scale areas within the reserves where moorings should not be permitted, there are likely to be specific areas of the reserves where the installation of moorings is unlikely to be considered acceptable for environmental and safety reasons. Areas were moorings are sought will be reviewed from environmental, safety and equity perspectives and where acceptable, a capacity (or number) of environmentally acceptable moorings permitted. CALM will be undertaking recreation planning (see Section 8) for the reserves to assist in managing activities throughout the reserves. The recreation plan will consider the suitability and need for moorings in specific parts of the reserves. Applications for moorings will be considered in light of the recreation plan and in relation to criteria established in the MPRA/CALM Mooring Policy.

In summary, the mooring plan for the reserves comprises the following approach:

- the reserves are to be declared mooring control areas to facilitate implementation of the Moorings Policy;
- moorings will be permitted in the Tantabiddi and Bundegi areas in accordance with detailed site plans developed by CALM in liaison with the major users;
- applications for moorings in the remainder of the reserves will be considered on a case by case basis, taking

into account the recreation masterplan and the MPRA/CALM Mooring Policy; and

- where use of an area increases to the point where conflicts are emerging in relation to moorings, CALM will prepare detailed mooring site plans in liaison with key users.

A summary of the objectives, strategies and targets for development proposals is outlined below.

Summary of Development Proposals Objectives, Strategies and Targets

Management objective/s	To ensure that the ecological and social impacts of infrastructure development proposals on the ecological and social values are evaluated through an appropriate level of environmental assessment.
Strategies	1. Develop and implement site plans for identified Tantabiddi and Bundegi mooring areas (CALM, DPI). **(H)** 2. Ensure appropriate advice is provided to relevant authorities with regard to proposed marine infrastructure and the relevant ecological targets for the reserves (CALM, DoE). **(H)** 3. Identify areas in which moorings are acceptable and/or necessary from environmental, safety and equity perspectives (CALM, DoE, DPI). **(M)** 4. Assess mooring applications on a case-by-case basis taking into account the recreation masterplan and the MPRA/CALM Mooring Policy (CALM, MPRA). **(M)**
Target	Implementation of management strategies within agreed timeframes.

10 PERFORMANCE ASSESSMENT

The effectiveness of the management plan will be periodically reviewed through a formal auditing and review process. This will be undertaken through an annual assessment carried out by CALM and a formal audit by the MPRA every three years. The audits will include reports on the status of the key ecological values of the reserves and an assessment of the effectiveness of current management strategies as well as providing feedback to reserve managers.

Overall management performance will be audited by the MPRA via a status report assessing compliance against the stated key ecological and social management targets (ie. outcome based approach) and against progress regarding implementation of the key management strategies (ie. activity based approach) as outlined in Sections 7 - 9. Management targets of selected key ecological and social values of the reserve are used as *key performance indicators* (KPIs) of the effectiveness of the reserves' management. These are identified in Section 7 by the symbol (*KPI*). The KPIs reflect both the conservation priorities and the management requirements of the MPRA, CALM and the community. *Key management strategies* (KMS) are identified in Sections 7 - 9 by the symbol (H-KMS).

10.1 Annual performance assessment by CALM

The prioritised strategies outlined in Sections 7 - 9 of the management plan will be built into successive annual works programs of CALM's Pilbara Region that is responsible for the day to day management of the reserves. Progress against the KPIs, KMSs and the remaining management targets and strategies will form the basis of an annual performance assessment of the reserves by CALM's Pilbara Region to CALM's Corporate Executive.

10.2 Performance assessment by the MPRA

Progress against the KPIs and KMSs will form the basis of a formal three yearly MPRA audit of the reserves. CALM will provide annual performance assessment reports to the MPRA from the time of approval of this management plan, from which the MPRA can monitor annual progress of CALM's implementation of the management plan. The adequacy of the range of selected KPIs and KMSs will be reviewed following each MPRA audit and amended if appropriate.

10.3 Review of the Management Plan

The management plan for the reserves will cover management of the reserves for a period of ten years from the date the plan is approved. This is the maximum allowable period that may be set for a management plan, as specified by the CALM Act.

At the completion of the ten-year period, the plan will be reviewed with full public consultation, re-submitted to the MPRA, and then submitted to the Minister for the Environment for approval following consultation with the Minister for Agriculture, Forestry and Fisheries and the Minister for State Development. The CALM Act specifies that in the event of such a revision not occurring by the end of the plan's specified life span, the plan will remain in force in its original form, unless it is either revoked by the Minister for the Environment or until a new plan is approved.

10.4 Links with State Environment Reporting

The first Western Australian State of the Environment Report was prepared in 1992 and a second report published in 1998 (Government of Western Australia, 1998b). These reports provided an overview of the key marine and terrestrial environmental issues in the State. The EPA will be responsible for ongoing State of the Environment reporting based on the framework contained within the 1998 report. Relevant marine issues covered by this framework are the implementation of a statewide system of marine conservation reserves, biodiversity, degradation of marine habitats, contamination of the marine environment, the introduction of exotic marine species and the tourism, fisheries, mining and petroleum industries. The performance assessment of the reserves as described above, is broadly consistent with the overarching State of the Environment reporting framework.

10.5 Links with National Environment Reporting

At a national level, there are two major reporting mechanisms relevant to marine conservation reserves. These are the national State of the Environment Report and the performance assessment framework for the National Representative System of Marine Protected Areas (NRSMPA). A State of the Marine Environment Report (SOMER) was published in 1996 (Commonwealth of Australia, 1996b) and progress in respect of marine

conservation reserves will form part of the national State of the Environment reporting. Performance assessment criteria are being developed to assess whether the goals of the NRSMPA are being achieved. The performance assessment framework of this plan is broadly consistent with the performance assessment criteria being developed for the NRSMPA.

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