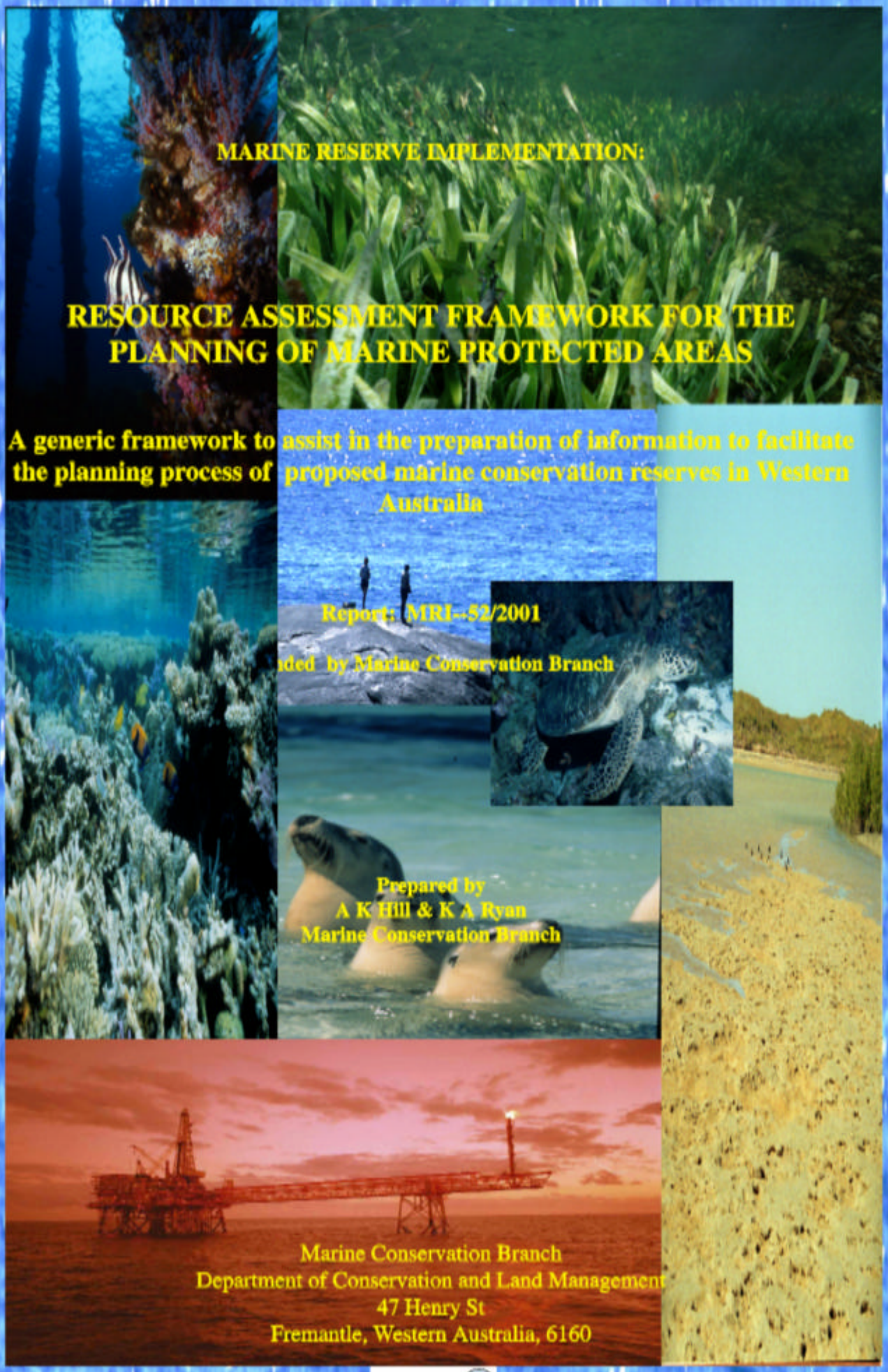

MARINE RESERVE IMPLEMENTATION:

RESOURCE ASSESSMENT FRAMEWORK FOR THE PLANNING OF MARINE PROTECTED AREAS

A generic framework to assist in the preparation of information to facilitate the planning process of proposed marine conservation reserves in Western Australia

Report: MRI--52/2001

...ded by Marine Conservation Branch

Prepared by
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Marine Conservation Branch

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47 Henry St
Fremantle, Western Australia, 6160

DEPARTMENT OF Conservation AND LAND MANAGEMENT

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CONTENTS

ACRONYMS

DoIA	Department of Indigenous Affairs
AMBIS	Australian Marine Boundaries Information System
DoA	Department of Agriculture
BoM	Bureau of Meteorology
Department	Department of Conservation and Land Management
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CU	Curtin University
DEP	Department of Environmental Protection
DPI	Department of Planning and Infrastructure
DMPR	Department of Minerals and Petroleum Resources
EA	Environment Australia
DoF	Department of Fisheries
LGA	Local Government Authority
MDU	Murdoch University
NNTT	National Native Title Tribunal
UWA	University of Western Australia
WAM	Western Australian Museum
WATC	Western Australian Tourism Commission
WC	Water Corporation
WRC	Water & Rivers Commission

A INTRODUCTION

The Western Australian Government is committed to establishing a statewide representative system of multiple use marine conservation reserves under the *Conservation and Land Management Act 1984 (CALM Act)* to protect the diverse and valuable natural heritage values of our nearshore marine environment. The *CALM Act* provides the framework for sustainable commercial and recreational use of these resources. In 1986, a Marine Parks and Reserves Selection Working Group (MPRSWG) was established to identify marine areas that where thought to be worthy of consideration for marine reserve status. The MPRSWG identified 70 areas around the Western Australian coast (Conservation and Land Management, 1994) which, if reserved, would provide a system of marine conservation reserves that would be representative of all the major ecosystems of the State.

In December 1997, the Western Australian Government, following advice provided by the Western Australian Marine Parks and Reserves Authority, announced priority areas for establishment as a marine conservation reserve. Subsequently, the Department, through the Marine Conservation Branch (MCB), has initiated the planning process for implementing a number of marine conservation reserves.

Under the State Government's marine conservation strategy detailed in *New Horizons - The way ahead in marine conservation and management* released by the Western Australian Government in 1998 (WA Government, undated), there is a requirement for:

> *"Extensive assessment, community consultation and management planning before a new marine conservation reserve is established."*

An essential component of this is that:

> *"A comprehensive assessment of the area's biological and economic resources, and social values is carried out."*

The Resource Assessment Framework is a generic framework developed to ensure that there is adequate information to support the planning process to consider proposed marine conservation reserves. It will guide the information gathering phase of the planning process, known as the Resource Assessment. The Resource Assessment will rely on information (written and spatial) from both the Department and external sources including other Government agencies, non-Government agencies and the local community. It has direct links with the Department's Marine Geographic Information Services data acquisition program (Appendix 1).

The planning process for marine conservation reserves can take up to five years, and during this period new information will become available. As such, the Resource Assessment document for a specific area should be dynamic and continually updated as required throughout the planning process of each marine conservation reserve. It will therefore maintain an up-to-date reference for the Department during the planning process, and provide the basis for the preparation of the Indicative Management Plan. In the longer term, this information would transfer to the managers of each reserve and provide a reference for ongoing management.

B PURPOSE

The Resource Assessment is an accurate information document to assist the planning process of a marine conservation reserve. It will have the following properties:

* up-to-date (i.e. dynamic);
* include spatial representation of data;
* clear identification of sources (i.e. well referenced);
* clear identification of priorities for future information collection;
* primarily for internal use; and
* facilitate easy retrieval of information.

The Resource Assessment specifies the level of information required for the planning process to focus time and resources, whereby:

* "overview" requires a summary of the available information;
* "moderate" requires an intermediate level of information; and
* "detailed" requires specific information, both qualitative and quantitative where applicable.

The objectives of the Resource Assessment process are to:

I. provide up-to-date ecological and social resource information for the planning process;
II. provide all of the necessary information to formulate the indicative management plan (including information for the Advisory Committee);
III. provide the necessary resource information for the preparation of public participation and education products; and
IV. provide resource data for the operational managers once the reserve is established.

C PROCEDURAL GUIDELINES

1 Study area

Question	Level of Information Required	Suggested Sources
1.1 Why was the study area identified for consideration as a marine conservation reserve by the Marine Parks and Reserves Selection Working Group in their 1994 report?	Detailed	Conservation and Land Management (1994)

- *Obtain datasets of the geographical location of the study area in an Australian, Western Australian and regional context, which include:*
  - *Marine Parks and Reserves Selection Working Group (MPRSWG) report study area;*
  - *proposed study area for the Resource Assessment (if different to the MPRSWG recommended area);*
  - *latitude/longitude;*
  - *geographical boundaries;*
  - *position in relation to major population centres and towns; and*
  - *position in relation to predominant features such as river outflows and islands.*

ECOLOGICAL VALUES

2 Geology and geomorphology

Question	Level of Information Required	Suggested Sources
2.1 What are the key events in the geological history of the study area (eg history of rock formation, major sea level changes, time of sediment deposition, formation of petroleum/mineral deposits)?	Overview	DMPR Department CU UWA
2.2 Is the geology/geomorphology of the study area generally uniform, or does the study area consist of distinct coastal zones?	Overview	As above
2.3 What are the rock and sediment types of the coastline of the study area (eg granite, gneiss, limestone) and when were they formed/deposited?	Detailed	As above
2.4 What are the major landforms/habitats of the coastline of the study area?	Detailed	Department UWA
2.5 What are the main processes that currently influence the geology/geomorphology of the study area (eg wave erosion, sediment transport by currents, water level change, cyclone events, biological erosion)?	Detailed	As above
2.6 Have there been any past, and/or are there any current/potential uses and/or pressures on the geology/geomorphology of the study area (eg coastal development such as groynes, marinas and shipping channels; aquaculture infrastructure)?	Detailed	Department DPI LGA DPI Port Authorities Private companies
2.7 Is there any evidence of environmental impact on the geologic/geomorphic values of the study area? Provide details of the relevant research/monitoring programs.	Detailed	Department DPI LGA
2.8 What is the current condition of the geology/geomorphology of the study area (good; fair; poor)?	Moderate	Department LGA
2.9 What strategies are the relevant management authorities utilising/proposing to minimise the environmental impact on geological/geomorphic values (eg monitoring programs)?	Moderate	Department LGA DMPR DPI

- *Obtain a dataset of the geology of the study area.*

3 Drainage and groundwater

Question	Level of Information Required	Suggested Sources
3.1 What are the size and nature (eg agricultural; urban) of the drainage basins of the study area, and what areas do these systems drain?	Overview	WRC Department DoA
3.2 For the major estuaries located within/adjacent to the study area, state: • National/International significance (ie listed under the RAMSAR convention (ANCA, 1993), are of national significance (ANCA, 1993), subject to a System 6 recommendation (DCE 1983) and/or are on the register of National Estate); • classification; • basin area (ha); • major drainage systems; • catchment area; • discharge (ML) and time (periodic, seasonal, constant); • surrounding land use; • condition; and • values.	Detailed	WRC Department
3.3 For the major coastal wetlands within/adjacent to the study area, state: • National/International significance (ie listed under the RAMSAR convention (ANCA, 1993), are of national significance (ANCA, 1993), subject to a System 6 recommendation (DCE 1983) and/or are on the register of National Estate); • basin area (ha); • condition; and • values.	Overview	As above
3.4 For the major rivers which flow to the coast or to an inlet of the study area, (≥350km2) state: • associated estuary (where appropriate); • catchment area (km2); • mean annual flow; • seasonal flow characteristics; • condition; and • values.	Overview	As above
3.5 What are the characteristics of the groundwater (eg water table level, quality, salinity)?	Overview	As above
3.6 What is the relationship of groundwater with the geological structures of the study area (eg formation of caves)?	Overview	As above

3.7 What are the characteristics of the rainfall of the study area in terms of its relationship to groundwater? Detail the rate, reliability, drainage and surface runoff. Does periodic flooding occur in the study area?	Overview	As above
3.8 What is the relationship of groundwater with seawater (ie flux)? Do groundwater discharge and other freshwater inputs affect the hydrodynamics of the study area (state direction and distance)?	Moderate	As above

4 Climate

Question	Level of Information Required	Suggested Sources
4.1 Outline the climate type of the study area (eg Mediterranean climate with cool, wet winters and hot, dry summers).	Overview	Department BoM www.bom.gov.au
4.2 What are the offshore and localised wind patterns of the study area (eg direction, seasonality, speeds)?	Detailed	As above
4.3 What are the mean maximum temperatures for the hottest months and the coldest months?	Detailed	Department BoM www.bom.gov.au BoS
4.4 What are the mean minimum temperatures for the hottest months and the coldest months?	Detailed	As above
4.5 What is the average annual precipitation, and detail the seasonal variation of precipitation?	Detailed	As above
4.6 What is the average daily and monthly humidity of the study area?	Detailed	As above
4.7 Outline any available evaporation data of the study area (eg annual mean, times of highest and lowest occurrence).	Detailed	As above
4.8 Do any extreme climatic events occur in the study area (eg cyclones)? If so, what has been the environmental and social impact of these events?	Moderate	Department BoM www.bom.gov.au

- *Obtain figures/datasets of:*
  - *typical series of synoptic charts for the study area for summer and winter;*
  - *mean annual rainfall contour;*
  - *evaporation isopleths;*
  - *air temperature;*
  - *cloud cover;*
  - *solar radiation;*
  - *wind roses;*
  - *mean monthly wind vectors for approximately the last decade, with long term means;*
  - *histograms of wind speed percentage occurrence per season for the study area; and*
  - *any extreme cyclonic events.*

5 Oceanography

Water level

Question	Level of Information Required	Suggested Sources
5.1 What are the tidal patterns and ranges of the study area?	Moderate	Department CSIRO, Marine Research UWA, Centre for Water Research
5.2 What is the influence of tides on the hydrodynamics of the study area (eg net water movement, estuary hydrodynamics)?	Moderate	As above
5.3 What are the implications of tides on the physical characteristics of the study area (eg influence of tides on coastal geomorphology)?	Detailed	Department Universities LGAs
5.4 What are the implications of tides on the biological characteristics of the study area (eg zonation patterns)?	Detailed	Department Universities
5.5 Are there any other meteorological influences on water level (eg winds, storm surges, barometric pressure and coastally trapped long period waves eg continental shelf waves, tsunamis, cyclone events)?	Moderate	Department CSIRO, Marine Research UWA, Centre for Water Research

Waves

Question	Level of Information Required	Suggested Sources
5.6 What are the oceanic swell patterns and local sea patterns which affect the study area (eg formation, direction, typical wave height and period as per season)?	Moderate	Department CSIRO, Marine Research UWA, Centre for Water Research
5.7 Does the study area have a high, medium or low energy coast?	Moderate	As above
5.8 How do waves affect the hydrodynamics of the study area? (circulation/flushing/net water movement/re-suspension)?	Moderate	As above

5.9 What is the effect of geomorphology (eg bathymetry, islands, reefs) on local wave patterns as ocean swells impact on the coastline?	Moderate	As above
5.10 What is the interaction between waves and sedimentation processes?	Overview	As above
5.11 What are the implications of waves on the physical characteristics of the study area (eg effect of swell on coastal geomorphology)?	Moderate	Department LGAs Universities
5.12 What are the implications of waves on the biological characteristics of the study area?	Detailed	Department Universities

Currents

Question	Level of Information Required	Suggested Sources
5.13 Describe the major regional currents of the study area. Include formation/key forcings, speed, direction and seasonality.	Moderate	Department CSIRO, Marine Research UWA, Centre for Water Research
5.14 Describe the local currents of the study area. Include formation/key forcings, speed, direction and seasonality	Moderate	As above
5.15 Outline the formation of eddies and the occurrence of upwelling	Moderate	As above
5.16 How do currents influence circulation, mixing and exchange?	Detailed	As above
5.17 What is effect of geomorphology (eg bathymetry, islands, reefs) on current patterns?	Overview	As above
5.18 What is the interaction between currents and sedimentation processes (eg littoral drift)?	Moderate	As above
5.19 What are the implications of currents on the physical characteristics of the study area (eg spread of oil spills and other threatening waterborne substances)?	Detailed	Department LGAs Universities
5.20 What are the implications of currents on the biological characteristics of the study area (eg spread of larvae)?	Detailed	Department Universities

Winds

Question	Level of Information Required	Suggested Sources
5.21 What is the influence of winds on the hydrodynamics of the study area (eg net water movement/circulation/flushing)?	Detailed	Department BoM www.bom.gov.au
5.22 What are the implications of winds on the physical characteristics of the study area (eg water quality)?	Detailed	Department LGAs Universities
5.23 What are the implications of winds on the biological characteristics of the study area (eg spread of larvae)?	Detailed	Department Universities

Temperature & Salinity

Question	Level of Information Required	Suggested Sources
5.24 Where and why do vertical and horizontal temperature and salinity gradients form? Outline the interaction of these gradients with local physical conditions (eg river runoff, winds, currents, tides).	Moderate	Department CSIRO, Marine Research UWA, Centre for Water Research
5.25 Describe the influence of salinity/temperature gradients on density and describe their role in driving circulation, mixing and exchange.	Moderate	As above
5.26 What is the impact of temperature and salinity on the marine communities of the study area?	Detailed	Department Universities

- *Obtain figures/datsets of*
  - *tidal water level;*
  - *wave patterns of the study area (e.g. maximum significant wave height at offshore and nearshore locations);*
  - *broadscale circulation/major currents (schematic diagrams, satellite images of sea-surface temperature and chlorophyll "a" distribution, annual temperature cycles);*
  - *indicative current patterns under tidal conditions (without wind);*
  - *indicative flow patterns under currents generated by typical winds and tides;*
  - *hydrodynamic model outputs for wind-driven flows;*
  - *nearshore and cross shelf temperature profiles; and*
  - *nearshore and cross shelf salinity profiles.*

6 Bathymetry

Question	Level of Information Required	Suggested Sources
6.1 Outline the bathymetry of the study area.	Detailed	Department DPI Universities
6.2 What is the interaction of bathymetry with the oceanographic processes of the study area?	Detailed	As above
6.3 Do any seasonal changes occur to the bathymetry of the study area (eg as a result of storm events, algal life cycles)?	Moderate	As above

- *Obtain dataset of the bathymetry of the study area.*

7 Ecological communities

	Question	Level of Information Required	Suggested Sources
7.1	In what IMCRA biogeographical province and biogeographical region(s) does the study area occur, and what are the defining features of the biota and the marine and coastal communities?	Overview	ANZECC (1998)
7.2	What are the major marine and coastal communities of the study area (see Appendix 2)? For each community, state:		Department LGAs Universities WAM
	a) distribution and area covered within the study area;	Detailed	
	b) structure (eg rock type, sediment type, relief);	Moderate	
	c) distribution and diversity of predominant flora and fauna;	Moderate	
	d) the occurrence of any species of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauan) Notice 1999*, the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999*?), rare or endemic species;	Detailed	
	e) the influence of the physical environment on structural morphology, and flora and fauna distribution and adaptations;	Overview	
	f) the influence of biological processes on structural morphology, and flora and fauna distribution and adaptations;	Overview	
	g) productivity/food webs/community structure;	Overview	
	h) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any);	Detailed	
	i) current condition/degree of naturalness (eg degraded; healthy); and	Detailed	
	j) current/proposed management strategies and future implications.	Moderate	

- *Obtain datasets of the major benthic habitat types and shoreline geomorphology (with associated percentages) of the study area.*

8 Marine fauna

Question	Level of Information Required	Suggested Sources
8.1 For the mammals found in the study area, state:		Department Universities
a) species diversity and the relative importance of the faunal group in statewide and regional contexts;	Moderate	
b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s);	Moderate	
c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999*, the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999?*);	Detailed	
d) If c), state: • biogeographical and local distribution; • seasonality of occurrence; and • behavioural patterns (eg migration, breeding, nesting);	Detailed	
e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and	Detailed	
f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate	
8.2 For the birds (seabirds and shorebirds) found in the study area, state:		Department Universities
a) species diversity and the relative importance of the faunal group in statewide and regional contexts;	Moderate	
b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s);	Moderate	
c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999*, the *Endangered Species Protection Act 1992*, the *Threatened Australian Fauna (ANZECC List) 1999* and/or CAMBA/JAMBA agreements?);	Detailed	
d) If c), state: • biogeographical and local distribution; • seasonality of occurrence; and • behavioural patterns (eg migration, breeding, nesting);	Detailed	
e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and	Detailed	
f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate	

8.3 For the reptiles found in the study area, state: a) species diversity and the relative importance of the faunal group in statewide and regional contexts; b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s); c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999,* the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999?*); d) If c), state: • biogeographical and local distribution; • seasonality of occurrence; and • behavioural patterns (eg migration, breeding, nesting); e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate Moderate Detailed Detailed Detailed Moderate	Department Universities
8.4 For the fishes found in the study area, state: a) species diversity and the relative importance of the faunal group in statewide and regional contexts; b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s); c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999,* the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999?*); d) If c), state: • biogeographical and local distribution;; • seasonality of occurrence (if applicable); and • behavioural patterns (if applicable); e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate Moderate Detailed Detailed Detailed Moderate	Department DoF WAM Universities
8.5 For the echinoderms found in the study area, state: a) species diversity and the relative importance of the faunal group in statewide and regional contexts; b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s); c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999,*	Moderate Moderate Detailed	Department WAM Universities

the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999?*);		
d) If c), state biogeographical and local distribution;	Detailed	
e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and	Detailed	
f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate	
8.6 For the crustaceans found in the study area, state:		Department WAM
a) species diversity and the relative importance of the faunal group in statewide and regional contexts;	Moderate	
b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s);	Moderate	
c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999*, the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999?*);	Detailed	
d) If c), state biogeographical and local distribution;	Detailed	
e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and	Detailed	
f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate	
8.7 For the molluscs found in the study area, state:		Department WAM
a) species diversity and the relative importance of the faunal group in statewide and regional contexts;	Moderate	
b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s);	Moderate	
c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999*, the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999?*);	Detailed	
d) If c), state biogeographical and local distribution;	Detailed	
e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and	Detailed	
f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate	

8.8 For the corals found in the study area, state:		Department WAM
a) species diversity and the relative importance of the faunal group in statewide and regional contexts;	Moderate	
b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s);	Moderate	
c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999*, the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999?*);	Detailed	
d) If c), state biogeographical and local distribution;	Detailed	
e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and	Detailed	
f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate	
8.9 For any other invertebrates (eg sponges, bryozoans, tunicates) found in the study area, state:		Department WAM
a) species diversity and the relative importance of the faunal group in statewide and regional contexts;	Moderate	
b) size of population(s), including size of any genetically distinct populations (if known), and details of most recent survey(s);	Moderate	
c) species which are rare, endemic and/or of special conservation status (ie is it listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 1999*, the *Endangered Species Protection Act 1992* and/or the *Threatened Australian Fauna (ANZECC List) 1999?*);	Detailed	
d) If c), state biogeographical and local distribution;	Detailed	
e) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any); and	Detailed	
f) past/current/proposed management strategies (eg codes of practice, monitoring programs).	Moderate	

- *Obtain datasets of wildlife distribution, with reference to use (eg breeding, nesting, nursery, spawning and feeding grounds); areas of high diversity; and species which are rare/threatened or of special conservation status*

9 Marine flora, protists & bacteria

Question	Level of Information Required	Suggested Sources
9.1 For any seagrass populations in the study area, state:		Department Universities LGAs WC
a) species diversity (give details of most recent survey) and relative importance in statewide and regional contexts;	Moderate Detailed	
b) biogeographical and local distribution and endemism;	Detailed	
c) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any);	Detailed	
d) current condition; and	Moderate	
e) management strategies currently used and/or proposed (eg moorings policies, monitoring programs).		
9.2 For any mangroves in the study area, state:		Department Universities LGAs
a) species diversity (give details of most recent survey) and relative importance in statewide and regional contexts;	Moderate Detailed	
b) biogeographical and local distribution and endemism;	Detailed	
c) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any);	Detailed	
d) current condition; and	Moderate	
e) management strategies currently used and/or proposed (eg codes of practice, monitoring programs).		
9.3 For any macroalgal populations in the study area, state:		Department Universities
a) species diversity (give details of most recent survey) and relative importance in statewide and regional contexts;	Moderate Detailed	
b) biogeographical and local distribution and endemism;	Detailed	
c) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any);	Detailed	
d) current condition; and	Moderate	
e) management strategies currently used and/or proposed (eg codes of practice, monitoring programs).		
9.4 For any populations of cyanobacteria (non-bloom populations, eg stromatolites) in the study area, state:		Department WRC Universities LGAs
a) species diversity (give details of most recent survey) and relative importance in statewide and regional contexts;	Moderate Detailed	
b) biogeographical and local distribution;	Detailed	
c) past, present and potential uses and/or pressures (natural and human-induced); evidence of impact and the relevant research/monitoring programs (if any);	Detailed	
d) current condition; and	Moderate	
e) management strategies currently used and/or proposed (eg codes of practice, monitoring programs).		

10 Coastal terrestrial biota

Question	Level of Information Required	Suggested Sources
10.1 What are the major coastal terrestrial plant assemblages of the study area? Include dominant species and conservation status.	Overview	Department Universities LGAs
10.2 What are the major groups of land mammals, birds and reptiles? Include number of species, dominant species and conservation status.	Overview	As above
10.3 What strategies are the relevant management authorities utilising/proposing to determine and/or minimise any potential environmental impact on the coastal terrestrial biota of the study area (eg is there an island management/natural resource plan; reintroductions/translocations; eradication of pests)?	Moderate	As above

SOCIAL VALUES

11 Cultural history

Aboriginal

Question	Level of Information Required	Suggested Sources
11.1 Outline the historical occupation of the study area by Aboriginal groups.	Overview	Department WAM Local Aboriginal groups
11.2 What sacred/significant sites have been registered with the Aboriginal Affairs Department under the *Aboriginal Heritage Act 1972*? What is the significance of these sites in a regional context?	Detailed	Department DoIA Local Aboriginal groups
11.3 What was the historical Aboriginal use of the study area and its resources? Outline any evidence of Aboriginal occupation and use of the study area (eg rock paintings, shell middens)?	Overview	Department WAM Local Aboriginal groups
11.4 What is the current use of the study area by Aboriginal groups (eg subsistence uses, commercial uses)?	Detailed	Department LGAs Local Aboriginal groups
11.5 Are there any applications on the Register of Native Title Claims under the *Native Title Act 1993* which refer to waters and/or adjoining land of the study area? Who have these been made by (provide contact details) and to what extent of an area do they apply? At what stage of the process are these Native Title applications (eg have they been accepted for mediation by the National Native Title Tribunal?)	Detailed	Department NNTT

Maritime

Question	Level of Information Required	Suggested Sources
11.6 Outline the significant aspects of the maritime history and European settlement of the study area (eg the naming and charting of localities, the first inhabitants) and any remaining evidence of this history.	Overview	Department WA Maritime Museum
11.7 Outline the historical commercial activities (eg whaling, sealing, pearling).	Overview	As above
11.8 Are there any sites gazetted by the WA Maritime Museum in the study area (eg shipwrecks/historical remains) governed by the *Heritage of Western Australia Act* 1990 or on the register of the National Trust?	Detailed	Department WA Maritime Museum National Trust of Australia (WA)

Military

Question	Level	Suggested Sources
11.9 Outline the history of any significant military activities relevant to the study area.	Overview	Department WAM Army Museum
11.10 Is there any evidence/remains of historical military activities?	Overview	As above
11.11 Have any sites of historic significance been declared?	Detailed	As above

- *Obtain datasets of the culturally significant sites of the study area:*
  - *Aboriginal sacred and ceremonial sites;*
  - *sites of Native Title claims;*
  - *gazetted maritime sites; and*
  - *significant military sites.*

12 Tenure

Question	Level of Information Required	Suggested Sources
12.1 Which shires/local government authorities are responsible for the administration of the area? What are the major townsites of each shire?	Detailed	LGAs DOLA
12.2 What is the population and growth rate of each shire?	Detailed	As above
12.3 Outline any illegal or formalised squatter development in the area (time of development, users of the shacks, recognisable communities, facilities such as water and toilets).	Moderate	As above
12.4 What are the details of any existing leases held by squatters (annual cost, date of expiry)?	Detailed	As above
12.5 Does the shire/s have a squatter removal program (provide details)?	Moderate	As above
12.6 What is the past, present and predicted future land development in the study area (eg proposed town sites, resort developments)?	Overview	As above
12.7 Is there any current use of the area for military purposes?	Detailed	As above
12.8 Are there any other existing leases on land, seabed or waters of the area (eg for industrial purposes)? Do these leases permit input into the administration of the area?	Detailed	Department DOLA
12.9 How is the territorial sea baseline determined in the identification of the seaward limit of state territorial seas?	Detailed	AMBIS

- *Obtain datasets of the:*
  - *Limits of Australian Territorial seas and Western Australian State Waters;*
  - *boundaries of the local government authorities;*
  - *major towns;*
  - *tenure and vestings in or adjoining the study area (eg Department reserve, shire reserve, residential area, pastoral lease, freehold land); and*
  - *existing conservation areas (eg Fish Habitat Protection Areas).*

Infrastructure and facilities

Coastal access

Question	Level of Information Required	Suggested Sources
12.10 Do roads/tracks provide access to all sections of the coast?	Detailed	Department LGAs DPI
12.11 What is the nature of the authorisation of the airports/landing strips?	Moderate	As above
12.12 Are there any plans to develop additional infrastructure and/or expand existing infrastructure?	Moderate	LGAs DPI
12.13 Have there been any past, and/or are there any current/potential environmental impacts of infrastructure in the study area? Provide details of the relevant research/monitoring programs.	Moderate	Department LGAs DPI
12.14 What strategies are the relevant management authorities and/or involved companies utilising/proposing to minimise the environmental impact of infrastructure on the marine and coastal environment (eg monitoring programs to determine environmental impact)?	Moderate	As above

Shipping and boating

Question	Level	Suggested Sources
12.15 What are the management authorities of the ports in the study area?	Detailed	Local port Authority DPI
12.16 What is the number of vessels calling at each port each year, and where are the majority from?	Overview	As above
12.17 What is the type and quantity of cargo exported/imported? Identify the importance of each port in relation to cargo exported and imported on a local scale and a state-wide scale (as a percentage of total exports and imports).	Overview	As above
12.18 What is the total value of trade through the port?	Overview	As above
12.19 What are the trade forecasts for the port?	Overview	As above

12.20 Provide the details of any shipping/boating channels. Who is responsible for maintaining the channels, and provide details of the associated dredging programs (eg where is the spoil dumped and how often)?	Detailed	As above
12.21 Provide the details of any public and private wharfs (eg maximum draughts).	Moderate	As above
12.22 Provide details of moorings and management of the harbours of the study area.	Overview	As above
12.23 Provide details of the holding capacity and management of the marina facilities in the study area.	Overview	As above
12.24 Are there any plans to develop additional shipping/boating infrastructure and/or expand existing infrastructure?	Moderate	As above
12.25 Have there been any past, and/or are there any current/potential environmental impacts of shipping/boating in the study area? Provide details of the relevant research/monitoring programs.	Moderate	Department LGAs CSIRO Division of Marine Research DPI
12.26 What strategies are the relevant management authorities utilising/proposing to minimise the environmental impact of shipping/boating?	Moderate	Local port authority DPI Department LGAs

Sewage

Question	Level	Suggested Sources
12.27 Provide details of any wastewater treatment plants located in the study area, including the type of treatment (primary or secondary), location, details of outfall pipes and the maximum volume of sewage that each is licensed to treat per day.	Detailed	WC DEP
12.28 Is the study area serviced by deep sewage?	Overview	As above
12.29 Are there any plans to develop additional sewage facilities and/or expand existing facilities?	Overview	As above
12.30 What are the controls on the discharge of sewage by boats in the study area?	Detailed	DPI
12.31 Have there been any past, and/or are there any current/potential environmental impacts of sewage treatment and disposal in the study area? Provide details of the relevant research/monitoring programs.	Moderate	WC LGAs DEP Department

12.32 What strategies are the relevant management authorities utilising/proposing to minimise the environmental impact of sewage treatment and disposal?	Moderate	WC WRC LGAs DEP DPI Department

- *Obtain datasets of the infrastructure of the study area, including:*
  - *major townsites and areas covered by the town planning schemes;*
  - *major highways and sealed roads;*
  - *railways; and*
  - *airports and landing strips.*

- *Obtain navigation charts and/or datasets of:*
  - *gazetted ports;*
  - *location of the major shipping routes and channels; and*
  - *other maritime infrastructure (eg public and private boat ramps, major beach launching sites, moorings, groynes, lighthouses, fish aggregating devices, jetties and navigation markers).*

13 Water quality

Question	Level of Information Required	Suggested Sources
13.1 How does flushing/exchange influence the water quality of the study area?	Detailed	Department CSIRO, Marine Research UWA, Centre for Water Research
13.2 What are the natural turbidity levels of the study area? Include rates of deposition and the effects of local conditions (eg wind, swell, riverine input).	Moderate	As above
13.3 What are the patterns of sediment re-suspension in the study area? Include rates and the effects of local conditions (eg wind, swell).	Moderate	As above
13.4 What are the natural nutrient levels of the study area?	Moderate	DEP CSIRO
13.5 Have there been any past, and/or are there any current/potential uses and/or pressures (ie nutrient/toxic/pathogenic contaminant inputs) on the water quality of the study area. Provide details of these inputs (source, type and level).	Moderate	Department LGAs Universities WRC WC DEP DPI
13.6 Is there any evidence of environmental impact (eg the occurrence of algal blooms; enhanced epiphyte growth)? Provide the details of the relevant research/monitoring programs.	Moderate	As above
13.7 According to water and sediment quality survey data and to the occurrence of historical and current input of nutrient, toxic and pathogenic contaminants, what is the current water and sediment quality of the study area (high, medium or low)?	Moderate	As above
13.8 What strategies are the relevant management authorities utilising/proposing to minimise the environmental impact on the water quality of the study area (eg water quality monitoring programs)?	Moderate	Department LGAs WRC WC DEP DPI

- *Obtain figures/datsets of*
  - *relative turbidity zones;*
  - *mean daily turbidity at offshore and nearshore locations;*
  - *location of pollution input sources; and*
  - *water and sediment quality survey data.*

14 Commercial fishing

Question	Level of Information Required	Suggested Sources
14.1 Identify the major commercial fisheries that operate in the study area (eg finfish, rock lobster, prawns). For each industry, identify: (a) number of licensed and actual operators in the study area; (b) species targeted as per season; (c) predominant techniques (eg potting, trawling, demersal gillnet and longline); (d) tonnes of product per annum and significance; (e) economic value and significance; (f) markets; (g) past trend, current status and predicted future trend; and (h) past/current/potential environmental impacts in the study area, providing details of the relevant research/monitoring programs.	Detailed	DoF
14.2 Provide details of any processing facilities, including location, products processed, quantity of product, markets and economic value.	Overview	DoF
14.3 What are the requirements of commercial fishing in the study area (eg high water quality)?	Overview	DoF
14.4 What strategies is DoF utilising/proposing to minimise the environmental impact of commercial fishing (eg management plans, quotas, gear reductions, licence buy-back, closed seasons, closed areas, designated fishing zones, bag and size limits)?	Moderate	DoF

- *Obtain datsets of:*
- *Fisheries licence areas (including nursery areas and areas which are closed to fishing); and*
- *Principal fishing areas.*

15 Aquaculture and pearling

Question	Level of Information Required	Suggested Sources
15.1 Identify the major aquaculture and pearling industries that operate in the study area. For each industry, identify: (a) number of current licenses/leases and details (eg duration) and number of applications for licenses; (b) species targeted; (c) mode of operation (eg with respect to season, physical requirements, source of juveniles); (d) tonnes of product per annum and significance; (e) economic value and significance; (f) markets; (g) past trend, current status and predicted future trend; and (i) past/current/potential environmental impacts in the study area, providing details of the relevant research/monitoring programs.	Detailed	DoF
15.2 What are the requirements of aquaculture/pearling industries in the study area (eg high water quality)?	Overview	DoF
15.3 What strategies is DoF utilising/proposing to minimise the environmental impact of aquaculture and pearling (eg size limits, quota system, minimum distance between farms)?	Moderate	DoF

- *Obtain datasets of:*
  - *aquaculture/pearling application sites; and*
  - *aquaculture/pearling licensed sites.*

16 Tourism

Question	Level of Information Required	Suggested Sources
16.1 Identify the major tourism industries that operate in the study area (eg fishing, diving, wildlife observation). Identify: (a) number of tourism-based charter boat companies; (b) mode of operation (eg with respect to season, constraints); (c) number of participants and significance; (d) economic value and significance; (e) market (domestic and/or overseas); (f) past trend, current status and predicted future trend; and (j) past/current/potential environmental impacts in the study area, providing details of the relevant research/monitoring programs.	Detailed	WATC Department
16.2 What are the major tourist attractions of the study area?	Overview	As above
16.3 What are the requirements of tourism industries in the study area (eg high water quality)?	Overview	As above
16.4 What strategies are the relevant management authorities utilising/proposing to minimise the environmental impact of tourism (eg codes of conduct)	Moderate	As above

- *Obtain datasets of the location and intensity of tourism activities in the study area.*

17 Mining and petroleum

Question	Level of Information Required	Suggested Sources
17.1 Identify the major mining and petroleum industries (exploration and production) that currently operate in the study area. For each industry, identify: (a) details of leases (eg size and duration); (b) processes involved; (c) tonnes of product per annum (including waste product and pollutants) and significance; (d) economic value and significance; (e) markets; (f) uses of the products; (g) past trend, current status and predicted future trend (ie identify any potential deposits, any expansions, new proposals or new interests); and (k) past/current/potential environmental impacts in the study area, providing details of the relevant research/monitoring programs.	Detailed	DMPR DEP Department
17.2 Outline the history of exploration and mining in the study area.	Overview	As above
17.3 Are there any operations in the study area which are covered by State Agreement Acts?	Detailed	As above
17.4 Are there any operations in the study area which are required to have an Environmental Management Plan? If so, what are the obligations with respect to operations and lease duration?	Detailed	As above
17.5 What are the requirements of mining and petroleum industries in the study area?	Overview	As above
17.6 What strategies are the relevant management authorities and/or involved companies utilising/proposing to minimise the environmental impact of mining and petroleum (eg waste disposal guidelines, oil spill management plans, exploration permits, production and pipeline licences).	Moderate	As above

- *Obtain datasets of:*
  - *exploration and production facilities and associated infrastructure (eg pipelines); and*
  - *exploration and mining leases/permits etc*

18 Recreational fishing

Question	Level of Information Required	Suggested Sources
18.1 Summarise DoF recreational fishing survey information if available.	Detailed	DoF
18.2 How many participants are involved in recreational fishing as per season and/or on an annual basis, and what is the recreational fishing effort? What is the significance of these values in an international/national/regional/local context?	Overview	As above
18.3 What is the origin of the recreational fishers (eg Perth metropolitan area, local coastal communities etc)?	Moderate	As above
18.4 What are the predominant fishing techniques used (eg shore or boat angling, net fishing, spearfishing, pots)?	Detailed	As above
18.5 What is the level of boat ownership of the study area?	Overview	DPI DoF
18.6 What is the total catch by species?	Detailed	DoF
18.7 What is the economic significance of recreational fishing in an international/national/regional/local context?	Overview	As above
18.8 What has been the past trend, and what is the current status and predicted future trend for recreational fishing in the study area?	Moderate	As above
18.9 Have there been any past, and/or are there any current/potential environmental impacts of recreational fishing in the study area (eg threats to the sustainability of local fish stocks)? Provide details of the relevant research/monitoring programs.	Moderate	As above
18.10 What factors have been shown or appear to influence patterns of recreational fishing activity throughout the study area (eg geomorphology such as sandy beach, season/holiday periods, presence of marine hazards such as crocodiles)?	Overview	As above
18.11 What are the requirements of recreational fishing in the study area (eg maintenance of target species habitat)?	Overview	As above
18.12 What strategies is DoF utilising to minimise the environmental impact of recreational fishing (eg closed seasons, closed areas, bag and size limits).	Moderate	As above

- *Obtain datasets of the location and intensity of the major recreational fishing and collecting activities (eg spearfishing, line fishing, crabbing).*

19 Non-extractive recreational activities

Question	Level of Information Required	Suggested Sources
19.1 Identify the major non-extractive recreational activities in the study area and state the: • number of participants per season; and • economic value and significance in an international/national/regional/local context. NB: Activities should be divided into the following general categories: ▪ boating (launches/dinghies, yachts, skiboats, hovercrafting, jetskiing); ▪ beach use (swimming, sunbathing, snorkelling); ▪ scuba-diving ▪ surface water sports – surfing, sea kayaking e.t.c; and ▪ coastal land based activities - camping, picnicing, walking, cycling, photography, nature appreciation e.t.c.	Moderate	Department Local community
19.2 What are the annual recreational events which occur in the study area (eg sporting classics)?	Overview	Department WATC LGAs
19.3 What has been the past trend, and what is the current status and predicted future trend for non-extractive recreational activities in the study area?	Overview	As above
19.4 Have there been any past, and/or are there any current/potential environmental impacts of non-extractive recreational activities in the study area? Provide details of the relevant research/monitoring programs.	Moderate	Department WATC LGAs DPI
19.5 What factors have been shown to or appear to influence patterns of recreational activity throughout the study area (eg geomorphology such as sandy beach or surf break, currents, season/holiday periods, presence of marine hazards such as crocodiles, proximity to population centres)?	Overview	As above
19.6 What are the requirements of the non-extractive recreational activities in the study area?	Overview	As above
19.7 What strategies are the relevant management authorities utilising to minimise the environmental impact of non-extractive recreational activities (eg speed restrictions, restricted access, monitoring)?	Moderate	As above

- *Obtain datasets of:*
  - *the location and intensity of the major non-extractive recreational activities (eg scuba-diving; shore-based activities); and*
  - *designated recreational special use zones (eg jet ski zones) and campsites.*

20 Education

Question	Level of Information Required	Suggested Sources
20.1 What has been the past and what is the current/potential use of the study area for education purposes?	Moderate	Department DPI
20.2 What has been the past and what is the current/potential use of the study area for scientific research purposes?	Moderate	Department Universities
20.3 Are there any existing community monitoring programs in the study area?	Detailed	Department DPI
20.4 What are the requirements of the education use of the study area?	Overview	As above

D RANKING VALUES AND PRIORITIES FOR MANAGEMENT

An essential stage of the planning process is the identification of the key management strategies and priorities for the study area of the proposed marine conservation reserve. Use the information gained from the Resource Assessment and Colman *et al.* (2000) to:

1. Identify and rank the key ecological and social values of the study area by determining:

A. Ecological significance, by considering:

- trophic status;
- areal extent/biomass;
- vulnerability; and
- recovery potential.

B. Biodiversity significance, by considering:

- local significance;
- regional significance;
- national significance; and
- global significance.

C. Cultural significance, by considering:

- social importance;
- economic importance;
- scientific importance; and
- recreational importance.

2. Undertake a risk assessment for the key ecological values of the study area by considering the range of existing and potential threats/pressures and their associated ecological and social implications. Rank the threats to each value by considering:

- biological intensity;
- spatial scale;
- temporal scale;
- likelihood; and
- consequences.

3. Perform an assessment of the adequacy of the existing information base in relation to key values and/or pressures by considering:

- inventories;
- baseline data;
- monitoring parameters; and
- management targets.

E REFERENCES

Australian and New Zealand Environment and Conservation Council (1998). Interim marine and coastal regionalisation of Australia: an ecosystem-based classification for marine and coastal environments. Environment Australia, Canberra.

Colman J G, Simpson C J & Hill A K (2000). A strategic framework for marine research and monitoring in the Shark Bay world heritage property (draft). Department of Conservation and Land Management, Perth.

Conservation and Land Management (1994). A representative marine reserve system for Western Australia. Report of the Marine Parks and Reserves Selection Working Group. Department of Conservation and Land Management, Perth.

WA Government (undated). New Horizons, the way ahead in marine conservation and management. Prepared for the Western Australian Government by the Department of Conservation and Land Management, Perth.

F APPENDICES

APPENDIX I: GIS Data Acquisition Program: Required Datasets for Marine Reservation and Management

Source: GIS Section, Marine Conservation Branch

BASE / CONTEXTUAL DATA

- air photos
- controlled mosaic
- georeferenced nautical charts (navy,DPI)
- georeferenced topo maps
- management unit(dss grid)
- orthophoto
- satellite imagery
- study area
- video/photographic

GEOSCIENCE

- sediment
- substrate

MARINE BIOLOGY

Benthic Habitat

- coral communities
- deepwater habitats
- intertidal limestone pavement
- intertidal reef
- intertidal sand
- macroalgal communities
- mangrove community
- saline coastal flat
- sandy beach
- seagrass communities
- subtidal reef
- subtidal sand

Marine Fauna

- cetaceans
- crocodiles
- dugongs
- fish
- fish spawning and nursery areas
- pinnipeds
- sea snakes
- seabirds
- turtles

METEOROLOGICAL

- wind
- air temp
- cyclones
- radiation
- rainfall

ONSHORE COASTAL(coastal hinterland)

- coastal landforms
- coastline
- hydrology
- Land use
- soils
- topography

PHYSICAL OCEANOGRAPHY

- bathymetry
- currents
- flushing Studies
- salinity
- sea Temperature
- tides
- upwellings
- waves

S0CIO - CULTURAL

Tenure

- Territorial Water Limits
- Existing Management/Ownership
- Conservation Reserve (Departmental)
- other Reserves (Govt /vested)
- private / leasehold / VCL
- Proposed Conservation Reserve
- Marine Park Zoning
- Petroleum Leases
- Mining Leases
- Aboriginal Claim Boundaries

Historical

- Aboriginal Sacred and Ceremonial Sites
- Australian Heritage Commission areas
- heritage / Historical Sites
- shipwrecks

URBAN & TOURIST DEVELOPMENT

Urban

- existing
- proposed

Resort

- existing
- proposed

Camping

- existing
- proposed
- wild (free)

INDUSTRIAL DEVELOPMENT

- mining
- oil & gas exploration
- oil & gas production
- other industry
- shipping

MARITIME INFRASTRUCTURE

- anchorages
- boat ramps
- fish attracting devices
- groynes
- jetties
- lighthouses
- marina facilities
- moorings
- navigable waters regulation areas
- navigation markers
- port facilities
- shipping lanes

RECREATION

Fishing

- rod & line fishing
- boat based
- shore based
- netting
- set
- haul
- throw
- abalone
- bait collection
- crabbing
- drop netting
- game fishing
- rock lobster
- shell collection
- spearfishing

Non extractive

- beach launching
- beach walking
- float planes
- hovercraft
- jet skiing
- kayaks/canoes
- paddle boats
- parasailing
- power boats
- reef walking
- sailing vessels
- scuba diving
- snorkelling
- surfing
- swimming
- water skiing
- wildlife interaction
- wildlife viewing
- windsurfing

SCIENTIFIC

- management (research & monitoring)
- extractive
- non-extractive

COMMERCIAL FISHING

Licence areas and usage data

- abalone
- aquaculture
- collection
- invertebrates
- vertebrates
- fish-trapping
- netting
- rock lobster
- trawling
- wetline fishing

WATER QUALITY

- chlorophyll
- nutrients
- salinity
- temperature
- turbidity

APPENDIX II: Draft Statewide Marine Benthic Habitat Classification System

HABITAT CLASSIFICATION	TIDAL RANGE	SUBSTRATE TYPE	TROPICAL	TEMPERATE	RELIEF	MACROBIOLOGY	SUB -CATEGORIES	COMMENTS
1. Island	Supratidal	Sand igneous metamorphic sedimentary	✓	✓	high & low	Can be vegetated or bare		• Permanent land above HWM • May have seasonal vegetation • Seabirds, terrestrial mammals & reptiles • Important for marine mammals as haul out or breeding areas
2. Rocky shore	Intertidal Supratidal	igneous metamorphic sedimentary	✓	✓	high & low	bare		• continuous rocky shore • cliff, boulders, pavement • around HWM • "*uncomfortable to walk on*"
3. Beach	Intertidal Supratidal	sand	✓	✓	low	bare		• continuous intertidal sand • unvegetated • mobile sands • "*comfortable to walk on*"
4. Salt marsh	Intertidal Supratidal	mud silt	✓	✓	n/a	samphire saltmarsh blue-green algal mats can be bare		• continuous salt marsh cover (>1 ha) • on protected or low energy coastline • often landward of mangals and estuaries • includes unvegetated coastal saline flats
5. Mangal	Intertidal	Muds silts	✓	✓	n/a	mangroves		• continuous mangrove cover (>1 ha) • mud/sand/intertidal reef/shoreline reef may be present • intertidal gastropods and other invertebrates may be present
6. Mudflat	Intertidal	mud silts	✓	✓	low	bare blue-green algal		• continuous mudflat, intertidal or very shallow, <1m lowest astronomical tide (LAT)

HABITAT CLASSIFICATION	TIDAL RANGE	SUBSTRATE TYPE	TROPICAL	TEMPERATE	RELIEF	MACROBIOLOGY	SUB -CATEGORIES	COMMENTS
						mats		• includes mudflats behind mangals • intertidal gastropods and other invertebrates may be present
7. Sand shoal	Intertidal	sand	✓	✓	low	bare little macroalgae		• Often in offshore macrotidal areas • medium to coarse sand • highly mobile sand • Intertidal or very shallow, <1m lowest astronomical tide (LAT)
8. Shoreline reef	Intertidal	igneous metamorphic sedimentary	✓	✓	low	bare, algal turf		• continuous reef platform along the shoreline • may be bare or have macroalgal turf or sand patches • intertidal gastropods and other invertebrates may be present
9. Offshore intertidal reef	Intertidal	igneous metamorphic sedimentary	✓	✓	low	coralline algae, macroalgal turf, macroalgae		• Offshore reef • Intertidal or very shallow, <1m lowest astronomical tide (LAT) • intertidal gastropods and other invertebrates may be present

HABITAT CLASSIFICATION	TIDAL RANGE	SUBSTRATE TYPE	TROPICAL	TEMPERATE	RELIEF	MACROBIOLOGY	SUB-CATEGORIES	COMMENTS
10. Coral reef communities	Intertidal & subtidal	n/a	✓		high & low	hard & soft corals other sessile invertebrates	• **Coral reef communities (subtidal)** - subtidal, often high live coral cover , coral colonies with sand patches in lagoons ➢ *Seaward reef slope* ➢ *Deep lagoon* • **Coral reef communities (intertidal or shallow)** - intertidal or shallow, <1m lowest astronomical tide (LAT), often live coral cover is low, ➢ *Reef crest* ➢ *Back reef* ➢ *Reef flat* ➢ *Shallow lagoon*	• typical coral reef community-hard coral, soft coral, sponges, bryozoans, ascidians, etc. • seaward reef slope, reef crest, back reef, reef flat and individual bommies • some sand, pavement, macroalgae or seagrass interspersed
11. Rubble	Subtidal	dead coral	✓		low	sparse live coral sparse vegetation		• lagoonal areas • mainly unconsolidated coral rubble
12. Subtidal reef platform	Subtidal	igneous metamorphic sedimentary	✓	✓	low	diverse algae sessile invertebrates (including sponges, sea-whips, sea-pens)	• **Subtidal reef platform (high relief)** - >1 m high • **Subtidal reef platform (low relief)** - <1 m high	• includes limestone pavement or low relief reef • may be covered with macroalgae or seagrass, patchy mobile sands • may incorporate sand patches, rubble and scattered isolated corals
13. Macroalgae (limestone reef)	Subtidal	sedimentary	✓	✓	high & low	large fleshy macroalgae invertebrates	• **Macroalgae (limestone reef/high relief)** - >1 m high • **Macroalgae (limestone reef/low relief)** - <1 m high	• typically covered in macroalgae with diverse invertebrate life in overhangs & caves • may incorporate sand patches, rubble and scattered isolated corals

HABITAT CLASSIFICATION	TIDAL RANGE	SUBSTRATE TYPE	TROPICAL	TEMPERATE	RELIEF	MACROBIOLOGY	SUB -CATEGORIES	COMMENTS
14. Macroalgae (granite reef)	Subtidal	igneous metamorphic	✓	✓	high & low	Large fleshy macroalgae invertebrates	• **Macroalgae (granite reef/high relief)** - >1 m high • **Macroalgae (granite reef/low relief)** - <1 m high	• typically covered in macroalgae with diverse invertebrate life in overhangs & caves
15. Seagrass meadows	Subtidal	sand pavement	✓	✓	low	seagrasses	• **Seagrass (perennial)** - ➢ Seagrass (perennial/dense) substrate cover < seagrass cover ➢ Seagrass (perennial/medium) substrate cover = seagrass cover ➢ Seagrass (perennial/sparse) substrate cover > seagrass cover • **Seagrass (ephemeral)** - ➢ Seagrass (ephemeral/dense) substrate cover < seagrass cover ➢ Seagrass (ephemeral/medium) substrate cover = seagrass cover ➢ Seagrass (ephemeral/sparse) substrate cover > seagrass cover	• continuous seagrass coverage (>1 ha) • ephemeral seagrass species *Halophila* *Halodule* • perennial seagrass species *Amphibolis*, *Cymodocea*, *Enhalus*, *Heterozostera*, *Posidonia*, *Syringodium*, *Thalassia* *Thalassodendron*, *Zostera*
16. Sand	Subtidal	Sand (generally white)	✓	✓	low	Bare may have seagrass or macroalgal patches		• little or no vegetation • may have patches of other habitat • may overlay reef platform • may have patches of seagrass or macroalgae • may have seasonal vegetation

HABITAT CLASSIFICATION	TIDAL RANGE	SUBSTRATE TYPE	TROPICAL	TEMPERATE	RELIEF	MACROBIOLOGY	SUB -CATEGORIES	COMMENTS
17. Silt	Subtidal	muds silts	✓	✓	low	bare		• marine and/or terrigenous muds & silts • little or no vegetation • may have seasonal vegetation
18. Pelagic	In waters >50m	various	✓	✓	N/a	Mainly pelagic fish and invertebrates		• This category is specific to those areas that are greater than 50 metres in depth. • May have various substrates however the water column is dominant