PUBLIC ENVIRONMENTAL REVIEW FOR TWO PROPOSALS FOR THE DEVELOPMENT OF A SINGLE BOATING FACILITY AT EITHER MONCK HEAD OR NORTH BILLS BAY, NEAR CORAL BAY

Prepared for:

Department for Planning and Infrastructure

Prepared by:

DAL Science & Engineering Pty Ltd

In collaboration with:

Environmental Advisory Services
Goble-Garratt & Associates
Michael Robinson & Associates
Kelley Whitaker

AUGUST 2002

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Prepared for:

ENVIRONMENTAL PROTECTION AUTHORITY

Prepared on behalf of:

DEPARTMENT FOR PLANNING AND INFRASTRUCTURE

Prepared by:

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AUGUST 2002

REPORT NO. 97/050/21

INVITATION TO MAKE A SUBMISSION

The Environmental Protection Authority (EPA) invites people to make a submission on either or both of these proposals for a boating facility near Coral Bay.

The Department for Planning and Infrastructure (DPI) proposes to develop a single boating facility at either Monck Head or North Bills Bay, in the vicinity of Coral Bay. In accordance with the Environmental Protection Act 1986, a Public Environmental Review (PER) has been prepared which describes the two alternative options for the boating facility and the likely effects on the environment of each option. The PER is available for a public review period of [8] weeks from 5th August 2002 closing on 1st October 2002.

Comments from government agencies and from the public will help the EPA to prepare an assessment report in which it will make recommendations to government regarding these two alternatives.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action, including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act 1992, and may be quoted in full or in part in the EPA's report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to ten people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

This document is different in that it describes the environmental impacts and the proposed environmental management procedures for two proposals, only one of which is to be constructed. It would be preferred that your submission makes it clear as to which proposal the comments relate.

When making comments on specific elements of the PER:

- Clearly state your point of view;
- Indicate the source of your information or argument if this is applicable; and
- Suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- Attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- Refer each point to the appropriate section, chapter or recommendation in the PER;
- If you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- Attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- Name;
- Address;
- Date; and
- Whether you want your submission to be confidential.

The closing date for submissions is: 1st October 2002.

Submissions ideally should be emailed if possible to:
emma.hopkins@environ.wa.gov.au
OR addressed to:

The Chairman
Environmental Protection Authority
PO Box K822
PERTH WA 6842

Attention: **Emma Hopkins**.

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EXECUTIVE SUMMARY

The Department for Planning and Infrastructure (DPI—formerly Department of Transport) is seeking an environmental assessment for the development of a single boating facility at either Monck Head or North Bills Bay, near Coral Bay. Both facilities essentially provide similar services for the launching of small trailered craft and for mooring and fuelling of large non-trailered vessels.

For the purposes of the Environmental Protection Authority's (EPA) assessment, the two facilities are being considered as separate proposals. The DPI understands the EPA will report on both proposals in a single report to the Minister for the Environment and Heritage. The EPA's report will assist the Government in making a decision on which facility should be constructed.

The DPI has been approached by several agencies, including the Shire of Carnarvon and Gascoyne Development Commission, to investigate the development of a boating facility in the vicinity of Coral Bay. The development of a boating facility will enable the reduction of boating activity in Southern Bills Bay with the concomitant minimisation of physical damage to the coral formations, reduced risk of fuel spills and increased safety of swimmers in the Southern Bills Bay area. The boating facility will enable the launching and retrieval of trailered boats and provide for mooring, loading and fuelling of non-trailered boats. Following completion, the responsibility for ongoing management and maintenance of the boating facility will be transferred to the Department of Conservation and Land Management (CALM), and the Shire of Carnarvon will be responsible for maintaining the access road to the facility.

A proposal for a boating facility in the vicinity of Coral Bay was referred to the EPA by the then Department of Transport in 1998. The EPA considered that the impacts of such a proposal warranted a formal level of assessment, namely Public Environmental Review. This PER document has been prepared to address the environmental factors which the EPA considered were relevant to the proposal as referred in 1998.

It should also be noted a proposal for a commercial marina resort village, the Coral Coast Resort development, at nearby Mauds Landing (within Bateman Bay), is being assessed by the EPA at the level of Public Environmental Review. The Coral Coast Resort is also undergoing concurrent environmental assessment under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. Public boating facilities would be provided in the marina of the Coral Coast Resort; however, periods of moderate to high wave-energy occur regularly within Bateman Bay and these conditions would preclude small craft access to and from this site. Hence, even if this private development were constructed there would remain a need for sheltered facilities for small trailered boats.

In this PER document, the DPI, on behalf of the future facility managers (CALM), seeks an environmental assessment for the development of a single boating facility at either Monck Head or North Bills Bay. It was considered that a facility at either of these sites would complement any private development at Mauds Landing. The environmental issues associated with the development of either of these two sites are examined in detail within this report.

A site in the vicinity of Mauds Landing was also initially considered by the former Department of Transport for the development of this public boating facility. However, a proposal for a facility at this site is not given consideration in this PER document. As noted above, this site is frequently exposed to high-energy wave conditions which would frequently preclude the passage of small craft to and from a facility at this location. Accordingly, as the majority of boats used at Coral Bay are small craft (<6 m in length), the DPI is of the view that a boating facility at Mauds Landing would not address all of the boating needs of Coral Bay. The higher energy conditions at the Mauds Landing site would also require the construction of a substantial

breakwater which would significantly increase the comparative cost of developing a boating facility at this site. Should a private marina development proceed at Mauds Landing, it would provide an appropriate base for the larger commercial vessels at Coral Bay and use by smaller trailered boats during quiescent weather conditions. The information contained within the accompanying Technical Appendices relating to a proposal for a boating facility at Mauds Landing is not considered to be relevant to the current environmental assessment as the DPI, after considering the above factors, has eliminated this site from further consideration for a boating facility at this time.

The proposals for a boating facility at either Monck Head or North Bills Bay are summarised briefly on the preceding pages in tables and in text. More detailed information on the proposals and their potential environmental impacts can be found throughout this PER document and the Technical Appendices which accompany the main PER document.

MONCK HEAD BOATING FACILITY

A facility at Monck Head would not require any dredging during construction and would only require minor excavation work near the boat ramp on an infrequent basis. The key elements for the Monck Head development include: offshore moorings, offshore boat launching ramp, piled bridge and culvert causeway, access road, car park and refuelling facilities (Table A1).

Table A1 Key proposal characteristics for the proposed Monck Head boating facility

ELEMENT	DESCRIPTION
Proposal	Monck Head boating facility
Proponent	Department for Planning and Infrastructure
Location	Monck Head, Coral Bay
Marine facilities	
Offshore moorings	For use by non-trailered vessels.
Offshore boat launching ramp	Rubble mound structure with two ramps facing approximately north east. A navigable water depth of at least –1.0 m Chart Datum will be provided at the base of the boat ramp. The breakwater will be constructed through the back loading of core material and placement of armour stones
Piled bridge and culvert causeway	Connecting the offshore boat launching ramp to the shoreline. This structure will minimise the interruption of the longshore sediment transport
Two jetties	Placed on either side of the two ramps to serve as boat holding structures. Western jetty will also serve as a wave screen to further reduce wave energy at the ramp. This jetty will also facilitate boat loading and unloading and refuelling of larger non-trailered vessels.
Channel markers	To assist navigation on the approach to the boating facility. In particular, the recommended boating track which parallels the back reef from Monck Head to Point Maud will be marked.
Terrestrial facilities	
Upgrade existing access	The existing access from the settlement to Monck Head is approximately 1.5 km long and will be upgraded to accommodate heavy vehicles for the transport of construction materials. This carriageway will be widened to approximately 14.4 m.
Car parking	Car parking for approximately 100 vehicles will be provided and will accommodate bus coaches and vehicles with trailers The total area of the car park will be approximately 1 ha.
Water tanks	Two tanks will be installed on-site: one to provide fresh water for drinking and the second to provide groundwater for hand washing and fish-cleaning. The water tanks will be regularly filled by hauling water from Coral Bay.
Public toilet facility	Using a dry-compost sealed system. This system will be low maintenance, fully sealed and will not require water for flushing.
Fish-cleaning facility	Facility for cleaning, scaling and gutting of fish. Solid waste reception facilities shall be provided on site and these facilities will be disposed of at the existing Coral Bay waste disposal site. The limited liquid waste will be discharged to a small groundwater soak.
Fuel storage tanks	Approximately 10,000 to 20,000 L of diesel fuel will be stored at the facility. The fuel will be stored in two, low profile, steel storage tanks which will be located in a lined and bunded storage area. Refuelling for non-trailered vessels is intended as an interim measure until this function can be provided elsewhere, possibly at the proposed private Coral Coast Resort at Mauds Landing.
On-site generator	Used to operate dieseline fuel pumps.
Limited public lighting	To illuminate car park and ramp areas.

The proposed Monck Head boating facility will provide services for both trailered craft and non-trailered vessels. However, the provision of refuelling facilities for the non-trailered boats is proposed as an interim solution pending any private development at Mauds Landing. A boating facility at Monck Head would provide the following advantages:

- The facility would lie outside the protected Maud Sanctuary Zone;
- The trailered craft would have improved access to the waters of the region;
- Non-trailered craft would be able to load and refuel from the service jetty and swing moor in the vicinity;
- Road access is already provided and would only require upgrading;
- The location and orientation affords some shelter from the prevailing south to south-westerly winds;

- The risk of injury to swimmers, physical damage to corals and fuel spills in Southern Bills Bay is reduced; and
- A facility for trailered craft would complement any private development at Mauds Landing.

The impacts of the development of a boating facility at North Bills Bay on the relevant environmental factors are outlined in Table A2. The environmental 'costs' associated with a boating facility at Monck Head include the following:

- Increased travel distance (approximately 1.5 km) from the accommodation at Coral Bay to the proposed site;
- Potential for increased fishing pressure due to increased boating usage of the area (this impact could be managed through the introduction of stricter controls and bag limits);
- Minor loss of macroalgae and hard/soft corals on the shore platform due to the construction of the piling jetty and culvert causeway;
- Minor negative impacts on terrestrial flora and fauna due to road widening and car park construction;
- Adverse impact on archaeological material due to road widening and construction of the car park; and
- If a spill were to occur from the refuelling facility it is anticipated that the fuel concentrations in waters overlying the corals would be far lower than levels at which toxicity effects occur. However, the prevailing winds and northerly currents would push the spill on to Paradise Beach and the intertidal communities in this area would suffer acute toxicity effects.

The environmental 'benefits' associated with a boating facility at Monck Head include the following:

- Relocation of the majority of the boating activity from Southern Bills Bay and Paradise Beach will reduce the conflict of use with the swimmers and snorkellers, and the associated safety issues;
- The potential for coral damage through boating impacts and anchoring in Southern Bills Bay will be considerably reduced; and
- The provision of formalised boat fuelling and mooring facilities will improve the boating amenity of the area.

It is concluded that the construction and operation of a boating facility at Monck Head can be undertaken and managed to meet the EPA's objectives.

Table A2 Summary of relevant environmental factors, potential impacts and proposed management for the Monck Head boating facility

ENVIRONMENTAL FACTOR	ENVIRONMENTAL OBJECTIVE	POTENTIAL IMPACT	PROPOSED MANAGEMENT OF ENVIRONMENTAL FACTOR	PREDICTED OUTCOME
Terrestrial vegetation	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities	Localised loss of coastal communities due to road and car park construction	The existing road to Monck Head will be used to minimise impact on terrestrial vegetation communities	Minimal disturbance to the terrestrial vegetation will occur with the road construction as the present alignment will be used. Car park construction will occur on the flat dune swale area to the north of Monck Head. The vegetation in this area has been overrun by Buffel Grass and is in poor condition and the impact should be minor
Terrestrial fauna	Maintain the abundance, species diversity and geographical distribution of terrestrial fauna	Localised loss of coastal habitat	Presence of rare and priority fauna in area considered unlikely. Impacts localised and mostly limited to disturbance during construction period. Restrict pedestrian access to parabolic dunes immediately east of Monck Head	No impact on abundance, species diversity and geographical distribution of terrestrial fauna
Marine flora—macroalgae	Maintain the ecological function, abundance, species diversity and geographic distribution of marine flora	Localised loss of natural macroalgal habitat	Macroalgal growth on facility will supplement losses of natural habitat. No priority species identified	No impact on ecological function, abundance, species diversity and geographic distribution of macroalgae
Coast—dunes	Maintain the integrity, function and environmental values of the dune system	Localised loss and instability of dunes due to road and car park construction	Existing road alignment will be used for access to Monck Head. Car park will be constructed in dune swale area where dune elevation is low.	Minimal impact on the integrity, function and environmental values of the dune system
Coast—seabed	Minimise significant impact on existing coastal processes, including offshore sediment movement	No change in longshore sediment movement	Open causeway to offshore launching ramp will enable free transport of sediment.	No change in longshore sediment movement
Coast—sea level	Development should not increase the potential impact on the environment from storm surge	No change in potential impact from storm surges	No change in potential impact from storm surges	No change in potential impact from storm surges
Marine water and sediment quality—hydrocarbons	Maintain or improve the quality of marine water and sediment consistent with the draft WA Guidelines for Fresh and Marine Waters (ANZECC/ARMCANZ, 2000)	Surface run-off from car park and launching ramp	Site drainage to be directed away from the marine environment. Refuelling of trailered craft not permitted at the Boating Facility	Minimal impacts expected
Marine water and sediment quality—turbidity	Ensure that development does not result in increased turbidity	Increased turbidity during construction	Turbidity levels to be monitored during construction	Expected to be small-scale, localised and of very short duration
Marine water and sediment quality—fuel spills	Ensure that the risk of a fuel spill is extremely low and that actions are taken to reduce identified risks	Worst impacts from a fuel spill will be felt by biota on intertidal reef and beach areas which are classified as having moderate environmental sensitivity.	Refuelling facility constructed to appropriate Australian Standard with safety mechanisms and regular maintenance. Emergency response plan for fuel spills will be prepared	Low risk of effects on receptors of 'moderate' environmental sensitivity and very low risk of effects on receptors of 'extreme' environmental sensitivity

ENVIRONMENTAL FACTOR	ENVIRONMENTAL OBJECTIVE	POTENTIAL IMPACT	PROPOSED MANAGEMENT OF ENVIRONMENTAL FACTOR	PREDICTED OUTCOME
Solid waste/sewage	Encourage waste minimisation, recycling and sustainable use and ensure that solid waste and sewage from the development is disposed of in an environmentally acceptable manner	Fish-cleaning and toilet facilities will generate solid waste/sewage	Use of sealed toilet system. Solid wastes will be regularly transferred to existing waste disposal site	Solid waste will be disposed of in an environmentally acceptable manner
Aboriginal culture and heritage	Ensure the proposal complies with the requirements of the Aboriginal Heritage Act 1972. Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area	Road and car park construction may disturb archaeological material	Access road will be aligned along existing route to minimise further impacts. Aboriginal representatives to be present during construction. Access to dune to the east of Monck Head will be restricted	Minimal impact expected
Recreation	Recreational amenity of Coral Bay should not be unduly affected by the proposal	No loss of recreational amenity.	Facility will increase most recreational amenities of the Monck Head area.	Facility will increase recreational amenities
Management responsibility	Ensure that a clear defined management structure is in place which delineates responsibilities for on-going management and monitoring of the environmental health of the boating facility	DPI to hand over management and maintenance of facility after construction	The management of the facility will be undertaken in accordance with the Ningaloo Marine Park management plan	CALM will take responsibility for ongoing management and maintenance of the facility. Management of the road access will become the responsibility of the Shire
Public health and safety	Ensure that public risk associated with the boating facility is as low as reasonably achievable	Possible conflict of use between boats and swimmers. Possible increased use of Yalobia Passage to the south which may be unsafe for navigation during various combinations of wind, swell and tide	Signs and buoys shall be installed, restricting boat access along the shore to the north which is a popular swimming area. The navigation chart will be reissued with increased warnings regarding use of Yalobia Passage	Location at Monck Head will greatly reduce boating traffic along popular swimming area between Southern Bills Bay and Monck Head. Increased warnings regarding Yalobia Passage should reduce risk associated with traversing this passage

NORTH BILLS BAY BOATING FACILITY

Due to the moderate prevailing wave energy at North Bills Bay, a wave protection system would be required to enable safe boat launching and pen moorings. To minimise the impact of sediment accumulation at the boat ramp, a connected breakwater would be required. The key elements of a boating facility at North Bills Bay include: offshore breakwater, boat launching ramp, mooring pens, access road, car park, and refuelling facilities (Table A3).

Table A3 Key proposal characteristics for the proposed North Bills Bay boating facility

ELEMENT	DESCRIPTION
Proposal	North Bills Bay boating facility
Proponent	Department for Planning and Infrastructure
Location	North Bills Bay, Coral Bay
Marine facilities	
Breakwater	A breakwater will be constructed to shelter the boat ramp, service jetty and mooring pens from the prevailing waves. Hind cast modelling shows that the typical average daily maximum wave height at this site is 0.4 m which indicates that boat launching at this site would require protection from wave energy via a breakwater (Egis Consulting, 1997). The breakwater will also minimise sedimentation within the harbour and will be constructed through the back loading of core material and placement of armour units from the beach and moving offshore. Without the breakwater, it is likely that the ramp would be periodically swamped with sand rendering it unusable. A navigable water depth of at least 1.4 m Chart Datum will be provided within the harbour.
Two lane boat launching ramp	For use by trailered craft. A small finger jetty will be located between the ramps to facilitate loading.
Service wharf	Located within the boat harbour.
Mooring pens	A limited number of mooring pens will be located within the boat harbour.
Channel markers	To assist navigation on the approach to the boating facility. Channel markers will also be installed to mark navigation channels through the lagoon area, in particular, the recommended boating track which parallels the back reef from Monck Head to Point Maud.
Dredging	Limited dredging will be required following construction to maintain navigable access.
Terrestrial Facilities	
Access road	The existing access road from the settlement to Mauds Landing is approximately 4.2 km long and a new access road (approximately 1.8 km) would be constructed from Mauds Landing through the dunes of Point Maud to the North Bills Bay site. The road will be constructed to accommodate heavy vehicles for the transport of construction materials and will be approximately 14.4 m to provide two-lane access.
Car parking	Car parking for approximately 100 vehicles will be provided and will accommodate bus coaches and vehicles with trailers. The total area of the car park will be approximately 1 ha.
Water tanks	Two tanks will be installed on-site: one to provide fresh water for drinking and the second to provide groundwater for hand washing and fish-cleaning. The water tanks will be regularly filled by hauling water from Coral Bay.
Public toilet facility	Using a dry-compost sealed system. This system will be low maintenance, fully sealed and will not require water for flushing.
Fish-cleaning facility	Facility for cleaning, scaling and gutting of fish. Solid waste reception facilities shall be provided on site and these facilities will be disposed of at the existing Coral Bay waste disposal site. The limited liquid waste will be discharged to a small groundwater soak.
Fuel storage tanks	Approximately 10,000 to 20,000 L of diesel fuel will be stored at the facility. The fuel will be stored in two, low profile, steel storage tanks which will be located in a lined and bunded storage area. Refuelling for non-trailered vessels is intended as an interim measure until this function can be provided elsewhere, possibly at the proposed private Coral Coast Resort at Mauds Landing.
On-site generator	Used to operate dieseline fuel pumps.
Limited public lighting	To illuminate car park and ramp areas.

The impacts of the development of a boating facility at North Bills Bay on the relevant environmental factors are outlined in Table A4. The proposed North Bills Bay boating facility will provide services for both trailered craft and non-trailered vessels. However, the provision of refuelling facilities for the non-trailered boats is proposed as an interim solution pending any private development at Mauds Landing.

A boating facility at North Bills Bay would provide the following advantages:

- The trailered craft would have improved access to the waters of the region, especially to Bateman Bay and Cardabia Passage to the north;
- Non-trailered craft would have fixed pens and be able to load and refuel from the service jetty;
- Reduces the risk of injury to swimmers, physical damage to corals and fuel spills in Southern Bills Bay; and
- A facility for trailered craft which would compliment any private development at Mauds Landing.

The environmental 'costs' associated with a boating facility at North Bills Bay include the following:

- Increased travel distance (approximately 6 km) from the accommodation at Coral Bay to the proposed site;
- Need for ongoing management of coastal sediment transport;
- Potential for a more rapid increase in boat traffic in the area and pedestrian traffic at Point Maud and Skeleton Beach. Along with the increased boating traffic, there is likely to be an increase in fishing pressure, boating noise and potential for boating strikes on larger marine fauna. The increased pedestrian traffic has the potential to increase the disturbance of the Point Maud bird roosting and also on the schools of sharks in Skeleton Bay (between late-August and December);
- Loss of inshore corals due to the construction of the breakwater and harbour basin;
- Minor negative impacts on terrestrial flora and fauna due to road and car park construction;
- Adverse impact on archaeological material due to road and car park construction; and
- If a spill were to occur from the refuelling facility, and be released from the boat harbour, it is anticipated that the fuel concentrations in waters overlying the corals would be far lower than levels at which toxicity effects occur. However, the prevailing winds and northerly currents would push the spill towards Point Maud where it would cause acute toxicity effects on the intertidal communities (including bird sanctuary).

The environmental 'benefits' associated with a boating facility at North Bills Bay include the following:

- Relocation of the majority of the boating activity from Southern Bills Bay and Paradise Beach will reduce the conflict of use with the swimmers and snorkellers and the associated safety issues;
- The potential for coral damage through boating impacts and anchoring in Southern Bills Bay will be considerably reduced;
- Formalised boating and fuelling facilities within the semi-enclosed harbour should reduce the potential risk for fuel spills when compared with the existing informal operations at Southern Bills Bay; and
- The provision of boat moorings and a boating beach will improve the boating amenity of the area.

It is concluded, it is considered that the construction and operation of a boating facility at North Bills Bay can be undertaken and managed to meet the EPA's objectives.

CONCLUSION

In conclusion, DPI, on behalf of the facility managers (CALM), is seeking an environmental assessment for the development of a single boating facility at either Monck Head or North Bills Bay. The EPA's assessment report will assist the Government in making a decision on the preferred site for a boating facility.

Table A4 Summary of relevant environmental factors, potential impacts and proposed management for the North Bills Bay boating facility

ENVIRONMENTAL FACTOR	ENVIRONMENTAL OBJECTIVE	POTENTIAL IMPACT	PROPOSED MANAGEMENT OF ENVIRONMENTAL FACTOR	PREDICTED OUTCOME
Terrestrial vegetation	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities	Localised loss of coastal communities due to road and car park construction and potential loss of some CALM Priority 2 species (*Acacia ryaniana*)	The existing road to Mauds Landing will be used to minimise impact on terrestrial vegetation communities	Minimal disturbance to the terrestrial vegetation will occur with the road construction to Mauds Landing as the present alignment will be used. The road from Mauds Landing to North Bills Bay will be aligned with the dune swales to minimise potential for wind erosion. Impact on the *Acacia ryaniana* is likely to be minimal due to the widespread and scattered distribution of these plants. Car park construction will occur on the low beach ridge plain to the north of the boating facility.
Terrestrial fauna	Maintain the abundance, species diversity and geographical distribution of terrestrial fauna	Minor impact of construction noise on birds at Point Maud. Small adverse impact on the birds at Point Maud due to increased presence of people in the area.	Management of pedestrian access to Point Maud may be implemented if required.	Some minor negative impacts on abundance, species diversity and geographical distribution of terrestrial fauna
Marine flora—macroalgae	Maintain the ecological function, abundance, species diversity and geographic distribution of marine flora	Localised loss of natural macroalgal habitat.	Macroalgal growth on facility will supplement losses of natural habitat. No priority species identified.	No impact on ecological function, abundance, species diversity and geographic distribution of macroalgae
Coast—dunes	Maintain the integrity, function and environmental values of the dune system	Localised loss and instability of dunes due to road and car park construction.	Existing road alignment to Mauds Landing will be used. Road from Mauds Landing to North Bills Bay will be aligned with the dune swales and crossings of the dune crests will be minimised. Car park will be constructed in low beach ridge plain where dune elevation is low.	Slight impact on the integrity, function and environmental values of the dune system
Coast—seabed	Minimise significant impact on existing coastal processes, including offshore sediment movement	Prevailing longshore sediment movement from south to north will be interrupted.	Regular sediment bypassing operation will be required to move sediment around the facility.	Bypassing of sediment will be managed to maintain existing longshore sediment movement.
Coast—sea level	Development should not increase the potential impact on the environment from storm surge	No change in potential impact from storm surges	No change in potential impact from storm surges.	No change in potential impact from storm surges.
Marine water and sediment quality—hydrocarbons	Maintain or improve the quality of marine water and sediment consistent with the draft WA Guidelines for Fresh and Marine Waters (ANZECC/ARMCANZ, 2000)	Small potential for surface run-off from launching ramp	Site drainage to be directed away from the marine environment. Refuelling of trailered craft not permitted at the Boating Facility.	Minimal impacts expected.
Marine water and sediment quality—turbidity	Ensure that development does not result in increased turbidity	Increased turbidity during construction.	Turbidity levels to be monitored during construction and a silt curtain will be deployed if necessary.	Expected to be small-scale, localised and of short duration.

ENVIRONMENTAL FACTOR	ENVIRONMENTAL OBJECTIVE	POTENTIAL IMPACT	PROPOSED MANAGEMENT OF ENVIRONMENTAL FACTOR	PREDICTED OUTCOME
Marine water and sediment quality—fuel spills	Ensure that the risk of a fuel spill is extremely low and that actions are taken to reduce identified risks	If a fuel spill exits from the fuelling facility there is the potential for adverse impacts on intertidal communities at Point Maud which are classified as having extreme environmental sensitivity.	Refuelling facility constructed to appropriate Australian Standard with safety mechanisms and regular maintenance. Emergency response plan for fuel spills will be prepared.	Low risk of effects on receptors of 'extreme' environmental sensitivity.
Solid waste/sewage	Encourage waste minimisation, recycling and sustainable use and ensure that solid waste and sewage from the development is disposed of in an environmentally acceptable manner	Fish-cleaning and toilet facilities will generate solid waste/sewage	Use of sealed toilet system. Solid wastes will be regularly transferred to existing waste disposal site.	Solid waste will be disposed of in an environmentally acceptable manner.
Aboriginal culture and heritage	Ensure the proposal complies with the requirements of the Aboriginal Heritage Act 1972. Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	Road and car park construction may disturb archaeological material and/or burial sites.	Access road will generally be aligned with the dune swales along existing route to minimise further impacts. Aboriginal representatives to be present during construction.	Minimal impact is expected.
Recreation	Recreational amenity of Coral Bay should not be unduly affected by the proposal	No loss of recreational amenity.	Facility will increase most recreational amenities of the North Bills Bay area.	Facility will increase recreational amenities.
Management responsibility	Ensure that a clear defined management structure is in place which delineates responsibilities for on-going management and monitoring of the environmental health of the boating facility	DPI to hand over management and maintenance of facility after construction.	The management of the facility will be undertaken in accordance with the Ningaloo Marine Park management plan.	CALM will take responsibility for ongoing management and maintenance of the facility. Management of the road access will become the responsibility of the Shire.
Public health and safety	Ensure that public risk associated with the boating facility is as low as reasonably achievable	Possible conflict of use between boats and swimmers.	The recommended boating track will be marked to provide passage to the boating facility.	Location at North Bills Bay will greatly reduce boating traffic along popular swimming area between Southern Bills Bay and Monck Head. This location should also increase the usage of the Cardabia Passage and reduce the usage of the Yalobia Passage.

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1. INTRODUCTION

1.1 BACKGROUND

Coral Bay is a small coastal tourist settlement adjacent to the Ningaloo Reef and situated on the southern shore of Bills Bay, North West Cape, Western Australia (Figure 1). Bills Bay has an extensive lagoonal coral assemblage, and is one of the few locations along the Ningaloo Reef where well-developed coral communities are accessible to swimmers and divers from the shore. The importance of this area has long been recognised and it has been a marine reserve for over 20 years (BBG, 1995). Coral Bay is presently the only settlement along the Ningaloo Reef Marine Park which offers formal accommodation, fuel and shopping facilities. Hence, the settlement represents one of the few focus points for recreational and commercial marine-based activities in this region. The marine-based activities occurring in Coral Bay include swimming, snorkelling and fishing; in addition sport diving and coral viewing operations operate from Coral Bay.

Due to the increase in boating activity in the Coral Bay region, the Department for Planning and Infrastructure (DPI—formerly Department of Transport) is investigating the development of a boating facility that aims to remove all boating activity (except glass bottomed tour boats and non-powered craft as determined) from Southern Bills Bay. Following satisfactory completion and operation of the boating facility, it is intended that a notice pursuant to Section 66 of the Western Australian Marine Act 1982 be published closing navigable waters of Southern Bills Bay to all vessels except glass bottomed tour vessels and non-powered craft. It is anticipated that this relocation of boating activity will help to minimise the physical damage to the coral formations, reduce the risk of fuel spills and increase the safety of swimmers in Southern Bills Bay.

The DPI, on behalf of the future facility managers, the Department of Conservation and Land Management (CALM), is seeking an environmental assessment for the development of a single boating facility at either Monck Head or North Bills Bay in the vicinity of Coral Bay. The proposal for the Monck Head site would include a nearshore rubble-mound structure with two boat ramps. This structure will be connected to the shore via a pile bridge and culvert causeway. The proposal for the North Bills Bay site would include a breakwater to shelter a boat ramp, service jetty and mooring pens. At either site, the boating facility would include an access road, car park, public toilets, boat fuelling facilities and limited public lighting.

1.2 THE PROPONENT

The development of a boating facility in the vicinity of Coral Bay is proposed by the Department for Planning and Infrastructure (DPI). Following construction, the responsibility for ongoing management and maintenance for this facility will be transferred to CALM. The Shire of Carnarvon will become responsible for management and maintenance of the access roads. The client representative for the proposed boating facility is:

Mr Martin Baird
Planning Manager, Coastal Asset Management
Department for Planning and Infrastructure
1 Essex Street, FREMANTLE WA 6160
PO Box 402, FREMANTLE WA 6959
Fax: (08) 9216 8983
Email: mbaird@transport.wa.gov.au

1.3 STATUTORY FRAMEWORK

Legislation, which directly affects the development and management of the boating facility at Coral Bay includes the following Commonwealth and State legislation (the key legislation for this development are shown in bold):

Commonwealth Legislation

Australian Heritage Commission Act 1995
Environmental Protection and Biodiversity Conservation Act 1999
Native Title Act 1993

The Environmental Protection and Biodiversity Conservation (EPBC) Act 1999 is administered by Environment Australia and the Commonwealth Environment Minister. The EPBC Act 1999 provides for the protection of the environment, especially those aspects which are matters of national environmental significance, these are:

- World Heritage areas;
- RAMSAR wetlands of international importance;
- Nationally threatened animal and plant species and ecological communities;
- Internationally protected migratory species;
- Commonwealth marine areas; and
- Nuclear actions.

The Native Title Act 1993 provides common law recognition of a form of native title which exists in accordance with the laws and customs of indigenous people where: those people have maintained their traditional connection with the land; and their title has not been 'extinguished' by a legislative or other act of government.

State Legislation

Aboriginal Heritage Act 1972
Conservation and Land Management Act 1984
Control of Vehicles (Off-road Areas) Act 1978
Dangerous Goods (Transport) Act 1998
Environmental Protection Act 1986
Explosive and Dangerous Goods Act 1961
Fish Resources Management Act 1994
Health Act 1991 and Regulations
Heritage of Western Australia Act 1990
Land Administration Act 1997
Local Government Act 1995
Marine and Harbours Act 1981
Marine Navigation Aids Act 1973
Museum Act 1969
Native Title (State Provisions) Act 1999
Parks and Reserves Act 1895
Pollution of Waters by Oil and Noxious Substances Act 1987
Shipping and Pilotage Act 1967–1978
Soil and Land Conservation Act 1945–1982
Western Australian Marine Act 1982
Wildlife Conservation Act 1950–1975

The Aboriginal Heritage Act 1972 is regulated by the Aboriginal Affairs Department and provides legislative protection for Aboriginal sites that have been, or are currently of cultural significance. Sacred beliefs and ritual/ceremonial usage are to be the primary considerations in the evaluation of places under the Act.

The Conservation and Land Management Act 1984 is regulated by the Department of Conservation and Land Management and provides for the use, protection and management of certain public lands and waters and the associated flora and fauna.

The Control of Vehicles (Off-road Areas) Act 1978 enables the use of off-road vehicles to be restricted in certain places and to provide for areas where the use of off-road vehicles shall be permitted.

The Environmental Protection Act 1986 is regulated by the Department of Environmental Protection and the Environmental Protection Authority and provides for the conservation and management of the environment and the control and abatement of environmental pollution. This Act generally prevails over other State legislation.

Fish Resources Management Act 1994 is administered by Fisheries WA and relates to the conservation of fish stocks and their habitat, development of fishing and aquaculture industries and optimum economic, social and other benefits from the sustainable exploitation of fish resources.

The Heritage of Western Australia Act 1990 is administered by the Heritage Council of Western Australia and provides and encourages the conservation of places which have significance to the cultural heritage in the State.

Native Title (State Provisions) Act 1999 makes alternative provisions to those contained in the Commonwealth Native Title Act 1993. These provisions are intended to deal with acts on pastoral lease or reserve land that would otherwise be subject to the right to negotiate provisions under the Native Title Act 1993. Those acts will principally be any act that creates a right to mine and any compulsory acquisition of native title rights and interests.

The Soil and Land Conservation Act 1945–1982 is administered by Agriculture Western Australia and provides for the conservation of soil and land resources. The act is intended to enable: mitigation of the effects of erosion, salinity and flooding; removal or deterioration of natural or introduced vegetation; and protection of natural vegetation.

The Wildlife Conservation Act 1950–1975 provides for the conservation and protection of wildlife and is administered by the Department of Conservation and Land Management.

1.4 ASSESSMENT AND APPROVALS PROCESS

It is noted that under Part IV of the Environmental Protection Act 1986 the process of environmental approval for the Coral Bay boating facility is preceding using the Section 38 assessment process. In summary, this process includes the following steps:

- Submission of referral document to the Environmental Protection Authority (EPA);

- EPA determines the level of assessment required. If a formal assessment is determined then the EPA also prepare guidelines to assist with the preparation of the review document;
- Submission of review document (in the case of the boating facility this was determined to be a Public Environmental Review [PER]);
- Release review document and seek public submissions;
- Prepare and submit responses to the public submissions to the EPA;
- EPA prepare bulletin and forward recommendations to the Minister for the Environment and Heritage;
- Within a period of two weeks following the release of the EPA's report, any person can appeal to the Minister for the Environment and Heritage if they disagree with the content of the EPA's report and/or recommendations; and
- Minister for the Environment and Heritage makes decision as to whether the proposal can proceed and if any conditions should be applied to it after determining any appeals.

In 1997 the DPI submitted a referral document for the Coral Bay Boating Facility to the EPA (DAL, 1997). The EPA determined the level of assessment to be a Public Environmental Review (PER) in mid-January 1998 (see Appendix A for a copy of the EPA guidelines). The present document represents this PER.

The development of the Coral Bay Boating Facility at either the Monck Head or North Bills Bay sites will require a zoning amendment, and therefore planning approval and a change to the scheme amendment is still required.

Referral of the Coral Bay Boating Facility to Environment Australia under the EPBC Act may also yet be required.

1.5 AIM AND CONTENT OF THE DOCUMENT

The DPI have commissioned DAL Science & Engineering (DALSE—formerly D.A. Lord & Associates Pty Ltd [DAL]) to lead a team of consultants to investigate the biophysical, cultural and social issues associated with the development of a boating facility near Coral Bay. The present Public Environmental Review (PER) document provides a detailed assessment of the biological, physical, cultural and social issues associated with the potential development of a boating facility at either Monck Head or North Bills Bay.

This PER presents a summary of the findings described in the following technical reports (which are provided as a separate volume of Technical Appendices and are reference throughout this PER):

- Coral Bay Boating Facility: Coastal Geomorphology and Processes, prepared by DAL Science & Engineering (Technical Appendix 1);
- Coral Bay Boating Facility: Marine Water and Sediment Quality, prepared by DAL Science & Engineering (Technical Appendix 2);
- Coral Bay Boating Facility: Fuel Spill Environmental Risk Assessment, prepared by DAL Science & Engineering (Technical Appendix 3);
- Proposed Boating Facility: Coral Bay Terrestrial Vegetation and Fauna Study, prepared by Goble-Garratt & Associates (Technical Appendix 4);

- Survey of the Marine Habitats and Assessment of Conservation Values of Marine Fauna and Flora for the Proposed Coral Bay Boating Facility, prepared by Kelley Whitaker (Technical Appendix 5);
- Coral Bay Boat Launching Facilities: Report on Archaeological and Anthropological Issues, Michael Robinson & Associates (Technical Appendix 6); and
- Coral Bay Boating Facility: Consultation with Local and State Government Agencies, Interest Groups and Land Owners, prepared by Environmental Advisory Services (Technical Appendix 7).

In addition, studies of the coastal processes, shoreline movement and preliminary engineering concept designs have been conducted (Egis Consulting, 1997; 1999).

2. PROJECT JUSTIFICATION

2.1 REQUIREMENT FOR A BOATING FACILITY

Coral Bay has a permanent population of approximately 150 residents (Cary et al., 2000). However, during school holiday periods (particularly in winter; June/July and late-September), the population increases to approximately 3,000–4,000 (Cary et al., 2000; Simpson and Field, 1995). A total of 17 licences have been issued by CALM for commercial vessels to operate in the Coral Bay area, including: 9 charter vessels; 3 coral viewing boats; 2 whale shark tour boats and 3 small craft hire operators (DAL, 2001). A one-year survey of recreational boat usage from April 1998 identified approximately 2,600 boat launchings at Coral Bay (Sumner et al., 2001). Approximately 90% of boats launched at Coral Bay were less than six metres and approximately 30% were less than 4 m. Approximately 35% of the recreational boat owners were from Perth, 30% from country areas of Western Australia and 2% were from the Gascoyne region (Sumner et al., 2001). The permanent population of Coral Bay owns twelve boats; however, during peak periods the number of boats in Coral Bay increases to approximately 150–170 (Caz Muntz, *pers. comm*., 1998).

Formalised boat launching facilities along the Ningaloo Reef coast are presently only provided in the vicinity of Exmouth, all at least 160 km north of Coral Bay: the Exmouth Marina, Bundegi and the Tantabiddi boat ramp (Cary et al., 2000). At Coral Bay, boat launching is presently conducted off the beach in the protected waters of Southern Bills Bay. This region is also popular for swimming/snorkelling due to its shelter and the nearby location of corals. The close proximity of boating and swimming activities in the Southern Bills Bay area is causing an increasingly undesirable conflict of use in this region, including risk of injury to swimmers, anchor damage to viewing corals and risk of fuel spills in the swimming area.

The need for formalised boating facilities in the Coral Bay region, and the removal of this activity from the Southern Bills Bay area has long been recognised. This need has been expressed by several agencies including the Department of Conservation and Environment (DCE) (DCE, 1984), Gascoyne Regional Strategy Steering Committee (Ministry for Planning [MFP], 1996a), Coral Bay Task Force (MFP, 1996b) and the EPA (EPA, 1996). The Gascoyne coast regional strategy (MFP, 1996a) noted that the informal boating facilities in the area are generally inadequate from a recreational, fishing, commercial and tourism perspective. The Coral Bay Task Force (MFP, 1996b) noted that "the need to separate boating facilities from swimming and snorkelling areas is extremely important as there is a substantial safety hazard with the current pattern of use in the bay".

As an interim measure to minimise coral damage, and prior to the provision of formalised boating facilities at Coral Bay, CALM have prepared a mooring management plan for Southern Bills Bay. This management plan recommends the construction of a series of fixed-point moorings within 150 m of the shoreline of Southern Bills Bay for use by commercial boats.

In November 2000, the Coral Coast Marina Development Pty Ltd released a PER for a proposed marina resort at Mauds Landing for public comment (ATA Environmental, 2000). This PER is presently being assessed by the EPA. The Coral Coast Resort is also presently undergoing Commonwealth environmental assessment under the EPBC Act 1999. Although public boating facilities would be provided in the marina of the Coral Coast Resort, the development alone would not satisfy all the boating needs at Coral Bay as periods of high-energy waves, which occur regularly in Bateman Bay,

would frequently preclude small craft access to and from this site. Hence, even if this development were constructed there would remain a need for sheltered facilities for small trailered boats.

2.2 DESCRIPTION OF ALTERNATIVE SITES

In 1996, the Coral Bay Task Force (MFP, 1996b) completed a brief examination of the following four sites for the development of a boating facility:

- Mauds Landing;
- North Bills Bay;
- North Monck Head; and
- Monck Head.

The Mauds Landing site is located on the northern flank of Point Maud in Bateman Bay, approximately 3 km north of the Coral Bay settlement. The North Bills Bay site is located on the southern flank of Point Maud, approximately 2 km north of the Coral Bay settlement. The North Monck Head and Monck Head sites are located approximately 1.5 km south of the Coral Bay settlement and include both Monck Head and the shoreline immediately north of Monck Head.

The Task Force examined these sites from a limited number of engineering considerations (Table 1) and recommended North Bills Bay as the preferred site for the location of the boating facility. The North Bills Bay site is located within the Maud Sanctuary Zone of the Ningaloo Marine Park and as a result the site selection process was revisited in this PER in more detail (see Technical Appendices). This detailed examination included a consideration of the environmental, engineering and management issues at Mauds Landing, North Bills Bay and the Monck Head sites and suggests that a boating facility could be constructed and managed at any of these three sites.

Table 1 Summary of site assessment for boating facility conducted by the Coral Bay Task Force

	MAUDS LANDING	NORTH BILLS BAY	NORTH MONCK HEAD	MONCK HEAD
Road access	Good	Non existent	Poor	Poor
Access to open ocean	Good	Good	Restricted and dangerous if Yalobia Passage used	Restricted and dangerous if Yalobia Passage used
Nearshore depth	Good	Restricted	Restricted	Restricted
Storm surge hazard	High	Moderate	Moderate	Moderate
Breakwater	Essential	Desirable	Desirable	Desirable
Area for parking	Good	Moderate	Poor	Moderate
Relative cost	High	Moderate	Not stated	Moderate

2.3 PREFERRED SITES

As noted above, the Mauds Landing site was found to be frequently exposed to high-energy wave conditions. These wave energy levels would frequently preclude the passage of small craft to and from a facility at Mauds Landing. Hence, as the majority of boats used at Coral Bay are small craft (<6 m in length), a boating facility at Mauds Landing, on its own, would not solve all of the boating needs of Coral Bay. The higher energy conditions at the Mauds Landing site would also require the construction of a substantial breakwater which would significantly increase the comparative cost of developing a boating facility at this site. Should a private marina development proceed at Mauds Landing, it would provide an appropriate base for the

larger commercial vessels at Coral Bay and use by smaller trailered boats during quiescent weather conditions. Following a consideration of these factors, the Mauds Landing site was eliminated from further consideration.

The DPI, on behalf of the future facility managers (CALM), seeks an environmental assessment for the development of a single boating facility at either Monck Head or North Bills Bay. Both facilities essentially provide similar services for the launching of small trailered craft and for mooring and fuelling of large non-trailered vessels.

For the purposes of the EPA's assessment the two facilities are being considered as two separate proposals. The DPI understands the EPA will report on both proposals in a single report to the Minister for the Environment and Heritage. The EPA's report will assist the Government in making a decision on which facility should be constructed. The environmental issues associated with the development of either of these two sites are examined in detail within this report.

Due to the different conditions encountered at the two sites, the types of marine structures proposed also differ. An offshore boat launching facility is proposed for Monck Head, whereas a small boat harbour is proposed for the North Bills Bay site. The engineering and management considerations for each site are covered in more detail in Sections 5.2 and 6.2 of this report.

3. THE EXISTING ENVIRONMENT

3.1 CLIMATE

(For additional information see Technical Appendix 1)

The Coral Bay area experiences an arid climate with two seasons, a hot summer which extends from October to April and a mild winter from May to September. The hottest month is January with a mean maximum temperature of 37.9°C and the coolest month is July with a mean maximum temperature of 24.1°C. The average annual rainfall is 268 mm; however, this is considerably exceeded by the mean annual average evaporation of 3,138 mm. The majority of the rain is associated with tropical cyclones and falls during February and March. During winter, rainfall is more regular, but less intense.

The synoptic wind patterns in the Coral Bay region are largely controlled by the west to east movement of a belt of anticyclonic systems. This anticyclonic belt undergoes a seasonal latitude migration resulting in predominantly south to south-westerly winds prevailing in summer, whereas in winter the winds are predominantly east to south-easterly. Strong southerly sea breezes typically develop during summer afternoons. Storm winds may arise from tropical cyclones and thunderstorms during summer, and mid-latitude depressions in winter. Tropical cyclones may occur in the region during summer and typically occur between January and March. The direction and speed of the winds experienced during a tropical cyclone are highly variable and depend on the path taken by the cyclone; however, tropical cyclones with wind speeds in excess of 40–50 knots occur in the region every three to five years (Lourensz, 1981). On 22 March 1999 the centre of tropical cyclone Vance passed approximately 80 km to the east of the Coral Bay settlement. At Learmonth, this cyclone produced the strongest wind gust speed (267 kh^{-1}) ever recorded on the Australian mainland shortly before midday on 22 March 1999. The impact of this cyclone on Coral Bay was reduced as the cyclone travelled across land and the speed of the cyclonic winds experienced at Coral Bay was reduced. At Coral Bay, the impact of a similar cyclone passing to the west (offshore) of the Coral Bay settlement would be considerably greater.

3.2 OCEANOGRAPHY

(For additional information see Technical Appendix 1)

The tides measured at Monck Head (approximately 1.5 km south of the Coral Bay townsite) are microtidal, mixed predominantly diurnal, with a mean spring tide range of 0.9 m and a mean neap tide range of 0.4 m (Transport, 1994). The tidal range from the lowest astronomic tide (LAT) to highest astronomic tide (HAT) at Coral Bay is 1.8 m.

The wave climate offshore of the Ningaloo Reef is dominated by low swell waves generated by the 'Roaring 40s' and the south-east trade wind belt of the Indian Ocean. Visual estimates of offshore wave height, period and direction indicate that the offshore waves in summer generally arrive from the south and typically have a wave height of 1–2 m. During winter the offshore waves typically have a height of 2–3 m and the wave direction shifts towards a more south-westerly direction.

Shoaling, refraction, diffraction and breaking processes across the reef crest and bottom friction across the reef lagoon results in considerable attenuation of the offshore wave energy prior to reaching the shoreline. During summer, regular sea-breezes cause the superposition of a southerly sea wave climate onto the

background swells. Extreme waves may also be generated in summer during tropical cyclones. Numerical modelling of tropical cyclone Hazel (February/March 1979), which was considered to be representative of a 100 year return period event, indicated that maximum significant wave heights could reach 6.2 m outside the reef line and 3.7 m in a water depth of 7 m near Mauds Landing (Port and Harbours Consultants, 1989).

Hind casting of typical and extreme wave conditions along the shoreline of Bills Bay by Egis Consulting (1997) has indicated that during non-cyclonic conditions the median wave height is 0.1–0.2 m and the wave height which would be experienced at least 10% of the time is 0.2–0.4 m. Modelling of extreme (tropical cyclone) conditions indicated that the offshore and inshore wave heights in Bills Bay during the one-in-five-year storm event would be 6.0 and 1.7 m, respectively. The 50-year recurrence interval wave heights for offshore and inshore were 10.1 and 2.0 m, respectively.

Storm events are typically associated with onshore winds and low atmospheric pressure and these factors together may result in elevated water levels at the shoreline, termed 'storm surge'. The one in 100 year storm surge at Carnarvon has been estimated to be 1.76 m above Australian Height Datum (AHD) (Wallace and Boreham, 1990). When wave run-up is added to the storm surge, water levels in Carnarvon may reach approximately 3.0–4.2 m above AHD (MFP, 1996a). Rogers & Associates (1994) expect that the storm surge at Coral Bay would be slightly more elevated than at Carnarvon due to the wave induced set-up across the nearshore reef system.

The regional offshore water circulation is dominated by the Leeuwin Current—a southward flow of warm, relatively low-salinity water of tropical origin. The flow of the Leeuwin Current is generally greatest between autumn and winter and is greatly attenuated by wind stress in summer. Inside the lagoon, the current structure is complex and driven by wind, waves and tides and modified by the coastal morphology, in particular the location and size of passages and channels through the reef system (Rogers & Associates, 1994). Typically, the persistent southerly swell waves break on the reef and result in the pumping of water over the reef crest and into the lagoon. This generally results in the generation of northward flowing circulation inside the lagoon which exit via the reef passages (Hearn and Parker, 1988). Observations from Bateman Bay indicated typical current velocities of 0.1–0.2 ms^{-1} and a localised increase in the current velocity (up to 0.5 ms^{-1}) may be experienced in the narrow channel immediately offshore of Point Maud (Rogers & Associates, 1994).

Observations at Osprey Bay (120 km north of the Coral Bay settlement) indicate that the lagoon in this region has a flushing time of less than 24 hours (Hearn and Parker, 1988). The lagoon flushing in the vicinity of Coral Bay is expected to be less influenced by tidal currents than at Osprey Bay due to the reduced tidal range at Coral Bay.

The Inter-governmental Panel on Climate Change (IPCC, 1995) presents several scenarios for future sea level rise and the figures for the 'most likely' scenario suggest a sea-level rise between 0.20 to 0.86 m by 2100 with the mid level of 0.49 m (Table 2).

Table 2 Sea level rise scenarios 'most likely' presented by IPCC (1995)

SCENARIO	YEAR		
	2030	2050	2100
LOW	0.04	0.07	0.20
MID	0.11	0.19	0.49
HIGH	0.23	0.37	0.86

Note: sea level rise presented in units of metres

3.3 COASTAL GEOLOGY, GEOMORPHOLOGY AND GEOHYDROLOGY

(For additional information see Technical Appendix 1)

The coast in the region of Coral Bay is largely composed of Pleistocene (1.5 million to 10,000 years old) limestone and Holocene (less than 10,000 years old) sands superimposed on a Miocene (26 to 7 million years old) limestone anticline (Department of Conservation and Land Management [CALM], 1994). The shoreline immediately north of Point Maud is sandy, whereas to the south of Point Maud, occasional limestone outcrops occur along the shoreline. The coastal belt is characterised by a series of carbonate-rich dune features including; Pleistocene parabolic dunes that have been stabilised by vegetation, isolated dune blowouts that occur where the dune sands have become unstable and active and relic beach ridge deposits (Figure 2). A large area of saline flats occurs to the east of Point Maud which appears to be a palaeolagoon feature which was open to the sea in the vicinity of Mauds Landing during a period of higher sea level (perhaps during the mid-Holocene sea level high stand of ca. 6,400 years ago).

The major marine geomorphologic feature in this region is the Ningaloo Reef which is the largest fringing reef in Australia and extends from Bundegi Reef, north of Exmouth, around the North West Cape and continues south for some 260 km to Gnarloo Bay (Australian Heritage Commission [AHC], 1997). The reef is discontinuous and encloses a lagoon which varies in width from 0.2 km to 6 km. In the vicinity of Coral Bay, the lagoon is approximately 2.0–2.5 km wide and has an average depth of 3 m. Two navigable channels through the outer reef occur in this region; Cardabia Passage (the northern passage) is located approximately 6 km north of Point Maud and Yalobia Passage (the southern passage) is located approximately 8 km south of Point Maud. The Yalobia Passage is considered dangerous at times and hence navigation through this passage is only recommended for experienced mariners.

There are essentially two aquifers in the Coral Bay region; a shallow unconfined aquifer, and a deep confined aquifer (the Birdrong Sandstone) (Rockwater, 1994). Most of the shallow groundwater in the vicinity of Coral Bay is saline (10–14 parts per thousand (ppt)) with salinities generally increasing towards the coast where seawater intrusion occurs. The salinity of the shallow groundwater beneath the saline flats is likely to be even higher than the coastal saline intrusion (Rockwater, 1994). In some dune locations there is a thin layer of fresh groundwater overlying the more saline waters; wells at Mauds Landing and Cardabia Station homestead contain salinities of 1–5 ppt. The Birdrong Sandstone is the deeper groundwater aquifer and extends over a wide area of the Carnarvon Basin. This aquifer is the main source of water for the Coral Bay settlement where it occurs at a depth of approximately 800 m. The water from this aquifer is hot (58°C) and saline (5.1–5.8 ppt).

3.4 COASTAL PROCESSES

The Ningaloo Reef results in considerable attenuation of the offshore swell wave energy; however, the prevailing southerly winds may generate considerable wind

wave energy and inshore currents within the reef lagoon. The net sediment transport along the coast between Monck Head and Point Maud is northwards.

At North Bills Bay the wave energy is relatively low, although the prevailing southerly winds may generate moderate wave energy at this location. The beach is broad and flat with an intertidal width of approximately 15 m and a narrow supertidal beach width of approximately 3 m. Analysis of shoreline change indicated that the shoreline in this region has accreted approximately 10 m between 1971 and 1994 which represents an average of 0.4 m per annum accretion (Egis Consulting, 1997).

The shoreline between Southern Bills Bay and Monck Head site is located in the lee of the Ningaloo Reef and is sheltered from the direct impact of the offshore swell waves. Immediately north of Monck Head the shoreline has a north-westerly aspect and is protected from the prevailing southerly winds and local wind waves. Immediately offshore of Monck Head there appears to be zone of active longshore sediment transport from south to north. However, north of Monck Head the shoreline is underlain by limestone pavement and there is little longshore sediment transport trapping in this region.

3.5 TOPOGRAPHY, LANDFORM AND SOILS

(For additional information see Technical Appendix 1)

The predominant soils found throughout the study area are calcareous, coarse sands with no, or minimal texture profile development (Bettenay et al., 1967). These sands overly a core of aeolianite limestone, which may form low cliff faces, platforms or shallow offshore bars along the coast in places. Dispersed throughout the region are small patches of weakly or strongly coherent calcareous loams. Inland from Mauds Landing the palaeolagoon forms a saline flat with heavier soils.

Mauds Landing is situated close to the boundary between a relic foredune plain with low dunes parallel to the coast, and an area of high parabolic dunes that stretch westwards towards Point Maud, and southwards along the coastline, including North Bills Bay and the area around Monck Head. The parabolic dunes are generally well vegetated and stable. However, a large blow-out has developed to the east of Skeleton Bay and several small blow-outs are also present to the north of Point Maud and near Monck Head.

3.6 MARINE WATER QUALITY

(For additional information see Technical Appendix 2)

The waters in the Coral Bay region are generally clear, nutrient-poor, low in phytoplankton biomass, and have no evidence of faecal contamination (Simpson and Field, 1995). However, in Southern Bills Bay elevated levels of inorganic nitrogen and faecal bacteria were observed by Simpson and Field (1995). This area also had relatively high levels of macroalgal and phytoplankton biomass and light attenuation (a measure of water clarity) when compared to sites further from the settlement. Water quality samples obtained during the present study (March 1998) indicated that the inorganic nitrogen (5–8 μg/L) and organic phosphorus (10–15 μg/L) concentrations were similar to those observed in September/October 1994 by Simpson and Field (1995). However, in the present study the total nitrogen and chlorophyll a concentrations (135–177 and 0.6–1.7 μg/L, respectively) measured were higher than those reported by Simpson and Field (1995). This difference was considered a natural seasonal variation.

The Shire of Carnarvon conducted regular sampling during 1996 in the Southern Bills Bay area and, in contrast to Simpson and Field (1995), found little or no bacterial contamination. The sampling by the Shire of Carnarvon indicated that these waters would have easily met national water quality guidelines for bathing (ANZECC, 1992).

3.7 MARINE SEDIMENT QUALITY

(For additional information see Technical Appendix 2)

Levels of heavy metals, pesticides, polychlorinated biphenyls (PCB) and polycyclic aromatic hydrocarbons (PAHs) in the sediments of the Coral Bay region are generally low and indicative of pristine sediments (Simpson and Field, 1995). Tributyltin (TBT), the active ingredient in anti-fouling paints, has been found in low concentrations at North Bills Bay (Simpson and Field, 1995). Extremely high TBT levels (3,412–10,237 μg/L) have been found adjacent to mooring locations of large boats in Southern Bills Bay. TBT is extremely toxic to many marine organisms, and regulations prohibiting the use of TBT on boats under 25 m (and restricting its use to low leaching forms on boats over 25 m) became effective in Western Australia on 1 November 1991. Simpson and Field (1995) expressed concern about the high levels of TBT found at some sites, particularly as the absence of TBT breakdown products suggested that the contamination might have occurred after 1991.

3.8 MARINE PLANT COMMUNITIES

(For additional information see Technical Appendix 5)

Red, green and brown macroalgae appear to be well represented in the Coral Bay region, particularly in the shallow reefs habitat in the North Bills Bay region (Marsh, 1978). Here, the relic reef structure and limestone pavement provide suitable substrata for the attachment of a variety of macroalgae including, *Padina* sp., *Caulerpa* spp., and green and brown filamentous algae.

Seagrass communities in the Coral Bay region are sparse and only *Halophila ovalis* was observed during this study. This is a tropical species and is widespread throughout the Ningaloo Reef and Rowley Shelf region (BBG, 1995). Meadows of *Posidonia coriacea* have been observed 4 km north-east of Mauds Landing (BBG, 1995). *Posidonia coriacea* is a temperate species and these meadows represent the most northern occurrence of this species. No seagrasses were recorded at North Bills Bay.

3.9 TERRESTRIAL PLANT COMMUNITIES

(For additional information see Technical Appendix 4)

The flora of the region was surveyed extensively by Payne et al. (1980) as part of an inventory of the rangelands of the Carnarvon Basin. Two of their land systems fall within the present study area. These are the Coast Land System where the vegetation is dominated by *Acacia* shrubs and the Cardabia Land System (south of Coral Bay) where hummock grasses assume a greater significance.

The local flora has typical arid (Eremean) affinities evidenced by the significant presence of the families *Poaceae*, *Malvaceae*, *Ateraceae* and *Mimosaceae*. However, there are also species more typical of the flora of the south-west of the state.

Point Maud is a relatively undisturbed parabolic dune system that is characterised by a low shrubland (containing 27 perennial species) in which isolated patches of larger shrubs, including *Acacia coriacea, Santalum spicatum* and *Heterodendrum oleaefolium* occur. A CALM Priority 2 species (*Acacia ryaniana*) occurs within this area. A series of beach ridges extend southward from the Point and this area is characterised by a species-poor hummock grassland (dominated by *Spinifex longifolius* with clumps of *Atriplex isatidea* and *A. coriacea* shrubs) in the foredunes.

3.10 MARINE FAUNAL COMMUNITIES

(For additional information see Technical Appendix 5)

The Ningaloo Reef supports a diverse array of animal and plant communities, including:

- 217 species of hard corals (Veron and Marsh, 1988);
- At least 11 species of soft corals (May et al., 1983);
- 464 species of fish (Allen and Swainston, 1988);
- 90 species of echinoderms (Marsh, 1980);
- At least 433 species of molluscs (Wells, 1980, cited from May et al., 1983); and
- An unknown number of crustaceans, but including the commercially important western rock lobster (Panulirus cygnus) as well as the painted (Panulirus versicolor) and ornate (Panulirus ornatus) rock lobsters.

However, there is a poor inventory of other animal groups including sponges, bryozoans, foraminifera's, hydrozoans, jellyfish, worms, sea squirts and macroalgae. These groups are represented at Ningaloo Reef, but little work has been done to quantify the numbers of species of each.

3.10.1 Corals

Ningaloo Reef may be divided into five environments; (1) fore-reef, (2) reef-crest, (3) reef flat, (4) back-reef and (5) lagoon with scattered patch reefs. The reef-crest, reef flat and back-reef environments typically experience strong current flows. The distribution of morphologies and species reflects the variations in wave energy with robust corals (e.g. 'brain corals', *Platygyra* and *Goniastrea*) occupying the reef-crest and corals resistant to strong surge occupying the reef flat (e.g. *Acropora digitifera* and *Acropora aspera*). Delicate branching and foliose corals (e.g. *Echinopora lamellosa* and foliose *Montipora*) are generally found in the calmer lagoonal waters.

Ningaloo Reef has a rich and diverse coral fauna with 217 species in 54 genera (Veron and Marsh, 1988). Ningaloo Reef is dominated by corals from the families Acroporidae, Poritidae and Faviidae and these are well represented in the Coral Bay

region. There is generally little coral in the reef lagoon; however, in the region of Coral Bay, between Point Maud and Point Anderson, 68 coral species have been recorded (Marsh, 1978; 1980; 1989). Many of the corals, and associated reef communities, in this region suffered severe mortalities in 1989 due to anoxic conditions following the coral spawning (Simpson et al., 1993).

The coral communities of North Bills Bay are showing good signs of recovery following severe mortalities due to the 1989 coral spawning. This region is dominated by corals from the family Faviidae, whereas, elsewhere in the lagoon, Acroporidae typically dominate the coral landscape. Hence, the corals of North Bills Bay are likely to be an important source of coral recruits for this region.

A small number of hard and soft corals occur on the limestone platform that extends from the shore immediately north of Monck Head. An extensive coral community is located approximately 350 m offshore from Monck Head and extends to within a few metres of the shore approximately 600 m north of Monck Head. It is in this region that the richest and most diverse coral fauna was recorded (Marsh, 1980). The corals in this community are dominated by staghorn (*Acropora*).

3.10.2 Benthic invertebrates

Most of the molluscs along the Ningaloo Reef have tropical distributions and several do not occur further south (May et al., 1983). 433 mollusc species have been observed during limited surveys and many of these species were new records for Western Australia (Wells, 1980). It is likely that more mollusc species may be present (May et al., 1983; BBG, 1995). The echinoderm fauna at Ningaloo is depauperate with only 56 genera and 90 species recorded (Marsh, 1980). Most are widespread Indo-Pacific coral reef species which are at, or toward, their southern limit of distribution (May et al., 1983). The crustacean fauna of the Ningaloo Reef is diverse but not completely described; many species are cryptic (well camouflaged) and nocturnal. Three crayfish occur in the Coral Bay region, the western rock lobster (*Panulirus cygnus*), which is the most common, the painted rock lobster (*P. versicolor*) and the ornate rock lobster (*P. ornatus*) (BBG, 1995).

The limestone beach rock, which outcrops along the shoreline of Bills Bay, supports an array of littorinids, barnacles, oysters (*Saccostrea* sp.), chitons and limpets. Starfish (Asteroidea), sea urchins (Echinoidea), molluscs, crustaceans, and polychaete worms (Serpulidae and Terebellidae) are all expected to be represented in the area of North Bills Bay. Giant clams (*Tridacna maxima*), the sea hare (*Aplysia* sp.), black holothurians (*Holothuria atra*) and a soft coral (*Sinularia* sp.) were recorded from the limestone reef platform just north of Monck Head.

3.10.3 Turtles

Five species of migratory turtle occur in the Ningaloo Reef region and are expected to occur in the Coral Bay region at some time during the year, including green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), hawksbill turtle (*Eretmochelys imbricata*), flatback (*Natator depressus*) and leathery turtle (*Dermochelys coracea*) (Cogger, 1992; Commonwealth of Australia, 2000). The green turtle is abundant throughout the year indicating the presence of a large resident population along the Ningaloo Reef.

Approximately 80 green and loggerhead turtle nests are laid each year between Point Maud and Oyster Bridge to the north-east. This region is considered a moderately large and significant rookery for these turtles (R. Prince *pers comm.,* 1998). Turtles do not regularly nest in the North Bills Bay region or immediately north of Monck Head.

Turtle densities are extremely high in the Ningaloo area and exceed the densities recorded on the Great Barrier Reef and most of the areas of Torres Strait (ATA Environmental, 2000). Turtles are extremely long-lived reptiles and are slow to reach maturity. They breed infrequently and return to the same location to lay their eggs. Six of the world's seven turtle species occur in Australian waters and the flatback turtle is endemic to Australian waters.

Under the Wildlife Conservation Act 1950–1975, loggerhead and leathery turtles are listed as Schedule 1 species (fauna which are rare or likely to become extinct and in need of special protection). Loggerhead turtles are also protected under the Commonwealth EPBC Act 1999 and are listed as endangered. Leathery, green, flatback and hawksbill turtles are listed as vulnerable under the Commonwealth EPBC Act 1999.

3.10.4 Sharks and rays

Ningaloo Reef supports diverse and abundant shark and ray populations (BBG, 1995). Sharks are most common offshore of the reef (BBG, 1995). The largest of these is the whale shark (*Rhiniodon typus)* and occurs in these waters between November and June. Other shark species include the tiger (*Galeocerdo cuvier*) and hammerhead sharks (*Sphyrna* spp.). Hammerheads apparently form schools in autumn near Stanley Pool, approximately 9 km north of Mauds Landing (BBG, 1995). A range of smaller shark species occur inside the reef in the Coral Bay region include tawny nurse sharks (*Nebeius ferrugineus*), lemon sharks (*Negaprion acutidens*), black (*Carcharinus melanopterus)* and white tip (*Triaenodon obesus)* and grey reef (*Carcharinus amblyrhynchos*) sharks and other whalers (Carcharhinidae), and wobbegongs (Orectolobidae).

Many sharks have been sighted in the Cardabia Passage region; however, it is unknown how important this area is to sharks (BBG, 1995). Large schools (*ca*. 70–100) of black- and grey-tip reef sharks (*Carcharhinus melanopterus* and *C. amblyrhynchos*) have been observed inshore of the submerged beach rock ridges along Skeleton Beach from late-August to December (Whitaker, *pers. comm*., 1998; Norman, In preparation).

The whale shark, *Rhiniodon typus,* is the largest shark and occurs on the seaward side of the reef between November and June. Although whale sharks occur along the entire length of the reef, they are less common at Coral Bay than further north (BBG, 1995), and swimming with these sharks is a popular tourist attraction. Whale sharks within the Ningaloo Marine Park are protected under the Wildlife Conservation Act 1950–1975.

3.10.5 Fish

The Ningaloo Reef encompasses two biogeographic zones, the West Oceanic Zone and the Central West Coast Zone, and generally supports a rich diversity of fish including 464 species from 81 families (Allen and Swainston, 1988). It is considered that this diversity may be partly attributed to the Leeuwin Current which originates in the tropics, and the relatively narrow continental shelf in this area (Hutchins, 1994).

The well developed coral reef to the north west of Monck Head provides ideal habitat for a diverse array of fish, including three families which are targeted by recreational fishers: emperor fishes (Lethrinidae), sweetlips (Haemulidae) and cod fishes (Serranidae).

3.10.6 Marine birds

Forty species of waders and 36 species of seabirds are expected to occur in the Coral Bay region; eight wader species and 14 seabird species are resident and the remaining species are either migrants or nomadic. Shallow sandy intertidal beaches interspersed with rocky shorelines provide diverse habitats for foraging waders, while the abundance of baitfish offshore is an important food source for seabirds including the two most common families, Laridae (gulls and terns) and Procellariidae (wedge-tailed shearwaters).

Point Maud is a refuge area for at least 12 different species of birds and in 1992 this area was gazetted as a Bird Roosting Sanctuary under the Control of Vehicles (Off-road Areas) Act 1978 and vehicle access is now prohibited (BBG, 1995). At least 1,000 birds were observed on the Point during the field survey in April 1998. Brahminy kites, ospreys and sea eagles roost in the cliffs north of Mauds Landing and are sighted frequently near Point Maud (BBG, 1995). Four species of waders were recorded on the water's edge in Skeleton Bay immediately south of North Bills Bay: Black-Winged Stilt, Great Egret, Eastern Reef Egret (dark form) and Grey-Tailed Tattler. At Monck Head, Osprey roosting was observed and the area is likely to be a foraging area for waders because of the rocky platform and adjacent sandy beaches.

The Commonwealth Government has signed international treaties which affect the endangered species and migratory birds in the area. The treaties are: the Convention on International Trade in Endangered Species, the Japan-Australia Migratory Birds Agreement, and the China-Australia Migratory Birds Agreement (JAMBA and CAMBA, respectively). Thirty six species of wader and seabirds that were sighted or are expected to occur in the Coral Bay area are protected under the JAMBA and/or CAMBA agreements. The little tern (*Sterna albifrons*) is presently under consideration for listing as a threatened species under the Commonwealth EPBC Act 1999.

3.10.7 Marine mammals

The Ningaloo Reef is an important area for marine mammals and the following species have been observed; Dugong (*Dugong dugon*), Bottle-nose Dolphin (*Tursiops aduncus*), Humpback Whale (*Megaptera novaeanglia*), Killer Whale (*Orcinus orca*), Minke Whale (*Balaenoptera acutorostrata*), Fin Whale (*Balaenoptera physalis*), Blue Whale (*Balaenoptera musculus*), Southern Right Whale (*Eubalena australis*) and Australian Sea Lion (*Neophoca cinerea*). Dugongs and bottle-nose dolphins are regularly sighted in Bills Bay (ANPWS, 1990) and would be expected to occasionally occur at Monck Head and North Bills Bay.

The Dugong is now extinct or near extinct in most of its former range which extended from East Africa to South East Asia and the Western Pacific (Commonwealth of Australia, 1995). Northern Australia has the last significant population (estimated as 80,000 in 1995) of dugong (ATA Environmental, 2000).
Under the Wildlife Conservation Act 1950–1975, humpback, fin, blue and southern right whales are listed as fauna which are rare or likely to become extinct and in need of special protection. The humpback (vulnerable), blue (endangered), fin (vulnerable) and southern right (endangered) whales are also protected by the Commonwealth EPBC Act 1999. The fin whale is listed as vulnerable by the International Whaling Commission (AHC, 1997). Dugongs are listed as vulnerable in the IUCN Red Data Book (IUCN, 1982) and as fauna in need of special protection by the Wildlife Conservation Act 1950–1975. The Australian sea lion is also listed as fauna in need of special protection by the Wildlife Conservation Act 1950–1975.

3.11 TERRESTRIAL FAUNAL COMMUNITIES

(For additional information see Technical Appendix 4)

Based on an assessment of the known distribution records and the range of habitats in the Mauds Landing area it is likely that 189 vertebrate species could potentially occur in this region (Ecologia, 1995). This total included 18 mammals, 116 birds, 51 reptiles and 4 amphibians. These data compare favourably with a desk survey of the potential fauna in which 175 vertebrate species (excluding *Amphibia*) were listed. This total included 17 native mammals, 6 introduce mammals, 102 birds and 56 reptiles.

Two Schedule 1 (fauna which is rare or likely to become extinct) vertebrate taxa could possibly occur in the study areas: the Red-tailed Tropic Bird and Loggerhead Turtle. Four Schedule 3 species (migratory birds that are subject to an agreement between the governments of Australia and Japan) namely Large Sand Plover, Grey-tailed Tatler, Common Sandpiper and Bar-tailed Godwit are expected to occur and one Schedule 4 species (fauna in need of special protection), the Peregrine Falcon. Additionally, 15 bird species that are the subject of the China and Australia Migratory Bird Agreement (CAMBA) occur.

No information on the terrestrial invertebrate fauna of the Coral Bay area has been documented. Until such work has been conducted it is assumed that vertebrate habitat protection will provide for the vertebrate fauna which share the same habitats.

3.12 SOCIO-ECONOMIC ENVIRONMENT

3.12.1 Recreational usage

Coral Bay provides one of the few focus points for marine-based recreation along the Ningaloo Reef and supports a variety of recreation activities. Snorkelling is popular in the Coral Bay area due to the diversity of corals in close proximity of the shore. The most popular site for snorkelling is located along Paradise Beach between Southern Bills Bay and Purdy Point. SCUBA diving is also conducted in the lagoon and along the outer reef edge and several commercial operators offer dive charters. Presently, three glass-bottomed boats operate from Southern Bills Bay and offer coral viewing tours. One of the highlights is the spawning of the corals in the week following the full moon in April each year.

Beach fishing, which occurs outside of the Maud Sanctuary Zone, is particularly popular, especially along Paradise Beach where a 100 m Recreational Zone corridor has been created alongside the Maud Sanctuary Zone. Boat fishing from trailered craft and larger boats (including commercial vessels) also occurs in the Coral Bay region. Fishing from the trailered craft is typically conducted within the lagoon and approximately 80% of this fishing occurs in the lagoon south of Monck Head (Caz Muntz, *pers. comm*., 1998). Fishing from the larger boats, including commercial fishing charters, is typically conducted offshore of the reef.

Several large commercial boats are used to conduct charter cruises for viewing and swimming with whale-sharks and more recently manta rays. The whale-shark tours are conducted offshore whereas the manta ray tours are conducted in Bateman Bay, often along the shore between Point Maud and Mauds Landing. Other marine-based recreation that occurs near Coral Bay includes beach walking, windsurfing, parasailing and canoeing in the lagoon and surfing on the outer reefs.

Apart from camping, caravanning and backpacking, opportunities for land-based recreation in the Coral Bay region include scenic flights over the area, bike hire (four

wheeler) and sand boarding. The turtle breeding season (December to March) also provides visitors with an opportunity to watch turtles laying their eggs, as well as the return of the hatchlings to the sea.

3.12.2 Land and marine tenure

The townsite of Mauds Landing was named after the landing of the schooner "Maud" in approximately 1880. The "Maud" was owned by John Bateman of Fremantle, and named after his daughter Maud who was born in 1855 (DOLA, history of country names on internet site, 2001). In 1898 the settlers of the Minilya, Yanare and Lyndon Rivers and the Bangemall Goldfields petitioned the Lands Department to declare a townsite there. Mauds Landing was becoming an important port for shipping stock, wool and gold in the late-1890s. The petitioners also asked for the townsite to be named Mervyn after Mervyn C R Bunbury, an old settler of the district who had done much to develop the port. However, there was no demand for lots there, and it was 1914 before any lots were surveyed. The townsite was gazetted in 1915 as Mauds Landing, although the district surveyor had suggested it be named Kooloobelloo, a local Aboriginal name.

A series of amendments subsequently reduced the area and split the townsite into two, namely Mauds Landing and Coral Bay (Figure 3). Mauds Landing and Coral Bay are within the Shire of Carnarvon and the Shire administers control over the area through the Local Government Act 1995, the Health Act 1991 and the Shire by-laws (DCE, 1984). Much of the land within the Mauds Landing and Coral Bay townsites is Vacant Crown Land and the administration of these areas is the responsibility of the Department of Land Administration under the Land Administration Act 1997.

The land adjacent to the Mauds Landing and Coral Bay townsites is Vacant Crown Land and is leased to Cardabia Station for pastoral purposes. To enable construction of the boating facility access road, it would be necessary to excise land from the pastoral lease for dedication as a public road. Likewise, the land area to support the boating facility parking area would need be set aside as reserve.

A gazetted port (not presently operating) exists offshore from Mauds Landing and extends three nautical miles from the high water mark on the western extremity of Point Maud, thence nine nautical miles north, thence east to the high water mark and thence southward along the coastline to Point Maud (Government Gazette, 5 February 1982). The port of Mauds Landing was surveyed in 1897 by Commander Dawson, RN.

The Coral Bay region is within an area that is the subject of a native title claim lodged under the Native Title Act 1993 on 14 April 1997. The claim (Gnulli—WC97/28) was lodged on behalf of the following named claimants; R. Crowe, E. Edney, R. McIntosh and S. Crowe, S. Dale, M. Franklin, L. Cooyou and G. Cooyou, B. Roberts, S. Peck, P. Salmon and R. Dodd. The application was made on behalf of the applicants and the Ingarda-Teddei people, the Baiyungu and Talangi peoples, and the Thalgari people. The Coral Bay area is the traditional country of the Baiyungu people. This claim passed registration testing in July 1999 and mediation commenced in July 2000 and is continuing. Negotiations and clearances for native title will be required prior to commencing construction. Details of the proposed facility were discussed with representatives of the Gnulli group in September 1999.

3.12.3 Marine park management

The Ningaloo Marine Park was declared in 1987 and is approximately 224,000 ha in size. It encompasses both Commonwealth and State waters (CALM, 1989).

Accordingly, the respective parts of the Ningaloo Marine Park have been declared under Commonwealth and State legislation. Both components are managed as a single unit by the State through CALM. However, management is ultimately vested in the Marine Parks and Reserves Authority (MPRA) which assumed responsibility from the National Parks and Nature Conservation Authority (NPNCA).

The Ningaloo Marine Park was established under the Conservation and Land Management Act 1984 and includes a strip of land (Reserve 40079) extending 40 m inland of the high-water mark (Figure 3). This land was reserved for foreshore protection under the Land Administration Act 1997). Virtually all terrestrial access to the Ningaloo Marine Park must occur through this foreshore reserve; however, this foreshore reserve is not present in the Mauds Landing and Coral Bay townsites. The Ningaloo Marine Park Management Plan 1989–1999 (CALM, 1989) was approved by the Hon. Minister for Conservation and Land Management in October 1989. This management plan is presently being reviewed by CALM

To minimise conflict, and provide for a wide range of activities, the Ningaloo Marine Park has been divided into the following three management zones:

- Sanctuary zones—which provide special protection areas for wildlife. Visitors to sanctuary zones can observe the wildlife, but no fishing or collecting is permitted;
- Recreation zones—which provide for recreation uses that are consistent with conservation of the environment. Fishing is allowed in accordance with fishing regulations, but collecting is not permitted; and
- General use zones—which provide for both recreational uses and commercial fishing.

Two management zones occur along the shoreline in the Coral Bay region. The Maud Sanctuary Zone extends along the shoreline north from the Coral Bay settlement to immediately north of Point Maud (Figure 3). Recreation zones extend north from Point Maud and as a 100 m wide corridor along the shoreline south of the Coral Bay settlement to Monck Head.

3.12.4 Aboriginal heritage

(For additional information see Technical Appendix 6)

The State Register of Aboriginal Sites records twelve sites (including burial sites) within a 5–10 km radius of Coral Bay. The presence of additional burial material in the area is considered highly likely.

Archaeological material is present throughout the Monck Head area with a large exposure of midden material located immediately east of Monck Head in a steep dune blow-out area. Midden material in this area included numerous stone artefacts and at least seven species of marine molluscs, turtle bone and shell fragments, sea urchin, crab carapace and fish bone. Archaeological material, including marine shell, stone artefacts and bone fragments were observed at the edges of the access track to Monck Head from Coral Bay. The presence of *Terebralia* sp. Shells at the Monck Head site is worthy of note. *Terebralia* (*Terebralia sulcata* and *Terebralia palustris*) are mangrove gastropods and are strictly associated with soft substrates of the intertidal mangrove environment of tropical Australia. Today the nearest known population of these species is over 200 km away at the Bay of Rest in Exmouth Gulf and at the mouth of the Gascoyne River. It is unlikely that at the time the Monck Head site was occupied, that these species would have been transported these distances when other

edible molluscs would have been available locally. This suggests the existence of mangroves at or near the Monck Head site during the early-middle Holocene.

A disused soak was recorded in a deep dune swale in the vicinity of North Bills Bay and a sparse scatter of archaeological material was observed in this region.

4. SCOPING

(For additional information see Technical Appendix 7)

To facilitate the exchange of information, views and concerns regarding the proposed Coral Bay boating facility, the proponent has given a high priority to consultation with relevant authorities, and interested and affected parties during the planning and assessment phases of the project. A letter describing the proposed boating facility and requesting comments (see Technical Appendix 7 for a copy of this letter) was sent to the following government agencies and non-government organisations with interests in the Coral Bay area:

GOVERNMENT AGENCIES

- Shire of Carnarvon;
- Ministry for Planning;
- Gascoyne Development Commission;
- Office of Water Regulation;
- Department of Environmental Protection;
- Western Australian Tourism Commission;
- Shire of Exmouth;
- Fisheries Department of Western Australia;
- Department of Conservation and Land Management;
- Australian Institute of Marine Science;
- Western Australian Museum;
- Department of Resources Development;
- Department of Land Administration;
- Australian Heritage Commission;
- National Native Title Tribunal;
- National Parks and Nature Conservation Authority; and
- Marine Parks and Reserves Authority.

NON-GOVERNMENT ORGANISATIONS

- Carnarvon Tourist Bureau;
- Exmouth Tourist Bureau;
- Cape Conservation Committee;
- Conservation Council of Western Australia;
- Coral Bay Adventures;
- Coral Bay Accommodation;
- Coral Bay Hotel;
- Glass Bottomed Boats;
- Yamatji Land and Sea Council;
- Coral Bay Backpackers and Ningaloo Reef Resort;
- Bayview Holiday Village;
- Ningaloo Reef Dive;
- Coral Coast Marina Development;
- Dominator Fish Charters;

- Peoples Park Caravan Village; and
- Cardabia Station.

4.1 RESPONSE FROM GOVERNMENT AGENCIES

Summaries of the responses from the government agencies are presented below.

The **Department of Conservation and Land Management (CALM)** supports the need to relocate the current boating activity away from Southern Bills Bay. However, with the proposed North Bills Bay site lying within the Maud Sanctuary Zone there are management plan restrictions in place, which were approved by the Minister of Environment in 1989, that prohibit the construction of breakwaters or similar structures in the area. CALM regarded the proximity of roosting sea birds at Point Maud; the potential trapping of sediment by the breakwaters; the substantial increase in boating activity and the difficulty of road access are all potential threats to the environment. The creation of the Maud Sanctuary Zone was intended to prevent these threats. CALM considers that the Mauds Landing site may have less environmental impact than the North Bills Bay site and is also suitable for larger boats, while Monck Head appears suitable for smaller boats. Further correspondence from CALM provided confirmation that the fuel spill modelling conducted as part of the PER studies appears to be technically sound and also outlined the process required for amending the Ningaloo Marine Park Management Plan.

The **National Parks and Nature Conservation Authority (NPNCA)** considers that location of the proposed boating facility at North Bills Bay would be inappropriate because of it being within the Maud Sanctuary Zone. The NPNCA indicated the following disadvantages of development of a boating facility at North Bills Bay: sediment trapping, the potentially negative impact on seabird roosts and on coral formations and the difficulty of road access through the dunes. The NPNCA concluded that, as a site for a boating facility, Mauds Landing appeared to be better suited than any other.

The **Marine Parks and Reserves Authority (MPRA)** supported the comments made by the NPNCA and drew attention to the undesirability of locating the proposed boating facility in the Maud Sanctuary Zone on the grounds that the proposal (which includes breakwaters) would require an amendment to the Ningaloo Marine Park Management Plan. It was considered that a small facility at Monck Head would be considered acceptable to the Authority on environmental grounds.

The **Department of Environmental Protection (DEP)** was supportive of the need to formalise boat launching facilities at Coral Bay. However, they expressed concern that the North Bills Bay site is within the Maud Sanctuary Zone and noted that the construction of groynes and breakwaters is inconsistent with the purpose of this Zone. The DEP suggested that development at the Mauds Landing site would be more acceptable. It was noted that the assessment of the EPA would be strongly guided by recommendations from the MPRA.

The **Fisheries Department of Western Australia (Fisheries WA)** was supportive of the proposed facility and mindful of the need to monitor compliance of increased number of recreational fishers. However, in recognition of the restriction on fishing and in the interests of preventing any degradation or loss of benthic and fish habitat in the sanctuary area Fisheries WA recommended locating the facility outside the Maud Sanctuary Zone.

The **National Native Title Tribunal** confirmed the existence of a native title claim over the Coral Bay area; provided details of the claimant group, the area under claim and of the claimants' representative. The Tribunal also emphasised the need for the proponent to consult/negotiate with this group in all matters relating to development of the proposed boating facility.

The **Australian Heritage Commission** drew attention to the need for the proponent to address the impact of the proposed boating facility on the national estate values of the Ningaloo Reef and to ensure that Aboriginal heritage values are assessed in consultation with the relevant communities.

The **Western Australian Tourism Commission** indicated its full support for the proposed development and emphasised the need for:

- The marking of access channels through the reef for boat users;
- Ongoing education of the boating public through signs and licensing conditions;
- Identification of the agency responsible for ongoing maintenance of the facility;
- The preparation of a management plan which addresses issues such as rubbish removal and wastewater handling;
- The provision of fish-cleaning facilities, public toilets, car and coach parking;
- Careful consideration of aesthetic issues at the design stage; and
- The provision of power to enable lighting of the facility and the undertaking of minor boat repairs at the site.

The **Office of Water Regulation** has no specific interest in the location of the proposed facility. However, as the facility could impact on other developments that require sewerage and water services, it drew attention to the rights and interests of the licensed water services provider. It noted that the decision to connect the facility to water and sewerage will need to be made in conjunction with the licensed service provider and it enclosed a sketch map showing the location of the proposed treatment plants.

The **Gascoyne Development Commission** strongly supports the development of the North Bills Bay site in keeping with the recommendations of the Coral Bay Task Force report (MfP, 1996b).

The **Ministry for Planning** notes that the development of the North Bills Bay site is consistent with recommendation of the Coral Bay Task Force report (MfP, 1996b). They also state that the North Bills Bay site is safer due to the proximity to the Cardabia Passage as opposed to the Yalobia Passage to the south.

4.2 RESPONSE FROM NON-GOVERNMENT ORGANISATIONS

Summaries of the responses received from non-government organisations with vested interests in the Coral Bay are presented below.

Bayview Coral Bay (representing the Coral Bay Lodge; Holiday Village; Caravan Park; and Backpackers) confirmed that the removal of boating from the main snorkelling and swimming area at Coral Bay was essential. However, it stressed that the economic feasibility; the acceptability to commercial and amateur boat owners and the accessibility to the North Passage were important criteria that needed to be used in selection of the site best suited for the proposed facility. After consideration of factors such as road access, holding ground, marine conditions, security, protection from wind

and weather, access to the North Passage, and Aboriginal heritage, Bayview Coral Bay concluded that North Bills Bay was the only feasible option as a site for the facility. Bayview Coral Bay considered that Mauds Landing was unsuitable as a site for the facility because of the high wave energy, the mobility of the coastline and the high construction costs (expected to be in the order of $15 million), and that Monck Head was unsuitable because of the difficulty of establishing moorings and the threat of fuel spills. Bayview Coral Bay felt that the idea of a split facility had no merit from an environmental point of view. It also suggested that the establishment of a large facility was undesirable and that the maximum carrying capacity of Coral Bay should be set at 3,000 people to limit the pressure that too many people would exert on the environment. It pointed out that on two occasions in the past, jetties built in Southern Bills Bay have been destroyed by storm waves; that a breakwater was not required at North Bills Bay; that road access to the site from the airstrip could be feasible and that there was also no reason why the site chosen in North Bills Bay site could not be moved southwards. If technically feasible, the idea of locating the facility at Skeleton Bay was most attractive because, in the past, boats 38 feet long had been able to negotiate the entrance into Skeleton Bay.

Glass Bottomed Boats considered that the prevailing northerly currents which could transport pollutants from Monck Head into Bills Bay were a sufficiently important drawback to 'totally eliminate the area as a potential ramp with associated facilities'. Being reasonably sheltered, North Bills Bay was considered to be a suitable site, but the probable need for dredging was regarded as a major constraint. Mauds Landing was regarded as 'the best site from the point of view of minimal damage to the environment' but being exposed to severe weather conditions and heavy wave action would be very costly to construct. Finally, Glass Bottomed Boats considered that the provision of two separate facilities (one catering for private craft and another for commercial craft) should not be contemplated and that regardless of where the facility may be sited, the need for proper demarcation of boating channels was essential.

Ningaloo Reef Resort noted that Monck Head would not be a suitable site for the facility because of its popularity as a snorkelling area; the north flowing current would make launching hazardous and carry pollutants into Bills Bay; and it would encourage inexperienced boat owners to use the dangerous South Passage. It considered Mauds Landing as too dangerous because of the large swells that are often experienced at this site and breakwater construction could induce coastal erosion. Consequently, although North Bills Bay was regarded as 'possibly the best of the three options', a fourth site, namely the blow out area in Skeleton Bay, was the logical choice when factors such as wind and tide direction, safety, and minimising damage to coastal vegetation were taken into consideration.

Coral Bay Adventures was of the opinion the reddish coloured soil in the Monck Head area would result in turbidity from the car park during periods of runoff and, in the event of a fuel spillage, pollutants would drift into Bills Bay. It considered North Bills Bay was better suited to the establishment of a boating facility because the corals in the immediate area are in a poor condition. Furthermore, while anchors did not hold in the area because of the hard bottom, the site is sufficiently well protected to not require the construction of a breakwater. All that was considered necessary was a launching ramp and finger jetty with flexible sheeting hanging beneath it to suppress wave action. The organisation felt that charter boat operators would not want to moor their boats at Mauds Landing because, being out of the sight of the public visiting Coral Bay, the site would not be conducive to trade.

The owners of the **Coral Bay Hotel** felt that in the interests of security the facility should be visible from Coral Bay and because of the inexperience of the majority of the persons launching boats at Coral Bay, the more sheltered the site was the better. Consequently, they considered that North Bills Bay had the best potential.

Ningaloo Reef Dive also regarded North Bills Bay as the best site for the proposed facility because of the substantial protection offered by Point Maud from wind and waves and the good access to the North Passage. It considered Mauds Landing as unsuitable because of the large swells, soft erodible beach, environmental fragility and the highly valued marine species associated with the site such as nesting turtles, dugongs and manta rays. Monck Head would require upgrading of the existing road, a lot of work on the cliffed foreshore and, with a sandbar offshore, was too shallow.

The **Coral Bay Supermarket** was of the opinion that, while the facility must offer the same degree of protection as the present launching site, the expected influx of people, boats and increased demand for water-based recreation in the near future meant that a delay caused, for example, by the prohibitively high costs of siting the facility at Mauds Landing must be avoided. They felt that because of the long distance from Coral Bay the pressure for further forms of development at North Bills Bay was a worrying aspect, and recognised that Monck Head is particularly attractive as a site for the launching and retrieval of trailered craft because over 80% of craft owners travel to fish in the Five Fingers area, south of the Maud Sanctuary Zone. Boats returning in the afternoon would also have the advantage of a following sea behind them.

Representatives from the **Yamatji Land and Sea Council** identified Mauds Landing as the Baiyungu-named place, 'Murlanda'. Two government soaks and a stock route across the area were identified. It was pointed out that, as well as being used for stock purposes, Aboriginal people had also taken advantage of the wells as a water source. However, despite its prior associations and significance as an important meeting place, the Aboriginal people did not raise specific objections to a boat launching facility at this location. The Aboriginal group representing the native title claimants did not identify the North Bills Bay location as having any separate cultural significance. No Aboriginal name for the Monck Head location was known and they did not believe that the area had any separate cultural significance, apart from the archaeological evidence of its prior use.

5. MONCK HEAD ALTERNATIVE

This section of the PER provides a detailed summary of the engineering, environmental and management issues associated with the development of a boating facility at the Monck Head site.

5.1 PROPOSED BOATING FACILITY FOR MONCK HEAD

At Monck Head, dredging will not be required during construction and only minor excavation work near the boat ramp would be required infrequently. The boating facility will be designed to accommodate the expected sea level rise during its operational life and withstand the impact from severe storm conditions. The key marine and terrestrial elements of the proposed boating facility at Monck Head are described below (Figure 4; Table 3):

Marine facilities

- A series of offshore moorings, in close proximity to the boating facility, will be planned for use by the permitted non-trailered vessels;
- An offshore boat launching ramp. This will be built as a rubble mound structure (0.3 ha) with two ramps facing north east. A navigable water depth of at least –1.0 m Chart Datum will be provided at the base of the boat ramp. The breakwater will be constructed through the placement of armour units and backloading of core material via the piled bridge and culvert causeway. It is likely that protection from current-shear will be required at the toe of the rubble mound structure to minimise the effects of sediment scour;
- A piled bridge and culvert causeway (75 m) will connect the offshore boat launching ramp to the shoreline. This structure will not interrupt longshore sediment movement;
- Two jetties will be placed on either side of the two ramps. The western jetty will provide a degree of wave screening to the ramp and will also assist boat loading and the unloading and refuelling of larger non-trailered vessels; and
- Channel markers to assist navigation on the approach to the boating facility. Channel markers will also be installed to mark navigation channels through the lagoon area, in particular the navigation passage which parallels the back reef from Monck Head to Point Maud.

Terrestrial facilities

- The existing access road from the settlement to Monck Head is approximately 1.5 km long and will be upgraded to accommodate heavy vehicles for the transport of construction materials. This carriageway will be widened to approximately 14.4 m and will be sealed;
- Car parking (approximately 1 ha) for approximately 100 vehicles which will include parking bays for vehicles with trailers, as well as parking for coaches, if required, to service charter boats. The surface will be sealed;
- Two on-site water tanks (2,000 L) will be provided, one to provide fresh water for drinking and filling water tanks on non-trailered boats, and the second to provide groundwater for hand washing and fish-cleaning. The two water tanks will be regularly filled by hauling water from Coral Bay;
- A public toilet facility which will use a sealed system and will therefore not require water for flushing, will require minimal maintenance and does not result in leaching to the groundwater;

- Fish-cleaning facility for cleaning, scaling and gutting of fish. Solid waste reception facilities shall be provided on site and waste from these facilities will be disposed of at the present Coral Bay waste disposal site and the limited liquid waste will be discharged to a small groundwater soak;
- Low-profile diesel fuel storage tanks (10,000 to 20,000 L) will be located in a lined and bunded storage area. Refuelling for non-trailered vessels is intended as an interim measure until this function can be provided elsewhere, possibly at the proposed private Coral Coast Resort at Mauds Landing;
- A small on-site generator may be required to operate the diesel fuel pumps; and
- Limited public lighting.

Table 3 Key proposal characteristics for the proposed Monck Head boating facility

ELEMENT	DESCRIPTION
Proposal	Monck Head boating facility
Proponent	Department for Planning and Infrastructure
Location	Monck Head, Coral Bay
Marine facilities	
Offshore moorings	For use by non-trailered vessels
Offshore boat launching ramp	Rubble mound structure with two ramps facing approximately north east. A navigable water depth of at least –1.0 m Chart Datum will be provided at the base of the boat ramp. The breakwater will be constructed through the back loading of core material and placement of armour stones
Piled bridge and culvert causeway	Connecting the offshore boat launching ramp to the shoreline. This structure will minimise the interruption of the longshore sediment transport
Two jetties	Placed on either side of the two ramps to serve as boat holding structures. Western jetty will also serve as a wave screen to further reduce wave energy at the ramp. This jetty will also facilitate boat loading and unloading and refuelling of larger non-trailered vessels.
Channel markers	To assist navigation on the approach to the boating facility. In particular, the recommended boating track which parallels the back reef from Monck Head to Point Maud will be marked.
Terrestrial facilities	
Upgrade existing access	The existing access from the settlement to Monck Head, is approximately 1.5 km long and will be upgraded to accommodate heavy vehicles for the transport of construction materials. This carriageway will be widened to approximately 14.4 m.
Car parking	Car parking for approximately 100 vehicles will be provided and will accommodate bus coaches and vehicles with trailers The total area of the car park will be approximately 1 ha.
Water tanks	Two tanks will be installed on-site: one to provide fresh water for drinking and the second to provide groundwater for hand washing and fish-cleaning. The water tanks will be regularly filled by hauling water from Coral Bay.
Public toilet facility	Using a dry-compost sealed system. This system will be low maintenance, fully sealed and will not require water for flushing.
Fish-cleaning facility	Facility for cleaning, scaling and gutting of fish. Solid waste reception facilities shall be provided on site and these facilities will be disposed of at the existing Coral Bay waste disposal site. The limited liquid waste will be discharged to a small groundwater soak.
Fuel storage tanks	Approximately 10,000 to 20,000 L of diesel fuel will be stored at the facility. The fuel will be stored in two, low profile, steel storage tanks which will be located in a lined and bunded storage area. Refuelling for non-trailered vessels is intended as an interim measure until this function can be provided elsewhere, possibly at the proposed private Coral Coast Resort at Mauds Landing.
On-site generator	Used to operate dieseline fuel pumps.
Limited public lighting	To illuminate car park and ramp areas.

5.2 ENGINEERING AND MANAGEMENT CONSIDERATIONS

A number of engineering and management constraints affect the development of the boating facility at Monck Head and these are outlined below.

5.2.1 Coastal processes

(For additional information see Technical Appendix 1)

For approximately 300 m to the north of Monck Head, the shoreline is rocky with a limestone pavement extending up to 50 m from the shoreline. This pavement is overlain with a bare sand shoal which extends offshore and north of Monck Head and forms a sand veneer which parallels the shoreline northward to Paradise Beach. The shoreline in this area is stable and there appears to be a net northward movement of sediment immediately offshore of the limestone pavement (Egis Consulting, 1998). It is estimated that the sediment transport rate in the vicinity of Monck Head is in the order of 10,000 m^3/year (Egis Consulting, 1998).

The use of an open structure jetty and culvert causeway to access the offshore launching ramp will enable the longshore sediment movement to naturally bypass this facility. There may be a small accumulation (100 m^3) of sediment on the north eastern lee-side of the offshore breakwater; this sediment could be easily managed using a long reach excavator if necessary. The rubble-mound structure would result in a sheltered zone at the shoreline which could potentially lead to the development of a shoreline salient up to 11 m from the shore (Egis Consulting, 1998). It is anticipated that this salient would be naturally removed approximately every 2 to 3 years due to action of sustained wind driven currents. However, to ensure that the channel remains open, it is planned to excavate the salient (3,000 m^3) by long reach excavator every 3 to 5 years (Egis Consulting, 1998).

The Monck Head site is relatively well protected by the fringing reef from the impact of swell waves. The significant background wave conditions have been estimated to be 0.2 m and the 10 and 50 year return period wave heights have been estimated to be 1.9 and 2.2 m, respectively (Egis Consulting, 1998). The headland of Monck Head provides this site with a degree of shelter from wind waves and the boat ramp will be oriented to the north east to provide further shelter from the prevailing south to south westerly winds.

5.2.2 Navigation considerations

The Monck Head facility would be located along the existing recommended boating track to and from Southern Bills Bay. As such, boats travelling from the Monck Head site will have reduced travel time from the existing Southern Bills Bay site. Vessels travelling from Coral Bay to the outer side of the fringing reef have two routes available: the Yalobia (south) Passage or the Cardabia (north) Passage.
The hydrographic chart for Coral Bay is presently being revised and will carry caution notes similar to the Coral Bay Boating Guide (Department for Planning and Infrastructure, 2001) which states *"Yalobia Passage breaks and becomes dangerous for navigation during times of heavy swell and/or low tides. The lead markers into Yalobia Passage are sometimes difficult to see at various times of the day and in hazy conditions. Yalobia Passage should only be attempted by experienced mariners"*. Copies of the Boating Guide are available free of charge and will be made available in Coral Bay. Caution signs regarding the Yalobia Passage will also be installed at the Boating Facility if constructed at Monck Head.

Boating access along the inside of the fringing reef, along the recommended boating track, would require marked navigation channels to ensure safe boat passage. The

markers would most likely be spar buoys. Driven pile markers would be avoided if possible.

5.2.3 Existing infrastructure

The existing road from Coral Bay to Monck Head is approximately 1.5 km and will require upgrading to accommodate heavy vehicles for the transport of construction materials. This carriageway will be widened to 14.4 m. The use of the existing road will minimise disturbance of the dunes and Aboriginal artefact material. Exposed dune areas will be re-vegetated and the road will be constructed to Council standards and will subsequently be transferred to the Shire for control and maintenance.

There is sufficient space for the siting of a trailer/car park at Monck Head. The parking area will be located on the species-poor flat dune swale area to the north of Monck Head and, where possible, will be designed so that it is screened from offshore.

There is no form of centralised power distribution in the Coral Bay area (MFP, 1996b). Consequently, a small generator may be required to service the boating facility at the proposed site.

The water supply for Coral Bay is provided by individual operators through artesian bores which intersect the Birdrong Sandstone. The groundwater is treated using reverse osmosis to desalinate prior to distribution to the individual operators sites (MFP, 1996b). Due to the high cost of the reverse osmosis treatment, the amount of potable water is limited. The treated groundwater is used for personal use and toilets whereas untreated water is used for irrigation (MFP, 1996b). There are no existing sources of water at Monck Head and water will need to be hauled from the Coral Bay settlement.

The Coral Bay settlement has an existing (and proposed) solid waste disposal site to the south-east of the settlement. The site could adequately accommodate solid wastes derived from the boating facility. At present, the sewage from the Coral Bay settlement is pumped to a disposal site (evaporation ponds) in the dunes directly north of the settlement, but a fully integrated sewerage system has been proposed to service the Coral Bay settlement (MFP, 1996b).

5.2.4 Marine park management

The boating facility at Monck Head would lie just outside of the Maud Sanctuary Zone in a Recreation Zone of the Ningaloo Marine Park. The construction of a boat ramp is permitted within this zone and jetties, groynes and other structures/platforms are allowed with special permission.

5.2.5 Land tenure

The majority of the land-based components of the boating facility, including the access road and car park fall within the pastoral lease of the Cardabia Station. Negotiations with the leaseholders would need to be undertaken. The strip of land 40 m inland from the high-water mark at Monck Head is designated as a foreshore reserve and is under the management of CALM as part of the Ningaloo Marine Park.

The area is subject of a native title claim (Gnulli—WC97/28) and negotiations and clearances for native title will be required prior to commencing construction. Details of the proposed facility were discussed with representatives of the Gnulli group in September 1999.

It is expected that the rock material for the boating facility will be obtained from an existing quarry and trucked to site.

5.3 ENVIRONMENTAL IMPACT ASSESSMENT

The concept design for the Monck Head boating facility (Section 5.1) was used to determine the potential impact of the boating facility on the following key environmental elements:

- Landforms and soils;
- Marine water quality;
- Fuel spill risks;
- Marine sediment quality;
- Groundwater;
- Marine plant communities;
- Terrestrial plant communities;
- Marine faunal communities;
- Terrestrial faunal communities;
- Aboriginal heritage;
- European heritage; and
- Social issues.

A description of the impacts on each of these key environmental elements is presented below.

5.3.1 Landforms and soils

(For additional information see Technical Appendix 1)

The clearing of vegetation which would result from the widening of the access road and the construction of the car park may cause small localised instability of the foredunes and flat dune swale area. The road and car park will be surfaced and all exposed dune cuttings will be rehabilitated as soon as possible. Rehabilitation will be done to the satisfaction of CALM using native vegetation.

The flat dune swale area is composed of relatively stable red soils and the car park in this area would be designed to blend with the existing contours. All run-off from the road and car park will be directed to stormwater drains to minimise erosion and prevent sedimentation into the marine environment. A cut-off trap will be located at the head of the boat ramps to minimise discharge to the sea. It is intended that during intense rainfall events, such as during a tropical cyclone, the stormwater drains will intercept the first-flush of run-off which typically has the highest concentration of contaminants.

5.3.2 Marine water quality

(For additional information see Technical Appendix 2)

The construction of the rubble-mound structure will result in a short-term increase in water column turbidity. There is the potential for this sediment plume to drift over coral communities to the north of Monck Head. If required, a silt curtain will be deployed to limit the extent of the turbidity plume.

In-water or dry-hull cleaning will not be permitted at the facility. The Exmouth Marina provides a range of facilities for boat servicing and maintenance and it is intended that this marina would be used when required.

Sullage facilities will not be provided at the facility. It is anticipated that sullage facilities would only be required by the large non-trailered vessels and these vessels would be expected to be operating consistently with the State's draft discussion paper on the Discharge of Sewerage from Vessels into the Marine Environment (Transport, 1999). The majority of the large non-trailered vessels would be CALM-licensed tour operators and these operators would be required to abide to this draft discussion paper through the tour operators handbook (CALM, 1999). This discussion paper recommends no refuse, sullage or bilge water to be discharged into marine conservation reserves. In addition, the volume of sullage would be reduced as no overnight accommodation will be permitted at the facility. Hence, nutrient enrichment of marine waters due to the operation of the boating facility is not expected.

The ablution facilities will use a sealed system and the use of this system will also prevent faecal contamination of nearshore waters. Solid waste from the fish-cleaning facilities will be disposed of at the present Coral Bay waste disposal site and the limited liquid waste will be discharged to a small groundwater soak. Therefore, the fish-cleaning facility is not expected to have a significant impact on the marine water quality. As noted above, all run-off from the road and car park will be directed to stormwater drains and discharge to the marine environment will be negligible.

5.3.3 Fuel spill risks

(For additional information see Technical Appendix 3)

Potential sources of fuel spills due to boating activities in the Coral Bay region include:

- Boat grounding;
- Collisions between boats;
- Collisions of boats with fixed objects such as a jetties or channel markers;
- Accidental spills from boats; and
- Accidental spills during refuelling operations.

Fuel spills from the first four sources are possible anywhere in the Coral Bay region. The provision of a formal boating facility at Coral Bay may result in increased boat traffic in the region and may thereby slightly increase the likelihood of one of these types of spills. There is a small risk of accidental spills occurring at the facility during refuelling operations.

A risk assessment was conducted to examine the potential environmental risks due to a spill at the Monck Head Boating facility. The daily risk of small fuel spills (30 L or less) during refuelling was estimated to be one in 620,500 boats per day and for large spills (1,000 L or more) the daily risk was estimated to be one in 6,205,000. These risks are very small and further, it should be noted a rapid management response should enable the spill to be retained in close proximity to the fuelling facility.

Dieseline is a light refined product that would disperse and evaporate very quickly, particularly under the warm, windy conditions that are typical of the Coral Bay region. Thus, a small-scale fuel spill would have negligible effects on the marine biota and recreational uses of the Coral Bay region and a large-scale fuel spill would, at worst, be

seen as an iridescent slick (about 0.3 μm thick) over several square kilometres of water and would be hard to detect after six hours.

The coral communities at Coral Bay are rarely exposed and even with a large spill, the most conservative calculations indicate that fuel concentrations in waters overlying corals would be far lower than levels at which toxicity effects occur. In the unlikely event of a large fuel spill during, or up to a week after, a coral mass spawning event (which occur for one or two nights a year in March or April), surface concentrations of fuel may be sufficient to kill eggs, sperm or larvae, and reduce subsequent recruitment of corals in localised areas (via effects on fertilisation and larval settlement). The intertidal communities (beach and rocky shore) at Monck Head would suffer acute toxicity effects following an unconfined diesel spill.

The siting of facilities in a marine park requires that an appropriate pollution contingency management plan (PCMP) be prepared, and the necessary spill response equipment be maintained on site. An outline of the PCMP is provided in Section 7.2.

5.3.4 Marine sediment quality

(For additional information see Technical Appendix 2)

Simpson and Field (1995) have observed elevated levels of some contaminants within the sediments at several sites within Bills Bay that are likely to be due to boating activities. With the exception of TBT in Southern Bills Bay, the contaminants are well below levels likely to cause adverse effects on marine biota.

Boating activities, and possibly minor run-off from the launching ramp, at the proposed boating facility may cause elevated levels of heavy metals in the sediments. However, as most boats would be trailered (and therefore not coated with anti-foulant) the potential for metal accumulation should be extremely low and very localised. The chances of sediment contaminants affecting benthic communities are low.

The majority of the boats using the facility are expected to be small trailered boats which use petrol which volatilises rapidly and does not accumulate in the environment. The number of larger boats using diesel is few and the majority of these would be CALM-licensed tour operators. These tour operators are required to abide by the standard operating conditions (CALM, 1999) which specify that bilge water is not discharged within confined waters of marine conservation reserves.

5.3.5 Groundwater

(For additional information see Technical Appendix 1)

The water requirements at the boating facility will be minor and will only be required for drinking, toilet facilities and fish-cleaning. This water will be drawn from the existing deep wells in Coral Bay and will be trucked to the site of the boating facility. This would represent a very minor additional extraction from the existing groundwater resource. Hence, the impact on the groundwater resources in the Coral Bay region is expected to be extremely small. As noted above the ablution facilities will use a sealed system and will therefore not impact on groundwater quality.

5.3.6 Marine plant communities

(For additional information see Technical Appendix 5)

A small amount (0.04 ha) of the macroalgae community on the shore platform at Monck Head would be removed through the construction of the piled bridge and culvert causeway. However, the offshore launching ramp formation would provide additional hard substrata (0.08 ha) for colonisation. The small amount of nutrients which may be discharged from boats could possibly enhance macroalgal growth, or

result in localised patches of 'nuisance' green algae such as *Cladophora* and *Ulva* spp. A sparse and patchy distribution of *Halophila ovalis* was observed in this area as a 'fringe' at the base of a coral outcrop or in shallow sand overlying limestone. Extensive seagrass communities are not in close proximity and hence the facility is unlikely to impact on seagrasses.

5.3.7 Terrestrial plant communities

(For additional information see Technical Appendix 4)

Clearing of terrestrial vegetation will be required to accommodate the infrastructure required to support the proposed boating facility, including: access road (2 ha); car park (1 ha); and buildings/fuel storage (0.1 ha).

Much of the vegetation in the area of the flat dune swale which has been identified for the construction of the car park has been overrun by Buffel Grass (*Cenchrus ciliaris*) which appears to have replaced the native grasses and many of the shrubs. The vegetation community in this area is in poor condition and no priority species have been identified in this area.

The access road and car park will incorporate standard road formation shoulders which provide a buffer to mitigate against fire risks to terrestrial plant communities from vehicle exhausts.

It is expected that the rock material for the boating facility will be obtained from an existing quarry and the impact of quarrying on the terrestrial flora is expected to be insignificant. If a new quarrying site is to be developed then the appropriate licences will be obtained from the Shire, DEP and Department for Minerals and Petroleum Resources prior to commencing operations.

5.3.8 Marine faunal communities

(For additional information see Technical Appendix 5)

A boating facility at Monck Head would result in a minor loss (0.4 ha) of limestone reef pavement in the immediate alignment of the piled bridge and culvert causeway. This would include a very minor loss of macroalgae and some hard/soft corals. The offshore rubble-mound boat launching ramp will be located on an area of bare sand and will provide habitat for macroalgae, coral, and a range of fish and invertebrate species.

Navigation markers will be installed to mark the access channel to the Monck Head boating facility and the inner reef channel from Monck Head to Point Maud. The majority of these navigation markers will be in the form of spar buoys and are not expected to have a significant impact on the marine faunal communities. The approach to the boating facility may be marked with navigation pylons and these will, where possible, be located to avoid impacts on the coral communities.

The direct impacts of the proposed boating facility on the other marine fauna are expected to be minimal due to the mobility of these fauna.

The indirect impacts from this facility will include a reduction in boat traffic in the Southern Bills Bay and Paradise Beach area. If the Coral Coast Resort is approved and constructed at Mauds Landing then this will provide an alternative site for boat launching and will further reduce the boating traffic across Bills Bay.

It is likely that the provision of formalised boating facilities at Coral Bay will result in a more rapid increase in boat traffic in the area. Along with the increased boating traffic, there is likely to be an increase in fishing, boating noise and potential for

boating strikes on marine fauna. However, the presence of formalised boating facilities will also provide an opportunity to implement centralised community education programmes as well as monitoring for these effects. The potential indirect impacts from a more rapid increase in boating traffic in the area will require a coordinated management response from a number of agencies including CALM, Fisheries and the DPI. It is likely that this management response will focus on public education and monitoring.

5.3.9 Terrestrial faunal communities

(For additional information see Technical Appendix 4)

The boating facility is expected to have both positive and negative impacts on the terrestrial fauna associated with the area. The rubble-mound offshore boat launching ramp will provide additional roosting sites for birds such as terns, while scavenging from the fish-cleaning facility will favour both native species (such as gulls) and introduced species (such as foxes). Regular inspection and maintenance of the fish-cleaning by the facility manager will ensure that the effect of scavenging is minimised.

The widening of the access road and construction of the car park could disturb some mammals and reptiles. However, it is likely that the impacts on the terrestrial faunal communities will be localised and largely confined to disturbance during the construction period. The increased presence of people at Monck Head may have a slight adverse impact on the ospreys and waders which use this area.

Overall it is predicted that human pressure and disturbances associated with construction and operation of the boating facility on terrestrial faunal communities will be small and manageable.

5.3.10 Aboriginal heritage

(For additional information see Technical Appendix 6)

Archaeological material will be disturbed in the widening of the access road and construction of the car park at Monck Head. Disturbance of this material has already occurred due to the existing access tracks. The development will be implemented under the provisions of the Aboriginal Heritage Act 1972 and all contractors will be informed of their obligations under this Act. A representative from the Yamatji Land and Sea Council will be invited to be present during all excavation and clearing and flexibility in layout of the infrastructure of the boating facility will be exercised to avoid areas of Aboriginal significance where necessary.

The large midden exposure immediately east of Monck Head will not be directly affected. However, it is recommended that access to this area be restricted to minimised disturbance and encourage dune stabilisation. To further minimise disturbance of this midden material, it is recommended that no on-site reference to the midden site be made.

5.3.11 European heritage

No sites of significant European heritage are located at Monck Head.

5.3.12 Social issues

A boating facility at Monck Head would not be directly visible from Coral Bay. However, some commercial boat owners from Coral Bay have considered this a disadvantage as viewing their boats provides peace of mind. Where possible, the car park area will be designed to minimise the view of parked vehicles from offshore.

The Monck Head facility would be located along the existing recommended boating track to and from Southern Bills Bay. As such, boats travelling from the Monck Head site will have reduced travel time from the existing Southern Bills Bay site. The location of the boating facility at Monck Head will not effect track access to the south of Monck Head. Two routes are available for boats travelling outside the reef. Cardabia Passage to the north is preferred because the alternative passage to the south via the Yalobia (south) Passage is considered unsafe at times. The Coral Bay navigation chart (DMH, 1991) notes the Yalobia Passage as being unsafe for navigation during various combinations of wind, swell and tide. Caution signs relating to the safety risks associated with the Yalobia Passage will be installed at Monck Head and the navigation chart for this area will be revised to strengthen warnings regarding the use of this Passage.

The Monck Head boating facility will be on bare sand and is not frequently visited by recreational snorkellers. The area approximately 1 km north of Monck Head is popular for recreational snorkellers for coral viewing and boating access to this area may be restricted to glass-bottom boats only.

The Boating Facility is expected to take a total of approximately 5 months to construct. A major component of this activity involves carting rock material for construction of the ramp formation and armour walls. It is anticipated that the rock material will be carted from an existing quarry over a 5 week period with an average of 20 truck loads per day during this period.

There will be a short-term benefit to the construction industry in the Gascoyne area during the construction of the facility.

5.4 CONCLUSIONS

The proposed Monck Head boating facility will provide services for both trailered craft and non-trailered vessels. However, the provision of refuelling facilities for the non-trailered boats is proposed as an interim solution pending any private development at Mauds Landing. A boating facility at Monck Head would provide the following advantages:

- The facility would lie outside the protected Maud Sanctuary Zone;
- The trailered craft would have improved access to the waters of the region;
- Non-trailered craft would be able to load and refuel from the service jetty and swing moor in the vicinity;
- Road access is already provided and would only require upgrading;
- The location and orientation affords some shelter from the prevailing south to south-westerly winds;
- Reduces the risk of injury to swimmers, physical damage to corals and fuel spills in Southern Bills Bay; and
- A facility for trailered craft would compliment any private development at Mauds Landing.

The environmental ‘costs’ associated with a boating facility at Monck Head include the following:

- Increased travel distance (approximately 1.5 km) from the accommodation at Coral Bay to the proposed site;

- Potential for increased fishing pressure due to increased boating usage of the area (this impact could be managed through the introduction of stricter controls and bag limits);
- Minor loss of macroalgae and hard/soft corals on the shore platform due to the construction of the piling jetty and culvert causeway;
- Minor negative impacts on terrestrial flora and fauna due to road widening and car park construction;
- Adverse impact on archaeological material due to road widening and construction of the car park; and
- If a spill were to occur from the refuelling facility it is anticipated that the fuel concentrations in waters overlying the corals would be far lower than levels at which toxicity effects occur. However, the prevailing winds and northerly currents would push the spill on to Paradise Beach and the intertidal communities in this area would suffer acute toxicity effects.

The environmental 'benefits' associated with a boating facility at Monck Head include the following:

- Relocation of the majority of the boating activity from Southern Bills Bay and Paradise Beach will reduce the conflict of use with the swimmers and snorkellers and the associated safety issues;
- The potential for coral damage through boating impacts and anchoring in Southern Bills Bay will be considerably reduced; and
- The provision of formalised boat fuelling and mooring facilities will improve the boating amenity of the area.

The environmental monitoring and management programmes which will be undertaken if the boating facility were constructed at Monck Head are outlined in Section 7. In conclusion, it is considered that the construction and operation of a boating facility at Monck Head can be undertaken and managed to meet the EPA's objectives.

6. NORTH BILLS BAY ALTERNATIVE

This section of the PER provides a detailed summary of the engineering, environmental and management issues associated with the development of a boating facility at the North Bills Bay site.

6.1 PROPOSED BOATING FACILITY FOR NORTH BILLS BAY

Due to the moderate prevailing wave energy experienced at the North Bills Bay site, a wave protection system would be required to enable safe boat launching and pen mooring (Egis Consulting, 1998—see Section 6.2.1 below for more details). In addition, the significant littoral transport and shoreline accretion at the North Bills Bay site would require a connected breakwater to minimise the impact of sediment accumulation at the boat ramp (Egis Consulting, 1998—see Section 6.2.1 below for more details). Consequently, the proposed boating facility, if constructed at North Bills Bay, would consist of a small enclosed boat harbour. This boat harbour will be within the Maud Sanctuary Zone and the construction of the breakwater will require an amendment to the Ningaloo Marine Park management plan.

The boating facility will be designed to accommodate the expected sea level rise during its operational life and withstand the impact from severe storm conditions. Dredging will not be required during construction but will be required at regular intervals following construction, to maintain access. The key marine and terrestrial elements of the proposed boating facility at North Bills Bay are described below (Figure 5; Table 4):

Marine Facilities

- An offshore breakwater (0.45 ha) will be constructed to provide shelter for a boat ramp, service jetty and mooring pens. The breakwater will be constructed through the placement of armour units and backloading of core material starting from the beach and moving offshore. The breakwater will also assist to minimise sedimentation within the harbour (harbour area will be 0.95 ha). Dredging will be required at regular intervals to ensure a navigable water depth of at least 1.4 m Chart Datum is maintained at the entrance to the Boating Facility;
- A two lane boat launching ramp for use by trailered craft. A small finger jetty will be located between the ramps to facilitate loading of these craft;
- A service jetty will be located within the boat harbour;
- A limited number of mooring pens; and
- Channel markers to assist navigation on the approach to the boating facility. Channel markers will also be installed to mark navigation channels through the lagoon area, in particular the navigation passage which parallels the back reef from Monck Head to Point Maud.

Terrestrial Facilities

- A 1.8 km long sealed access road from Mauds Landing to North Bills Bay will be constructed with a width of 14.4 m;
- Car parking (approximately 1 ha) for approximately 100 vehicles which will include parking bays for vehicles with trailers, as well as parking for coaches if required to service charter boats. The surface of the car park will be sealed;

- Two on-site water tanks (2,000 L) will be provided, one to provide fresh water for drinking and filling water tanks on non-trailered boats, and the second to provide groundwater for hand washing and fish cleaning. The two water tanks will be regularly filled by hauling water from Coral Bay;
- A public toilet facility which will use a sealed system. This system will not require water for flushing, will require minimal maintenance and does not result in leaching to the groundwater;
- Fish cleaning facility for cleaning, scaling and gutting of fish. Solid waste reception facilities shall be provided on site and these facilities will be disposed of at the present Coral Bay waste disposal site and the limited liquid waste will be discharged to a small groundwater soak;
- Low-profile diesel fuel storage tanks (10,000 to 20,000 L) will be located in a lined and bunded storage area. Refuelling for non-trailered vessels is intended as an interim measure until this function can be provided elsewhere, possibly at the proposed private Coral Coast Resort at Mauds Landing;
- A small on-site generator may be required to operate dieseline fuel pumps; and
- Limited public lighting.

Table 4 Key proposal characteristics for the proposed North Bills Bay Boating facility

ELEMENT	DESCRIPTION
Proposal	North Bills Bay boating facility
Proponent	Department for Planning and Infrastructure
Location	North Bills Bay, Coral Bay
Marine facilities	
Breakwater	A breakwater will be constructed to shelter the boat ramp, service jetty and mooring pens from the prevailing waves. Hind cast modelling shows that the typical average daily maximum wave height at this site is 0.4 m which indicates that boat launching at this site would require protection from wave energy via a breakwater (Egis Consulting, 1997). The breakwater will also minimise sedimentation within the harbour and will be constructed through the back loading of core material and placement of armour units from the beach and moving offshore. Without the breakwater, it is likely that the ramp would be periodically swamped with sand rendering it unusable. A navigable water depth of at least 1.4 m Chart Datum will be provided within the harbour.
Two lane boat launching ramp	For use by trailered craft. A small finger jetty will be located between the ramps to facilitate loading.
Service wharf	Located within the boat harbour.
Mooring pens	A limited number of mooring pens will be located within the boat harbour.
Channel markers	To assist navigation on the approach to the boating facility. Channel markers will also be installed to mark navigation channels through the lagoon area, in particular, the recommended boating track which parallels the back reef from Monck Head to Point Maud.
Dredging	Regular dredging will be required following construction to maintain navigable access.
Terrestrial Facilities	
Access road	The existing access road from the settlement to Mauds Landing is approximately 4.2 km long and a new access road (approximately 1.8 km) would be constructed from Mauds Landing through the dunes of Point Maud to the North Bills Bay site. The road will be constructed to accommodate heavy vehicles for the transport of construction materials and will be approximately 14.4 m to provide two-lane access.
Car parking	Car parking for approximately 100 vehicles will be provided

ELEMENT	DESCRIPTION
	and will accommodate bus coaches and vehicles with trailers. The total area of the car park will be approximately 1 ha.
Water tanks	Two tanks will be installed on-site: one to provide fresh water for drinking and the second to provide groundwater for hand washing and fish-cleaning. The water tanks will be regularly filled by hauling water from Coral Bay.
Public toilet facility	Using a dry-compost sealed system. This system is low maintenance, fully sealed and does not require water for flushing.
Fish-cleaning facility	Facility for cleaning, scaling and gutting of fish. Solid waste reception facilities shall be provided on site and these facilities will be disposed of at the existing Coral Bay waste disposal site. The limited liquid waste will be discharged to a small groundwater soak.
Fuel storage tanks	Approximately 10,000 to 20,000 L of diesel fuel will be stored at the facility. The fuel will be stored in two, low profile, steel storage tanks which will be located in a lined and bunded storage area. Refuelling for non-trailered vessels is intended as an interim measure until this function can be provided elsewhere, possibly at the proposed private Coral Coast Resort at Mauds Landing.
On-site generator	Used to operate dieseline fuel pumps.
Limited public lighting	To illuminate car park and ramp areas.

6.2 ENGINEERING AND MANAGEMENT CONSIDERATIONS

A number of engineering and management constraints affect the development of the boating facility at North Bills Bay and these are outlined below.

6.2.1 Coastal processes

(For additional information see Technical Appendix 1)

The North Bills Bay site is relatively well protected by the fringing reef from the impact of swell waves; however, with a south-westerly aspect, this site will be exposed to wind waves generated in the lagoon by the prevailing south to south westerly winds. The average significant wave height at North Bills Bay is 0.2 m with an average daily maximum of 0.4 m. Wave heights of 0.6 m are possible at this site under non-storm conditions, which is unacceptable for boat launching (Egis Consulting, 1998). The 10, 20 and 50 year recurrence storm wave heights at North Bills Bay are 1.8, 1.9 and 2.0 m, respectively (Egis Consulting, 1998). It is recommended that the 20 year return period wave be used as the design wave for the breakwater construction.

The shoreline of North Bills Bay is accreting at an average annual rate of approximately 0.4 m (Egis Consulting, 1997). A net northward sediment transport (with an average annual drift of 12,000 m^3) prevails at this site and sand bypassing of the breakwater would be required. It is estimated that approximately 6,000 m^3 of sand will accrete annually on the eastern side of the breakwater and following an initial 3 to 5 year saturation period, maintenance dredging will be required every 3 to 6 years to remove this accreted sand. Bypassing would move sand to the west of the boat harbour clear of the approach channel. If bypassing is not undertaken, sand will eventually accumulate in the boating basin and the approach channel.

Initial trapping of sand on the eastern side of the boat harbour (covering an area of approximately 0.8 ha) would mean that some erosion may be experienced between the boat harbour and Point Maud. Any erosion caused would be rectified during bypassing operations.

6.2.2 Navigation considerations

A boating facility at the North Bills Bay site would be closer to the Cardabia Passage and hence could encourage boats travelling outside the reef to use this Passage rather than the more dangerous Yalobia Passage to the south.

The hydrographic chart for Coral Bay is presently being revised and will carry caution notes similar to the Coral Bay Boating Guide (Department for Planning and Infrastructure, 2001) which states *"Yalobia Passage breaks and becomes dangerous for navigation during times of heavy swell and/or low tides. The lead markers into Yalobia Passage are sometimes difficult to see at various times of the day and in hazy conditions. Yalobia Passage should only be attempted by experienced mariners"*. Copies of the Boating Guide are available free of charge and will be made available in Coral Bay. Caution signs regarding the Yalobia Passage will also be installed at the Boating Facility if constructed at North Bills Bay.

Boats (particularly smaller boats) that seek the sheltered waters to south of Coral Bay would be required to leave the North Bills Bay facility and travel past Point Maud into Bateman Bay before proceeding south along the recommended boating track inside the reef.

Boating access along the inside of the fringing reef, along the recommended boating track, would require marked navigation channels to ensure safe boat passage. The location of a boating facility at North Bills Bay is likely to increase the number of boats in southern Bateman Bay, hence it may be necessary to install some isolated danger navigation markers to mark the submerged pile of the jetty at Mauds Landing (note that these "jetty ruins" are already marked on the hydrographic chart of the area). The majority of the navigation markers would most likely be installed as spar buoys. If necessary, larger markers will be installed using drilling methods to avoid pile-driving operations wherever possible.

6.2.3 Existing infrastructure

At present, there is no infrastructure to support a boating facility at the North Bills Bay site. A new road will be required to access the site and will be constructed from the unsealed, but well established road to Mauds Landing. This road will be approximately 1.8 km long and will follow the alignment of an existing track for the first 250 m; thereafter, the road will be aligned to follow the valleys between the dunes, where possible (Figure 1). Crossings of the dune ridges will be minimised and the exposed dune areas will be re-vegetated. The road will be constructed to Council standards and will subsequently be handed to the Shire for control and maintenance.

There is no form of centralised power distribution in the Coral Bay area (MFP, 1996b). Consequently, a small generator may be required to service the boating facility at the proposed site.

The water supply for Coral Bay is provided by individual operators through artesian bores which intersect the Birdrong Sandstone. The groundwater is treated using reverse osmosis to desalinate prior to distribution to the individual operators sites (MFP, 1996b). Due to the high cost of the reverse osmosis treatment, the amount of potable water is limited. The treated groundwater is used for personal use and toilets whereas untreated water is used for irrigation (MFP, 1996b). There are no existing sources of water at North Bills Bay and water will need to be hauled from the Coral Bay settlement.

The Coral Bay settlement has an existing (and proposed) solid waste disposal site to the south-east of the settlement. The site could adequately accommodate solid wastes derived from the boating facility. At present, the sewage from the Coral Bay settlement is pumped to a disposal site (evaporation ponds) in the dunes directly north of the settlement, but a fully integrated sewerage system has been proposed to service the Coral Bay settlement (MFP, 1996b).

6.2.4 Marine park management

The North Bills Bay site would be wholly within the Maud Sanctuary Zone of the Ningaloo Marine Park. The Management Plan for the Ningaloo Marine Park does not allow the construction of breakwaters within a sanctuary zone. Hence, prior to construction, it will be necessary to amend the Management Plan. The process of amending the Management Plan will require notification of the community and affected Government organisations. The public and agency submissions will then be considered and the proposal would be submitted to the MPRA. Following consideration by the MPRA the proposal for amendment of the Management Plan would be forwarded to the Minister for the Environment for approval.

6.2.5 Land tenure

The North Bills Bay development site falls within the Mauds Landing townsite boundary that was gazetted in the 1915 but has remained Vacant Crown Land ever since. A portion of the site also lies on the Cardabia Station pastoral lease and a small portion lies within the Ningaloo Marine Park, being within 40 m of the coast.

The area is subject of a native title claim (Gnulli—WC97/28); this claim passed registration testing in July 1999 and mediation commenced in July 2000 and is continuing. Negotiations and clearances for native title will be required prior to commencing construction. Details of the proposed facility were discussed with representatives of the Gnulli group in September 1999.

It is expected that the rock material for the boating facility will be obtained from an existing quarry and trucked to site.

6.3 ENVIRONMENTAL IMPACT ASSESSMENT

The following environmental elements were examined to determine the impacts of the development of a boating facility at North Bills Bay:

- Landforms and soils;
- Marine water quality;
- Marine sediment quality;
- Groundwater;
- Marine plant communities;
- Terrestrial plant communities;
- Marine faunal communities;
- Terrestrial faunal communities;
- Aboriginal heritage;
- European heritage; and
- Social issues.

A description of the impacts on each of these key environmental elements is presented below.

6.3.1 Landforms and soils

(For additional information see Technical Appendix 1)

Construction of the 1.8 km long new access road from Mauds Landing to the North Bills Bay site, and the car park, may cause localised instability of the foredunes, relic foredunes and parabolic dunes. The road and car park will be surfaced and all exposed dune cuttings will be rehabilitated as soon as possible. Rehabilitation will be done to the satisfaction of CALM using native vegetation.

The parking area will be designed so that it is screened from the beach and existing townsite where possible. All run off from the road and car park will be directed to stormwater drains to minimise erosion and prevent sediment delivery to the marine environment. A cut-off trap will be located at the head of the boat ramps to minimise discharge to the sea. It is intended that during intense rainfall events, such as during a tropical cyclone, the stormwater drains will intercept the first-flush of run-off which typically has the highest concentration of contaminants.

6.3.2 Marine water quality

(For additional information see Technical Appendix 2)

The construction of the breakwater will result in a short-term increase in water column turbidity. There is the potential for this sediment plume to drift over adjacent coral communities in the North Bills Bay area. If required, a silt curtain will be deployed to limit the extent of the turbidity plume.

In-water or dry-hull cleaning will not be permitted at the facility. The Exmouth Marina provides a range of facilities for boat servicing and maintenance and it is intended that this marina would be used when required.

Sullage facilities will not be provided at the facility. It is anticipated that sullage facilities would only be required by the large non-trailered vessels and these vessels would be expected to be operating consistently with the State's draft Discussion Paper on the Discharge of Sewerage from Vessels into the Marine Environment (Transport, 1999). The majority of the large non-trailered vessels would be CALM-licensed tour operators and these operators would be required to abide to this draft policy through the tour operators handbook (CALM, 1999). This Discussion Paper recommends no refuse, sullage or bilge water to be discharged into marine conservation reserves. In addition, the volume of sullage would be reduced as no overnight accommodation will be permitted at the facility. Hence, nutrient enrichment of marine waters due to the operation of the boating facility is not expected.

No nutrient inputs to marine waters are expected due to human activities associated with the operation of the boating facility. The ablution facilities will use a sealed system and the use of this system will also prevent faecal contamination of nearshore waters. Solid waste from the fish-cleaning facilities will be disposed of at the present Coral Bay waste disposal site and the limited liquid waste will be discharged to a small groundwater soak. Therefore, the fish-cleaning facility is not expected to have a significant impact on the marine water quality. As noted above, all run-off from the road and car park will be directed to stormwater drains and discharge to the marine environment will be negligible.

There may be a slight change in water quality within the enclosed waters of the boating facility (compared to water quality outside the breakwaters), simply due to the calmer conditions and increased residence time of the water. Based on tidal prism

calculations, complete flushing due to tide alone will be achieved in two to six days, depending on whether a spring or neap tide occurs. This estimate is extremely conservative, as it does not allow for exchange due to wind (or boating activity). Due to the increase in residence time, slightly elevated chlorophyll levels and turbidity may occur within the boating facility, but the degree of this effect should be minimal as wind-stirring in the shallow waters of the boating facility is likely to prevent any significant degree of organic matter build-up in sediments (a key factor causing increased chlorophyll levels in enclosed waters). Furthermore, based on empirical data from larger, deeper and less well flushed structures in waters with similar tidal ranges (eg Hillary's boat harbour, Success Harbour; BBG, 2001), effects on water quality immediately outside the boating facility are expected to be negligible.

6.3.3 Fuel spill risks

(For additional information see Technical Appendix 3)

Potential sources of fuel spills due to boating activities in the Coral Bay region include:

- Boat grounding;
- Collisions between boats;
- Collisions of boats with fixed objects such as a jetties or channel markers;
- Accidental spills from boats; and
- Accidental spills during refuelling operations.

Fuel spills from the first four sources are possible anywhere in the Coral Bay region. The provision of a formal boating facility at Coral Bay may result in increased boat traffic in the region and may thereby slightly increase the likelihood of one of these types of spills. There is a small risk of accidental spills occurring at the facility during refuelling operations. The siting of facilities in a marine park requires that an appropriate fuel spill emergency response plan be prepared, and the necessary spill response equipment be maintained on site. It is anticipated that a rapid response to a fuel spill, which might occur during refuelling operations, would ensure that the majority of the fuel spill is retained within the boat harbour and dispersion of the fuel to the nearby ecologically sensitive areas will be minimised.

A risk assessment was conducted to examine the potential environmental risks due to a spill exiting from the boat harbour at North Bills Bay. The daily risk of small fuel spills (30 L or less) during refuelling was estimated to be one in 620,500 boats per day and for large spills (1,000 L or more) the daily risk was estimated to be one in 6,205,000. These risks are very small and further, it should be noted a rapid response to any spill should ensure that the spill from the refuelling facility would be retained within the harbour. Dieseline is a light refined product that would disperse and evaporate very quickly, particularly under the warm, windy conditions that are typical of the Coral Bay region. Thus, a small-scale fuel spill would have negligible effects on the marine biota and recreational uses of the Coral Bay region and a large-scale fuel spill would, at worst, be seen as an iridescent slick (about 0.3 µm thick) over several square kilometres of water and would be hard to detect after six hours.

The coral communities at Coral Bay are rarely exposed and even with a large spill, the most conservative calculations indicate that fuel concentrations in waters overlying corals would be far lower than levels at which toxicity effects occur. North Bills Bay has already suffered mass mortality of corals due to anoxic conditions that developed in unusually calm weather following a mass spawning event in 1989, and recruitment of coral larvae from spawning events is important in the recovery of the coral

communities in this area. In the unlikely event of a large fuel spill being released from the boat harbour during, or up to a week after, a coral mass spawning event (which occur for one or two nights a year in March or April), surface concentrations of fuel may be sufficient to kill eggs, sperm or larvae, and reduce subsequent recruitment of corals in localised areas (via effects on fertilisation and larval settlement). In the unlikely event of a large fuel spill being released from the North Bills Bay boat harbour, the intertidal communities (including the bird sanctuary) at Point Maud which are classified as having extreme environmental sensitivity would suffer acute toxicity effects.

The siting of facilities in a marine park requires that an appropriate pollution contingency management plan (PCMP) be prepared, and the necessary spill response equipment be maintained on site. An outline of the PCMP is provided in Section 7.2.

6.3.4 Marine sediment quality

(For additional information see Technical Appendix 2)

Simpson and Field (1995) found elevated levels of some contaminants within the sediments at several sites within Bills Bay that are likely to be due to boating activities. With the exception of TBT in Southern Bills Bay, the contaminants are well below levels likely to cause adverse effects on marine biota.

Boating activities, and possibly surface run-off from the launching ramp, of the proposed boating facility may cause elevated levels of heavy metals in the sediments. However, as most boats would be trailered (and therefore not coated with anti-foulant) the potential for metal accumulation should be extremely low and very localised. As a result, the chances of sediment contaminants affecting nearby benthic communities are low.

The majority of the boats using the facility are expected to be small trailered boats which use petrol which volatilises rapidly and does not accumulate in the environment. The number of larger boats using diesel is few and the majority of these would be CALM-licensed tour operators. These tour operators are required to abide by the standard operating conditions (CALM, 1999) which specify that bilge water is not discharged within confined waters of marine conservation reserves. Hence, the potential for accumulation of hydrocarbons in the sediment is low. The potential for a significant change in sediment quality within the boating facility (eg increased percentage of fine particles, increased organic matter) is also considered low despite calmer conditions and increased residence times, due to the influence of wind stirring and sediment re-suspension (see Section 6.3.2).

6.3.5 Groundwater

(For additional information see Technical Appendix 1)

The water requirements at the boating facility will be minor and will only be required for drinking, toilet facilities and fish-cleaning. This water will be drawn from the existing deep wells in Coral Bay and will be trucked to the site of the boating facility. This would represent a very minor additional extraction from the existing groundwater resource. Hence, the impact of the proposed boating facility on the groundwater resources in the Coral Bay region are expected to be extremely small. As noted above the ablution facilities will use a sealed system and will therefore not impact on groundwater quality.

6.3.6 Marine plant communities

(For additional information see Technical Appendix 5)

It is considered that the macroalgal communities would be favoured by the development of a boating facility as the breakwater, boat launching ramp and moorings would provide additional hard substrata (ca 0.25 ha) for colonisation. In addition, the small amount of nutrients which may be discharged from the boats could possibly enhance macroalgal growth, or result in localised patches of 'nuisance' green algae such as *Cladophora* and *Ulva* spp. No seagrass communities were observed in the vicinity of the North Bills Bay site and hence there will be no impact of the facility on seagrasses at this site.

6.3.7 Terrestrial plant communities

(For additional information see Technical Appendix 4)

Clearing of terrestrial vegetation will required to accommodate the infrastructure required to support the proposed boating facility, including: access road (4 ha); car park (1 ha); and buildings/fuel storage (0.1 ha).

The construction of the new 1.8 km long access road from Mauds Landing to North Bills Bay will cause considerable localised disturbance to the terrestrial plant communities. Depending on the exact route chosen through the dunes some individuals of the priority (CALM Priority 2) species *Acacia ryaniana* could be removed during clearing. However, this is not expected to significantly deplete the local population as few individuals would be impacted due to the widespread and scattered distribution of these plants.

The access road and car park will incorporate standard road formation shoulders which provide a buffer to mitigate against fire risks to terrestrial plant communities from vehicle exhausts.

It is expected that the rock material for the boating facility will be obtained from an existing quarry and the impact of quarrying on the terrestrial flora is expected to be insignificant. If a new quarrying site is to be developed then the appropriate licences will be obtained from the Shire, DEP and Department of Minerals and Petroleum Resources prior to commencing operations.

6.3.8 Marine faunal communities

(For additional information see Technical Appendix 5)

A boating facility at North Bills Bay would result in some loss of corals and limestone reef in the immediate vicinity of the facility. However, it should also be noted that the breakwater will provide habitat for macroalgae, coral, and a range of fish and invertebrate species. The total potential loss of coral and limestone reef (including loss from shoreline accretion on the eastern breakwater) is estimated as 0.5 ha, but this

would be partly offset by the provision of habitat by the breakwater. The loss of 0.5 ha represents about 0.1% of the estimated 560 ha of primary producer habitat in the area of Bills Bay from Point Maud to Fletcher Hill and offshore to the edge of the outer reef. The percentage loss is extremely minor, but would occur within an area designated as 'Category A' (areas of extremely high conservation significance, eg. existing or proposed marine nature reserves or sanctuary zones in marine parks), where the EPA's draft policy for benthic primary producer habitat protection (EPA, 1998) states that no loss due to any proposed development should occur. The policy has yet to be finalised, and there is also a limitations clause that allows the environmental impact assessment of every proposal to be assessed on its merits.

Large numbers (*ca*. 70–100) of black and grey-tip reef sharks (*Carcharinus melanopterus* and *Carcharinus amblyrhynchos*) have been observed inshore of the submerged beach rock ridges at Skeleton Bay in late-August and October to December (Whitaker, *pers. comm*., 1998; Norman, In preparation) and it is considered that this is probably a nursery area for both species. The operation of the boating facility at North Bills Bay may negatively impact on the sharks' usage of this area.

Navigation markers will be installed to mark the access channel to the North Bills Bay boating facility and the inner reef channel from Monck Head to Point Maud. The majority of these navigation markers will be in the form of spar buoys and are not expected to have a significant impact on the marine faunal communities. The approach to the boating facility may be marked with navigation pylons and these will, where possible, be located to avoid impacts on the coral communities.

The direct impacts of the proposed boating facility on the other marine fauna are expected to be minimal due to the mobility of these fauna.

The indirect impacts from this facility will include a reduction in boat traffic in the Southern Bills Bay and Paradise Beach area. If the Coral Coast Resort is approved and constructed at Mauds Landing then this will provide an alternative site for boat launching and will further reduce the boating traffic across Bills Bay.

It is likely that the provision of formalised boating facilities at Coral Bay will result in a more rapid increase in boat traffic in the area and an increase in pedestrian traffic at Point Maud and Skeleton Beach. Along with the increased boating traffic, there is likely to be an increase in fishing pressure, boating noise and potential for boating strikes on larger marine fauna. The increased pedestrian traffic has the potential to increase the disturbance of the Point Maud bird roosting and also on the schools of sharks in Skeleton Bay (between late-August and December).

The presence of formalised boating facilities will provide an opportunity to implement centralised community education programmes as well as monitoring for these effects. The potential indirect impacts from a more rapid increase in boating and pedestrian traffic in the area will require a coordinated management response from a number of agencies, including CALM, Fisheries and the DPI. It is likely that this management response will focus on public education and monitoring.

6.3.9 Terrestrial faunal communities

(For additional information see Technical Appendix 4)

The boating facility is expected to have both positive and negative impacts on the terrestrial fauna associated with the area. The breakwater will provide additional roosting sites for birds such as terns, while scavenging from the fish-cleaning facility will favour both native species (such as gulls) and introduced species (such as foxes).

Regular inspection and maintenance of the fish-cleaning by the facility manager will ensure that the effect of scavenging is minimised.

The construction and use of the access road could disturb some mammals and numerous reptiles that are associated with the dunes. During construction, it may be necessary to pile drive supports for the boating pens; however, it is anticipated that this operation could be completed within a few days and hence the impact of this noise on the birds at Point Maud is not expected to be significant. However, the increased presence of people at North Bills Bay may have an adverse impact on the Point Maud bird rookery.

Overall it is predicted that human pressure and disturbances associated with construction and operation of the boating facility on terrestrial faunal communities will be moderate.

6.3.10 Aboriginal heritage

(For additional information see Technical Appendix 6)

The new access road and car park will be positioned to avoid any known sites of Aboriginal significance including the existing soak which is considered to be of low archaeological significance. However, it is possible that construction of the new access road and car park may disturb unknown burial sites. The development will be implemented under the provisions of the Aboriginal Heritage Act 1972 and all contractors will be informed of their obligations under this Act. A representative from the Yamatji Land and Sea Council will be invited to be present during all excavation and clearing and flexibility in layout of the infrastructure of the boating facility will be exercised to avoid areas of Aboriginal significance where necessary.

6.3.11 European heritage

No sites of significant European heritage are known to be located at North Bills Bay.

6.3.12 Social issues

A boating facility at North Bills Bay would be visible from Coral Bay. Several of the commercial boat operators have considered this an advantage as viewing their boats provides peace of mind. However, at a distance of 2.25 km from Coral Bay to the Boating Facility at North Bills Bay is unlikely to be overly intrusive visually or detract from the present view of Point Maud from the Coral Bay townsite. Furthermore, with North Bills Bay having recently become accessible to motorised bikes, the former remoteness of the site, which was an aesthetic quality valued by persons such as beach-combers and nudists, is presently under threat. Where possible, the car park area will be designed to minimise the view of parked vehicles from Coral Bay and offshore.

The area at North Bills Bay is not frequently visited by recreational snorkellers for coral viewing. As such, a boating facility here will minimise the conflict between boats and snorkellers that currently exists at South Bills Bay.

The Boating Facility is expected to take a total of approximately 7 months to construct. A major component of this activity involves carting rock material for construction of the breakwater walls. It is anticipated that the rock material will be carted from an existing quarry over a 13 week period with an average of 20 truck loads per day during this period.

There will be a short-term benefit to the construction industry in the Gascoyne area during the construction of the facility.

6.4 CONCLUSIONS

The proposed North Bills Bay boating facility will provide services for both trailered craft and non-trailered vessels. However, the provision of refuelling facilities for the non-trailered boats is proposed as an interim solution pending any private development at Mauds Landing. A boating facility at North Bills Bay would provide the following advantages:

- The trailered craft would have improved access to the waters of the region, especially to Bateman Bay and Cardabia Passage to the north;
- Non-trailered craft would have fixed pens and be able to load and refuel from the service jetty;
- Reduces the risk of injury to swimmers, physical damage to corals and fuel spills in Southern Bills Bay; and
- A facility for trailered craft which would compliment any private development at Mauds Landing.

The environmental 'costs' associated with a boating facility at North Bills Bay include the following:

- Increased travel distance (approximately 6 km) from the accommodation at Coral Bay to the proposed site;
- Need for ongoing management of coastal sediment transport;
- Potential for a more rapid increase in boat traffic in the area and pedestrian traffic at Point Maud and Skeleton Beach. Along with the increased boating traffic , there is likely to be an increase in fishing pressure, boating noise and potential for boating strikes on larger marine fauna. The increased pedestrian traffic has the potential to increase the disturbance of the Point Maud bird roosting and also on the schools of sharks in Skeleton Bay (between late-August and December);
- Loss of inshore corals due to the construction of the breakwater and harbour basin;
- Minor negative impacts on terrestrial flora and fauna due to road and car park construction;
- Adverse impact on archaeological material due to road and car park construction;
- If a spill were to occur from the refuelling facility, and be released from the boat harbour, it is anticipated that the fuel concentrations in waters overlying the corals would be far lower than levels at which toxicity effects occur. However, the prevailing winds and northerly currents would push the spill towards Point Maud where it would cause acute toxicity effects on the intertidal communities (including bird sanctuary).

The environmental 'benefits' associated with a boating facility at North Bills Bay include the following:

- Relocation of the majority of the boating activity from Southern Bills Bay and Paradise Beach will reduce the conflict of use with the swimmers and snorkellers and the associated safety issues;
- The potential for coral damage through boating impacts and anchoring in Southern Bills Bay will be considerably reduced;

- Formalised boating and fuelling facilities within the semi-enclosed harbour should reduce the potential risk for fuel spills when compared with the existing informal operations at Southern Bills Bay; and
- The provision of boat moorings and a boating beach will improve the boating amenity of the area.

The environmental monitoring and management programmes which will be undertaken if the boating facility were constructed at North Bills Bay are outlined in Section 7. In conclusion, it is considered that the construction and operation of a boating facility at North Bills Bay can be undertaken and managed to meet the EPA's objectives.

7. ENVIRONMENTAL MONITORING AND MANAGEMENT COMMITMENTS

The Department for Planning and Infrastructure undertake to be guided by the following management policies and actions when developing a boating facility, if approved, at either Monck Head or North Bills Bay:

- Maintain and enhance the integrity of the flora and fauna within the Ningaloo Marine Park in the vicinity of the boating facility through design and best practice environmental management;
- Reduce the risk of damage to the coral communities from recreational boating within the vicinity of the boating facility; and
- Restrict the impact of the proposed facility to within as small an area as possible.

7.1 ENVIRONMENTAL MANAGEMENT PLANS

The management policies and actions listed above will be implemented via a suite of environmental management plans (EMPs) covering the following phases (Table 5):

- Construction;
- Rehabilitation; and
- Operation.

As noted above, the materials for the construction of roads and breakwaters will be sourced from existing approved borrow pits and quarries in the area where possible. The DPI understands that it has responsibilities to seek all relevant approvals for additional sources of construction material if required.

7.2 POLLUTION CONTINGENCY MANAGEMENT PLAN

In addition, a Pollution Contingency Management Plan (PCMP) will be prepared to control and mitigate the environmental impacts in the event of a fuel spill (Table 5). This plan will be implemented during the operation of the facility and will include the provision and maintenance of appropriate fuel spill response equipment. It is anticipated that a rapid response to a fuel spill would reduce the fuel dispersion to the nearby ecologically sensitive areas.

The PCMP will delineate procedures to be followed in the event of a fuel spill, including flow charts showing assessment and response procedures during normal office hours and after hours. After any spill clean up exercise, an audit of all spill response equipment shall be conducted, and any disposed or damaged equipment shall be replaced immediately.

Table 5 Environmental management commitments

NO	TOPIC	ACTIONS	OBJECTIVE(S)	TIMING	ADVICE
1	Construction EMP	Prepare a Construction EMP to address: 1. Design of roads, carparks and stormwater management systems; 2. Timing and duration of construction; 3. Management of construction traffic; 4. Management of dust and noise; 5. Monitoring (including the identification of alert and action triggers) and management of turbidity and sedimentation associated with construction of marine structures; 6. Education of all site personnel regarding the protection of Aboriginal Heritage sites and the provisions of the *Aboriginal Heritage Act 1972*; and 7. Signage.	The key objectives of the construction management plan include: • Design terrestrial facilities to minimise the impact of construction on dunes and associated vegetation; • Control the speed of construction traffic to minimise potential risks to the public and native fauna; • Minimise erosion and prevent sedimentation into the marine environment; • Ensure that dust and noise levels caused by construction activities do not adversely impact on the welfare and amenity by meeting statutory requirements and acceptable standards; • Manage turbidity levels from construction to meet acceptable criteria in order to protect the values of the Ningaloo Marine Park; and • Ensure that construction activities comply with the requirements of the *Aboriginal Heritage Act 1972* and any other conditions related to Native Title negotiations	Prior to construction	Shire of Carnarvon CALM DIA
2	Construction EMP	Implement the approved Construction Phase EMP referred to in commitment 1.	Achieve the objectives of commitment 1.	During construction	As for commitment 1
3	Rehabilitation EMP	Prepare a Rehabilitation EMP to address: 1. The rehabilitation of areas disturbed by construction activities; 2. Appropriate native species for rehabilitation; 3. Monitoring and on-going management of rehabilitated areas.	Key objectives of the Rehabilitation Plan include: • stabilise dunes disturbed by construction activities to minimise erosion; and • the use native species where practical.	Prior to construction	CALM Shire of Carnarvon
4	Rehabilitation EMP	Implement the approved Rehabilitation EMP referred to in commitment 3.	Achieve the objectives of commitment 3.	Post construction	As for commitment 3
5	Operations EMP	Prepare an Operations EMP to address: 1. Ongoing management responsibilities for terrestrial (e.g. signage, roads, carparks, stormwater, waste management) and marine (e.g. boat ramps, breakwaters, boat fuelling) elements of the boating facility; 2. Establishment of environmental values and quality objectives for the facility consistent with the principles of the National Water Quality Management Strategy (NWQMS) and the EPA's implementation of the NWQMS;	The key objectives of the Operations EMP are to: • Identify monitoring and management responsibilities for the ongoing operation of the facility; • Monitor and maintain roads and carparks, to protect public safety; • Monitor and maintain stormwater management systems to protect marine water quality; • Monitor and manage environmental quality consistent with the NWQMS to protect the values of the Ningaloo Marine Park; • To minimise pollution and feral animal proliferation from waste	Prior to operation.	CALM MPRA Shire of Carnarvon

NO	TOPIC	ACTIONS	OBJECTIVE(S)	TIMING	ADVICE
		3. Collection of baseline water and sediment quality data; 4. Development of site-specific criteria (guidelines and standards) on the basis of baseline data (where there are no generic criteria) against which to measure whether environmental values are protected and objectives met; 5. Ongoing annual water quality monitoring against criteria; 6. Ongoing bi-annual sediment monitoring against criteria; 7. Development and implementation of adaptive management strategies to protect agreed values if environmental quality standards are exceeded; and 8. Management of waste generated at the facility; 9. Boating safety at the facility including navigation markers, access channels, warning signs and provision of free boating guide.	generated at the facility; and • Minimise safety risk to users of boating facility and surrounding area.		
6	Operations Phase EMP	Implement the approved Operations Phase EMP.	Achieve the objectives of commitment 5.	During operation	As for commitment 5
7	Pollution Contingency Management Plan	Prepare a Pollution Contingency Management Plan to address : 1. Responsibilities of the response team for a spill incident; 2. Assessment of an incident; 3. Deployment of spill response equipment; 4. Post incident audit and debriefing procedures; 5. Storage and maintenance of response equipment; and 6. Potential environmental impacts of a pollution incident at the facility.	To implement agreed actions in the event of a pollution incident and to mitigate potential environmental impacts of a pollution incident (e.g. fuel spill) at the facility to minimise impacts on the values of the Ningaloo Marine Park.	Prior to operation	DPI CALM MPRA
8	Pollution Contingency Management Plan	Implement the approved Pollution Contingency Management Plan.	Achieve the objectives of commitment 7.	During operation, as required	As for commitment 7

Note: CALM = Department of Conservation and Land Management; DIA = Department of Indigenous Affairs; DPI = Department for Planning & Infrastructure; MPRA = Marine Parks and Reserves Authority.

8. ACKNOWLEDGMENTS

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9. REFERENCES

ATA Environmental, 2000. *Coral Coast Resort Public Environmental Review Document*. Prepared for Coral Coast Marina Development Pty Ltd, November 2000.

Australian National Parks and Wildlife Service [ANPWS], 1990. *Ningaloo Marine Park (Commonwealth Waters) Plan of Management*. Australian National Parks and Wildlife Service.

Australian and New Zealand Environment Conservation Council [ANZECC]/Agriculture and Resource Management Council of Australia and New Zealand [ARMCANZ], 2000. *Australian Water Quality Guidelines for Fresh and Marine Waters*.

Australian and New Zealand Environment Conservation Council [ANZECC], 1992. *Australian Water Quality Guidelines for Fresh and Marine Waters*. Australian and New Zealand Environment and Conservation Council.

Allen G.R. and Swainston R., 1988. *The Marine Fishes of North-Western Australia: A Guide for Anglers and Divers*. Western Australian Museum, Perth, 201 pp.

Australian Heritage Commission, 1997. *Registration of the National Estate Database: Place Report—Ningaloo Marine Park and Proposed Additions*. Australian Heritage Commission.

Australian National Parks and Wildlife Service, 1990. *Ningaloo Marine Park (Commonwealth Waters) Plan of Management*. Australian National Parks and Wildlife Service.

Bettenay E., Churchwood H.M. and McArthur W.M., 1967. *Atlas of Australian Soils: Sheet 6 Meekatharra to Hamersley Range Area*. CSIRO and Melbourne University Press.

Bowman Bishaw Gorham [BBG], 1995. *Public Environmental Review: Coral Coast Resort—Mauds Landing*. Prepared for Coral Coast Marina Development Pty Ltd by Bowman Bishaw Gorham, Koltasz Smith & Partners, Ewing Consulting Engineers, M.P. Rogers & Associates and Trevor Saleeba & Associates, February 1995.

Bowman Bishaw Gorham [BBG], 2001. *Port Catherine Environmental Review*. Volume 2 Appendices I–VIII. Prepared by Bowman Bishaw and Gorham for the Western Australian Planning Commission, Perth, Western Australia. BBG Report No. R97062.

Cary, J.L., Grubba, T., Hogstrom, A., Milton, K. and Williams, C., 2000. *Human usage in Ningaloo Marine Park*. Prepared by Department of Conservation and Land Management, Data Report: MMS/NIN/NMP-20/2000

Cogger H.G., Cameron E.E., Sadlier R.A. and Eggler P., 1993. *The Action Plan for Australian Reptiles*. Australian Nature Conservation Agency.

Cogger H.G., 1992. *Reptiles and Amphibians of Australia*. Reed Books.

Commonwealth of Australia, 2000. *Ningaloo Marine Park (Commonwealth Waters) Draft Management Plan*, Environment Australia, Canberra.

D.A. Lord & Associates Pty Ltd [DAL], 2001. *Coral Bay Swing Moorings Concept Plan for E-Class Licence Holders*. Prepared for Department of Conservation and Land Management, Report No. 01/194/1, November 2001.

D.A. Lord & Associates Pty Ltd [DAL], 1997. *Notice of Intent for Coral Bay Boating Facility*. Prepared for Department of Transport, Report No. 96/050/3, December 1997.

Department of Conservation and Land Management [CALM], 1999 *Tour Operator Handbook-Marine— The Official Manual for CALM-Licensed Marine Tour Operators*. Published by the Department of Conservation and Land Management.

Department of Conservation and Land Management [CALM], 1994. *A Representative Marine Reserve System for Western Australia. Report of the Marine Parks and Reserves Selection Working Group*. Published by the Department of Conservation and Land Management.

Department of Conservation and Land Management [CALM], 1989. *Ningaloo Marine Park (State Waters): Management Plan 1989–1999*. Department of Conservation and Land Management.

Department of Conservation and Environment [DCE], 1984. *Coral Bay Draft Coastal Management Plan*. Department of Conservation and Environment, Perth WA. Bulletin 174.

Department of Planning and Urban Development, 1992. *Coral Bay Planning Strategy*. September 1992.

Department of Transport, 2001. *The Official Western Australian Boating Guide (4th Edn)*. June 2001.

Department of Transport, 1999. *The Discharge of Sewage from Vessels into the Marine Environment: A Draft Discussion Paper*. April 1999.

Department of Transport, 1994. *Submergence curve for Monck Head, Coral Bay*.

Ecologia Environmental Consultants, 1995. *Coral Coast Marina Project: Vertebrate Fauna & Habitats Assessment*. In *Coral Coast Resort Mauds Landing: Public Environmental Review—Appendices*. Bowman Bishaw and Gorham.

Egis Consulting (formerly CMPS&F), 1999 (Draft). Coral Bay Boating Facilities—Feasibility Study. Report prepared for the Department of Transport, Document No. RW0988-RP-000-003, October 1999, Draft.

Egis Consulting (formerly CMPS&F), 1997. *Coral Bay Boat Harbour: Coastal Process Study*. Report prepared by Egis Consulting for the Department of Transport, Report No. RW0988-RP-00-001, December 1997.

Environmental Protection Authority, 2001. *Cockburn Sound Environmental Protection Policy*, December 2001 (Draft).

Environmental Protection Authority [EPA], 1998. *Guidance for the Assessment of Environmental Factors (in Accordance with the Environmental Protection Act 1986) Draft Policy No. 29: Benthic Primary Producer Habitat Protection*. Environmental Protection Authority, Perth, Western Australia.

Environmental Protection Authority [EPA], 1996. *Annual Report 1995–1996*. Environmental Protection Authority.

Environmental Protection Authority [EPA], 1995. *Coral Coast Resort, Mauds Landing: Report and Recommendations of the Environmental Protection Authority*. EPA Bulletin 796, December 1995.

Hearn C.J. and Parker I.N., 1988. Hydrodynamic processes of the Ningaloo Coral Reef, Western Australia. *Proceedings of the 6th International Coral Reef Symposium.* Australia.

Honourable Minister for the Environment, 1997. *Report on Appeals and Related Issues: Coral Coast Resort, Mauds Landing*. Prepared by the appeals Convenor for the Environmental Protection Act 1996.

Hutchins G., 1994. A Survey of the Nearshore Reef Fish of Western Australia's West and South Coasts—The Leeuwin Province. *Records of the Western Australian Museum, Supplement No 46*.

Intergovernmental Panel on Climate Change, 1995. *Climate Change 1995—The Science of Climate Change*. Edited by Houghton J.T., Meira Filho L.G., Callander B.A., Harris N., Kattenberg A. and Maskell K., Cambridge University Press.

Lourensz R.S., 1981. *Tropical Cyclones in the Australian Region July 1909 to June 1980*. Department of Science and Technology, Bureau of Meteorology, 94 pp.

Marsh L.M., 1989. Corals and Echinoderms of the Ningaloo Reefs. Unpublished notes for the Department of Conservation and Land Management.

Marsh L.M., 1980. Corals and Echinoderms of the Ningaloo Reefs. Unpublished notes for the Department of Conservation and Land Management.

Marsh L.M., 1989. Corals and Echinoderms of the Ningaloo Reefs. Unpublished notes for the Department of Conservation and Land Management.

May R.F., Lenanton R.C.J. and Berry P.F., 1983. *Ningaloo Marine Park. Report and Recommendations by the Marine Park Working Group.* National Parks Authority, Perth.

Ministry for Planning, 1996a. *Gascoyne Coast Regional Strategy*. Prepared by Ministry for Planning for the Gascoyne Regional Strategy Steering Committee with the assistance of ERM Mitchell McCotter & Associates as part of the Strategic Planning Program of the Western Australian Planning Commission.

Ministry for Planning, 1996b. *Coral Bay Task Force: Report on Infrastructure Requirements for Coral Bay*. Report prepared by the Ministry for Planning on behalf of the Coral Bay Task Force.

Norman B., In Preparation. *Shark Aggregations Near Point Maud, Ningaloo Marine Park—Highlighting an Area of Great Conservation Significance*. Prepared by the Australian Marine Conservation Society.

Payne A.L., Curry P.J. and Spencer G.F., 1980. *An Inventory and Condition Survey of Rangelands in the Carnarvon Basin, Western Australia*. Technical Bulletin, No. 73, Western Australian Department of Agriculture.

Port and Harbour Consultants, 1989. *Maud Landing Extreme Events Study*. Prepared for Coral Coast Marina Development Pty Ltd, October 1989.

Rockwater, 1994. Evaluation of Groundwater Conditions Near Mauds Landing. In *Coral Coast Resort Mauds Landing: Public Environmental Review—Appendices*. Bowman Bishaw and Gorham.

Rogers M.P. & Associates, 1994. Mauds Landing Coastal Engineering Study. In *Coral Coast Resort Mauds Landing: Public Environmental Review—Appendices*. Bowman Bishaw and Gorham.

Simpson C.J. and Field S., 1995. *Survey of Water Quality, Groundwater, Sediments and Benthic Habitats at Coral Bay, Ningaloo Reef, Western Australia*. Department of Environmental Protection, Technical Series 80, November 1995.

Simpson C.J, Carey J.L. and Masini R.J., 1993. Destruction of Corals and Other Reef Animals by Coral Spawn Slicks on Ningaloo Reef, Western Australia. *Coral Reefs, 12*: 185–191.

Sumner, N.R., Williamson, P.C. and Malseed, B.E., 2001. *A 12-Month Survey of Recreational Fishing in the Gascoyne Region of Western Australia during 1998–1999*. Prepared by the Research Division, Department of Fisheries,

Western Australian Marine Research Laboratories, Fisheries WA, Fisheries Research Report No 132, 2001, August 2001.

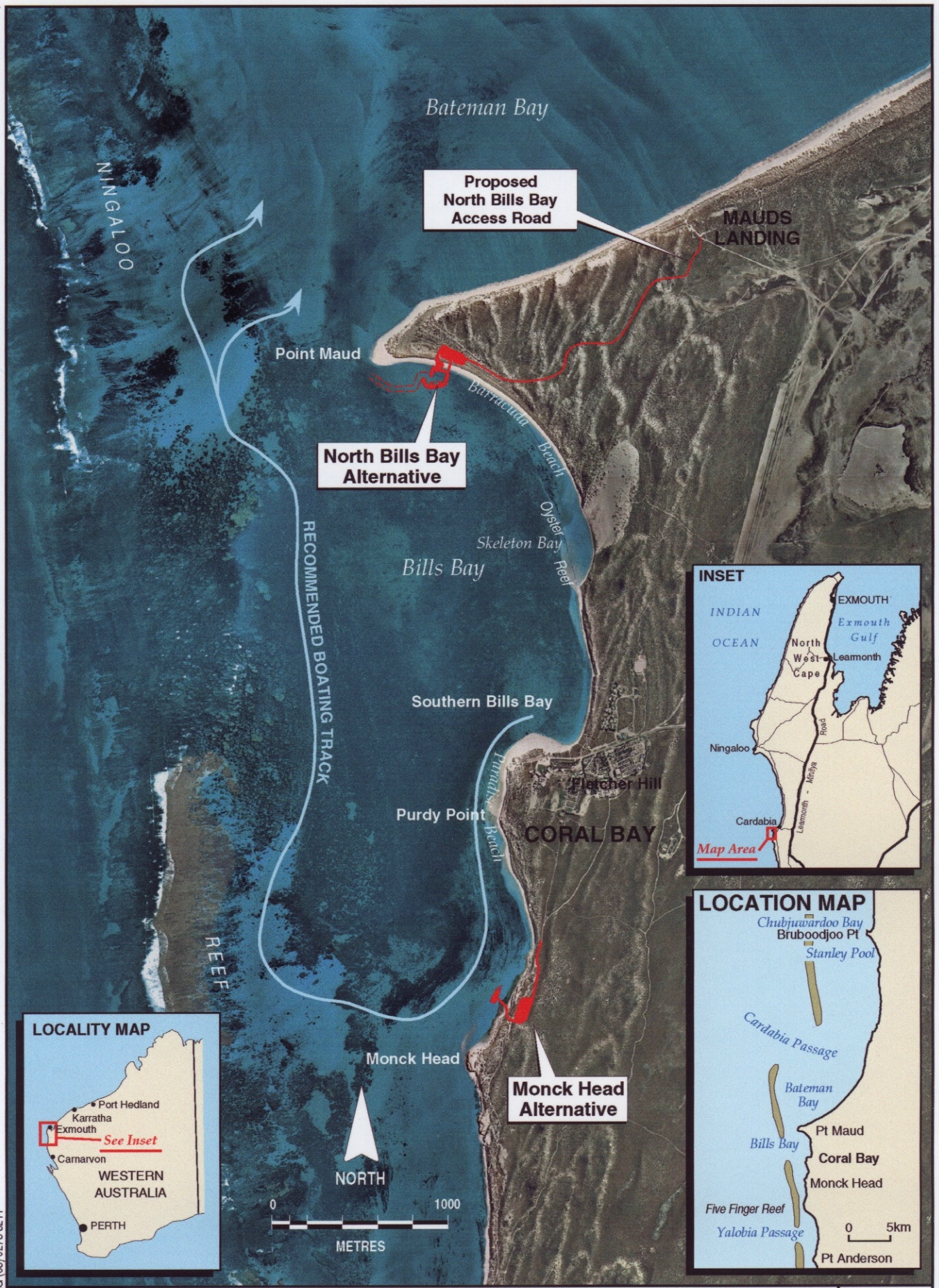
Swan J.M., Neff J.M. and Young P.C., 1994. *Environmental Implications of Offshore Oil and Gas Development in Australia. The Findings of an Independent Scientific Review*. Australian Petroleum Exploration Association and Energy Research and Development Corporation, 696 pp.

Veron J.E.N. and Marsh L., 1988. *Hermatypic Corals of Western Australia: Records and Annotated Species List*. Western Australian Museum.

Wallace D. and Boreham P., 1990. Prediction of Extreme Water Levels Due to Storm Surge at Denham. In *Carnarvon Fascine Redevelopment Study*. Department of Marine and Harbours, Report No. DMH D2/90.

Wells F.E., 1980. The Distribution of Shallow-Water Marine Prosobranch Gastropod Molluscs Along the Coastline of Western Australia. *Veliger, 22(3)*: 232–247.

FIGURES



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LOCATION DIAGRAM

Figure
1

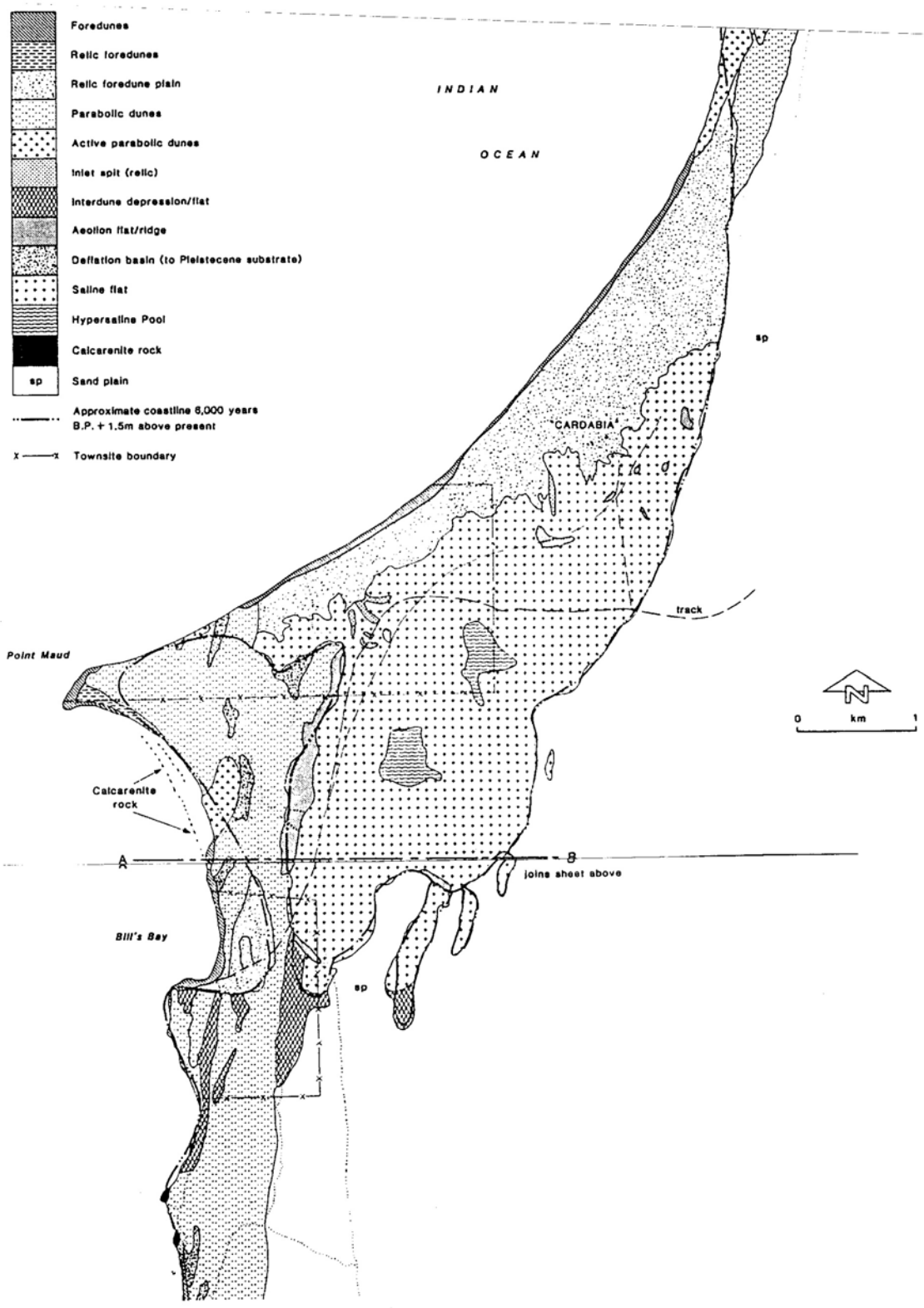
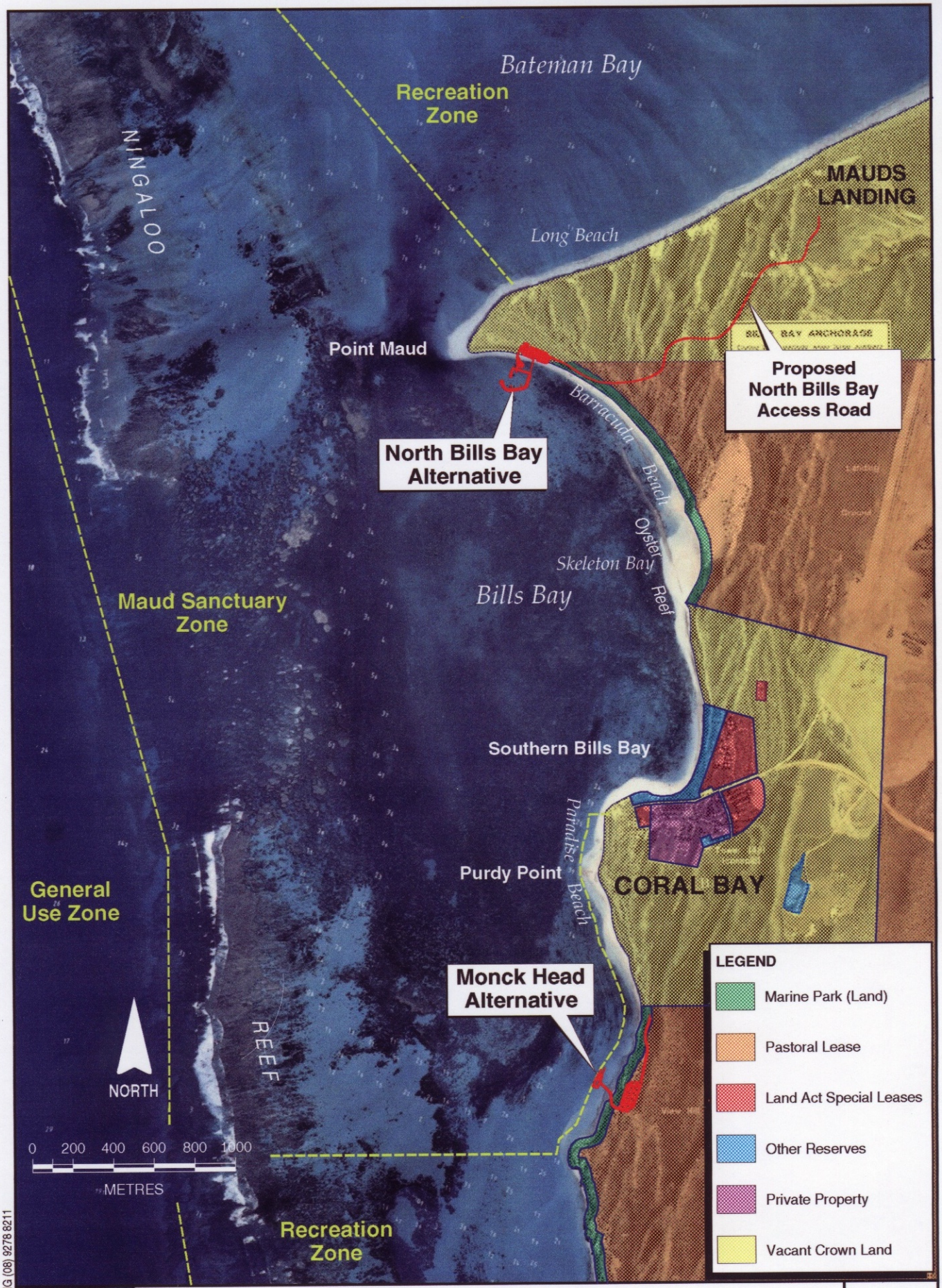


Figure 2 Coastal geomorphology of the Coral Bay region



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LAND AND MARINE TENURE

Figure 3

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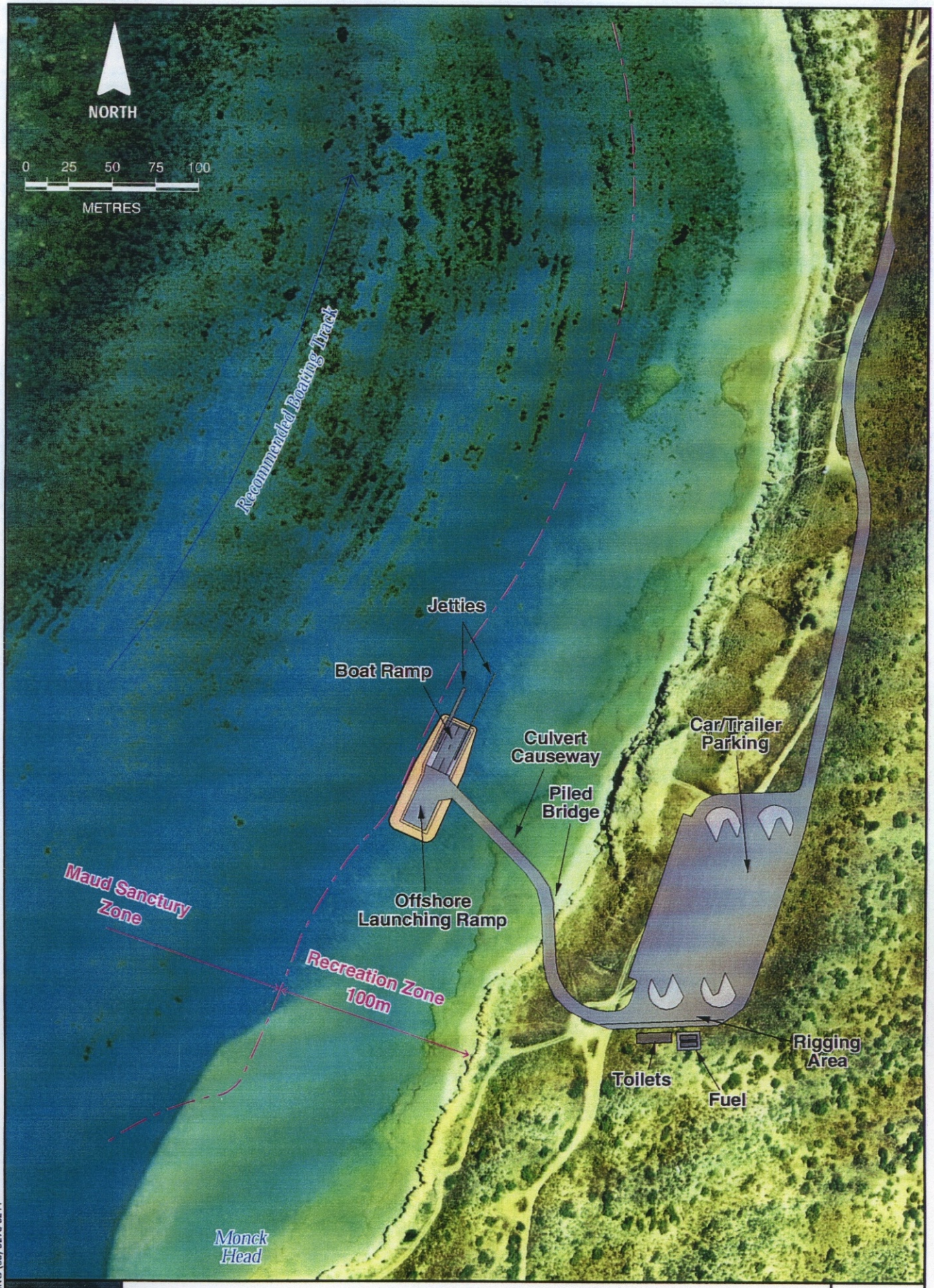

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CORAL BAY BOATING FACILITY PUBLIC ENVIRONMENTAL REVIEW

CONCEPT DESIGN FOR BOAT LAUNCHING FACILITY AT MONCK HEAD

Figure

4

ENVIRONMENTAL DRAFTING (08) 9278 8211

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Department for Planning and Infrastructure

CORAL BAY BOATING FACILITY PUBLIC ENVIRONMENTAL REVIEW

CONCEPT DESIGN FOR BOAT LAUNCHING FACILITY AT NORTH BILLS BAY

Figure

5

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APPENDIX A
DEPARTMENT OF ENVIRONMENTAL PROTECTION GUIDELINES FOR THIS PUBLIC ENVIRONMENTAL REVIEW DOCUMENT

Environmental Protection Authority
Guidelines

CORAL BAY BOATING FACILITY

(Assessment Number 1186)

Part A	Specific Guidelines for the preparation of the Public Environmental Review
Part B	Generic Guidelines for the preparation of an environmental review document

Attachment 1	Example of the invitation to make a submission
Attachment 2	Advertising the environmental review
Attachment 3	Site map of proposal location

These guidelines are provided for the preparation of the proponent's environmental review document. The specific environmental factors to be addressed are identified in Part A. The generic guidelines for the format of an environmental review document are provided in Part B.

Part A: Specific Guidelines for the preparation of the Public Environmental Review

1. The proposal

The Western Australian Department of Transport (DoT, the proponent) intends to build a boating facility in the Coral Bay region. Three sites have been identified as suitable: Mauds Landing, Northern Bills Bay and Monck Head.

The DoT propose:

- a two-lane boat launching ramp protected by a breakwater
- a boat loading, fuelling and service jetty
- a limited number of protected mooring pens inside the breakwater
- a limited number of cyclone moorings outside the breakwater for non-trailable boats
- a limited number of shoreline-based moorings outside the breakwater for trailable boats
- on iste water tanks
- public toilet and boat sullage facilities
- public lighting
- car parking for 70-80 vehicles

Could you please supply the project officer with an electronic copy of the document for use on Macintosh, Microsoft Word Version 6, and any scanned figures. Where possible, figures should be reproducible in a black and white format.

2. Environmental factors relevant to this proposal

At this preliminary stage, the Environmental Protection Authority (EPA) believes the relevant environmental factors, objectives and work required is as detailed in the table below:

CONTENT		SCOPE OF WORK	
Factor	**Site specific factor**	**EPA objective**	**Work required for the environmental review**
BIOPHYSICAL			
Vegetation communities		Maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities	Survey to identify existing vegetation communities at access road, carpark, and toilet facilities
Terrestrial fauna		Maintain the abundance, species diversity, geographic distribution of terrestrial fauna	Survey to identify existing usage of foreshore, carpark, and toilet facilities by waterbirds
Marine flora	Macroalgae	Maintain the ecological function, abundance, species diversity and geographic distribution of marine flora	Baseline studies to identify existing marine vegetation communities at proposal locations Assessment of potential impacts on marine flora as a result of proposal Detail measures proposed to ensure protection of marine flora in proposal locations
Marine fauna	Coral reefs Turtles Shark breeding area	Maintain the ecological function, abundance, species diversity and geographic distribution of marine fauna Protect turtles, consistent with the provisions of the Wildlife Conservation Act 1950 Maintain the ecological function and integrity of shark breeding sites	Baseline studies to identify existing marine fauna at proposal locations Assessment of potential impacts (direct and indirect) on marine fauna as a result of proposal Detail measures proposed to ensure protection of marine fauna and benthic habitats in proposal location and sea passages through sanctuary zones

Dunes		Maintain the integrity, ecological function and environmental values of the dune system	Detail measures proposed to ensure protection of dune system
Foreshore		Maintain the stability of beaches	Assessment of potential impact of breakwater on littoral drift Detail measures proposed to ensure protection of beaches from littoral drift
Seabed		Development should not have a significant impact on existing coastal processes, including off-shore sediment movement	Assessment of potential impact of breakwater on littoral drift Detail measures proposed to ensure protection of beaches from littoral drift
Sealevel		Development should not increase the potential impact on the environment of/from storm surge	Outline predicted effects of proposal on storm surge and tidal movements
POLLUTION MANAGEMENT			
Marine water and sediment quality	Hydrocarbons Turbidity	Maintain or improve the quality of marine water consistent with the draft WA Guidelines for Fresh and Marine Waters (EPA 1993) Ensure that development does not result in increased turbidity	Risk analysis of likelihood of contamination of water and beaches from hydrocarbon spills Provide a pollution contingency management plan
Solid waste/sewage		To encourage waste minimisation, recycling and sustainable use, and to ensure that solid waste and sewage from the development is disposed of in an environmentally acceptable manner	Detail measures to be taken to dispose of waste and sewage
SOCIAL SURROUNDINGS			

Aboriginal culture and heritage		Ensure the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area	Undertake surveys for sites of Aboriginal significance Detail measures proposed to protect any sites of Aboriginal significance identified during survey
Recreation		Recreational amenity of Coral Bay should not be unduly affected by the proposal.	Details measures proposed to ensure minimal disruption to current boat-dependent recreational pursuits by residents of Coral Bay

In addition to defining the specific environmental factors relating to the proposal and the means by which the EPA's objective in relation to each of these would be met, the proponent must provide clear evidence in the Public Environmental Review document, that linkages between environmental factors and with the overall integrity of the local ecosystem, have been considered.

These factors should be addressed within the environmental review document for the public to consider and make comment to the EPA. The EPA expects to address these factors in its report to the Minister for the Environment.

The EPA expects the proponent to take due care in ensuring any other relevant environmental factors which may be of interest to the public are addressed.

TECHNICAL APPENDICES
(BOUND SEPARATELY)