STRATEGEN
environmental consultants

Mangles Bay Marina Based Tourist Precinct

Scoping Document

DRAFT FOR PUBLIC COMMENT

Prepared for
Cedar Woods
by Strategen

February 2011

Mangles Bay Marina Based Tourist Precinct

Scoping Document

DRAFT FOR PUBLIC COMMENT

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February 2011

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Client: Cedar Woods

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Preliminary Draft Report	1	ND	LA	Electronic	4/10/10
Draft Report	2	LA	Cedar Woods	Electronic	7/10/10
Draft Report	3	LA	Cedar Woods/ LandCorp	Electronic and hard copies to OEPA	11/10/10
Draft Report	4	LA/TS	OEPA/Cedar Woods	Electronic	10/12/10
Draft Report	7	LA/TS	Cedar Woods	Electronic and hard copy to OEPA	16/12/10
Draft Report	9	LA/TS	OEPA Marine Branch	Electronic copy to OEPA	31/1/2011
Final Report					

INVITATION TO MAKE A SUBMISSION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. Both electronic and hard copy submissions are most welcome.

Cedar Woods Properties Limited proposes to develop a tourist based marina development within the City of Rockingham, approximately 40 km south of Perth. The proposed development is at the southern end of Cockburn Sound, immediately east of the Garden Island Causeway and bounded by Hymus Street/Safety Bay Road to the east. The proposed development would have a single entrance and would accommodate about 500 boats and would incorporate local boating clubs, commercial areas and boat pens for public use. The surrounding land development would be 'mixed use' with tourism facilities, accommodation, commercial areas, public open space and residential areas.

In accordance with the *Environmental Protection Act 1986* (EP Act), an Environmental Scoping Document (ESD) has been prepared in accordance with Western Australian Government procedures and is released for public review. The Environmental Scoping Document describes the proposal, summaries current knowledge about the area, identifies environmental issues associated with the proposal and further works to be carried out and provides an outline of the contents for the Public Environmental Review (PER).

The ESD is available for a public review period of 2 weeks from Monday 7 February 2011 closing on Monday 21 February 2011.

Comments from government agencies and from the public will help the proponent and the EPA to finalise the scope of work that will provide the information required for the PER document.

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* (FOI Act), and may be quoted in full or in part at the EPA's discretion.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining 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 10 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 ESD or the specific proposal. 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.

When making comments on specific elements of the ESD:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives to the proposed scope to ensure accurate information is collected.

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 ESD;
- if you discuss different sections of the ESD, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether and the reason why you want your submission to be confidential.

Information in submissions will be deemed public information unless a request for confidentiality of the submission is made in writing and accepted by the EPA. As a result, a copy of each submission will be provided to the proponent but the identity of private individuals will remain confidential to the EPA.

The closing date for submissions is: Monday 21 February

The EPA prefers submissions to be made electronically using one of the following:

- the submission form on the EPA's website www.epa.wa.gov.au/submissions.asp
- by email to submissions@epa.wa.gov.au
- by email to the officer leanne.thompson@epa.wa.gov.au

Alternatively, submissions can be

- posted to: Chairman, Environmental Protection Authority, Locked Bag 33, CLOISTERS SQUARE WA 6850, Attention: Leanne Thompson; or
- delivered to the Environmental Protection Authority, Level 4, The Atrium, 168 St Georges Terrace, Perth, Attention: Leanne Thompson; or
- If you have any questions on how to make a submission, please ring the EPA assessment officer, Leanne Thompson on 6467 5246.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

1.1 BACKGROUND

The Mangles Bay area of Cape Peron, Rockingham (approximately 40 km south of Perth), is the focus for the development of a marina-based tourism and residential precinct. The proposed development is at the southern end of Cockburn Sound, immediately east of the Garden Island Causeway and bounded by Hymus Street/Safety Bay Road to the east (Figure 1). The precinct would occupy 77 ha.

The proposed Mangles Bay Marina Based Tourist Precinct (the Proposal) is a refinement of previous proposals that have been put forward since the early 1990's. This Proposal has been designed to address the physical, environmental and social opportunities and constraints that have been identified in the development and assessment of these previous proposals.

In its most recent advice on the concept of an inland marina development at Mangles Bay, the Environmental Protection Authority (EPA 2006) identified the following primary environmental issues:

- seagrass and water quality – direct loss through construction of the Project footprint and indirect loss through changes in water quality, sand bypassing activities and coastal processes
- Lake Richmond – indirect impact on the Lake and its key attributes (two threatened ecological communities (TEC)) through potential changes in hydrogeology, modifying the Lake's water quality and water level, potentially threatening the TECs
- terrestrial vegetation – direct loss of vegetation and additional indirect loss through fragmentation, edge effects and changes in hydrology of the site.

This Environmental Scoping Document (ESD) describes the studies and investigations that will be conducted by the proponent to add to the existing information resources regarding the above environmental issues, as well as others identified through consultation and screening processes. The objective of the reviews and additional studies and investigations will be to ensure that the full environmental effects of the proposal are properly understood, thus guiding the development and timely implementation of optimal management controls and enabling a reliable and knowledge-based environmental impact assessment to be conducted.

1.2 PURPOSE OF DOCUMENT

The Mangles Bay Marina Based Tourist Precinct Proposal was referred to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act) on 25 August 2010. The level of assessment for the Project was advertised on 20 September 2010 as a Public Environmental Review (PER) with a ten week public review period and a two week public review of this ESD.

Assessment at the level of PER requires the Proponent to prepare an Environmental Scoping Document. The purpose of this document is to provide the EPA, stakeholders and the public with information to understand the proposal, confirm the environmental issues and their significance and outline the scope and direction of the preparation of the PER. This document has been prepared in accordance with the EPA Guide to Preparing an Environmental Scoping Document (EPA 2009a) and provides a description of the Proposal, summary of the potential environmental impacts, their significance and possible management responses; proposed scope of studies for incorporation into the PER; key legislation; stakeholder consultation programme; project and assessment schedule; study team and peer review mechanisms.

1.3 SUMMARY OF PROPOSAL

The proposed Mangles Bay Marina Based Tourist Precinct would be constructed inland of the current shoreline, immediately to the east of the Garden Island Causeway. The marina would have a single entrance and would accommodate about 500 boats and would incorporate local boating clubs, commercial areas and boat pens for public use. The surrounding land development would be 'mixed use' with tourism facilities, accommodation, commercial areas, public open space and residential areas.

1.4 IDENTIFICATION OF PROPONENT

Cedar Woods Properties Limited (Cedar Woods) is the Proponent for this Proposal. The Western Australian Government endorsed the progressing of the Mangles Bay Marina Based Tourist Precinct Proposal. Subsequently, the Western Australian Land Development Authority, LandCorp (Government's Land Development Agency), has appointed Cedar Woods as its private sector partner to progress this project. The nominated contact for the Proponent is:

Marcus Deshon

Development Manager

Cedar Woods Properties Limited

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Email: Marcus.deshon@cedarwoods.com.au

2. PROPOSAL DESCRIPTION

This Proposal is for a tourist based marina development comprising a single entry marina to accommodate up to 500 pens and moorings and a surrounding land development comprising tourism, accommodation, commercial, public open space and residential land uses.

The project will provide much needed protected boating facilities in Mangles Bay, enhance public access to Mangles Bay and create a vibrant tourist district that will attract visitors to the region and create employment opportunities for Rockingham and the surrounding area. The project will also include rehabilitation of the wider Cape Peron bushland and provide additional passive recreation facilities such as walkways and information. The Project design objectives are included in Appendix 1. The development will also incorporate local aquatic clubs.

The Proposal consists of the following elements:

- marina
- boating access channel
- provision and maintenance of service infrastructure
- land development area
- rehabilitation of degraded areas of surrounding vegetation and seagrass transplantation to offset vegetation losses.

Figure 2 outlines the Proposal area and the indicative layout of marina, access channel, breakwaters and land development. The exact layout of the Proposal, especially of the marina, channel and breakwaters, is still subject to amendment on the basis of stakeholder consultation, environmental investigations and engineering investigations.

2.1 LOCATION

The Mangles Bay Marina Based Tourist Precinct is located within the Perth Metropolitan Area, on the Swan Coastal Plain approximately 40 km south-south-west of Perth within the City of Rockingham, Western Australia.

2.2 KEY COMPONENTS OF THE PROJECT

2.2.1 Land development area

The total land development area is estimated to be up to 47.1 ha. The land development area will encompass various land uses which includes tourist based commercial uses, aquatic club area, short-term accommodation, public open space and residential uses. The distribution and density of residential land uses will be defined during the structure planning process of the Proposal. The development will however, comprise a variety of lot sizes and residential densities to provide a diverse mix of buildings.

It is intended that the marina will provide a focal point for the local community and a tourist destination. It is the Proponent's vision to provide the community with a gathering place from which locals and tourists will embark to explore the Cape and its surrounds. Memorial Drive, a local access road within the project area that connects to Safety Bay Road will be realigned as part of the Proposal development. The road will be redesigned to meet current urban road standards and increased traffic volumes resulting from the Proposal.

2.2.2 Marina

The total water area of the single entrance marina is estimated to be up to 12 ha (Figure 2). The marina will be able to accommodate pens for up to 500 craft, ranging from 8 m to 25 m in length.

The marina will be constructed using dry excavation methods. The first stages of construction will involve the creation of a bund (which will be the future marina entrance) then progressive dewatering of the area to allow for dry excavation.

The precise layout of the marina will be finalised following hydrodynamic modelling to be undertaken for the Proposal.

2.2.3 Access channel

The Proposal includes a dredged access channel to allow large (up to 25 m) power and sail craft to access the marina. The channel will extend approximately 550 m north from the breakwaters at the entry of the marina, towards deeper waters in Cockburn Sound. The channel will be within Mangles Bay east of the Garden Island Causeway. The breakwater and channel will be subject to further detail design to minimise the area disturbed.

The channel will be dredged using a 'cutter suction dredge', with dredged material piped back to the mainland. The dredged material will be placed in settlement and infiltration basins located within the Proposal area adjacent to the coast, where the seawater will infiltrate into the shallow groundwater system (which discharges to Mangles Bay) and solid material will be treated and disposed off site, where necessary. The channel and breakwater will be subject to further detailed design to minimise disturbed area.

2.2.4 Key infrastructure

A Water Corporation easement is currently located within the Proposal area (Figure 3). It is understood that the Water Corporation proposes to upgrade and duplicate the infrastructure within this easement in the future. As part of this Proposal, Cedar Woods, through an agreement with Water Corporation are proposing to relocate the infrastructure easement from its current location to an alignment parallel to the southern boundary of the Proposal area within the proposed realigned Memorial Drive road reserve. Cedar Woods is to prepare a concept design for the realignment of the Water Corporation's infrastructure.

Although Water Corporation has agreed to this Proposal, it is also progressing a separate proposal to upgrade and duplicate the pipeline in case the Cedar Woods Proposal does not proceed. Only one of these proposals will be implemented.

An ocean outfall pipe carrying stormwater overflow from Lake Richmond to Mangles Bay (near the Mangles Bay Fishing Club jetty) is located within the Proposal area (Figure 3). The Proposal includes the relocation of this ocean outfall pipe to the end of Hymus Street with the pipeline infrastructure to be contained within the Safety Bay Road /Hymus Street road reserve.

2.2.5 Area west of the Garden Island Causeway

The project boundary includes the existing car park and boat launching facility west of the Garden Island Causeway. Improvement works to the facility including an upgrade to the car park, boat ramp and jetty platforms will be considered as part of the Proposal. These improvement works will be limited to upgrading the amenity value of these facilities with works such as pile driving and dredging no longer proposed in this area.

2.2.6 Other elements of this Proposal

Other elements of this Proposal include:

- road improvements to cater for additional traffic
- improved beach access to the public
- remediation and enhancement works outside the proposed action including revegetation of degraded areas around Cape Peron, dune restoration, seagrass transplantation and improved walkways with educational signage to the history and natural values of Cape Peron
- construction of a dual use path along the length of the beachfront to the causeway
- affordable family holiday accommodation with beachfront access
- a site for the Boating Clubs, on a non-commercial leasehold basis, with marina frontage and beach access
- a seabed lease within the marina and adjoining the boating clubs land site in which the clubs can build pens and lease them to members
- commercial pens to be provided in the public tourist area for commercial charter operators
- a tourism hub including restaurants, cafes and short-term serviced accommodation
- a site for a Marine Science Centre.

2.2.7 Construction

Dewatering will be required to allow the construction of the marina and waterways. The dewatered groundwater may be infiltrated into the superficial aquifer through infiltration basins within the construction area. The Proposal area will be designed to be internally drained with flood overflows into the marina.

Groundwater is proposed to be used during the construction with dewatering water likely to be used for dust suppression as appropriate. Appropriate licences will be obtained from the Department of Water (DoW) prior to any abstraction of groundwater. The water requirement for dust suppression will be met through the excess water from dewatering. Total dewatering volumes (to allow for dry excavation of the marina) are not known at this time, as pump tests are yet to be carried out to determine aquifer water quality and quantity.

2.3 KEY PROJECT CHARACTERISTICS

The key characteristics of the Proposal are included in Table 1.

Table 1 Key project characteristics

Project detail	Characteristics
Main activities	Construction activities to include clearing, dewatering and excavation of the marina and dredging of the access channel. Operational activities include marina operation and maintenance dredging.
Proposal area (Refer to Figure 2).	Proposal area up to 77 ha Total land development area up to 47.1 ha Total vegetation clearing up to 38 ha Total marine disturbance (below current high water mark): 6 ha
Marina	Total water area of marina up to 12 ha Deepest depth in marina up to -4.0 mAHD Excavation for marina up to 1 000 000 m^3
Dewatering requirements	Dewatering required for up to 18 months during construction Dewater returned to the local groundwater system via infiltration ponds within Proposal area. Total dewatering requirements will be further defined as hydrogeological information from pump testing becomes available.
Channel construction	Total channel length up to 550 m Total channel width up to 30 m Total channel area up to 3.4 ha (includes the footprint of 1:5 batters) Total channel depth up to -4.0 mAHD Total channel dredging of up to 50 000 m^3 Dredged material will be piped to the Proposal area, where it will be settled and then the water infiltrated and solid material treated and disposed of offsite.
Reclamation	Total reclamation area up to 1 ha Total breakwater length up to 290 m Total breakwater width up to 40 m includes breakwater batters of 1:5 Total breakwater area up to 1.1 ha
Area west of Garden Island causeway	Improvement works potentially including an upgrade to the car park, boat ramp and jetty platforms
Seagrass loss	Total seagrass removal up to 5 ha (includes breakwaters, reclamation areas, channel and batters) Total indirect loss of seagrass (due to halo effects around infrastructure of approximately 15 m) up to 1 ha. Total marine footprint up to 6 ha
Water Corporation asset	Relocation of Water Corporation pipeline
Outfall	Relocation of Mangles Bay ocean outfall pipe to Hymus Street.

2.4 HISTORY OF THE PROPOSAL

The redevelopment of the Mangles Bay area has been the subject of a number of previous proposals since the 1970's that have included both sea-based and inland marina options. A water based marina proposal in 1993 involved a loss of about 30 ha of seagrass and this loss was considered unacceptable by the EPA, especially as seagrass rehabilitation was not a proven technique at the time. In 1998, another marina concept for the development of an inland marina in Mangles Bay was developed. The project was never formally assessed but advice from the EPA indicated that the proposal would not be environmentally acceptable due to seagrass loss. Processes for rehabilitation of seagrass were not considered reliable at the time.

In 2005, concept plans were prepared for a marina development at the site following a comprehensive community consultation process. A 'Strategic Environmental Review' on the proposal was undertaken by the EPA in 2006. The process undertaken was in accordance with section 16(e) of the

EP Act. The purpose of reviewing the project under section 16(e) of the EP Act was to identify key environmental issues associated with the proposal and to gather, at a strategic level, information on those environmental issues.

The Strategic Environmental Review was released for public comment on the 7 March 2006 for a four week period and received approximately 440 submissions. Following the public comment, and EPA review period, the EPA provided advice in October 2006 as Bulletin 1237. The EPA recommended that the following main environmental factors should be evaluated in detail for any future proposal:

- seagrass and water quality
- Lake Richmond
- terrestrial vegetation.

Other factors also to be considered include:

- geoheritage, including impacts on Cape Peron's significant geoheritage features
- terrestrial fauna
- marine fauna
- coastal processes
- natural value/wilderness value of Mangles Bay.

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Scale

0 200 400 600 800

Metres

N

Figure 1 Locality plan - Broad Scale

Coordinate System: GDA 1994 MGA Zone 50
Date: 11/08/2010
Prepared By: jcrute
File: Figure 1 Locality plan - Broad Scale.mxd

Original scale:1:35,000 at A4
Source: Geoscience Australia 2006, Google Earth 2010, TABEC 2010
Note that positional errors may occur in some areas

Legend

- Kwinana Grain Terminal
- Mangles Bay Fishing Club
- Road
- Project area
- Shoalwater Islands Marine Park

COCKBURN

SOUND

INDIAN

OCEAN

MARINA

Legend

- Pedestrian Bridge
- Water Corporation easement relocation
- Project Area (77ha)
- Area not to be cleared (8ha)
- Marina (10.1ha)
- Land development (47.1ha)
- Reclamation area (0.8ha)
- Access channel (3.4ha)
- Breakwaters (1.1ha)

Note: Site plan subject to further planning and engineering investigations.

Figure 2 Site Plan - Proposal Details

DRAFT

MANGLES BAY

plan: 10/033/001
designed: BK
date: 06/10/2010
checked: PLANNER
projection: MGA 94
drawn: TB
scale: 1:6000@A3
0 10 20

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2.5 PROPOSAL JUSTIFICATION AND ALTERNATIVES

2.5.1 Consideration of alternatives

The Proposals primary aim is to meet the high demand for boating facilities in the Rockingham area. Cockburn Sound is an important destination for boating, providing a large area of protected water for yachting and powerboat use. Rockingham is one of the fastest growing population centres in the south-west corridor. As a result, boat ownership and the demand for boating facilities are also rapidly increasing in the area.

Currently, boats unable to fit on non-commercial trailers are confined to moorings in Mangles Bay, which provide little protection to vessels from winter storms which approach from the north-west. The existing swing moorings in Mangles Bay have also removed seagrass in mooring scars visible in Figure 3.

In 2005, a high level review of the costs, benefits and constraints of Mangles Bay and other potential sites along the City of Rockingham coastline was undertaken. The review concluded that Mangles Bay presented the least constraints and most opportunities for a combined marina and land development when compared with the other sections of the coastline in the City of Rockingham.

Alternative design concepts have been considered in consultation with the community during the 2005 and 2006 process and the development of the current Proposal. All options involved an inland marina, however each differed with respect to layout and the extent of land footprint. An offshore marina option in Mangles Bay was not considered likely to provide the project benefits of a mixed use tourism precinct, would involve the loss of a substantial proportion of seagrass in Mangles Bay and would not be likely to be found environmentally acceptable even with rehabilitation of seagrass.

The details of the 2005/6 process and community and stakeholder involvement in developing the concept and project objectives are provided in Appendix 2 as part of the Strategic Environmental Review.

The current Proposal been developed taking into account previous community and regulatory agency consultation and the EPA advice provided within Bulletin 1237 in October 2006. The configuration of the marina and breakwaters is still subject to detailed design and will be refined based on ongoing hydrogeological and hydrodynamic investigations and modelling being undertaken for the development.

The development footprint has been reduced from the original design(s) presented in 1998 and 2006 to reduce the amount of native vegetation clearing, avoid disturbance to the TEC (FCT 30a: *Callistris preissii* forest and woodlands), to allow a greater buffer distance between the development and Lake Richmond and to reduce impacts on Shoalwater Island Marine Park.

2.5.2 Requirement for marina

The need for boating and marine facilities in the south of Cockburn Sound has been identified in several tourism and recreational studies of the area (LandCorp 1998).

Cockburn Sound is an important destination for boating, providing a large area of protected water for yachting and powerboat use. Its shoreline currently supports both yacht and power boat clubs. There are approximately 560 swing moorings in Mangles Bay, which provide little protection for vessels in winter storms which approach from the north west. These swing moorings have also caused seagrass loss in Mangles Bay and potentially contaminating activities such as re-fuelling, rubbish and sullage disposal are difficult to manage in this area. Regular damage to vessels occurs during these storms, and provision of a marina would provide an alternative option for mooring of these vessels.

The Port Rockingham Marina was approved in February 2010 and when built, will provide pens for up to 500 boats. Even with these additional marina facilities, the demand for boating facilities in the area is intensifying as the population increases. Rockingham is one of the fastest growing areas in the south west corridor and levels of disposable income have increased with expanded employment opportunities and comparatively lower housing mortgage rates.

The projected population increase for the Cockburn, Kwinana and Rockingham areas between 1996 and 2011 is 77 800 from the 1996 level of 138 800, an increase of 56%. The primary source of demand for moorings in the proposed Mangles Bay marina will be from the local Rockingham region and this demand will increase with population growth. The availability of pens will also allow current boat owners to upgrade beyond trailerable vessels. Boat owners from other areas of metropolitan Perth will add to the demand as mooring space in existing metropolitan clubs and marinas reach capacity. Room for expansion of existing metropolitan facilities is limited, resulting in long waiting periods for pens.

2.5.3 Social and economic benefits of the project

The project is expected to have the following social and economic benefits.

Social benefits

- provision of a range of public recreation and tourist facilities to enhance Cape Peron as a destination for local and international visitors
- improved public access to Shoalwater Bay and Mangles Bay and pedestrian and cycle linkages between Rockingham Beach, Point Peron and Shoalwater Bay
- provision of a secure marina area specifically designed for commercial and recreational boating and yachting clubs
- increased facilities for management and regulation of boating activity with associated improvements in public safety
- increased management presence, lighting and increased public use of Cape Peron will help discourage anti-social behaviour
- effective traffic management in the local area
- provision of low cost, family holiday accommodation for a wide cross section of the community.

Economic benefits

A detailed analysis of the economic impacts of the Proposal has not been undertaken, however the construction and operation of the Proposal would generate significant economic revenue in Rockingham with flow on effects for local industries.

The development will have at least one hotel, retail, tourist and commercial businesses that will all create long term employment opportunities in Rockingham. There will also be flow on effects on employment opportunities.

The Proposal will be a major construction project and will also create large employment for that period.

2.6 RELATIONSHIPS TO OTHER PROPOSALS

A Water Corporation easement is currently located within the Proposal area (Figure 3). It is understood that the Water Corporation proposes to upgrade and duplicate the infrastructure within this easement in the future.

As part of this Proposal, Cedar Woods, through an agreement with Water Corporation are proposing to relocate the infrastructure easement from its current location to an alignment that will run parallel to the southern boundary of the Proposal area within the proposed realigned Memorial Drive road reserve. Although Water Corporation has agreed to this Proposal, it is also progressing a separate proposal to upgrade and duplicate the pipeline in case the Cedar Woods Proposal does not proceed. Only one of these proposals will be implemented.

3. REGIONAL SETTING OF PROPOSAL

3.1 SOCIAL ENVIRONMENT

3.1.1 City of Rockingham

The Proposal is within the City of Rockingham (proclaimed a city in 1988), which has a population of greater than 100 000 residents. Historically, Rockingham was a seaside holiday town, however it is now one of fastest growing cities in Western Australia. Rockingham has undergone significant development, with increased industry, large residential developments (e.g. Port Kennedy and Secret Harbour) and redevelopment of the old Rockingham town centre foreshore and surrounds and the Rockingham City centre. Rockingham is also one of the most popular coastal destinations south of Perth.

The Royal Australian Navy has a strong presence in the area, with its base on Garden Island and a significant amount of residential requirement being filled in and around Rockingham.

Main industries and employment sectors in the City of Rockingham include:

- defence (Navy)
- heavy industry (Kwinana Industrial Area)
- light general industry (including boat building, structural engineering, ceramics)
- commercial fishing (crayfish, fish, mussels)
- land-based agriculture, horticulture, viticulture, market gardens, forestry
- grain export
- building and construction
- entertainment and leisure
- retail and commerce
- marine ecotourism.

3.1.2 Land tenure and zoning

The majority of the Proposal area south of Point Peron Road is currently vested in the Recreation Camps and Reservations Board and is managed by DEC. The aquatic clubs along the Mangles Bay foreshore are vested with the Minister for Transport, Western Australia. The details of land tenure are shown in Figure 4.

The area to the south of Point Peron Road is zoned as 'Parks and Recreation' and the area to the north of Point Peron Road, along the Mangles Bay foreshore, is zoned 'Port Installations' under the Metropolitan Region Scheme. There are other small areas within the project area that are reserved for parking, drainage, special use (e.g. wastewater treatment plant) and a possible future road connection to the Garden Island Causeway.

3.1.3 Land use

The Cape Peron area is the focus for the pursuit of many recreational activities, including:

- **water based activities:** boating, swimming, snorkelling, fishing and crabbing
- **land based activities:** walking, fishing and nature appreciation.

A large proportion of the Mangles Bay foreshore is currently occupied by the local yacht club, fishing club (with associated jetty and boat ramp) and chalet accommodation. The use of the land by these facilities means that public access to the area is somewhat restricted.

Other facilities within the Mangles Bay area include day-use car parks for accessing beaches and lookouts, and a public boat ramp directly to the west of the Garden Island Causeway. The City of Rockingham is currently undertaking minor upgrade works to the existing boat ramp facilities west of the Causeway. The development will look to build upon this infrastructure and improve facilities for the community.

Most of the Mangles Bay foreshore and some of the Shoalwater Bay foreshore are designated dog beaches. An area directly to the east of the Garden Island Causeway is designated a power water craft and water ski area. Visitor facilities on Cape Peron include ten recreation camps, mainly located to the west of Memorial Drive along the Shoalwater Bay foreshore, which are managed by DEC and leased to private groups. DEC also manages one educational camp lease (leased by the Department of Education), which is located to the west of the Garden Island Causeway.

The Naragebup Rockingham Regional Environment Centre is located on the southwest corner of the Memorial Drive / Safety Bay Road intersection, opposite Lake Richmond. The centre is a community run non-profit organisation that is actively involved in conservation activities in the Rockingham area and also provides a role in environmental education.

The Water Corporation Point Peron Wastewater Treatment Plant is located to the west of the Garden Island Causeway and a Water Corporation drain dissects the landscape from Lake Richmond to Mangles Bay.

Residential areas are located immediately to the east and south of the project area.

3.2 PHYSICAL ENVIRONMENT

Mangles Bay is at the southern end of Cockburn Sound and is part of the shoreline leading to the Garden Island Causeway and Point Peron. This area is known as Cape Peron. Point Peron is a cuspate (sharp headland with adjacent smooth shoreline) foreland, formed where sand has been trapped and deposited in the lee of offshore islands including Garden Island. Cape Peron was once an island that became connected to the mainland as sand accumulated.

Groundwater occurs in two main aquifer systems in the Proposal area:

- superficial aquifer: collectively made up of the Safety Bay Sands over Tamala Limestone
- underlying Rockingham aquifer: made up of the Rockingham Sand formation.

Groundwater in the superficial aquifer (top 30 m of profile) generally flows in a westerly direction. As this aquifer is the surface aquifer and is relatively shallow, flows tend to discharge to the near shore marine environment along the coastline. Initial results of groundwater monitoring in the Proposal area indicate the groundwater at 10 m depth was fresh with electrical conductivity of approximately 1000 µS/cm (MWH 2010a provided in Appendix 3).

The most significant surface water feature in the vicinity of the Proposal is Lake Richmond, which is located to the southeast of the project area and separated from it by Safety Bay Road. Lake Richmond is a perennial freshwater lake covering approximately 40 ha that is approximately 0.6 m above sea level (spill level of outlet drain) and is up to 14.4 m deep (MWH 2010b provided in Appendix 4). Currently, there are three main drains into Lake Richmond and one outlet that discharges to Mangles Bay (this drain traverses the Proposal area).

Lake Richmond is described in more detail in section 5.1.

3.3 TERRESTRIAL ENVIRONMENT

The vegetation of the Proposal area consists mostly of coastal shrublands dominated by common species of coastal areas on the Swan Coastal Plain over a series of low lying dunes between the rocky headland of Point Peron and Lake Richmond (Keating & Trudgen 1986). There are no wetland vegetation communities within the project area; Lake Richmond is to the south east of the project area.

The site is mapped as containing the Quindalup Vegetation Complex: Coastal dune complex consisting mainly of two alliances – the standard fore-dune alliance and the mobile and stable dune alliance. Local variations include the low closed forest of *Melaleuca lanceolata – Callitris preissii* and the closed scrub of *Acacia rostellifera* (ENV 2010a).

The majority of the Proposal area was classified as coastal heath with a moderate value as fauna habitat. Other fauna habitat types in the Proposal area are woodland and shoreline habitats; also with a moderate value as fauna habitat (ENV 2010b).

All land within the project area south of Point Peron Road is within Bush Forever Protection Area (BFPA) 355 (Government of Western Australia 2000) and within the Rockingham Lakes Regional Park.

3.4 MARINE ENVIRONMENT

The Cape Peron headland extends westward into the Indian Ocean and defines the southern extent of Cockburn Sound. The Mangles Bay foreshore (within Cockburn Sound) forms most of the northern shoreline of the Cape and the Shoalwater Bay foreshore forms most of the southern shoreline of the Cape (Figure 3). The Cape Peron shoreline consists of sandy beaches and limestone rocky shores and headlands and the seabed consists of extensive sandy areas and limestone reefs.

The Shoalwater Islands Marine Park (Figure 3) comprises the chain of islands that run parallel to the coastline between Cape Peron and Becher Point to the south. The Marine Park borders Mangles Bay at the Garden Island causeway and contains the waters of Shoalwater Bay and Warnbro Sound.

Cockburn Sound is the most intensively used marine embayment in Western Australia. Historically it has suffered poor water quality and contaminated sediment due to industrial discharge, but with increasing improvements to industrial practice in the region, discharge of contaminants has decreased substantially. Subsequently, water quality has improved considerably since the 1970's but still remains the focus of current management attention.

Mangles Bay is sheltered by the Garden Island Causeway and Cape Peron, and is therefore relatively calm and poorly 'flushed' by marine waters under most circumstances. Natural patterns of sediment movement have been disrupted by the Causeway and the Cape Peron boat ramp, which has resulted in sediment accumulation and erosion problems along the Mangles Bay foreshore. The waters in Mangles Bay within and adjacent to the Proposal area have been declared an Environmentally Sensitive Area.

The shallow sheltered waters of Cockburn Sound (and Mangles Bay) support extensive seagrass meadows. Widespread loss of seagrass on the eastern margin of the Sound occurred during the 1970's; the loss attributed to shading caused by nutrient-stimulated growth of epiphytes (algae that grow on seagrass leaves) and phytoplankton (microscopic algae in the water).

The seagrass meadows in Mangles Bay show evidence of nutrient enrichment in the form of heavy epiphyte loads in summer and some areas of seagrass are partially exposed at low tide and experience desiccation and heat stress. The seagrass meadows are also damaged by numerous mooring scars. Although the seagrass meadows that Mangles Bay supports are degraded, the shallow, sheltered,

slightly nutrient-enriched waters of Mangles Bay are also recognised as an important fish nursery habitat.

Cockburn Sound supports a wide range of fauna and has significant fauna values because of its utilisation by dolphins, a large range of seabirds, protected migratory birds, and Little Penguins. The whole of Cockburn Sound is considered significant as a fish nursery/habitat. About 130 species of fish and 14 large crustacean and mollusc species are estimated to exist in Cockburn Sound, and the Sound is a significant fisheries resource.

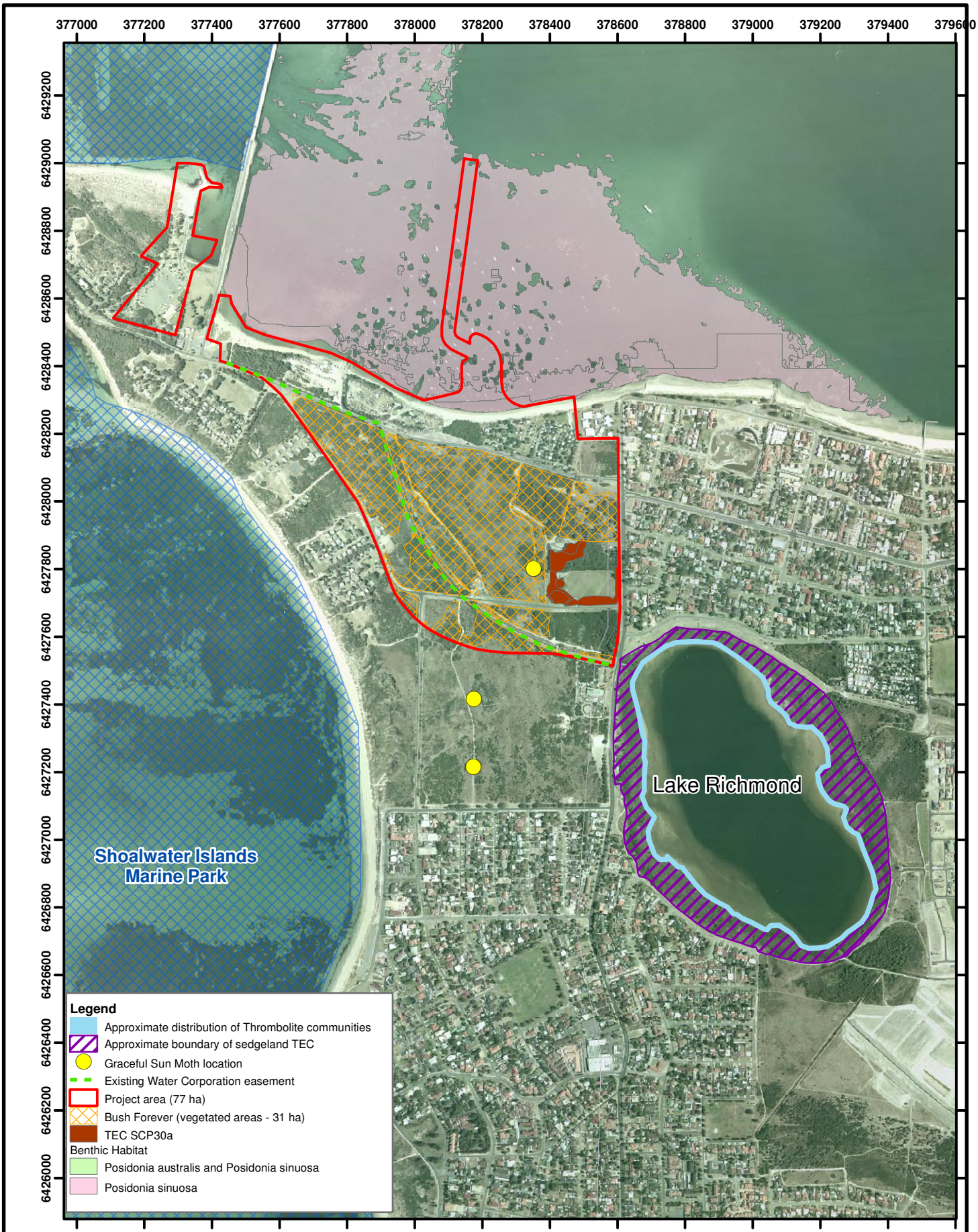


Figure 3 Site Plan - Existing Environment

stratagen

Scale

0 200 400

Metres

N

1:15,000

at A4

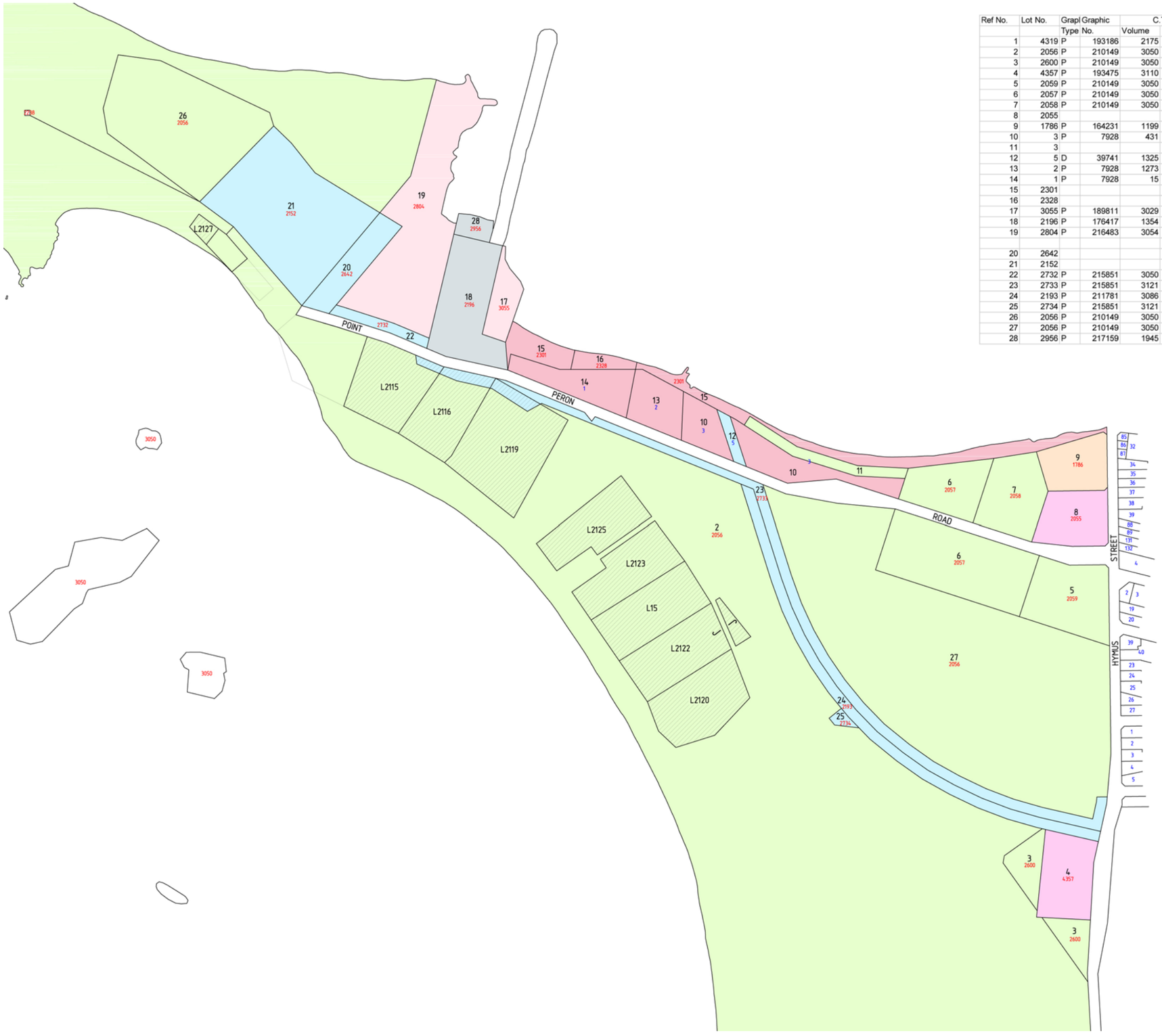
Coordinate System: GDA94 MGA 94 Zone 50
Date: 08/10/2010
Prepared By: jcrute
File: Figure 3 Site Plan - Existing environment_vs6.mxd

Source: Geoscience Australia 2006,
Google Earth 2010, TABEC 2010, Oceanica 2008

Note that positional errors may occur in some areas

Regional

Source: ESRI 2006



Ref No.	Lot No.	Graph Type	Graphic No.	C.T. Volume	C.T. Folio	Reserve No.	Lot Area	Registered Proprietor / Manager	Land use	Other interests
1	4319	P	193186	2175	563		0.0320ha	Water Corporation		
2	2056	P	210149	3050	970	27853	130.6010ha	Minister for Sport & Recreation	Recreation	
3	2600	P	210149	3050	970	27853	1.2090ha	Minister for Sport & Recreation	Recreation	
4	4357	P	193475	3110	212	45307	1.6330ha	Department for Planning & Infrastructure	Conservation	
5	2059	P	210149	3050	970	27853	2.1000ha	Recreation Camps & Reserves Board	Recreation	
6	2057	P	210149	3050	970	27853	5.0530ha	Recreation Camps & Reserves Board	Recreation	RSL Perth Sub Branch - Caravan Committee
7	2058	P	210149	3050	970	27853	1.7090ha	Recreation Camps & Reserves Board	Recreation	Aviator Interior & Works Recreation Assoc
8	2055					27854	1.3760ha	Department for Planning & Infrastructure	Parking	
9	1786	P	164231	1199	484		1.2130ha	Crippled Childrens Seaside Home Society		
10	3	P	7928	431	35A		2.0850ha	Minister for Transport		The Cruising Yacht Club of WA
11	3					27853	0.6580ha	Recreation Camps & Reserves Board	Recreation	The Cruising Yacht Club of WA
12	5	D	39741	1325	694		0.2090ha	Water Corporation		
13	2	P	7928	1273	533		1.0090ha	Minister for Transport		Mangles Bay Fishing Club Inc
14	1	P	7928	15	226A		1.3130ha	Minister for Transport		Mangles Bay Fishing Club Inc
15	2301						1.7410ha	Minister for Transport	Harbour	Mangles Bay Fishing Club Inc
16	2328					32771	0.3360ha	Minister for Transport	Harbour	
17	3055	P	189811	3029	460	41965	0.7460ha	Department for Planning & Infrastructure	Access Control	Commonwealth of Australia
18	2196	P	176417	1354	345		2.5460ha	Commonwealth of Australia		
19	2804	P	216483	3054	289	39475	5.3910ha	Department for Planning & Infrastructure	Parking / Recreation	Rockingham Volunteer Sea Rescue
										Naval Association of Australia
20	2642					30188	1.1330ha	Water Corporation	Sewerage treatment	
21	2152					30188	5.5400ha	Water Corporation	Sewerage treatment	
22	2732	P	215851	3050	782	42518	0.3910ha	Water Corporation	Sewerage treatment	
23	2733	P	215851	3121	544	42518	3.3440ha	Water Corporation	Sewage	
24	2193	P	211781	3086	723	30940	2.0660ha	Water Corporation	Drainage	
25	2734	P	215851	3121	545	42518	0.1020ha	Water Corporation	Sewage	
26	2056	P	210149	3050	970	27853	5.3810ha	Recreation Camps & Reserves Board	Recreation	Department of Education
27	2056	P	210149	3050	970	27853	20.6640ha	Recreation Camps & Reserves Board	Recreation	
28	2956	P	217159	1945	909		0.3040ha	Commonwealth of Australia		

Crippled Childrens Seaside Home Society
Recreation, Camps & Reserves Board (administered by CALM)
Water Corporation
Commonwealth of Australia
Minister for Transport
Department for Planning & Infrastructure
State of Western Australia (unallocated)

Lease No.	Lessee	Commencement	Term
L15	A.I.W. Recreation Centre (Inc)	1/11/1972	Annually
L2115	Apex Holiday Centre (Inc)	1/11/2001	Monthly
L2116	Australian Post-Tel Institute (WA) Incorporated	1/11/2001	Monthly
L2119	L & S Recreation Centre Inc.	1/11/2001	Quarterly
L2120	Point Peron Aquatic, Youth & Family Association	1/11/2001	Monthly
L2122	The Returned Services League of Australia WA Branch	1/01/2001	Monthly
L2123	The Maritime Union of Australia	1/11/2001	Monthly
L2125	The Maritime Union of Australia	1/11/2001	Monthly
L2127	The Blinded Soldiers of St Dunstans Western Australia	1/11/2001	Monthly

Camping & Recreation Leases managed by CALM

MANGLES BAY MARINA BASED TOURIST PRECINCT
LANDOWNERSHIP

100m 0m 100 200 300m

SOURCE: MCMULLEN NOLAN & PARTNERS SURVEYORS PTY LTD

TAYLOR BURRELL BARNETT
Town Planning and Design
187 Roberts Road Subiaco
Western Australia 6008
Telephone: (08) 9382 2911
Facsimile: (08) 9382 4586
admin@tbbplanning.com.au

FIGURE 4

4. SUMMARY OF ENVIRONMENTAL IMPACTS AND MANAGEMENT

The environmental factors related to the Proposal, their potential impacts, proposed management and proposed studies to inform the environmental impact assessment are summarised in Table 4.

4.1 IDENTIFICATION OF KEY ENVIRONMENTAL ISSUES

The s16(e) strategic environmental review process undertaken in 2005 and 2006 involved extensive stakeholder consultation and culminated in the EPA advice provided in Bulletin 1237. Both the results of the stakeholder consultation process and the EPA advice have provided a sound basis for the identification of the key environmental issues associated with this Proposal.

The key environmental issues associated with the Proposal are considered to be:

1. Loss of seagrass in Mangles Bay.
2. Potential changes to water quality in Mangles Bay.
3. Potential for indirect impacts on Lake Richmond from hydrological changes or increased use.
4. Clearing of vegetation and fauna habitat within the predominantly cleared Metropolitan area.
5. The excision of the Proposal area from the Rockingham Lakes Regional Park and the Bush Forever Protection Area 355.
6. Continued and enhanced public access to Mangles Bay and Cape Peron.

Existing threatening processes that the Proposal offers an opportunity to address include:

- degradation of the Cape Peron vegetation from uncontrolled access and weeds
- water quality threats to Lake Richmond from stormwater
- mooring scars and unmanaged boating practices in Mangles Bay.

4.2 SCOPING FOR RELEVANT FACTORS

The scoping process involved preliminary identification of environmental aspects of the Proposal and associated key environmental issues and factors for the Proposal. The scoping process utilised EPA guidelines and reports, as well as stakeholder consultation to confirm the relevant factors and those key aspects that have the potential to affect environmental factors.

4.2.1 Key environmental factors

The following key environmental factors considered relevant to this project as requiring detailed assessment in the PER:

1. Terrestrial environment

- Lake Richmond (encompassing the factors of groundwater, surface water and threatened ecological communities)
- flora and vegetation
- terrestrial fauna
- conservation areas (included in terrestrial vegetation and flora chapter for the purposes of scoping).

2. Marine environment

- water quality
- coastal processes
- benthic primary producer habitat
- marine fauna.

3. Social surrounds

- recreation and public access
- Aboriginal heritage.

4. Matters of National Environmental Significance.

4.2.2 Other environmental factors

The remaining environmental factors relevant to this project but identified as requiring less detailed assessment in the PER:

- traffic
- contaminated sites
- construction impacts of dust, noise and waste.

4.3 ENVIRONMENTAL MITIGATION

The Proposal has been developed with consideration of the EPA mitigation sequence. A summary of how mitigation has been incorporated into the Proposal is included in Table 2.

Table 2 Mitigation sequence

Mitigation	Consideration in the Proposal
Avoid - avoiding the adverse environmental impact altogether	The marina has been moved to the west and north to avoid potential impacts on Lake Richmond. The configuration of the marina has been designed to avoid stagnant water.
Minimise - limiting the degree or magnitude of the adverse impact	The Proposal includes an inland marina to minimise the marine footprint and potential seagrass loss in Mangles Bay. The terrestrial footprint of the Proposal has been reduced to minimise clearing of vegetation generally and clearing of a threatened ecological community. The construction of the marina will be conducted by dry excavation to minimise marine water quality impacts. Dredging will be undertaken using best practice cutter suction dredge techniques to minimise water quality effects.
Rectify - repairing, rehabilitating or restoring the impacted site as soon as possible	The Proposal footprint will be permanent so rectification is not applicable.
Reduce - gradually eliminating the adverse impact over time by preservation and maintenance operations during the life of the action	Indirect effects of construction such as groundwater drawdown and turbidity from dredging will naturally reduce and return to normal following the completion of construction activities. This process will be monitored and if conditions fail to return to normal as expected, contingencies would be implemented.
Offset - undertaking such activities that counterbalance an adverse residual environmental impact	Transplantation of seagrass to offset direct and indirect losses of seagrass associated with the Proposal. Rehabilitation of vegetation within the Cape Peron area. Provision of infrastructure for passive recreation within the Cape Peron area.

4.4 PRINCIPLES OF ENVIRONMENTAL PROTECTION

The Proposal has been developed with consideration of the principles of environmental protection (EPA 2004d). A summary of how the environmental principles have been incorporated into the Proposal is included in Table 3.

Table 3 Principles of environmental protection, as they apply to the Proposal

Principle	Applicability to this proposal
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk – weighted consequences of various options.	The Proposal is the culmination in a series of development options for a marina at Mangles Bay. The Proposal has been designed to avoid, as far as practicable, harm to the areas recognised environmental values, including Lake Richmond and Cockburn Sound/Mangles Bay. The potential effects to the environment have been or will be studied rigorously, in order to ensure predictions of environmental outcomes are reliable. Mitigation measures have been developed from extensive consultation and review and will be finalised through the environmental impact assessment process.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	The Proposal will improve the social amenity of the area by addressing an increasing need for safe boat anchorage and improving recreation assets. The Proposal will derive long-term environmental improvements to the area through mitigation measures, including rehabilitation of seagrass and terrestrial vegetation, while improving knowledge of the area's environment. The provision of facilities for passive recreation will ensure that the environment is protected from increased pressure from both the development and surrounding areas.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	The Proposal has been designed to maximise the separation distance to Lake Richmond. The Proposal will also minimise impacts to seagrass and terrestrial vegetation in the short-term while seeking to enhance conservation in the long term. The Proposal involves loss of vegetation but the rehabilitation of the balance of vegetation on Cape Peron is expected to enhance ecological integrity of this area.
4. Principles relating to improved valuation, pricing and incentive mechanisms (1) Environmental factors should be included in the valuation of assets and services. (2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. (3) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. (4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.	Cost estimates of potential offsets have been incorporated into the cost estimates for the Proposal. The management of the marina, including water quality monitoring, marina regulation and maintenance of public open space, will be funded by the development.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Owing to its nature, the Proposal is expected to generate a minimal amount of waste. Any wastes will be managed consistent with the waste hierarchy.

4.5 FACTOR SUMMARY TABLE

A summary of the relevant environmental factors, potential impacts and proposed studies is provided in Table 4.

Table 4 Summary of relevant environmental factors, potential impacts and proposed studies

Environmental factor and objective	Existing environment	Potential impacts	Proposed management	Proposed studies
Groundwater EPA Objectives *To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.* *To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards*	Groundwater in the area is quite shallow and movement is towards Mangles Bay. Lake Richmond is a 'flow-through' lake, being in contact with the local groundwater and is predominantly fresh. The potential presence of stygofauna has been identified in the groundwaters of the Proposal area.	Dewatering to allow construction of the marina waterbody will lead to temporary groundwater drawdown which may lead to lowering of water levels in Lake Richmond and/or exposure of acid sulphate soils if they exist around Lake Richmond. Saltwater intrusion may result from the inland marina. This impact is considered highly unlikely to occur but will be investigated.	If groundwater investigations and modelling conclude that there is a significant risk to the water quality of Lake Richmond, the project will be amended to avoid this impact. This is not an expected outcome but will be thoroughly investigated due to the significance of Lake Richmond. A Dewatering Management Plan will be prepared to ensure drawdown is kept within modelled scenario and will include monitoring and response requirements. The management plan will also address acid sulfate soils if studies confirm the presence of acid sulfate soils within the drawdown zone. Monitoring of groundwater quality and levels in the aquifer in contact with Lake Richmond will continue.	Ongoing groundwater monitoring program within the Proposal area. Hydrogeological pump testing to determine hydraulic conductivities in the Proposal area. Hydrogeological modelling to predict local groundwater flows and effects of marina development on saltwater wedge along the coast

Environmental factor and objective	Existing environment	Potential impacts	Proposed management	Proposed studies
Surface water EPA Objectives *To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.* *To ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.*	The Lake Richmond thrombolite community is a Threatened Ecological Community and is found only in Lake Richmond. Stormwater drains enter and exit Lake Richmond, affecting water levels and quality.	Dewatering to allow construction of the marina waterbody will lead to temporary groundwater drawdown which may lead to lowering of water levels in Lake Richmond and/or exposure of acid sulphate soils if they exist around Lake Richmond. Saltwater intrusion may result from the inland marina, potentially altering water chemistry of Lake Richmond. This impact is considered highly unlikely to occur but will be investigated.	Monitoring of lake water quality and levels in Lake Richmond will continue.	Ongoing surface water monitoring program within the Proposal area. Drainage design and flood modelling within the Proposal area
Lake Richmond – Threatened Ecological Communities EPA objective *To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.* *To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards*	The Lake Richmond thrombolite community is a Threatened Ecological Community and is found only in Lake Richmond. Lake Richmond is also surrounded by vegetation that is within the 'Sedgelands in Holocene dune swales' Threatened Ecological Community.	As above	As above	As above

Environmental factor and objective	Existing environment	Potential impacts	Proposed management	Proposed studies
Flora and vegetation EPA Objective *To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.*	The majority of the project area is within Rockingham Lakes Regional Park and Bush Forever Site 355. Vegetation condition is highly variable. Cape Peron is considered to be a large and protected representation of the Quindalup vegetation complex. No Declared Rare Flora or priority flora have been recorded in the proposal area.	Direct loss of 38 ha of vegetation from clearing. Indirect loss of vegetation through altered groundwater levels and/or quality.	Proposal has minimised direct clearing through design selection. Proposal will contain measures to mitigate effects on native vegetation and habitat.	Investigations have been completed. Additional *Lomandra maritima* surveys will be undertaken to appropriately map this vegetation type within and outside the Proposal area. Hydrogeological modelling to predict local groundwater flows and effects on groundwater chemistry.
Fauna EPA Objectives *To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.*	Proposal area and surrounds degraded by weed invasion and fragmented by roads, but some intact remnants considered to be of significance. Six bird species (migratory) and one reptile species of conservation significance have been recorded in the area. The Graceful Sun Moth (*Synemon gratiosa*) has been recorded in the area. Groundwater habitats in the area and extending into the wider area are highly likely to contain stygofauna. The Priority Listed Lined Skink (*Lerista lineata*) has also been recorded in the area.	Direct loss of 38 ha of habitat from clearing. Indirect loss of vegetation through altered groundwater levels and/or quality. Increased risk of road kill and predation.	Rehabilitation within the balance of Cape Peron to improve habitat condition.	Fauna surveys largely complete and included as appendices. Targeted survey for scorpions in April 2010 (completed). Targeted survey for millipedes and snails in August 2010 (completed). Additional *Lomandra maritima* surveys will be undertaken to appropriately map this vegetation type within and outside the Proposal area. An additional report will be prepared on the regional significance of fauna species within the Proposal area. A stygofauna habitat assessment will be conducted on the Proposal area to determine the likelihood for stygofauna to occur within the Proposal area, using newly available information on the hydrogeological and hydrological characteristics of the Proposal area.

Environmental factor and objective	Existing environment	Potential impacts	Proposed management	Proposed studies
Benthic Primary Producer Habitats EPA Objective *To ensure no net loss of benthic primary producer habitat and where possible. Where losses are unavoidable, the intent is to manage the cumulative loss of BPPH and communities such that marine ecological integrity is maintained.*	Mangles Bay contains approximately 100 ha of seagrass. Swing moorings and poor water quality (nutrients and chlorophyll a) represent the most significant threats to seagrass in Mangles Bay.	The Proposal will require the direct removal of approximately 5 ha of seagrass. *Indirect effects relating to marine water quality are considered under that heading.*	Design has been selected that results in minimum direct seagrass loss. Transplanting of seagrass in damaged areas to offset seagrass loss.	Seagrass transplants monitoring program (12 month program scheduled to be completed March 2011) Modelling of the dredge plume and assessment of the effect on seagrass Identification of suitable seagrass transplantation sites
Marine water quality EPA Objective *To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards*	Mangles Bay is sheltered by the Garden Island Causeway and Cape Peron and is relatively calm and poorly flushed in most circumstances. Monitoring results show Mangles Bay water quality typically exceeds guidelines for nutrients and faecal bacteria. Mangles Bay has a high Level of Ecological Protection (LEP).	Construction of the access channel (dredging) may temporarily increase turbidity and suspended sediments in the area. Dewatering of dredge spoil may result in seepage to the marine environment, increasing turbidity. Quality of water leaving the proposed marina and entering Mangles Bay could further impact on the bay's water quality.	Dredging will be conducted under controlled conditions, including the management and disposal of spoil. Water quality within the marina will protected by maximising circulation and exchange (design factors), managing discharges from vessels and support services and minimising stormwater contaminant inputs.	Sediment sampling and analysis in the area to be dredged. Modelling of dredge plume and return water plume dispersion characteristics. Hydrodynamic modelling of the marina and adjacent waters in Mangles Bay, which will include residence times of waters of the final concept design, and box modelling of nutrient-based water quality.
Coastal processes EPA Objective *To maintain the integrity, ecological functions and environmental values of the seabed and coast.*	Mangles Bay is a sheltered environment with only small volumes of longshore sediment movement. There is a slight erosional trend. Sediment has been accreting to the west of the causeway and boat ramp since they were constructed in the 1970's and the City of Rockingham transports sand from the west of the causeway to other areas of the Rockingham foreshore	Construction of the marina entrance breakwater and channel which may interrupt longshore sediment transport. Potential build up of seagrass wrack against the breakwaters of the marina	Design of the marina entrance and access channel to minimise ongoing management requirements	Collection of local current data for flow modelling (if sufficient baseline information does not currently exist) Design wave estimates within Mangles Bay using empirical or numerical wave models Undertake modelling of longshore sediment transport and flow modelling, as appropriate.

Environmental factor and objective	Existing environment	Potential impacts	Proposed management	Proposed studies
Marine fauna EPA Objective *To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge*	Cockburn Sound and Mangles Bay are known to be important fish nursery habitats. Mangles Bay is also an important crab habitat.	Removal of seagrass habitat Indirect impacts to seagrass habitat through 'halo' effects and turbidity due to dredging	Offset seagrass habitat loss	Desktop reviews of available information on fish, crabs and fish nursery areas in Cockburn Sound, assessing potential impacts of the Proposal Consultation with the Department of Fisheries and relevant experts regarding fauna impacts Assessment of the additional risks from increased boating activity desktop reviews of available information on dolphins and penguins in Cockburn Sound
Aboriginal heritage EPA Objective To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	Cockburn Sound, Lake Richmond and Mangles Bay are registered sites of aboriginal significance. Other important areas have also been identified through consultation.	Potential for cultural associations to be disrupted or archaeological/ethnological material to be disturbed during earthworks.	Direct impacts will be managed in accordance with relevant heritage legislation.	Additional consultation as part of approvals under Aboriginal Heritage Act.
Matters of National Environmental Significance Objective *No significant impact on a MNES*	A Threatened Ecological Community "Thrombolite (microbial) community of Lake Richmond" exists in the vicinity of the proposal. The Graceful Sun Moth (*Synemon gratiosa* - endangered) has been recorded in the area.	Potential habitat reduction for the fauna species. Potential for water chemistry/level changes in Lake Richmond, which could affect the lake's thrombolites. Direct loss of 38 ha of habitat from clearing. Indirect loss of vegetation through altered groundwater levels and/or quality.	Rehabilitation efforts to improve habitat condition Maximise separation distance between the marina waterways and Lake Richmond.	Additional *Lomandra maritima* surveys will be undertaken to appropriately map this vegetation type within and outside the Proposal area.

5. POTENTIAL IMPACTS AND INVESTIGATIONS/STUDIES PROPOSED

5.1 GROUNDWATER

5.1.1 Introduction

Groundwater occurs in two main aquifer systems in the Proposal area. The superficial aquifer is collectively made up of the Safety Bay Sands and the Tamala Limestone. The Tamala Limestone unconformably overlies the Rockingham Sand formation and the Rockingham aquifer.

The superficial aquifer is a complex unconfined aquifer with a maximum thickness of approximately 70 m with an average thickness between 45 m and 20 m (MWH 2010a). Groundwater within the superficial aquifer generally flows in a westerly direction, discharging to the near shore marine environment along the coastline. The underlying Rockingham aquifer extends to a depth of approximately -65 m AHD, with flow of aquifer tending in a westerly direction discharging into the ocean well below sea level.

Groundwater within the Rockingham area is mainly used for irrigation water for public open spaces and recreational areas (DoW 2008). The Rockingham area has the greatest percentage of domestic garden bores (DoW 2008). A 1995 bore-ownership survey of 16 133 households indicated that 76% of properties in the Rockingham area had garden bores, compared with the average of 36% in the Perth region (DoW 2008).

5.1.2 Overview of existing information

Several sources of information are available within the vicinity of the Proposal area including:

- Department of Water and Water Corporation regional Perth metropolitan groundwater model PRAMS (Davidson and Yu 2006) to assess groundwater availability, rainfall recharge and aquifer yields
- Perth Regional Aquifer Modelling System (PRAMS) model development: hydrogeology and groundwater modelling (Davidson and Yu 2008)
- *Hydrogeology and groundwater resources of the Perth region, Western Australia,* Western Australia Geological Survey, Bulletin 142 (Davidson 1995)
- groundwater level and quality monitoring of the superficial aquifer and Rockingham Sand within the Warnbro groundwater subarea undertaken by the Department of Water from 1975 – 2005

Additionally, the following investigation has been undertaken to date to investigate the hydrogeology of the Proposal area:

- Cape Peron Groundwater Study, Draft Interim Report (MWH 2010a provided in Appendix 3).

The initial results of the groundwater investigation program within the Proposal area are:

1. Groundwater quality to 10 m depth is slightly brackish to brackish with electrical conductivity of approximately 1000 µS/cm.
2. Groundwater salinity increases with depth, with many bores showing a marked increase in salinity below 20 m.
3. Drill logs confirmed that the geology is Safety Bay Sand to approximately 20 to 25 m depth overlaying Tamala Limestone.

5.1.3 Assessment framework

EPA Objective

The relevant EPA objective is:

- *to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.*

Other relevant legislation and policy

The *Rights in Water and Irrigation Act 1914* (RIWI Act) makes provision for the regulation, management, use and protection of water resources, to provide for irrigation schemes, and for related purposes. The Proposal area is located within the *Rights in Water and Irrigation Act 1914 Act* (RIWI Act) proclaimed Rockingham Groundwater area, Warnbro Groundwater subarea.

Licences issued by the Department of Water (DoW) under the RIWI Act are required for works associated with groundwater abstraction (including for dewatering purposes) within the Rockingham Groundwater Area. Groundwater licences specify the maximum abstraction rate from aquifers and includes conditions for monitoring.

Stormwater management, surface water discharges and potentially polluting activities are managed under an environmental licence issued under Part V of the EP Act.

Rockingham – Stakehill Groundwater Management Plan

The Rockingham – Stakehill Groundwater Management Plan (2008) developed by the DoW guides groundwater licence assessments and allocations within the Rockingham – Stakehill groundwater areas. The plan provides the objectives, policies and principles and strategies used to manage the groundwater resources of the plan area with the long term objective to achieve sustainable use of the groundwater resources within the groundwater areas. Groundwater abstraction licences submitted to the DoW will be assessed in accordance with the groundwater objectives set in this plan.

Water resource strategies

The Government of Western Australia developed the State Water Quality Management Strategy in 2001 with the objective 'to achieve sustainable use of the Nation's water resources by protecting and enhancing their quality while maintaining economic and social behaviour'.

The State Water Quality Management Strategy requires that a Water Conservation Plan be developed before a water allocation licence is issued or renewed. The Water Conservation Plan must outline water efficiency objectives and timeframes. Licence conditions require implementation of the Water Conservation Plan to an agreed schedule.

5.1.4 Potential sources of impact

The following aspects of the proposed Mangles Bay Marina may potentially impact on groundwater values within the Proposal area:

- **dewatering to allow construction of the marina waterbody** will lead to temporary groundwater drawdown which may lead to:
    - lowering of water levels in nearby private garden bores
    - exposure of acid sulphate soils if they exist within the land development area
- **saltwater intrusion** caused by the inland movement of the saltwater-groundwater (fresh) interface due to the inland marina.

5.1.5 Further studies and investigations

The primary objective of the groundwater investigations being undertaken by MWH is to characterise the hydrogeology of the Proposal area in order to predict and model the hydrological changes that will result from the construction (including dewatering) and operation of an inland marina. One of the key questions to be answered through the groundwater investigation and modelling is whether there is any risk of a change to water quality in Lake Richmond as a result of the Proposal.

The hydrogeological investigations undertaken to date include:

- drilling and construction of a network of 14 groundwater monitoring bores at 13 locations throughout the Proposal area (Figure 5); in April 2010
- monthly water level monitoring of all bores with dataloggers installed in six bores to monitor water levels every 30 minutes
- one barometric datalogger to allow water level readings to be corrected for barometric pressure
- monthly downhole monitoring of electrical conductivity, pH, dissolved oxygen and temperature surveys at 1 m depth intervals
- monthly water quality sampling and analysis for a full suite of water quality parameters including:
    - general water chemistry (total dissolved solids (TDS), pH, electrical conductivity (EC) cations, anions, Ca, Cl, Na, K, Mg, Fe, SO4, NO3, HCO3 and CO3)
    - eight standard metals (As, Cd, Cu, Cr, Hg, Pb, Ni and Zn)
    - nutrients (TKN, TN, NH3, NO3, NO2, PO4 and TP).

Further groundwater investigations to be undertaken include:

1. Continue the monthly water level and quality monitoring program outlined above until March 2011 to establish a 12 month dataset.
2. The drilling and construction of one test production bore, targeting the Safety Bay Sand aquifer located in the centre of the planned marina.
3. The drilling and construction of a network of 3 or 4 monitoring bores around the proposed test production bore.
4. Undertake a controlled pump test of the production bore to determine hydraulic parameters of the Safety Bay Sand aquifer, using the network of new and old monitoring bores to observe drawdown response in aquifer. Results from the test pumping will assist in determining the likely dewatering requirements during the construction of the marina, and provide a valuable data set for the numerical groundwater model.

Groundwater modelling to be undertaken includes:

1. Develop a conceptual hydrogeological model of the area including the understanding of the geological and hydrogeological relationships of the various units in particular the relationship of the Safety Bay Sands and the underlying Tamala Limestone units, interaction of Lake Richmond with the groundwater system, impact of tidal influence on the groundwater systems, the dynamics of the salt water interface and groundwater recharge.
2. Construction and calibration of a numerical groundwater model. Calibrated to the existing monitoring data currently being collected as part of this project and from long term regional monitoring bore network. The results and observations of the test pumping would also be utilised in the calibration of the groundwater model.
3. Undertake simulations for various dewatering scenarios and marina configurations to assess likely aerial extent of impacts.
4. The construction and calibration of a solute transport model to allow simulations of the potential saline groundwater plume that is likely to develop as a result of the marina connection to the ocean.

5.1.6 Information to be provided in the PER

The PER will include the following information:

- groundwater volume required to dewater the marina to allow for safe excavation of the marina water body
- groundwater volume required for construction activities
- timeline and any staging of the marina construction
- the proposed method and management during opening of the marina water body to Mangles Bay
- modelling predictions of expected drawdown as a result of dewatering
- modelling predictions of saltwater intrusion as a result of the inland marina and any effects on other water users, Lake Richmond and groundwater dependent ecosystems
- modelling predictions of best, worst and most likely scenarios of the Proposal, including potential effects over time
- potential flow on environmental impacts from dewatering.

5.2 SURFACE WATER

The surface water system within the vicinity of the Proposal area consists of an urban stormwater drainage network, with Lake Richmond being the dominant surface water feature adjacent to the Proposal boundary. The Proposal area itself south of Point Peron Road is currently internally draining with little surface runoff.

5.2.1 Drainage

The landscape within the Proposal area is mostly undeveloped and internally draining with surface water infiltrating the sandy soils. In high rainfall events, surface flows enter Mangles Bay from the Lake Richmond drainage network. The Lake Richmond partially open stormwater drain currently traverses the Proposal area, and is planned to be relocated as part of the development.

The proposed development will be internally draining with all stormwater being infiltrated on site and with high flood flows being designed to flow into the marina.

5.2.2 Lake Richmond

Lake Richmond is a perennial freshwater lake covering approximately 40 ha that is approximately 0.6 m above sea level (spill level of outlet drain) and is up to 14.4 m deep (MWH 2010b provided in Appendix 4). The lake receives the majority of water from stormwater drains but is also in contact with the groundwater. It is located across Safety Bay Road, near, but outside, the Proposal and is bounded by residential development on most sides (Figure 3). The lake is considered to be of iconic value to the Rockingham community.

Lake Richmond evolved from a marine embayment and historically (prior to the 1960's) contained saline water (English et al. 2003). Cape Peron, to the northwest, was once an island that became connected to the mainland as sand accumulated on the leeward side. Lake Richmond was cut off from the marine environment by this process (CALM 2003).

Lake Richmond is a protected wetland under the *Environmental Protection* (Swan Coastal Plain Lakes) *Policy 1992* and supports two TECs. The TECs are both identified by DEC as 'critically endangered' and listed as 'endangered' under the EPBC Act:

- Floristic Community Type 19a (as identified by Gibson et al. 1996); 'Sedgelands in Holocene dune swales'
- stromatolite-like microbialite community of coastal freshwater lakes (Lake Richmond).

The Lake Richmond thrombolite community is the only known occurrence of this community. Lake Richmond is also listed on the Register of the National Estate due in part to the presence of the thrombolite community.

Lake Richmond is known to support bird species protected by the Japan Australia Migratory Bird Agreement (JAMBA) and the China Australia Migratory Bird Agreement (CAMBA), and are therefore also protected under the EPBC Act.

Additional background information on Lake Richmond is presented in the SER included in Appendix 2.

5.2.3 Overview of existing information

Owing to the high conservation status of Lake Richmond, there are a number of existing studies that are quite detailed and would be drawn from in the preparation of the PER, namely:

- the *Rockingham Lakes Regional Park Draft Management Plan 2003-2013* (CALM 2003).
- the *Interim Recovery Plan for Sedgelands in Holocene Dune Swales* (English et al 2002)
- the *Interim Recovery Plan for the Thrombolite Community of Coastal Freshwater Lakes (Lake Richmond)* (English et al 2003)
- water level and quality monitoring in Lake Richmond (Table 5); this historical data provides a useful baseline dataset and is summarised in Appendix 4
- 3 month monitoring of winter water quality in 2002 in the Lake Richmond outlet drain by Naragebup Natural Resource Management office (Appendix 4).

Table 5 Surface water monitoring by DoW

Site ID	Site Name	Type of monitoring	Date	Number of readings
13662	Lake Richmond	Water Level	1945 – current	330
13662	Lake Richmond	Water quality	1970 – 1986	35
23002414	Lake Richmond Outlet	Water Level	2002-2003	10
23002414	Lake Richmond Outlet	Water quality	2002-2003	10
23015714	Mangles Bay Drain	Water quality	2003	20
23015717	Rockingham North Drain	Water quality	2003	23
23015718	Rockingham Central Drain	Water quality	2003	53
23015720	Lake Richmond	Water quality	2003	1
23015721	Lake Richmond	Water quality	2003	1
23018873	Safety Bay SW Drain	Water quality	2005	93

Source: MWH 2010a

Additionally, the following studies have been undertaken to date to support the current Proposal:

- Cape Peron Groundwater Study, Draft Interim Report (MWH 2010a provided in Appendix 3)
- Cape Peron Surface Water Study, Draft Interim Report (MWH 2010b provided in Appendix 4)
- Cape Peron Fauna Assessment (ENV 2010b provided in Appendix 5) included habitat assessment around Lake Richmond.

The initial results of the surface water investigation in Lake Richmond are:

1. Depth transects of the lake recorded a maximum depth of 14.4 m in January 2010.
2. Water quality in the lake is fresh/slightly brackish at the surface with an increase in salinity and a drop in pH below approximately 8 m depth.
3. The lake has slightly elevated nutrient levels when compared to ANZECC/ARMCANZ (2000) guidelines.
4. Water levels in the lake varied from 0.1 mAHD in January 2010 to 0.8 mAHD in August 2010. The spill level of the outlet drain is 0.6 mAHD.

5.2.4 Assessment framework

EPA objective

The EPA relevant objectives are:

- *to maintain the integrity, ecological functions and environmental values of wetlands*
- *to maintain the quantity and quality of water (groundwater and surface water) so that existing and potential environmental values, including ecosystem maintenance, are protected*
- *to maintain biological diversity where that represents the different plants, animals and micro-organism, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.*

Other relevant legislation and policy

Various water resources policies, strategies, guidelines exist for the management of surface water systems within the urban environment. These include:

- State Planning Policy 2.9 Water Resources which provides guidance for private landowners wishing to undertake development on or abutting water sources or potentially impacting on water resources
- Better Urban Water Management (WAPC 2008) developed to facilitate better management of urban water resources at each stage of the planning system
- State Water Quality Management Strategy (Government of Western Australia 2001) national strategy with the objective 'to achieve sustainable use of the Nation's water resource by protecting and enhancing their quality while maintaining economic and social development'
- ANZECC/ARMCANZ Guidelines national principles aim to improve the approach to water resource allocation and management and to incorporate the water requirements of the environment in the water allocation process.

Several environmental protection policies provide specifically for the protection of significant wetlands on the Swan Coastal Plain and the south-west region of the State:

- *Environmental Protection of Wetlands Preliminary Position Statement* (Position Statement No. 4) (EPA 2004)
- *Wetlands Conservation Policy for Western Australia 1997*
- *Environmental Protection* (Swan Coastal Plain Lakes) *Policy 1992* (EPP).

The EPP prohibits disturbance to any registered EPP wetland (Lake Richmond is a registered wetland under the EPP) without an assessment by the EPA. There are also policy requirements in relation to the minimum distance between intensive land uses and wetlands that will be assessed in the PER.

The two Lake Richmond TECs (thrombolites and the 'sedgelands in Holocene dune swales') are recognised as matters of national environmental significance under the EPBC Act, which is addressed in section 5.10.

5.2.5 Potential sources of impact

The following aspects of the proposed Mangles Bay Marina may potentially impact on the values of Lake Richmond:

- **stormwater runoff** from the development into marine environment
- **dewatering to allow construction of the marina waterbody** will lead to temporary groundwater drawdown which may lead to:
    - lowering of water levels in Lake Richmond
    - exposure of acid sulphate soils if they exist around Lake Richmond
- **saltwater intrusion** caused by the inland movement of the saltwater-groundwater (fresh) interface due to the inland marina
- **increased population** as a result of development may increase indirect impacts on Lake Richmond through uncontrolled access, rubbish and domestic pets.

Dewatering effects on Lake Richmond are considered highly unlikely as the marina will be at least 400 m north west of the lake and dewatering will only be shallow. However, this potential will be investigated.

The inland waterbody of the marina will result in tidal seawater coming closer to Lake Richmond, which has the potential to affect the inland movement of the salt water-groundwater interface; affecting groundwater chemistry. Any change in water quality as a result of saltwater intrusion could potentially have an impact on the thrombolite community although it is likely they are supported by freshwater inflows from stormwater which will be unaffected by the proposed action. As the indicative marina water-body will be at least 400 m north west of the lake and the groundwater flow is towards the coast (west and north), it is highly unlikely that any groundwater changes below the marina will affect water quality in Lake Richmond.

Nutrient inputs to the lake from the proposed development are not anticipated because groundwater under the development flows away from Lake Richmond to Mangles Bay.

5.2.6 Further studies and investigations

No further studies or investigations are proposed for the stormwater management across the Proposal area. As part of the local structure planning process for the development, the relevant water sensitive urban design and state planning requirements will be undertaken. This may include the development of a local water management strategy to meet structure planning requirements and an urban water management plan for subdivision approval.

The surface water investigations undertaken to date (MWH 2010b provided in Appendix 4) include:

- six depth transects of the lake were completed on 18 January 2010
- lake water level monitoring using a datalogger
- monthly water quality monitoring at two sites; each sample is analysed for standard water quality (pH, EC, TDS, Na, K, Ca, Mg, Fe, Cl, SO4, NO3, HCO3 andCO3), TSS, DO, total nitrogen, total phosphorus, nitrite, RFP (subsequent anions), eight standard metals (As, Cd, Cu, Cr, Hg, Pb, Ni, Zn), hydrocarbons (TRH C6 – C36), turbidity (NTU) and colour
- monthly stratification monitoring at three sites in the lake with electrical conductivity, pH, dissolved oxygen and temperature recorded at one metre depth intervals.

The surface water level and monthly water quality and stratification monitoring program outlined above will be continued until March 2011 to provide a baseline dataset for understanding the lake's hydrology.

5.2.7 Information to be provided in the PER

The PER will include the following information:

- input of stormwater runoff within marina modelling flushing scenarios
- an assessment of the potential impacts to surface water systems, including Lake Richmond, within and around the Proposal area
- a discussion on the strategies used, if required, to ensure the minimisation of impacts to Lake Richmond
- construction environmental management plan addressing the protection of the environmental values of Lake Richmond.

Figure 5 Groundwater monitoring locations

5.3 TERRESTRIAL FLORA AND VEGETATION

5.3.1 Introduction

The majority of the Proposal area is within both the Rockingham Lakes Regional Park and Bush Forever Site 355. Bush Forever Site 358, incorporating Lake Richmond and its surrounding vegetation, is adjacent to the Proposal area. In addition to the physical removal of native vegetation, there is the potential for secondary impacts to vegetation health arising from changes in the groundwater hydrology to be considered in the assessment. Both of these effects may reduce the values of the Rockingham Lakes Regional Park without proper management.

For the purposes of this Scoping Document, the conservation areas and vegetation and flora factors have been combined as the background information and investigations are the same. These factors will however be considered separately in the PER.

5.3.2 Overview of existing information

Several surveys have been conducted within the area between 2005 and 2010 in addition to those earlier surveys conducted at the local and wider scales, including:

- *A Flora and Vegetation Survey of the Point Peron – Lake Richmond Area* (Keating & Trudgen 1986)
- *Interim Recovery Plan for Sedgelands in Holocene Dune Swales* (English et al 2002)
- *Flora and Vegetation, Point Peron, Western Australia* (Bennett Environmental Consulting 2005) based on a vegetation survey of the Proposal area in June 2005
- *Flora and Vegetation Survey of the Mangles Bay Area, Cape Peron, Rockingham* (ENV 2010a provided in Appendix 6) describing the results of a spring vegetation survey of the Proposal area in October 2009 (initial report).

Bennett 2005 Flora and Vegetation Survey

Bennett Environmental Consulting Pty Ltd (Bennett) 2005 undertook a detailed Level 2 flora and vegetation survey of the Proposal area and surrounds. The level of survey required was determined in accordance with EPA Guidance Statement No. 51 (EPA 2004) based on the potential impacts of the Proposal and the likely flora and vegetation to be present within the Proposal area. The objective of the survey was to record and map the vegetation units and vegetation condition within and outside the Proposal area and record the location of Declared Rare Flora (DRF) and Priority Flora.

The field survey was undertaken over three days 14, 20 and 21 June 2005. The survey was undertaken during this period to ensure all weed species had germinated, to ensure the vegetation condition assessment could be undertaken with confidence (Bennett 2005). Any native species would have also germinated during the survey period however, may not have been in flower at time of survey.

Remnant vegetation within the survey area was surveyed using methods stated within EPA Guidance Statement No 51 (EPA 2004). A total of 38, 10 m x 10 m quadrats/relevees were surveyed, with other locations of the same vegetation unit also recorded resulting in 67 GPS points mapped for the survey area. The area outside of each quadrat was also surveyed to record additional (opportunistic) species for that vegetation unit. All species unknown in the field were collected, pressed and identified later using appropriate methods required by the Western Australian Herbarium.

ENV 2010 Flora and Vegetation Survey

The objective of the ENV 2010 Flora and Vegetation Survey was to undertake a targeted spring flora and vegetation survey for threatened ecological communities and declared rare flora (DRF) and Priority Flora. This survey was considered necessary to complete the botanical data for the survey area collected by Bennett (2005). The ENV 2010 report included the findings of the Bennett (2005) and historical survey conducted by Keating and Trudgen in October 1986.

The survey consisted of a desktop assessment and field survey. The desktop investigation involved reviewing regional vegetation complexes, soils, landforms and Bush Forever references sites, including available reports addressing the site. A Geographic Information Systems (GIS) database search was also undertaken to ascertain the locations of any DRF, Priority Flora, Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC) species within the survey and surrounding areas. The search was undertaken within a 15 km radius of the Proposal area.

The targeted spring survey was undertaken between 27 – 29 October 2009 and consisted of:

- establishing two permanent quadrats within each of the inferred FCTs as identified by Bennett (2005), as defined by DEC recommendations for statistical analysis
- production of an inventory list of plant taxa associated with the potential TEC SCP30a
- searching and mapping the location of any DRF and Priority Flora species and other flora of local or taxonomic significance along a minimum 100 m spaced grid transects throughout the study area; this search effort was intensified in the vegetation types where these species were considered most likely to occur
- description and map/s of vegetation condition over the study area as per the Keighery (1994) condition rating scale
- identifying and mapping any TECs within the survey area.

Key findings of surveys

These surveys provide comprehensive information of the vegetation and flora values of the Proposal area and surrounds including vegetation and condition mapping. Eight floristic community types (FCTs) were mapped in the Cape Peron area with four FCTs occurring within the Proposal area. The majority of the vegetation within the Proposal area is currently in 'good' condition. However, the vegetation does vary from very good to completely degraded. The high variability in vegetation condition is attributed to human influences, such as uncontrolled access tracks, accumulation of litter and the introduction and spread of weed species throughout the Proposal area.

Recent surveys include a targeted spring survey for Declared Rare Flora and priority flora that was undertaken in accordance with EPA guidance (EPA 2004). The survey by ENV (2010a) did not identify any endangered species, declared rare flora or Priority flora species within the Proposal area.

One Threatened Ecological Community, Floristic Community Type SCP30a *Callitris preissii* (or *Melaleuca lanceolata*) forest and woodlands extends into the Proposal area, although the Proposal boundary has been designed to protect the majority of this vegetation. This Floristic Community Type is listed as Vulnerable by the State and is not listed by the Commonwealth. This Floristic Community Type was also identified at two locations outside the impact area near Point Peron (Figure 3).

5.3.3 Assessment framework

EPA objective

The EPA environmental objective for vegetation and flora is:

- *to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.*

Vegetation and flora are protected through the following legislation:

- *Wildlife Conservation Act 1950*
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Conservation and Land Management Act 1984*
- EP Act.

Other guidelines and policies relevant to the protection and assessment of vegetation and flora impacts include:

- *National Strategy for Conservation of Australia Biodiversity*
- *National Strategy for Ecologically Sustainable Development*
- EPA Position Statement No 2, *Environmental Protection of Native Vegetation in Western Australia*
- EPA Position Statement No. 3, *Terrestrial Biological Surveys as an Element of Biodiversity Protection*
- EPA Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*
- EPA Guidance Statement No. 10, *Level of assessment for proposals affecting natural areas within the System 6 region and Swan Coastal Plain portion of the System 1 Region*.

5.3.4 Potential sources of impact to be managed

The following aspects of the Proposal may affect flora and vegetation values:

- **clearing of vegetation** for the development will directly reduce the extent of vegetation communities with minimal disturbance to expected to occur to threatened ecological community
- **dewatering to lower groundwater levels** to allow for the excavation of the marina therefore may affect groundwater dependent vegetation
- **creation of new saltwater interface** as a result of the land based marina therefore may affect saltwater/freshwater interface dependent vegetation
- **increased population** as a result of development may increase indirect impacts on vegetation through uncontrolled access, rubbish and domestic pets
- **vehicle movements and earthworks** have the potential to introduce and spread weed species
- **fragmentation of Bush Forever site 355** as a result of clearing for the development
- **dust generation due to earthworks** and vehicle movements has the potential to smother vegetation.

Approximately 52 ha of Bush Forever Protection Area 355 (of which approximately 31 ha is vegetated), is located within the Proposal area whilst an approximately equivalent area remains located outside the Proposal area. Of the area included within the Proposal boundary, approximately 8 ha will be retained and rehabilitated as required.

5.3.5 Further flora and vegetation studies and investigations

All flora and vegetation surveys and investigations have been completed, however an additional *Lomandra maritima* survey will be undertaken within and surrounding the Proposal area to further define potential habitat distribution of the Graceful Sun-moth.

The PER will include a comprehensive assessment of the effects of the Proposal on the vegetation of Cape Peron as a whole, as per EPA Bulletin 1237 (EPA 2006). An offsets package will also be developed in consultation with DEC, OEPA and the City of Rockingham to offset the vegetation loss and area excised from the Rockingham Lakes Regional Park and Bush Forever Protection Area 355.

5.3.6 Information to be provided in the PER

The PER will include the following information:

- details of any vegetation to be retained within the Proposal area
- details on the clearing requirement of the TEC FCT30a, together with an assessment of the potential effects of clearing and indirect effects (including hydrological changes) on the remaining distribution of this FCT30a within the Cape Peron surrounds
- assessment of potential fragmentation of Bush Forever site 355 together with assessment of likely impacts to the ecological integrity of the remaining vegetation within Cape Peron
- details on vegetation rehabilitation within and outside the Proposal area
- an offset plan, if required, developed in consultation with the EPA, SEWPaC and relevant government agencies
- a construction environmental management plan outlining flora and vegetation management during construction.

5.4 TERRESTRIAL FAUNA

5.4.1 Introduction

The Proposal area exhibits a high level of disturbance from anthropogenic sources and influences, including buildings, roads, weeds and feral predators. However, surveys of the area have indicated that a number of fauna values have been retained, but mostly at the micro- and invertebrate scales, although numerous migratory birds are also recorded using the area.

5.4.2 Overview of existing information

The following fauna studies have been undertaken within the Proposal area and surrounds:

- Bamford MJ and AR, Consulting Ecologists (Bamford) 2005, *Fauna Assessment of Bush Forever Site 355 (Point Peron and adjacent bushland),* unpublished report prepared for Strategen
- ENV 2010b, *Cape Peron Fauna Assessment,* unpublished report prepared for Strategen; Appendix 5

- Subterranean Ecology 2010a, *Cape Peron Tourist Precinct Project Short Range Endemic (SRE) Terrestrial Invertebrates Desktop and habitat assessment,* unpublished report prepared for ENV Australia; Appendix 9.
- Subterranean Ecology 2010b, *Cape Peron Tourist Precinct Project Stygofauna desktop and habitat assessment,* unpublished report prepared for ENV Australia; Appendix 10
- Subterranean Ecology 2010c, *Cape Peron Tourist Precinct Project Troglofauna Desktop and habitat assessment*; unpublished report prepared for ENV Australia Appendix 11
- ENV 2010c, Cape Peron Graceful Sun Moth Survey, unpublished report prepared for Strategen.

The above information and surveys fulfil the requirements of the EPA Guidance Statement No. 56. All fauna survey work is complete with the exception of some targeted surveys for short range endemic species as recommended by Subterranean Ecology 2010a.

ENV 2010 fauna survey

A detailed Level 2 terrestrial fauna survey was undertaken by ENV (2010b) in November 2009. The level of survey required was determined in accordance with EPA Guidance Statement No. 56 (EPA 2004b) based on the potential impacts of the Proposal and the likely fauna and fauna habitats to be present within the Proposal area. The objectives of the terrestrial fauna survey were to:

- conduct a comprehensive fauna database/literature review for the survey area
- conduct a terrestrial vertebrate fauna survey within the survey area
- conduct a habitat assessment of the survey area documenting general habitat types
- identify terrestrial vertebrate and invertebrate fauna of conservation significance that may occur in the survey area.

The terrestrial fauna survey consisted of a desktop review and field investigation. The desktop review consisted of searches of the DECs threatened and Priority Fauna database, NatureMap and the Department of Sustainability, Environment, Water , Population and Communities (SEWPaC) Protected Matters Search Tool (previously DEWHA). The field survey consisted of trapping from the 20 to 27 November 2009 with traps being open for up to six nights during the survey. The fauna field survey consisted of:

- a fauna habitat assessment
- a trapping program (up to 12 trap nights for cage traps, up to 30 trap-nights for hair tubes, 60 trap-nights for bucket and Elliott traps, and 120 trap-nights for funnel traps)
- diurnal and nocturnal searches (a total of 12 hours of diurnal searching and 16.5 of nocturnal spotlighting)
- an ornithological census (a total of 22 hours of census)
- bat recordings (a total of six nights using AnaBat recording units to document bat species in the area)
- targeted conservation significant species search (transects conducted 100 m apart across the Proposal area)
- opportunistic observations.

Key findings of terrestrial fauna surveys

A total of 1645 trap nights from the trapping programme and over 50 hours of diurnal and nocturnal searching was conducted within the survey area (ENV 2010b). This resulted in a total of 96 fauna taxa being recorded within the survey area; comprising five amphibian species, 19 reptile species, 66 avifauna species and six mammal species. Seven fauna species of conservation significance (listed under the *Environment Protection and Biodiversity Conservation Act 1999*, the *Wildlife Conservation Act 1950* or occurring on the Department of Environment and Conservation Priority list) were recorded within the survey area. Six species, namely the Eastern Great Egret, Eastern Osprey, Common Sandpiper, Bridled Tern, Rainbow Bee-eater and Australian Reed-warbler are listed as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999*. One species the Lined Skink (*Lerista lineata*), is listed as Priority on the Department of Environment and Conservation Priority list. A further 34 conservation significant fauna species potentially occur in the survey area. No evidence of the Quenda and South-west Carpet Python were recorded during the survey, nor any migratory waders and conservation significant black cockatoo species.

The survey area already exhibits a moderate to high level of disturbance due to existing infrastructure, an influx of weed species and other anthropogenic effects such as clearing and rubbish dumping. The survey area also exhibits disturbance from an existing caravan park and boat-yards in the developed areas to weed infestations and anthropogenic effects in the vegetated areas.

Key findings of subterranean fauna surveys

Two desktop studies of the subterranean fauna of the project area have recently been completed by Subterranean Ecology Pty Ltd; one for stygofauna (2010a) and one for troglofauna (2010b). Both studies included literature reviews and site inspection and habitat assessments.

The stygofauna habitat review (Subterranean Ecology 2010b) concluded that there is a moderate to high likelihood that stygofauna occurs in the Proposal area, largely owing to the nature of the underlying geological substrates and the carbonate-rich groundwaters, as well as the biological productivity of Lake Richmond and its connectivity to the local groundwater systems.

The troglofauna habitat review (Subterranean Ecology 2010c) concluded that there is a very low likelihood of troglofauna being present at the project area, on the basis that the consolidated sandy substrate would lack secondary permeability, and the more permeable limestone features were only present beneath the water table and would be unsuitable as habitat for air-breathing troglofauna.

5.4.3 Assessment framework

EPA objective

The EPA objective relevant to fauna is:

- *to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystems levels through the avoidance or management of adverse impacts and improvement in knowledge.*

The following overriding EPA objective addressing biodiversity is also relevant:

- *maintain biological diversity where that represents the different plants, animals and micro-organism, the genes they contain and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.*

Fauna are protected through the following legislation:

- *Wildlife Conservation Act 1950*
- *Environment Protection and Biodiversity Conservation Act 1999.*

Other guidelines and policies relevant to the protection and assessment of vegetation and flora impacts include:

- *National Strategy for Conservation of Australia Biodiversity*
- *National Strategy for Ecologically Sustainable Development*
- EPA Position Statement No. 3, "*Terrestrial Biological Surveys as an Element of Biodiversity Protection*"
- EPA Guidance Statement No. 56, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*
- EPA Guidance Statement No. 20, "*Sampling for Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia*
- Draft EPA Guidance Statement No. 54a, "*Sampling methods and survey considerations for Subterranean Fauna in Western Australia.*

The DEC Priority Fauna List also nominates Priority conservation species. The Priority Fauna List does not confer any additional legal protection apart from the normal protection afforded to most native fauna. It is expected however, that the potential impacts from a proposal on these Priority listed species should be managed so that the species do not meet the International Union for Conservation of Nature and Natural Resources criteria for threatened species.

A range of shorebirds are listed under the Japan–Australia (JAMBA) and China–Australia (CAMBA) Migratory Bird Agreements. Most of these are associated with saline wetlands or coastal shorelines and have little relevance to the project area. However, some migratory birds not associated with water are also listed on these international treaties.

5.4.4 Potential sources of impact to be managed

The following aspects of the Proposal may affect terrestrial fauna values:

- **clearing of vegetation** for the project will directly disturb fauna habitat and may result in the loss of individual terrestrial fauna
- **vehicle movements** in the Proposal area may result in the loss of individual terrestrial fauna habitat
- **predation** on terrestrial fauna species from introduced domestic pets from the land development
- **indirect impacts from increase in population** degrading habitat quality over time thereby reducing habitat quality for terrestrial fauna
- **indirect impacts from increase in saltwater interface** as a result of the land based marina impacting groundwater dependent vegetation.

Approximately 38 ha of fauna habitat will be cleared as a result of the Proposal.

Potential impacts to the Priority Listed Lined Skink (*Lerista lineata)* and the Graceful Sun Moth, recorded within the Proposal impact area, may occur as a result of vegetation clearing.

The Proposal is not likely to affect local populations of conservation significant species such as migratory waders, the Quenda, the South-west carpet Python and black cockatoo species, due to the lack of appropriate habitat. These conservation significant species were not recorded during fauna surveys of the Proposal area.

5.4.5 Further fauna studies and investigations

The targeted short range endemic survey is in progress with the preparation of the report waiting until all survey work and taxonomic identifications have been completed. The work being undertaken includes:

- targeted survey for scorpions in April 2010 (completed)
- targeted survey for millipedes and snails in August 2010 (completed).

Regional significance of fauna

A report will be prepared by a fauna specialist to address the regional significance of the site for fauna. The report will include the use of publically available investigations and reports undertaken on the Swan Coastal Plain. The importance of the site for fauna species within the Proposal area will be outlined, particularly for the Bush Forever site within and outside the Proposal area.

Review of initial ENV 2010 Fauna Report

The EPA's *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (September 2010) was released following the development of the ENV Fauna Survey (2010b), which was prepared in February 2010.

The Proponent understands the need to adhere to relevant environmental guidelines and has commissioned a review of the initial ENV 2010 Fauna survey. The review will determine any additional information that may need to be included within the report, to ensure it is up to date with these latest guidelines.

Stygofauna habitat assessment

A comprehensive stygofauna habitat assessment will also be conducted within and surrounding the Proposal area. The objective of the habitat assessment is to:

- determine the likelihood of the presence/absence of stygofauna within and surrounding the Proposal area
- determine the likelihood for endemic stygofauna to occur within and surrounding the Proposal area.

The habitat assessment is warranted, as there is substantial additional information on the hydrogeology of the Proposal area available as a result of the MWH 2010 drilling program that has been undertaken since the Subterranean Ecology desktop investigation. The habitat assessment will include a detailed review of the comprehensive hydrogeological and hydrological data collected from the Proposal area since March/April 2010 together with a review of similar stygofauna assessments undertaken on the Swan Coastal Plain.

If the habitat assessment concludes there is a moderate to high likelihood of short range endemic stygofauna occurring within the Proposal area, then a stygofauna sampling program will be undertaken in accordance with the EPA Draft Guidance Statement 54a. If the habitat assessment concludes there is a low likelihood of short range endemic stygofauna occurring within the Proposal area, then no sampling program is proposed.

5.4.6 Further information to be provided in the PER

The following information will be provided in the PER:

- a description of the regional significance of fauna species within the Proposal area, particularly for the Bush Forever site
- an assessment of the potential impacts to the regional values of fauna species within and surrounding the Proposal area.

5.5 MARINE WATER QUALITY

5.5.1 Introduction

The Proposal is located in Mangles Bay, which is sheltered by the Garden Island Causeway and Cape Peron, and therefore relatively calm and poorly 'flushed' by marine waters under most circumstances. In terms of nutrient-related water quality, chlorophyll levels in Mangles Bay are relatively high compared to most other waters in Cockburn Sound. The relatively high chlorophyll values in Mangles Bay are believed to be largely due to the reduction in flushing of the area by the construction of the Garden Island Causeway in 1971–73, although the area would also have been naturally calm and sheltered before this time.

Water quality is one of the two primary marine environmental issues relevant to the Proposal identified in the EPA's Bulletin 1237 in its strategic advice to the Minister for the Environment, under Section 16(e) of the EP Act (EPA 2006).

5.5.2 Overview of existing information

Numerous studies into the water quality and inputs of nutrients and contaminants in Cockburn Sound and Mangles Bay have been conducted by the Western Australian Government, the Cockburn Sound Management Council, and local non government organisations. Studies include:

- *The Influence of the Garden Island Causeway on the Environmental Values of the Southern End of Cockburn Sound* (DAL Science & Engineering Pty Ltd 2003)
- results of water quality samples taken from the Lake Richmond outflow drain that discharges into Mangles Bay (Naragebup Rockingham Regional Environment Centre Inc.).

In addition, WorleyParsons (2005) were commissioned as part of the previous Cape Peron proposal to conduct a screening level hydrodynamic numerical study for the twofold purpose of identification/selection of a preferred marina option, and examination of potential impacts on water quality in Mangles Bay and adjacent waters.

The Cockburn Sound Management Council (CSMC) presently undertakes surveys of nutrient-related water quality each week from December to March inclusive, and the Department of Health and the City of Rockingham undertake fortnightly surveys of faecal bacteria at popular beaches in the main bathing season. CSMC results indicate that water quality in Mangles Bay typically exceeds guidelines for nutrient-related water quality and faecal bacteria, but does not exceed the standards.

5.5.3 Assessment framework

EPA objective

The EPA environmental objective for marine water quality is:

- *to maintain the integrity, ecological functions and environmental values of the seabed and coast.*

Other relevant legislation and policy

State Environmental (Cockburn Sound) Policy 2005

The State Environmental (Cockburn Sound) Policy 2005 (Cockburn Sound SEP) establishes the framework within which Cockburn Sound and the adjacent land (the Cockburn Sound catchment) are to be managed so as to protect environmental quality in the Sound. The Cockburn Sound SEP establishes a risk-based approach to environmental management, which is underpinned by Environmental Values (EVs) and spatially defined Environmental Quality Objectives (EQOs) (Government of Western Australia 2005) to ensure the EVs are protected,(Table 6).

Table 6 Environmental quality values and environmental quality objectives for Cockburn Sound

Environmental values	Environmental quality objectives
Ecosystem health	Maintenance of ecosystem integrity in terms of structure (e.g. biodiversity, biomass and abundance of biota) and function e.g. food chains and nutrient cycles).
Seafood safe for eating	Maintenance of aquatic life for human consumption, such that seafood is safe for human consumption when collected or grown.
Aquaculture	Maintenance of aquaculture, such that water is of a suitable quality for aquaculture purposes.
Recreation and aesthetics	Maintenance of primary contact recreation values, such that primary contact recreation (e.g. swimming) is safe. Maintenance of secondary contact recreation values, such that secondary contact recreation (e.g. boating) is safe. Maintenance of aesthetic values, such that the aesthetic values are protected.
Industrial water supply	Maintenance of industrial water supply values, such that water is of suitable quality for industrial water supply purposes.

Environmental quality criteria (EQC) have been specifically developed for Cockburn Sound to provide the quantitative benchmarks for measuring success in achieving the EQOs set in the SEP (Government of Western Australia 2005). There are two types of EQC:

1. Environmental quality guidelines (EQGs): threshold numerical values which, if met, indicate a high degree of certainty that the associated environmental quality objective has been achieved. If the guideline value is not met then a more detailed assessment process against an environmental quality standard is triggered.
2. Environmental quality standards (EQSs): threshold numerical values that indicate a level beyond which there is a significant risk that the associated environment quality objective has not been achieved and a management response is triggered (Government of Western Australia 2005).

The ecological EV of ecosystem health has different EQC for zones of high, moderate and low ecological protection, whereas the social EVs (safe seafood, aquaculture, recreation and aesthetics, and industrial water supply) have the same EQC applied throughout Cockburn Sound.

The ongoing (operational) effects of the Proposal on the marine waters of Cockburn Sound will need be assessed in terms of EQC for key water quality indicators for the EVs of Cockburn Sound, particularly Ecosystem Health (e.g. nutrient-related water quality, contaminants), and Recreation and Aesthetics (e.g. water clarity, faecal bacteria). Some temporary effects (e.g. turbidity and any nutrient-related effects due to construction) will need be managed and monitored differently (although still using the same indicators), as they are likely to take place outside the summer monitoring season targeted by the Cockburn Sound SEP.

Shoalwater Islands Marine Park

Shoalwater Islands Marine Park borders Mangles Bay at the Garden Island Causeway. The Park covers an area of approximately 6545 hectares and contains the waters of Shoalwater Bay, Warnbro Sound and a part of Cockburn Sound off Cape Peron. The Park is vested to the Marine Parks and Reserves Authority, and managed by the DEC, apart from recreational fishing which is managed by the Department of Fisheries in close cooperation with DEC. The Shoalwater Islands (i.e. the terrestrial portion) are managed under the 1992 Shoalwater Islands Management Plan.

The Shoalwater Islands Marine Park Management Plan 2007–2017 (the management plan) was formally approved by the Minister for the Environment in August 2007. The management plan sets out, among other things, a zoning scheme and a 'best practice' model for managing the identified ecological and social values of the Marine Park. The zoning scheme proposes that the areas to the north of Point Peron (to the west of the Causeway) be within a General Use Zone. Shoalwater Bay (on the southern side of Point Peron) is a recommended Special Purpose Zone for wildlife conservation, and further south are two sanctuary zones (at Second Rock, and Becher Point), and a Special Purpose Zone for Special Purpose Zone for scientific reference at Murray Reef.

Each ecological and social value for the Marine Park has identified management objectives, strategies, performance measures and targets to achieve. For example, the management objective for water and sediment quality is "To ensure the water and sediment quality of the marine park is not significantly impacted by future human activities". Performance measures include nutrient-related water quality (chlorophyll concentrations), contaminant concentrations, faecal bacteria and litter. Targets have yet to be developed.

Within the General Use Zone (which includes waters west of the causeway), the conservation of natural values is still the priority, but activities such as sustainable commercial and recreational fishing, aquaculture, pearling and petroleum exploration and production are permitted provided they do not compromise the ecological values of the marine park. Impacts of the Proposal on water quality in Shoalwater Islands Marine Park will need to be assessed relative to the management objectives for this General Use Zone. It is noted that the Marine Park is characterised by high water quality: sites monitored in Warnbro Sound presently provide the 'reference' data used to generate nutrient-related water quality EQC for Cockburn Sound.

5.5.4 Potential sources of impact

The Proposal will result in temporary impacts on marine water quality during construction, and ongoing impacts on marine water quality due to outflow of water from the marina. Marinas are, by necessity, calm, sheltered environments: the waters of the proposed development will be less well flushed than the adjacent waters of Mangles Bay, and therefore of lesser quality. There will also be effects on water quality in the marina due to the concentration of boats in the marina, plus any stormwater runoff from adjacent land (both potential sources of a source of nutrients, contaminants and bacteria). As the proposed marina will have lesser water quality than in Mangles Bay, outflow of marina water has the potential to affect water quality in Mangles Bay and adjacent waters in Cockburn Sound and the Shoalwater Islands Marine Park.

The following aspects of the Proposal may affect marine water quality values:

- **dredging of the seabed** to allow for the construction of the access channel into the proposed marina, may temporarily affect water quality due to increased turbidity, and the release of any nutrients and contaminants in dredged sediments
- **seepage of return water from bunded areas used for temporary storage of dredged sediments,** which may temporarily impact water quality due to increased turbidity and the release of nutrients and contaminants in dredged sediments

- **placement of limestone for the marina breakwaters and leaching of fines from the limestone** causing temporary turbidity during and after the limestone is placed
- **creation of land-based marina** which may potentially affect the water quality within Mangles Bay (and potentially the adjacent waters of Cockburn Sound and the Shoalwater Islands Marine Park) on an ongoing basis, due to outflow of lesser water quality from the marina
- **increased boat numbers** increasing the potential for pollution.

Due to the small size of the marina breakwaters and their location in very shallow flats at the south eastern extreme of Cockburn Sound, it is not anticipated that the creation of the marina will cause any significant changes in water quality due to changes in the overall water circulation patterns of Cockburn Sound.

5.5.5 Further marine studies and investigations

The Proponent has undertaken a baseline survey of nutrient-related water quality immediately adjacent to the Proposal in the 2009/2010 summer, according to the protocols used by the CSMC. These results will be available for the PER, and will be placed into context along with a detailed review of the current water quality status in Cockburn Sound.

It is anticipated that the waters in the marina will be considered 'inland waters' and therefore not assessed via the marine water quality EQC of the Cockburn Sound SEP, although suitable water quality for inland waters will still need to be demonstrated. The small area between the breakwaters, however, be part of the marine environment, and it is anticipated that the OEPA will assign this marine area as a 'Moderate Protection Zone' for the EQO of Maintenance of Ecosystem Health (consistent with the EPA's approach for other marinas and harbours), and assessed accordingly.

The following further marine studies and investigations are scheduled to be undertaken for this Proposal:

- sediments sampling and analysis in the area to be dredged
- modelling of dredge plume and return water plume dispersion characteristics
- hydrodynamic modelling of the marina and adjacent waters in Mangles Bay, which will include residence times of waters of the final concept design, and box modelling of nutrient-based water quality.

Further detail on each is provided below.

Sediment sampling and analysis

Sediments in the area to be dredged will be sampled and analysed according to National Assessment Guidelines for Dredging (Commonwealth of Australia 2009). Analyses of sediments will include:

- physical characteristics (particle size distribution, settling rates)
- contaminants (metals, polycyclic aromatic hydrocarbons, tributyltin)
- nutrients and total organic carbon
- acid sulphate soil (ASS) potential.

Sediment contaminant data will be used to determine the need for management of return water discharge, and sediment disposal options. Data on the physical characteristics of sediments will be used as input in turbidity plume modelling (see below).

Dredge plume modelling and return water modelling

Hydrodynamic modelling of sediment transport will be undertaken to simulate turbidity and sedimentation due to the dredge plume, and return water discharge. A validated three-dimensional hydrodynamic model will be used for this purpose. Data on the physical characteristics of sediment (see above) will be used as an input to plume modelling. Subsequent analysis of model output will be undertaken to derive potential zone of high impact, zone of moderate impact and zone of influence using derived thresholds for impacts on seagrass (based on seagrass-light shading relationships derived for Cockburn Sound and other temperate WA locations. Results will be used to guide the selection of sites for water quality and seagrass monitoring for the duration of dredging and return water discharge.

The proposed dredging program is less than three months in duration and will take place in winter. Indirect effects on seagrasses are therefore expected to be temporary and minimal. Similarly, effects on the recreational use of adjacent beaches are expected to be temporary and minimal. Therefore, although impacts on social values for the duration of the dredging program will be discussed, no assessment of secchi depths (as a measure of recreational water clarity) is proposed.

Hydrodynamic modelling of marina water quality

A validated hydrodynamic model will be used to simulate the residence times of marina waters, and outflow of marina waters into Mangles Bay for three main hydrodynamic 'seasons' of:

- autumn (worst-case conditions for flushing)
- winter-spring
- summer (when EQC for nutrient-related water quality will apply).

An Acoustic Doppler Current Profiler (ADCP) will be deployed in waters adjacent to the Proposal area to provide current data to validate the model. The location and duration of deployment will be determined in consultation with the OEPA.

Impacts on nutrient-related water quality in Mangles Bay due to marina residence times will be estimated using simple box modelling of nutrient-related water quality, based on inputs of dissolved inorganic nitrogen (DIN) from ambient waters, marina sediments and groundwater, and conservative relationships relating DIN to phytoplankton growth. Various scenarios for nutrient release from marina sediments will be examined, to allow for the organic enrichment of sediments that typically develops in all sheltered water bodies. Residence times will also be used to assess the potential for algal blooms in marina waters, and to predict secchi depths in marina waters based on expected chlorophyll concentrations and TSS concentrations.

The water quality modelling work underpinning the assessment will be independently peer reviewed by an appropriate technical expert(s).

5.5.6 Information to be provided in the PER

The PER will include the following information:

- numerical modelling to present best, worst and most-likely case scenarios with predictions presented as time series of tracer and DIN concentration at discrete points as well as spatial maps
- numerical modelling and monitoring will be undertaken in accordance with the EPA's *Environmental Assessment Guideline 7 – Marine Dredging Proposals 2010*
- an assessment of the potential impacts to marine water quality following construction associated with the ongoing maintenance dredging of the marina access channel

- an assessment of the Proposal's potential impacts on ecosystem integrity as outlined within Section 5.5.3
- a construction environmental management detailing management of marine water quality as related to the construction phase of the Proposal
- marine water quality management plan for the operation of the Proposal.
- Local meteorology data will be collected at a suitable location near the project site. It is intended that data will be collected for a minimum of 6 months with a correlation analysis undertaken to link this data to nearby long term records.

5.6 COASTAL PROCESSES

5.6.1 Introduction

Mangles Bay is at the southern end of Cockburn Sound and bounded by the Garden Island causeway and Point Peron to the west. The Garden Island causeway was constructed in 1971 to 1973 and includes trestle bridges to allow water flow. The causeway reduced water exchange and the penetration of swell into the southern end of the Cockburn Sound considerable. Since the construction of the causeway and the construction of the groyne to the west, sand has accreted to the west and Mangles Bay has eroded slightly. The City of Rockingham oversees sediment removal of approximately 10 000 m^3/yr bi-annually from the west of the causeway to areas along the Rockingham foreshore.

A preliminary review (JFA 2010) of existing coastal processes information has shown that the volume of longshore transport is relatively small in Mangles Bay due to the sheltering effects of the Causeway. However, there is a small long term erosion trend which means that this beach requires management (replenishment) in its current state.

5.6.2 Overview of existing information

A desktop assessment of coastal processes in Mangles Bay and the potential effects of the marina development has been undertaken by JFA (2010, provided in Appendix 7).

5.6.3 Assessment framework

EPA objective

The EPA environmental objective for coastal processes is:

- *to maintain the integrity, ecological functions and environmental values of the seabed and coast.*

Other relevant legislation and policy

The Western Australian Planning Commission has developed the following policies relevant to coastal processes:

- *Statement of Planning Policy 2.6 State Coastal Planning Policy*, as amended December 2006
- *Position Statement – State Planning Policy 2.6 State Coastal Planning Policy Schedule 1 Sea Level Rise*.

5.6.4 Potential sources of impact

The following aspects of the Proposal may potentially impact on coastal processes:

- **construction of the marina entrance breakwater and channel** which may interrupt longshore sediment transport
- **Construction of the breakwaters** may result in the accumulation of seagrass wrack against the structure.

The proposed development is not expected to have significant additional adverse effects on the longshore movement of sediment from Cape Peron into Mangles Bay because this process is already interrupted by the Cape Peron boat ramp and Causeway.

5.6.5 Further studies and investigations

Further investigations required for the environmental impact assessment and to provide input into the marina entrance design will be required to more accurately estimate longshore transport rates and to determine final beach alignments. Investigations will include:

1. Collection of local current data for flow modelling (if sufficient baseline information does not currently exist).
2. Design wave estimates within Mangles Bay using empirical or numerical wave models.
3. Undertake modelling of longshore sediment transport and flow modelling, as appropriate.

The above investigations would be used to identify the impacts of the development on coastal processes as a result of the development infrastructure including erosion and deposition of sediments on the beaches and within the access channel. The severity and timing of coastal processes impacts will inform management decisions in final design and ongoing management.

5.6.6 Information to be provided in the PER

The PER will include the following information:

- assessment of climate change on the Proposal infrastructure
- engineering design requirements for the implementation of the Proposal
- outcomes of *Position Statement – State Planning Policy 2.6 State Coastal Planning Policy Schedule 1 Sea Level Rise*
- construction environmental management plan.

5.7 BENTHIC PRIMARY PRODUCER HABITATS

5.7.1 Introduction

Cockburn Sound has a history of poor water quality and large-scale loss of seagrass meadows dating from the 1960s and '70s. Although environmental conditions have improved markedly since the 1970s, a legacy of this past is that water quality and seagrass meadows remain key environmental concerns.

The shallow flats of Mangles Bay contain approximately 100 hectares of seagrass, comprising the main area of seagrass meadow that remains on the eastern shore of Cockburn Sound between the Causeway and Woodman Point. Loss of seagrass is one of the two primary marine environmental issues relevant to the Proposal identified in the EPA's Bulletin 1237 in its strategic advice to the Minister for the Environment, under Section 16(e) of the EP Act (EPA 2006).

5.7.2 Overview of existing information

Studies into the seagrasses of Cockburn Sound and Mangles Bay and their values and functions that would be reviewed for use in the PER include:

- *Benthic Habitat Mapping for 2002 of Selected Areas of Cockburn Sound* (DAL Science & Engineering Pty Ltd 2002)
- *The Influence of the Garden Island Causeway on the Environmental Values of the Southern End of Cockburn Sound* (Cockburn Sound Management Council 2003)
- *Summary paper. Fish habitat in the nearshore regions of Cockburn Sound* (G. Hyndes 2004).

5.7.3 Assessment framework

EPA objective

The EPA environmental objective for benthic primary producer habitat is:

- *to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge*.

Other relevant legislation and policy

EPA Environmental Assessment Guidelines No. 3 (*Protection Of Benthic Primary Producer Habitats In Western Australia's Marine Environment*; EPA 2009) classifies Cockburn Sound as a Category F: areas where cumulative loss guidelines have been significantly exceeded. Proposals in Cockburn Sound must therefore not cause any net loss of seagrass, necessitating seagrass transplantation to offset any losses.

There are also specific EQSs for seagrass health (in terms of shoot density) established under the Cockburn Sound SEP (Government of Western Australia 2005, see also Section 5.5.3). The ongoing (operational) effects of the Proposal on the marine waters of Cockburn Sound will need be assessed in terms of these EQS. Temporary effects (e.g., turbidity and any nutrient-related effects due to construction) will be managed and monitored differently (although still based on measures of seagrass shoot density), as they are likely to take place outside the summer monitoring season targeted by the Cockburn Sound SEP.

5.7.4 Potential sources of impact to be managed

The Proposal will result in an approximate 5 ha of direct seagrass loss. Any loss of seagrass in Cockburn Sound is required to be offset by rehabilitation of at least an equal area of seagrass within Cockburn Sound.

A major objective of this Proposal is to provide the opportunity for safe anchorage for all power and sail craft in the area, which may ultimately lead to the removal of the majority if not all moorings currently located within the bay. The removal of these moorings will provide opportunity for the rehabilitation of all areas scarred by moorings.

The following aspects of the Proposal may affect Benthic Primary Producer Habitat values:

- **direct removal of seagrass** to allow for the construction of the access channel and breakwaters to allow access to the marina
- **indirect impacts to seagrass meadows** as altered sediment movement and flows due to the breakwaters result in the shear or smothering of seagrass, creating a 'halo' effect around breakwaters
- **indirect impacts to seagrass meadows as a result of alteration in water quality** within Mangles Bay as a result of the creation of the marina
- **indirect impacts to seagrass meadows as a result of relocation of ocean outfall pipe to Hymus Street**.

Potential impacts on seagrass due to altered water quality impacts are discussed in Section 5.5.5.

5.7.5 Further studies and investigations

Seagrass transplant rehabilitation trials in Mangles Bay were initiated by LandCorp (prior to the appointment of Cedar Woods as the Proponent) in April to May 2010 to provide local data on the success rate of seagrass transplanting (Oceanica 2010 provided in Appendix 8). The transplanting occurred within mooring scars after the moorings had been replaced by seagrass friendly moorings. An interim monitoring visit carried out at 3 months following the transplants indicates that transplanting has been successful with a good level of shoot density recorded at each of the transplant sites. Monitoring of these sites will continue to be undertaken quarterly.

The Proponent has undertaken a baseline survey of seagrass health in shallow waters at two sites (one on either side of the Causeway) in the 2009/2010 summer, according to the protocols used by the CSMC. These results will be available for the PER, and will be placed into context along with a detailed review of the status of seagrass health in Mangles Bay.

Detailed mapping of seagrass in Cockburn Sound has already been undertaken, and cumulative seagrass loss based on the final marina design will be calculated, including those due to the Proposal, and those due to proposed future developments in Cockburn Sound. It is anticipated that the Proposal could involve up to 6 ha of seagrass loss, comprising direct seagrass removal of up to 5 ha (includes breakwaters, reclamation areas, channel and batters), and indirect loss (based on a 15 m halo effects around the breakwaters) of up to 1 ha. The target for the total area of seagrass rehabilitation will exceed the total losses.

Potential sites for seagrass rehabilitation previously identified in the SER for the Mangles Bay Marina Based Tourist Precinct (Strategen 2006) included moorings historical barge scars and existing mooring scars in Mangles Bay, as well as areas on nearby Southern Flats (Figure 6). There are over 500 moorings in Mangles Bay, which potentially create over 3 hectares of mooring scars that could be used for seagrass rehabilitation if existing moorings were replaced by seagrass friendly moorings.

On Southern Flats an existing Seagrass Research and Rehabilitation Plan undertaken for Cockburn Cement Ltd and the State Government has also successfully transplanted 3 ha of seagrass, and suitable sites for seagrass rehabilitation for the Mangles Bay Marina Based Tourist Precinct lie immediately adjacent this area (Figure 7).

Suitable sites for seagrass transplantation will be identified and surveyed to ensure suitable substrate, water quality and flow conditions.

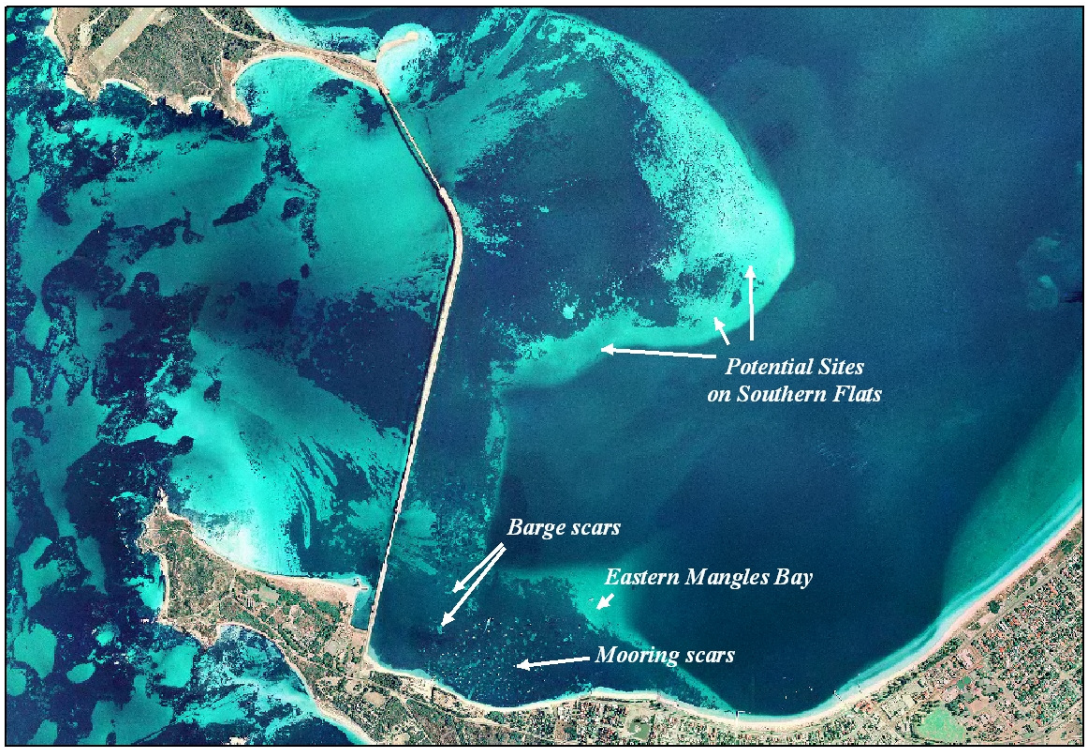


Figure 6 Aerial photograph showing potential sites for seagrass rehabilitation

5.7.6 Information to be provided in the PER

The PER will include the following information:

- an assessment of the likely impacts to marine benthic primary producers and habitats resulting from turbidity generated by dredging and discharge of spoil return water, and from sedimentation impacts through the settlement of dredge spoil and sediment within the return water (see Section 5.5.5)
- an assessment of the potential cumulative impacts for marine benthic primary producers and habitats; including existing projects, approved but not implemented projects and proposals currently being assessed by the EPA
- an assessment of the potential cumulative impacts to include both infrastructure and discharges of existing projects, approved but not implemented projects and proposals currently being assessed by the EPA
- an assessment of the potential impacts to benthic primary producer habitats following construction associated with the ongoing maintenance dredging of the marina access channel
- an assessment of the Proposal's potential impacts on ecosystem integrity as per Section 5.5.3
- an assessment of the baseline seagrass monitoring results within the context of the WA Auditor General's Report Environmental Management of Cockburn Sound, Report 8, September 2010 and its significance in the context of the potential impacts of the Proposal
- details on the engineering mitigation measures to reduce impacts to seagrass communities
- establishment of the sensitivity of seagrass to disturbance as per the EPA's EAG 7
- seagrass transplant and monitoring plan.

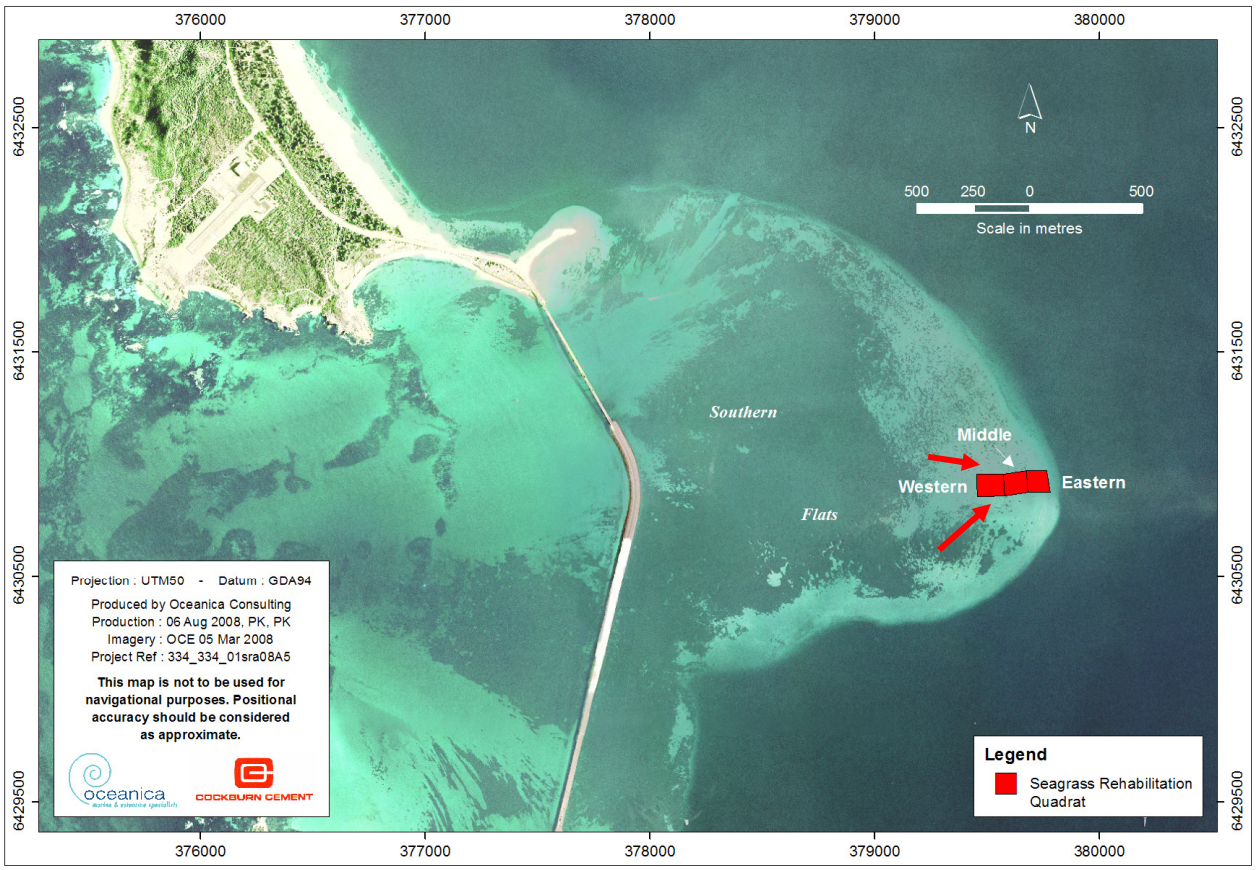


Figure 7 Aerial photograph of the Southern Flats region at the southern end of Garden Island: location of 3 ha of existing successful seagrass rehabilitation marked by red squares, and location of potential rehabilitation sites marked by red arrows

5.8 MARINE FAUNA

5.8.1 Introduction

Availability of suitable habitat and water quality are key factors affecting marine fauna in Cockburn Sound. Other threatening processes include fishing pressure (recreational and commercial), boat strike, entanglement in fishing gear/rubbish, and introduced marine pests.

5.8.2 Overview of existing information

The Department of Fisheries considers the whole of Cockburn Sound to be a significant fish nursery area. Nearshore habitats are known to act as nursery grounds for the juveniles of many species in general, and in particular the Mangles Bay area is known to provide an important nursery habitat for King George whiting. Cockburn Sound is also an important crab habitat. Crabs live their entire lifecycle in Cockburn Sound, with eggs laid in the deep basin area over November-January, and then the juveniles migrate to the shallow margins and settle in nearshore shallow seagrass environments.

Other significant marine fauna in Cockburn Sound include dolphins and Little Penguins. Cockburn Sound has a resident subpopulation of approximately 75-90 bottlenose dolphins (*Tursiops* sp.), though over 200 individuals may use the area if 'visitors' are included (Finn 2005). The shallow flats of

Mangles Bay do not appear to be an important foraging and/or resting area or for dolphins, unlike the flats of the Kwinana shelf further north. Similarly, Cockburn Sound is home to a small colony of Little Penguins, established around Careening Bay on Garden Island in the 1980s, and which contains approximately100 pairs. The Garden Island penguins forage in and around Cockburn Sound, but the shallow flats of Mangles Bay do not appear to be an important foraging area.

5.8.3 Assessment framework

EPA objective

The EPA environmental objective for marine fauna is:

> *To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.*

Other relevant legislation and policy

The EPA does not have specific management objectives for fauna, other than the broader objective to maintain ecosystem health in Cockburn Sound. Some fauna (e.g. dolphins and Little Penguins) are protected under State and Commonwealth Law:

- *Environment Protection and Biodiversity Conservation Act 1999 (addressed in Section 5.10)*
- *Wildlife Conservation Act 1950.*

The Department of Fisheries is responsible for managing the State's finfish and crab stocks, this is done on the basis of sustainability assessments, i.e. ensuring that fishing does not cause long-term decline of the resident population. The Department of Fisheries is also responsible for coordinating WA's introduced marine species control and management actions. With regard to introduced marine species, the EPA has a stated objective "to conserve WA's marine environment by managing and reducing the impacts of introduced marine species and by preventing further introductions and spread" (EPA 2007).

5.8.4 Potential sources of impact to be managed

The following aspects of the Proposal may affect marine fauna:

- **temporary changes in water quality during construction** (turbidity, nutrient-related water quality, contaminants) due to dredging and the discharge of return water
- **ongoing changes in water quality due to outflow of lesser water quality from the marina into Mangles Bay**
- **direct and indirect loss of habitat** due to construction of the access channel and breakwaters of the marina
- **increased risk of introduced marine species** due to increased numbers of large recreational vessels berthing in the marina
- **increased people access** causing littering
- **increased boat numbers** causing increased fishing pressure and the potential for boat strike.

5.8.5 Further studies and investigations

Further investigations to be undertaken for this Proposal include:

- desktop reviews of available information on fish, crabs and fish nursery areas in Cockburn Sound, assessing potential impacts of the Proposal
- consultation with the Department of Fisheries on potential impacts of the Proposal on fish and crabs, and management options
- liaison with the Department of Fisheries to obtain the most current information on the status of introduced marine species in Cockburn Sound, and available management procedures
- assessment of the additional risks arising from the Proposal relative to the current levels of activity in the Sound based on predicted increases in large recreational vessels
- desktop reviews of available information on dolphins in Cockburn Sound, assessing potential impacts of the Proposal
- consultation with the dolphin expert Dr Hugh Finn on potential impacts of the Proposal, and management options
- desktop reviews of available information on Little Penguins in Cockburn Sound, assessing potential impacts of the Proposal
- consultation with the Little Penguin expert Dr Belinda Cannell on potential impacts of the Proposal, and management options.

The assessment of potential impacts on marine fauna will be informed by the results of water quality studies (Section 5.3), seagrass loss (Section 5.7) and increased boating pressure.

5.8.6 Information to be provided in the PER

The PER will include the following information:

- an assessment of potential impacts to dolphins, Little Penguins and sea lions of the Proposal based on the predicted water quality effects, increased boating and habitat loss
- an assessment of potential impacts to the marine ecology of Mangles Bay especially in terms of its value as a fish nursery and crab habitat
- marine fauna management plan for dredging and construction of the Proposal.

5.9 RECREATION AND PUBLIC ACCESS

5.9.1 Introduction

The Mangles Bay foreshore comprises sandy beach backed by low sand dunes. A large proportion of this foreshore is presently occupied by the local yacht club, fishing club (with associated jetty and boat ramp) and chalet accommodation. The use of the land by these facilities means that public access to the area is constrained, although access along the beach is unimpeded. Offshore of the beach from the Proposal area to the Causeway, the waters are extremely shallow and have dense seagrass meadows that grow to the intertidal mark. The beach is thus not a popular swimming area, and beach-based recreation is more focussed on walking, and the launching of boats.

The recreational use of the beach within the Proposal area includes walking (most of the Mangles Bay foreshore is a designated dog beach), yachting and fishing. Mangles Bay waters to the east of the Causeway are popular for boat fishing and crabbing, with waters to the west of the Causeway utilised less often. An area directly to the east of the Garden Island Causeway is also designated a power water craft and water ski area.

The Cape Peron area to the west of the Causeway (which is outside the development footprint of the Proposal) has day-use car parks for accessing beaches and lookouts, and a public boat ramp directly to the west of the Garden Island Causeway. This area is the focus for many recreational activities, including:

- water-based activities: boating, swimming, snorkelling, fishing and crabbing
- land-based activities: walking, fishing and nature appreciation.

5.9.2 Overview of existing information

A coastal mapping and cumulative impact study undertaken for the strategic assessment of the four options for expansion of the Fremantle Ports Outer Harbour (GHD 2006) established that 62.6% of the coastline from Woodman Point to Mangles Bay is presently accessible to the public.

5.9.3 Assessment framework

The EPA environmental objective for recreation is:

- *to ensure that existing and planned recreational uses are not compromised.*

5.9.4 Potential sources of impact to be managed

The proposed development will result in the loss of a small amount of beach, and although the Mangles Bay shoreline will remain publicly accessible, pedestrian traffic flow along the beach will be interrupted by the marina entrance channel.

The Proposal is intended to improve access to, and the types of, recreational amenities of Mangles Bay. Once operational the Proposal should not restrict recreational fishing and yachting activities. There may be some temporary disruption of recreational fishing and yachting due to dredge movements, and effects on fishing movements due to turbidity generated during dredging, but effects are expected to be minimal due to the proposed timing of dredging in winter. There will also be temporary effects on recreational amenity due to turbidity and noise during construction.

The following aspects of the Proposal have the potential to affect recreational values:

- **dredge movements** may cause temporary disruption to yachting and recreational fishing activities
- **turbidity (during dredging) and construction noise** may affect recreational amenity
- **turbidity** may affect fish and crab behaviour and locations during dredging
- **direct removal of a small amount of beach** due to the construction of the access channel and breakwaters to allow access to the marina
- **interruption of pedestrian traffic flow along the beach** due to the access channel and breakwaters
- **interruption with adjacent gazetted waterski area and power craft area**.

A key issue for the CSMC and public is that community use of the eastern foreshore of Cockburn Sound is becoming increasingly limited due to the construction of foreshore developments, along with the erosion of beaches at Wells Park, Challenger Beach and Woodman Point.

Dredging is expected to have minimal impact on recreation uses of Mangles Bay as it will be undertaken in winter.

5.9.5 Further studies and information to be provided in the PER

Further studies to be undertaken for this Proposal include a desktop review of the recreational uses of Mangles Bay and adjacent waters that addresses.

- cumulative loss calculations for beach access, including those due to the Proposal, and those due to current and proposed future developments
- development of appropriate mitigation/offset measures for direct loss of beach and interruption of pedestrian traffic flow along the beach, resulting from the Proposal
- the current recreational usage of Mangles Bay and the adjacent waters of Cockburn Sound and Shoalwater Islands Marine Park
- an assessment of potential impacts on recreational amenity due to turbidity and noise during construction
- compilation of available data on boating movements from the Department of Transport (public boat ramps, Mangles Bay moorings), yacht clubs and fishing clubs (private boat ramps)
- identification of any boat access restrictions to Mangles Bay during construction
- an assessment of potential impacts on the movement of recreational fish species during dredging (see also Section 5.8)
- the outcomes of consultation with recreational fishers in relation to the project
- the outcomes of consultation with the local community in relation to impacts on coastal access
- the outcomes of consultation with recreational boat owners in relation to the project
- identification of management measures to address potential impacts.

5.10 ABORIGINAL HERITAGE

5.10.1 Introduction

Cockburn Sound, Lake Richmond and parts of the Mangles Bay and Rotary Park foreshore are sites of Aboriginal significance and are registered by the Department of Indigenous Affairs (DIA). Collectively, these sites have mythological, ceremonial and artefact significance, with connections to the Waugal, which created the various water bodies (e.g. Lake Richmond and Rotary Park pond) and other topographic features (e.g. dunal depressions) through its movement across the land and water.

5.10.2 Overview of existing information

A previous Aboriginal heritage assessment undertaken for the project area by McDonald Hale & Associates (1997) was used in the preparation of the 2006 SER and has also been sourced for the information presented here.

In addition to the registered sites, several other Aboriginal heritage areas have been identified through the previous stakeholder consultation and include:

- a dancing/ceremonial ground near the existing RSL hall
- a burial ground in the vicinity of the public carpark at the point.

The local Aboriginal community utilise an area on the Mangles Bay foreshore, just to the east of the Garden Island Causeway, as a meeting and learning place. The Sister Kate's former orphanage holiday camp has been identified as having emotional significance as part of recent Aboriginal history in the area. These sites are not heritage sites but have significance to the local Aboriginal community.

5.10.3 Assessment framework

EPA objective

The EPA environmental objective for Aboriginal heritage is:

- *to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.*

Other relevant legislation and policy

The Minister for Indigenous Affairs is responsible for the administration of the *Aboriginal Heritage Act 1972*. Under section 17 of the Aboriginal Heritage Act, it is an offence to disturb any Aboriginal site without consent under section 18 of that Act. The Minister considers recommendations from the Aboriginal Cultural Material Committee and the general interests of the community when making a decision on disturbance to a site and may also impose conditions on the approval.

The Registrar of Aboriginal Sites is responsible for maintaining the Register of Aboriginal Sites. The DIA has a database of all recorded sites.

EPA Guidance Statement No. 41, "*Assessment of Aboriginal Heritage*", provides guidance on the process for the assessment of Aboriginal heritage as an environmental factor. This guidance statement also details those actions that may be pertinent to the factor of Aboriginal heritage.

5.10.4 Potential sources of impact to be managed

The following aspects of the Proposal have the potential to disturb heritage sites and/or affect ethnographic significance:

- **physical disturbance** to the land during construction and associated activities
- **modified landform** may alter areas which may be of heritage significance.

5.10.5 Further studies and investigations

In addition to those studies into the potential effects of the Proposal on the biophysical environment and Cockburn Sound and Lake Richmond themselves, the proponent will eventually be seeking consent to disturb the sites from the Minister for Indigenous Affairs through a section 18 application under the Aboriginal Heritage Act. Close consultation with the local Aboriginal community will be maintained during this process.

5.11 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

5.11.1 Introduction

A search using the Protected Matters Database search tool was undertaken on the 16 August 2010. The search returned a number of threatened ecological communities and birds, mammals, reptiles, sharks, marine and migratory species. These matters are outlined in Table 7 together with their location in respect to the Proposal and likelihood of their occurring within the Proposal area.

The Matters of National Environmental Significance (MNES) that may be affected by the proposal are:

- TEC: Sedgelands in Holocene dune swales of the southern Swan Coastal Plain (occurring around Lake Richmond)
- TEC: Thrombolite (microbial) community of coastal freshwater lakes of the Swan Coastal Plain (Lake Richmond)
- Graceful Sun-moth (*Synemon gratiosa*).

Table 7 Matters of National Environmental Significance identified by the Protected Matters search tool

MNES	Species identified with Protected Matters Search tool	Status	Likelihood to occur within Proposal area (ENV 2010b)
Threatened Ecological Communities	Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Expected to occur approximately 200 m, from Proposal area.
	Thrombolite (microbial) community of coastal freshwater lakes of the Swan Coastal Plain (Lake Richmond)	Endangered	Not within Proposal area, but approximately 200 m from Proposal area and 400 m from the marina.
Birds	Forest Red-tailed Black Cockatoo	Vulnerable	Unlikely to occur due to lack of habitat within the Proposal area.
	Carnaby's Cockatoo, short-billed Black-Cockatoo	Endangered	Unlikely to occur due to lack of habitat
	Gibsons Albatross	Vulnerable	Unlikely to occur due to lack of habitat
	South Giant-Petrel	Endangered	Unlikely to occur due to lack of habitat
	Northern Giant-Petrel	Vulnerable	Unlikely to occur due to lack of habitat
	Shy Albatross, Tasmanian Shy Albatross	Vulnerable	Unlikely to occur due to lack of habitat

MNES	Species identified with Protected Matters Search tool	Status	Likelihood to occur within Proposal area (ENV 2010b)
Insects	Graceful Sun-moth	Endangered	Occurs within Proposal area, however, regional population is unlikely to be impacted
Mammals	Blue Whale	Endangered , Migratory	Unlikely to occur, due to nature of proposed action
	Chuditch, Western Quoll	Vulnerable	Unlikely to occur, due to lack of appropriate habitat
	Southern Right Whale	Endangered, Migratory	Unlikely to occur, due to nature of proposed action
	Humpback Whale	Vulnerable, Migratory	Unlikely to occur, due to nature of proposed action
	Australian Sea-lion	Endangered, listed	Unlikely to occur, due to nature of proposed action
	Red-tailed Phascogale	Endangered	Unlikely to occur due to lack of habitat
	Quokka	Vulnerable	Unlikely to occur due to lack of habitat
Reptiles	Loggerhead Turtle	Endangered	Unlikely to occur, due to the nature of the Proposal area
	Green Turtle	Vulnerable	Unlikely to occur, due to the nature of the Proposal area
	Leatherback Turtle, Leathery Turtle, Luth	Endangered	Unlikely to occur, due to the nature of the Proposal area
Sharks	Grey Nurse Shark (west coast population)	Vulnerable (migratory)	Unlikely to occur, due to the nature of the Proposal area
	Grey White Shark	Vulnerable (migratory)	Unlikely to occur, due to the nature of the Proposal area
	Whale Shark	Vulnerable (migratory)	Unlikely to occur, due to the nature of the Proposal area
Plants	Centrolepis caespitosa	Endangered	Unlikely to occur, as targeted searches for conservation significant species (ENV 2010) did not return results for this species
Migratory terrestrial species	White-bellied Sea-Eagle	Migratory	Unlikely to occur in the Proposal area
	Rainbow Bee-eater	Migratory	Located outside the Proposal area near Lake Richmond. Impacts are unlikely as direct impacts will not occur on Lake Richmond.
Migratory wetland species	Great Egret, White Egret	Migratory (and marine)	May forage at Lake Richmond. Impacts are unlikely as direct impacts will not occur on Lake Richmond.
	Cattle Egret	Migratory (and marine)	May forage at Lake Richmond. Impacts are unlikely as direct impacts will not occur on Lake Richmond.
Migratory Marine Birds	Fork-tailed Swift	Migratory	Impacts are unlikely as the species forages in high airspace.
Migratory Marine Species – mammals	Bryde's Whale	Migratory	Unlikely to occur, due to the nature of the Proposal area
	Pygmy Right Whale	Migratory	Unlikely to occur, due to the nature of the Proposal area
	Dusky Dolphin	Migratory	Unlikely to occur, due to the nature of the Proposal area
	Killer Whale, Orca	Migratory	Unlikely to occur, due to the nature of the Proposal area

MNES	Species identified with Protected Matters Search tool	Status	Likelihood to occur within Proposal area (ENV 2010b)
Mammals	New Zealand Fur-seal	Listed	Unlikely to occur within Proposal area, most likely to occur on offshore Garden Island approximately 3.5 km from proposed action
Ray-finned fishes	Southern Pygmy Pipehorse	Listed	Unlikely to occur within Mangles Bay however is most likely to occur within Shoalwater Islands Marine Park, on the southern side of Point Peron. Unlikely to be impacted from proposed action.
	Gale's Pipefish	Listed	
	Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish	Listed	
	Western Spiny Seahorse, Narrow-bellied Seahorse	Listed	
	Short-head Seahorse, Short-snouted Seahorse	Listed	
	West Australian Seahorse	Listed	
	Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish	Listed	
	Australian Smooth Pipefish, Smooth Pipefish	Listed	
	Prophet's Pipefish	Listed	
	Javelin Pipefish	Listed	
	Sawtooth Pipefish	Listed	
	Western Crested Pipefish	Listed	
	Bonyhead Pipefish, Bony-headed Pipefish	Listed	
	Leafy Seadragon	Listed	
	Common Seadragon, Weedy Seadragon	Listed	
	Pugnose Pipefish, Pug-nosed Pipefish	Listed	
	Gunther's Pipehorse, Indonesian Pipefish	Listed	
	Spotted Pipefish, Gulf Pipefish	Listed	
	Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish	Listed	
	Hairy Pipefish	Listed	
	Mother-of-pearl Pipefish	Listed	
	Port Phillip Pipefish	Listed	
	Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish	Listed	
Reptiles	Spectacled Seasnake	Listed	Unknown. May occur within Shoalwater Islands Marine Park, southern side of Point Peron
Whales and other cetaceans	Minke Whale	Listed	Unlikely to occur, due to the nature of the Proposal area

5.11.2 Overview of existing information

Investigations are currently underway to determine the potential indirect impacts to the Threatened Ecological Communities of Lake Richmond through hydrogeological investigations and modelling in the area. These investigations are described in Section 5.1.

A Graceful Sun Moth survey was conducted in March 2010 (ENV 2010c provided in Appendix 12) and a *Lomandra maritama* (Graceful Sun Moth habitat) survey of the Proposal area and surrounding vegetation was undertaken in April 2010. One Graceful Sun Moth was recorded within the Proposal area and two were recorded in the vegetation to the south (Figure 3).

No other investigations specific to MNES have been conducted.

5.11.3 Assessment framework

MNES are protected under the Australian Government EPBC Act.

The EPBC Act Guidelines on assessing the significance of impacts to matters of National Environmental Significance (DEWHA 2010) will form the basis of the assessment in the PER.

5.11.4 Potential sources of impact to be managed

The following aspects of the Proposal may affect MNES:

- **clearing** for the development will result in clearing of Graceful Sun Moth habitat
- **hydrological changes as a result of the inland marina** may result in the inland migration of the salt water interface and have potential impacts on the water quality in Lake Richmond and the thrombolites and Holocene dune swale TECs.

5.11.5 Further studies and investigations

The investigation and modelling of potential hydrological effects on groundwater and Lake Richmond is described in Section 5.2.6.

An additional habitat survey is proposed to accurately map the distribution and density of the *Lomandra maritama* species in the Proposal area and surrounds. A follow up survey of the Graceful Sun Moth population on Cape Peron will also be undertaken in March 2011.

5.11.6 Information to be provided in the PER

The PER will include the following information:

- a comprehensive section on MNES, which discusses the impacts of the project for these matters
- the impact of habitat clearing on the listed threatened species (terrestrial) and the measures that will be put in place to mitigate or reduce this impact
- assessment of potential impact from construction and operation on the Lake Richmond TECs including the results of surface water and groundwater investigations and modelling
- assessment of the potential impacts on all MNES that have been identified by SEWPaC as controlling provisions (including listed migratory birds, turtles, whales, other cetaceans and the Australian Sea-Lion) based on the studies outlined in Sections 5.5 and 5.7
- demonstration that there are no potential impacts on Ramsar wetlands.

5.12 ROAD TRAFFIC

5.12.1 Introduction

The proposed Mangles Bay Marina and Tourist Precinct will increase the volume of traffic on roads connected with it. Memorial Drive, a local access road within the Proposal area that connects to Safety Bay Road will be upgraded and realigned as part of the development. The road will be redesigned to meet current urban road standards and increased traffic volumes resulting from the Proposal. A previous study (Riley Consulting 2005) indicated that increases in volume could be as high as 181% for Memorial Drive. The proponent would seek to ensure that traffic management within the proposed development worked well with the existing road network by working with the relevant planning and transport authorities.

5.12.2 Overview of existing information

A traffic assessment was conducted by Riley Consulting (2005) for the preparation of the 2006 SER. The following material has been derived from that study and traffic numbers will have increased since that assessment.

Local roads of significance within proximity to the proposed development include:

- **Safety Bay Road** (which runs in Hymus Street at the Parkin Street intersection): the road runs north- south to form the eastern side of the project area; current traffic flow is between 8000 to 9000 vehicles per day
- **Parkin Street:** joins Safety Bay Road from the east; current traffic flow is around 6200 vehicles per day
- **Esplanade:** provides a continuation of Hymus Street eastwards along the foreshore; only historical traffic flow data is available (around 3000 vehicles per day in 1992) however, traffic flow is expected to be higher now
- **Memorial Drive:** is a local access road within the project area that connects to Safety Bay Road; current traffic flow is around 1300 vehicles per day
- **Point Peron Road:** is a local access road within the project area that connects to Hymus Street; current traffic flow is around 4600 vehicles per day.

HMAS Stirling Naval Base is located on Garden Island and a causeway links Cape Peron to the island for naval personnel access requirements. Access to Garden Island via the causeway is restricted and is not available to the general public. It is estimated that up to 3000 vehicles per day access Garden Island with peak traffic flow times occurring between 0600 – 0800 hours and 1500 – 1700 hours Monday to Friday. Point Peron Road provides the only entry point to the causeway. Although the traffic loads in the area are within the design limitations for an entire day, significant problems do occur due to car stacking on local distributor roads during the peak morning and afternoon periods resulting in existing community concern about the amount of traffic on these roads.

5.12.3 Assessment framework

The following management objective is considered relevant to this project:

- to ensure that the increase in traffic resulting from the Proposal does not adversely impact on the amenity of social surroundings or increase the risk to local public safety.

5.12.4 Potential sources of impact

The proposed development would increase the volume of traffic flow along roads in its proximity. The increase in traffic may impact on residents and users of the area with regard to:

- **public safety issues** (e.g. road traffic and pedestrian safety)
- **reduction in amenity** (e.g. increase in noise emissions from vehicles).

The proposed development would increase traffic flow on some of the main roads within the vicinity of the development, however flows are expected to be within the current capacity of the roads, so would not pose a significant traffic hazard. The traffic increases on the smaller residential roads would not be expected to be noticeable.

5.12.5 Further studies

The results of the 2005 study and any available traffic data from the City of Rockingham will be re-assessed and, if suitable to the current Proposal, will be used to develop a draft Traffic Management Plan, for inclusion in the PER.

5.13 CONTAMINATED SITES AND ACID SULPHATE SOILS

5.13.1 Introduction and overview of existing information

A preliminary site investigation (PSI) has been undertaken by Strategen (2010) over the Proposal area. The results of the investigation at the site show that no soil contamination was detected in samples taken from part of the site associated with historical land use activities. Although groundwater was not tested in this investigation, soils samples indicate that there is no reason to suspect groundwater contamination.

The investigation did however identify three small localised locations where soil contamination may have occurred within the Mangles Bay Fishing Boat Club and the Cruising Yacht Club. No potential contaminating land uses exist over the majority of the Proposal area south of Point Peron Rd.

Geotechnical investigations undertaken by GHD (2010) included sampling for acid sulphate soils. A total of 42 samples were submitted for analysis, values for pH ranged from 7.8 to 9 with values of pH_{FOX} ranging from 6.2 to 6.7. The change in pH ranged from 1.3 to 2.7. The results suggest that the majority of soil samples contain neutral to alkaline soils with a significant amount of acid neutralising capacity.

To confirm minimal risk of ASS and identify net acidity, Suspension Peroxide Oxidation Combined Acidity and Sulphate (SPOCAS) was conducted on 19 of the samples. No exceedances of DEC reporting criteria were recorded (Strategen 2010).

5.13.2 Assessment framework

Contamination is addressed under the *Contaminated Sites Act 2003.*

Relevant guidance on contaminated sites investigations is provided in the DEC Contaminated Sites Management Series.

5.13.3 Potential sources of impact

The Proposal will involve ground disturbance and dewatering which could expose acid sulphate soils. The Proposal also involves a change of land use and investigations are required to ensure that the soil is suitable for the intended land use.

5.13.4 Further studies

The PSI undertaken by Strategen (2010) identified three potentially contaminated areas within the Fishing Club/Yacht Club areas. In order to confirm the extent of potential extent of contamination and remediation measures a detailed site investigation (DSI) will be undertaken.

Further advice will also be sought from the contaminated sites branch of the Department of Environment and Conservation to determine the appropriate management measures for the proposed land based disposal of dredge spoil during the construction stage of the Proposal.

5.14 CONSTRUCTION IMPACTS (DUST, NOISE AND WASTE)

No long term discharge of pollutants will result from this Proposal. However, short term emissions during the construction phase of the project will occur including noise, vibration, odour and dust.

The Proposal will be subject to *Environmental Protection* (Noise) *Regulations 1997* during the construction phase of the project. However, under Regulation 13, construction noise from construction sites are not required to meet the assigned levels, provided certain conditions are met. The Proponent will ensure that:

- construction equipment is the quietest reasonably available
- construction work will be carried out in accordance with Section 6 of the Australian Standards 2436-1981 "Guide to noise control on construction, maintenance and demolition sites"
- screens, enclosures and other noise mitigating devices shall be used where there is a risk of unacceptable noise levels to the community.

Solid wastes are expected to occur as a result of excavation of the marina and dredging the channel of the Proposal. Dredge spoil is expected to be settled and the water infiltrated on-site via infiltration ponds and where required solid material will be disposed off-site. Any sand suitable for use as fill from the dredge spoil will be used on site, however as the dredging is relatively shallow it is expected that the majority of the dredge spoil (maximum 50 000 m^3) will have organic content and will need to be disposed of off-site.

The excavated material for the marina is expected to be sand and will be largely re-used on site as fill. All material will be tested for geotechnical stability and any material that contains organic matter will be disposed of off-site.

Dewatering will be required to allow for the dry excavation of the marina. Dewatering will occur in stages totalling up to 18 months during the construction of the Proposal. Dewatering will be undertaken using dewatering spears, with excess water returned to the groundwater system via infiltration basins located within the Proposal area. Excess water will be settled and treated where necessary via a series of infiltration basins and settlement ponds, lined appropriately with geofabric, as part of routine dewatering management requirements.

No further studies are required in regards to construction impacts, although these impacts will be considered in the PER and in consultation for the Proposal. The PER will include details of the key management measures to be implemented during the construction phase(s) of the Proposal.

6. COMMUNITY AND STAKEHOLDER CONSULTATION PROGRAM

6.1 OVERVIEW

This Proposal has built on the outcomes of formal advice and inputs from the community and specialised stakeholders. Much of this input was generated during the 2005 – 2006 consultation for the Cape Peron SER (Strategen 2006).

In the development of the current Proposal, the Proponent has undertaken consultation with a number of government agencies, including the EPA, and has also commenced discussions with local fishing and boating clubs.

The following section summarises the consultation and outcomes to date, including consultation undertaken as part of the 2006 SER, owing to its relevance to the current Proposal.

6.2 PREVIOUS CONSULTATION

6.2.1 Consultation process

The consultation process for the development of a concept plan for a marina based tourist precinct in 2005 and 2005 focussed on an active community engagement approach in developing concept options. A high level of interest was shown in the concept plan with more than 800 community members from a broad range of stakeholder groups participating in the process. The consultation process included public forums, establishment of a Stakeholder Reference Group, public advertising, project website, information hotline and various individual stakeholder meetings including Aboriginal representatives.

The outcomes of the stakeholder consultation process are summarised in the SER (Strategen 2006) and the Response to Submissions included as an appendix of Bulletin 1237.

Key agencies, NGOs and other stakeholder groups consulted at that time included:

- Royal Australian Navy and Corporate Support Infrastructure Group
- Environmental Protection Authority Services Unit
- Department of Environment
- Department of Conservation and Land Management
- Cockburn Sound Management Council (CSMC)
- Department for Planning and Infrastructure and the WA Planning Commission
- Public Transport Authority
- Main Roads WA
- Water Corporation
- City of Rockingham
- Naragebup Rockingham Regional Environment Centre
- Recreation camp leasees (e.g. Returned and Services League, Apex)
- Mangles Bay foreshore user groups (e.g. Mangles Bay Fishing Club)
- Aboriginal groups

- Local residents and interest groups
- Local business operators
- Local sport and recreation groups
- Boat owners and mooring owners
- Recreational beach users.

As described in section 4, the Proponent has used the outcomes of the previous consultation to identify and help identify the relevant environmental factors for assessment in the PER.

6.3 CURRENT CONSULTATION

In September 2009, Premier Colin Barnett announced that the State Government would progress the marina project at Mangles Bay and commence the environmental impact assessment process. Once Cedar Woods was appointed as the proponent for the Project, consultation commenced with the City of Rockingham and key government agencies including the OEPA and the Department of Planning. The Proponent has also met with the local fishing and boating clubs and formulated the Boating Clubs User Group.

The Proponent is commencing a broader stakeholder engagement process with a Stakeholder Reference Group formed to include local user groups, community groups and adjacent leaseholders.

A summary of the key stakeholder consultation undertaken to date for this is include in Table 8.

Table 8 Key stakeholder consultation undertaken for this Proposal to date

Stakeholder	Outcome of consultation
City of Rockingham	Preliminary comments into marina design. Advice provided to the strategy for obtaining planning approval.
Department of Planning	MRS amendment to be initiated subsequent to the s.38 environmental approval process.
Department of Transport	Preliminary comments to marina design and suggestions for the marina management.
Office of EPA	Confirmation of the assessment process to the proposal.
Mangles Bay Fishing Club	Inclusion of the clubs comments into the planning of the marina and club site facility.
Rockingham Offshore Fishing Club	Inclusion of the clubs comments into the planning of the marina and club site facility.
The Cruising Yacht Club of WA	Inclusion of the clubs comments into the planning of the marina and club site facility.
Rockingham Volunteer Sea Rescue Group	Inclusion of the clubs comments into the planning of the marina and club site facility.
RSL Rockingham	Investigate the realignment of Memorial Drive to retain the RSL Hall
Cockburn Sound Management Council	Preliminary comments on Proposal and advice on marine water quality within Cockburn Sound.

7. PROJECT AND ASSESSMENT SCHEDULE

The Proponent is expecting to release its PER for the 12 week public review period commencing in July 2011, following preliminary review by the OEPA (Table 9). The dates shown in the table are targets and are based on EPA guidelines (2010). However, the timeframe may be affected by the results of investigations, consultation or appeals. The EPA also acknowledges that complex assessments may require additional time.

The Proponent anticipates that, following the release of the WA Minister's decision in February 2012, the Commonwealth Minister for the Environment, Heritage and The Arts may issue a decision under the EPBC Act by early May 2012.

Table 9 Project and assessment schedule

Project stage	Timing
Undertaking additional environmental surveys/investigations	Underway
Consultation program	Underway
Submission of draft PER to OEPA	April 2011
Public Review of PER	July to September 2011
Proponent's response to submissions	October to November 2011
EPA assessment and report	November 2011 to January 2012
Two week appeal period on OEPA's report and recommendations	February 2012 to March 2012
WA Minister decision	March 2012 to April 2012
Federal Minister decision	April 2012

8. PEER REVIEW

Peer review of the groundwater modelling and hydrodynamic modelling is proposed.

The peer review of the groundwater modelling will include review of the conceptual hydrological model, modelling methodology, calibrations, model outputs and conclusions. The groundwater peer reviewer has not yet been identified but is likely to include appropriate expertise from ERM, as they are undertaking the groundwater assessment for the pipeline re-alignment for the Water Corporation and will also be able to review the investigations in this context.

The peer review of the hydrodynamic and marine water quality modelling will include review of model inputs, modelling methodology, calibration, outputs and conclusions. The proposed peer reviewer is Dr Jason Antenucci, Deputy Director of the Centre for Water Research, University of Western Australia.

9. STUDY TEAM

The study team for the Proposal is outlined in Table 10.

Table 10 Proposal study team

Company and key contact	Role	Expertise
Strategen – Lisa Adams	Lead environmental consultant, preparation of the PER	Environmental impact assessment and approvals advice
Oceanica – Dr Karen Hillman	Undertake the marine impact assessment	Marine impact assessment, management and monitoring
Asia-Pacific Applied Science Associates – Murray Burling	Undertake hydrodynamic and water quality modelling	Hydrodynamic modelling, waves, sediment transport and water quality
JFA Consultants – Brad Saunders	Undertake the coastal processes assessment, design of marina entrance and management	Coastal engineering, physical and numerical coastal modelling
ENV – Teresa Gepp	Have largely completed the terrestrial flora and fauna investigations for the site.	Terrestrial flora and fauna surveys and assessment
Subterranean Ecology – Dr Erich Volschenk	Desktop review of subterranean fauna, targeted surveys for short range endemic species	Short range endemic invertebrate surveys and assessment, subterranean fauna surveys, monitoring and research
MWH – Gary Clark	Groundwater investigations and modelling	Hydrogeological investigations and modelling
TABEC – Barry Trewin	Lead engineer, including design of surface water drainage system within the development	Engineering design and implementation of urban development
TBB – Samantha Thompson	Project planning and the planning approvals process	Urban planning

The consultants undertaking the contamination investigations and the traffic investigations are yet to be determined.

10. ACRONYMS AND SHORT TITLES

Acronym	Definition
µS/cm	MicroSiemens per centimetre
ANZECC/ARMCANZ	Australian and New Zealand Environment and Conservation Council / Agriculture and Resource Management Council of Australia and New Zealand
ASS	Acid Sulphate Soil
BFPA	Bush Forever Protection Area
CALM	Department of Conservation and Land Management
CAMBA	China Australia Migratory Bird Agreement
Cedar Woods	Cedar Woods Properties Limited
Cockburn Sound SEP	State Environmental (Cockburn Sound) Policy 2005
CSMC	Cockburn Sound Management Council
DEC	Department of Environment and Conservation
DIA	Department of Indigenous Affairs
DIN	Dissolved Inorganic Nitrogen
DSI	Detailed Site Investigation
EC	Electrical Conductivity
EP Act	Environmental Protection Act 1986
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPP	Environmental Protection Policy
EQC	Environmental Quality Criteria
EQG	Environmental Quality Guidelines
EQO	Environmental Quality Objectives
EQS	Environmental Quality Standards
ESD	Environmental Scoping Document
EV	Environmental Values
FCT	Floristic Community Types
ha	Hectares
JAMBA	Japan Australia Migratory Bird Agreement
LEP	Level of Ecological Protection
m3	Cubic meters
m3/yr	Cubic metres per year
mAHD	Metres above Australian Height Datum
MNES	Matters of National Environmental Significance
NTU?	Nephelometric Turbidity Units
PER	Public Environmental Review
PSI	Preliminary Site Investigation
SER	Strategic Environmental Review
SPOCAS	Suspension Peroxide Oxidation Combined Acidity and Sulphate
SRE	Short-range Endemics
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
TRH	Total Recoverable Hydrocarbons
WA	Western Australia

11. REFERENCES

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LIST OF APPENDICES

(Appendices contained on CD-ROM found inside the back cover of this report)

1. Project design objectives
2. 2006 Strategic Environmental Review
3. Cape Peron Groundwater Study Interim Report
4. Cape Peron Surface Water Study Interim Report
5. Cape Peron fauna assessment (ENV 2010b)
6. Cape Peron vegetation assessment (ENV 2010a)
7. Coastal assessment (JFA Consultants 2010)
8. Seagrass transplantation (Oceanica 2010)
9. Short range endemic terrestrial invertebrates desktop and habitat assessment (Subterranean Ecology 2010a)
10. Stygofauna desktop and habitat assessment (Subterranean Ecology 2010b)
11. Troglofauna desktop and habitat assessment (Subterranean Ecology 2010c)
12. Cape Peron Graceful Sun Moth survey (ENV 2010c)
13. Bennett Flora and Vegetation Report (2005)