Australian Government

Department of Sustainability, Environment,
Water, Population and Communities

East Coast Cape Barren Island Lagoons

Ramsar Site

Ecological Character Description

Image credits: Entura

Introductory Notes

This Ecological Character Description (ECD Publication) has been prepared in accordance with the *National Framework and Guidance for Describing the Ecological Character of Australia's Ramsar Wetlands* (National Framework) (Department of the Environment, Water, Heritage and the Arts, 2008).

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) prohibits actions that are likely to have a significant impact on the ecological character of a Ramsar wetland unless the Commonwealth Environment Minister has approved the taking of the action, or some other provision in the EPBC Act allows the action to be taken. The information in this ECD Publication does not indicate any commitment to a particular course of action, policy position or decision. Further, it does not provide assessment of any particular action within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), nor replace the role of the Minister or his delegate in making an informed decision to approve an action.

This ECD Publication is provided without prejudice to any final decision by the Administrative Authority for Ramsar in Australia on change in ecological character in accordance with the requirements of Article 3.2 of the Ramsar Convention.

Disclaimer

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Note: There may be differences in the type of information contained in this ECD publication, to those of other Ramsar wetlands.

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Executive summary

East Coast Cape Barren Island Lagoons (ECCBIL) Ramsar site is a complex of freshwater, brackish, saline and sometimes hypersaline lagoons, wetlands and estuaries. They have been formed due to a dune system which has been slowly developing in an easterly direction, leaving shallow sandy soils, depressions and intermittently flowing water courses. Cape Barren Island lies in Bass Strait and is part of the Furneaux Group, about 50 kilometres from Cape Portland, the north-eastern tip of Tasmania and has an area of 460 km^2. The few residents of Cape Barren Island mostly live on the north-western corner (The Corner) of the island. Dense scrub on hills in the centre of the island allows only very limited access to the eastern coast. Freehold title to part of Cape Barren Island was vested in the Aboriginal Land Council of Tasmania, on behalf of the Tasmanian Aboriginal community, under the *Aboriginal Lands Act 1995* (Tasmania). A second land transfer in 2005 placed most of the Island, including the ECCBIL, under Aboriginal ownership. The local Aboriginal community organisation, the Cape Barren Island Aboriginal Association (CBIAA) are the land managers for the site.

At the time of Ramsar listing in 1982, the ECCBIL had not been impacted by humans or other sources of disturbance, providing an environment where the dynamics of wetland processes were sustained. The lagoons provide habitat for a wide range of vegetation communities and flora species. The lagoons may be important for birds as the extensive undisturbed shorelines provide potential habitat and nesting sites for shorebirds, waders and other birdlife. However there is insufficient data at present to evaluate the significance of ECCBIL for birds.

This Ecological Character Description (ECD) is based upon limited data sources since the very isolation of the ECCBIL also has constrained access to the site for researchers and wildlife observers. The ECD draws upon a geomorphic analysis of the site using air photo analysis coupled with available information on wetland communities. The air photo analysis used vegetation types as surrogates to identify the geomorphic character across the site. This in turn has enabled a clearer picture to emerge of the important factors which sustain the ecology of the site and hence its Ramsar values.

Ramsar criteria

The values present in the ECCBIL have been re-assessed against the current Ramsar criteria in the context of the Tasmanian Drainage Division and IMCRA Southeast Shelf Transition biogeographic regions as part of the preparation of this ECD. The ECCBIL currently meets criterion as described below.

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

The diverse complex of wetlands in the east of Cape Barren Island lies in a prograding sandy plain overlaying Devonian granite. Some 100 separate wetlands, mostly of small size with variable degrees of hydration, stretch from the northern to southern ends of the eastern coast of Cape Barren Island. The main wetlands types present in the ECCBIL include

F – Estuarine waters; permanent water of estuaries and estuarine systems of deltas

H – Intertidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; tidal brackish and freshwater marshes

J – Coastal brackish/saline lagoons; brackish to saline lagoons with at least one relatively narrow connection to the sea

K – Coastal freshwater lagoons; includes freshwater delta lagoons.

This suite of wetlands is representative of the process of progradation of coasts, a process that is uncommon in southern Australia. It is the most extensive example of such a system in the Tasmanian Drainage Division covering over 800 hectares and includes eight Ramsar wetland types. Its remoteness means that it is a largely natural system and is in near natural condition compared to other coastal wetlands. Most other extensive wetland ecosystems in Tasmania have been the subject of significant decline and large areas have been lost and most others have suffered significant alteration in some way (Harwood 1991, Kirkpatrick and Tyler 1988, Kirkpatrick and Harwood 1981). This naturalness makes it unique within Tasmania and the South Eastern seaboard of Australia.

Whilst dune barred lagoons are reasonably common (particularly on King, Flinders and Cape Barren Islands) it is now very rare to find examples of deflation basins in good condition within the bioregion, particularly with intact vegetation. Most have been cleared, drained or otherwise altered from natural and geomorphic processes of formation have been severely disrupted.

The lagoon in the south end of the Ramsar site near Jamiesons Bay is the best example of a deflation basin in the ECCBIL. Other wetlands further north are polygenetic, they are a mixture of dune (or beach-ridge) barred lagoons and deflation basins. All are good representative examples because of their near natural condition. (Ian Houshold pers. comm.).

It is considered that this criterion is still met.

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered or critically endangered species or threatened ecological communities.

No wetland dependent nationally listed species or communities have been identified as occurring within the ECCBIL. It is considered that this criterion is not met.

Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

A large range of Tasmanian wetland vegetation types occurs within the site. The wetlands are important for maintaining the biological diversity of the bioregion.

It is considered that this criterion is still met.

Criteria 4-9 It was considered that ECCBIL did not meet these criteria.

Ecosystem components and processes

A summary of the components and processes at ECCBIL at time of listing are provided in Table E.1.

Table E.1 Summary of the components and processes at time of listing in 1982

Component/Process	Summary Description
Geomorphology	• Active process of beach progradation following the Holocene marine transgression, strongly related to successional stages in wetland and other vegetation communities.
Hydrology	• Dendritic drainage channels flow into a series of deflation plains • Impounded lagoons lie behind parallel dunes • Some lagoons are connected to fresh water drainage channels and deflation features that are subject to varying inundation.
Water Quality	• Relatively pristine site • Varying salinities from fresh to hypersaline.
Flora	• Good representation of diverse array of wetland vegetation types and floristic communities • Driven largely by length of inundation and degree of salinity • Important representation of regional biodiversity.
Fauna	• Supports both freshwater and estuarine faunal associations, however these are poorly documented • Habitat for listed migratory bird species.

Ecosystem benefits and services

A number of key benefits and services including regulating, cultural and supporting services are provided by the ECCBIL and are summarised in Table E.2.

Table E.2 Key regulating, cultural and supporting services provided by ECCBIL and their related components and processes

Ecosystem benefit or service	Description	Related component or process
Regulating service		
Coastal Shoreline Stabilisation	Vegetation associated with the wetlands plays an important role in stabilising the highly dynamic coastal system.	Flora Geomorphology, including sediment deposition and retention of soils Hydrology Water quality, including groundwater recharge and discharge.

Ecosystem benefit or service	Description	Related component or process
Cultural service		
Spiritual and Inspirational	ECCBIL has a significant place in recent history of the Tasmanian Aboriginal community Cultural Heritage and is of spiritual and religious significance	Geomorphology Hydrology Flora Fauna.
Supporting service		
Natural or near-natural wetland ecosystems	ECCBIL is a regional example of a near natural coastal wetland	Flora Fauna Geomorphology Hydrology Water quality.
Threatened wetland species, habitats and ecosystems	ECCBIL supports rare plant species and communities at the limit of their ranges.	Flora Fauna Geomorphology Hydrology Water quality.

Critical ecosystem components, processes, benefits and services

Critical ecosystem components, processes, benefits and services are those that strongly influence the ecological character of the site. They are critical because:

- they are important determinants of the sites unique character;
- they are important for supporting the Ramsar criteria under which the site was listed;
- change is reasonably likely to occur over the short or medium term (<100 years); or
- if change occurs to them they will cause significant negative consequences.

The critical components of ECCBIL are:

- **Geomorphology and hydrology**: The geomorphic conditions and associated hydrology of the site have resulted in a unique diversity and range of wetland types. It is the most extensive example of such a system in the Tasmanian Drainage Division biogeographic region.
- **Vegetation types**: The geomorphic and hydrological conditions associated with the ECCBIL Ramsar site have created a range of habitat conditions, resulting in a mosaic of vegetation communities. Thirteen different Tasmanian wetland vegetation communities were found within the ECCBIL in the Kirkpatrick and Harwood (1981) survey. These correspond to six TASVEG vegetation communities. In addition, sixteen plant species have been recorded within the site that are threatened in Tasmania.

While there is some anecdotal evidence that ECCBIL is important for shorebirds, there is insufficient data to evaluate whether they form a critical component. Due to the paucity of data for ECCBIL, there may be critical components, process or services of which we are currently unaware.

The critical ecosystem service is:

- Natural or near-natural wetland ecosystem: ECCBIL is an example of a near natural coastal wetland which contains a suite of different types of wetlands. The dynamics of these vegetation types is maintained as there are no infrastructure developments within the boundaries of the site. Due to their remoteness the ECCBIL wetlands lack large scale disturbance and make them unique within the Tasmanian Drainage Division. All six TASVEG wetland types (mapping units) are found within the site with a total of thirteen separate floristic wetland communities.

Threats to ecological character

ECCBIL retains its ecological character by virtue of the lack of disturbance to its distinctive geomorphology and hydrology. Any significant loss of integrity of the structural and vegetative mosaics that can be attributable to anthropogenic causes may signal a potential threat. The major threatening activities identified for ECCBIL are presented in Table E.3.

Table E.3 Major threatening activities identified for ECCBIL

Actual or likely threat of threatening activities	Potential impact(s) to wetland components, processes and/ or services
Fire (increase in intensity and frequency)	• Removal of the vegetation and opening the underlying sediments to destabilisation by wind • Increased fire frequency can cause changes in floristics to more fire-tolerant species • Loss of habitat, flora and fauna.
Exotic species (introduction and spread of invasive species such as rabbits, feral turkeys, thistle, marram grass and gorse.	• Competition with native flora and fauna • Reduced habitat (i.e. choking of wetlands, changes in vegetation structure) • Loss of native species
Pathogens	• *Phytophthora cinnamomi* can cause changes to floristics and structure of vegetation communities and potentially result in changes to wetland dynamics • Chytrid fungus *Batrachochytrium dendrobatidis* causes death in frogs it infects
Vehicle access (particularly four wheel drives)	• Erosion and increased run off • Increased turbidity • Disturbance of native species • Loss of habitat • Loss of native species Introduction or spread of weed propagules and pathogens such as *Phytophthora cinnamomi*

Actual or likely threat of threatening activities	Potential impact(s) to wetland components, processes and/ or services
Grazing	• Increased sediment deposition and turbidity (run off) • Nutrient enrichment • Establishment of weeds • Reduced habitat quality • Change in floristics
Climate change (change in sea level, temperature and rainfall)	• May influence wetland physical and chemical processes, groundwater discharge, the diversity of wetland types, wetland biology • Change in the distribution and abundance of flora and fauna • Change in the lifecycles of fauna (e.g. waterbird breeding, macroinvertebrates)

Limits of acceptable change

It is very difficult, given the paucity of data about many of the components and processes of the ECCBIL, to set specific limits of acceptable change (LACs). ECCBIL is characterised by two defining descriptors: its very low level of human-induced disturbance, and the diversity of wetland forms and processes captured within its boundary on the coastal plain. If there are significant human-induced changes to either of these descriptors, the change should be considered unacceptable. These have been identified in Table E4.

Table E4 Limits of acceptable change

Critical ecological components, processes and services	Baseline condition and range of natural variation where known	Limits of acceptable change (based on baseline and natural variability)	Basis of LAC	Level of confidence
Critical component and process: **Geomorphology and hydrology** Critical service: **Natural or near-natural wetland ecosystem**	There is a diversity and range of Ramsar wetland types which are defined by their geomorphology and hydrology. There is an absence of information relating to the variability in extent and types of wetland around the time of listing	The areal extent of Ramsar wetland types[1] does not change by ±20%, i.e. • estuarine waters (F) ± 20% from 200 hectares • intertidal marshes (H) ± 20% from 44 hectares • coastal brackish/saline lagoons (J and K) ± 20% from 375 hectares • intertidal mud sand or salt flats (G) ± 20% from 55 hectares.	Based on aerial photograph interpretation and geomorphological mapping by Mowling (2007).	Low: Limited confidence in estimates of areal extent. Limited data on changes to geomorphology, hydrology and vegetation types since time of listing (refer to Chapter 7 of ECD).
Critical component and process: **Hydrology** Critical service: **Natural or near-natural wetland ecosystem**	Hydrology as a critical component and service is linked to the geomorphology of the wetland.	As above, this LAC is linked to the geomorphology of the wetland.	As above	As above

[1] Does not include the Ramsar wetland types − rocky shores (D), sand shingle or pebble shores (E), or seasonal/intermittent/irregular/rivers/streams/creeks (N) because the coastal land forms (D) and waterways (N) are natural formations which will not change significantly without human intervention whereas coastal shorelines (E) are likely to have a high natural variability depending on weather conditions (e.g. storm events).

Critical ecological components, processes and services	Baseline condition and range of natural variation where known	Limits of acceptable change (based on baseline and natural variability)	Basis of LAC	Level of confidence
Critical component **Vegetation types** Critical service: **Natural or near-natural wetland ecosystem**	Thirteen different Tasmanian wetland vegetation communities were identified within ECCBIL which corresponds to six TASVEG communities. Sixteen flora species have been recorded on site that are threatened in Tasmania. Vegetation succession is an integral component of the ECCBIL wetlands such that some changes in vegetation communities are normal.	Maintenance of the extant TASVEG vegetation communities on site at time of listing i.e. • lacustrine herbland (AHL) • freshwater aquatic sedgeland and rushland (ASF) • freshwater aquatic herbland (AHF) • saline aquatic herbland (AHS) • saline sedgeland/rushland (ARS) • succulent saline herbland (ASS).	Based on the limited available vegetation data i.e. TASVEG mapping, the Kirkpatrick and Harwood (1981) survey and expert opinion.	Low: Not confident in the data and not confident that this will represent a change in ecological character. Limited information about the variability in extent and condition of the vegetation types since the time of listing is available. Difficult to describe baseline condition and variability (refer to Chapter 7 of ECD).

Current ecological condition

The limited information available on ECCBIL makes an assessment of changes to the ecological character difficult. There has been large fires through the area since the time of listing but little data is available either at the time of listing or more recently to be able to determine changes since listing. However, based on the remoteness and relatively undisturbed nature of the site, it is considered that the site has largely remained unchanged since the time of listing in 1982 and has retained its ecological character.

Knowledge gaps

Information about ECCBIL is very limited. There have been no systematic surveys of components of the wetland ecosystems other than the survey of 24 wetlands. Information on the biota of the wetlands is limited to two studies confined to a few sites (Rolfe et al. 2001; Walsh et al. 2001, Hirst et al. 2006) and collation of bird records. Knowledge gaps include:

- Accurate information regarding soil types and geomorphic features including dune, estuary, lagoon and stream form, material and process mapping.
- The extent of, and any damage caused by, grazing and human activity (e.g. 4WDs).
- Hydrological information associated with wetland types.
- Accurate vegetation mapping and detailed inventory of vascular and non-vascular flora, including mapping of the distribution of threatened species and the microflora of the wetlands.
- Detailed inventory of fauna (mammals, reptiles, frogs and fish), including mapping the distribution of threatened vertebrate and invertebrate fauna and birds (migratory and other) utilising the site.
- Further details of Aboriginal heritage values.
- The fire history of the area.

Monitoring needs

The monitoring recommendations are designed to detect change in ecological character, monitor threats, and fill the knowledge gaps. Aerial photography and mapping of the wetlands will provide a baseline against which change in wetland type can be monitored. An analysis of aerial images at ten-yearly intervals should be sufficient to provide evidence of change. However, more frequent mapping may be required should there be indications that potential damaging processes are occurring.

Monitoring requirements include:

- Ground-truthing of vegetation mapping to confirm the distribution of vegetation communities and important species (this will also enable the monitoring of changes from this baseline).
- Determining the impact of human activity on dune stabilisation and the wetlands, monitoring the levels of human use of the area (including the shorelines).
- Mapping and monitoring of formed tracks or accessible routes to ensure that no further routes are developed into the wetlands and beach habitats.
- Taking systematic records of the use of the immediate coastal habitats by resident and migratory waders.
- To determine the fire frequency, intensity, source of ignition and risk on site.

Community and education messages

There is currently no public interpretation of the ECCBIL Ramsar site. Developing a mechanism for ongoing discussions with the Cape Barren Island community, as part of the National Action Plan, would address the following issues including:

- Aboriginal community involvement and participation in the management of the Ramsar site and ongoing research and monitoring work.
- Integration of management actions.
- Minimising threats associated with use of the site – such as *Phytophthora*, Chytrid fungus and soil or dune erosion.

- Development of specific management plans for dealing with events such as wildfires, damage from vehicles, or disease.
- Promoting the values for which the site was listed.

Community support is critical to good management, especially in the case of Cape Barren Island, where ownership has passed to the CBIAA. Aboriginal people on Cape Barren Island have indicated that they would like to be actively involved in ongoing management. It is important to work closely with both the Aboriginal community and Government organisations to ensure consistency between management plans, site plans and the municipal planning scheme.

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Abbreviations

AHD - Australian Height Datum

ALCT - Aboriginal Land Council of Tasmania

CBIAA - Cape Barren Island Aboriginal Association

CLAC - Crown Land Assessment and Classification

DEWHA - Department of the Environment, Water, Heritage and the Arts (formerly DEWR)

DEWR - Department of the Environment and Water Resources

DPIPWE - Department of Primary Industries, Parks, Water and Environment (formerly DPIW)

DPIW - Department of Primary Industries and Water (formerly DPIWE)

DPIWE - Department of Primary Industries, Water and Environment

DSEWPaC - Department of Sustainability, Environment, Water, Population and Communities (formerly DEWHA)

ECD - Ecological Character Description

EPBC Act - Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*

IUCN - International Union for Conservation of Nature

NRM - Natural Resource Management

psu – practical salinity units

PWS - Parks and Wildlife Service

RIS - Ramsar Information Sheet

TSP Act - Tasmanian *Threatened Species Protection Act 1995*

1. Introduction

1.1 Site details

Site Name	East Coast Cape Barren Island Lagoons (ECCBIL)
Location in coordinates	40 degree 18' 00" to 40 degrees 26' 00"S, 148 degrees 20' 00" to 148 degrees 26' 00"E.
General location of site	East Coast Cape Barren Island Lagoons Ramsar site lies along the eastern edge of Cape Barren Island. Cape Barren Island lies within the Furneaux group of islands in eastern Bass Strait, in the municipality of Flinders, Tasmania. ECCBIL is located 20 kilometres from Lady Barron, on Flinders Island, the second largest settlement in the Furneaux group. The Corner is the largest settlement on Cape Barren, located in the north-west, and is approximately 30 kilometres from ECCBIL. The site occupies most of the eastern lowland and lagoon complex, from just north of Tar Point down to Jamieson's Bay and extends westwards from the coast for a distance varying from 1 to 4 kilometres.
Area of site	4473 hectares
Date of Ramsar designation	1982
Ramsar criteria met by the wetland	1, 3
Management Authority	Title is vested with Aboriginal Land Council of Tasmania. The local community, the Cape Barren Island Aboriginal Association is the land manager[2].
Date the ecological character description applies	1982
Date the ecological character description was compiled	July 2010
Names of Compilers	Dr Helen Dunn, Dr Frances Mowling and Entura
Reference for Ramsar Information Sheet	Ramsar Information Sheet prepared by DPIW 2005 http://www.deh.gov.au/cgi-bin/wetlands/report.pl
Reference to the Management Plan	N/A.

[2] Graham Gardiner, Aboriginal Land Council of Tasmania pers. comm.

1.2 Purpose of the Ecological Character Description

The purpose of the ecological character description (ECD) for the ECCBIL Ramsar site is to provide a baseline description of the site at the time of listing in 1982. The Ramsar Convention (2005a) has defined "ecological character" as "the combination of the ecosystem components, processes and benefits/services that characterise the wetlands at a given point in time". The convention has defined a "change in ecological character" as "the human induced adverse alteration of any ecosystem component, process and or ecosystem benefit/service" (Ramsar Convention 2005a). This ECD forms the baseline used to assess changes in the ecological character of the Ramsar wetland. The ECD can also be used as the reference for:

- development and implementation of a management plan designed to maintain the ecological character of the site
- design of a monitoring program to detect changes in ecological character
- assessment of the likely impact on ecological character of proposed actions, as required under the EPBC Act, including environmental impact assessments
- reporting to the Australian Government and the Ramsar Convention about any changes in the ecological character of Ramsar sites.

The ECD also provides a basis for updating the Ramsar Information Sheet (RIS). The RIS provides information and data about the Ramsar site and is a major component of the documentation provided when proposing a site for Ramsar listing. A RIS must be prepared for each Ramsar site at the time of listing and updated every six years if necessary (Ramsar Convention 1996, Resolution VI.1 paragraph 2.3). The ECD for the ECCBIL Ramsar site will provide detailed information to update the RIS for the entire site.

McGrath (2006) outlined the aims of an ECD for Ramsar wetlands as follows:

1. To assist in implementing Australia's obligations under the Ramsar Convention, as stated in Schedule 6 (Managing wetlands of international importance) of the Environment Protection and Biodiversity Conservation Regulations 2000 (Australian Government):
    (a) To describe and maintain the ecological character of declared Ramsar wetlands in Australia; and
    (b) to formulate and implement planning that promotes:
        (i) conservation of the wetland; and
        (ii) wise and sustainable use of the wetland for the benefit of humanity in a way that is compatible with maintenance of the natural properties of the ecosystem.
2. To assist in fulfilling Australia's obligation under the Ramsar Convention – "to arrange to be informed at the earliest possible time if the ecological character of any wetland in its territory and included in the Ramsar List has changed, is changing or is likely to change as the result of technological developments, pollution or other human interference."
3. To supplement the description of the ecological character contained in the Ramsar Information Sheet submitted under the Ramsar Convention for each listed wetland and, collectively, form an official record of the ecological character of the site.
4. To assist the administration of the EPBC Act, particularly:
    (a) To determine whether an action has, will have or is likely to have a significant impact on a declared Ramsar wetland in contravention of sections 16 and 17B of the EPBC Act; or

(b) To assess the impacts that actions referred to the Minister under Part 7 of the EPBC Act have had, will have or are likely to have on a declared Ramsar wetland.

5. To assist any person considering taking an action that may impact on a declared Ramsar wetland whether to refer the action to the Minister under Part 7 of the EPBC Act for assessment and approval.

6. To inform members of the public who are interested generally in declared Ramsar wetlands to understand and value the wetlands.

1.3 Treaties, legislation and regulations

The following section outlines the treaties, legislation and regulations that are relevant to the ECCBIL Ramsar site. For further information regarding international, national or state legislation or policies, refer to http://www.austlii.edu.au/.

1.3.1 International

- *The Convention on Wetlands of International Importan*ce - an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. Negotiated through the 1960s by countries and non-governmental organisations that were concerned at the increasing loss and degradation of wetland habitat for migratory waterbirds, the treaty was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975. It is the only global environmental treaty that deals with a particular ecosystem, and the Convention's member countries cover all geographic regions of the planet (Ramsar Convention 2009)
- *The Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment (JAMBA) (1974)*
- *The Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment (CAMBA) (1986)*

The JAMBA and CAMBA are bilateral agreements relating to the conservation of migratory birds and were formed with the Government of Japan in 1974 and the People's Republic of China in 1986. They list terrestrial, water and shorebird species which migrate between Australia and the respective countries. In both cases the majority of listed species are shorebirds. Both agreements require the parties to protect migratory birds by:

- limiting the circumstances under which migratory birds are taken or traded
- protecting and conserving important habitats
- exchanging information
- building cooperative relationships.

The JAMBA agreement also includes provisions for cooperation on the conservation of threatened birds. Australian government and non-government representatives meet every two years with Japanese and Chinese counterparts to review progress in implementing the agreements and to explore new initiatives to conserve migratory birds (DEWHA 2009a).

- *The Agreement between the Government of Australia and the Republic of Korea for the Protection of Migratory Birds and their Environment (ROKAMBA) (2006)* – a bilateral migratory bird agreement similar to the JAMBA and CAMBA. Australia and the Republic of Korea agreed to develop ROKAMBA and the agreement came into force in 2007. The ROKAMBA formalises

Australia's relationship with the Republic of Korea in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (DEWHA 2009a).

- *Convention on the Conservation of Migratory species of Wild Animals (Bonn Convention)* - The Bonn Convention adopts a framework in which countries with jurisdiction over any part of the range of a particular species co-operate to prevent migratory species becoming endangered. For Australian purposes, many of the species are migratory birds.

1.3.2 National

1.3.2.1 Legislation

- The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) - is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance. The EPBC Act provides for protection and promotes cooperative management of Australia's Ramsar wetlands. Ramsar wetlands are recognised as a matter of national environmental significance under the EPBC Act. In Australia a 'declared Ramsar wetland' is a wetland, or part of a wetland, designated by the Commonwealth under Article 2 of the Ramsar Convention for inclusion in the List of Wetlands of International Importance kept under that Article The EPBC Act also establishes criteria for declaring threatened wetlands of international importance and subordinate legislation (EPBC Regulations 2000) promotes best practice management of Ramsar wetlands through nationally consistent management principles.

1.3.2.2 Guidelines and policies

- The *National Framework and Guidance for Describing the Ecological Character of Australian Ramsar Wetlands*. *Module 2 of the National Guidelines for Ramsar Wetlands* (DEWHA 2008) - provides background information on ecological character, guidance on interpreting terms, the essential elements of an ecological character description, and a step-by-step guide to developing a description of ecological character for wetlands.
- The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000* - provides a framework for water resource management, and states specific water quality guidelines for each environmental value and the context within which they should be applied.
- *EPBC Act Policy Statement 1.1: Significant Impact Guidelines" 2006* - provides overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance protected by the EPBC Act.

1.3.3 State

A number of state policies and legislation and regulations are relevant to the site and include:

- *Nature Conservation Act 2002* - makes provision with respect to the conservation and protection of the fauna, flora and geological diversity of the State, to provide for the declaration of national parks and other reserved land and for related purposes.
- Wildlife Regulations 1999 - provides for regulations under the *Nature Conservation Act 2002*.
- *Threatened Species Protection Act 1995* - provides for the protection and management of threatened native flora and fauna and to enable and promote the conservation of native flora and fauna.
- *Forest Practices Act 1985* - ensures that all forest practices are conducted in accordance with the Forest Practices Code, to provide for the issue of that Code, to provide for the creation of private timber reserves, to provide for the constitution of the Forest Practices Tribunal, and to provide for incidental and consequential matters.
- *Aboriginal Relics Act 1975* - provides for the preservation of aboriginal relics.
- *Inland Fisheries Act 1995* - consolidates the law relating to inland fisheries.
- *Water Management Act 1999* - provides for the management of Tasmania's water resources. In particular the Act is to provide for the use and management of freshwater resources in Tasmania having regard to the need to:
    - Promote sustainable use and facilitate economic development of water resources.
    - Recognise and foster the significant social and economic benefits resulting from the sustainable use and development of water resources for the generation of hydro-electricity and for the supply of water for human consumption and commercial activities dependent on water.
    - Maintain ecological processes and genetic diversity for aquatic and riparian ecosystems.
    - Provide for the fair, orderly and efficient allocation of water resources to meet the community's needs.
    - Increase the community's understanding of aquatic ecosystems and the need to use and manage water in a sustainable and cost-efficient manner.
    - Encourage community involvement in water resources management.
- *Aboriginal Lands Act 1995* - promotes reconciliation with the Tasmanian Aboriginal community by granting to Aboriginal people certain parcels of land of historic or cultural significance.
- *Living Marine Resources Management Act 1995* –promotes the sustainable management of living marine resources, to provide for management plans relating to fish resources, to protect marine habitats and to repeal the *Fisheries Act 1959*.
- *State Policy on Water Quality Management* 1997 - provides for the sustainable management of Tasmania's surface water and groundwater resources by protecting or enhancing their qualities while allowing for sustainable development in accordance with the objectives of Tasmania's Resource Management and Planning System.
- *State Coastal Policy 1996* – promotes the sustainable development of Tasmania's coastal resources.

2. Site description

2.1 Site location and general description

The East Coast Cape Barren Island Lagoons Ramsar site (ECCBIL) is located on the eastern shore of Cape Barren Island in the Furneaux Group of islands, Bass Strait, to the north-east of Tasmania. ECCBIL occupies an area of some 4473 hectares (approximately 10 per cent of the area of Cape Barren Island) and has a maximum elevation of less than 20 metres ASL. The Ramsar site extends from just north of Tar Point down to Jamieson's Bay, excluding Cape Barren (Figure 2-1).

The Ramsar site was listed as a result of a state-wide study of the flora of wetlands in Tasmania (Kirkpatrick and Harwood 1983). The site is characterised by having a diversity of wetlands and lagoons lying in close proximity to each other and the almost complete absence of human disturbance. ECCBIL occupies a prograding low relief coastal plain that is bounded to the east by a wave-dominated coast (to low water mark) and to the west (external to the boundary of ECCBIL) by two granite ranges (Cocker 1980). These ranges run north-south and provide catchment runoff to the low lying coastal plain. The western edge of the wetlands merges into coastal scrub and heathland. A variety of native vegetation communities including coastal scrub, heathland, *Callitris* woodland and *Allocasuarina* forest form the greater part of ECCBIL, interspersed by numerous wetland associations.

The sandy soils and low relief create a context for the development of wetlands and numerous shallow saline lagoons. The largest lagoon is Thirsty Lagoon located in the southern sector (Figure 2-1). It is a barred estuary connected by a narrow neck to Little Thirsty Lagoon. Most of the remaining lagoons are small un-named ephemeral water bodies that are not connected to the sea (Figure 2-1).

Lagoons lying in the coastal plains vary in area, depth, salinity and continuity of inundation. This is reflected in the different dominant vegetation communities, ranging from saltmarsh able to withstand extended periods of drying, to freshwater plant species intolerant of saline conditions.

Figure 2-1
Location of East Coast Cape Barren Island Lagoons Ramsar site in Bass Strait, North-east Tasmania. (Sharpe 1994)

Four low energy estuarine systems, the barrier impounded Thirsty Lagoon, Little Creek, and two small unnamed systems, are flushed by intermittent fresh water inputs from shallow, frequently dendritic stream channels. Spits and bars located at the entrances to these estuarine systems suggest intermittent flushing by marine waters. The larger estuaries provide habitat for seabirds and waders, while the extensive undisturbed sandy beaches are used by beach-nesting shorebirds. The shorelines are backed by a more or less continuous parallel dune system extending for about 15 kilometres along the coast and some hundreds of metres inland. A large number of small non tidal freshwater lagoons occur throughout the site.

The site is largely undisturbed and almost inaccessible by road. There is some invasion by exotic species, notably marram grass (*Ammophila arenaria*) which has established on the frontal dune system. The root-rot fungus (*Phytophthora cinnamomi*) is believed to have been introduced, most probably from quad bikes or cattle. Cattle have roamed freely on the site in the past. The current lease restricts stock access, protecting the lagoons from grazing and trampling. Fire is the greatest disturbance to the vegetation of the site. A history of high fire frequency and unplanned bushfires are a threat to the integrity of the vegetation communities.

2.2 Site history

Cape Barren Island is significant in recent history of the Tasmanian Aboriginal community; however no formal assessment of Aboriginal values within the ECCBIL Ramsar site has been documented.

Freehold title to part of Cape Barren Island was vested in the Aboriginal Land Council of Tasmania, on behalf of the Tasmanian Aboriginal community, under the *Aboriginal Lands Act 1995* (Tasmania). A second land transfer of 45 000 hectares in 2005 placed most of the island fully under Aboriginal ownership. The local Aboriginal community organisation, the Cape Barren Island Aboriginal Association (CBIAA) is the land manager for the Ramsar site.

Transfer of ownership to the Aboriginal community acknowledges the long association and significant meaning of the area for Indigenous people. Future management will be under the direction of the Aboriginal Land Council of Tasmania.

The northern area of ECCBIL has a long-term cattle grazing lease. The cattle have roamed freely across the site, trampling around wetlands. Since the listing of the site, attempts have been made to reduce these impacts. Natural Heritage Trust funding was provided to the lessee in 2002 to fence the areas used for grazing and prevent livestock from straying into the wetland areas (Department of Premier and Cabinet 2004). In addition, part of the lease area has been revoked but the effectiveness of these measures is unknown. The lease arrangements since the transfer of ownership from Crown Land to the Aboriginal Land Council of Tasmania are also unknown.

The Tasmanian Aboriginal people have a long history of traditional activities associated with lagoon environments, including gathering plant and animal resources. Information about the cultural values of the ECCBIL Ramsar site for the local community was not available for this ECD. However, the CBIAA have stated that they do not use four-wheel drives (4WD) or motor-bikes around the Ramsar site.

2.2.1 Climate

Cape Barren Island has a temperate maritime climate with an estimated mean annual rainfall of 710 millimetres (Perrin 1988). Monthly rainfall ranges from an average of 38 millimetres in January to 62 millimetres in June. Maximum daily temperatures peak in February around 23° C, while the lowest daily maximum falls to around 13° C in July. The prevailing wind directions are westerly and north-

easterly (Perrin 1988). Data for temperature, wind and rainfall have been derived from the nearest Bureau of Meteorology (BoM) site on Swan Island, which is located in Bass Strait, approximately 50 kilometres south of ECCBIL (Figure 2-2).

The ECCBIL Ramsar site lies on the eastern side of the island and is fully exposed to the north-easterly wind and rainfall events. The predominant westerly rain-bearing winds are likely to lose much of their moisture on the western face of the ranges around Mount Munro (687 metres AHD) and Mount Kerford (503 metres AHD). Run-off from the north-eastern face of Mount Kerford and Hogans Hill passes down onto the coastal plain of ECCBIL.

The alignment of parabolic dune bedforms located within the prograding plain at ECCBIL indicate that the prevailing effective wind flow originates from the north-north-west for the northern portion of ECCBIL, from the south-west for the southern portion of ECCBIL, whilst the mid portion of ECCBIL is apparently sheltered from westerly wind flows. The north-easterly winds, coming in across the ocean, carry in salt in the form of aerosols that may be dropped on the sandy plain of ECCBIL and contribute to the observed salinity of some wetlands.

Rainfall data indicate that during late spring, summer and early autumn (November to February) mean rainfall is between 32 millimetres to 45 millimetres per month, with an incidence of mean number of days of rainfall per month between 7 and 10 days. Rainfall is associated with the low temperature and low evaporation months, commencing late April and extending through to September. During this period mean monthly rainfall is between 52 millimetres to 65 millimetres per month, with an incidence of mean number of days of rainfall per month between 10 and 15 days.

The ECCBIL wetlands have developed and are sustained under a climatic regime where rainfall occurs throughout the year. For about five months over the coolest period sufficient rainfall and runoff occurs, along with low temperatures and less wind, to maintain the hydrological functioning of most of the numerous small wetlands.

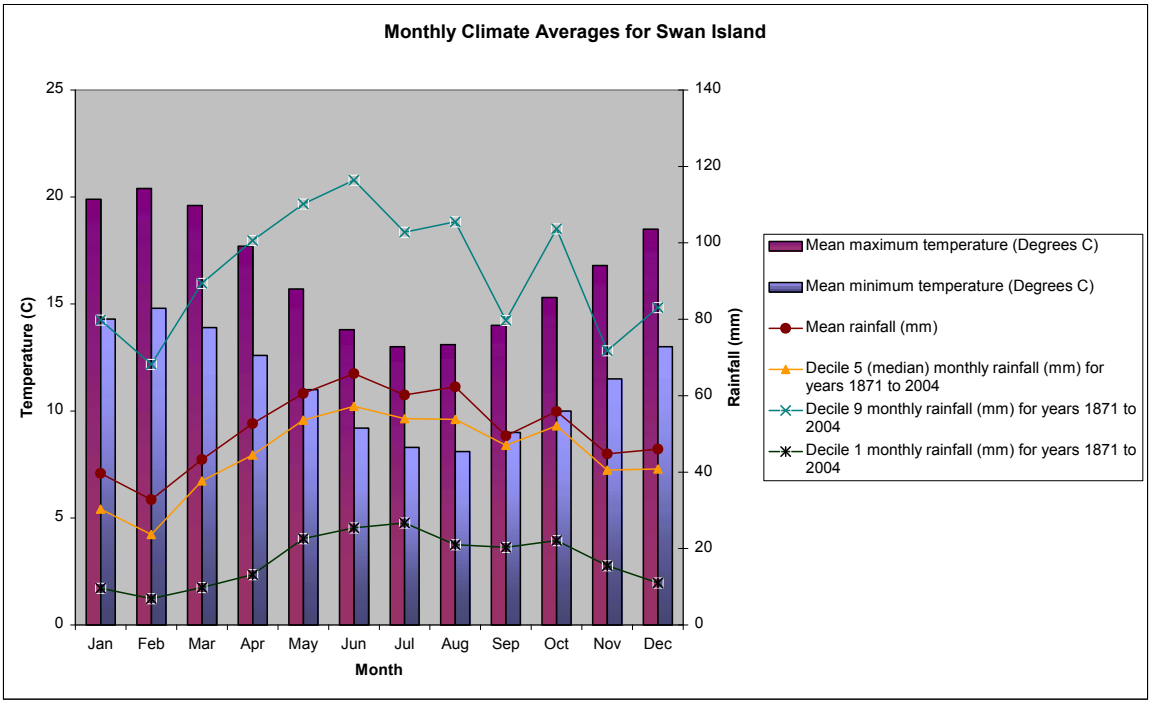

Figure 2-2
Climate data for ECCBIL from Bureau of Meteorology site at Swan Island

2.2.2 Biogeographic setting

The representativeness of the inland wetlands of the ECCBIL Ramsar site within a bioregional setting was generally evaluated in the context of the drainage division but also within the Integrated Marine and Coastal Regionalisation of Australia (IMCRA) for the estuarine and marine sites.

2.2.2.1 Drainage Division and river basins

ECCBIL sits within the Tasmanian Drainage Division which encompasses all of Tasmania, including the Bass Strait Islands to the North. The Tasmanian Drainage Division has a total area of 68 363 square kilometres encompassing 19 river basins (Figure 2-3) with areas ranging from 678 to 11 344 square kilometres (DEWHA 2009a). The estuary types in this drainage division are wave-dominated estuaries and delta systems and the climate is wet temperate in the west and north east with a mainly mild to cool summer low rainfall in the central midlands (DEWHA 2009a).

The ECCBIL Ramsar site is also part of the Flinders-Cape Barrens Islands River Basin (Figure 2-3). The major rivers in this basin are the Patriarch River, Nelsons Drain and Samphire River.

The Flinders Cape Barren Islands catchment covers 2072 square kilometres and is located in Bass Straight off the north eastern tip of Tasmania and consists of many islands, with Cape Barren and Flinders being the largest and most significant from a water resource perspective (DEWHA 2009b). There are no major storages in the catchment and the major landuse consists of natural forest and agriculture (DEWHA 2009b). Water use on Cape Barren Island is fairly small with irrigation being the largest user (DEWHA 2009b).

Figure 2-3
Tasmanian Drainage Division and river basins

2.2.2.2 Integrated Marine and Coastal Regionalisation of Australia (IMCRA)

ECCBIL also falls within the IMCRA bioregion called the Southeast Shelf Transition (SST). IMCRA (v4.0) is a spatial framework for classifying Australia's marine environment into bioregions that make sense ecologically and are at a scale useful for regional planning (DEWHA 2008). This bioregionalisation is part of the benthic (sea floor) component of the National Marine Bioregionalisation, and covers the 80 per cent of Australia's Exclusive Economic Zone (EEZ) that lies beyond the continental shelf break (Heap et al. 2005). It provides a description of patterns of biological distributions and physical habitats on the seafloor. The Provincial Bioregions are large bio-geographic regions that capture the broad-scale distribution of benthic marine fauna and broad patterns in benthic marine biodiversity for areas of the EEZ seaward of the shelf break (Heap et al. 2005).

The Southeast Shelf Transition (SST) encompasses the south eastern coast of NSW, eastern coast of VIC and the eastern Bass Strait Islands, including the Furneaux Group (Figure 2-4). The SST covers 4270 square kilometres and is the most southerly shelf provincial bioregion in the East Marine Region (DEWHA 2009c). This provincial bioregion contributes less than one per cent to the total area of the East Marine Region (59 620 square kilometres), and falls mainly within the South-East Marine Region and the State waters of NSW and VIC (DEWHA 2009c).

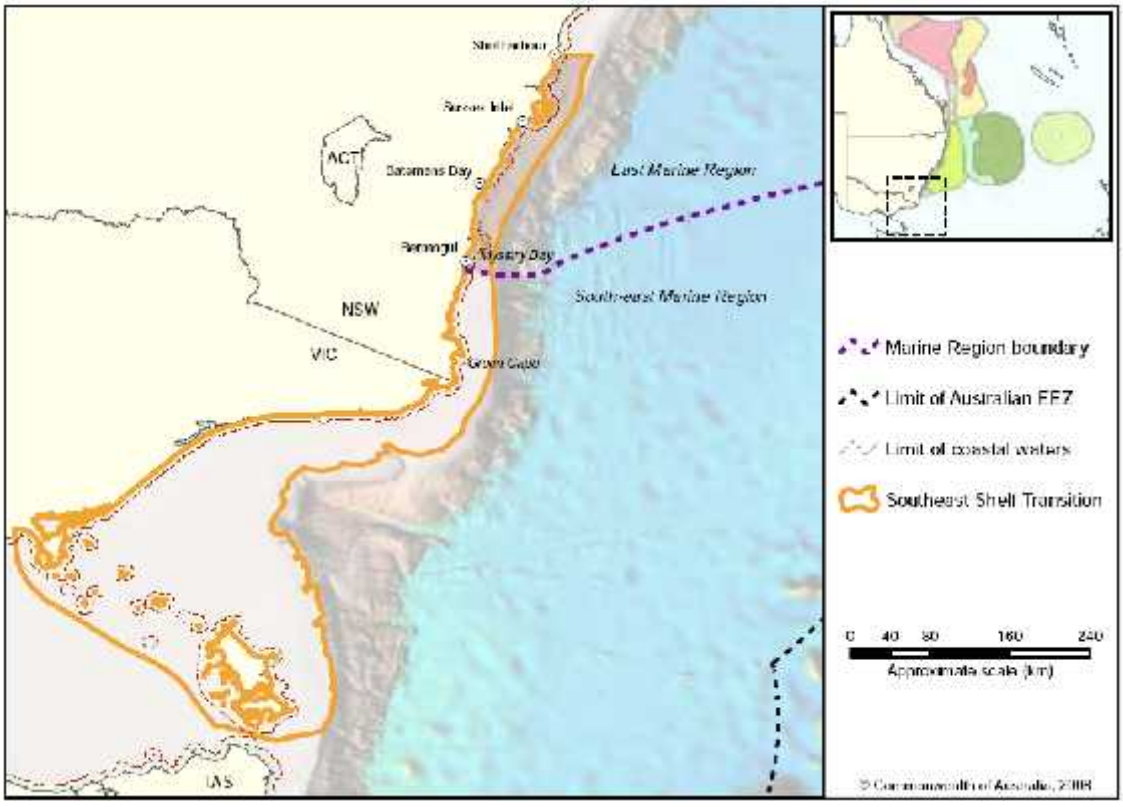

Figure 2-4
Southeast Shelf Transition of the Integrated Marine and Coastal Regionalisation of Australia (IMCRA). Taken from DEWHA (2009c) page 54.

2.3 Land tenure

At the time of listing ECCBIL was unallocated Crown Land under the *Crown Lands Act 1976* and was managed by the Tasmanian National Parks and Wildlife Service. Freehold title to part of Cape Barren Island, including the Ramsar site, was vested in the Aboriginal Land Council of Tasmania, on behalf of

the Tasmanian Aboriginal community, under the *Aboriginal Lands Act 1995* (Tasmania). The hand back to the Tasmanian Aboriginal Community of Cape Barren Island of full land title was made in 2005 under the *Aboriginal Lands Amendment Act 2004* (Tasmania). It included 45 000 hectares of Cape Barren Island, to be held and managed by the Aboriginal Land Council of Tasmania.

2.4 Ramsar Criteria

At the time of listing in 1982, ECCBIL Ramsar site satisfied the then Ramsar criteria 2b and 2d. Since listing, the criteria have been revised a number of times in 1990, 1996, 1999 and 2005 when the current criteria were adopted (DEWHA 2008). Those criteria met by ECCBIL Ramsar site at the time of listing equate to the current Criterion 3. The ECCBIL Ramsar site is considered to satisfy additional criteria that were not in place at the time of listing. Justification statements as to how these criteria are met are provided below.

2.4.1 Ramsar Criteria as described in the Ramsar Information Sheet (1982)

Criteria 2b - It is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna.

Criteria 2d - It is of special value for one or more endemic plant or animal species or communities.

2.4.2 Ramsar Criteria as described in the Ramsar Information Sheet (2005)

Criteria 1- **A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.**

These lagoons are significant as they form a representative sample of coastal lagoons in the region and are relatively undisturbed and free from invasion by exotic species.

Criteria 3- A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

The lagoons are an important habitat for numerous species which are both rare and poorly reserved in Tasmania and in some cases on a national level.

2.4.3 Re-assessment of Ramsar Criteria within the context of the Tasmanian Drainage Division

The ECCBIL Ramsar site has been re-assessed against the current Ramsar criteria within the context of the Tasmanian Drainage Division during the preparation of this ECD and the results are presented below.

Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

The diverse complex of wetlands in the east of Cape Barren Island lies on a prograding sandy plain overlaying Devonian granite. Some 100 separate wetlands, mostly of small size with variable degrees of hydration, stretch from the northern most to southernmost point of the east coast of Cape Barren

Island. The main wetland types present in the ECCBIL Ramsar site include (see section 2.5 for the full list of types present):

F – Estuarine waters; permanent water of estuaries and estuarine systems of deltas.

H – Intertidal marshes; includes salt marshes, salt meadows, saltings, raised salt marshes; tidal brackish and freshwater marshes.

J – Coastal brackish/saline lagoons; brackish to saline lagoons with at least one relatively narrow connection to the sea.

K – Coastal freshwater lagoons; includes freshwater delta lagoons.

The suite of wetlands at ECCBIL are representative of the process of progradation of coasts, a process that is uncommon in southern Australia. It is one of the most extensive example of such a system in the Tasmanian Drainage Division covering over 800 hectares and includes eight Ramsar wetland types. The remoteness of the site means that it is a largely natural system in near pristine condition compared to other coastal wetlands. Most other extensive wetland ecosystems in Tasmania have undergone significant alteration in some way and large areas have been lost (Harwood 1991, Kirkpatrick and Tyler 1988, Kirkpatrick and Harwood 1981). The high degree of naturalness of ECCBIL makes it unique within Tasmania and South Eastern Australia.

Whilst dune barred lagoons are reasonably common (particularly on King, Flinders and Cape Barren Islands) it is rare to find examples of deflation basins in good condition within Tasmania, particularly with intact vegetation. Most others in Tasmania have been cleared, drained or otherwise altered from natural and the geomorphic processes of formation have been severely disrupted. The lagoon in the south end of the Ramsar site near Jamiesons Bay is the best example of a deflation basin in the ECCBIL Ramsar site. This lagoon is a good representative example of this landform type in near natural condition. Other wetlands further north are polygenetic, that is they are a mixture of dune (or beach-ridge) barred lagoons and deflation basins. All are good representative examples because of their near natural condition. (Ian Houshold, pers. comm.).

It is considered that this criterion is still met.

Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered or critically endangered species or threatened ecological communities.

No wetland dependent nationally listed species or communities have been identified as occurring within ECCBIL. It is considered that this criterion is not met.

Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

A large range of Tasmanian wetland vegetation types occurs within the site, including 13 wetland communities. The representation of many successional stages present in ECCBIL means that it has a high diversity of habitats and species present (including thirteen species uncommon in Tasmania). Therefore it is important for maintaining the biological diversity of the biogeographic region. At the time of this determination the biogeographic region considered was based upon the Interim Biogeographic Regionalisation for Australia v5 (IBRA).

More recently, a decision was made through the Natural Resource Policy and Program Committee, that the appropriate biogeographic regionalisation scheme for aquatic ecosystems in Australia is the

Australian Drainage Division system for inland and coastal ecosystems, and the Integrated Marine and Coastal Regionalisation of Australia (IMCRA).

A comprehensive analysis of the importance of this wetland with respect to supporting populations of species important for maintaining biological diversity within the Tasmanian Drainage Division bioregion has not been undertaken. In the absence of such information, it is not possible to make an assessment against this criterion. However, based upon the previous assessment (RIS 2005) it is considered that this criterion is still met.

Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

This criterion is considered not to be met because there is currently no data to suggest that it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Criterion 5: A wetland should be considered internationally important if it regularly supports 20 000 or more waterbirds.

This criterion is not met because there is no evidence that ECCBIL regularly supports 20 000 or more waterbirds.

Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of water bird.

This criterion is not met because there is no available data to suggest that ECCBIL regularly supports 1% of the individuals in a population of a species or subspecies of water bird.

Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.

This criterion is not met because ECCBIL does not support a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values.

Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

This criterion is currently not met because there is no available data to suggest that ECCBIL is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

Criterion 9: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

This criterion is not met because there is no available data to suggest that ECCBIL regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

2.5 Wetland types

There are eight different wetland types present within the ECCBIL Ramsar site; six saline wetlands (marine/coastal wetland types D, E, F, G, H, and J) and two freshwater wetland types, one coastal and one inland (wetland types K and N), (Table 2-1). Determination of the areas of the wetland types present is difficult as there is no high resolution mapping available for the site. TASVEG mapping (Harris and Kitchener 2005) of the site has been done from aerial photo-interpretation and previous mapping (Kirkpatrick and Harwood 1981). However some generic mapping units have been used that do not match some of the communities described by Kirkpatrick and Harwood (1981). The identification of wetland types that are present in the ECCBIL Ramsar site and their approximate extent have been extrapolated from TASVEG mapping and are indicated in Table 2-1

Table 2-1
Ramsar wetland types found in ECCBIL[3]

Marine / coastal wetland type	**Code**	**Approximate area (ha)**
Rocky shores	D	20.3
Sand shingle or pebble shores	E	80.5
Estuarine waters	F	200
Intertidal mud sand or salt flats	G	55
Intertidal marshes	H	44
Coastal brackish/saline lagoons	J	375[4]
Coastal freshwater lagoons	K	
Other terrestrial areas	N/A	3660.2
Total area		**4472.8**
Inland wetland type	**Code**	**Approximate length (km)**
Seasonal/intermittent/irregular rivers/streams/creeks	N	37.8

[3] Note: No specific mapping or assessment of the areas of each type of wetlands has been undertaken. Indicative distribution of the vegetation types is presented in Appendix 2.
[4] The distinction between these categories was not possible from the current mapping and so areas were unable to be calculated.

3. Ecosystem components, processes, benefits and services

3.1 Ecosystem components and processes

This section describes the components and processes for the East Coast Cape Barren Island Lagoons Ramsar site that characterise the site at the time of listing in 1982. The underlying determinants for the Ramsar wetland types are geomorphology and hydrology which in turn influence the wetland biota and the physio-chemical components and processes.

3.1.1 Geomorphology

This section describes the geomorphological processes for ECCBIL which have been defined as being important dynamic forces within the system. This has been done by reviewing the various sources of information including aerial photographs, vegetation mapping, published descriptions, personal observations, images and climate data and collating the information to identify the geomorphic features and processes of the ECCBIL Ramsar site. This information will enable the reader to understand the ongoing processes that have shaped the nature of the site and which continue to maintain the wetland environments.

The Tasmanian Geoconservation Database lists significant geological, geomorphological and soil sites in Tasmania. Listed sites relevant to this ECD include:

- Little Creek Pleistocene shoreline
- Cape Barren dunes
- Cape Barren tufa
- Harleys Point whale bones.

Further information can be found in the Tasmanian Conservation Database.

3.1.1.1 Geomorphic origins and overview

ECCBIL is generally a sandy plain with occasional small outcrops of granite. The west of the site is bounded by the foothills of a granite ridge reaching almost 400 metres at Hogans Hill. The northern end of this ridge is low hills comprised of sedimentary Mathinna beds (Cocker 1980). The sandy soils are composed of coarse-grained felsic materials built from alluvial sediments and sand cover. Elongate parabolic dunes have westerly wind vectors as do the lunettes around deflation lakes within the coastal plain. Recent parallel and blowout dunes fringe the coast (Cocker 1980).
The geomorphic forms and processes are the result of action over time with wind and water re-shaping the sediments. The prograding plain we see today was formed probably in response to rising sea levels, which commenced some 10 000 years before present (BP). The rise in sea level was accompanied by an abundance of sediment which was reshaped in the process of dune formation. Around 6 500 BP the present stable period of sea level commenced and rates of reshaping the geomorphic features also stabilised (Figure 3.1).

The most recent sandy sediments are found on the beaches and parallel to shore dunes and coastal barrier. Cocker (1980) describes the earlier Quaternary sediments as sand cover composed of alluvial coarse grained felsic minerals from weathered granitoids. Wind has reworked these coarse grained sediments, forming elongate parabolic dunes and occasional truncated trailing arms, both with

associated intercorridor deflation features including troughs, basins, plains and dams. Other aeolian (wind-generated) features include deflation basins with lunettes, possibly of Pleistocene origin. There are numerous wetlands scattered across the sandy plain and extending to the coast. These are identifiable in the aerial photograph (Figure 3-1) and have been used to interpret the underlying geomorphological forms. The arrangement of the geomorphic features in ECCBIL is shown in Figure 3-2. More detailed mapping of the geomorphic features of the northern and southern sections is presented in Figure 3-3 and Figure 3-4.

The wetlands, generally, have formed in response to a number of historic and ongoing geomorphic processes, including:

- deflation of loose sediment by wind to bed rock, or to water table
- physical obstructions that impede water flow, for example sand barriers (parallel dunes, bars, spits, or sediment accumulation), which effectively seal lagoon beds
- tidal and wave driven coastal processes operating within and at the mouths of tidal lagoons
- water scour of drainage channels
- a combination of these processes potentially varying over time.

The rate of sediment accumulation in the deflation basins and impounded lagoons is unknown.

3.1.1.2 Key geomorphic components

The diversity of wetland types and conditions at ECCBIL are strongly influenced by the geomorphic context in which they occur:

Four small low energy estuarine systems, comprised of the barrier-impounded Thirsty and Little Thirsty Lagoons, Little Creek and two unnamed systems, are flushed by intermittent fresh water inputs from shallow, frequently dendritic stream channels. Spits and bars have formed at the entrances to these estuarine systems suggesting intermittent flushing by marine waters, indicating some isolation from marine influence for long periods.

Impounded lagoons that occur in ECCBIL are generally located inland of shore parallel dunes or beach ridges. A string of such lagoons occurs in the north of the site (Figure 3-3). These features are possibly the result of deflation basins originally formed during colder climatic stages of the last 2 million years, subsequently becoming impounded (Ian Houshold pers. comm.). There is marked variation between the lagoons in depth of basin and duration of inundation. Some lagoons contain fresh water, others are brackish to hypersaline.

There are several lagoons, mainly in the southern part of ECCBIL, formed predominantly in response to deflation by wind at the site, including lagoons 3338, 2338, 329 and 335 (Figure 3-3 and Figure 3-4). They may also have been modified by wind action. Lagoon 341 is a deflation basin possibly of Pleistocene origin with an area of 33 hectares. Granitic sands underlie four metres of water in the lagoon which had a pH of 6.77 and was very saline (Walsh et al. 2001). Lagoon 341 has a lunette.

Deflated plains occur where wind has reduced the dune to either ground water level or to bedrock, forming low lying areas that are subject to inundation for variable periods. The distribution of wetted areas and degree of inundation is not well described across this site. The deflated plains have a network of dendritic drainage channels that originate in the Mount Kerford range and are particularly evident in the northern portion of ECCBIL. These channels disperse water across the

deflated plains following effective rainfall. Groundwater flow lying on granite or consolidated clay soils may also contribute to the moist conditions of the plains.

Drainage channels which arise in the ranges external to ECCBIL become low energy stream capture channels on the prograding plain. The channels are either deeply scoured through the sandy sediments or shallow indentations in the deflated plain. The channels are more numerous in the northern portion of ECCBIL (Figure 3-3) dispersing fresh water flow across the plain wetlands. The channels then subsequently re-drain into single channels, which drain into impounded lagoons or single channels that flow into the estuaries. Some channels are lined with vegetation. Aerial photographs and on-ground observation (Stephen Harris pers. comm.) indicate that some channels are barred by sediment dams with resulting formation of organic soils.

Whilst dune barred lagoons are reasonably common (particularly on King, Flinders and Cape Barren Islands) it is now rare to find examples of deflation basins in good condition within the bioregion or even Tasmania, particularly with intact vegetation. Most have been cleared, drained or otherwise altered from natural and the geomorphic processes of formation severely disrupted.

The lagoon in the south end of the Ramsar site near Jamiesons Bay (wetland #341 on Figure 3-4) is the most obvious example of a deflation basin in the ECCBIL. This lagoon is of at least regional significance as a representative example of this landform, and possibly outstanding given its condition (Ian Houshold, pers. comm.). Deflation basins on Cape Barren Island also tend to have elevated salinities and reasonably permanent inundation, compared with other brackish/saline basins on mainland Tasmania.

Other wetlands further north are polygenetic and are a mixture of dune (or beach-ridge) barred lagoons and deflation basins. All of these wetlands are good representative examples because of their good condition. The two Flyover Lagoons (wetland #330 & #331 on Figure 3-3) are also good examples.

The beach ridge/transverse dune system is also important, as a component of similar systems on Flinders Island, and further south on the Tasmanian mainland. They record rates of beach progradation following the Holocene marine transgression, and are strongly related to successional stages in vegetation communities.

3.1.2 Hydrology

The hydrology of the wetlands has been inferred from maps, topography, geomorphological form and vegetation. As with many dune systems perched on impermeable bedrock, streams and surface flow from catchments rapidly sinks into dune sands at the contact. Water then follows subterranean flow paths, often concentrated in joints in the buried granite. Where wind has deflated the sand, the watertable is exposed in lagoons. Groundwater exits the system through beach springs, or through the estuary of Thirsty Lagoon. Some small lagoons are perched above the regional water table by peats, which effectively seal lagoon beds. Disruption of this peat seal by vehicles could affect its ability to hold water. The only stream to traverse the dunefield is Little Creek, in the north of the site (Houshold pers. comm. 2005). This watercourse is ephemeral.

Drainage channels, standing water and estuaries have been mapped (Figure 3-2). The northern area of ECCBIL (Figure 3-3)[5] has a more extensive catchment area with rainfall discharging into dendritic fresh water drainage channels that flow into a series of deflation plains that are subject to inundation, then into Little Creek and two unnamed estuarine systems. A series of impounded lagoons lies on the lee (generally westerly side) of the parallel dunes and some of these lagoons are connected to fresh water drainage channels and deflation features that are subject to inundation.

The southern area of ECCBIL (Figure 3-4) incorporates Thirsty and Little Thirsty Lagoons, deflation basins and the chains of impounded lagoons located behind the parallel dune ridges. This area has fewer channels draining from Hogan's Hill, possibly indicative of lower volumes of fresh water inputs. Two deflation basins that are located on the same drainage channel, shown in Figure 3-4, intercept fresh water inputs into Little Thirsty Lagoon. The area west of Thirsty and Little Thirsty Lagoons is comprised of sand grain- sized sediment of several metres depth. The area is low lying, subject to inundation and a mosaic of drainage channels and hummocky 'islands' (Stephen Harris pers. comm. 2007).

[5] Numbers on Figures 3.3 and 3.4 are wetland sites surveyed by Kirkpatrick and Harwood in 1981. A map of all their sampling sites in CBIL is shown in Appendix 2. Only those wetlands discussed in the text of the report are shown on Figures 3.3 and 3.4.

Figure 3-1
ECCBIL –ortho rectified aerial photographic mosaic (flown at 22 500 ft in 2006, scale 1:42 000, DPIWE 2006)

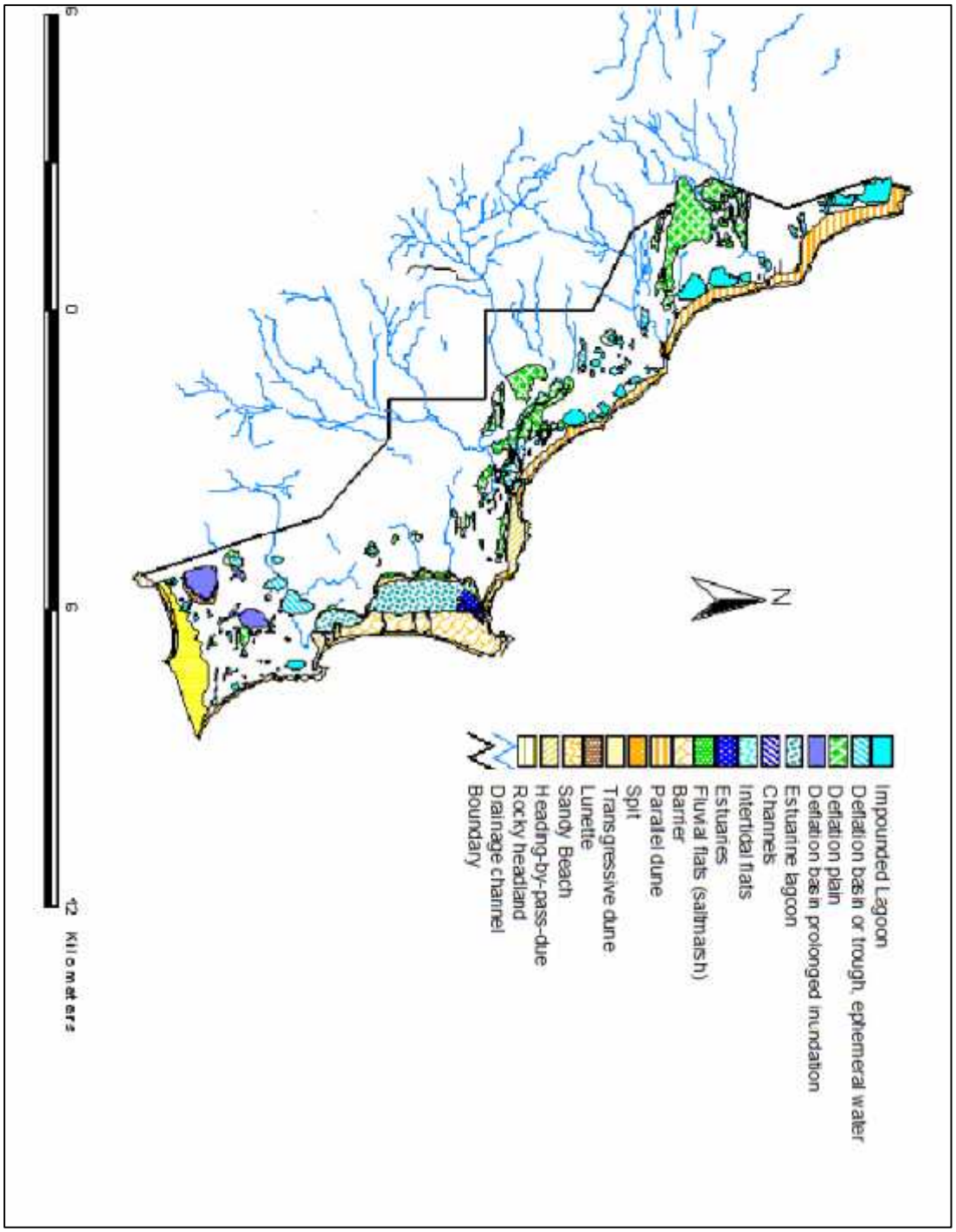

Figure 3-2
ECCBIL geomorphic and sedimentary features plotted from air photo interpretation (F Mowling 2007)

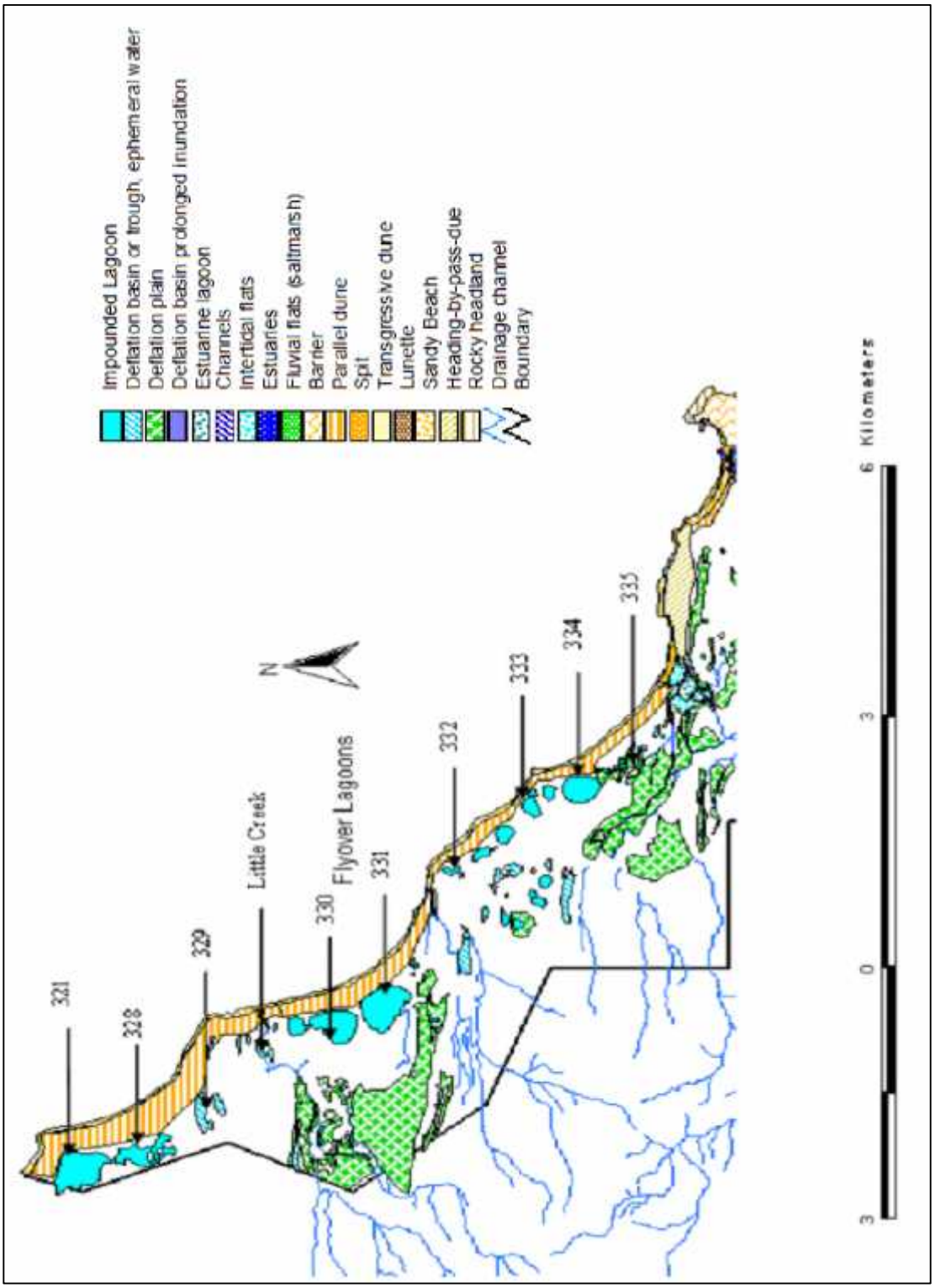

Figure 3-3
ECCBIL North: enlargement of
Figure 3-2– geomorphic and sedimentary features (numbers indicate wetlands referenced in the text, F Mowling 2007)

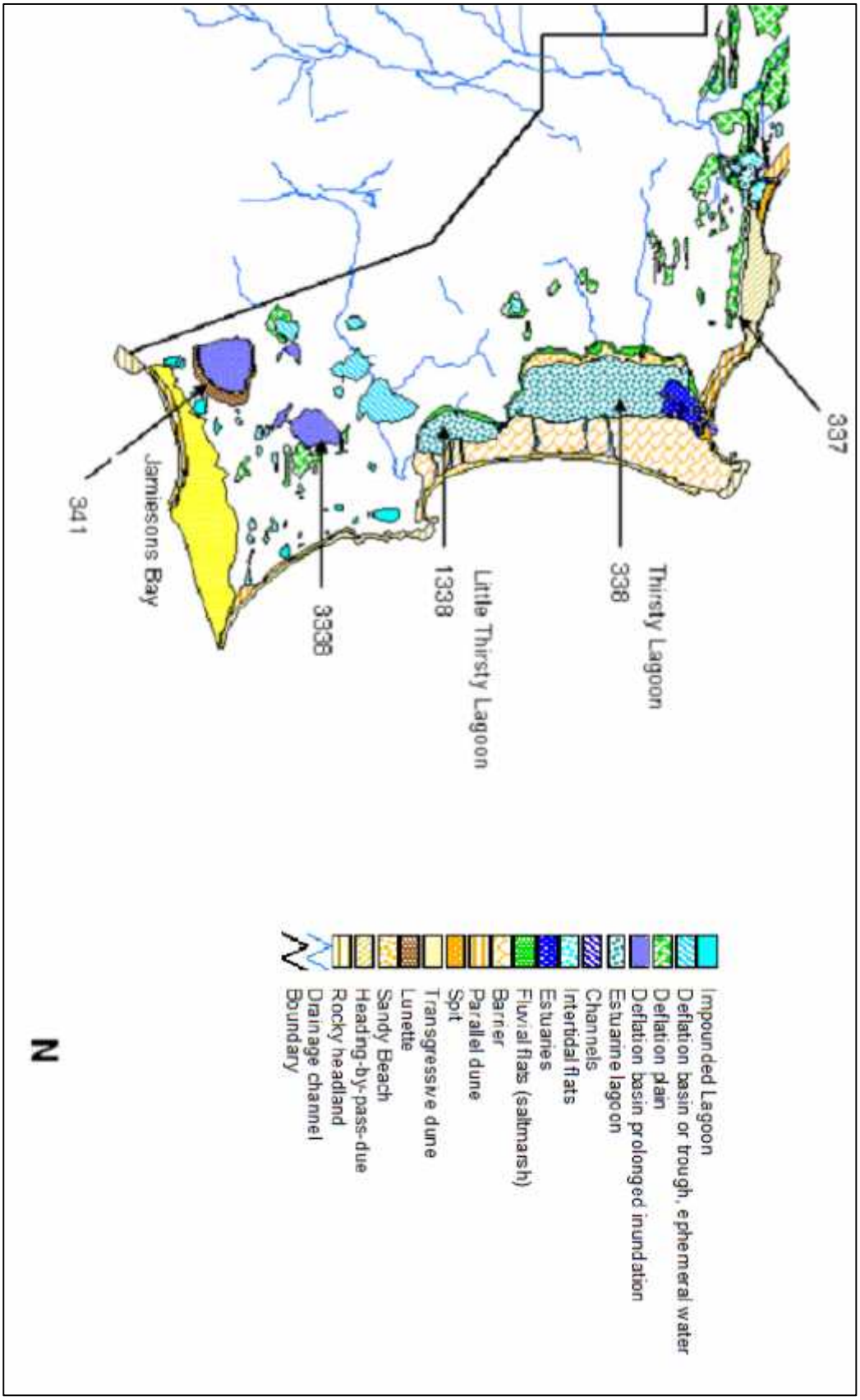

Figure 3-4
ECCBIL South: enlargement of
Figure 3-2 – geomorphic and sedimentary features (numbers indicate wetlands referenced in the text, F Mowling 2007)

The area located east of an approximate line between Little Thirsty Lagoon and the rocky headland at the southwestern boundary of ECCBIL has very few drainage channels. This undulating landscape is formed from a longitudinal dune field that overlays granite. There are numerous shallow deflation basins and elongated troughs located between dune ridges. A series of impounded lagoons (basins) is located behind the parallel dunes aligned north-south on the eastern shore, and another located behind the late Holocene transgressive dune on the south-east aligned shore.

The duration of inundation of many of these geomorphic features remains unknown, although some of the lagoons (deflation and impounded), retain open water for prolonged periods as indicated by the presence of aquatic plants.

3.1.3 Water quality

The only water quality information available is from four sites in Thirsty Lagoon and three sites in Little Thirsty Lagoon which were sampled in March 2005. These samples showed a gradient of increasing salinity from the marine entrance of Thirsty Lagoon to the upper reaches of Little Thirsty Lagoon (Figure 3-5) where salinities of over 60 psu (practical salinity units) were recorded (Hirst et al. 2006). Water with these salinity levels is almost hypersaline.

Due to the isolation of these wetlands and the fact they have been relatively undisturbed by human activity, it is expected that the water quality at the time of listing would be similar to the water quality in 2005.

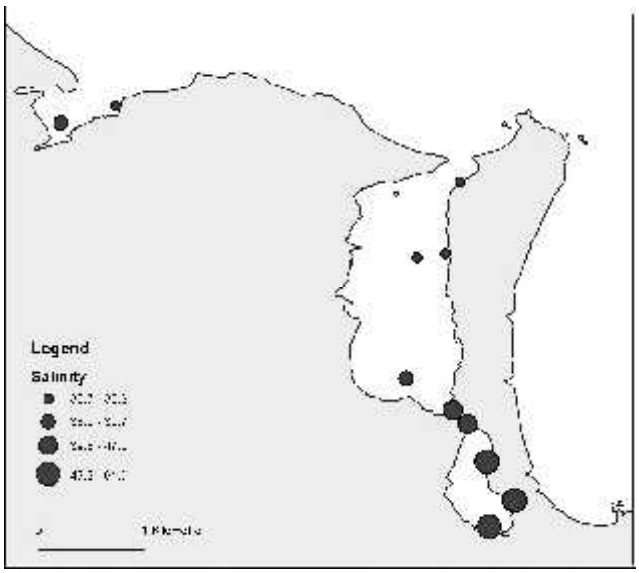

Figure 3-5
Salinity levels (psu) recorded in the unnamed marine lagoon (337), Thirsty (338) and Little Thirsty Lagoons (1338) (source: Hirst et al. 2006; these wetland numbers correspond to the numbering system by Kirkpatrick and Harwood (1981))

No environmental data were collected at the small unnamed marine lagoon (wetland 337). This 'Northern Lagoon' is open to the sea only at high tide when water spills over the sand bar at the entrance. The lagoon is up to 1 metre deep and is fed by two small creeks. Hirst et al. (2006) suggest that, at least at the time of sampling in 2005, Northern Lagoon has a greater inflow of freshwater than Thirsty (wetland 338) and Little Thirsty Lagoons (wetland 1338).

Although the estuarine survey took place in 2005, the findings on salinity gradient are compatible with the 1981 flora data. The vegetation communities recorded by Kirkpatrick and Harwood (1981) adjacent to Thirsty and Little Thirsty Lagoons are suggestive of frequently hypersaline conditions. In addition, the absence of any change in the drainage, waterways or sandbars in the intervening years supports the description of the estuarine conditions at these lagoons.

3.1.4 Flora

The geomorphology, hydrology and climate of the ECCBIL Ramsar site have created a range of conditions, resulting in a mosaic of vegetation communities. ECCBIL includes vegetation communities dependent on saline conditions, periodic and episodic inundation by fresh or salt water, as well as more typically terrestrial communities reliant on different drainage characteristics.

The processes driving the formation of the wetlands vegetation communities and their maintenance can, for the most part, only be inferred from the geomorphological descriptions and analysis. In particular, many of the wetlands are not fed by discrete water courses or tidal connections. In the absence of local data on rainfall patterns and extent, it is not possible to assess with confidence which wetlands are seasonally inundated or ephemeral, and where they occur.

Thirteen different Tasmanian wetland vegetation communities were identified within the ECCBIL Ramsar site in the Kirkpatrick and Harwood (1981) survey. Their corresponding TASVEG code and status in Tasmania are shown in Table 3-1. The work of Kirkpatrick and Harwood (1981) provided the foundation for the Ramsar listing of the ECCBIL. It is also the only systematic data collected for the wetlands of ECCBIL. The survey provided a finer classification of wetlands vegetation than was mapped by the TASVEG statewide mapping project however no definitive map of the vegetation communities as described by Kirkpatrick and Harwood (1981) exists. Current TASVEG mapping identified 17 different native vegetation mapping units within the ECCBIL (Appendix 2). All freshwater and saltmarsh TASVEG mapping units and a significant proportion of the wetland floristic vegetation communities found in Tasmania are represented in the ECCBIL. Flora species at each wetland surveyed by Kirkpatrick and Harwood (1981) are provided in Appendix 3.

Three groups of saline wetland vegetation communities occur in ECCBIL. *Wilsonia rotundifolia* and *Sarcocornia quinqueflora* herbfields occur in highly saline situations with prolonged exposure above water level. *Juncus kraussii* rushland and *Selliera radicans* herbfield occur in brackish to saline sites with prolonged exposure. *Lepilaena cylindrocarpa* and *Lamprothamnium* communities are saline but with longer periods of inundation. The most saline locations in the ECCBIL were vegetated by *Wilsonia rotundifolia* herbfield and *Sarcocornia quinqueflora* herbfield (Kirkpatrick and Harwood 1983).

The wetlands (Wetlands 321, 328, 329, 1329, 330, 331) in the northern area of the site (Figure 3-6 and Appendix 2) are in the lee of the parallel dunes north of Little Creek and have generally higher pH than those further south. This may be attributed to the underlying marine-origin calcium carbonate sheet. These wetlands contain several flora species of particular conservation significance (Appendix 4) with impounded lagoons (330/331) of special interest for their microflora (Walsh et al. 2001). The wetlands are notable for the uncommon *Wilsonia rotundifolia* community and other flora species uncommon in the region.

Table 3-1
Wetland floristic communities present in the ECCBIL and their corresponding TASVEG mapping unit and conservation status

TASVEG description	TASVEG code	Conservation status (NC Act[6])	Floristic community description Kirkpatrick and Harwood (1981)
Lacustrine herbland	AHL	Threatened	*Mimulus repens* (creeping monkey flower) herbfield *Selliera radicans* (shiny swampmat) herbfield *Wilsonia rotundifolia* (roundleaf wilsonia) herbfield
Freshwater aquatic sedgeland and rushland	ASF	Threatened	*Baumea arthrophylla* (fine twigsedge) sedgeland *Eleocharis sphacelata* (tall spikesedge) sedgeland *Lepidosperma longitudinale* (spreading swordsedge) sedgeland
Freshwater aquatic herbland	AHF	Threatened	*Triglochin procerum* (greater waterribbons) aquatic herbland *Myriophyllum elatinoides* [7]aquatic herbland *Myriophyllum propinqua*[8] aquatic herbland
Saline aquatic herbland	AHS	Threatened	*Lamprothamnium* spp. (charophyte) aquatic herbland *Lepilaena cylindrocarpa* (longfruit watermat) aquatic herbland
Saline sedgeland/rushland	ARS	N/A	*Juncus kraussii* (sea rush) rushland
Succulent Saline herbland	ASS	N/A	*Sarcocornia quinqueflora* (beaded glasswort) herbfield

Further south, wetlands 332 to 337 are vegetated with communities requiring fresh to slightly brackish water for most of the year, with 332 and 333 believed to retain open water throughout the year (Kirkpatrick and Harwood, 1981).

The vegetation in and around Thirsty and Little Thirsty Lagoons (Wetlands 338 and 1338) is more complex with extensive lacustrine herbfields and margin of *Sarcocornia quinqueflora* saltmarsh. Little Thirsty Lagoon shows much the same pattern of floristic communities. The lacustrine herbfields are

[6] Schedule 3 of the Tasmanian *Nature Conservation Act 2000*
[7] Now known as *Myriophyllum salsugineum* (lake watermilfoil), (Buchanan 2009)
[8] This taxon has been split into *Myriophyllum simulans* (amphibious watermilfoil) and *M. variifolium* (variable milfoil), (Buchanan 2009)

largely comprised of the charophyte *Lamprothamnium*, a plant with the ability to re-establish after periods of drying out or saline to hypersaline conditions.

The south eastern area of ECCBIL supports extensive sedgey heathland interspersed with numerous small wetlands often dominated by *Baumea arthrophylla*.

The ECCBIL includes representative examples of a significant proportion of wetland vegetation communities of Tasmania from highly saline to freshwater, and from mostly inundated to vegetation that is mostly exposed (Figure 3-6 and Figure 3-7). Sixteen species of flora listed on the Tasmanian *Threatened Species Protection Act 1995* have been recorded at the site (Appendix 4). These species occur in different habitats and flora communities within ECCBIL. While some of these species are common on mainland Australia, the species are uncommon in Tasmania and highlight the regional significance of ECCBIL in maintaining the biodiversity in the region. Several of these rare species including: bassian bristlewort (*Centrolepis strigosa* subsp. *pulvinata*),hooded watermilfoil (Myriophyllum *muelleri*), fennel pondweed (*Stuckenia pectinata*) and *Wilsonia rotundifolia* occur in Flyover Lagoon (wetlands 330 and 331), which is distinctive for its deeper, mostly permanent water and alkaline pH. The southern basin is also important for its small spikesedge (*Eleocharis pusilla*) sedgeland community.

Wetland 328 lies over marine calcium carbonate and seasonally dries out. The flora is dominated by species that are tolerant of salinity and desiccation.

Wetland 329 lies over limestone and has a pH of 8. Two floristic communities with a perimeter of low growing forbs and aquatic species adapted to periodic drying out in the open water.

Wetland 330, Flyover Lagoon shares physical characteristics of wetland 329. There are both low growing forbs and aquatic species in the perimeter zone and aquatic species in the open water.

Figure 3-6
Wetlands in the northern end of ECCBIL. For locations see Appendix 2, flora species listed in Appendix 3. Images by C Harwood, 1981, for Kirkpatrick and Harwood (1981) survey

Wetland 334 is located midway down the coast over Quaternary sands. Flora communities are dominated by sedges and rushes, with localised patches of aquatic taxa.

Wetland 341 located in the SW corner of ECCBIL. It is a 33 hectare deflated basin with a conspicuous lunette. Granitic sands underlie up to a 4 metre depth of water. The flora is comprised of freshwater species and *Baumea* is the dominant species.

Wetland 345 is located south of 341 in the coastal swale. Water is retained for much of the year and three wetland zones are evident. Wetland 345 has a high diversity of aquatic species.

Figure 3-7
Wetlands in central and southern ECCBIL. For locations see Appendix 2, flora species listed in Appendix 3. Images by C Harwood, 1981, for Kirkpatrick and Harwood (1981) survey

3.1.4.1 Microflora

Two lagoons in the ECCBIL Ramsar site were sampled as part of an extensive reconnaissance of the limnology of Bass Strait Islands (Rolfe et al. 2001; Walsh et al. 2001). The information from these studies is also considered to be relevant to the ECCBIL wetlands at the time of listing. The lagoons sampled were Flyover Lagoon (Appendix 2, sites 330, 331) in the northern part of ECCBIL and a large lagoon north of Jamieson's Bay (site 341). These lagoons are slightly brackish with low levels of nutrient and moderately dystrophic (Rolfe et al. 2001).

The other lagoon sampled for microflora, a deflation basin near Jamieson's Bay, has an intact lunette on its eastern shoreline clothed with dry scrub (Figure 3-7). The water is clear and brackish (10 420 K25 µS.cm-1) with less aquatic vegetation.

While detailed identification of the microflora (as well as much of the microfauna) has yet to be undertaken, Rolfe et al. (2001) considered that the environmental characteristics of both Flyover Lagoon and the southern lagoon demonstrate attributes that often favour endemic algae and may be important for conservation of such taxa.

3.1.5 Fauna

3.1.5.1 Estuarine invertebrates

The physical features of the estuarine systems are discussed in Chapter 2. No information is available about the estuaries at the time of listing, but it may be assumed that there has been no significant change in the faunal communities since then. A survey of invertebrates was undertaken in 2005, sampling salinity and taking benthic samples at sites in the Thirsty Lagoon system (Appendix 5), (wetland sites 338 and 1338) and at an unnamed estuary to the north west of the mouth of Thirsty Lagoon.

Twenty invertebrate taxa were identified in the estuaries. All of these taxa occurred in Thirsty Lagoon, while only nine taxa were collected in Little Thirsty Lagoon. Most of the nine taxa were also found in the Northern Lagoon (seven in common with Little Thirsty). Chironomid larvae were notably absent from the Northern Lagoon, although they were one of the most abundant taxa at other sites. Other taxa common to all three lagoons included the gastropod molluscs *Batillariella estuarina* and *Ascorbis victoriae*, the bivalve *Arthritica semen*, the amphipod *Paracorophium* sp. and the polychaete worm *Simplisetia aequisitis*.

Some species, including the polychaete worms *Perinereis vallata* and *Clymnella* sp., and the bivalve *Paphies erycinea*, are restricted to sites in lower Thirsty Lagoon, where the salinity was near-seawater. Little Thirsty and the upper reaches of Thirsty Lagoon are dominated by estuarine species, which are tolerant of a range of salinities. Dominant species include *Simplisetia aequisitis, Paracorophium* sp. and *Ascorbis victoriae*. These species can tolerate both very high and very low salinities, often over short time-frames. In addition, they have life-cycles not dependent upon continuity of connection with the ocean and are able to withstand the effects of contraction in the size and depth of the waterbody. These species either have a direct development life history, or for the chironomids, an aerial adult stage.

The coastal lagoons of ECCBIL exhibit similar low faunal diversity as coastal lagoons elsewhere and are depauperate in comparison to Tasmanian meso-tidal estuaries (Hirst et al. 2006). The low species richness is a consequence of the smaller size of the lagoons, paucity of micro-habitat variability and the tendency towards hypersalinity. The ECCBIL also suffer temporary isolation from the ocean,

limiting the capacity for recruitment of species with marine affinities or life-history stages. As the estuaries are shallow, often hypersaline and at times disconnected from tidal influence, it seems unlikely that the estuary is important for fish habitat or breeding.

3.1.5.2 Microfauna

The southern Flyover Lagoon, possibly due to its water chemistry, hosts a high diversity of microfauna. With 28 recorded species, it ranked among the highest of any lagoons on the Bass Strait Islands (Walsh et al. 2001). The range of planktonic taxa in Flyover Lagoon included copepods (calanoid, cyclopoid and harpacticoid), testate amoebae, cladocerans, ostracods, rotifers and small stages of various macroinvertebrates. Walsh et al. (2001) suggest that the presence of *Calmoecia gibbosa* (Copepoda: Calanoidea) at Flyover Lagoon is evidence of a faunal link with north-east Tasmania.

The deflation basin near Jamiesons Bay had a low diversity of microfauna with only five species recorded (Walsh et al. 2001). The calanoid copepod *Calamoecia clitellata*, a species that favours saline conditions, occurs in this lagoon (Walsh et al. 2001).

3.1.5.3 Birds

ECCBIL offers a range of habitats important for waterbirds, shorebirds and migratory waders (Blackhall 1986, 1988; Bryant 2002; Hirst et al. 2006). Blackhall (1986) noted that large numbers of duck (species not specified) had been seen at Flyover Lagoon. Seeds of longfruit watermat (*Lepilaena cylindrocarpa*) in the herbfields of the lagoon are an important food item for black ducks and teal (Blackhall 1986). The surrounding vegetation provides nesting sites for duck. The numerous other smaller lagoons of ECCBIL would also provide some habitat for duck and other waterfowl.

A bird survey of ECCBIL was conducted in March 1996. Sixty-three species of birds were recorded of which 13 are considered wetland dependent (Appendix 6). There are seven species which may potentially breed in the ECCBIL (Appendix 6). Eight migratory species were recorded including the double-banded plover (*Charadrius bicinctus*), red-necked stint (*Calidris ruficollis*), curlew sandpiper (*Calidris ferruginea*), ruddy turnstone (*Arenaria interpres*), crested tern (*Sterna benghalensis),* Caspian tern (*Sterna caspia*), great egret (*Ardea modesta)* and the short-tailed shearwater (*Puffinus tenuirostris*).

No systematic surveys of migratory birds have been conducted at ECCBIL, but Hirst et al. (2006) suggest that the characteristics of Thirsty and Little Thirsty Lagoons offer suitable habitat for stop–off points or summer feeding grounds for such avifauna. The extensive areas of intertidal and shallow subtidal sediments of the Thirsty Lagoons provide important wader feeding habitats (Hirst et al. 2006). Hirst et al. (2006) suggest that "despite high salinities, and evidence of periodic evaporation and drying-out, these lagoons still support high densities of macroinvertebrates that are commonly found among the diets of wading birds" (p22).

Birds migrating further south to sites on the east coast of mainland Tasmania potentially could use the coastal lagoons and estuaries in ECCBIL as stop-over points. Records from nearby Flinders Island, notably in Adelaide Bay on its southern coast, indicate several species of migratory waders, some in numbers exceeding 500, frequent the area (Appendix 4).

Harris and Harris (2002) recorded two species of migratory waders, red-necked stint (*Calidris ruficollis*) and ruddy turnstone (*Arenaria interpres*), on a visit to the east coast of ECCBIL.

While these species are notable, no information on the numbers or frequency of occurrence exists for the ECCBIL.

3.1.6 Critical components and processes

The critical components and processes for the ECCBIL Ramsar site at the time of listing in 1982 have been determined to be:

- Geomorphology,
- hydrology, and
- vegetation types.

While there is some anecdotal evidence that ECCBIL is important for shorebirds, there is insufficient data to evaluate whether they are a critical component. Due to the paucity of data for ECCBIL, there may be critical components, process or services of which we are currently unaware. Further investigation and monitoring of the site is required (refer Chapter 9).

These components have been chosen because they determine, or strongly influence, the ecological character of the site. They have been assessed as critical because:

- they are important determinants of the sites unique character,
- they are important for supporting the Ramsar criteria under which the site was listed,
- change is reasonably likely to occur over the short or medium term (<100 years), or
- if change occurs to them they will cause significant negative consequences (DEWHA 2008).

3.2 Ecosystem benefits and services

The Millennium Ecosystem Assessment provided an assessment of the current state of the world ecosystems and the services they provide to humans (Millennium Ecosystem Assessment 2005). This assessment resulted in a list of recognised services wetlands may provide and forms the basis of assessments of ecosystem services for Ramsar listed wetlands. Ecosystem services provided by the ECCBIL Ramsar site are an important foundation of its ecological character. The relationships between the ecological service and the critical components and processes have been examined to identify the primary drivers of the ecological character of the site and are summarised in Table 3-2.

Table 3-2
Ecosystem services, and related components and processes in ECCBIL

Ecosystem benefit or service	Description	Related component or process
Regulating service		
Coastal shoreline stabilisation	Vegetation associated with the wetlands plays an important role in stabilising the highly dynamic coastal system.	• Flora • Geomorphology, including sediment deposition and retention of soils • Hydrology • Water quality, including groundwater recharge and discharge
Cultural service		
Spiritual and inspirational	ECCBIL has significant cultural value in recent history of the Tasmanian Aboriginal Community and is a place of spiritual and religious significance	• Geomorphology • Hydrology • Flora • Fauna
Supporting service		
Natural or near-natural wetland ecosystems	ECCBIL is a good example of an almost natural coastal wetland system in near pristine condition.	• Flora • Fauna • Geomorphology • Hydrology • Water Quality
Threatened wetland species, habitats and ecosystems	ECCBIL supports rare or uncommon plant species and communities at the limit of their ranges.	• Flora • Fauna • Geomorphology • Hydrology • Water Quality

3.2.1 Regulating services

3.2.1.1 Coastal stabilisation

Vegetation associated with the wetlands plays an important role in stabilising a highly dynamic system. Where sediments are deflated to bedrock or the water table, or sand barriers impede water flow, wet areas form. These areas are gradually colonised by wetland flora species (saline or fresh) which in turn trap more sediments and organics to create a more favourable habitat for other species. Over time some of these wetlands may infill and (depending on salinities or water tables) will then become occupied by other vegetation types present on the coastal plain. These wetlands are often the earliest successional stages in colonising and stabilising the coastal plain.

3.2.2 Cultural services

3.2.2.1 Spiritual and inspirational

Cape Barren Island has a significant place in recent history of the Tasmanian Aboriginal community. No formal assessment of these values within ECCBIL has been documented. Sim and Gait (1992) identified 11 sites on Cape Barren Island which are recorded on the Tasmanian Aboriginal Site Index. These are listed in Department of Premier and Cabinet (2004) and while none lies within ECCBIL, a nearby freshwater wetland is thought to indicate high level of prehistoric occupation.

3.2.3 Supporting services

3.2.3.1 Natural or near-natural wetland ecosystem

ECCBIL is an example of a near natural coastal wetland which contains a suite of different types of wetlands, typical of the temperate Tasmanian Drainage Division. All TASVEG wetland types (mapping units) are found within the site with a total of thirteen separate floristic wetland communities. The wetlands demonstrate the interaction between landform, geology, geomorphic processes (both past and present), climate and rainfall patterns and trends. The dynamics of these vegetation types is maintained as there is no infrastructure or development within boundaries of the site. Due to their remoteness the ECCBIL wetlands have no large scale human disturbances which make them unique within the bioregion.

3.2.3.2 Threatened wetland species, habitats and ecosystems

ECCBIL supports rare or uncommon plant species and vegetation communities at the limit of their ranges. All wetland vegetation in Tasmania is considered to be under threat (Stephen Harris pers. comm.) and four TASVEG wetland types that occur in the ECCBIL are listed as threatened ecological communities under the Tasmanian *Nature Conservation Act 2002* (Table 3-1) and are considered rare in the bioregion.

The ECCBIL Ramsar site is also recognised as a key site for a number of flora species rare or unusual in the Tasmanian Drainage Division (Harris and Magnus 2004). Species of conservation interest recorded from ECCBIL are listed in Appendix 4 along with information on the general location of each species and an account of the importance of the various geomorphic components or wetland habitats where these occur.

Cape Barren Island is of particular importance for tall blown-grass (*Lachnagrostis robusta*); Flyover Lagoons and Little Thirsty Lagoon for round-leaf wilsonia (*Wilsonia rotundifolia*); and Flyover Lagoon for fennel pondweed (*Potamogeton pectinatus*). Whinray (1977) reports the presence of the rare bog club moss (*Lycopodiella serpentina*) within ECCBIL and suggests it may be an Australia-wide stronghold for this species.

Rolfe et al. (2001) and Walsh et al. (2001) reported that two lagoons in ECCBIL supported a diversity of micro-organisms typical of the environmental character of each site. The different environmental profiles of the numerous wetlands present in the ECCBIL provides habitat for different communities of microflora (Rolfe et al. 2001).

3.2.4 Critical ecosystem benefits and services

The critical ecosystem service for the ECCBIL Ramsar site at the time of listing in 1982 has been determined to be:

- *Natural or near-natural wetland ecosystem*. ECCBIL is an example of a near natural coastal wetland which contains a suite of different types of wetlands. The dynamics of the associated vegetation types is maintained because of the absence of human induced disturbance (i.e. there is no infrastructure or development within boundaries of the site) which makes them unique within the Tasmanian Drainage Division. All six TASVEG freshwater and saline wetland types (mapping units) are found within ECCBIL and they are comprised of 13 separate floristic wetland communities.

This service has been selected because it strongly influences the ecological character of the site. It has been assessed as critical because:

- it is an important determinant of the sites unique character
- it is important for supporting the Ramsar criteria under which the site was listed
- if a change was to occur to the wetland, it is reasonably likely to occur over the short or medium term (<100 years)
- if a change was to occur to the wetland, it would cause significant negative consequences (DEWHA 2008).

4. Interactions and conceptual models

The key components and processes that sustain the ecological character of the ECCBIL are shown in Figure 4-1. The absence of human induced disturbance has allowed a range of wetland types, their associated floristic and faunal communities and species of biogeographic significance to persist. The high wetland diversity within a relatively small area and the absence of human induced disturbance are uncommon, especially in temperate climates.

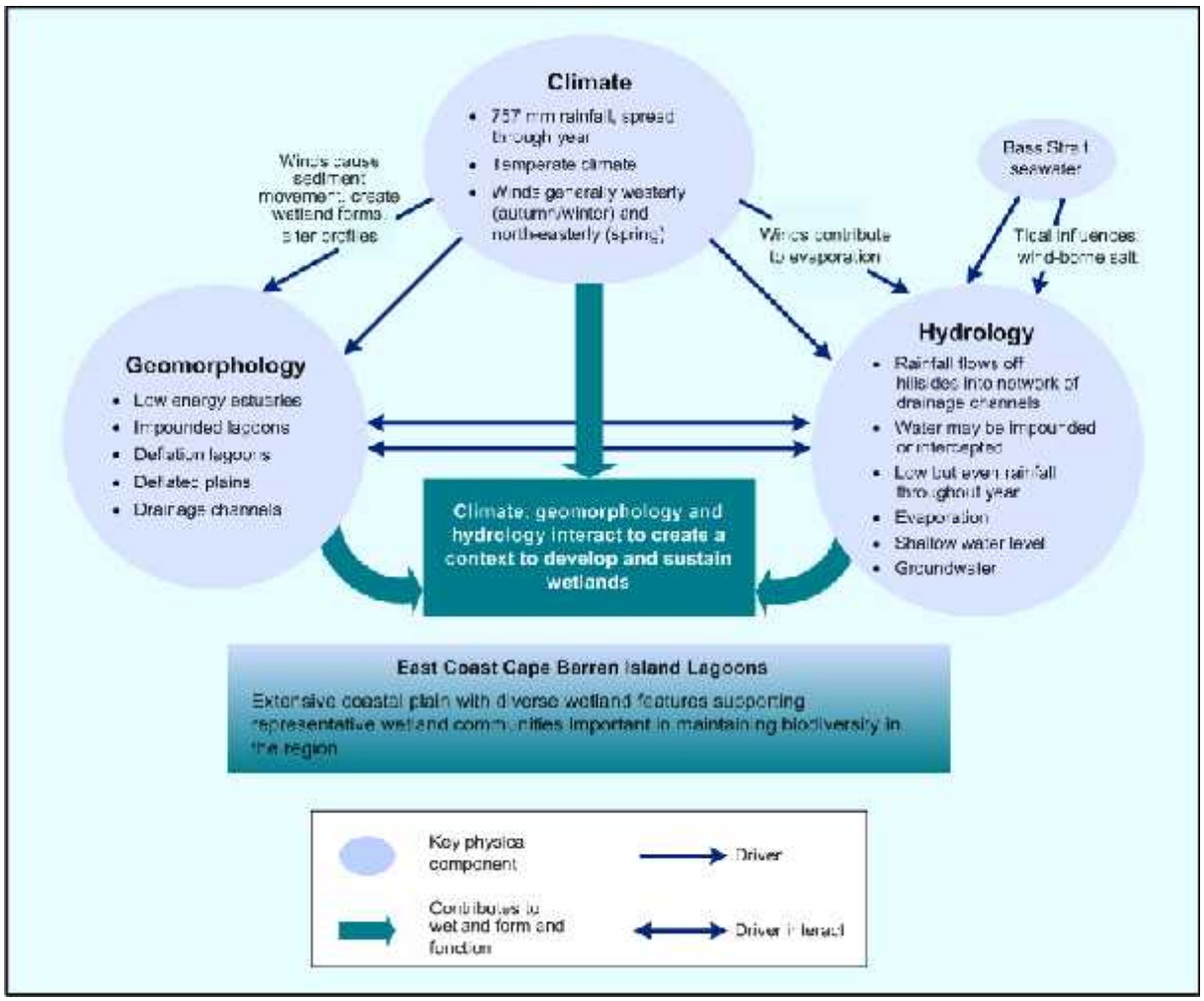

Figure 4-1
Conceptual model of East Coast Cape Barren Island Lagoons

5. Threats to ecological character

ECCBIL retains its ecological character because of the absence of human induced disturbance to its distinctive geomorphology and hydrology. Any significant loss of integrity of the structural and vegetative mosaics that is caused by anthropogenic activity may signal an unacceptable change to the ecological character of the Ramsar site.

The known threats to the ECCBIL Ramsar site are presented in Table 5-1. Note that this table only includes those threats which have the potential to affect the ecological character. For each threat identified, the likelihood (probability) of the threat occurring and timing of the threat (i.e. when the threat will actually result in an adverse impact to the ecological character of the wetland) is also included. The following categories have been used to define the likelihood of a threat occurring:

- Already occurring – threat is currently known to occur
- Almost certain – threat is expected to occur in the short term (one to two years)
- Possible - threat may occur in the short term
- Unlikely - threat not expected in the short term but may occur in medium (three to five years) or long term (greater than five years)
- Rare - threat may only occur in extreme and/or exceptional circumstances.

Davies and Brock (2008) suggest that a 'stressor' or driver model can facilitate recognition of the external drivers that generate stress on a wetland, leading to ecological effects that can irreversibly alter the wetland's values and ecosystem services. A stressor model for ECCBIL has been developed and is shown in Figure 5-1.

Six principal types of threat have been identified for ECCBIL, fire, exotic species (flora, fauna), pathogens, inappropriate 4WD and other human access, climate change and grazing (Table 5-1). At the time of listing, the area was regarded as generally weed-free (Kirkpatrick and Harwood 1981) and human access was very limited. Fire frequency was not sufficiently high as to cause major impact since significant examples of undisturbed fire-sensitive vegetation such as stands of unburnt large Oyster Bay pine (*Callitris rhomboidea*) remained.

The discussion that follows outlines the impacts of these threatening processes and activities, and lists the apparent changes caused by these processes in the ECCBIL since the time of listing.

Table 5-1
Threats to ECCBIL wetland system

Actual or likely threat of threatening activities	Potential impact(s) to wetland components, processes and/ or services	Likelihood	Timing of threat
Fire (increase in intensity and frequency)	• Removal of the vegetation and opening the underlying sediments to destabilisation by wind • Increased fire frequency can cause changes in floristics to more fire-tolerant species • Loss of habitat, flora and fauna	Already occurring	Immediate to medium term
Exotic species – introduction and spread of invasive species such as rabbits, feral turkeys, thistle, marram grass, and gorse	• Competition with native flora and fauna • Reduced habitat (i.e. choking of wetlands, changes in vegetation structure) • Loss of native species	Already occurring	Immediate to medium term
Pathogens	• *Phytophthora cinnamomi* can cause changes to floristics and structure of vegetation communities and potentially result in changes to wetland dynamics • Chytrid fungus *Batrachochytrium dendrobatidis*	Already occurring	Immediate to medium term
Vehicle access – particularly four wheel drives	• Erosion and increased run off • Increased turbidity • Disturbance of native species • Loss of habitat • Loss of native species • Introduction or spread of weed propagules and pathogens such as *Phytophthora cinnamomi*	Almost certain	Immediate to medium term
Grazing	• Increased sediment deposition and turbidity (run off) • Nutrient enrichment • Establishment of weeds • Reduced habitat quality • Change in floristics	Possible	Immediate to medium term

Actual or likely threat of threatening activities	Potential impact(s) to wetland components, processes and/ or services	Likelihood	Timing of threat
Climate change – change in sea level, temperature and rainfall	• May influence wetland physical and chemical processes, groundwater discharge, the diversity of wetland types, wetland biology • Change in the distribution and abundance of flora and fauna • Change in the lifecycles of fauna (e.g. waterbird breeding, macroinvertebrates)	Already occurring	Immediate to long term

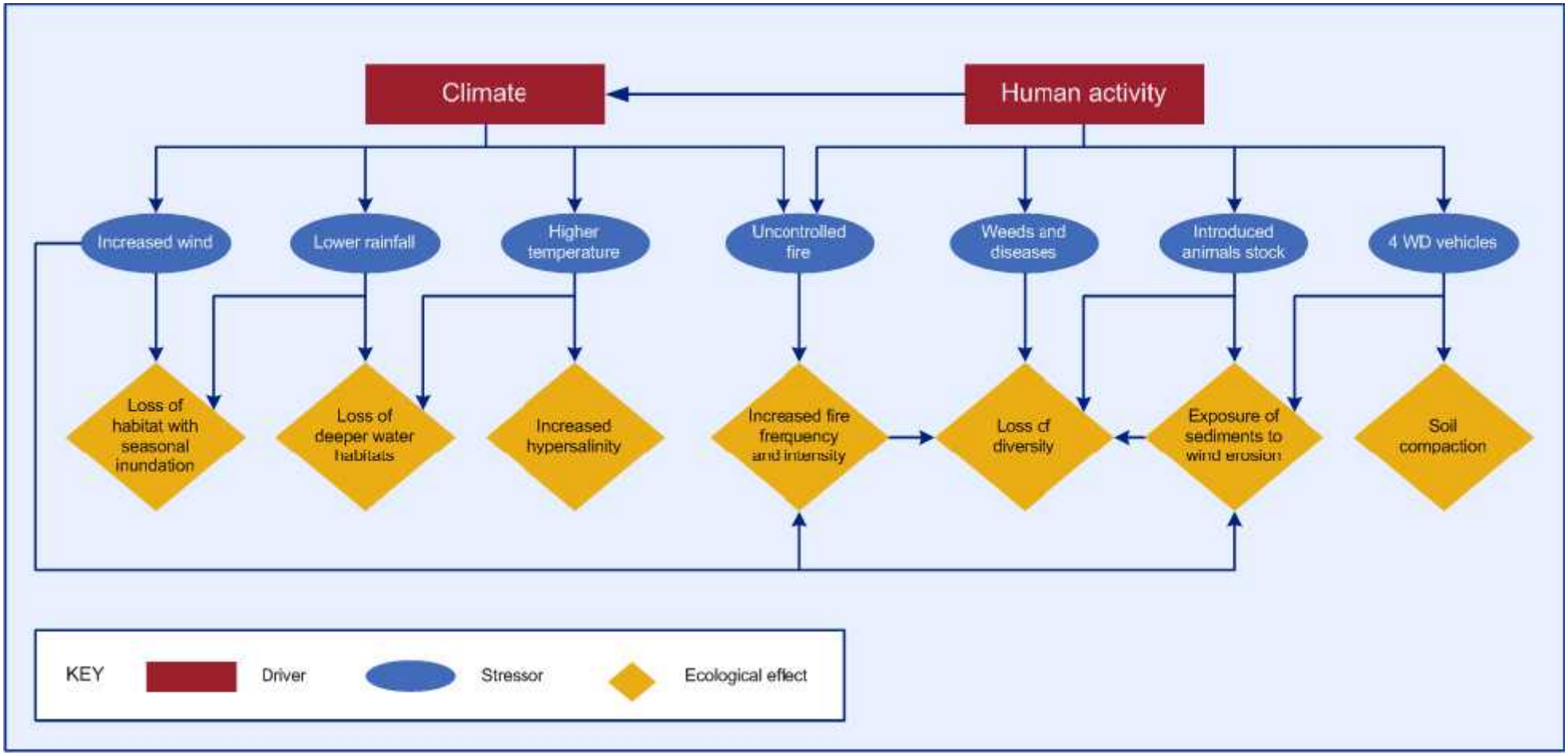

Figure 5-1
Stressor model for East Coast Cape Barren Island Lagoons Ramsar site (after Davis and Brock 2008)

Due to the recent geomorphological process shaping the topography of the ECCBIL, one of the significant threats to the site is large scale destabilisation of the coastline. Typically the process of dune formation begins with the formation of incipient dunes above the high water mark which become vegetated. As the beach progrades, the incipient dunes become foredunes. Alternating sequences of erosion and deposition can lead to multiple dune ridges forming that are separated by swales (depressions); these alternating ridges are referred to as parallel dunes (Bird 2008). Where foredunes and parallel dunes lose their vegetative cover they scour and migrate landward which is known as a blow-out. Blow-outs and mobilising sand dunes can smother vegetation and fill in wetlands. While this can be a natural feature of coastal systems, anthropogenic factors can significantly increase the likelihood and scale of occurrence.

Loss of vegetation cover leading to dune mobilisation is likely to be attributable to:

- excessive fire frequency (anthropogenic)
- impact of introduced species
- inappropriate use of four wheel drives.

5.1 Fire

Fire is a natural and beneficial component of the ecology of the coastal vegetation communities, but the site suffers from inappropriate fire frequencies and unmanaged fire events.

The vegetation of Cape Barren Island has been affected by burning as a consequence of deliberately lit or poorly managed fuel reduction burns, and/or lightning strikes (Perrin 1988). Although some of the vegetation types are adapted to, or dependent upon, a certain fire frequency, some of ECCBIL has burnt with excessive frequency or intensity. As the coastal lagoons are inaccessible with a barrier of densely vegetated ridges to the west, it is not feasible to control a fire moving away from the settlement at the western side of the island. Blackhall (1988) however, notes that 'fires originating from the settlement in the north-west corner of the island do not seem to be a threat to this area' (p19) and suggests that some fires may be consequent upon landings from fishing boats.

The biggest threat to the wetlands from fire is removal of the vegetation and exposure of the underlying sediments to destabilisation by wind.

5.2 Exotic species

Recent years have seen the spread and new invasions of exotic plants, animals and pathogens. Kirkpatrick and Harwood (1981) reported that the area was free of weed species. Since then several exotic plant species have been reported, including thistle (*Cirsium arvense*) (Blackhall 1986), marram grass (*Ammophila arenaria*), gorse (*Ulex europaeus*) and sea spurge (*Euphorbia paralias*) (Harris and Magnus 2004).

Marram grass has extensively colonised the coastal dune system. Sea spurge has been brought by tides and currents and become established. This species generates numerous seeds which are long-lived in the soil seed bank and spreads easily. Hence any attempt to eradicate it must be ongoing. Marram grass and sea spurge can also affect dune dynamics as well as displacing native species such as the dune binding beach spinifex (*Spinifex sericeus*).

Rabbits (*Oryctolagus cuniculus*) were thought to be absent from Cape Barren Island at the time of listing, but in recent years they have been seen close to the settlement and are believed to be extending eastwards towards ECCBIL. Feral turkeys (*Meleagris gallopava*) are now common on Cape Barren Island and their scratching in soil and leaf litter has the potential to impact on litter fauna as well as the regeneration of flora species.

5.3 Grazing

Uncontrolled stock access to wetlands can be a major cause of degradation. While funding for fencing has been provided to fence-off the ECCBIL wetlands from stock access, the current status of the fencing is unknown. In the past stock have been free to access the site and cattle have the potential to trample and eat wetland vegetation, cause siltation and nutrient enrichment and the associated decline in water quality through pugging and defecation.

Stock also increase the potential for spread of weeds and disease through the creation of bareground as well as providing a vector for weed seeds and pathogens.

5.4 Vehicle access

A single bush track from the settlement of Cape Barren reaches the ECCBIL near its northern end. It is only useable by four wheel drive (4WD) vehicles. The track provides access for duck shooters to Flyover Lagoon. Drivers often choose to drive on to the beach, where they drive along the sand. Vehicles cause soil compaction which can impact on drainage patterns and the presence of vehicles may disrupt breeding habitats or nests of shorebirds.

Access by humans also has the potential to introduce and/or spread weed seeds and pathogens such as *Phytophthora cinnamomi*. Some visitors may bring dogs which can harass wildlife.

5.5 Pathogens

The root rot fungus *Phytophthora cinnamomi* has been introduced to ECCBIL although it is not known when it first arrived. Phytophthora is affecting vulnerable flora taxa (Magnus and Harris 2004). *Phytophthora cinnamomi* kills the host plant with consequent changes to vegetation structure and potentially changes to wetland dynamics. It has the effect of reducing a once diverse heathland into sedgeland with the loss of healthy species.

Chytridiomycosis is a fatal disease of amphibians and is caused by the chytrid fungus *Batrachochytrium dendrobatidis.* The disease is a global epidemic and is widespread across Australia (DECC 2009). The fungus invades the surface layers of the frog's skin, causing damage to the keratin layer. Although the disease is known to cause death, the exact mechanism is not known. Although the abundance and community composition of amphibians remains a knowledge gap, chytrid fungus could pose a serious threat to frogs within the site.

5.6 Climate change

The conceptual model of the site, Figure 4-1, demonstrates the significance of climate and its interaction with geomorphology and hydrology, at ECCBIL. The diversity of wetland types and vegetation communities is sustained by this interaction and projected climate changes, such as changes in sea level, an increase in temperature, decline in rainfall and an altered seasonality of rainfall along with an increase in winds can produce cumulative effects. Groundwater recharge will

also be affected. The projected influences (McInnes et al. 2004; McIntosh et al. 2005; Grose et al. 2010) of increasing air temperatures, declining rainfall and increasing wind speeds may extend the duration of dry months over the next twenty five years.

6. Limits of acceptable change

The limits of acceptable change (LAC) are defined in the ECD Framework broadly as the upper and lower bounds of variability for a measure of a particular ecosystem component, process or service (DEWHA 2008). If the particular measure exceeds these bounds (moves outside the limits of acceptable change) this may indicate a significant change in ecological character that could lead to a decline or loss of the values that the site was listed for. LAC are not considered to be management triggers, as management triggers should occur before the LAC are reached to allow management actions to be implemented to limit any change in ecological character. As such, management triggers are not dealt with within the ECD as they would form part of any management plan developed for the site.

Limits of acceptable change have been developed for the critical components, processes and services that have been identified for the site as required by the ECD Framework (DEWHA 2008) and are presented in Table 6-1.

It is expected that where the limits of acceptable change that have been set for these critical components, processes and services are exceeded, this may lead to a change in the ecological character of the ECCBIL Ramsar site. It is noted that for some critical components and processes there is limited baseline information with which to develop quantitative LACs. In these cases it will be noted that there is minimal or no existing data to set a LAC with any level of confidence. This will be treated as a key knowledge gap and recommendations made for monitoring and later development of a LAC when sufficient data is obtained. It is difficult, given the paucity of data for the majority of the critical components, processes and services of the ECCBIL, to determine the natural variability and set LACs for the site.

Additional explanatory notes for Limits of Acceptable Change

Limits of Acceptable Change are a tool by which ecological change can be measured. However, Ecological Character Descriptions are not management plans and Limits of Acceptable Change do not constitute a management regime for the Ramsar site.

Exceeding or not meeting Limits of Acceptable Change does not necessarily indicate that there has been a change in ecological character within the meaning of the Ramsar Convention. However, exceeding or not meeting Limits of Acceptable Change may require investigation to determine whether there has been a change in ecological character.

While the best available information has been used to prepare this Ecological Character Description and define Limits of Acceptable Change for the site, a comprehensive understanding of site character may not be possible as in many cases only limited information and data is available for these purposes. The Limits of Acceptable Change may not accurately represent the variability of the critical components, processes, benefits or services under the management regime and natural conditions that prevailed at the time the site was listed as a Ramsar wetland.

Users should exercise their own skill and care with respect to their use of the information in this Ecological Character Description and carefully evaluate the suitability of the information for their own purposes.

Limits of Acceptable Change can be updated as new information becomes available to ensure they more accurately reflect the natural variability (or normal range for artificial sites) of critical components, processes, benefits or services of the Ramsar wetland.

Table 6-1
Summary of limits of acceptable change

Critical ecological components, processes and services	Baseline condition and range of natural variation where known	Limits of acceptable change* (based on baseline and natural variability)	Basis of LAC	Level of confidence
Critical component and process: **Geomorphology and hydrology** *Critical service:* **Natural or near-natural wetland ecosystem**	There is a diversity and range of Ramsar wetland types which are defined by their geomorphology and hydrology. There is an absence of information relating to the variability in extent and types of wetland around the time of listing	The areal extent of Ramsar wetland types[9] does not change by ±20%, i.e. • estuarine waters (F) ± 20% from 200 hectares • intertidal marshes (H) ± 20% from 44 hectares • coastal brackish/saline lagoons (J and K) ± 20% from 375 hectares • intertidal mud sand or salt flats (G) ± 20% from 55 hectares.	Based on aerial photograph interpretation and geomorphological mapping by Mowling (2007).	Low: Limited confidence in estimates of aerial extent. Limited data on changes to geomorphology, hydrology and vegetation types since time of listing (refer to Chapter 7 of ECD).
Critical component and process: **Hydrology** *Critical service:* **Natural or near-natural wetland ecosystem**	Hydrology as a critical component and service is linked to the geomorphology of the wetland.	As above, this LAC is linked to the geomorphology of the wetland.	As above	As above

[9] Does not include the Ramsar wetland types – rocky shores (D), sand shingle or pebble shores (E), or seasonal/intermittent/irregular/rivers/streams/creeks (N) because the coastal land forms (D) and waterways (N) are natural formations which will not change significantly without human intervention whereas coastal shorelines (E) are likely to have a high natural variability depending on weather conditions (e.g. storm events).

Critical ecological components, processes and services	Baseline condition and range of natural variation where known	Limits of acceptable change* (based on baseline and natural variability)	Basis of LAC	Level of confidence
Critical component **Vegetation types** *Critical service:* **Natural or near-natural wetland ecosystem**	Thirteen different Tasmanian wetland vegetation communities were identified within ECCBIL which corresponds to six TASVEG communities. Sixteen flora species have been recorded on site that are threatened in Tasmania. Vegetation succession is an integral component of the ECCBIL wetlands such that some changes in vegetation communities are normal.	Maintenance of the extant TASVEG vegetation communities on site at time of listing i.e. • lacustrine herbland (AHL) • freshwater aquatic sedgeland and rushland (ASF) • freshwater aquatic herbland (AHF) • saline aquatic herbland (AHS) • saline sedgeland/rushland (ARS) • succulent saline herbland (ASS). .	Based on the limited available vegetation data i.e. TASVEG mapping, the Kirkpatrick and Harwood (1981) survey and expert opinion.	Low: Not confident in the data and not confident that this will represent a change in ecological character. Limited information about the variability in extent and condition of the vegetation types since the time of listing is available. Difficult to describe baseline condition and variability (refer to Chapter 7 of ECD).

- Exceeding or not meeting a LAC does not automatically indicate that there has been a change in ecological character.

7. Current ecological condition

7.1 Changes and trends since 1982

The limited information available on ECCBIL, particularly on changes to geomorphology, hydrology and vegetation types, makes an assessment of changes to the ecological character difficult. Little data is available either from the time of listing or more recently to be able to determine any changes since listing. However, based on the remoteness and relatively undisturbed nature of the site, it is considered that the site has largely remained unchanged since the time of listing in 1982 and has retained its ecological character. Anecdotal evidence of changes to exotic species and grazing is available and is presented below.

7.1.1 Exotic species and pathogens

One change noted by the few people to have visited the site is the increase in distribution and invasion by weed species. However, the weed invasion is at a low level on a landscape scale rather than significantly impacting directly on the wetlands themselves. At this stage it is considered unlikely to be having a significant effect on individual wetlands. Weeds that invade dried out wetlands tend not to thrive once the wetlands become inundated again, however the margins of wetlands may be severely degraded by weed species. More information in regard to the presence and extent of weeds is needed to better document any changes since listing.

Phytophthora cinnamomi is thought to have spread to ECCBIL since listing, mainly because its effects have become more apparent. The impact of *Phytophthora cinnamomi* on the wetland vegetation is unknown.

7.1.2 Grazing

The northern area of ECCBIL has had a long-term grazing lease used for cattle grazing. The cattle have roamed freely across the site, trampling around wetlands. Since the listing of the site, attempts have been made to reduce these impacts. Natural Heritage Trust funding was provided to the lessee in 2002 to fence the areas used for grazing and prevent livestock from straying into the wetland areas (Department of Premier and Cabinet 2004). In addition, part of the lease area has been revoked but the effectiveness of these measures is unknown. Lease arrangements since the transfer of ownership from Crown Land to the Aboriginal Land Council of Tasmania are unclear and await resolution.

Specific changes thought to have had some impact on the condition of the ECCBIL are discussed within the context of the threats to the wetlands in Section 5. As far as it is possible to assess, the impacts noted to date have not altered the overall ecological character of the ECCBIL. Nevertheless, given the likelihood of changing climatic conditions combined with these threats, there is the potential for irreversible damage to the wetland system. Such changes could include rises in sea level, increasing storm surges, lower rainfall or changing rainfall patterns and increasing windiness.

8. Knowledge gaps

The knowledge gaps identified during preparation of this ECD are presented in Table 8-1. The knowledge gaps are linked to components, processes or services that describe the ecological character of the ECCBIL Ramsar site. Where possible the knowledge gaps have been prioritised (high, medium, low) based on their importance to understanding critical components, processes or services of the ecological character and determining limits of acceptable change or major threats. Those knowledge gaps that have been identified as high (i.e. directly related to critical components or processes, or major threats) which can be addressed through monitoring are discussed further in Chapter 9.

Information about ECCBIL is limited; there have been no systematic surveys of components of the wetland ecosystems other than the survey of 24 wetlands. Information on the biota of the wetlands is limited to three studies confined to a few sites (Rolfe et al. 2001; Walsh et al. 2001, Hirst et al. 2006) and collation of bird records.

Table 8-1
Knowledge gaps identified for the ECCBIL site

Component, process, service, threat	Sub – component/ process/ service/ threat	Identified Knowledge Gap	Recommended action	Priority
Components and processes				
Geomorphology	Soil types and geomorphological features	Accurate information on soil types and geomorphic features including dune process mapping.	Surveys, characterisation and mapping Aerial photographic interpretation of extent of soil types, geomorphological features and wetland types	High
	Coastal stabilisation	The extent of, and any damage caused by, grazing and human activity (e.g. 4WDs).	Map and monitor formed tracks or accessible routes to ensure that no further routes develop into the wetlands and beach habitats. Monitor levels of human use of the area (including the shorelines).	Medium

Component, process, service, threat	Sub – component/ process/ service/ threat	Identified Knowledge Gap	Recommended action	Priority
Hydrology	Hydrology of wetland types	Hydrological information associated with wetland types.	Hydrological survey and monitoring.	High
Flora	Species and vegetation communities	Accurate TASVEG vegetation mapping. Detailed inventory of vascular and non-vascular flora, including mapping of the distribution of threatened species. Data on micro-flora of the wetlands.	Ground-truth vegetation mapping to validate distribution of communities and important species; including weeds. Aerial photography interpretation of extent vegetation types.	High
Fauna	Species and habitats	Detailed inventory of native vertebrate fauna (mammals, reptiles, frogs and fish) including mapping of the distribution of threatened species. Data on invertebrate fauna	Surveys, identification and mapping of important species, including invertebrate fauna.	Low
	Birds	Regular monitoring of birds (migratory and other) utilising the site.	Develop systematic records of the use of the site by resident and migratory waterbirds.	Low
Services				
Cultural	Aboriginal	Aboriginal heritage values	Assessment of Aboriginal heritage values. To be done in conjunction with ALCT and the CBIAA.	Medium

Component, process, service, threat	Sub – component/ process/ service/ threat	Identified Knowledge Gap	Recommended action	Priority
Threats				
Fire	Fire regime	Fire history of the area	Fire frequency, intensity, source of ignition and area should be recorded and compared with the appropriate fire regime (see below).	Medium
		Identification of an appropriate fire regime.	Develop a fire management plan which includes an appropriate fire regime which maintains flora and fauna values.	High

9. Monitoring needs

Monitoring recommendations to measure changes in the ecological character of the ECCBIL are outlined in Table 9-1. The recommendations are targeted at measuring changes in those critical components and processes or major threats that may indicate a change in ecological character is occurring.

The monitoring required has also been designed to provide baseline information for the knowledge gaps identified in the previous section.

Aerial photography and mapping of the wetlands (Figure 3-1) will provide a baseline against which change in wetland type can be monitored. An analysis of aerial images at ten-yearly intervals should be sufficient to provide evidence of change. However, more frequent mapping may be required should there be indications that potential damaging processes are occurring.

Table 9-1
Monitoring requirements and actions for the ECCBIL to address knowledge gaps

Overarching component, process, benefit, service or threat	Specific component, process, benefit, service or threat	Objective of monitoring	Indicator/ measure	Frequency	Priority
Components and processes					
Geomorphology	Coastal stabilisation	To determine the impact of human activity on dune stabilisation and the wetlands.	• Land form classification and extent of disturbance • Use GIS mapping and aerial photographic interpretation • Focus on areas with high risk/frequency of use.	Every five years	Medium
Biota	Wetland vegetation	To evaluate the distribution of vegetation communities and important species to enable the monitoring of changes from the baseline.	• Ongoing on-ground vegetation survey and community boundary mapping. • Aerial photograph interpretation, photo-monitoring of site. • Vegetation Condition Assessments. • Threatened species/ community mapping and verification. • Weed mapping.	Every five to ten years	High

Overarching component, process, benefit, service or threat	Specific component, process, benefit, service or threat	Objective of monitoring	Indicator/ measure	Frequency	Priority
	Birds	To develop a systematic record of the use of the coastal habitats by resident and migratory waders.	• Presence/ absence of resident waterbird species (and migratory) • Presence/ absence of migratory waterbird species • Numbers of breeding pairs • Habitat for breeding • Number of nests • Feeding/ foraging habitats.	Annual bird counts (including during the breeding season)	Medium
Services					
Cultural	Aboriginal spiritual associations	To monitor the levels of human use of the area (including the shorelines) and establish appropriate levels and uses of the area. To be done in conjunction with ALCT and the CBIAA.	• Presence/ absence of culturally significant areas • Community use of areas • Number of visitors and intention of visit (i.e. cultural).	Every five years	Medium
Threats					
Natural system modification	Fire	To determine the fire frequency, intensity, source of ignition and risk on site.	• Fire boundary mapping	Bi-annually (seasonal, dry season)	High

10. Communication and education messages

The Ramsar Convention established a Program of Communication, Education and Public Awareness 2003-2008 to raise awareness of wetland values and functions. In response to this, Australia has established the Wetland Communication, Education and Public Awareness (CEPA) National Action Plan 2001-2005. Australia's National Action Plan provides an umbrella for coordinated activities across Australia.

There is currently no public interpretation of the ECCBIL Ramsar site.

Developing a mechanism for ongoing discussions with the Cape Barren Island community, as part of the National Action Plan, would address the following issues including:

- Aboriginal community involvement and participation in the management of the Ramsar site and ongoing research and monitoring work.
- Integration of management actions.
- Minimising threats associated with use of the site – such as Phytophthora, Chytrid and soil or dune erosion.
- Development of specific management plans for dealing with events such as wildfires, damage from vehicles, or disease.
- Promoting the values for which the site was listed.

Community support is critical to good management, especially in the case of Cape Barren Island, where ownership has passed to the CBIAA. Aboriginal people on Cape Barren Island have indicated that they would like to be actively involved in ongoing management. It is important to work closely with both the Aboriginal community and Government organisations to ensure consistency between management plans, site plans and the municipal planning scheme.

11. Glossary

Acceptable change	The variation that is considered 'acceptable' in a particular measure or feature of the ecological character of a wetland. Acceptable variation is that variation that will sustain the component or process to which it refers. See "Limits of Acceptable Change".
Aerosols	Air-borne suspended particles (of salt).
Alluvial	Pertaining to alluvium, or material transported by flowing water.
Barred estuary	Estuary with a sand-bar at the mouth, which may or may not close off the exchange of water.
Baseline	Evidence at a starting point.
Biogeographic region	A scientifically rigorous determination of regions as established using biological and physical parameters such as climate, soil type and vegetation cover. For example IBRA, or Drainage Division.
Biological diversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species (genetic diversity), between species (species diversity), of ecosystems (ecosystem diversity), and of ecological processes.
Brackish	Water containing salt. Normally a mixture of fresh water and sea water.
Catchment	The total area draining into a river, reservoir, or other body of water.
Change in ecological character	The human-induced adverse alteration of any ecosystem component, process, and/or ecosystem benefit/service (Ramsar Convention 2005a, Resolution IX.1 Annex A).
Chironomid	Chironomidae is a family of small flies (midges) with aquatic larval forms, common in fresh and brackish water.
Community	An assemblage of organisms characterised by a distinctive combination of species occupying a common environment and interacting with one another (ANZECC and ARMCANZ 2000).
Community Structure	All the types of taxa present in a community and their relative abundances (ANZECC and ARMCANZ 2000).
Conceptual model	A summary, often diagrammatic, to express ideas about components and processes and their interrelationships.
Deflation	The process by which wind removes dry, loose sand, silt and clay form the land surface.
Dendritic drainage	Drainage pattern which develops as a random network because of the absence of structural controls.
Deposition	The dropping of material which has been picked up and transported by wind, water, or other processes (Ryan et al. 2003).
Dystrophic	Low in available nutrients.
Ecological	The combination of the ecosystem components, processes and

character	benefits/services that characterise the wetland at a given point in time.
Ecological communities	Any naturally occurring group of species inhabiting a common environment, interacting with each other especially through food relationships and relatively independent of other groups. Ecological communities may be of varying sizes, and larger ones may contain smaller ones (Ramsar Convention 2005b).
Ecosystem Components	The separate physical, chemical and biological parts of a wetland ecosystem.
Ecosystem Processes	The changes, reactions and interactions which occur naturally within ecosystems.
Ecosystem Services	The benefits that people receive or obtain, directly or indirectly, from an ecosystem.
Endemic species	A species that originates and occurs naturally in a particular limited area.
Evaporative basin	Shallow depression in landscape from which any open water is prone to evaporate.
Felsic	Light-coloured rocks with an abundance of quartz-type material.
Fluvial geomorphology	The study of water-shaped landforms and processes.
Floristic community	Clearly definable assemblage of plant species derived from quantitative analysis of plot data.
Granitoid	Derived from granite rocks.
Groundwater	Water occupying cracks, pores and other spaces below the surface.
Holocene	Most recent geological epoch up to the present.
Hypersaline	Water with a high concentration of salt (Ryan et al. 2003) greater than 40 ppt.
Impounded lagoon	Lagoon constrained by a barrier such as a dune.
Introduced (non-native) species	A species that does not originate or occur naturally in a particular area.
Inundation	The condition of water occurring above the surface, (Brinson, 1993).
Lacustrine herbfield	Sward of small ground-hugging plants on the fringes of standing water usually wet and sometimes inundated.
Limits of Acceptable Change	The variation that is considered acceptable in a particular measure or feature of the ecological character of the wetland without indicating change in ecological character which may lead to a reduction or loss of the values for which the site was Ramsar listed.
Limnology	Study of chemical, physical and biological features of lakes and waterways.
Lunettes	Crescent-shaped ridge of sand on the rim of a lake caused by the effect of prevailing wind.

Meso-tidal	Estuary where tides have a strong, but not necessarily dominant, influence on the estuarine environment.
Microflora	Plants only visible with a microscope.
Monitoring	The systematic collection of information over time intervals to provide evidence of any change.
Parabolic dune	Curved dune with the horns pointing upwind, usually caused by blow-out of the dune.
Planktonic species	Very small plants and animals that dwell in the water column.
Pleistocene	Geological epoch preceding the Holocene.
Polychaetes	Marine bristle worms.
Prograde	The outward building of a sedimentary deposit, such as the seaward advance of a delta or shoreline (Ryan et al. 2003).
Prograding	Outward building of a sedimentary deposit, such as the seaward advance of a delta or shoreline.
psu	Practical Salinity Units – an expression of salinity based on water temperature and conductivity.
Quaternary	Youngest geological period comprising the Holocene and Pleistocene epochs, from about 2 million years ago to present.
Ramsar Convention	Convention on Wetlands of International Importance especially as Waterfowl Habitat. Ramsar (Iran), 2 February 1971. UN Treaty Series No. 14583. As amended by the Paris Protocol, 3 December 1982, and Regina Amendments, 28 May 1987. The abbreviated names "Convention on Wetlands (Ramsar, Iran, 1971)" or "Ramsar Convention" are more commonly used [http://www.ramsar.org/].
Ramsar Criteria	Criteria for Identifying Wetlands of International Importance, used by Contracting Parties and advisory bodies to identify wetlands as qualifying for the Ramsar List on the basis of representativeness or uniqueness or of biodiversity values. [http://www.ramsar.org/].
Ramsar Information Sheet (RIS)	The form upon which Contracting Parties record relevant data on proposed Wetlands of International Importance for inclusion in the Ramsar Database; covers identifying details like geographical coordinates and surface area, criteria for inclusion in the Ramsar List and wetland types present, hydrological, ecological, and socioeconomic issues among others, ownership and jurisdictions, and conservation measures taken and needed.
Ramsar List	The List of Wetlands of International Importance [http://ramsar.wetlands.org/].
Ramsar Site	A wetland designated by the Contracting Parties for inclusion in the List of Wetlands of International Importance because they meet one or more of the Ramsar Criteria [http://ramsar.wetlands.org/].
TASVEG	Classification and mapping of vegetation communities in Tasmania.
Threatened species	A species that is scheduled under legislation according to established criteria of status or risk.

Transgressive dunes	Dunes that have been driven in the direction of the prevailing wind.
Wetlands	Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres (DEWHA 2008).

12. References

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Personal communications

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Appendix 1: Ecological Character Description method

This Ecological Character Description has been prepared by Entura. A previous draft of an ECD was prepared by H. Dunn and F.A. Mowling and submitted to the Department of Environment and Water Resources in June 2008. The current ECD builds on the previous work done in 2008 and incorporates comments made by Roger Jaensch (Wetlands International) on the 2008 ECD. The ECD follows the *National Framework and Guidance for Describing the Ecological Character of Australia's Ramsar Wetlands* (DEWHA 2008).

Specific information on the biology of the ECCBIL wetlands is extremely limited. Some of the vegetation data is based of vegetation mapping from aerial photography that has not been ground truthed. No systematic on-ground survey across the entire site (which could validate the TASVEG mapping) has been undertaken. A previous attempt to ground truth site information was made in 2008 but was unsuccessful due to inclement weather.

Materials, resources and data used to compile this ECD were drawn from: air photos, TASVEG mapping, published literature, research studies, informal surveys and personal communications.

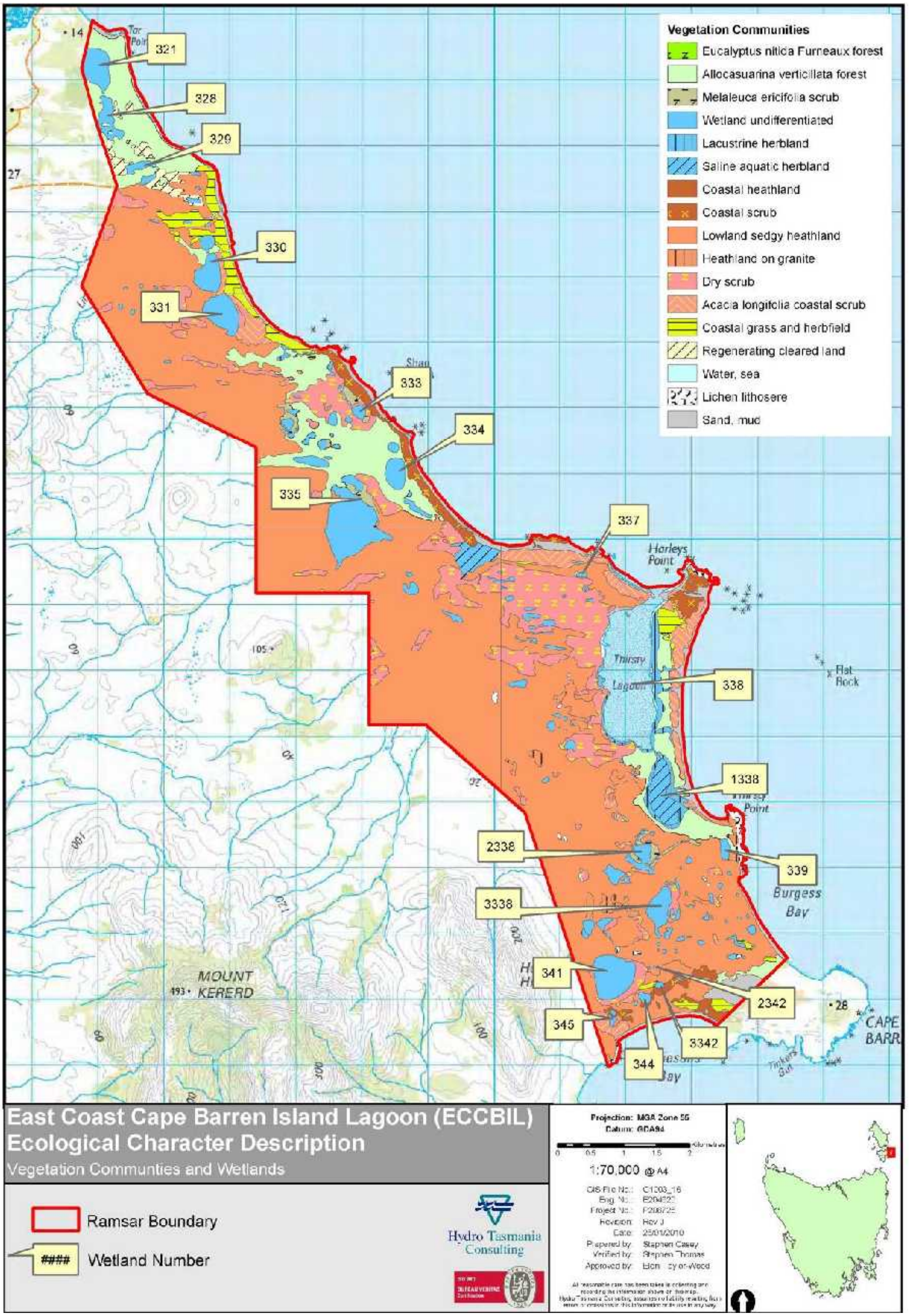
A single, one-off extensive survey of the wetland vegetation communities of a number of individual wetlands was undertaken in 1981, providing a record of 24 individual wetlands at the time of listing. This resulted in the Ramsar listing of ECCBIL, largely for some rare wetland communities and flora species. This survey has not been repeated or extended to encompass all wetlands and saltmarsh communities that were included within the site's boundaries. There is an absence of invertebrate fauna data from the wetlands, with the exception of a one-off survey of some small estuaries, limiting the description of this component within the site. Birds, usually strongly associated with wetlands, have also only been documented in a few passing comments, with little or no reference to habitats or ecology and records of bird life are sparse, sporadic and opportunistic. A study of microflora was conducted around the same time, however was limited as there were only two sites investigated.

Weather data were inferred from the closest recording station located on nearby Swan Island.

The ECD commences with a detailed description of this context and proceeds to describe the characteristics of the variety of wetland communities that arise in response to the interaction between these key drivers. Interpretation of the vegetation drawn from air photos and vegetation mapping was used to confirm geomorphic assessment of topographic features and wetland forms. While these descriptive components can be assembled from several sources of evidence, the processes that sustain the wetlands can only be inferred.

No specific sites of Aboriginal significance have been recorded in ECCBIL, although the entire island is Aboriginal land and is important to present-day Aboriginal peoples. The absence of an Aboriginal heritage assessment is a major constraint for the ongoing management of the site. To date, the Cape Barren Island Aboriginal Association has not been consulted as part of this ECD, nor has there been an Aboriginal heritage assessment undertaken for this area.

Appendix 2: Vegetation of the ECCBIL Ramsar Site and location of wetlands surveyed by Kirkpatrick and Harwood (1981)



Appendix 3: Flora species records for selected wetlands in ECCBIL (Kirkpatrick and Harwood 1981)

		Chenopodium glaucum	Suaeda australis	Sarcocornia quinqueflora	Angianthus eriocephalus	Cirsium vulgare	Cotula coronopifolia	Leptinella longipes	Leptinella reptans	Senecio quadridentatus	Wilsonia backhousei	Wilsonia rotundifolia	Crassula helmsii	Drosera pygmaea	Sebaea albidiflora	Villarsia reniformis	Goodenia humilis	Selliera radicans	Myriophyllum spp.	Myriophyllum salsugineum	Gonocarpus micranthus	Haloragus myriocarpa	Utricularia dichotoma	Utricularia laterifolia	Lobelia alata	Pratia irrigua
321	no data																									
328		1,1,	1,	1,2	1,	2,+,	0,+,		1,			1,1,						2,+,								
329									1,	?	1,						1,+,	1.		2,3,					1,	2,1
1329																	2,	1,		0,0,2,		0,1,2,			1,	1,3,1,
330		1,		0,1,		+,			2,			,+,		1,	1,		+,	2,				0,1,				0,1,
331									1,					1,			1,	1,		1,1,			+,			1,
332									1,					1,			1,	2,						+,	1,	
333														+,		+,	1,	1,								1,
334									2,		+,					2,+,										+,
335																1,2,				1,4,						
336	no data																									
337									1,							0,1,	1,	1,							1,	1,
338			1,	0,1,				1,			1,							1,								
339														1,		0,1,	1,	2,								
340									1,		+,					+,	1,	1,	1,						1,	1,
341														1,			1,	1,					+,		+,	
344														+,			1,	1,								
345														1,			1,				1,		+,			0,2,2

site number	Myoporum insulare	Melaleuca ericifolia	Epilobium spp.	Samolus repens	Acaena novae-zelandiae	Limsoella lineata	Mimulus repens	Centella cordifolia	Eryngium vesiculosum	Hydrocotyle muscosa	Lilaeopsis brownii	Viola hederacea	Aphelia spp.	Centrolepis fascicularis	Centrolepis polygyna	Centrolepis strigosa	Baumea arthrophylla	Baumea juncea	Eleocharis acuta	Eleocharis pusilla	Eleocharis sphacelata	Gahnia trifida	Lepidosperma longitudinale	Schoenus fluitans
321																								
328									1,					1,1				1,				1,		
329		3,	1,	1,			2,1,	1,	1,		0,2,2	1,		+,			1,	1,	0,1,	0,2,2,		+,	2,	
1329		1,							1,		1,2,2,			1,						0,2,2,				
330		1,		1,			1,1,	+,	2,	1,	1,1,			1,	+,			1,	+,	1,1,				
331		1,				1,	1,		1,	2,	1,			1,		1,				3,1,				
332		3,							1,															
333									1,	1,	1,					1,		2,		+,			2,	
334	1,	+,		1,	+,			1,			0,+,						,+,	1,				4,		
335		4,`,						1.			1,						2,2,				0,1,		+,	
336																								
337				1,				1,	1,	2,							1,4,	1,				1,	1,	1,
338		1,		0,1,							1,							1,						
339		1,						1,	1,	1,	1,						0,4,	1,					1,	1,1,
340				1,				1,	1,	1,	1,			1,			1,5,	1,						2,
341								1,						1,			1,	1,				+,	1,	
344													+,			0,1,	2,1,	1,						
345		1,							1,	1,2,	0,1,1			1,			0,+,+,			2,1,				

Site number	Schoenus maschalinus	Schoenus nitens	Isolepis cernua	Isolepis fluitans	Isolepis inundata	Isolepis nodosa	Isolepis producta	Schoenoplectus pungens	Agrostis avenacea	Deyeuxia quadriseta	Distichlis distichophylla	Poa labillardierei	Polypogon monspeliensis	Sporobolus virginnicus	Zoysia macrantha	Juncus articulatus	Juncus caespiticus	Juncus krausii	Juncus pallidus	Trichoglochin procera	Triglochin striata	Potomageton sppp.	Potomageton pectinatus	Ruppia polycarpa	Lepilaena spp.	Lepileana cylindrocarpa
321																										
328		2,							1,1,		1,		1,					2,+,			1,1,				0, 1,	
329		2,	1,							1,							0,1,	1,			0,1,		0,1,	0,0,1		0,0,2
1329		2,					,2,											1,			1,					0,0,3
330								1,	1,	1,			1,					1,			1,					0,2,
331		1,			+			1,	?	1								1,	1,		1,					0,2,
332			1,		1,		1.1.		0,1,											0,1,						
333			1,							1,						1,				+,						
334		1,				,+,			1,			,+,			+,			3,1,						0,1,		
335							4,2,											+,								
336																										
337		3,							1,									2,			1,	1,2,				
338		2,									2,				1,			2,1,								
339	1,	2,	1,				0,+,													0,1,	1,	0,1,				0,1,
340		2,	1,																		1,	1,1,				
341			1,																							
344		1,							+,					+,							+,					0,1,
345		1,		0,1,	0,1,				1,												1,	0,0,2,				0,0,1

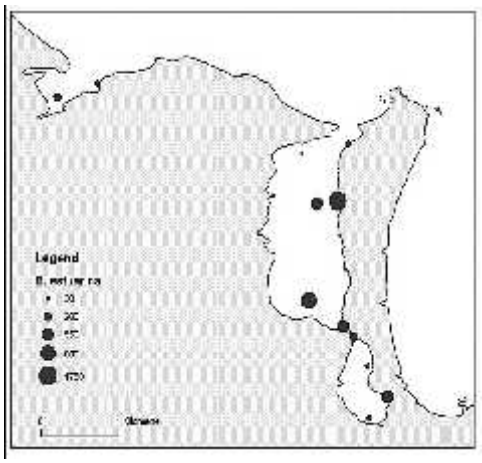
Appendix 4: Plant species of conservation interest in ECCBIL

Species	Common name	Status	Location and other information.
*Centrolepis strigosa subsp. pulvinata**	Scarce Centrolepis	r	Flyover Lagoon, endemic to Tasmania, restricted to the Furneaux Islands
*Haloragis myriocarpa**	Prickly raspwort,	r	Northern part of site
Lachnagrostis robusta	Tall blown-grass	r	Bay / estuary north of Thirsty Lagoon
*Lepidosperma forsythii**	Stout rapier sedge	r	Coastal wet heath / sedgeland, just south of the most northerly lagoons
*Leucopogon esquamatus**	Swamp beard heath	r	Moist heathland in deflation plain west of Thirsty Lagoon
*Myriophyllum muelleri**	Water milfoil	r	Flyover Lagoon, north of Little Creek
*Pomaderris paniculosa subsp. paralia**	Shining Pomaderris	r	Southern part of site, near coast at Jamieson's Bay
Stuckenia pectinata	Fennel pondweed	r	Flyover Lagoon, north part of site, in fresh or brackish water less than two metres deep
Wilsonia rotundifolia	Round-leaf wilsonia	r	Flyover Lagoon, & Little Thirsty Lagoon, northern section of site
Sporobolus virginicus	Salt couch	r	Southern section of site, near coast at Jamieson's Bay
*Hakea ulicina**	Furze hakea	v	Species at limit of range, near Wetland 341 south part of site
*Isopogon ceratophyllus**	Horny cone bush	v	Species at limit of range on drier slopes of the western perimeter of ECCBIL site
*Chrysocephalum baxteri**	Fringed everlasting	r	In dunes north of Jamiesons Bay
Aphelia sp	Fanwort	r	Inhabits damp, sandy ground and wet places In dunes north of Jamieson's Bay
*Utricularia tenella**	Pink bladderwort	r	Wetland 344
Tricostularia pauciflora	Needle bog sedge	r	South of Little Thirsty Lagoon

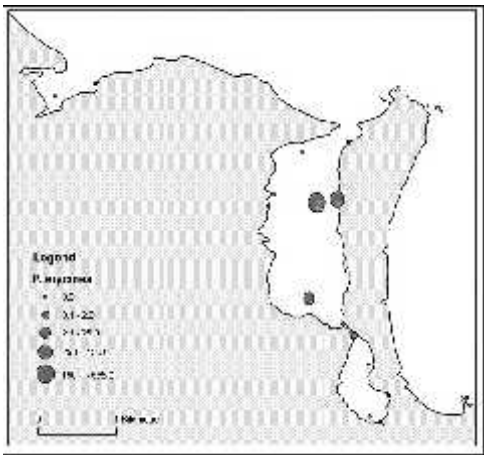
Shaded species are not wetland species and are found outside wetland areas.
r = Rare v =Vulnerable (*Threatened Species Protection Act 1995*)
*= Species considered to be edge-of-range and confined to far north eastern Tasmania and Bass straight Islands
Kirkpatrick and Harwood (1981) recorded *Aphelia* sp. as rare. There are two *Aphelia* spp, both considered rare in Tasmania. The identity of the ECCBIL record has not been confirmed.

Appendix 5: Invertebrate fauna of Thirsty and Little Thirsty Lagoons

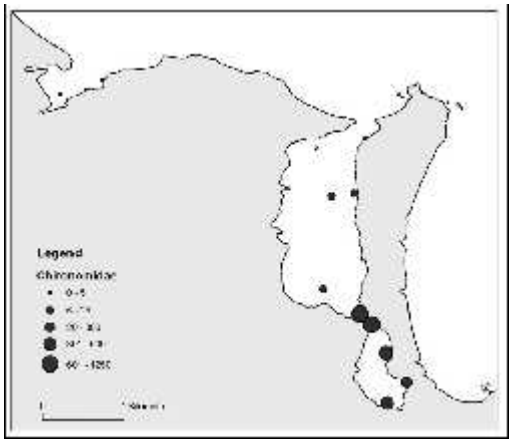
Densities (no of individuals per square metre) of selected faunal species at in Thirsty and Little Thirsty Lagoons (Hirst et al. 2006).



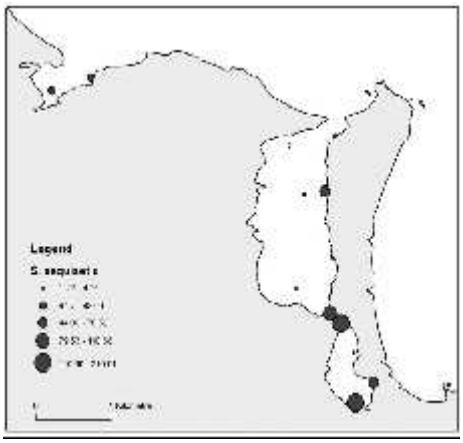
Gastropod (*Batillariella estuarine)*



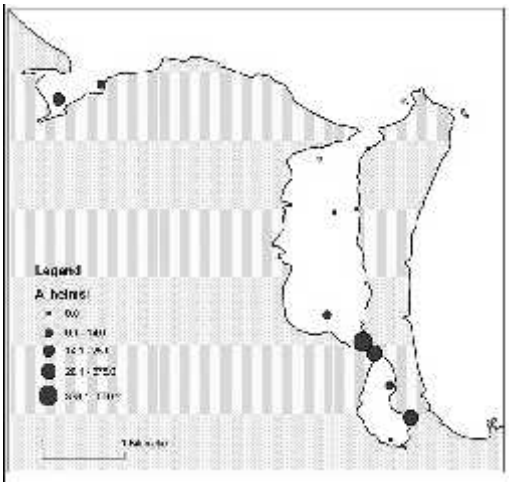
Bivalve (*Paphies erycinea*)



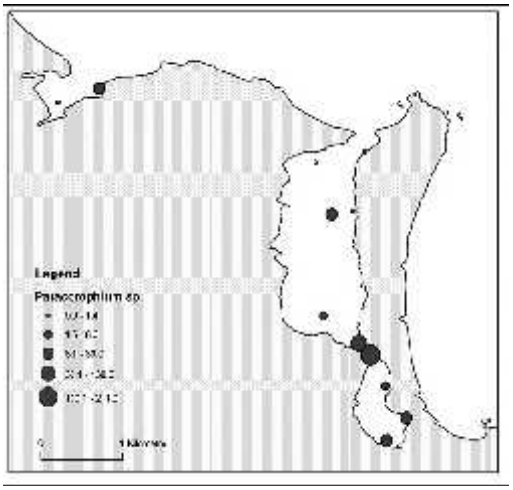
Chironomidae insect larvae



Polychaete worm (*Simplisetia sp.*)



Bivalve (*Arthritica semen*)



Amphipod (*Paracorophium sp.*)

Appendix 6. Bird records

Bird records at Eastern Cape Barren Island wetlands, field survey 23-25 March 1996. (Department of Primary Industry and Water 1996 file #502972). Population comments from Bryant (2002).

Name	Comments
Red-capped plover *(Charadrius ruficapillus)**	
Double-banded plover *(Charadrius bicinctus)**	Migratory, small population
Hooded plover *(Thinornis rubricollis)**	Declining population
Red-necked stint *(Calidris ruficollis)**	Migratory declining population
Ruddy turnstone *(Arenaria interpres)**	Migratory, declining nationally
Curlew sandpiper *(Calidris ferruginea)**	Migratory
Knot (unspecified) *(Calidris sp.)**	
Masked lapwing *(Vanellus miles)*	
Banded lapwing *(Vanellus tricolor)*	Low numbers
Sooty oystercatcher *(Haematopus fuliginosus)*	Low numbers
Pied oystercatcher *(Haematopus longirostris)*	Declining population
White-fronted chat *(Epthianura albifrons)*	
Pacific gull *(Larus pacificus)*	Small population
Silver gull *(Larus novaehollandiae)*	
Crested tern *(Sterna bergii)*	Migratory
Caspian tern *(Sterna caspia)*	Migratory
Short-tailed shearwater *(Puffinus tenuirostris)*	Migratory
Little penguin *(Eudyptula minor*)	Requires monitoring
White-bellied sea eagle *(Haliaeetus leucogaster)**	Migratory, vulnerable in Tasmania
Wedge-tailed eagle *(Aquila audax)*	Endangered Nationally
Peregrine falcon *(Falco peregrinus)*	
Spotted owl *(Strix occidentalis)*	
Great egret *(Ardea alba)*	Migratory
Large black cormorant *(Phalacrocorax sp.)**	
Black-faced cormorant *(Phalacrocorax fuscescens)*	
Australian pelican *(Pelecanus conspicillatus)**	Uncommon in Tasmania
Black swan *(Cygnus atratus)**	
Cape Barren goose *(Cereopsis novaehollandiae)*	
Chestnut teal *(Anas castanea)**	
Pacific Black duck (*Anas superciliosa* *	
Green rosella (*Platycercus caledonicus*)	Endemic to Tasmania
Yellow-tailed black cockatoo (*Calyptorhynchus funereus*)	

Name	Comments
Forest raven (*Corvus tasmanicus*)	Sub species is endemic to Tasmania
Black currawong (*Strepera fuliginosa*)	Endemic to Tasmania
Yellow-throated honeyeater (*Lichenostomus flavicollis*)	Tasmania race endemic
New Holland honeyeater (*Phylidonyris novaehollandiae*)	
Crescent honeyeater (*Phylidonyris pyrrhopterus*)	
Strong-billed honey-eater (*Melithreptus validirostris*)	Endemic to Tasmania
Tawny-crowned honeyeater (*Phylidonyris melanops*)	
Eastern spine-bill (*Acanthorhynchus tenuirostris*)	
Tasmanian thornbill (*Acanthiza ewingi*)	Endemic to Tasmania
Brown scrub wren (*Sericornis humilis*)	
Superb blue (fairy) wren (*Malurus cyaneus*)	
Grey fantail (*Rhipidura fuliginosa*)	
Dusky robin (*Melanodryas vittata*)	Endemic to Tasmania
Flame robin (*Petroica phoenicea*)	
Golden whistler (*Pachycephala pectoralis*)	
Black-faced cuckoo shrike (*Coracina novaehollandiae*)	
Olive whistler (*Pachycephala olivacea*)	
Horsfields bronze cuckoo (*Chrysococcyx basalis*)	
Pallid cuckoo (*Cuculus pallidus*)	
Brush bronzewing (*Phaps elegans*)	
Australian pipit (*Anthus australis*)	
Little grassbird (*Megalurus gramineus*)	
Spotted pardalote (*Pardalotus punctatus*)	
Firetail finch (*Stagonopleura* sp.)	
Grey shrike-thrush (*Colluricincla harmonica*)	
Welcome swallow (*Hirundo neoxena*)	
Striated pardalote (*Pardalotus striatus*)	
Brown goshawk (*Accipiter fasciatus*)	
Skylark (*Alauda arvensis*)	introduced
Starling (*Sturnus vulgaris*)	introduced
Feral turkey (*Meleagris gallopava*)	introduced

*Wetland Dependent species

Appendix 7: Curricula vitae

Short curricula vitae for the authors of this version of the ECD are provided below.

Stephen Casey

Stephen Casey is a Senior Consultant with Entura with expertise in the areas of environment impact assessments and ecological surveys and assessments. This role requires Stephen to provide advice on environmental impact assessments for major projects, undertake flora and fauna habitat surveys, and develop mitigation strategies for clients. This involves engaging with stakeholders and liaising and negotiating with regulatory authorities.

Stephen has an excellent knowledge of Tasmania's conservation values, including threatened species and vegetation communities and is involved in ecological assessment surveys for wind farm development in Australia.

Eleni Taylor-Wood

Dr Eleni Taylor-Wood is a Principal Consultant with Entura and has over ten years experience in project management and terrestrial and aquatic ecology. Eleni specialises in aquatic plants having studied seagrasses, marine and estuarine macroalgae, aquatic freshwater macrophytes and phytoplankton (freshwater and marine) both as a research scientist and environmental consultant. While working as an environmental consultant, Eleni has been involved in a diverse range of studies including: terrestrial flora and fauna assessments; aquatic surveys and impact assessment; environmental flow studies; design and implementation of monitoring programs; instream, riparian and wetland management; and investigations into the transportation pests (aquatic and terrestrial).

Eleni was a member of the Independent Expert Panel assisting the Hawkesbury-Nepean Management Forum from 2001 - 2005. Eleni's role on this panel was to provide advice on matters relating to vegetation (aquatic and riparian) especially in regards to environmental flow regimes, monitoring programs and management of the riverine environment. Eleni has considerable experience with successfully project managing large-scale, complex projects that run over several years. Eleni also has experience in providing expert advice and critically reviewing reports.

Raymond Brereton

Raymond Brereton is a Senior Ecologist for Entura. His role requires Raymond to be a technical specialist and project manager being responsible for conducting and managing environmental impact assessments and development approvals for wind farm developments, and other energy and water infrastructure projects. Raymond also has a technical specialist and project management role in natural resource planning and management projects for government agencies.

Raymond has expertise in performing environmental assessments and approvals and assessing the impacts of developments on fauna, flora and their habitats, providing advice on policy and prescriptions for fauna and flora conservation and providing guidance and training on fauna and flora conservation and management.

Raymond has had over twenty years previous experience working for natural resource management agencies in the field of fauna and flora conservation, addressing the impacts of developments on fauna, flora and their habitats; providing advice on policy and prescriptions for fauna and flora

conservation; providing guidance and training on fauna and flora conservation and management; monitoring implementation of management prescriptions; and supervising fauna research projects.

Raymond has continuing research interests in bird utilisation at wind farm sites and monitoring butterfly populations and is a Member of Forest Practices Tribunal (Fauna Specialist).

Johanna Slijkerman

Johanna Slijkerman is a Senior Environmental Scientist with Entura. Johanna is responsible for the delivery of flora and fauna surveys, stream condition assessments, environmental management plans, strategies and environmental investigations. Her role also involves the preparation of submissions and project management of large multi-disciplinary projects.

Prior to joining Entura, Johanna managed the development of the Tasmanian River Condition Index (TRCI), a rapid, multi-disciplinary approach for assessing the condition of Tasmanian waterways. She co-ordinated a team of over 20 scientists and was involved in the technical development of the riparian vegetation and geomorphology components of method. Johanna also completed field assessments and trained field staff in the application of the TRCI.

Johanna has over seven years experience as a consultant environmental scientist, specialising in vegetation and stream condition assessments, riparian ecology, monitoring and catchment planning. She has worked extensively in urban and regional Victoria, southern New South Wales and Tasmania. Johanna has qualifications in Botany and Physical Geography.

Catherine Walsh

Catherine Walsh is an Environmental Scientist with Entura and assists with flora and fauna habitat assessments, surveys and preliminary investigations for the development of environmental impact assessments and management plans.

This role requires Catherine to provide advice on environmental impact assessments for major projects, undertaking flora and fauna habitat surveys and develop mitigation strategies for clients.

Catherine has an excellent understanding of river assessment methods and in-stream physical and biological processes in arid and semi-arid river and coastal systems in sub tropical and tropical Australia. She has excellent knowledge of tropical marine systems, seagrass communities and water quality.