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Culburra West Urban Development Project
Culburra Beach

Ecological & Riparian Issues & Assessment Report

22 March 2013

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Document Control

Reference	Status	Date	Prepared	Checked	Authorised
610.10684.00000	Version 1.0	November 2012	F Dominic Fanning	F Dominic Fanning	F Dominic Fanning
610.10684.00000	Version 2.1	March 2013	F Dominic Fanning	F Dominic Fanning	F Dominic Fanning

CULBURRA WEST URBAN DEVELOPMENT PROJECT
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ECOLOGICAL & RIPARIAN ISSUES & ASSESSMENT REPORT

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PART A INTRODUCTION & INFORMATION BASE

1 INTRODUCTION

1.1 Background

This *Ecological & Riparian Issues & Assessment Report* has been prepared in respect of a proposed new urban development to the immediate west of the existing township of Culburra[1], on the south coast of NSW (Figure 1). The township of Culburra (Figures 1 and 2) is located on the NSW south coast, on the northern side of Lake Wollumboola, to the east of the main regional town of Nowra.

The new urban development proposal is referred to throughout this *Report* as the 'Culburra West Project'.

Future residential development in the Jervis Bay Regional Area has been the subject of substantial and extensive consideration by Shoalhaven City Council (SCC) and the then Department of Planning[2] (DoP) over a long period. Those deliberations culminated in the *South Coast Regional Strategy* (DoP 2007; Appendix A), which is promoted by the DoP/DP&I as a "*whole of government*" approach to regional planning for the South Coast of NSW, "*which balances the demands for future growth with the need to protect and enhance environmental values*".

An expansion of the residential opportunities associated with the existing township of Culburra is identified in the *South Coast Regional Strategy* as an opportunity for accommodating some of the future requirements for urban growth in the Jervis Bay Regional Area. The Culburra West Project will *inter alia* provide an increased population base to support improvements to local community facilities at Culburra, including schools, employment opportunities, residential and tourist accommodation, and recreational facilities (such as the proposed 18-hole golf course on Long Bow Point).

It is to be noted that:

- the lands proposed for the Culburra West Project were all zoned for residential purposes (Figure 3), in the Shoalhaven City Council *Local Environmental Plan 1985* (LEP 1985); and
- those lands are also to be zoned for residential purposes pursuant to the new draft *Local Environmental Plan 2012* (LEP 2012).

1 The village is officially called Culburra Beach, but is popularly referred to simply as Culburra.

2 The DoP is now relevantly, the Department of Planning & Infrastructure (DP&I).

The Draft LEP 2012 has been developed and prepared by Shoalhaven City Council (SCC), in consultation with relevant government agencies, including the DP&I and the Office of Environment & Heritage (OEH), in cognisance of the ecological attributes of the subject land (based on existing data).

The proposed development is consistent with the original 1985 and the draft 2012 LEPs, and with the *South Coast Regional Strategy*. It also corresponds to the area recommended by the then NPWS[3] during the *Long Bow Point Commission of Inquiry* in 1999.

1.2 The Subject Land

The land which is the subject of this *Ecological & Riparian Issues & Assessment Report* (ERIAR), and within which the proposed Culburra West Project is to be located (Figure 4), consists of part of a substantial tract of privately owned land to the north of the Culburra Road, immediately west of the existing Culburra township (Figures 2 and 4).

The "*subject land*" for the Culburra West Project (Figure 4) occupies a total of approximately 253ha, and includes:

- the northern part of Lot 5 in DP 1065111 (north of the Culburra Road) as well as a small part of Lot 5 to the south of the Culburra Road, adjacent to the existing Culburra Retirement Village – which comprises the eastern part of the "*subject land*";
- the northern part of Lot 6 in DP 1065111 (north of the Culburra Road – which comprises the bulk of the central part of the "*subject land*");
- Lot 61 in DP 755971 – which constitutes the northwestern part of the "*subject land*"; and
- the northern part of Lot 7 in DP 755971 (north of the Culburra Road) – which constitutes the southwestern part of the land.

The Culburra West Project will occupy just 87ha of the subject land, and is confined predominantly to the Crookhaven River catchment (Figure 5; Appendix C). Only minor elements of the Culburra West Project are located in the Lake Wollumboola catchment, including:

- parts of a few lots in the central and southeastern parts of the Project;
- minor parts of the main access road – at its eastern end near the industrial/employment lands (where it joins the Culburra Road), and in the central part along the southern side of the Project; and
- the proposed playing field.

Most of these 'incursions' can be drained to the Crookhaven River catchment or, in the case of the playing field, would involve the capture and re-use of stormwater runoff for irrigation purposes.

Most of the subject land is covered by native forest and woodland vegetation, which (through the Project site) has mostly regrown from previous partial clearing or thinning for agricultural purposes (see historical aerial photographs in Appendix B). The western parts of Lot 61 (in the northwest of the land) and parts of Lot 5 (in the east of the land) have long been fully cleared of native vegetation, and used for grazing purposes (Figure 2). Other clearing and land modification has taken place for access tracks,

3 The NPWS (National Parks & Wildlife Service) is now part of the OEH.

motorcycle tracks, fencing, an abandoned marijuana plantation, and maintenance throughout the subject land.

Various parts of the subject land are zoned for a variety of purposes pursuant to LEP 1985 (Figure 3):

- *2(c) – Residential (New Living Areas)* – covering the bulk of the Project area;
- *3(f) – Business (Village)* – in the east (between the existing village and the STP);
- *4(a) – Industrial (General)* – in the eastern part of the land (south of the STP);
- *5(a) – Special Uses* – in the southeastern part of the site; and
- *7(a) – Environmental Protection (Wetlands)* – along the Crookhaven River frontage, along and to the north of the Project site.

Development has been excluded from virtually all of the 7(a)-zoned land, except in the western part – where the zoning line is not consistent with environmental parameters, but is located along the existing sewer line. It is to be noted, however, that the provision of a 100m buffer to the Crookhaven River (as detailed in Chapter 2) includes some areas zoned for residential purposes, offsetting those minor incursions.

1.3 Definitions and Acronyms

For the purposes of this *Report*, five specific areas around Culburra (the "*subject land*", "*subject site*", "*study area*", "*locality*" and "*region*") have been identified (Figure 4).

Subject Land

For the purposes of this *Report*, the "*subject land*" (Figures 1 and 2) is identified as those private landholdings of Realty Realizations Pty Ltd located to the south of the Crookhaven River, north of the Culburra Road, and west of the village of Culburra (Figure 3). These lands, which occupy an area of approximately 253ha, are bound by:

- the Crookhaven River and Curleys Bay to the north;
- the existing township of Culburra to the east;
- the Culburra Road to the south (except for a small area to the immediate west of the Culburra Retirement Village, in the southeastern corner of the subject land); and
- predominantly cleared grazing land to the west.

Subject Site

For the purposes of this *Report*, the "*subject site*" is identified as that portion of the "*subject land*" which is proposed for urban development activities as part of the Culburra West Project (Figure 5). The "*subject site*" is substantially confined to, but does not include all of, the lands which have been zoned by SCC for various urban development purposes (Figure 3). Excluding the Crookhaven River Foreshore Reserve, the Project occupies a total of approximately 87ha. The Reserve occupies an

additional area of approximately 25ha, of which the overwhelming majority is part of the "*subject land*" and the balance (to the north of site on Crown land – Appendix C).

The "*subject site*" (Figures 4 and 5) includes:

- the urban development elements of the Culburra West Project;
- the proposed playing field on its southern side;
- a major roundabout and 'entrance' at the junction of the Culburra Road and the main access road into the Project;
- a new sewer rising-main and four pump stations along the northern boundary of the Project; and
- a pedestrian and bicycle path along the Crookhaven River frontage, with educational and interpretive materials.

Study Area

The "*study area*" is the area around Lake Wollumboola and Culburra in which detailed investigations have been undertaken by a range of consultants, including the previous consultancies of the principal author of this *Report* (Mr F Dominic Fanning) – Gunninah Environmental Consultants and Environmental InSites.

Those lands include *inter alia* Culburra (East Crescent), Long Bow Point, Callala Beach, Culburra West, Carama Creek, Kinghornee Point and other lands to the south of the subject land (Figure 4).

Locality

The "*locality*" for the purposes of this *Report* encompasses the area of contiguous, or near-contiguous, ecosystems and habitats within a radius of 10km of the "*subject site*".

Region

The *"region"*, when generally referred to in this *Report*, constitutes the *Jervis Bay Regional Area*, as identified in the *Jervis Bay Regional Environmental Plan* (REP). That area is relevant for many of the threatened and other native biota discussed in this *Report*, and correlates generally to the *Shoalhaven Local Government Area* (LGA).

This is considered the relevant *"region"* with respect to local populations of potentially relevant or known threatened biota such as the Powerful and Masked Owl, Glossy Black Cockatoo and an array of microchiropteran bats.

It is noted that the term *"region"* is also used in the *Threatened Species Conservation Act 1995* (TSC Act) with respect to "*biogeographical regions*" or "*bioregions*". These are often used to define the distributions of threatened species and/or endangered ecological communities (particularly in the *Final Determinations* for such biota), but are generally considered too extensive when considering the

potential for a proposal to impose adverse impacts upon threatened biota or their habitats. Where relevant, the biogeographical regions will be identified separately as "*bioregions*".

Acronyms

The following abbreviations are used frequently throughout this *Report*.

- TSC Act *Threatened Species Conservation Act 1995*
- EP&A Act *Environmental Planning & Assessment Act 1979*
- LGA *Local Government Area*
- APZ *Asset Protection Zone*
- EEC *Endangered Ecological Community*
- TEC *Threatened Ecological Community*
- DoP NSW Department of Planning
- DP&I NSW Department of Planning & Infrastructure
- DPI NSW Department of Primary Industries
- SCC Shoalhaven City Council
- OEH NSW Office of Environment & Heritage
- DECC Department of Environment & Climate Change (subsequently DECCW)
- DECCW Department of Environment & Climate Change & Water (now relevantly OEH)
- NOW NSW Office of Water
- EPBC Act Commonwealth *Environment Protection & Biodiversity Conservation Act 1999*

1.4 Scope of This *Report*

This *Ecological & Riparian Issues & Assessment Report* addresses the ecological and riparian issues as they currently apply to the subject land and subject site, on the basis of the proposed Culburra West Project *Concept Plan* detailed herein (Figure 5), and in other documents associated with the proposal.

The scope of this *Ecological & Riparian Issues & Assessment Report* is:

- to provide a baseline description of the nature and condition of the subject land and the subject site, and of adjoining and nearby habitats and ecosystems, in terms of the ecological communities and wildlife habitats and resources present and/or likely to occur on the site;
- to categorise the vegetation types present, and to assess their ecological values in terms of their status with respect to the *Threatened Species Conservation Act 1995* (TSC Act) and/or the *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act), and as habitat for native biota (particularly for threatened species);
- to collate other existing information (publications and empirical data) regarding the subject site and native biota of potential relevance;
- to consider the likelihood of and the potential for adverse impacts to be imposed upon threatened and other native biota as a consequence of the proposal;

- to recommend impact amelioration and environmental management measures to be implemented to minimise, avoid and/or offset any adverse impacts likely to be imposed by the Project on the natural environment and on native (including threatened) biota; and
- to address the relevant statutory and environmental planning issues and matters, including *inter alia*:
  - the *Environmental Planning & Assessment Act 1979* (EP&A Act), including the "*objects*" of that Act;
  - "*threatened species, populations and ecological communities, and their habitats*", listed in the TSC Act;
  - *State Environmental Planning Policy No. 14 – Coastal Wetlands* (SEPP 14);
  - *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44);
  - the *Water Management Act 2000* (WM Act);
  - *State Environmental Planning Policy No. 71 – Coastal Protection* (SEPP 71);
  - the *South Coast Regional Strategy*;
  - the *Director-General's Requirements* (DGRs) for this Part 3A application;
  - relevant OEH *Guidelines*; and
  - relevant *Matters of National Environmental Significance* (MNES) listed in the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (the EPBC Act).

1.5 Assumptions

The impact assessments and conclusions contained in this *Report* are based *inter alia* on a number of assumptions and considerations, including that:

- development of the subject site will be undertaken in an environmentally responsible and legal manner, employing 'best practice' techniques to avoid or minimise adverse impacts wherever possible on adjoining vegetation and habitats, and the natural environment;
- all appropriate methods to protect retained native vegetation and habitats on the subject land and adjoining lands will be implemented as identified in this *Report* (see Chapters 16 and 17);
- the provision of *Asset Protection Zones* (APZs) will require little or no clearing of vegetation beyond the development footprint;
- the stormwater management and treatment regime will be implemented as designed (see *Water Cycle Management Report* by Martens 2013), and will be monitored and maintained so as to ensure the highest water quality standards in discharges from the development; and
- the recommendations contained in this *Report* with respect to impact amelioration and environmental management measures will be implemented as part of the future development of the Culburra West Project.

As discussed in Chapter 3.5, and as is essentially always the case, the consideration of and the assessment of potential impacts upon the natural landscape (including *inter alia* on threatened biota and their habitats) is based on incomplete data. However, in the case of the Culburra West Project site and adjoining lands (particularly including Long Bow Point to the immediate south), there have been extremely substantial flora and fauna investigations over the last two decades, since at least 1993 (see Chapter 3 and Appendix D).

The ecosystems, native biota and biodiversity generally of the Culburra West and Long Bow Point area are doubtless one of the most comprehensively documented in the whole of the Shoalhaven LGA. As a consequence, the likely impacts of the proposed Culburra West Project on the natural environment in general, and on threatened biota and their habitats in particular, are readily amenable to consideration and assessment.

It is a fundamental tenet of the principal author of this *Report* (Mr F Dominic Fanning), and of his team, that the observations contained within this *Report* and the opinions expressed herein are based on an objective analysis of the relevant circumstances. The assessment and conclusions of this *Report* are independent of the desires or preferences of the proponent, or of any other persons or authorities. That is, the *Report* has been prepared in an objective and independent manner sufficient to satisfy the requirements of the *Uniform Civil Procedures Rules* (UCPRs) with respect to expert witnesses in the NSW Land & Environment Court, Federal Court and/or other tribunals.

2 THE CULBURRA WEST DEVELOPMENT CONCEPT

The urban development proposal which is the subject of this *Report* contemplates an extension of the village of Culburra on the NSW south coast (Figures 2 and 5), consisting of:

- a residential subdivision (with associated roads and other infrastructure);
- some light industrial development (adjacent to the existing light industrial development at Culburra); and
- a minor element of commercial, retail and tourism development.

The proposal also includes:

- the creation of a foreshore park along the Crookhaven River (at least 100m wide); and
- an active recreation area (a playing field) on the southern side of the development (Figure 5).

The Culburra West Project has been generated as a *Concept Plan*, and future development activities would be the subject of future *Development Applications* (DAs) to Shoalhaven City Council (SCC) for various stages of the Project (to be determined at a future date). The Project is being considered pursuant to Part 3A of the EP&A Act, notwithstanding the repeal of that part of the EP&A Act.

The Culburra West Project is substantially consistent with:

- the zoning of the subject site and subject land by Shoalhaven City Council (SCC) in the *Local Environmental Plan 1985* (LEP 1985);
- the proposed zoning of the subject site pursuant to the SCC Draft *Local Environmental Plan 2012* (LEP 2012); and
- the *South Coast Regional Strategy*, which is promoted by the DP&I as a "*whole of government approach to regional planning of the south coast of NSW, which balances the needs for future growth with the need to protect and enhance environmental values*".

The development concept which has been prepared for the Culburra West Project, as documented in the *Environmental Assessment* (EA) and in this *Report* (Figure 5), includes:

- an urban development footprint of approximately 87 hectares, of which approximately 73ha is currently native woodland and open forest;
- small areas of vegetation to be modified and managed for local views, occupying approximately 2ha along the Crookhaven River frontage, involving part of the subject land as well as small parts of the adjoining Crown Land. These areas are proposed to be managed by the removal or trimming of trees, but the retention and/or replanting (as required) of native shrubs and groundcover species;
- 47 small residential lots (aimed at retirees and the 'over 55' market) and 500 standard residential lots (ranging from 500-900m^2);
- 2-bedroom apartments, medium density townhouses and mixed-use dwellings (commercial activities beneath with residences above);
- approximately 26 industrial lots of various sizes and 2 commercial sites with frontages to Culburra Road (1.5ha each);
- waterfront sites for tourist and motel accommodation;

- a 3.75km long foreshore park along the Crookhaven River frontage, a minimum of 100m wide (Figure 5; Appendix C), to provide a buffer between the residential development and the Crookhaven River and its habitats. This Park will *inter alia* protect both valuable elements of the natural environment and items and locations of aboriginal heritage;
- a pedestrian and bicycle pathway through the Crookhaven River Foreshore Park - to provide access for residents and for the people of Culburra, and for the public generally, education (aboriginal heritage and the natural environment) opportunities, health benefits, and passive surveillance of the foreshore – to avoid the unmanaged creation of tracks through and impacts on the Crookhaven River Foreshore Park; and
- a playing field on the southern side of the proposed development area.

The Culburra West Project has been designed *inter alia* to incorporate current 'best practice' water volume and water quality discharge regimes, as detailed in the *Water Cycle Management Report* prepared by Martens & Associates (dated March 2013). Relevant elements of the stormwater management regime, detailed in the Martens 2013 *Report*, that are of particular relevance with respect to the consideration of the ecological impacts of the Culburra West Project include:

- dedicated bioretention and treatment swales along roads within the development area;
- four proposed bioretention basins along the northern boundary of development - to capture and treat stormwater prior to discharge through the Crookhaven River Foreshore Park; and
- an extended artificial wetland along the northern boundary of development to capture stormwater for treatment and ultimate slow release, and to allow for 'over bank' flows to create broad overland flows during periods of very high rainfall, to mimic natural conditions.

Where required, *Asset Protection Zones* (APZs) will be contained within the peripheral road system and stormwater management infrastructure along the northern boundary of the proposed development. There will be no use of the Crookhaven River Foreshore Park for the provision of APZs, other than areas of existing open grassland at the western end of the Project. Similarly, APZs (where required for residential development) will be contained within the peripheral road system and front yards of dwellings along the southern boundary of the proposed development footprint.

The Culburra West Project also includes *inter alia*:

- a commitment to the preparation and implementation of a comprehensive *Vegetation Management Plan* (VMP) for the Crookhaven River Foreshore Park, and the areas of managed native vegetation (for view corridors);
- the provision of biodiversity conservation offsets, by the dedication of other privately owned forested lands as extensions to the Jervis Bay National Park (see Chapter 17.3); and
- the implementation of a *Hollow-bearing Tree Protocol* - to ensure that there is no net loss of tree-hollows as a result of the proposal.

3 INFORMATION BASE

3.1 Published Information

The "*subject land*", as well as other lands in the immediate vicinity (*eg* Long Bow Point) and in the general locality (*ie* the "*study area*"), have been investigated on many occasions over the last two decades for a range of potential residential and/or industrial development opportunities (Figure 6; Appendix D; Table 1).

A significant array of flora and fauna investigations has been conducted within the locality by the principal author of this *Report* and his employees (at Gunninah Environmental Consultants, Environmental InSites and now SLR Ecology), and his agents (see below). Several other ecological consultants have also previously conducted investigations in the locality, including *inter alia* for previous development proposals and for the *Long Bow Point Commission of Inquiry* (Daly 1994; Daly & Leonard 1996; Hoye 1996; NPWS[4] 1996, 1997).

This *Ecological & Riparian Issues & Assessment Report* collates the information from the wide range of studies and investigations on the subject site and in the vicinity, including:

- the investigations undertaken by Gunninah Environmental Consultants for a previous development proposal at Long Bow Point (Gunninah 1995, 1999f);
- information provided by other consultants during the *Long Bow Point Commission of Inquiry*, particularly with respect to Long Bow Point and Lake Wollumboola (Daly 1994; Daly & Leonard 1996; Hoye 1996; NPWS 1996, 1997);
- a survey of lands to the west and south of Culburra for the Culburra West Urban Expansion Area (UEA) study (Gunninah 2001c, g, 2002a);
- information contained in the *Flora & Fauna Assessment Report* for an industrial development proposal at Culburra West (Gunninah 2003);
- detailed investigations for a draft *Concept Plan* for urban development in the Culburra West UEA (Environmental InSites 2008);
- further detailed investigations on lands to the north of Culburra Road in 2010, conducted in part by Lesryk Environmental Consultants for the principal author (Environmental InSites 2011), and subsequently (see below);
- information from additional surveys undertaken by Environmental InSites for dwellings on several allotments to the immediate south and west of the subject site, which have subsequently been approved by Shoalhaven City Council (Environmental InSites 2010a, b, c, d, e), and two sites which are still being evaluated;
- recent investigations undertaken by SLR Ecology at Callala Beach and in some of the proposed offset lands;

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4 NPWS – the NSW National Parks & Wildlife Service, which is now part of the Office of Environment & Heritage (OEH), in the Department of Premier & Cabinet.

The NPWS had previously been incorporated into the Department of Environment & Conservation (DEC), which became the Department of Environment & Climate Change (DECC) and subsequently the Department of Environment, Climate Change & Water (DECCW).

- other investigations undertaken by Gunninah Environmental Consultants in the vicinity and locality (*eg* at Kinghorne Point, Carama Creek, Callala Beach and in the Jervis Bay National Park – see Bibliography; Figure 6);
- data contained in the OEH Wildlife Atlas regarding the subject site, and species known to occur in the locality (Appendix E), and in the EPBC website (Appendix F); and
- information regarding threatened biota and other native biota contained within the scientific and published literature, including material published by the OEH and its predecessors.

Information regarding potential constraints to development of the site has also been obtained from a variety of other sources, including:

- inspection of historical and recent aerial photography of the subject site (Appendix B), and of lands in the immediate vicinity and general locality;
- detailed contour mapping of the subject site and adjoining lands, provided at 1m intervals by Realty Realizations and digitised by Whelans InSites; and
- the riparian zone definitions and analyses undertaken by the previous Department of Water & Energy (DWE)[5] for implementation of the *Water Management Act 2000*, and the more recent modifications to the application of that Act.

It is noted that whilst many of the ecological *Reports* referred to above are 10 years old or more, and might be deemed by some to be 'out-of-date', it would be inappropriate in the opinion of the authors of this *Report* to ignore or discount the data contained in those substantial documents. There is considerable value in a database covering approximately 20 years covering the subject land and Long Bow Point (to its south), and providing an extensive long-term picture of the biota (both flora and fauna) at this general location.

As will be evident throughout this *Report*, the more recent investigations within the study area and on Long Bow Point (from 2010) are the primary sources of information regarding the Culburra West Project (and the Culburra Golf Course Project), and build on the substantial pre-existing database which is available for this location.

3.2 Previous Investigations – 1993 to 2008

As noted above, parts of the Culburra study area, including the subject site, have been investigated on many previous occasions for other development proposals or concepts. Those investigations have included the application of an array of flora and fauna assessment techniques by a variety of ecologists (Appendix D) over a considerable period, which provide a comprehensive and substantial database of the native biota within the local context of the subject site (*ie* within the "*study area*").

With respect to native flora and vegetation communities, various parts of the Culburra study area have been surveyed on foot by the principal author of this *Report* and his employees and/or agents on a substantial number of occasions since 1995 (Appendix D; Table 1).

5 The DWE included *inter alia* the previous Department of Natural Resources (DNR). Implementation and management of the *Water Management Act 2000* is now relevantly a function of the NSW Office of Water (NOW), which is part of the Department of Primary Industries (DPI).

Table 1 Summary of ecological surveys undertaken at Culburra and Callala since 1993

Year	Survey Team	Types of Surveys
1993	Daly & Leonard	**November-December** -14 day reptile trapping, 3 day arboreal, mammal trapping and Spotlighting at Long Bow Point.
1996	Daly & Leonard, Hoye	**September and November-December-**15 day general fauna survey at Long Bow Point **October**- 5 day nocturnal mammal survey at Long Bow Point
1997	Gunninah	**July-August** - 2 weeks general fauna survey at Long Bow Point (July-August)
2001	Gunninah	**January to March** - Approx. 2 months of general flora and fauna surveys on the subject land (January to March)
2002	Gunninah	**December -** 2 days of general fauna searches on the subject land
2007	InSites	**October** - 1 week general fauna survey on the subject land (October)
2010	Lesryk Environmental Consulting	**December -** 1 week general fauna survey on the subject land (December)
2012	SLR Consulting	**January** – approx. 3 weeks general fauna survey at Long Bow Point **February** – 3 days general fauna survey at Long Bow Point. **May** – 5 days general fauna survey on subject land **August** – 5 days general flora and fauna survey on subject land **September** – 3 days general flora and fauna survey at Long Bow Point and 3 days general flora and fauna survey on subject land **October** - 3 days general flora and fauna survey on subject land **November** - 2 days general flora and fauna survey on Long Bow Point
2013	SLR Consulting	**January** - 5 days general flora and fauna survey at Long Bow Point **March** - 7 days of general flora and fauna survey on subject land

Flora survey techniques within the study area have included:

- driven transects through substantial parts of the study area, with the recording and identification of plant communities;
- extensive walked surveys to provide floristic details of plant communities, and to establish a comprehensive plant species list for various sites through the study area; and
- dedicated surveys for individual threatened plant species known to occur in the locality, and which could potentially occur on the subject land.

There have been a substantial number of flora surveys, undertaken by walked transects, random meanders and dedicated meanders, throughout the subject land and the study area over a very long period. Many of the investigations undertaken in the 1990s and early 2000s have not been well documented in terms of specific quadrats, transects or other metrics of investigation, or those data have been lost through old technology or the misplacement of old files.

However, it is clear that there have been very substantial and extensive flora surveys throughout the subject land, Long Bow Point and other parts of the study area, over the nearly two decades of intensive investigations in this general locality. In particular, detailed investigations in 2001 and 2002 (undertaken by Gunninah Environmental Consultants) involved several weeks of field investigations, which included:

- extensive walked surveys by dedicated botanists;
- the collection of detailed floristic information regarding various vegetation types in the study area; and
- dedicated searches for threatened plant species.

Subsequent investigation undertaken by SLR Ecology and previously Environmental InSites, have involved very extensive walked and driven surveys of the subject site, the subject land and Long Bow Point, including:

- dedicated searches within appropriate vegetation types for threatened orchids known to occur in the vicinity or locality;
- very extensive walked surveys to 'ground-truth', review and map vegetation community boundaries;
- walked transects along seven cross-sections from the Crookhaven River foreshore up into the subject site (Appendices D and J) - to identify the locations of various vegetation types and communities, and to search for threatened species of potential relevance; and
- through the latter half of 2012 and the early part of 2013, the SLR Ecology Team has conducted a very substantial regime of flora investigations of the subject land and Long Bow Point for the purposes of this ERIAR for the Culburra West Project, and for the *Species Impact Statement* (SIS) being prepared for the Culburra Golf Course Project on Long Bow Point.

Those investigations have involved:

- 10 dedicated surveys for threatened orchids within the Culburra West Project site and Culburra Golf Course site;
- at least 30 person-days of flora surveys by dedicated meanders, random meanders and walked inspections of cross-sections from the Crookhaven River onto the subject site; and
- dedicated surveys for threatened plant species and hollow-bearing trees throughout the subject site, subject land and Culburra Golf Course site.

In addition, a substantial array of surveys for native fauna (particularly for threatened species, and their habitats and resources) have been undertaken over a long period (nearly two decades) within the study area. Those previous investigations (Appendix D; Tables 1 and 2) have involved the application of a comprehensive and extensive array of fauna survey techniques, including:

- trapping for native fauna using a variety of techniques (pit traps, Elliott traps – both terrestrial and tree-mounted, cage traps, harp traps, tree-mounted glider traps, hair tubes and mist nets);
- extensive diurnal walked surveys for native fauna and for habitats and features of particular relevance over many years and in all seasons, involving hundreds of days of investigation by an array of ecologists;

- extensive spotlighting surveys for nocturnal species, including the use of call playback for amphibians, gliders and forest owls;
- targeted surveys for threatened species known to occur in the locality;
- the use of Anabat recorders for microchiropteran bats;
- the deployment of infra-red cameras, with baits, for the recording of fauna; and
- targeted searches for habitats and resources of special relevance for native species (*eg* hollow-bearing trees, ponds and watercourses, Lake Wollumboola and its shores, and the Crookhaven River foreshore.

Table 2 Summary of previous fauna surveys at Culburra West and nearby

Year	Surveyor	Technique	Effort
1993		Trapping survey	110 trap nights – pitfall traps 75 trap nights – arboreal Elliotts
1993-6		Spotlighting	11hrs 30 mins
1996		Trapping Hair tube surveys Anabat survey Spotlighting + microchiropteran bats Harp trap – microchiropteran bats	55 trap nights – terrestrial Elliotts 380 trap nights – hair tubes 4 nights 4 nights 4 nights
1997		Spotlighting Call playback Anabat surveys Harp trap Amphibian surveys Hair tube survey	62hrs 30mins 1hr 30 mins 18 nights 16 nights 62hrs 30 mins 425 trap nights
2001		Trapping Amphibian surveys Avifauna surveys Anabat survey Harp trap Hair tube survey Call playback (Owls, Yellow-bellied Glider, Koala and Black Bittern) Spotlighting	805 trap nights – terrestrial Elliotts 150 trap nights – arboreal Elliotts 101 trap nights – cage traps 170 trap nights – pitfall traps 13 hrs 14 nights 25 trap nights 1700 trap nights 4hrs 15 mins 22hrs 40mins 11hrs 55mins
2002		Spotlighting Call playback (Owls, Squirrel Glider, Yellow-bellied Glider, Koala) Anabat surveys Amphibian surveys Reptile surveys	4hrs 1hr 52 mins 2 nights 6 hours 6 hours
2007		Avifauna surveys Spotlighting Anabat surveys Avifauna surveys Call playback (Owls, Yellow-bellied Glider)	12 hrs 11hrs 4 nights 4 hours 1hr

It is noted that the detailed surveys listed in Table 2 identify only the dedicated survey activities, including nocturnal studies (spotlighting, Anabats *etc*). However, during those survey events, the diurnal surveys and opportunistic recordings by teams of ecologists on the relevant lands amount to thousands of hours of observations and survey by experienced and dedicated ecologists, traversing various portions of the study area. Those very substantial investigations and opportunistic surveys constitute an extremely large database for the subject land and study area.

As indicated in Chapter 2.1 of this *Report*, Gunninah Environmental Consultants, Whelans Insites and SLR Ecology have surveyed various parts of the subject land and nearby lands on a number of occasions since 1996. A brief summary of the main *Reports* that have been prepared during this time is provided below, with details of the field surveys conducted provided in Appendix D.

Fauna Impact Statement - Long Bow Point, Culburra (Gunninah 1999)

A *Fauna Impact Statement* (FIS), pursuant to the now-repealed *Endangered Fauna (Interim) Protection Act 1991* (EFIP Act), was prepared for a proposed residential development on Long Bow Point, to the south of the Culburra West Project site. The FIS was based on detailed field investigations on Long Bow Point and throughout the Culburra West UEA lands, as well as on lands which have subsequently been dedicated as part of Jervis Bay National Park (*ie* the "*study area*" – Figure 6) between 1995 and 1999.

As part of the database for that FIS, extensive surveys were undertaken not only on the Long Bow Point site itself but also on adjoining lands, both within the Jervis Bay National Park and within other private landholdings in the locality (Appendix D; Figure 6). In addition, a number of previous surveys (as discussed above) were also considered within that assessment (see above), including:

- *Investigation of the Fauna & Flora of Long Bow Point* (Daly & Leonard 1996a);
- *Fauna Assessment – Culburra Urban Expansion Stage 1* (Daly & Leonard 1996b);
- *Supplementary Assessment of Protected Fauna – Culburra Urban Expansion Stage 1* (Daly 1996);
- *Survey of the Bat Fauna of the Proposed Long Bow Point Residential Development Area, Culburra, New South Wales* (Hoye 1996);
- *Consideration of the Potential Impact of the Proposed Development at Long-Bow Point on Threatened Fauna* (NPWS 1996); and
- *A Regional Assessment of the Natural Heritage Values of the Proposed Culburra Urban Expansion Area and Environs* (NPWS 1997).

Culburra West Urban Expansion Area (Gunninah 2001)

A *Development Strategy Plan* for the Culburra West UEA was the subject of a detailed *Flora & Fauna Assessment Report* and associated investigations (Gunninah 2001). The area of relevance for that *Report* was confined to that part of the study area north of the Culburra Road (*ie* the "*subject land*" for the Culburra West Project).

In addition to extensive investigations for threatened plant species and the identification of plant communities, the Gunninah 2001 *Report* provides documentation of the extensive fauna surveys undertaken throughout the Culburra West UEA (Appendix D).

The specific field investigations for the Gunninah 2001 investigation (Appendix D) included:

- walked and driven flora surveys throughout the land which was the subject of that investigation (Figure 6), including the identification of plant community boundaries and dedicated surveys for threatened plant species known to occur in the general locality;
- dedicated and intensive fauna surveys including:
  - the use of Elliot traps, cage traps and pit traps for terrestrial fauna;
  - the deployment of Elliot traps in trees for arboreal mammal species;
  - spotlighting surveys throughout the Culburra UEA study area (*ie* the "*subject land*");
  - the deployment of harp traps and Anabat recorders for microchiropteran bats;
  - call playback and spotlighting surveys for nocturnal fauna species; and
  - diurnal surveys for birds, reptiles and other native fauna throughout the Culburra UEA site, particularly in areas likely to support threatened species or which contained resources of potential relevance for such species.

The 2001 Gunninah *Report* identified a number of threatened fauna species, but no threatened plant species were recorded. Threatened fauna species which were identified in that investigation and/or which are of potential relevance to the Culburra West UEA, and which are considered in further detail in this *Report*, include the Powerful Owl, Glossy Black Cockatoo, Green & Golden Bell Frog and a number of threatened microchiropteran bats (the East-coast Freetail Bat, Common Bent-wing Bat, Greater Broad-nosed Bat, Yellow-bellied Sheath-tail Bat, Large-footed Myotis and Eastern Falsistrelle).

Proposed Industrial Subdivision at Culburra (Gunninah 2003)

A flora and fauna investigation was undertaken on land to the north of Culburra Road, south of the Culburra STP and to the west of Strathstone Street (Part Lot 5 in DP 872852) for a proposed industrial subdivision. The surveys were conducted in December 2002 (Tables 1 and 2; Appendix D).

The small area of land south of the STP which was investigated for the proposed industrial development was surveyed both for flora and fauna by walked transects and random searches, and by dedicated fauna surveys to identify threatened species which could potentially be present. Information from that investigation has been incorporated into this *Report*.

Specific field investigations for the industrial subdivision *Report* (Gunninah 2003; Appendix D) included:

- walked flora surveys throughout the land which was the subject of that investigation; and
- dedicated fauna surveys, including:
  - call playback and spotlighting surveys for nocturnal fauna species; and
  - diurnal surveys for native fauna.

Culburra West Demonstration Project (2007/2008 Surveys)

Supplementary investigations for flora and fauna were undertaken for the preparation of an *Ecological & Riparian Issues & Assessment Report* for the Culburra West Demonstration Project, which included both the "*subject land*" for the Culburra West Project and the Culburra Golf Course site on Long Bow Point.

Those investigations (Tables 1 and 2; Appendix D) included:

- refinement of the vegetation mapping which had previously been undertaken by Gunninah;
- dedicated searches for threatened biota more recently listed in the TSC Act, and suitable habitat and resources for such biota; and
- the conduct of supplementary targeted and general flora and fauna studies.

The dedicated flora surveys of the study area in 2007-2008 (Tables 1 and 2; Appendix D) included:

- walked and/or driven surveys through most of the subject lands, with the collection of supplementary species lists (Appendices G and H);
- the mapping of vegetation community boundaries by GPS; and
- the undertaking of flora quadrats and surveys at various locations (Appendix D), including dedicated searches for threatened flora species.

The supplementary fauna surveys of the study area in 2007 and 2008 (Appendix D; Table 2) included:

- supplementary spotlighting and call playback surveys throughout the subject lands, particularly for threatened nocturnal fauna known to occur in the locality (the Powerful Owl, Yellow-bellied Glider, other threatened forest owls and the Green & Golden Bell Frog);
- the deployment of Anabat recorders to detect microchiropteran bat species;
- the inspection of tree-hollows for threatened fauna (using a pole-mounted video camera) or for evidence of their presence (*eg* scratches, feathers or fur, owl 'whitewash');
- dedicated diurnal surveys of fauna habitats and resources throughout the subject land and on Long Bow Point; and
- searches for indirect evidence of threatened fauna species (*eg* diggings, scratches, feeding indications, footprints, remains and other indirect evidence).

Other investigations

There have been a significant number of other investigations undertaken by the principal author of this *Report* and his staff and agents within the study area, all of which have contributed to the accumulation of knowledge and understanding of the study area and the subject land. As indicated earlier, these investigations have been conducted over an extensive period by the principal author of this *Report* and his staff and agents, and constitute a very considerable body of information regarding the biota, threatened or otherwise, in the study area.

Other investigations which are not documented in particular detail in Appendix D of this *Report* include *inter alia*:

- extensive flora and fauna surveys at Kinghorne Point, including surveys for the threatened Jervis Bay Leek Orchid *Prasophyllum affine*;
- investigations along land around Carama Creek for a potential development opportunity;
- various flora and fauna habitat assessment surveys throughout lands which are now part of the Jervis Bay National Park, *inter alia* for the Long Bow Point *Commission of Inquiry*; and
- investigations of various portions of land at Callala for a range of development proposals, over at least the last 15 years.

3.3 Recent Investigations in the Study Area

Rural Dwelling Sites between Culburra and Callala (2010-2013)

In 2011 and 2012, investigations were undertaken on various portions of land between Culburra and Callala Bay for a total of seven rural dwelling sites. Those investigations occurred on lands to the south of the "*subject land*" (within the "*study area*"), and included walked surveys and investigations of potential dwelling sites, *Asset Protection Zones* (APZs) and driveway locations in forested private lands in the months of February and August of 2010, July 2011, June, October and December 2012, and January 2013.

Whilst no dedicated trapping or spotlighting was conducted for six of those investigations, supplementary surveys have been undertaken, with a total of approximately 100 person-hours of field surveys on Lots 2 and 507 Callala Beach Road by two SLR ecologists, involving extended walked surveys, and spotlighting, Anabats and infra-red camera surveys (on the 14th, 15th and 16th of June 2012). Further surveys for threatened orchids, and other threatened biota simultaneously, have been undertaken on those two lots in October and December 2012, and in January 2013 (Table 1; Appendix D).

Culburra West Project - 2010 Investigations

Further field investigations for native fauna within the subject land were undertaken in December 2010, to supplement the previous fauna surveys that had been undertaken previously in the study area.

Those investigations involved three field biologists from Lesryk Environmental Consultants over a period of 5 days, and included a complete array of standard fauna survey techniques (Table 3; Appendix D), including:

- trapping – using pit traps, cage traps and Elliott traps (terrestrial and arboreal);
- hair tubes for terrestrial mammals;
- harp traps and Anabat detectors for microchiropteran bats;
- call playback and spotlighting surveys for nocturnal mammals and birds, and for amphibians;
- dedicated herpetological and bird surveys; and
- the deployment of infra-red cameras.

It is noted that in undertaking the specific dedicated field survey techniques during the December 2010 survey (Table 3), a total of 15 person-days of general opportunistic surveys were also undertaken by the field ecologists during that week of investigations, amounting to approximately 120 person-hours (see Appendix D).

Table 3 Summary of the December 2010 dedicated fauna surveys on the Culburra West Project land

Year	Dates	Technique	Effort
2010	13-17 Dec	Echo-location (Anabats) Elliott traps – terrestrial and arboreal Cage traps Hair funnel trapping Harp trapping Pitfall trapping Call playback Spotlighting Herpetofauna searches Bird surveys Infrared cameras	Dusk to dawn, totalling ~ 70 hours 300 trap-nights 24 trap-nights 400 trap-nights 4 trap-nights 72 trap-nights ~ 3 hours ~ 24 person-hours ~ 3 person hours (~ 15 person-hours) per day ~ 5 person hours (~ 25 person-hours) per day ~ 192 camera hours

Culburra West Project - 2011 Investigations

Further field investigations specifically for the purposes of this *Report* were undertaken in April and June 2011 by Environmental InSites, to refine and clarify the vegetation mapping of the subject site, and to undertake additional diurnal surveys for native biota – both flora and fauna (Appendix D).

Those investigations involved a total of 40 person-hours on the subject site, utilising an accurate GPS unit to confirm and/or refine the vegetation types present. The surveys involved substantial walked and driven transects throughout the subject site, recording both vegetation characteristics and fauna habitat types, and opportunistically recording native biota.

Culburra West Project - 2012 and 2013 Investigations

An array of subsequent investigations have been undertaken on the subject land, and on the Long Bow Point land (which is highly relevant because of its proximity and 'connectedness'), throughout 2012 and 2013, as detailed below and in Appendix D.

A further detailed fauna survey and habitat assessment was conducted on the subject land over 5 days in early May 2012 by two SLR Ecologists.

One primary objective of that survey was to document all of the significant hollow–bearing trees present on the subject site, and to record and map their locations. This was carried out by opportunistic spotting while walking throughout the entire site. Each tree which contained favourable habitat features for bird species, arboreal mammals or microchiropteran bats was tagged, and its location mapped using

GIS Roam. A total of 92 hollow-bearing trees have been located within the subject site (Figure 7; Chapter 6.1.2).

In order to supplement the previous fauna surveys undertaken on the subject land and nearby, the May 2012 fauna survey also employed an array of appropriate techniques (Table 4), which involved:

- spotlighting and call playback for nocturnal mammals and birds;
- opportunistic sightings throughout each of the 5 days of survey, while conducting hollow-bearing tree searches;
- deployment of infrared cameras (x2) with baits for nocturnal mammals;
- deployment of Anabat detectors (x2) and harp traps (x2) for microchiropteran bats; and
- deployment of 40 hair funnels for small terrestrial mammals.

During the May 2012 survey period, the weather conditions were predominantly cold and dry, with moderate SW winds each day. The last two days (10 and 11 May) saw a large increase in temperatures during the middle of the day (reaching around 30^{o}C), and the evening temperatures returned to around 15^{o}C and decreased further into the mornings. The sky was clear each day and night except for Thursday and Friday afternoons, when storm clouds formed. There were no precipitation events during the May 2012 survey.

There were three subsequent surveys on the Culburra West Project "*subject land*" during 2012, as well as on Long Bow Point (see below), undertaken by SLR Ecology (Appendix D). Those investigations included:

- a general survey for flora and fauna (28-31 August) - with cool temperatures (9^{o}C - 24^{o}C), dry southwesterly winds and slight cloud cover, with nil precipitation;
- a follow-up general survey for flora and fauna (17-21 September) - including the deployment of 40 hair funnels for 2 weeks. This survey was undertaken in slightly milder weather, with mostly overcast days and a brief evening storm with light precipitation; and
- spring flora and fauna surveys (16-18 October), including specific searches for threatened orchid species. Temperatures during this survey were warmer (14^{o}C to 26^{o}C).

Survey methods employed during these supplementary surveys (Table 4; Appendix D) included:

- spotlighting for nocturnal fauna species;
- stag watching at hollow-bearing trees for arboreal, nocturnal mammals or birds;
- call playback to attract nocturnal mammal or bird species;
- diurnal avifauna surveys for terrestrial and aquatic bird species;
- reptile searches beneath logs, rocks and debris, as well as opportunistic spotting;
- installation of glider tube traps to capture gliders or small arboreal mammals;
- installation of harp traps to capture michrochiropteran bat species;
- installation of Anabat detectors to record michrochiropteran bat species;
- installation of infrared cameras and baits to record terrestrial species; and
- setting of hair funnels and baits to take small mammal hair samples.

Table 4 2012 and 2013 fauna surveys on the subject land at Culburra West

Year	Dates	Technique	Effort
2012	07 to 11 May	Harp trapping Call playback Spotlighting Opportunistic diurnal searches Infrared cameras Anabat detectors Hair funnels (2 weeks)	8 trap-nights 16 person-hours 12 person-hours 48 person-hours 180 camera-hours 96 hours 560 trap-nights
	28 to 31 August	Spotlighting Stag watching Call playback Anabat detectors Infrared cameras	7 hrs 1 hr 1 hr 16 hrs (x 2 units) 48 hrs (x 2 units)
	17-21 September	Avifauna surveys Spotlighting Stag watching Anabat detectors Infrared cameras Call playback Hair funnels	8.5 hrs 5.5 hrs 1.5 hrs 24 hrs (x 2 units) 36 hrs (x 2 units) 1 hr 720 trap-nights
	16-18 October	Infrared cameras Avifauna surveys Reptile surveys	38 hrs (x 2 units) 5.5 hrs 1.5 hrs
2013	13-17 March	Infrared cameras Avifauna surveys	106 hrs (x 4 units) 4 person-hours
	18-20 March	Infrared cameras Avifauna surveys Glider traps Anabat detectors Reptile surveys Spotlighting Call Playback	92 hrs (x 4 units) 18 person-hours 20 TN 1 night (x 3 units) 3 hrs 4 hrs 1 hr

Culburra Golf Course – 2012 and 2013

Detailed field surveys which have been undertaken in 2012 and 2013 on the Culburra golf course site (Long Bow Point) are of relevance to the Culburra West Project because of the proximity of that site to the Culburra West site, and because of the similarity of most of the vegetation types on both sites, and their contiguity.

In addition to the substantial number of previous investigations which have been undertaken on the Long Bow Point site (the location of the proposed 18-hole Culburra Golf Course Project), as detailed in Appendix D, two substantial and comprehensive supplementary investigations have been undertaken on Long Bow Point for the purposes of preparing:

- the original DA for the golf course (InSites 2011); and

- a *Species Impact Statement* (SIS) for the Culburra Golf Course Project. That project is being assessed by Shoalhaven City Council.

The field investigations which have been undertaken to date (in 2012 and 2013 above) on the Culburra golf course site on Long Bow Point (Appendix D) are documented in Table 5, below.

Table 5 Ecological investigations on the Culburra golf course site in 2012 and 2013

Year	Dates	Technique
2012	04-19/01 15-17/02 27-30/08 17-19/09 7-9/11 19-20/12	Comprehensive summer flora and fauna surveys – Supplementary fauna surveys – Comprehensive winter flora and fauna surveys – General flora and fauna surveys with threatened orchid searches General flora and fauna surveys with threatened orchid searches General flora and fauna surveys with threatened orchid searches
2013	14-19 /01 18-20/03	Comprehensive summer flora and fauna surveys with specific searches for threatened orchids and also Glossy Black Cockatoo habitat General fauna surveys with threatened orchid searches

Fauna survey methods employed on Long Bow Point over that period (Appendix D) have included:

- spotlighting for nocturnal fauna;
- stagwatching at hollow-bearing trees for mammals (particularly gliders and microchiropteran bats) and birds;
- call playback to attract nocturnal mammal and bird species;
- targeted and opportunistic diurnal avifauna surveys for terrestrial and aquatic bird species;
- reptile searches beneath logs, rocks and debris, as well as opportunistic spotting;
- installation of glider tube traps to capture gliders or small arboreal mammals;
- installation of harp traps to capture michrochiropteran bats;
- installation of Anabat detectors to record michrochiropteran bat species;
- installation of infrared cameras and baits to record terrestrial species; and
- setting of hair funnels and baits to take small mammal hair samples.

Recent surveys have included meanders for threatened species of flora, in particular threatened orchids which are known in the locality. Details of record surveys are included in Figure A3 and include:

- 17 October 2012 – 7 hours search for Illawarra Greenhood and Pretty Beard Orchid;
- 19 December 2012 – 3 hours search for Leafless Tongue Orchid, Eastern Lynne Midge Orchid, Bauer's Midge Orchid and Tangled Bedstraw;

- 21 February 2013 – 2 hours search for Leafless Tongue Orchid, Bauer's Midge Orchid and *Pterostylis ventricosa*;
- 06 March 2013 – 2 hours search for Leafless Tongue Orchid, Bauer's Midge Orchid and *Pterostylis ventricosa*;
- 19 March 2013 – 2 hours search for Leafless Tongue Orchid, Bauer's Midge Orchid and *Pterostylis ventricosa*.

3.4 Summary of Investigations in the Study Area

The cumulative evidence from the substantial number of investigations that have been undertaken on the subject land and on other relevant lands in the vicinity, since at least 1993, is substantial (Appendix D; Table 6). Detailed field investigations of the Culburra West Project land, and on other adjoining lands in the immediate vicinity (particularly Long Bow Point), have been undertaken over a period of nearly 20 years, and have involved a number of different ecological consultants, as well as the then NPWS.

It cannot reasonably be asserted that the field investigations undertaken to date are less than sufficient, given the two decades of research in this locality over a variety of seasons and through a variety of climatic conditions.

Investigations undertaken on the subject land and on Long Bow Point, as well as on other relevant lands nearby, over that 20-year period amount to many thousands of person-hours of surveys by qualified ecologists (including the NPWS) and many thousands of trap-nights. The accumulated data constitute a very substantial body of information for both the subject site itself, the subject land and other relevant contiguous habitats in the immediate vicinity and locality.

Table 6 Overview of dedicated fauna surveys on the subject land and on Long Bow Point

Year	Days	Site	Survey Description
1993	23-30 November 13-17 December	Long Bow Point	Fauna trapping
1993-6		Long Bow Point	Spotlighting
1996	4-19 September 20-24 October 23 November – 13 December	Long Bow Point	Fauna trapping, hair funnels and nocturnal investigations
1997	16-21 July 11-15 August 21 July – 14 August	Long Bow Point	Fauna trapping, hair funnels and nocturnal investigations
2001	12-22 January 22 January – 07 March 28 February – 12 March	Culburra West	Extensive fauna trapping, hair funnels and nocturnal investigations
2002	16-17 December	Culburra West	Spotlighting, call playback, Anabats and herpetofauna
2007	15-19 October	Culburra West	Avifauna and nocturnal surveys
2010	13-17 December 13-23 December	Culburra West land	Extensive fauna surveys (trapping, diurnal and nocturnal techniques, hair funnels, infrared cameras)
2012	04-06 January 05-15 January 14-19 January 15-17 February 27-28 August 28 August – 17 September 17-19 October	Long Bow Point	Extensive fauna surveys (mammal trapping, spotlighting, call play-back, infrared cameras, Anabats, pitfall traps, reptile searches, amphibian searches, avifauna searches, hair funnels.
Year	**Days**	**Site**	**Survey Description**
	07-11 May 08-29 May 29-31 August 18-21 September 18 September – 06 October 16-18 October	Culburra West	Extensive fauna surveys (mammal trapping, spotlighting, call play-back, infrared cameras, Anabats, pitfall traps, reptile searches, amphibian searches, avifauna searches, hair funnels
2013	14-19 January 13-17 March 18-20 March	Long Bow Point Culburra West Culburra West	Extensive fauna surveys (trapping, diurnal and nocturnal techniques, hair funnels, infrared cameras) Infrared cameras, avifauna searches Extensive fauna surveys (Infrared cameras, avifauna searches, mammal trapping, Anabat detectors, spotlighting, call play-back, reptile searches)

3.5 Limitations

It is a function of all ecological studies, virtually without exception, that the information regarding flora and fauna on any one site is incomplete. That circumstance arises because the natural environment is dynamic, not static, and because there will be variations in the flora and fauna assemblage on any one site through various seasons and through different climatic circumstances, over a few years or decades.

As a consequence, all ecological assessments are unavoidably reliant on only a partial and incomplete information base. All such assessments, therefore, must also rely *inter alia* on:

- various other sources of information, in addition to field investigations;
- informed assumptions regarding the biota (including threatened species) likely to occur on a site, based on the habitats and resources present;
- the general and scientific knowledge of native biota, and their habits and habitats; and
- the experience of the investigators and assessors.

However, with respect to the subject site and the associated lands at Culburra, it must be noted that there have been a considerable and substantial array of investigations undertaken both on the subject site itself and on contiguous habitat in its immediate vicinity (as documented above). Those investigations (see above; Appendix D; *Bibliography*) have included *inter alia*:

- studies by the principal author of this *Report*, and his staff and agents, over a period of 18 years;
- investigations undertaken by other ecological consultants for the proponent of the previous residential subdivision proposal on Long Bow Point;
- investigations undertaken by opponents of that proposal, as documented in the *Long Bow Point Commission of Inquiry* (1999);
- investigations undertaken by the then National Parks & Wildlife Service (NPWS) on Long Bow Point and in the vicinity, *inter alia* for the *Long Bow Point Commission of Inquiry*; and
- surveys by other consultants of the Culburra UEA lands.

The subject land and immediately adjoining lands of relevance, therefore, have been the subject of a considerable and comprehensive array of investigations by a variety of ecological consultants and agencies over a period of approximately 20 years. The subject land has been the focus of a greater level of inspection, investigation and survey than almost any other location within the *Jervis Bay Regional Area*. It cannot reasonably be asserted that there have been insufficient investigations of the subject site or the subject land at Culburra.

Furthermore, the approach adopted in this *Report* is, *inter alia*, that threatened species for which there is suitable habitat present on the subject site, and for which there are relevant records, should be assumed to be present, even if there is no evidence for their presence on the site. Obviously, on that basis, if assumed to be present in potentially suitable habitat on the subject site, any such species should also be assumed to be present in all other potential habitat in the vicinity and the locality.

Thus, the approach which has been adopted for this *Report* is one of an 'abundance of caution' (a 'precautionary' approach). It is assumed for the purposes of this *Report* that some threatened species which have not been recorded on the subject site or in its immediate vicinity (despite the plethora of

investigations) could in any case potentially be present. The likelihood (or otherwise) of an adverse impact, or of a "*significant effect*" pursuant to Section 5A of the EP&A Act (notwithstanding that Section 5A does not apply to the current proposal), being imposed upon such threatened biota has been considered, whether or not there is any evidence for such biota being present on the site.

4 EXISTING ENVIRONMENT

The "*subject site*" to which this *Report* refers (the Culburra West Project area) is located within the greater *Jervis Bay Regional Area*[6], and constitutes a westerly expansion of the existing village of Culburra (Figures 1 and 5; Appendix C).

The existing residential area of Culburra is located on the northern shore of Lake Wollumboola, with the Crookhaven River to the immediate north and west, and the Pacific Ocean to the east. The Culburra West Project site is bound to the north by the Crookhaven River, to the south by native vegetation on private lands, to the east by the township of Culburra and to the west by cleared grazing land (Figures 1 and 2).

The land which is specifically the subject of this *Report* (*ie* the land on which the Culburra West Project is proposed – the "*subject site*") occupies approximately 87 hectares of land directly to the west of Culburra (Figures 2 and 5). The subject site is predominantly gently undulating, with slopes of less than 10% being characteristic of most of the area (Figure 8). The only areas where slopes are greater than 10% is at a few locations along the foreshore of the Crookhaven River (Figure 8).

The majority of the subject site, and much of the local study area (as identified in Figure 4), is vegetated by a mosaic of predominantly native xeric and (less common) mesic to the south plant communities. The overwhelming majority of the subject site itself, and the adjoining lands, supports a range of xeric forest and woodland types, with mesic vegetation confined to the Crookhaven River frontage (Figures 9A to 9D).

Most of the forest and woodland communities on the subject site and in the study area are in good to very good condition with respect to levels of degradation or disturbance, and/or levels of weed infestation. There are, however, patches of significant weed infestation (predominantly of Bitou Bush and/or Lantana) within the subject site, and in the Crown land to its immediate north, along the Crookhaven River. There are other patches of weeds scattered throughout the subject site, along tracks and at various sites of previous disturbance (*eg* the abandoned marijuana plantation site).

Much of the forest on the subject site is regrowth, and the site had previously been partially cleared or thinned for agricultural purposes (see historical aerial photographs in Appendix B). This circumstance explains the relatively low density of hollow-bearing trees (Appendix J), with the concentrations of hollow-bearing trees (Figure 7) clearly correlated with the areas where trees had not been cleared or thinned (Appendix B). It may also explain the numbers of relatively small trees, and the lack of records of threatened plant species and the scarcity of small terrestrial mammals.

The subject site does not contain rock outcrops, rocky ridges or cliff lines, which represent specific habitat or resources for a range of native fauna species. As a consequence, biota which specialise in rocky habitats are unlikely to be present within the subject site. Further, there are no freshwater ponds or wetlands present within the subject site itself, and all estuarine and aquatic habitats are located to the north, along the Crookhaven River, with the exception of a small tidal creek in the eastern part of the subject site (Figures 9A and 9B).

6 The *Jervis Bay Regional Area* is defined as the land identified in the *Jervis Bay Regional Environmental Plan 1996*, and corresponds essentially with the Shoalhaven LGA.

The subject site is located predominantly within the catchment of the Crookhaven River (Figure 10), with only the proposed playing field and a few very small areas of proposed development located in the Lake Wollumboola catchment (Appendix C). The Crookhaven River catchment contains *inter alia* the villages of Culburra (in part), Greenwell Point and Orient Point, as well as extensive areas of cleared grazing lands (Figures 1 and 2).

The Lake Wollumboola catchment, by contrast, has only small areas of development (the southern part of the Culburra village) and small areas of cleared grazing land (Figure 11). The majority of the Lake Wollumboola catchment is contained within the Jervis Bay National Park, including the body of Lake Wollumboola itself (Figure 12).

The Crookhaven River is located to the immediate north of the subject site, and the overwhelming majority of the proposed development will drain to that watercourse. Other than a very small tidal creek in the northeastern part of the subject site, all current drainage from the site to the Crookhaven River is by overland flow. There are a few minor drainage swales along the Crookhaven River frontage, but no formed creeklines (Figures 2 and 8; Martens 2013).

The soil landscapes on the subject land have been classified into two main types (Hazelton 1992; Figure 13) - the Greenwell Point and Seven Mile soil landscapes:

- the Greenwell Point soil landscape consists of "*gently undulating rises on siltstone*", and is predominantly found on ridges and elevated areas of the site. The soils are generally "*Red Podzolic Soils … on simple slopes and in drainage lines*"; and
- the Seven Mile soil landscape is described as a "*series of dune ridges and swales, swamps or lagoons on Quaternary marine sands*". These landscapes support "*deep siliceous sands*" and "*podzols occur on ridges*".

There are no "*dune ridges and swales, swamps or lagoons*" on the subject land, and the Seven Mile soil landscape is therefore not present.

The water table is described as generally being close to the surface (Hazelton 1992), and it is stated that standing water is common in these landscapes. On the Culburra West Project site, however, areas of "*standing water*" are few and highly ephemeral, and there are no ponds, swamps or permanent freshwater wetlands on the Project site.

A highly relevant and significant consideration in the assessment of the proposed Culburra West Project is the considerable extent of conservation reserves and State Forests in the vicinity and locality, and throughout the Shoalhaven region. In this regard:

- there are substantial areas of land contained in the Jervis Bay National Park to the south and southwest of the subject land (Figure 12), much of which contain similar or identical habitats and resources to those present on the subject land and subject site;
- there are substantial additional State Forests (which also act as conservation reserves, given current management practices) in the locality (Figure 12); and
- there are very substantial areas of conservation reserves (including National Parks, Nature Reserves and State Forests) in the Shoalhaven region (Figure 13).

From a physiographic and geomorphological perspective, the Culburra West Project site:

- is not located on a "*coastal floodplain*"; nor

- is it part of a "*coastal floodplain*"; nor
- is it "*associated with*" a coastal floodplain.

Nevertheless, the OEH (or individuals within the OEH) maintain that some vegetation on the "*subject site*" conforms to one or other "*endangered ecological communities*" (EECs) that occur on, or are "*associated with*", coastal floodplains (see Chapter 5). Whilst the principal author of this *Report* does not concede that point, the relevant "*ecological communities*" are regarded as constituting those EECs, the possibility of impacts being imposed upon those EECs is considered in this *Report*.

Whilst parts of the subject land or adjoining land to its immediate north, along the fringes of the Crookhaven River, are subjected to occasional flood events, there is only a narrow band of land (5-20m wide) above the River (approximately 1m above the Mangrove Forest or Coastal Saltmarsh). There is no "*floodplain*" along the edges of the Crookhaven River at this location (Appendix J).

5 FLORA and VEGETATION

5.1 Plant Communities

The mapping of vegetation within the subject site (and on immediately surrounding lands) contained in this *Report* (Figures 9A to 9D) has identified a total of fifteen main vegetation community types, with a number of variants within some of those community types (Table 7; Appendix G). The vegetation mapping of other parts of the study area has identified a number of additional plant community types, but several of these are not present on or adjacent to the subject site itself.

The vegetation types have been grouped into four main classes of vegetation (Figures 9A to 9D; Table 7):

- cleared and disturbed areas – open grazing pasture in the west of the subject site and in the eastern part;
- xeric (dry) plant communities – which are typically located on the ridges and slopes of the subject site and subject land, and which dominate the proposed development area (*ie* the "*subject site*");
- mesic or swamp plant community types – which are confined to the northern fringe of the subject site (*ie* along the Crookhaven River), with a slightly more extensive patch on the Crookhaven River frontage in the northeast; and
- estuarine communities, which are confined to the edges of the Crookhaven River, and are not located on the "*subject site*" itself.

It should be noted that the mapped 'boundaries' of vegetation communities are in most instances somewhat arbitrary, given that distinct boundaries rarely occur naturally, and that adjacent communities will often share a number of species. Further, because of the gentle slopes over much of the subject site, there are often broad ecotones, both within the xeric community types and the moist communities, and (in places) between adjoining xeric and mesic communities. There are, however, a number of vegetation types that are quite distinct and readily distinguishable (*eg* the Mangrove Forest, Coastal Saltmarsh and Swamp Oak Forest communities).

As a consequence of the observations noted above, and given the nature of the subject site, the mapping of vegetation types contained within this *Report* is approximate only. It is, for the most part at least, inappropriate to regard the boundary of a vegetation type as depicted in this *Report* as being the precise edge of any community type.

It is also relevant to note that there are many different approaches to the identification, classification and mapping of vegetation communities. It is not to be assumed by readers of this *Report* either that the vegetation mapping contained herein is the only possible depiction of vegetation on the subject site or that there are no variations within the vegetation types which are depicted.

Table 7 Summary of plant communities recorded on the subject site at Culburra

Map Unit	Description	Corresponding EEC[#]
Modified Communities		
C	Cleared and Disturbed	-
Xeric Communities		
D1	Grey Ironbark/Rough-barked Apple Open Forest	-
D2	Bangalay Woodland Open Forest	-
D3	Blackbutt Open Forest	-
D4	Bangalay/Woolybutt/Rough-barked Apple Open Forest	-
D5	Forest Red Gum Open Forest	-
D6	Hard-leaved Scribbly Gum Woodland	-
D7	Swamp Oak/Bangalay Forest	-
D8	Black She-oak Closed Forest/Tall Shrubland (Regrowth)	-
D9	Woolybutt/Black She-oak Open Forest	-
Mesic Communities		
MF	Moist Forest - Swamp Oak/Bangalay/Woolybutt Forest	SSFCF[7]
SF	Swamp Forest – Swamp Oak/Paperbark Forest	SSFCF[8]
SOF	Swamp Oak Forest	SOFF[9]
Estuarine Communities		
CSM	Coastal Saltmarsh	CSM
M	Mangrove Forest	-

[#] *Endangered Ecological Communities* (EECs) listed in the *Threatened Species Conservation Act 1995* (TSC Act)

SSFCF Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

SOFF Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions

CSM Coastal Saltmarsh of the NSW North Coast, Sydney Basin and South East Corner Bioregions

7 Whilst this vegetation type satisfies the floristic criterion for the SSFCF community, it is not located on a "*coastal floodplain*", and therefore is not the EEC (see Chapter 5.3 below).

8 Ibid.

9 Whilst this vegetation type satisfies the floristic criterion for the SOFF community, it is not located on a "*coastal floodplain*", and therefore is not the EEC (see Chapter 5.3 below).

5.1.1 Xeric Vegetation Communities

The xeric (dry) forest communities occupy virtually all of the subject site and, indeed, most of the remainder of the vegetated lands in the Culburra West Project study area (Figures 9A to 9D, 16 and 17; Table 8), and in the locality.

Within the Culburra West Project development area (*ie* the "*subject site*"), the xeric forest communities (Table 8) occupy essentially all of the areas proposed for the development activities, including the proposed playing field. The mesic and/or estuarine communities are confined to mostly narrow bands along the Crookhaven River (Figures 9A to 9D), other than the broad bands of Mangrove Forest along the River. These areas are almost totally to be avoided by the proposal, other than the small areas proposed to be modified (by the removal of canopy trees) for 'view corridor' purposes.

As elsewhere on the subject site (and, indeed, generally), vegetation types or communities are not 'precise'. There are patches within any xeric community where different tree species may be dominant, and adjoining vegetation types generally merge across (in this instance, often broad) ecotones.

Table 8 Xeric forest communities on the subject site at Culburra West

Map Unit	Community Type	Comments
D1	Grey Ironbark/Rough-barked Apple Open Forest	Moderate to large patches scattered throughout the landscape on upper slopes and ridges; in southeastern and southwestern parts of the development footprint
D2	Bangalay/Woodland Open Forest	A single stand on the ridge in the centre of the development footprint area; partly within the development footprint
D3	Blackbutt Open Forest	Very extensive distribution on the subject site and subject lands; widely distributed in the locality
D4	Bangalay/Woolybutt/Rough-barked Apple Open Forest	Occurs generally on lower slopes and, in places, along drainage swales; a small patch in the northwestern part of the development footprint
D5	Forest Red Gum Open Forest	Scattered patches through the subject land and Long Bow Point; small disturbed patches in the southeastern part of the subject site
D6	Hard-leaved Scribbly Gum Woodland	Broad bands throughout the subject land, Long Bow Point and general locality; occurs on slopes and ridges; broad area through the central part of the development footprint
D7	Swamp Oak/Bangalay Forest	Scattered locations in the vicinity; a small patch in northwestern extremity of the subject site
D8	Black She-oak Closed Forest (Regrowth)	A large patch of partly regrowth vegetation in the eastern part of the subject site
D9	Woolybutt/Black She-oak	A small patch along Culburra Road on the subject land, but outside the development footprint

D1 - Grey Ironbark/Rough-barked Apple Open Forest

This vegetation type is confined to the western part of the subject site, between the cleared grazing land and the extensive Blackbutt Open Forest vegetation (Figures 9A to 9D).

The canopy foliage projective cover (FPC) is 30% to 40%, with the canopy reaching a height of 20m, with occasionally emergents to 25m. The mid-canopy layer is generally patchy and discontinuous, to 8m high where isolated mature examples exist or where regeneration is extensive. The shrub layer is similarly patchy throughout much of the community. In some areas, shrub species are present to 2.5m high, and occasionally to 3.5m. The groundcover layer consists of a mixture of hardy native species, with few exotic species.

Common canopy species are Grey Ironbark and Rough-barked Apple, with a number of other less common eucalypts (Appendix E). Mid-canopy species include Forest Oak, Black She-oak, Two-veined Hickory, Sweet Pittosporum, Prickly-leaved Paperbark and Narrow-leaved Geebung. Native shrub species recorded include Tick Bush, Prickly Heath, Sweet Wattle, Tea-trees and Rice Flower.

The groundcover layer comprises a range of native grasses, sedges and vines, including Bordered Panic, Hedgehog Grass, Spear Grass, Bracken, Sword Sedge, *Poranthera microphylla,* Love Creeper, Mat Rush, Stinkweed and Apple Dumplings.

Weeds are generally uncommon, although patches of Lantana, Flaxleaf Fleabane and Bitou Bush are present along exposed edges of the community.

D2 - Bangalay Woodland/Open Forest

This community is limited to a low ridge in the centre of the subject land, extending to the south of the subject site (Figures 9A to 9D).

The FPC is 25% to 35%, with trees to 18m in height, occasionally to 20m. The majority of the canopy is of semi-mature individuals and juvenile specimens, with mature individuals scattered throughout. The shrublayer element of the understorey is open, and to 2-4m in height. The groundcover is generally continuous throughout, and is composed of endemic species and occasional exotic species.

Common upper canopy species are Bangalay, with occasional Blackbutt, White Stringybark, Red Bloodwood, Hard-leaved Scribbly Gum, Woolybutt, Swamp Mahogany and Rough-barked Apple. Occasional mid-canopy species include Forest Oak, Hickory, Pittosporum, Hickory, Two-veined Hickory, Snow-in-Summer and Prickly-leaved Paperbark. Characteristic species where the mid-canopy layer is present are Tick Bush, Sweet Wattle, Broad-leaved Hakea, Hairpin Banksia, *Lomatia ilicifolia,* Tea-trees, Geebungs, *Gahnia* species and Prickly Moses.

Typical climbers and groundcover species include False Sarsaparilla, Blue Flax Lily, Common Couch, *Pratia purpurascens,* Guinea Flower, Bordered Panic, *Lindsaea microphylla, Eustrephus latifolius,* Hedgehog Grass, *Billardiera scandens,* Love Creepers, Common Silkpod, Weeping Meadow Grass, Wallaby Grass, Blady Grass and *Xanthorrhoea* species. In damper sites, close to the drainage line, species include Basket Grass, *Gahnia sieberiana,* Commelina, Mat Rush and Maiden Hair Fern.

Common exotic species in disturbed areas include Paddys' Lucerne, Cats' Ears, Bitou Bush, *Sporobolus indicus* var. *capensis,* Quaking Grass, Trembling Grass, *Oxalis corniculata* and Plantago.

D3 - Blackbutt Open Forest

This community is the most extensive vegetation type on the subject land north of the Culburra Road, generally occupying the mid-slopes and upper slope areas (Figures 9A to 9D).

The FPC is 25% to 40%, with trees to 25m in height, occasionally to 30m where mature specimens occur. The mid-canopy layer is generally discontinuous, with occasional dense pockets in more protected areas, typically 6m to 8m high. The understorey is patchy throughout, and 1-3m high. The groundcover is continuous throughout, with endemic grass and herb species to 0.5m high. Sedge and rush species are common in open areas adjacent to minor drainage swales or areas of slightly impeded drainage.

The community is generally dominated by the Blackbutt, with scattered Grey Ironbark, Red Bloodwood, White Stringybark, Bangalay, Swamp Mahogany, Rough-barked Apple, Grey Gum, Turpentine, Woolybutt and Hard-leaved Scribbly Gum. Common mid canopy species include *Acacia implexa*, Two-veined Hickory, Black She-oak, Sweet Pittosporum, Mock Olive, Snow-in-Summer and Narrow-leaved Geebung.

Typical shrub species include Tick Bush, Sydney Golden Wattle, Corkwood, Narrow-leaved Geebung, Cherry Ballart and Tea-tree. Common groundcover species include Weeping Meadow Grass, Mat Rush, Kangaroo Grass, *Gahnia sieberiana, Carex appressa*, Spear Grass, Hedgehog Grass, Wombat Berry, Stinkweed, Apple Berry, Blue Flax Lily, Wallaby Grass, Sword Sedge, Bracken and Pomax.

Common exotic species include Bitou Bush, Fireweed, Paddys' Lucerne, Paspalum, Common Centaury, Cats' Ears and Senna. These tend to be concentrated along tracks and in previously cleared areas, although Bitou Bush and Lantana are abundant in bands near and along the Crookhaven River frontage.

D4 - Bangalay/Woolybutt/Rough-barked Apple Open Forest

This community is generally restricted to the lower slopes directly adjacent to Lake Wollumboola, above the main saltwater influence, and grades into Swamp Mahogany Forest/Open Forest (described above) in more elevated areas. It also occurs adjacent to Downs Creek to the north and south of Culburra Road.

The FPC is 5% to 35%, with trees growing to 12 to 15m in height, occasionally to 18m where mature specimens occur. The majority of the upper canopy species are present as mature, semi-mature and juvenile trees, characterised by multi-trunks and broad open canopies. The mid-canopy is generally discontinuous throughout and occasionally absent, typically to 3m high. The understorey is mostly discontinuous throughout, with occasional dense thickets of exotic species to 2.5m high. The groundcover is continuous throughout, with endemic grass and herb species to 1m high. Sedge and rush species are common in damper areas.

Commonly occurring tree species are Bangalay and Swamp Oak, with occasional associates Woollybutt, Forest Red Gum, Blackbutt, Swamp Mahogany, Red Bloodwood, Hard-leaved Scribbly Gum, Grey Ironbark, Rough-barked Apple, White Stringybark and Grey Gum.

Commonly occurring mid canopy species include Tea-trees, Two-veined Hickory, Cherry Ballart, Snow-

in-Summer, Prickly-leaved Paperbark, White Feather Honeymyrtle, Sweet Pittosporum Black She-Oak and Narrow-leaved Geebung.

Common shrub species include Tick Bush, Sydney Golden Wattle, Blackthorn, Native Olive, *Pimelea linifolia* subsp. *linifolia,* Prickly Heath, *Leptospermum continentale,* Corkwood, *Persoonia levis,* Tea-trees and Cherry Ballart.

Common species are *Brunoniella pumilio,* Blady Grass, *Dianella longifolia* var. *longifolia,* Mat Rush, Weeping Meadow Grass, Blue Flax Lily, Hedgehog Grass, White Root, Saw Sedge, Swamp Pennywort, Bordered Panic, Common Couch, *Lagenifera stipitata, Entolasia stricta,* Kangaroo Grass, *Viola hederacea,* Pomax, *Aristida ramosa* var. *ramosa, Danthonia tenuior,* Sword Sedge and Bracken.

Characteristic climbing and twining species include Golden Guinea Flower, False Sarsaparilla, Silkpod, Wonga Wonga Vine and Apple Berry.

Bitou Bush and Lantana occur as scattered individuals throughout, and form dense thickets along exposed margins.

D5 - Forest Red Gum Open Forest

This community occurs on plateau areas and upper slopes within the Culburra West Project site (Figures 9A to 9D)

The FPC is 30% to 35%, with trees growing 15 to 22m in height. The majority of the upper canopy species are present as single-trunked mature, semi-mature and juvenile forms. The mid-canopy is generally patchy and typically 6-8m high. The understorey is also generally patchy throughout, to 1.5m high. The groundcover is continuous throughout, with endemic grass and herb species to 1.5m high.

Commonly occurring tree species are Forest Red Gum, with occasional associates being Blackbutt, Rough-barked Apple, Woollybutt, White Stringybark, Red Bloodwood, Grey Gum and Swamp Oak. Commonly occurring mid canopy species include Teatree, Two-veined Hickory, Narrow-leaved Geebung, Sweet Pittosporum, Black She-oak, *Acacia irrorata* subsp. *irrorata* and Cherry Ballart.

Common shrub species include Sydney Golden Wattle, Native Olive, Hairy Clerodendron, Rice Flower, *Leucopogon juniperinus,* Blackthorn and *Leptospermum polygalifolium* subsp. *polygalifolium.*

Characteristic groundcover species include Blady Grass, Mat Rush, Hedgehog Grass, Bordered Panic, Kangaroo Grass, White Root, Swamp Pennywort, Blue Flax Lily, Sword Sedge and Bracken. Characteristic climbing and twining species include *Marsdenia rostrata,* Common Silkpod and Apple Berry.

Bitou Bush and Lantana occur as scattered individuals, and form dense thickets along exposed margins of this community.

D6 - Hard-leaved Scribbly Gum Woodland

This vegetation type is present on the ridges and slopes in the western and eastern parts of the site, and in broad band through the centre of the site (Figures 9A to 9D).

The FPC is 30% to 40%, with trees growing to 18m in height (with occasional individuals to 22m). The mid-canopy layer is generally sparse (typically to 6m high), but is dense in the eastern patch. The understorey is generally continuous, to 3m, but more commonly to 1.5m high. The groundcover is also continuous, with endemic grass and herb species to 1.5m high.

The dominant tree species is the Hard-leaved Scribbly Gum, with occasional specimens of White Stringybark, Rough-barked Apple, Blackbutt and Red Bloodwood. Typical mid-canopy species include Black She-oak, Bushy Needlebush, Old Man Banksia and Finger Hakea.

The shrub layer is typically diverse albeit patchy, and common species include *Banksia oblongifolia, Pultenaea daphnoides,* Narrow-leaved Geebung, Hairpin Banksia, Broad-leaved Wedge-pea, Prickly Moses, Mountain Devil and Cone-sticks and Drumsticks. Characteristic groundcover species include Bracken, Kangaroo Grass, Mat Rush, Blue Flax Lily, Rock Xanthosia, Silky Purple Flag, Sword Sedge and Milkmaids. The Large Tongue Orchid, Hyacinth Orchid and Hooded Orchid occur sporadically, and characteristic climbing species include Variable-leaved Goodenia, Snake Flower, False Sarsaparilla and Apple Berry.

D7 - Swamp Oak/Bangalay Forest

The Swamp Oak/Bangalay Forest community is a variant of the Swamp Oak Closed Forest community, occurring on slightly higher ground where soils are not permanently moist.

This community is similar to the Swamp Oak Closed Forest community described below (Chapter 5.1.2), with the exception of a greater density of Bangalay than generally occurs in that mesic community.

D8 - Black She-oak Closed Forest

The Black She-oak Closed Forest is a mixed community, located on the north-facing slope down from the Culburra Road towards the Crookhaven River in the eastern part of the subject land (Figure 9A).

This community in places appears to be a regrowth from previous clearing or fire, with dense Black She-oak to 5m in height, and in places with mallee-form Scribbly Gums and other eucalypts. Both the eucalypts and the Black She-oaks increase in size (to 18m) in the western and northwestern parts of this community, in areas which are (in part) to be retained.

The community is generally dominated by the Black She-oak, with scattered Red Bloodwood, Bangalay, Rough-barked Apple, Grey Gum and Hard-leaved Scribbly Gum. Common mid-canopy species include *Acacia implexa,* Two-veined Hickory, Sweet Pittosporum (in places), Mock Olive and Snow-in-Summer.

Typical shrub species include Tick Bush, Sydney Golden Wattle, Narrow-leaved Geebung and Tea-tree. Scattered groundcover species include Mat Rush, Kangaroo Grass, *Gahnia sieberiana, Carex appressa,* Wombat Berry, Blue Flax Lily, Sword Sedge, Bracken and Pomax.

Common exotic species along tracks or adjacent to cleared land include Bitou Bush, Fireweed, Common Centaury, Cats' Ears, Lantana and Senna.

5.1.2 Mesic Vegetation Communities

There are only small areas of mesic vegetation types on and/or adjacent to the subject site, in a generally narrow band associated with low-lying areas along or close to the Crookhaven River (Figures 9A to 9D).

The three mesic forest communities located on and adjacent to the subject site (Table 9) have the floristic characteristics of two "*endangered ecological communities*" (EECs) listed in the TSC Act:

- the Moist Forest (Swamp Oak – Eucalypt Forest) and the Swamp Forest communities – which conform floristically with the Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF) EEC; and
- the Swamp Oak Closed Forest – which conforms floristically with the Swamp Oak Floodplain Forest (SOFF) EEC.

However, as discussed in detail in Chapter 5.3 of this *Report*, these EECs are not considered to be present at Culburra West because there is no "*coastal floodplain*" at this location.

As indicated elsewhere in this *Report*, the presence of EECs can (theoretically at least) represent a significant constraint to development opportunities, although they are not a 'prohibition' on development. In any case, the proposed residential development at Culburra West for the most part will avoid either direct or indirect impacts upon any such communities.

The overwhelming majority of the areas of these communities at this location (notably along the Crookhaven River frontage) are to be retained, protected and rehabilitated (there are large areas of dense weed infestation). Only very small areas are proposed to be managed (by the removal/trimming of tree and tall shrub canopies) for the purposes of providing 'view corridors'.

Table 9 The mesic forest communities on and adjacent to the subject site at Culburra West

Map Unit	Community Type	Comments
MF	Moist Forest (Swamp Oak – Eucalypt)	On low-lying lands on and/or to the north and northeast of the site, along the Crookhaven River
SF	Swamp Forest	Small areas of Swamp Forest are located on low-lying lands on and/or to the north of the subject site, along the Crookhaven River
SOFF	Swamp Oak Closed Forest	A narrow band (generally 5-10m wide) along the edges of the Crookhaven River, generally behind the Mangrove Forest and Coastal Saltmarsh communities

MF - Moist Forest - Swamp Oak/Eucalypt

The Swamp Oak/Eucalypt Open Forest community is confined to low-lying areas adjacent to the Crookhaven River, generally between a narrow band of Swamp Oak and the more xeric communities (Figures 9A to 9D).

The FPC of this community is 25% to 35%, with trees to 8-14m high and occasionally to 18m. A discontinuous mid-canopy layer of sclerophyllous and mesic tall shrub species is present to 8m in height, and the understorey is moderately dense (to 4m high). The groundcover stratum is generally continuous throughout, composed of a mixture of hardy endemic species and occasional exotic species.

Common canopy species include Swamp Oak, Bangalay, Woolybutt and Rough-barked Apple, with occasional specimens of other eucalypts (Appendix D). Mid-canopy species include Prickly-leaved Paperbark, Snow-in-Summer and Two-veined Hickory.

Common understorey species include Sydney Golden Wattle, Rice Flower, Sweet-scented Wattle, Coffee Bush, Sandfly Zieria, Flaky-barked Tea-tree and Tick Bush. Common groundcover species include Blue Flax Lily, Mat Rush, Weeping Meadow Grass, Common Couch, Blady Grass, Kidney Weed, Lacy Wedge Fern and Bracken. Occasional specimens of Bare Twig Rush, Sea Rush and Warrigal Cabbage are present in more saline areas, and occasional climbing species include Love Creepers, Golden Guinea Flower, Scrambling Lily, Common Silkpod and Apple Berry.

Introduced species are not common, and include Paddys' Lucerne, Cats' Ears, Bitou Bush, Lantana, Fireweed, Slender Rat's Tail Grass, Winter Senna and Plantain.

This vegetation type has many of the floristic characteristics of the "*endangered ecological community*" (EEC) known as Swamp Sclerophyll Forest on Coastal Floodplains (SSFCF). However, as discussed in detail in Chapter 5.3, there is no "*coastal floodplain*" at this location, and the vegetation therefore cannot constitute the SSFCF EEC.

SF - Swamp Forest

The community is predominantly composed of dense *Melaleuca* and *Casuarina* Forest up to 18m high, with occasional eucalypts at some locations. The FPC is generally 70% or more. The dense canopy reduces light levels, and limits the groundcover and shrub layers in this vegetation type.

The dominant canopy species are Swamp Paperbark and Swamp Oak, with very occasional specimens of Snow-in-Summer, Bottlebrush, *Babingtonia virgata,* Tick Bush, Sydney Golden Wattle, Paperbark Tea-tree and Black She-oak.

Other scattered groundcover species occurring in this community include Yellow Stars, Matrush, Native Violet, *Parsonsia straminea*, Vanilla Lily, *Lobelia alata,* Apple Berry, Wiry Panic, Fringe Lily, Kidney Weed, Pomax, *Sellaginella uliginosa* and *Lepidosperma laterale*.

In wetter and more open areas, sedge and rush species present include Tassel Rush, Saw Sedges, White-root, *Restio tetraphyllus,* Common Rush, Twig Rushes and Round-headed Bristle Rush*es*. There are substantial bands of weeds between the Crookhaven River foreshore and up the banks, into the edges of the xeric forest, particularly Lantana, with additional areas of Bitou Bush.

This community has the floristic characteristics of the EEC known as SSFCF, but (like the Moist Forest community – above) does not satisfy the topographic or locational criteria for that EEC, not being located "*on a coastal floodplain*".

SOF - Swamp Oak Closed Forest

This community is restricted to a narrow band along the Crookhaven River, generally located between the estuarine communities (Mangrove Forest and Coastal Saltmarsh) and either the mesic Swamp Oak – Eucalypt Forest or more xeric communities (Figures 9A to 9D).

The FPC is between 25% and 45%, with trees to 12-16m in height, and mature specimens to 20m high. The mid-canopy and shrub layers are generally absent, with only occasional native or dense thickets of exotic species to 2.5m. The groundcover is patchy, and exotic groundcover species occur sporadically throughout.

The canopy is characterised by the Swamp Oak, with occasional Woolybutt, Bangalay, Grey Ironbark and Rough-barked Apple where the community grades into the Swamp Oak/Eucalypt Forest community. Mid-canopy and shrub layer species are rare.

Characteristic groundcover species are Yellow Stars, Mat Rush, Flax Lily, *Lobelia alata,* Swamp Pennywort and Sword Sedge. Species in low-lying, slightly more saline, areas include Bare Twig Rush, *Leptinella longipes,* Salt Couch, Sea-blite, Sea Rush and Swamp Goodenia. Occasional climbing and trailing species are Common Silkpod, Common Milk Vine and Apple Berry.

Scattered introduced species include Paddy's Lucerne, Cats' Ears, Bitou Bush, Lantana, Rats' Tail Grass, Winter Senna and Plantago.

This community has the floristic characteristics of the "*endangered ecological community*" (EEC) known as Swamp Oak Floodplain Forest (SOFF). However, as discussed in Chapter 5.3, there is no "*coastal floodplain*" at this location, and the vegetation therefore cannot constitute the SOFF EEC.

5.1.3 Estuarine Communities

Of the five wetland plant communities identified in the Culburra West UEA (Environmental InSites 2008), only two are present on or immediately adjacent to the Culburra West Project site (Figures 9A to 9D; Table 10):

- the Coastal Saltmarsh community - along the Crookhaven River, behind the Mangrove Forest; and
- the Grey Mangrove Forest - which lines much of the Crookhaven River, including Billys Island, Crow Island and Curleys Bay.

Both of these estuarine communities are protected – the Mangrove Forest pursuant to the *Fisheries Management Act 1994* (FM Act) and the Coastal Saltmarsh (CSM) community, which is listed as an "*endangered ecological community*" in the TSC Act.

Table 10 Estuarine communities on or adjacent to the subject site at Culburra West

Map Unit	Community Type	Comments
CSM	Coastal Saltmarsh	On tidal mudflats along the Crookhaven River, generally between the Mangrove Forest and the Swamp Oak Closed Forest
M	Grey Mangrove Forest	On tidal mudflats along the Crookhaven River, in areas which are inundated on a daily basis

M - Grey Mangrove Forest

There is a substantial area of Grey Mangrove Forest along the Crookhaven and Shoalhaven River estuaries, and those adjacent to the subject land range in size from narrow bands along the Crookhaven River foreshore to very large stands (Figures 9A to 9D).

The Mangrove Forest community is characterised by the Grey Mangrove *Avicennia marina*. This is a closed forest community, but with a generally low canopy height (to approximately 10m), with occasionally emergents. There is no shrub layer or groundcover, which is typical of Mangrove Forest communities, and the stands of Grey Mangrove Forest are generally a monoculture of that species, except at the interface (or ecotone) with Coastal Saltmarsh (which the Mangroves often invade).

The Grey Mangrove Forest has the open water of the Crookhaven River (in this instance) on one side and bands or patches of either Coastal Saltmarsh or Swamp Oak Forest on the landward side.

CSM - Coastal Saltmarsh

The Coastal Saltmarsh community occurs as sporadic patches along the Crookhaven River foreshore, generally between the Grey Mangrove Forest and the Swamp Oak Forest communities. Most of the patches are very small (Figures 9A-9D), although there is one large patch of Coastal Saltmarsh on the promontory to the immediate northwest of the Culburra STP (Figures 9A and 9B).

The Coastal Saltmarsh community is a low herbland, with patches of exposed mud and occasional Mangroves. The majority of the community, however, is simply a herbland or (on the edges) a sedgeland, mostly less than 10cm in height.

Characteristic species in the Coastal Saltmarsh community include the Bare Twig Rush, *Leptinella longipes*, Salt Couch, Sea-blite, Sea Rush and Swamp Goodenia.

As discussed above, and in further detail below (Chapter 5.3), the Coastal Saltmarsh community is listed as an "*endangered ecological community*" in the TSC Act.

5.1.4 Cleared and Disturbed Land

There are three areas of cleared land within the Culburra West Project site (Figures 9A-9D), including:

- an area of cleared pasture, long used for grazing purposes – north of the Culburra Road, in

the northeastern part of the subject site;

- an area of cleared grassland with patches of woodland - in the northeastern of the subject site south of the Culburra Road, near the existing Culburra township; and
- a large area of cleared grassland areas in the eastern part of the subject site - to the south of Culburra Road (Figures 9A to 9D).

These areas consist generally of improved pasture dominated by introduced grass species, with a few small patches of and/or individual trees in the northwestern part and patches of trees in the eastern area (to the south of the Culburra Road).

5.2 Plant Species

A total of 359 plant species have been recorded within the study area during the various field investigations (Appendix F), of which 60 are introduced species.

The floristic diversity on the subject site at Culburra West is typical of the substantial tracts of land containing an array of native vegetation within the study area and in the *Jervis Bay Regional Area*. This floristic assemblage is indicative of the number of different vegetation communities present and the range of physical characteristics across the study area (such as the variety of soil types, drainage and topographic features, and land uses).

However, the subject site represents only a small part of the study area, and many (although not most) of the plant species recorded in the study area would not be present on the subject site. For example, there are a number of vegetation types found elsewhere in the study area (such as rainforests) that are not present on the subject site, and some plant species would be reliant on the edaphic or moisture conditions that pertain only to those vegetation types.

Most of the native vegetation on the subject land is in good to very good, and in some places, excellent condition. However, there are localised patches of introduced and weed species through the subject land, predominantly along tracks or where there have been localised disturbances (camp sites, dumped vehicles, an old marijuana plantation *etc*).

In addition, there is a band of often substantial weed infestation along and above the Crookhaven River foreshore. This involves significant areas of Bitou Bush, Lantana and other weed species (Appendix K). In the eastern part of the subject land (between the STP and existing residential development), there is substantial disturbance and degradation along the main track through that area and in adjacent bushland, with patches of dense Lantana, Bitou Bush and other weed species. In the western part of land, there are substantial bands of Lantana on the small 'river flat' and the slope up from the Crookhaven River (Appendices J and K).

Of the 60 introduced flora species recorded in the study area, 4 are classified as noxious weed species pursuant to the *NSW Noxious Weeds Act 1993* (NW Act) for the Shoalhaven City LGA (Table 11).

Fireweed is classified as a 'W3' category weed and should be "*prevented from spreading and its numbers and distribution reduced*" in accordance with the requirements of the NW Act. Blackberry and Bitou Bush are both classified as 'W2' weeds and should be "*fully and continuously suppressed and destroyed*". Prickly Pears are classified as 'W4f' weeds and should not be "*sold, propagated or*

knowingly distributed". Furthermore, "*any biological control or other control program directed by a local control authority must be implemented*" for W4f weeds.

Table 11 Noxious weed species recorded on the subject site at Culburra

Scientific Name	Common Name	Code[10]
Senecio madagascariensis	Fireweed	W3
Opuntia sp.	Prickly Pear	W4f
Rubus fruticosus species aggregate	Blackberry	W2
Chrysanthemoides monilifera	Bitou Bush	W2

5.3 Threatened Biota

Threatened Species

No threatened plant species listed in the *Threatened Species Conservation Act 1995* (TSC Act) have been recorded during any investigations within the subject site or the subject land, or on adjoining lands (*eg* Long Bow Point), including by the NPWS and by other consultants (see *Bibliography*; Chapter 3).

Further, none of the areas proposed for the Culburra West Project are regarded as particularly likely to support those threatened plant species known to occur in the locality. Moreover, even if any such species are present, the study area and general locality contains substantial areas of potentially suitable habitat for any such species.

It cannot reasonably be maintained that the area proposed for development activities at Culburra West would be the sole location of populations of any such species, given the extent and distribution of potentially suitable in the vicinity and locality. Further, as noted above, no such species have been recorded on the subject site or on Long Bow Point.

Endangered Ecological Communities

Of the fifteen plant communities which have been identified and mapped within the subject land at Culburra West (Figures 9A to 9D; Table 6), four possess the floristic characteristics of three "*endangered ecological communities*" (EECs) listed in the TSC Act. The EECs which are, or which might be, represented within or immediately adjacent to the subject land (Figures 9A to 9D) include:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SSFCF);

10 W2 The weed must be fully and continuously suppressed and destroyed.
W3 The weed must be prevented from spreading and its numbers and distribution reduced.
W4f The weed must not be sold, propagated or knowingly distributed. Any biological control or other control program directed by the local control authority must be implemented.

- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SOFF); and
- the Coastal Saltmarsh community (CSM).

As is clearly indicated in Figure 8 and Appendix J, however, there is no "*floodplain*" along the edges of the Crookhaven River on the subject land at Culburra West:

- there are no "*level landforms*" associated with the edges of the Crookhaven River at this location; and
- there is no evidence of typical floodplain geomorphological processes (*eg* "*active erosion and aggradation by channelled and overbank stream flow*").

Rather, the land slopes either steeply or gradually up from the Crookhaven River (Appendix J), and any flooding that occurs would be the result of major freshwater discharges down the Crookhaven River and/or Shoalhaven River during periods of major flooding events, sometimes coincided with high tides. However, the mere fact that there are flooding events does not demonstrate the presence of a "*floodplain*", as a topographic or geomorphological feature.

Further, it is crucial to note that these vegetation types are all located along the Crookhaven River foreshore, on adjoining land to the north of the subject site (Figures 9A to 9D). All of these areas of vegetation are located on lands which are to be retained or protected, and none of these vegetation types will be significantly affected (directly or indirectly) by the Culburra West Project, other than at three locations where 'view corridors' are proposed (Appendix C).

None of the drier forest communities on the subject site is listed as an EEC in the TSC Act, and the future development of the Culburra West Project site substantially avoids the three potentially relevant communities, whether they are EECs or not.

6 FAUNA and FAUNA HABITATS

6.1 Fauna Habitats

The variety of vegetation types within the subject site for the proposed Culburra West Project, and the vegetation and aquatic environments along the adjoining Crookhaven River, provide a range of habitats and resources for native fauna species. As noted above (in Chapter 3), however, the subject site itself does not contain several types of fauna resources (such as rock outcrops, cliffs, creeklines, pools or freshwater wetlands), which are essential for some native fauna known to occur in the locality.

Four broad fauna habitat types are present on the site at Culburra West or to tis immediate north (Figures 9A-9D):

- xeric forest and woodland communities – which occupy the majority of the site, with canopy trees, tree-hollows and a variable flowering understorey;
- small areas of mesic or 'swamp' forest – along the Crookhaven River foreshore;
- riverine and estuarine habitats associated with the Crookhaven River; and
- small areas of cleared and pasture-improved grassland in the western and eastern parts of the site.

Much of the vegetation on the subject site displays only relatively low levels of recent disturbance (other than the cleared grazing lands in the west of the subject site, patches in the east and the various tracks created through the site). It is noted, however, that the subject site had been substantially cleared or thinned previously (Appendix B), for grazing and agricultural purposes. Those activities, and long-term selective timber harvesting, have doubtless reduced the abundance of hollow-bearing trees throughout most of the site.

6.1.1 Forest and Woodland

The open forest and woodland across the majority of the subject site at Culburra West provides an array of habitats and resources for a variety of native fauna species. It is also to be noted, however, that these resources and habitat types are abundant throughout the study area, general locality and region, and are not confined to the subject site itself, or to the subject land.

The canopy of the forest and woodland vegetation provides foraging and nesting resources for a range of native arboreal mammal species (*eg* gliders and possums) and a wide array of bird species. The canopy also provides foraging habitat for microchiropteran bat species that hunt for insects whilst flying above, through or just below the canopy, and also provides some resources for the Grey-headed Flying Fox (which forages on fruits and blossoms within the canopy). Stands of Forest Oak and Black She-oak provide specific foraging resources for the Glossy Black Cockatoo, and the larger hollow-bearing trees may also provide roosting habitat for the Glossy Black Cockatoo and for some of the forest owls.

Tree-hollows, ranging in size from small holes along limbs to large hollows in senescent trees (and occasional stags), are distributed throughout the woodland and open forest communities on the Culburra West Project site, particularly in the more xeric communities (Figure 7; Appendix I). Trunk and limb hollows are utilised by arboreal mammals and a range of birds for nesting, and many

microchiropteran bats also utilise tree-hollows for roosting. Species such as the Glossy Black Cockatoo and Powerful Owl require very large hollows or large 'pipes' for nesting.

However, these resources are not particularly abundant on the subject site, because of the previous clearing and/or thinning of vegetation on the site (see Appendix B) and the use of the subject site for timber harvesting. Further, as discussed below (in Chapter 6.1.2), they are common to abundant and widespread throughout the locality generally.

The mid-canopy and shrub layers of the forest and woodland, where present on the subject site (as elsewhere throughout the study area), provide resources for a range of native mammal, bird and reptile species. Small terrestrial mammals (*eg* bandicoots, native rats and dasyurids) would shelter, forage and nest amongst the shrub layer, whilst small cryptic birds (*eg* thornbills, wrens and gerygones) forage and nest in the dense mid-canopy and shrub layers. Several native reptile species also utilise this habitat for shelter and foraging.

The composition of the groundcover varies throughout the forest and woodland of the subject site, and includes areas of dense leaf litter, woody debris, logs, vegetation and bare earth. Such resources provide habitat for native herpetofauna (*eg* skinks, dragons and frogs), including shelter and foraging resources. Large terrestrial mammals (*eg* kangaroos and wallabies) would forage amongst the native grasses and shrubs, although these species are also commonly found in open grassland or cleared and disturbed areas in the study area.

The native fauna on the subject site (including small mammals, birds, reptiles and frogs) also constitute prey for carnivorous species, both native (such as the Powerful and Masked Owls), and introduced (*ie* the Fox, Dog and Feral Cat).

The subject site also contains small areas of more mesic forest types and vegetation communities, along the edges of the Crookhaven River. The mesic communities do not generally provide any particular additional habitat features or resources for native biota, other than possibly for some amphibians.

6.1.2 Hollow-bearing Trees

The subject site for the Culburra West Project contains an array of hollow-bearing trees, with a wide variety of tree-hollows (Appendix I; Figure 7). This situation is typical of the open forest and woodland vegetation throughout the subject land and in the general locality, including in the extensive National Parks and State Forests to the south and southwest of the subject site.

The Scribbly Gum open forest and woodland vegetation contains a variety of small to moderate sized tree-hollows (as is typical of this tree species), with small spouts and small to moderate hollow branches being common. Large to very large tree-hollows, however, are uncommon in the forests and woodlands of the subject site, in part, no doubt, to previous clearing and timber harvesting activities. Indeed, the distribution of hollow-bearing trees is clearly related to the previous clearing and thinning of vegetation (Figure 7; Appendix B).

Nevertheless, there is a variety of tree-hollows present on the subject site (Figure 7), and it is assumed for the purposes of this *Report* and assessment that all of those hollow-bearing trees are to be removed for the Culburra West Project. However, it is proposed that all tree-hollows be salvaged and utilised in

habitat offset areas, either as hollow logs on the ground or placed in existing trees in those areas (see the *Hollow-Bearing Tree Protocol* in Chapter 17).

A variety of native fauna are either regular users of tree-hollows or are hollow-obligate. Most of the possums and gliding mammals require tree-hollows for shelter and breeding, as do the majority of the microchiropteran bats. A variety of birds also utilise hollows for shelter and breeding, including Rosellas, Lorikeets, Parrots, Cockatoos, Owls, Kingfishers and the Maned Duck.

6.1.3 Riverine and Estuarine Habitats

The estuarine and riverine habitats along the Crookhaven River occupy substantial areas to the immediate north of the subject site, as well as other substantial areas to the north, east and west (Figure 16). Estuarine habitats (including mangroves, sea-grasses and aquatic habitats) extend upstream along the Crookhaven River for a distance of at least 4km, as well as 8km to the north and northeast (to the northern side of the Shoalhaven River) and throughout Curleys Bay (to the east). There are thousands of hectares of estuarine environments and aquatic habitats at this location (Figures 16A-16C).

The southern bank of the Crookhaven River is located at the northern boundary of the subject site, and there are extensive areas of tidal estuarine mudflats and mangrove forests to the north of the site (Figures 16A-16C). There are also small patches, and one large patch, of Coastal Saltmarsh to the immediate north of the subject site (Figures 9A to 9D), between the stands of Mangrove Forest and the Swamp Oak Forest community (which forms a generally narrow band between the estuarine habitats and the terrestrial habitats).

The extensive mangrove forests and mudflats (Figures 16A-16C) provide habitat and resources for an array of wetland and wading birds in particular, including a variety of threatened species listed in the TSC Act and/or EPBC Act, and migratory species listed in the EPBC Act. There are extensive areas of mangrove forests and mudflats in and around the Crookhaven River and Shoalhaven River estuaries (Figures 16A-16C), as noted above, and these would provide significant resources for a variety of wading and wetland bird species.

The Crookhaven and Shoalhaven River estuaries also contain extensive sea-grass beds (Figures 16A-16C), that provide important habitat for many fish and other marine fauna.

The mangrove forests, mudflats, sea-grass beds and Coastal Saltmarsh adjacent to the subject site represent only a very small proportion of those present in the estuary at Culburra. Further, these features have been taken into account in the design of the Culburra West Project, and the stormwater management regime for the Project has been specifically designed to maintain high quality water discharges and an appropriate fresh water discharge regime.

6.1.4 Cleared Land

The cleared grazing land on the subject site, whilst not constituting a significant habitat or resource for native biota, would nevertheless be utilised by a range of species which are characteristic either of open grasslands or of the interface between woodland habitats and open grasslands.

This habitat type, whilst artificial, provides resources for granivorous and insectivorous bird species particularly, and also provides foraging resources for kangaroos, wallabies and bandicoots. In addition, some microchiropteran bats and the Masked Owl (if present) often use woodland and forest edges along such cleared land for foraging purposes.

6.2 Fauna Assemblage

A total of 240 vertebrate fauna species have been recorded during the various field investigations within the subject land and the Culburra West UEA, including 177 birds, 40 mammals, 11 amphibians and 12 reptiles (Appendix L). A total of 11 introduced fauna species have also been recorded during the fauna investigations.

The diversity of fauna species recorded reflects the array of habitats and resources within the study area, and the structural and floristic diversity of the vegetation present, and is reflective of the substantial area of vegetation and habitats present on the subject site and in the study area. It is to be noted, however, that some groups of these fauna species would be restricted to features which are not present on or around the subject site (*eg* species associated with freshwater wetlands and ponds, or with Lake Wollumboola).

6.2.1 Birds

The avifauna recorded within the subject site and through the general locality is dominated by woodland and forest bird species, typical of the vegetation which characterises most of the subject site. The species present on the subject site are also typical of the general locality, and of the substantial forested areas of the Shoalhaven LGA.

Five broad guilds of birds (based on foraging and habitat requirements) were identified during the various surveys (Appendix L), including:

- waterbirds and wading species, which forage in or along the margins of estuaries and rivers (*eg* waders, herons, cormorants and oystercatchers);
- insectivorous species, which utilise the forest and woodland habitats, and also the open grassland vegetation;
- larger species which prey on vertebrates and large invertebrates, and often cover large distances whilst foraging (*eg* the Powerful Owl, Southern Boobook, Kookaburra);
- granivorous and nectarivorous species which utilise forests and woodlands (*eg* the Crimson Rosella, Glossy Black Cockatoo, Rainbow Lorikeet and honeyeaters); and
- smaller and more cryptic birds which utilise dense shrubs and mid-storey vegetation for shelter (*eg* the Eastern Yellow Robin, Eastern Whipbird, Brown Thornbill and Golden Whistler).

A number of threatened bird species have been recorded within the subject site and/or in the vicinity during the current and previous field surveys (Table 12; Figures 18A and 18B), including the Powerful Owl, Glossy Black Cockatoo, Gang Gang Cockatoo, Square-tailed Kite and Scarlet Robin. The conservation significance of the subject site with respect to these threatened bird species is discussed in further detail in Chapter 6.3 of this *Report*.

Individuals of an array of wading and wetland bird species would utilise the mudflats, mangrove forests and small areas of Coastal Saltmarsh to the immediate north of the subject site at Culburra West. A wide variety of such species have been recorded within the Crookhaven River and Shoalhaven River estuaries and/or in Lake Wollumboola (Appendix L), and it is anticipated that a number of such species would utilise the mudflats and mangrove forests to the immediate north of the subject site.

There are, however, no records of any roosting by wetland and wading species on the subject site itself, and the subject site *per se* does not contain even potential roosting resources for any such species. The overwhelming majority of the estuarine habitats are located well to the north of the proposed development footprint (Figures 16A-16C).

6.2.2 Reptiles

The reptile species which have been recorded on the subject site and in the vicinity (Appendix L) during the current and previous field surveys (Appendix D) are generally widespread and abundant in distribution, and have been recorded from a wide variety of habitats throughout the Jervis Bay region. The subject site contains a variety of predominantly xeric forest and woodland habitats, as well as small patches of moist vegetation and small moist forest areas, which provide suitable habitat and resources for an array of reptile species.

It is likely that a range of other reptiles, in addition to those already recorded (Appendix L), would occur on the subject site, given the understorey, the variety of substrates and habitats, and the depth of the leaf litter in places.

However, no threatened reptile species have been recorded from the subject site, nor indeed from anywhere in the local study area. No such species are considered likely to occur given the habitats and resources present, and the lack of specific resources for those threatened reptiles that could theoretically be present.

In particular, there is no suitable habitat present for Rosenberg's Goanna on the subject site at Culburra West. There are no termite mounds (which provide both food and shelter for Rosenberg's Goanna) on the subject land or subject site, and there have been no records of this species in the locality or vicinity.

6.2.3 Amphibians

Only a few cosmopolitan amphibian species have been recorded from the subject site itself, although several additional amphibian species have been recorded in the vicinity during the substantial current and previous field investigations (Appendix L). The subject site does not *per se* contain significant or notable habitats or resources for amphibians, as there are no ponds, dams, freshwater wetlands or watercourses present.

One threatened amphibian species has been identified in the general vicinity - the Green & Golden Bell Frog, which is listed as "*Vulnerable*" in the TSC Act and in the EPBC Act. This species has been recorded around Lake Wollumboola and the village of Culburra, but not on or within the subject site itself (Figures 18A and 18B). The subject site is not of relevance with respect to the conservation of the Green & Golden Bell Frog, as discussed in detail in Chapter 6.3 of this *Report*.

6.2.4 Mammals

The variety of habitats and resources within the subject site support (or potentially support) an array of mammal species, with a total of thirty-three native and seven introduced mammal species having been recorded in the study area during the current or previous field investigations (Appendix L). Of the native species identified in the study area, five species utilise arboreal habitats, eight are predominantly terrestrial and twenty are aerial species (microchiropteran bats and the Grey-headed Flying Fox).

The open forest and woodland communities which characterise the majority of the subject site provide habitats and resources for arboreal mammal species, such as the Common Brushtail Possum, Common Ringtail Possum and Sugar Glider. These arboreal marsupials are frequently recorded throughout the forested areas in the region, utilise tree-hollows as dens and exhibit varying tolerances to disturbance. The Common Ringtail Possum, which also builds dreys in dense vegetation, is a common resident of bushland fragments within disturbed areas. Similarly, the Common Brushtail Possum is regularly recorded in urban environments.

One threatened arboreal mammal species, the Yellow-bellied Glider (listed as "*Vulnerable*" in the TSC Act), was allegedly recorded to the southwest of Long Bow Point (approximately 2km to the south of the subject site – Figure 18B) during the 1995/1996 field investigations (Daly & Leonard 1996a). There are also records to the southwest (Figure 18B; Appendix E), including recently at Callala Bay (SLR Ecology in prep).

The Daly & Leonard 1996a records were of trees ostensibly bearing glider feeding marks (notches in bark to obtain sap). However, no Yellow-bellied Gliders have ever been recorded on Long Bow Point, and this species has not been recorded on the subject site (the Culburra West Project site) itself. Whilst potentially or theoretically suitable habitat for this species is available on the subject site, the Yellow-bellied Glider has not been recorded at this location, and no evidence for its presence (*ie* characteristic incisions on trees) has been obtained from the Culburra West Project site.

Large macropods, including the Eastern Grey Kangaroo, Red-necked Wallaby and Swamp Wallaby, are recorded regularly on the subject site and on adjoining lands. These species graze on the grasses and understorey species of forests and woodlands of southeastern Australia, as well as in the adjoining artificial grasslands.

Small mammals, such as the Long-nosed Bandicoot, Brown Antechinus and Bush Rat, have also been recorded on the site or in the general vicinity (Appendix L). Such species are common terrestrial residents of bushland in the locality, and are relatively disturbance tolerant, utilising resources in the vicinity of residential development.

Of the gliding mammals recorded in the general vicinity (Appendix L), the Sugar Glider is regularly recorded in close proximity to urban environments, but the Greater Glider (which was recorded on Long Bow Point to the south of the subject site) is not generally recorded in urban environments. This latter species was not recorded on the subject site for the Culburra West Project, and the Squirrel Glider has not been recorded on the Culburra West Project site, or in this general locality.

Despite an array of investigations using appropriate techniques over a very long period, the White-footed Dunnart has never been recorded on the subject site or in the Culburra UEA lands, including on Long Bow Point. Given the lack of records despite appropriate investigations, it would appear that the White-footed Dunnart is not present on the subject site or on the subject land at Culburra. Similarly,

there are no records of the Eastern Pygmy Possum, Tiger (Spotted-tailed) Quoll or the Southern Brown Bandicoot, despite an array of surveys by a range of consultants and the NPWS in the locality.

The Grey-headed Flying Fox is regularly recorded in the general locality, but this species has only been recorded in paperbarks in the eastern part of the subject site. Doubtless, individuals of the Grey-headed Flying Fox could forage on flowering eucalypts at appropriate times of the year, but the subject site does not appear to constitute significant or important habitat for this species.

Conversely, an array of microchiropteran bats, including several threatened species, has been recorded on the subject land at Culburra (Appendix L; Table 12; Figures 18A and 18B). All of the species are widespread and generally common (or at least frequently recorded) in the locality, and many are recorded in most comprehensive fauna surveys conducted throughout the general locality and in the Shoalhaven region. The presence of an array of tree-hollows would provide roosting and potentially breeding resources for many microchiropteran bats, but there are no foraging habitats for the Large-footed Myotis (which forages over farm dams and freshwater wetlands) on the Culburra West Project site.

Seven introduced mammal species have also been recorded in the study area, reflecting the proximity of the site to urban development and the long history of modification and disturbance. The presence of two introduced predators (*ie* the Cat and Fox) is likely to have affected populations of native fauna to some degree, particularly terrestrial fauna. The introduced Black Rat also preys on the eggs of native birds. Whilst Rabbits and Hares compete with native herbivorous mammals for foraging resources, and can cause high levels of disturbance within the understorey, these species do not appear to be of significance on the subject site.

6.3 Threatened Biota

6.3.1 Fauna Species

The purposes of this discussion, the threatened fauna species which have been recorded on the subject land or in the vicinity (by various investigations) and/or which are recorded in the locality on the OEH Wildlife Atlas have been divided into four groups, as below.

- **Definite**

  Species that have been recorded on the subject land and which are considered highly likely to utilise the vegetation and habitats within the subject site (Chatper 6.3.2; Table 12). These include species such as the Powerful Owl, Glossy Black Cockatoo, Square-tailed Kite and several threatened microchiropteran bats.

- **Potential**

  These are threatened fauna species recorded on the subject land or in the general vicinity that could possibly utilise the forest habitats within the subject site, on occasions at least (Chapter 6.3.3; Table 13). These include:

  - species recorded in the general vicinity that could utilise vegetation present on the subject site – such as the Gang Gang Cockatoo;
  - species that could potentially be present (Appendix E), but which have not been recorded in the vicinity – such as the Masked Owl, Swift Parrot and Turquiose Parrot; and

- species which have been recorded on the subject land or subject site on a single occasion, but for which there is no evidence of a "*viable local population*" – the Sooty Owl, Scarlet Robin and Varied Sitella.

- **Unlikely**

  Those threatened species for which the subject site is not considered likely to provide habitat or resources or to be present on the subject site (Chapter 6.3.4; Table 14), including:

  - an array of mammal and bird species that have never been recorded on the subject land or in the immediate vicinity;
  - species (such as the Large-footed Myotis and Green & Golden Bell Frog) for which there is no relevant habitat on the subject site itself; and
  - species which rely on the estuarine habitats along the Crookhaven River.

- **Not Relevant**

  These are threatened species for which neither the subject site nor the subject land provide relevant habitat, or species such as the Koala which has not been recorded in the vicinity or locality for many decades (Chapter 6.3.5; Table 15).

Of the threatened species that have been recorded on the subject site or in the immediate vicinity, it is the species dependent on open forest and woodland communities that are of most relevance to the proposed Culburra West Project. The subject site (*ie* that area to be directly affected by the proposal) is characterised almost exclusively by open forest and woodland vegetation, with a small area of artificial grassland at its western and eastern extremities (Figures 9A to 9D). There are no freshwater wetlands or ponds within the development footprint, however, and the estuarine and riverine habitats of the Crookhaven River are located to its immediate north (Figures 16A-16C), and are not part of the Culburra West Project.

As a consequence of those considerations, not all of the threatened fauna which have been recorded in the immediate vicinity are of relevance to the proposed Culburra West Project. In this regard:

- there is no relevant habitat for the Green & Golden Bell Frog on the proposed development area, given the lack of freshwater wetlands and given the estuarine nature of the Crookhaven River habitats (as discussed below);
- the threatened fauna species of most relevant are confined to those which are dependent or reliant upon open forest and woodland habitats;
- species associated with estuarine and riverine habitats, particularly wetland and wading birds which would utilise the mudflats, Coastal Saltmarsh and mangrove forests along the Crookhaven River, are of only minimal or marginal relevance to the proposal (at best), because those areas of habitat are well outside of the development footprint; and
- there are an array of threatened fauna species which have been recorded in the general locality or even immediate vicinity of the subject site which are of little or no relevance (such as the Osprey, Little Tern and other open water species).

Detailed consideration of the array of threatened fauna species known to occur on the subject site or in the vicinity is provided below.

6.3.2 Definite Threatened Species

As noted above, several threatened fauna species have been recorded on the subject site and/or on Long Bow Point, and are considered highly likely to (or are known to) utilise resources on the Culburra West Project site itself.

Species such as the Square-tailed Kite are also considered as 'Definite' species, because Square-tailed Kites are regularly recorded in the immediate vicinity. However, other species which have only been recorded once, (such as the Flame Robin, Sooty Owl and Varied Sitella) are considered in the following sub-chapter of this *Report* – as 'potential' species.

Table 12 Threatened fauna species that have been recorded on the subject land or in the vicinity during the current and previous field investigations (Appendix D)

Common Name	Scientific Name	Comments
Square-tailed Kite	*Lophoictinia isura*	Recorded once soaring over the subject site; a single nest is present on Long Bow Point; highly mobile and wide-ranging, with a very large home range
Glossy Black Cockatoo	*Calyptorhynchus lathami*	Recorded frequently and widely in the Jervis Bay region; recorded only occasionally on the Project site; limited areas of foraging resources on the site itself; moderate density of tree-hollows
Powerful Owl	*Ninox strenua*	Recorded occasionally on the Project site, and in the study area; known huge nest tree in southwest of the subject land, but no recent nesting activities; one individual recorded to the south in February 2013
East-coast Freetail Bat	*Micronomous norfolkensis*	Recorded on the Project site and Long Bow Point; suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Common Bent-wing Bat	*Miniopterous schreibersii*	Recorded on the Project site and Long Bow Point; suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Eastern Falsistrelle	*Falsistrellus tasmaniensis*	Recorded on the Project site and Long Bow Point; suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Recorded on the Project site and Long Bow Point; suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Yellow-bellied Sheath-tail Bat	*Saccolaimus flaviventris*	Recorded on the Project site and Long Bow Point; suitable foraging habitat and roosting resources present; suitable resources are widely distributed and well protected in locality and region
Grey-headed Flying Fox	*Pteropus poliocephalus*	Recorded flying over the Project site and Long Bow Point; potential foraging resources present; suitable resources are widely distributed and well protected in locality and region

Square-tailed Kite

The Square-tailed Kite *Lophoictinia isura* had been tentatively recorded from Long Bow Point (to the south) in the past (Daly & Leonard 1996a), and has been recorded previously in the locality (NPWS 1996). It was definitely recorded on Long Bow Point in early 2012 (SLR Ecology 2012), and a nest was located on Long Bow Point during the surveys for the Culburra Golf Course SIS (SLR Ecology *in prep*).

The Square-tailed Kite is a wide-ranging raptor which preys upon small birds and large insects. It is generally solitary, with breeding pairs requiring large home ranges of at least 100km^2 (Daly & Evison 1995; Debus & Czechura 1989). The subject land provides suitable foraging and roosting habitat for the Square-tailed Kite, but the Culburra West Project site would only form an extremely small part (less than 1%) of a much larger home range for even a pair of this species.

Whilst individuals of the Square-tailed Kite have been recorded flying over the subject land and nesting in the forest of Long Bow Point in recent times, no nests of this species have been recorded on the subject site itself. The Culburra West Project site is not regarded as of particular relevance or significance for the Square-tailed Kite, given:

- the lack of evidence of nesting on the subject site;
- the extent of suitable foraging habitat and resources within the potential home range of a pair of this species;
- the substantial area of suitable habitat and resources contained in the extensive conservation reserves and State Forests in the locality and region;
- the very substantial home range of this species; and
- the very high mobility and wide-ranging habitats of the Square-tailed Kite.

For those reasons, the Culburra West Project site is regarded as only of Moderate (at best) relevance for the Square-tailed Kite, and then only for a single pair of that species.

Glossy Black Cockatoo

The Glossy Black Cockatoo *Calyptorhynchus lathami* is a large member of the cockatoo family, distributed widely throughout eastern Australia, particularly east of the Great Dividing Range. This species is highly mobile and sometimes nomadic, moving in response to the availability of suitable food resources.

The Shoalhaven Local Government Area (LGA) appears to be a stronghold for the Glossy Black Cockatoo in coastal NSW. This species is regularly recorded throughout the Shoalhaven LGA, particularly within the substantial State Forests, National Parks and private forested lands throughout the LGA (Figures 18A and 18B). The minimal records of this species in the extensive National Parks and Nature Reserves of the Shoalhaven LGA should not be considered as demonstrating that the species does not occur in these areas. Rather, they reflect the inadequacy of detailed field investigations in those reserves (in contrast to the subject site).

Critical resources for the Glossy Black Cockatoo include:

- areas of dense she-oak stands (particularly the Black She-oak *Allocasuarina torulosa* and the Forest Oak *A. littoralis*), on which the Glossy Black Cockatoo feeds; and

- hollow-bearing trees with ‘pipes’ or ‘chimneys’ in which to nest and rear young.

As noted above, the Glossy Black Cockatoo is regularly recorded in the Shoalhaven LGA (see Bibliography; F Dominic Fanning *pers obs*), and is represented by a substantial number of records on the OEH Wildlife Atlas (Figures 20A and 20B). As also noted above, this species appears to be common to abundant in the Shoalhaven LGA, with substantial areas of dry forest and open woodland communities providing significant areas of suitable foraging habitat for this species.

The Glossy Black Cockatoo has been recorded both on Long Bow Point and, less frequently and at scattered locations, throughout the lands which are the subject of this *Report*. The vegetation north of the Culburra Road does not support particularly dense or substantial areas of she-oaks suitable for foraging by Glossy Black Cockatoos, and there are relatively few records of the species in this part of the study area. Conversely, lands to the south of the Culburra Road (on Long Bow Point) contain moderate to large patches of she-oaks in which Glossy Black Cockatoos have been regularly recorded (F Dominic Fanning *pers obs*).

Evidence of a small amount of Glossy Black Cockatoo feeding activity was obtained in the central part of the Project site (in 2013) and in the western areas (in 2010), as indicated in Figure 17. This species is recorded on Long Bow Point at a much greater frequency.

Evidence of Glossy Black Cockatoo foraging has also been obtained within lands which are now part of the Jervis Bay National Park (further to the south of the subject land). As noted elsewhere, this species is regularly recorded during field investigations in the Shoalhaven LGA, and the subject lands are not unusual or particularly significant in this regard. In particular, the Culburra West Project site does not contain significant stands of she-oaks, and Glossy Black Cockatoos are only rarely sighted in the proposed development land.

On the basis of the considerations detailed above, particularly given the limited records of the species on the subject site over a long period of observations, and the minimal resources for this species on the subject site, the Culburra West Project site is regarded as only of Moderate (at best) relevance for the Glossy Black Cockatoo.

Powerful Owl

The Powerful Owl *Ninox strenua* is the largest of Australia’s owl species, and has a distribution which includes the whole of the eastern part of Australia from the Cape York Peninsula to Tasmania. This species inhabits tall, generally moist, forest communities, although it also utilises open dry forest and even patches of remnant trees in urban environments (F Dominc Fanning *pers obs*).

Important elements of the habitat requirements and behavior of the Powerful Owl include:

- a healthy population of arboreal mammals upon which this species primarily feeds, noting that the Powerful Owl also takes flying foxes and some birds as prey;
- a substantial home range (of approximately 1000ha for a breeding pair) to provide suitable roosting and nesting habitats, and a sufficient food supply;
- patches of suitable trees for diurnal roost sites (such as Turpentines and other species with a dense canopy); and
- very large tree-hollows in which to nest and rear young.

The Powerful Owl has been recorded from a number of widely distributed locations in the Culburra West study area and in the surrounding forested lands (Figures 17, 18A and 18B). Observations of the Powerful Owl have been obtained by Gunninah Environmental Consultants and Environmental InSites between 1995 and the present, with a few records over that period within the subject land and on Long Bow Point, and two records on the subject site (Figure 17).

In addition to the sighting of animals on the subject land, two roost trees and a nest tree for the Powerful Owl had been identified on the subject land to the immediate north of the Culburra Road (Figure 18B). The nest tree is located about 25m from the Culburra Road, but no nesting activities have been observed for several years. However, an individual Powerful Owl was observed on Lot 51 in DP 1124845 (approximately 3km to the southwest) in February 2013 by SLR Ecology, during a survey of part of the proposed offset lands.

As noted above, recent surveys of the subject land including *inter alia* the Culburra West Project site and Long Bow Point (since 2010 by Environmental InSites and SLR Ecology) have revealed no evidence of those trees currently being used by Powerful Owls for nesting or breeding purposes. Further, recent use of call playback during those surveys (Appendix D) elicited no response from Powerful Owls, and there have been no recent records of nests or breeding by this species within the Culburra West Project site.

In addition to the previous records obtained by Gunninah Environmental Consultants during investigations in the Culburra locality, there are substantial other records of Powerful Owls both in the immediate vicinity and in the general Jervis Bay area (Appendix E; Figures 18A and 18B). The Powerful Owl is widespread in the Jervis Bay area, and the extensive naturally forested areas of the Shoalhaven LGA (including the very considerable National Parks and State Forests) provide substantial resources for this species throughout the region (Figures 12 and 13).

On the basis of the considerations detailed above, the Culburra West Project site:

- is not a significant area of habitat for the Powerful Owl, although an individual or pair are likely to use the Project site for foraging as part of a much larger 'home range';
- of itself would not be capable of supporting even an individual or pair of the Powerful Owl;
- does not contain any suitable nesting hollows for this species;
- has not been identified as currently being used by Powerful Owls; and
- represents only a tiny proportion of the very substantial habitats for this species compared to the extensive conservation reserves and State Forests in the locality and region.

East-coast Freetail Bat

The East-coast Freetail Bat *Micronomus norfolkensis* is a small insectivorous bat which utilises dry eucalypt forest and coastal woodlands, although individuals have also been captured within riparian zones, wet sclerophyll forest and rainforest (Allison & Hoye 1995; Churchill 2008). This species forages above the canopy or in unobstructed corridors in open areas (Strahan 1995), on either winged or wingless ants (Allison 1989). Small colonies of the East-coast Freetail Bat roost in tree-hollows or under loose bark on large trees (Churchill 2008).

This species has been recorded within the subject land at Culburra, and is likely to utilise much or all of the forested areas of the subject site, as well as surrounding lands and forests throughout the locality and region. There is a substantial supply of potential roosting habitat for this species (hollow-bearing and large trees) throughout the subject lands, although it is not intended that any such trees be retained within the Culburra West project area. All tree-hollows that are removed will be the subject of the *Hollow-bearing Tree Protocol* (see Chapter 17).

The Culburra West Project area is not regarded as of particular significance for the East-coast Freetail Bat, and is considered of only low to moderate value for this species, because:

- the subject site contains only a relatively small part of actual and/or potentially suitable habitat for this species in the immediate vicinity, locality and region;
- this species is highly mobile and wide-ranging, and would not be restricted to the subject site; and
- there are substantial areas of suitable habitat and resources for the species contained in the extensive and substantial conservation reserves and State Forests in the vicinity, locality and region.

Common (Eastern) Bent-wing Bat

The Common (Eastern) Bent-wing Bat *Miniopterous schreibersii* forages above dry and moist forest, and can be found in forested as well as urban areas. This species preferentially roosts in caves, although man-made structures (such as old mines, tunnels, bridges, and other similar structures) are also used, and occasionally hollow-bearing trees. Specific maternity caves are used by females during summer to give birth.

The Common Bent-wing Bat has been recorded within the subject site and subject land, and individuals can be expected to utilise much or all of the forested areas of the subject lands and general locality, and region, for foraging purposes. However, no significant roosting habitat is present on the subject site for this species, although individuals do utilise tree-hollows for roosting on occasions.

The Culburra West Project area is not regarded as of particular significance for the Common (Eastern) Bent-wing Bat, and is considered of only low to moderate value for this species, because:

- the subject site contains only a relatively small part of actual and/or potentially suitable habitat for the species in the immediate vicinity, locality and region;
- this species is highly mobile and wide-ranging, and would not be restricted to the subject site; and
- there are substantial areas of suitable habitat and resources for the species contained in the extensive and substantial conservation reserves and State Forests in the vicinity, locality and region; and

Greater Broad-nosed Bat

The Greater Broad-nosed Bat *Scoteanax rueppellii* is found in a variety of habitats, ranging from woodlands to moist and dry eucalypt forest and rainforest (Hoye & Richards 1995; Churchill 2008). This species prefers open habitats in which individuals can fly straight and direct, and is known to utilise

artificial openings in forests, with favoured habitats being river and creek corridors (Hoye & Richards 1995). Individuals have been recorded roosting in tree-hollows, cracks and fissures in the trunk and boughs of stags, and under exfoliating bark.

This species has been recorded within the subject land at Culburra, and in the vicinity and general locality. The Greater Broad-nosed Bat would be expected to utilise much or all of the forested areas of the subject site and surrounding lands. There is a substantial supply of hollow-bearing trees as potential roosting habitat for this species, including in the substantial adjoining lands and National Parks lands. Any removal of tree-hollows or hollow-bearing trees for future development of the subject site will be subject to implementation of the *Hollow-bearing Tree Protocol* (see Chapter 17).

Given the high mobility of this species and the retention of large areas of habitat containing suitable roosting resources in the locality and region (Figures 1, 12 and 13), the proposed Culburra West Project would not be likely to impose any significant adverse impacts upon any local population of the Greater Broad-nosed Bat.

The Culburra West Project area is not regarded as of particular significance or importance for the Greater Broad-nosed Bat, and is considered of only low to moderate value for this species, because:

- the subject site contains only a relatively small part of actual and/or potentially suitable habitat for the Greater Broad-nosed Bat in the immediate vicinity, locality and region;
- this species is highly mobile and wide-ranging, and would not be restricted to the subject site; and
- there are substantial areas of suitable habitat and resources for the species contained in the extensive and substantial conservation reserves and State Forests in the vicinity, locality and region.

Yellow-bellied Sheath-tail Bat

The Yellow-bellied Sheath-tail Bat *Saccolaimus flaviventris* is found in a variety of habitats, ranging from grasslands and desert to woodlands, moist and dry eucalypt forest and rainforest (Churchill 2008). This species flies "*fast and straight usually above the canopy, but lower over open spaces and at the forest edge*" (Churchill 2008), and roosts in large tree-hollows.

The Yellow-bellied Sheath-tail Bat has been recorded on the subject land at Culburra, and elsewhere in the locality. This species would be expected to utilise the forested areas of the subject site as well as the substantial areas of suitable habitat in the surrounding lands. There are substantial National Parks and State Forests in the vicinity and throughout the LGA (Figures 12 and 13), and it is anticipated that significant areas of forest habitat will also be retained on private lands in the vicinity, being zoned for conservation purposes.

Given the high mobility of this species and the retention of large areas of habitat containing suitable foraging and roosting resources in the locality and region (Figures 1, 12 and 13), the proposed development of the site is not likely to impose any significant adverse impacts upon any local population of the Yellow-bellied Sheath-tail Bat.

The Culburra West Project area is not regarded as of particular significance or importance for the Yellow-bellied Sheath-tail Bat, and is considered of only low to moderate value for this species, because:

- the subject site contains only a relatively small part of actual and/or potentially suitable habitat for this species in the immediate vicinity, locality and region;
- the Yellow-bellied Sheath-tail Bat is highly mobile and wide-ranging, and would not be restricted to the subject site; and
- there are substantial areas of suitable habitat and resources for the species contained in the extensive and substantial conservation reserves and State Forests in the vicinity, locality and region.

Eastern Falsistrelle

The Eastern Falsistrelle *Falsistrellus tasmaniensis* has been recorded from coastal mallee and moist forest, generally with a dense understorey (Churchill 2008). This species is a "*swift and direct*" flier, generally targeting larger prey (Churchill 2008), and usually roosts in tree-hollows.

The Eastern Falsistrelle has been recorded on the subject land at Culburra, and in the locality. This species would be expected to utilise most or all of the forested areas of the subject site and surrounding lands, including the extensive forests in National Parks and State Forests, and substantial areas of private forested land zoned for conservation purposes.

Given the high mobility of this species and the retention of large areas of habitat containing suitable foraging resources within the vicinity, locality and region (Figures 1, 12 and 13), the proposed residential development of the subject site at Culburra is not likely to impose any significant adverse impacts upon any local population of the Eastern Falsistrelle.

The Culburra West Project area is not regarded as of particular significance or importance for the Eastern Falsistrelle, and is considered of only low to moderate value for this species, because:

- the subject site contains only a relatively small part of actual and/or potentially suitable habitat for this species in the immediate vicinity, locality and region;
- the Eastern Falsistrelle is highly mobile and wide-ranging, and would not be restricted to the subject site; and
- there are substantial areas of suitable habitat and resources for the species contained in the extensive and substantial conservation reserves and State Forests in the vicinity, locality and region.

Grey-headed Flying Fox

The Grey-headed Flying Fox is a wide-ranging megachiropteran bat, which occupies dedicated 'camps' (involving a few to many tens of thousands of individuals), and which utilises a wide range of foraging resources throughout the year. This species has been recorded flying over the Project site and subject land on a number of occasions, and could potentially utilise foraging resources within the Project site on occasions.

However, there are no 'camps' of the Grey-headed Flying Fox in the immediate vicinity of the subject land, and the potential resources present on the Project site are widespread, abundant and well protected within the substantial conservation reserves within the locality and region.

Even if the Grey-headed Flying Fox utilises the subject site at all, the resources present:

- constitute only a minute fraction of those available for those species in the immediate vicinity;
- constitute a minuscule proportion of those available in the locality and region; and
- do not constitute a relevant resource for this species, even if it does utilise the subject site.

6.3.3 Potentially Relevant Threatened Fauna

Several species of threatened fauna which have previously been recorded in the locality have not been recorded on the subject site *per se* during any investigations, despite the presence of potential habitat and despite the conduct of appropriate surveys (Table 13; Appendices D and L).

Table 13 Additional threatened or the Crookhaven River fauna species which could theoretically utilise the Culburra West Project site on occasions

Common Name	Scientific Name	Comments
Yellow-bellied Glider	*Petaurus australis*	Never recorded on the site, or on Long Bow Point; no indirect evidence in subject land; substantial potential habitat in locality and region
Masked Owl	*Tyto novaehollandiae*	Potentially present, but never recorded; high mobility and large home range; substantial habitat in locality and region
Osprey	*Pandion haliaetus*	Potential foraging along the Crookhaven River; recorded once – perching on a transmission tower in industrial area; no relevant habitat on the subject site *per se*
White-footed Dunnart	*Sminthopsis leucopus*	Never recorded in the vicinity; potential habitat widespread; substantial areas protected in the locality and region
Squirrel Glider	*Petaurus norfolcensis*	Not recorded in the vicinity; substantial areas of suitable potential habitat protected in the locality and region
Tiger Quoll	*Dasyurus maculatus*	Not recorded in the vicinity or locality; substantial areas of potential habitat protected in the locality and region
Southern Brown Bandicoot	*Isoodon obesulus*	Never recorded despite appropriate surveys; substantial suitable potential habitat protected in locality and region
Bush Stone-curlew	*Burhinus grallarius*	Potential habitat in woodlands on the site; never recorded in study area; substantial potential habitat in locality and region
Swift Parrot	*Lathamus discolor*	Favoured tree species not common on the site; few recent records in the vicinity; never recorded on the Project site; substantial suitable potential habitat protected in locality and region

Common Name	Scientific Name	Comments
Turquoise Parrot	*Neophema pulchella*	Site lacks preferred foraging habitat; species never recorded on the Project site or adjacent land; substantial suitable potential habitat protected in locality and region
Gang Gang Cockatoo	*Callocephalon fimbriatum*	Recorded only once in Culburra village; not recorded elsewhere; substantial potential habitat in locality and region
Scarlet Robin	*Petroica boodang*	Recorded only once on the Project site (in 2010); not recorded elsewhere or since; substantial potential habitat in locality and region
Varied Sitella	*Daphoenositta chrysoptera*	Recorded only once on the Project site (in 2010); not recorded elsewhere or since; substantial potential habitat in locality and region
Little Eagle	*Hieraaetus morphnoides*	Recorded only once soaring over the subject land; not recorded elsewhere; substantial potential habitat in locality and region
Sooty Owl	*Tyto tenebricosa*	Recorded only once (by call) on the southern side of the subject land; no particular habitat or resources on the site; not recorded elsewhere; substantial potential habitat in locality and region

Masked Owl

The Masked Owl *Tyto novaehollandiae*, a large nocturnal predator of small and medium-sized terrestrial mammals, was observed roosting, and heard calling, within Currambene State Forest - to the southwest of the subject site during previous fauna investigations (Gunninah 1999f). Although recorded frequently within the Shoalhaven LGA (NPWS 1996), this species has not been recorded on the Culburra West Project site or on Long Bow Point (to the south).

Being territorial, the Masked Owl will frequently respond to taped calls broadcast within its territory, and may compete with the Powerful Owl for large hollow-bearing trees for roosting and nesting.

The Masked Owl prefers to forage in open areas adjacent to forest and woodland vegetation with a sparse understorey (Higgins 1999). Whilst the subject site supports suitable foraging resources and some suitable tree-hollows for the Masked Owl, these resources are not restricted to the subject site or the locality, and are well represented regionally.

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for the Masked Owl.

White-footed Dunnart

The most recent observation of the White-footed Dunnart *Sminthopsis leucopus* in the locality of the subject land was in 1988 (OEH Wildlife Atlas – Appendix E). The White-footed Dunnart has not been recorded on the subject site or in the vicinity, including in the Culburra UEA and on Long Bow Point, despite intensive survey efforts using suitable methods (*ie* Elliott traps, pitfall traps, hair funnels, predator scats).

This species is a small terrestrial carnivorous marsupial, which feeds on a variety of invertebrates and small lizards (Lunney *et al* 1989; Lunney & Leary 1989; Menkhorst 1995; King 1980). The White-footed Dunnart occupies xeric grassy woodlands and open forests, generally with relatively low densities of shrubs.

Whilst the Culburra West Project would remove some areas of theoretical or potential habitat for this species:

- there is no evidence that the White-footed Dunnart is present on the subject land or in the locality; and
- there are very extensive areas of potentially suitable habitat protected in the locality and region.

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for the White-footed Dunnart.

Scarlet Robin

The Scarlet Robin *Petroica boodang* occurs in southeastern Australia and southwest Western Australia. In NSW, this species occupies open forest and woodland habitats, generally preferring xeric eucalypt forest and woodlands with an open understory of shrubs and grasses.

The *Final Determination* to list the Scarlet Robin as a vulnerable species notes that "*Abundant logs and coarse woody debris are important structure components of its habitat*", as this species feeds on invertebrates associated with those habitat features.

The Scarlet Robin was apparently recorded on the subject site in December 2010 (by Lesryk). However, no individuals of this species have been recorded during any of the subsequent field surveys within the subject land or on the adjoining Culburra golf course land (Long Bow Point). Whilst it is doubtless possible that individuals or a small population of the Scarlet Robin could be present within the subject site, there are very substantial areas of contiguous vegetated habitat to the south and southwest, which would provide suitable resources for, and essentially identical habitat for, the Scarlet Robin at Culburra.

Whilst the subject site provides some potentially suitable habitat:

- there is no 'unique' habitat for the Scarlet Robin present;
- potential habitat for this species (if present on the site) is widespread throughout the general locality; and
- there are substantial areas of potentially suitable habitat (if the species is present) in the locality and region – particularly in the substantial conservation resources and State Forests in the region.

Given those circumstances, the Culburra West Project site is regarded as of only low relevance (at best) for the Scarlet Robin.

Gang Gang Cockatoo

The Gang Gang Cockatoo *Callocephalon fimbriatum* is listed as a vulnerable species in the TSC Act, and occurs from southern Victoria throughout the southern and central eastern parts of NSW. In NSW, it occurs from the southeastern coast of the state to the Hunter region, and westwards to the central tablelands and southwest slopes.

The Gang Gang Cockatoo occupies tall dense wet sclerophyll forest during the summer, but moves to lower altitudes and more xeric forests and woodlands during the winter. This species, like the Glossy Black Cockatoo, requires tree-hollows in trunks or in large tree limbs, with breeding usually occurring in tall mature sclerophyll forest with a dense understorey, and occasionally in coastal forests (Scientific Committee 2005).

Individuals of the Gang Gang Cockatoo were recorded over Culburra in December 2010, but this species has not been recorded at Culburra since that time, despite intensive investigations conducted both on the subject land and on Long Bow Point. Given its high mobility and its migratory habits, and the very considerable area of native forest within conservation reserves, State Forests and private lands in the locality and region, the forests of the West Culburra site are not regarded as of particular relevance or significance for the Gang Gang Cockatoo.

On the basis of the considerations detailed above, the subject site is regarded as of only minimal or low relevance for the Gang Gang Cockatoo.

Sooty Owl

The Sooty Owl *Tyto tenebricosa* is represented by a single record near the Culburra Road, on the southern boundary of the subject land. That was an aural record obtained by Lesryk in December 2010, in response to call playback of the Powerful Owl.

The Sooty Owl generally occupies tall moist forests and rainforest communities, and occurs along the eastern parts of NSW and into the greater Dividing Range. Whilst not as large as the Powerful Owl, the Sooty Owl also requires large tree-hollows for nesting purposes.

There are no other records of the Sooty Owl in the study area, either as a result of any other field surveys undertaken over the last two decades or on the OEH Wildlife Atlas (Appendix E). Without impugning the professionalism of Lesryk Environmental Consultants, it is possible that this single aural record is a mis-identification.

It is not considered likely that the subject site constitutes significant or important habitat (if indeed habitat at all) for the Sooty Owl. Further, even if this species is present in the locality, the subject site itself is not regarded as of particular relevance, given:

- the habitat requirements of the Sooty Owl, which are not typical of the subject site;
- the minute area of even potential habitat, by comparison to the substantial areas of habitat in the locality and region;
- the high mobility of the Sooty Owl; and
- the considerable extent of similar habitats and resources contained within the extensive conservation reserves and State Forests in the Shoalhaven LGA.

Little Eagle

The Little Eagle *Hieraaetus morphnoides* is a wide-ranging raptore which utilises forests, woodlands and shrublands throughout much of Australia. This species occupies substantial home ranges, and pursues a range of prey including birds, reptiles and small mammals.

An individual Little Eagle was observed flying over the subject land in December 2010. This species is occasionally recorded in the study area and general locality, but there have been no records of Little Eagle nests in the vicinity or locality to date.

Given that the Little Eagle has only been recorded once, soaring over the subject land, the subject site is considered to be of only extremely limited or marginal relevance to the species. The proposed Culburra West Project is not regarded of any concern with respect to the Little Eagle, given:

- the habitat requirements of the Sooty Owl;
- the minute area of even potential habitat by comparison to the substantial areas of habitat in the locality and region;
- the high mobility of the Sooty Owl; and
- the considerable extent of relevant habitats and resources contained within the extensive conservation reserves and State Forests in the Shoalhaven LGA.

Varied Sitella

The Varied Sitella *Daphoenositta chrysoptera* utilises open forests and woodlands, as well as tall shrublands, parks and golf courses. It occurs throughout much of Australia, except in the harsher desert environments of central and northwestern Australia, and on the Nullarbor Plain.

The Varied Sitella has been recorded on only one occasion on the subject site or in the vicinity – with a small group observed foraging in open forest to the east of the existing industrial area of Culburra in 2010. This species has not been recorded previously or since, and there is no evidence for a "*viable local population*" of the Varied Sitella either on the subject site or subject land, or within the general vicinity.

Given those circumstances, the proposed Culburra West Project site is not considered of particular relevance for the Varied Sitella.

Squirrel Glider

The Squirrel Glider *Petaurus norfolcensis* has not been recorded during any field investigations on the subject site or in the immediate locality (see Chapter 2), and only one record of the Squirrel Glider (from 1970) exists for the locality (OEH Wildlife Atlas – Appendix E). This species inhabits dry sclerophyll forests and woodlands in southeastern Australia, although it is also found in coastal vegetation in northern and central NSW and in Queensland (Suckling 1995; Menkhorst *et al* 1988).

Both the subject land and the subject site contain potential habitat for the Squirrel Glider, although the species has never been recorded in those locations. In any case, there are substantial areas of

suitable potential habitat for that species in the locality and region, including in the extensive conservation reserves within the Shoalhaven LGA (Figures 12 and 13).

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for the Squirrel Glider.

Tiger (Spotted-tailed) Quoll

The Tiger Quoll *Dasyurus maculatus* was not recorded during any current or recent field investigations on the Culburra West Project site, and has not been recorded on the subject land or in the immediate vicinity during any previous surveys (see Chapter 2). Only one record of its presence exists from the locality, dating back to 1980 (OEH Wildlife Atlas – Appendix E).

This species is known to inhabit a range of forest and woodland environments (Edgar & Belcher 1995), although it prefers moist forest and rainforest habitats with a generally dense understorey and groundcover.

The Tiger Quoll preys on insects and small to medium-sized vertebrates, and utilises hollow logs, stages, caves or rock crevices for denning. Although some potentially suitable (limited or marginal) foraging and denning habitat is present on the subject site, the lack of any recent records of the species suggests that it no longer occurs in the locality. Further, there are substantial tracts of potential habitat in the locality and region (particularly in the extensive conservation reserves and State Forests), and the Culburra West Project site cannot be considered of likely or even potential significance for this species.

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for Tiger Quoll.

Southern Brown Bandicoot

The Southern Brown Bandicoot *Isoodon obesulus* occurs essentially along the coastal fringe of NSW, from the southern side of the Hawkesbury River to the Victorian border (and thence into Victoria).

This species occupies a variety of habitats in NSW, including heathland, shrubland, dry sclerophyll forest (generally with a heath understorey), sedgelands and woodland communities. The species also appears to be tolerant of bushfire, and appears to prefer the early seral stages of some vegetation communities following disturbance by fire.

There have been no records of the Southern Brown Bandicoot either on the subject land or on the Long Bow Point golf course site, despite the use of an array of appropriate techniques over a very long period. Recent use of infra-red cameras has failed to record any individuals of the Southern Brown Bandicoot. Furthermore, as is the case for many of other terrestrial woodland and open forest species, there are very substantial areas of suitable habitats for this species (potentially or theoretically at least) in the immediate vicinity and general locality, and throughout the extensive conservation reserves and State Forests within the Shoalhaven region.

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for Southern Brown Bandicoot.

Osprey

The Osprey *Pandion haliaetus*, although seen regularly (albeit infrequently) along the coast around Jervis Bay and along the Crookhaven River, has not been recorded on the subject site itself during any investigations undertaken to date. Whilst this species doubtless utilises the Crookhaven River for hunting purposes, and could occasionally perch in large trees along the Crookhaven River shoreline, no nests of the Osprey have been recorded in the vicinity.

There is no relevant habitat on the subject site itself, and the Crookhaven River will be separated from the development by a vegetated buffer along the full length of the Culburra West Project.

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for Osprey.

Turquoise Parrot and Swift Parrot

Whilst individuals of the Turquoise Parrot *Neophema pulchella* and/or Swift Parrot *Lathamus discolour* could theoretically utilise some of the open forest and woodland vegetation on the subject site, on occasions at least, neither of these species have been recorded from the subject site itself or in other lands in the immediate vicinity or locality (see investigations cited in Chapter 2). Both of these species are highly nomadic, and will move significant distances in response to the availability of foraging resources (flowering eucalypts in particular).

Given those circumstances, these species could potentially occur throughout the forests of the study area, although (as noted above) neither species has been recorded on the subject site or in the immediate vicinity during the substantial investigations that have been undertaken for development proposals in the Culburra West Project land or on Long Bow Point.

Further, as discussed elsewhere in this *Report*, there are substantial areas of potential habitat for these species in the locality and region, particularly in the extensive conservation reserves and State Forests present in the Shoalhaven LGA (Figures 12 and 13). Even if these species do occur on the subject site on occasions, the land to be affected by the Culburra West Project represents only a minute fraction of potential habitat in the locality and region.

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for Turquoise Parrot and/or Swift Parrot.

Conclusions

It is doubtless possible, theoretically at least, that individuals of some of the threatened fauna species considered in this sub-chapter of the *Report* could utilise parts of the subject land and/or subject site, on occasions at least. However, with respect to these species, the following considerations need to be taken into account:

- there have been no records of many of these species within the subject land or on Long Bow Point, despite the conduct of significant and substantial field investigations over a very long period;

- in some instances at least, the site is of only marginal potential value because of the habits and habitat preferences of the species (*eg* the Osprey);
- there are substantial areas of potentially suitable habitat and resources for those species that rely on forests and woodlands in the immediate vicinity and general locality, including in substantial conservation reserves (National Parks and State Forests) nearby; and
- there are very substantial areas of suitable habitat and resources for these species in the Shoalhaven region, again considerable areas of which are protected in conservation reserves and other government lands (Figure 13).

Given those circumstances, the proposed development area on the subject land at Culburra West is not considered to be of significance or special value for any of the threatened fauna species (Table 13) discussed in this sub-chapter of the *Report*.

6.3.4 Unlikely Threatened Fauna

There are several threatened fauna species which have been recorded from the vicinity or locality (Table 14), but which are considered either:

- not likely to occur on the subject site or subject land because of a lack of specific resources; or
- not likely to be reliant upon the resources present within the Culburra West Project site.

Table 14 Threatened fauna species which are unlikely to utilise the Project site currently

Common Name	Scientific Name	Explanation
Green & Golden Bell Frog	*Litoria aurea*	No suitable habitat on site; potential habitat to be created; no recent records at Culburra
Large-footed Myotis	*Myotis adversus*	Recorded on the Project site and Long Bow Point; no suitable foraging habitat or prime roosting resources present; suitable resources are widely distributed and well protected in locality and region
Australasian Bittern	*Botaurus poiciloptilus*	No potential habitat to be removed; very little potential habitat present along Crookhaven River

The Green & Golden Bell Frog

The Green & Golden Bell Frog *Litoria aurea* is a large, highly mobile and terrestrial amphibian species, which is considered a 'pioneer species' and a 'disturbance specialist'. This species is regularly recorded in artificial ponds and water bodies, and appears to thrive in situations where competition from other amphibian species in better established water bodies is less intense.

The Green & Golden Bell Frog breeds in either temporary or permanent ponds, dams and swamps, but does not utilise flowing streams or watercourses for breeding purposes. It prefers ponds with reeds and/or other emergent vegetation, as well as with rock piles or other substrates on which to bask and in which to shelter or hibernate.

Green & Golden Bell Frogs have been located at a variety of locations within the Shoalhaven LGA, including around Culburra (Figures 18A and 18B; Appendix E). There are records of the Green & Golden Bell Frog within and around the village of Culburra:

- along the northern edges of Lake Wollumboola (on occasions); and
- in several artificial ponds in the southwestern part of Culburra Beach, associated with the existing retirement village.

There are key populations of this species in the Coomonderry Swamp, to the west of the Seven Mile Beach National Park (DECC 2005), and at Worrigee (to the immediate east of Nowra). The DECC[11] prepared a *Management Plan for the Green & Golden Bell Frog Key Population within the Crookhaven River Floodplain* (DECC 2007), which identifies a sub-population of the species in Lake Wollumboola and at Culburra. The *Management Plan* notes that Green & Golden Bell Frogs have not been recorded in the drains and roads in or adjacent to Culburra since between 2003 and 2006.

There is no suitable habitat for the Green & Golden Bell Frog within the areas proposed to be developed for the Culburra West Project. There are no permanent or even semi-permanent ponds or dams present in the Culburra West Project area in which the Green & Golden Bell Frog would be likely to reside or breed.

The Culburra West Project will contain several bioretention swales along the Crookhaven River frontage for water quality treatment and flow control. These features could provide potential new supplementary habitat for the Green & Golden Bell Frog.

The Culburra West Project will be consistent with the Green & Golden Bell Frog *Management Plan* (DECC 2007) by avoiding impacts on any even theoretical Green & Golden Bell Frog habitat, and by providing additional potential habitat in artificial wetlands and detention basins. The proposal will not impose novel adverse impacts upon the Green & Golden Bell Frog (even if still present at Culburra), and provides an opportunity to increase habitat and resources for this species.

Large-footed Myotis

The Large-footed Myotis *Myotis adversus* is distributed throughout eastern and northern Australia, and roosts in caves, tunnels and under bridges, and sometimes in hollow-bearing trees. This species has very large hind feet to catch insects and small fish from the water, and narrow wings for fast flight. Individuals of the Large-footed Myotis fly over creeks and ponds, raking their clawed hind feet through the water to catch fish and insects.

This species has been recorded within the vicinity, but there are no suitable ponds or waterbodies present within the Culburra West Project area. Further, no critical or important roosting habitat is present, although this species does on occasion use tree-hollows for roosting.

The Culburra West Project area is not regarded as of any real significance for the Large-footed Myotis, and is considered of only low value for this species, because:

- the subject site does not contain relevant suitable habitat or resources for this species;

11 The DECC is now relevantly part of the OEH.

- this species is highly mobile and wide-ranging, and would not be restricted to the subject site or be likely to reside on the site; and
- there are substantial areas of suitable habitat and resources for this species in the extensive and substantial conservation reserves and State Forests in the vicinity, locality and region.

Australasian Bittern

The Australasian Bittern *Botaurus poiciloptilus* has been recorded previously in the vicinity of Long Bow Point (Daly & Leonard 1996a), although Daly & Leonard did not specify the location of their record (most likely in dense vegetation fringing Lake Wollumboola). This species is also known from other records in the locality (Appendix E - OEH Wildlife Atlas; Birds Australia).

Although it has not been recorded on or close to the Culburra West Project site, some potentially suitable habitat is present along the Crookhaven River foreshore, at least in a few scattered locations. No habitat for this species will be affected by the proposed Culburra West Project.

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for the Australasian Bittern.

6.3.5 Non-Relevant Threatened Fauna

A number of additional threatened species have been recorded within the locality of the subject site (Appendices E and L), including in the OEH Wildlife Atlas (Appendix E), but are not regarded as relevant to the Culburra West Project site (Table 15).

These species require habitats and resources which are either not present on the subject site at all, or which are to be retained and protected (along the Crookhaven River foreshore). Furthermore, none of these species have been recorded on the subject site or on adjacent land during any of the current or previous field surveys (see *Bibliography* and investigations cited in Chapter 2).

There is no suitable habitat on the subject land at Culburra, nor in its immediate vicinity, for the Blue-billed Duck. This species requires deep freshwater lakes, none of which are present in the immediate vicinity of the subject land. Similarly, there is no suitable habitat on the subject land or in its immediate vicinity for the Ground Parrot, and there is no likelihood of this species occurring on the subject site or subject land.

The Eastern Quoll is considered to be extinct on mainland Australia, and has not been sighted for many decades. There is no likelihood of the Eastern Quoll being present on the subject land at Culburra.

The remaining species identified in Table 15 are inhabitants of sandy ocean beaches or marine environments. Neither the subject land nor even the Crookhaven River to its immediate north, constitute suitable or relevant habitat for any of these species.

Other species recorded on the vicinity (Table 15) are confined to marine or pelagic environments, and are not of any relevance with respect to the subject site at Culburra. The whales, Wandering Albatross, Providence Petrel and Little Shearwater would not utilise resources even along the Crookhaven River.

They would not be considered even of marginal relevance to the proposal, even if individuals do use the Crookhaven River on occasions.

Table 15 Other threatened fauna species recorded within 10km of the subject site (OEH Wildlife Atlas), which are not considered of relevance to the Culburra West Project

Common Name	Scientific Name	Explanation
Blue-billed Duck	*Oxyura australis*	No suitable habitat
Ground Parrot	*Pezoporus wallicus*	No records on site or adjacent land; no suitable habitat on site
Hooded Plover	*Thinornis rubricollis*	No suitable habitat on site (sandy ocean beaches)
Little Shearwater	*Puffinus assimilus*	No suitable habitat (marine and island habitats)
Providence Petrel	*Pterodroma solandri*	No suitable habitat (marine)
Wandering Albatross	*Diomedea exulans*	No suitable habitat on site (strictly marine)
Eastern Quoll	*Dasyurus viverrinus*	Species thought to be extinct on mainland Australia
Southern Right Whale	*Eubalaena australis*	No suitable habitat (oceanic species)
Sperm Whale	*Physeter macrocephalus*	No suitable habitat (oceanic species)
Beach Stone-curlew	*Esacus neglectus*	Limited habitat along the Crookhaven River; little or no potential habitat to be affected
Black Bittern	*Ixobrychus flavicollis*	Little potential habitat (swamps and reed beds) along the Crookhaven River; all habitat to be retained
Broad-billed Sandpiper	*Limicola falcinellus*	No suitable habitat on site
Great Knot	*Calidris tenuirostris*	No suitable habitat on site; habitat along the Crookhaven River will be protected
Terek Sandpiper	*Xenus cinereus*	No suitable habitat on site
Black-tailed Godwit	*Limosa limosa*	No suitable habitat on site
Sanderling	*Calidris alba*	No suitable habitat on site
Pied Oystercatcher	*Haematopus longirostris*	No suitable habitat on site
Sooty Oystercatcher	*Haematopus fuliginosus*	No suitable habitat on site
Lesser Sand Plover	*Charadrius mongolus*	No suitable habitat on site
Greater Sand Plover	*Charadrius leschenaulti*	No suitable habitat on site
Little Tern	*Sterna albifrons*	No suitable habitat on site; no likely impacts
Large-footed Myotis	*Myotis adversus*	Recorded on the Project site and Long Bow Point; no suitable foraging habitat or prime roosting resources present; suitable resources are widely distributed and well protected in locality and region

Koala

The Koala *Phascolarctos cinereus* is presumed to be locally extinct, as only two records exist within 10km of the subject site (OEH Wildlife Atlas – Appendix E). One of these records is from 1930, and the other (from 1995) is located to the west of Callala Beach, some distance to the south of the subject site. Recent surveys have not revealed any evidence that the species exists in the locality (Gunninah 1999, 2001a; Environmental InSites 2010a, b, c, d, e, 2011; SLR Ecology 2012, this study).

Furthermore, the subject site does not constitute "*core koala habitat*" pursuant to *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44), and there is no requirement for a *Koala Plan of Management* pursuant to SEPP 44 (see Chapter 12).

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for Koala.

Wetland and Estuarine Birds

With respect to the wetland and estuarine birds identified in Table 15, it is to be noted that:

- suitable potential habitat for these species is confined to the Crookhaven River and the adjoining mudflats, mangroves, saltmarshes and other estuarine ecosystems;
- the overwhelming majority of those habitats are located to the north of the subject land, with only a very narrow fringe in places along its northern boundary (*ie* the Crookhaven River shoreline and foreshores);
- there is no suitable habitat for any of these species within the proposed residential development footprint (Figure 15);
- the Culburra West Project will be separated by a vegetated band along the Crookhaven foreshore from any habitat of relevance or potential relevance for any of those species; and
- any future development proposals (*eg* for human access to the Crookhaven River foreshore) would be the subject of detailed consideration to avoid or ameliorate the imposition of potential adverse impacts upon those habitats or species.

The Culburra West Project site is not regarded as of particular (or indeed any) relevance for wetland and estuarine birds.

6.3.6 Endangered Populations

No "*endangered populations*" of any fauna species listed in Schedule 1 of the TSC Act are of relevance to the Culburra West Project site.

7 PART 3A CONSIDERATIONS

7.1 Director-General's Requirements

A set of *Director-General's Environmental Assessment Requirements* (DGRs) were provided by the then Department of Planning (DoP), pursuant to Section 75F of the *Environmental Planning & Assessment Act* (dated the 27th of May 2010). Those DGRs *inter alia* identify a series of general requirements, as well as a number of '*Key Issues'*, that the *Environmental Assessment* (EA) "*must address*", including issues relating to ecological and riparian matters.

Relevant "*general requirements*" which need to be addressed in this *Report* include *inter alia*:

- the provision of a "*thorough site analysis including constraints mapping and description of the existing environment*" (Chapters 4-6 and 8; Figures);
- the "*consideration of any relevant statutory and non-statutory provisions*", including consideration of the *South Coast Regional Strategy* (Part C of this *Report*; Chapters 7-15);
- "*the consistency of the project with the objects*" of the EP&A Act (Chapter 12);
- consideration of the "*impacts, if any, on matters of National Environmental Significance*" pursuant to the EPBC Act (Chapter 15);
- an "*assessment of the potential impacts of the project*" (Chapters 8-15); and
- the *environmental management, mitigation and monitoring measures to be implemented to minimise any potential impacts of the project*" (Chapters 16-18).

With respect specifically to flora and fauna issues, the DGRs identified the following considerations (in Item 9 of the requirements), including the following matters (Table 14):

- an assessment of "*the potential direct impacts of the development on flora and fauna*", including threatened biota, "*in accordance with DECC's Guidelines for threatened species assessment (2005)*";
- Step 5 of *the Draft Part 3A Threatened Species Assessment Guidelines* of the DECC;
- description of "*the actions that will be taken to firstly avoid or, if necessary, mitigate or compensate unavoidable impacts, where relevant*";
- details "*of any offset strategy or other suitable mitigation measures*";
- the provision of information and data regarding *inter alia* endangered ecological communities (EECs), tree-hollows, targeted surveys for threatened flora and fauna, and the identification of riparian zones and wetlands;
- an outline of "*measures for the (in-perpetuity) management of EECs and other conservation areas*";
- "*measures for the conservation of existing wildlife corridors*"; and
- consideration of *Matters of National Environmental Significance* (MNES) pursuant to the EPBC Act.

Table 16 The relevant Director-General's Requirements for the Culburra West Project

Item	DGRs	Where Addressed
9.1	Assess the potential direct and indirect impacts of the development on flora and fauna (including aquatic) taking into consideration impacts on any threatened species, populations, ecological communities and/or critical habitat and any relevant recovery plan in accordance with DECC's *Guidelines for Threatened Species Assessment* (2005).	Chapters 3, 8 and 9
	Identify whether the proposal meets each of the key thresholds set out in Step 5 of the draft *Part 3A Threatened Species Assessment Guidelines* and describe the actions that will be taken to firstly avoid or, if necessary, mitigate or compensate unavoidable impacts, where relevant.	Chapter 9.5, Chapters 16 and 17
	Provide details of any offset strategy or other suitable mitigation measures to ensure that there is no net loss of native vegetation values.	Chapter 17
9.2	The assessment should at a minimum:	
	i map the extent of the Endangered Ecological Communities on site (and show adequate buffers)	Chapter 5
	ii map the distribution of hollows on and adjacent the site	Chapter 6; Figure 7
	iii include targeted surveys for threatened flora (refer to the list in DECCW response attached)	Chapters 3 and 5; Appendix B
	iv include targeted surveys for identified threatened fauna (refer to the list in DECCW response attached)	Chapters 3 and 6; Appendix B
	v address (and identify in relation to the 7(a) zoning) riparian zone buffering to adjoining wetlands and waterways demonstrating how the Wetlands, the Crookhaven River and Curleys Bay will be protected.	Chapters 9, 11, 16 and 17
9.3	Outline measures for the (in-perpetuity) management of EECs and other conservation areas including riparian area buffers and any proposed offsets.	Chapter 17
9.4	Outline measures for the conservation of existing wildlife corridor values (particularly the north/south linkage) and/or connective importance of any vegetation on the subject land.	There is no relevant "*north/south linkage*"; Chapter 9
9.5	Address impacts on migratory species listed under Section 20 and 20A and species listed under Section 18 and 18A of the EPBC Act.	Chapter 15

7.2 Statutory Considerations

The relevant policies, environmental planning instruments and statutes which have been taken into account in respect of the potential environmental impacts of the Culburra West Project include:

- the "*objects*" of the *Environmental Planning & Assessment Act 1979* (EP&A Act), including *Ecologically Sustainable Development* (ESD);
- *State Environmental Planning Policy No. 14 – Coastal Wetlands* (SEPP 14);
- *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44);
- *State Environmental Planning Policy No. 71 – Coastal Protection* (SEPP 71) and the *NSW Coastal Policy*;
- the *Fisheries Management Act 1994*, with respect to Mangroves along the Crookhaven River and the associated fish habitats; and
- the *Water Management Act 2000* (the WM Act), with respect to the protection of water sources, waterfront land, and riparian and aquatic habitats.

The DGRs also identify (in Attachment 3) an array of state government technical and policy guidelines "*which may assist in the preparation of the environmental assessment*", noting that "*this list is not exhaustive*". Where relevant, the *Policies* and *Guidelines* identified in the DGRs have been addressed in this *Ecological Issues & Assessment Report* (see Table 16).

It is noted by the DoP (DP&I) that Section 75U of the EP&A Act determines that "*Part 3 applications do not require certain permits/approvals required under other legislation*". Nevertheless, the letter from the DoP (dated the 27th of May 2010) notes that "*the Department still requires an equivalent level of information within the EA as would ordinarily be required for the issue of any such permit/approval to enable an assessment of the relevant works*".

Table 17 Relevant government agency *Policies* and *Guidelines*

Policy or Guideline		Where addressed
SEPP 14	*State Environmental Planning Policy No. 14 – Coastal Wetlands*	Chapter 11; Figures 19 and 20A-20C
SEPP 44	*State Environmental Planning Policy No. 44 – Koala Habitat Protection*	Chapter 12
SEPP 71	*State Environmental Planning Policy No. 71 – Coastal Protection*	Chapter 13
Coastal Policy		Chapter 13
DECC Guidelines	*Draft Guidelines for Threatened Species Assessment* July 2005	Chapter 9

7.3 Agency Consultation

Consultation to date with government agencies with respect to ecological matters associated with the Culburra West Project has included:

- a telephone conversation with the Department of Sustainability, Environment, Water, Population & Communities (SEWPaC) – in which it was determined that detailed consultation should await the provision of the revised *Ecological & Riparian Issues & Assessment Report* (ERIAR); and
- and on-site meeting with Mr Miles Boak of the NSW Office of Environment & Heritage (OEH), on the 13th of March 2013 – to undertake selected walked inspections of parts of the Project site, and to review and address the comments which have been made by OEH officers on the initial version of the ERIAR.

Supplementary consultation will occur during the period between submission of the *Environmental Assessment Report* and associated *Reports* (including this ERIAR) and the provision of a final *Preferred Project Plan* (PPP) for the Project.

8 ECOLOGICAL ISSUES and CONSTRAINTS

8.1 Ecosystems and Biota

The analysis of ecological issues and constraints contained in this *Report* has taken into account both the relevant elements of the natural environment (including threatened biota and their habitats) and the expectations of the community (both in Culburra and the Shoalhaven LGA, and in NSW generally) with respect to achieving an appropriate balance between development needs and biodiversity conservation values.

Assessment of the acceptability of impacts on the natural environment in general, and on threatened biota or their habitats in particular, requires achieving an appropriate balance between those often competing outcomes. Consideration of the significance (or otherwise) of potential impacts on threatened biota or their habitats, on the other hand, requires an assessment *inter alia* of the extent of the biota and their habitats in the locality and region.

Relevant features of the subject land and the adjoining landscape at Culburra, which have been taken into account in assessing the acceptability of the impacts on native biota which will be imposed by development of the Culburra West Project site, have included *inter alia*:

- the proximity of the Crookhaven River and Billy's Island, and the ecosystems associated with those features (particularly the Mangrove Forest and Coastal Saltmarsh communities, and sea-grass beds);
- the presence of SEPP 14 wetlands along the Crookhaven River frontage of the subject land and subject site;
- the presence of possible "*threatened ecological communities*" (TECs) along the Crookhaven River frontage;
- the presence of an array of "*threatened species*", and their habitats, including those species typical of forest and woodland communities (as are typical of the subject site) and those biota characteristic of wetlands and estuaries (along the northern boundary of the subject site); and
- the extent of suitable habitat and resources for native biota, including *inter alia* threatened biota, in the immediate vicinity, general locality and Shoalhaven region.

In addition to considering the natural features of the subject land and the Culburra West Project site, analysis of the constraints that the natural environment may impose upon development of the subject site includes, relevantly, the consideration of:

- the existing Culburra township - to the immediate east of the subject site;
- the desire of the local community and relevant state agencies (as expressed in the existing 1985 LEP and the draft LEP for this location, and in the *South Coast Regional Strategy*) for extension of the Culburra township;
- identification of the Lake Wollumboola catchment as being more sensitive than the Crookhaven River catchment, with the latter being the preferred location for extension of the Culburra township, as reflected in submissions to and the *Report* of the *Long Bow Point Commission of Inquiry* (CoI); and

- the extent of native vegetated lands in the immediate vicinity and general locality, including (particularly) in the substantial conservation reserves (National Parks and Nature Reserves) and State Forests in the Shoalhaven region (Figure 13). There are currently many thousands of hectares of National Parks and Nature Reserves in the Shoalhaven LGA (Figure 13), which contain significant areas of similar or identical habitats to those present in the Culburra West Project site. The majority of the Shoalhaven LGA is conserved or environmentally protected land, or State Forest (Figure 13).

The majority of the land which is proposed for the Culburra West Project supports open forest and woodland vegetation (Figures 9A to 9D). The development area itself is characterised by xeric open forest and woodland communities, dominated in different places by a variety of eucalypts, with a predominantly sparse shrub layer and a variable groundcover. This forest is substantially regrowth from previous clearing or thinning (Appendix B), although there are numbers of remnant mature to 'over-mature' trees present that had been retained.

The more mesic forest types and estuarine ecosystems are confined to a narrow band along the Crookhaven River (Figures 9A to 9D), on land which is in public ownership and/or which has been zoned for *Environmental Protection*, or land within the buffer to the Crookhaven River. Other than some very minor tree removal for 'view lines' and/or access to the Crookhaven River, these communities are to be left intact and *in situ*.

The Culburra West Project development area contains a moderate number of hollow-bearing trees (Figure 7) with a variety of tree-hollow characteristics, ranging from small spouts to large hollows in trunks and/or 'pipes' in dead stags. Importantly, however, these resources are also widespread in the immediate vicinity and general locality. This is not a limited or restricted resource in the Shoalhaven region, and hollow-bearing trees are widespread and abundant in the extensive conservation reserves, State Forests and private forested lands within the LGA.

As discussed in considerable detail in Chapters 5 and 6 of this *Report*, the subject land in general and the proposed Culburra West Project development area itself, contain habitats and resources of relevance for a number of threatened biota. In particular, threatened microchiropteran bats, the Glossy Black Cockatoo and Gang Gang Cockatoo, and the Powerful Owl, have been recorded in the proposed development area, as well as in the extensive other forested lands in the immediate vicinity and general locality. These species (and other potentially relevant threatened species) are discussed in some detail in Chapter 6, and the potential impacts of the proposal are addressed in subsequent chapters of this *Report*.

It is relevant in this regard to take into consideration the substantial area of existing conservation reserves (National Parks and Nature Reserves) and State Forests (which are managed *inter alia* for the conservation of threatened biota and their habitats) in the locality (Figure 12) and the Shoalhaven LGA (Figure 13). There are tens of thousands of hectares of conservation reserves and State Forests in the Shoalhaven LGA, substantial areas of which provide suitable habitat and resources for the threatened biota which are considered of likely relevance to the Culburra West Project.

In addition, there are thousands of hectares of privately owned open forest and woodland vegetation in the locality and LGA, which are either zoned for biodiversity conservation purposes or which are not likely ever to be developed (given their locations). The total extent of suitable habitat and resources for even potentially relevant threatened biota in the immediate vicinity, locality and Shoalhaven LGA is extremely large, with the majority of the LGA protected for biodiversity conservation purposes.

8.3 Conclusions

Most of the subject site (*ie* the development footprint for the Culburra West Project) currently supports dry (xeric) open forest and woodland vegetation, which is characteristic of substantial swathes of such vegetation in the vicinity and general locality. It is acknowledged that these areas of open forest and woodland contain habitat and resources of relevance for an array of threatened fauna species, but no threatened flora species have been recorded from the subject site or subject land during any investigations conducted to date.

Notwithstanding those circumstances, habitats and vegetation types of greater sensitivity and ecological significance are located within, and along the Crookhaven River foreshore, within and to the north of the subject site. The Mangrove Forest and Coastal Saltmarsh communities within the estuarine parts of the Crookhaven River adjacent to the subject site are of high biodiversity conservation value, and there is a narrow band of moist terrestrial plant communities along the Crookhaven River foreshore, which (floristically at least) correspond with two "*endangered ecological communities*" (EECs[12]).

It is to be noted that even if those vegetation types do constitute EECs (which is not conceded) essentially all areas (other than a tiny edge in the west of the subject site) are to be retained, protected and rehabilitated as part of the Crookhaven River Foreshore Park.

Notwithstanding the presence of habitat and resources for threatened fauna species within the 73ha of open forest and woodland to be removed for the Culburra West Project, the loss of those features and resources is not regarded as a constraint or such an impediment to the Culburra West Project as to require any further reduction in the development footprint or a prohibition on any element of the project.

In this regard:

- the most sensitive and significant ecosystems (within the Crookhaven River estuary and along the Crookhaven River foreshore) are to be retained, rehabilitated and managed in perpetuity for biodiversity conservation purposes;
- the habitats, resources and vegetation types contained within the Culburra West Project footprint are a minute fraction of those ecosystems and resources present both on private forested lands which will never be developed and within the substantial and extensive conservation reserves and State Forests in the vicinity, locality and Shoalhaven LGA;
- there are no threatened biota present on the subject site or likely to occur which would be confined to that area of vegetation, given the extent and contiguity of similar or identical habitats and resources;
- the loss of vegetation for the Project is to be offset by the dedication of an appropriate area of other land (see Chapter 17.3); and
- the development proposal includes the implementation of a *Hollow-bearing Tree Protocol*, which is designed to ensure there is 'no net loss' of tree-hollows in the vicinity and locality.

12 It is to be noted that the principal author of this *Report* does not concede that there are any "*coastal floodplains*" present along the Crookhaven River foreshore on or in the vicinity of the subject site. As a consequence, whilst the Swamp Forest, Swamp Oak Forest and Moist Forest communities satisfy the floristic criteria for those EECs, the absence of a "*coastal floodplain*" at this location means that they do not constitute those EECs.

Thus, from an ecological perspective, it is concluded that the presence of threatened biota and/or habitats and resources for those biota on the Culburra West Project site does not constitute a constraint sufficient to further modify or prevent the development as currently proposed. There has been significant modification to the Project already, involving a substantial reduction in the footprint, greater setback from the Crookhaven River, and a significant reduction in the extent of development proposal in the Lake Wollumboola catchment.

Furthermore, the Culburra West Project (as currently designed) provides an appropriate balance between development expectations and biodiversity conservation goals. The land to be developed has been identified in both the 1985 LEP and in the draft 2012 LEP as appropriate for urban development activities (being zoned for those activities), and the area is also identified in the *South Coast Regional Strategy* as appropriate area for urban development.

9 IMPACT ASSESSMENT

9.1 Vegetation Removal and Modification

The proposed Culburra West Project will require the removal of approximately 73 hectares of native vegetation from the subject site (Figures 5 and 15; Table 16). The Project also proposes the modification (by the removal and/or trimming of trees) of an additional 2ha (approximately) of native vegetation at 3 locations along the Crookhaven River.

Conversely, the Project will also retain approximately 25ha (approximately) of vegetation along the Crookhaven River frontage, and rehabilitate that vegetation and dedicate it in perpetuity for biodiversity conservation purposes. Other than small areas to be modified for 'view lines', all of the possible TECs along the Crookhaven River frontage are to be retained, protected and rehabilitated.

All of the vegetation to be removed from the development footprint, and the majority of that to be modified for 'view lines', consists of xeric open forest and woodland communities, with just 0.92ha of moist forest and estuarine ecosystems to be modified for the 'view lines' (assuming that those elements of the Project proceed). The area of native vegetation to be affected by the proposal represents a miniscule proportion of the total area of National Parks and Nature Reserves in the Shoalhaven LGA.

All of the required *Asset Protection Zones* (APZs) and all of the stormwater treatment basins and swales and bioretention swales, are to be located outside the vegetation setback from the Crookhaven River required by the DP&I.

The Project will also involve the removal of all hollow-bearing trees from the development footprint. However, as detailed in the *Hollow-Bearing Tree Protocol* (Chapter 17), all tree-hollows are to be salvaged and deployed in the areas of vegetation which are to be provided as an offset for the vegetation to be lost from the development area (Chapter 17).

Table 18 Vegetation to be removed for the Culburra West Project

Code		**Area**
Vegetation to be Removed		
C	Cleared and Disturbed	13.989
D1	Grey Ironbark/Rough-barked Apple Open Forest	0.444
D2	Bangalay Woodland/Open Forest	2.238
D3	Blackbutt Open Forest	36.25
D4	Bangalay/Woolybutt/Rough-barked Apple Open Forest	0.386
D5	Forest Red Gum Open Forest	0.264
D6	Hard-leaved Scribbly Gum Woodland	23.972
D8	Black She-oak Closed Forest	8.991
SoF	Swamp Oak Closed Forest	0.49
Total #		87.025

Total area of native vegetation to be removed is **73.036 hectares**

Further, the loss of vegetation from the development footprint will be offset by the rehabilitation (where necessary) and management of other areas of those same vegetation types elsewhere within the Realty Realizations landholdings at or near Culburra, including:

- along the Crookhaven River foreshore buffer, small parts of which are zoned for residential development with the majority zoned for environmental protection purpose (of which significant areas will require substantial rehabilitation activities – see Chapter 17); and
- other land to the southwest (see Chapter 17.3 for details on the *Offset Package*).

Whilst the loss of vegetation from the subject site will clearly have an adverse impact in an immediate or highly localised sense, the importance or significance of that loss needs to be considered in terms of:

- the overall distribution of habitats and resources for native biota, including threatened species, in the vicinity, locality and region;
- the extent of reserved conservation lands and State Forests in the vicinity, locality and region (Figures 12 and 13);
- the zoning of the subject site, including (importantly) the confirmation of its zoning for residential purposes in the 2012 draft LEP and in the *South Coast Regional Strategy*; and
- the *South Coast Regional Strategy* (SCRS), which has identified "*land within the Crookhaven River Catchment, north of Culburra Road and immediately west of the Culburra Village Centre*" as being appropriate "*for development*".

As also noted above, the loss of vegetation for the Culburra West Project is proposed to be offset by the rehabilitation (where necessary), management and dedication of other land on the subject land (along the Crookhaven River frontage) and elsewhere in the general vicinity for biodiversity conservation purposes.

9.2 Significant Habitats and Resources

Much of the proposed Culburra West Project site contains native vegetation which is generally in good to excellent condition. Conversely, there are no habitats or resources which are considered of particularly high significance or restricted distribution within the vegetation to be removed, noting that hollow-bearing trees are widespread and abundant in the locality and region. The development area does not include any watercourses, ponds or lakes, and there are no rocky outcrops or caves present.

As noted above, the main resource of particular relevance or significance is the array of hollow-bearing trees present within the development footprint. However, it needs also to be noted that:

- hollow-bearing trees are not confined to the subject site itself;
- this resource is relatively abundant through the abundant forests (both private and public) in this general vicinity and locality, including in the extensive conservation reserves and State Forests in the Shoalhaven LGA (Figure 13);
- hollow-bearing trees cannot be regarded as a limiting resource, given their abundance and distribution in the vicinity, locality and region; and
- the proposed development of the Culburra West Project will involve implementation of the *Hollow-Bearing Tree Protocol* (see Chapter 17). This *Protocol* will involve the salvage and re-use of tree-hollows in areas of vegetation which are to be used as offsets for the

Project. This approach would facilitate an increase in the densities of tree-hollows and hollow-bearing trees in areas where there are currently relatively few such resources, and would thus enhance the habitat values of those areas of forest. It is also intended to ensure 'no nett loss' of tree-hollow resources (see Chapter 17).

Whilst elements of the vegetation and fauna habitats within the Culburra West Project footprint are doubtless of relevance and value for individuals of a range of native species, including some threatened fauna species, it must be recognised that these features, resources and vegetation types are wide-spread and abundant in the Shoalhaven LGA. They are also, relatively, extremely abundant in the very substantial conservation reserves, State Forests and other lands which currently function, and will function into the future, for biodiversity conservation purposes. Large swathes of the privately forested lands in the Shoalhaven LGA are either zoned for environmental protection purposes or in locations which would never likely be the subject of development.

9.3 Threatened Biota

The threatened biota of relevance or potential relevance to the Culburra West Project have been discussed in some detail in Chapters 5 and 6 of this *Report*.

Whilst no threatened plant species have been recorded on the subject site, there are current and previous records for a number of threatened fauna species, including:

- the Glossy Black Cockatoo – which has been recorded in the xeric forests on the site;
- the Square-tailed Kite and Little Eagle – of which only individuals have been recorded flying over or adjacent to the site;
- the Powerful Owl – which has been recorded to the south of the subject site, but only once (in 2010) on the site itself (although it is assumed that individuals do use the site for foraging purposes, as part of a much larger home range);
- the Scarlet Robin and Varied Sitella – which were apparently recorded on the site in 2010, but has not been recorded in the study area before or since;
- the Grey-headed Flying Fox – which has been recorded flying over the site, and would doubtless forage in the eucalypts in parts of the site on occasions. There is, however, no 'camp' of this species present; and
- several threatened microchiropteran bats (the Common Bent-wing Bat, Eastern Freetail Bat, Eastern Falsistrelle, Large-footed Myotis and Greater Broad-nosed Bat) – most of which doubtless both reside on the (except the Large-footed Myotis and the Common Bent-wing Bat), and all of which (except the Large-footed Myotis) would forage widely across the site.

Other threatened fauna are considered likely to occur on the subject site, as individuals on occasions at least. It is highly likely, for example, that individuals of the Square-tailed Kite (which has been recorded nesting to the south of Culburra Road) would utilise the forests of the Culburra West Project site as part of a larger home range. Similarly, other threatened microchiropteran bats known from the locality would also likely use the forests of the Culburra West Project site, for foraging at least, and individuals of the Swift Parrot and Turquoise Parrot could theoretically use the site on occasions.

However, there are a number of threatened species that are not likely to utilise or be dependent on the subject site as detailed in Chapter 6.

The proposed development of the subject site for the Culburra West Project will doubtless remove some resources for at least individuals of some threatened species. The proposal will remove the tree canopy from the whole of the forested part of the subject site, thus removing foraging resources for the Cockatoos and foraging habitat for the Powerful Owl and microchiropteran bats. In addition, the removal of hollow-bearing trees constitutes a loss of nesting or roosting habitat for many of those species, at this specific location.

However, the impacts upon those threatened biota as a result of the proposed Culburra West Project are not regarded as of particular concern with respect to the survival of those biota on a landscape or locality scale, given that:

- all of the relevant species are highly mobile and wide-ranging, with:
    - the Powerful Owl having a home range of up to 1,000 hectares, and the Square-tailed Kite having a home range of approximately 10,000 hectares;
    - the microchiropteran bats regularly foraging over distances of several kilometres in an evening;
    - the Grey-headed Flying Fox flying 50km or more in an evening's feeding; and
    - the Glossy Black Cockatoo also having a substantial home range;
- none of the threatened (or other native) species known or likely to occur would be dependent on the proposed development area *per se* for their survival in this locality, given the extent and distribution of suitable habitat and resources in the vicinity and locality, and the extent of records of such species in the locality;
- there are substantial areas of suitable habitats and resources for all of those species in the extensive vegetated lands in the immediate vicinity and general locality. In addition to the substantial National Parks and State Forests to the south and southwest of the subject land (Figures 12 and 13), there are substantial areas of native forest on private lands in the immediate vicinity and general locality which are not likely ever to be developed. As a consequence, there are significant areas of suitable habitat and resources for all of the threatened biota known to occur within the subject site at Culburra West;
- there are very substantial areas of conserved lands and State Forests in the Shoalhaven LGA (Figure 13); and
- the proposal contemplates the dedication of private forested lands as offsets for the removal of vegetation. These lands contain the same habitats and resources as are present on the areas to be cleared for development activities (see Chapter 17).

The significant habitats and ecosystems associated with the Crookhaven River estuarine environment (particularly sea-grass beds, mangrove forests and coastal saltmarsh communities) are all located outside the proposed development footprint. In addition, these estuarine ecosystem and habitats are protected from the Culburra West Project site both by the intervening 100m plus vegetated buffer along the Crookhaven River foreshore and the comprehensive water quality and water volume treatment management regime which has been incorporated into the Project (see Chapter 9.4).

There is also a narrow band of moist forest vegetation along the Crookhaven River frontage, including Swamp Oak Forest, Swamp Forest and Moist Forest communities (see Chapter 5). Whilst the OEH maintains that these vegetation types are "*endangered ecological communities*" (EECs) listed in the TSC Act, it is the opinion of the principal author of this *Report* that those EECs are not present on the subject site or, on the Crookhaven River foreshore adjacent to it.

In this regard, there is no "*coastal floodplain*" along this part of the Crookhaven River, although it is readily acknowledged that other parts of the Crookhaven River do have adjoining coastal floodplains (*eg* to the north of the river, west of Greenville Point). However, there are no "*coastal floodplains*" on the subject land or adjacent to it, and those EECs therefore cannot be present.

In any case, even adopting the OEH position that the EECs are present, it is to be noted that essentially all of those vegetation types (with a minor exception at the western end of the proposal) are to be retained within the Crookhaven River Foreshore Park, and will be rehabilitated (where they are areas of dense weed infestation) and managed in perpetuity for biodiversity conservation purposes.

9.4 Water Cycle Management Regime

A detailed *Water Cycle Management Report* for the Culburra West Project has been prepared by Martens & Associates (2013).

With respect to groundwater issues, the Martens 2013 *Report* concludes that:

- the Project site "*contains two low permeability aquifers, being an unconfined shallow clay aquifer and a deeper confined aquifer in rock*";
- "*it is anticipated that shallow ephemeral aquifers .. exist in local drainage depressions*";
- "*Shallow aquifer(s) beneath the site are likely to be ephemeral .. in some areas, non-existent in others and permanent in low lying areas and areas with low grades*";
- the "*aquifers beneath the site are of low value to stakeholders (ecological and anthropogenic) given their low yield, limited distribution, and ephemeral nature*"; and
- "*groundwater recharge will not be significantly altered due to the proposed development. Consequently, no mitigation is required to address changes to groundwater recharge which may impact downslope vegetation*".

Given the stormwater management regime described below, and the lack of evidence for any GDEs (see above), it is not considered likely that any vegetation downslope of the proposed development will be adversely affected by any alterations to the groundwater regime, if any such changes occur.

The stormwater treatment train is described in some detail in the Martens 2013 *Report*, and has been designed specifically *inter alia* to avoid the imposition of adverse impacts upon ecosystems downslope of the proposed development, including within the Crookhaven River estuary. Specific measures detailed in the Martens 2013 *Report* include:

- the utilisation of rainwater tanks across the Project, and the re-use of rainwater for toilet flushing and laundry requirements;
- the interception of stormwater runoff using commercially available devices "*to remove gross pollutants, suspended solids and nutrients from stormwater runoff*";

- the use of roadside bio-retention swales to treat stormwater before discharge;
- the construction of detention basins – to treat stormwater before discharge; and
- the construction of elongated wetlands along the Crookhaven River frontage, downslope of the perimeter road, to allow for stormwater treatment, some recharge of soil water, and overland flows during major rainfall events to mimic existing conditions.

9.5 Groundwater Dependent Ecosystems

Geoscience Australia (an agency of the Australian government) identifies *Groundwater Dependent Ecosystems* (GDEs) as "*ecosystems that rely on groundwater for some or all of their water requirement*". The Geoscience Australia definition also notes that "*Not all GDEs draw on groundwater directly and not all are solely reliant on groundwater. However, in many cases groundwater commonly provides an important and reliable source of water to many ecosystems*".

Of the six types of GDEs which have been identified in Australia, the only ecosystems present on or near the subject land at Culburra that could potentially be dependent upon groundwater are:

- "*wetlands such as paperbark swamp forests*" and other swamp forests, along the northern fringe of the subject land; and
- "*estuarine and near-shore marine systems, such as coastal mangroves, salt marshes and sea-grass beds, which rely on the submarine discharge of groundwater*".

It is noted that there is no evidence that the mangroves, saltmarshes or sea-grass beds along the Crookhaven River are, in fact, reliant "*on the submarine discharge of groundwater*", although it is possible that some elements of those ecosystems at this location may rely on such discharges. However, it is not even remotely likely that all of those ecosystems within the Shoalhaven and Crookhaven River estuaries would be GDEs.

The mapping of terrestrial groundwater dependent ecosystems by the NSW Department of Primary Industries does not indicate the presence of any GDEs along the Crookhaven River or its estuaries (see Plan attached below).

Whilst the *Report* associated with that mapping indicates that Swamp Sclerophyll Forests and Woodlands may, in some instances, be dependent upon groundwater, it is not considered likely that the Swamp Oak Forest, Moist Forest or Swamp Forest communities along the northern fringes of the subject land at Culburra West are dependent on groundwater for their survival. There are no expressions of groundwater along the downslope edge of the subject site (along Crookhaven River foreshore), and there are no freshwater swamps or sedgelands which would indicate the presence of persistent groundwater flows.

In addition, the study of groundwater on the subject land by Martens & Associates (2013) does not indicate the presence of any significant groundwater aquifers or groundwater flows. In this regard:

- several of the Groundwater Monitoring Bores installed by Martens were dry during their investigations;
- only limited areas of groundwater were detected across the subject land; and
- the groundwater flow rates through the soils of the site are very low.

Given those circumstances, the Swamp Oak Forest and the Moist and Swamp Forest communities present along the northern fringe of the subject land are doubtless reliant almost substantially (if not entirely) on incipient rainfall, overland flows and soil moisture levels, rather than on any groundwater.

Similarly, whilst the DPI *Report* on terrestrial GDEs indicates that mangroves, saltmarshes and sea-grass beds may be dependent upon groundwater discharges, that is clearly not the case in all instances of the occurrences of such ecosystems. In this regard, the DPI *Report* notes *inter alia*:

- "*while seawater in considered to be the primary water source for most of the vegetation communities, sites have been noted where mangroves occupy relatively fresh groundwater discharge areas*";
- the "*nature of any groundwater dependency* [for saltmarshes] *is unknown*"; and
- "*the distribution of sea-grass beds in some coastal areas is influenced by groundwater discharge*".

However, given the very substantial extend of sea-grass beds and mangroves in the Crookhaven River and Shoalhaven River estuaries (Figures – 9C, 16A-16C), it cannot be considered likely that these ecosystems are all dependent on groundwater discharges. Indeed, it cannot be reasonably considered likely that any of these ecosystems within those estuaries are "*dependent*" upon groundwater discharges, given their extent and distribution.

Further, given the assessment of the groundwater system within the subject land (Martens 2013), it cannot be considered likely that any of the estuarine ecosystems in this location would be dependent upon groundwater discharges for their survival.

Notwithstanding the low likelihood for any Groundwater Dependent Ecosystems (GDEs) being associated with the subject site at Culburra West, the Culburra West Project has been designed *inter alia* to re-use and re-distribute stormwater runoff. Specific measures which are proposed in this regard are detailed in the Martens 2013 *Report*, and include *inter alia*:

- the use of bio-retention swales within the development (along roads) to treat stormwater and to allow for infiltration;
- the provision of detention basins and long bio-retention swales running along the contours – to provide for water quality treatment and to provide a broader area for infiltration and over-bank distribution of storm flows to maintain soil moisture conditions in the buffer between the development and the Crookhaven River and its associated ecosystems; and
- the capture of a portion of the stormwater and its discharge directly into the Crookhaven River, at locations away from sea-grass beds, mangroves or oyster beds.

9.6 Corridors

The subject site itself does not constitute an integral element of any wildlife movement corridor or vegetated linkage through the landscape.

The subject site is located (Figures 1, 4 and 12):

- at the northern extremity of contiguous terrestrial habitats, which extend for a considerable distance to the south and southwest, and onto the Beecroft Peninsula;

- at the northeastern periphery of a broad band of vegetation extending east to west between the Pacific Ocean and the Princes Highway. That band of vegetation extends further to the southwest, as well as southeast onto the Beecroft Peninsula; and
- between existing residential land to the east and cleared grazing land to the west.

Given its location at the periphery of that broad area of vegetated land (Figures 1, 4 and 12), development of the subject site for the Culburra West Project will not adversely affect the connectivity of habitats or the movement of wildlife through the area generally (see below).

There is no north-south 'wildlife corridor' at this location (Figures 1, 4 and 12).

The broad bands of Mangrove Forest around Billy's Island are contiguous with the subject site, but constitute a very different habitat, utilised by a specialist suite of species which does not utilise the xeric forest types typical of the Culburra West site, and vegetated lands to its south. Further to the north are the estuarine habitats and shallows of the Crookhaven River and the lower reaches of the Shoalhaven River, as well as the residential areas of Greenwell Point and Orient Point (Figures 1, 4 and 12). In addition, large areas of rural land to the northwest (north of the Crookhaven River) are cleared for agricultural and grazing purposes.

Given the considerations outlined above, it cannot be maintained that there is currently any functional 'north-south corridor' at this location, because:

- there are no species for which the estuarine and aquatic habitats and Mangrove Forests of the Shoalhaven and Crookhaven Rivers AND the xeric forest of the subject site would (or indeed could) function as habitat, or contain relevant resources;
- there is no relevant contiguous habitat to the north of the subject land; and
- the only fauna (threatened or otherwise) that could move north-south through this landscape are highly mobile (such as bats and birds). Such species would not be impeded by the Culburra West Project.

In this regard, whilst there would doubtless be some movement of native fauna and propagules of native flora between the proposed Culburra West development area and the forested lands to the immediate south (on the subject land), and thence further to the south and southwest:

- the subject site cannot constitute a 'movement corridor' for the transfer of individuals or propagules of native fauna and flora in an east-west direction, because the existing Culburra village is located to the immediate east of the subject land, and cleared grazing lands are located to the immediate west (Figures 1, 4 and 12);
- the subject site itself constitutes the northernmost periphery of a very substantial band of native forest and woodland vegetation, which extends for many kilometres to the south, southeast and southwest (Figures 1, 4 and 12);
- there are no terrestrial fauna or flora, or arboreal mammals, that could conceivably move in a northerly direction from the subject site to anywhere:
    - because of the presence of the Crookhaven River and the Mangrove Forest community within that area;
    - because the village of Greenwell Point is located on the nearest terrestrial land to the north; and

- because the nearest significant xeric forest and woodland vegetation to the north is located several kilometres to the north, across a broad estuarine landscape involving the whole of the Shoalhaven and Crookhaven River estuaries (Figures 1, 4 and 12);

- the native fauna which utilise the estuarine habitats of the Crookhaven River are essentially separate from and different to the fauna which would utilise the xeric forest and woodlands of the subject site and subject land; and
- the only native biota which would be likely, under any circumstances, to move northwards from the subject land into other habitats (which are significantly north of the Shoalhaven River estuary – at a distance of at least 5km) are highly mobile and generally larger bird species, the Grey-headed Flying Fox and possibly some microchiropteran bat species.

Given those considerations, the subject land and subject site cannot be considered to constitute part of any 'wildlife movement corridor'. There is no 'corridor' at this location, other than on a very broad scale for some highly mobile and wide-ranging species. Such species would not be impeded in their local or regional movements by the proposed Culburra West Project.

9.7 Draft 2005 Guidelines and Key Thresholds

9.7.1 The Draft 2005 Guidelines

A set of *Draft Guidelines for Threatened Species Assessment* was prepared by the then Department of Environment & Conservation and Department of Primary Industries (dated July 2005). The *Draft Guidelines* identify "*important factors and/or heads of consideration that must be considered by proponents and consultants when assessing potential impacts on threatened species, populations or ecological communities, or their habitats, for development applications assessed under Part 3A of the Environmental Planning and Assessment Act 1979*".

The *Draft Guidelines* provide *inter alia* six *Guiding Principles* or "*environmental outcomes*":

- "*maintain or improve biodiversity values* (*ie there is no net impact on threatened species or native vegetation*)";
- "*conserve biological diversity and promote ecologically sustainable development*";
- "*protect areas of high conservation value, including areas of critical habitat*";
- "*prevent the extinction of threatened species*";
- "*protect the long-term viability of local populations of species, population or ecological community*"; and
- "*protect aspects of the environment that are matters of national environmental significance*".

It is also noted that the *Guiding Principles* also state that the "*assessment is designed to provide information and analysis to demonstrate that feasible alternatives have been considered, that the project has been designed to be consistent with the principles outlined above, and where there are impacts, that adequate mitigation measures are implemented*".

In addition, there are four "*key thresholds*" which the *Guidelines* enunciate as necessary to provide "*a justification of the preferred option*" for any proposal. These "*key thresholds*" are:

- "*whether or not the proposal, including actions to avoid or mitigation impacts or compensate to prevent an avoidable impacts will maintain or improve biodiversity values*";
- "*whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population and ecological community*";
- "*whether or not the proposal is likely to accelerate the extinction of species, population or ecological community or place it at risk of extinction*"; and
- "*whether or not the proposal adversely affect critical habitat*".

9.7.2 The Culburra West Project

The substantial array of field investigations in the study area provide a comprehensive and appropriate database on which to assess the likely or potential impacts of the Culburra West Project on threatened biota or their habitats. As detailed elsewhere in this *Report*, the subject site does not support any threatened species, or their habitats, that are not otherwise well represented in the locality and region.

Further, it is to be noted that the Culburra West Project has been developed over a considerable period, and has undergone a substantial number of iterations. Specific elements of that process have included:

- many modifications to the development footprint design and the location of various elements of the Project to provide greater setbacks from the Crookhaven River and to minimise and/or delete development activities within the Lake Wollumboola catchment;
- iterative development of the stormwater and water cycle management regime, leading to the provision of bioretention swales, biodetention basins and ponds designed to provide habitat, as well as to maintain soil moisture regimes downslope and to ensure the high quality of stormwater discharged to the Crookhaven River ecosystems;
- incorporation of ameliorative measure such as re-use of vegetative material to be removed (*eg* in the rehabilitation of weed patches in the Crookhaven River Foreshore Park) and the salvage and re-use of tree-hollows; and
- the identification of offsets to compensate for the removal of the xeric vegetation communities required for the development on the subject site itself (see Chapter 17.3).

9.7.3 The Guiding Principles

The "*Guiding Principles for threatened species assessment*" contained in the DECC *2005 Draft Guidelines* have been taken into account both in the design of the Culburra West Project and in the assessment contained in this *Report* of the likely impacts upon threatened biota and their habitats. With respect to the six "*environmental outcomes*" identified in the "*Guiding Principles*":

- the Culburra West Project will "*maintain or improve biodiversity values*" by virtue of:
  - the rehabilitation of the Crookhaven River Foreshore Park, significant areas of which are heavily weed-infested;
  - the salvage and re-use of tree-hollows in 'offset areas'; and

- the application of a biobanking approach for offset areas, and the subsequent dedication of appropriate areas of forested land to compensate for the removal of vegetation within the Project site;

- the Project will ensure that there is "*no net impact on threatened species or native vegetation*" by virtue of the mechanisms identified above, and the Project will "*conserve biological diversity*" – also by virtue of the mechanisms identified above;
- the Project will "*promote ecologically sustainable development*" *inter alia* by the mechanisms identified above and by the implementation of a stormwater management regime designed specifically to protect the Crookhaven River and its ecosystems, as well as other adjoining vegetation (particularly in the Crookhaven River Foreshore Park) and to capture and re-use stormwater (WSUD);
- the Project will "*protect areas of high conservation value*" – particularly those associated with the Crookhaven River and its foreshores – by virtue of the retention and rehabilitation of the 100m+ wide Crookhaven River Foreshore Park and its rehabilitation, and the implementation of the stormwater management regime identified by Martens (2013);
- the Culburra West Project will have no impact upon "*areas of critical habitat*", as no such areas have been declared at this location;
- the Project will "*prevent the extinction of threatened species*" as a consequence of the retained Crookhaven River Foreshore Park and the 'offset areas' which are to be identified for the Project (noting that the Project site *per se* is not likely to be 'critical' for the survival of "*viable local populations*" of any of the threatened species known or likely to occur on the site);
- the Project will "*protect the long-term viability of local populations*" of the relevant threatened species, populations and ecological communities – given the substantial 'offset areas' which will ultimately be dedicated and given the rehabilitation of the proposed Crookhaven River Foreshore Park; and
- the Project will "*protect aspects of the environment that are matters of national environmental significance*" – by virtue of the rehabilitation and maintenance of the Crookhaven River Foreshore Park for biodiversity conservation purposes and the dedication of lands as 'offset areas' in the locality.

With respect to "*feasible alternatives*", it should be noted that the current proposed Culburra West Project has been modified on a number of occasions in order to reduce or limit impacts upon the national environment in general and upon threatened biota in particular, and to ensure an appropriate balance between development goals and biodiversity conservation aspirations. The proposal has been modified *inter alia* to reduce the total development footprint, to remove virtually all development activities from the Lake Wollumboola catchment, and to ensure a 100m+ 'buffer' to the Crookhaven River. The opportunities for urban development at this location are restricted by the current and proposed zoning of lands to the west of Culburra.

Further, "*the Project has been designed to be consistent with the principles outlined above*" (the "*Guiding Principles for Threatened Species Assessment*"), as discussed above.

In addition, the Culburra West Project has provided "*adequate mitigation measures*", both to minimise or avoid the imposition of adverse impacts upon the natural environment in general and on threatened biota and their habitats in particular, and to compensate for the loss of vegetation and habitat resources

which is necessary for the Project to proceed. The Culburra West Project, consequently, constitutes appropriate balance between development and conservation, and achieves the "*environment outcomes*" identified in the "*Guiding Principles*" contained in the DECC 2005 *Draft Guidelines*.

9.7.4 The Key Thresholds

Based on the discussions detailed above, and the offset and compensatory measures incorporated into the Culburra West Project (including offsets and rehabilitation of the Crookhaven River Foreshore Park), it is the conclusion of the authors of this *Report* that the Culburra West Project satisfies the "*Key Thresholds*" outlined in the DECC 2005 *Draft Guidelines*.

Relevant measures in this regard include *inter alia*:

- the retention and rehabilitation of the 100m+ wide Crookhaven River Foreshore Park, along the northern boundary of the proposed development;
- the implementation of appropriate stormwater management measures - to ensure that appropriate water quality and water volume discharges occur, in order to protect and maintain ecosystems downslope of the development;
- the salvage and re-use of tree-hollows - to ensure there is no net loss of tree-hollows in the vicinity, and the re-use of removed vegetation for rehabilitation purposes in the Crookhaven River Foreshore Park and at other appropriate sites; and
- the implementation of an *Offset Strategy*, based on the biobanking methodology, to compensate for the areas of vegetation which need to be removed for the proposal.

With respect to the "*Key Thresholds*" identified in the DECC 2005 *Draft Guidelines*:

- the Culburra West Project "*will maintain or improve biodiversity values*" – as discussed above;
- the Culburra West Project will not "*reduce the long-term viability*" of any threatened biota – given the extent of suitable habitat and resources in the substantial conservation reserves, State Forests and private forested lands in the locality and region, and given the proposed *Offset Strategy*. In this regard, it is not considered likely that any "*local population*" of any of the relevant threatened species would be restricted to or dependent solely upon the Culburra West Project site *per se*;
- the Culburra West Project is not "*likely to accelerate the extinction*" or place "*at risk of extinction*", any threatened biota – given the considerations outlined above; and
- the Culburra West Project will not "*adversely affect critical habitat*" – as no "*critical habitat*" for any of the relevant threatened biota has been declared at this location.

10 ENVIRONMENTAL PLANNING & ASSESSMENT ACT

10.1 General Considerations

This *Ecological Issues & Assessment Report* has been prepared *inter alia* to address the ecological values and potential impacts of development of the subject site at Culburra West, as required by the *Environmental Planning & Assessment Act 1979* (EP&A Act), and pursuant to the DGRs provided for the project by the DP&I. The assessment is being undertaken pursuant to Part 3A of the EP&A Act, which still applies to this *Concept Plan* application, notwithstanding the repeal of Part 3A in 2011.

Section 75U of the EP&A Act determines that Part 3A Applications "*do not require certain permits/approvals required under other legislation. These matters are considered as part of the Part 3A assessment process*". Nevertheless, the DP&I (previously the DoP) "*still requires an equivalent level of information within the EA as would ordinarily be required for the issue of any such permits/approval to enable an assessment of the relevant works*".

This *Ecological Issues & Assessment Report* has been prepared to provide that information, and to assess the potential impacts of the proposal on the natural environment in general, and on threatened biota and their habitats in particular.

10.2 Objects of the EP&A Act

The relevant "*objects*" of the EP&A Act with respect to ecological issues are:

- "*the proper management, development and conservation of natural and artificial resources for the purpose of promoting the social and economic welfare of the community and a better environment*";
- "*the promotion and co-ordination of the orderly and economic use and development of land*";
- "*the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats*"; and
- the achievement of "*ecologically sustainable development*".

The "*objects*" of the EP&A Act seek to achieve an appropriate and reasoned balance between development opportunities (undertaken in an environmentally responsible manner) and biodiversity conservation. The intent of the EP&A Act is to facilitate both development and conservation across the landscape, rather than to guarantee one at the expense of the other.

In terms of the "*objects*" of the EP&A Act, this *Report* takes an holistic approach. The *Report* considers the significance of possible impacts on natural environment in terms of:

- the extent of contiguous habitat and resources of potential or known relevance for native biota to the south, southeast and southwest, and in the locality and region;
- the sensitive nature of the estuarine and riverine habitats and ecosystems to the immediate north along the Crookhaven River, and further into the Crookhaven and Shoalhaven River estuaries; and

- the accepted need for residential development at this location, given the previous and current zoning of the land for that purpose, and given the *South Coast Regional Strategy* and the *Jervis Bay Settlement Strategy*.

In this latter regard, it is critical to note that:

- the current 1985 *Local Environmental Plan* (LEP) identifies the subject site, and land to its immediate south, as appropriate for residential purposes – by virtue of the current residential residential zoning;
- the new draft LEP (dated 2012), which has been on public display, further reinforces the residential zoning of the subject site. The proposed new zoning, prepared by Council, supports the appropriateness of the Culburra West Project; and
- the *South Coast Regional Strategy* (SCRS) and the *Jervis Bay Settlement Strategy* also identify a requirement for residential development to the immediate west of the existing Culburra Village, along the banks of the Crookhaven River.

Further, whilst it is acknowledged that the proposed development will remove habitat and resources for native biota, including for some threatened species as discussed above, that loss needs to be put into context:

- there are very large areas of contiguous habitat and resources for native biota in the immediate vicinity, with the substantial extent of the Jervis Bay National Park and Currambene State Forest, occupying a broad east-west swathe through the landscape to the south and southwest of the subject land (Figures 4 and 12);
- there are very substantial areas of suitable habitat and resources in the locality and region for all of the threatened species that do or are likely to reside on or utilise the subject site, including in the substantial conservation reserves and State Forests in the Shoalhaven LGA (Figures 12 and 13); and
- further, the proposal incorporates the provision of offsets for the vegetation, resources and habitats to be removed (see Chapter 17).

Given those considerations, the proposed Culburra West Project satisfies, or at the very least does not contravene, the "*objects*" of the EP&A Act, particularly with respect to:

- the conservation of biodiversity in NSW;
- the protection and conservation of native biota, including threatened biota and their habitats; and
- the achievement of "*ecologically sustainable development*" (ESD) outcomes (as discussed in detail below).

10.3 Ecologically Sustainable Development

10.3.1 The Principles of ESD

The "*objects*" of the *Environmental Planning & Assessment Act 1979* (EP&A Act), as defined in Section 5 of the Act, include *inter alia* encouragement of the application of the principles of *Ecologically Sustainable Development* (ESD) in the management and use of lands within New South Wales.

The *Protection of the Environment Administration Act 1991* (PoEA Act) states (in Section 6 of that Act) that "*ecologically sustainable development requires* ***effective integration*** *of economic* ***and*** *environmental considerations in decision-making processes*" (emphases added). To achieve that outcome, the Act identifies four "*principles and programs*", the implementation of which are indicated as facilitating the achievement of ESD.

Section 6 of the PoEA Act further states that ESD "*can be achieved through the implementation of*" the following four principles and approaches:

1 The *Precautionary Principle* – which states that "*if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*".

   Further, the Act states that "*In the application of the precautionary principle, public and private decisions should be guided by*:

   (i) *careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and*

   (ii) *an assessment of the risk-weighted consequences of various options*".

2 The principle of "*Inter-generational Equity*" – which asserts that "*the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations*".

3 The principle of the *Conservation of Biological Diversity and Ecological Integrity* – which states that the conservation of biological diversity and ecological integrity should be a fundamental consideration in the assessment of any development proposal.

4 The application of "*improved valuation, pricing and incentive mechanisms*" – which states that environmental factors should be included in the valuation of assets and services, employing such principles as:

   "(*i*) *polluter pays – that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,*

   (ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,

   (iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximize benefits or minimize costs to develop their own solutions and responses to environmental problems".

It is important to note that neither the principles of ESD nor the "*objects*" of the EP&A Act are intended to function as a prohibition on development activities or as a means of constraining development in an unreasonable or inappropriate manner. Indeed, as noted above, the concept of ESD "*requires* ***effective integration*** *of economic* ***and*** *environmental considerations in decision-making processes*" (emphases added). Even where a development will require the removal of native vegetation and natural resources, or the imposition of adverse impacts on threatened biota or their habitats, the pursuit of ESD outcomes does not countenance the prohibition of development.

It is not the case, as is often incorrectly proposed by opponents of development activities, that the principles of ESD are a means of effectively prohibiting development activities in areas of native vegetation, or where there is a requirement to remove native vegetation and habitats for development

purposes. Conversely, the concept of ESD is specifically, and in specific terms, intended to promote the achievement of a balanced outcome between development objectives and biodiversity conservation goals.

10.3.2 Discussion

As noted above, it is important to acknowledge that the concept of *Ecologically Sustainable Development* (ESD) does not mean or imply a prohibition on development activities. Rather, ESD (and its underlying principles) require:

- that there be "*effective integration of economic and environmental considerations in decision-making processes*";
- that appropriate 'caution' be used in the conduct of development activities;
- that appropriate "*measures to prevent environmental degradation*" be applied; and
- that any adverse impacts which are imposed by development are appropriately mitigated, ameliorated and/or offset.

The proposed Culburra West Project will inevitably and unavoidably involve the removal of vegetation from the areas of land which have been identified as appropriate for residential purposes - in both the current and draft LEPs, and in the *South Coast Regional Strategy* and *Jervis Bay Settlement Strategy*.

However, that loss of vegetation and habitats is not regarded by the authors of this *Report* as involving a significant impact on the natural environment in general, or on threatened biota or their habitats in particular, when considered in the appropriate context. This assessment is based *inter alia* on the substantial areas of native habitat and resources suitable for all of the potentially relevant threatened biota, and other native biota, through the general locality.

In this regard:

- there are very substantial areas (thousands of hectares) of contiguous habitat and resources for the relevant forest and woodland species to the immediate south of the subject site, and for some considerable distance to the southeast and southwest (Figures 4, 12 and 13);
- there are considerable and substantial National Parks and Nature Reserves, as well as State Forests, estuaries, embayments and lakes in the immediate locality and in the region, and throughout the Shoalhaven LGA (Figure 13). These features provide vast areas of suitable habitat and resources for the relevant threatened biota;
- none of the habitats, vegetation types or resources to be affected are limited or confined to the subject site, and all such habitats and resources are widespread in the locality and region;
- most of the threatened biota that are of even potential relevance for the subject site are wide-ranging and highly mobile, seasonal migrants and/or occupy substantial home ranges; and
- there are very substantial estuarine and riverine habitats and ecosystems (including EECs) within the Crookhaven and Shoalhaven River estuary system. Unlike those associated with the Culburra West Project, those ecosystems have not been the subject of dedicated

and detailed water quality control measures, or habitat buffers from adjoining urban development (Figures 1, 16A-16C).

In addition to the protection measures associated with the stormwater treatment regime for the Culburra West Project (Martens 2013), it is anticipated that any future *Development Application* for any works associated with the Project would fully implement the standard 'best practice' array of environmental protection mechanisms, including *inter alia*:

- the use of protection fencing - to exclude inappropriate access to areas of retained vegetation;
- the use of temporary sediment basins and silt fences – to prevent the discharge of sediment or other contaminants from development areas;
- the preparation of an appropriate *Waste Management Program* for any construction activities; and
- other appropriate environmental protection measures.

Whilst there will doubtless be a reduction in the habitat and resources for native biota on the subject site itself as a consequence of realisation of the Culburra West Project:

- there are no species, including threatened biota, which would be confined to the subject site *per se*;
- the area of habitat to be affected is very small by comparison with the significant areas of suitable habitat to be retained in the vicinity and locality;
- there are substantial areas of suitable habitat for all of the relevant threatened biota in the extensive conservation resources and State Forests in the vicinity, locality and Shoalhaven LGA (Figures 12 and 13);
- no threatened biota will be "*placed at risk of extinction*" by the proposal (see Chapter 9); and
- there will be no adverse impact on any 'wildlife corridor' through the landscape (see Chapter 9).

10.4 Conclusions

The proposed Culburra West Project constitutes an appropriate and reasonable balance between development aspirations and biodiversity conservation goals.

The Project site is currently zoned for urban development purposes, and was identified in the *South Coast Regional Strategy* as appropriate for those purposes. In addition, that zoning is to be retained in the *Draft 2012 Local Environmental Plan* (LEP), and the area had been identified at the *Long Bow Point Commission of Inquiry* as the appropriate location for urban development at Culburra.

The Culburra West Project satisfies the objects of the EP&A Act. It also satisfies the requirements for ecologically sustainable development (ESD), as documented above, by virtue of the *Offset Strategy* proposed compensate for the removal of vegetation from the development footprint.

11 SEPP 14 – COASTAL WETLANDS

11.1 The Statutory Regime

State Environmental Planning Policy No. 14 – Coastal Wetlands (SEPP 14) aims "*to ensure that the coastal wetlands* [of NSW] *are preserved and protected in the environmental and economic interests of the State*". The Department of Planning (DoP – now DP&I) maintains a series of maps which identify the Coastal Wetlands of NSW pursuant to SEPP 14. The SEPP notes that the "*Policy relates to the land outlined by the outer edge of the heavy black line on the map*".

The *Coastal Wetlands Policy* establishes that the clearing, draining, filling or constructing of a levee on an SEPP 14 Coastal Wetland shall not be undertaken, "*except with the consent of the Council and the concurrence of the Director*" of the Department. It is to be noted in particular that the Culburra West Project does not propose the clearing, draining, filling or constructing of a levee, nor any other physical works, on any SEPP 14 Wetland.

The *Policy* also identifies, in Clause 7(2), those matters which must be taken into consideration by the Director-General in determining whether or not to grant concurrence to works within an SEPP 14 Wetland, including *inter alia*:

- "*the environmental effects of the proposed development*" on native biota and on the salinity and water quality of surrounding areas;
- whether the development would "*be consistent with the aims of this Policy*"; and
- the adequacy of "*safeguards and rehabilitation measures .. to protect the environment*".

It is important to note with respect to SEPP 14 that there is no requirement in the *Policy* for any setbacks from or buffers to SEPP 14 Wetlands, and there is therefore no statutory basis for any required setbacks. Nevertheless, the Culburra West Project does incorporate buffers of approximately 100m to the SEPP 14 Wetlands (as correctly mapped – see below) along the Crookhaven River.

11.2 SEPP 14 Wetlands at Culburra West

There is one SEPP 14 Wetland located immediately adjacent to and/or within the Culburra West Project site (Figure 20) – SEPP 14 Wetland No. 350. There is a second SEPP 14 Wetland (No. 351) to the north (within the Crookhaven River), and a number of SEPP 14 Wetlands further to the north and northwest within the Crookhaven and Shoalhaven River estuaries (Figure 19).

All of these SEPP 14 Wetlands are wholly or substantially estuarine wetlands, predominantly or solely consisting of Mangrove Forest and Coastal Saltmarsh communities. There are no freshwater wetlands on the Culburra West Project site.

It is to be noted that the southern boundary of SEPP 14 Wetland No. 350, as identified in the SEPP 14 mapping of the DP&I, is highly inaccurate in some areas (see Figures 20A to 20C). Part of the land which is mapped as SEPP 14 Wetland No. 350 consists of elevated and xeric open forest and woodland, and other parts are open water of the Crookhaven River. The actual boundaries of SEPP 14 Wetland No. 350 need to be adjusted on the basis of the site contours and the vegetation types present (as discussed further below).

It is also particularly relevant to note that none of the vegetation present within the proposed development footprint for the Culburra West Project consists of vegetation which could conceivably constitute any SEPP 14 Wetland, or any other wetland. All areas of swamp forest, estuarine ecosystems or any other ecosystems that could potentially constitute a wetland are located outside the development footprint, within the areas to be protected within the existing *7A – Environmental Protection* zoned lands, and the 100m buffer zone along the Crookhaven River foreshore.

As discussed briefly above, and as detailed in Figure 19 of this *Report*, SEPP 14 Wetland No. 350:

- is entirely estuarine in nature (*ie* there are no freshwater elements to that SEPP 14 Wetland); and
- should, properly, be confined to those vegetation community types that correspond to wetland communities (Figures 20A to 20C). In this instance, those are confined to the Mangrove Forest and Coastal Saltmarsh communities, which are identified in Figures 9A-9D of this *Report*).

Given those considerations, a modified boundary for the SEPP 14 Wetland No. 350 has been mapped in this *Report* in relation to the location of appropriate vegetation community types (Figures 20A to 20C). This modified boundary of the SEPP 14 Wetland is adopted for the purposes of this *Report*, acknowledging that (in statutory terms) the boundaries are identified in SEPP 14 as "*the outer edge of the heavy black line on the maps*" maintained by the DP&I. Those boundaries, in the case of SEPP 14 Wetland No. 350, however, are clearly incorrect.

11.3 SEPP 14 Management

In addition to the avoidance of the SEPP 14 Wetland by the proposed Culburra West Project, the development has been designed to provide substantial buffers to the actual SEPP 14 Wetlands (notwithstanding that there is no statutory requirement for any buffers to SEPP 14 Wetlands).

Furthermore, the Culburra West Part 3A project has been designed, and is to be managed, specifically *inter alia*:

- to avoid direct impacts upon the SEPP 14 Wetland (*ie* areas of vegetation which actually conform to "*wetlands*", rather than the current inaccurate SEPP 14 maps), other than for very small areas to be modified for access to the Crookhaven River and for 'view lines';
- to avoid the clearing of vegetation in the immediate vicinity of SEPP 14 Wetland No. 350 - by providing significant buffers to the SEPP 14 Wetland;
- to contain and manage stormwater runoff from the development footprint so as to maintain existing hydrological regimes, as detailed in the *Water Cycle Management Report* (Martens 2013) and Part D of this *Report*; and
- to ensure the capture and treatment of stormwater runoff from the residential area to ensure that no contaminants (pesticides, fertilisers or other chemicals) are discharged from the site into any SEPP 14 Wetlands (see Part D of this *Report*).

The stormwater management measures which have been detailed in the *Water Cycle Management Report* for the Culburra West Project (Martens 2013) are specifically intended *inter alia* to avoid the imposition of indirect adverse impacts upon SEPP 14 Wetland No. 350, and indeed upon any wetland or estuarine habitats associated with the Crookhaven River.

In this regard, the design of the proposed Culburra West Project is predicated upon appropriate stormwater capture, treatment and management in order to prevent the imposition of adverse impacts upon the natural environment (including the SEPP 14 Wetland). Stormwater controls and water quality management are considered a critical and crucial element of the Culburra West Project, given the sensitivity of elements of the landscape (including the SEPP 14 Wetlands and habitats along the Crookhaven River) to water quality and stormwater flow discharges.

The stormwater treatment train is described in some detail in the Martens 2013 *Report*, and has been designed specifically *inter alia* to avoid the imposition of adverse impacts upon ecosystems downslope of the proposed development, including within the Crookhaven River estuary. Specific measures detailed in the Martens 2013 *Report* include:

- the utilisation of rainwater tanks across the Project, and the re-use of rainwater for toilet flushing and laundry requirements;
- the interception of stormwater runoff using commercially available devices "*to remove gross pollutants, suspended solids and nutrients from stormwater runoff*";
- the use of roadside bio-retention swales to treat stormwater before discharge;
- the construction of detention basins – to treat stormwater before discharge; and
- the construction of elongated wetlands along the Crookhaven River frontage, downslope of the perimeter road, to allow for stormwater treatment, some recharge of soil water, and overland flows during major rainfall events to minic existing conditions.

12 SEPP 44 – KOALA HABITAT PROTECTION

12.1 Statutory Regime

The relevant aim of *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44) is:

> "*to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline*".

The aims of SEPP 44 are to be achieved:

- "*(a) by requiring the preparation of Plans of Management before development consent can be granted in relation to areas of core koala habitat*";
- "*(b) by encouraging the identification of areas of core koala habitat*"; and
- "*(c) by encouraging inclusion of areas of core koala habitat in environmental protection zones*".

The *Policy* establishes a process for determining whether or not a *Koala Plan of Management* (KPoM) is required for a proposed development activity, and the circumstances under which development consent may be granted for works on land which has been identified as "*core koala habitat*".

The *Policy* also provides relevant definitions including:

- *Potential Koala Habitat* –

  "*areas of native vegetation where the trees of the types listed in Schedule 2* [of SEPP 44] *constitute at least 15% of the total number of trees in the upper or lower strata of the tree component*".

- *Core Koala Habitat* –

  "*an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population*".

12.2 SEPP 44 Considerations

The subject site does not constitute "*potential koala habitat*" pursuant to SEPP 44, because the Koala food trees listed in the *Policy* do not constitute "*at least 15% .. of the tree component*".

Furthermore, there are no recent records of Koalas on the subject site or anywhere in the locality. There is no evidence of any "*resident population of koalas*", and there have been no "*recent sightings of and historical records of a population*" in the study area at Culburra.

On that basis, the subject site and the subject land do not constitute an area of "*core koala habitat*" pursuant to SEPP 44.

Given that conclusion, and irrespective of whether parts or even all of the subject site could theoretically constitute "*potential koala habitat*", there is no requirement for the preparation of a *Koala Plan of Management* pursuant to SEPP 44 in respect of the Culburra West residential development Project.

12.3 Conclusions

Given the considerations detailed above, and the lack of records of Koalas at this location, and in the locality generally, it is the conclusion of this *Report* that:

- the subject site, and indeed the subject land, do not constitute "*potential koala habitat*" pursuant to SEPP 44 - because it is not the case that more than 15% of the canopy of the land consists of the listed Koala food tree species;
- neither the subject site nor the subject land constitute "*core koala habitat*" - because there are no recent records of Koalas on the site or in the vicinity, and there is no "*resident population of Koalas*" at this location; and
- there is, as a consequence of the above, no requirement for the preparation of a *Koala Plan of Management* pursuant to SEPP 44 in respect of the Culburra West urban development Project.

13 COASTAL PROTECTION – SEPP 71 and the COASTAL POLICY

13.1 Aims of SEPP 71

State Environmental Planning Policy No. 71 – Coastal Protection (SEPP 71) is intended to assist in the protection and management of the NSW coast.

The aims of SEPP 71 (as expressed in clause 2 of the *Policy*) are:

"*(a) to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast, and*

(b) to protect and improve existing public access to and along coastal foreshores to the extent that this is compatible with the natural attributes of the coastal foreshore, and

(c) to ensure that new opportunities for public access to and along coastal foreshores are identified and realised to the extent that this is compatible with the natural attributes of the coastal foreshore, and

(d) to protect and preserve Aboriginal cultural heritage, and Aboriginal places, values, customs, beliefs and traditional knowledge, and

(e) to ensure that the visual amenity of the coast is protected, and

(f) to protect and preserve beach environments and beach amenity, and

(g) to protect and preserve native coastal vegetation, and

(h) to protect and preserve the marine environment of New South Wales, and

(i) to protect and preserve rock platforms, and

(j) to manage the coastal zone in accordance with the principles of ecologically sustainable development (within the meaning of section 6 (2) of the Protection of the Environment Administration Act 1991), and

(k) to ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding area, and

(l) to encourage a strategic approach to coastal management".

The proposed Culburra West Project satisfies the aims of SEPP 71 by virtue of:

- the provision of setbacks from the Crookhaven River and its associated ecosystems – as a consequence in part of the *7(a) – Environmental Protection* zoned conservation land along the margins of the Crookhaven River, but also including additional areas of residential-zoned land that have been included by the proponent (see Figure 5 and Appendix C);
- the stormwater management and treatment regime proposed for the Culburra West Project – which is designed *inter alia* to prevent the discharge of contaminants into the Crookhaven River and its associated habitats (see detailed discussion in Chapter 13);
- public access along the Crookhaven River foreshore, by the provision of a dedicated pedestrian and bicycle path with seats and aboriginal archaeology interpretation points[13]; and

13 It is noted that the DP&I has insisted that the public access along the foreshore be removed from the proposal, although the OEH (Mr Miles Boak *pers comm*) is in favour of that proposal.

- the commitment to the implementation of a stage dedicated *Vegetation Management Plan* (VMP) for the retained land along the Crookhaven River.

With respect to the specific aims of SEPP 17 listed above, the proposed Culburra West Project:

(a) protects the natural attributes of the Crookhaven River at this location by the provision of substantial vegetated setbacks and by the implementation of a specifically designed stormwater management regime;

(b) proposes to facilitate "*existing public access to and along coastal foreshores*" along the Crookhaven River (notwithstanding the objections of DP&I officers);

(c) proposes to provide "*new opportunities for public access to and along coastal foreshores*" (notwithstanding the objections of DP&I officers);

(d) will have no impact upon any "*aboriginal cultural heritage*" or any "*aboriginal places, values, customs, beliefs and traditional knowledge*", as all such features along the Crookhaven River will be retained and the proposed public access element of the Project intends *inter alia* to celebrate the aboriginal archaeological features;

(e) will modify "*visual amenity*" at this location to some (limited) extent by the replacement of forest and woodland vegetation with residential development, but will retain a band of vegetation between the residential area and the Crookhaven River. As a consequence, little of the development will be visible from general vantage points because of the intervening vegetation, other than at the eastern end of the Culburra West Project, adjacent to the existing village of Culburra Beach. This outcome, in any case, is consistent with (and will be better than) the existing visual landscape of the Crookhaven River at this location;

(f) will have no adverse impacts at all on "*beach environments and beach amenity*", as there are no beaches proximate to the Culburra West Project;

(g) will "*protect and preserve native coastal vegetation*" - in the *7(a) – Environmental Protection* zoned land along the edge of the Crookhaven River;

(h) will not have any adverse impact upon "*the marine environment of NSW*", by virtue of the high level of stormwater quality management (see Chapter 9.4);

(i) will not have any impact upon any "*rock platforms*";

(j) satisfies the "*principles of ecologically sustainable development*" (see Chapter 10.3);

(k) proposes a "*type, bulk, scale and size of development*" that is "*appropriate for the location*", particularly given the zoning of the subject land (most notably in the Draft 2012 LEP), and in the *South Coast Regional Strategy* and *Jervis Bay Settlement Strategy*; and

(l) constitutes an appropriate element of a "*strategic approach to coastal management*" by protecting the Crookhaven River and estuarine ecosystems, and by providing for future development in an area which has been identified for such purposes (as discussed above).

Given the approaches to the Culburra West Project, as detailed above and in previous Chapters of this *Report*, the aims of SEPP 71 have been fully addressed and satisfied by the proposal.

The Project includes a carefully designed and constructed public thoroughfare along the foreshore areas to provide both pedestrian and bicycle access along the Crookhaven River foreshore. This feature of the development concept will include:

- carefully sited and constructed paths, with elevated boardwalks where necessary;
- benches, seats, tables and observation platforms at points along the pathway;
- physical exercise stations;
- a focus on aboriginal heritage items, with observation points and educational signage created in consultation with the local aboriginal community; and
- educational signage and observation points for ecosystems and points of ecological interest at appropriate locations along the pathway.

It is noted, however, that the DP&I has required, in recent correspondence, that these features be removed from the 100m foreshore setback area along the Crookhaven River. Conversely, the OEH has indicated their support for this facility (Mr Miles Boak *pers comm*).

13.2 Matters for Consideration

Clause 8 of SEPP 71 sets out the "*matters for consideration*" for a consent authority with respect to any development to which SEPP 71 and/or the *Coastal Policy* applies, which are:

"*(a) the aims of this Policy set out in clause 2,*

(b) existing public access to and along the coastal foreshore for pedestrians or persons with a disability should be retained and, where possible, public access to and along the coastal foreshore for pedestrians or persons with a disability should be improved,

(c) opportunities to provide new public access to and along the coastal foreshore for pedestrians or persons with a disability,

(d) the suitability of development given its type, location and design and its relationship with the surrounding area,

(e) any detrimental impact that development may have on the amenity of the coastal foreshore, including any significant overshadowing of the coastal foreshore and any significant loss of views from a public place to the coastal foreshore,

(f) the scenic qualities of the New South Wales coast, and means to protect and improve these qualities,

(g) measures to conserve animals (within the meaning of the Threatened Species Conservation Act 1995) and plants (within the meaning of that Act), and their habitats,

(h) measures to conserve fish (within the meaning of Part 7A of the Fisheries Management Act 1994) and marine vegetation (within the meaning of that Part), and their habitats

(i) existing wildlife corridors and the impact of development on these corridors,

(j) the likely impact of coastal processes and coastal hazards on development and any likely impacts of development on coastal processes and coastal hazards,

(k) measures to reduce the potential for conflict between land-based and water-based coastal activities,

(l) measures to protect the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals,

(m) likely impacts of development on the water quality of coastal waterbodies,

(n) the conservation and preservation of items of heritage, archaeological or historic significance,

(o) only in cases in which a council prepares a draft local environmental plan that applies to land to which this Policy applies, the means to encourage compact towns and cities,

(p) only in cases in which a development application in relation to proposed development is determined:

(i) the cumulative impacts of the proposed development on the environment, and

(ii) measures to ensure that water and energy usage by the proposed development is efficient".

As is the case with the aims of the SEPP 71, the proposed Culburra West Project appropriately addresses the "*matters for consideration*" of the *Policy*.

With respect to the "*matters for consideration*" contained in SEPP 71, the proposed Culburra West Project:

(a) satisfies the aims of the *Policy* (see Chapter 13.1);

(b) proposes to facilitate "*public access to and along*" the Crookhaven River foreshore, notwithstanding the opposition of officers of the DP&I;

(c) proposes to "*to provide new public access to and along the coastal foreshore for pedestrian and persons with disability*";

(d) is an appropriate development given:

- the nature of the site and its environs;
- the location of the Project - predominantly in the Crookhaven River catchment;
- the design of the Project and its water management features; and
- the need for further urban development at Culburra;

(e) will not involve any relevant "*detrimental impact … on the amenity of the coastal foreshore*". In this regard, the Culburra West Project maintains a substantial setback from the Crookhaven River, and will be separated from it by a band of vegetated land (at least 100m wide). There is no potential for any "*overshadowing of the coastal foreshore*", and there will be no "*loss of views from a public place to the coastal foreshore*" as a result of the proposal;

(f) will not adversely affect the "*scenic qualities of the NSW coast*", given the band of forest which is located between the Culburra West proposal and the Crookhaven River, and the extent of other urban development at this location;

(g) has incorporated appropriate measures to protect threatened biota, and has appropriately considered those biota in the Project;

(h) will not involve adverse impacts upon fish or marine vegetation, or their habitats. In this regard, the development has incorporated specific measures to maintain high water quality and to ensure that there is no adverse impact upon the condition of ecosystems, habitats and/or the Crookhaven River itself;

(i) will not involve detrimental impacts to any "*existing wildlife corridors*", given the location and distribution of habitats and vegetation in the locality and the position of the site (at the

northern extremity of terrestrial habitats in the locality). The subject site *per se* does not constitute a "*wildlife corridor*", nor does it contribute to any "*wildlife corridor*" – see Chapter 9.4;

(j) will not impose any impact upon "*coastal processes and coastal hazards*", and will not be adversely affected by any "*coastal processes or coastal hazards*";

(k) will not involve any "*conflict between land-based and water-based coastal activities*";

(l) will have no adverse impact upon "*the cultural places, values, customs, beliefs and traditional knowledge of Aboriginals*". Indeed, the Project includes a proposal to celebrate aboriginal heritage along the foreshore park;

(m) will not involve the imposition of significant (or any) adverse impacts "*on the water quality of coastal waterbodies*". As noted above, and as discussed at some length in this *Report* and in detail in the *Water Cycle Management Report* by Martens (2013), the proposed Culburra West Project has incorporated an array of appropriate and 'best quality' stormwater management measures intended to avoid the potential for discharges of contaminated runoff into the Crookhaven River and to avoid changes in salinity for any relevant ecosystems (mangroves, saltmarsh or sea-grasses);

(n) will have no impact on any "*items of heritage, archaeological or historic significance*" (as discussed above);

(o) is not relevant; and

(p) has incorporated measures (including the appropriate management and treatment of stormwater and adjoining retained native vegetation which are specifically intended to:

- minimise any "*cumulative impacts of the proposed development on the environment*" (see Chapters 16 and 17); and
- has incorporated detailed measures with respect to water management and water quality treatment (see Martens 2013).

13.3 NSW Coastal Policy

The *NSW Coastal Policy 1997* was adopted by the NSW Government in order to set a *"new direction for coastal zone management, planning and conservation in NSW".* The *Policy* states that its *"overriding vision .. is the ecologically* [sic] *sustainability of the NSW coast"*.

The *Coastal Policy* has adopted nine goals (or objectives) "*which represent a commitment to*":

- protecting, rehabilitating and improving the natural environment of the coastal zone;
- recognising and accommodating the natural processes of the coastal zone;
- protecting and enhancing the aesthetic qualities of the coastal zone;
- protecting and conserving the cultural heritage of the coastal zone;
- providing for ecologically sustainable development and use of resources;
- providing for ecologically sustainable human settlement in the coastal zone;
- providing for appropriate public access and use;
- providing information to enable effective management of the coastal zone; and

- providing for integrated planning and management of the coastal zone.

The *Coastal Policy* also notes that the *"nine goals are inter-related. No one is more or less important than another. It is fundamental when using the policy that a specific goal is placed in the context of the other eight goals".* It is noted that none of the goals or objectives of the *Coastal Policy* are to 'prohibit' urban development in the coastal zone.

The Culburra West Project has taken into account the *NSW Coastal Policy*, in particular by providing for the protection of the Crookhaven River and its associated estuarine environments. The development footprint provides a variable buffer (100m at least) to the Crookhaven River and its embankments, and the stormwater management measures incorporated into the Project are specifically intended to minimise or avoid the imposition of adverse impacts upon the coastal zone and the Crookhaven River.

With respect to the nine goals and objectives of the *Coastal Policy*, the Culburra West Project *inter alia*:

- protects, rehabilitates and improves "*the natural environment of the coastal zone*" on and adjacent to the subject site - providing a 100m minimum setback to the Crookhaven River, and by committing to a rehabilitation program to remove substantial areas of weeds from that area of vegetation. The Project also involves the implementation of stormwater quality control and management measures to protect both the setback and ecosystems in and associated with the Crookhaven River;
- recognises and accommodates the "*natural processes of the coastal zone*" - by providing a buffer zone from the Crookhaven River shoreline;
- protects and enhances the "*aesthetic qualities*" and the cultural heritage of the coastal zone, again by the provision of the setback and the management of resources within that setback;
- addresses the issues of ecologically sustainable development, and does not require any "*use of resources*" derived from "*the coastal zone*";
- has considered at considerable length the proposed residential development of the subject site, in an "*ecologically sustainable*" manner;
- incorporates a public pedestrian and bicycle path along the Crookhaven River for "*appropriate public access and use*", and education (notwithstanding opposition from some DP&I officers, but with the support of the OEH);
- provides a commitment to the implementation of a comprehensive VMP for the "*effective management of the coastal zone*" along the Crookhaven River; and
- constitutes an "*integrated planning and management*" regime for the Crookhaven River and the "*coastal zone*" frontage at this location.

13.4 Biodiversity Conservation Considerations

With respect to SEPP 71 and the *Coastal Policy*, the proposed Culburra West Project has taken into account all of the elements of both of those planning documents. The proposal seeks to promote appropriate development and use of the coastal zone from an ecological perspective, whilst also recognising and protecting relevant environmental features of that zone.

In ecological terms, the Culburra West Project has been designed *inter alia*:

- to protect important ecological elements of the Crookhaven River, including its ecosystems, aquatic environments and foreshore;
- to provide a development design which recognises the significance of the Crookhaven River foreshore and the ecosystems along it and within it; and
- to protect threatened biota which utilise the coastal part of the subject site, including the Crookhaven River.

In those respects, the proposed Culburra West Part 3A urban development project satisfies the requirements of both SEPP 71 and the NSW *Coastal Policy*.

14 RIPARIAN ISSUES

14.1 The Statutory Regime

The *Water Management Act 2000* (WM Act) establishes *inter alia* that any activities to be undertaken within 40m of the "*highest bank*" of a "*watersource*" (relevantly in this instance a "*river*") constitute a "*controlled activity*", as defined in the Act. Any such activities (on "*waterfront land*"[14]) would require the provision of a "*controlled activity approval*" (CAA) by the NSW Office of Water[15] (NOW).

The consideration of riparian issues and the protection of riparian habitat and aquatic environments, encompassed by the WM Act, includes *inter alia* the identification of a "*controlled activity*", which is defined as:

- *"the erection of a building or the carrying out of a work (within the meaning of the Environmental Planning and Assessment Act 1979)*";
- "*the removal of material (whether or not extractive material) or vegetation from land, whether by way of excavation or otherwise*";
- "*the deposition of material (whether or not extractive material) on land whether by way of landfill operations or otherwise*"; or
- "*the carrying out of any other activity that affects the quantity or flow of water in a watersource*".

Any of those activities would normally require a "*controlled activity approval*" (CAA), which "*confers a right on its holder to carry out a specified controlled activity at a specified location in, on or under waterfront land*".

As the current Project is the subject of an application pursuant to Part 3A of the EP&A Act, the requirements of the *Water Management Act 2000* do not strictly apply, and a CAA would not be required. However, some future activities (particularly construction of the proposed foreshore path) would ultimately require the provision of a CAA, as it is anticipated that elements of that proposal would be located within 40m of the Crookhaven River.

14.2 Riparian Considerations

There is only a single "*bank*" along this part of the Crookhaven River, being a 'step' (approximately 0.5m to 1m high). This 'step' separates the estuarine ecosystems (Mangrove Forest and Coastal Saltmarsh) from the Swamp Oak Forest, which is located on the narrow 'bench' or 'river flat' above the tidal zone.

Along most of the Project site, except for the eastern end between the STP and the existing village, there is a further steep embankment (generally 2m to 4m high). In some places, the Swamp Oak

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14 The *Water Management Act* defines "*waterfront land*" relevantly as "*the bed of any river, together with any land lying between the bed of the river and a line drawn parallel to, and the prescribed distance inland of, the highest bank of the river*".

15 The NSW Office of Water (NOW), which is responsible for implementation of the *Water Management Act 2000*, is part of SEWPaC.

Forest extends up the embankment whereas in others the more xeric forest communities extend to the base of that steep embankment. Along most of the subject site, the steep embankment and parts of the 'bench' have a dense mid-storey of Lantana.

It should be noted, however, that the 1:100 floodline (at the year 2100) along most of the subject site is not located in most instances near the top of the embankment along the River (wherever it is present). Rather, that floodline is located at approximately 2.7m AHD, which in most instances is located near the base of the embankment, rather than near the top (Figure 8).

Given the nature of the landform on the subject site at Culburra West (Figure 8; Appendix J), where there is an embankment along path of the Crookhaven River frontage of up to 5m in height, there is generally only a very narrow band of riparian vegetation present. In many areas, this consists solely of a narrow band of Swamp Oak Forest at the base of the embankment, with relatively steep slopes up to xeric forest immediately behind the Swamp Oak Forest. In the eastern part of the subject site, however, and in one place in the western half, the slopes up from the Crookhaven River are more gentle (Figure 8), and there are broader areas of Swamp Oak Forest, as well as Swamp Forest and Moist Forest communities (Figures 9A-9D; Appendix J).

There is no "*floodplain*" present at this part of the Crookhaven River, or at the very most there is only a very narrow "*floodplain*", a few metres wide. Further upstream there are extensive broad river flats or "*floodplains*", most of which have been cleared and used for dairy cattle grazing. However, the subject site and most of the areas of Greenwell Point, Orient Point and the Culburra Beach village do not have floodplains, or at most have only narrow "*river flats*".

In the eastern parts of the subject site, particularly between the Culburra STP and Culburra Village, the land slopes gradually away from the river, and there is no "*highest bank*" present.

In any case, the proposed development has been designed *inter alia* to provide a vegetated buffer to the Crookhaven River (defined by the 1:100 floodline at approximately 2.7m AHD). That "*buffer*" will avoid the imposition of any construction works within the "*riparian zone*", with the exception of small areas in which the modification of vegetation is proposed for viewlines and/or access to the River, and the proposed public access along the Crookhaven River frontage. It is not considered likely that these very small areas of disturbance would be of any significance or concern with respect to any native biota or habitats, threatened or otherwise.

As noted above, it is proposed to modify the riparian zone in some locations by some removal of trees to provide 'view lines' and access to the Crookhaven River possibly for the launching of boats (Figures 5 and 15). In addition, a pedestrian and bicycle path is proposed along the Crookhaven River foreshore, which would be designed and constructed in a sensitive manner (similar to many such features in National Parks in NSW). These activities would need special and careful design to ensure minimal disturbance to the Crookhaven River and its banks, whilst facilitating appropriate recreational and other activities.

15 ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT

15.1 The Statutory Regime

The *Commonwealth Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act) aims:

- "*to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance*"; and
- "*to promote the conservation of biodiversity*".

Pursuant to the EPBC Act, any action which "*has*, *will have*, *or is likely to have a significant impact on a matter of national environmental significance*" is defined as a "*controlled action*", and will require approval from the Minister for the Environment.

The "*matters of national environmental significance*" (MNES) listed in the EPBC Act are:

- World Heritage properties;
- wetlands protected by international treaty (the Ramsar Convention);
- nationally listed threatened species and ecological communities;
- nationally listed migratory species protected under international agreements;
- nuclear actions; and
- the environment of Commonwealth marine areas and/or Commonwealth lands.

Pursuant to Section 68 of the EPBC Act, "*a person proposing to take an action that the person thinks may be or is a controlled action must refer the proposal to the Minister for the Minister's decision whether or not the action is a controlled action*". However, a person proposing to take an action that the person thinks is not a "*controlled action*" may also refer the proposal to the Minister for the Minister's decision, whether or not the action is a "*controlled action*".

15.2 The Assessment Process

The EPBC Act provides a mechanism for accrediting state environmental planning processes to assess the potential environmental impacts of activities and developments on "*matters of national environmental significance*" (MNES). As noted in the DGRs, the "*Commonwealth Government has accredited the NSW environmental assessment process for assessing any impacts on matters of NES*".

A set of "*Administrative Guidelines*" has been prepared by the then Environment Australia (now, relevantly, the Department of Sustainability, Environment, Water, Population and Communities[16]) for implementation of the EPBC Act. The *Guidelines* are provided to assist a proponent in determining whether an action should be referred to the Minister for the Environment for a decision on whether an approval by the Minister is required. In particular, the *Guidelines* include a set of criteria "*for determining whether an action has, will have, or is likely to have a significant impact on a matter of national environmental significance*", an relevant threatened and/or migratory species.

16 The SEWPaC was formerly the Department of the Environment, Water, Heritage & the Arts (DEWHA), and previously Environment Australia.

15.3 Culburra West Urban Development Project

With respect to the MNES listed in the EPBC Act:

- there are no "*world heritage properties*" on the subject land or in the vicinity;
- the Crookhaven River estuary is not protected by the Ramsar Convention;
- the proposal will not involve any "*nuclear actions*"; and
- the proposed Culburra West urban development Project will have no impact upon the environment of any "*Commonwealth marine areas*", or upon any Commonwealth lands.

The *Online Database* of items of "*national environmental significance*" listed in the EPBC Act was accessed with respect to Culburra West Project (Appendix F). A number of MNES were identified within an area of up to 10km around the subject site at Culburra, including:

- 43 threatened species;
- 45 migratory (terrestrial and wetland) fauna species;
- 64 protected marine fauna species;
- 13 whales and other cetaceans; and
- a number of "*other matters protected by the EPBC Act*", including *inter alia* the Beecroft Peninsula, various Natural, Indigenous and Historic Places, Nationally Important Wetlands (including Lake Wollumboola), and State and Territory Reserves.

15.3.1 Other Matters

Other than Lake Wollumboola, none of the "*other matters*" identified in Appendix F are of any potential or particular relevance, as they are neither located on or near the "*subject site*" nor will be affected to any relevant (if any) extent by the proposal. Lake Wollumboola is identified as a *"Nationally Important Wetland"* in the listing of "*other matters protected by the EPBC Act*" (Appendix F), but the Crookhaven River estuary is not so listed.

The Culburra West Project involves only a minor area of development activities in the Lake Wollumboola catchment - a playing field at the upper end of the Downs Creek catchment and very small areas of development along the main access road and at the eastern end (Figure 10). However, these activities are not considered likely to be of concern with respect to environmental impacts, because of:

- the environmental protection measures incorporated into the project design,
- their distance from Lake Wollumboola;
- the ability in most instances to drain stormwater back to the Crookhaven River; and
- the extremely small areas of affectation involved compared to the substantial area of the Lake Wollumboola catchment (4055 hectares).

In addition, it is proposed that stormwater from the playing field would be captured, stored and re-used to irrigate the playing field.

15.3.2 Migratory and Protected Marine Species

None of the "*marine protected fauna species*" and none of the whales, other cetaceans and/or pelagic birds are of any relevance to the proposed Culburra West Project (Appendices F and M). There is no potential for the proposed development to impose any relevant (or indeed any) adverse impacts upon any of these biota, or their habitats.

With respect to the alleged migratory species (some of which are not, in fact, migratory at all, at least not in this region), the subject site at Culburra West constitutes only minor habitat (in some instances at least) in terms of the home ranges and distributions of any such species (Appendix M). There are no populations, or even likely individuals, of any such species which would be dependent solely or even significantly (or, in most cases, at all) upon those parts of the subject land at Culburra which are proposed for development activities.

It cannot be considered "*likely*" that a "*significant impact*" (if indeed any impact at all) would be imposed upon any individuals of any 'migratory' species by the proposed Culburra West Project. Those MNES, therefore, are not of particular (or any) relevance to the proposal at Culburra West.

Of the (purported) "*migratory species*" recorded in the locality (Appendices F and M):

- the majority of any such species which are even potentially relevant to the Culburra West Project are associated with the estuarine and riverine habitats along the Crookhaven River, which are to be retained and protected;
- there are very substantial estuarine habitats in the lower reaches of the Crookhaven and Shoalhaven Rivers (Figures 16A-16C), the overwhelming majority of which are not likely to ever be the subject of any development activities, the vast majority of which would not be affected even to a minute extent by the Culburra West Project;
- the few 'migratory' species which could conceivably be associated with those portions of the subject site proposed for development activities are widely distributed in this locality, because of the significant extent of suitable habitat and resources. In particular, there are substantial National Parks and State Forests in the immediate vicinity, general locality and region generally, as well as extensive private forests and woodlands;
- the proposed development could not be reasonably expected to impose a "*significant impact*" upon any such potentially relevant 'migratory' species because of the very substantial relevant resources in the locality and region, and their wide-ranging habitats (over many hundreds or thousands of kilometres). The subject site could conceivably constitute only an infinitesimal proportion of the habitat for even an individual of any such species; and
- those migratory wading and wetland bird species listed in the EPBC Act (Appendix F) are not likely to be adversely affected to any relevant (if any extent) by the Culburra West Project given the substantial areas of suitable habitat in Lake Wollumboola and in the Crookhaven and Shoalhaven River estuaries, and the infinitesimal contribution that the potentially relevant habitat associated with the Project could conceivably make to species which migrate internationally or even nationally (Appendix M; Figures 16A-16C).

15.3.3 Threatened Species

With respect to threatened species listed in the EPBC Act, the same or very similar considerations apply (albeit in a different statutory framework) as to threatened species listed within the TSC Act. In this regard, it is relevant to note that:

- the extent of native vegetation containing relevant habitats or resources to be removed by the proposed Culburra West Project is extremely small relative to other areas of similar vegetation in the immediate vicinity and general locality (Figures 1 and 12);
- there are substantial areas of suitable habitat for all of the potentially relevant threatened biota within the extensive National Parks and State Forests in the general locality and region (Figures 12 and 13);
- most of the potentially relevant threatened fauna species are highly mobile and wide-ranging and/or occupy substantial home ranges (Appendix M);
- other species listed in the EPBC Act occupy habitats or environments that will not be affected significantly, or at all, by the proposal (Appendix M);
- there is no likelihood that a "*viable local population*" of any threatened flora or fauna species would be present solely within or confined to the development area on the subject site, given the proximity of suitable and appropriate habitat and resources; and
- the subject site does not contain habitats or resources which are restricted in nature or confined to the subject site, even in their local distribution.

Given those considerations, it is not likely that a "*significant impact*" would be imposed upon any threatened species listed in the EPBC Act.

15.4 Conclusions

Consideration has been given to the potential for the proposed Culburra West Project to impose a *"significant impact"* upon a *"matter of national environmental significance"* (MNES).

It is the conclusion of this analysis that no MNES would be the subject of a *"significant impact"* as a consequence of the proposed Culburra West Project, given:

- the habits and habitat requirements of the potentially relevant threatened biota;
- the extent of similar and/or identical vegetation, habitats and resources in the vicinity, locality and region;
- the very considerable extent of the conservation reserves and State Forests, and other privately owned conserved lands, in the locality, region and Shoalhaven LGA; and
- the impact amelioration and environmental management measures which are integral parts of the project.

Given those considerations, there is no requirement for a *Referral* of the project to the Commonwealth for consideration pursuant to the likelihood of a "*significant impact*" being imposed upon a MNES. Nevertheless, a *Referral* is likely to be made, on a precautionary basis, and the proponent is currently in discussions with SEWPaC regarding the Culburra West Project.

16 IMPACT AVOIDANCE

By virtue of the nature of the Culburra West Project (being a broad-scale urban and residential development) and of the subject site (which is substantially vegetated), the opportunities to avoid impacts on the natural environment in general and on threatened biota and their habitats in particular within the development area itself are extremely limited.

The proposed development will inevitably involve the removal of essentially all of the vegetation present within the development footprint, including the removal of all hollow-bearing trees from the development footprint (Figures 5 and 7; Appendix I). However, the vegetation and habitats or resources to be removed, as discussed in detail earlier in this *Report*, are widespread, abundant and extremely well conserved in the locality and region.

However, the proposed Culburra West Project has been designed specifically *inter alia* to avoid the imposition of significant adverse impacts upon the Crookhaven River and its associated estuarine habitats and ecosystems. The development footprint is set back from the Crookhaven River frontage by at least 100m, and it is proposed that the intervening band of vegetation be rehabilitated, with major areas of weeds (particularly Lantana and Bitou Bush) to be removed, and by the regeneration and/or replanting of native understorey species.

Furthermore, the proposed stormwater management regime for the project has been specifically designed *inter alia* in order to avoid the discharge of contaminated water into the Crookhaven River and its estuarine habitats. The water management regime has also been designed to avoid any significant alterations to soil moisture regimes within the Crookhaven River foreshore habitats, and to avoid any relevant effects on salinity levels within the estuarine ecosystems of the Crookhaven River (see Chapter 9.4). This will be achieved by the use of bioretention swales and detention basins, as documented in the *Water Cycle Management Report* for the project (Martens 2013).

The Culburra West Project has been designed *inter alia* to avoid the imposition of significant adverse impacts upon the natural environment in general and upon threatened biota and/or their habitats in particular. The proposed development:

- is located in areas of vegetation which:
    - are widespread throughout the locality and region;
    - are extremely well represented in conservation reserves (including State Forests) within the locality and the Shoalhaven region;
    - are of only limited significance or value for most threatened biota (noting that hollow-bearing trees are abundant and widespread at this location); and
    - are not a significant constraint on development activities;
- includes the implementation of an array of environmentally sensitive water management and treatment mechanisms, including bio-retention swales, water harvesting, WSUD, and detention basins, some of which will be utilised for the creation of supplementary habitat for native biota (including threatened species);

- commits to the implementation of a *Hollow-bearing Tree Protocol* - which involves the salvage of tree-hollows from the subject land and their re-use within offset areas proposed for the development; and
- proposes the provision of habitat offset areas, contained in the same or similar vegetation types as present on the development site, in the vicinity.

17 IMPACT AMELIORATION and ENVIRONMENTAL MANAGEMENT

17.1 Impact Amelioration Measures

Several of the potential impacts which could have arisen as a result of the Culburra West Project have been ameliorated by:

- locating the development proposal entirely outside of the *7(a) – Environmental Protection* (*Wetlands*) *Zone* along the Crookhaven River foreshore;
- providing a 100m minimum vegetated setback from the Crookhaven River - to buffer the estuarine and aquatic habitats from development impacts;
- avoiding any significant or substantial direct impacts on the significant and/or sensitive wetlands and mesic communities present, including the known or possible "*threatened ecological communities*" (TECs), along the Crookhaven River;
- incorporating measures to manage and control stormwater discharges from the site, both during development activities (to avoid sediment and other contaminant discharges) and during subsequent occupation of the site (to ensure appropriate water volumes and water quality discharges), in accordance with the detailed recommendations of the Martens 2013 *Report*;
- requiring the implementation of the *Hollow-bearing Tree Protocol* (see below) - to facilitate the salvage and re-use, and/or the replacement, of tree-hollows which require removal for the proposal;
- the design of water quality features and ponds to provide supplementary habitat for a range of native biota, by specialist design elements and by the provision of relevant resources (such as rock piles, reed plantings and dead trees or artificial structures for bird perching); and
- the provision of an *Offset Package* to provide significant areas of vegetation as biodiversity conservation offsets for the vegetation to be removed for the Culburra West Project (see Chapter 17.3 below).

These elements of the proposed Culburra West Project act to ameliorate the impacts which could otherwise be imposed by a less sensitive or less environmentally sound approach.

In addition, the project will facilitate a substantial program of weed removal and control (particularly of Bitou Bush and Lantana) in the band of conserved land along the Crookhaven River frontage, and the supplementary planting program of native indigenous plant species (where required). This approach is to be adopted to enhance retained habitat and vegetation communities on the subject site, *inter alia* in order to offset the impacts of the proposed development.

These measures would be the subject of a comprehensive *Vegetation Management Plan* (VMP) for that portion of the subject land, as part of future *Development Applications* (DAs) for staged development of the subject land. They will be implemented in concert with the staged development of the pedestrian and bicycle path along the Crookhaven River foreshore.

The Culburra West Project is to be located predominantly in the more common xeric vegetation types and communities on the subject site, which are abundant in the general vicinity and throughout the Jervis Bay region. Further, there is a broad vegetated setback between the proposed residential

development and the Crookhaven River, with the intervening *Environmental Protection* zone to retain the existing natural vegetation (including rehabilitation thereof). That approach, in addition to the rigorous treatment of stormwater discharges from the project, is intended to ensure that adverse impacts are not imposed upon the Crookhaven River and its ecosystems, including its dependent native biota.

17.2 Environmental Management Measures

In addition to the impact amelioration measures discussed above, an array of specific environmental management measures are to be implemented both during construction of the Culburra West Project and its associated features, and during its future use.

It is anticipated that all works associated with the Culburra West Project will be undertaken in an environmentally sensitive manner, involving the use of current 'best practice' techniques to contain and manage sediment and stormwater discharges. In particular, the use of temporary sediment basins, sediment fences and protection fencing for retained vegetation and retained trees would be anticipated as standard elements of the future works to be undertaken on the site.

The stormwater management regime for the proposed Culburra West Project (Martens 2013) has been designed *inter alia*:

- to strictly control and manage sediment, erosion and stormwater discharges during the construction phase of the project;
- to capture and treat stormwater runoff from roads and parking areas prior to its discharge into the Crookhaven River; and
- to capture and re-use stormwater run-off using 'Water Sensitive Urban Design' (WSUD) principles and 'best practice' methods.

Other environmental management measures which are to be implemented during the construction phase of the Culburra West Project and its associated facilities will include *inter alia*:

- the collection of native plant material, and its re-use in areas to be rehabilitated around the site and/or in the offset areas;
- implementation of the *Hollow-bearing Tree Protocol* (see below); and
- the preparation and implementation of a *Tree & Vegetation Protection Protocol* to ensure that vegetation which is to be retained adjacent to the site is protected during construction works.

Environmental management measures which are proposed for implementation throughout the life of the Culburra West Project include a number of measures to ensure the maintenance of native vegetation adjoining the subject site and to protect water quality throughout the life of the development. Relevant features in this regard include:

- preparation of a detailed *Vegetation Management Plan* (VMP) - which is to be implemented throughout the areas of retained vegetation between the development and the Crookhaven River;
- the ongoing monitoring and management of all stormwater detention and quality control basins, ponds and bioretention swales - to both provide supplementary habitat for native

biota and to ensure the highest standards of stormwater discharge into the Crookhaven River; and

- long-term management of the vegetation 'buffer' along the Crookhaven River to ensure its condition and quality.

The Culburra West Project will also involve the implementation of a *Hollow-bearing Tree Protocol*, designed to ensure that there is no net loss of tree-hollows in the locality as a consequence of the project. The *Hollow-bearing Tree Protocol* includes *inter alia*:

- the segmental 'dismantling' by professional tree experts of hollow-bearing trees in order to salvage tree-hollows, wherever possible;
- the placement of salvaged tree-hollows on existing large trees or on dedicated posts;
- alternatively, the placement of salvaged tree-hollows on the ground as hollow log habitat, where placement in existing trees is not practical; and
- the use of artificial nest boxes to replace tree-hollow which cannot be salvaged and re-used.

17.3 The Offset Strategy

The Culburra West Project incorporates an *Offset Strategy* which is intended *inter alia* to provide biodiversity conservation offsets for the loss of vegetation required for the development project. As indicated in Figures 5 and 15, and in Chapter 9, the proposed urban development project will require the removal of approximately 73 hectares of predominantly xeric vegetation, all of which is well represented within the immediate vicinity, general locality and extensive conservation reserves within the Shoalhaven LGA.

Nevertheless, it is an accepted government policy approach that development activities which require the removal of native vegetation should offset the loss of any such vegetation by the provision of other lands (and/or financial contributions) for the purposes of biodiversity conservation.

The approach to biodiversity conservation offsets preferred for the Culburra West Project has considered *inter alia* the *Biodiversity Certification* approach which was adopted for the Northwest and Southwest Growth Centres in Sydney. In short, that approach determined that an offset ratio (in terms of hectares of vegetation communities) of approximately 2:1 was appropriate.

It is of significance to note, however, that the application of the *Biodiversity Certification* process in the Northwest and Southwest Growth Centres involved the removal of significant areas of "*endangered ecological communities*" (EECs) and/or "*critically endangered ecological communities*" (CEECs), listed at both the State and Federal levels. No EECs or CEECs will be affected by the proposed Culburra West Project.

The DP&I have indicated that the BioBanking approach should be utilised for the Culburra West Project as a means of determining appropriate offsets for the loss of vegetation and habitats required for the urban development at Culburra West. The landowner (Realty Realizations Pty Ltd) has substantial other forested lands in the locality, and an assessment of both the Culburra West Project site and of

proposed or possible offset areas is currently being undertaken in order to determine an appropriate area to compensate for the loss of vegetation for the Culburra West Project.

Those assessments will be completed during the exhibition period for the Culburra West Project.

GLOSSARY

APZ	*Asset Protection Zone*
Bioregion	"*a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes*" (TSC Act).
DA	*Development Application* prepared pursuant to the EP&A Act.
DEC	the Department of Environment & Conservation (part of the DECCW).
DECC	the Department of Environment & Climate Change (part of the DECCW).
DECCW	the Department of Environment, Climate Change & Water (now part of the OEH).
DoP	NSW Department of Planning
DP&I	Department of Planning & Infrastructure
DPI	Department of Primary Industry
Endangered Ecological Community	"*an ecological community specified in Part 3 of Schedule 1*" of the TSC Act.
Endangered Population	"*a population specified in Part 2 of Schedule 1*" of the TSC Act.
EP&A Act	*Environmental Planning & Assessment Act 1979*.
Key Threatening Process	"*a threatening process specified in Schedule 3*" of the TSC Act.
LGA	*Local Government Area*
Locality	"*the area within a 20km radius of the study area*".
NOW	NSW Office of Water
NPWS	NSW National Parks & Wildlife Service.
OEH	Office of the Environment & Heritage, which is part of the Department of Premier & Cabinet, and which incorporates most of the DECCW.
Recovery Plan	"*a plan prepared and approved under Part 4*" of the TSC Act.
Region	The Jervis Bay Regional Area, which essentially comprises the Shoalhaven Local Government Area.
SIS	*Species Impact Statement* prepared pursuant to Sections 109, 110 and 111 of the TSC Act.
Study Area	The broad area of Lands around the subject site that have been the subject of previous and current studies and investigations.
SCC	Shoalhaven City Council
Subject Land	The lands of the Culburra West Urban Expansion Area, owned by Realty Realizations, and including the subject site.
Subject Site	The southern parts of Lots 5 and 6 in DP 1065111 on which the Culburra West urban development is proposed, including *inter alia* Long Bow Point.
Threatening Process	"*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*" (TSC Act).
Threatened Species	"*a species specified in Part 1 or 4 of Schedule 1 or in Schedule 2*" of the TSC Act.
TSC Act	*Threatened Species Conservation Act 1995*.

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