Cobaki Estate
Fauna Management Plan
Precincts 9 & 11 Borrow Areas - Bulk Earthworks

Revision 1
December 2013

For LEDA Manorstead Pty Ltd

Project Name:	Cobaki Estate Development – Precincts 9 & 11
Project Number:	30031162
Report for:	LEDA Manorstead PTY LTD

PREPARATION, REVIEW AND AUTHORISATION

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1 INTRODUCTION

This Fauna Management Plan (FMP) has been prepared by SMEC Pty Ltd for LEDA Manorstead Pty Ltd for the proposed borrow areas located within Precincts 9 and 11 of the Cobaki Estate development.

1.1 Project Location

The Cobaki Development is located west of the Tugun Bypass and Gold Coast Airport, Tweed Heads. The proposed development is bound by the Queensland and New South Wales border to the north and west and Piggabean Road to the south. The site adjoins Cobaki Creek and Cobaki Broadwater to the east. It is located approximately 6 km west of Tweed Heads/Coolangatta Town Centre and 1.5 km west of the Gold Coast Airport and the Gold Coast Highway, and 500 m west of the Pacific Motorway (Tugun Bypass). Access is currently off Piggabean Road. Future access will be off Boyd Street from the north and linking to Piggabean Road via the proposed Cobaki Parkway.

The site exists in its current state as a large portion of cleared land, which was previously cleared for agricultural purposes (cattle grazing), and scatterings of native vegetation communities.

This report specifically pertains to the borrow areas located in Development Precincts 9 and 11. Precincts 9 and 11 occur in the south-western portion of the Cobaki site and consist of land described as Lot 2 DP 566529, Lot 1 DP 562222, Lot 1 DP 570077, Lot 1 DP 823679, Lots 46, 228 & 305 DP 755740. Precinct 9 covers a total area of approximately 22.6 ha and Precinct 11 covers an area of approximately 15.6 ha.

The location of Development Precincts 9 and 11 with respect to the Cobaki site is shown in Figure 1.

1.2 Scope

LEDA Manorstead are seeking an amendment to the current modification application for the Cobaki Estate Central Open Space Project Approval (08_0200 Mod 1) for the winning of fill from Precincts 9 and 11 for construction of the Central Open Space (as approved under 08_0200), including:

- Precinct 9 - Quarrying of approximately 500,000m^3 of fill material sufficient to complete bulk earthworks in Stage 1 of the Central Open Space.
- Precinct 11 – Quarrying of approximately 100,000m^3 of fill material to complete bulk earthworks in the Central Open Space (Stage 2 and 3).

This Report details potential impacts to fauna as a result of the proposed borrow earthworks and a description of environmental management, mitigation and monitoring measures to minimise these potential impacts.

Refer to Drawing YC0229-1E1-D03 of Appendix A for Scope of Works.

Figure 1: Site Locality

COORDINATE SYSTEM GDA 1994 MGA Zone 56	0 1 2 km Scale: 1: 40,000 @ A4	**FIGURE** 1 - Site Locality	**REVISION** 1	**STATUS** FINAL
		CREATED BY AM11482	**DATE** 12/12/2013	**ISSUED FOR INFORMATION**
PROJECT NO. 30031162	**PROJECT TITLE** Cobaki Estate Management Plans	**SOURCE** The State of Queensland (Department of Environment and Resource Management), Copyright 2010 Aerial Imagery from Nearmap Hypertiles, copyright 2011	**CLIENT** LEDA MANORSTEAD PTY LTD	**CONSULTANT** SMEC Australia

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1.3 Previous Studies

A number of previous studies have been undertaken as part of the various stages of development approval for this proposed development.

Such studies reviewed as part of this report include:

- Long-nosed Potoroo Management Plan (SMEC, 2013a)
- Flora and Fauna Monitoring Program (SMEC, 2013b)
- Wallum Froglet Compensatory Habitat Management Plan (SMEC, 2012a)
- Freshwater Wetland Compensatory Habitat Management Plan (SMEC, 2012b)
- Revised Assessment of Significance (JWA, 2013a)
- Revised Ecological Assessment (JWA, 2013b)
- Revised Regeneration and Revegetation Plan (JWA, 2012a)
- Revised Saltmarsh Rehabilitation Plan (JWA, 2012b)
-
- Revised Fauna Management Plan (JWA, 2010a)
- Stormwater Quality Concept Plan (Yeats, 2010)
- Cobaki Lakes Biting Midge and Mosquito Management Control Plan (Darryl McGinn, 2008)
- Environmental Assessment Report Part 3A Concept Plan (JBA Urban Planning, 2008)

2 PURPOSE & OBJECTIVES

2.1 Purpose

The purpose of this FMP is to protect native fauna and their habitat throughout construction associated with Precincts 9 & 11, and to provide a practical guide to minimising adverse impacts to fauna associated with the proposed development.

2.2 Objectives

The main objective of the FMP is to ensure that the proposed development will have minimal impacts to native fauna and their habitat by:

- Identifying actual and potential impacts to fauna;
- Identifying applicable legislative requirements;
- Identifying fauna habitat to be retained within Environmental Protection/No-Go Zones; and
- Recommending practical mitigation measures and monitoring requirements to manage identified impacts to fauna.

2.3 FMP Targets

The following targets have been established for the management of fauna impacts during construction works associated with Precincts 9 & 11:

- Minimal loss or significant impacts to native fauna, with no loss of endangered or threatened fauna;
- Minimal loss or significant impacts to identified habitat trees and/or features;
- No decrease in the diversity of the local protected fauna species population;
- Adequate control/management of any introduced/invasive pest species, where identified; and
- No infringements of the regulatory requirements relevant to fauna.

3 PLANNING & LEGISLATION

3.1 Relevant Legislation

3.1.1 Legislative Requirements

Key environmental legislation specifically relating to fauna management for the proposed development includes:

- **Commonwealth Legislation**
  - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)

- **New South Wales Legislation**
  - *Environment Planning and Assessment Act 1979* (EP& A Act)
  - *Threatened Species Conservation Act 1995* (TSC Act) and amendments
  - *Fisheries Management Act 1994* (FM Act)
  - *Fisheries Management Amendment Act 1997* (FMA Act)
  - *National Parks and Wildlife Act 1974*

It is noted that the Cobaki Estate Development was assessed under Part 3A of the EP&A Act. Section 75U of the EP&A Act provides that a range of NSW legislative approvals are not required for projects approved under Part 3A. However, the relevant regulator will be consulted and where necessary, inspections and ongoing advice will be sought during the course of the proposed development.

- **Other Statutory Instruments**
  - Tweed Local Environment Plan (2000)
  - Draft Tweed Local Environment Plan (2012)
  - Tweed Shire Council Development Control Plan (2008).

3.2 Compliance with Legislative Requirements

Table 1 specifies compliance details of all conditions of approval and statements of commitment relevant to fauna management for the proposed development.

Table 1: Compliance summary of all relevant conditions of approvals and statements

Condition/ Commitment Reference	Details of Condition/Commitment
EPBC	
3: Biodiversity Strategy	The person taking the action must submit a Biodiversity Offset Strategy to the Minister for approval. The strategy must address the following requirements: a. The acquisition and conservation of land containing a minimum of 3 ha of foraging habitat for the Grey-headed Flying fox for every 1 ha of habitat cleared or degraded for this species, that is of equal or greater quality to the removed for Cobaki Lakes residential development. In the event that

	land acquired is of lower value, then the ratio will need to be greater to account for the difference; b. The land referred to in condition 3 (a) must be protected by a legal instrument under relevant nature conservation legislation, that ensures the land is conserved in perpetuity; and c. The strategy must include key milestones, performance indicators, corrective actions and timeframes for the completion of all actions outlined in the strategy. The approved strategy must be implemented. The person taking the action must not remove any habitat for the Grey-headed Flying Fox until the Minister approves the strategy.
Concept Plan Approval 06_0316 Mod 1	
C4(1)	All future applications are to include, where relevant, draft stage-specific management plan updates to the Preliminary FMP. Each plan is to consider all other existing plans for the site to ensure management strategies do not conflict.
C14	All future development applications must demonstrate that the keeping of cats within the Cobaki Lakes site shall be totally prohibited and that all residential lots are to be encumbered to this effect with a Section 88B instrument under the *NSW Conveyancing Act 1919*.
Revised Statement of Commitments (8 May 2013) – Concept approval	
4.5.1	The provisions of the Revised Fauna Management Plan (James Warren & Associates, 2010) will be implemented.
4.5.2	The provisions of the SEPP 44 Assessment – Cobaki Lakes – Preferred Project Report (James Warren & Associates, 2009h) will be implemented.

3.3 Licenses & Permits

Table 2: Licenses and Permits Required

Legislation	License / Permit	Timing and Responsibility
National Parks and Wildlife Act 1974	Permit to collect seed/cuttings from a threatened plant	During landscaping stages, a permit may be required
National Parks and Wildlife Act 1974	License to rescue protected Fauna under Section 132(c) of the *National Parks and Wildlife Act 1974*	An appropriately licensed Fauna Spotter Catcher will be engaged prior to clearing works commencing.
Animal Research Act 1995	Ethics approval through an approved Animal Care and Ethics Committee for fauna monitoring involving trapping	All monitoring of fauna which includes trapping will be carried out by an appropriately licensed contractor.

4 RESPONSIBILITIES & RESOURCES

The responsibilities of key staff for the project, including the Construction Manager and on-site Environmental Officer will be detailed in the CEMP (SMEC, 2013c).

The Proponent, Leda Manorstead Pty Ltd, will ensure that adequate resources are available to carry out and maintain all mitigation measures discussed in subsequent sections in accordance with relevant Acts and this plan.

The personnel that will be required during the implementation of this FMP include:

- Fauna specialist
- Ecologist
- Fauna Spotter – Catcher

Contact details for relevant personnel involved in the implementation of this FMP include:

Table 3: Contact Details Relevant to the Fauna Management Sub Plan

Organisation	Name	Contact Details
Construction Manager	Dennis Hughes	Phone:0417 797 099 Email: leda@hughesintermodal.com.au
Project Manager Leda Developments	Reg Van Rij	Phone: (07) 5570 5500 Email: rvr@ledagc.com
Office of Environment and Heritage (OEH) (DECC)	Chris Sayer	(02) 6640 2500 131 555
Fisheries	Pat Dwyer	(02) 6626 1397 1300 550 474
Tweed Shire Council Representatives	Mick Denny	Phone: (02) 6670 2602 Email: MDenny@tweed.nsw.gov.au
	Tanya Fountain	Phone: (02) 6670 2787 Email: TFountain@tweed.nsw.gov.au
Environmental on-site Officer	Jon Alexander	Phone: 0424 152 298 Email: Jon.Alexander@smec.com
Bush regenerator	*TBA*	Phone: *TBA*
Ecologist	*TBA*	Phone: *TBA*
Fauna Specialist	*TBA*	Phone: *TBA*
Veterinary Hospital (Billinudgel)		(02) 6680 3480
Wildlife Relocation and Management Services		(07) 5590 4301
Currumbin Sanctuary		(07) 5534 1266

5 ENVIRONMENTAL IMPACTS

5.1 Impacts to native fauna and habitat

Activities associated with the development have the potential to affect fauna and habitats through:

- Direct mortality and loss of habitat (foraging, breeding, and roosting/nesting) due to vegetation clearing and changes in land use (vehicle strike, trampling, arson, spills, dumping of waste);
- Habitat degradation due to alteration of natural hydrological regimes and increases in pollutants (e.g heavy metals, oils, greases, petroleum hydrocarbons, etc) associated with urban run-off, particularly downstream aquatic habitats.
- Increased competition and predation on native fauna due to potential prevalence of invasive species and domestic animals;
- Increased risk of disease due to increased stress of native fauna induced by construction.

5.2 Impacts to threatened and locally significant fauna

Eleven (11) threatened fauna species and/or their habitat have been recorded within or adjacent to Precincts 9 and 11 , as detailed in **Table 4** below.

Table 4: Threatened fauna species and/or habitat within or adjacent to Precincts 9 and 11.

Common name	Scientific name	Status	Act	Precinct location	
				9	11
Powerful owl	*Ninox strenua*	Vulnerable	TSC Act		
Masked owl	*Tyto novaehollandiae*	Vulnerable	TSC Act		
Black-necked stork	*Ephippiorhynchus asiaticus*	Endangered	TSC Act		
Osprey	*Pandion haliaetus*	Vulnerable	TSC Act		
Grey-headed flying fox	*Pteropus poliocephalus*	Vulnerable	EPBC Act		
Little bent-wing bat	*Miniopterus australis*	Vulnerable	TSC Act		
Common bent-wing bat	*Miniopterus schreibersii*	Vulnerable	TSC Act		
Yellow-bellied sheathtail bat	*Saccolaimus flaviventris*	Vulnerable	TSC Act		
Greater broad-nosed bat	*Scoteanax rueppelli*	Vulnerable	TSC Act		
Eastern free-tail bat	*Mormopterus norfolkensi*	Vulnerable	TSC Act		
Koala	*Phascolarctos cinereus*	Vulnerable	TSC Act		

Specific impacts to threatened fauna and habitat are detailed below.

Powerful Owl (*Ninox strenua*)

The powerful owl is endemic to eastern and south-eastern Australia, inhabiting a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest from Mackay to south-western Victoria (DECC, 2012).

The Powerful owl was recorded within a patch of vegetation at the far northern end of the site in 1994 (Warren 1994). Further spotlighting and call playback surveys of the subject site have failed to record this species (JWA, 2008).

Approximately 70 hectares of suitable forage habitat occurs on the site, of which 0.08 hectares (0.1%) will be removed from the Precinct 9 and 11 borrow areas (0.03 ha and 0.05 ha, respectively) (**Figure 2**).

Masked owl *(Tyto novaehollandiae)*

The masked owl is widely distributed from the coast to the western plains, where it inhabits dry eucalypt forests and woodlands. Pairs have a home range between 500 and 1000 hectares and they roost and breed within large tree hollows in moist eucalypt gullies (DECC, 2012). The species was recorded in a patch of vegetation at the far northern end of the site in 1994 (Debus 1994). Further spotlighting and call playback surveys of the subject site have failed to record this species (JWA, 2008).

Approximately 70 hectares of suitable forage habitat occurs on the site, of which 0.08 hectares (0.1%) will be removed from the Precinct 9 and 11 borrow areas (0.03 ha and 0.05 ha, respectively) (**Figure 2**).

The masked owl will persist in disturbed environments as long as existing and potential nest trees are retained, and suitable areas of forested or woodland areas are conserved so as to conserve prey species (Woodward-Clyde 1997). It is considered that the proposed development is highly unlikely to result in the local extinction of this species.

Black-necked stork (*Ephippiorhynchus asiaticus)*

The black-necked stork inhabits wetlands, such as floodplains of rivers with large shallow swamps and pools, freshwater meadows, wet heathland, farm dams, shallow floodwaters and adjacent grasslands, paddocks and open savannah woodlands in coastal and sub-coastal northern and eastern Australia (DECC, 2012). Approximately 142 hectares of potential forage habitat for the species exists within the low-lying eastern and south eastern portions of the site, and the species has been identified foraging approximately 200 metres east of Precinct 9. Refer to **Figure 3** for Potential Habitat for the Black-necked Stork.

Approximately 0.07 hectares (0.05%) of potential habitat for the black-necked stork occurs within a dam in Precinct 9. The proposed bulk earthworks within the Precinct 9 borrow area will not involve the removal of this dam, however mitigation measures such as sediment and erosion control, as detailed in Section 4, will be required to minimise impacts of nearby earthworks on this habitat. Given the high mobility of this species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species.

Osprey (*Pandion haliaetus)*
The osprey occupies coastal areas, especially the mouths of large rivers, lagoons and lakes throughout most of Australia (excluding Tasmania and Victoria).

Three ospreys and a stick nest were observed by SMEC on the southern nesting platform in the Saltmarsh Rehabilitation Area in June 2013. This nest site is approximately 1 kilometre south-east of Precinct 9 (**Figure 4**), and human disturbance near the nest site is not expected. The proposed development is considered highly unlikely to result in significant impacts on this species (JWA, 2010a).

Wedge-tailed eagle (*Aquila audax)*
A pair of wedge-tailed eagles was identified nesting in a tree stag on the boundary of Precinct 9 and Rehabilitation and Management Area 8 during the 2011 breeding season. This nest no longer exists, however, SMEC have identified a wedge-tailed eagle utilising a stick nest on the boundary of Precinct 11 and Rehabilitation and Management Area 6 (June & November, 2013) (see **Figure 4** for location). While the wedge-tailed eagle is not listed as threatened on mainland Australia, the occurrence of a nesting pair which may be utilizing this tree for breeding is considered significant for the local Tweed area.

It is expected that impacts of the proposed development will be limited to noise and dust related impact in the vicinity of the nest site. It is not likely that the proposed development will result in significant impacts on the wedge-tailed eagle.

Koala (*Phascolarctos cinereus)*
Although no evidence of a resident koala population exists on the site (JWA, 2008), given the observation of faecal pallets and a low density of scratches on Grey gums and Tallowwoods throughout the site, it is considered that koalas utilise the site as they commute between areas of primary use habitat.

SMEC conducted four Koala Spot Assessment Technique (KSAT) Surveys on the site in 2013, including one on the boundary of Precinct 9 and Rehabilitation and Management Area 9. Koala pellets were only detected within the northern end of Rehabilitation and Management Precinct 5, 1 km north of Precinct 11.

Potential habitat for the species exists in the sclerophyll forest (mostly *E. microcorys*) located within and adjacent to Precincts 9 and 11. 0.08 hectares (0.2%) of suitable Koala habitat will be removed from the Precinct 9 and 11 borrow areas (0.03 ha and 0.05 ha, respectively). Refer to **Figure 5**.

Potential impacts of the proposed works on transient koalas include:

- Death, injury or loss of habitat due to earthworks
- Increased risk of death or injury from vehicle strike; and
- Risk of harassment, death or injury from dogs.

Fauna management measures, as detailed in Section 4.1 will reduce these risks.

Grey-headed flying fox (*Pteropus poliocephalus)*
The grey-headed flying-fox forages in rainforest, wet and dry sclerophyll forest, mangroves, fruit crops and fruiting trees in parks and urban areas. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (DECC, 2012). The species has been recorded foraging in various locations on and adjacent to the site, including within a dry sclerophyll community located approximately 250 metres north of Precinct 11. No flying-fox roosting camps have been identified on or adjacent to the site (JWA, 2008).

Approximately 72 hectares of potential forage habitat occurs on the site for this species. Approximately 0.08 hectares of potential forage habitat will be removed from the Precinct 9 and 11 borrow areas. Refer to **Figure 6** for potential habitat on site.

Given the high mobility of this species (up to 50 km), this loss of foraging habitat is not considered significant. The grey-headed flying-fox is likely to continue foraging within retained areas of vegetation on the site. Clearing works on the site are not likely to affect this species.

Little bent-wing bat (*Miniopterus australis)* & Common bent-wing bat (*Miniopterus schreibersii*)
The little bent-wing bat and common bent-wing bat forage on insects in forested habitats, and roost in caves, tunnels or similar structures located nearby.

Approximately 72 hectares of potential forage habitat occurs on the site, of which approximately 0.08 hectares of potential forage habitat will be removed from Precinct 9 and 11 borrow areas. Refer to **Figure 6** for potential habitat on site.

Given the high mobility of these species, the loss of potential foraging habitat is not considered significant in relation to the regional distribution of habitat for this species. The extent of impacts to these species due to loss of roost habitat is currently unknown and will be determined based on the number of suitable hollows and fissures identified during pre-clearing surveys. Any loss of roost sites will be mitigated by the installation of nest-boxes within retained vegetation.

Eastern free-tail bat (*Mormopterus norfolkensi*), Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) & Greater broad-nosed bat (*Scoteanax rueppelli*)
Potential habitat impact for eastern freetail bat, yellow-bellied sheathtail bat and greater broad-nosed bat within the current development precincts is limited to approximately 0.08 hectares from the Precinct 9 and 11 borrow areas. Refer to **Figure 6** for potential habitat on site.

Given the high mobility of these species, the loss of potential foraging habitat is not considered significant. There may be a minor loss of potential roost sites (e.g. hollow-bearing trees and fissures) for these species however the installation of bat boxes within retained vegetation (in accordance with the Fauna Management Plan – JWA, 2010a) will increase roosting opportunities for these species. Potential roost sites will be identified during pre-clearing surveys in order to determine the extent of the resulting impact to these species. It is considered that these species will continue to utilise retained vegetation for foraging and retained habitat trees for roosting.

Figure 2: Potential Habitat for the Powerful Owl and Masked Owl

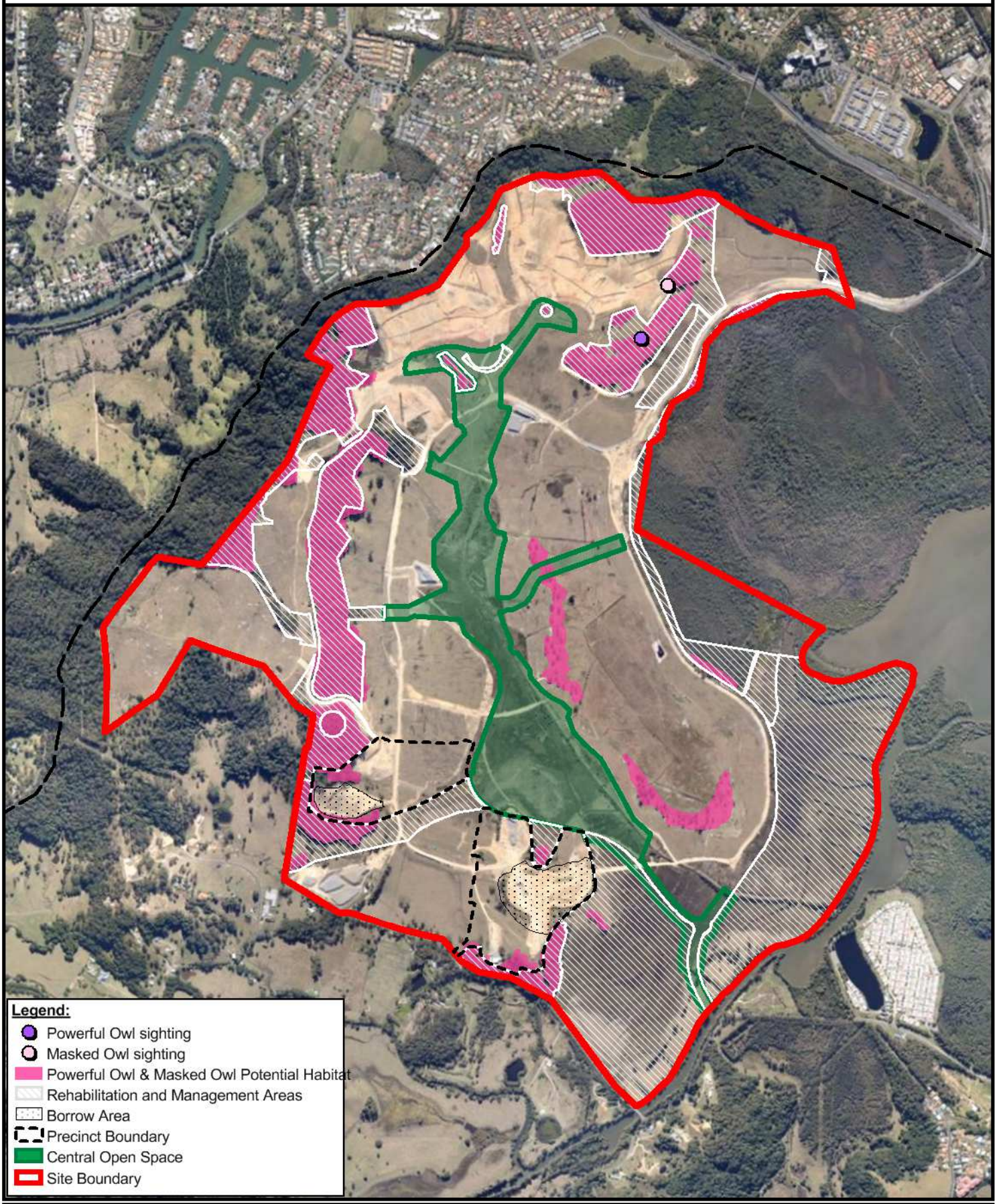

FIGURE 2: Potential Habitat for the Powerful Owl and Masked Owl **CREATED BY** AM11482	**REVISION** 2 **STATUS** FINAL **DATE** 17/12/2013 **ISSUED FOR INFORMATION** N	SMEC **CONSULTANT** SMEC Australia
PROJECT NO. 30031162 **PROJECT TITLE** Cobaki Estate Environmental Management Plans	**COORDINATE SYSTEM** GDA 1994 MGA Zone 56 0 0.5 1km Scale: 1:20,000 @ A4	
	SOURCE The State of Queensland (Department of Environment and Resource Management), Copyright 2010 Species Records from James Warren & Associates, 2010 Aerial Imagery by Nearmap Hypertiles, Copyright 2011	**CLIENT** LEDA MANORSTEAD PTY LTD

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Figure 3: Black-necked Stork Records and Potential Habitat

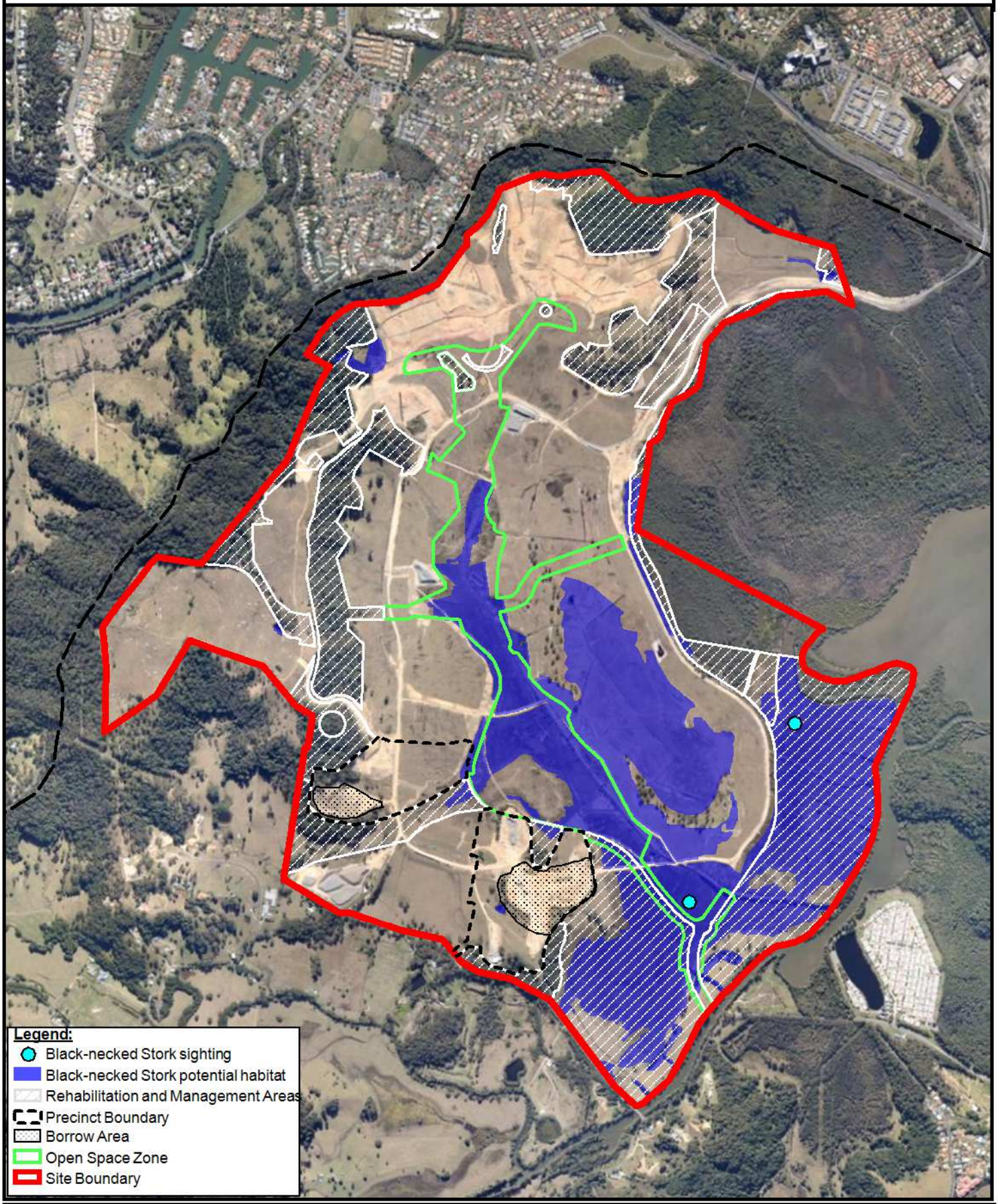

FIGURE 3: Black-necked Stork Records and Potential Habitat	**REVISION** 2 **STATUS** FINAL	N
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Figure 4: Raptor Nesting Platforms and Nest Locations

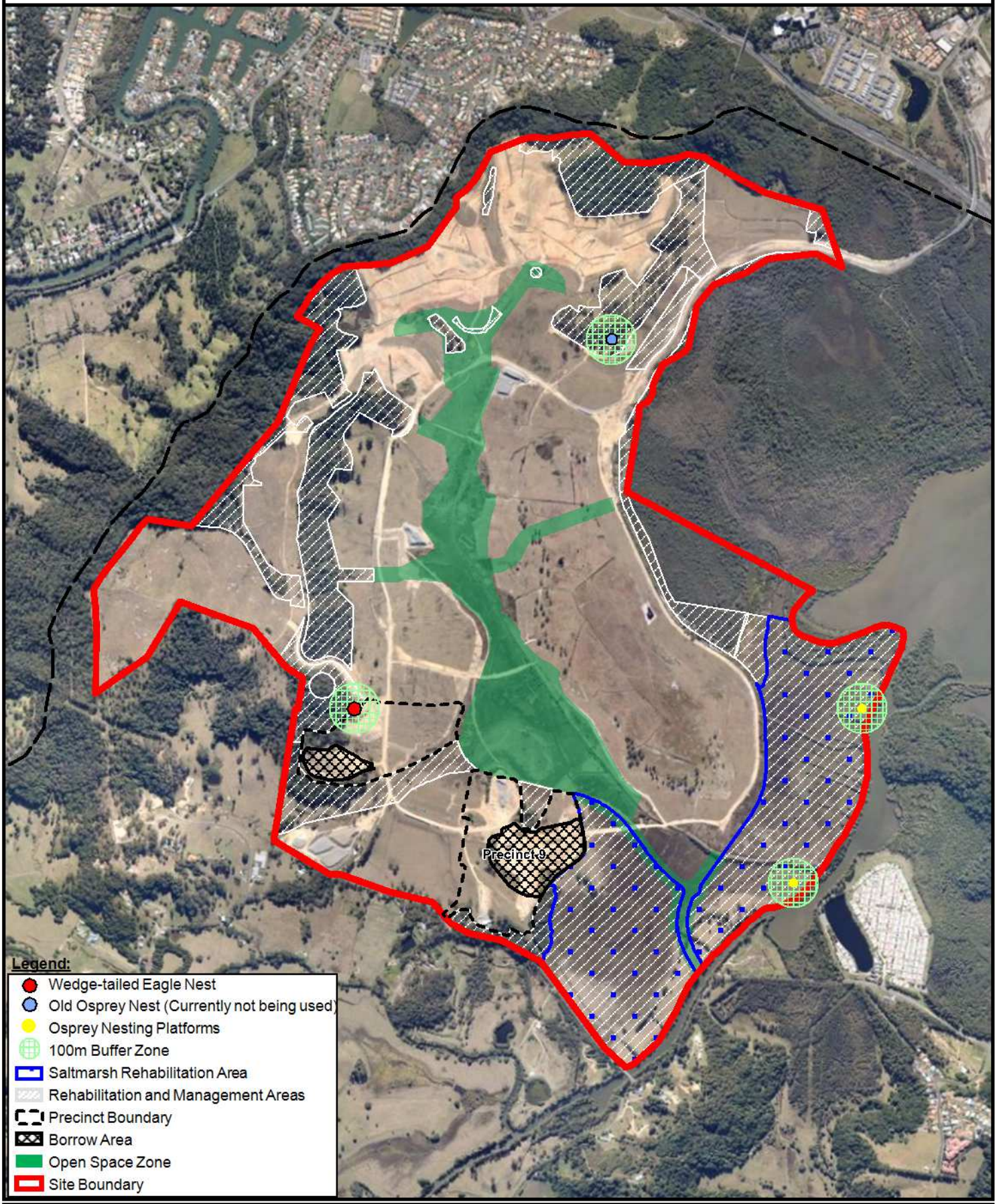

FIGURE 4: Proposed Raptor Nesting Platform Locations **CREATED BY** AM11482	**REVISION** 2 **STATUS** FINAL **DATE** 17/12/2013 **ISSUED FOR INFORMATION** N	SMEC **CONSULTANT** SMEC Australia
PROJECT NO. 30031162 **PROJECT TITLE** Cobaki Estate Environmental Management Plans	**COORDINATE SYSTEM** GDA 1994 MGA Zone 56 0 0.5 1km Scale: 1:20,000 @ A4	 **CLIENT** LEDA MANORSTEAD PTY LTD
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Figure 5: Potential Habitat for the Koala

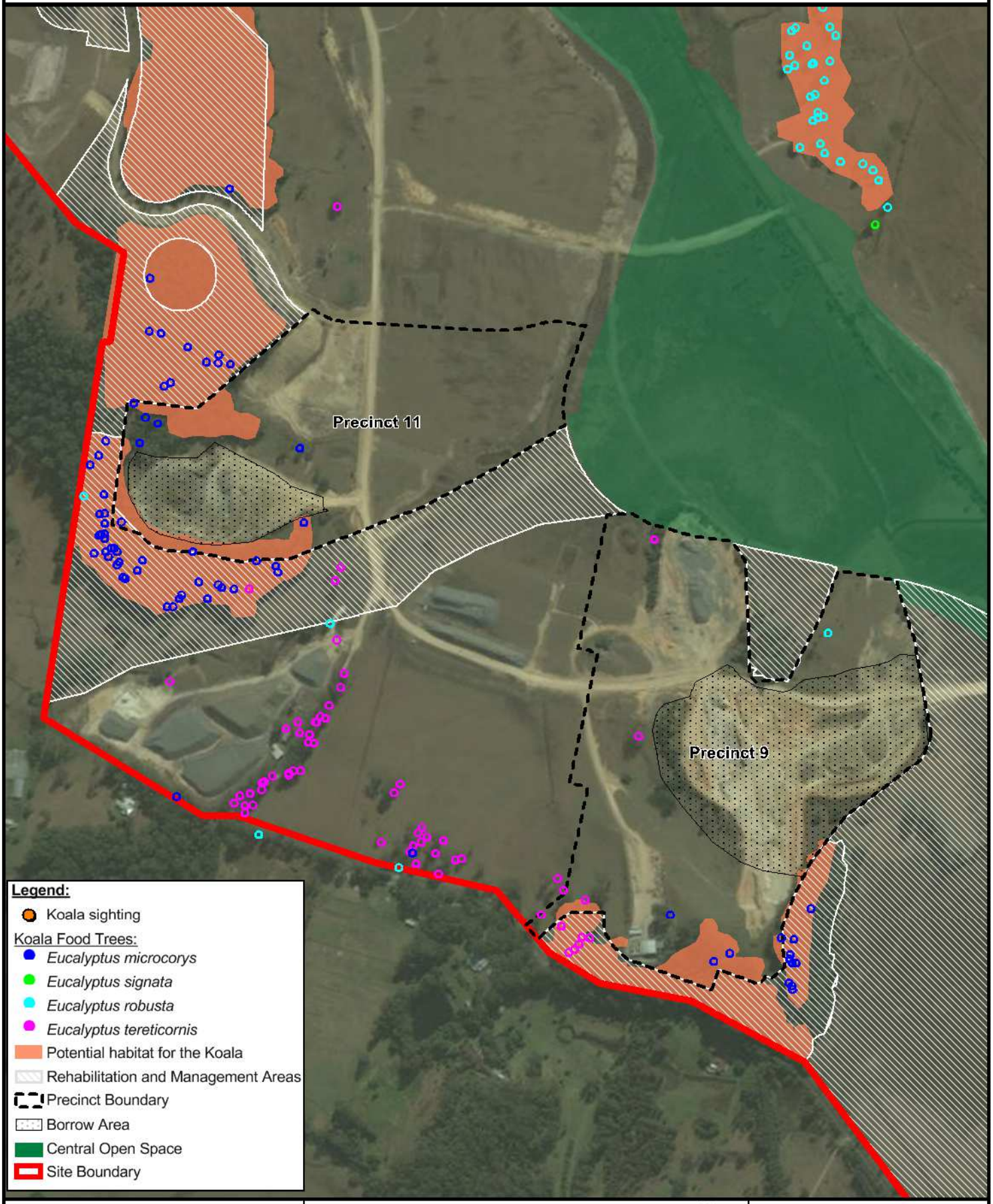

FIGURE 5: Potential Habitat for the Koala

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Cobaki Estate Environmental Management Plans

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GDA 1994 MGA Zone 56

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Figure 6: Grey-headed Flying Fox and Micro-bats

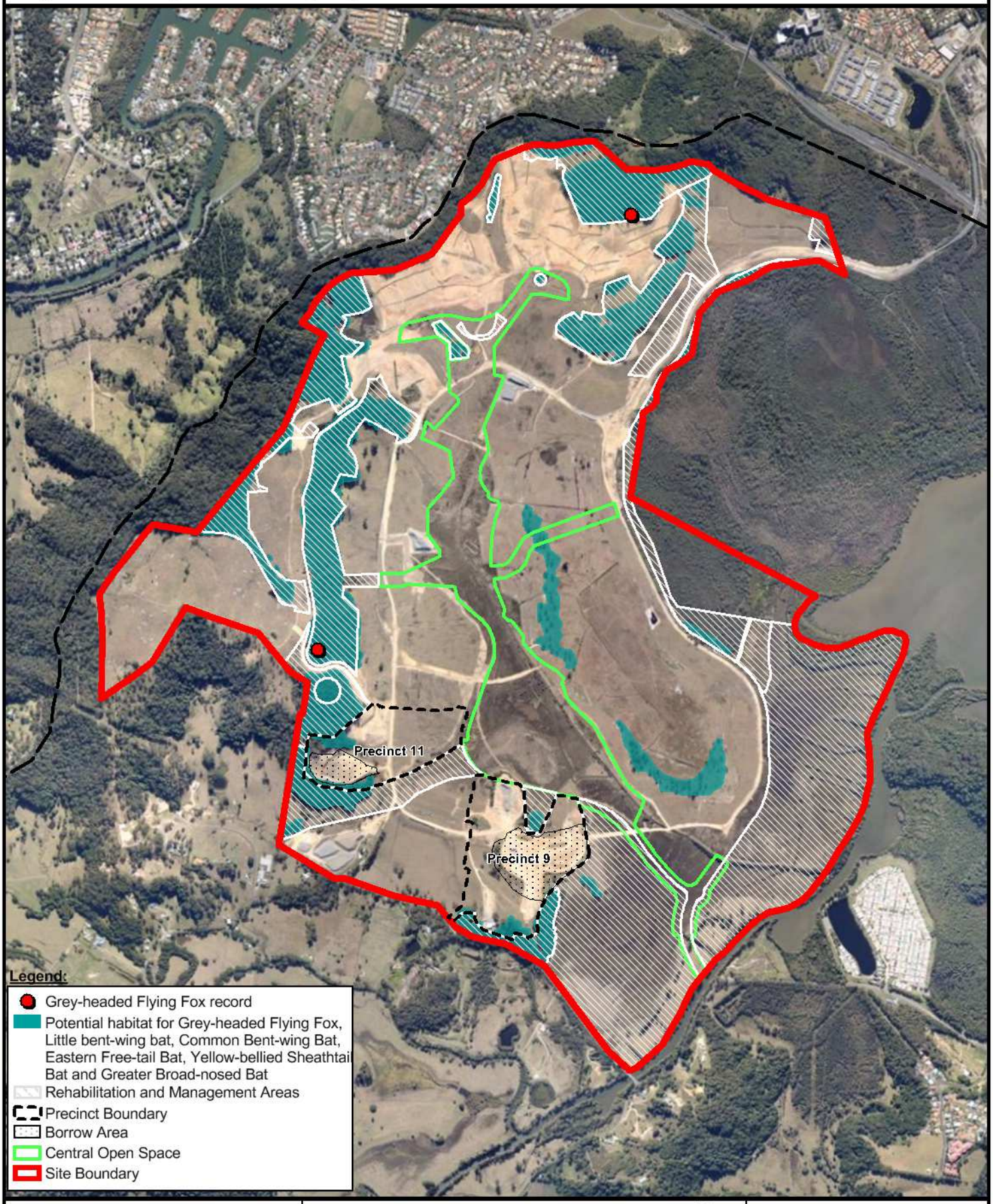

FIGURE 6: Grey-headed Flying Fox and Micro-bats

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Cobaki Estate Environmental Management Plans

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6 MITIGATION MEASURES

Aside from minimising the total area of habitat to be cleared, mitigation measures to be discussed in this section are: the management of native fauna during construction, the maintenance of native fauna within retained habitat areas, management of pest species and maintenance of connectivity between habitats.

6.1 Pre-clearing

Prior to any clearing within Precincts 9 and 11, the following procedures are to be followed:

At least two (2) weeks prior to clearing and earthworks:

- A pre-clearing survey will be undertaken by the Ecologist as part of baseline surveys, involving:
    - Extensive searches for all native fauna, particularly threatened species and arboreal mammals.
    - Visual inspection for breeding places (hollow-bearing trees, roost sites), fissures and other habitat features. The locations of all fauna identified shall be GPS recorded, and trees containing fauna and/or habitat features shall be GPS recorded and flagged.
- A pre-clearing checklist (Appendix A) will be completed by the Environmental Officer.

Within 12 hours prior to clearing:

- Additional inspection of flagged habitat trees to be cleared (as identified within the pre-clearing fauna survey) will be undertaken by the fauna spotter-catcher. The fauna spotter-catcher will be present during all stages of clearing and the initial stage of earthworks in order to inspect on-ground habitat features and ensure the safety of any fauna detected. Checking for hollows and the presence of fauna in breeding places above eye level must be undertaken with the use of camera poles or other such suitable equipment. The Hollows Inspection Checklist provided in Appendix B should be used to record all hollows and fissures identified and to determine nest-box requirements.
- All retained habitat will be clearly delineated using parawebbing prior to any earthworks to ensure that vehicles and other direct disturbances associated with earthworks do not encroach into adjacent habitat. An Earthworks Fencing Plan is provided in Appendix C. Signage is to be erected on fencing stating: “No Entry – Environmental Protection Area” or “No Entry – Compensatory Habitat Area” as appropriate.
- In the event of injury to an animal, the fauna rescue procedures outlined in Section 6.2.3 should be followed.

6.2 Management of Fauna during Construction

6.2.1 Clearing and Earthworks

The following management strategies shall be implemented during clearing and earthworks:

- A fauna spotter-catcher will be present during all stages of clearing and the initial stage of earthworks.
- To minimise impacts on fauna species of conservation significance during clearing, a two-stage clearing process is proposed:
    - The first stage of clearing will involve removal of smaller, non-habitat trees in order to allow fauna to leave inhabited trees of their own accord, thereby minimizing risk of injury or death. The second stage of clearing will involve removal of remaining flagged habitat trees (identified during pre-clearing surveys to contain suitable roosting/nesting hollows or fissures).
    - Prior to the 2nd stage of clearing, under the supervision of the spotter catcher will inspect the trees, and where fauna has not relocated of its own accord, the tree must be gently tapped with the arm of a piece of machinery. If the nesting animal cannot be readily removed by the spotter-catcher, the portion of the tree containing the hollow will be soft-felled and reattached to suitable standing trees in nearby retained vegetation.
    - Soft-felling techniques will be implemented for the removal of habitat trees in order to reduce the disturbance and risk of injury to any inhabiting fauna.
- Following clearing, a second inspection of felled trees will be undertaken to relocate fauna disturbed or remaining within the felled trees to suitable nearby habitat areas.
- Sections of felled trees containing medium to large hollows will be removed and attached to suitable standing trees found in nearby retained vegetation.
- Grubbing operations shall ensure the site is left free draining with no ponding of stormwater which may result in breeding habitat for mosquitoes and cane toads, or cause alterations to the hydrology of wetland habitats.
- Erosion and sediment control works shall be designed and managed in accordance with the Erosion and Sediment Control Plans (Yeats, 2013).
- No unrestrained dogs shall be allowed on site during construction. The Environment Officer is to monitor compliance with the *Companion Animals Act 1998*.
- Contact details for the qualified ecologist/fauna specialist, Wildlife Relocation and Management Services and the Local Veterinary Hospital will be kept on site at all times in the case that injured wildlife are identified (**Section 6.2.3**).

6.2.2 Management Practices Specific to Threatened and Significant Fauna

Koala *(Phascolarctos cinereus)*

- Visual inspection for koalas in trees to be removed shall be completed on the day of clearing, prior to any vegetation removal.
- In the event that a koala is identified in a tree marked for removal, no works will be undertaken within 25 m of the tree until the individual has moved from the area of

its own accord. If necessary, the tree shall be left overnight to enable the koala to move away. The tree can only be removed following inspection by an appropriately qualified spotter catcher to ensure that the koala has dispersed and that the removal of the tree poses no direct threat to the health or survival of the koala.

Black-necked stork (*Xenorhynchus asiaticus*)

- The boundaries of the Environmental Protection Areas will be demarcated to exclude construction traffic.
- Sediment and erosion control measures will be implemented during construction in accordance with the approved Erosion and Sediment Control Plans (Yeats, 2013).
- Exclusion fences will be retained until clearing and construction works are completed.

Powerful owl (*Ninox strenua*) and Masked owl (*Tyto novaehollandiae*)

- In the event that a powerful owl or masked owl is identified in any tree marked for removal, whether habitat or otherwise, no works will be undertaken within 25m of the tree until the individual has moved from the area of its own accord. The tree shall be left overnight to enable the owl to move away. The tree can only to be removed following inspection by an appropriately qualified spotter catcher to ensure that the owl has dispersed and that the removal of the tree poses no direct threat to the health or survival of the owl.

Microchiropteran bats

- In the event that a little bent-wing bat, common bent-wing bat, eastern free-tail bat, yellow-bellied sheathtail bat of greater broad-nosed bat is located within felled timber, the bat will be captured by a suitably qualified spotter-catcher and relocated to a suitable location. The bat will be released at dusk to prevent undue stress or predation.
- If a bat is located within a hollow limb, but cannot be readily removed by an ecologist, it is recommended that the hollow end of the limb be blocked with porous material and a chainsaw be used to remove the limb. The limb should then be relocated to a suitable place and the hollow end unblocked at an appropriate time of day to minimise predation.

Wedge-tailed Eagle

- No works will be allowed within 100m of the wedge-tailed eagle nests (refer to Appendix C).

6.2.3 Fauna Rescue

Contact details for the qualified ecologist/fauna specialist, Wildlife Relocation and Management Services (07 5590 4301) and the Local Veterinary Hospital (Billinudgel: 02 6680 3480) must be kept at all times in the site offices and with the on-site Environmental Officer. If an injured, shocked or juvenile animal and/or eggs are discovered during works, including during activities associated with the relocation/removal or hollow bearing trees, the following procedures will be followed:

- If fauna require handling, this should be done with care and by a fauna specialist, who should hold the relevant licenses and permits listed in **Table 2** (**Section 3.3**).

- Large animals shall be covered with a towel or blanket to minimise stress and gently placed in a cardboard box or natural fibre bag.
- Small animals shall be placed in a cotton bag, tied at the top.
- Keep the animal in a quiet, warm, ventilated and dark place. A designated site will be decided upon in advance of any construction works commencing.
- If the animal is seriously injured and requires immediate attention, as determined by the fauna specialist, the veterinarian should be contacted immediately.
- If the fauna specialist is not present when an injured/juvenile animal is found, Wildlife Relocation and Management Services or veterinary surgeon shall be contacted immediately, as required.
- If the animal is reluctant to move away or is injured, it should not be released and Wildlife Relocation and Management Services shall be contacted.
- Some animals require specialised handling skills (e.g. venomous reptiles, raptors) and should not be handled by site personnel.

6.2.4 Two-stage Post Clearing and Earthworks Report

Given the potential time lapse between clearing and earthworks activities, the Post-Clearing and Earthworks Report will be completed in two stages. At the completion of clearing activities, the project ecologist/environmental officer in consultation with the fauna specialist will produce a Draft Stage 1 report providing a summary of the results of pre-clearing surveys, clearing operations and hollow relocations. A follow-up Stage 2 report will then be prepared to follow up on any additional issues that may have resulted from Earthworks activities. A separate two-stage report will be prepared for activities within each stage of construction (Precincts 9 and 11).

Details within each report will include:

- Information on clearing and earthworks operations, dates, procedures, areas
- Details of habitat trees
- Information on tree species and tree sizes being used for breeding or roosting by fauna, including location, size, height and girth (i.e. for information base purpose).
- Detailed information about any incursion into no-go zones.
- Assessment against the performance criteria detailed in Section 8.
- Recommended remediation measures for any incursions into no-go zones.

Final reports will be submitted to TSC at the completion of Earthworks.

6.3 Long-term Management of Fauna

The following measures will be implemented to manage fauna during the operational phase of the project:

- Maintenance of habitat and connectivity between the estate and adjacent habitat areas
- Hollow management
- Management of pests and domestic species

These will be discussed further below.

6.3.1 Maintenance of Habitat and Connectivity for Fauna

The following fauna structures will be implemented in order to maintain habitat connectivity between the estate and adjacent habitat areas:

- Buildings, roads and fences shall be sited and constructed to allow movement of fauna through the rehabilitated central east-west fauna corridor retained on the site. These structures will be constructed in consultation with an Ecologist, where necessary, to determine the most appropriate location and design that maximises fauna movement between adjacent habitat areas (JWA, 2010a).
- Fauna friendly fences will be constructed at the interface of the development envelope and all areas of retained vegetation. Fences are not to exceed 1.2m in height, and should be installed at least 150mm away from the base of retained vegetation, so as not to impede fauna movement along these areas (JWA, 2010a). Specifications for the design of Fauna Friendly fences are provided in Appendix D.
- Fauna underpasses under Cobaki Parkway have been designed. This is discussed further in the Long-nosed Potoroo Management Plan (SMEC, 2013a).
- As mentioned below, nest boxes of varying sizes will be installed in retained vegetation to provide habitat for species such as gliders, possums, owls and parrots.

6.3.2 Hollow Management

Tree hollows provide refuge and breeding habitat for a range of arboreal fauna species such as gliders, possums, owls and bats. The following hollow management requirements shall be implemented by the Proponent under the direction of the spotter-catcher and Environmental Officer:

- As mentioned in Sections 5.1 and 5.2, a pre-clearing survey will identify and record all hollow-bearing trees to be cleared and sections of felled trees containing medium to large hollows will be removed and attached to suitable standing trees found in close proximity to the development footprint.
- Should tree hollows be destroyed during felling, nest boxes will be placed in adjacent habitat according to the following protocol:
    - Smalls hollows will be replaced with nest boxes designed for bats, incorporating an overhanging roof and internal baffles with both external and internal walls lined flyscreen to improve grip
    - Medium sized hollows will be replaced with those designed for gliders, medium sized parrots and Microchiropteran bats
    - Large sized hollows will be replaced with those designed for cockatoos, greater glider, common brush-tail possum
    - Nails used to attach nest boxes will not be galvanised or coated and will not contain zinc so as to not poison the tree
    - Galvanised wire covered in tubing will be used to attach boxes to large branches
    - Boxes will be placed between four and eight metres above the ground and orientated to minimise penetration by rainfall and sunlight
    - Boxes will be placed away from main access tracks to minimise the chances of them falling and injuring anyone.

- The number and size of nest boxes and felled hollows to be installed will be no less than the number and size of hollows within trees to be cleared, as identified during the hollows inspection undertaken by a qualified ecologist prior to clearing (Checklist provided in Appendix B).
- All nest boxes will be GPS mapped and the tree species they are installed in recorded for future monitoring.
- Nest boxes and felled hollows shall be inspected for colonisation by exotic bees (*Apis melinifera*) and maintained on an annual basis. If colonisation by bees has occurred, the nest box shall be removed and replaced. Inspections for bees shall occur in winter to avoid disturbance to breeding animals.
- Nest boxes and felled hollows within the retained vegetation areas shall be maintained by the Proponent for a minimum of 5 years. Following the 5 year maintenance period, management responsibilities will be overtaken by Tweed Shire Council.

Specifications for the design of nest boxes are included as Appendix E.

6.3.3 Management of Pest and Domestic Species

- The keeping of cats within the Cobaki Estate development shall be prohibited.
- Domestic dogs shall be contained to fenced yards and prohibited from the central drainage reserve and Environmental Protection Areas.
- Pest management will be adaptive in response to the identification of an increase in pest species during monitoring (methodology detailed in the Flora and Fauna Monitoring Program (SMEC, 2013b)). Suggested responses provided in Section 10.

6.3.4 Operational Management Practices Specific to Threatened Fauna:

Koala *(Phascolarctos cinereus)*

- Koala habitat will be retained and protected within Environmental Protection areas throughout the site.
- Additional areas will be enhanced to facilitate koala movement through the site in accordance with the Site Regeneration & Rehabilitation Plan (JWA, 2012b).

Black-necked stork (*Xenorhynchus asiaticus*)

- Habitat for the black-necked stork is proposed to be retained within Environmental Protection and Open Space Areas throughout the site.
- A Compensatory Habitat Area comprised of freshwater wetland will provide approximately 2.25 ha of additional habitat for the black-necked stork, east of the Cobaki Parkway.
- An area of Swamp Sclerophyll Forest on Floodplain within the northern part of the Central Open Space will be established through revegetation works in accordance with the Site Regeneration and Revegetation Management Plan (JWA, 2012b). Buffer vegetation will be incorporated as the outer 5 m of planting.
- 93.3 ha of suitable forage habitat for the black-necked stork within the south-eastern portion of the site will be retained and rehabilitated in accordance with the Revised Saltmarsh Rehabilitation Plan (JWA, 2012c).

Powerful owl (*Ninox strenua*)

- Habitat for the powerful owl (i.e. old growth trees) will be retained and protected within the Environmental Protection Areas throughout the site. Additional areas will be enhanced to facilitate fauna movement through the site, and to provide forage resources, in accordance with the Site Regeneration and Revegetation Plan (JWA, 2012b).
- At least 1-3 nest-boxes of a suitable size for powerful owl will be installed within retained vegetation in order to improve the habitat values of the site, the quantity and location of which will be confirmed following baseline surveys. Additional nest boxes will be installed to compensate for the loss of any hollows which could not be salvaged during clearing. The number and location will be determined based on the outcomes of the pre- clearing survey (using the Hollows Inspection Checklist provided in Appendix B).

Masked owl – (*Tyto novaehollandiae*)

- Habitat for the masked owl (i.e. old growth trees) will be retained and protected within Environmental Protection and Open Space areas throughout the site. Additional areas will be enhanced to facilitate fauna movement through the site, and to provide forage resources, in accordance with the Site Regeneration and Revegetation Plan (JWA, 2012b).
- At least 1-3 large nest-boxes for the masked owl will be installed within retained vegetation in order to improve the habitat values of the site, the quantity and location of which will be confirmed following baseline surveys. Additional nest boxes will be installed to compensate for the loss of any hollows which could not be salvaged during clearing. The number and location will be determined based on the outcomes of the pre-clearing survey (using the Hollows Inspection Checklist provided in Appendix B).

Osprey (*Pandion haliaetus*)

- The developer has installed two (2) artificial nesting platforms on the site. These platforms have been highly successful to date (NSW Scientific Committee, 2009). They have been located within the Salt Marsh Rehabilitation Area on the southeast side of the site, adjacent to the Cobaki Broadwater (**Figure 8**).

Grey-headed flying-fox (*Pteropus poliocephelus*)

- The proponent has committed to submitting a Biodiversity Offset Strategy to SEWPaC for approval. No clearing of grey-headed flying fox habitat is permitted until the strategy is approved by the Minister. The strategy will include key milestones, performance indicators, corrective actions and completion timeframes for:
    - The acquisition and conservation of land containing a minimum of 3 ha of foraging habitat for the grey-headed flying fox for every 1 ha of habitat cleared or degraded for this species, that is of equal or greater quality to that removed. If the land acquired is of lower value, then the ration will need to be greater to account for the difference; and

    - The land acquired must be protected by a legal instrument under relevant nature conservation legislation that ensures the land is conserved in perpetuity.
- Forage habitat for the grey-headed flying-fox will be retained and protected within Environmental Protection areas throughout the site. (Note: No roosting flying-fox camps have been identified on or adjacent to the site.)
- Areas of additional Swamp sclerophyll forest on Floodplain will be generated and enhanced in accordance with the Site Regeneration and Revegetation Management Plan (JWA, 2012b) to provide forage resources and facilitate fauna movement throughout the site. Landscaping within this area will utilise Swamp Sclerophyll forest species.
- Flowering and fruiting trees and shrubs (e.g. Eucalypts, Figs etc.) shall be planted as part of the landscaping practices throughout the development site.

Microchiropteran bats

- Approximately 64 ha of on-site revegetation/regeneration will be completed in accordance with the Site Regeneration and Revegetation Plan (JWA, 2012b) to offset any loss of remnant bushland and to provide vegetated links across the site.
- Landscaping within this area will utilise Swamp Sclerophyll forest species.
- Additional areas will be enhanced to facilitate fauna movement throughout the site, and to provide forage resources.
- At least 2-5 nest-boxes of a suitable size for microchiropteran bats will be installed within retained vegetation in order to improve the habitat values of the site, the quantity and location of which will be confirmed following baseline surveys. Additional nest boxes will be installed to compensate for the loss of any hollows which could not be salvaged during clearing. The number and location will be determined based on the outcomes of the pre-clearing survey (using the Hollows Inspection Checklist provided in Appendix B).

7 IMPLEMENTATION OF CONTROL MEASURES

Table 5 provides a summary of the management actions, timing, and responsibility recommended to minimise the impact of construction activities on fauna and fauna habitat. This table will act as a schedule to ensure items are completed according to requirements, and to clarify necessary staging of construction works as a result of environmental requirements.

Table 5: Summary of Actions to mitigate impacts to fauna.

Action	Responsibility	Prior to Construction	During construction	Post Construction
Parawebbing around vegetation protection areas	Environmental Officer	X		
Installation of permanent fauna-friendly fencing (posts and rails) on the boundary of the Saltmarsh Rehabilitation Area and Freshwater Wetland Management Area and erection of signage on fencing stating 'No entry – Environmental Protection Area'.	Construction Manager/Site Superintendent Sign off: Environmental officer	X		
Installation of sediment and erosion controls to protect drainage lines, Compensatory Habitat Area and saltmarsh wetland habitat to be retained	Construction Manager/Site Superintendent Sign off: Environmental officer	X		
Flagging of any identified habitat features (hollows, nests, etc)	Fauna Spotter Catcher (under direction of the Environmental Officer)	X		
Undertaking of a site-specific threatened species induction for all site staff. Induction would cover issues relating to threatened species, designated and restricted areas of access and waste disposal	Environmental Officer	X		
Vegetation Clearing				
Visual inspection for koalas in trees to be removed on the day of clearing, prior to any vegetation removal	Fauna Spotter Catcher (under direction of the Environmental Officer)	X		

Two stage clearing ensuring that non-hollow bearing trees are cleared first	Fauna Spotter Catcher (under direction of the Environmental Officer)		X	
Relocation of hollows	Environmental Officer/Fauna Spotter Catcher		X	
Fencing inspections	Environmental Officer/ Site Superintendent		X	
Post-clearing report to Tweed Shire Council	Environmental Officer		X	
Retention and stockpiling of large woody debris for use in the habitat augmentation program	Environmental Officer		X	
Protection of fauna				
Construction of fauna friendly fences around retained vegetation	Environmental Officer		X	
Ongoing education of site staff through 'toolbox talks', ensuring important information relating to the protection of fauna are reiterated regularly. To be signed off by all attendees.	Environmental Officer		X	
Weekly inspection of construction site/works (Weekly Construction Checklist – Appendix F)	Environmental Officer		X	
Inspection to ensure that grubbing operations are leaving the site free draining with no ponding of stormwater which may result in breeding habitat for mosquitos and cane toads or cause alterations to the hydrology of wetland habitats.	Environmental Officer		X	
Maintenance of protection fencing and monitoring to ensure that non permitted activities do not occur within protected areas	Environmental Officer		X	
Monitoring compliance with the *Companion Animals Act 1998* (That no unrestrained dogs are allowed on site during construction)	Environmental Officer		X	
Construction/design and Installation of nest boxes. Recording location of installed nest boxes for future monitoring.	Environmental Officer	X	X	
Maintenance and monitoring of nest boxes within the retained vegetation areas for	Ecologist (under direction of the			X

a minimum of 5 years.	Environmental Officer)			
Contact details for the qualified ecologist/fauna specialist, Wildlife Relocation and Management Services (07 5590 4301) and the Local Veterinary Hospital (Billinudgel: 02 6680 3480) must be kept at all times in the site offices and with the on-site Environmental Officer.	Environmental Officer	X	X	
Notification of any additional threatened species identified to DECCW (NPWS)	Environmental Officer	X	X	
No works within 100m of the raptor nests (subject to confirmation of usage)	Project Manager/ Environmental Officer		X	
Erecting at least 2 artificial nesting platforms within the Saltmarsh Rehabilitation Area	Project Manager/ Environmental Officer		X	X
Adaptive pest management	Ecologist (under direction of the Environmental Officer)		X	X
Annual Fauna Monitoring	Ecologist (under direction of the Environmental Officer)		X	X
Removal of protection fencing	Site Superintendent Sign off: Environmental Officer			X

8 FAUNA MONITORING PROGRAM

Mitigation measures and management programs will be inspected, reviewed and updated regularly by the Environmental Officer.

Baseline surveys (as outlined in Table 6) will be undertaken in accordance with the Flora and Fauna Monitoring Program (SMEC, 2013b) at least two weeks prior to the commencement of construction. This will provide current baseline data that can be used to establish performance criteria and to compare annual monitoring results.

Table 6. Inspections and Monitoring relevant to Fauna

Monitoring Focus	Monitoring Site	Frequency	Implementation	Person Responsible	Prior to Construction	During Construction	Post-Construction
Baseline Fauna Survey	Overall site	Already completed	A baseline fauna survey will be completed over the entire site to determine species presence. The fauna surveys will be in accordance with methodology provided in the Flora and Fauna Monitoring Program (SMEC, 2013b). All fauna surveys will include visual inspection for evidence of pest species including dogs, cats, foxes and cane toads,	Ecologist (under direction of the Environmental Officer	X		
Pre-clearing Fauna Survey	Precincts 9 and 11	Within 12hrs prior to clearing	Pre-clearing fauna survey will include: • Extensive searches for all native fauna within the development footprint, particularly threatened species and arboreal mammals; • Additional inspection of flagged habitat trees to be cleared (as identified within the baseline fauna survey) will be undertaken by the fauna spotter-catcher. Checking for hollows and the presence of fauna in breeding places above eye level must be undertaken with the use of camera poles or other such suitable equipment. The Hollows Inspection Checklist provided in Appendix B should be used to record all hollows and fissures identified and to determine nest-box requirements.	Fauna Specialist/ Fauna Spotter Catcher	X		
Fauna	Work areas	Daily	Inspection of integrity of fencing around retained vegetation during clearing	Environmental Officer/ Site Superintendent		X	

Monitoring Focus	Monitoring Site	Frequency	Implementation	Person Responsible	Prior to Construction	During Construction	Post-Construction
		Daily	Inspection of erosion and sediment controls to ensure they are clean and working correctly	Environmental Officer/ Site Superintendent		X	
		Weekly	A general inspection of fencing.	Environmental Officer		X	
		Weekly	A general inspection of works (a biweekly inspection shall take place during substantial clearing activities)	Environmental Officer		X	
	Retained vegetation	Monthly	Monitoring of re-instated nest boxes. Further detail is provided in the Fauna and Flora Monitoring Plan (SMEC, 2013b).	Ecologist (under direction of the Environmental Officer		X	
		Annually	Monitoring of nest boxes. Further detail is provided in the Flora and Fauna Monitoring Program (SMEC, 2013b).	Ecologist (under direction of the Environmental Officer			X
		Annually	A Fauna survey (inclusive of pest species) will be completed within the Rehabilitation and Management Areas, Compensatory Habitat Area and Saltmarsh Rehabilitation Area for a minimum of 5 years. The annual surveys are to replicate the baseline survey in methodology, timing and location to allow data comparison over time. Baseline survey methodology is provided in Section 3 of the Flora and Fauna Monitoring Plan (SMEC, 2013b). A report will be prepared after each annual fauna survey and will include the following: • An assessment of habitat; • Information on clearing operations, dates, procedures, areas; • Details of type/area/location of vegetation that has been cleared;	Ecologist (under direction of the Environmental Officer		X	X

Monitoring Focus	Monitoring Site	Frequency	Implementation	Person Responsible	Prior to Construction	During Construction	Post-Construction
			• Details on identification and/or clearance of hollow bearing trees; • Live animal sightings, captures, any releases or injured/shocked wildlife; • Any dead animals located; • Photographs of rescued fauna; • Recommendations on how many and what type of hollows/nest boxes will be installed to compensate for hollows lost; and • Information on tree species and tree sizes being used for breeding or roosting by fauna, including location, size, height and girth (i.e. for information base purpose). The completed report will be submitted to Tweed Shire Council annually.				
Raptors	Nest sites	Annually	Visual monitoring of the two (2) artificial nesting platforms located within the Salt Marsh Rehabilitation Area on the southeast side of the site adjacent to the Cobaki Broadwater during breeding season (May to September). Visual monitoring of existing nest site during breeding season (May to September). Results of monitoring of nest sites will be included in the annual fauna survey to be submitted to Tweed Shire Council.	Ecologist (under direction of the Environmental Officer		X	X

9 PERFORMANCE CRITERIA

Performance criteria for management and monitoring of fauna during construction are as follows:

- All hollows and other habitat features are inspected and flagged by the Fauna Spotter Catcher prior to clearing.
- All identified hollows are relocated or, where required, nest-boxes are installed in nearby retained vegetation in accordance with recommendations provided in the Hollows Inspection Checklist (Appendix B).
- Erection and maintenance of protective fencing and signage prior to and during construction in accordance with the Earthworks Fencing drawings (Appendix C).
- Erection and maintenance of erosion and sediment controls in accordance with ESC Plans (CEMP).
- All workers inducted in site-specific fauna management measures.
- No injury or death of fauna during clearing, earthworks and construction.
- No damage to or clearing of Environmental Protection Areas or areas of retained vegetation during clearing, earthworks and construction.
- The suite of fauna (including threatened species) known to currently occupy the site continue to persist within identified habitat and Environmental Protection Areas on the site.
- Annual monitoring of nest boxes demonstrates that at least 75% of nest boxes are being used by the target native species.
- No evidence of nest boxes being colonised by pest species or competitors, such as Indian mynas and European bees.
- Osprey nesting platforms have been successfully constructed and installed by the commencement of construction on Stage 1 of Central Open Space (adjacent to precinct 9).
- Evidence of utilisation of at least one of the artificial nesting platforms within three years of their construction.
- Decreased abundance of pest species during annual fauna surveys as compared to baseline monitoring (as detailed in the F&FMP).

Performance criteria specific to each threatened species identified on site are included in the Flora and Fauna Monitoring Program (SMEC, 2013b)

10 DATA ANALYSIS AND REPORTING

10.1 Adaptive Management

Regular analysis and annual documentation of data will allow for improvements and refinements in the survey design to be incorporated into future monitoring events. Monitoring results will be reviewed and assessed against performance criteria to examine whether the mitigation measures and monitoring methods implemented for fauna species are effective. Should monitoring results fail to meet performance criteria, corrective action will be required to remediate the issues. The appropriate action will be determined in conjunction with Tweed Shire Council.

Suggested corrective action/responses to a range of potential incidents or management failures specific to fauna are detailed below.

Species to which the incident applies	Incident/Failure	Corrective Action/Response
All threatened fauna	Protective exclusion fences or erosion control measures become damaged or degraded during construction	Any damaged exclusion fencing and/or sediment fencing is to be reported and re-instated immediately.
Raptors	Inspections fail to detect utilisation of artificial nests.	The suitability of the artificial nests will be investigated, and recommendations to rectify/improve their effectiveness will be provided, depending on the nature of the problem identified.
Masked Owl, Powerful Owl, Microchiropteran bats,	Nest boxes fail to attract target species.	The monitoring program and/or suitability of the nest boxes will be reviewed and recommendations provided in the annual monitoring report (Section 10.2).
	Colonisation of nest boxes by exotic bees (*Apis melinifera*) or other invasive species.	If colonisation by bees has occurred, the nest box shall be removed and replaced.
	Tree branches supporting the nest boxes break or nest boxes become weathered making them unsuitable for habituation.	Regular maintenance will be undertaken by the proponent, according to recommendations provided in the annual report prepared by the Ecologist. Any damage to nest boxes will be reported and repaired/replaced immediately.
Grey-headed flying fox	Surveys fail to detect evidence of utilization of retained foraging areas by Grey-headed fox.	The suitability of the Environmental Protection areas as foraging habitat for the species should be investigated and effective adaptive management undertaken.
	Unsuccessful regeneration of flowering and fruit trees.	If less than 95% of flowering and fruiting tree stems have survived, causes should be investigated and suitable remediation measures recommended.

Species to which the incident applies	Incident/Failure	Corrective Action/Response
Black-necked Stork	Surveys fail to detect the presence of target species within retained habitat areas.	The monitoring program and/or suitability of the area will be reviewed and recommendations provided in the annual monitoring report.
Pest species	Surveys detect an increase in pest species from baseline results.	Recommendations will be made for appropriate control of identified pest species. The use of methods such as traps, baiting or further exclusion fencing will be investigated

10.2 Reporting

Results of monitoring by the Ecologist will be documented in an annual report, which will discuss:

- Monitoring undertaken (including any changes to methodologies);
- Analysis of results and assessment against baseline data/performance criteria;
- Discussion of results and any survey limitations;
- Success or failures of measures implemented to rectify previously identified problems (if any);
- Recommendations

The annual report will be submitted to the Director General (NSW DoP), OEH, Tweed Shire Council and other agencies as required.

11 REFERENCES

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APPENDIX A – PRE-CLEARING CHECKLIST

Project:	**COBAKI ESTATE**
Inspection Date:	**Area/Precinct:**

PRE-CLEARING CHECKLIST

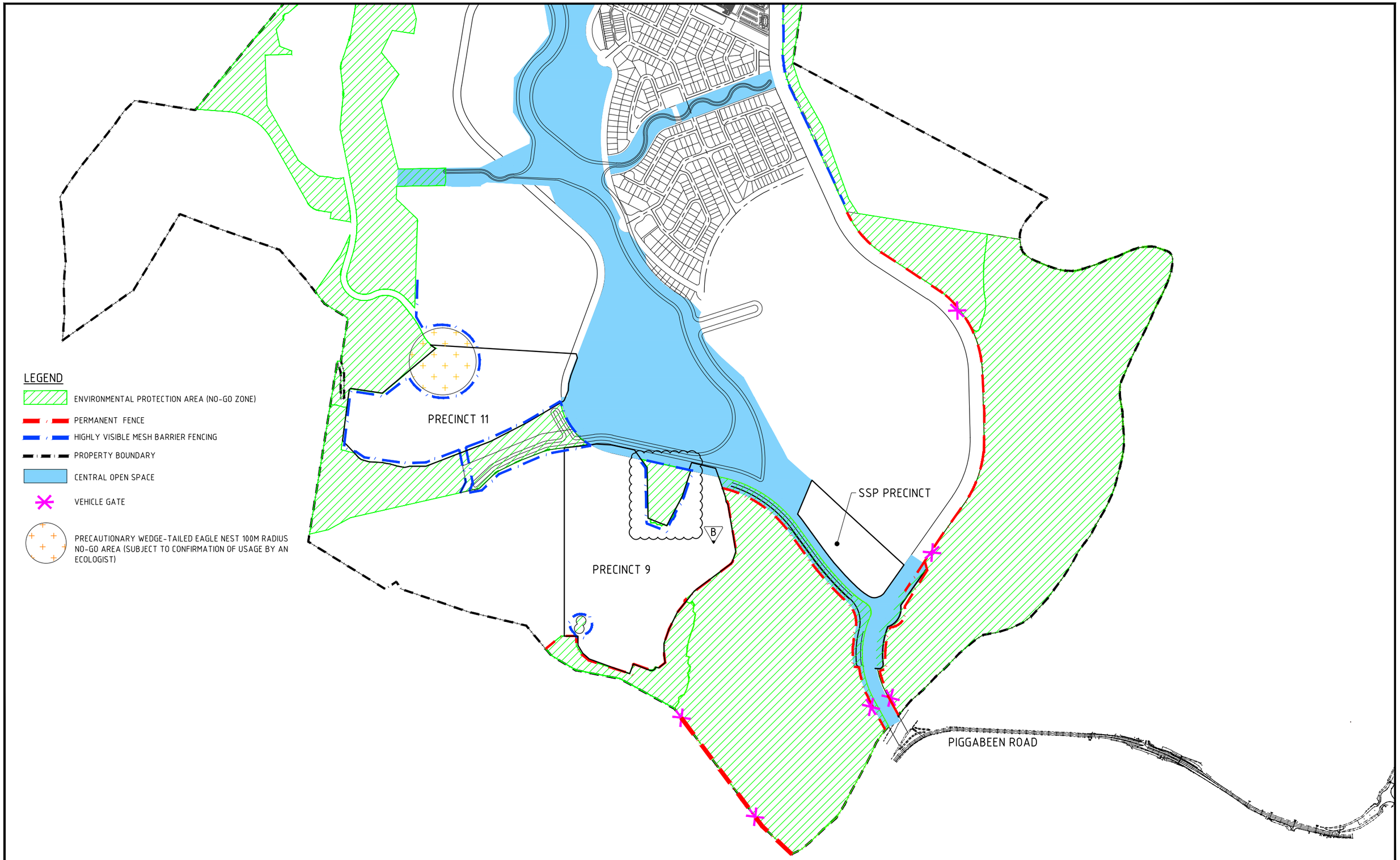
#	Control Measure	Yes	No	N/A	Comments/Corrective Action
1	Have pre-clearing fauna surveys been undertaken?				
2	Is a qualified spotter/catcher present?				
3	Has the boundary of the clearing zone been fenced/delineated?				
4	Have targeted surveys for Koala been undertaken?				
5	Have populations and or individuals of identified threatened flora species been marked?				
6	Has protective fencing been installed around Environmental Protection Zones to be retained?				
7	Have habitat trees within clearing areas been identified?				
8	Has weed mapping and eradication been completed?				
9	Have areas of weed-infected topsoil been removed?				
10	Have all residents adjoining the corridor been advised at least 5 days prior to clearing vegetation?				
11	Has the clearing sub-contractor undergone specific training regarding their obligation not to over-clear?				
12	Have all heritage and other items been identified and managed?				
13	If near a Creek or waterway, is the riparian zone being maintained?				
14	Have all sediment control measures been installed?				
15	Are all relevant permits been obtained?				
16	Is water quality monitoring being undertaken?				
17	Has vegetation and topsoil to be salvaged for re-use been identified?				
18	Have the clearing sub-contractors been informed to leave fallen trees for fauna?				
19	Any other issues to be added to the checklist?				
Completed by:		**Signature:**			

APPENDIX B – HOLLOW INSPECTION CHECKLIST

Hollows and/or bark fissures identified during pre-clearing surveys will be documented using the following Hollow Inspection Checklist. One checklist will be completed per hollow, and used to calculate the appropriate nest box or felled hollow relocation requirements as per Section 5.3.2.

Hollow Inspection Checklist	
Part 1 (To be completed prior to clearing)	
Inspection Date:	Location:
Project Ecologist:	
Tree Number:	Tree Location:
Tree species:	
Size of entrance: (Small: ≤5cm; Medium: 5-15cm; Large: 15-30cm; Extra Large: >30cm)	
Height of hollow from ground:	
Are there any additional hollows on same tree:	
Fauna species inhabiting hollow (if present) or species most likely to utilize the hollow:	
Can the hollow be soft-felled and relocated? If so, provide recommended GPS location for relocation:	
Part 2 (To be completed during clearing of the identified hollow)	
If an animal was present in the hollow, is it injured?	
Does it require immediate attention?	
Can it be released and, if so, where will it be released?	
If not, what time was the fauna rescue agency called?	
What was the outcome of the fauna rescue?	
Will a compensatory nest box be required? If so, specify the type/size and recommended GPS location:	
Additional Notes/Comments:	
Completed By:	Signed:

APPENDIX C - EARTHWORKS FENCING PLAN



REVISION		DATE	DES/DFT	APP'D
B	Barrier Fencing Amended	10.12.13	SS/DK	
A	Issued for Approval	24.10.13	SS/JF	

LEDA

Principal
Leda Developments
Suite 14, Level 1, 46 Cavill Avenue
Surfers Paradise

Project Leader
S.Sandford
Designed
S.Sandford
Drawn
J.Flynn
Checked

Authorised

Date
September 2011

Scale @ A1

smec urban consulting group

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COBAKI ESTATE
OVERALL
Tweed Shire Council

Fencing Plan Precinct 9,11 and SSP
Drawing No. 3310071E-044 **Rev B**

Sheet No. 1 of 1

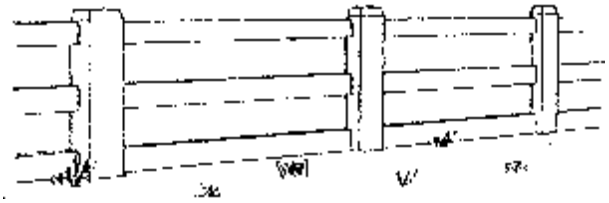
Subject to Approval
Not to be used for construction

APPENDIX D – FAUNA FRIENDLY FENCE DESIGN

A Fauna Friendly Fence should have either:

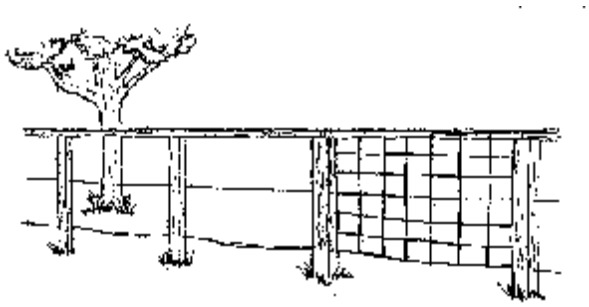
1. A 50cm gap between ground level and the first rail or strand. Spacing above this level is at the owner's discretion.

2. A series of 30cm gaps between the rails or strands (the first gap should be no higher than 15cm above ground level).



3. A 30cm gap between ground level and the first rail or strand followed by a series of 30cm gaps.

4. Box wire mesh (squares of no less than 15cm) may be used provided that there is a 15cm gap between the ground level and the mesh, and provided the fence is not more than 1.2m in height. A capping rail along the top allows for easy movement.



Note: Rails should not be in excess of 15cm wide. Wire strands should not be too tightly strung.

Fencing Materials

When choosing your fencing materials, consider the environment in which it will be situated. The character of an area, whether it is of a rural, bush or park nature, attracts residents to live within its boundaries and as such should be taken into account when designing fences.

Wood, brick, metals and wire can be combined in a variety of designs to create an effective and unique fence while maintain the character of the area. Slight variations in the materials and design of these fences can create an individual look for your property.

Barbed wire and electric fences of any description are definitely NOT fauna friendly!

Source: Fauna Friendly Fence Design Guidelines, Redland Shire Council Fact Sheet: Fauna Friendly Fencing (2002).

APPENDIX E – NEST BOXES FOR NATIVE WILDLIFE

Nest Boxes for Native Wildlife

Artificial nest boxes can substitute for tree hollows, providing arboreal species with nesting and roosting sites.

Different species have different hollow requirements (hollow size, depth, shape degree of insulation and entrance size).

Small species such as feather tail and sugar gliders choose hollows that are only slightly larger than their bodies to prevent larger animals attacking them or taking site. Larger species such as brush tail possums, greater gliders and ringtail possums need hollows with entrances greater than 5cm. Common brush tail possums generally choose hollows with 12cm to 15cm entrances. The width of the hollow determines how much space a species has for nesting and sleeping.

The micro-climate inside the hollow is also important, particularly for micro-bats, and this can be affected by depth. Studies have shown that deeper, wider hollows have a greater likelihood of occupancy. Deeper hollows can deter would-be predators (Douglas, 2003).

Nest box materials

Nest boxes can be made from timber or exterior-grade plywood (2mm to 19mm is ideal). To waterproof the box, screw the ends together and paint the exterior. Do not paint inside the box. Sawn timber boxes such as these should be well ventilated and have good drainage (a small gap under the roof or a few small holes in the floor). 20-30mm of hardwood sawdust should be placed in the base of the box. Avoid using treated timber, toxic paints, chipboard or smelly glues and make sure there are no sharp edges or protruding nails. Some designs also use hollow logs. Nesting material is not required as this will be brought in by the fauna using the nest box (Franks, 2007).

The inside diameter, entrance above the floor, height above the ground and placement should be considered when construction and hanging a nest box. Entrance holes should be just large enough for the animal to enter.

To establish a feeling of security, the box must be firmly mounted. Boxes can be attached to the trunks of trees with wire or two coach screws with metal spaces to allow for tree growth without putting stress on the nest box. Alternatively, nest boxes can be fixed in trees by resting the box in the fork of a tree and securely wiring in position (Douglas, 2003). This method of attachment also applies to the relocation of salvaged tree hollows.

Species-Specific nest box design

Microchiropteran Bats

Nest boxes for Microchiropteran bats should accord with the general design of the Bat – Insectivorous Habitat/Nest Box below. Bats tend to select roosts with entrances only marginally bigger than the thickness of their skull and chest.

To ensure effectiveness of bat nest boxes they should be installed:

- Within 400m of a water body;
- In sunny positions on growing, mature or dead trees, and free from overhanging branches. There should be no overhanging branches within 3m in a horizontal distance from the box base entrance; and
- At a height of 4m or greater.

Owls and other bird species

Nest boxes for owl species such as the Powerful owl and Masked owl should be of the vertical habitat/nest box design, with a circular entrance a minimum of 100mm in diameter. They should be installed in large mature trees at a height of great than 5m. Similar nest box design with smaller entrances could be used to accommodate smaller bird species.

Arboreal Mammals

Nest boxes for arboreal mammals such as possums and gliders should be designed to accommodate whole familes of the target species and in accordance with the general horizontal habitat/nest box design.

Keeping pest species out of nest boxes

The following strategies will assist in preventing disturbance or habituation of non-native species from nest boxes:

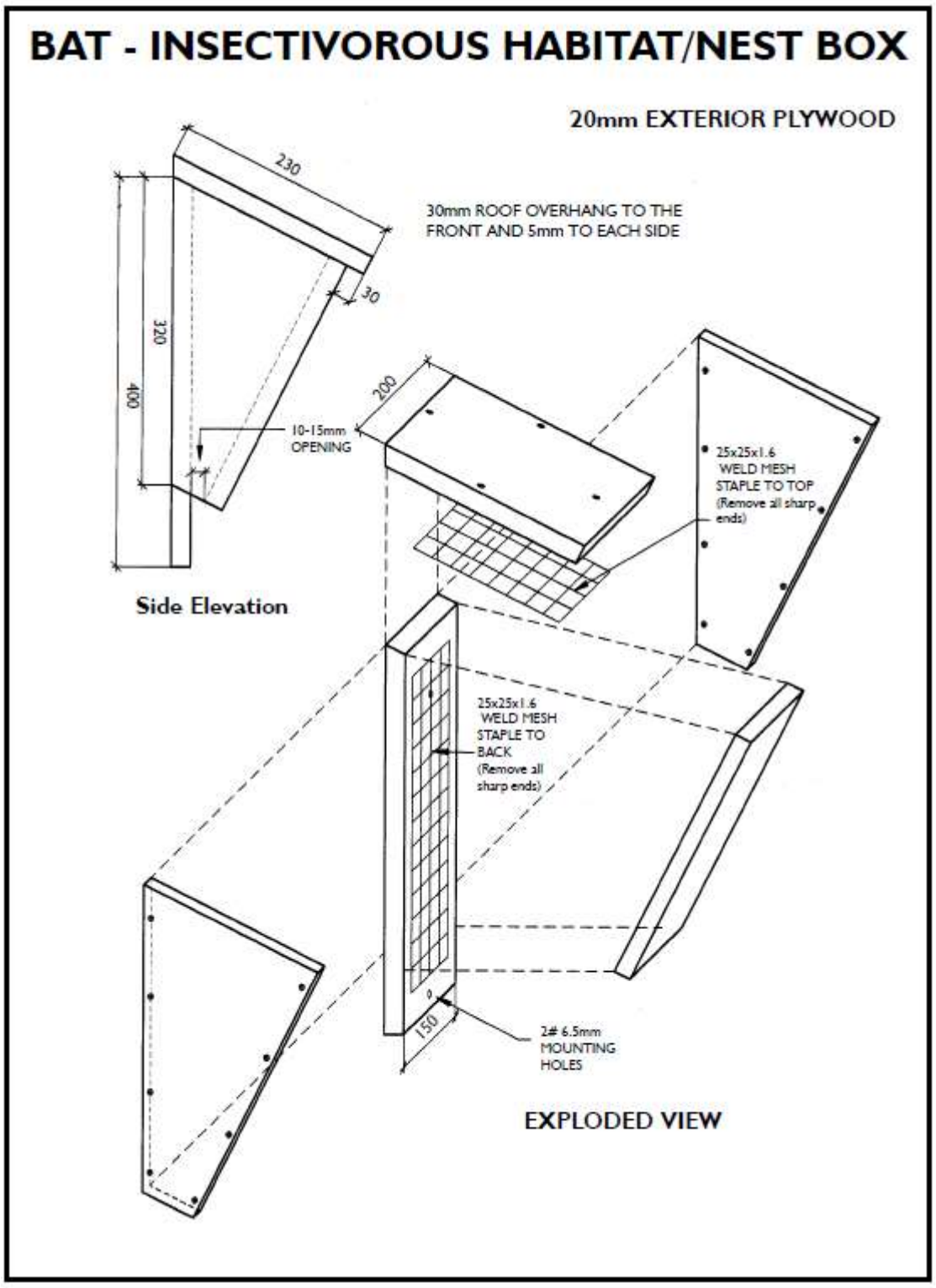
- Ensure nest boxes are at a suitable height so that they cannot be disturbed by dogs, cats and children
- Monitor nest boxes for colonisation by introduced species. Contact a pest controller for eradication of introduced species such as bees

Recommended Nest Box Dimensions for common species (Gould Group, 2008)

Species	Dimensions (L*B*H) (cm)	Entrance diameter (mm)	Depth below entrance (mm)	Height above ground (m)	Placement
Brushtail Possum	30*30*40	100	300-500	3-5	Vertical
Ringtail Possum	20*20*45	60-80	250-350	3-5	Vertical
Feathertail Glider	15*15*45	30	100-200	2	Vertical
Sugar glider	20*20*50	50	250-450	4-8	Vertical
Eastern Freetail Bat, Common bentwing bat and Little Bentwing bat	10*20*45	10	Entrance at bottom	4	Clear flight path
Greater Broad nosed bat	15*20	15	Entrance at bottom	4	Clear flight path
Crimson Rosella	20*20*50	80-100	400	5	Vertical
Galah	20*20*75	120	600	6	Vertical
Rainbow lorikeets	13*13*80	50-70	400	5	45degrees
Kookaburra	22*40*22	180 (arch)	level	5-10	Horizontal
Barn owl	40*90*20	Platform	Platform	5-10	Horizontal
Owlet nightjar	15*15*15	70	300	5	Vertical
Powerful Owl/Masked Owl	100*180*240	100	300	>5	Vertical

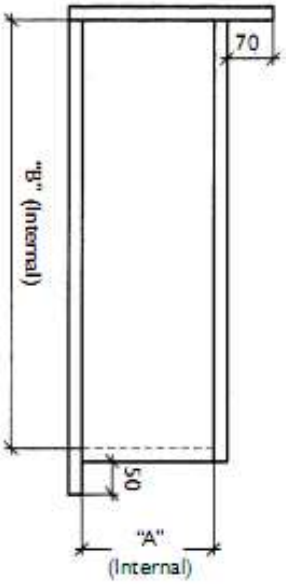
Eastern Freetail bat, Common bentwing and Little Bentwing bat, the base entrance of the nest box should be 12 to 15mm. For the Greater Broad nosed bat, a base entrance of 15 to 20mm would be more suitable. It is therefore recommended that emphasis is placed on construction of bat roost boxes with a base entrance ranging from 12 to 20mm.

BAT - INSECTIVOROUS HABITAT/NEST BOX

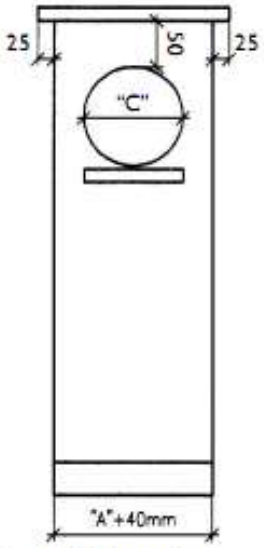


VERTICAL HABITAT/NEST BOX

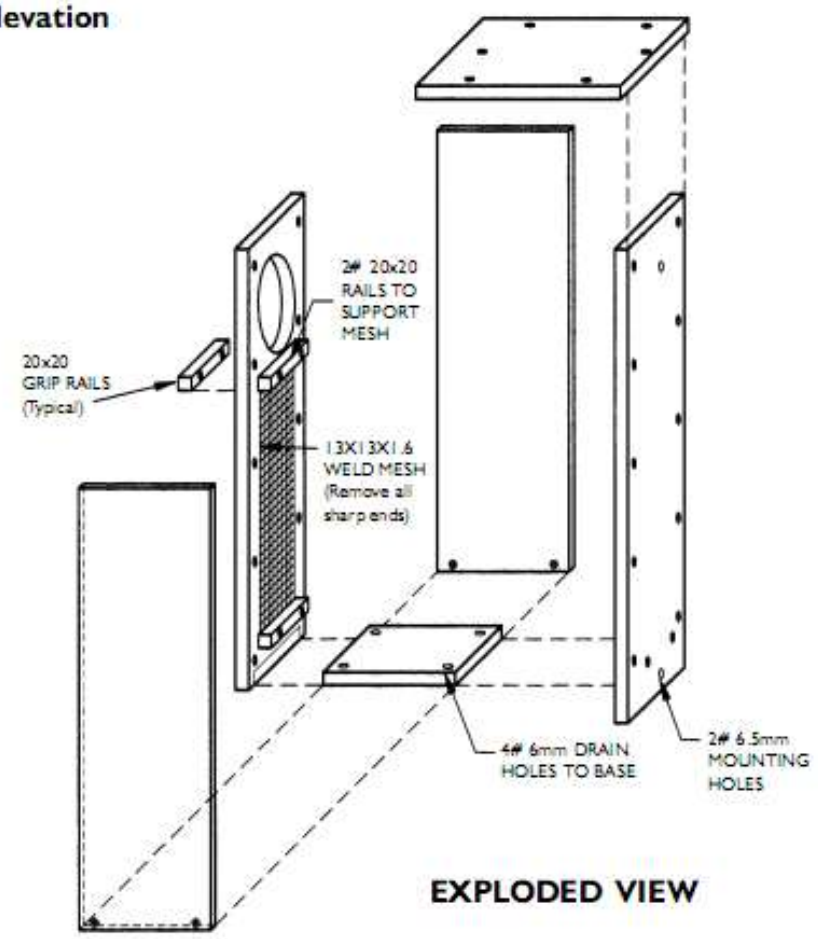
20mm EXTERIOR PLYWOOD



Side Elevation

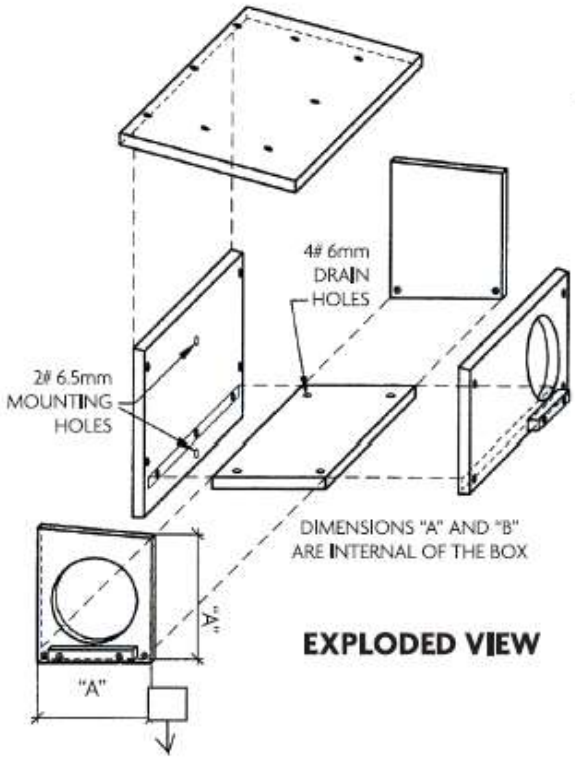


Front Elevation



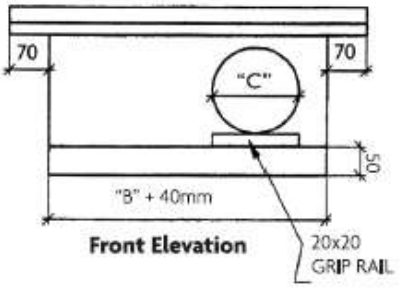
EXPLODED VIEW

HABITAT/NEST BOX

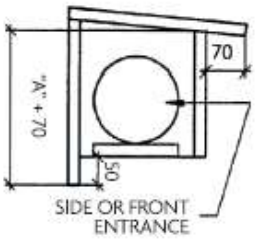


EXPLODED VIEW

20mm EXTERIOR PLYWOOD

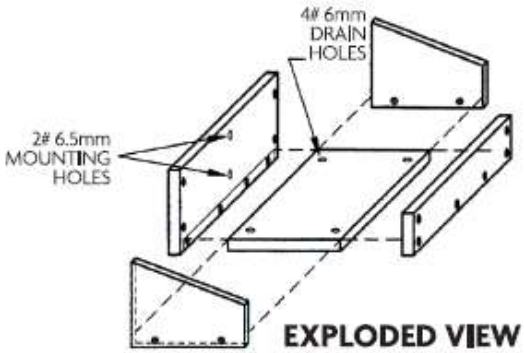


Front Elevation



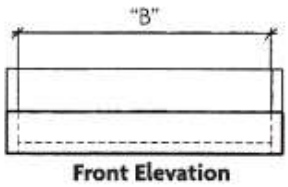
Side Elevation

HABITAT/NEST PLATFORM

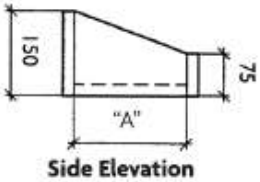


EXPLODED VIEW

20mm EXTERIOR PLYWOOD



Front Elevation



Side Elevation

APPENDIX F – WEEKLY INSPECTION CHECKLIST

Project:	**COBAKI ESTATE**
Inspection Date:	**Area/Precinct:**

WEEKLY CONSTRUCTION CHECKLIST

#	Control Measure	Ye	No	N/A	Comments/Corrective Action
1	Are all protected areas adequately fenced and signed? Is the integrity of the delineation fencing satisfactory?				
2	Are suitable sedimentation and erosion control devices in place where necessary?				
3	Are sediment fences clean/free of silt and working effectively?				
4	Are areas surrounding waterways satisfactorily stable?				
5	Has the site induction been undertaken by all personell on site (is the induction register up to date?)				
6	Is drainage from the project site being directed through necessary controls prior to entering any watercourse?				
7	Have any areas of standing or ponded water been appropriately filled?				
8	Has weekly water quality monitoring been undertaken within stormwater retention basins?				
9	Are surface waters free of Mosquito larvae?				
10	Has the Compensatory habitat area been inspected for the presence of unrestrained dogs?				
11	Are fauna structures (nest boxes) in place?				
12	Have hollows been inspected by the ecologist?				
13	Have any new weed infestations been identified on site?				
14	Is there evidence to suggest changes should be made to the site induction relating to flora and fauna aspects? (i.e. reoccurring issues, prevention measures, etc)				
15	Have any injuries or death to wildlife been identified or reported?				
16	Have all complaints been recorded and addressed?				
17	Any other issues to add to the checklist?				
Completed by:		**Signature:**			