JAMES WARREN & Associates Pty Ltd

ECOLOGICAL CONSULTANTS

KINGS FOREST

STAGE 1 PROJECT APPLICATION

PRECINCT 2 - 4 & 6 - 11
VEGETATION MANAGEMENT PLAN

AMENDED
SEPTEMBER 2011

A REPORT PREPARED FOR PROJECT 28 PTY LTD

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1 INTRODUCTION

1.1 Background

The NSW Minister for Planning approved a Concept Plan for the proposed residential community at Kings Forest on the 19th August 2010. The approved documents included a Revised Vegetation Management Plan (LandPartners 2009), which proposed the principles upon which the management of retained vegetation on the Kings Forest site would be based.

Subsequently, the Director General issued modified Environmental Assessment Requirements (DGR's) on the 22nd December 2010. James Warren & Associates (JWA) were engaged by Project 28 Pty Ltd to complete a Kings Forest Stage 1 Project Application Vegetation Management Plan (VMP) for Precincts 2 - 4 & 6 - 11 in accordance with requirements of 9.4 of these DGR's and Clause C2 of the modified Concept Approval.

JWA have now amended the VMP to address issues raised in the NSW Department of Planning (DoP) Test of Adequacy process, and reflect some minor layout changes.

1.2 Proposed Development

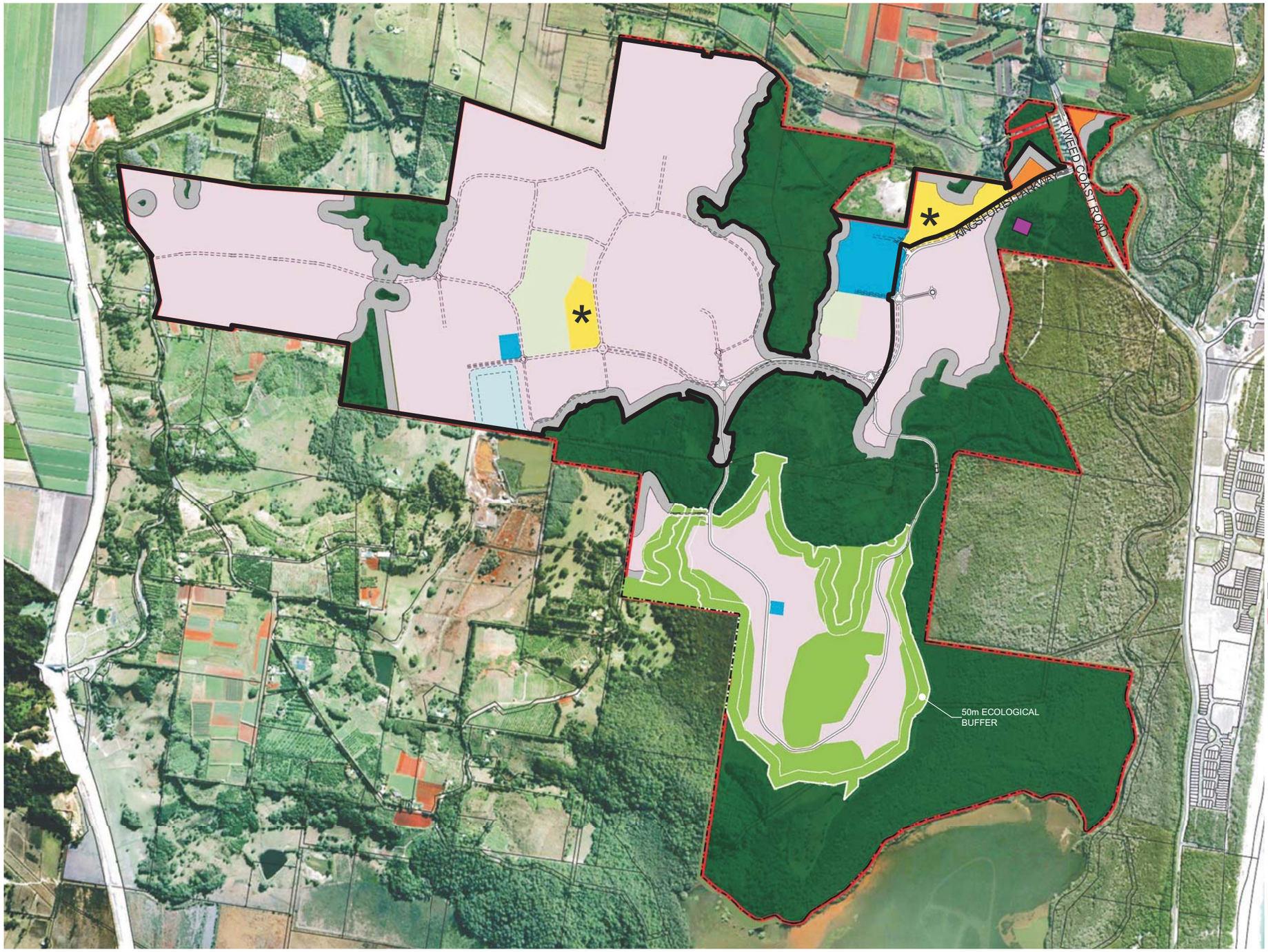
1.2.1 Kings Forest Stage 1 Project Application

The Kings Forest site consists of 872 hectares of land located at Cudgen between Bogangar to the south-east and Kingscliff to the north in Northern New South Wales (NSW). The concept plan for the Kings Forest site is shown in **FIGURE 1**.

The scope of the Stage 1 Project Application works is as follows:

- Construction of the entrance road to the site and associated intersection works on Tweed Coast Road.
- Alignment and construction details of two lanes of Kings Forest Parkway, from Tweed Coast Road via Precincts 2, 3, 4 and 5 through to the roundabout in the western part of the site from which access to the southern part of the site is to be gained.
- Alignment and construction details for the civil works of the two proposed roads through the east-west SEPP 14 area to access the southern part of the site.
- Rural retail development in Precinct 1 to the east of Tweed Coast Road.
- Subdivision and construction of residential Precinct 5.
- Bulk earthworks across the site in Precincts 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13 & 14.

The scope of works is illustrated in **FIGURE 2.**



N

LEGEND

- Town Centre / Neighbourhood Centre
- Residential
- Community Facilities / Education
- Employment Land
- Structured Open Space (Active)
  (Passive open space to council standards, location subject to urban design)
- Environmental Protection Area
  to be Dedicated to Council or NPWS
- 50m Ecological Buffer
  (Includes APZs & Roads where approved)
- * State School Site
- Proposed Zone Substation
  (Subject to Country Energy final approval)

Private Open Space

- Golf Course Area
  (Encompassing ecological buffers where indicated)
- Private Open Space Including Lake
- Precincts 2-4 & 6-11
- Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: MPS Architects
(Ref: 2011-06-23 DA Set.pdf)
SCALE: 1 : 20 000 @ A3

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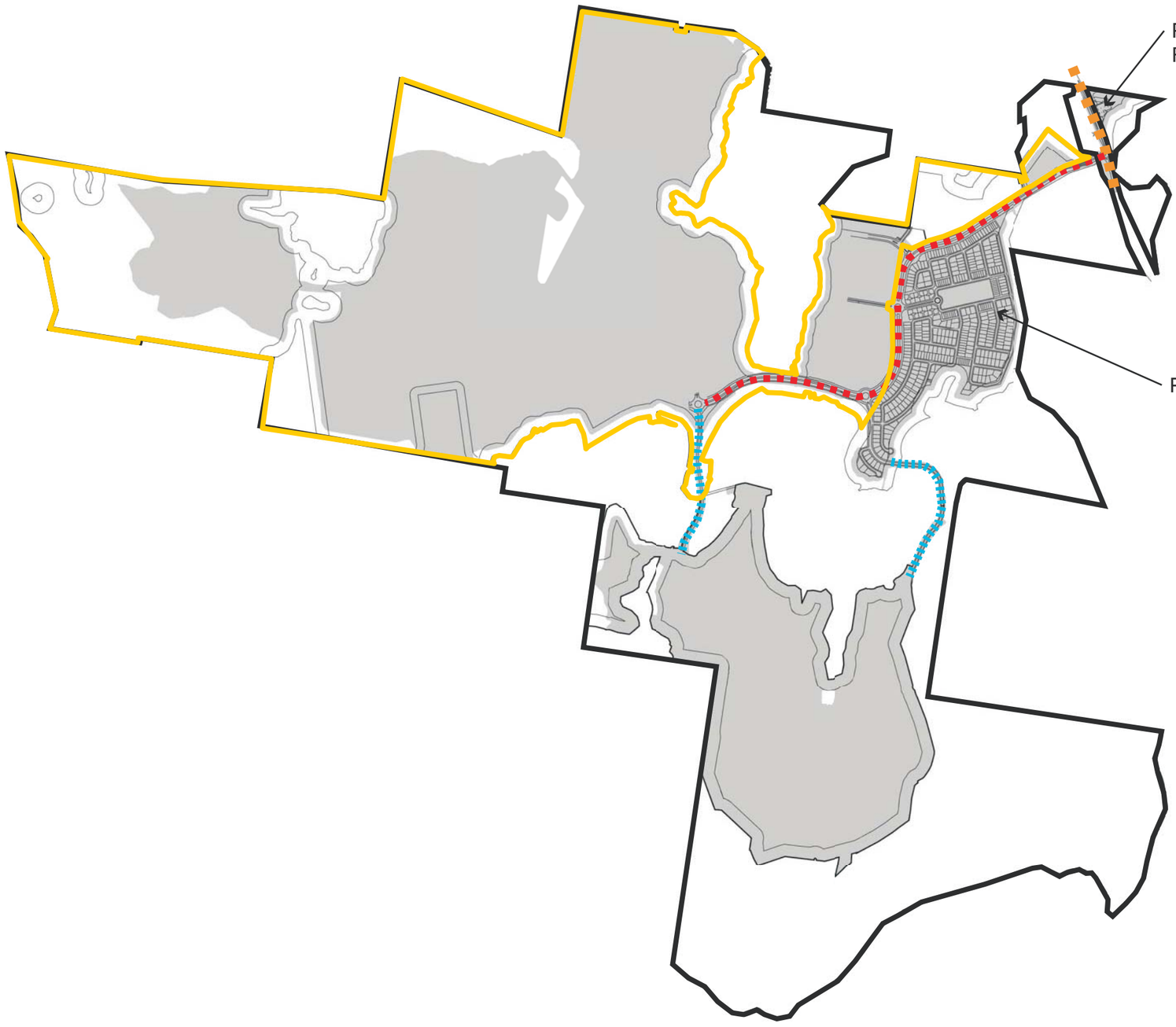
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 1

PREPARED: BW
DATE: 24 June 2011
FILE: N97017_VMP_Concept.cdr

TITLE
CONCEPT PLAN



LEGEND

- Tweed Coast Road Intersection Works
- Kings Forest Parkway through to Western Precincts
- Roads through to Southern Precincts
- Bulk Earthworks
- Precincts 2-4 & 6-11
- Kings Forest Boundary

0 500m

1 : 20 000

SOURCE: MPS Architects
(Ref: 2011-06-23 DA Set.pdf)

SCALE: 1 : 20 000 @ A3

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FIGURE 2

PREPARED: BW
DATE: 24 June 2011
FILE: N97017_VMP_Scope.cdr

TITLE

STAGE 1 SCOPE OF WORKS

1.2.2 Precincts 2 – 4 & 6 - 11

This VMP has been prepared for the proposed bulk earthworks in Precincts 2, 3, 4, 6, 7, 8, 9, 10 & 11 (**FIGURE 2**).

1.3 Aim & Objectives

The aim of this VMP is to protect and enhance the available habitat for fauna and flora (including threatened species).

Specific objectives of this VMP are to:

- Protect the environmentally significant site values from bulk earthworks activities; and
- Restore, enhance and manage the retained and protected vegetation including providing guidelines for the:
    - The revegetation of ecological buffers to Environmental Protection Zones and SEPP 14 Wetlands; and
    - Management and rehabilitation of significant areas of Koala habitat (as recommended in the Stage 1 KPoM [JWA 2011a]).

1.4 Plan Requirements

As discussed above, this VMP has been prepared in accordance with DGR 9.4 which states:

> *"Updates are to be provided, where relevant, for the various management plans for koalas, vegetation, threatened species, feral animals weeds, the buffers, and the golf course providing where relevant details on timelines for implementation of recommended works including maintenance periods and measurable performance and completion criteria. Each plan is to consider all other plans for the site to ensure that management strategies do not conflict and that each plan can be implemented without negatively impacting on the objectives of another."*

This VMP has also been prepared to comply with Clause C2 of the modified Concept Approval as follows:

> *Vegetation Management Plan*
>
> *"Each Vegetation Management Plan update is to provide details on:*
>
> 1. *the short, medium and long term measures to be implemented to rehabilitate degraded areas, and manage remnant vegetation and habitat within the buffers and Environmental Protection zoned land within the site.*
> 2. *revegetation and regeneration including establishment of appropriate canopy (including koala feed trees), sub-canopy, understorey and ground strata.*

3. *rehabilitation of creeks and drainage lines.*
4. *conserving and re-using, where appropriate, the soil seed bank where good quality native vegetation is being removed.*
5. *collection and propagation of endemic native seed for revegetation on the site.*
6. *monitoring of water quality and vegetation health within buffers and environmental protection zoned areas; and*
7. *the design, regeneration/revegetation and management of the east-west wildlife corridor/s.*
8. *measurable performance criteria are to be based on appropriate reference sites within the adjacent Cudgen Nature Reserve."*

1.5 Relationship to other Management Plans

Additional to this VMP, the following Management Plans relevant to Precincts 2, 3, 4, 6, 7, 8, 9, 10 & 11 have been prepared for the Stage 1 Project Application, and should be read in conjunction with this VMP:

- Kings Forest Stage 1 Project Application: Precinct 2 – 4 6 - 11 Threatened Species Management Plan (Precinct 2-4 & 6-11 TSMP) (JWA 2011b);
- Kings Forest Stage 1 Project Application: Precinct 2 – 4 6 – 14 Buffer Management Plan (Precinct 2-4 & 6-14 BMP) (JWA 2011c); and
- Kings Forest Stage 1 Project Application: Precinct 2 – 4 6 - 11 Weed Management Plan (Precinct 2-4 & 6-11 WMP) (JWA 2011d).

Furthermore, a Kings Forest Stage 1 Project Application Koala Plan of Management (Stage 1 KPoM) (JWA 2011a) has been prepared for the entire Kings Forest site and is therefore relevant to Precincts 2 – 4 6 – 11.

2 SUMMARY OF SIGNIFICANT VALUES

2.1 Background

Kings Forest has been comprehensively studied. A summary of the significant values relevant to this TSMP are provided in the following sections.

2.2 Endangered Ecological Communities

Three (3) Endangered Ecological Communities (EEC's)[1] occur within the vicinity of Precincts 2, 3, 4, 6, 7, 8, 9, 10 & 11 (**FIGURE 3**):

- Swamp sclerophyll forest on coastal floodplain;
- Freshwater wetlands; and
- Subtropical coastal floodplain forest.

2.3 Threatened Species

2.3.1 Flora

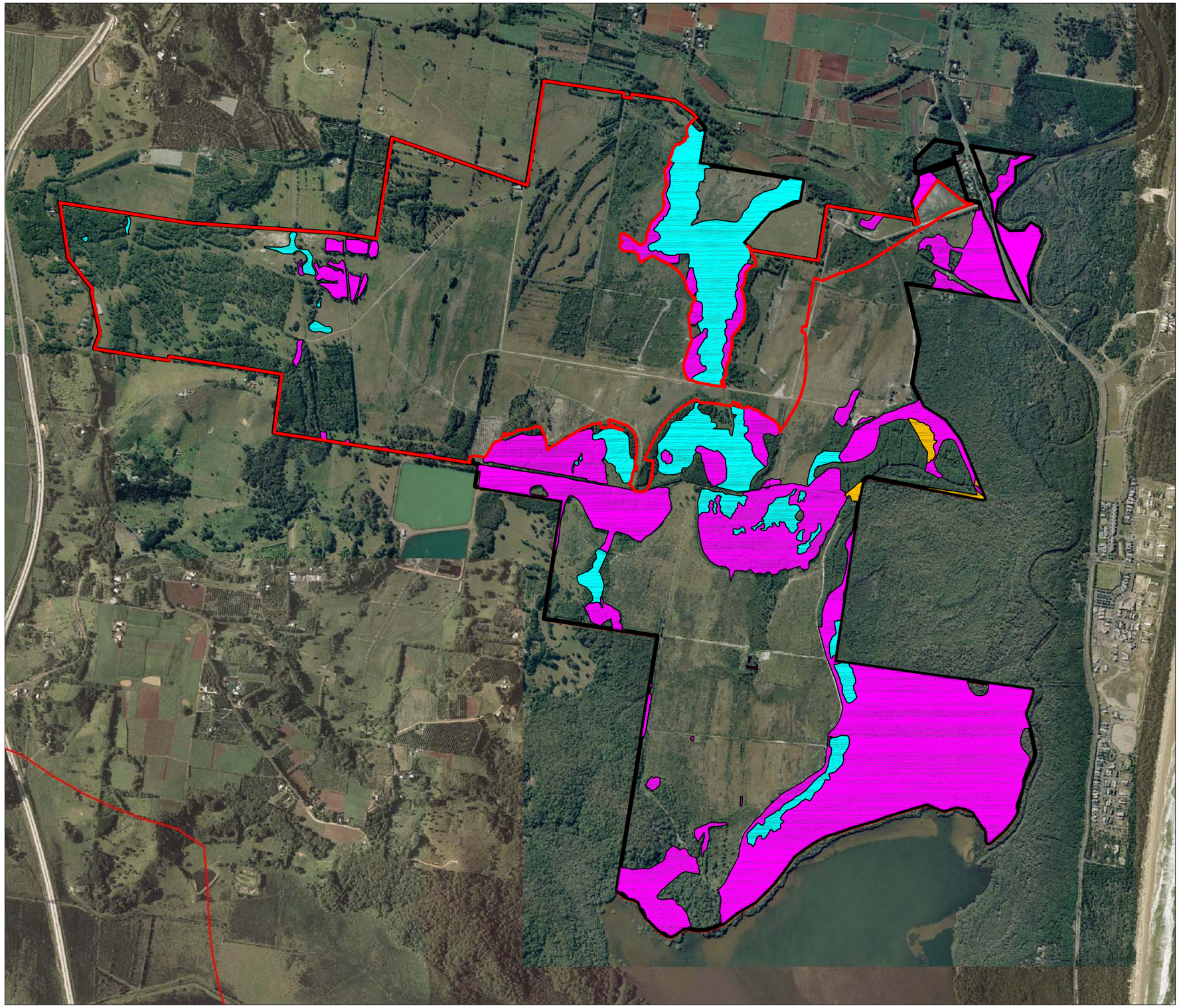
One (1) Threatened flora species was recorded from Precincts 2, 3, 4, 6, 7, 8, 9, 10 & 11 - the Square-stemmed Spike rush (*Eleocharis tetraquetra*), has been recorded in the western portion of Kings Forest (**FIGURE 4**).

2.3.2 Fauna

Ten (10) Threatened fauna species have been recorded (**FIGURES 5 & 6**), or are considered to occur over time within the area subject to this VMP. These species are as follows:

- Wallum froglet (*Crinia tinnula*)
- Olongburra frog (*Litoria olongburensis*)
- Osprey (*Pandion haliaetus*)
- Grass Owl (*Tyto capensis*)
- Masked Owl (*Tyto novaehollandiae*)
- Glossy black cockatoo (*Calyptorhynchus lathami*)
- Black bittern (*Ixobrychus flavicollis*)
- Grey Headed Flying fox (*Pteropus poliocephalus*)
- Koala (*Phascolarctos cinereus*)
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*).

[1] As listed within schedules of the TSC Act (1995).



LEGEND

- Freshwater Wetlands
- Subtropical Floodplain Forest
- Swamp Sclerophyll Forest on Coastal Floodplain
- Precincts 2-4 & 6-11
- Kings Forest Boundary

N

0 500m
1 : 20 000

SOURCE: Landpartners - EEC's; 2007 Aerial Photograph

SCALE: 1 : 20 000 @ A3

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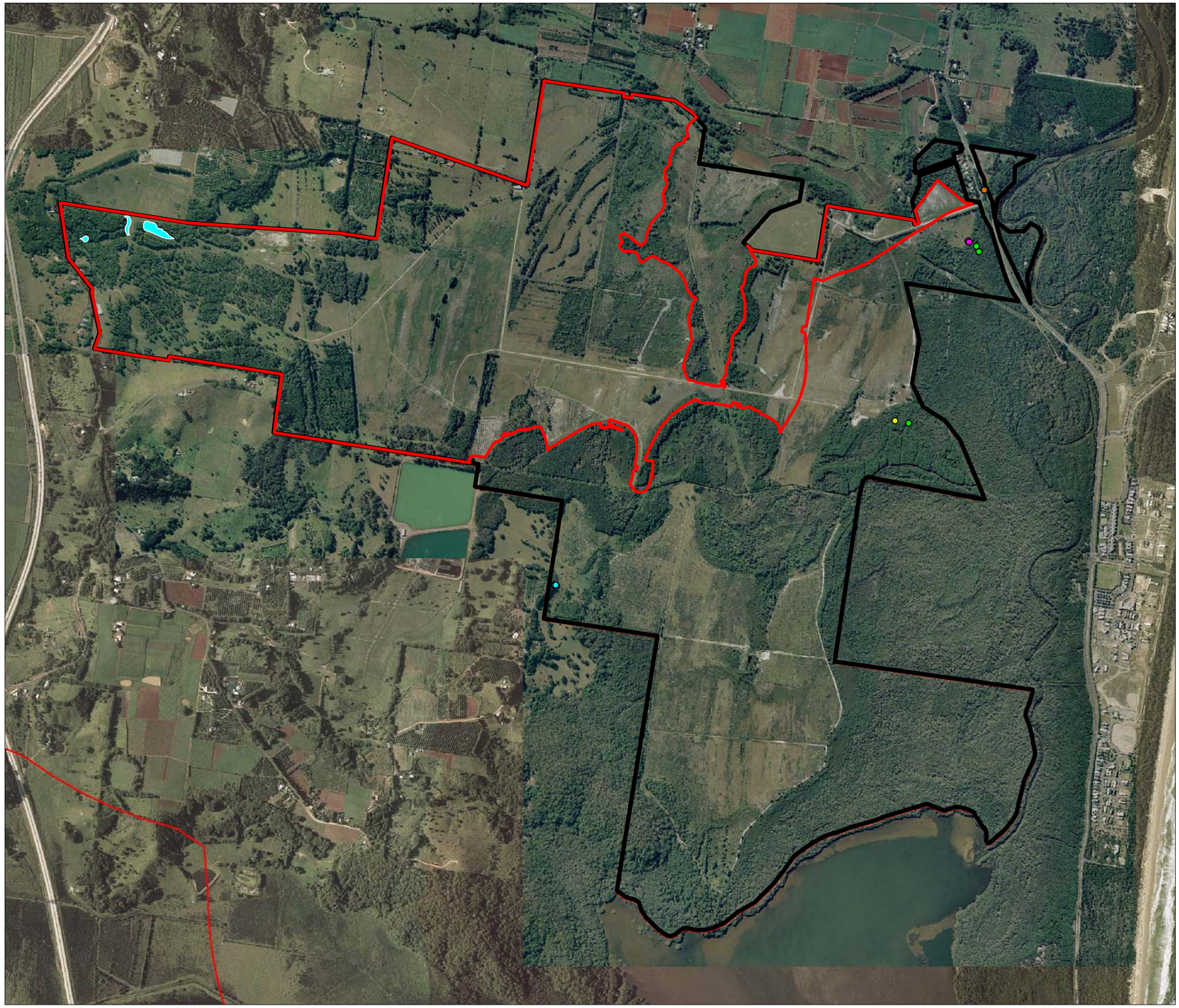
Shire of Tweed

FIGURE 3

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_VMP_Base.dwg

TITLE
ENDANGERED ECOLOGICAL COMMUNITIES (EEC's)



N

LEGEND

- Green leaved rose walnut
- Southern swamp orchid
- Stinking laurel
- White laceflower
- White yiel yiel
- Square stemmed spike rush
- Precincts 2-4 & 6-11
- Kings Forest Boundary

0 500m

1 : 20 000

SOURCE: Landpartners - Threatened Flora; 2007 Aerial Photograph

SCALE: 1 : 20 000 @ A3

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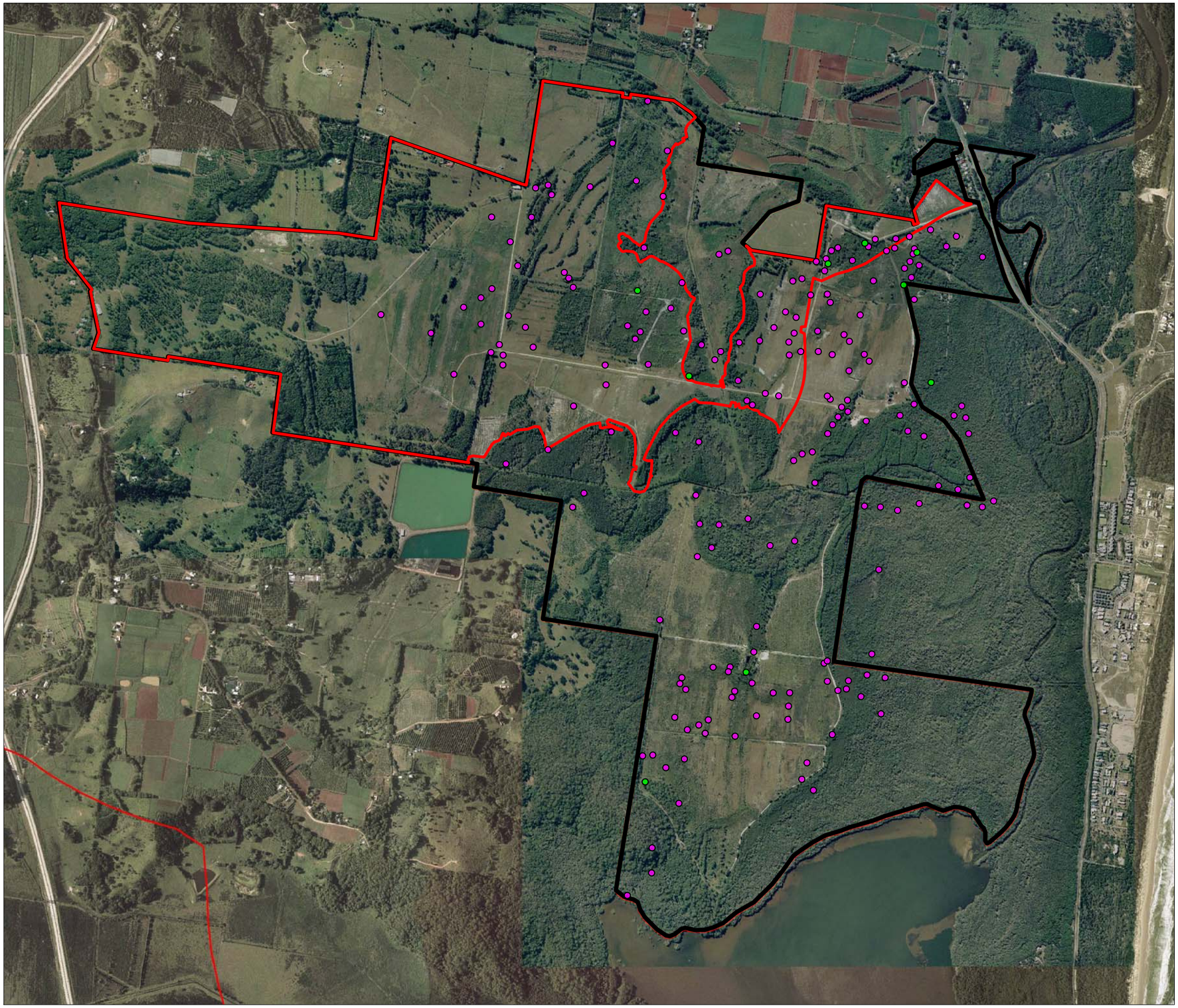
FIGURE 4

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_VMP_Base.dwg

TITLE

THREATENED FLORA



N

LEGEND

- Wallum sedge frog
- Wallum froglet
- Precincts 2-4 & 6-11
- Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: Landpartners - Threatened Fauna - Amphibians; 2007 Aerial Photograph

SCALE: 1 : 20 000 @ A3

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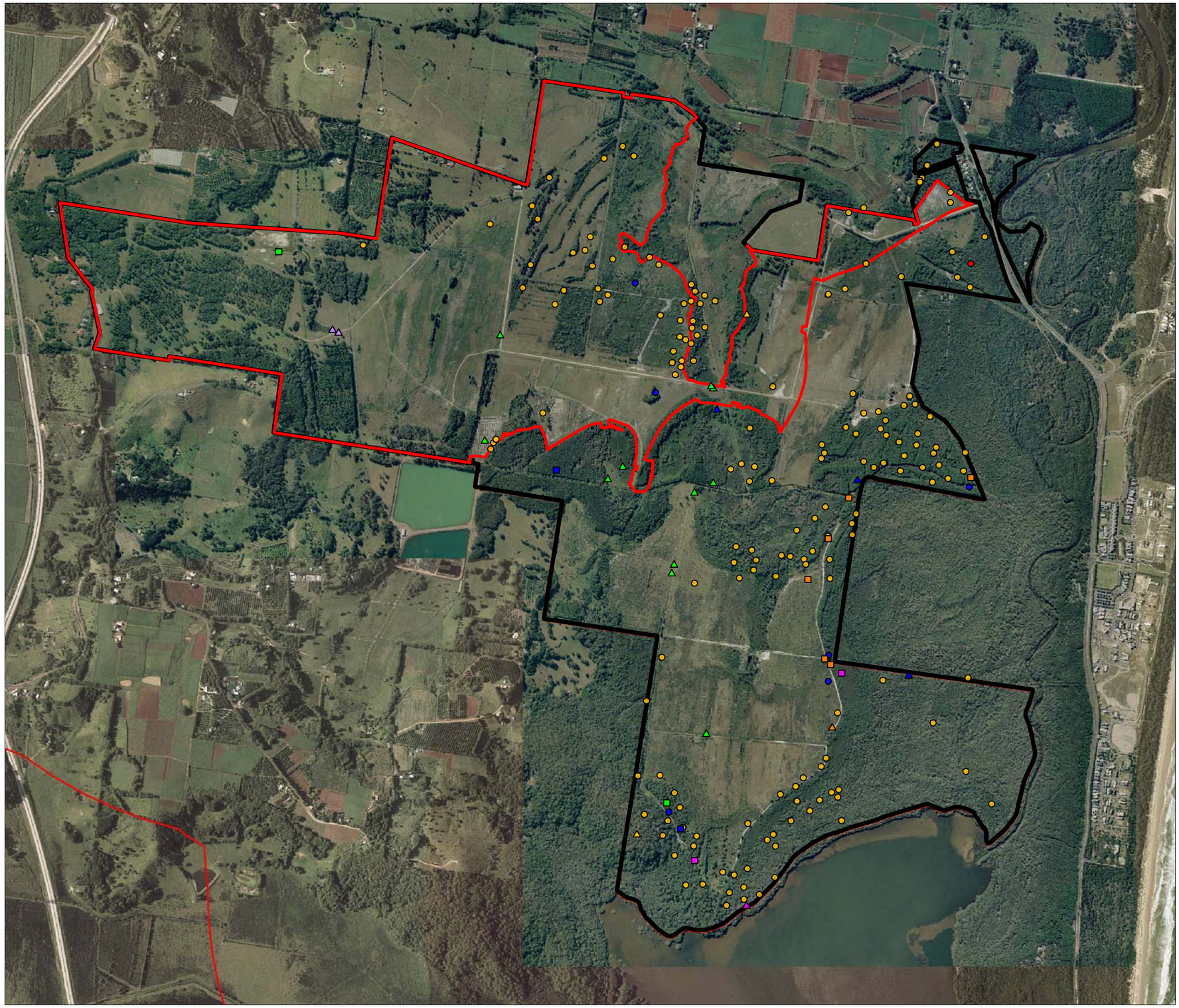
FIGURE 5

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_VMP_Base.dwg

TITLE

THREATENED FAUNA SPECIES - AMPHIBIANS



N

LEGEND

- Black bittern
- Black-necked stork
- Bush hen
- Bush stone-curlew
- Common blossom bat
- Common planigale
- Glossy black cockatoo
- Grass owl
- Grey-headed flying-fox
- Koala
- Masked owl
- Osprey
- Yellow-bellied sheathtail bat
- Precincts 2-4 & 6-11
- Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: Landpartners - Threatened Fauna - Birds & Mammals; 2007 Aerial Photograph

SCALE: 1 : 20 000 @ A3

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FIGURE 6

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_VMP_Base.dwg

TITLE

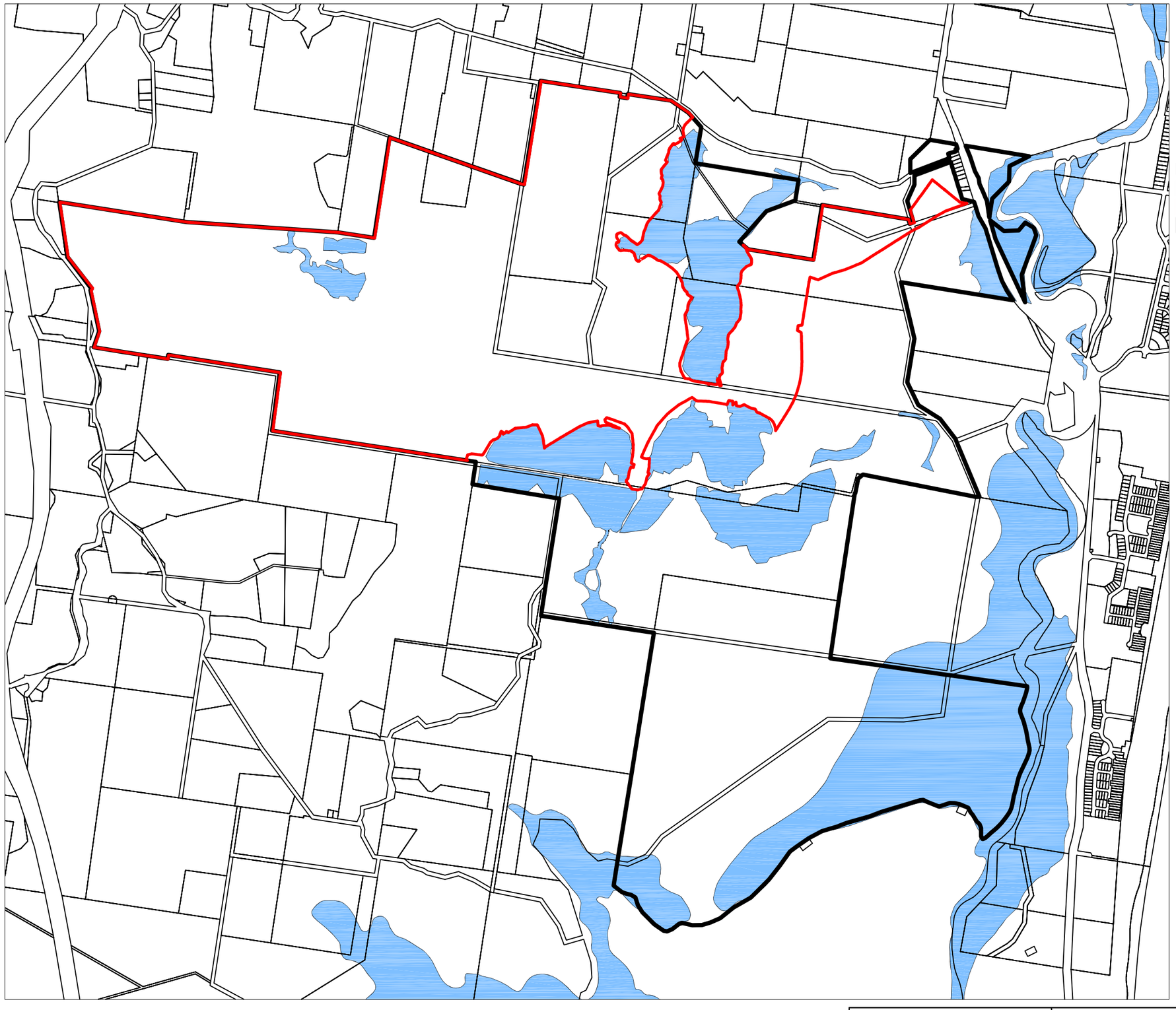
THREATENED FAUNA SPECIES - BIRDS & MAMMALS

2.4 SEPP 14 Wetlands

SEPP 14 – Coastal Wetlands are mapped over large areas of the Kings Forest site. These wetlands are protected by State Environmental Planning Policy No. 14 – Coastal Wetlands (SEPP 14). **FIGURE 7** shows the SEPP 14 wetlands relevant to this VMP.

2.5 Cudgen Nature Reserve

Cudgen Nature Reserve occurs immediately adjacent to the eastern and southern boundaries of the Kings Forest site (**FIGURE 8**).



LEGEND

- SEPP 14 Wetlands
- Precincts 2-4 & 6-11
- Kings Forest Boundary

N

0 500m
1 : 20 000

SOURCE: Landpartners - SEPP14 Wetlands (Amendment 15)

SCALE: 1 : 20 000 @ A3

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FIGURE 7

PREPARED: BW
DATE: 01 March 2011
FILE: N97017_VMP_Base.dwg

TITLE

SEPP No. 14
COASTAL WETLANDS

N

LEGEND

- Cudgen Nature Reserve
- Precincts 2-4 & 6-11
- Kings Forest Boundary

0 1km

1 : 40 000

SOURCE: NPWS 05.06.06; Leda Developments (Ref: 6400_121.dwg Recd' 09.06.06)

SCALE: 1 : 40 000 @ A3

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FIGURE 8

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_VMP_Reserves.cdr

TITLE

CUDGEN NATURE RESERVE

3 MANAGEMENT STRATEGIES

3.1 Introduction

The following sections will outline the vegetation management strategies to be carried out within Precincts 2-4 & 6-11. The Stage 1 Project Application is for the completion of bulk earthworks only within Precincts 2, 3, 4, 6, 7, 8, 10 & 11. However, it is proposed to commence restoration and enhancement activities immediately upon the completion of bulk earthworks.

The following sections detail strategies for the:

- Protection of environmentally significant site values during bulk earthworks activities; and
- Restoration, enhancement and management of retained vegetation.

3.2 Protection of ecologically significant site values during bulk earthworks activities

3.2.1 Vegetation Protection

During bulk earthworks activities, temporary high visibility fencing will be erected to assist in the protection of the retained vegetation by restricting access from machinery and contractors. This fencing will be erected in accordance with the requirements of the Precinct 2-4 & 6-11 BMP (JWA 2011c).

Temporary signage will be provided along all temporary fencing during bulk earthworks stating "Environmental Protection Zone – No Unauthorised Entry".

3.2.2 Protection of Threatened Flora

A detailed Precinct 2-4 & 6-11 TSMP (JWA 2011b) has been prepared outlining specific and detailed management procedures for the protection of Threatened flora species which occur within the vicinity of Precincts 2-4 & 6-11.

3.2.3 Protection of EECs

Temporary high visibility fencing erected to protect retained vegetation (i.e. Section 3.2.1) will guard against damage to EEC's during bulk earthworks activities.

Temporary signage will be provided along all temporary fencing during bulk earthworks stating "Environmental Protection Zone – No Unauthorised Entry".

3.2.4 Protection of SEPP 14 Wetlands

The SEPP 14 Wetlands on the site are all well within the vegetated areas that will be retained**.** Temporary high visibility fencing erected to protect retained vegetation (i.e.

Section 3.2.1) will guard against damage to SEPP 14 Wetlands during the bulk earthworks activities.

Furthermore, Erosion and sediment control devices shall be installed prior to commencement of earth works within Precincts 1 & 5 in accordance with the Erosion & Sediment Control Plan (Gilbert & Sutherland 2011a). This will prevent the movement of sediment into ecologically sensitive areas as well prevent the dispersal of weed seeds and vegetative material.

3.3 Restoration, enhancement and management of retained vegetation

Strategies for the restoration, enhancement and maintenance of significant areas of vegetation, including SEPP 14 wetlands, Environmental Protection Zones and EEC's, are detailed in the Action Plan (i.e. Section 4). Restoration, enhancement and management techniques include:

- Weed control;
- Regeneration/Revegetation;
- Pest Management; and
- Adaptive Management.

This will increase both the quantity and quality of native habitat available to the indigenous flora and fauna.

4 ACTION PLAN

4.1 Introduction

The following sections detail the actions required to ensure the aims and objectives of the VMP are met. The action plan includes the following measures:

- Re-use of topsoil;
- Weed control;
- Regeneration/revegetation measures; and
- Adaptive management.

4.2 Re-use of topsoil to promote natural regeneration

Topsoil is an important source of seeds and propagules and has been effectively used in rehabilitation of native vegetation communities (e.g. Bellairs & Bell 1993; Koch & Ward 1994; Ward et al. 1996**).** Therefore, handled correctly, the topsoil seedbank can be used to successfully revegetate after disturbances like bulk earthworks.

At the commencement of the Stage 1 earthworks at Kings Forest, stockpiles of topsoil will be created. This soil will then be used in the regeneration of the heath communities within the ecological buffer.

To optimise the recovery of native vegetation rehabilitation areas it is important to considered the manner in which the top soil is handled. The following should be considered:

- It is important to consider the timing of topsoil recovery. Stripping topsoil immediately after summer seed drop may improve the germinable seed load (Berg 1975);

- The seed bank is usually concentrated in the upper soil layer (i.e. 40–50 mm) so it is important to only remove this depth of soil. A greater depth will dilute the seed bank and reduce the effectiveness of the soil as a potential mechanism for natural regeneration (Putwain & Gillham 1990);

- Topsoil should be used as soon as possible after stripping to prevent loss of seed viability (Koch *et al.* 1996; Mahesh *et al.* 1996); and

- Top soil should be replaced at maximum depths of 100mm (Rokich *et al.* 2000).

4.3 Weed control

Due to the significant disturbance history, Kings Forest supports a variety of weed species. Slash Pine (*Pinus elliottii*) is the most common. Plantations have resulted in the species being naturalised on the site. Progeny range in size from small seedlings to trees 15-20 metres in height. In some areas of the site there is significant invasion into

native vegetation communities, while in other areas there may be only one or two plants.

The aim of weed control within the vicinity of Precinct 2-4 & 6-11 is the permanent removal of weeds to enable the protection of the Environmental Protection Zones.

Disturbance during the bulk earthworks activities will create an opportunity for weeds to colonise and establish, therefore weeds should be diligently controlled both during and after completion of bulk earthworks in accordance with the Precinct 2-4 & 6-11 WMP (JWA 2011d).

4.4 Regeneration and Revegetation measures

4.4.1 Background

Due to the large size of rehabilitation areas, rehabilitation will be completed with an emphasis on assisting natural regeneration rather than the labour intensive and costly approach of planting trees, although enhancement planting will still be completed in some areas (see below).

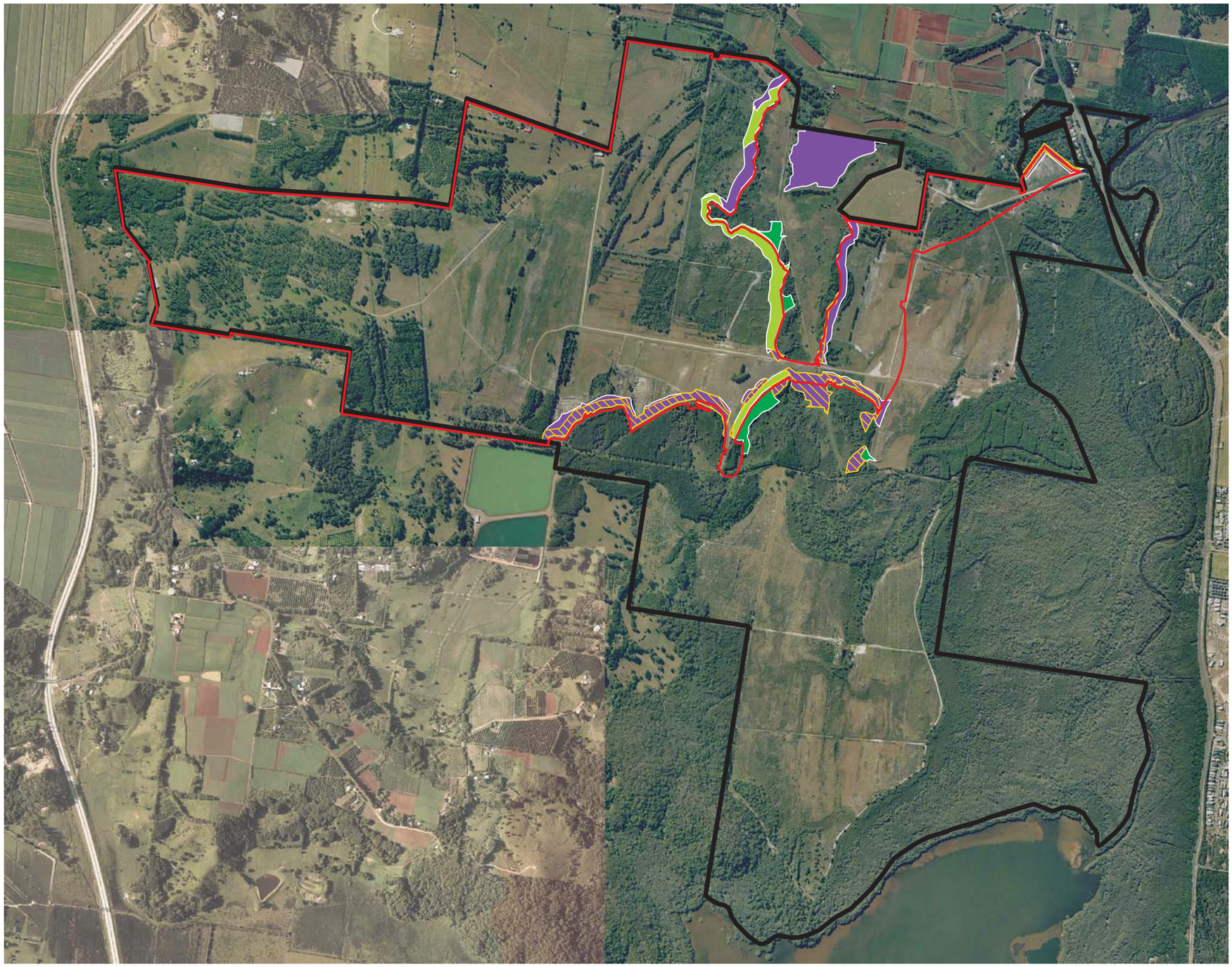
Natural regeneration is already occurring within some areas of the site and will be encouraged within retained vegetation communities. Rehabilitation/Regeneration works to be completed within Precinct 2, 3, 4, 6, 7, 8, 9, 10 & 11 Environmental Protection Zones and associated ecological buffers will generally include a combination of:

- Assisted natural regeneration where appropriate;
- Planting of preferred Koala food trees in accordance with the KPoM (**FIGURE 9**);
- Creation of core Acid frog compensatory habitat in accordance with the Precinct 2-4 & 6-11 TSMP (JWA 2011b); and
- Regeneration/revegetation of heath communities (**FIGURE 9**).

It should be noted that there is some overlap in the characteristics and objectives of proposed regeneration/revegetation areas at the Kings Forest site. For example, Koala food tree planting areas will also provide opportunities for revegetation with heath species (i.e. Koala food tree species will form the canopy with heath species forming the sub-canopy and understorey). Similarly, the creation of acid frog compensatory habitat provides an opportunity for further planting of scattered Koala food trees and wet heath species. The resulting revegetation areas will be structurally diverse and more closely mimic intact native vegetation communities.

A suitably qualified Bush Regeneration Company will be engaged via a tendering process to complete necessary rehabilitation works. The Bush Regeneration Company will employ qualified Bush Regenerators, including a Regeneration Site Manager, who will be responsible for all project management and staff supervision, and report directly to the site Ecologist.

Techniques to be employed to facilitate natural regeneration will be in accordance with those promoted by the Australian Association of Bush Regenerators (AABR).



LEGEND

- Existing Heathland & Shrubland to be Retained within Environmental Protection Zones
- Heathland to be Naturally Regenerated
- Heathland to be Revegetated
- Koala Rehabilitation Areas
- Precincts 2-4 & 6-11
- Kings Forest Boundary

N

0 500m

1 : 20 000

SOURCE: JWA Site Investigations; Landpartners Figure 1 Koala Tree Planting Plan

SCALE: 1 : 20 000 @ A3

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FIGURE 9

PREPARED: BW
DATE: 21 April 2011
FILE: N97017_VMP_R&R Areas.cdr

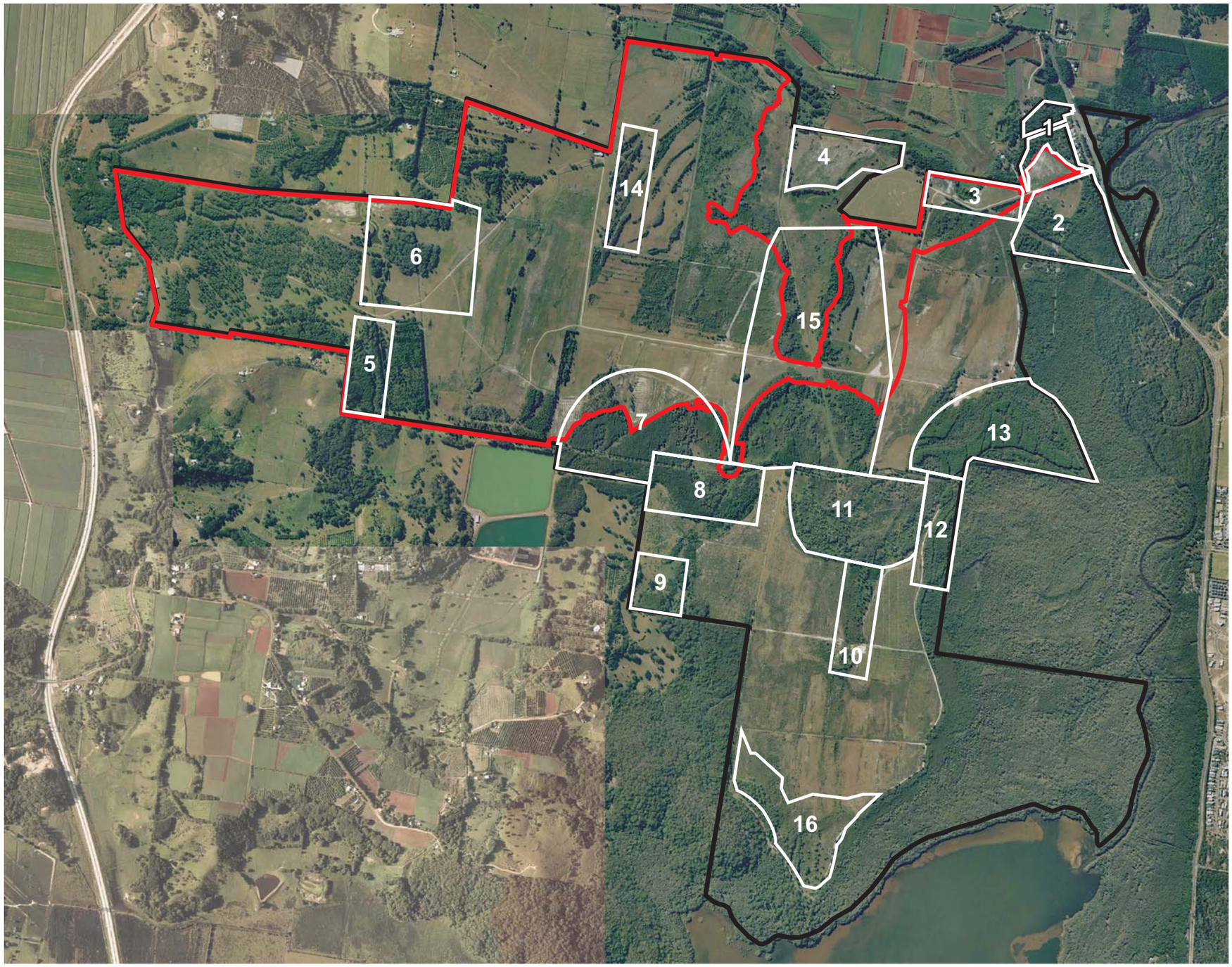
TITLE

REGENERATION & REVEGETATION AREAS

4.4.2 Work Areas

The Revised Vegetation Management Plan (Landpartners 2009b) identifies eighteen (18) work areas across the Kings Forest site. Work Areas 4, 5, 6, 7, 14 and 15 are relevant to this VMP (**FIGURE 10**).

Furthermore, portions of the Precinct 2, 3, 4, 6, 7, 8, 9, 10 & 11 ecological buffers have been identified as requiring regeneration and/or revegetation works during recent site assessments and occur outside of the LandPartners work areas. These are included in the following works schedule as 'Additional Work Areas'.



N

LEGEND

- Vegetation Work Unit
- Precincts 2-4 & 6-11
- Kings Forest Boundary

0 500m

1 : 20 000

SOURCE: Landpartners Revised Vegetation Management Plan (2009) Figure 9

SCALE: 1 : 20 000 @ A3

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FIGURE 10

PREPARED: BW
DATE: 21 April 2011
FILE: N97017_VMP_Veg Mgt.cdr

TITLE

VEGETATION MANAGEMENT AREAS

4.4.3 Works schedule

The following works schedule summarises the works relevant to the Environmental Protection Zones and associated ecological buffers within the area subject to this VMP.

Work unit	Proposed measures
2	➢ Ripping within grassland/heath community to promote regeneration. ➢ Management of native vines within canopy on Eastern margins. Vines to be cut at head height and at the base, but not poisoned. Particular attention to be paid to threatened White Laceflower. ➢ Removal of any pine wildings (completed as part of Weed Management Plan). ➢ Harvesting of mature Slash Pine (responsibility of client). ➢ Opportunities for establishment of Koala feed and shelter trees where appropriate. ➢ Koala food trees will also be planted in road reserve.
3	➢ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 9**). ➢ Maintenance of existing restoration plantings North of Depot Road. ➢ Ripping (where appropriate) within heath/grassland communities to promote regeneration.
4	➢ This entire area will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2011b) and is to be revegetated with heath species (**FIGURE 9**). ➢ Burning windrows of previously cleared vegetation to promote regeneration. ➢ Ripping of entire area to promote regeneration.
5	➢ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 9**). ➢ Burning or ripping pine plantation after harvesting to promote regeneration.

Work unit	Proposed measures
6	➢ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 9**). ➢ Ripping sandy disturbed area along Northern boundary to promote regeneration.
7	➢ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 9**). ➢ Koala food trees also to be planted in accordance with the KPoM (**FIGURE 9)**.
14	➢ Pockets of vegetation to be retained ➢ Possible treatments include landscape plantings or removal of stock in combination with weed control to allow natural regeneration.
15	➢ Cleared/disturbed areas within the EPZ's and inner 30m ecological buffer will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 9**). ➢ Koala food trees also to be planted in accordance with the KPoM (**FIGURE 9)**. ➢ Harvesting of mature Slash Pine.
Additional work areas	➢ Inner 30m buffer areas will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 1 & 5 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 9**). ➢ Ripping should be considered where appropriate to promote natural heath regeneration.

4.4.4 Methodology

4.4.4.1 Planting methods

A general methodology for the planting of any trees/shrubs or groundcovers is as follows:

- Stockpiled topsoil is to be spread within revegetation areas where required.
- Where exotic grasses occur within planting areas they are to be sprayed with Glyphosate at least 2 weeks prior to planting.
- Plant holes to be dug to at least twice the root ball height and width.
- Soil is to be loosened, wetted and then the plant hole to be back filled with excavated soil.
- Weed free mulch should be applied to a minimum 75mm depth around the base of the plants but not adjacent to the stem.
- Plantings are to be protected with bags (e.g. gro-bags) held in position with bamboo stakes.
- Appropriate wallaby protection measures must be implemented to optimise survival of plantings (refer 'Wallaby Protection' section below).
- Plantings are to be watered for the first 3 months. Heavy mulching will reduce the need for regular watering, provided it is replaced at between 6-12 month intervals.
- Ongoing monitoring of native species recruitment maintenance of enhancement planting works and control of environmental weeds are to be undertaken throughout the proposed five year plan and beyond.
- Native species from locally sourced seed stock only are to be planted wherever possible. Consideration should be given to setting up an on-site nursery to assist in the collection and propagation of endemic native seed for revegetation on the site. Alternatively, plants should only be sourced from local nurseries that can provide proof of local provenance (i.e. within 20km of the site).
- Revegetation is to include canopy as well as sub-canopy and understorey species (Section 4.4.5). Canopy species will generally be comprised of Koala food tree species. Sub-canopy and understorey species will generally be comprised of heath species. A species list is also provided for revegetation in areas not suitable for Koala feed trees and/or heath species.
- Plant spacing is flexible, for instance in areas which act as Asset Protection Zones, spacing of canopy trees will be greater (e.g. 10 m). Generally, plants are spaced according to the following prescriptions:
    - 3m spacing for trees (upper canopy plants);
    - 1.5m spacing for shrubs and small trees (midstorey plants); and
    - 1m spacing for groundcover (ground storey plants up to 1.5m in height).

4.4.4.2 Wallaby protection

The site is inhabited by a large population of Swamp wallabies which are likely to browse any newly planted trees, causing potential death of plants. A combination of the following measures should be considered for the protection of plants on a site by site basis:

- protective bags;
- wallaby repellents (eg. Sen-Tree®); and
- Wallaby-proof fencing using star pickets and pig mesh.

Koala proof fencing (JWA 2011a) may also exclude wallabies from some planting areas.

4.4.4.3 Koala Feed Trees

Planting of Koala feed and shelter trees is recommended within numerous work zones to establish linkages between areas of Koala habitat and to increase foraging resources for the species at the site in the long term (in accordance with the Stage 1 KPOM [JWA 2011a])(**FIGURE 9**). Faecal cuticle analysis undertaken by James Warren & Associates (Warren 2000) showed that the main species consumed by Koalas at the time of the SIS were Swamp mahogany (*Eucalyptus robusta*) and Swamp box (*Lophostemon suaveolens*) with smaller amounts of Brushbox (*L. confertus*), Blackbutt (*E. pilularis*) and Broad-leaved paperbark (*Melaleuca quinquenervia*).

Therefore tree species nominated for planting include known feed tree species identified at the site (Swamp mahogany and Swamp box) in addition to other species such as Brushbox and Blackbutt (as per JWA), Red mahogany, Tallowwood and Forest red gum (Approved Koala Recovery Plan, DECC 2008). Koala feed trees should only be planted where conditions are appropriate (i.e. soils, topography, vegetation) so that plantings are compatible with any existing natural vegetation. For example species such as Tallowwood should be planted in higher elevation parts of the site, while planting which occurs in proximity to large areas of naturally occurring vegetation should be more conservative in its species selection and utilise species which commonly occur in surrounding vegetation (e.g. Swamp mahogany, Swamp box, Blackbutt, Forest red gum). Areas identified within the KPoM (JWA 2011a) for planting preferred Koala food trees are shown in **FIGURE 9**.

4.4.4.4 Acid Frog Compensatory Habitat

It is proposed to create Core Acid frog habitat within Environmental Protection Zones (EPZ's) and ecological buffers on the Kings Forest site in accordance with the Precinct 2-4 & 6-11 TSMP (JWA 2011b). Areas requiring rehabilitation works within EPZ's and buffers will be targeted for the creation of Core Acid Frog habitat.

The compensatory habitat areas will be planted with a combination of Swamp sclerophyll (i.e. Swamp mahogany & Broad-leaved paperbark) and Wet heath species.

4.4.4.5 Heath regeneration/revegetation

FIGURE 9 identifies proposed rehabilitation areas on the subject site which are currently comprised of regenerating heath communities, or are suitable for revegetation with heath species. The basis for revegetation with wet vs. dry heath vegetation will be determined by the topography of each revegetation area. Species lists are provided in **Section 4.4.5**.

4.4.4.6 Constructed Wetlands

Freshwater wetlands covering approximately 8.2 ha will be constructed within the golf course buffer zone (refer to Precinct 2-4 & 6-14 BMP, JWA 2011c), forming bio-retention basins to trap sediment, nutrients and act as chemical renovators for the entire urban development adjacent to the golf course. These wetlands will contribute to the golf course's buffering attributes (i.e. environmental protection for the surrounding SEPP 14 Wetlands and Environmental Protection Zones) and provide habitat for native flora and fauna. They will also augment the existing wetlands and adjacent ecosystems.

4.4.4.7 Enhancement Plantings

In areas where extensive weed infestations have been removed or where Slash pine has been harvested (i.e. leaving large cleared areas) that are not suitable for revegetation with Koala food trees or heath regeneration/restoration, enhancement plantings with other locally endemic species will be completed. Additional species lists for each Work area are provided in **Section 4.2.5.3.**

4.4.5 Species Schedule

4.4.5.1 Heath species

Where heath revegetation is necessary (**FIGURE 14**) , the following sub-canopy and understorey species are to be utilised:

Common name	**Botanical name**
Dry heath species*	
Sweet wattle	*Acacia suaveolens*
Prickly moses	*Acacia ulicifolia*
Heath aotus	*Aotus ericoides*
Wooly aotus	*Aotus lanigera*
Starhair bush	*Astrotricha longifolia*
Midgenberry	*Austromyrtus dulcis*
Wallum banksia	*Banksia aemula*
Heath-leaved banksia	*Banksia ericifolia*
Hairpin banksia	*Banksia spinulosa var. collina*
Leafless bossiaea	*Bossiaea ensata*
Variable bossiaea	*Bossiaea heterophylla*

Common name	Botanical name
Showy bossiaea	*Bossiaea rhombifolia*
Milkmaids	*Burchardia umbellata*
Curly wigs	*Caustis recurvata*
Christmas bush	*Ceratopetalum gummiferum*
Pink matchheads	*Comesperma ericinum*
Blue dampiera	*Dampiera stricta*
Blue flax-lilly	*Dianella caeruela*
Rolled flax-lilly	*Dianella revoluta*
Eggs & bacon pea	*Dillwynia retorta*
Hopbush	*Dodonaea triquetra*
Wiry panic	*Entolasia stricta*
Wallum heath	*Epacris pulchella*
Pinnate wedge pea	*Gompholobium pinnatum*
Slender bloodroot	*Haemodorum tenuifolium*
Finger hakea	*Hakea dactyloides*
Narrow-leaved guinea flower	*Hibbertia linearis*
Hoary guinea flower	*Hibbertia obtusifolia*
Hairy guinea flower	*Hibbertia vestita*
Dogwood	*Jacksonia scoparia*
Wire lilly	*Laxmannia gracilis*
Sword sedge	*Lepidosperma laterale*
Knotted scale-rush	*Lepyrodia interrupta*
Erica heath	*Leucopogon ericoides*
Lance beard heath	*Leucopogon lanceolatus*
Wire beard-heath	*Leucopogon microphyllus*
Coast beard heath	*Leucopogon parviflorus*
Common beard-heath	*Leucopogon virgatus*
Screw fern	*Lindsaea linearis*
Long-leaved matrush	*Lomandra longifolia*
Many-flowered matrush	*Lomandra multiflora*
Crinkle bush	*Lomatia silaifolia*
Large nectar heath	*Melichrus adpressus*
Jam tarts	*Melichrus procumbens*
Broom heath	*Monotoca elliptica*
Prickly-leaved monotoca	*Monotoca scoparia*
White dogwood	*Ozothamnus diosmifolius*
Broad-leaved geebung	*Persoonia cornifolia*
Small-leaved geebung	*Persoonia virgata*
Candlesticks	*Petrophile canescens*
Conesticks	*Petrophile pulchella*
Heath phyllota	*Phyllota phylicoides*

Common name	Botanical name
Slender riceflower	*Pimelea linifolia*
Heathy platysace	*Platysace ericoides*
Shrubby platysace	*Platysace lanceolata*
Pomax	*Pomax umbellata*
Bracken	*Pteridium esculentum*
Green styphelia	*Styphelia viridis*
Black-eyed susan	*Tetratheca thymifolia*
Kangaroo grass	*Themeda australis*
Yellow rush-lilly	*Tricoryne elatior*
Austral bluebell	*Wahlenbergia gracilis*
Woollsia	*Woollsia pungens*
Wooly xanthosia	*Xanthosia pilosa*
Twiggy zieria	*Zieria minutiflora*
Sandfly zieria	*Zieria smithii*
*Wet heath species**	
Swamp wattle	*Acacia elongata*
Heath aotus	*Aotus ericoides*
Wooly aotus	*Aotus lanigera*
Heath myrtle	*Baeckea imbricata*
Feathertop	*Baloskion tetraphyllum*
Heath banksia	*Banksia ericifolia*
Swamp banksia	*Banksia robur*
Jointed twig-rush	*Baumea articulata*
Wallum boronia	*Boronia falcifolia*
Swamp boronia	*Boronia parvifolia*
Milkmaids	*Burchardia umbellata*
Pale grass-lilly	*Caesia parviflora*
Wallum bottlebrush	*Callistemon pachyphyllus*
Curly wigs	*Caustis recurvata*
Swamp parrot pea	*Dillwynia floribunda*
Tall sundew	*Drosera auriculata*
Rosette sundew	*Drosera spathulata*
Spreading rope-rush	*Empodisma minus*
Coral heath	*Epacris microphylla*
Blunt-leaf heath	*Epacris obtusifolia*
Swamp mahogany	*Eucalyptus robusta*
Tall saw-sedge	*Gahnia clarkei*
Red-fruited saw-sedge	*Gahnia sieberana*
Coral fern	*Gleichenia dicarpa*
Rocket goodenia	*Goodenia bellidifolia*
Slender bloodroot	*Haemodorum tenuifolium*

Common name	Botanical name
Sword sedge	*Lepidosperma laterale*
Prickly tea-tree	*Leptospermum juniperinum*
Lemon-scented tea-tree	*Leptospermum liversidgei*
Knotted scale-rush	*Lepyrodia interrupta*
Slender clubmoss	*Lycopodium laterale*
Thyme honeymyrtle	*Melaleuca thymifolia*
Heath phyllota	*Phyllota phylicoides*
Slender rice-flower	*Pimelea linifolia*
Feather plant	*Restio pallens*
Common bog rush	*Schoenus apogon*
	Schoenus paludosus
Swamp clubmoss	*Selaginella uliginosa*
Swamp heath	*Sprengelia sprengelioides*
Spoon-leaf goodenia	*Valleia spathulata*
Swamp grasstree	*Xanthorrhoea fulva*

* The basis for revegetation with wet vs. dry heath species will be determined by the topography of the revegetation area.

4.4.5.2 Koala food tree species

Where revegetation with preferred Koala food trees is necessary (**FIGURE 9**), the following canopy species are to be utilised:

Koala food trees	
Tallowwood	*Eucalyptus microcorys*
Blackbutt	*Eucalyptus pilularis*
Red mahogany	*Eucalyptus resinifera*
Swamp mahogany	*Eucalyptus robusta*
Forest red gum	*Eucalyptus tereticornis*
Brushbox	*Lophostemon confertus*
Swamp box	*Lophostemon suaveolens*
Broad-leaved paperbark	*Melaleuca quinquenervia*

4.4.5.3 Additional plant species

Additional canopy, sub-canopy and understorey plant species (i.e. for areas not suitable for Koala feed trees and/or heath species) are as follows:

Common name	Botanical name
Baumea*	*Baumea rubiginosa*
Blueberry ash	*Elaeocarpus reticulatus*
Broad-leaved paperbark	*Melaleuca quinquenervia*

Common name	Botanical name
Club rush*	*Schoenoplectus validus*
Common reed*	*Phragmites australis*
Corkwood	*Duboisia myoporoides*
Common spikerush*	*Eleocharis acuta*
Rusty sedge*	*Fimbristylis ferruginea*
Black wattle	*Acacia melanoxylon*
Scribbly Gum	*Eucalyptus racemosa*
Giant sedge*	*Lepironia articulata*
Willow Bottlebrush	*Callistemon salignus*

* Macrophytes to be planted in areas of shallow water and surrounds.

4.5 Adaptive Management

Adaptive management is an approach that involves learning from management actions, and using those lessons to improve upon the overall plan. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997). Comprehensive, long-term monitoring is a component of adaptive management as adaptive management strategies rely on the accumulation of evidence supporting decisions that demand changes in action.

An adaptive management approach involves an integrated process of firstly monitoring, then reviewing and responding to the health and conditions of the plantings, natural regeneration and the status of the weed infestation. Alteration to the design and maintenance of works required, to ensure the objectives of the BMP are achieved, are then made.

Adaptive management strategies will be determined by the information provided in monitoring reports. Adaptive management strategies that may be required within this VMP are as follows:

- Amendment of species list for revegetation works;
- Replacement of enhancement plantings that do not survive;
- Alteration of weed control methods or timing.

Before the implementation of any adaptive management strategy a brief report is be provided to Project 28 Pty Ltd and other relevant agencies detailing the proposed management actions and the predicted outcomes. The implementation must be approved by the relevant authority prior to implementation.

5 MONITORING AND REPORTING

5.1 Introduction

Monitoring is an essential component of this VMP and associated rehabilitation works. The condition of revegetation areas can be assessed by checking environmental conditions and matching these with management aims and objectives. The results obtained through monitoring can help managers to prioritise management actions and keep track of the health of rehabilitated areas.

A well-designed monitoring program will allow project managers to detect results months, years, or decades following implementation of a plan. This section outlines the monitoring requirements for the area subject to this VMP.

5.2 Rehabilitation Monitoring

5.2.1 Monitoring requirements

The vegetation monitoring will include regular visits by a qualified ecologist who is to complete the following:

- Transects
  - Ten (10) transects are to be placed within the retained vegetation areas;
  - Transect locations are to be permanently marked;
  - Transects are to be thirty (30) metres in length;
  - During monitoring visits tape measures are to be placed on the ground and the specific measureable features recorded along the transects;
  - Specific measurable features include:
    - Areas of vegetation cover (native species);
    - Areas of weed cover;
    - Areas of bare ground/mud;
    - Number, percentage and species of planted stems surviving;
  - Results are to be shown in a table which is to be presented in the monitoring reports.

- Quadrats
  - Three (3) quadrats ($1m^2$) are to be placed along each of the transects;
  - Quadrats must be placed a minimum of 5m apart along the length of the transect;
  - Quadrats are to be placed randomly within five (5) meters of the transect line;
  - The boundary of the quadrat with respect to the tape measure (e.g. between 3.5 – 4.5 metres on tape measure) will be recorded;
  - For each quadrat the following specific measurable features will be recorded:

        - Plant species occurring;
        - Percentage cover;
        - Height;
        - Relative abundance of native species;
        - Weed cover; and
        - Number, percentage and species of planted stems surviving.
    - Results are to be shown in a table which is to be presented in the monitoring reports.

- Fixed Photo points
    - A central transect marker on each established monitoring transect is to be used as permanent photo station for photographic monitoring;
    - Four (4) photos are to be taken from each central transect marker. Photos are to be taken to the north, south, east and west;
    - Photos should be labelled with the:
        - Transect code;
        - Direction of view; and
        - The date & time.
    - Photos must be supplied in the monitoring reports in a form of prints no smaller than 4" x 6" and must be colour.

5.2.2 Timing of monitoring visits

The monitoring is to be completed by a suitably qualified ecologist. Site visits should occur:

- Six (6) weeks after primary weeding;
- Six (6) weeks after initial plant-out;
- Every six (6) months thereafter until groundcovers are sufficiently established (i.e. between two (2) - three (3) years)
- Annually after establishment until completion criteria are met (refer Section 5.3).

5.2.3 Long Term Monitoring

Along with the regular monitoring within the EPZ's, the overall vegetation composition is to be regularly assessed and recorded. Long term monitoring will use both aerial photos and yearly assessments (ground truthing) of the vegetation communities using a hand held GPS.

The Long term monitoring of the vegetation composition within the EPZ's will include:

- A detailed vegetation map at a scale of 1:5,000 is to be completed within the EPZ's every twelve (12) months;
- Each year, after completion of vegetation mapping, a report is to be completed showing the changes in the composition of the vegetation communities. The results are to be shown in a table that shows the

vegetation community and the area of the vegetation community as a percentage of the EPZ's. Monitoring will continue until completion criteria are met (refer Section 5.3).

5.3 Performance Criteria

A number of criteria will indicate successful rehabilitation of the EPZ's, including:

- Survival of 95% of stems planted;
- Establishment of a 70% native ground cover after 2-3 years;
- Average percentage cover of 90% native ground cover at the 5th year;
- Noxious weeds are to be eradicated and environmental weeds less than 1% of the area;
- Natural recruitment of native seedlings throughout planting areas; and
- Maintenance of 100% of planted diversity.

Performance criteria will be assessed as follows:

- The photos taken during monitoring visits, in combination with the annual monitoring and mapping of native vegetation composition and the results of the annual flora survey, will be used to determine the extent of native plant species and the levels of biodiversity the area is supporting.
- When it is determined that all performance criteria have been met, completion will have occurred.

5.4 Reporting

Following each inspection by the qualified ecologist, a report will be prepared that will include tables and photographs from the monitoring visits. At the end of each year a detailed report will be prepared for the Department of Environment and Climate Change (DECC) and Tweed Shire Council. The report will discuss the following:

- Works undertaken;
- Progress of regeneration/revegetation areas against completion criteria using photos and tables showing the results of the monitoring visits;
- Significant problems encountered (death of seedlings, broken fences, vandalism etc.) and the effect of these on the plantings and aims of the revegetation or regeneration strategy;
- Success or failures of measures implemented to rectify previously identified problems;
- Measures to be taken to rectify new problems; and
- Performance against performance criteria (Section 5.3).

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JAMES WARREN & Associates Pty Ltd

ECOLOGICAL CONSULTANTS

KINGS FOREST

STAGE 1 PROJECT APPLICATION

PRECINCT 12, 13 & 14
VEGETATION MANAGEMENT PLAN

AMENDED
SEPTEMBER 2011

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1 INTRODUCTION

1.1 Background

The NSW Minister for Planning approved a Concept Plan for the proposed residential community at Kings Forest on the 19th August 2010. The approved documents included a Revised Vegetation Management Plan (LandPartners 2009), which proposed the principles upon which the management of retained vegetation on the Kings Forest site would be based.

Subsequently, the Director General issued modified Environmental Assessment Requirements (DGR's) on the 22nd December 2010. James Warren & Associates (JWA) were engaged by Project 28 Pty Ltd to complete a Kings Forest Stage 1 Project Application Vegetation Management Plan (VMP) for Precincts 12, 13 & 14 in accordance with requirements of 9.4 of these DGR's and Clause C2 of the modified Concept Approval.

JWA have now amended the VMP to address issues raised in the NSW Department of Planning (DoP) Test of Adequacy process, and reflect some minor layout changes.

1.2 Proposed Development

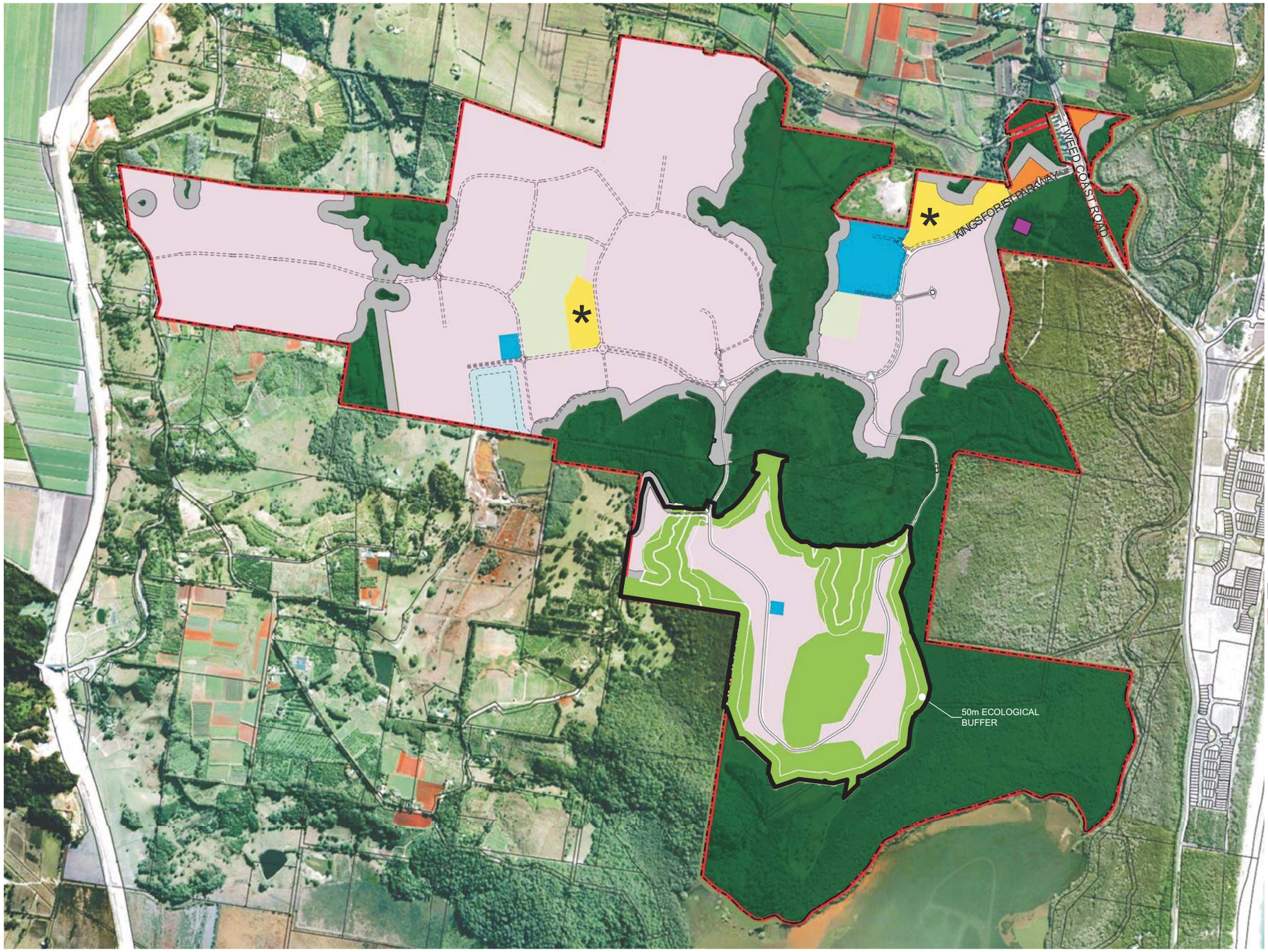
1.2.1 Kings Forest Stage 1 Project Application

The Kings Forest site consists of 872 hectares of land located at Cudgen between Bogangar to the south-east and Kingscliff to the north in Northern New South Wales (NSW). The concept plan for the Kings Forest site is shown in **FIGURE 1**.

The scope of the Stage 1 Project Application works is as follows:

- Construction of the entrance road to the site and associated intersection works on Tweed Coast Road.
- Alignment and construction details of two lanes of Kings Forest Parkway, from Tweed Coast Road via Precincts 2, 3, 4 and 5 through to the roundabout in the western part of the site from which access to the southern part of the site is to be gained.
- Alignment and construction details for the civil works of the two proposed roads through the east-west SEPP 14 area to access the southern part of the site.
- Rural retail development in Precinct 1 to the east of Tweed Coast Road.
- Subdivision and construction of residential Precinct 5.
- Bulk earthworks across the site in Precincts 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13 & 14.

The scope of works is illustrated in **FIGURE 2.**



N

LEGEND

- Town Centre / Neighbourhood Centre
- Residential
- Community Facilities / Education
- Employment Land
- Structured Open Space (Active)
  (Passive open space to council standards, location subject to urban design)
- Environmental Protection Area
  to be Dedicated to Council or NPWS
- 50m Ecological Buffer
  (Includes APZs & Roads where approved)
- * State School Site
- Proposed Zone Substation
  (Subject to Country Energy final approval)

Private Open Space

- Golf Course Area
  (Encompassing ecological buffers where indicated)
- Private Open Space Including Lake
- Precincts 12-14
- Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: MPS Architects
(Ref: 2011-06-23 DA Set.pdf)

SCALE: 1 : 20 000 @ A3

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Project 28 Pty Ltd

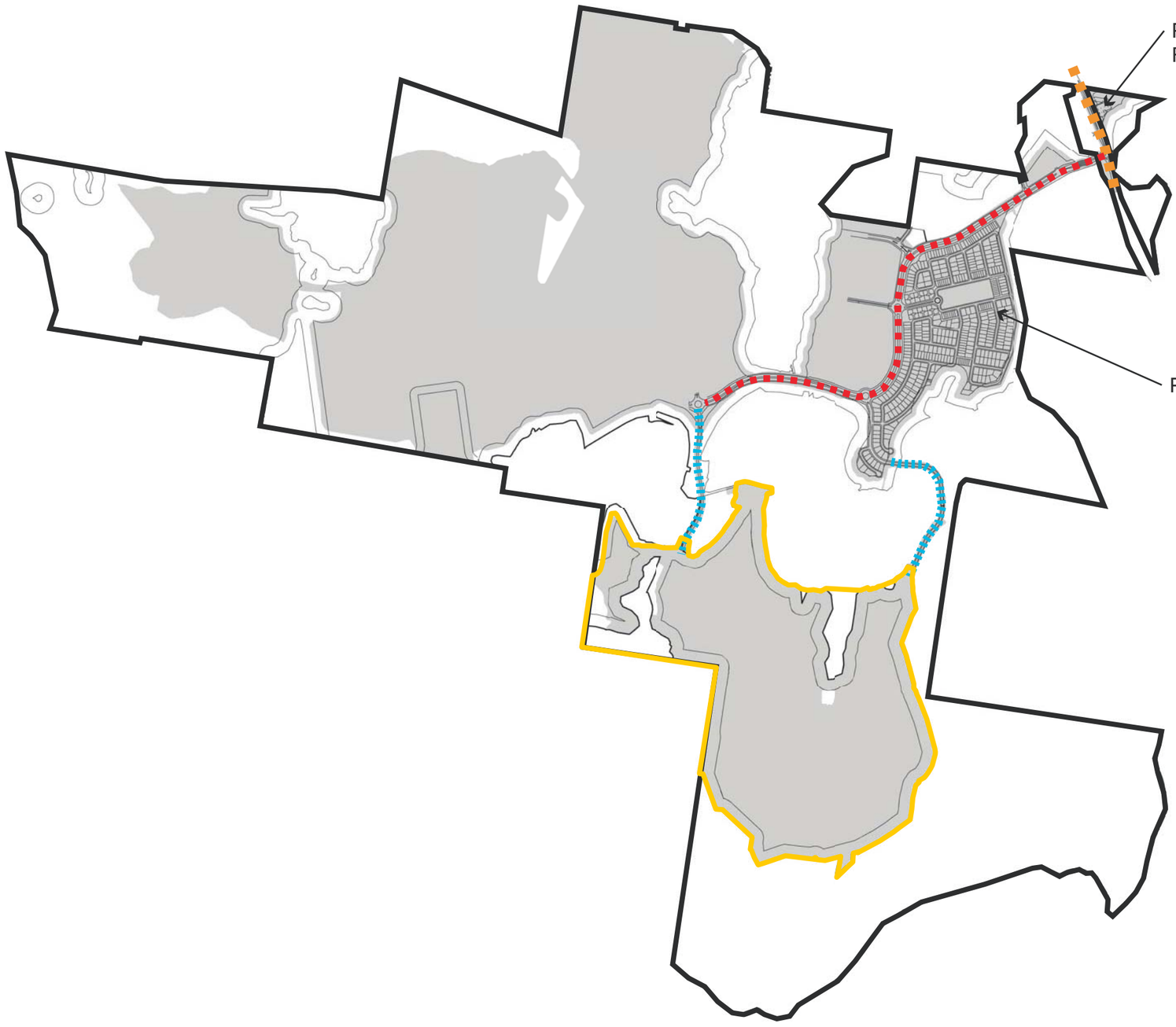
PROJECT
Kings Forest Stage 1 Project Application
Precincts 12-14 - Vegetation Management Plan
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 1

PREPARED: BW
DATE: 24 June 2011
FILE: N97017_VMP_Concept.cdr

TITLE

CONCEPT PLAN



LEGEND

- Tweed Coast Road Intersection Works
- Kings Forest Parkway through to Western Precincts
- Roads through to Southern Precincts
- Bulk Earthworks
- Precincts 12-14
- Kings Forest Boundary

0 500m

1 : 20 000

SOURCE: MPS Architects
(Ref: 2011-06-23 DA Set.pdf)

SCALE: 1 : 20 000 @ A3

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Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 2

PREPARED: BW
DATE: 24 June 2011
FILE: N97017_VMP_Scope.cdr

TITLE

STAGE 1 SCOPE OF WORKS

1.2.1 Precincts 12, 13 & 14

This VMP has been prepared for the proposed bulk earthworks in Precincts 12, 13 & 14 (**FIGURE 2**).

1.3 Aim & Objectives

The aim of the Precinct 12, 13 & 14 VMP is to protect and enhance the available habitat for flora and fauna (including threatened species) within the vicinity of Precincts 12, 13 & 14. Specific objectives of this VMP are to:

- Protect the environmentally significant site values from bulk earthworks and/or construction activities; and
- Restore, enhance and manage the retained and protected vegetation including providing guidelines for the:
    - Restoration/revegetation of heath communities within the Golf Course (i.e. Precinct 14);
    - Restoration/revegetation of the Scribbly gum community south of Precincts 12, 13 & 14;
    - Management and rehabilitation of significant areas of Koala habitat (as recommended in the Stage 1 KPoM [JWA 2011a]).

1.4 Plan Requirements

As discussed above, this VMP has been prepared in accordance with DGR 9.4 which states:

> *"Updates are to be provided, where relevant, for the various management plans for koalas, vegetation, threatened species, feral animals weeds, the buffers, and the golf course providing where relevant details on timelines for implementation of recommended works including maintenance periods and measurable performance and completion criteria. Each plan is to consider all other plans for the site to ensure that management strategies do not conflict and that each plan can be implemented without negatively impacting on the objectives of another."*

This VMP has also been prepared to comply with Clause C2 of the modified Concept Approval as follows:

> *Vegetation Management Plan*
>
> *"Each Vegetation Management Plan update is to provide details on:*
>
> 1. *the short, medium and long term measures to be implemented to rehabilitate degraded areas, and manage remnant vegetation and habitat within the buffers and Environmental Protection zoned land within the site.*

2. *revegetation and regeneration including establishment of appropriate canopy (including koala feed trees), sub-canopy, understorey and ground strata.*
3. *rehabilitation of creeks and drainage lines.*
4. *conserving and re-using, where appropriate, the soil seed bank where good quality native vegetation is being removed.*
5. *collection and propagation of endemic native seed for revegetation on the site.*
6. *monitoring of water quality and vegetation health within buffers and environmental protection zoned areas; and*
7. *the design, regeneration/revegetation and management of the east-west wildlife corridor/s.*
8. *measurable performance criteria are to be based on appropriate reference sites within the adjacent Cudgen Nature Reserve."*

1.5 Relationship to other Management Plans

Additional to this VMP, the following Management Plans relevant to Precincts 12, 13 & 14 have been prepared for the Stage 1 Project Application, and should be read in conjunction with this VMP:

- Kings Forest Stage 1 Project Application: Precinct 12, 13 & 14 Threatened Species Management Plan (Precinct 12, 13 & 14 TSMP) (JWA 2011b);
- Kings Forest Stage 1 Project Application: Precinct 12, 13 & 14 Weed Management Plan (Precinct 12, 13 & 14 WMP) (JWA 2011c).
- Kings Forest Stage 1 Project Application: Precinct 2 – 4 6 – 14 Buffer Management Plan (Precinct 2-4 & 6-11 BMP) (JWA 2011d);

Furthermore, a Kings Forest Stage 1 Project Application Koala Plan of Management (Stage 1 KPoM) (JWA 2011a) has been prepared for the entire Kings Forest site and is therefore relevant to Precincts 12, 13 & 14.

2 SUMMARY OF SIGNIFICANT VALUES

2.1 Background

Kings Forest has been comprehensively studied. A summary of the significant values relevant to the development of Precincts 12, 13 & 14 is provided in the following sections.

2.2 Endangered Ecological Communities

Three (3) Endangered Ecological Communities (EEC's)[1] occur within the vicinity of Precincts 12, 13 & 14 (**FIGURE 3**):

- Swamp sclerophyll forest on coastal floodplain;
- Freshwater wetlands; and
- Subtropical coastal floodplain forest.

2.3 Threatened Species

2.3.1 Flora

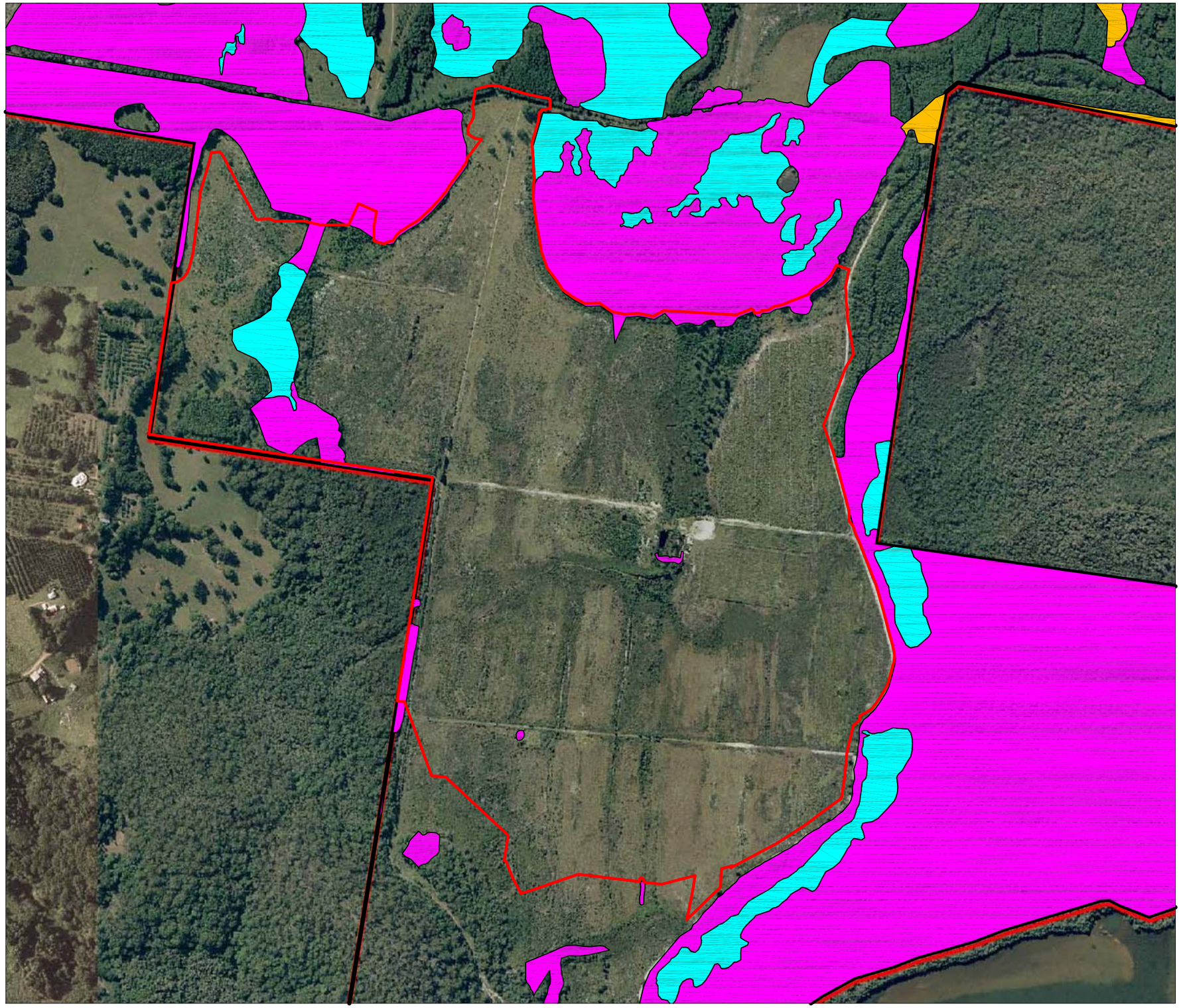
One (1) Threatened flora species occurs within the vicinity of Precincts 12, 13 & 14 - the White yiel yiel (*Grevillea hilliana*) (**FIGURE 4**).

2.3.2 Fauna

Eleven (11) Threatened fauna species have been recorded (**FIGURE 5**), or are considered to be provided with potential habitat, within the vicinity of Precincts 12, 13 & 14. These species are as follows:

- Bush hen (*Amaurornis olivaceus)*
- Bush stone-curlew (*Burhinus grallarius)*
- Common planigale (*Planigale maculata)*
- Glossy black cockatoo (*Calyptorhynchus lathami)*
- Grass Owl (*Tyto capensis)*
- Grey Headed Flying fox (Pteropus poliocephalus)
- Koala (*Phascolarctos cinereus)*
- Masked Owl (*Tyto novaehollandiae)*
- Wallum sedge frog (*Litoria olongburensis)*
- Wallum froglet (*Crinia tinnula)*
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris)*

[1] As listed within schedules of the TSC Act (1995).



LEGEND

- Freshwater Wetlands
- Subtropical Floodplain Forest
- Swamp Sclerophyll Forest on Coastal Floodplain
- Precincts 12 & 14
- Kings Forest Boundary

N

0 200m
1 : 8000

SOURCE: Landpartners - EEC's; 2007 Aerial Photograph

SCALE: 1 : 8000 @ A3

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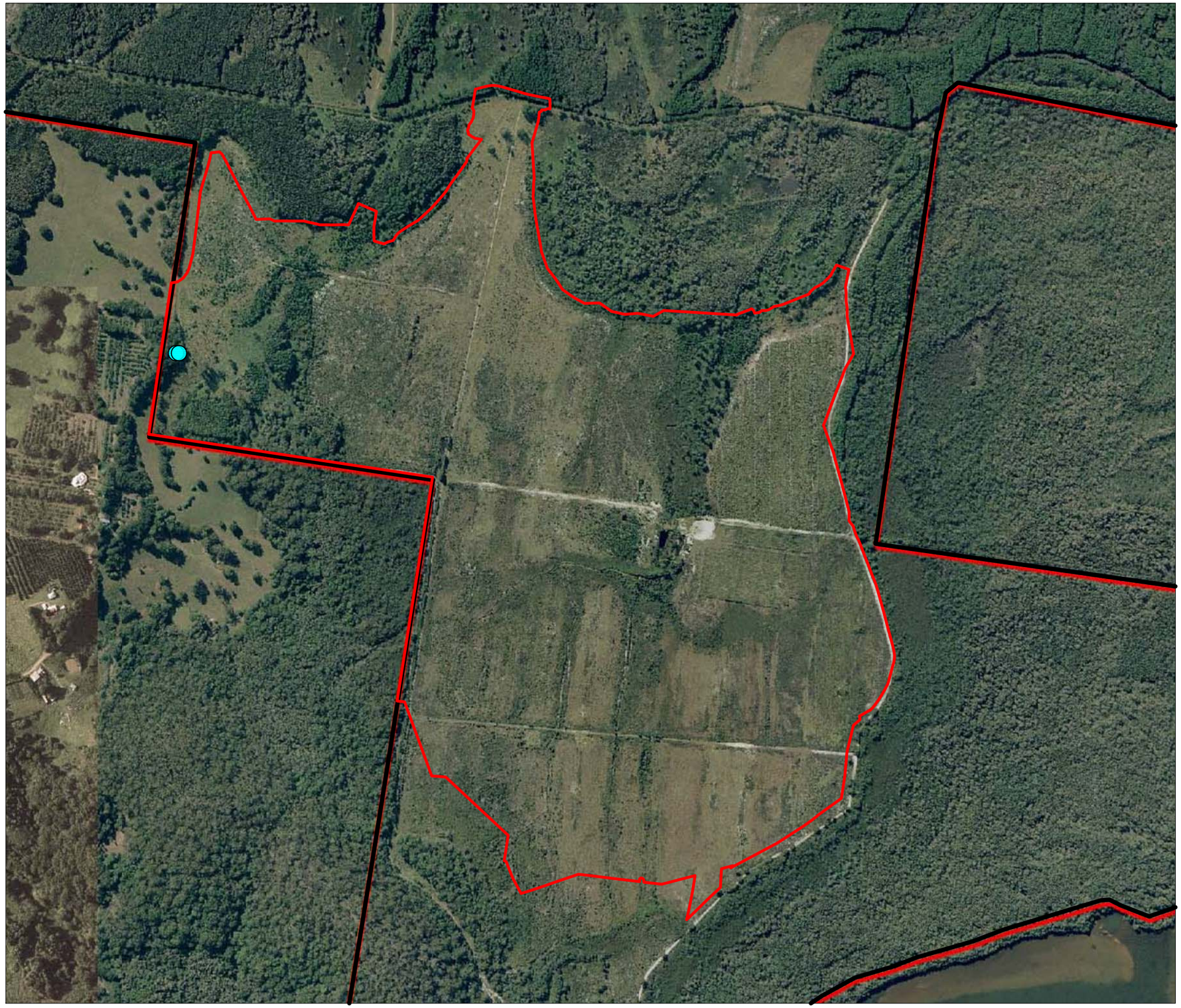
FIGURE 3

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_VMP_Base.dwg

TITLE
ENDANGERED ECLOGICAL COMMUNITIES (EEC'S)



N

LEGEND

- White yiel yiel
- Precincts 12 & 14
- Kings Forest Boundary

0 200m
1 : 8000

SOURCE: JWA Site Investigations; Landpartners - AKF 2005 Vegetation Mapping

SCALE: 1 : 8000 @ A3

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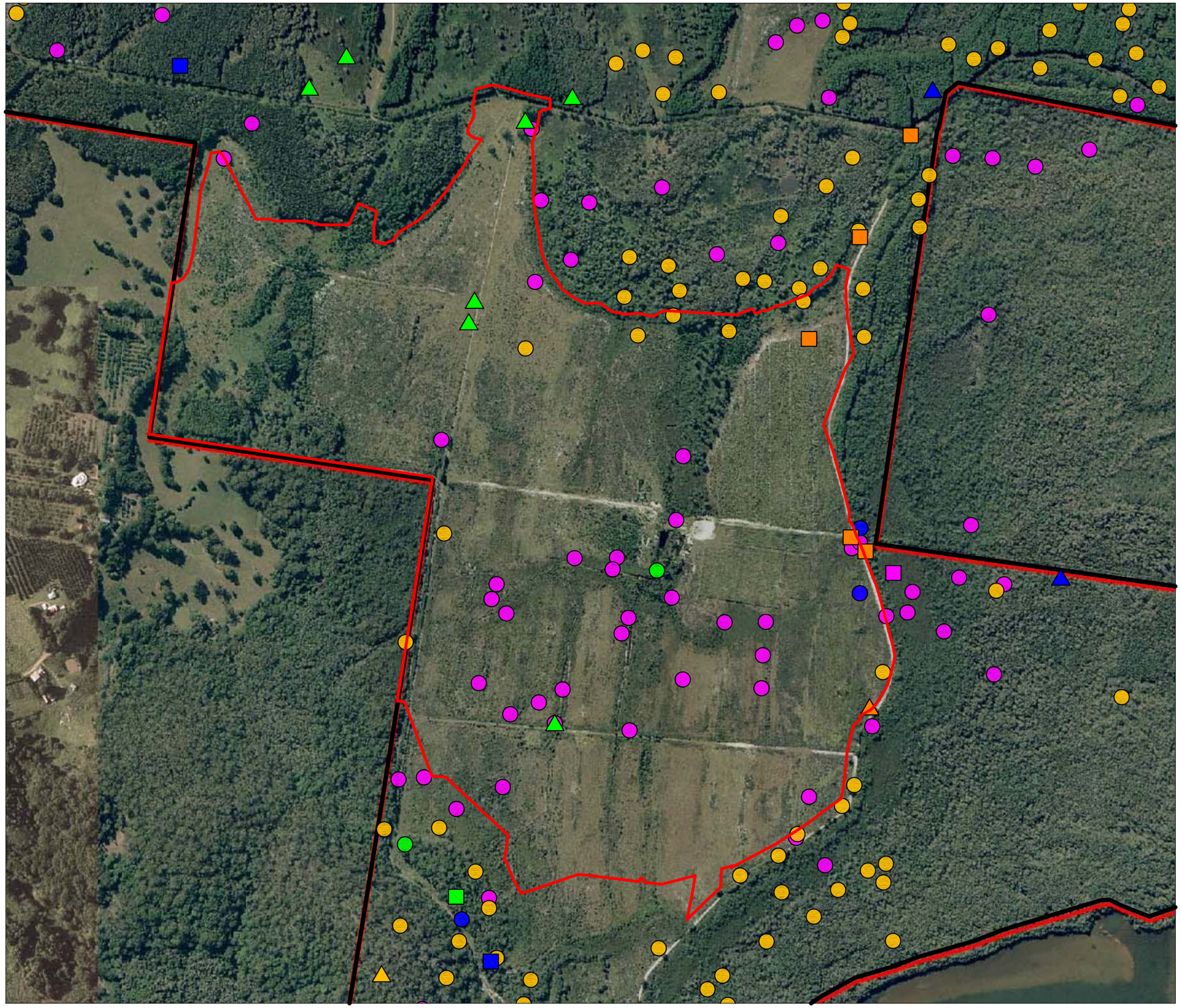
FIGURE 4

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_VMP_Base.dwg

TITLE

THREATENED FLORA



LEGEND

- Wallum sedge frog
- Wallum froglet
- Black bittern
- Bush stone-curlew
- Common blossom bat
- Common planigale
- Glossy black cockatoo
- Grass owl
- Grey-headed flying-fox
- Koala
- Masked owl
- Yellow-bellied sheathtail bat
- Precincts 12 & 14
- Kings Forest Boundary

N

0 200m
1 : 8000

SOURCE: Landpartners - Threatened Fauna - Amphibians + Birds & Mammals; 2007 Aerial Photograph

SCALE: 1 : 8000 @ A3

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FIGURE 5

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_VMP_Base.dwg

TITLE

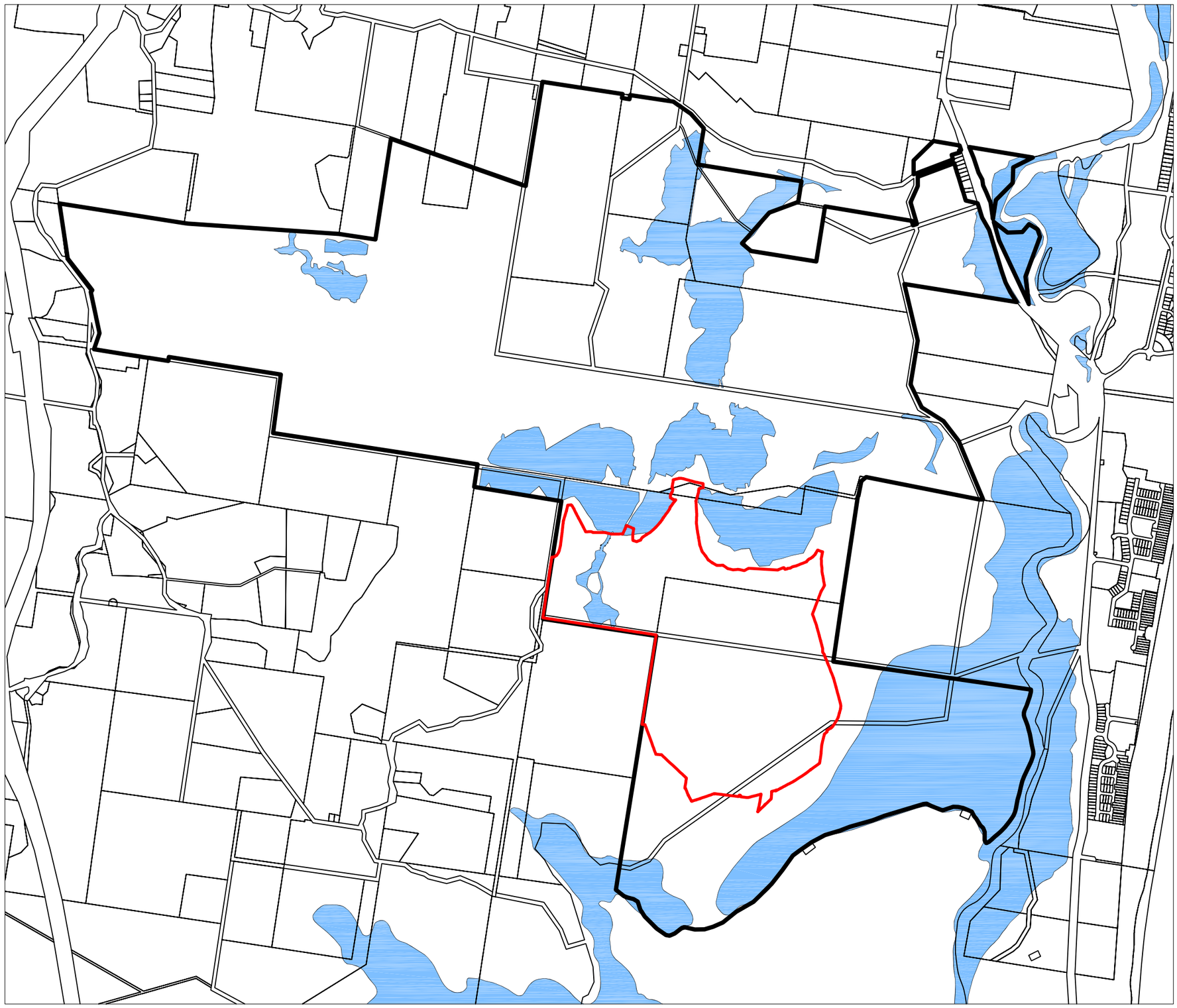
THREATENED FAUNA

2.4 SEPP 14 Wetlands

SEPP 14 – Coastal Wetlands are mapped over large areas of the Kings Forest site, including areas adjacent to Precincts 12, 13 & 14 (**FIGURE 6**). These wetlands are protected by State Environmental Planning Policy No. 14 – Coastal Wetlands (SEPP 14).

2.5 Cudgen Nature Reserve

Cudgen Nature Reserve occurs immediately adjacent to the eastern and southern boundaries of the Kings Forest site (**FIGURE 7**).



LEGEND

- SEPP 14 Wetlands
- Precincts 12 & 14
- Kings Forest Boundary

N

0 500m
1 : 20 000

SOURCE: Landpartners - SEPP14 Wetlands (Amendment 15)

SCALE: 1 : 20 000 @ A3

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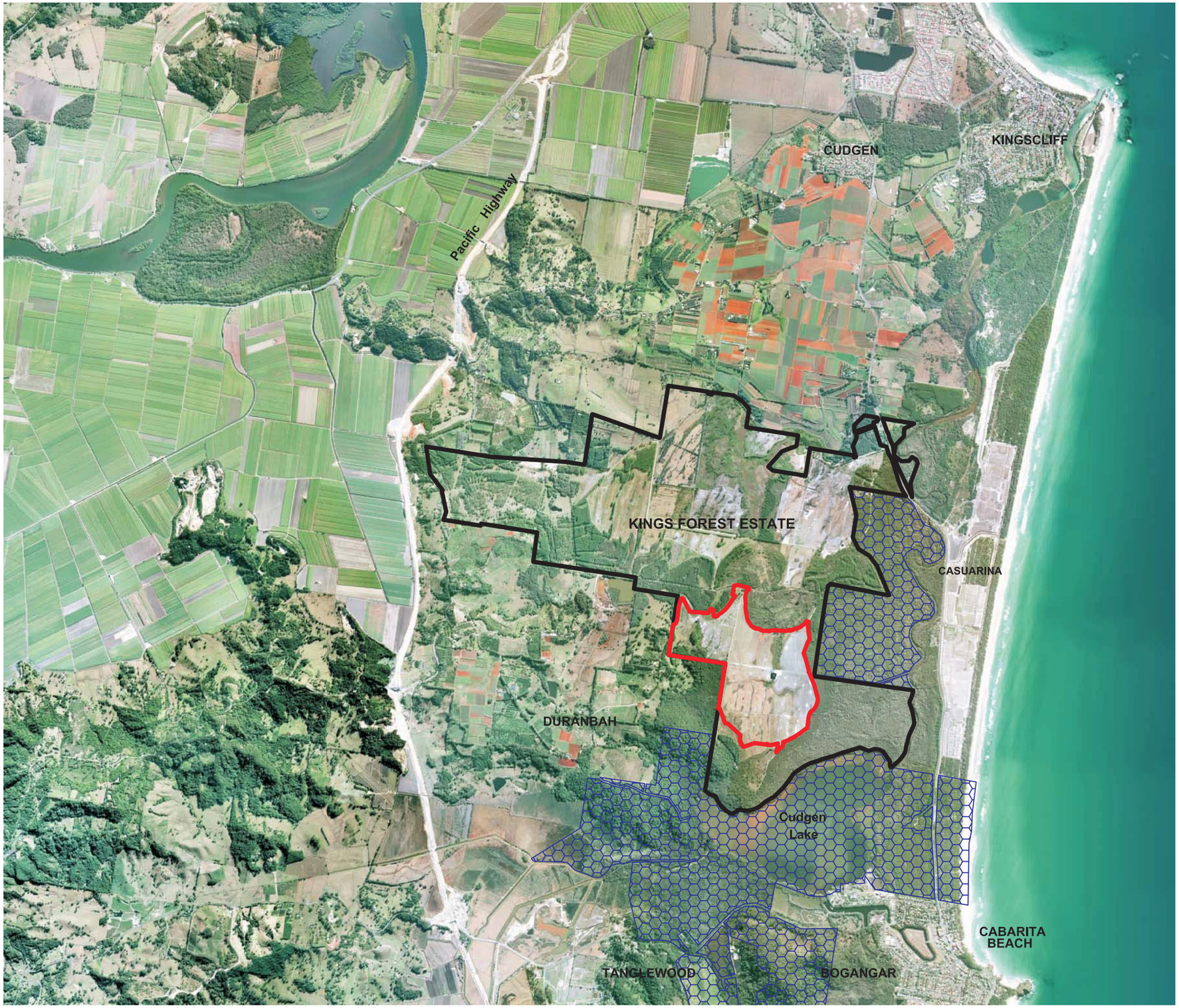
FIGURE 6

PREPARED: BW
DATE: 01 March 2011
FILE: N97017_VMP_Base.dwg

TITLE

SEPP No. 14
COASTAL WETLANDS



N

LEGEND

- Cudgen Nature Reserve
- Precincts 12-14
- Kings Forest Boundary

0 1km

1 : 40 000

SOURCE: NPWS 05.06.06; Leda Developments (Ref: 6400_121.dwg Recd' 09.06.06)

SCALE: 1 : 40 000 @ A3

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FIGURE 7

PREPARED: BW
DATE: 18 April 2011
FILE: N97017_TSMP_Reserves.cdr

TITLE

CUDGEN NATURE RESERVE

3 MANAGEMENT STRATEGIES

3.1 Introduction

The following sections will outline the vegetation management strategies to be carried out within Precincts 12, 13 & 14. The Stage 1 Project Application is for the completion of bulk earthworks only within Precincts 12, 13 & 14. However, it is proposed to commence restoration and enhancement activities immediately upon the completion of bulk earthworks.

The following sections detail strategies for the:

- Protection of environmentally significant site values during bulk earthworks activities; and
- Restoration, enhancement and management of retained vegetation.

Permanent protection measures for environmentally significant site values (i.e. permanent fencing, signage etc.) will be required at the operational phase.

3.2 Protection of ecologically significant site values during bulk earthworks activities

3.2.1 Vegetation Protection

During bulk earthworks activities, temporary high visibility fencing will be erected around the edges of all vegetation to be retained to assist in the protection of the retained vegetation by restricting access from machinery and contractors.

Signage will be provided along all temporary fencing during the construction phase stating "Environmental Protection Zone – No Unauthorised Entry".

3.2.2 Protection of Threatened Flora

A detailed Precinct 12, 13 & 14 TSMP (JWA 2011b) has been prepared outlining specific and detailed management procedures for the protection of Threatened flora species which occur within the vicinity of Precincts 12, 13 & 14.

3.2.3 Protection of EECs

Temporary high visibility fencing erected to protect retained vegetation (i.e. Section 3.2.1) will guard against damage to EEC's during bulk earthworks activities.

Temporary signage will be provided along all temporary fencing during bulk earthworks activities stating "Environmental Protection Zone – No Unauthorised Entry".

3.2.4 Protection of SEPP 14 Wetlands

The SEPP 14 Wetlands adjacent to Precincts 12, 13 & 14 occur within vegetated areas that will be retained**.** Temporary high visibility fencing erected to protect retained vegetation will guard against damage to SEPP 14 Wetlands during the bulk earthworks activities.

Furthermore, Erosion and sediment control devices shall be installed prior to commencement of earth works within Precincts 1 & 5 in accordance with the Erosion & Sediment Control Plan (Gilbert & Sutherland 2011a). This will prevent the movement of sediment into ecologically sensitive areas as well prevent the dispersal of weed seeds and vegetative material.

3.3 Restoration, enhancement and management of retained vegetation

Strategies for the restoration, enhancement and maintenance of significant areas of vegetation, including SEPP 14 wetlands, Environmental Protection Zones and EEC's, are detailed in the Action Plan (i.e. Section 4). Restoration, enhancement and management techniques include:

- Weed control;
- Regeneration/Revegetation;
- Pest Management; and
- Adaptive Management.

This will increase both the quantity and quality of native habitat available to the indigenous flora and fauna.

4 ACTION PLAN

4.1 Introduction

The following sections detail the actions required to ensure the aims and objectives of the VMP are met. The action plan includes the following measures:

- Re-use of topsoil;
- Weed control;
- Regeneration/revegetation measures; and
- Adaptive management.

4.2 Re-use of topsoil to promote natural regeneration

Topsoil is an important source of seeds and propagules and has been effectively used in rehabilitation of native vegetation communities (e.g. Bellairs & Bell 1993; Koch & Ward 1994; Ward et al. 1996**).** Therefore, handled correctly, the topsoil seedbank can be used to successfully revegetate after disturbances like bulk earthworks.

At the commencement of the Stage 1 earthworks at Kings Forest, stockpiles of topsoil will be created. This soil will then be used in the regeneration of the heath communities within the buffer zones.

To optimise the recovery of native vegetation rehabilitation areas it is important to considered the manner in which the top soil is handled. The following should be considered:

- It is important to consider the timing of topsoil recovery. Stripping topsoil immediately after summer seed drop may improve the germinable seed load (Berg 1975);

- The seed bank is usually concentrated in the upper soil layer (i.e. 40–50 mm) so it is important to only remove this depth of soil. A greater depth will dilute the seed bank and reduce the effectiveness of the soil as a potential mechanism for natural regeneration (Putwain & Gillham 1990);

- Topsoil should be used as soon as possible after stripping to prevent loss of seed viability (Koch *et al.* 1996; Mahesh *et al.* 1996); and

- Top soil should be replaced at maximum depths of 100mm (Rokich *et al.* 2000).

4.3 Weed control

Due to the significant disturbance history, Kings Forest supports a variety of weed species. Slash Pine (*Pinus elliottii*) is the most common. Plantations have resulted in the species being naturalised on the site. Progeny range in size from small seedlings to trees 15-20 metres in height. In some areas of the site there is significant invasion into

native vegetation communities, while in other areas there may be only one or two plants.

The aim of weed control within the vicinity of Precincts 12, 13 & 14 is the permanent removal of weeds to enable the protection of the Environmental Protection Zones and the adjacent Cudgen Nature Reserve.

Disturbance during the bulk earthworks activities will create an opportunity for weeds to colonise and establish, therefore weeds should be diligently controlled both during and after completion of bulk earthworks in accordance with the Precinct 12, 13 & 14 WMP (JWA 2011c).

4.4 Regeneration and Revegetation Measures

4.4.1 Background

Due to the large size of rehabilitation areas, rehabilitation will be completed with an emphasis on assisting natural regeneration rather than the labour intensive and costly approach of planting trees, although enhancement planting will still be completed in some areas.

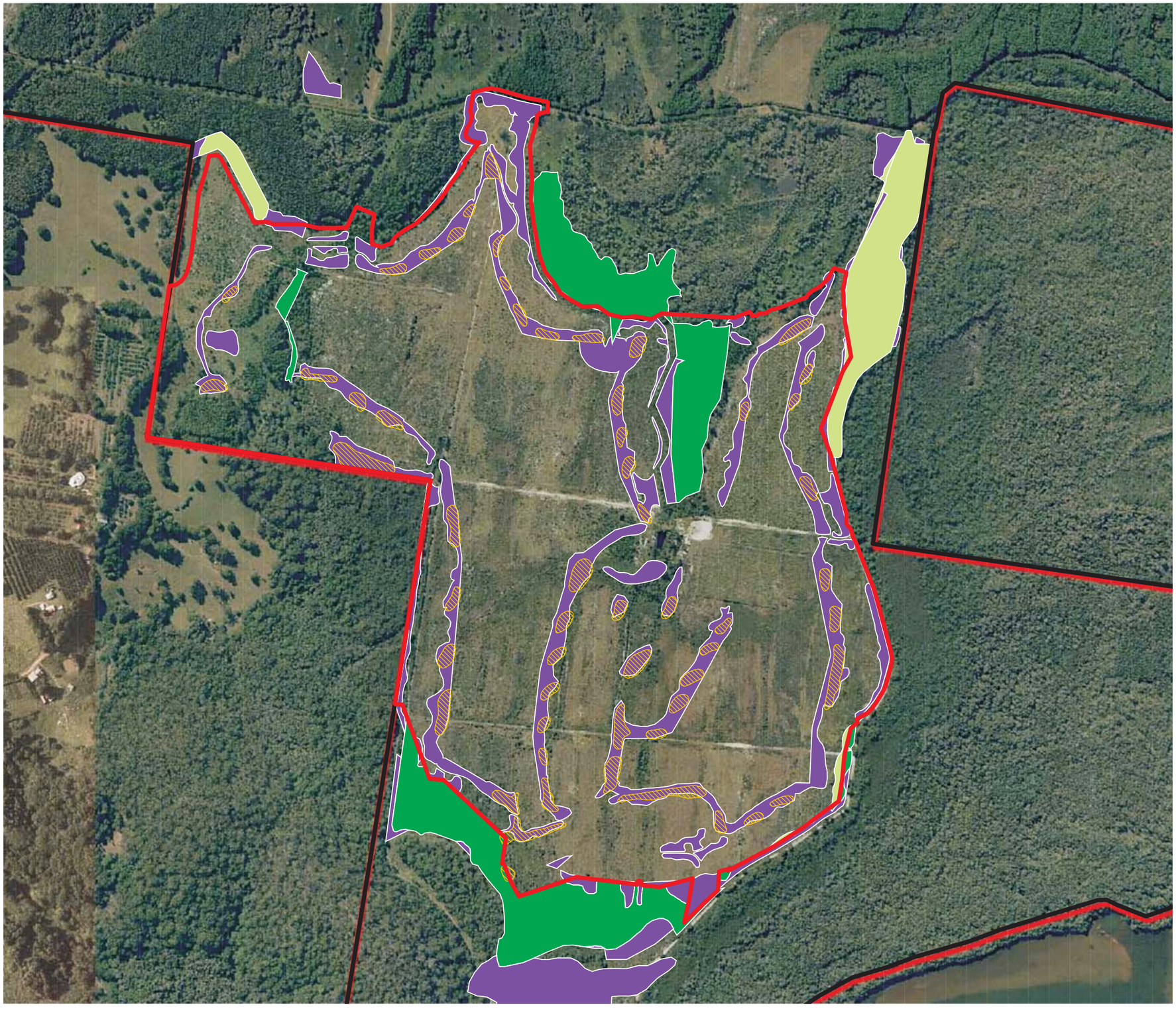
Natural regeneration is already occurring within some areas of the site and will be encouraged within retained vegetation communities. Rehabilitation/Regeneration works to be completed within Precinct 12, 13 & 14 Environmental Protection Zones and the golf course will generally include a combination of:

- Assisted natural regeneration where appropriate;
- Planting of preferred Koala food trees in accordance with the KPoM (**FIGURE 8**);
- Creation of core Acid frog compensatory habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b); and
- Regeneration/revegetation of heath communities (**FIGURE 8**).

It should be noted that there is some overlap in the characteristics and objectives of proposed regeneration/revegetation areas at the Kings Forest site. For example, Koala food tree planting areas will also provide opportunities for revegetation with heath species (i.e. Koala food tree species will form the canopy with heath species forming the sub-canopy and understorey). Similarly, the creation of acid frog compensatory habitat provides an opportunity for further planting of scattered Koala food trees and wet heath species. The resulting revegetation areas will be structurally diverse and more closely mimic intact native vegetation communities.

A suitably qualified Bush Regeneration Company will be engaged to complete necessary rehabilitation works. The Bush Regeneration Company will employ qualified Bush Regenerators, including a Regeneration Site Manager, who will be responsible for all project management and staff supervision, and report directly to the site Ecologist.

Techniques to be employed to facilitate natural regeneration will be in accordance with those promoted by the Australian Association of Bush Regenerators (AABR).



N

LEGEND

- Existing Heathland & Shrubland to be Retained within Environmental Protection Zones
- Heathland to be Naturally Regenerated
- Heathland to be Revegetated
- Koala Rehabilitation Areas
- Precincts 12-14
- Kings Forest Boundary

0 100m 200m

1 : 8000

SOURCE: JWA Site Investigations; Landpartners Figure 1 Koala Tree Planting Plan

SCALE: 1 : 8000 @ A3

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Shire of Tweed

FIGURE 8

PREPARED: BW
DATE: 21 April 2011
FILE:N97017_VMP_R&R Areas.cdr

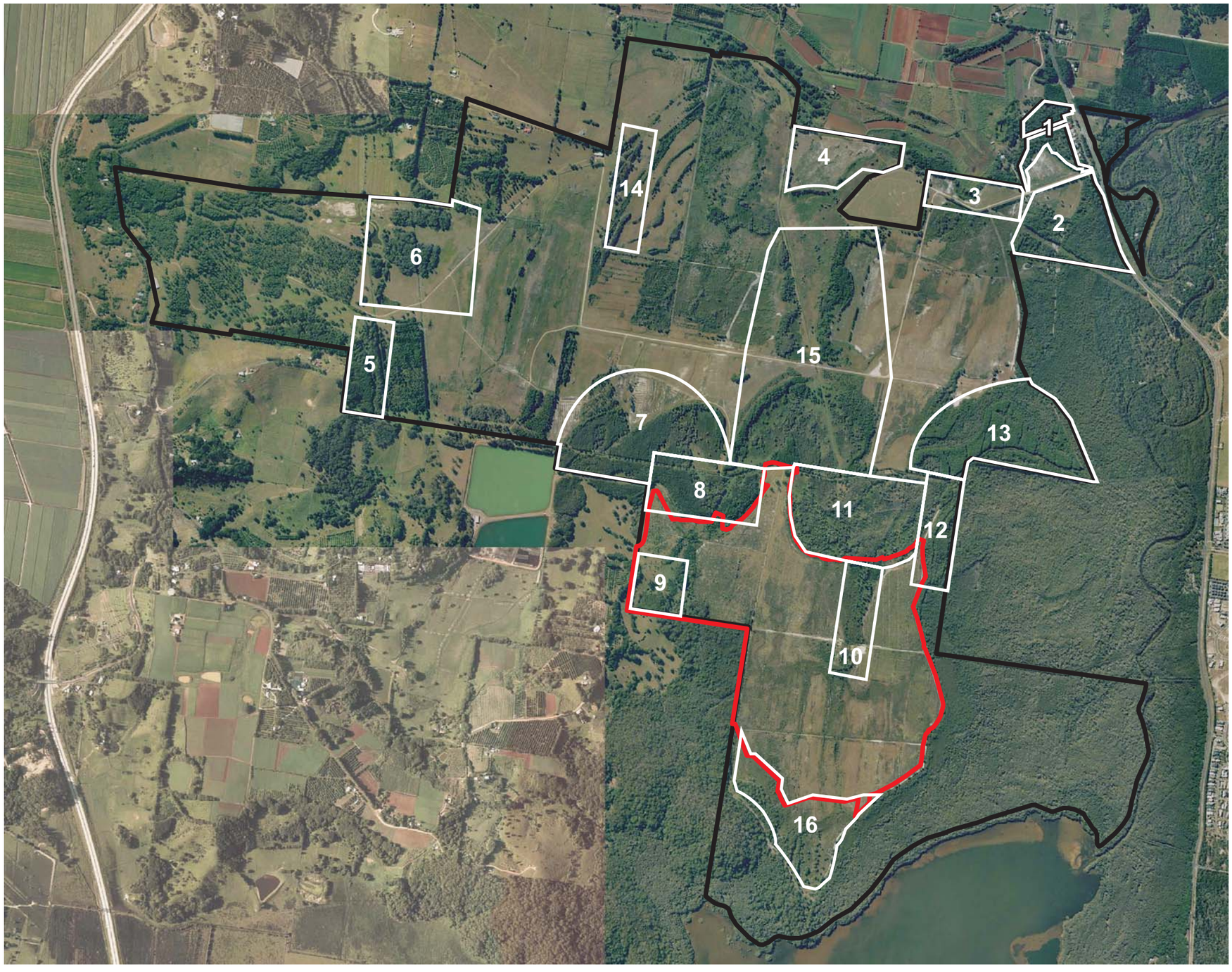
TITLE

REGENERATION & REVEGETATION AREAS

4.4.2 Work Areas

The Revised Vegetation Management Plan (LandPartners 2009) identifies eighteen (18) work areas across the Kings Forest site. Work Areas 8, 9, 10, 11, 12, and 16 are relevant to Precinct 12, 13 & 14 Environmental Protection Zones **(FIGURE 9).**

Furthermore, portions of the Precinct 12, 13 & 14 EPZ's and the golf course have been identified as requiring regeneration and/or revegetation works during recent site assessments and occur outside of the LandPartners work areas. These are included in the following works schedule as 'Additional Work Areas'.



LEGEND

- Vegetation Work Unit
- Precincts 12 & 13
- Kings Forest Boundary

N

0 500m

1 : 20 000

SOURCE: Landpartners Revised Vegetation Management Plan (2009) Figure 9

SCALE: 1 : 20 000 @ A3

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FIGURE 9

PREPARED: BW
DATE: 01 March 2011
FILE: N97017_VMP_Veg Mgt.cdr

TITLE

VEGETATION MANAGEMENT AREAS

4.4.3 Works schedule

The following works schedule summarises the regeneration/revegetation works relevant to the Precinct 12, 13 & 14.

Work unit	Proposed measures
8	➢ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 8**). ➢ Koala food trees also to be planted in accordance with the KPoM (**FIGURE 8**). ➢ Ripping within heath/grassland communities to promote regeneration.
9	➢ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 8**). ➢ Koala food trees also to be planted in accordance with the KPoM (**FIGURE 8**). ➢ Buffer plantings (rainforest species) within ecological and agricultural buffer areas.
10	➢ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 8**). ➢ Koala food trees also to be planted in accordance with the KPoM (**FIGURE 8**). ➢ Ripping to promote heathland regeneration. ➢ Opportunity for extensive rehabilitation of dam with wetland plantings.
11	➢ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 8**). ➢ Koala food trees also to be planted in accordance with the KPoM (**FIGURE 8**). ➢ Ripping to promote heathland regeneration around edges.
12	➢ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 8**). ➢ Koala food trees also to be planted in accordance with the KPoM (**FIGURE 8**). ➢ Ripping to promote heathland regeneration.

Work unit	Proposed measures
16	➢ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 8**). ➢ Koala food trees also to be planted in accordance with the KPoM (**FIGURE 8**). ➢ Ripping of grasses to promote regeneration of heath.
Additional Work Areas	➢ Cleared/disturbed areas within the EPZ's and within the golf course will be the focus for the creation of core Acid frog habitat in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b) and are to be revegetated with heath species (**FIGURE 8**). ➢ Ripping should be considered where appropriate to promote natural heath regeneration.

4.4.4 Methodology

4.4.4.1 Planting methods

A general methodology for the planting of any trees/shrubs or groundcovers is as follows:

- Stockpiled topsoil is to be spread within revegetation areas where required.
- Where exotic grasses occur within planting areas they are to be sprayed with Glyphosate at least 2 weeks prior to planting.
- Plant holes to be dug to at least twice the root ball height and width.
- Soil is to be loosened, wetted and then the plant hole to be back filled with excavated soil.
- Weed free mulch should be applied to a minimum 75mm depth around the base of the plants but not adjacent to the stem.
- Plantings are to be protected with bags (e.g. gro-bags) held in position with bamboo stakes.
- Appropriate wallaby protection measures must be implemented to optimise survival of plantings (refer 'Wallaby Protection' section below).
- Plantings are to be watered for the first 3 months. Heavy mulching will reduce the need for regular watering, provided it is replaced at between 6-12 month intervals.
- Ongoing monitoring of native species recruitment maintenance of enhancement planting works and control of environmental weeds are to be undertaken throughout the proposed five year plan and beyond.
- Native species from locally sourced seed stock only are to be planted wherever possible. Consideration should be given to setting up an on-site nursery to assist in the collection and propagation of endemic native seed for revegetation on site. Alternatively, plants should only be sourced from local nurseries that can provide proof of local provenance (i.e. within 20km of the site).
- Revegetation is to include canopy as well as sub-canopy and understorey species (Section 4.4.5). Canopy species will generally be comprised of Koala food tree species. Sub-canopy and understorey species will generally be comprised of heath species. A species list is also provided for revegetation in areas not suitable for Koala feed trees and/or heath species.
- Plant spacing is flexible, for instance in areas which act as Asset Protection Zones, spacing of canopy trees will be greater (e.g. 10 m). Generally, plants are spaced according to the following prescriptions:
    - 3m spacing for trees (upper canopy plants),
    - 1.5m spacing for shrubs and small trees (midstorey plants), and
    - 1m spacing for groundcover (ground storey plants up to 1.5m in height).

4.4.4.2 Wallaby protection

The site is inhabited by a large population of Swamp wallabies which are likely to browse any newly planted trees, causing potential death of plants. A combination of the following measures should be considered for the protection of plants on a site by site basis:

- protective bags;
- wallaby repellents (eg. Sen-Tree®); and
- Wallaby-proof fencing using star pickets and pig mesh.

4.4.4.3 Koala Feed Trees

Planting of Koala feed and shelter trees is recommended within numerous work zones to establish linkages between areas of Koala habitat and to increase foraging resources for the species at the site in the long term (in accordance with the Stage 1 KPoM [JWA 2011a]) (**FIGURE 8**). Faecal cuticle analysis undertaken by James Warren & Associates (Warren 2000) showed that the main species consumed by Koalas at the time of the SIS were Swamp mahogany (*Eucalyptus robusta*) and Swamp box (*Lophostemon suaveolens*) with smaller amounts of Brushbox (*L. confertus*), Blackbutt (*E. pilularis*) and Broad-leaved paperbark (*Melaleuca quinquenervia*).

Therefore tree species nominated for planting include known feed tree species identified at the site (Swamp mahogany and Swamp box) in addition to other species such as Brushbox and Blackbutt (as per JWA), Red mahogany, Tallowwood and Forest red gum (Approved Koala Recovery Plan, DECC 2008). Koala feed trees should only be planted where conditions are appropriate (i.e. soils, topography, vegetation) so that plantings are compatible with any existing natural vegetation. For example species such as Tallowwood should be planted in higher elevation parts of the site, while planting which occurs in proximity to large areas of naturally occurring vegetation should be more conservative in its species selection and utilise species which commonly occur in surrounding vegetation (e.g. Swamp mahogany, Swamp box, Blackbutt, Forest red gum). Areas identified within the KPoM (JWA 2011a) for planting preferred Koala food trees are shown in **FIGURE 8**.

4.4.4.4 Acid Frog Compensatory Habitat

It is proposed to create Core Acid frog habitat within Environmental Protection Zones (EPZ's), ecological buffers and the golf course on the Kings Forest site in accordance with the Precinct 12, 13 & 14 TSMP (JWA 2011b). Areas requiring rehabilitation works within EPZ's and buffers will be targeted for the creation of Core Acid Frog habitat.

The compensatory habitat areas will be planted with a combination of Swamp sclerophyll (i.e. Swamp mahogany & Broad-leaved paperbark) and Wet heath species.

4.4.4.5 Heath regeneration/revegetation

FIGURE 8 identifies proposed rehabilitation areas on the subject site which are currently comprised of regenerating heath communities, or are suitable for revegetation with heath species. The basis for revegetation with wet vs. dry heath vegetation will be determined by the topography of each revegetation area. Species lists are provided in **Section 4.4.5**.

4.4.4.6 Enhancement Plantings

In areas where extensive weed infestations have been removed or where Slash pine has been harvested (i.e. leaving large cleared areas) that are not suitable for revegetation with Koala food trees or heath regeneration/restoration, enhancement plantings with other locally endemic species will be completed. Additional species lists for each Work area are provided in **Section 4.4.5.3**.

4.4.5 Species Schedule

4.4.5.1 Heath species

Where heath revegetation is necessary (**FIGURE 8**), the following sub-canopy and understorey species are to be utilised:

Common name	Botanical name
Dry heath species*	
Sweet wattle	*Acacia suaveolens*
Prickly moses	*Acacia ulicifolia*
Heath aotus	*Aotus ericoides*
Wooly aotus	*Aotus lanigera*
Starhair bush	*Astrotricha longifolia*
Midgenberry	*Austromyrtus dulcis*
Wallum banksia	*Banksia aemula*
Heath-leaved banksia	*Banksia ericifolia*
Hairpin banksia	*Banksia spinulosa var. collina*
Milkmaids	*Burchardia umbellata*
Curly wigs	*Caustis recurvata*
Christmas bush	*Ceratopetalum gummiferum*
Pink matchheads	*Comesperma ericinum*
Blue dampiera	*Dampiera stricta*
Blue flax-lilly	*Dianella caeruela*
Rolled flax-lilly	*Dianella revoluta*
Eggs & bacon pea	*Dillwynia retorta*
Hopbush	*Dodonaea triquetra*
Wiry panic	*Entolasia stricta*

Common name	Botanical name
Wallum heath	*Epacris pulchella*
Pinnate wedge pea	*Gompholobium pinnatum*
Slender bloodroot	*Haemodorum tenuifolium*
Finger hakea	*Hakea dactyloides*
Narrow-leaved guinea flower	*Hibbertia linearis*
Hoary guinea flower	*Hibbertia obtusifolia*
Hairy guinea flower	*Hibbertia vestita*
Dogwood	*Jacksonia scoparia*
Wire lilly	*Laxmannia gracilis*
Sword sedge	*Lepidosperma laterale*
Knotted scale-rush	*Lepyrodia interrupta*
Erica heath	*Leucopogon ericoides*
Lance beard heath	*Leucopogon lanceolatus*
Wire beard-heath	*Leucopogon microphyllus*
Coast beard heath	*Leucopogon parviflorus*
Common beard-heath	*Leucopogon virgatus*
Screw fern	*Lindsaea linearis*
Long-leaved matrush	*Lomandra longifolia*
Many-flowered matrush	*Lomandra multiflora*
Crinkle bush	*Lomatia silaifolia*
Large nectar heath	*Melichrus adpressus*
Jam tarts	*Melichrus procumbens*
Broom heath	*Monotoca elliptica*
Prickly-leaved monotoca	*Monotoca scoparia*
White dogwood	*Ozothamnus diosmifolius*
Broad-leaved geebung	*Persoonia cornifolia*
Small-leaved geebung	*Persoonia virgata*
Candlesticks	*Petrophile canescens*
Conesticks	*Petrophile pulchella*
Heath phyllota	*Phyllota phylicoides*
Slender riceflower	*Pimelea linifolia*
Heathy platysace	*Platysace ericoides*
Shrubby platysace	*Platysace lanceolata*
Pomax	*Pomax umbellata*
Bracken	*Pteridium esculentum*
Green styphelia	*Styphelia viridis*
Black-eyed susan	*Tetratheca thymifolia*
Kangaroo grass	*Themeda australis*
Yellow rush-lilly	*Tricoryne elatior*
Austral bluebell	*Wahlenbergia gracilis*
Woollsia	*Woollsia pungens*

Common name	Botanical name
Wooly xanthosia	*Xanthosia pilosa*
Twiggy zieria	*Zieria minutiflora*
Sandfly zieria	*Zieria smithii*
*Wet heath species**	
Swamp wattle	*Acacia elongata*
Heath aotus	*Aotus ericoides*
Wooly aotus	*Aotus lanigera*
Necklace fern	*Asplenium flabellifolium*
Heath myrtle	*Baeckea imbricata*
Feathertop	*Baloskion tetraphyllum*
Heath banksia	*Banksia ericifolia*
Swamp banksia	*Banksia robur*
Jointed twig-rush	*Baumea articulata*
Wallum boronia	*Boronia falcifolia*
Swamp boronia	*Boronia parvifolia*
Milkmaids	*Burchardia umbellata*
Pale grass-lilly	*Caesia parviflora*
Wallum bottlebrush	*Callistemon pachyphyllus*
Curly wigs	*Caustis recurvata*
Swamp parrot pea	*Dillwynia floribunda*
Tall sundew	*Drosera auriculata*
Rosette sundew	*Drosera spathulata*
Spreading rope-rush	*Empodisma minus*
Coral heath	*Epacris microphylla*
Blunt-leaf heath	*Epacris obtusifolia*
Swamp mahogany	*Eucalyptus robusta*
Tall saw-sedge	*Gahnia clarkei*
Red-fruited saw-sedge	*Gahnia sieberana*
Coral fern	*Gleichenia dicarpa*
Rocket goodenia	*Goodenia bellidifolia*
Slender bloodroot	*Haemodorum tenuifolium*
Sword sedge	*Lepidosperma laterale*
Prickly tea-tree	*Leptospermum juniperinum*
Lemon-scented tea-tree	*Leptospermum liversidgei*
Knotted scale-rush	*Lepyrodia interrupta*
Slender clubmoss	*Lycopodium laterale*
Thyme honeymyrtle	*Melaleuca thymifolia*
Heath phyllota	*Phyllota phylicoides*
Slender rice-flower	*Pimelea linifolia*
Feather plant	*Restio pallens*
Common bog rush	*Schoenus apogon*

Common name	Botanical name
	Schoenus paludosus
Swamp clubmoss	*Selaginella uliginosa*
Swamp heath	*Sprengelia sprengelioides*
Spoon-leaf goodenia	*Valleia spathulata*
Swamp grasstree	*Xanthorrhoea fulva*

* The basis for revegetation with wet vs. dry heath species will be determined by the topography of the revegetation area.

4.4.5.2 Koala food tree species

Where revegetation with preferred Koala food trees is necessary (**FIGURE 8**), the following canopy species are to be utilised:

Koala food trees	
Tallowwood	*Eucalyptus microcorys*
Blackbutt	*Eucalyptus pilularis*
Red mahogany	*Eucalyptus resinifera*
Swamp mahogany	*Eucalyptus robusta*
Forest red gum	*Eucalyptus tereticornis*
Brushbox	*Lophostemon confertus*
Swamp box	*Lophostemon suaveolens*
Broad-leaved paperbark	*Melaleuca quinquenervia*

4.4.5.3 Additional plant species

Additional canopy, sub-canopy and understorey plant species (i.e. for areas not suitable for Koala feed trees and/or heath species) are listed below.

Common name	Botanical name
Baumea*	*Baumea rubiginosa*
Blueberry ash	*Elaeocarpus reticulatus*
Broad-leaved paperbark	*Melaleuca quinquenervia*
Club rush*	*Schoenoplectus validus*
Common reed*	*Phragmites australis*
Corkwood	*Duboisia myoporoides*
Common spikerush*	*Eleocharis acuta*
Rusty sedge*	*Fimbristylis ferruginea*
Black wattle	*Acacia melanoxylon*
Scribbly sum	*Eucalyptus racemosa*
Giant sedge*	*Lepironia articulata*
Willow bottlebrush	*Callistemon salignus*

* Macrophytes to be planted in areas of shallow water and surrounds.

4.5 Adaptive Management

Adaptive management is an approach that involves learning from management actions, and using those lessons to improve upon the overall plan. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997). Comprehensive, long-term monitoring is a component of adaptive management as adaptive management strategies rely on the accumulation of evidence supporting decisions that demand changes in action.

An adaptive management approach involves an integrated process of firstly monitoring, then reviewing and responding to the health and conditions of the plantings, natural regeneration and the status of the weed infestation. Alteration to the design and maintenance of works required, to ensure the objectives of the VMP are achieved, are then made.

Adaptive management strategies will be determined by the information provided in monitoring reports. Adaptive management strategies that may be required within this VMP are as follows:

- Amendment of species list for revegetation works;
- Replacement of enhancement plantings that do not survive;
- Alteration of weed control methods or timing.

Before the implementation of any adaptive management strategy a brief report is be provided to Project 28 Pty Ltd and other relevant agencies detailing the proposed management actions and the predicted outcomes. The implementation must be approved by the relevant authority prior to implementation.

5 MONITORING AND REPORTING

5.1 Introduction

Monitoring is an essential component of this VMP and associated rehabilitation works. The condition of revegetation areas can be assessed by checking environmental conditions and matching these with management aims and objectives. The results obtained through monitoring can help managers to prioritise management actions and keep track of the health of rehabilitated areas.

A well-designed monitoring program will allow project managers to detect results months, years, or decades following implementation of a plan. This section outlines the monitoring requirements for the Precinct 12, 13 & 14 VMP.

5.2 Rehabilitation Monitoring

5.2.1 *Monitoring requirements*

The vegetation monitoring will include regular visits by a qualified ecologist who is to complete the following:

- Transects
  - Ten (10) transects are to be placed within the retained vegetation areas;
  - Transect locations are to be permanently marked;
  - Transects are to be 30 metres in length;
  - During monitoring visits tape measures are to be placed on the ground and the specific measureable features recorded along the transects;
  - Specific measurable features include:
    - Areas of vegetation cover (native species);
    - Areas of weed cover;
    - Areas of bare ground/mud;
    - Number, percentage and species of planted stems surviving;
  - Results are to be shown in a table which is to be presented in the monitoring reports.

- Quadrats
  - Three (3) quadrats ($1m^2$) are to be placed along each of the transects;
  - Quadrats must be placed a minimum of 5m apart along the length of the transect;
  - Quadrats are to be placed randomly within five (5) meters of the transect line;
  - The boundary of the quadrat with respect to the tape measure (e.g. between 3.5 – 4.5 metres on tape measure) will be recorded;
  - For each quadrat the following specific measurable features will be recorded:

        - Plant species occurring
        - Percentage cover
        - Height
        - Relative abundance of native species
        - Weed cover
        - Number, percentage and species of planted stems surviving
    - Results are to be shown in a table which is to be presented in the monitoring reports.

- Fixed Photo points
    - A central transect marker on each established monitoring transect is to be used as permanent photo station for photographic monitoring;
    - Four (4) photos are to be taken from each central transect marker. Photos are to be taken to the north, south, east and west;
    - Photos should be labelled with the:
        - Transect code
        - Direction of view
        - The date & time
    - Photos must be supplied in the monitoring reports in a form of prints no smaller than 4" x 6" and must be colour.

5.2.2 *Timing of monitoring visits*

The monitoring is to be completed by a suitably qualified ecologist. Site visits should occur:

- Six (6) weeks after primary weeding;
- Six (6) weeks after initial plant-out;
- Every six (6) months thereafter until groundcovers are sufficiently established (i.e. between two (2) - three (3) years)
- Annually after establishment until completion criteria are met (refer Section 5.3).

5.2.3 *Long term Monitoring*

Along with the regular monitoring within the EPZ's, the overall vegetation composition is to be regularly assessed and recorded. Long term monitoring will use both aerial photos and yearly assessments (ground truthing) of the vegetation communities using a hand held GPS.

The Long term monitoring of the vegetation composition within the EPZ's will include:

- A detailed vegetation map at a scale of 1:5,000 is to be completed within the EPZ's every twelve (12) months;
- Each year, after completion of vegetation mapping, a report is to be completed showing the changes in the composition of the vegetation communities. The results are to be shown in a table that shows the

vegetation community and the area of the vegetation community as a percentage of the EPZ's. Monitoring will continue until completion criteria are met.

5.3 Performance Criteria

A number of criteria will indicate successful rehabilitation of the EPZ's, including:

- Survival of 95% of stems planted;
- Establishment of a 70% native ground cover after 2-3 years;
- Average percentage cover of 90% native ground cover at the 5th year;
- Noxious weeds are to be eradicated and environmental weeds less than 1% of the area;
- Natural recruitment of native seedlings throughout planting areas;
- Maintenance of 100% of planted diversity; and
- Plantings providing variable habitats for native fauna species.

Performance criteria will be assessed for the EPZ's as follows:

- The photos taken during monitoring visits, in combination with the annual monitoring and mapping of native vegetation composition and the results of the annual flora survey, will be used to determine the extent of native plant species and the levels of biodiversity the area is supporting.
- When it is determined that all performance criteria have been met, completion will have occurred.

5.4 Reporting

Following each inspection by the qualified ecologist, a report will be prepared that will include tables and photographs from the monitoring visits. At the end of each year a detailed report will be prepared for the Department of Environment, Climate Change & Water (DECCW) and Tweed Shire Council. The report will discuss the following:

- Works undertaken;
- Progress of regeneration/revegetation areas against completion criteria using photos and tables showing the results of the monitoring visits;
- Significant problems encountered (death of seedlings, broken fences, vandalism etc.) and the effect of these on the plantings and aims of the revegetation or regeneration strategy;
- Success or failures of measures implemented to rectify previously identified problems;
- Measures to be taken to rectify new problems; and
- Performance against performance criteria (Section 5.3).

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