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KINGS FOREST

FERAL ANIMAL MANAGEMENT PLAN

A Report Prepared for
Project 28 Pty Ltd

DECMBER 2020

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1 INTRODUCTION

1.1 Background

JWA Pty Ltd have been engaged by Project 28 Pty Ltd (Project 28) to prepare a Feral Animal Management Plan (FAMP) for the Kings Forest project site. The Kings Forest site is 846 hectares in area and is located in the coastal zone of the Tweed Shire Local Government Area (LGA). The Kings Forest site was zoned for residential and commercial development in the early 1990s and has been subject to a lengthy Commonwealth, State and Council approval process. Numerous ecological studies have been completed on the site over the last 30 years including detailed flora, fauna and hydrological surveys.

For the purposes of this Plan, the Kings Forest site also includes the area of the adjacent property known as "Turners Land" (Lot 51 DP 1188902) which is to be used to create compensatory koala habitat.

The impacts of the feral animals known to occur on the Kings Forest site are related to their predation of, and competition with, native species of fauna (particularly threatened species) and their affect upon the biodiversity of a given area by modifying species richness, abundance and ecosystem function (NPWS 2003a). Mosquitoes and biting midge are abundant in this region and the extensive areas of wet low-land and intertidal areas along the Tweed coastal districts contain many suitable breeding sites for these insects. As a result of the proximity of these low-lands to urban areas, biting insect nuisance is likely to occur seasonally in many areas.

This FAMP provides specific measures for mitigating and/or minimising the potential impacts of feral animals on native fauna species and the potential impacts of biting insects (i.e. midges and mosquitoes) on the future human population as a result of development activities over the Kings Forest site. There are a number of strategies potentially available for the control of feral animals and biting insects known or considered to potentially occur on the Kings Forest site and each has advantages and disadvantages. These strategies have been reviewed and recommendations made as to which may be most appropriate to employ on the Kings Forest site. Recommendations are also provided with regard to the timing of the implementation of the various strategies. Specific management actions discussed in this FAMP will be triggered and completed over the Kings Forest site on a pre-construction, construction and operational phase basis.

1.2 Aim and Objectives

This FAMP is intended to assist Project 28 in managing and mitigating the impacts that feral animals may have on native fauna species and the impacts that biting midges and mosquitoes may have on the human population of Kings Forest.

The aim of this FAMP is to develop a comprehensive and integrated approach to guide the immediate and ongoing management of feral animals and biting insects on the Kings Forest site and to ensure the protection of native fauna species, with a primary focus on threatened species.

Specific objectives are to:

- Review relevant literature on feral animal and biting insect control;
- Identify feral animals which have been recorded at the site;
- Prioritise species considered to warrant priority management;
- Examine control and/or eradication methods for 'high priority' feral animals and biting insects; and
- Recommend ongoing control methods, including monitoring and reporting.

1.3 Compliance with Relevant Approval Conditions

On the 19th January 2007, the NSW Minister for Planning authorised a Concept Plan (06_0318) for a proposed residential community at Kings Forest. The Minister for Planning granted part 3A approval (with conditions) for the Concept Plan for Kings Forest in August 2010. A FAMP was prepared in accordance with the Concept Plan approval conditions.

The Kings Forest Stage 1 Project Application (MP 08_0194) was lodged in November 2011. The Project Application was approved (with conditions) on the 11th August 2013. Conditions of this approval required that all environmental management plans be revised.

On the 21st May 2015 the Commonwealth Department of Environment approved (with conditions) the Kings Forest residential development (EPBC 2012/6328). The Commonwealth approval is confined to the mitigation of impacts of the proposed development on the koala and wallum sedge frog, both of which are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). There are no EPBC Act approval conditions specifically relating to feral animal management on the Kings Forest development site.

Since the Commonwealth approval decision, Project 28 have been liaising with Tweed Shire Council (TSC) and the NSW Department of Planning, Industry and Environment (DPI&E) to reconcile all approval conditions.

This FAMP has been prepared to comply with all relevant Commonwealth, State and Local Government approval conditions. **APPENDIX 1** contains the details of the following relevant Consolidated Approval Conditions and also notes where they are addressed in this FAMP:

- Concept Plan 06_0318 Consolidated Approval Conditions incorporating the following:
    - Modification No. 1, approved on 22 December 2010;
    - Modification No. 2, approved on 11 August 2013;
    - Modification No. 3, approved on 16 May 2014;
    - Modification No. 4, approved on 20 November 2014;
    - Modification No. 5, approved on 10 November 2015;
    - Modification No. 8, approved on 24 May 2018;

- Project Approval 08_0194 Consolidated Approval Conditions incorporating the following:
    - Modification No. 1, approved on 16 May 2014;
    - Modification No. 2, approved on 20 November 2014;
    - Modification No. 3, approved on 20 February 2017;
    - Modification No. 6, approved on 21 December 2017; and
    - Modification No. 7, approved 24 May 2018.

JWA hereby certify that this FAMP has been prepared in accordance with the requirements of Condition C2 of Concept Plan Approval No. CP06_0318 (as modified) and generally in accordance with the requirements of Conditions 39 and 43 of Major Project Approval No. MP08_0194 (as modified) for Kings Forest Stage 1.

1.4 Related Management Plans Prepared for the Kings Forest Site

A number of management plans were completed for the Kings Forest Stage 1 Project Application and approved under Project Approval 08_0194. Subsequent to their approval, significant work has been completed on the site. Several of these management plans have therefore been amended (and others will need to be amended) as required by Condition 39 of MP 08_0194.

This FAMP should be read in conjunction with the following documents prepared for the Kings Forest development:

- Kings Forest Koala Plan of Management (KPoM) (JWA 2019);
- Kings Forest Wallum Sedge Frog Management Plan (WSFMP JWA 2020a);
- Kings Forest Precincts 1- 5 Buffer Management Plan (BMP) (JWA 2020b);
- Kings Forest Precincts 6 – 14 Buffer Management Plan (BMP) (JWA 2020c);
- Kings Forest Precincts 1 – 5 Threatened Species Management Plans (TSMP) (JWA 2020d);
- Kings Forest Precincts 6 – 11 Threatened Species Management Plans (TSMP) (JWA 2020e);
- Kings Forest Precincts 12 - 14 Threatened Species Management Plans (TSMP) (JWA 2020f);
- Kings Forest Precincts 1 – 5 Vegetation and Weed Management Plan (VWMP) (JWA 2020g);
- Kings Forest Precincts 6 – 11 Vegetation and Weed Management Plan (VWMP) (JWA 2020h);
- Kings Forest Precincts 12 - 14 Vegetation and Weed Management Plan (VWMP) (JWA 2020i);
- Kings Forest Flora and Fauna Monitoring Report (JWA 2020j);
- Kings Forest Stage 1 Bushfire Risk Management Plan (BushfireSafe 2020);
- Kings Forest Koala Fire Management Plan (Wildsite 2020);

- Construction Environmental Management Plan (CEMP) (MUS 2020);
- Kings Forest Summary of Management Plans (SOMP) (G&S 2020a); and
- Kings Forest Overall Water Management Plan (OWMP) (G&S 2020b).

APPENDIX 2 provides further details of these management plans and details of their relationship to the FAMP.

1.5 Relevant Biosecurity Legislation, Strategies, Policies and Procedures

Relevant legislation applicable to this FAMP includes:

- NSW *Biodiversity Conservation Act* (2016).
- NSW *Environmental Planning and Assessment Act (1979)*.
- NSW *National Parks and Wildlife Act (1974)*.
- NSW *Pesticides Act (1990)*.
- NSW *Prevention of Cruelty to Animals Act* (*1979*).
- NSW *Biosecurity Act (2015)* - regulates for the control and management of invasive weed species in NSW.
- NSW *Companion Animals Act (1998)* - Regulates for the responsibilities for control of domestic dogs and cats.
- NSW *Local Land Services Act (2013)* - Regulates pest control orders and eradication orders for declared pests. The wild dog and European Red Fox are both declared pests known to occur in the project area.
- Commonwealth *Biosecurity Act* (2015).

Of particular relevance are the *Biosecurity Act (2015)*, the *Companion Animals Act (1998)*, and *the Local Land Services Act (2013)*. It is also noted that all landholders have a "general biodiversity duty" under the *Biosecurity Act (2015)* to manage all pest species on their land.

This FAMP is also to be implemented in accordance with the following documents:

- North Coast Regional Strategic Weed Management Plan 2017 - 2022 (NCLLS 2017);
- North Coast Regional Strategic Pest Animal Management Plan 2018 – 2023 (NCLLS 2018);
- Humane Pest Animal Control – Codes of Practice and Standard Operating Procedures (DPI 2005);
- NSW Wild Dog Management Strategy 2017 - 2021 (DPI 2017);
- any relevant Priority Action Statements/Recovery Plans/Saving Our Species (SOS) programs for relevant threatened species (www.threatenedspecies.environment.nsw.gov.au); and
- any relevant Pesticide Control Orders.

The following Pesticides Control Orders currently apply to both public and private land managers and establish obligations under the NSW *Local Land Services Act (2013*) to manage declared pests on their land:

- Pesticide Control (1080 Bait Products) Order 2020;
- Pesticide Control (Pindone Products) Order 2010; and
- Pesticide Control (1080 Ejector Capsules) Order 2015.

2 SITE DESCRIPTION

2.1 Locality

Kings Forest is located on the far north coast of NSW in the Tweed local government area (LGA) approximately 20 km south of the Queensland/NSW border, 5 km north-west of the village of Bogangar and 4 km south-west of Kingscliff (**FIGURE 1**).

2.1 Subject Site

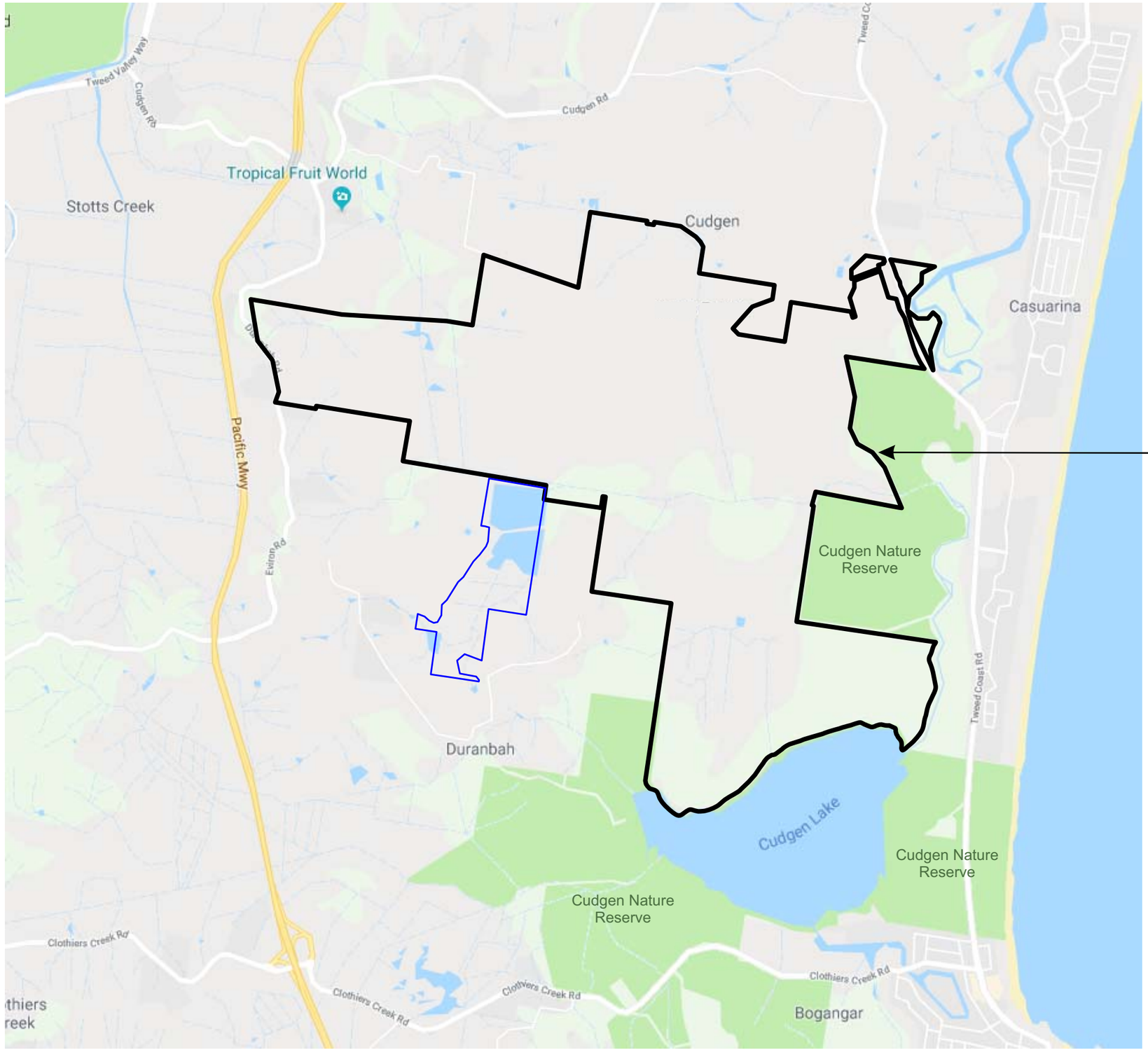
The Kings Forest site is comprised of fourteen (14) land parcels with a total area of 846 hectares:

- Lot 76, 272, 323 and 326 in DP 755701;
- Lot 6 in DP 875446;
- Lot 2 in DP 819015;
- Lot 1 in DP 706497;
- Lot 40 in DP 7482;
- Lot 37A in DP 13727;
- Lot 38A in DP 13727;
- Lot 38B in DP 13727;
- Lot 1 in DP 129737;
- Lot 1 in DP 781633; and
- Lot 7 in DP 875447.

An additional parcel of land referred to as 'Turners Land' (i.e. Lot 51 DP 1188902) occurs immediately to the south of the western portion of the Kings Forest site and is included within the land subject to this FAMP.

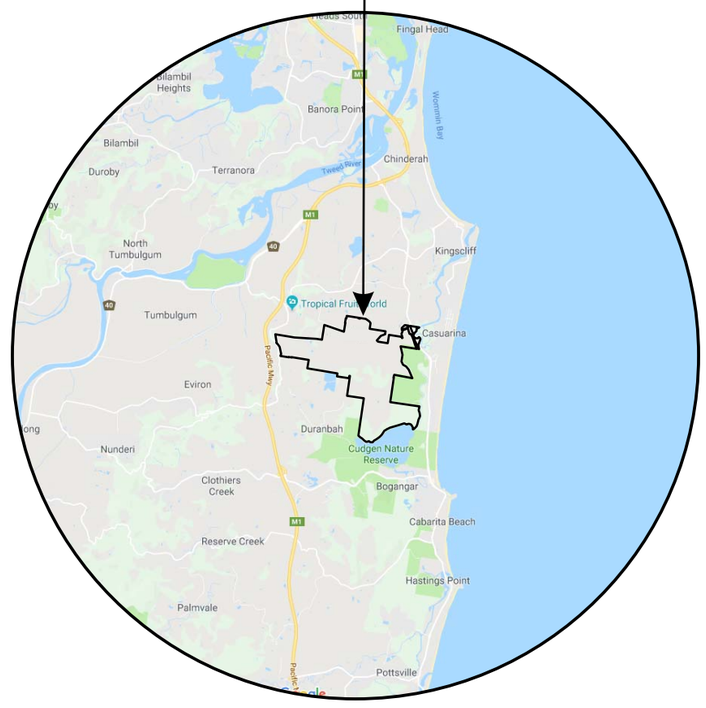
Project 28 Pty Ltd owns and manages the site which is currently used for cattle grazing and silviculture. The site consists of a mosaic of natural, partially natural, modified and regenerating plant communities including Heathland, Swamp sclerophyll (Paperbark) forest, Woodland, Pine plantation, Freshwater wetland and Pasture. The majority of the site is maintained as pasture for cattle grazing.

The Kings Forest site abuts agricultural and rural lands to the north, west and south west. Cudgen Nature Reserve (including Cudgen Lake and Cudgen Creek) abuts the site boundaries to the south and east. There are a small number of residential properties along Tweed Coast Road to the north of the site.



LEGEND
Kings Forest Boundary
Turners Land Boundary

SUBJECT SITE



0 750m
1 : 30 000

SOURCE: Google Maps

SCALE: 1 : 30 000 @ A3

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Project 28 Pty Ltd

PROJECT
Feral Animal Management Plan
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 1

PREPARED: BW
DATE: 10 December 2019
FILE: N97017_Locality.cdr

TITLE
LOCALITY PLAN

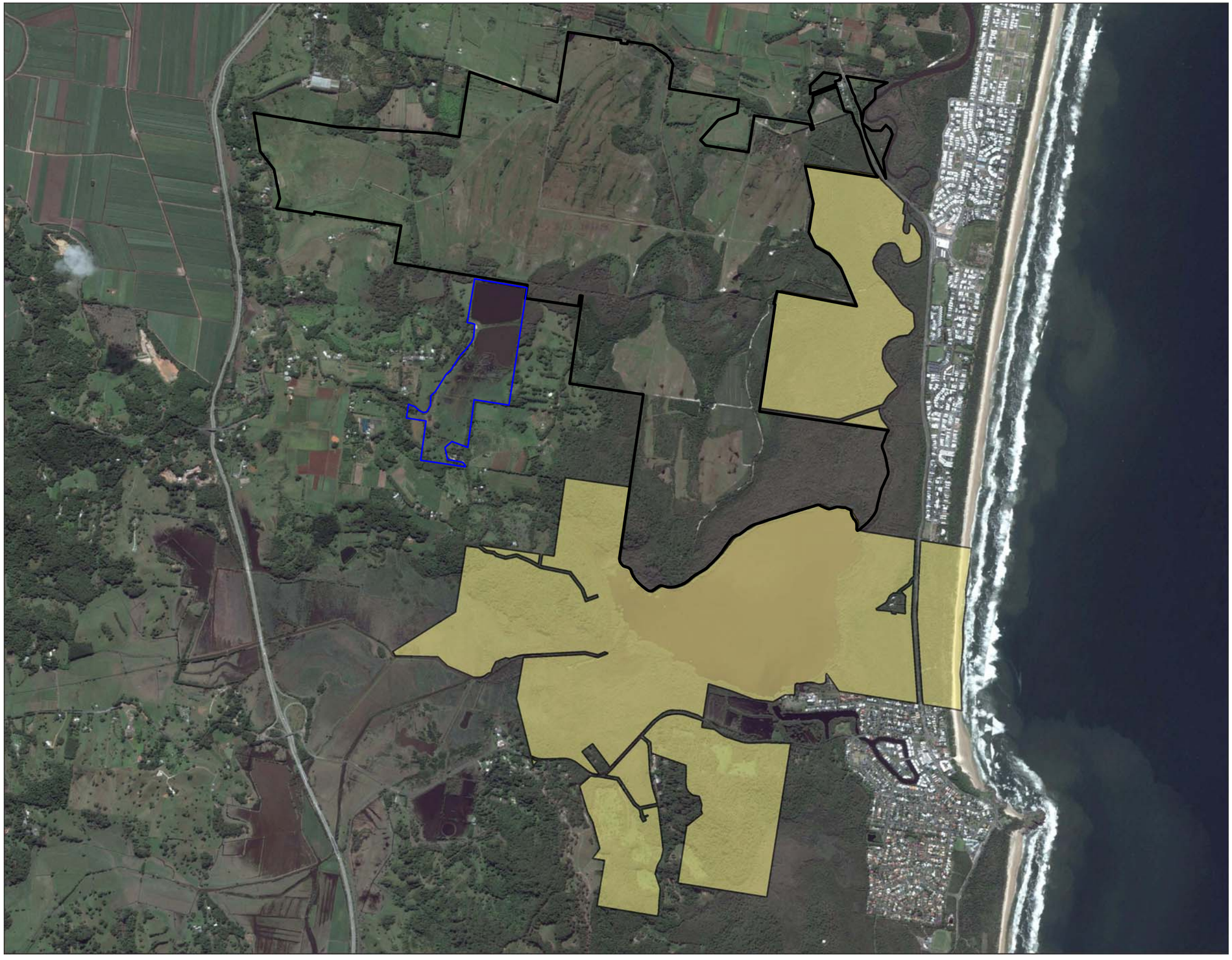
2.2 Conservation Reserves/Ecologically Significant Areas in the Locality

The Cudgen Nature Reserve adjoins the southern and (in part) eastern boundaries of the subject site (**FIGURE 2**). Stotts Island Nature Reserve is situated approximately 2 km to the north-west of the site.

Several Freshwater wetland and Littoral Rainforest areas protected under the (superseded) State Environmental Planning Policy (SEPP) 14 (Coastal Wetlands) and SEPP26 (Littoral Rainforests) exist within and near the site (**FIGURE 3**). These SEPP's have been superseded by State Environmental Planning Policy (SEPP) Coastal Management (2018). Whilst there are areas of discrepancy between the superseded and current SEPP wetland mapping on site, the wetlands generally occur in areas zoned for Environmental Protection on the NSW Planning SEPP Major Development 2005 – Kings Forest land zoning map (**FIGURE 4**). As all relevant approvals were granted prior to the gazettal of the Coastal Management SEPP reference to this mapping has not been shown to avoid confusion.

2.3 Land Use Zones

Land use zones over the Kings Forest development site are identified on the NSW Planning SEPP Major Development 2005 – Kings Forest land zoning map (**FIGURE 4**). SEPP 14 wetland areas, as well as a number of smaller wetland and Littoral rainforest parcels have been designated Environmental Protection (Wetlands and Littoral Rainforests) (7a) zones. Substantial buffer zones occur wherever the 2(c) lands abut neighbouring agricultural land (150 metres) and Environmental Protection zones (50 metre). Lands in the far south of the property are subject to clause 50b of the Tweed LEP, committing them to conservation. Apart from other smaller areas of Environmental Protection (Habitat) (7l), the remainder of the property is zoned Urban Expansion (2c).



LEGEND
- Cudgen Nature Reserve
- Kings Forest Boundary
- Turners Land Boundary

N

0 750m
1 : 30 000

SOURCE: NSW DPI Cadastre
Google Earth Apr 2017 Aerial

SCALE: 1 : 30 000 @ A3

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Kings Forest
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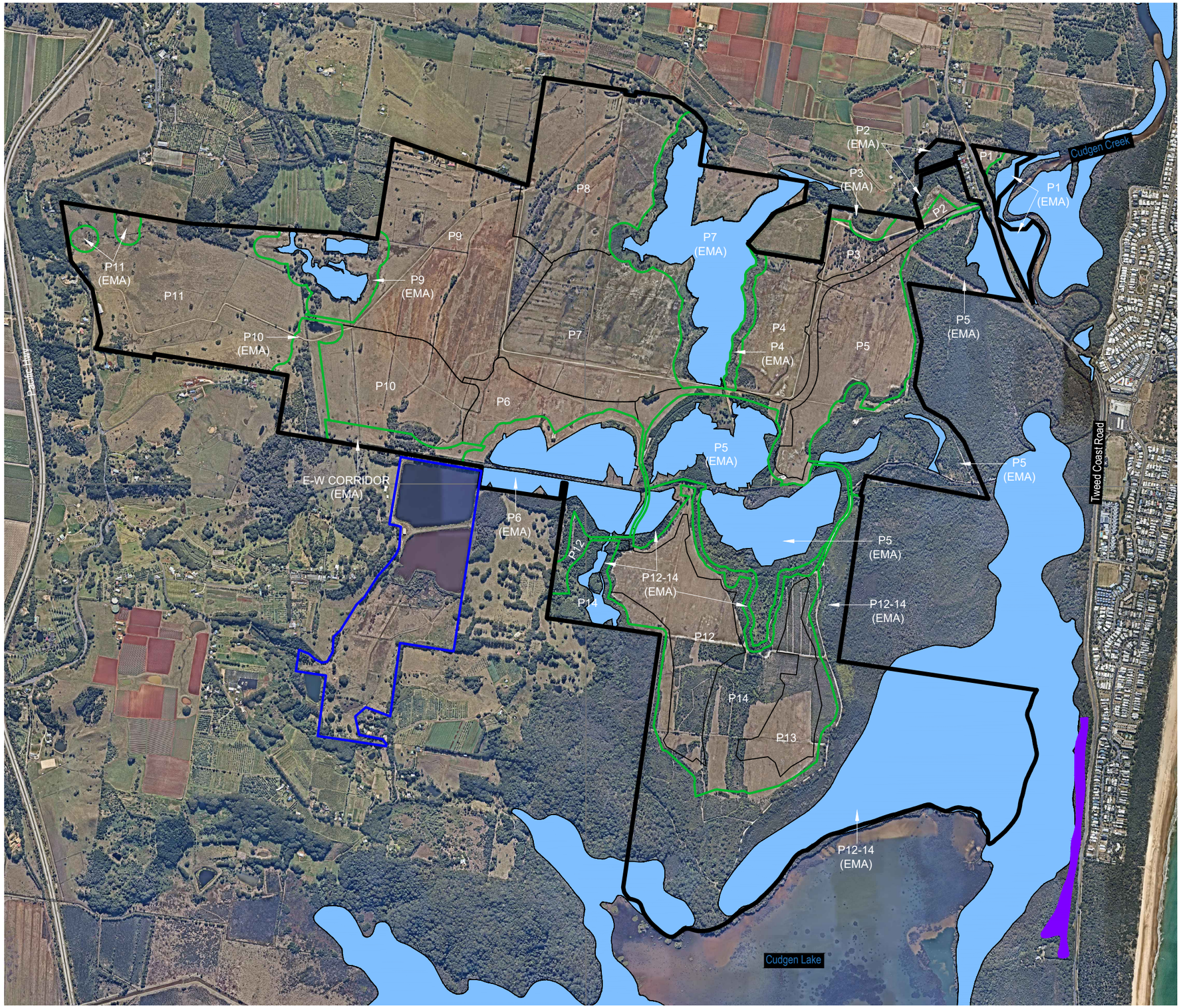
FIGURE 2

PREPARED: BW
DATE: 10 December 2020
FILE: N97017_Cudgen NR.cdr

TITLE
CUDGEN NATURE RESERVE



LEGEND

- SEPP 14 Coastal Wetlands (#1)
- SEPP 26 Littoral Rainforest (#1)
- Environmental Management Area (EMA) Boundary (#2)
- Precinct Boundary
- Kings Forest Boundary
- Turners Land Boundary

Note 1:
These SEPP's have been superseded by State Environmental Planning Policy (SEPP) Coastal Management (2018). As all relevant approvals were granted prior to the gazettal of the Coastal Management SEPP, reference to the revised mapping has not been shown to avoid confusion.

Note 2:
To assist in identifying the staging of rehabilitation and management actions, EPZs and buffer areas have been associated with a relevant development precinct and are collectively titled as Environmental Management Areas (EMAs).

0 500m
1 : 20 000

SOURCE: Landpartners - SEPP14 Wetlands (Amendment 15) & SEPP26 Littoral Rainforest; Near Map 08/08/18 Aerial

SCALE: 1 : 20 000 @ A3

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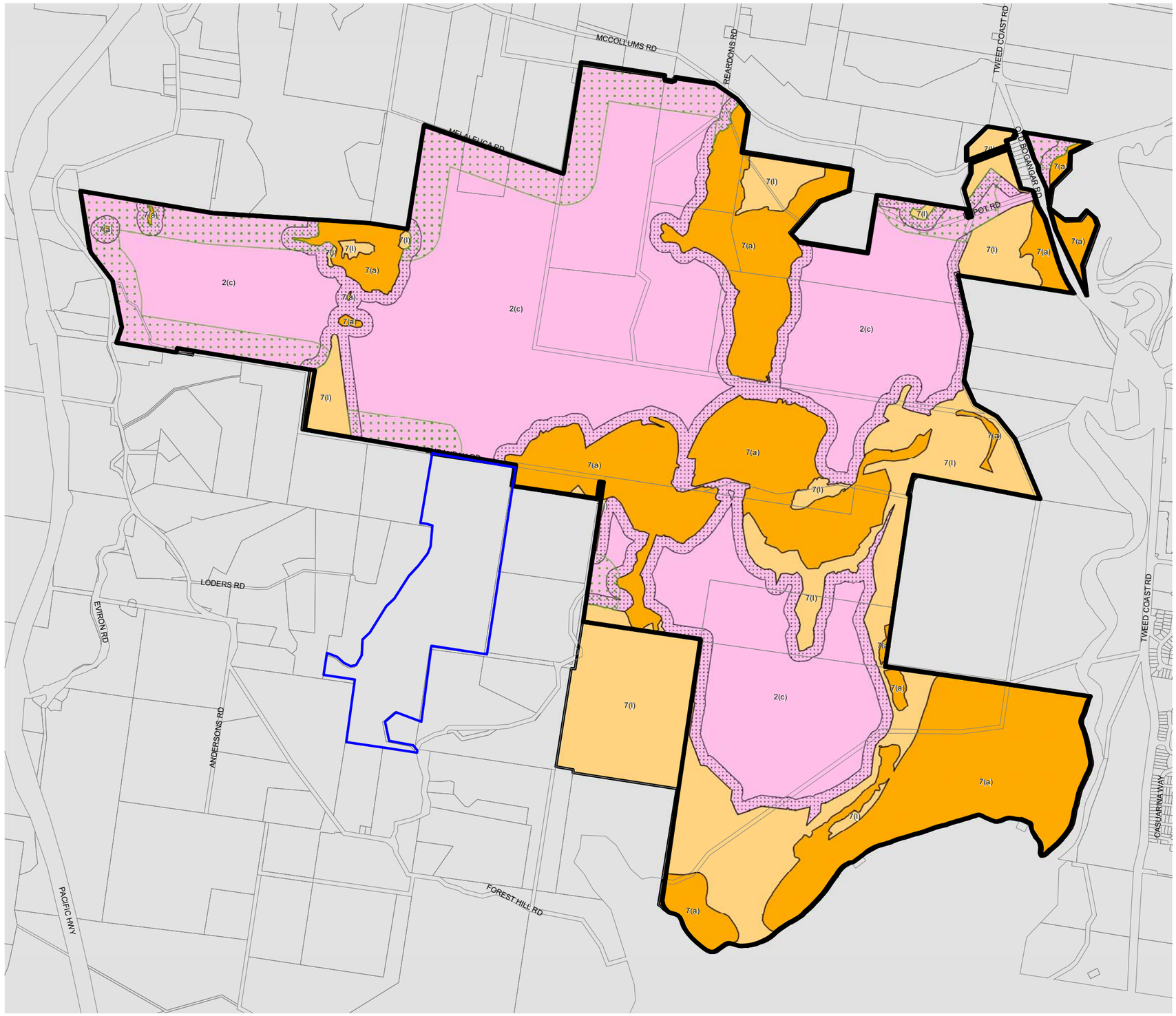
Feral Animal Management Plan
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 3

PREPARED: BW
DATE: 10 December 2020
FILE: N97017_FAMP_20201210.dwg

TITLE
SEPP No. 14 COASTAL WETLANDS & SEPP No. 26 LITTORAL RAINFOREST



N

LEGEND

Kings Forest Boundary

Turners Land Boundary

ZONING

- 2(c) Urban Expansion
- 7(a) Environmental Protection (Wetlands & Littoral Rainforests)
- 7(l) Environmental Protection (Habitat)
- Agricultural Buffer (150m)
- Ecological Buffer (50m)

0 500m

1 : 20 000

SOURCE: NSW Planning SEPP (Major Development) 2005 - Kings Forest Land Zoning Map (Ref: SEPP_MD_KIF_LZN_001_20100201)
SCALE: 1 : 20 000 @ A3

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Feral Animal Management Plan
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 4

PREPARED: BW
DATE: 10 December 2020
FILE: N97017_Zoning.cdr

TITLE

ZONING PLAN

3 PROPOSED DEVELOPMENT

3.1 Background

The Kings Forest project is a master planned residential community. The total area of the proposed development is 422.32 ha and will include the following in accordance with the Concept Plan Approval (as modified Mods 1 to 5):

- Residential development for approximately 4500 dwellings;
- Town centre and neighbourhood centre for future retail and commercial uses;
- Community and education facilities;
- Employment land;
- 18 hole Golf Course;
- Open space;
- Wildlife corridors;
- Protection and rehabilitation of environmentally sensitive land;
- Utility services infrastructure;
- Water management areas and lake; and
- Roads and pedestrian and bicycle paths.

The proposed development comprises a total of fourteen (14) separate precincts (**FIGURE 5**) and development of the site will be completed on a precinct-by-precinct basis.

Retained vegetation and habitat areas across the site generally occur within Environmental Protection Zones (EPZs) and associated buffers. To assist in identifying the staging of rehabilitation and management actions, these EPZ and buffer areas have been associated with a relevant development precinct and are collectively titled as Environmental Management Areas (EMAs). Works within EMAs will be completed in accordance with the staging of the associated Precinct.

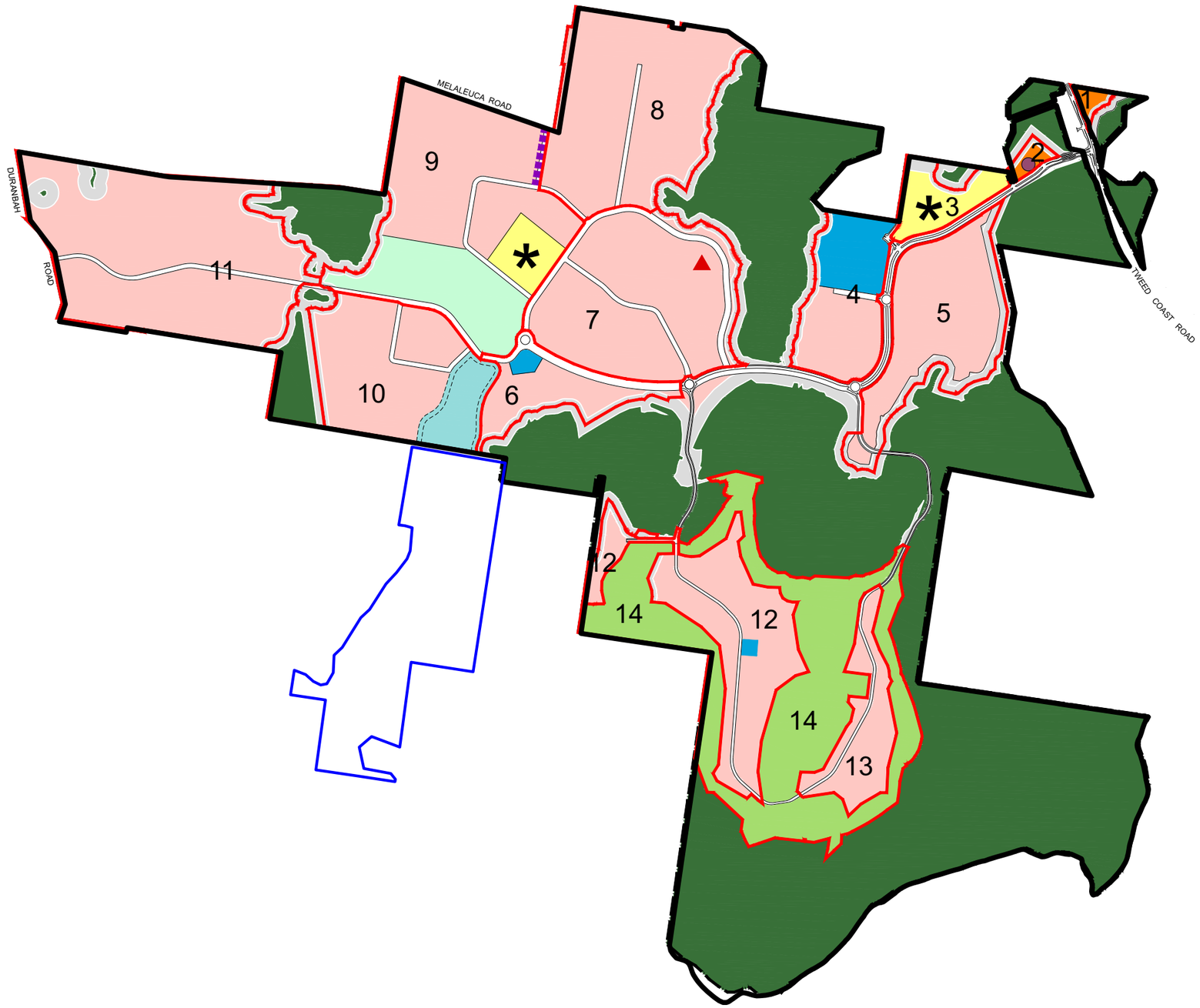
3.2 Precinct Descriptions

3.2.1 Precinct 1

Precinct 1 occurs in the far east of the Kings Forest site. Tweed Coast Road traverses the western boundary of Precinct 1 and Cudgen Creek occurs offsite to the east. Precinct 1 is proposed to be developed for the purposes of a Service Station. An EPZ and associated 50 m buffer zone occur to the south of Precinct 1 (collectively referred to as the Precinct 1 EMA) in which no development works are proposed**.**

3.2.2 Precinct 2

Precinct 2 is located at the entrance to the Kings Forest site, to the west of Tweed Coast Road and north of the proposed Kings Forest Parkway. Precinct 2 is proposed to be developed for



LEGEND

- Precinct Boundary
- Kings Forest Boundary
- Turners Land Boundary

PRECINCT PLAN

- 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
- 50m Ecological Buffer
  (Includes APZs & roads where approved)
- State School Site
- Proposed Zone Substation
  (Subject to Country Energy final approval)
- Potential Affordable Housing Location
- Potential Road Connection to Melaleuca Road

Private Open Space

- Golf Course Area
  (Encompassing ecological buffers where indicated)
- Private Open Space including lake

IMPORTANT NOTE

This plan was prepared as a preliminary concept plan for planning purposes only. As such all particulars, including lot design, areas and densities, are subject to detailed survey, site investigations and to the requirements of council and any other authority which may have requirements under any relevant legislation.
This note is an integral part of this plan.

0 500m
1 : 20 000

SOURCE: RPS Precinct Plan Rev B dated 05/12/13 (Ref: 113691-PSP-4b(PRECINCT PLAN).dwg)
SCALE: 1 : 20 000 @ A3

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Feral Animal Management Plan
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 5

PREPARED: BW
DATE: 10 December 2020
FILE: N97017_Precinct Plan.cdr

TITLE
PRECINCT PLAN

employment purposes. An EPZ and associated 50 m buffer zone occur to the north of Precinct 2 (collectively referred to as the Precinct 2 EMA) in which no development works are proposed.

3.2.3 Precinct 3

Precinct 3 is proposed to be developed as a Community Facility/Education Precinct. A small EPZ and associated 50 m buffer occur adjacent to the central northern portion of the Precinct (collectively referred to as the Precinct 3 EMA) in which no development works are proposed.

3.2.4 Precinct 4

Precinct 4 is located in the central portion of the Kings Forest site, to the east of the northern SEPP and west of the proposed Kings Forest Parkway. The northern portion of Precinct 4 is proposed to be developed as a Town Centre precinct while the southern portion is proposed to be developed as a residential precinct. A large EPZ associated with Precinct 7 occurs to the west of Precinct 4. A 50 m buffer (referred to as the Precinct 4 EMA) occurs between the Precinct 7 EPZ and Precinct 4 in which no development works are proposed.

3.2.5 Precinct 5

Precinct 5 is located at the entrance to the Kings Forest site to the west of Tweed Coast Road and south of the proposed Kings Forest Parkway. Cudgen Nature Reserve occurs to the east of Precinct 5 and lacks Creek occurs to the south.

Precinct 5 is proposed to be developed as a residential precinct and will also include the construction of a significant portion of the proposed Kings Forest Parkway. Large areas adjacent to Precinct 5 will be retained within EPZs and associated 50 m buffer zones (collectively referred to as the Precinct 5 EMA). Where the 50 m buffer zones occur adjacent to development in Precinct 5, the outer 20 m zone will be utilised for stormwater conveyance and ancillary structures such as fauna exclusion fencing whilst the inner 30 m zone will be utilised for conservation purposes only such as revegetation and assisted regeneration works.

3.2.6 Precinct 6

Precinct 6 occurs in the central portion of the Kings Forest site at the western end of the proposed Kings Forest Parkway. A small area in the north of Precinct 6 is proposed to be developed as a Town/Neighbourhood Centre whilst the remainder of the precinct is proposed to be developed as a residential precinct. An EPZ and associated 50 m buffer zone occur to the south of Precinct 6 (collectively referred to as the Precinct 6 EMA) in which no development works are proposed.

3.2.7 Precinct 7

Precinct 7 is located in the central portion of the Kings Forest site, to the west of the northern SEPP wetland. Precinct 7 is proposed to be developed as a residential precinct. An EPZ and associated 50 m buffer zone occur to the east of Precinct 7 (containing the northern SEPP

wetland and collectively referred to as the Precinct 7 EMA) within in which no development works are proposed.

3.2.8 Precinct 8

Precinct 8 is located in the central northern portion of the Kings Forest site, to the west of the northern SEPP wetlands. Precinct 8 is proposed to be developed as a residential precinct. A large EPZ and associated 50 m buffer occurs to the east of Precinct 8 in which no development works are proposed. It is noted that the EPZ and associated 50 m ecological buffer to the east of Precinct 8 are included in the EMA associated with Precinct 7.

3.2.9 Precinct 9

Precinct 9 occurs in the north-western portion of the Kings Forest site. The northern portion of Precinct 9 is proposed to be developed as a residential precinct while the southern portion is proposed to be developed as a Community Facility/Education precinct and Structure Open Space (Active) area. An EPZ and associated 50 m buffer zone occur to the west of Precinct 9 (collectively referred to as the Precinct 9 EMA) in which no development works are proposed.

3.2.10 Precinct 10

Precinct 10 is located in the western portion of the Kings Forest site. The western portion of Precinct 10 is proposed to be developed as a residential precinct whilst the eastern portion will contain a Private Open Space area including a lake. An EPZ and associated 50 m buffer zone occur to the west of Precinct 10 (collectively referred to as the Precinct 10 EMA) in which no development works are proposed.

It should be noted that an area to the immediate south of Precinct 10 has been allocated to the proposed East-West Corridor which will link the Precincts 6 and 10 EPZs and bolster movement/dispersal corridors in this portion of the Kings Forest site. The proposed East-West Corridor is designated as a koala compensatory habitat area.

3.2.11 Precinct 11

Precinct 11 occurs in the far west of the Kings Forest site and is proposed to be developed as a residential precinct. Two (2) small EPZs and associated 50 m buffer zones occur in the north west of the precinct (collectively referred to as the Precinct 11 EMAs) in which no development works are proposed.

3.2.12 Precincts 12-14

Precincts 12 - 14 occur in the southern portion of the Kings Forest site. Precincts 12 and 13 and are proposed to be developed as residential precincts. Precinct 14 contains the proposed Golf Course and will also act as an ecological buffer (minimum 50 m in width) between the residential precincts and retained and compensatory habitat areas.

3.2.13 East-West Corridor

The proposed East-West Corridor is located in the central west section of the Kings Forest site and extends along the southern boundary of Precinct 10. The proposed East-West Corridor will link the Precincts 6 and 10 EPZs and bolster movement/dispersal corridors in this portion of the Kings Forest site. Works within the East-West Corridor will include compensatory koala habitat creation in accordance with Section 7.6 of the Kings Forest KPoM (JWA 2019).

3.3 Development Staging

The Kings Forest project will likely proceed over many years. The length of time will be dependent, to a certain degree, on the demand for land over time. The development of the site will be completed on a precinct-by-precinct basis in accordance with approved Precinct Plan (**FIGURE 5**). It is intended to developed Precincts 1, 2, 5 and majority of Precinct 4 as Stage 1. The staging of development of remaining precincts will be then proceed in accordance with the approved Precinct Plan, however this may be subject change. Indicative staging is shown in **TABLE 1.**

TABLE 1
INDICATIVE DEVELOPMENT STAGING

Development Stage	Precinct
Stage 1	Precinct 1
	Precinct 2
	Majority of Precinct 4
	Precinct 5
	East-West Corridor
Stage 2	Precinct 3
	Remainder of Precinct 4
Stage 3	Precinct 6
Stage 4	Precinct 7
Stage 5	Precinct 8
Stage 6	Precinct 9
Stage 7	Precinct 10
Stage 8	Precinct 11
Stage 9	Precincts 12-14

4 EXISTING SITE VALUES

4.1 Introduction

The following sections detail the existing ecological values contained within the Kings Forest site and the feral animal species known to occur on the Kings Forest site and within the locality. An aerial photograph of the site is shown in **FIGURE 6.**

4.2 Vegetation

The Kings Forest site has a decades-long history of various land uses and land management practices, including pine plantation, sand mining, pasture improvement and turf production, dairy farming, small cropping and sugar cane production. It is presently used generally for cattle grazing. Over many years the land has been extensively cleared for these activities. There remain, however, large areas of undisturbed vegetation in the eastern and south-eastern portions of the property and within wetland areas throughout. These areas of the site are generally zoned for Environment Protection.

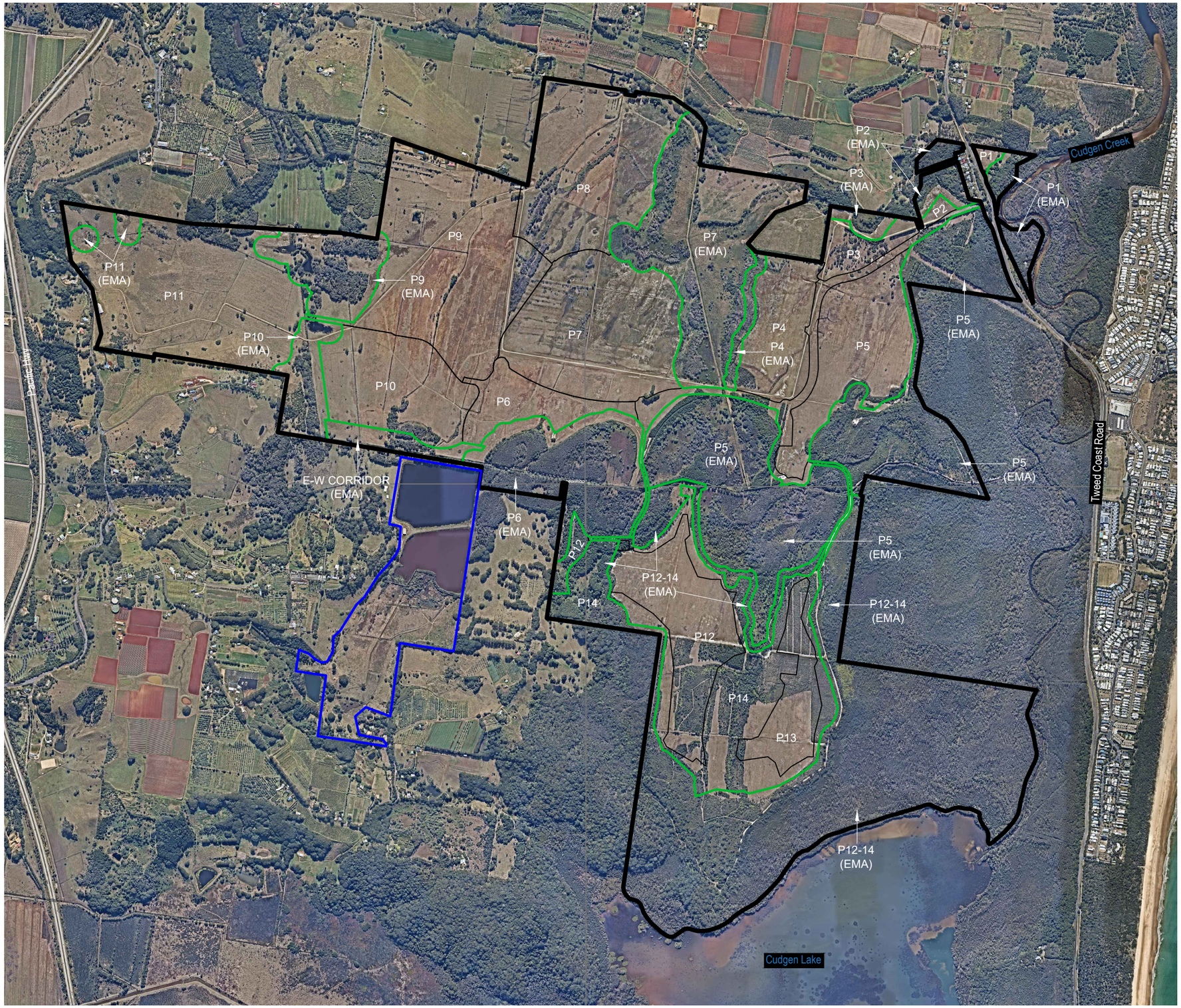
Vegetation on the Kings Forest subject site has been described in varying degrees of detail (Warren 2000, Kingston *et al*. 2004, Callaghan *et al*. 2005). The most comprehensive vegetation mapping over the Kings Forest site was completed by the Australian Koala Foundation (Callaghan *et al*. 2005). However, harvesting of areas of pine plantation, continued infestation of native vegetation with Slash pine wildings and areas of natural heath regeneration has occurred since the preparation of this map.

Vegetation mapping on the Kings Forest site (as of July 2018) has been adapted from the Callaghan *et al.* (2005) mapping combined with detailed re-mapping/ground-truthing surveys completed by JWA between 2010 – 2018. In total, six (6) broad vegetation types comprising forty-three (43) discrete vegetation communities have been identified over the Kings Forest site.

FIGURE 7 shows that the following broad vegetation types have been mapped within the Kings Forest land:

- Highly modified vegetation communities;
- Freshwater wetlands;
- Heathland and shrublands;
- Swamp sclerophyll floodplain forests;
- Dry to moist open forests; and
- Rainforest.

Vegetation community descriptions in this FAMP, including proposed offset/compensatory habitat areas, are discussed in relation to their closest Plant Community Type (PCT) descriptions which were accessed via the Biodiversity and Conservation Division (BCD) (formerly OEH) of the Environment, Energy and Science Group in the NSW DPI&E database (i.e. the BioNet



LEGEND

- Environmental Management Area (EMA) Boundary (#)
- Precinct Boundary
- Kings Forest Boundary
- Turners Land Boundary

Note:
To assist in identifying the staging of rehabilitation and management actions, EPZs and buffer areas have been associated with a relevant development precinct and are collectively titled as Environmental Management Areas (EMAs).

0 500m
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SOURCE: Near Map 08/08/18 Aerial

SCALE: 1 : 20 000 @ A3

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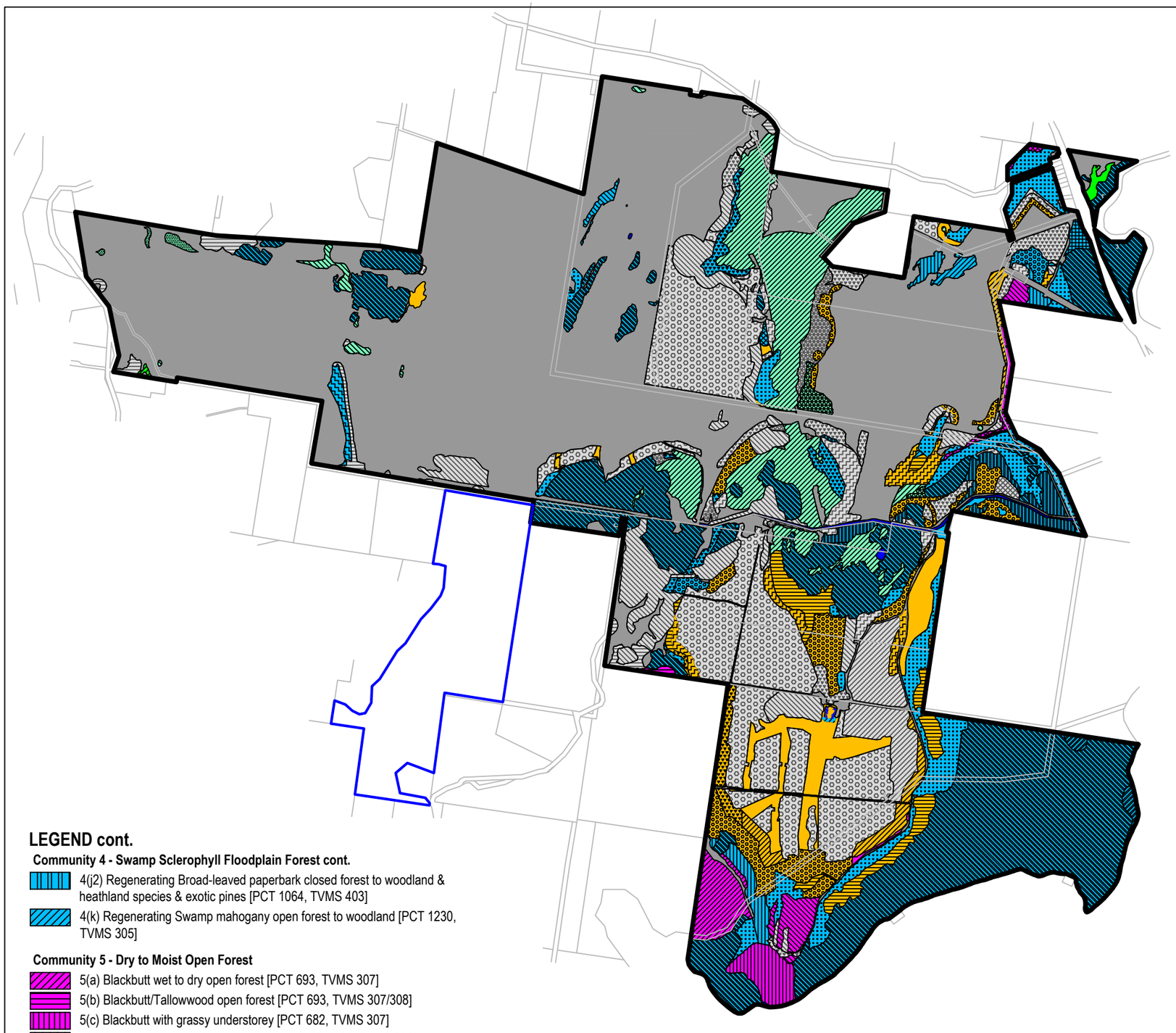
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 6

PREPARED: BW
DATE: 10 December 2020
FILE: N97017_FAMP_20201210.dwg

TITLE

AERIAL PHOTOGRAPH



LEGEND

Kings Forest Boundary
Turners Land Boundary

Community 1 - Highly Modified

1(a) Substantially cleared of native vegetation
1(b) Camphor laurel dominant closed forest (with rainforest species)
1(c) Native plantation/plantings
1(d) *Leptospermum petersonii* plantation (with heathland species)
1(e1) Exotic pine plantation
1(e2) Exotic pine plantation (with heathland species)
1(f) Exotic grassland dominated (with heathland species)
1(g) Exotic grassland dominated (with regrowth Acacia & other native species)
1(h) Exotic pines with sedgeland/rushland/fernland
1(i) Exotic pines with swamp sclerophyll floodplain forest

Community 2 - Freshwater Wetland

2(a) Hillside seepage swamp (with *Eleocharis tetraquetra*) [PCT 1911, TVMS 701]
2(b) Ponds & fringing wetland [PCT 1911, TVMS 701]
2(c1) Sedgeland/rushland/fernland [PCT 1911, TVMS 701/702]
2(c2) Sedgeland/rushland/fernland (with exotic pines) [PCT 1911, TVMS 701/702]

Community 3 - Heathland & Shrubland

3(a1) Dry coastal heathland to shrubland [PCT 663, TVMS 501]
3(a2) Dry coastal heathland to shrubland (with exotic pines) [PCT 663, TVMS 501]
3(b1) Wet coastal heathland to shrubland [PCT 1297, TVMS 502]
3(b2) Wet coastal heathland to shrubland (with exotic pines) [PCT 1297, TVMS 502]
3(d) Regenerating wet/dry coastal heathland to shrubland [PCT 1297, TVMS 501/5022]
3(e) Regenerating wet/dry coastal heathland to shrubland (with exotic pines) [PCT 1297, TVMS 501/502]

Community 4 - Swamp Sclerophyll Floodplain Forest

4(a) Forest red gum open forest to woodland/Broad-leaved paperbark closed forest to woodland [PCT 1064, TVMS 403]
4(b) Swamp mahogany open forest to woodland & heathland species [PCT 1230, TVMS 305]
4(c) Scribbly gum/Swamp mahogany +/- Red mahogany, Swamp turpentine, Hard corkwood closed forest to woodland [PCT 1230, TVMS 305/306]
4(d) Swamp box open forest to woodland [PCT 1064, TVMS 309]
4(e) Broad-leaved paperbark closed forest to woodland [PCT 1064, TVMS 401]
4(f) Broad-leaved paperbark closed forest to woodland (with Scribbly gum) [PCT 1064, TVMS 401]
4(g1) Broad-leaved paperbark closed forest to woodland (with rainforest species) [PCT 1064, TVMS 401]
4(g2) Broad-leaved paperbark closed forest to woodland (with rainforest species & camphor laurel) [PCT 1064, TVMS 401]
4(h) Broad-leaved paperbark closed forest to woodland/Swamp mahogany open forest to woodland [PCT 1064, TVMS 403]
4(i) Swamp sclerophyll & heathland species (with exotic pines) [PCT 1064, TVMS 403]
4(j1) Regenerating Broad-leaved paperbark closed forest to woodland & heathland species [PCT 1064, TVMS 403]

LEGEND cont.

Community 4 - Swamp Sclerophyll Floodplain Forest cont.

4(j2) Regenerating Broad-leaved paperbark closed forest to woodland & heathland species & exotic pines [PCT 1064, TVMS 403]
4(k) Regenerating Swamp mahogany open forest to woodland [PCT 1230, TVMS 305]

Community 5 - Dry to Moist Open Forest

5(a) Blackbutt wet to dry open forest [PCT 693, TVMS 307]
5(b) Blackbutt/Tallowwood open forest [PCT 693, TVMS 307/308]
5(c) Blackbutt with grassy understorey [PCT 682, TVMS 307]
5(d) Scribbly gum open forest to woodland [PCT 1136, TVMS 306]
5(e1) Regenerating Scribbly gum open forest to woodland & heathland species [PCT 1136, TVMS 306]
5(e2) Regenerating Scribbly gum open forest to woodland & heathland species & exotic pines [PCT 1136, TVMS 306]

Community 6 - Rainforest

6(a) Littoral rainforest [PCT 751, TVMS 101]
6(b) Regenerating sub-tropical rainforest [PCT 1302, TVMS 102]
Open water

NOTE: Vegetation mapping has been adapted from the Australian Koala Foundation (Callaghan *et al.* 2005) mapping combined with detailed re-mapping/ground-truthing surveys completed by JWA between 2010 - 2018.

0 500m
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SOURCE: JWA Site Investigations 2018; Near Map 08/08/18 Aerial

SCALE: 1 : 20 000 @ A3

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FIGURE 7

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TITLE

VEGETATION COMMUNITIES

Vegetation Classification System). PCTs are classified based on vegetation types occurring within the Interim Biogeographic Regionalisation for Australia (IBRA) subregions, as developed by the Commonwealth government. The IBRA framework divides Australia landscapes into bioregions and subsequently subregions based on common features such as climate, geology, landform, and vegetation.

It is noted however that PCT descriptions are still undergoing revision and many remain undescribed for the SEQ03 – Burringbar-Conondale Ranges IBRA subregion. Therefore, corresponding Tweed Vegetation Management Strategy 2004 (TVMS) codes have also been provided.

4.3 Endangered Ecological Communities

Two (2) Endangered Ecological Communities (EECs) as defined by the NSW *Biodiversity Conservation Act 2016* (BC Act) have also been mapped within Kings Forest buffers and EPZs (**FIGURE 8**):

- Freshwater wetlands on coastal floodplains of the NSW North Coast; and
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast.

4.4 Threatened Flora and Fauna

A number of threatened flora and fauna species have been recorded on the Kings Forest site over the last 30 years. These threatened species are listed in **TABLE 2** and their locations shown in **FIGURE 8.** The conservation status of each species listed in **TABLE 2** is shown in accordance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the NSW BC Act.

TABLE 2
THREATENED SPECIES RECORDED WITHIN THE KINGS FOREST SITE

Scientific Name	Common Name	BC Act*	EPBC Act#
Threatened flora species			
Endiandra muelleri subsp. *bracteata*	Green-leaved rose walnut	E	-
Phaius australis	Southern swamp orchid	E	E
Cryptocarya foetida	Stinking cryptocarya	V	V
Archidendron hendersonii	White laceflower	V	-
Grevillea hilliana	White yiel yiel	E	-
Threatened fauna species			
Ixobrychus flavicollis	Black bittern	V	-
Ephippiorhynchus asiaticus	Black-necked stork	E	-
Calyptorhynchus lathami	Glossy-black cockatoo	V	-
Pteropus poliocephalus	Grey-headed flying fox	V	V
Phascolarctos cinereus^	Koala	V	V

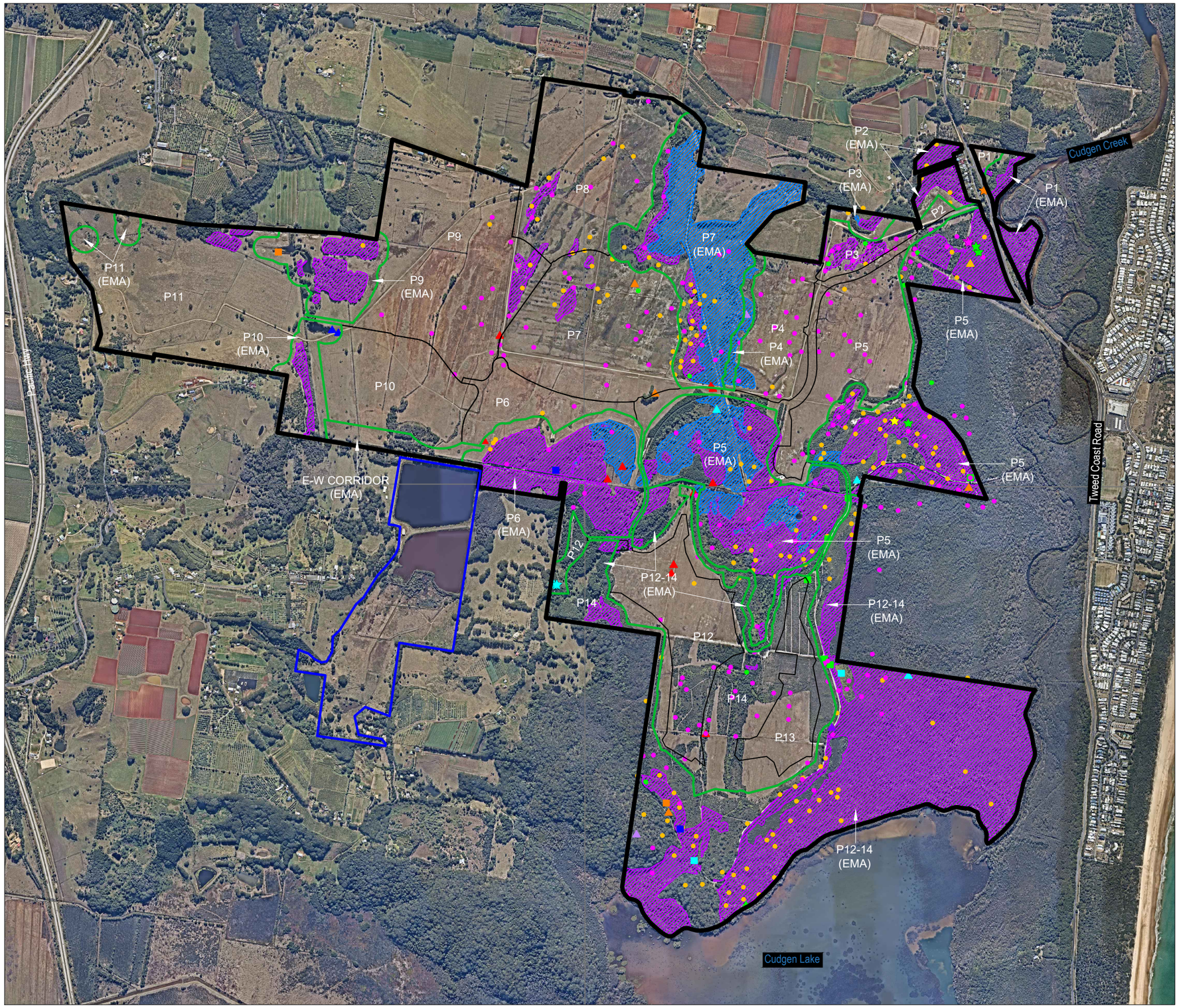
Scientific Name	Common Name	BC Act*	EPBC Act#
Tyto novaehollandiae	Masked owl	V	-
Tyto longimembris	Grass owl	V	-
Pandion haliaetus	Osprey	V	-
Amauronis moluccana	Pale-vented Bush hen	V	-
Burhinus grallarius	Bush stone-curlew	E	-
Planigale maculate	Common planigale	V	-
Miniopterus australis	Little bent-wing bat	V	-
Saccolaimus flaviventris	Yellow-bellied sheathtail bat	V	-
Syconycteris australis	Common blossom bat	V	-
Ptilinopus regina	Rose-crowned fruit-dove	V	-
Crinia tinnula	Wallum froglet	V	-
Litoria olongburensis	Wallum sedge frog	V	V
Falsistrellus tasmaniensis	Eastern false pipistrelle**	V	-
Myotis macropus	Southern myotis**	V	-

* E - Endangered, V - Vulnerable as listed within schedules of the NSW *BC Act* (2016).

E – Endangered and V - Vulnerable as listed within schedules of the Commonwealth *EPBC Act* (1999).

** These species are highly mobile were recorded foraging over the site and are not included in **FIGURE 8.**

^ The koala (combined population in Queensland, New South Wales and the Australian Capital Territory) is listed as a vulnerable species within schedules of the Commonwealth *EPBC Act* (1999). The koala, between the Tweed and Brunswick Rivers east of the Pacific Highway, is listed as an endangered population within schedules of the NSW *BC Act* (2016).



N

LEGEND

- Environmental Management Area (EMA) Boundary (#)
- Precinct Boundary
- Kings Forest Boundary
- Turners Land Boundary

THREATENED FLORA RECORDS

- Green-leaved rose walnut (*Endiandra muelleri* subsp. *bracteata*) - Endangered (BC Act 2016)
- Southern swamp orchid (*Phaius australis*) - Endangered (BC Act 2016 & EPBC Act 1999)
- Stinking cryptocarya (*Cryptocarya foetida*) - Vulnerable (BC Act 2016 & EPBC Act 1999)
- White laceflower (*Archidendron hendersonii*) - Vulnerable (BC Act 2016)
- White yiel yiel (*Grevillea hilliana*) - Endangered (EPBC Act 1999)

THREATENED FAUNA RECORDS

Birds

- Black bittern (*Ixobrychus flavicollis*) - Vulnerable (BC Act 2016)
- Black-necked stork (*Ephippiorhynchus asiaticus*) - Endangered (BC Act 2016)
- Bush stone-curlew (*Burhinus grallarius*) - Endangered (BC Act 2016)
- Glossy-black cockatoo (*Calyptorhynchus lathami*) - Vulnerable (BC Act 2016)
- Grass owl (*Tyto longimembris*) - Vulnerable (BC Act 2016)
- Masked owl (*Tyto novaehollandiae*) - Vulnerable (BC Act 2016)
- Osprey (*Pandion haliaetus*) - Vulnerable (BC Act 2016)
- Pale-vented bush hen (*Amouronis moluccana*) - Vulnerable (BC Act 2016)

Mammals

- Common blossom bat (*Syconycteris australis*) - Vulnerable (BC Act 2016)
- Common planigale (*Planigale maculata*) - Vulnerable (BC Act 2016)
- Grey-headed flying-fox (*Pteropus poliocephalus*) - Vulnerable (BC Act 2016 & EPBC Act 1999)
- Koala (*Phascolarctos cinereus*) - Vulnerable (BC Act 2016 & EPBC Act 1999)
- Yellow-bellied sheathtail bat (*Saccolaimus flaviventris*) - Vulnerable (BC Act 2016)

Amphibians

- Wallum froglet (*Crinia tinnula*) - Vulnerable (BC Act 2016)
- Wallum sedge frog (*Litoria olongburensis*) - Vulnerable (BC Act 2016 & EPBC Act 1999)

ENDANGERED ECOLOCICAL COMMUNTIES

- Freshwater wetlands on coastal floodplains of the NSW North Coast
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast

Note:
To assist in identifying the staging of rehabilitation and management actions, EPZs and buffer areas have been associated with a relevant development precinct and are collectively titled as Environmental Management Areas (EMAs).

0 500m
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SOURCE: Landpartners - SEPP14 Wetlands (Amendment 15) & SEPP26 Littoral Rainforest; Near Map 08/08/18 Aerial
SCALE: 1 : 20 000 @ A3

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FIGURE 8

PREPARED: BW
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TITLE THREATENED FLORA & FAUNA RECORDS & ENDANGERED ECOLOGICAL COMMUNITIES

5 TARGET SPECIES

TABLE 3 lists the exotic (non-native) animal species recorded on the Kings Forest site and by the NSW BCD BioNet database as occurring within 10 km of the Kings Forest site.

TABLE 3
FERAL ANIMALS RECORDED ON THE KINGS FOREST WITH AND WITHIN 10KM OF THE SUBJECT SITE

Common Name	Scientific Name
Black rat	*Rattus rattus*
Brown hare	*Lepus capensis*
Cane toad	*Rhinella marina*
Cat	*Felis catus*
Common (Indian) Myna	*Sturnus tristis*
Dingo, domestic dog	*Canis lupus*
Dog	*Canis lupus familiaris*
Unidentified canid	*Canidae sp.*
European cattle	*Bos taurus*
Horse	*Equus caballus*
Fox	*Vulpes vulpes*
Goat	*Capra hircus*
Sheep (feral)	*Ovis aries*
House mouse	*Mus musculus*
House sparrow	*Passer domesticus*
Mosquito fish	*Gambusia holbrooki*
European rabbit	*Oryctolagus cuniculus*
Rock dove	*Columba livia*
Spotted turtle-dove	*Streptopelia chinensis*

The cattle and goat record in the atlas database would refer to domestic animals as part of the grazing use of the properties in the area. The House sparrow, Rock dove, Common (Indian) myna and Spotted turtle-dove are elements of the urban and urban/rural fringe. The House mouse and Black rat are widespread rodents that are well established and probably form the basis of the diet of many predatory birds such as the Black-shouldered kites (*Elanus axillaris*) and Grass owl (*Tyto longimembris*). The European rabbit (*Oryctolagus cuniculus*) and Brown hare (*Lepus capensis*) are opportunistic pest species utilising pasture and disturbed vegetation present at the site and are known to have become problematic elsewhere on the Tweed Coast.

Feral dogs and cats have been recorded from the site but are considered likely to occur only in limited numbers. The site has a record of dog predation on cattle (Land Partners 2009) with dog baiting undertaken over several years on site to reduce losses of young cattle to feral dogs. Given the future development of the site, it is possible that there may be an increase in feral dogs and cats resulting from straying and/or dumped animals. The NSW DPI&E has requested that these species be addressed in association with the management objectives and control programs for other pest species.

Although Black rats, House mice, Cattle, Goats, Rock doves, House sparrows and Spotted turtle-doves are acknowledged as potential pest species, their control on the Kings Forest site is not considered a high priority.

The predatory impacts of the Cane toad, Red fox, Mosquito fish, feral dog and feral cat, along with competition grazing and land degradation by the European rabbit and Brown hare, are all recognised as Key Threatening Processes (KTPs) under the NSW *BC Act* (2016). Feral animals such as pigs and rabbits also have the potential to damage sites of Aboriginal cultural heritage significance.

Notwithstanding the landholders "general biodiversity duty" under the NSW *Biodiversity Act* (2015) to manage all pest species, this plan focuses on the following high priority species and emerging pest species declared by biosecurity agencies where relevant to the site:

- Feral dogs (*Canis familiaris*);
- Red fox (*Vulpes vulpes*);
- Feral cats (*Felis catus*);
- Cane toad (*Rhinella marina*);
- Common (Indian) myna (*Acridotheres tristis*);
- European rabbit (*Oryctolagus cuniculus*);
- Brown hare (*Lepus capensis*);
- Mosquito fish (*Gambusia holbrooki*); and
- Alert species - Alert species addressed by this plan include:
    - Big-headed ant (*Pheidole megacephala*);
    - Common carp (*Cyprinus carpio*);
    - Indian ring-necked parrot (*Psittacula krameri*);
    - Mozambique tilapia (*Oreochromis mossambicus*);
    - Red-eared slider turtle (*Trachemys scripta elegans*);
    - Red (imported) fire ant (*Solenopsis invicta*);
    - Yellow crazy ant (*Anoplolepis gracilipes*); and
    - Any other species declared a prohibited matter event under the NSW *Biosecurity Act 2015*.

A species profile for each of the identified priority feral animal species is provided in **APPENDIX 3**. Included in each profile is a review of the potential threat to native fauna on the Kings Forest site and an assessment of possible control options.

Biting insects (i.e. midges and mosquitoes) will also be targeted due to their potential impacts on the future human population of the Kings Forest development. Relevant species profiles and possible control options are discussed in **APPENDIX 3**.

6 IMPLEMENTATION OF THE FAMP

6.1 Introduction

The long-term and effective control of the Red fox, Cane toad, Common myna, European rabbit, Brown hare, Mosquito fish, feral cats and dogs at the Kings Forest development site is problematic as their numbers are influenced by many factors including off-site management activities beyond the control of the landholders. Pests occur and move across the landscape irrespective of tenure boundaries. Therefore, to be most effective, pest management should be collaborative and coordinated across the landscape with key stakeholders in the region.

Currently, there is limited information available in relation to feral animal and biting insect populations on the Kings Forest site. The primary approach adopted by the FAMP therefore will be to complete targeted monitoring programs in order to determine:

- What species are present;
- What assets are impacted;
- Where control should be implemented; and
- What the most appropriate control method will be.

Based on the result of the targeted monitoring program, appropriate control methods will then be chosen if a significant issue or threat posed by a target species is detected.

The following sections detail the management strategies to be implemented as part of this FAMP to minimise the potential impacts of feral animals on native fauna, including threatened species, and the potential impacts of biting insects on the future human population. These strategies include:

- Requirements for liaison with NSW BCD and TSC;
- Requirements for liaison with biosecurity agencies;
- General management strategies including:
    - Education of site personnel and residents;
    - Habitat management; and
    - Reduction of the impacts of hydrological change.
- A targeted monitoring and reporting program; and
- Adaptive management.

All feral animal management and control works are to be overseen by the project Environmental Officer(s) with necessary specialist contractors approved by the relevant agencies as required.

6.2 Liaison with NSW BCD and Tweed Shire Council

All land on the Kings Forest site which has been zoned for conservation purposes is intended to be dedicated to either NSW BCD or TSC in accordance with Section 7.10 of the Kings Forest KPoM (JWA 2019). The proponent will be responsible for the management of all future BCD land and Potential Council Land (PCL) until such time as an agreement is reached regarding the dedication of the land. The maintenance of land dedicated with each relevant precinct will become the responsibility of the new landowner at the time of dedication.

The implementation of feral animal control strategies at the Kings Forest site will therefore need to be consistent with control and monitoring strategies currently employed by NSW BCD and TSC to ensure a seamless transition to their management after dedication.

In addition, it is acknowledged that NSW BCD and TSC have significant experience and expertise actively managing feral species elsewhere in the Tweed Coast and regular liaison with these organisations throughout the implementation of this plan will allow for a coordinated and collaborative approach to feral animal control.

Consultation with NSW BCD and TSC regarding feral animal management will occur:

- Three (3) monthly in the first year and at least annually thereafter to review and potentially amend the monitoring program to ensure target species are effectively detected;
- When monitoring indicates action is required with regard to any of the listed feral species; and
- At other times to consider emerging issues as they arise.

6.3 Liaison with Biosecurity Agencies

Although this FAMP is specifically concerned with the management of feral animals on the Kings Forest site, it is important that control measures are consistent with broader Government objectives and operating procedures.

In NSW, biosecurity is managed by the NSW Department of Primary Industries (DPI) and NSW Local Land Services (LLS) through research, policies, strategies, codes of practice, standard operating procedures and legislation such as the NSW *Biosecurity Act* (2015). Similarly, the Commonwealth Department of Agriculture administers the biosecurity under the Commonwealth *Biosecurity Act* (2015).

The North Coast Regional Strategic Pest Animal Management Plan 2018 – 2023 (NCLLS 2018) is particularly relevant to feral animal management in the region.

The following specific provisions will apply:

- The project Environmental Officer(s) will maintain a watching brief on emerging priority species, issues (e.g. Fire ant outbreaks), monitoring methods and control techniques identified by the relevant biosecurity agencies.

- All control methods shall be developed in accordance with the North Coast Regional Strategic Pest Animal Management Plan 2018 – 2023 (NCLLS 2018), and relevant State and Commonwealth legislation including but not limited to standard operating procedures and control orders.

6.4 General Management Strategies

6.4.1 Introduction

General management strategies to be implemented as part of the Kings Forest FAMP are detailed in the following sections. These management strategies will be implemented directly after "commencement" and will continue through to pre-construction, construction and operational phases of the development or until relevant conserved and rehabilitated lands are dedicated to NSW BCD and TSC.

6.4.2 Education of Site Personnel and Residents

A key action to be implemented in accordance with the approved KPoM (JWA 2019), VWMPs (JWA 2020g, h, i) and other management plans is the development of a construction personnel induction program and a resident awareness program. The programs shall be developed by the proponent and should include information about feral animals likely to be present on site and characteristic signs of their presence.

The general induction of all construction personnel and the provision of relevant information to residents, will aim to ensure awareness of feral animal issues and of responsibilities and procedures in relation thereto, covering such matters as:

- Why the FAMP is necessary;
- Why these species need to be reported;
- Species covered by the FAMP and their identification (including Alert species);
- General provisions of the FAMP;
- Biosecurity procedures to ensure high risk species such as fire ants/yellow crazy ants are not brought onto the site via construction equipment etc.;
- Prohibition on construction personnel bringing dogs onto the site; and
- Requirement to report any evidence of feral animals, particularly dogs within buffers (sightings, footprints, droppings, dead or injured koalas) to the project Environmental Officer(s).

The construction personnel induction program is to be approved by NSW BCD and TSC prior to construction commencing and all construction personnel, and any other persons/contractors completing works within or adjacent to habitat need to complete the induction prior to starting work on the site.

6.4.3 Habitat Management

Habitat management is the primary recommended control option with some potential to reduce the impact of priority feral animal species occurring at the Kings Forest site. Habitat management incorporates strategies such as the reduction of fragmentation, rationalisation of access, rehabilitation of trails, roads and clearings and increasing vegetation density. Native animals may be more secure in structurally complex habitats (Dickman 1996, cited in Environment Australia 1997) and management of habitat to reduce fragmentation and increase vegetation density may be effective in reducing the level of feral animal predation, particularly foxes and feral dogs and cats. Likewise, the establishment of dense vegetation around noted frog breeding or foraging areas may function to exclude cane toads as they are known to favour areas of cleared and/or disturbed land.

It is noted that the need to manage fire and habitat areas retained on site will necessitate that the majority of existing tracks will need to be retained. It is acknowledged that this potentially provides favourable habitat for some feral species including dogs, foxes, cats and cane toads. These retained tracks will therefore be targeted during feral animal monitoring and control procedures.

Regeneration/revegetation works and retained vegetation management strategies proposed for the Kings Forest site in accordance with the following Management Plans are likely to assist in reducing impacts of feral animals:

- Precincts 1 - 5 VWMP (JWA 2020g) – Sections 6.7 and 6.9;
- Precincts 6 – 11 VWMP (JWA 2020h) – Sections 6.7 and 6.9;
- Precincts 12 – 14 VWMP (JWA 2020i) – Sections 6.6 and 6.8;
- Kings Forest Koala Plan of Management (JWA 2019) – Sections 7.5 and 7.6; and
- Kings Forest Wallum Sedge Frog Management Plan (JWA 2020a) – Sections 7.7 and 7.8.

6.4.4 Reduction of Impacts of Hydrological Change

Each relevant precinct of the Kings Forest development will be constructed in accordance with the Kings Forest Erosion and Sediment Control Plan (G&S 2020c) and the Kings Forest Overall Water Management Plan (G&S 200b).

The following specific provisions will apply:

- Development activities must not create areas where water may pool and stagnate, thereby creating habitat for cane toads and/or mosquito fish and/or biting insects;
- Any construction or reprofiling of drainage lines should encourage flow and regular flushing and incorporate dense fringing vegetation to discourage cane toads; and
- Dense plantings and/or physical barriers will be included around all created waterways and wetlands such as stormwater detention basins, lakes etc. to discourage cane toads.

6.5 Monitoring and Reporting Program

6.5.1 Introduction

Given that there are limited details on the current usage of the site by feral animal species and biting insects, the need to control and/or manage individual feral animal species and/or biting insects on the site and the appropriate control methods will be determined in consultation with NSW BCD and TSC based on the outcomes of a targeted monitoring program. The monitoring program will follow similar work TSC has been applying successfully across its bushland estate elsewhere on the Tweed Coast.

The following sections detail the monitoring program to be completed on the site including a Year One Targeted Monitoring Program, monitoring methods and procedures, requirements for post fire monitoring and reporting.

6.5.2 Targeted Monitoring Program

A targeted monitoring program for feral animals will be undertaken by a suitably qualified ecologist and where possible should be completed in conjunction with other monitoring activities (i.e. threatened fauna monitoring) as outlined in the following management plans:

- Kings Forest Koala Plan of Management (JWA 2019);
- Kings Forest Wallum Sedge Frog Management Plan (JWA 2020a);
- Kings Forest Precincts 1 – 5 Threatened Species Management Plan (JWA 2020d);
- Kings Forest Precincts 6-11 Threatened Species Management Plan (JWA 2020e); and
- Kings Forest Precincts 12-14 Threatened Species Management Plan (JWA 2020f).

The monitoring program will use one or more of the following methods depending on the species:

- Heat and motion cameras (infrared and white flash) - targeting wide ranging landscape species such as feral dogs, foxes and feral cats;
- Detection dog searches - targeting potential fox den sites and hotspots of fox and cat activity (to guide trapping sites);
- Targeted searches for feral animals;
- Sampling for biting insects during mosquito breeding season; and
- Opportunistic records from site workers/community and other monitoring programs.

Further information on each of these monitoring methods is provided in **SECTION 6.5.3**.

A targeted monitoring program to be implemented for the first year is detailed in **SECTION 6.5.5**. It is expected that there will need for progressive refinement and modification to the monitoring program over subsequent years. This will occur in response to better understanding of the site, regional factors and the progression to an urban landscape. All control/management actions and changes to the monitoring program are to be developed in collaboration with NSW

BCD and TSC in accordance with the adaptive management procedures detailed in **SECTION 6.7**.

6.5.3 Monitoring Methods and Procedures

6.5.3.1 Introduction

The following sections provide further details relating to each of the relevant monitoring methods to be implemented.

6.5.3.2 Heat and Motion Cameras

The use of heat and motion cameras (infrared and white flash) is particularly useful for detecting the presence of mobile landscape species such as dogs, foxes and cats. For these species, cameras are the most reliable method and cost effective for collecting data across time. Heat and motion cameras area also good for monitoring activity at a site before, during and after a control program. Given sufficient coverage of the Kings Forest site a network of fixed location cameras should provide comprehensive view of what is happening with dogs, foxes and cats across the site throughout the year. Cameras may also be deployed to target other priority species although this is typically done in conjunction with other methods such as targeted searches of known habitats (e.g. rabbits and hares).

To be effective the initial camera monitoring program should identify sites with good access:

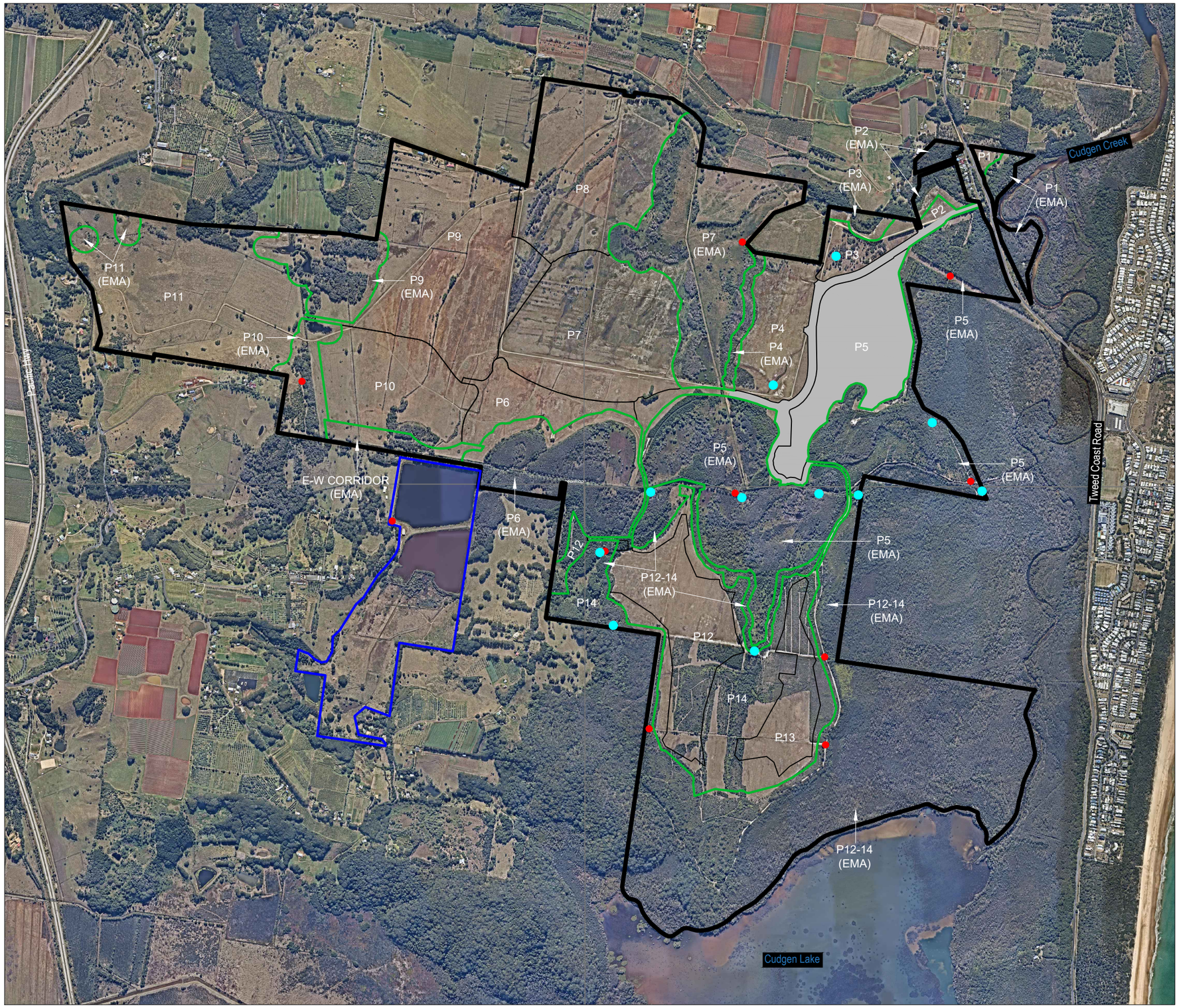
- That represent the habitat types on the Kings Forest site;
- Cover habitats of key ecological assets at risk (e.g. koala, bush stone curlew); and
- Provide good coverage of the tracks and trails network across the property.

Camera monitoring sites should be well managed sites in order to increase the efficiency of data collection and decrease the instances of cameras triggered by moving leaves and grass.

Given the size of the site, ten (10) cameras should be deployed full time. At least two (2) of the ten (10) cameras should be located in areas frequented by bush stone curlews. One (1) of the ten (10) cameras should be deployed on Turners land. Initial proposed camera trap locations are shown in **FIGURE 9**. Cameras should be left in place in these locations for a minimum of one (1) month until "fixed location monitoring sites" are identified. Depending on the results, cameras may need to be relocated to better reflect movement routes of target species both onto and across the site.

The following specific procedures will apply to the placement and management of cameras on the site:

- Cameras are to be of a high quality with rapid trigger speed.
- Cameras will be placed on a track or trail, ideally at a track intersection, at approximately 50 cm above ground level and at an approximate 45^{o} angle to the road;
- A security case and cable will always be used to secure the camera. All cameras will be code locked and the lock used while the camera is deployed. Affixed to each camera



N

LEGEND

- Initial Proposed Camera Trap Locations
- Biting Insect Sampling Locations
- Stage 1 Development Footprint
- Environmental Management Area (EMA) Boundary (#)
- Precinct Boundary
- Kings Forest Boundary
- Turners Land Boundary

Note:
To assist in identifying the staging of rehabilitation and management actions, EPZs and buffer areas have been associated with a relevant development precinct and are collectively titled as Environmental Management Areas (EMAs).

0 500m
1 : 20 000

SOURCE: Near Map 08/08/18 Aerial

SCALE: 1 : 20 000 @ A3

JWA PTY LTD
Ecological Consultants

CLIENT
Project 28 Pty Ltd

PROJECT
Feral Animal Management Plan
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 9

PREPARED: BW
DATE: 10 December 2020
FILE: N97017_FAMP_20201210.dwg

TITLE

MONITORING LOCATIONS

will be a notice informing the public that the camera is code-locked and that the camera is being used for wildlife monitoring purpose only.

- Initially, cameras will be checked fortnightly for the first year with data downloaded, batteries checked and all vegetation in front of the camera removed or trimmed to minimize false triggers. After the first year it may be possible to adjust this to monthly once the site is better understood.
- All images of people will be deleted when data is analysed.

6.5.3.3 Detection Dog Searches

Detection dog searches are an efficient method of monitoring to inform subsequent trapping and ground-baiting programs. Detection dogs can efficiently identify areas of increased or concentrated fox, cat or wild dog activity and to also identify the location of active fox or wild dog dens which may be subsequently fumigated.

Limitations in the use of detection dogs are primarily the expense and the need to have a defined focus area for the search. Use of this method is also limited to the cooler months of the year due to animal welfare and handler safety constraints.

Detection dog searches may be undertaken when resources permit and for a specific purpose such as locating active dens in areas identified from camera monitoring data (i.e. a fox or wild dog regularly attending a certain area or returning on a frequent basis with prey to an area suggesting provisioning of cubs or young pups).

Detection dog searches should be completed annually during August when considered necessary (i.e. when required to locate active fox den sites) and/or to identify "hotspots" of activity at which to focus either trapping or baiting events.

6.5.3.4 Targeted Searches

Targeted searches are key methods for monitoring:

- Dogs, foxes and cats;
- Cane toads;
- Common mynas;
- European rabbit / Brown hare; and
- Mosquito fish.

The following specific procedures will apply for targeted searched on the site:

- Spotlighting and scat searches targeting dogs, foxes and cats will be completed four (4) times per year utilising track network;
- Targeted searches of potential Cane toad breeding habitat will be carried out in conjunction with Wallum sedge frog surveys completed in accordance with the approved

Wallum Sedge Frog Management Plan (JWA 2020a) i.e. three (3) times per breeding season (spring/ summer) during suitable conditions;

- Targeted searches for Common myna in preferred habitat (including tree hollows, areas of mowed grass, grazing land and cattle feeding bins) will be completed four (4) times per year;
- Targeted observations (dawn/dusk) and scat searches for European rabbit / Brown hare within preferred habitat (including grassy areas near cover) will be completed four (4) times per year; and
- Targeted searches for Mosquito fish within drainage lines and waterbodies will be carried out in conjunction with wallum sedge frog surveys completed in accordance with the approved Wallum Sedge Frog Management Plan (JWA 2020a) i.e. three (3) times per breeding season (spring/ summer) during suitable conditions.

6.5.3.5 Biting Insect Sampling

Monitoring for biting insects is to occur for the duration of the mosquito breeding season i.e. late August to April. A number of sample points have been identified in consultation with TSC (**FIGURE 9**). The locations have been (and any future locations should be) selected on the basis that the point will hold water for at least one (1) week.

The following specific provisions will apply to biting insect sampling on the site:

- Each point will be sampled (by dip net) weekly during the monitoring period by dipping standing water at the sampling point six (6) times. Samples containing more than one (1) larva per dip will activate the need for treatment at the relevant sample site (refer **SECTION 7.5.9**).
- Sampling will also occur after treatment to establish effectiveness of treatment. Weekly sampling should resume at the normal time after treatment unless the treatment and effectiveness sampling occurred within three (3) days before the normal sampling time, sampling should, in this case, be resumed the week afterwards.
- Sampling will also occur opportunistically after a storm event (over 25 mm of rain within a 24 hour period) but only if the sampling point had been dry prior to the storm event. If the sampling point had already contained water prior to the storm event then no opportunistic sampling is required and sampling remains on the normal weekly basis.
- Data collected during all sampling events should be collated and sent to TSC quarterly.

6.5.3.6 Opportunistic Observations

All opportunistic observations and reports of target species (sightings, tracks scats etc.) collected by the project Environmental Officer(s) from site workers and/or the community, as well as opportunistic observations noted during other monitoring programs are to be recorded and mapped in the Annual Feral Animal Monitoring report (refer **SECTION 6.5.7**) and used to inform the ongoing monitoring effort and control measures.

6.5.4 Year One Targeted Monitoring Program

TABLE 11 details a targeted monitoring program to be implemented for the first year. The monitoring program will commence with the commencement of construction[1] of the site.

Depending on the result of the Year One Monitoring Program, it may be necessary to modify the program for subsequent years. All changes to the monitoring program are to be developed in collaboration with NSW BCD and TSC in accordance with the adaptive management procedures detailed in **SECTION 6.7**.

[1] Commencement of construction is defined under Concept Plan Approval Condition B7 and Major Project Approval A13 as any physical works including clearing vegetation, the use of heavy duty equipment for the purpose of breaking ground for bulk earthworks, or infrastructure for the proposed project.

TABLE 11
YEAR 1 FERAL ANIMAL MONITORING PROGRAM

Monitoring Requirement	Target Species	Method/Location	Timing
Heat and Motion Cameras	Feral dogs / Feral cats / Red Fox Incidental sightings of Cane toads, Common myna, European rabbit/Brown hare to inform target searches.	Ten (10) cameras across site on track network with at least two (2) located in areas frequented by bush stone curlews and one (1) located on Turners land. Initially, cameras should be left in place for a minimum of one (1) month until "fixed location monitoring sites" are identified.	Full time with cameras checked fortnightly (data downloaded, batteries checked and all vegetation in front of the camera removed or trimmed to minimize false triggers) for the first year.
Detection Dog Searches	Feral cats / Red Fox	Targeted to located fox dens and fox and cat hotspots.	Annually in August.
Targeted Searches	Feral dogs / Feral cats / Red Fox	Spotlighting and scat searches utilising track network.	Four (4) times per year
	Cane toad	Targeted searches of potential Cane toad breeding habitat.	To be carried out at the same time as WSF surveys (i.e. three (3) times per breeding season (spring/ summer) and after a storm events and opportunistically.
	Common myna	Targeted searches of preferred habitat including tree hollows, areas of mowed grass, grazing land and cattle feeding bins.	Four (4) times per year.
	European rabbit / Brown hare	Targeted observations (dawn/dusk) and scat searches of preferred habitat including grassy areas near cover.	Four (4) times per year.

Monitoring Requirement	Target Species	Method/Location	Timing
	Mosquito fish	Targeted searches of drainage lines and waterbodies.	Three (3) times per breeding season (i.e. during spring/ summer).
Biting Insect Sampling	Mosquitoes and biting midges	Dip net sampling for biting insects.	Weekly for the duration of the mosquito breeding season (i.e. late August to April). After treatment to establish effectiveness of treatment. Opportunistically after a storm event (over 25 mm of rain within a 24 hour period) but only if the sampling point had been dry prior to the storm event.
Opportunistic Searches	All species	Sightings from monitoring sites established for other management plans. Other incidental records from ecologists, construction workers and community.	Ongoing

6.5.5 Post Fire Monitoring

Planned and unplanned bushfire can provide significant opportunity for incursions of feral animals (and weeds). Monitoring for priority species shall be carried out after any bushfire and will include additional targeted searches (refer **SECTION 8.1.3.1**) for vertebrate predators (dogs, foxes and cats). Additional targeted searches for cane toads and mosquito fish (refer **SECTION 8.1.3.1**) will also be completed where fire occurs in wetlands and around open water.

6.5.6 Reporting

An Annual Feral Animal Monitoring Report will be prepared by a suitably qualified ecologist which discusses the results of the targeted monitoring program. The information provided in the report should include, but not necessarily be limited to:

- A summary of monitoring activities undertaken over the previous 12 months;
- The details of any feral animals detected for the previous 12 month monitoring period;
- A summary of control actions taken in response to monitoring; and
- Any recommendations made for future control and management.

Each Annual Feral Animal Monitoring Report will be submitted to NSW BCD and TSC within two (2) months of completion of the relevant monitoring.

6.6 Implementation of Control Measures

If the targeted monitoring program identifies a consistent presence of a priority feral animal species or a significant issue or threat posed by target species, targeted control measures for that species will be implemented as detailed in **SECTION 7**. The basis for the selection of a particular control/management method will be determined on a site-specific basis based on the results of the monitoring program and in consultation with NSW BCD and TSC considering factors such as:

- The level of threat as determined from the monitoring program and other relevant information.
- Key ecological assets to be protected.
- Control objectives for the species on the site:
    - Prevention – to prevent a feral animal species from arriving and establishing itself on the site;
    - Eradication – to permanently remove a feral animal species for the site and prevent its re-establishment;
    - Containment – to prevent the spread of a feral animal species; and
    - Asset protection – to reduce the impact of a feral animal species on key location and/or values.
- Requirements of relevant state and commonwealth Standard Operating Procedures and Control Orders. This includes managing any collateral risks to residents, local pet

animals and native species and their habitats (e.g. risks from laying poison baits, trapping and shooting) and animal ethics considerations.

- Current best practice control techniques.
- The need to coordinate management with adjoining landholders i.e. NSW BCD and TSC.
- Seasonality and timing e.g. whether the method is implemented prior to or just after known breeding activities.
- Costs and available resourcing.

Once an agreed course of action is determined, a brief operational plan (1 - 2 pages plus a map) should be prepared to document the proposed control/management actions prior to implementation. It is expected that this plan shall form a key component of the documentation required under the adaptive management procedures address in **SECTION 7.6**.

The results arising from the implementation of the operational plan referred to above shall be recorded in the Annual Feral Animal Monitoring report (refer **SECTION 8.3**) including a discussion of any relevant matters that may inform future monitoring and/or control actions.

6.7 Adaptive Management

6.7.1 Introduction

Adaptive management is an approach that involves continually monitoring a process to evaluate its effectiveness, an improving the process based on this evaluation. It requires transparent planning systems and implementation strategies, and a strong emphasis on monitoring and reviewing to ensure emerging information is reflected in future planning. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997).

The Kings Forest site is a large and complex project with interrelated management plans and conditions and is expected to be carried out over many years. As the project evolves, it has been acknowledged by NSW DPI&E, BCD and TSC that conflicts between management plans may be identified during the management plan approval process. In addition, changes to site conditions and the results of monitoring (i.e. rehabilitation monitoring) may require amendments to the details management plans.

The following sections outline the adaptive management approaches to be utilised to manage conflicts between management plans and to respond to issues identified during routine monitoring.

6.7.2 Management Plan Conflicts

Issues related to conflicts between management plans will be addressed using the following adaptive management approach:

1. Issues of concern will be identified as they are detected during the management plan review and approval process.

2. Approved management plans can only be updated using the adaptive management approach where the inconsistency:
    - results following the approval of an associated management plan, and:
    - is in response to advice from, or acknowledged in writing by TSC or a relevant State agency, and
    - is genuinely minor and/or administrative in nature, and
    - results in no additional environmental impact.

    Discretion as to whether approved management plans may be updated using the adaptive management approach (or may require re-satisfaction or a modification of the Project Approval) rests with the DPI&E, in consultation with TSC, BCD and any other relevant agencies.
3. The management plan under review will be amended to acknowledge the issue(s) of concern and how the issue(s) will be addressed through the adaptive management provisions. Updates must be consistent with the rationale, aims, objectives and expected outcomes of the relevant management plan (e.g. the principles of the Koala Plan of Management) and continue to comply with the relevant conditions of the Project Approval and any relevant benchmarks. For example, where proposed offset plantings conflict with other uses an alternative offset site will need to be located elsewhere to satisfy the overall offset commitment.
4. Once the plans commence implementation, the recommended adaptive management issues and the relevant management response should be implemented and included in the annual reporting for the affected management plan.
5. When management plans are updated (which is required for each new stage of the development) any changes made to the plan because of adaptive management are to
6. Be included in the updated plan and adaptive management log (**SECTION 5.9.4**). A copy of all management plans will be kept on the project website, clearly indicating current and archived versions.

6.7.3 FAMP Adaptive Management

Once the FAMP commences implementation, adaptive management strategies will be determined based on monitoring reports. If monitoring shows that management strategies are not adequately controlling numbers or is no longer feasible due to a loss of resources or other change in circumstance, it may be necessary to modify and adapt the plan. This could include a change in where and when control is carried out or the addition of further techniques (e.g. trapping as well as ground baiting).

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

When management plans are updated (which is required for each new stage of the development) any changes made to the plan because of adaptive management are to be included in the updated plan and adaptive management log (**SECTION 5.9.4**). A copy of all management plans will be kept on the project website, clearly indicating current and archived versions.

6.7.4 Adaptive Management Log

A log of changes to each management plan will be updated monthly and published on the project website. In addition, a copy of the adaptive management log will be included in the Annual Monitoring Report (**SECTION 6**). The log shall include (as a minimum), the date, the title of the plan affected, an explanation of the inconsistency and update made, and confirmation that TSC, NSW BCD or any relevant agencies support the amendment.

No issues have been identified to date within this FAMP during the management plan review. An adaptive management log is provided in **TABLE 10** and will be updated as necessary.

TABLE 10
ADAPTIVE MANAGEMENT LOG

Date	Affected Management Plans	Conflict	Description of Issue	Proposed Adaptive Management Response	Confirmation of TSC, BCD or Any Relevant Agencies Support the Amendment	Success of Adaptive Management Response
No issues identified to date.						

7 TARGETED CONTROL OPTIONS

7.1 Introduction

As noted in **SECTION 6**, feral animal management and control strategies will be determined based on ongoing monitoring in consultation with NSW BCD and TSC. If the monitoring program identifies a consistent presence of a priority feral animal species or a significant issue or threat posed by target species, then targeted control measures will be implemented for that species as soon as practicable. All feral animal management and control works are to be overseen by the project Environmental Officer(s) with necessary specialist contractors approved by the relevant agencies as required.

The following sections provide information on the targeted control options for each priority species including management triggers and specific procedures required to implement them. As the control of feral animals is an emerging field it is expected that over time new control measures will need to be considered. This will be achieved under the adaptive management procedures described in **SECTION 6.7**.

Detailed profile of all the species targeted for control in this management plan are provided in **APPENDIX 3**. These profiles include a comprehensive discussion on methods available for control of each targeted species.

7.2 Feral Dogs, Red Foxes and Feral Cats

Dogs, foxes and cats are all landscape scale species, in that they are most often wide ranging and move across the landscape in search for food and other resources. Foxes and cats seem to have smaller home ranges on the Tweed Coast compared to wild dogs (P. Gray, TSC, pers. Com., Sept 2020).

The Year One Targeted Monitoring Program for dogs, foxes and cats at Kings Forest in outlined in **SECTION 6.5.4**. **TABLE 5** sets out the management objectives and triggers for the control of dogs, foxes and cats on the Kings Forest site as well as the control measures that are considered the most appropriate.

The following specific provisions will apply to the control of dogs, foxes and cats on the Kings Forest site:

- In accordance with the North Coast Regional Wild Dog Management Plan 2015 (REF), appropriate consideration should be given to balancing the management of wild dogs and the damage they can cause, with the ecological role dingos have in the landscape.
- All captured or killed wild dogs should be DNA tested to determine their genetic makeup. Such information should then be used to inform future management.
- Captured dogs, foxes and cats will be taken to the nearest veterinarian, checked for microchips and if necessary euthanised in a manner recommended by the relevant Animal Care and Ethics Authority (NSW Agriculture).

- Stray dogs or cats within urban parts of the site would be reported to the ranger at Tweed Shire Council for removal.
- It is noted that the provisions of the Pesticide Control (1080 Wild Dog Bait) Order 2002, which falls under Section 38 of the *Pesticides Act 1999*, outlines a number of restrictions to the use of baits where domestic pets may be at risk. Specifically, Schedule 1 of the Pesticide Control (1080 Wild Dog Bait) Order 2002 – Permit to Allow Use of 1080 Baits for Control of Wild Dogs states that "1080 baits must not be laid within close proximity to urban areas unless the baiting program is planned in conjunction with, and has been agreed to, by an Authorised Control Officer. Such programs must include strategies for minimising risk to non-target animals. Proposals for baiting in closely settled farming areas or areas within four (4) kilometres of a village or any street with a speed restriction of 70 kilometres per hour or less fall within this requirement". The Kings Forest site falls within these criteria. Bait stations will therefore need to be deployed in locations not likely to be accessed by domestic pets, and the baiting program will need to be developed in consultation with an Authorised Control Officer.
- The siting, laying and retrieval of dog or fox baits are to be carried out strictly in accordance with relevant Pesticides Control Orders.
- Where possible control programs for dogs, foxes and cats should be carried out in an integrated way in conjunction with other neighbouring landholders.

TABLE 5
RECOMMENDED MANAGEMENT OBJECTIVES AND CONTROL MEASURES FOR DOGS, FOXES AND CATS

Species	Management Objective	Management Trigger	Control Measure	Situations Where this Measure may be Appropriate
Feral Dog	To minimise the impact of dogs on key ecological assets such as Koalas, Bush stone curlews recognising the ecological role that Dingos have in the landscape.	Any of the following: • Two (2) or more passes of a dog past any camera in a two (2) week period. • More than one (1) opportunistic sighting in a two (2) week period. • Evidence of adverse impacts on key ecological assets.	Further monitoring and investigation	First line action to more closely examine behaviour patterns, site usage and other factors to determine if the dog(s) represents a threat to humans or native fauna and therefore needs control.
			Shooting	Preferred where a dog is considered a threat and shooting is viable. Potential use in threatened species habitat. Labour intensive.
			1080 baiting	Where domestic animal are unlikely to come into contact with bait.
			Cage trapping	Where domestic dogs are suspected of entering EPZs and require recapture.
			Soft jaw traps	Judicious use only – need to be confident that koalas and other fauna not at risk (e.g. open areas away from koala feed trees). Labour intensive.
Red Fox	To minimise the impact of foxes on key ecological assets such as small terrestrial and arboreal mammals, frogs, reptiles and birds.	Any of the following: • Two (2) or more passes of a fox past any camera in a two (2) week period. • More than one (1) opportunistic sighting in a two (2) week period. • Evidence of adverse impacts	Further monitoring and investigation	First line action to more closely examine behaviour patterns, site usage and potential denning to inform control methods
			Shooting	As per dogs where den fumigation is not possible.
			1080 baiting	Where domestic animal are unlikely to come into contact with bait.
			Cage trapping	Where animals area suspected of being bait-shy.
			Soft jaw traps	As per dogs.
			Den fumigation	Preferred method where active den sites are located.

Species	Management Objective	Management Trigger	Control Measure	Situations Where this Measure may be Appropriate
		on key ecological assets.		
Feral Cat	To minimise the impact of cats on key ecological assets such as small terrestrial and arboreal mammals, frogs, reptiles and birds.	Any of the following: • Two (2) or more passes of a cat past any camera in a two (2) week period. • More than one (1) opportunistic sighting in a two (2) week period. • Evidence of adverse impacts on key ecological assets.	Further monitoring and investigation	First line action to more closely examine behaviour patterns, site usage to inform control methods.
			Shooting	As per dogs.
			Poisoning	Generally not effective but new technologies on the horizon.
			Cage trapping	Where control is triggered.
			Soft jaw traps	As per dogs

7.3 Cane Toads

Habitat management and modification as outlined in **SECTION 7.4** is recommended for the control of Cane toads. Specifically, management strategies should consider factors such as promoting dense ground cover (or other physical barriers) in areas adjacent to waterbodies, leaving grassed areas unmown, avoiding the creation of tracks including both vehicular and foot trails.

The Year One Targeted Monitoring Program for Cane toads at Kings Forest in outlined in **SECTION 6.5.4**. If monitoring identifies cane toads at the site, the following control methods will be implemented where appropriate:

- Light traps;
- Cane toad muster;
- Manual survey and removal of eggs and tadpoles; and
- Chemical tadpole traps.

Further details of these control methods are provided in **APPENDIX 3**.

TABLE 6 sets out the management objectives and triggers for the control of Cane toads on the Kings Forest site as well as the control measures that are considered the most appropriate.

TABLE 6
RECOMMENDED MANAGEMENT OBJECTIVES AND CONTROL MEASURES FOR CANE TOADS

Management Objective	Management Trigger	Control Measure	Situations Where this Measure may be Appropriate
To minimise the presence of Cane toads in the development envelope and prevent their spread into adjacent natural habitat areas.	Cane toads detected in WSF habitat. Cane toads detected in previously unoccupied natural areas. Cane toads detected in newly created wetlands, detention basins, waterbodies etc.	Dense plantings of vegetation or physical barriers	Drainage lines created waterways and wetlands (e.g. stormwater detention basins, lakes etc.) within the development envelope and ecological buffers.
		Light traps	Locations where adult Cane toads are present in vicinity of a waterbody where there are no other light sources nearby.
		Cane toad muster	Small, preferably enclosed areas with

Management Objective	Management Trigger	Control Measure	Situations Where this Measure may be Appropriate
			large numbers of adult Cane toads.
		Manual survey and removal of eggs and tadpoles	Where egg clusters and/or tadpoles are observed during monitoring completed in accordance with the WSFMP (JWA 2020a).
		Chemical tadpole traps	Where Cane toad breeding activity has been detected. Most effective in waterbodies with shallow, slow moving water, gently sloping muddy banks, low surrounding vegetation and a sunny aspect.

The following specific provisions will apply to the control of Cane toads on the Kings Forest site:

- Cane toad control should only be undertaken by people trained and proficient in the identification of cane toads and native frogs of similar appearance.
- Cane toad control should take place prior to the breeding season and following significant rainfall events that may trigger breeding.
- When traps are in use, it must be inspected on a regular basis, preferably daily.
- When traps are left in the field but not in use, they must be rendered incapable of holding or catching Cane toads. Attractants should be removed when traps are not in use.
- Cane toads should be euthanased as soon as possible after capture and not held for long periods of time. The Methods for the field euthanasia of cane toads: Standard Operating Procedure – CAN001 (Sharp *et al.* 2011) contains current best practice for the euthanasia (or humane killing) of cane toads. Euthanasia procedures must be performed by persons competent in or qualified for the methods to be used, or under the direct supervision of a competent person.
- Where possible control programs for Cane toads should be carried out in an integrated way in conjunction with other neighbouring landholders.

7.4 Common Myna

The Year One Targeted Monitoring Program for Common myna at Kings Forest in outlined in **SECTION 6.5.4**. If monitoring identifies Common myna at the site it is considered that the most appropriate method for the control is trapping. As outlined in **APPENDIX 3** there are a number of trap types available. Selecting the right trap for the site will be a matter of trial and error.

TABLE 7 sets out the management objectives and triggers for the control of Common mynas on the Kings Forest site as well as the control measures that are considered the most appropriate.

TABLE 7
RECOMMENDED MANAGEMENT OBJECTIVES AND CONTROL MEASURES FOR COMMON MYNAS

Management Objective	Management Trigger	Control Measure	Situations Where this Measure may be Appropriate
To minimise the presence of common mynas in the development envelope and prevent their spread into adjacent natural habitats.	Common mynas detected in the development envelope. Common mynas detected in previously unoccupied natural areas.	Trapping (PeeGee, Mynamagnet or Mirror traps)	Open areas where Common myna have been seen feeding on the ground and where there is minimal traffic from people and animals.

The following specific provisions will apply to the control of Common mynas on the Kings Forest site:

- Trapping should only be undertaken by people trained and proficient in the identification of Common mynas.
- Traps must have sufficient height, length, and breadth to permit the bird to stretch its wings freely.
- Adequate shade is essential for the humane operation of the trap. Shade material (e.g. shade cloth, tarpaulin, plywood etc.) can be incorporated into the trap during construction or added during trap setup. Waterproof material will also provide protection during extremes of weather.
- When the trap is in use, it must be inspected on a regular basis, preferably daily.
- When the cage traps are left in the open but not in use, they must be rendered incapable of holding or catching birds (e.g. door secured in open position). Food should be removed when the trap is not in use.
- Trapped birds are likely to suffer from distress when confined and they can sometimes be injured while trying to escape from the trap or during capture or restraint prior to euthanasia. Trapped birds must only be killed by humane methods recommended by the relevant Animal Care and Ethics Authority (NSW Agriculture) with minimal delay.

7.5 European Rabbit and Brown Hare

The Year One Targeted Monitoring Program for European rabbits and Brown hares at Kings Forest in outlined in **SECTION 6.5.4**. If monitoring identifies European rabbits and/or Brown hares at the site, a combination of biological and mechanical (warren ripping and harbour destruction) techniques will be implemented where appropriate. If necessary chemical control methods such as warren fumigation may also be used in consultation with relevant authorities such as TSC or NPWS. Further details of these control methods are provided in **APPENDIX 3**.

TABLE 8 sets out the management objectives and triggers for the control of European rabbits and Brown hares on the Kings Forest site as well as the control measures that are considered the most appropriate.

TABLE 8
RECOMMENDED MANAGEMENT OBJECTIVES AND CONTROL MEASURES FOR EUROPEAN RABBITS AND BROWN HARES

Management Objective	Management Trigger	Control Measure	Situations Where this Measure may be Appropriate
To minimise the impacts of European rabbits and Brown hares on protected vegetation and habitats.	European rabbits and Brown hares detected in previously unoccupied natural areas.	Shooting	As per dogs.
		Poisoning	Generally not effective but new technologies on the horizon.
		Cage trapping	Where control is triggered.
		Soft jaw traps	As per dogs
		Mechanical control (i.e. warren ripping and harbour destruction)	Locations where warrens are detected. Mechanical control should only be undertaken where works will not impact on retained or compensatory habitat areas. Labour intensive.
		Biological control	Where other control measures are not deemed to be appropriate or is unsuccessful.

The following specific provisions will apply to the control of European rabbits and Brown hares on the Kings Forest site:

- It is noted that the provisions of the Pesticide Control (Rabbit Haemorrhagic Disease Virus) Order 2017, which falls under Section 38 of the *Pesticides Act 1999*, outlines a number of restrictions to the use of Rabbit Haemorrhagic Disease Virus in NSW. The use of biological controls is to be carried out strictly in accordance with relevant Pesticides Control Orders.
- Rabbits and hares must only be killed by humane methods recommended by the relevant Animal Care and Ethics Authority (NSW Agriculture) with minimal delay.
- Native wildlife may use rabbit warrens. Where use of a warren by wildlife is suspected, the warrens should be monitored before treatment to determine which animals are using the burrows. If monitoring shows that native fauna are using the warrens, these warrens should not be ripped.
- Where possible control programs for European rabbit and Brown hares should be carried out in an integrated way in conjunction with other neighbouring landholders.

7.6 Mosquito Fish

The Year One Targeted Monitoring Program for Mosquito fish at Kings Forest in outlined in **SECTION 6.5.4**. If monitoring identifies mosquito fish at the Kings Forest site, physical control methods (i.e. preventing access to and draining/drying of waterbodies) will be implemented where possible and appropriate to eradicate mosquito fish from sensitive frog habitats.

TABLE 9 sets out the management objectives and triggers for the control of Mosquito fish on the Kings Forest site as well as the control measures that are considered the most appropriate.

TABLE 9
RECOMMENDED MANAGEMENT OBJECTIVED AND CONTROL MEASURES FOR MOSQUITO FISH

Management Objective	Management Trigger	Control Measure	Situations Where this Measure may be Appropriate
To minimise the impacts of Mosquito fish on key ecological assets such as frogs and native fish and prevent their spread into adjacent natural habitats.	Mosquito fish detected in previously unoccupied natural areas.	Draining and drying of waterbodies.	Locations where the water level in the wetland or waterbody can be readily manipulated and the potential for reintroduction of mosquito fish from either upstream or downstream can be controlled.

The following specific provisions will apply to the control of mosquito fish on the Kings Forest site:

- Mosquito fish control should only be undertaken by people trained and proficient in the identification of Mosquito fish and native fish of similar appearance.

- As the waterbodies on the Kings Forest site support a number of native species, including some threatened frog species (i.e. wallum sedge frog and wallum froglet), the use of non-species specific chemical control methods is considered impractical.
- Mosquito fish control should be avoided during WSF breeding season (spring/ summer) where possible.
- Waterbodies should be check for the presence of native species prior to draining and drying. If native fish and frogs are using the waterbodies, these waterbodies should not be drained.
- Mosquito fish should be euthanased by humane methods recommended by the relevant Animal Care and Ethics Authority (NSW Agriculture) with minimal delay.
- Where possible control programs for Mosquito fish should be carried out in an integrated way in conjunction with other neighbouring landholders.

7.7 Biting Insects

The Year One Targeted Monitoring Program for biting insects at Kings Forest in outlined in **SECTION 6.5.4**. If monitoring identifies mosquitoes or biting midges at sampling locations, treatment will be required using Bti (short for *Bacillus thuringiensis* subspecies *israelensis*). Bti is a biological or a naturally occurring bacterium found in soils. It contains spores that produce toxins that specifically target and only affect the larvae of the mosquito, blackfly and fungus gnat. EPA has registered five (5) different strains of Bti found in forty-eight (48) pesticide products that are approved for use in residential, commercial and agricultural settings primarily for control of mosquito larvae. Bti is only effective up to and including the 3rd instar of mosquito development.

The following specific provisions will apply to the control of biting insects on the Kings Forest site:

- Biting insect control should only be undertaken by trained professionals based on current best practice.
- Where possible control programs for biting insects should be carried out in an integrated way in conjunction with other neighbouring landholders.
- Community awareness programs may also be necessary to advise residents of risks from biting insects and measures they can take to minimise these risks. Such programs will be considered at times when biting insects risks are high.

7.8 Alert Species

Alert species are those that are not known to be present on the Kings Forest site but which represent a significant threat. Land managers and community members play a major role in reporting any unusual sightings of pest animals (e.g. direct sightings, signs of presence, impacts) in the region. Working together is critical to ensuring early detection, awareness and the swift and effective management of alert species incursions. It is important that the

community remains vigilant and report any unusual (i.e. animals or signs of animal presence) sightings to ensure a rapid management response.

For all species in this category the management objective should be to prevent the species arriving and establishing on the site.

The following specific provisions will apply to the control of Alert species on the Kings Forest site:

- Through the education and awareness programs describes in **SECTION 5.2** ensure that construction workers and Kings Forest residents report any incursions of Alert species and that measures are in place to present any of these species from being inadvertently brought onto the site (e.g. via construction equipment from infected areas).
- An annual risk assessment will be carried out to ensure that the provisions of this plan are up to date and are able to respond to any incursions.
- Where any Alert species are identified on the site, the landholder shall notify NSW Department of Primary Industries (DPI) Invasive Plants and Animals Enquiry Line (ph: 1800 680 224 or email: invasive.species@dpi.nsw.gov.au).
- The landholder is to promptly implement any management response to incursions in accordance with the directions of the relevant Biosecurity agency.

8 IMPLEMENTATION SCHEDULE

8.1 Introduction

The implementation schedule provided in **TABLE 10** below summarises all feral animal and pest species management strategies and identifies the associated management actions, timing, responsibilities and performance measures.

In accordance with Project Approval (MP08_0194) Condition 72, evidence of commencement of implementation of this FAMP shall be provided to the Secretary prior to commencement of bulk earthworks.

8.2 Roles and Responsibilities

The successful implementation of this FAMP requires a number of key personnel to complete various roles. As many of the contractors for the project are yet to be appointed, these will be specified and list of key contacts for the project contained in revised versions of the FAMP (in accordance with Conditions B1 and C2 of the Concept Plan Approval 06_0318, MOD 6). A summary of key roles/personnel responsible for the management strategies identified in **TABLE 10** below includes:

Proponent
Project 28 Pty Ltd is the Proponent for the works as the approval holder.

Construction/Site Manager
The Construction/Site Manager (to be appointed) is a representative of the project team (typically the project engineer) and is responsible for coordinating the project consultants and construction contractor.

Principal Contractor
The Principal contractor (to be appointed) is responsible for the management of all activities involved in the construction phase of the development.

Site Supervisor
The Site Supervisor is a representative of the Principal Contractor (to be appointed) and responsible for overseeing all pre-clearing, clearing and construction activities are undertaken in accordance with the VMP and subsequent environmental management documentation.

Ecologist
For the purposes of this FAMP means a qualified ecologist with appropriate training and at least five (5) years of experience in undertaking vegetation and fauna surveys.

8.3 Implementation Table

TABLE 10
FERAL ANIMAL MANAGEMENT STRATEGIES

Management Strategy	Management Action	Responsibility	Performance Measure
Liaison with Tweed Shire Council and NSW BCD	Liaison with Tweed Shire Council and NSW BCD as required.	Proponent/ Environmental Officer(s)	Liaison with Tweed Shire Council and NSW BCD in accordance with **SECTION 6.2**.
Liaison with NSW Biosecurity Agencies	Liaison with NSW Biosecurity Agencies as required.	Proponent/ Environmental Officer(s)	Liaison with NSW Biosecurity Agencies in accordance with **SECTION 6.3**.
Education of Construction Personnel	A construction personnel induction program shall be developed and implemented by the Proponent prior to commencement of construction.	Principal Contractor / Site Supervisor	A construction personnel induction program developed and implemented, and an annual report prepared detailing the induction procedure and personnel inducted in accordance with **SECTION 6.4.2** and Section 7.2.1 of the Kings Forest KPoM (JWA 20219).
Education of Residents	A resident awareness program shall be developed prior to the sale of the first lot and implemented by the proponent.	Proponent	A resident awareness program developed and implemented in accordance with **SECTION 6.4.2** and Section 7.13.1 of the Kings Forest KPoM (JWA 2019).
Management of Retained Vegetation/ Habitat	Retained vegetation/habitat managed as required by **MP08_0194 Conditions 40 and 41**.	Suitably Qualified Bush Regeneration Company	Retained vegetation within the Precincts 1 - 5 EMAs will be protected and maintained in accordance with the following documents where applicable: • Kings Forest KPoM (JWA 2019) – Section 7.5; • Kings Forest WSFMP (JWA 2020a) – Section 7.7; • Precincts 1 - 5 VMP (JWA 2020g) – Section 6.7; • Precincts 6 - 11 VMP (JWA 2020h) – Section 6.7;

Management Strategy	Management Action	Responsibility	Performance Measure
			• Precincts 12 - 14 VMP (JWA 2020i) – Section 6.6; • Precincts 1 - 5 WMP (JWA 2020j) – Section 7.4; • Precincts 6 - 11 WMP (JWA 2020l) – Section 7.4; and • Precincts 12 - 14 WMP (JWA 2020m) – Section 7.4.
Rehabilitation and Compensatory Habitat Works	Rehabilitation works completed as required by **MP08_0194 Condition 40 and 41**.	Suitably Qualified Bush Regeneration Company	All regeneration/revegetation works (including compensatory koala and WSF habitat creation) to be completed in accordance with the following documents where appropriate: • Kings Forest KPoM (JWA 2019) – Section 7.6; • Kings Forest WSFMP (JWA 2020a) – Section 7.8; • Precincts 1 - 5 VMP (JWA 2020g) – Section 6.8; • Precincts 6 - 11 VMP (JWA 2020h) – Section 6.8; • Precincts 12 - 14 VMP (JWA 2020i) – Section 6.7; • Precincts 1 - 5 WMP (JWA 2020j) – Section 7.4; • Precincts 6 - 11 WMP (JWA 2020l) – Section 7.4; and • Precincts 12 - 14 WMP (JWA 2020m) – Section 7.4.
Reduction of Impacts of Hydrological Change	Sediment and erosion control devices installed prior to commencement of earthworks and maintained throughout construction phase.	Construction Manager	Each relevant precinct of the Kings Forest development constructed in accordance with the Kings Forest Erosion and Sediment Control Plan (G&S 2020c) and the Kings Forest Overall Water Management Plan (G&S 200b).
	Development works does not create new habitat for cane toads and/or mosquito fish.	Construction Manager	Earthworks and development activities undertaken in a manner that does not create new habitat for cane toads and/or mosquito fish in accordance with **SECTION 6.4.4**.

Management Strategy	Management Action	Responsibility	Performance Measure
			Any construction or reprofiling of drainage lines encourages flow and regular flushing, and incorporates dense fringing vegetation to discourage cane toads in accordance with **SECTION 6.4.4**.
Monitoring and Reporting	Feral animal monitoring and reporting program to be completed across the site.	Qualified Ecologist	Monitoring programs and reporting completed in accordance with **SECTION 6.5.** Reports provided to relevant government agencies.
Implementation of Targeted Feral Animal Control Measures (if necessary)	Targeted feral animal control programs (**SECTION 7**) implemented if the targeted monitoring program identifies a consistent presence of a priority feral animal species or a significant issue or threat posed by target species.	Principal Contractor / Site Supervisor	Feral dogs – 1080 baiting and/or cage trapping if required in accordance with **SECTION 7.2.**
			Red fox - 1080 baiting and/or cage trapping and/or den fumigation if required in accordance with **SECTION 7.2.**
			Feral cats – cage trapping if required in accordance with **SECTION 7.2.**
			Cane toads - Establishment of dense vegetation around noted breeding or foraging areas. Light traps and/or cane toad muster and/or manual survey and removal of eggs and tadpoles and/or chemical tadpole traps if required in accordance with **SECTION 7.3**
			Common mynas - Trapping program commenced if required in accordance with **SECTION 7.4.**
			European rabbits and Brown hares – Mechanical and/or biological control methods employed if required and as appropriate in accordance with **SECTION 7.5.**
			Mosquito fish – Pools drained and dried if required where appropriate and necessary in accordance with **SECTION 7.6.**

Management Strategy	Management Action	Responsibility	Performance Measure
			Biting insects – control program commenced if required in accordance with **SECTION 7.7.**
			Alert species - NSW Department of Primary Industries (DPI) notified where any Alert species are identified on the site in accordance with **SECTION 7.8**. The landholder is to promptly implement any management response to incursions in accordance with the directions of the relevant Biosecurity agency.
Adaptive Management	Adaptive Management strategies implemented as required.	Proponent	Adaptive Management Log detailing issues raised and any changes made to this management plan to be updated as monthly and included in the Annual Monitoring Report and published on the project website in accordance with **SECTION 6.7**.

9 INDICATIVE COSTINGS

TABLE 11 contains an indicative costing for the implementation of mitigation measures within each precinct of the development.

TABLE 11
INDICATIVE COSTINGS

Management Action/	Management Item	Cost ($) Establishment Phase	Cost ($/yr) Maintenance Phase
Camera monitoring	Camera purchase X 10 including security boxes	$7,500	
	Develop and implement camera monitoring program and analyse data		$20,000
	Reporting and recommendations for control		$5,000
Fox den searches	Annual detector dog searches (specialist contractor) 26hrs @ 200hr + Reporting 5hrs @90/hr		$5,550
Rabbit and hare monitoring		$3,000 initially	$2,000
Cane toad monitoring	Completed in conjunction with wallum sedge frog monitoring	Refer to approved WSFMP (JWA 2020a)	
Mosquito fish monitoring	Completed in conjunction with wallum sedge frog monitoring	Refer to approved WSFMP (JWA 2020a)	
Common Myna Monitoring	Completed as part of general construction/operational phase management and monitoring		$0
Alert Species monitoring	Completed as part of general construction/operational phase management and monitoring		$0
Biting insect monitoring	Weekly monitoring during the mosquito breeding season i.e. late August to April		$40,000
Dog, fox, cat, rabbit and hare control*	Reactive baiting X 3 events pa (subject to data) 36hrs/event @ 90/hr		$10,000
	Reactive soft jaw trapping (specialist contractor) – 90hrs @90/hr + trap hire and euthanasia.		$9,000
	Shooting (specialist contractor) X 2 events pa including planning 30hrs/event @ 90/hr		$5,400

Management Action/	Management Item	Cost ($) Establishment Phase	Cost ($/yr) Maintenance Phase
	Cage trapping including trap hire		$5,000
	Public notification		$2,000
Fox den fumigation^			$30,000
Mechanical control (i.e. (warren ripping and harbour destruction)^			
Cane toad Control^			
Mosquito fish Control^			
Common Myna Control^	Trap purchase		
	Develop and implement trapping program		
	Reporting and recommendations		
Alert Species control^			
Biting insect control	Larval control measures		$10,000
	Community awareness		
Administration/ record keeping			$5,000
Annual Reporting			$10,000
	TOTAL	**$10,500**	**$158,950**

Notes

*Individual cost estimates for dogs, foxes, cats, rabbits and hare control are based on similar programs at Koala Beach on the Tweed Coast. At Kings Forest, it is expected that relative use of specific control measures will vary depending on the situation. In general, however a lower use of one control measure (e.g. baiting) will need to be compensated by an increase in another (e.g. cage trapping).

^Monitoring and control costs for these species could be significant but cannot be accurately determined due to significant uncertainties regarding their potential future occurrence and the scale of any incursions. A notional budget of $30,000/yr has been allocated to cover these items.

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APPENDIX 1 – COMPLIANCE WITH RELEVANT APPROVAL CONDITIONS

CONDITION	SECTION
Major Project Approval – Condition 39 *"1) All Environmental Management Plans shall be revised to address management actions to be undertaken throughout the life of the project as relevant to the development precincts that the plan covers. This includes a detailed set of agreed establishment and maintenance phase performance completion criteria, ongoing monitoring and an annual maintenance schedule of works following the initial establishment period.* *2. Performance criteria for all management plans are reviewed to ensure they are specific to each precinct and action, measurable, achievable, relevant and timely.* *3) The implementation schedule of all Environmental Management Plans shall be revised to include the following details as relevant to the precincts that the plan covers:* *a. Actions that are specific to the precinct for which they are addressing* *b. Specific map references to identify locations of works for all actions* *c. Total areas to be planted (m2)* *d. Planting density (per m2)* *e. Number of permanent signs to be erected and maintained* *f. Total areas for weed management activities (m2)* *g. Length of any fencing (temporary and permanent)* *h. Total areas for heath regeneration and revegetation (m2)* *i. Locations and areas (m2) of proposed threatened species habitat* *j. Timing and frequency of actions* *k. Monitoring requirements (frequency) that are specific to the action".*	1. All Environmental Management Plans have been updated as required. 2. **SECTION 6** details the monitoring process. 3. a. The tables in **SECTION 5 and 7** identify actions related to this management plan across the Kings Forest site. b. Feral animal control **w**orks will occur on an as-needs basis across the entire Kings Forest site**.** c. Refer to VMPs (JWA 2020g, h, i) d. Refer to VMPs (JWA 2020g, h, i) e. Refer to VMPs (JWA 2020g, h, i) and KPoM (JWA 2019) f. Refer to WMP (JWA 2020j, k, l)**.** g. Refer to KPoM (JWA 2019). h. Refer to WSFMP (JWA 2020a). i. Locations and areas of habitat are outlined in the KPoM (JWA 2019), WSFMP (JWA 2020a) and precinct specific VMPs (JWA 2020g, h, i). j. Timing and frequency of actions are detailed in **SECTION 5 - 7.** k. Monitoring requirements and frequency are discussed in **SECTION 6.**

CONDITION	SECTION
Major Project Approval – Condition 44 *"1) The implementation schedule of the Feral Animal Management Plan shall be revised to include the following details as relevant to the Precincts that the plan covers:* *a. Estimated number of resources required for trapping activities, capture activities and habitat removal activities;* *b. Estimated resources required for monitoring actions.* *2) The Feral Animal Management Plan is to be revised to include mitigation and management actions for the control of Biting Insects, and consistent with Section A6 Biting Midge and Mosquito Controls of the Tweed DCP 2008.* *3) The final Feral Animal Management Plan shall be prepared in consultation with Council and submitted to the Secretary (MOD 2) for approval within 6 months of the date of determination of the application (No. 2012/2328) made under Sections 130(1) and 133 of the Commonwealth Environment Protection and Biodiversity Conservation Act (MOD 1) or prior to issue of any construction certificate, whichever occurs first."*	1. a. estimates of resources will be made upon the commencement of monitoring activities, at which time the extent of control activities will be estimated. b. The majority of monitoring activities will be completed in tandem with monitoring requirements of the KPoM and WSFMP and are therefore not expected to require significant additional resources. 2. The FAMP has been updated to include biting insect monitoring and control requirements. 3. The FAMP has been prepared in consultation with Council.

APPENDIX 2 – ADDITIONAL KINGS FOREST MANAGEMENT PLANS & THEIR RELATIONSHIP TO THE FERAL ANIMAL MANAGEMENT PLAN

Management Plan	Relationship to the FAMP
Kings Forest Koala Plan of Management (JWA 2019)	The aim of the Kings Forest KPoM is to protect and conserve the koala population in the Kings Forest area to ensure its ongoing survival through appropriate management of project impacts. The objectives are: • To ensure that the proposed development does not remove significant areas of habitat known, or likely to be important for the local koala population; • To ensure that movement corridors for the local koala population are maintained and/or improved; • To protect individual koalas from injury or other adverse impacts during the development phase; • To embellish the habitat values of the site, including the creation of koala habitat as part of a comprehensive offset strategy; • To protect, restore and provide for ongoing maintenance of existing koala habitat; • To ensure that changes in the local environment resulting from the proposed development (e.g. additional traffic, introduction of dogs) do not significantly impact on the local koala population; • To ensure that koalas continue to utilise habitat at Kings Forest; • To ensure appropriate monitoring and management programs are undertaken; • To raise awareness and promote community ownership of environmental management (including the conservation of the local koala population); • Compliance with relevant conditions; and

Management Plan	Relationship to the FAMP
	• Further revision of the KPoM as appropriate.
Kings Forest Wallum Sedge Frog Management Plan (JWA 2020a)	The aim of the Kings Forest WSFMP is to protect and conserve the WSF population in the Kings Forest area to ensure the ongoing survival of the population through appropriate management of project impacts. The objectives are: • To ensure that the proposed development does not remove areas of habitat outside of approved clearing areas; • To ensure that movement corridors for the local WSF population are maintained and/or improved; • To protect WSF from injury or other adverse impacts associated with the construction phase of the development through the implementation of appropriate management actions; • To improve the habitat values of the site, including the creation of WSF habitat as part of a comprehensive and staged offset strategy; • To protect WSF from injury or other adverse impacts associated with the operational (post-construction) phase of the development through the implementation of appropriate management actions; • To ensure that WSF continue to utilise habitat at Kings Forest by way of providing for effective monitoring of performance in relation to the provisions of this WSFMP; • To raise awareness and promote community ownership of environmental management (including the conservation of the local WSF population); • Compliance with relevant conditions; and • Revision of the WSFMP as appropriate.

Management Plan	Relationship to the FAMP
Kings Forest Vegetation and Weed Management Plans (JWA 2020g, h, i)	The precinct specific VWMPs are intended to assist Project 28 in managing existing native vegetation and other environmentally sensitive areas within the EMAs on the Kings Forest site before, during and after development. The aims of the VWMPs are to develop a comprehensive and integrated approach to guide the immediate and long-term management of retained and compensatory native vegetation within EMAs and to ensure its protection and enhancement. Specific objectives of the VWMPs are to: • Protect the environmentally significant site values within buffers and EPZs from bulk earthworks and construction activities; • Remove vegetation from the development footprint in a controlled and an environmentally sustainable way; • Provide permanent protection for the environmentally significant values within EMAs associated with development (i.e. threatened flora and fauna species, endangered ecological communities, and wetlands); • Manage noxious and environmental weeds in an environmentally sustainable manner and prevent the further spread of weeds resulting from the development; • Utilise assisted natural regeneration where appropriate; • Restore, enhance and manage the retained and protected vegetation including providing guidelines for the revegetation of ecological buffers, EPZs, wetlands and the Cudgen Nature Reserve; and • Monitor the condition of retained and rehabilitated vegetation to assess if the project completion criteria have been met and report where appropriate.
Kings Forest Threatened Species Management Plans (JWA 2020d, e, f)	The precinct specific TSMPs have been prepared to address the management of threatened species (other than the Koala and WSF) and their habitat/s occurring in EMAs. The TSMPs contain the following objectives:

Management Plan	Relationship to the FAMP
	• Weed control measures specific to areas containing listed threatened flora and fauna; • Guidelines for the control of human and animal access to areas containing threatened species; • Strategies for the embellishment of threatened species habitat through revegetation works and/or the creation of compensatory habitat areas where required.
Kings Forest Buffer Management Plans (JWA 2020b, c)	The aim of the precinct specific BMPs are to provide guidelines, strategies and methods for the treatment and management of ecological buffers to Cudgen Nature Reserve and EPZs. The BMPs provides details of the protection of retained and compensatory habitat where these areas occur within ecological buffers.
Kings Forest Flora and Fauna Monitoring Report (JWA 2020j)	The Kings Forest Flora and Fauna Monitoring Report summarises all flora and fauna monitoring requirements of the development including the feral animal monitoring program.
Kings Forest Stage 1 Bushfire Management Plan (BushfireSafe 2020)	A fundamental strategy of the Kings Forest Stage 1 Bushfire Management Plan (BushfireSafe 2020) is to assess and manage fuel loads within the Kings Forest site. The risk of high intensity fires will be reduced through controlled low intensity burns or mechanical means if and where appropriate. High-intensity hazard reduction burns and wildfires that result in crown scorch or crown fires should be avoided.
Kings Forest Koala Fire Management Plan (Wildsite 2020)	The Kings Forest Koala Fire Management Plan details fire management strategies for koala habitat areas on the Kings Forest site. The aim of this plan is to protect and conserve the population and habitat of koalas and other associated biodiversity values in the Kings Forest area through the restoration and maintenance of appropriate fire regimes.
Construction Environmental Management Plan (MUS 2020)	The Construction Environmental Management Plan (MUS 2020) provides details sufficient to understand and avoid, mitigate and remedy all potential environmental impacts of the project during construction and should be read in conjunction with this FAMP.
Kings Forest Summary of Management Plans (G&S 2020a)	The Kings Forest SOMP (G&S 2020a) has been prepared to summarise all of the management requirements of the various management plans including the FAMP.

APPENDIX 3 - FERAL ANIMAL SPECIES PROFILES AND CONTROL STRATEGIES

1 FERAL DOG

1.1 Introduction

Feral dogs occur in a broad range of habitats including natural wilderness areas, grazing land and on the fringes of urban population centres. They feed opportunistically, with the diet including live prey items in addition to roadkill, vegetable matter and scraps from rubbish tips or compost heaps. Feral and domestic dogs are known to exert a high intensity of predation pressure on native fauna, especially medium to large macropods (Mitchell & Banks 2005, cited in DECC 2008). The preliminary listing for predation and hybridisation of feral dogs (DECC 2008) notes that there is a continual influx of domestic dogs to the wild.

1.2 Biology

Feral dogs may be stray domestic animals living wild or be wild dogs which have hybridised with dingo stock. Depending on the breed of parent dogs, feral dogs may weigh between 8 – 38 kg and can live for up to 12 years, although an average lifespan of around 5 – 7 years is more common (Moreton Bay Regional Council, undated). Feral/wild dogs may hunt in packs and usually take smaller prey such as rabbits, possums, bandicoots and wallabies. In grazing areas, calves and lambs are also vulnerable to feral dog attack. Domestic dogs and dingo-hybrids may have two (2) oestrus periods per year with pups born in spring and autumn (Catling *et al.* 1992, cited in DECC 2008), whereas pure dingos only breed once a year.

1.3 Habitat and Home Range

Feral dogs will utilise a broad variety of habitat types, with evidence that habitat modification and increased availability of prey have contributed to population increases (Corbett 2001, cited in DECC 2008). Home ranges of feral dogs may vary widely, depending on availability of resources and species numbers. A study of ten (10) free-roaming domestic dogs indicated that half of the dogs wandered widely with an average home range of 927 ha, while the remaining dogs roamed within the vicinity of the local community, with an average home range of 2.6 ha (Meek 1999).

1.4 Potential Impacts on Threatened Species Occurring at the Subject Site

Feral dogs have potential to prey on a variety of native fauna, and their impacts on several threatened species is of concern. Dog attack is well documented as being one of the major threats to koala populations, while ground-dwelling bird species including the bush Stone-curlew and grass owl are also particularly vulnerable to predation and disturbance by feral and domestic dogs. Threatened species occurring at the site that are considered to be potential prey of the feral dog are listed in **TABLE 7**.

TABLE 7
THREATENED SPECIES KNOWN FROM THE KINGS FOREST SITE THAT REPRESENT POTENTIAL PREY FOR THE FERAL DOG

Common Name	Scientific Name
Bush stone-curlew	*Burhinus grallarius*
Bush-hen	*Amaurornis olivaceus*
Common planigale	*Planigale maculata*
Grass owl	*Tyto longimembris*
Koala	*Phascolarctos cinereus*

1.5 Possible Control Methods

1.5.1 Background

The options currently available for the control of feral/wild dogs are:

- Shooting;
- Trapping;
- Exclusion fencing; and
- Baiting.

When planning and carrying out control activities, risks to human safety, non-target species, domestic animals and any other environmental concerns must be taken into account (NPWS 2005). As shooting is considered inappropriate in an urban context (without appropriate consultation with Game Council NSW, NPWS, TSC and adjacent landholders), the most practical control options for feral dog control are trapping, exclusion fencing and baiting.

These control methods are further discussed below. In addition, **APPENDIX 4** contains a discussion of the possible constraints to the implementation of possible control methods on the Kings Forest site.

1.5.2 Trapping

Trapping for wild dogs is usually only undertaken in areas with low dog populations or where small numbers of 'problem' dogs occur. As for feral cats, deployment of soft-catch traps is a skilled, costly and time-consuming business, with risks associated with the catching of non-target animals and the risk of escaped dogs becoming wary and 'trap shy'.

1.5.3 Exclusion Fencing

Exclusion fencing (dog-proof and electric types) has been used for the control of wild dogs and dingoes with some success. So long as fencing is properly installed and regularly maintained, it represents a viable control option in targeted areas.

1.5.4 Baiting

Ground-baiting with buried 1080 baits is the most widely used method of wild dog control, and is the method employed by the BCD in park management. A new toxin called 'PAPP' (para-aminopropiophenone) is also now available in some states.

It is noted that the provisions of the Pesticide Control (1080 Wild Dog Bait) Order 2002, which falls under Section 38 of the *Pesticides Act 1999*, outlines a number of restrictions to the use of baits where domestic pets may be at risk. Specifically, Schedule 1 of the Pesticide Control (1080 Wild Dog Bait) Order 2002 – Permit to Allow Use of 1080 Baits for Control of Wild Dogs states that "1080 baits must not be laid within close proximity to urban areas unless the baiting program is planned in conjunction with, and has been agreed to, by an Authorised Control Officer. Such programs must include strategies for minimising risk to non-target animals. Proposals for baiting in closely settled farming areas or areas within four (4) kilometres of a village or any street with a speed restriction of 70 kilometres per hour or less fall within this requirement".

The Kings Forest site falls within these criteria. Bait stations will therefore need to be deployed in locations not likely to be accessed by domestic pets, and the baiting program will need to be developed in consultation with an Authorised Control Officer.

1.5.5 Ejectors

An ejector is a small cylindrical device that is buried in the ground, leaving only a 'bait head' exposed on the surface. The bait head contains a replaceable capsule of poison and is about the size of a cylindrical golf ball. When an animal puts its mouth over the bait head and pulls it, the poison is ejected into the mouth in a quick puff or spurt (Centre for Invasive Species Solutions 2016).

2 RED FOX

2.1 Introduction

The red fox (*Vulpes vulpes*) is the largest of the true foxes as well as being the most geographically spread member of the Carnivora order, being distributed across the entire northern hemisphere from the Arctic Circle to North Africa, Central America, and the steppes of Asia. Its range has increased alongside human expansion, having been introduced to Australasia, where it is considered harmful to native mammal and bird populations (Henry 1986).

2.2 Biology

Female foxes reproduce only once a year and the gestation period is 51 to 53 days with most cubs born during the period between August and September. The average litter size is four (4) and the maximum number of offspring is typically around ten (10). Both sexes become sexually mature from around ten (10) months of age. Although social groups of one male and several females (vixens) may exist, most foxes are thought to have only one mate.

Males may leave their normal home territory temporarily in search of a mate (Saunders *et al.* 1995).

2.3 Habitat and Home Range

The red fox is widely distributed throughout the southern half of mainland Australia and can survive in habitats ranging from arid lands through to alpine landscapes as well as in urban environments (Saunders *et al.* 1995). Foxes are most active between dawn and dusk periods.

Fox groups typically have well defined home ranges. The size of the home range depends on the resources present but is usually around 30 hectares in an urban environment (Saunders *et al.* 1995).

As foxes are known to occur in urban, agricultural, disturbed, natural and semi natural areas, it is most probable that individual animals would roam between the neighbouring beach and private land into the Kings Forest site.

2.4 Potential Impacts on Threatened Species Occurring at the Subject Site

Foxes are considered to be opportunist omnivores. They are known to take a wide range of vertebrate and invertebrates as well as fruits, fungi and carrion. They also feed on human refuse and rubbish. Diet studies conducted in Australia show sheep taken as carrion, rabbits and house mice to be the most common food (Saunders *et al.* 1995). The fox, however, is known to prey upon a diversity of native fauna species. According to the NSW TAP (NPWS 2010), although the impact of fox predation on the abundance of the majority of native fauna is not known, evidence of impacts is greatest for medium sized ground dwelling and semi-arboreal mammals, ground-nesting birds and chelid tortoises. Additionally, the TAP states that these impacts may be intensified in areas of minimal understorey.

A number of threatened species of avifauna, mammals and amphibians occurring at the site are considered to be potential prey of the Red fox. These species are listed in **TABLE 1**.

TABLE 1
THREATENED SPECIES KNOWN FROM THE KINGS FOREST SITE THAT REPRESENT POTENTIAL PREY FOR THE RED FOX

Common Name	Scientific name
Primary Prey Species#	
Grass owl	*Tyto longimembris*
Black bittern	*Ixobrychus flavicollis*
Bush stone-curlew	*Burhinus grallarius*
Common Planigale	*Planigale maculata*
Secondary Prey Species*	
Australasian bittern	*Botaurus poiciloptilus*

Common Name	Scientific name
Black-necked stork	*Ephippiorhynchus asiaticus*
Bush-hen	*Amaurornis olivaceus*
Koala	*Phascolarctos cinereus*
Wallum sedge frog	*Litoria olongburensis*
Wallum froglet	*Crinia tinnula*
Notes: # Primary prey species are those considered likely to be preyed upon. * Secondary prey species are those considered less likely to be preyed upon on a regular basis.	

2.5 Possible Control Methods

2.5.1 Background

The options currently available for the control of foxes are:

- Trapping;
- Poisoning;
- Shooting;
- Control of food supply; and
- Exclusion fencing.

Each technique has a short-term effect on local fox numbers and no single control method will likely be successful on its own. Reducing the impact of the red fox relies on a mixture of control techniques as once foxes are removed from an area, reinvasion or immigration from existing untreated areas generally occurs within 2 to 6 weeks. The most efficient way to reduce the impact of foxes is to conduct a strategic coordinated program over a number of land holdings (NSW DPI 2020a). The implementation of any of these methods on the Kings Forest site should include collaboration with adjoining landowners (DPI 2007).

Research is currently being undertaken into the biological control of foxes including immunocontraception (which controls fertility rather than killing the host pest species). This research is, however, considered to be breaking new ground and has to address difficult scientific, technical and biological problems. Consequently, the research is considered high-risk, with long-term effects still unknown (Saunders *et al*. 1995).

Considering that shooting is generally regarded as an inappropriate, or illegal control method in urban, near-urban or semi-urbanised environments, the potentially available methods of control for foxes occurring at the Kings Forest Site are poisoning, trapping and/or exclusion fencing. However, the Game Council NSW, a statutory authority established under the *Game and Feral Animal Control Act 2002*, may be utilised to harness the efforts of licensed, accredited hunters to assist in feral animal control (DPI 2012).

APPENDIX 4 contains a discussion of the possible constraints to the implementation of possible control methods on the Kings Forest site.

2.5.2 Baiting of Foxes

According to Saunders *et al*. (1995), poisoning using 1080 is the most suitable lethal technique for the control of foxes. This method can be made somewhat target-specific to foxes by controlling the amount of poison used, the form of the bait and bait placement (for example the bait can be buried which lessens the chance of the bait being taken by non-target species particularly birds and reptiles). Because baiting using 1080 is the most effective and target specific method of fox control currently available, it is used widely throughout Australia (DPI 2007). The ability of a given baiting program to reduce fox populations will be limited by many factors including:

- Immigration and reproduction;
- The proportion of the population exposed to baits;
- The proportion of bait-shy individuals in the population; and
- The potential for compensatory increases in survival among unexposed and bait-shy foxes.

Most of these factors are influenced in turn by the methods employed in baiting programs (NPWS 2001). The National Feral Animal Control Program *Effective Implementation of Regional Fox Control Programs* (DPI 2007) details the importance of involving liaisons and cooperation between landholders and government agencies. The main aim is to implement strategic fox baiting over as large an area as possible to improve the efficiency and cost-effectiveness of baiting practices and to promote best practice techniques (DPI 2007). These techniques are, specifically, to:

- Synchronise baiting within a control group;
- Bait at least twice a year;
- Bait during periods when the fox is most susceptible (i.e. March-April, when juvenile foxes disperse from their natal dens to seek their own territories, and August-September, when vixens require additional food pre- and post-whelping);
- Regularly check and replace baits that are taken; and
- Continue the baiting program until bait take declines.

Bait stations are made up of bait mounds, comprising one or more baits buried in a mound of earth or sand, surrounded by an area that has been raked smooth to allow for the identification of tracks. A baiting program can be completed with an initial free-feeding period when un-poisoned baits are placed in the mound. This allows for the identification of visits by non-target animals and only mounds visited solely by target species are refilled with poisoned baits (Fleming *et al*. 2001). The NSW Fox TAP (NPWS 2001) provides preliminary guidelines for the use of 1080 baits to control foxes and these recommend that where quolls are absent from a given site, a free-feeding period is not necessary and that poison baits only be used.

Alternatively, Canid Pest Ejectors can be utilised. Canid Pest Ejectors are a spring-loaded toxin delivery device buried in the ground with an attractant attached. An animal pulls up

on the attractant triggering a spring-loaded plunger that punctures a capsule of toxin and propels it into the animals mouth. These devices have been trialled extensively in NSW and QLD. The technique should be used in combination with other control methods and not seen as a single option (NSW DPI 2020a). The advantages of this method include:

- the target specificity associated with the pull strength required to trigger the ejector; and
- the placement of toxin in a stable capsule environment rather than in a bait substrate where degradation in toxin potency may occur over time.

Depending on the results of a baiting program, trapping and/or shooting may need to be considered for the subsequent control of individual foxes that are found to be bait-shy. The incidence of certain animals being wary of taking baits is well recorded.

It is noted that the provisions of the Pesticide Control (1080 Wild Dog Bait) Order 2002, which falls under Section 38 of the *Pesticides Act 1999*, outlines a number of restrictions to the use of baits where domestic pets may be at risk. Specifically, Schedule 1 of the Pesticide Control (1080 Wild Dog Bait) Order 2002 – Permit to Allow Use of 1080 Baits for Control of Wild Dogs states that "1080 baits must not be laid within close proximity to urban areas unless the baiting program is planned in conjunction with, and has been agreed to, by an Authorised Control Officer. Such programs must include strategies for minimising risk to non-target animals. Proposals for baiting in closely settled farming areas or areas within four (4) kilometres of a village or any street with a speed restriction of 70 kilometres per hour or less fall within this requirement".

The Kings Forest site falls within these criteria. Bait stations will therefore need to be deployed in locations not likely to be accessed by domestic pets, and the baiting program will need to be developed in consultation with an Authorised Control Officer.

2.5.3 Exclusion Fencing for Foxes

Foxes are agile and adaptable animals that are difficult to exclude with fences. Nevertheless, fences have been used successfully in some instances (Fleming *et al*. 2001). In the NSW TAP for the Red Fox (NPWS 2001) the NPWS acknowledges that "exclusion fencing may be particularly useful to protect colonial shore-nesting birds such as Little terns because nesting birds are restricted to small areas and human habitation (presumably to monitor/maintain) is often close".

In addition to appropriate design, the success of a fence depends upon appropriate construction, regular maintenance, frequent monitoring for breaches and quick action to remove any animals that break through (Fleming *et al*. 2001).

2.5.4 Trapping of Foxes

2.5.4.1 Introduction

The effectiveness of trapping can be hampered by the fact that it is labour intensive, requires training, can be considered inhumane and can harm non-target native fauna.

However, considering the constraints on the use of poisoned baits and/or fencing at the site, trapping for the control of foxes has been included here as a preferred control option despite these limitations. Trapping methods for the control of foxes include treadle snare traps, soft catch traps and cage traps (Fleming *et al*. 2001).

It may be necessary to try different bait types in an area to determine the most attractive. One of the more successful baits is chicken fast food or rabbit (NSW DPI 2020a).

2.5.4.2 Treadle Snare Traps

In Victoria a treadle snare trap, originally designed for the control of wild dogs, has been used for the capture of foxes in urban areas where other control methods are not practical (for example, where poison baiting is deemed to be an unacceptable risk).

The treadle snare consists of a thrower arm activated by a trap plate which draws a cable noose about the target animal's leg. The snare cable usually causes minimal injury and non-target species can be released relatively unharmed. The snare plate is set to withstand a certain weight before triggering which minimises the risk to most smaller animals. Treadle snares need to be checked at regular intervals (preferably every 4-8 hours) so captured animals can be humanely removed.

2.5.4.3 Soft Catch Traps

Soft-catch or soft-jaw traps are a humane version of the traditional steel jaw trap. These traps have a rubber-like padding on each jaw, which cushions the initial impact and provides friction thus preventing the captured animal from sliding along or out of the jaws. They are designed to reduce the risk of injury to a captured animal by having the jaws offset, reduced spring strength, a spring added to the anchor chain and a centrally attached bottom swivel to which the chain is attached (Saunders *et al*. 1995). As for treadle snare traps above, soft catch traps need to be checked at regular intervals so captured animals can be humanely removed.

2.5.4.4 Cage Traps

Cage traps are a simple method of capturing animals whereby the door of the cage is set in an open position using a trigger mechanism that is connected either to a treadle plate or swinging bait. In the event that an animal enters the trap and either depresses the treadle plate or manipulates the swinging bait, the door of the trap is released and falls to a closed and locked position. There is sometimes limited success with this method of trapping as it relies on the typically wary target animal actually entering the confines of the cage.

One advantage of cage traps is that domestic pets and non-target animals captured in the trap can be released unharmed. Cage traps are most successful in towns and around houses where foxes are stealing pet food or poultry. Cage traps should be relatively large, 1200 mm x 500 mm x 500 mm to reduce the impression of entering a confined space. The trap

must be pegged down to prevent the fox rolling it over and releasing the door and the wire floor should be covered with soil. All traps should be well concealed (NSW DPI 2020a).

2.5.5 Den Fumigation

Fox control can be difficult to achieve in urban areas. Fumigation of breeding, or natal dens with carbon monoxide (CO) gas is sometimes used to destroy young cubs. Carbon monoxide is a colourless, odourless gas that causes oxygen depletion leading to unconsciousness and rapid death without pain or discernible discomfort. The gas is generated by the incomplete combustion of carbon using sodium nitrate within a fumigant cartridge.

3 FERAL CAT

3.1 Introduction

Feral cats occur in nearly all terrestrial habitats in Australia, with the main determinant of population size being the availability of food and shelter (NPWS 2000). In excess of 18 million feral cats occur on the continent (Mcleod 2004, cited in DEWHA 2008b) resulting in the decline and extinction of native fauna, particularly on islands. Feral cats are capable of killing prey items up to 2-3 kg, however preference is shown for mammals weighing less than 220 grams, although reptiles, amphibians and invertebrates are also eaten (NPWS 2000).

3.2 Biology

Feral cats may weigh up to 9 kg, are solitary and predominantly nocturnal creatures. Breeding capabilities are reached after one (1) year, with females breeding in any season and producing up to two (2) litters/year, averaging four (4) kittens per litter, of which few survive (DEWHA 2008b).

3.3 Habitat and Home Range

Males may have home ranges of up to 10 ha, with females occupying smaller areas (DEWHA 2008b). All habitat types are utilised by the species with the exception of very wet rainforests. Feral cats are likely to occur within all habitats at the Kings Forest site.

3.4 Potential Impacts on Threatened Species Occurring at the Subject Site

Feral cats prey upon a variety of fauna groups, with small ground-dwelling mammals consisting of the major part of the diet, with ground-nesting birds also at particular risk (NPWS 2000).

Threatened species occurring at the site that are considered to be potential prey of the feral cat are listed in **TABLE 6**.

TABLE 6
THREATENED SPECIES KNOWN FROM THE KINGS FOREST SITE THAT REPRESENT POTENTIAL PREY FOR THE FERAL CAT

Common Name	Scientific Name
Bush Stone-curlew	*Burhinus grallarius*
Bush-hen	*Amaurornis olivaceus*
Common planigale	*Planigale maculata*
Grass owl	*Tyto longimembris*
Wallum sedge frog	*Litoria olongburensis*
Wallum froglet	*Crinia tinnula*

3.5 Possible Control Methods

3.5.1 Background

The options currently available for the control of feral cats are:

- Shooting;
- Trapping;
- Exclusion fencing;
- Baiting;
- Fumigants;
- Biological control;
- Fertility control; and
- Commercial harvesting.

Of the above options the latter four (4) control methods are either very rarely used, or still under development. Furthermore, as shooting is not considered appropriate within proximity to urban/residential areas (without appropriate consultation with Game Council NSW, NPWS, TSC and adjacent landholders), the most practical control options for feral cats are trapping, exclusion fencing and baiting.

These control methods are further discussed below. In addition, **APPENDIX 4** contains a discussion of the possible constraints to the implementation of possible control methods on the Kings Forest site.

3.5.2 Trapping

Trapping is an expensive, labour intensive and time-consuming control method and is usually only recommended on a small scale where eradication is the objective.

Although cage trapping is considered an ineffective tool for large areas, it may be useful in urban/residential areas where domestic cats are present, or where populations have already been reduced and individual cats need to be targeted. In urban/residential areas cage traps are preferred over leg hold traps as fewer injuries are sustained, non-target

animals can be released unharmed and trapped feral cats can be transported away from the area for euthanasia (Sharp 2016).

Padded jaw leg-hold traps should only be used at sites where the animal can be destroyed by shooting whilst still held in the trap. Leg-hold traps may be more effective than cage traps for hard to-catch-cats that have had minimal exposure to humans (Sharp 2016).

Soft net traps consist of a flexible metal frame and netting and/or bag which collapses over the animal when triggered. Soft net traps rely on entanglement to secure and hold the targeted animal, potentially reducing the risk of injury. Soft net traps are used to trap feral and nuisance domestic cats and dogs, foxes, birds and rabbits as well as native animals such as small wallabies, bandicoots and possums. Although soft net trapping is considered an ineffective tool for control of large populations, it may be useful in urban/residential or where numbers have already been reduced and individual animals need to be targeted (Sharp and McLeod 2013).

3.5.3 Exclusion Fencing

Exclusion fencing has been used successfully in small reserves to preclude predators, including feral cats. Ideally, fencing should be combined with an integrated baiting or trapping program to reduce the risk of the fence being breached by predators.

3.5.4 Baiting

While baiting is the cheapest and most cost-effective technique for many small and medium-sized pest animals, baiting programs for feral cats tend to be less effective.

Baiting programs can be unsuitable for feral cat control as feral cats may have large home ranges, occur in low densities and are naturally wary animals. The timing of a baiting program is considered critical to successful feral cat control.

While 1080 is the bait poison most commonly used for other feral animals (dogs, foxes), it is not well-suited to feral cat control as it must be buried. Research into the use of cyanide is currently being pursued, although its use in Australia is currently illegal. The development of a specific cat toxin has been identified as a high priority for cat control.

4 CANE TOAD

4.1 Introduction

The cane toad (*Rhinella marina*) is a large ground-dwelling amphibian that was introduced into the sugar cane fields of North Queensland in 1935 to eradicate the cane beetle and its larvae from the sugar industry. The Toads thrived and have themselves become a major pest species in Australia with their range extending annually (DEH 2005).

The cane toad is an extremely adaptable species that can quickly reach high densities in suitable habitat. Densities of over 2000 individuals per hectare have been recorded (DEH 2005). In these situations, they can quickly outnumber native frogs. It is possible that it

competes with some native species for resources and it is poisonous at all stages of its development (Robinson 1998).

4.2 Biology

Cane toads are considered to be extreme generalists capable of adapting to a wide range of habitats, climatic and environmental conditions and prey variety. Cane toads breed in temporary or permanent still or slow-moving waters, can tolerate salinity levels up to 15% and have even been recorded in Mangroves. The species breeds quickly and is able to rapidly colonise and dominate an area (DEH 2005). Cane toad spawn occurs as long gelatinous strings comprising two (2) rows of black eggs which is usually interweaved around rocks or water plants in shallow water. This gelatinous string-like spawn is unique to the Cane toad in Australia, none of the native anurans lay such spawn. Females lay approximately 8,000 – 35,000 eggs at a time and usually breed twice a year. Eggs hatch in 48 to 72 hours and tadpoles develop into toadlets any time between 17 days to 6 months. Cane toads need between 6 and 18 months to reach sexual maturity and have a lifespan of approximately 5 years (CSIRO 2004).

In subtropical areas, breeding occurs during warmer periods that coincide with the onset of the wet season. Cane toads are considered to be opportunistic breeders, have a far greater fecundity than native anurans and tadpoles develop rapidly under suitable conditions (DEH 2005).

4.3 Habitat and Home Range

Cane toads were first recorded on the NSW North Coast in the 1960s and today they are considered to be resident along the wet coastal fringe as far South as the Clarence River with a smaller outlying population at Lake Innes South of Port Macquarie (DEH 2005).

The cane toad is found in most habitats within its range and can breed in fresh or brackish water. The species thrives in urban and disturbed areas and has been found in mangroves. Cane toads readily make their homes around areas inhabited by humans and feed on insects that are attracted to outside lights and breed in urban fishponds (Robinson 1998).

Cane toad numbers are often greatest in grassland and/or cleared or disturbed areas near to urban settlement (DEH 2005, Australian Museum 2002). Mown grassland areas in close proximity to bodies of water may be particularly favoured, as such areas provide ready access to water for egg laying. Cleared tracks may provide dispersal routes for the species and allow for movement through otherwise uninhabitable native vegetation.

The cane toad is an abundant breeding resident of the Tweed Shire, with principle populations occurring in more developed and disturbed areas such a farm dams, urban areas and areas of short mown grass.

This species is a common breeding resident at the Kings Forest site and it is likely that there is a relatively large population in the local area due to the diversity of habitats, degree of development and abundant water.

4.4 Potential Impacts on Threatened Species Occurring at the Subject Site

In Australia, the cane toad has no natural enemies and is an opportunistic breeder and extreme generalist. There is concern in Australia over the impact of this species on native invertebrate populations and consequently their impact upon native frog and toad species.

Most significantly, the species possesses highly toxic chemical predator defences whereby they secrete a toxin from an enlarged pair of parotoid glands and this toxin can kill most native animals that normally eat frogs. All stages of the cane toad's life cycle are poisonous, including the eggs, tadpoles and frogs.

Cane toad tadpoles have been known to prey upon the eggs of some native frog species while the adult toads consume large volumes of invertebrates they will consume almost any small creature that fits in their mouth including small native mammals, birds, reptiles and frogs (Van Dam et. al. 2002). Cane toads have been recorded as consuming approximately 200 prey items a night, which is far more than a native frog would consume in the same period. Cane toads are also suspected of carrying diseases that may be transmitted to native frogs and fishes (CSIRO 2004).

Populations of native frogs may decline following the colonisation of an area by cane toads and a number of native fauna species that occur at the Kings Forest site are likely to be impacted by the presence of the cane toad. Under the key threatening process listing, cane toads are expected to reduce the population viability of four (4) threatened frog species, of which two (2), the wallum sedge frog and wallum froglet, have been recorded at the site.

The ability of cane toads to rapidly colonise an area, to rapidly reach high densities in a recently colonised area, to take advantage of a wide variety of habitats, and to consume a relatively large variety of prey types has led to concerns that the cane toad may be a key factor in the decline of many native frog and toad species (DEH 2005). It is for these reasons that the cane toad has been listed as a "Key Threatening Process" under both the EPBC Act 1999 and the NSW BC Act (2016).

Threatened species occurring at the Kings Forest site that are considered to be potential predators of, prey of, or subject to competition pressures from, the cane toad are listed in **TABLE 2**.

TABLE 2
THREATENED SPECIES KNOWN FROM THE KINGS FOREST SITE
THAT ARE POTENTIALLY AT RISK FROM CANE TOADS

Common Name	Scientific Name
Australasian bittern	*Botaurus poiciloptilus*
Black bittern	*Ixobrychus flavicollis*
Black-necked stork	*Ephippiorhynchus asiaticus*
Bush stone-curlew	*Burhinus grallarius*
Bush-hen	*Amaurornis olivaceus*

Common Name	Scientific Name
Common planigale	*Planigale maculata*
Wallum sedge frog	*Litoria olongburensis*
Wallum froglet	*Crinia tinnula*

4.5 Possible Control Methods

4.5.1 Background

Aside from habitat management, there is little that can be done to permanently reduce cane toad levels in a given area. Possible control methods include:

- Light traps;
- Cane toad musters;
- Manual survey for eggs and tadpoles; and
- Tadpole traps.

These control methods are further discussed below.

4.5.2 Light Traps

Light traps as developed by Frogwatch in the Northern Territory have proved to be an effective and cost-efficient method to reduce cane toad densities within a defined area (Frogwatch 2006). Existing cane toad trap designs use lights to lure insects to traps, and toads enter the traps to feed. The traps have proven to be humane and cane toad specific. Acoustic attractants have also been found to enhance trapping success for cane toads – with up to three times more toads caught in traps with playbacks than in traps without playbacks (Schwarzkopf and Alford 2007).

Capture toads only should be euthanised in a manner recommended by the relevant Animal Care and Ethics Authority (NSW Agriculture).

4.5.3 Cane Toad Muster

In the past some authorities have organised cane toad 'musters' whereby members of the public capture large numbers of individual toads by hand. Captured toads are later euthanised. This method of control, where it is completed without appropriate training and supervision, is now considered inappropriate as there is an element of risk to do with an unknowing public killing non-target (native) frog species.

Cane toad musters should only be undertaken by people trained and proficient in the identification of cane toads and native frogs of similar appearance. Cane toad musters should take place prior to the breeding season and following significant rainfall events that may trigger breeding. Toads should only be euthanised in a manner as recommended by the relevant Animal Care and Ethics Authority (NSW Agriculture).

4.5.4 Manual Survey for and Removal of Eggs and Tadpoles

Cane toad eggs and tadpoles can be manually removed using a dip-net. Cane toad spawn has the shape of long strings of black eggs arranged in pairs in continuous jelly, quite different to the spawn of all native frog species (Anstis 2002). While some native species string their eggs together, they are not usually in pairs.

If cane toads have laid eggs in a water body, or are about to do so, it is easier to destroy the spawn or catch adults that are mating than it is to trap tadpoles, which usually hatch within two (2) days of the eggs being laid (NSW OEH 2013).

4.5.5 Chemical Tadpole Traps

A chemical method of trapping tadpoles has recently been developed (Crossland *et al.* 2012) which may replace dip-netting in the future, except where the water is too shallow to install any traps. The chemical method involves funnel-traps placed in natural water bodies baited with toxins collected from adult cane toads. Cane toad tadpoles usually eliminate intraspecific competitors by consuming newly laid eggs, and they find these by searching for the toxins present in the eggs. As a result, almost all toad tadpoles will swim into these traps. Most native (non-target) tadpoles are repelled by the toad's toxins.

The chemical method not only can achieve targeted toad-tadpole removal, it can also provide an early-warning system to detect toad breeding in natural water bodies. The technology involved is quite simple and is well suited for use by land managers or community groups (NSW OEH 2013).

5 COMMON (INDIAN) MYNA

5.1 Introduction

The common myna or Indian myna (*Acridotheres tristis*) was introduced to Australia in the late 1860s to control insects in market gardens (Wagner *et al.* 2009). Populations of these birds are increasing rapidly (hundreds of mynas can roost in a single tree or building) and present a number of problems in cities, urban centres and regional areas across the east coast of Australia (Parkins n.d.). Common mynas are also known to damage fruit and cereal crops where they occur in close proximity to urban areas (Wagner *et al.* 2009).

5.2 Biology

Common mynas are opportunistic omnivorous scavengers, with a diet that includes bird eggs, small reptiles, fledging birds, food scraps from schools and shopping centres, pet food, insects, worms, stock food, grains, fruit, compost etc. (Markula *et al.* 2009; Wagner *et al.* 2009). They form pairs for breeding from September to March and find a protected nesting site where they have four (4) to five (5) chicks (Parkins n.d.).

5.3 Habitat and Home Range

Common mynas nest in tree hollows, palms and under roofs (Wagner *et al.* 2009). Mynas prefer open woodland and grassland to forested areas in warm to hot climates but are also well adapted to urban areas where there are many opportunistic feeding sites (Markula *et al.* 2009; Parkins n.d.). They have been recorded across all Local Government Areas (LGAs) in the Northern Rivers including Tweed, Byron, Ballina, Lismore, Richmond Valley, Clarence Valley, Kyogle and Tenterfield (Wagner *et al.* 2009).

5.4 Potential Impacts on Threatened Species Occurring at the Subject Site

Common mynas evict native birds and animals from their nests, destroy eggs and chicks of other birds, compete with native animals for tree hollows (such as bats, possums and gliders) and leave hollows mite-ridden and unusable by other wildlife (Markula *et al.* 2009; Parkins n.d.). They also carry diseases that may not affect them directly (e.g. avian malaria) but can have a significant impact on native birds (Markula *et al.* 2009).

Threatened species occurring at the site that are considered to be potentially subject to competition pressures from Common mynas are listed in **TABLE 3**.

TABLE 3
THREATENED SPECIES KNOWN FROM THE KINGS FOREST SITE
THAT ARE POTENTIALLY AT RISK OF COMPETITION FROM INDIAN (COMMON) MYNAS

Common Name	Scientific Name
Masked owl	*Tyto novaehollandiae*
Grey-headed flying fox	*Pteropus poliocephalus*
Little bent-wing bat	*Miniopterus australis*
Yellow-bellied sheathtail bat	*Saccolaimus flaviventris*
Glossy black cockatoo	*Calyptorhynchus lathami*

5.5 Possible Control Methods

5.5.1 Background

Reducing populations of the Common mynas and minimising range expansion requires not only the removal of individuals from existing populations, but also measures to address the factors that have led to colonisation and rapid population rise in the region (i.e. abundant food supply and nesting resources) (TSC and BSC 2010a). It is important to ensure that Common mynas do not have easy access to food sources such as bird seed/feeders, pet food and stock food (Parkins n.d.). Control methods include shooting, control at roost sites, netting and chemical control, however, the most widely used method of control for Common mynas is trapping. Trapped birds are then euthanised humanely.

The following sections detail the types of traps commonly used for controlling Common mynas. **APPENDIX 4** contains a discussion of the possible constraints to the implementation of possible control methods on the Kings Forest site.

5.5.2 PeeGee Trap

The PeeGee trap is a two-cage trap that uses food to lure mynas into the trap. Food is placed in and around the trap for a few days without the trap being set. After the mynas are confident moving in and around the trap, the doors are closed. The mynas enter the trap through tunnels, moving through a vertical tunnel into the holding cage in which they cannot escape (Parkins n.d.).

5.5.3 Mynamagnet Trap

The Mynamagnet is a commercial two-chamber trap that uses dog food and food scraps as bait (seed attracts native birds). This trap also uses a staged process in which free feeding is completed for a number of days before the trap is set and also utilises wire tunnels (Parkins n.d.).

5.5.4 Mirror Trap

This trap consists of a cage, a full-length mirror, a bird entry and a flap to allow access into the cage. Food and water are placed in the cage, however, as the mynas see their reflection in the mirror, they are tricked into thinking there are other birds already in the cage (TSC and BSC 2010b).

5.5.5 Control at Roost Sites

As Common mynas roost communally with others from the local population, undertaking control efforts at overnight roost sites is an appealing method. This approach has been successfully utilised by the Mid-north Coast Indian Myna Action Group (in collaboration with the NSW Game Council) and has proven to be effective in eliminating a large number of birds from a local population within a short time period (TSC and BSC 2010b). This method involves shooting roosting birds and is therefore largely unsuitable for application within urban areas.

5.5.6 Shooting

Shooting at sites other than roosting sites, such as feeding sites, nesting sites and pre-roosting sites can be a successful form of Common mynas control when skilfully applied (TSC and BSC 2010b). Again, this method is generally unsuitable for urban areas without appropriate consultation with Game Council NSW, NPWS, TSC and adjacent landholders.

5.5.7 Chemical Control

Alphachloralose is a chemical product registered for the control of domestic pigeons (also known as the feral pigeon or rock pigeon), sparrows and starlings etc (TSC and BSC 2010b). It is a restricted product and may only be used by, or supplied to, an authorised person. Alphachloralose is applied to a food source (e.g. grain) and once consumed, renders a bird unconscious and lowers its body temperature (TSC and BSC 2010b). During the colder months, lower night temperatures will kill the birds before they regain consciousness, otherwise unconscious birds must be recovered and euthanised before they revive and escape (TSC and BSC 2010b).

6 EUROPEAN RABBIT AND BROWN HARE

6.1 Introduction

The European rabbit (*Oryctolagus cuniculus*) was deliberately released on the Australian mainland in the mid to late 1800s and is now widely distributed and well adapted to climatic conditions in much of Australia (DEWHA 2008a). Rabbits and hares, along with foxes and cats, are considered to be Australia's most serious vertebrate pests. They are the most abundant small mammal in Australia (with the possible exception of the introduced house mouse) and cause significant impact to native flora and fauna, vegetation communities, landforms, geomorphic processes and sensitive sites, as well as primary industries (DEWHA 2008a).

6.2 Biology

Rabbits and hares can increase their population size very quickly due to short gestation periods, early sexual maturity and large litter sizes (a single female can produce 30 to 40 young per year) (CSIRO 2011). Rabbits and hares reach sexual maturity at five months of age and mature females can be continuously pregnant between six (6) to eight (8) months per year under the right conditions (CSIRO 2011).

6.3 Habitat and Home Range

Rabbits and hares are abundant throughout Australia and can be found almost everywhere, with the exception of the wet tropics and dense coastal forests (CSIRO 2011). They are able to colonise a diverse range of habitat types (DEWHA 2008a) and are abundant where soils are deep and sandy, though they are scarce in areas with clay soils (DSEWPC 2011).

6.4 Potential Impacts on Threatened Species Occurring at the Subject Site

Rabbits and hares have direct and indirect impacts on a variety of native flora and fauna including preventing regeneration of native vegetation by digging/grazing, and by competing with native fauna for food and shelter (DEWHA 2008a). They also support populations of introduced species such as cats and foxes, and denude vegetation thereby exposing native fauna species to increased predation.

Threatened species occurring at the site that are considered to be potentially subject to competition pressures and land degradation from European rabbits and Brown hares are listed in **TABLE 4**.

TABLE 4
THREATENED SPECIES KNOWN FROM THE KINGS FOREST SITE THAT ARE POTENTIALLY AT RISK FROM COMPETITION AND LAND DEGRADATION BY EUROPEAN RABBITS AND BROWN HARES

Common Name	Scientific Name
Glossy black cockatoo	*Calyptorhynchus lathami*
Grass owl	*Tyto longimembris*
Bush hen	*Amaurornis olivaceus*
Common planigale	*Planigale maculata*
Bush stone-curlew	*Burhinus grallarius*

6.5 Possible Control Methods

6.5.1 Background

Effective control of the European rabbit and Brown hares requires integration of different methods, as any technique used in isolation is less effective than two or more techniques carefully combined (DSEWPC 2011). The current methods available for the control of rabbits and hares can be broadly categorised as:

- Biological control;
- Chemical control; and
- Mechanical control.

Other methods of control include rabbit-proof fencing, trapping, and shooting, however, these are used less extensively (DSEWPC 2011).

The following sections discuss potential biological, chemical and mechanical control options. **APPENDIX 4** contains a discussion of the possible constraints to the implementation of possible control methods on the Kings Forest site.

6.5.2 Biological Control

Biological controls include the myxoma virus causing the disease myxomatosis, which only affects rabbits and hares. This pathogen is very effective at reducing population sizes, however, some rabbits and hares have developed resistance to the virus (DSEWPC 2011). Rabbits and hares usually become infected after being bitten by an insect vector, typically mosquitos, but also European and Spanish rabbit fleas that have been introduced to Australia. While myxomatosis depresses rabbit and hare numbers, the percentage killed is usually too low to achieve a significant reduction in their impacts (NSW DPI 2020b).

The other important biological control, which has been more effective in wetter regions than in drier parts of the country, is the rabbit calicivirus disease (rabbit haemorrhagic disease virus - RHDV) (DSEWPC 2011). RHDV appears to be spread in rabbits and hares by direct contact and through insect vectors. The virus may be introduced to rabbits and hares on carrot and oat feed, by treating several warrens then allowing the disease to spread. The disease initially achieved a high level of control among rabbit and hare populations,

particularly in more arid environments, however despite efforts to spread it the effects have been very patchy in some districts (NSW DPI 2020b).

6.5.3 Chemical Control

The main chemical control used for rabbits and hares is the poison - sodium flouroacetate (1080), which provides a mortality rate of up to 90 per cent (DSEWPC 2011). There are also methods used to kill rabbits and hares while they are still in their warrens, in which pressure fumigation or diffusion fumigation techniques are used with toxins such as chloropicrin and carbon monoxide (DSEWPC 2011). Pindone is a registered rabbit poison and is more suitable for use in urbanised areas as it has an antidote (vitamin K1) (DPI 2007).

Poisoning is most effective during the non-breeding season (when rabbits and hares are less territorial and less tied to warrens) and feed is scarce. The best time is usually during mid to late summer (NSW DPI 2020b).

The objective of poisoning is to remove 90% or more of rabbits and hares, which will prevent the population from quickly recovering, allowing time to implement follow up control. Carrots are the preferred feed material for rabbits and hares, but oats and pellets may be used (NSW DPI 2020b).

6.5.4 Mechanical Control

The most widely used mechanical control method for rabbits and hares is the destruction of warrens and above ground harbours (DSEWPC 2011). The warren provides shelter and protection for rabbits and hares, to avoid extremes of weather and predators. Rabbits and hares do not readily dig new warrens, so destruction of warrens greatly inhibits resurgence and re-colonisation of treated areas.

Warren ripping can be an efficient, cost effective method for reducing rabbit and hare numbers and preventing reinvasion of the treated area, as it deprives rabbits and hares of a safe breeding place. Warren ripping is highly target specific and can be successfully employed during the breeding season (when poisoning programs are less effective). The aim of warren ripping is to simultaneously destroy the structure of the warren and kill all of the rabbits and hares. It is best to use dogs to force surface rabbits and hares into warrens before the start of ripping. Note that warrens may extend under fences, buildings, rock ledges and the root system of large trees. These inaccessible burrows should be fumigated some hours before ripping. In some situations where mechanical rippers cannot be used, explosives may be used to destroy warrens. Explosives may only be purchased and used by licensed operators (NSW DPI 2020b).

Rabbits and hares may also live among surface shelter, such as dense vegetation and weeds. Other rabbit and hare harbour includes blackberry, lantana, fallen logs, farm refuse, old machinery and rock piles. When removing vegetation, the onus is on the land manager to ensure that it is within clearing laws and does not threaten endangered species (NSW DPI 2020b).

7 MOSQUITO FISH

7.1 Introduction

Originally introduced for the purpose of mosquito control, the mosquito fish (*Gambusia holbrooki*) has been described as the 'animal weed' of Australia's aquatic environment, due to its ability to reproduce rapidly, disperse widely and occupy diverse habitats to the detriment of native species (NPWS 2003b).

7.2 Biology

The mosquito fish is an opportunistic omnivore and satisfies seven of the criteria, identified by Erlich (1986), of a successful invader in that they; are abundant in their original range; are polyphagous; have a short generation time; can colonise a site with a single female; have a broad physical tolerance; are closely associated with humans; and have a high genetic variability (Courtenay and Meffe 1989). In addition to these criteria, Courtenay and Meffe (1989) proposed the following attributes for the success of the mosquito fish; specialised reproduction (i.e. high fecundity, highly developed young, reproduce numerous times per year, independent young after birth, tolerant of a broad range of temperatures and day lengths); and that females are extremely aggressive often causing the death of other species. Mosquito fish become sexually mature in less than two months after birth and mature females have been recorded to have up to nine broods a year (NPWS 2003b).

7.3 Habitat and Home Range

Mosquito fish are found in at least eight (8) of the eleven (11) major drainage divisions in Australia (Merrick and Schmida 1984). The species is considered to be widespread and common throughout New South Wales, Victoria and South Australia in both coastal and inland drainages (NPWS 2003b). Mosquito fish inhabit rivers, creeks, lakes, swamps and drains and occur in clear and muddy water (Cadwallader and Backhouse 1983) and are well suited to stagnant waters (Aarn 2011).

7.4 Potential Impacts on Threatened Species Occurring at the Subject Site

Interspecific competition for resources may lead to mosquito fish preying on eggs and larvae of native fish and amphibians (NPWS 2003b; Aarn 2011). In habitats undergoing degradation (particularly decreased flow rate and eutrophication) the mosquito fish has a competitive advantage over endemic species (Aarn 2011), largely due to abundant sources of food and low species richness because of harsh physical conditions (NPWS 2003b). Mosquito fish also exhibit aggressive behaviour towards other fish and tadpoles, including those much larger than themselves, which has a number of direct and indirect negative impacts on these species (NPWS 2003b).

Threatened species occurring at the site that are considered to be potential prey of, or subject to competition pressures from, the Mosquito fish are listed in **TABLE 5**.

TABLE 5
THREATENED SPECIES KNOWN FROM THE KINGS FOREST SITE THAT REPRESENT POTENTIAL PREY FOR THE MOSQUITO FISH

Common Name	Scientific Name
Wallum sedge frog	*Litoria olongburensis*
Wallum froglet	*Crinia tinnula*

7.5 Possible Control Methods

7.5.1 Background

There are very few documented control programs that are both effective and specific for the mosquito fish (NPWS 2003b). The only effective control methods kill all fish species and often other fauna present (NPWS 2003b). The options currently available for the control of mosquito fish are:

- Chemical control;
- Biological control; and
- Physical control.

The following sections discuss potential biological, chemical and mechanical control options. **APPENDIX 4** contains a discussion of the possible constraints to the implementation of possible control methods on the Kings Forest site.

7.5.2 Chemical Control

The registered garden pesticide Rotenone, used as a garden insecticide and produced from the roots of several different plants (most commonly derris root), has been used to control fish such as the mosquito fish and carp (NPWS 2003b). Its application has generally been limited to small closed water bodies such as ponds or farm dams.

Rotenone can be applied to fish by:

- Suspension in water;
- Injection; and
- Ingestion of an oral bait.

Rotenone enters the fish through the gills as the fish respire (when in suspended form) and causes the fish to suffocate, as it impedes oxygen release into the tissues (NPWS 2003b). Rotenone is toxic to most fishes and likely to impact on other species such as macro-invertebrates and frogs, particularly at the egg and tadpole stages (NPWS 2003b). Lime and chlorine have also been used to control Mosquito fish, however, neither are registered fish poisons nor are they species specific (NPWS 2003b).

7.5.3 Biological Control

Biological control using predation of mosquito fish by larger species is considered to hold high potential for long-term control; however, there is little quantitative data to support

this method under natural conditions (NPWS 2003b). The mouth almighty (*Glossamia aprion)* is a species of fish native to coastal drainages of (possibly) northern NSW, QLD, Northern Territory, northern Western Australia and southern rivers of Papua New Guinea (McDowall 1996). The mouth almighty has been suggested as a useful addition to fish poison in eradicating mosquito fish from warm temperate ponds (White 2001). Potential impacts on tadpoles and other fish from this species are unknown and there would be significant risks associated with translocating this (and other) predatory species to sites outside the range of their normal distribution (NPWS 2003b).

Other biological control methods include the use of parasites, pathogens, bacteria and viruses, however, more research is needed to assess their effectiveness and possible impacts on native fauna (NPWS 2003b).

7.5.4 Physical Control

Physical control methods involve preventing access to specific habitat by mosquito fish by reducing water levels (e.g. draining and drying of isolated habitats of specific frog species) (NPWS 2003b). This method is feasible if the water level in the wetland or water body can be readily manipulated and the potential for reintroduction of mosquito fish from either upstream or downstream can be controlled (NPWS 2003b). A significant constraint to this technique is the size and number of watercourses entering the water body.

An indirect method of control is to restore fully functioning ecosystems and ecological processes as modified or degraded environments can favour the establishment of mosquito fish (Arthington *et al.* 1990). Management of issues such as water quality, environmental flows, fish passage and snags can maintain or return conditions to those that best suit native fish. This improves the ability of native fish to compete and creates conditions less suitable for pest fish species (NSW DPI 2020c). The rehabilitation of ecological attributes such as habitat structure, stream bed contours, substrate type, flow regime, water quality, aquatic plants, riparian vegetation and connectivity between habitats should create habitat more favourable to native species and inhibit mosquito fish establishment (NPWS 2003b).

8 BITING INSECTS

8.1 Introduction

Tweed Shire Council currently coordinates programs for the control of nuisance mosquitoes and biting midge.

Mosquitoes (Culicidae) and biting midge (Ceratopogonidae), are abundant in this region of Australia. The extensive areas of wet low-land and intertidal areas along the Tweed coastal districts contain many suitable breeding sites for these insects. As a result of the proximity of these low-lands to urban areas, biting insect nuisance is likely to occur seasonally in many areas.

8.2 Mosquitoes

The Tweed Shire area is home to many species of mosquitoes. As well as being a nuisance, some mosquito species spread human disease-causing pathogens such as Dengue fever, Ross River and Barmah Forest viruses, and Murray Valley encephalitis. They can also be a vector of dog heartworm.

Tweed Shire Council has been actively involved in mosquito abatement since 1983 and undertakes larvae control programs in selected areas during warmer months. The Kings Forest site is not one of these selected areas.
The following management strategies can be utilised to control mosquitoes:

- Mosquito monitoring traps;
- Breeding habitat reduction. Management strategies aimed at controlling these nuisance insects relate to ensuring that all areas designated for stormwater control do not allow water to stand for long periods of time. Obviously, areas of standing water will occur in retained and compensatory habitat. These areas are critical to the life cycle requirements of native frogs on site eg, wallum sedge frog and wallum froglet. The use of larvicides would need to be strictly limited to areas outside of the native frog habitats unless there is strong evidence to demonstrate the native frog habitats are also significant mosquito breeding habitat and that the larvicide will be harmless to the frogs and their tadpoles.
- Mosquito larvae control: When extensive areas hatch mosquito larvae following heavy rain or higher than usual tides. Larger areas are treated by aircraft, whereas smaller areas can be treated with on-ground works. Biological larvicides are used:
    - *Bacillus thuringiensis* - Council uses a bacterial larvicide called Bti to spray mosquito breeding areas when warranted. This larvicide is specific to mosquitoes and several other closely related flies. Bti poses no harm to other aquatic non-target organisms.
    - Methoprene – This chemical is an insect growth regulator with sustained release formulations to inhibit mosquito larvae from turning into adult mosquitoes.
- Fish stocking for mosquito control is a useful strategy in freshwater ecosystems. Choosing the right fish is important. Fish that are native to local waterways ensure that local ecosystems are not disturbed.
- The use of machines which, under pressure, deliver a fine fog of particles containing a chemical substance can be used and delivered by a backpack over limited areas. Sprays and fogs containing pyrethrum or a combination of pyrethrum and synthetic pyrethrum (called pyrethroids) is a toxic and popular combination. These products kill adult mosquitoes on contact and also work to repel others. Weather conditions e.g. wind and rain are obviously a major constraint to their use. This option is not currently employed in Tweed Shire due to the potential for off-target impacts, including human health.

8.3 Biting Midges

Also known as 'sand flies', biting midges are small flies renowned for their nuisance biting. They tend to occur in areas such as coastal lagoons, estuaries, mangrove swamps and tidal flats. Only the female biting midge feeds blood. She does this to gain the protein she needs to develop her eggs. The 'itchiness' from her bite is due to allergens in midge saliva. Most people find the bites uncomfortable and distressing with the irritation leading to scratching and sometimes infected sores.

Tweed Shire Council has been carrying out research and control work on biting midge since 1981. Including the following activities.

- Midge monitoring biting midge larval numbers are monitored monthly at set points along canal estate beaches.
- Biting Midge larvae are controlled with a larvicide during the year, as required, along artificial beaches of the Shire's canal developments.

Treatments are timed to have the biggest impact on midge adult numbers for the least number of chemical applications.