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URBAN DEVELOPMENT

YEATS
CONSULTING ENGINEERS

Flora and Fauna Assessment

RIVA VUE ESTATE

Rous River Way, Murwillumbah

NEWLAND DEVELOPERS PTY LTD

23 MAY 2011

REVISION NO.3

GOLD COAST

GLADSTONE

MACKAY

BRISBANE

T 07 3844 9546
E info@yeats.com.au
W www.yeats.com.au

Lvl 1, 119 Melbourne St
South Brisbane 4101

PO Box 3629
South Brisbane 4101

ABN 29 011 204 604

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1 Introduction

1.1 Project Overview

Yeats Consulting Engineers were engaged by Newland Developers to provide a flora and fauna assessment to support the wider rezoning and development of the Riva Vue Estate.

The site was the subject of a detailed flora and fauna assessment undertaken by James Warren and Associates in 2005. Since then, Newland Developers have submitted a request to Tweed Shire Council to rezone Lot 332 in DP1158142 from 1B Rural to R1 General Residential and RE1 Public Recreation.

Specifically, Yeats were asked to 1) assess and update (if necessary) the original flora and fauna assessment (James Warren and Associates 2005) specific to the subject site in its current condition and context, and 2) assess in more detail the area subject to the current rezoning request.

1.2 Subject site and rezoning request

Figure 1 shows the subject site and the subset of the site that is the subject of the current rezoning request.

The rezoning request falls over Lot 332 in DP1158142, Rous River Way, Murwillumbah. The proposed rezoning intends to rezone this site from 1B Rural to R1 General Residential and RE1 Public Recreation.

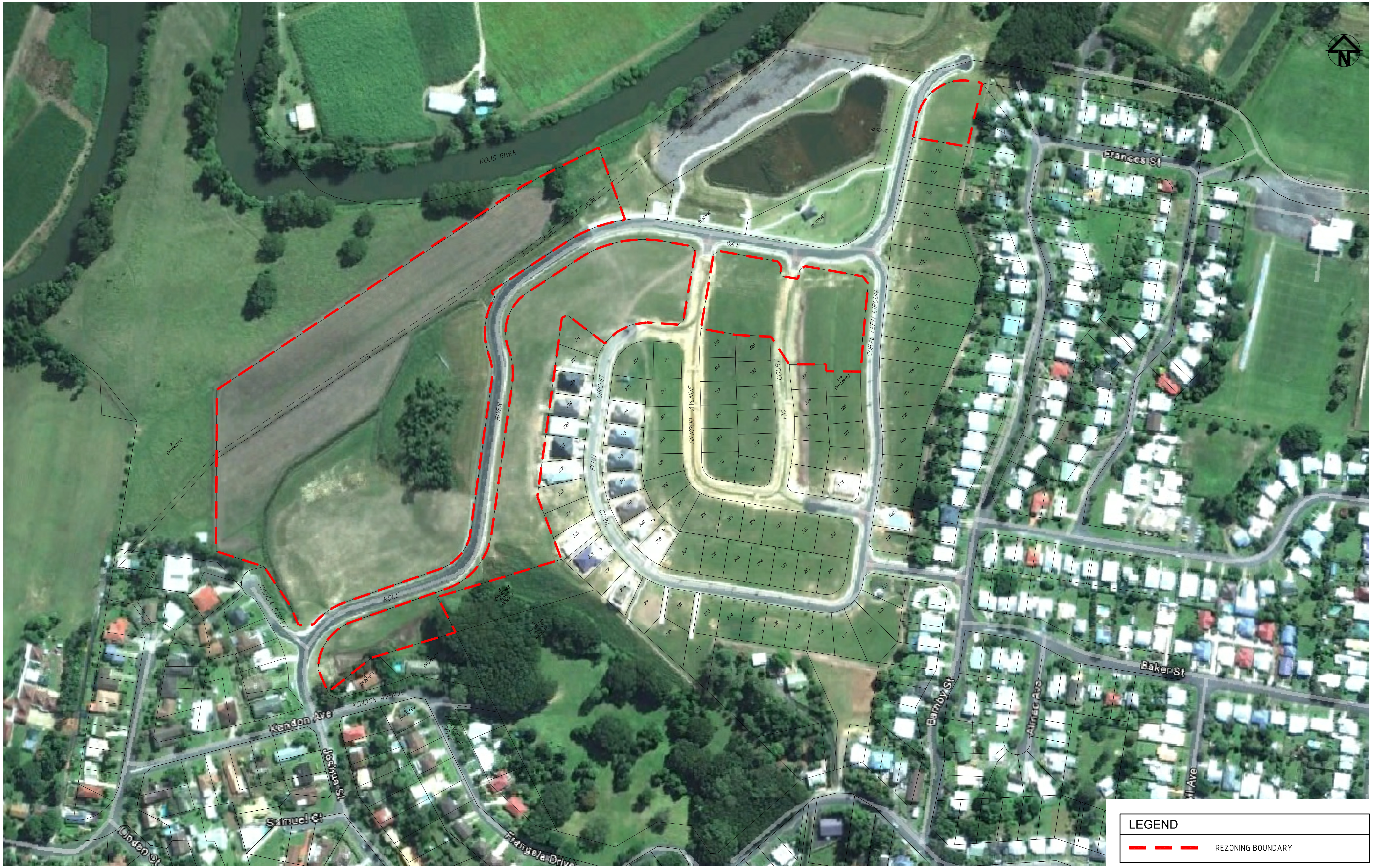
1.3 Objectives

The objectives of this study were to:

- Assess the flora of the subject site, including threatened species, critical habitat, ecological communities or their habitat;
- Assess the fauna habitat of the site;
- Assessment and identification of habitat corridors, in particular between open space to the south (Frangela Drive Reserve) and environmental land to the south east of the site and towards the river;
- Buffers required and suitability of buffers to the riverine corridor within the context of flora needs including corridors, legislative requirements for riverine buffers, ownership of buffers and zoning of buffers;
- Consideration of appropriate revegetation and improvement (native species) required and suitable management strategy. The appropriate revegetation and improvement should be a concept level plan (rather than operational level) which outlines the type of work to be undertaken and locations for that work to occur.

The approach in undertaking the assessment included:

- Desktop assessment and literature review of available information relating to the flora, fauna and vegetation of the subject site; and
- Field survey to confirm and provide additional data to the desktop information collected.



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REZONING REQUEST BOUNDARY

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2 Methods

This section outlines the methods undertaken to describe the existing environmental values of the subject site. A combination of desktop assessments and a field survey were conducted as part of this study. The desktop assessments included a review of relevant literature and mapping, database searches and previously prepared technical reports. The field survey was conducted to obtain specific ecological information relevant to the subject site and to ground-truth results from desktop assessments. This section also outlines the terminology and nomenclature used in this technical report and describes the procedures and guidelines used for assessing the vegetation and flora and fauna values of the study area.

2.1 Field Survey

A field survey was conducted to identify species and vegetation within the subject site. Field surveys also aimed to determine the likelihood of occurrence of gazetted threatened flora and fauna species or threatened ecological communities considered to have the potential to occur on the subject site, as identified by desktop searches.

2.2 Timing of Field Surveys

The survey was undertaken on the 13th of April 2011. The date of the survey falls in the optimal period for vegetative vigour and inflorescence set, particularly for herbaceous and grass species.

2.3 Site Selection

Flora surveys were undertaken in representative vegetation communities across the subject site. Survey sites were selected on the basis of:

- Aerial photography interpretation of site characteristics;
- Presence of vegetation; and
- Targeted threatened flora species and ecological communities and their habitats identified from database searches.

Fauna habitat assessment was undertaken over the whole site.

2.4 Field Survey Methods

Flora and fauna sampling methods included:

- Site species lists; and
- Traverses.

2.4.1 Site species lists

Vegetation and flora

A total of two sites were surveyed in the area that is the subject of the rezoning request, and one site outside in the adjacent riparian vegetation owned by Council, to assist in the identification of vegetation on and adjacent to the site. At each of the sampling sites, a comprehensive species inventory was prepared together with any ecologically significant characteristics, including the presence of threatened species or vegetation communities (or

potential habitats) and threatening processes (such as significant weed infestations). Plant species were either identified *in situ* or collected for later identification. A condition rating (Table 1) was given for each identified community.

Condition	Description
Very good to excellent	80% to 100% native flora composition; Vegetation structure intact; Cover/abundance of weeds <5%; No or minimal signs of disturbance.
Fair to good	50% to 80% native flora composition; Vegetation structure modified or nearly so; Cover/abundance of weeds 5% to 20%, any number of individuals; Minor signs of disturbance.
Poor	20% to 50% native flora composition; Vegetation structure completely modified or nearly so; Cover/abundance of weeds 20% to 60%, any number of individuals; Disturbance incidence high.
Very poor	0% to 20% native flora composition; Vegetation structure not apparent; Cover/abundance of weeds 60% to 100%, any number of individuals; Disturbance incidence very high.

Table 1 Condition scale (Kaesehagan 1994) used in assessment of vegetation condition at each site

2.4.2 **Traverses**

In addition to the detailed survey sites, specific areas of vegetation in the subject site were traversed on foot and the random meander technique (Cropper 1993) applied. The random meander technique is a widely accepted method to survey for threatened flora species that may not occur in surveyed plots. It involves traversing sections of the subject site and recording vegetation type and vascular flora species along each traverse. The purpose of this type of assessment was to ensure adequate site coverage and to establish a comprehensive floral species list for the subject site.

Fauna

Targeted random meander foot traverses were employed to survey the fauna species present on site and to assess the habitat values of the site. Similar to the flora random meander, this involved traversing those sections of the site considered to represent the most valuable habitat for native species.

2.5 **Nomenclature**

Scientific names for terrestrial flora are consistent with those used in PlantNet (NSW Flora Online) and botanical binomials presently accepted by the National Herbarium of New South Wales. Scientific names for fauna follow those used by the NSW National Parks and Wildlife Service Atlas of NSW Wildlife. Those botanical species name preceded by an asterisk (*) indicates a non-native exotic species and those preceded by an addition sign ($^{+}$) are non-indigenous native species.

2.6 **Co-ordinate System and Map Datum**

Positional data was collected with a handheld Garmin eTrex Geographic Positioning System (GPS), with accuracy between 4 and 8 m. Locations were recorded using the UTM coordinate system with a GDA94 datum. All locations presented in this report are within zone 56J.

3 Property Description

The rezoning request falls over Lot 332 in DP1158142, Rous River Way, Murwillumbah.

3.1 Climate

The climate of the general area can be described as humid subtropical. Climate records for the closest Bureau of Meteorology station to the subject site (Murwillumbah (Bray Park) – 58158) indicates a mean annual rainfall of 1608.7 mm, 65% of which falls in the summer half year of October through to March.

3.2 Geology and Geomorphology

Geology mapping covering Riva Vue Estate indicates that two distinct geologies occur on the subject site:

- Qa – Quaternary aged alluvium of flood plains and river terraces;
- DCn – Devonian – Carboniferous aged mudstone, shale, greywacke, chert, jasper, conglomerate, basic metavolcanics, pillow lava (Neranleigh – Fernvale Beds).

The area mapped as DCn is associated with a low hill on the subject site. The remainder of the subject site is mapped as Qa – alluvium associated with the Rous River.

3.3 Soils

CSIRO soils mapping prepared at 1:2,000,000 scale broadly indicates that the subject site occurs on soils mapped as NY1, this being:

"Coastal plains, generally low-lying, poorly drained, and subject to flooding (lower and middle reaches of river flood-plains, swamps, estuarine areas, and tidal marshes): chief soils seem to be friable acidic gley soils (Dg4.11, Dg4.41, and Dg4.81), friable acidic yellow mottled soils (Dy5.11), leached sand soils (Uc2.2 and/or Uc2.3), and sandy acidic yellow mottled soils (Dy5.61, Dy5.41, and Dy5.81) in a complex and not well-known pattern."

3.4 Site Survey

Surveys were undertaken throughout the site to verify that the conditions described within the the 2005 assessment by James Warren and Associates was still valid. Specific attention was paid to areas within the area subject to the current rezoning request.

3.4.1 Vegetation Communities

Vegetation communities in and around Lot 332 included one native and four non-native vegetation communities. Two of the communities occur only within Lot 332, one occurs both within and adjacent to Lot 332 and two communities occur outside of Lot 332 (i.e. adjacent).

Vegetation in and around the subject site is highly fragmented with native vegetation occurring as an isolated patch of regrowth occurring within Lot 332. Non-native vegetation communities include cleared sites associated with cultivation and fallow land. Detailed descriptions of the vegetation communities present on and around the subject site are detailed below with the extent of each community illustrated in Figure 2. Detailed survey sites are also indicated on Figure 2. No threatened ecological communities were identified from the subject site during this

survey. Plant taxa observed from the subject site during the field investigation are listed in Appendix A.

Communities within Lot 332

1. Regrowth of pink bloodwood (*Corymbia intermedia*) and tallowwood (*Eucalyptus microcorys*)

   The unit occurs on a low hill along Rous River Way (lot 332 on DP1158142). A few emergent remnant trees mainly of pink bloodwood (*Corymbia intermedia*) to 30 m tall are present over a moderately dense canopy of regrowth pink bloodwood and tallowwood (*Eucalyptus microcorys*) with blackwood (*Acacia melanoxylon*) to 8.5 m tall. Other species in the canopy layer include swamp mahogany (*Lophostemon suaveolens*), camphor laurel (**Cinnamomum camphora*), and the non-indigenous species cadagi (*+Corymbia torelliana*). The understorey was moderately sparse and supported species such as foam bark (*Jagera pseudorhus*), umbrella cheese tree (*Glochidion sumatranum*) and blackwood. Groundcover was variable and characterised by spiny-headed mat-rush (*Lomandra longifolia*), bracken (*Pteridium esculentum*) and exotic grasses such as para grass (**Urochloa mutica*) and pale pigeon grass (**Setaria pumila*). This vegetation community covers 0.3 ha of the subject site and is in a fair to good condition with obvious signs of past disturbances and regrowth.

   James Warren and Associates (2005) originally mapped this community within their Tall Open Forest (*Eucalyptus microcorys*, *Corymbia intermedia*) vegetation community. While the original assessment records remnant trees in this vegetation community as "old growth trees (i.e. they have a diameter at breast height of well over one metre)" (James Warren and Associates 2005), no remnant trees of this size were recorded from the patch surveyed with diameters at breast height ranging between 40 and 60 cm.

   Representative site: RIVA1.

2. Cultivation/fallow area

   This vegetation unit is characterised by cleared sites that previously supported sugar cane cultivation or fallow land on alluvial flats associated with the Rous River. The site is actively slashed to assist with weed control and to reduce combustible fuel levels. These areas are dominated by exotic species and as such are not classed as native vegetation.

Communities both within and adjacent to Lot 332

3. Camphor laurel (*Cinnamomum camphora) over closed forest species – **this community occurs predominantly outside of Lot 332**

   This unit occurs along a drainage line and along the high bank of the Rous River. At site RIVA2 (within the area subject to the rezoning request), the canopy was dominated by camphor laurel with a single large individual of hard quandong (*Elaeocarpus obovatus*) to 17 m tall. A moderately dense understorey is present and characterised by species more commonly associated with closed forest communities, such as guioa (*Guioa semiglauca*), and rough-leaved elm (*Aphananthe philippensis*). A moderately dense shrub layer is present and dominated by small-leaved privet (**Ligustrum sinense*). The ground layer is dominated mainly by exotic species such as Guinea grass (**Megathyrsus maximus*) and pale pigeon grass among others. This site is classed as having a degraded condition mainly due to the dominance of exotic species.

   At site RIVA3 (along the high bank of the Rous River), the large camphor laurels which originally formed the dominant canopy have been chemically treated. The understorey

has been maintained and includes species more commonly associated with closed forest communities, such as guioa, red kamala (*Mallotus philippensis*), rough-leaved elm and green tamarind (*Elattostachys nervosa*). The ground layer is sparse. This site is classed as having a poor condition mainly due to the past dominance of camphor laurel on the site. Camphor laurels still persist on land owned by Tweed Shire Council immediately adjacent – see Figure 2.

James Warren and Associates (2005) originally mapped this community as part of their Wet Closed Forest (*Ficus watkinsiana* +/- regeneration rainforest species) vegetation community. The predominant canopy of this vegetation community is dominated by the exotic species camphor laurel and no individuals of *Ficus watkinsiana* were recorded from either site during this survey. As a consequence of the results of this survey, this vegetation community has been classed as a non-native vegetation community.

Representative sites: RIVA2, RIVA3.

Communities outside of Lot 332

4. Revegetation areas

   A small area abutting the high bank of the Rous River (lot 133 on DP1139107 adjacent to site 3) has been cleared of exotic species and revegetated with a number of native species. These tended to be around 1 to 1.5 m tall and are actively maintained. This area will eventually act as a buffer to the Rous River once the plantings reach a certain height and ecosystem processes are restored. This vegetation community is classed as non-native as the predominant canopy consists of native species introduced to the site. This revegetated area should be extended towards the south-west and incorporate the proposed RE1 zone along the Rous River.

5. Parkland

   A public reserve (lot 132) and drainage reserve (lot 131) have been established. These areas support a range of planted and amenity species. The site is well maintained with many facilities available for public use (picnic benches, bike path, playground).

3.4.2 Habitat

Six habitat types are represented on and adjacent to the subject site - one native and five non-native. Habitats one to five correspond with the vegetation communities described above. Habitat six comprises the constructed wetland located within the parkland (vegetation community 4). The values of each fauna habitat are described below.

Habitats within Lot 332

1. Habitat 1: Regrowth of pink bloodwood (*Corymbia intermedia*) and tallowwood (*Eucalyptus microcorys*).

   This habitat comprises a mix of native and exotic species and has a moderate level of structure having canopy, understorey and ground cover layers. The understorey is generally sparse, and the ground cover provides a moderate level of structure in the form of fallen timber, but is densely covered by exotic grasses in parts. The larger emergent trees looked to contain some tree hollows. However, the small size of this fragment renders it highly susceptible to disturbances in the form of edge effects. Brown quail (*Coturnix ypsilophora*) and noisy miner (*Manorina melanocephala*) were the only species observed in this habitat, but figbirds (*Sphecotheres viridis*) were also heard

calling from nearby habitat not contained on the subject site. This community is considered to be of low to moderate value for native fauna.

2. Habitat 2: Cultivation/fallow area.

   This area is comprised of slashed exotic species. As such, there is low habitat value for native fauna.

Habitats both within and adjacent to Lot 332

3. Habitat 3: Camphor laurel (**Cinnamomum camphora*) over closed forest species - predominantly outside of area subject to rezoning request

   This community is dominated by exotic species and, being linear, is highly edge effected. However, there are some elements associated with nearby, larger, more intact areas of closed forest. A number of species known to use fragments of habitat as 'stepping stones' between larger, more intact areas of forest were observed in this vegetation (e.g common koel (*Eudynamys scolopacea*), black faced cuckoo-shrike (*Coracina novaehollandiae*), grey goshawk (*Accipiter novaehollandiae*)). As such, despite the dominance of exotic species and the degraded condition, this area plays a role in riparian protection and, at a larger scale, represents an important refuge for animals moving between larger patches of habitat. Because of these roles, this community is considered to represent moderate value for native fauna. The majority of this habitat type is outside of the are currently requested for rezoning, however a small patch (depicted as RIVA2) in Figure 1, is contained within the area requested for rezoning.

Habitats outside of Lot 332

4. Habitat 4: Revegetation areas

   These areas are too immature to serve as effective habitat for native fauna. Consequently, they are considered to represent low value for native fauna.

5. Habitat 5: Parkland – outside of area subject to rezoning request

   These areas provide highly modified habitat for a number of locally common native species such as Australian magpie (*Gymnorhina tibicens*) and willie wagtail (*Rhipidura leucophrys*). The non-indigenous native noisy miner (*Manorina melanocephala*) was also observed in this area.

6. Habitat 6: Constructed wetland – outside of area subject to rezoning request

   This habitat comprises areas of open water and semi aquatic vegetation. A number of birds (e.g dusky moorhen (*Gallinula tenebrosa*), white faced heron (*Egretta novaehollandiae*), Australasian grebe (*Tachybaptus novaehollandiae*), welcome swallows (*Hirunxo neoxena*)) commonly associated with water were observed in this habitat. This habitat is of moderate value to native fauna.

3.4.3 Flora

A total of 84 plant species (Appendix A) were recorded from both the previous survey by James Warren and Associates and by Yeats across and adjacent to Lot 332. These included 48 native, 34 exotic or weed species and two non-indigenous Australian native species. James Warren and Associates (2005) list 35 threatened species retrieved from a NPWS Atlas of NSW Wildlife database search within 10 km of the subject site. None of these gazetted threatened species

were recorded from the subject site during this survey and no critical habitat for these species was encountered.

3.4.4 **Fauna**

Sixteen animal species (15 birds and one reptile) were recorded during the habitat assessment (Appendix B). None of the species recorded during the habitat assessment were conservation significant. James Warren and Associates (2005) list 37 threatened species retrieved from a NPWS Atlas of NSW Wildlife database search within 10 km of the subject site. None of these gazetted threatened species were recorded from the subject site during this survey and no critical habitat for these species was encountered.

3.4.5 **Weeds**

A weed is defined as any plant that requires some form of action to reduce its harmful effects on the economy, the environment, human health and amenity (Natural Resource Management Ministerial Council, 2006). There are two types of invasion: introduction of exotic plants and movement by native species into new areas well outside their native range. Weeds have an adverse effect on an area's environmental values and ecological functioning for the following reasons:

- Competition with native species;
- Change in the structure of a plant community through addition or removal of strata;
- Repress recruitment of native species;
- Change the natural fire fuel characteristics, which can change the natural fire regime to the detriment of native species, often resulting in the loss of native species;
- Change the food sources and habitat values available to native fauna, reducing some and increasing others;
- May change geomorphological processes such as erosion; and
- May lead to changes in the hydrological cycle.

Under the *Noxious Weeds Act 1993*, introduced species that represent a threat to primary industries, natural resources and the environment can be declared as Class 1, 2, 3, 4 or 5 noxious weeds (Table 2).

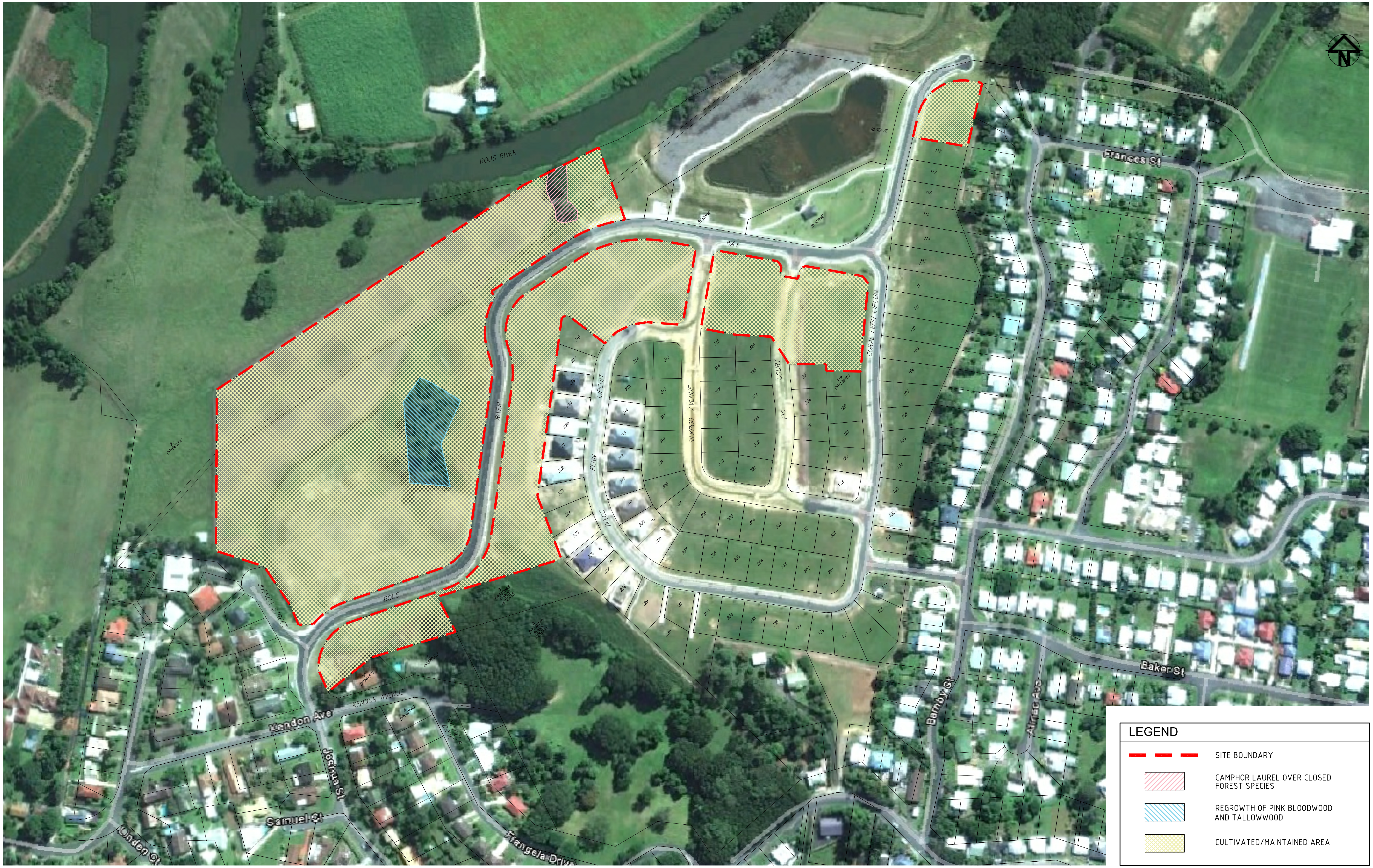
Table 2 Categories of noxious weeds in New South Wales

Class	**Description**
1	Class 1 noxious weeds are plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.
2	Class 2 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.
3	Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.

Class	Description
4	Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.
5	Class 5 noxious weeds are plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

The present survey identified 34 exotic or weed species and two non-indigenous Australian native species occurring on the subject site (Appendix 1). Chinese celtis (class 3), Camphor laurel (class 4), small-leaved privet (class 4), and lantana (class 4) are all declared noxious weeds for the Far North Coast County Council area.

A number of North Coast environmental weeds were recorded during the field survey, including: small leaved privet (**Ligustrum sinense*), camphor laurel (**Cinnamomum camphora*), Chinese celtis (**Celtis sinensis*), cocos palm (**Syagrus romanzoffiana*), lantana (**Lantana camara*), umbrella tree (*+Schefflera actinophylla*), mile-a-minute (**Ipomoea cairica*), ochna (**Ochna serrulata*), slash pine (**Pinus ellioti*), mock orange (**Murraya paniculata*), blue billygoat weed (**Ageratum houstonianum*), cadagi (*+Corymbia torelliana*), pale pigeon grass (**Setaria pumila*), corky passionflower (**Passiflora suberosa*), silver-leaved Desmodium (**Desmodium uncinatum*), para grass (**Urochloa mutica*), siratro (**Macroptilium atropurpureum*), Guinea grass (**Megathyrsus maximus*), grader grass (**Themeda quadrivalvis*), farmer's friend (**Bidens pilosa*), purpletop (**Verbena bonariensis*), and taro (**Colocasia esculenta*).



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TITLE
FIGURE 2
VEGETATION COMMUNITY MAP
FIGURE 2

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4 Potential Impacts and Mitigation

4.1 Overview of Potential Impacts

The following section identifies and discusses potential impacts considered relevant to the proposed rezoning and development of the subject site. This section also details a range of mitigation measures to ameliorate potential impacts.

There are a number of potential impacts relating to the rezoning and development of the subject site. However, as the subject site is highly disturbed and it is largely located on a former sugar cane farm the potential impacts associated with rezoning and development of the site on the flora and habitat values are considered low.

The subject site largely corresponds with areas of previous disturbance with the only area of native vegetation being disturbed occurring on a low hill adjacent to Rous River Way (site 1). Potential impacts to flora, fauna, habitat and vegetation communities within the subject site include vegetation clearing, increased disturbance, loss of habitat and increased incidence of weeds.

4.2 Construction Phase

In general, the loss of native vegetation from the subject site is expected to be minimal with the majority of the site being previously cleared of vegetation. The physical removal of vegetation associated with the development of the subject site has the potential to cause direct mortality to individual animals that are residing within this area at the time of clearing. Impacts associated with construction include:

Direct Impacts

- Clearing of native vegetation;
- Loss of habitat; and
- Direct fauna mortality associated with any clearing operations.

Secondary Impacts

- Degradation of flora and fauna habitat due to invasion and spread of weeds; and
- Decreased connectivity of remaining vegetation causing increased vulnerability to environmental changes.

Objectives

- To minimise the potential for impacts to terrestrial flora and vegetation communities, particularly those of state and/or national significance during design, construction and operational activities;
- Minimise the extent of clearance of riparian vegetation and associated habitat;
- Where possible, maximise retention of native vegetation;
- Manage disturbed sites to minimise colonisation by and spread of weed species.

4.3 **Vegetation Clearing and Habitat Protection**

The Riva Vue subject site is located in an area that has largely been previously cleared and used for sugar cane cultivation. The proposed development of the subject site will result in the loss of vegetation on the site. The majority of this vegetation is non-native exotic grassland, however, the 0.3 ha patch of regrowth of pink bloodwood and tallowwood with emergent remnant trees occurs in an area proposed as general residential and will be consequently cleared.

Mitigation Measures

- Obtain all necessary permits and approvals under the relevant environmental legislation and ensure that any clearing of vegetation is carried out in accordance with approval conditions;
- Ensure all necessary permits and approvals are gained prior to the commencement of construction;
- All tree clearing activities will be undertaken in the presence of a qualified fauna spotter;
- Undertake rehabilitation as soon as possible after completion of earthworks to restore habitat values to the site;
- Native woody vegetation removed during the development process should be mulched on site. This mulch can then be used in revegetation plantings on the subject site; and
- Weed control and prevention measures should be implemented, especially with respect to declared weed species and areas not presently infested.

4.4 Weeds and Pests

Introduced plant species successfully and rapidly invade areas cleared of native vegetation or otherwise disturbed by humans, thereby altering the nature of flora and fauna habitats. Exposed areas of soil are rapidly colonised by exotic weed species, often at the expense of native plants. Weed proliferation may result in changes to the structure of remnant vegetation, increases in fuel loads which may lead to hotter more frequent fires and will alter remaining fauna habitat. Introduced plant species may replace native species that provide shelter or foraging areas for native fauna. The vegetation present along the corridor has a number of declared or problem plant species present, particularly camphor laurel, small-leaved privet, lantana and ochna.

Mitigation Measures

- Limit and manage the number of introduced plant species resulting from construction;
- Existing populations of declared plants and environmental weeds will require control measures to reduce their distribution and potential for spread within the subject site; and
- Weed hygiene measures should be included in site environmental management plans to ensure construction activities do not exacerbate the spread of weeds along the corridor.

4.5 Reduced Connectivity

The subject site consists of a small patch of regrowth vegetation, one small area characterised by camphor laurel and cleared areas now dominated by exotic grass species. Areas of woody vegetation are largely isolated with no connectivity between patches. A thin strip of camphor laurel dominated vegetation over native closed forest species occurs along the high bank of the Rous River, outside of the area requested for rezoning.

Mitigation Measures

- Revegetation programs should include the expansion of the existing revegetated site and the expansion of the reinstatement of endemic native riparian vegetation along the banks of the Rous River (within the area subject to the request for rezoning) to eventually provide a corridor for wildlife movement and a buffer between residential areas and the river; and
- Implement a native street tree/amenity planting strategy to provide additional fauna habitat within the subject site.

5 Management and Maintenance

5.1 Buffers

There has already been revegetation of the riparian area along the Rous River to a width of 50 m in the north-western part of the site. The continuation of this revegetation within the area subject to request for rezoning will provide a buffer between the proposed R1 general residential zone and the river itself, stabilise the banks and may eventually contribute to provision of a wildlife corridor through this section of the Riva Vue Estate. James Warren and Associates (2005 – Appendix 3) lists a range of endemic native species that could be considered as part of the revegetation of the site. Where adjacent to the Rous River, the revegetated section should be continued from the already revegetated area and be 50 m wide as a minimum to ensure that a suitable buffer exists between residential areas and the river.

5.2 Guidelines for Revegetation

This section outlines a rehabilitation strategy for the subject site and provides suggestions for replanting techniques, monitoring and on-going management requirements using native species identified from onsite investigations and previous revegetation plantings.

5.3 Management Objectives

- To maximise survival opportunities for areas of retained vegetation and newly rehabilitated or revegetated areas;
- To improve the ecological values by providing a naturally vegetated weed free area with habitat complexity, food resources and linkages to other areas;
- To improve the visual amenity of the revegetated site to local residents and park users; and
- To prevent existing and new weeds from re-establishing within the revegetated areas.

5.4 Revegetation Plan

A revegetation plan is suggested in order to complement existing closed forest species present as understorey under camphor laurel, control exotic weed species, reduce water quality impacts, and stabilise the bank of the Rous River. The area to be revegetated will also establish a buffer between the proposed development and the river itself, while also providing habitat and wildlife movement corridor for native fauna species.

The list of species to be used for revegetation should be those native plant species identified from onsite investigations of natural vegetation and those species determined by James Warren and Associates (2005) for revegetation. Existing native trees should be retained wherever possible as the root zones of these trees are already established. This diversity of planting should also allow for some natural regeneration of the site. The revegetation program should consider the following:

- planting densities
- species selection and planting regime
- corrective measures
- weed control and management - weed removal methods should include consideration of direct contact spray, cut stump method, type of herbicide, timing, and noxious weed surveillance.

6 Conclusion

The findings of the 2011 ecological assessment undertaken by Yeats verify that the ecological values described in the 2005 flora and fauna assessment undertaken by James Warren and Associates are still broadly accurate. However, since the 2005 study, the ecological values of the area have been further degraded by the approved development activities occurring within and adjacent to the site. The site is considered to provide habitat for a range of locally common and widespread species, but given the history of clearing in and around the site, and the relatively degraded nature of the small areas of habitat that remain, the site is not considered to represent significant ecological value for rare and threatened species. Revegetation of the area adjacent to the Rous River and sensitive landscaping with locally endemic species would enhance the habitat value of the site for locally common species.

7 References

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Appendix A

Flora species recorded from Lot 332 on DP1158142 and Lots 130, 131, 132 and 133 on DP1139107

(13 April 2011)

Family	Status	Taxon	Common Name	Life Form	1	2	3
Adiantaceae		*Adiantum hispidulum*	rough maidenhair fern	F		+	
Apiaceae		*Centella asiatica*	Indian pennywort	H	+		
Apocynaceae		*Parsonsia straminea*	monkey rope	V	+		
Araceae	*	*Colocasia esculenta*	taro	H			+
Araliaceae	+	*Schefflera actinophylla*	umbrella tree	ST	+		
Arecaceae	*	*Syagrus romanzoffiana*	cocos palm	T		+	
Asteraceae	*	*Ageratum houstonianum*	blue billygoat weed	H	+	+	
Asteraceae	*	*Bidens pilosa*	farmer's friend	H	+	+	
Asteraceae	*	*Cirsium vulgare*	spear thistle	H	+		
Asteraceae	*	*Conyza bonariensis*	flaxleaf fleabane	H	+		
Asteraceae	*	*Crassocephalum crepidioides*	thickhead	H	+	+	
Asteraceae		*Eclipta prostrata*		H		+	
Asteraceae	*	*Emilia sonchifolia*	lilac tasselflower	H	+		
Bignoniaceae		*Pandorea pandorana*	wonga vine	V	+		
Blechnaceae		*Blechnum* sp.		F	+		
Convolvulaceae	*	*Ipomoea cairica*	mile-a-minute	V		+	+
Cyperaceae		*Cyperus gracilis*	slender flat-sedge	R		+	+
Dennstaedtiaceae		*Pteridium esculentum*	bracken	F	+		
Ebenaceae		*Diospyros pentamera*	myrtle ebony	ST		+	
Elaeocarpaceae		*Elaeocarpus obovatus*	hard quandong	T		+	
Euphorbiaceae		*Mallotus philippensis*	red kamala	ST			+
Fabaceae	*	*Crotalaria lanceolata*	rattlepod	H	+		
Fabaceae		*Desmodium rhytidophyllum*		V	+		
Fabaceae	*	*Desmodium uncinatum*	silver-leaved desmodium	V	+	+	
Fabaceae		*Glycine clandestina*		V	+		

Family	Status	Taxon	Common Name	Life Form	1	2	3
Fabaceae		*Hardenbergia violacea*	false sarsaparilla	V	+		
Fabaceae		*Hovea acutifolia*		S	+		
Fabaceae	*	*Macroptilium atropurpureum*	siratro	V		+	
Fabaceae	*	*Macroptilium lathyroides*	phasey bean	V	+		
Fabaceae		*Mucuna gigantea*	burny bean	V		+	+
Lauraceae	*	*Cinnamomum camphora*	camphor laurel	T	+	+	+
Lobeliaceae		*Pratia purpurascens*	whiteroot	H	+	+	
Lomandraceae		*Lomandra longifolia*	spiny-headed mat-rush	R	+		
Loranthaceae		*Amylotheca dictyophleba*	a mistletoe	epS		+	
Luzuriagaceae		*Eustrephus latifolius*	wombat berry	V	+		
Luzuriagaceae		*Geitonoplesium cymosum*	scrambling lily	V	+		
Malvaceae	*	*Sida rhombifolia*	Paddy's lucerne	S	+	+	
Mimosaceae		*Acacia maidenii*	Maiden’s wattle	S	+		
Mimosaceae		*Acacia melanoxylon*	blackwood	ST	+		
Moraceae		*Ficus coronata*	creek sandpaper fig	ST	+		
Moraceae		*Maclura cochinchinensis*	cockspur thorn	V		+	+
Myrtaceae		*Angophora* sp.		ST	+		
Myrtaceae		*Corymbia intermedia*	pink bloodwood	T	+		
Myrtaceae	+	*Corymbia torelliana*	cadagi	T	+		
Myrtaceae		*Eucalyptus microcorys*	tallowwood	T	+		
Myrtaceae		*Lophostemon suaveolens*	swamp mahogany	T	+		
Ochnaceae	*	*Ochna serrulata*	ochna	S	+	+	
Oleaceae	*	*Ligustrum sinense*	small-leaved privet	S		+	
Oxalidaceae		*Oxalis chnoodes*		H	+		
Oxalidaceae	*	*Oxalis corniculata*	soursob	H		+	

Family	Status	Taxon	Common Name	Life Form	1	2	3
Passifloraceae	*	*Passiflora suberosa*	corky passionflower	V	+	+	
Passifloraceae	*	*Passiflora foetida*	stinking passionflower	V	+		
Phormiaceae		*Dianella caerulea*	blue flax lily	R	+		
Phyllanthaceae		*Glochidion sumatranum*	umbrella cheese tree	ST	+		
Pinaceae	*	*Pinus elliottii*	slash pine	ST	+		
Pittosporaceae		*Pittosporum lancifolium*	narrow-leaved orange thorn	S	+		
Poaceae		*Cymbopogon refractus*	barbed wire grass	G	+		
Poaceae		*Cynodon dactylon*	couch	G	+		
Poaceae		*Echinochloa colona*	awnless barnyard grass	G		+	
Poaceae		*Imperata cylindrica*	blady grass	G	+		
Poaceae	*	*Megathyrsus maximus*	Guinea grass	G	+	+	
Poaceae		*Oplismenus aemulus*		G	+		
Poaceae		*Paspalidium distans*		G	+		
Poaceae	*	*Setaria pumila*	pale pigeon grass	G	+	+	+
Poaceae		*Themeda australis*	kangaroo grass	G	+		
Poaceae	*	*Themeda quadrivalvis*	grader grass	G	+		
Poaceae	*	*Urochloa mutica*	para grass	G	+	+	
Polygonaceae		*Rumex brownii*	swamp dock	H		+	
Rosaceae	*	*Rhaphiolepis indica*	Indian hawthorn	S	+		
Rutaceae	*	*Murraya paniculata*	mock orange	S	+		
Rutaceae		*Zieria smithii*	sandfly zieria	S	+		
Sapindaceae		*Elattostachys nervosa*	green tamarind	ST			+
Sapindaceae		*Guioa semiglauca*	Guioa	ST		+	+
Sapindaceae		*Jagera pseudorhus*	foambark	ST	+	+	+
Smilacaceae		*Smilax australis*	lawyer vine	V	+	+	

Family	Status	Taxon	Common Name	Life Form	1	2	3
Solanaceae	*	*Solanum chrysotrichum*	Devil's fig	S		+	
Solanaceae	*	*Solanum lycopersicum*	tomato	H		+	+
Solanaceae	*	*Solanum seaforthianum*	Brazilian nightshade	V			+
Tiliaceae	*	*Triumfetta rhomboidea*	Chinese burr	S	+		
Ulmaceae		*Aphananthe philippensis*	rough-leaved elm	ST		+	+
Ulmaceae	*	*Celtis sinensis*	Chinese celtis	T		+	
Verbenaceae	*	*Lantana camara*	lantana	S		+	
Verbenaceae	*	*Verbena bonariensis*	purpletop	H	+		
Vitaceae		*Cayratia clematidea*	slender grape	V		+	

Notes:

* = exotic species

$^{+}$ = native non-indigenous species

Life form: T = tree; ST = Short tree; S = Shrub; G = Grass; H = Herb; R = Sedge, rush or lily; V = Vine; F = Fern; e = epiphytic; p = parasitic.

Appendix B

Fauna species recorded during the habitat assessment of Lot 332 on DP1158142 and Lots 130, 131, 132 and 133 on DP1139107

(13 April 2011)

Class	Taxon	Common Name
Aves	*Coturnix ypsilophora*	brown quail
Aves	*Gallinula tenebrosa*	dusky moorhen
Aves	*Egretta novaehollandiae*	white faced heron
Aves	*Tachybaptus novaehollandiae*	Australasian grebe
Aves	*Hirunxo neoxena*	welcome swallow
Aves	*Accipiter novaehollandiae*	grey goshawk
Aves	*Trichoglossus haematodus*	rainbow lorikeet
Aves	*Eudynamys scolopacea*	common koel
Aves	*Manorina melanocephala*	noisy miner
Aves	*Grallina cyanoleuca*	Australian magpie lark
Aves	*Coracina novaehollandiae*	black faced cuckoo-shrike
Aves	*Sphecotheres viridis*	figbird
Aves	*Gymnorhina tibicen*	Australian magpie
Aves	*Hirundo rustica*	welcome swallow
Reptila	*Physignathus lesuerii*	Eastern water dragon

Yeats Brisbane Pty Ltd

Level 1, 119 Melbourne Street

South Brisbane QLD 4101

Email: info@yeats.com.au