Travers
bushfire & ecology

FLORA AND FAUNA CONSTRAINTS ASSESSMENT

LOT 2 DP 533402
LOT 3 DP 230943
LOT 20 DP 214753
LOT 50 DP 751637
LOT 52 DP 1104504
LOTS 1, 2 & 3 DP 784300
LOT 75 DP 214752
LOT 20 DP 214753
LOT 44 DP 214755

OFF SPINKS ROAD & KURMOND ROAD, GLOSSODIA

SEPTEMBER 2009

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EXECUTIVE SUMMARY

This Flora and Fauna Constraints Assessment report has been prepared by *Travers bushfire & ecology* to identify the flora and fauna characteristics of 179.1ha of lands currently referred to as 'Jacaranda Park' and 'Analee' within the confines and accessed from Spinks Road and Kurmond Road, Glossodia.

The subject site, upon which development is proposed, includes Lot 2 DP 533402, Lot 3 DP 230943, Lot 20 DP 214753, Lot 50 DP 751637, Lot 52 DP 1104504, Lots 1, 2 & 3 DP 784300, Lot 75 DP 214752, Lot 20 DP 214753 and Lot 44 DP 214755, Glossodia. The proposal will refer to these combined lots as 'Jacaranda Ponds'. The Total Area of the lots is approximately 179 ha.

Recorded Threatened Species and Endangered Ecological Communities

The following threatened species and endangered ecological communities have been recorded onsite:-

- Three (3) threatened fauna species, East-coast Freetail-bat (*Micronomus norfolkensis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceansis*) and Large-footed Myotis (*Myotis macropus*) were recorded within the subject site; one threatened mollusc – Cumberland Plain Land Snail was previously recorded onsite by SKM (2009). Until such time the Cumberland Plain Land Snail records are verified by a mollusc specialist, the Cumberland Plain Snail records are potentially erroneous.

- One (1) threatened flora species, *Pimelea spicata* was recorded (by SKM) within or in close proximity to the subject site; and

- Two (2) endangered ecological communities, *Cumberland Plain Woodland and River-flat Eucalypt Forest on Coastal Floodplains* were recorded within or in close proximity to the subject site.

Ecological & Riparian Constraints

The key ecological and riparian constraints are 4-fold:-

- **The provision of riparian buffers** for each of the identified watercourses including the *Endangered Ecological Community – River-flat Eucalypt Forest on Coastal Floodplains* adjacent to Currency Creek. The watercourse forms part of an extended wildlife corridor network in the local region. The management of the watercourses will require significant rehabilitation works to meet DWE riparian management requirements. The Currency Creek riparian corridor contains most if not all of the remnant *River-flat Eucalypt Forest* found onsite (7.5 ha). Whilst the *River-flat Eucalypt Forest* is an endangered ecological community, it will be retained onsite within the riparian buffers. The proposed development of this site will not impact significantly on this community except for the provision of possible cross over points for site access. The total area of riparian buffer to be provided onsite is 13.2 ha for 2 watercourses.

- **The existing large basins** also form significant aquatic and waterbird habitat which provides roosting and foraging habitat for recorded Migratory Birds (White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Great Egret (*Ardea alba*) and Cattle Egret (*Ardea ibis*)) and threatened micro-chiropteran bats ((East-coast Freetail-bat

(*Micronomus norfolkensis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceansis*) and Large-footed Myotis (*Myotis macropus*)). It is expected that given the size of the water bodies, both will need to be retained to support the roosting and foraging of threatened and migratory species. The management of the water bodies would also require a vegetated buffer of approximately 20 m to protect the habitat within the water bodies.

- The ***Cumberland Plain Woodland*** onsite (*Cumberland Plain Woodland*) is preliminary listed as a Critically Endangered Ecological Community under the TSC Act, and is also listed as an Endangered Ecological Community under the EPBC Act. As *Cumberland Plain Woodland* has a preliminary listing as critically endangered, a maintain and improve outcome would need to be achieved for *Cumberland Plain Woodland,* with the exception of low condition vegetation. The current area of *Cumberland Plain Woodland* on site is 18.4 ha. Subject to a detailed vegetation condition assessment and flora quadrat analysis, *Cumberland Plain Woodland* may be removed if it is considered to be in a 'low condition'. The removal of the *Cumberland Plain Woodland* is likely to trigger a significant impact requiring offsetting as a protection and or a restoration offset. Vegetation of a moderate or high condition generally needs to be retained onsite. Any removal of Cumberland Plain Woodland would require a minimum offset ratio of 3:1.

- ***Provision of wildlife corridors*** to link remnant *Cumberland Plain Woodland* onsite and Currency Creek with vegetation to the north of the site. The respective authorities of Hawkesbury Council, DECC and DEWHA will require consideration to the provision of wildlife corridors onsite. These corridors would generally be expected to link existing watercourses and to enhance the connectivity of existing remnants onsite.

Ecological Assessments Required

Besides an assessment of the significance of potential impacts under the EPA Act for DA submission purposes, the proposed development would require referral to the commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) and assessment under the EPBC Act.

The project will attract significant assessment attention given the 'critical status' of the *Cumberland Plain Woodland* onsite and clearly a well thought out vegetation management strategy will be required.

A full set of documentation will be required including:-

- Flora and Fauna Assessment report including 7 part test;
- A referral to DEWHA for assessment under the EPBC Act;
- Vegetation Management Plan;
- Habitat Tree Assessment;
- Tree Condition Assessment;
- GTA's and Controlled Activity Approval from NSW DWE; and
- Fisheries Permit Application from NSW DPI - Fisheries

The preparation of these reports will need to be integrated with other consultancy reports such as a Bushfire Protection Assessment.

In respect of matters required to be considered under the *Environmental Planning & Assessment Act* (1979) and relating to the species / provisions of the *Threatened Species*

Conservation Act (1995), three (3) threatened fauna species East-coast Freetail-bat (*Micronomus norfolkensis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceansis*) and Large-footed Myotis (*Myotis macropus*) were recorded within the subject site during surveys. One (1) threatened flora species *Pimelea spicata* (recorded by SKM) and two (2) endangered ecological communities *Cumberland Plain Woodland* & River-flat Eucalypt Forest were recorded within or in close proximity to the subject site.

In accordance with Section 5A of the EP&A Act, a 7 part test of significance assessment would be required following the preparation of a proposed development layout to determine if such a proposal will have a significant impact on any threatened species, populations or endangered ecological communities under the provisions of the TSC Act (1995). This assessment will determine if a Species Impact Statement should be required for the proposed development.

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act* (1999), no threatened fauna species, one (1) threatened flora species *Pimelea spicata*, and one endangered ecological communities *Cumberland Plain Woodland* listed under this Act were recorded within or in close proximity the subject site. Three (3) protected migratory bird species of national significance listed under this Act White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Great Egret (*Ardea alba*) and Cattle Egret (*Ardea ibis*) were recorded within the subject site.

In respect of matters relative to the *Fisheries Management Act 1994*, the proposed activity is not located in an area identified as critical habitat. It is expected that there will not be a significant detrimental effect on water quality, water quantity or any direct / indirect impacts upon threatened fish species habitat from the proposed action. Given this, a Species Impact Statement should not be required for the proposed development in regard to fish species.

It is considered that the subject site provides potential habitat for the Macquarie Perch (*Macquaria austalasica*) and as such the proposed development should ensure that there is no detrimental effect on water quality, water quantity or any direct impacts upon threatened fish species habitat from the proposed action. The proposed activity is not located in an area identified as critical habitat under the *Fisheries Management Act* (1994).

Proposed Vegetation Management Strategy

We have prepared a series of figures which identifies the existing flora and fauna constraints onsite, the condition of the remnant vegetation and ecological constraints and opportunities. A potential vegetation management strategy is discussed below that promotes vegetative connectivity and potentially offsets partial removal of EEC vegetation onsite.

The importance of the vegetation management strategy is to maximise the retention of medium and high quality vegetation onsite which needs to be retained under current government policy, and to connect remnants to ecologically support the native vegetation and threatened species habitat in the long term. Based on a preliminary vegetation condition assessment, only 0.7 ha of low condition vegetation onsite can be removed. A more detailed condition assessment is required to refine the total area of low condition vegetation onsite.

The Vegetation Management Strategy has 4 components:-

- Protection of existing *Cumberland Plain Woodland i*n either a wildlife corridor or retained vegetation and within lot habitat - total area of existing *Cumberland Plain Woodland* – 18.4 ha;
- If required, offset any removed *Cumberland Plain Woodland* by providing a protection offset and or high quality restoration outcome – Offset Ratio of 3:1; estimated total

area of retained and restored onsite *Cumberland Plain Woodland* – 32 ha (This figure is subject to the development design and the impacts on existing vegetation and agreement by the assessing authority);

- Protection and restoration of *River-flat Eucalypt Forest* within the designated riparian corridors – Total area of *River-flat Eucalypt Forest on Coastal Floodplains* will potentially increase from 7.45 ha to 13 ha; and
- Protection of the roosting and foraging habitat of recorded threatened & migratory fauna within two major waterbird reserves – total area 6.5 ha.

Based on an offset analysis the optimum conservation area to achieve onsite would be in the order of 52 ha. This conservation area accounts for the removal of up to 7 ha of existing *Cumberland Plain Woodland* to be theoretically removed or modified for development purposes. A total area of 13 ha of *River-flat Eucalypt Forest* can be provided along Currency Creek within a 50m riparian buffer and 6.5 ha of waterbird habitat on the two major water bodies. An estimated total area of 51.9 ha of the existing site would be used for conservation purposes, which includes the two existing large water bodies, the riparian corridor, vegetated corridors and retained vegetation. The total area required for offsets is subject to the degree of impact of the proposed layout on the existing vegetation.

Vegetation Management Strategy	**Area**
Existing *Cumberland Plain Woodland*	18.4 ha
Allowance for removal of *Cumberland Plain Woodland*	7 ha
Restoration offset of *Cumberland Plain Woodland* - 3:1 ratio	21 ha
Total Conservation Area *Cumberland Plain Woodland*	**32.4 ha**
Existing Area of River-flat Eucalypt Forest	7.45 ha
Total Area of Riparian Buffer	13 ha
Total Conservation Area of *River-flat Eucalypt Forest*	**13 ha**
Total Area of Conserved Waterbird habitat	**6.5 ha**
Total Conservation Area	**51.9 ha**

Figure 3 highlights those areas perceived as potential corridors to enable retention of Cumberland Plain Woodland remnants insitu and areas to restore and rehabilitate as part of an onsite offset for the loss of other remnants. These potential corridors will aim to link remnant bushland patches with vegetation outside of the site from the north and north-east along the western boundary to the riparian corridor on the southern boundary. A second eastern corridor further enhances the vegetative connectivity of the site.

The provision of vegetated corridors is seen by the NSW DECC, Hawkesbury Council and DEWHA (commonwealth) as an important strategy to overcome restricted movement corridors for wildlife that require movement to expand their available foraging resources and to migrate in the event of progressive climate change. The proposed wildlife corridor aims to link external remnants surrounding the site with the existing riparian corridors. This means that a vegetated link can potentially be provided between the Currency Creek Catchment to the south and the Howes Creek Catchment to the north.

The existing vegetation is generally found in discontinuous clumps on either side of the north-western ridgeline. Whilst there have been significant amounts of vegetation removed within and surrounding these remnants, they have a high level of natural resilience and will regenerate quickly if grazing pressures are removed. Weed management would be required to promote a natural condition.

The proposed corridors cover an area of 22 ha which includes a large portion of the existing *Cumberland Plain Woodland.* Figure 3 shows two (2) corridors providing connectivity across the site. The first corridor has been placed on the northern side of the existing ridge to take advantage of existing native vegetation on adjoining lots to the north of the site. Connectivity is provided to the northern and western boundaries with a minimum width of 70m. The second corridor is 50m in width and links the northern and southern boundaries of the site taking advantage of existing *Cumberland Plain Woodland* remnants in the eastern portion of the site.

Note: - The restoration of *Cumberland Plain Woodland* adjacent to Currency Creek is not viable due to the unsuitability of the land for regeneration of this vegetation type. Consequently a vegetated corridor that takes advantage of the upper slopes enables the restoration of *Cumberland Plain Woodland.* These corridors would also attract asset protection zones that would impact into the developable area.

As shown on Figure 3 an additional 7 ha may also need to be protected insitu in the form of retained vegetation or within-lot habitat on large lots. The replacement of *Cumberland Plain Woodland* with *River-flat Eucalypt Forest* is also not viable due to the DECC policy of replacing 'like with like'. Now that *Cumberland Plain Woodland* is preliminary listed as Critically Endangered, this policy is likely to be enforced on this site.

Conclusion

It is concluded that any proposed development for the lots incorporated into the *Jacaranda Ponds* landscape would be constrained by the presence of the following ecological features:

- **Two (2) large dams** providing high quality aquatic habitat for a diversity of bird species including waterfowl, waders and migratory species of national significance. These habitats also have potential to be utilised seasonally by listed threatened species. The surrounding foreshore area of the dams will need to be protected by a minimum natural habitat buffer of 20m for the restoration of fringing vegetation, roosting and foraging habitat.

- **Two (2) endangered ecological communities** – *Cumberland Plain Woodland* and *River-flat Eucalypt Forest on Coastal Floodplains* were recorded. It is likely that the *River-flat Eucalypt Forest on Coastal Floodplains* along Currency Creek will be fully retained due to riparian constraints imposed by DWE. Due to the preliminary critical habitat status listing for the *Endangered Ecological Community - Cumberland Plain Woodland,* the proponent will have to demonstrate an outcome which would achieve a no net loss of *Cumberland Plain Woodland.* Any removal of *Cumberland Plain Woodland* could be considered a significant impact requiring a protection offset and or a restoration offset at a minimum ratio of 3:1.

- **Hollow-bearing trees** providing suitable habitat for recorded threatened micro-chiropteran bats and other hollow-dependent species. A detailed hollow-bearing tree assessment based on land surveyed trees should be undertaken to determine actual locations and densities of hollows present. Planning provisions should retain representatives of mixed size classes of hollows within and in close proximity to medium and high quality vegetation remnants, water resources and connected vegetation. The assessment would involve gathering the data on all hollow-bearing trees across the site including the size, density and number of hollows, as well as the presence of fauna occupation if applicable. Stag-watching for threatened fauna species may be required on high quality habitat trees.

- **Riparian Buffers** for the existing watercourses onsite including Currency Creek on the southern boundary (Class 1 Watercourse – Environmental Corridor), and one (1) minor unnamed watercourse located in the north western corner of the site (Class 3 – Water quality and Stream Protection). The Environmental Corridor attracts a riparian buffer width of 50m not inclusive of the channel width. The Class 3 watercourse attracts a riparian buffer of 10m from top of bank.

Based on the proposed preliminary vegetation management strategy (as illustrated on Figure 3) and subject to the potential development design, approximately 52 ha of land would need to be set aside for conservation purposes including the proposed wildlife corridors, riparian buffers, dams and associated buffers, and pockets of retained native vegetation.

These ecological constraints when taken into consideration will limit the amount of potential development, however land outside of the constrained bushland remnants, existing large dams and riparian corridors are considered suitable for development provided actions are in place to reduce and minimise environmental risks to those sensitive areas.

Recommendations

The following recommendations are made in order to promote an ecologically sustainable approach to the management of the site and to ensure that adequate land area is set aside for conservation purposes.

- To adopt a Vegetation Management Strategy that conserves as much of the existing vegetation as possible, offsets the loss of significant vegetation in the form of wildlife corridors, riparian corridors, retained vegetation and waterbird reserves (Figure 3). Section 6.2 of the report details such strategies.
- Ongoing ecological site management of the site would need to be firmly incorporated within the sites development layout and managed in the form of a Vegetation Management Plan. Ecological site management would need to include restoration of native vegetation within the proposed riparian corridor, the two wildlife corridors, within and adjoining the two large dams to be retained onsite and within natural retained vegetation. Restoration works will need to specifically restore *Cumberland Plain Woodland* and *River-flat Eucalypt Forest* vegetation communities' onsite.
- In regard to the Cumberland Plain Land Snail (*Meridolum corneovirens*); this species was recorded by SKM within remnants of *Cumberland Plain Woodland,* being its typical host community. Whilst there are records of Cumberland Plain Land Snail in the locality, Glossodia is considered to be on the extremity of the known range of Cumberland Plain Snail. The site is within the known range of *Pommerhelix sp.*, another snail of similar appearance and closely related, however the two species are not typically found in sympatry (together) with Cumberland Plain Land Snail. A further targeted search in more appropriated conditions (during and following rain) is recommended to provide a conclusive assessment for this species. The presence of Cumberland Plain land Snail within a remnant patch of vegetation would result in full protection of that remnant and the need to provide vegetated connectivity to support the population.
- A comprehensive assessment of hollow bearing trees will be required to identify the potential impact of the proposed development on threatened hollow dependent threatened species for the Section 5A assessment of the EPA Act - 7 part test.
- Stormwater management of the site will need to achieve a maintain or improve outcome in the management of water quality onsite. Given the migratory and

threatened fauna habitat value of the two existing main dams onsite, the dams to be retained should not be seen as water quality or quantity treatment systems even though they will contribute to water quality and retention onsite. A general Improvement in water quality would need to be achieved prior to the delivery of water into the two main dams.

Suitability of the site for development options is dependent on an iterative design process. However large portions of the site (approximately 127 ha) are ecologically unconstrained due to the lack of native vegetation (Figure 3).

The existing vegetation onsite has largely a medium to high quality condition classification and consequently large portions of the site's vegetation will need to be retained. A rigorous vegetation condition assessment based on the Biometric method would need to be undertaken to support the removal of any low quality stands of vegetation.

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Licences

Individual staff members are licensed under Clause 20 of the *National Parks and Wildlife (Land Management) Regulation 1995* and Section 120 & 131 of the *National Parks and Wildlife Act, 1974* to conduct flora and fauna surveys within service and non-service areas. NPWS Scientific Licence Numbers: S10359.

The staff of *Travers bushfire & ecology* are licensed under an Animal Research Authority issued by the Department of Agriculture. This authority allows *Travers bushfire & ecology* staff to conduct various fauna surveys of native and introduced fauna for the purposes of environmental consulting throughout New South Wales.

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Travers bushfire & ecology have been engaged by *EG Property Group* to carry out a Flora and Fauna Assessment within Lot 2 DP 533402, Lot 3 DP 230943, Lot 20 DP 214753, Lot 50 DP 751637, Lot 52 DP 1104504, Lots 1, 2 & 3 DP 784300, Lot 75 DP 214752, Lot 20 DP 214753 and Lot 44 DP 214755, Glossodia. The proposal will refer to these combined lots as 'Jacaranda Ponds'.

Figure 1 provides an aerial appraisal of *Jacaranda Ponds* and the ecological survey effort undertaken.

Figure 2 provides a preliminary assessment of vegetation condition that is subject to detailed vegetation quadrat analysis.

Figure 3 shows the location of the identified constraint ecological and riparian constraints; threatened species, endangered ecological communities, habitat features and a recommended corridor strategy.

1.1 Aims of the assessment

The aims of the flora & fauna constraints assessment are to:

- Carry out a botanical survey to describe the vegetation communities and their condition in accordance with the guidelines adopted by Hawkesbury Council;
- Carry out a fauna survey for the detection and assessment of fauna and their habitats in accordance with the guidelines adopted by Hawkesbury Council;
- Complete target surveys for threatened species, populations and ecological communities;
- Assess the conservation value of the site; and
- Identify potential flora and fauna constraints in accordance with the requirements of the *Environment Protection and Biodiversity Conservation Act 1999,* the *Threatened Species Conservation Act 1995,* the *Fisheries Management Act 1994* and guidelines issued by the National Parks and Wildlife Service.

1.2 Information collation

A review of the relevant information pertinent to the subject site was undertaken prior to the initiation of field surveys as background to the study. Information sources reviewed include the following documents.

Client documents including:

- Preliminary mapping by SKM including ecological and flooding constraints

Standard Technical Resources

- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (working draft) *(Department of Environment and Conservation (2004))*

- Aerial photographs (scale 1:25,000) and Topographical maps (scale 1:25,000)
- *Atlas of NSW Wildlife* (DECC, 2009) 1:100,000 scale map sheet
- The schedules of the *Threatened Species Conservation Act, 1995*
- The schedules of the *Fisheries Management Act, 1994*
- Lists of threatened species and communities in the *Environmental Protection and Biodiversity Act 1999*
- Rare or Threatened Australian Plants (ROTAP)
- Vegetation mapping of the Cumberland Plain (2003)

1.3 Statutory requirements

1.3.1 Threatened Species Conservation Act (1995)

The specific requirements of the *Threatened Species Conservation (TSC) Act* (1995) must be addressed in the assessment of flora and fauna matters. This requires the consideration of potential impacts on threatened species, populations and ecological communities. The factors to be taken into account in deciding whether there is a significant effect are set out in Section 5A of the *Environmental Planning & Assessment (EP&A) Act* (1979) and are based on a 7 part test of significance. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

1.3.2 Fisheries Management Act (1994)

The Fisheries Management Act (1994) provides a list of threatened aquatic species, which require consideration when addressing the potential impacts of a proposed development. Where a proposed activity is located in an area identified as critical habitat, or such that it is likely to significantly affect threatened species, populations, ecological communities, or their habitats, a Species Impact Statement (SIS) is required to be prepared.

1.3.3 Environment Protection and Biodiversity Conservation (EPBC) Act (1999)

The *Environmental Planning and Biodiversity Conservation Act* requires that Commonwealth approval be obtained for certain actions. The Act provides an assessment and approvals system for actions that have a significant impact on matters of national environmental significance (NES). These may include:

- World Heritage Properties and National Heritage Places
- Wetlands of International Importance protected by international treaty
- Nationally listed threatened species and ecological communities
- Nationally listed migratory species
- Commonwealth marine environment

Actions are projects, developments, undertakings, activities, and series of activities or alteration of any of these. An action that needs Commonwealth approval is known as a controlled action. A controlled action needs approval where the Commonwealth decides the action would have a significant effect on a NES matter.

Where a proposed activity is located in an area identified to be of NES, or such that it is likely to significantly affect threatened species, ecological communities, migratory species or their habitats then the matter needs to be referred to *Department of the Environment, Water, Heritage & the Arts* for assessment. In the case where no listed federal species are located

on site then no referral is required. The onus is on the proponent to make the application and not the Hawkesbury Council to make any referral.

A significant impact is regarded as being:

> *'Important, notable, or of consequence, having regard to its context or intensity' and depends upon the sensitivity, value, and quality of the environment which is impacted and upon the duration, magnitude, and geographical extent of the impacts. A significant impact is likely when it is a real or not a remote chance or possibility.*
>
> *Source EPBC Policy Statement '.*

Guidelines on the correct interpretation of the actions and assessment of significance are located on the department's web site *http://WWW.envionment.gov.au/epbc/publications*.

1.4 Development concept

The proposed development layout is yet to be finalised however a general subdivision of the existing land is proposed into approximately 1ha allotments.

1.5 Site description

The planning and cadastral details of the subject site are provided in Table 1.1 while Table 1.2 summarises the geographical characteristics of the site.

Table 1.1 - Site details

Location	Lot 2 DP 533402, Lot 3 DP 230943, Lot 20 DP 214753, Lot 50 DP 751637, Lot 52 DP 1104504, Lots 1, 2 & 3 DP 784300, Lot 75 DP 214752, Lot 20 DP 214753 and Lot 44 DP 214755, Glossodia. The proposal will refer to these combined lots as 'Jacaranda Ponds'.
Description of Location	Bound by Currency Creek to the south and the rural residential township of Glossodia to the north, approximately 6km north of the township of Richmond.
Area	Approximately 179ha
Topographic Map	Wilberforce 1:25,000
Grid Reference	292500E and 6286400N
Local Government Area	Hawkesbury
Existing Land Use	Chicken and egg processing plant, pastoral lands and rural properties
Proposed Development	Unknown – likely to be 1ha rural residential allotments

Table 1.2 - Site characteristics

Elevation	Approximately 25-75m AHD
Topography	Situated on gentle slopes, mostly less than 5% gradients
Aspect	Various
Geology and Soils	Wianamatta Group Geology (Ashfield Shale) with clay-silt soils
Catchment	Hawkesbury River
Drainage	Southern portion of the site drains into Currency Creek. The northern portion drains into tributaries off Howes Creek.
Vegetation	Cleared paddocks with scattered trees – mostly *E. crebra* and *E. tereticornis*; remnant patches of vegetation in various conditions scattered throughout the site; riparian vegetation along Currency Creek.

The subject site has been affected by the following impacts:

Table 1.3 – Site Disturbance

Clearing	Approximately 85% of the subject site is cleared vegetation for paddocks or has been underscrubbed and managed
Agriculture / Pastoral	Some paddocks are currently grazed by cattle and horses. Existing chicken sheds in several locations onsite.
Earthworks	Roadworks; cut and fill for roads, drainage and housing; two large water storages and several minor dams
Introduced Weeds	Within the bushland areas there is a moderate incursion of weeds, mostly grasses and annuals with Lantana, Moth Vine and Bridal Creeper.
Evidence of Feral, Introduced or Domestic fauna	Native fauna species present are likely to be impacted upon by recorded exotic species such as Black Rat, Dogs, Cattle, Fox, Rabbits, Horses, Common Mynas, Common Starlings, Red-whiskered Bulbul, Junglefowl and Spotted Turtle-doves.



2.1 Background

It is important to note that field survey data collected during the survey period is representative of species occurring within the subject site for that occasion. Due to effects of fire, breeding cycles, migratory patterns, camouflage, weather conditions, time of day, visibility, predatory and / or feeding patterns, increased species frequency or richness may be observed within the subject site outside the nominated survey period. Habitat assessments based on the identification of micro-habitat features for various species of interest, including regionally significant and threatened species, has been used to overcome this survey limitation.

2.2 Survey techniques

To determine the likely and actual occurrence of flora species, fauna species and plant communities on the subject site a variety of assessments were undertaken to supplement previous surveys of the area and literature reviews. The methods utilised included:

- ***Literature Review*** - A review of readily available literature for the area was undertaken to obtain reference material and background information for this survey.

- ***Data Search*** - A search of the Atlas of NSW Wildlife (DECC, 2009) was undertaken to identify records of threatened flora & fauna species located within a 10km radius of the site. This enabled the preparation of a list of threatened flora and fauna species that could potentially occur within the habitats found on the site (Tables 4.1 & 4.3).

- ***Aerial Photograph Interpretation*** - Aerial photographs at 1:25,000 scale were utilised to identify the extent of vegetation with respect to the site and surrounding areas.

- ***Accuracy of Identification*** - Specimens of plants not readily discernible in the field were collected for identification. Structural descriptions of the vegetation were made according to Specht *et. al.* (1995). Scat and hair samples collected are sent to Barbara Triggs for identification. Mollusc sample are sent to Michael Shea of the Malacology Section at the Australian Museum.

- ***Landscape Assessment*** – The site was inspected to assess presence or absence of watercourses, terrestrial connectivity, aquatic habitat, insitu habitat and peripheral land use and connectivity. Flora and fauna survey was also conducted onsite for the purposes of identify the site's vegetation and extent, and the presence of threatened species and endangered ecological communities.

2.3 Fauna survey methodology

2.3.1 Diurnal birds

Visual observation and call identification of birds was carried out during visits to the site.

Opportunistic bird counts are also made while undertaking other survey work and during spotlight surveys of the site.

Birds were observed and identified using handheld binoculars. Calls were generally identified in the field by the observer. If an unknown call was heard it is recorded and identified using reference libraries.

2.3.2 Nocturnal birds

The presence of Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*) were targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Each call was played for 5-minute periods with 5-minute quiet listening for response intervals. This was followed with quiet listening and spotlighting. Call-playback stations are provided in Figure 1. Call-playback for the two threatened bitterns was only undertaken adjacent to Currency Creek.

Searches for evidence of owl roosts and potential owl roosting / breeding hollows were made during surveys of the subject site. Any whitewash, or regurgitated pellets found were noted.

2.3.3 Arboreal and terrestrial mammals

Hair tubes were used to survey for arboreal and terrestrial mammals. Hair tube transects were placed in areas of connective habitat and larger remnants with representations in each remnant community present.

Five (5) hair tube transect lines were placed from August 3rd to August 11th 2009. Each transect consisted of five trap stations. Stations were selected using generally 10-25 metre separations based on the most suitable trees and terrestrial habitat available along 80-100m transects. One large arboreal, one large terrestrial and one small terrestrial hair tube were placed at each station amounting to a total of 40 arboreal and 80 terrestrial hair tube nights.

All hair tubes were baited with a mixture of rolled oats, honey and peanut butter. Large terrestrial hair tubes were also baited with Sardines to target Spotted-tailed Quoll (*Dasyurus maculatus*). Arboreal hair tubes were placed on the lower trunk of selected trees facing downwards to prevent water entry. A mixture of honey and water was then sprayed onto the trunk up to 5-8 metres above the arboreal tube as a lure.

Double-sided tape was attached around the entry of tubes so hair samples of animals entering the tube were collected. Hair samples collected were sent to Barbara Triggs for identification.

Spotlighting within the subject site

Spotlighting for nocturnal mammalian fauna was carried out using a hand held lamp of 750,000 candlelight power (100W halogen globe). This technique involved walking amongst the woodland areas and around the fringes of remnants within the subject site so that a maximum number of trees could be observed.

Call-playback techniques for nocturnal mammals

The presence of Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) were targeted by broadcasting taped calls through a 15 watt Toa 'Faunatech' amplifier. Calls were played for 5-minute periods during nocturnal surveys. This was followed by quiet listening and spotlighting. Call-playback stations are provided in Figure 1.

Secondary indications within the subject site

Assessment was made of 'found' scats, markings, diggings, runways and scratches during visits to the site. Any scats or pellets not readily identifiable are collected and sent to expert Barbara Triggs for identification of contents, hair or bone fragments. Habitat was also assessed to determine the likelihood of threatened native species of fauna occurring within the subject site.

Koala Assessment

The subject area was assessed for activity by Koalas using the following method:

i. A search of the Atlas of NSW Wildlife (DECC 2009) databases.

ii. The site was surveyed on foot, with known Koala food trees being inspected for signs of use. Trees were inspected for characteristic scratch and claw marks on the trunk and scats around the base of each tree. The proportion of trees showing signs of Koala use was calculated. Additionally the location and density of droppings if found were documented.

iii. Koalas were also targeted during spotlight surveys.

iv. Identification and an assessment of the density of tree species listed as Koala feed trees in State Environmental Protection Policy No. 44 - Koala Habitat Protection was undertaken across the site. An estimate of the percentage density of each tree species across the site was determined by averaging the percentage of stems counted.

2.3.4 Bats

Micro-chiropteran bats were surveyed by echolocation using Anabat Mk 2 and SD-1 detectors in fixed passive monitoring positions throughout the subject site. Bat call recordings were interpreted through Anabat V and Anabat CF Storage and Interface Module ZCAIM devices and analysed using Anabat 6 and Analook 3.3q computer software packages.

Anabat station locations are provided in Figure 1.

Mega-chiropteran bat species, such as Grey-headed Flying-fox (*Pteropus poliocephalus*), were surveyed by targeting flowering / fruiting trees during spotlighting activities.

2.3.5 Amphibians

Amphibians were surveyed by vocal call identification, spotlighting and opportunistically by driving along sealed roads near waterways. A tape recorder was used to record male calls where site identification was not possible and then later comparing these to known calls from a reference library.

Combined habitat searches for amphibians were also undertaken within the Cumberland Plain Land Snail search areas indicated on Figure 1.

Any amphibians found are visually identified and when required to be examined are handled with Latex gloves and kept moist until release. Any tadpoles requiring capture are collected with a scoop net and placed within a snaplock clear plastic bag for analysis of colour and morphological features.

2.3.6 Reptiles

Searches for reptiles in likely localities such as under logs, rubbish debris, and in deep leaf litter were carried out during diurnal visits to the site. Combined habitat searches for reptiles were also undertaken within the Cumberland Plain Land Snail search areas indicated on Figure 1. Opportunistic observations are often made whilst undertaking other survey techniques.

2.3.7 Invertebrates

Given the proximity to previous Atlas of NSW Wildlife Database records of Cumberland Plain Land Snail (*Meridolum corneovirens*), the previous recordings of this species within the subject site by SKM (2009) and the recorded presence of its typical host community, target surveys were undertaken. Searches were undertaken within each of the twelve (12) fauna habitat assessment quadrats (20x50m) undertaken as well as areas radiating out from these where appropriate. Search areas are provided on Figure 1. Within search areas the most appropriate areas of observed habitat were targeted. Dense areas of leaf litter with likely moisture retaining properties were scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks were also turned over.

The top (spiral side), side (showing aperture) and underside (showing umbilicus) of snail specimens found were photographed and sent to Michael Shea of the Australian Museum Malacology Unit for confirmation of identification.

2.3.8 Habitat Trees

A detailed hollow-bearing tree survey was not undertaken as part of surveys conducted. Given the presence of hollow-dependent threatened microchiropteran bat species, locations of obvious hollow-bearing trees were noted in the field on maps whilst conducting other survey activities.

Based on opportunistic sitings, the location of significant hollow-bearing trees is shown on Figure 3. Note a full habitat tree assessment will identify further hollow bearing trees of varying quality within and outside of existing vegetated areas.

Field Survey Method

Tables 2.1 and 2.2 below detail the flora and fauna survey effort undertaken for the subject site.

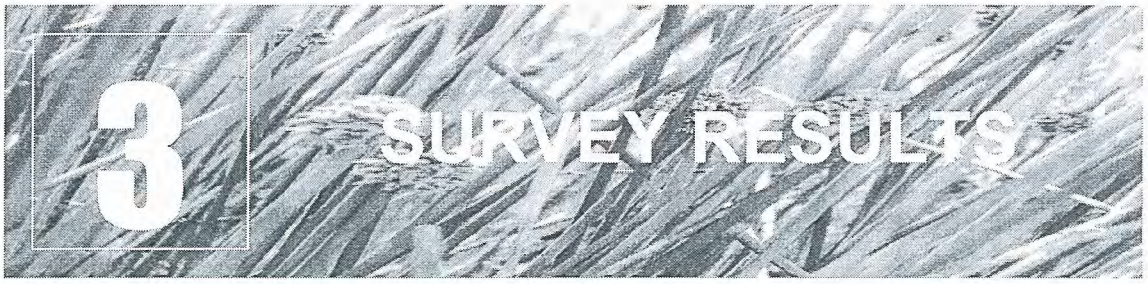
Table 2.1 – Flora survey methodology and dates

Flora Survey	Method	Dates
Vegetation Communities	GPS Survey of the boundaries of most vegetation communities	18/08/09
Stratified Sampling	20x20 metre quadrats in all existing vegetation communities	11/08/09 & 18/08/09
Target Searches	Target searches in known habitats	11/08/09 & 18/08/09

Table 2.2 – Fauna Survey Methodology and Dates

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
Diurnal Birds	3/08/09	3-1/8 cloud, no wind, no rain, temp 24-16°C	Diurnal Opportunistic	4hrs 30min 1300 - 1730
	11/08/09	8/8 cloud, no wind, showers, temp 11.5-17°C	Diurnal Opportunistic	8hrs 0930 - 1730
	19/08/09	0/8 cloud, no wind, no rain, temp 14-24°C	Diurnal Opportunistic	6hrs 5min 0855 - 1500
Nocturnal Birds	3/08/09	1/8 cloud, no wind, no rain, 4/4 moon temp 16-6°C	Call-playback (Powerful Owl, Masked Owl, Barking Owl, Bush Stone-curlew) & spotlighting	3hrs 45min 1800 - 2145
	11/08/09	8/8 cloud, no wind, early showers, late ¾ moon, temp 16-9°C	Call-playback (Powerful Owl, Masked Owl, Barking Owl, Bush Stone-curlew, Black Bittern, Australasian Bittern) & spotlighting	3hrs 25min 1810 - 2135
Arboreal Mammals	3/08/09	1/8 cloud, no wind, no rain, 4/4 moon temp 16-6°C	Spotlighting + Call playback (koala, Yellow-bellied Glider & Squirrel Glider)	3hrs 50min 1755 - 2145
	3-11/08/09	Various	Large Hair Tubes	40 trap nights
	11/08/09	8/8 cloud, no wind, early showers, late ¾ moon, temp 16-9°C	Spotlighting + Call playback (koala, Yellow-bellied Glider & Squirrel Glider)	3hrs 25min 1810 - 2135

Fauna Group	Date	Weather Conditions	Survey Method	Survey Effort/Time (24hr)
Terrestrial Mammals	3/08/09 3-11/08/09 11/08/09	1/8 cloud, no wind, no rain, 4/4 moon temp 16-6°C Various 8/8 cloud, no wind, early showers, late ¾ moon, temp 16-9°C	Spotlighting Large Hair Tubes Spotlighting	3hrs 50min 1755 - 2145 40 trap nights 3hrs 25min 1810 - 2135
Bats	3/08/09 11/08/09	1/8 cloud, no wind, no rain, 4/4 moon temp 16-6°C 8/8 cloud, no wind, early showers, late ¾ moon, temp 16-9°C	Anabat II & SD-1 / Spotlighting Anabat II x2 & SD-1 / Spotlighting	7hrs 30min 1705 - 2050 10hrs 15min 1710 - 2125
Reptiles	3/08/09 11/08/09 19/08/09	3-1/8 cloud, no wind, no rain, temp 24-16°C 8/8 cloud, no wind, showers, temp 11.5-17°C 0/8 cloud, no wind, no rain, temp 14-24°C	Habitat Searches, Opportunistic Habitat Searches, Opportunistic Habitat Searches, Opportunistic	4hrs 30min 1300 - 1730 8hrs 0930 - 1730 6hrs 5min 0855 - 1500
Amphibians	3/08/09 11/08/09 11/08/09 19/08/09	1/8 cloud, no wind, no rain, 4/4 moon temp 16-6°C 8/8 cloud, no wind, showers, temp 11.5-17°C 8/8 cloud, no wind, early showers, late ¾ moon, temp 16-9°C 0/8 cloud, no wind, no rain, temp 14-24°C	Spotlighting & Call Identification Habitat Searches Spotlighting & Call Identification Habitat Searches	3hrs 50min 1755 - 2145 8hrs 0930 - 1730 3hrs 25min 1810 - 2135 6hrs 5min 0855 - 1500



3.1 Flora results

Four (4) vegetation communities were identified within the subject site through aerial photographic interpretations and ground truthing. Note all vegetation community boundaries are mapped on the basis of GPS boundaries and aerial photographic interpretation. The exact location of vegetation should be based on verified land survey data.

- Pasture with Scattered Trees
- Open Forest (*E. tereticornis & A. floribunda*)
- Woodland (*E. crebra and E. tereticornis*)
- Water bodies with fringing Aquatic Herbfield

Further descriptions of the above communities are within section 4.

The plants observed within the vegetation communities of the subject site are listed in the Table 3.1 below.

Table 3.1 - Flora observations for the subject site

Family	Scientific Name	Common Name
TREES		
Mimosaceae	*Acacia parramattensis*	Sydney Green Wattle
Myrtaceae	*Angophora floribunda*	Rough-barked Apple
Casuarinaceae	*Casuarina cunninghamiana*	River Oak
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved Ironbark
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark
Myrtaceae	*Eucalyptus globoidea*	White Stringybark
Myrtaceae	*Eucalyptus moluccana*	Grey Box
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum
Proteaceae	*Grevillea robusta* (planted)*	Silky Oak
Bignoniaceae	*Jacaranda mimosifolia**	Jacaranda
Myrtaceae	*Melaleuca linariifolia*	Snow in Summer
Meliaceae	*Melia azedarach* var. *australasica*	White Cedar
Arecaceae	*Phoenix canariensis**	Canary Island Date Palm
SHRUBS		
Mimosaceae	*Acacia floribunda*	Sally Wattle
Mimosaceae	*Acacia implexa*	Hickory
Solanaceae	*Cestrum parqui**	Chilean Cestrum
Fabaceae	*Indigofera australis*	Native Indigo
Verbenaceae	*Lantana camara**	Lantana
Solanaceae	*Lycium ferocissimum**	African Boxthorn

Table 3.1 - Flora observations for the subject site

Family	Scientific Name	Common Name
Myrtaceae	*Melaleuca sieberi*	-
Asteraceae	*Ozothamnus diosmifolius*	Ball Everlasting
Euphorbiaceae	*Phyllanthus hirtellus*	Thyme Spurge
Phytolaccaceae	*Phytolacca octandra**	Inkweed
Thymelaeaceae	*Pimelea spicata*[TS]	Pink Pimelea
Rosaceae	*Rubus anglocandicans**	Blackberry
Rosaceae	*Rubus parvifolius*	Native Raspberry
Solanaceae	*Solanum mauritianum**	Wild Tobacco
Solanaceae	*Solanum pungetium*	Eastern Nightshade
Ulmaceae	*Trema tomentosa* var. *viridis*	Native Peach
GROUNDCOVERS		
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed
Asteraceae	*Ambrosia artemisifolia**	Annual Ragweed
Primulaceae	*Anagallis arvensis var. caerulea**	Blue Pimpernel
Primulaceae	*Anagallis arvensis**	Scarlet Pimpernel
Poaceae	*Andropogon virginicus**	Whisky Grass
Poaceae	*Anisopogon avenaceus*	Oat Speargrass
Poaceae	*Aristida ramosa*	Wire Grass
Poaceae	*Aristida vagans*	Three-awn Speargrass
Poaceae	*Austrodanthonia tenuior*	Wallaby Grass
Poaceae	*Austrostipa pubescens*	Tall Speargrass
Poaceae	*Axonopus fissifolius**	Narrow-leaf Carpet Grass
Asteraceae	*Bidens pilosa**	Cobbler's Pegs
Brassicaceae	*Brassica juncea**	Indian Mustard
Acanthaceae	*Brunoniella australis*	Blue Trumpet
Crassulaceae	*Bryophyllum delagoense**	Mother of Millions
Brassicaceae	*Capsella bursa-pastoris**	Shepherds Purse
Cyperaceae	*Carex inversa*	Knob Sedge
Gentianaceae	*Centaurium erythraea**	Pink Stars
Apiaceae	*Centella asiatica*	Swamp Pennywort
Carophyllaceae	*Cerastium glomeratum**	Mouse-ear Chickweed
Sinopteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	Poison Rock Fern
Poaceae	*Chloris gayana**	Rhodes Grass
Poaceae	*Chloris truncata*	Windmill Grass
Asteraceae	*Cirsium vulgare**	Spear Thistle
Commelinaceae	*Commelina cyanea*	Scurvy Weed
Asteraceae	*Conyza bonariensis**	Flax-leaf Fleabane
Asteraceae	*Conyza sumatrensis**	Fleabane
Apiaceae	*Cyclospermum leptophyllum**	Slender Celery
Poaceae	*Cymbopogon refractus*	Barbwire Grass
Poaceae	*Cynodon dactylon*	Common Couch
Cyperaceae	*Cyperus congestus**	-

Table 3.1 - Flora observations for the subject site

Family	Scientific Name	Common Name
Cyperaceae	*Cyperus sesquiflorus**	-
Solanaceae	*Datura ferox**	Fierce Thornapple
Convolvulaceae	*Dichondra repens*	Kidney Weed
Poaceae	*Digitaria parviflora*	Small-flowered Finger Grass
Poaceae	*Digitaria ramularis*	-
Blechnaceae	*Doodia aspera*	Rasp Fern
Chenopodiaceae	*Einadia hastata*	Berry Saltbush
Poaceae	*Entolasia marginata*	Bordered Panic
Poaceae	*Entolasia stricta*	Wiry Panic
Poaceae	*Eragrostis brownii*	Brown's Lovegrass
Poaceae	*Eragrostis curvula**	African Lovegrass
Asteraceae	*Erechtites valerianifolia**	Brazilian Fireweed
Rubiaceae	*Galium aparine**	Cleavers
Asteraceae	*Gamochaeta spicata**	Cudweed
Geraniaceae	*Geranium homeanum*	Northern Cranesbill
Geraniaceae	*Geranium sp.* (cultivar)*	Geranium
Asteraceae	*Hypochaeris radicata**	Flatweed
Juncaceae	*Juncus usitatus*	Common Rush
Lomandraceae	*Lomandra longifolia*	Spiky-headed Mat-rush
Marsileaceae	*Marsilea mutica*	-
Fabaceae	*Medicago arabica**	Spotted Burr Medic
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Rice Grass
Malvaceae	*Modiola caroliniana**	Red-flowered Mallow
Haloragaceae	*Myriophyllum aquaticum**	Brazilian Water Milfoil
Brassicaceae	*Nasturtium microphyllum**	Brown Watercress
Menyanthaceae	*Nymphaea caerulea* subsp. *zanzibarensis**	Cape Waterlily
Poaceae	*Oplismenus aemulus*	Basket Grass
Cactaceae	*Opuntia stricta**	Prickly Pear
Oxalidaceae	*Oxalis latifolia**	Pink Fishtail
Oxalidaceae	*Oxalis perrenans*	-
Poaceae	*Panicum effusum*	Hairy Panic
Poaceae	*Panicum maximum**	Guinea Grass
Poaceae	*Panicum simile*	Two Colour Panic
Poaceae	*Paspalum dilatatum**	Paspalum
Poaceae	*Paspalum urvillei**	Vasey Grass
Polygonaceae	*Persicaria praetermissa*	-
Philydraceae	*Philydrum lanuginosum*	Woolly Frogsmouth
Plantaginaceae	*Plantago lanceolata**	Ribwort
Poaceae	*Poa labillardieri* var. *labillardieri*	Tussock Grass
Lobeliaceae	*Pratia purpurascens*	Whiteroot
Acanthaceae	*Pseuderanthemum variabile*	Pastel Flower
Ranunculaceae	*Ranunculus inundatus*	River Buttercup
Ranunculaceae	*Ranunculus plebeius*	Hairy Buttercup

Table 3.1 - Flora observations for the subject site

Family	Scientific Name	Common Name
Polygonaceae	*Rumex crispus**	Curled Dock
Cyperaceae	*Schoenus imberbis*	-
Asteraceae	*Senecio madagascariensis**	Fireweed
Poaceae	*Setaria distans*	
Poaceae	*Setaria gracilis**	Slender Pigeon Grass
Malvaceae	*Sida rhombifolia**	Paddy's Lucerne
Asteraceae	*Sigesbeckia orientalis*	Indian Weed
Solanaceae	*Solanum nigrum**	Black Nightshade
Solanaceae	*Solanum prinophyllum*	Forest Nightshade
Asteraceae	*Soliva sessilis**	Jojo
Asteraceae	*Sonchus oleraceus**	Common Sow-thistle
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass
Asteraceae	*Taraxacum officinale**	Dandelion
Poaceae	*Themeda australis*	Kangaroo Grass
Commelinaceae	*Tradescantia fluminensis**	Wandering Jew
Fabaceae	*Trifolium repens**	White Clover
Juncaginaceae	*Triglochin microtuberosum (procerum)*	Water Ribbons
Typhaceae	*Typha orientalis*	Cumbungi
Urticaceae	*Urtica incisa*	Stinging Nettle
Scrophulariaceae	*Verbascum virgatum**	Twiggy Mullein
Verbenaceae	*Verbena bonariensis**	Purpletop
Verbenaceae	*Verbena rigida* var. *rigida**	Veined Verbena
Plantaginaceae	*Veronica plebeia*	Creeping Speedwell
Violaceae	*Viola hederacea*	Ivy-leaved Violet
VINES		
Apocnyaceae	*Araujia sericifera**	Mothvine
Asparagaceae	*Asparagus asparagoides**	Bridal Creeper
Ranunculaceae	*Clematis glycinoides* var. *glycinoides*	Clematis
Asteraceae	*Delairea odorata**	Cape Ivy
Fabaceae	*Desmodium varians*	-
Fabaceae	*Glycine clandestina*	Twining Glycine
Fabaceae	*Glycine microphylla*	-
Fabaceae	*Glycine tabacina*	Twining Glycine
Fabaceae	*Hardenbergia violacea*	False Sarsparilla
Oleaceae	*Jasminum polyanthum**	Jasmine
Bignoniaceae	*Pandorea pandorana*	Wonga Vine
Apocynaceae	*Parsonsia straminea*	Common Silkpod
Passifloraceae	*Passiflora edulis**	Common Passionfruit
Passifloraceae	*Passiflora herbertiana*	Native Passionfruit
Species name^{TS} = Threatened Species * = Introduced Species		

3.2 Fauna results

Fauna species observed throughout the duration of fauna surveys are listed in Table 3.2.

Table 3.2- Fauna observations for the study area

Common name	Scientific name	Method Observed
Birds		**August 2009**
Australasian Grebe	*Tachybaptus novaehollandiae*	O C
Australasian Shoveler	*Anas rhynchotis*	O
Australian Magpie	*Gymnorhina tibicen*	O C
Australian Pelican	*Pelecanus conspicillatus*	O C
Australian Raven	*Corvus coronoides*	O C
Bell Miner	*Manorina melanophrys*	O C
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O C
Black Swan	*Cygnus atratus*	O C
Black-shouldered Kite	*Elanus axillaris*	O C
Black-winged Stilt	*Himantopus himantopus*	O C
Brown Gerygone	*Gerygone mouki*	O C
Brown Goshawk	*Accipiter fasciatus*	O
Brown Quail	*Coturnix ypsilophora*	O C
Cattle Egret	*Ardea ibis*	O
Chestnut Teal	*Anas castanea*	O
Common Bronzewing	*Phaps chalcoptera*	O C
Common Myna *	*Acridotheres tristis*	O C
Common Starling *	*Sturnus vulgaris*	O C
Crested Shrike-tit	*Falcunculus frontatus*	O C
Double-barred Finch	*Taeniopygia bichenovii*	O C
Dusky Moorhen	*Gallinula tenebrosa*	O C
Dusky Woodswallow	*Artamus cyanopterus*	O C
Eastern Rosella	*Platycercus eximius*	O C
Eurasian Coot	*Fulica atra*	O C
Galah	*Cacatua roseicapilla*	O C
Great Cormorant	*Phalacrocorax carbo*	O C
Great Egret	*Ardea alba*	O
Grey Fantail	*Rhipidura fuliginosa*	O C
Grey Shrike-thrush	*Colluricincla harmonica*	O
Grey Teal	*Anas gracilis*	O
Hardhead	*Aythya australis*	O
Hoary-headed Grebe	*Poliocephalus poliocephalus*	O
Laughing Kookaburra	*Dacelo novaeguineae*	O C
Lewin's Honeyeater	*Meliphaga lewinii*	C
Little Corella	*Cacatua sanguinea*	O C
Little Pied Cormorant	*Phalacrocorax melanoleucos*	O
Magpie-lark	*Grallina cyanoleuca*	O C
Masked Lapwing	*Vanellus miles*	O C
Noisy Friarbird	*Philemon corniculatus*	O C
Noisy Miner	*Manorina melanocephala*	O C
Pacific Black Duck	*Anas superciliosa*	O C
Pallid Cuckoo	*Cululus pallidus*	O
Peaceful Dove	*Geopelia striata*	O C
Purple Swamphen	*Porphyrio porphyrio*	O C

Table 3.2- Fauna observations for the study area

Common name	Scientific name	Method Observed
Rainbow Lorikeet	*Trichoglossus haematodus*	O C
Red-browed Finch	*Neochmia temporalis*	O C
Red Junglefowl *	*Gallus gallus*	O C
Red-rumped Parrot	*Psephotus haematonotus*	O C
Red-whiskered Bulbul *	*Pycnonotus jocosus*	O C
Richard's Pipit	*Anthus novaeseelandiae*	O C
Rufous Whistler	*Pachycephala rufiventris*	O C
Satin Bowerbird	*Ptilonorhynchus violaceus*	O C
Scarlet Honeyeater	*Myzomela sanguinolenta*	C
Spotted Pardalote	*Pardalotus punctatus*	O C
Spotted Turtle-Dove *	*Streptopelia chinensis*	O C
Straw-necked Ibis	*Threskiornis spinicollis*	O
Striated Pardalote	*Pardalotus striatus*	O C
Sulphur Crested Cockatoo	*Cacatua galerita*	O C
Superb Fairy-wren	*Malurus cyaneus*	O C
Tree Martin	*Hirundo nigricans*	O C
Wedge-tailed Eagle	*Aquila audax*	O
Welcome Swallow	*Hirundo neoxena*	O
Whistling Kite	*Haliastur sphenurus*	O C
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	O C
White-faced Heron	*Egretta novaehollandiae*	O C
White-necked Heron	*Ardea pacifica*	O C
White-throated Treecreeper	*Cormobates leucophaeus*	O C
White-plumed Honeyeater	*Lichenostomus penicillatus*	O C
White-winged Chough	*Corcorax melanorhhamphos*	O
Willie Wagtail	*Rhipidura leucophrys*	O C
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	O C
Yellow Thornbill	*Acanthiza nana*	O C
Yellow-faced Honeyeater	*Lichenostomus chrysops*	O C
Mammals		
Black Rat *	*Rattus rattus*	S
Antechinus species	*Antechinus sp.*	Sc [PR]
Rat species	*Rattus sp.*	Sc [PR]
Cat (feral)*	*Felis cattus*	Sp Sc [PR]
Chocolate Wattled Bat	*Chalinolobus morio*	A
Common Brushtail Possum	*Trichosurus vulpecula*	Sp Sc [PR]
Common Ringtail Possum	*Pseudocheirus peregrinus*	Sp
Domesticated Cattle *	*Bos taurus*	O
Domesticated Dog *	*Canis familiaris*	O
Eastern Bentwing-bat [TS]	*Miniopterus schreibersii oceansis*	A
East Coast Freetail-bat [TS]	*Micronomus norfolkensis*	A
European Red Fox *	*Vulpes vulpes*	Sp
Gould's Wattled Bat	*Chalinolobus gouldii*	A
Horse *	*Equus caballus*	O
Large-footed Myotis [TS]	*Myotis macropus*	A
Rabbit *	*Oryctolagus cuniculus*	O
Swamp Rat	*Rattus lutreolus*	Sc
White-striped Mastiff-bat	*Austronomus australis*	A

Table 3.2- Fauna observations for the study area

Common name	Scientific name	Method Observed
Reptiles		
Eastern Water Dragon	*Physignathus lesueurii*	S
Grass Skink	*Lampropholis guichenoti*	O S
Red-Bellied Black Snake	*Pseudechis porphyriacus*	O
Amphibians		
Common Eastern Froglet	*Crinia signifera*	C
Dwarf Tree Frog	*Litoria fallax*	C
Striped Marsh Frog	*Limnodynastes peronii*	C
Whistling Tree Frog	*Litoria verreauxii*	C S
Mollusc		
Land Snail	*Pommerhelix cf bowdenae*	S
An exotic garden snail *	*Bradybaena similaris*	S

Note: * indicates introduced species
[TS] indicates threatened species

All species listed are identified to a high level of certainty unless otherwise noted as:

[PR] indicates species identified to a 'probable' level of certainty
[PO] indicates species identified to a 'possible level of certainty

A	-	Anabat II/SD-1	C	-	Call Identification
O	-	Observation	P	-	Call Playback Response
E	-	Trap (Elliott, cage, etc)	S	-	Habitat Search
Sp	-	Spotlight	Sc	-	Scat, Track or Sign Identification

Table 3.3- Habitat assessment quadrat data

Quadrat	No. of Trees with ollows	No. of Hollows			Fallen Logs (m)	Ground Hollows	Leaf Litter (% Area)	Leaf Density	Understorey Comments (particularly in consideration of Cumberland Plain Land Snail total available Habitat
		Small	Medium	Large					
1	-	-	-	-	5	-	4	0 - med	50% shrubby understorey, grassy cover
2	2	3	-	-	19	-	-	-	No shrub / midstorey layer, grassy understorey
3	1	-	-	1	1	-	6	0 - high	50% shrubby understorey, grassy cover
4	-	-	-	-	10	1 sml	5	0 - med	5% shrub understorey, grassy cover
5	-	-	-	-	10	2 med	15	0 - low	50% weed scrub, grassy remainder
6	2	1	1	-	-	-	-	-	Grass & low weed understorey
7	-	-	-	-	3	-	1	0 - low	Grass & 70% weed understorey
8	-	-	-	-	15	-	2	0 - low	60% shrubby understorey, weed under
9	-	-	-	-	34	-	30	0 - high	10% weed scrub, 30% litter, 60% grass
10	-	-	-	-	-	-	-	-	Dense weed understorey
11	2	2	-	-	26	-	5	0 - med	Grass & weed understorey
12	2	1	1	-	15	-	10	0 - high	60% shrubby understorey, grassy cover



4.1 Previous surveys reviewed

4.1.1 Cumberland Plain Vegetation Mapping (2002) and Tozer (2003)

An extensive vegetation mapping survey of the Cumberland Plain area of Western Sydney which suggests vegetation on site to be;

- Shale Plains Woodland (*Cumberland Plain Woodland*)
- Shale Sandstone Transition Forest (High sandstone influence) (SSTF)
- Alluvial Woodland (*River-flat Eucalypt Forest*)
- Western Sydney Dry Rainforest (WSDR)
- Cleared
- Undefined

Patches of WSDR were identified by the *Cumberland Plain Vegetation Mapping* along Currency Creek. Two (2) quadrats (number 12 and 13) were undertaken in the vicinity of this mapped vegetation unit with the result being that the indicator species for this community as presented by *Tozer 2003* were not present. The entire riparian corridor of Currency Creek was found to be moderately to highly representative of the EEC – *River-flat Eucalypt Forest on Coastal Floodplains.* The riparian corridor of Currency Creek was sampled via four (4) 20x20m quadrats and random meander, and the outer edge of the vegetation was recorded by *Trimble* GPS.

Various patches of remnant vegetation throughout *Jacaranda Ponds* were surveyed either via random meander searches or quadrat analysis. For the majority of patches greater than 1ha, a quadrat analysis was undertaken (shown on Figure 1). The *Cumberland Plain Vegetation Mapping* showed that these remnant patches were a mix of SSTF, *Cumberland Plain Woodland* and WSDR. It was instantly clear that WSDR did not occur as the dominant canopy and shrub layers were inconsistent with the key indicator species of this community. Working through *Tozer 2003,* the analysis of key indicator species was generally more in favour of *Cumberland Plain Woodland* however there was marginal difference to that of SSTF. The scientific committees final determinations were consulted which give a clearer indicator that the majority of non riparian remnants were in fact *Cumberland Plain Woodland* .

4.1.2 Preliminary analysis of Ecology Constraints prepared by Sinclair Knight Merz

The SKM advice was prepared with an associated site figure detailing constrained areas being affected by the following:

1) Threatened Flora & Fauna, primarily;
    - *Cumberland Plain Woodland* (*Cumberland Plain Woodland*)
    - River-flat Eucalypt Forest (mainly contained within the Currency Creek riparian corridor.

- Threatened flora, fauna and habitat features, shown as isolated occurrences based on preliminary field surveys

2) Estimated flood plain extent for the 1:100 yr local flood, estimated at 75m from the centreline of Currency Creek.

3) Riparian zones of Currency Creek (40m riparian corridor plus a 10m buffer on either side) and two small drainages exiting the site to the north and north-west (10m either side of the drainages).

4) Farm dams which provide moderate ecological value.

A total of one hundred and forty two (142) flora species were observed within the subject site during the survey. SKM identified *Pimelea spicata* (threatened species) within one remnant patch of *Cumberland Plain Woodland,* as shown on Figure 3.

4.1.3 Preliminary analysis of Flooding Constraints prepared by Sinclair Knight Merz

This letter was prepared with an associated site figure summarising the major flooding and related constraints as being:

1) Estimated 1:100 yr flood extent from Currency Creek
2) Large farm dams
3) A proposed stormwater wetland
4) Riparian corridors

The remainder of the site was considered unconstrained.

4.1.4 Riparian Assessment Report prepared by WorleyParsons

WorleyParsons reviewed the existing watercourse mapping by DWE and after site investigation reviewed and recommended the re-classification of watercourses. Currency Creek retained its Category 1 Status – Environmental Corridor and the north-western most watercourses were shortened and recommended for classification as Category 3 Watercourses – Water Quality and Stream Protection.

4.2 Flora species

A total of one hundred and forty two (142) flora species were observed within the subject site during the survey. All species recorded on site are listed in Table 3.1.

4.3 Vegetation communities

Four (4) vegetation communities were identified within the subject site through aerial photographic interpretations and extensive ground truthing.

- Pasture with Scattered Trees
- Open Forest (*E. tereticornis & A. floribunda*)
- Woodland (*E. crebra and E. tereticornis*)
- Water bodies with fringing Aquatic Herbfield

Pasture with Scattered Trees

This vegetation community resembles what would have been *Cumberland Plain Woodland* for most parts of the site. Riparian vegetation off Currency Creek prior to vegetation clearance would have extended further within the site. Remnant tree species within this community are almost entirely *E. crebra* or *E. tereticornis* and form canopy coverage of less than 1%. The shrub layer has been removed except for some very small patches or individuals of *Bursaria spinosa.* The understorey vegetation is regularly maintained by slashing and grazing and comprises mostly of native and lawn grasses with a moderate incursion of annual weeds.



Photo 1 – An example of the pasture with scattered trees vegetation within the southern portion of the subject site looking east, parallel to the remnant River-flat Eucalypt Forest. The trees are sparse comprising mostly E. tereticornis with occasional E. crebra.

Open Forest (*E. tereticornis & A. floribunda*)

This vegetation community occurs primarily along the southern boundary of *Jacaranda Ponds* in association with Currency Creek riparian corridor. The quadrat analysis suggests that this vegetation is the endangered ecological community *River-flat Eucalypt Forest on Coastal Floodplains.*



Photo 2 – One of the bends in Currency Creek with River-flat Eucalypt Forest adjacent; close to quadrat 12.

The canopy species comprises of mostly *E. tereticornis & A. floribunda* with an approximate height of 20-30m and canopy coverage of 30%. The coverage rate decreases significantly west of the current entry road to the site, and there is a higher influence of *Melaleuca linariifolia*.

The upper-mid storey contained a dominance of *Acacia parramattensis.* The average coverage of the shrub layer was 15-30%, but deteriorates west of the current entry road to the site during to grazing activities.

The understorey vegetation is comprised of numerous herbs and grasses, the more common species include *Microlaena stipoides, Cynodon dactylon, Pratia purpurascens, Oxalis perennans, Lomdandra longifolia* and *Glycine clandestina.*

Woodland (E. crebra and E. tereticornis)

The dominant canopy species are *E. crebra* and *E. tereticornis* with a projected foliage cover on average between 15-25%. The shrub layer was occasionally dense with *Bursaria spinosa* and may also have contained *Indigofera australis, Lantana camara* (exotic) and *Solanum mauritianum* (exotic) as the next dominant shrub species. The ground layer contained a range of grass species both exotic and native. There were overall low percentages of *Themeda australis and a* high percentage of *Oplismenus aemulus* within remnant patches in the north-western portions of *Jacaranda ponds*.



Photo 3 – An example of Cumberland Plain Woodland in the vicinity of flora quadrat 8 looking west north-west.

This community is moderately impacted upon by grazing animals and shrub layer clearance north of the existing chicken sheds. Quadrat 7 recorded the lowest diversity of flora species for any quadrat. It is almost impacted by pasture grasses and the presence of exotic species such as *Lantana camara, Solanum mauritianum, Solanum nigrum, Sida rhombifolia, Bidens pilosa, Araujia sericifera, Asparagus asparagoides, Senecio madagascariensis, Cirsium vulgare* and *Phytolacca octandra.*

Water bodies with fringing Aquatic Herbfield

This vegetation community comprises the dams and watercourse (Currency Creek). Emergent vegetation was generally sparse and may have consisted of *Typha orientalis, Carex inversa, Juncus usitatis, Nymphaea caerulea, Triglochin procerum* and *Marsilea mutuca.*



Photo 4: This main water body is in the north-east corner of Jacaranda Ponds at a low water level. The remnant trees surrounding the wetland are sparse and the wetland itself contains very little emergent macrophyte vegetation. When full the water surface extends upslopes and creates wading habitat. This water body has significant habitat for migratory birds and microbats.



Photo 5: This water body is in the centre of the western portion of Jacaranda Ponds looking downhill to the south-west. The dam/wetland contains very little vegetation except for some fringing macrophytes. This water body is foraging habitat for migratory birds and microbats.



Photo 4 – An example of one of the semi vegetation dams in the south-east corner, to the north of flora quadrat 13.

4.4 Threatened flora legislation

One threatened flora species, *Pimelea spicata*, was observed by SKM during a preliminary site survey. This was recorded within a patch of *Cumberland Plain Woodland* of moderate quality within an area containing an overstorey of *E. tereticornis and E. crebra* and a shrub layer of *Bursaria spinosa.* Whilst targeted survey was undertaken across the suitable remnant patches of vegetation, no other threatened flora species were observed at the time of survey.

Two (2) endangered ecological communities, *Cumberland Plain Woodland and River-flat Eucalypt Forest on Coastal Floodplains* were observed within the subject site. The locations of these EEC's are shown on Figures 1.

4.4.1 State legislative matters

TSC Act (1995) – A search of the Atlas of NSW Wildlife (DECC 2009) database indicated that twenty three (23) species have been recorded within a 10 km radius of *Jacaranda Ponds*. Those species are listed in Table 4.1.

Of those twenty three (23) threatened flora species, six (6) have the potential to occur within *Jacaranda Ponds*. Those species are *Acacia pubescens, Cynanchum elegans, Dillwynia tenuifolia, Persoonia nutans, Pimelea spicata* and *Pultenaea parviflora.* Of these, one (1), *Pimelea spicata,* was observed at *Jacaranda Ponds* (by SKM).

4.4.2 Endangered populations

There is one endangered flora population within the Hawkesbury LGA, namely, *Keraudrenia corrolata var. denticulata* in the Hawkesbury Local Government Area

Keraudrenia corrolata var. denticulata is unlikely to occur as it favours sandstone soils which are prominent north of the site, from Wilberforce. Despite searches undertaken for this species within the subject site, no specimens were located.

4.4.3 National legislative matters

A review of the schedules of the *EPBC Act* (1999) indicated the potential for fifteen (15) threatened flora species to occur within a 10km radius of the site (Table 4.1).

Of those fifteen (15) threatened flora species, four (4) have the potential to occur within *Jacaranda Ponds*. Those species are *Cynanchum elegans, Dillwynia tenuifolia, Persoonia nutans* and *Pultenaea parviflora.* None of these were observed within *Jacaranda Ponds*.

4.5 Endangered ecological communities

Two (2) endangered ecological communities were located onsite, namely;

- *River-flat Eucalypt Forest on Coastal Floodplains*
- *Cumberland Plain Woodland*

The areas occupied by these communities are shown of Figures 1 and 2.

Analysis comparing the species recorded within each quadrat was referenced against *Tozer 2003* and the NSW Scientific Committees final determinations as shown below.

River-flat Eucalypt Forest on Coastal Floodplains

This EEC occurs along Currency Creek and in the lower elevations where remnant vegetation occurs in the south-eastern corner of *Jacaranda Ponds.*

Quadrat analysis of the four (4) quadrats undertaken revealed the following;

Quadrat	No of positive indicator species for Map Unit 11 – Alluvial Woodland (*Tozer 2003*)	No of species as indicative of the EEC in accordance with the scientific committees final determinations
1	75%	88%
11	62%	81%
12	65%	82%
13	60%	73%

There was a strong affiliation to the *River-flat Eucalypt Forest on Coastal Floodplains* EEC. The analysis against Western Sydney Dry Rainforest was less than 25% for all quadrats therefore not considered as a potential EEC on site.

Cumberland Plain Woodland (*Cumberland Plain Woodland*) vs. Shale Sandstone Transition Forest (SSTF)

Quadrat analysis of the remaining (13) quadrats undertaken revealed the following;

Quadrat	No of positive indicator species for Map Unit 10 – Shale Plains Woodland (*Tozer 2003*)	No of positive indicator species for Map Unit 1 – Shale Sandstone Transition Forest (Low sandstone influence) (*Tozer 2003*)	No of species as indicative of the EEC - *Cumberland Plain Woodland* in accordance with the scientific committees final determinations	No of species as indicative of the EEC - SSTF in accordance with the scientific committees final determinations	Outcome
2	58%	58%	74%	47%	*Cumberland Plain Woodland*
3	69%	44%	69%	31%	*Cumberland Plain Woodland*
4	50%	43%	57%	57%	*Cumberland Plain Woodland*
5	53%	53%	65%	47%	*Cumberland Plain Woodland*
6	54%	38%	62%	46%	*Cumberland Plain Woodland*
7	86%	43%	86%	57%	*Cumberland Plain Woodland*
8	48%	33%	62%	52%	*Cumberland Plain Woodland*
9	76%	53%	88%	47%	*Cumberland Plain Woodland*
10	60%	53%	67%	47%	*Cumberland Plain Woodland*
14	67%	56%	78%	56%	*Cumberland Plain Woodland*
15	38%	46%	62%	38%	*Cumberland Plain Woodland*
16	20%	50%	80%	40%	*Cumberland Plain Woodland*
17	50%	42%	67%	58%	*Cumberland Plain Woodland*

The analysis suggests that the vegetation within these quadrats more closely resembled *Cumberland Plain Woodland* as opposed to SSTF. For quadrats 15 and 16, the analysis on *Tozer 2003* showed a low percentage of indicator species for *Cumberland Plain Woodland* however the final determinations for the EEC were much more in favour than for SSTF.

4.6 Threatened flora species habitat assessment

Table 4.1 below provides an assessment of threatened flora species habitat likely to occur within the subject site.

Table 4.1 - Threatened flora habitat assessment

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
Acacia bynoeana DECC EPBC	Erect or spreading shrub to 0.3 m high growing in heath and dry sclerophyll open forest on sandy soils. Often associated with disturbed areas such as roadsides. Distribution limits N-Newcastle S- Berrima.	Blue Mountains NP, Royal NP, Castlereagh NR, Agnes Banks NR, Lake Macquarie SRA, Dharawal NR, Marramarra NP, Parr SRA	No potential habitat, not observed during flora survey.	E1	V
Acacia gordonii DECC	Erect or spreading shrub 0.5-1.5 m high growing in heath and dry sclerophyll forest on sandstone outcrops. Distribution limits N-Bilpin S- Faulconbridge.	Not currently known from conservation reserves.	No potential habitat, not observed during flora survey.	E1	E
Acacia pubescens DECC	Spreading shrub 1-4 m high open sclerophyll growing in open forest and woodlands on clay soils. Distribution limits N-Bilpin S- Georges River.	Wollemi NP, Scheyville NP	Marginal habitat present, not observed during flora survey.	V	V
Allocasuarina glareicola DECC	Small shrub 1-2 m high growing in open sclerophyll forest on lateritic soils derived from tertiary alluviums. Distribution limits Castlereagh NR region.	Castlereagh NR	Outside of geographical range. No potential habitat, not observed during flora survey.	E1	E
Asterolasia elegans DECC	Erect shrub 1-3 m high growing in moist sclerophyll forests on Hawkesbury sandstone slopes hillsides. Distribution limits Maroota region.	Marramarra NP	No potential habitat, not observed during flora survey.	E1	E
Cryptostylis hunteriana EPBC	Saprophytic orchid. Grows in swamp heath on sandy soils. Distribution limits N-Gibraltar Range S- south of Eden.	Gibraltar Range NP, Ku-ring-gai Chase NP, Ben Boyd NP	No potential habitat, not observed during flora survey.	V	V

Table 4.1 - Threatened flora habitat assessment

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
Cynanchum elegans DECC EPBC	Climber or twiner to 1 m. Grows in rainforest gullies, scrub & scree slopes. Distribution limits N - Gloucester S - Wollongong.	Camel's Hump NR, Woko NP, Booti Booti NP, Oxley Wild Rivers NP, Goulburn River NP, Glenrock SRA, Kooragang Island NR, Camels Hump NR, New England NP, Sea Acres NR, Wollemi NR Darawank NR Khappingaht NR	Marginal habitat present more so along Currency Creek, although nearest record 10km away. Not observed during flora survey.	E1	E
Dillwynia tenuifolia DECC EPBC	Erect shrub 0.6-1 m high. Grows in Woodlands and Open Forest on sandstone shale or laterite. Distribution limits N - Howes Valley S - Cumberland Plain.	Blue Mountains NP, Windsor Downs NR, Yengo NP, Agnes Banks NR, Scheyville NP, Castlereagh NR, Mulgoa NR	Marginal habitat present, not observed during flora survey.	V	V
Eucalyptus benthamii DECC	Blue gum to 40 m high. Wet forest on sandy alluvial soils. Distribution limits N - Yarramundi S - Bents Basin.	Blue Mountains NP, Bents Basin SRA	No potential habitat, not observed during flora survey.	V	V
Grevillea juniperina subsp. juniperina DECC	Erect to spreading shrub 0.5-1.5 metres tall. Grows on laterite and Tertiary alluvium. Distribution limits St Marys-Londonderry-Prospect.	Castlereagh NR	Outside of geographic range. No potential habitat, not observed during flora survey.	V	-
Leucopogon exolasius DECC	Erect shrub to 2 metres high. Rocky hillsides and creek banks in Sydney Sandstone Gully Forest. Confined to Woronora and Georges Rivers and Stokes Creek.	Heathcote NP	No potential habitat, not observed during flora survey.	V	V
Leucopogon fletcheri ssp. fletcheri DECC	Shrub to 1.8 m high growing in woodland on lateritic soils. Distribution limits N-St Albans S- Springwood.	Nil	No potential habitat, not observed during flora survey.	E1	-
Melaleuca deanei DECC EPBC	Shrub to 3 m high. Grows in heath on sandstone. Distribution limits N - Gosford S - Nowra.	Berowra Valley Regional Park, Brisbane Water NP, Ku-ring-gai Chase NP, Garrigal NP, Lane Cove NP, Royal NP, Heathcote NP	No potential habitat, not observed during flora survey.	V	V

Table 4.1 - Threatened flora habitat assessment

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
Micromyrtus minutiflora DECC EPBC	Spreading shrub to 2 m high. Grows in dry sclerophyll forest dominated by Scribbly gums and Ironbarks on Tertiary Alluviums. Distribution limits Western part of Cumberland Plain.	Castlereagh NR	No potential habitat, not observed during flora survey.	E1	V
Olearia cordata EPBC	Shrub to 2 m high. Grows in dry sclerophyll forest and shrubland on Hawkesbury sandstone. Distribution limits N - Wollombi S - Wiseman's Ferry.	Wollemi NP, Wiseman's Ferry HS, Yengo NP	No potential habitat, not observed during flora survey.	V	V
Persoonia hirsuta DECC EPBC	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. Distribution limits N - Glen Davis S - Hill Top.	Blue Mountains NP, Wollemi NP, Dharug NP, Ku-ring-gai Chase NP, Marramarra NP, Royal NP, Sydney Harbour NP	No potential habitat, not observed during flora survey.	E1	E
Persoonia nutans DECC EPBC	Erect to spreading shrub. Grows in dry sclerophyll forest and woodland on laterite and alluvial sands. Distribution limits Cumberland Plain.	Agnes Banks NR, Windsor Downs NR, Castlereagh NR	Marginal habitat present more so along Currency Creek, although nearest record 6km away. Not observed during flora survey.	E1	E
Pimelea curviflora var. curviflora DECC	Woody herb or sub-shrub to 0.2-1.2 m high. Grows on Hawkesbury sandstone near shale outcrops. Distribution Sydney.	Not currently known from conservation reserves.	No potential habitat, not observed during flora survey.	V	V
Pimelea spicata DECC	Decumbent or erect shrub to 0.5 m high. Occurs principally in woodland on soils derived from Wianamatta Shales. Distribution limits N - Lansdowne S - Shellharbour.	Killalea SRA	Potential habitat present. Observed by SKM.	E1	E
Pomaderris brunnea EPBC	Shrub to 3 metres high. Confined to Upper Nepean and Colo Rivers where it grows in open forest.	Wollemi NP	No potential habitat, not observed during flora survey.	V	V
Pterostylis saxicola DECC EPBC	Terrestrial orchid. Grows in shallow sandy soil above rock shelves, usually near Wianamatta / Hawkesbury transition. Distribution limits N - Hawkesbury River S- Campbelltown.	Not currently known from conservation reserves.	No potential habitat, not observed during flora survey.	E1	E

Table 4.1 - Threatened flora habitat assessment

Scientific name	Growth Form and Habitat Requirements	Conservation Status	Comments	TSC Act	EPBC Act
Pultenaea parviflora DECC EPBC	Erect shrub. Grows in dry sclerophyll forest at the intergrade between Tertiary Alluviums and Wianamatta Shales. Distribution limits Cumberland Plain.	Scheyville NP, Windsor Downs NR, Castlereagh NR	Marginal habitat present, not observed during flora survey.	E1	V
Rhizanthella slateri EPBC	Underground orchid that is poorly known. Grows in sclerophyll forests. Usually only seen if the soil is disturbed. Scattered records in Great Lakes Council area, Watagan Mtns, Blue Mtns, and Agnes Banks. Flowers in Oct – Nov.	Unknown	No records within 10km. Unlikely to occur.	V	E
Tetratheca glandulosa DECC EPBC	Spreading shrub to 0.2 m high. Sandy or rocky heath or scrub. Distribution limits N - Mangrove Mountain S – Port Jackson.	Berowra Valley RP, Dharug NP, Garigal NP, Ku-ring-gai Chase NP, Popran NP, Parr SRA, Cattai NP, Brisbane Water NP, Yengo NP, Cattai NP, Marramarra NP, Muogamarra NR, Wollemi NP	No potential habitat, not observed during flora survey.	V	V
Tetratheca juncea DECC	Prostrate shrub to 1 m high. Dry sclerophyll forest and heath. Distribution limits N - Bulahdelah S - Port Jackson.	Glenrock SRA, Awabakal NR, Munmorah SRA, Lake Macquarie SRA, Karuah NR, Wallaroo NR	No potential habitat, not observed during flora survey.	V	V
Velleia perfoliata DECC	Herb. Heath on shallow sandy soil over sandstone. Distribution limits N - Murrurundi S - Wisemans Ferry.	Wollemi NP, Yengo NP, Parr SRA	No potential habitat, not observed during flora survey.	V	-
Wollemia nobilis EPBC	Pine tree to 40m in height, multi-stemmed and with a population limited to Wollemi NP. Grows in remote canyons at 670-780m above sea level.	Wollemi NP	No potential habitat present. Not observed.	E1	E
Zieria involucrata DECC	Tall erect shrub. Wet sclerophyll forest. Distribution limits chiefly Lower Blue Mountains. Reserves -	Blue Mountains NP, Marramarra NP, Parr SRA Yengo NP	No potential habitat, not observed during flora survey.	E1	V
DECC	- Denotes species listed within 10km of the subject site on the Atlas of NSW Wildlife database				
EPBC	- Denotes species listed within 10km of the subject site in the EPBC Act habitat search				

4.7 Fauna species

A total of one-hundred (100) fauna species were observed within or in close proximity to the subject site during the survey. This number comprised 73 species of birds, 18 species of mammals, 3 species of reptile, 4 species of amphibian and 2 species of molluscs.

All species are listed in Table 3.2.

4.8 Threatened fauna legislation

Three (3) threatened fauna species Eastern Bentwing-bat (*Miniopterus schreibersii oceansis*), Large-footed Myotis (*Myotis macropus*) and East-coast Freetail-bat (*Micronomus norfolkensis*) were recorded within the subject site. All other fauna species are considered relatively common in the local area.

Cumberland Plain Land Snail (*Meridolum corneovirens*) was indicated to be previously recorded at three locations within the subject site by SKM (2009). Snail shell samples collected during surveys by *Travers bushfire & ecology* were sent to expert Michael Shea of the Australian Museum for identification. *Pommerhelix cf bowdenae* was identified which is a very similar species in the same snail sub-family as the Cumberland Plain Land Snail (*Meridolum corneovirens*). It is considered that identifications by SKM may have been erroneous given that *Meridolum* are considered to be parapatric whereby there are no distributional overlaps between species (Clark 2009).

It is considered that the subject site provides potential habitat for the following threatened fauna species:

- Green and Golden Bell Frog
- Square-tailed Kite
- Black-necked Stork
- Comb-crested Jacana
- Painted Snipe
- Freckled Duck
- Bush Stone-curlew
- Glossy Black-Cockatoo
- Gang-gang Cockatoo
- Swift Parrot
- Turquoise Parrot
- Painted Honeyeater
- Regent Honeyeater
- Barking Owl
- Powerful Owl
- Masked Owl
- Speckled Warbler
- Black-chinned Honeyeater
- Brown Treecreeper
- Spotted-tailed Quoll
- Koala
- Squirrel Glider
- Yellow-bellied Glider
- Grey-headed Flying-fox
- Large-footed Myotis
- Eastern Bentwing-bat
- Greater Broad-nosed Bat
- East-coast Freetail Bat
- Eastern Falsistrelle
- Large-eared Pied Bat
- Macquarie Perch
- Cumberland Plain Land Snail

4.8.1 State legislative matters

TSC Act (1995) – A search of the Atlas of NSW Wildlife (DECC, 2009) database for threatened species resulted in records of forty-one (41) threatened fauna species within a 10 km radius of the subject site. These species are listed in Table 4.3 and are considered for potential habitat within the subject site.

Coastal and oceanic threatened species found within 10 km have not been included.

Fisheries Management Act (1994) – A review of the *EPBC Act Protected Matters Report* identified the presence of two (2) threatened aquatic species or habitat for these species within a 10km radius of the study area. These species are also listed under the *Fisheries Management Act* (1994) and include the Macquarie Perch (*Macquaria austalasica*) and Australian Greyling (*Prototroctes maraena*).

It is considered that the subject site provides potential habitat for the Macquarie Perch (*Macquaria austalasica*) and as such the proposed development should consider that there is no detrimental effect on water quality, water quantity or any direct impacts upon threatened fish species habitat from the proposed action. The proposed activity is not located in an area identified as critical habitat under the *Fisheries Management Act* (1994).

4.8.2 Endangered populations

There are no endangered fauna populations within the Hawkesbury LGA.

4.8.3 National legislative matters

EPBC Act (1999) – A review of the schedules of the *EPBC Act* (1999) identified the presence of sixteen (16) threatened fauna species or species habitat likely to occur within a 10km radius of the subject site.

These species have been listed in Table 4.3, and those with potential to utilise the subject site will be considered in the seven-part test within Section 5.

Of those sixteen (16) species, 8 were considered to have potential habitat within the subject site. No nationally listed threatened fauna species were recorded foraging within the subject site.

Additionally listed Terrestrial, Wetland and Marine Migratory species of national significance likely to occur or with habitat for these species likely to occur within a 10km radius of the subject site are assessed in Table 4.2.

Table 4.2 - Migratory fauna habitat assessment

COMMON NAME *Scientific Name*	COMMENTS
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Marginally suitable habitat present. A juvenile was recorded in flight and roosting along the central areas of Currency Creek during surveys. It is expected that this individual was in dispersal and may have been lured to the site by the chicken farming. The existing large dams may also provide foraging habitat. The available habitat within the subject would not provide ongoing support for this individual.
White-throated Needletail (*Hirundapus caudacutus*)	Suitable roosting and foraging habitat present. Not recorded during surveys.

Table 4.2 - Migratory fauna habitat assessment

COMMON NAME *Scientific Name*	COMMENTS
Rainbow Bee-eater (*Merops ornatus*)	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys.
Black-faced Monarch (*Monarcha melanopsis*)	Sub-optimal roosting, breeding and foraging habitat present. Not recorded during surveys.
Satin Flycatcher (*Myiagra cyanoleuca*)	Suitable roosting and foraging habitat on migration present. Not recorded during surveys.
Rufous Fantail (*Rhipidura rufifrons*)	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys.
Great Egret (*Ardea alba*)	Suitable roosting, breeding and foraging habitat present. Recorded at dams located within the eastern portions of the site during surveys.
Cattle Egret (*Ardea ibis*)	Suitable roosting, breeding and foraging habitat present. Recorded with cattle as a host within the western portions of the subject site during surveys.
Latham's Snipe (*Gallinago hardwickii*)	Sub-optimal roosting and foraging habitat present. Not recorded during surveys.
Fork-tailed Swift (*Apus pacificus*)	Suitable roosting and foraging habitat present. Not recorded during surveys.

Given that the two large dams and fringing habitat is retained for Great Egret and Cattle Egret activity and possibly future breeding potential, a referral to Department of the Environment, Water, Heritage & The Arts in regard to fauna species should not be required. Any provisions to retain cattle farming within portions of the subject site would subsequently retain foraging habitat for the Cattle Egret within. However, given the regional availability of this resource it would not be a critical element in this species assessment.

4.9 Threatened fauna species habitat assessment

Table 4.3 below provides an assessment of all state and national listed threatened fauna species habitat likely to occur within the subject site.

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Giant Burrowing Frog *Heleioporus australiacus* DECC EPBC	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. Distribution Limit- N-Near Singleton. S-South of Eden.	No suitable habitat present.	V	V
Green and Golden Bell Frog *Litoria aurea* DECC EPBC	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. Distribution Limit - N-Byron Bay. S-South of Eden.	Sub-optimal habitat present. Not recorded during surveys. 5 records within 10km, none within close proximity or since 1975. Not likely to occur.	E	V

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Littlejohn's Tree Frog *Litoria littlejohnii* DECC EPBC	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. Distribution Limit – N-Hunter River. S-Eden.	No suitable habitat present.	V	V
Stuttering Frog *Mixophyes balbus* DECC EPBC	Terrestrial inhabitant of rainforest and wet sclerophyll forests. Distribution Limit - N-Near Tenterfield. S-South of Bombala.	No suitable habitat present.	E	V
Giant Barred Frog *Mixophyes iteratus* DECC EPBC	Terrestrial inhabitant of rainforest and open forests. Distribution Limit-N-Border Ranges National Park. S-Narooma.	No suitable habitat present.	E	E
Red-crowned Toadlet *Pseudophryne australis* DECC	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non breeding periods. Distribution Limit- N-Pokolbin S-Near Wollongong.	No suitable habitat present.	V	-
Broad-headed Snake *Hoplocephalus bungaroides* EPBC	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. Distribution Limit - N-Mudgee Park. S-Nowra.	No suitable habitat present.	E	E
Square-tailed Kite *Lophoictinia isura* DECC	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. Distribution Limit - N-Goondiwindi. S-South of Eden.	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. 9 records within 10km, none in close proximity yet considered with potential to occur.	V	-
Black-tailed Godwit *Limosa limosa* DECC	A mainly coastal species feeding along estuarine mudflats, beaches, mangroves and lagoons. Also found at sewerage ponds and large inland shallow waters. Distribution Limit - N-Tweed Heads. S-South of Eden.	No suitable habitat present.	V	-

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Australasian Bittern *Botaurus poiciloptilus* DECC	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, and brackish wetlands. Distribution Limit - N-North of Lismore. S- Eden.	No suitable habitat present.	V	-
Black Bittern *Ixobrychus flavicollis* DECC	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater & brackish streams & ponds, sheltered mudflats and oyster slats. Distribution Limit - N-Tweed Heads. S-South of Eden.	No suitable habitat present.	V	-
Black-necked Stork *Ephippiorhynchus asiaticus* DECC	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. Distribution Limit - N-Tweed Heads. S-Nowra.	Suitable foraging habitat present. Marginally suitable roosting and breeding habitat present. Not recorded during surveys. 5 records at 10km and 1 record at 6km. No records since 1978. Not likely to occur.	E	-
Comb-crested Jacana *Irediparra gallinacean* DECC	Floating vegetation of deep and permanent vegetation-choked tropical and warm temperate wetlands and dams. Occasionally feeds along muddy wetland margins. Distribution Limit - N-Tweed Heads. S - Ku-ring-gai Chase National Park.	Sub-optimal habitat present. Not recorded during surveys. 3 records within 10km, none since 1986. Not likely to occur.	V	-
Painted Snipe *Rostratula benghalensis* DECC EPBC	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. Distribution Limit- N-Tweed Heads S-South of Eden.	Sub-optimal habitat present. Not recorded during surveys. 8 records within 10km, none since 1985. Not likely to occur.	V	V

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Freckled Duck *Stictonetta naevosa* DECC	Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. Distribution Limit - N-Tenterfield. S-Albury.	Sub-optimal habitat present. Not recorded during surveys. 12 records within 10km, none since 2002. Low potential to occur.	V	-
Bush Stone-curlew *Burhinus grallarius* DECC	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. Distribution Limit- N-Border Ranges National Park S-Near Nowra.	Sub-optimal habitat present. Not recorded during surveys. 6 records within 10km, none since 1986. Not likely to occur.	E	-
Major Mitchell's Cockatoo *Cacatua leadbeateri* DECC	Commonly found within the arid interior of Australia within desert scrubs, open woodland, mallee, mulga, and callitris woodlands. Distribution Limit - N-Goodooga. S-Albury.	No suitable habitat present.	V	-
Glossy Black-Cockatoo *Calyptorhynchus lathami* DECC	Open forests with *Allocasuarina* species and hollows for nesting. Distribution Limit - N-Tweed Heads. S-South of Eden.	Suitable roosting and breeding habitat present. Not recorded during surveys. 9 records within 10km, none within close proximity. Low potential to occur given lack of foraging habitat.	V	-
Gang-gang Cockatoo *Callocephalon fimbriatum* DECC	Prefers wetter forests and woodlands from sea level to > 2000m on Divide, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. Distribution Limit –mid north coast of NSW to western Victoria.	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. 11 records within 10km, none within close proximity. Potential to occur.	V	-
Swift Parrot *Lathamus discolour* DECC EPBC	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Suitable foraging habitat present. Not recorded during surveys. 4 records within 10km. Potential to occur.	E	E

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Turquoise Parrot *Neophema pulchella* DECC	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. Distribution Limit - N-Near Tenterfield. S-South of Eden.	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. 2 records at 6km in 2002. Low potential to occur.	V	-
Superb Parrot *Polytelis swainsonii* DECC	Inhabits open woodland and riverine forests of inland NSW. Distribution Limit - N-Near Walgett. S-South of Deniliquin.	No suitable habitat present.	V	V
Painted Honeyeater *Grantiella picta* DECC	Found in open forest, woodland and scrubland feeding on mistletoe fruits. Distribution Limit- N-Boggabilla S-Albury.	Marginally suitable habitat present. Not recorded during surveys. 1 record at 9km in 1982. Not likely to occur.	V	-
Regent Honeyeater *Xanthomyza Phrygia* DECC EPBC	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. Distribution Limit - N-Urbanville. S-Eden.	Suitable foraging habitat present. Not recorded during surveys. 13 records within 10km with one record at 1km in 1981. Potential to occur.	E	E
Star Finch *Neochmla ruficauda* DECC	Occurs mainly in tall rank streamside grass and rushes within warm temperate to tropical swamps and woodlands. Distribution Limit - N-Tweed Heads. S-Campbelltown.	No suitable habitat present. Considered extinct from the mainland.	E	E
Barking Owl *Ninox connivens* DECC	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. Distribution Limits- N-Border Ranges National Park S-Eden	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. 9 records within 10km with one record just within 4km in 1996 and the most recent at 9km in 2006. Low potential to occur.	V	-

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Powerful Owl *Ninox strenua* DECC	Forests containing mature trees for shelter or breeding & densely vegetated gullies for roosting. Distribution Limits - N-Border Ranges National Park. S-Eden	Suitable breeding and foraging habitat present. Not recorded during surveys. 13 records within 10km with one record along the northern boundary in 1996. Potential to occur.	V	-
Masked Owl *Tyto novaehollandiae* DECC	Open forest & woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. Distribution Limit - N-Border Ranges National Park. S-Eden	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. 2 records within 10km, at 3km and 1km in 2003. Potential to occur.	V	-
Sooty Owl *Tyto tenebricosa* DECC	Tall, dense, wet forests containing trees with very large hollows. Distribution Limit - N-Border Ranges National Park. S-South of Eden	No suitable habitat present.	V	-
Speckled Warbler *Chthonicola sagittata* DECC	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. Distribution Limit - N-Urbanville. S-Eden	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. 3 records within 10km, none in close proximity. Low potential to occur.	V	-
Black-chinned Honeyeater *Melithreptus gularis gularis* DECC	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. Distribution Limit. N – Cape York pen. Qld. S – Victor H. Mt Lofty Ra & Flinders Ra. SA	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. 4 records within 10km three at 3km. Potential to occur.	V	-
Brown Treecreeper *Climacteris picumnus victoriae* DECC	Occupies Eucalypt woodlands, open woodland lacking a dense understorey with fallen dead timber. Distribution Limit. (Sub species *victoriae)* Central NSW west of Great Div. Cumberland Plains, Hunter Valley, Richmond, Clarence, and Snowy River Valleys.	Suitable roosting, breeding and foraging habitat present. Not recorded during surveys. 1 record at 10km in 1982. Low potential to occur.	V	-

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Spotted-tailed Quoll *Dasyurus maculatus* DECC EPBC	Dry and moist open forests containing rock caves, hollow logs or trees. Distribution Limit- N-Mt Warning National Park S-South of Eden.	Sub-optimal breeding and foraging habitat present. Not recorded during surveys. 7 records within 10km None in close proximity. Low potential to occur.	V	V
Long-nosed Potoroo *Potorous tridactylus* EPBC	Coastal heath and dry and wet sclerophyll forests with a dense understorey. Distribution Limit - N-Mt Warning National Park. S-South of Eden.	No suitable habitat present.	V	V
Brush-tailed Rock-wallaby *Petrogale penicillata* DECC EPBC	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. Distribution Limit - N-North of Tenterfield. S-Bombala.	No suitable habitat present.	V	V
Koala *Phascolarctos cinereus* DECC	Inhabits both wet & dry eucalypt forest on high nutrient soils containing preferred feed trees. Distribution Limit - N-Tweed Heads. S-South of Eden	Suitable habitat present. Not recorded during surveys. 12 records within 10km, none in close proximity. Low potential to occur.	V	-
Squirrel Glider *Petaurus norfolcensis* DECC	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. Distribution Limit - N- Tweed Heads S-Albury	Suitable denning, breeding and foraging habitat present. Not recorded during surveys. 16 records within 10km, none in close proximity. Potential to occur.	V	-
Yellow-bellied Glider *Petaurus australis* DECC	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. Distribution Limit- N-Border Ranges National Park. S-South of Eden.	Suitable denning, breeding and foraging habitat present. Not recorded during surveys. 25 records within 10km, including 1 record along the northern boundary in 1996 and 1 record at 1km north in 2000. Potential to occur.	V	-

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Grey-headed Flying-fox *Pteropus poliocephalus* DECC EPBC	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. Distribution Limit – N – Tweed Heads S - Eden	Suitable foraging habitat present. Not recorded during surveys. Lack of records given the absence of camps within the region. Potential to utilise the site for foraging on a seasonal basis.	V	V
Large-footed Myotis *Myotis macropus* DECC	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. Distribution limits - N - Border Ranges National Park, S - South of Eden.	Suitable roosting, breeding and foraging habitat present. Recorded foraging over the large dam in the central western portions of the site.	V	-
Eastern Bentwing-bat *Miniopterus schreibersii oceansis* DECC	Prefers areas where there are caves, old mines, old buildings, stormwater drains & well timbered areas. Distribution Limit - N-Border Ranges National Park. S-South of Eden.	Suitable foraging and roosting habitat present. Recorded foraging within all major habitats across the site.	V	-
Greater Broad-nosed Bat *Scoteanax rueppellii* DECC	Inhabits areas containing moist river & creek systems especially tree lined creeks. Distribution Limit - N-Border Ranges National Park. S-Pambula.	Suitable roosting, foraging and breeding habitat present. Not recorded during surveys. 2 records at 9km SW from the site in 2002 & 2003. Low potential to occur.	V	-
East-coast Freetail Bat *Micronomus norfolkensis* DECC	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. Distribution Limit - N-Woodenbong. S-Pambula.	Suitable foraging roosting and breeding habitat present. Recorded foraging within all major habitats across the site.	V	-

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
Eastern Falsistrelle *Falsistrellus tasmaniensis* DECC	Recorded roosting in caves, old buildings and tree hollows. Distribution Limit- N-Border Ranges National Park S-Pambula	Sub-optimal roosting, foraging and breeding habitat present. Not recorded during surveys. 4 records all further than 9km from the site, the most recent in 2003. Low potential to occur.	V	-
Large-eared Pied Bat *Chalinolobus dwyeri* DECC EPBC	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. Distribution Limit - N-Border Ranges Nation Park. S-Wollongong.	Sub-optimal roosting, foraging and breeding habitat present. Not recorded during surveys. 1 record at 10km from the site in 2002. Not likely to occur.	V	V
Macquarie Perch *Macquaria australasica* EPBC	Occurs in south east Australia at moderate to high altitudes in rivers and reservoirs. Historical records show the species was widespread and abundant in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers and their tributaries. Allen (1989) states that introduced populations are present in Nepean River and water supply dams in the Sydney area. Occurs in lakes and flowing streams, usually in deep holes.	Sub-optimal habitat present. Not recorded during survey. No records within 10km.	V	E
Australian Greyling *Prototroctes maraena* EPBC	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (eg weirs, waterfalls).	No suitable habitat present.	Part 2, Section 19 – Protected Fish	V
Cumberland Plain Land Snail *Meridolum corneovirens* DECC	Inhabits remnant eucalypt woodland of the Cumberland Plan. Shelters under logs, debris, clumps of grass, around base of trees and burrowing into loose soil. Distribution Limit- Cumberland Plain of Sydney Basin Region.	Fragmented areas of suitable to poor quality habitat present. Currently considered to have unlikely present given considered range and presence of *Pommerhelix bowdenae*.	E	-

Table 4.3 - Threatened fauna habitat assessment

COMMON NAME *Scientific Name*	PREFERRED HABITAT	COMMENTS	TSC Act	EPBC Act
DECC	- Denotes species listed within 10km of the subject site on the Atlas of NSW Wildlife database			
EPBC	- Denotes species listed within 10km of the subject site in the EPBC Act habitat search			
TE	- Denotes species considered to have potential to utilise the subject site however not recorded in the NSW Wildlife Atlas or EPBC Act database searches			
NOTE:	- 'Records' refer to those provided by the Atlas of NSW Wildlife database. Updated 1:100,000 database mapsheet requests to DECC are undertaken every 3 months as recommended.			

A detailed assessment in accordance with Section 5A of the *EP&A Act* (1979) will be completed for these species in Section 5 of this report.

4.10 Summary of threatened fauna species recorded

4.10.1 Cumberland Plain Land Snail (Meridolum corneovirens)

This species has been assessed, given that it was previously recorded at three locations within the subject site by SKM (2009).

Snail shell samples collected during surveys by *Travers bushfire & ecology* were sent to expert Michael Shea of the Australian Museum for identification. *Pommerhelix cf bowdenae* was identified which is a very similar looking & behavioural species in the same snail sub-family as the Cumberland Plain Land Snail (*Meridolum corneovirens*).

It is considered that identifications by SKM may have been erroneous given that *Meridolum* and *Pommerhelix* have parapatric distributions whereby there is no overlap between species distributions (Clark 2009). See Figure 1 for locations of all samples. SKM were contacted regarding verification of samples, verification was not undertaken independently. As the SKM samples cannot be verified, further targeted survey in locations recorded by SKM is recommended during more appropriate conditions (following rain).

A clear outcome on the occurrence of Cumberland Plain Land Snail can be achieved by undertaking target snail searches within the Cumberland Plain Woodland remnants which contained the SKM Cumberland Plain Land Snail records. A comprehensive review of vegetation condition within the remnants can also be used to objectively argue the suitability of habitat or lack of suitability for Cumberland Plain Land Snail.

Cumberland Plain Land Snail (*Meridolum corneovirens*) is restricted to remnant Eucalypt woodland of the Cumberland Plain, generally in areas characterised by moist soils together with growths of various species of lichen. This species is known to shelter under logs, debris, and clumps of grass, around the base of trees and burrowing into loose soil.

The twelve (12) habitat assessment quadrats undertaken during surveys also considered habitat potential for the Cumberland Plain Land Snail. The results of these quadrats (provided in Table 3.3) reflect that the remnant areas of *Cumberland Plain Woodland* and adjacent connective communities within the subject site provide generally sub-optimal to poor quality habitat for this species. This is given due to the disturbed nature of the understorey even within the remnant areas sampled.

The habitat assessment results also indicate that the higher quality natural terrestrial habitat areas available for this snail species occurs in the free ranging chicken compounds to the north of the large sheds located in the north-western portion of the site. Portions of the remnants in this area north of these sheds have less weed surface domination and more surface branches. This is the locality of two SKM records of Cumberland Plain Land Snail.

Pommerhelix bowdenae was recorded by *Travers bushfire & ecology* at the third recorded location by SKM. These overlapping recordings give rise to the fact that all three SKM recordings may have been erroneous as the two species, although very similar, do not occur together.

Management of weeds by slashing is evident within some of the above mentioned north-western compounds which were not evident in other habitat sampling areas. Although this practice may more likely trample snails, it has prevented the establishment of a weed scrub understorey and allowed a more appropriate assemblage of dry surface debris. Additionally to this, large piles of branches were seen within and outside of these compounds and it has not been determined if these were gathered from the compound area or collected for placement within these areas for the chickens. It is also not known if the chickens will forage upon the snail whilst free-ranging. Regardless of this, the retention and further placement of surface logs would provide a more suitable outcome for the Cumberland Plain Land Snail.



Photo 5: Free-ranging chicken compound north the larger sheds

Subject to confirmation of Cumberland Plain Land Snail within the site, any proposed development within the subject site would be required to consider and ensure their longevity where a local population is present. This would require conserving representations of remnant communities where the species has been detected, restoring suitability of habitat within these and ensuring adequate connectivity to adjacent areas of more extensive suitable habitat is restored.

This may be best accomplished by retaining and restoring all areas to the north and south east of the existing large sheds where the species has been detected and linking these to adjacent areas further to the north-west. The remaining area where the species was detected along the western boundary was considered to be of very poor quality habitat. Nonetheless, retention and restoration of these areas would be of obvious additional benefit to a local population.

In conclusion further survey for the Cumberland Plain Land Snail is advised during more appropriated survey conditions. All samples are to be independently verified by the Australian Museum.

4.10.2 East-coast Freetail-bat (Micronomus norfolkensis)

The East-coast Freetail Bat forages above and within the canopy of open forests and woodlands, feeding on small insects (Allison, Hoye & Law 2008). This species is thought to roost predominantly in tree hollows and occasionally in buildings (Allison, Hoye & Law 2008). All known natural roosts have occurred within hollow spouts of large mature eucalypts. The East-coast Freetail Bat species will utilise paddock trees and isolated remnant vegetation when in close proximity to larger forest remnants (Allison, Hoye & Law 2008). Foraging distances have been recorded up to 6km from roosting locations.

It is considered that the subject site provides suitable roosting, breeding and foraging habitat for the East-coast Freetail-bat. This species was recorded foraging at most Anabat recording stations located across the entire subject site (see Figure 3). The high degree of foraging presence throughout the site gives greater potential for this species to be utilising the site for roosting and breeding activity. This highlights the need for a detailed hollow-bearing tree survey to be conducted for trees located within any proposed development areas.

It is generally recommended to retain as many hollow bearing trees as possible based on the surveyed quality of those trees. It is best practice that any hollow bearing tree to be removed should be 'stagwatched' for activity and to ensure that any hollow-bearing tree being removed is dismantled under the supervision of a licensed fauna ecologist. Where any microbat species are found in such hollows, the fauna ecologist would need to direct the relocation of such a roost, particularly if found to be a threatened species.

This species is also known for roosting within building structures. As such any old structures proposed for removal (such as old houses and sheds) that provide enclosed wall cavities or ceiling areas would be recommended for prior access by a fauna ecologist to target and relocate where roosting activity is found.

Given the above management of hollow bearing trees, any valued roosting and breeding habitat can be retained or managed such that there will be no detrimental effect on a local population.

4.10.3 Eastern Bentwing-bat (Miniopterus schreibersii oceansis)

The Eastern Bentwing-bat forages above and below the canopy within open forests and woodlands, feeding on small insects (Dwyer 1995). The Eastern Bentwing-bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and, in particular, caves (Dwyer 1995). Caves are an important resource for this species, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer 1995). Roost sites in tree hollows have not been reported within the literature reviewed.

It is considered that the subject site provides suitable foraging habitat throughout for the Eastern Bentwing-bat. This species was recorded foraging at most Anabat recording stations located across the entire subject site (see Figure 3).

Although there was a high degree of recorded foraging presence, the extensive foraging range and flight behaviour of this species does not give suggestion to the site as being significant for roosting. However the retention or provision of roosting sites would enhance

the sustainability of this population onsite. As there is no subterranean habitat such as caves present within the subject site, there is subsequently no breeding habitat. Non-breeding roosting habitat may be present within structures such as buildings or bridges which provide adequate shelter from temperature fluctuations. As such any old structures proposed for removal (such as old houses and sheds) that provide enclosed wall cavities or ceiling areas would be recommended for prior access by a fauna ecologist to target and relocate where roosting activity is found.

Given the above management of hollow bearing trees, any valued roosting and breeding habitat can be retained or managed such that there will be no detrimental effect on a local population.

4.10.4 Large-footed Myotis (Myotis macropus)

The Large-footed Myotis inhabits rainforests and open forests predominantly foraging along creeklines and over waterbodies where it takes insects and small fish from on and just below the waters surface (Richards 1995). The large-footed Myotis roosts in tree hollows, caves, mines, under bridges, in tunnels and occasionally buildings (Richards 1995).

The subject site provides suitable foraging, roosting and breeding habitat for the Large-footed Myotis. This species was recorded over the large western dam within the subject site during surveys (see Figure 2). Although not recorded at the Anabat station located at the large eastern dam, it is expected that this species would be foraging here also and to a lesser extent over remaining smaller dams within the site.

The recording of another microchiropteran bat species known to utilise hollows highlights the need for a detailed hollow-bearing tree survey to be conducted for trees located within any proposed development areas following accurate land survey of all trees.

Whilst it would not be common practice to target all suitable habitat trees for activity, it is best practice to ensure that any hollow-bearing tree identified for removal is dismantled under the supervision of a licensed fauna ecologist. Where any microbat species are found in such hollows, the fauna ecologist would need to direct the relocation of such a roost, particularly if found to be a threatened species.

This species is also known for roosting within numerous different structures where microclimatic conditions are appropriate. As such any old structures proposed for removal (such as old houses and sheds) that provide enclosed wall cavities or ceiling areas would be recommended for prior access by a fauna ecologist to target and relocate where roosting activity is found.

Given the above management of hollow bearing trees, any valued roosting and breeding habitat can be retained or managed such that there will be no detrimental effect on a local population.

4.11 Summary of threatened fauna species previously recorded nearby

Powerful Owl *(Ninox strenua)*

The Powerful Owl breeds in open or closed sclerophyll forests and woodlands, including wet sclerophyll forest and dry sclerophyll forest and woodlands. They nest in hollows in large old trees; usually living Eucalyptus, within or below canopy in stumps or broken-off trunks. (Higgins 1999). Powerful Owls are sedentary within home ranges of about 1,000 hectares within open Eucalypt, Casuarina or *Callitris* pine forest and woodlands, though they often roost in denser vegetation, including rainforest or exotic pine plantations. (Garnett & Crowley

2000). Powerful Owls feed mainly on those medium-sized species of arboreal marsupials that are most readily available at any given locality. (Lavazanian *et.al.* (1994).

It is considered that the subject site provides suitable foraging and low potential roosting and breeding habitat for the Powerful Owl. This species was not recorded during targeted recent surveys undertaken but has been recorded along the central northern boundary of the site in 1996 (Atlas of NSW Wildlife Database, 2009) in the same reference point (292900E: 6287050N) as the Yellow-bellied Glider record mentioned below. As this map reference point is to the nearest 50m it is assumed that it was used for all fauna records obtained for a nearby survey.

As this species is not expected to be utilising the site for roosting or nesting, provisions to retain foraging habitat within the subject site landscape would provide for a positive assessment. This would be accomplished by retaining forested remnants and medium sized hollows for arboreal prey species contained within, with connectivity linkage between both the remnant communities present. This would ensure prey species have access to year round foraging resources.

Yellow-bellied Glider

The Yellow-bellied Glider is an arboreal tree-dwelling mammal that utilises tall mature Eucalypt forests which contain high nectar producing species and hollow bearing trees (Russell 1988). The bulk of the diet of the Yellow-bellied Glider consists of plant and insect exudates including sap, nectar, honeydew and manna while arthropods and pollen are also eaten (Goldingay and Kavanagh 1991). Yellow-bellied Gliders occupy large exclusive home ranges between 30 and 65 hectares in size (Goldingay and Kavanagh 1991).

It is considered that the subject site provides suitable foraging, denning and breeding habitat for the Yellow-bellied Glider. This species was not recorded during targeted recent surveys undertaken but has been recorded along the central northern boundary of the site in 1996 (Atlas of NSW Wildlife Database, 2009) in the same reference point (292900E: 6287050N) as the Powerful Owl record mentioned above. As this map reference point is to the nearest 50m it is assumed that it was used for all fauna records obtained for a nearby survey.

Although this species was not detected during recent surveys, a nearby previous record suggests it should not be ruled out as occurring seasonally within the forested (and to a lesser extent woodland) resources present. It should be noted that the average life span of this species is six years (the record being 13 years ago) and viable populations require extensive areas forested habitat. The location of the record is within now highly fragmented and somewhat isolated habitat.

Nonetheless, provisions to retain habitat within the subject site landscape would provide a positive assessment for this species. This would be accomplished by retaining forested remnants and medium sized hollows with connectivity linkage between both the remnant communities present. This would ensure access to year round foraging resources. Suitable denning hollows were observed to be in low supply, giving additional cause to undertake detailed hollow-bearing tree surveys within the subject site following accurate land survey of trees.

If the above suggestions are not within the development concept, target surveys in a separate season would be advised in order to better rule out the presence of this species.

4.12 Habitat assessment

The following assessment is based on habitat assessment quadrats undertaken throughout the subject site with representations in each community as well as general observations.

4.12.1 Summary of site observations

An analysis of aerial photographs as well as general survey observations indicated that the majority of remnant forest and woodland areas within the subject site have been subject to varying levels of understorey disturbance. Remnant tree species within all communities present provide year round foraging resources for bird and arboreal mammal species.

The *River-flat Eucalypt Forest* along the banks of Currency Creek provides the most extensive and suitable areas of connective habitat that extends beyond the site at best to the east. This community also supports the only presence of adequate shrub level protection for various terrestrial fauna species. Surface litter, suitable burrowing soil type, vegetated creek margins and surface logs and debris provides habitat for reptile and frog species. Currency Creek shows signs of stagnance and nutrient imput which may limit frog species diversity along its margins. Small adjacent depression, possibly old river oxbows, supplement frog habitat.

The other remaining remnants are represented by *Cumberland Plain Woodland* within the northern and western portions of the site. Although these areas of woodland do provide small areas of connectivity beyond the site and into the rear of lots off Spinks Road to the north, these areas are generally highly fragmented and the degraded understorey limits movement and utilisation by many terrestrial species. Hollows were also observed to be in very low density within the woodland areas possibly due to the young nature of most trees present combined with the low hollow-bearing nature of the dominant trees Narrow-leaved Ironbark (*Eucalyptus crebra*).

SKM have recorded the presence of the endangered Cumberland Plain Land Snail within areas of *Cumberland Plain Woodland;* however the habitat for this species is only sub-optimal to poor quality throughout. Varying levels of fallen logs and litter deposits provide the fundamental habitat for this snail as well as small reptile and frog species.

Blackthorn (*Bursaria spinosa*) has been recorded as the dominant shrub species within much of the woodland community providing suitable shelter for small birds. Otherwise the dominance of weed scrub and exotic grasses within these fragmented remnants provides little habitat value within the low structures.

Several dams are located within the subject site which are currently utilised by grazing cattle and horses. Subsequently, the margins of these dams are generally degraded. Two particularly prominent large dams, one located in the eastern portion and the other in the central western portion, provide high quality habitat for the numerous recorded waterbirds present. The internal vegetation of these provides valuable and extensive foraging areas for birds and frog species.

Although no threatened species were recorded, nationally protected migratory species Cattle Egret and Great Egret were recorded foraging on the margins of these large dams. The Cattle Egrets, whilst foraging amongst host cattle within the paddocks during most of the day, were observed roosting together on an isolated stag in the middle of the large eastern dam. Restoration of the fringing habitat would provide high quality breeding habitat for such a nationally significant species and other numerous waterbirds.

Pasture with Scattered Trees was the remaining community present throughout the majority of the subject site. Although this community provided little structural habitat, most stags observed with hollows present were located within this community. At the time of survey Red-rumped Parrots were observed to be making use of hollows for early breeding activity. Many raptor bird species were recorded during survey, most likely attributed to the chicken farming activities within the site. These raptors as well as other larger and open woodland bird species were seen to utilise the scattered trees as outlook perches. This community provided little in the way of terrestrial and connective shelter habitats.

A summary of fauna habitats present throughout the site include:

- Vegetated areas of Forest and Woodland communities
- Nectar producing tree species, principally *Eucalyptus, Melaleuca* and *Acacia*
- Sparse to dense shrublayers
- Sparse to moderate density ground cover
- Large, medium and small hollows of varying quality
- Fallen logs, hollow sections and branches
- Loose soil suitable for foraging
- Perennial creek with moderate to dense riparian vegetation along the margins
- Farm dams with small areas of surface and fringing vegetation
- Sparse to dense litter layers
- Exfoliated bark on trunks and piles at the base of smooth-barked *Eucalyptus* species
- Artificial debris & refuse

4.12.2 Tree hollows

A complete assessment of the location of habitat trees and the size of hollows within was not conducted as part of ecological survey. Hollow-bearing trees and ground hollows were noted within the twelve habitat assessment quadrats undertaken to represent the vegetation communities present. Trees providing obvious hollows were also searched for whilst undertaking other surveys. All hollows observed are marked on Figure 3.

The density of hollows across the entire site was observed to be generally low although all size classes were observed to be present from small hollows (<10cm) to large hollows suitable for owl species (>30cm). One large hollow was recorded within habitat assessment quadrat 3, with other large hollows observed during general survey activities. No threatened fauna species dependent specifically on large-sized hollows were recorded within the subject site during surveys.

Medium-sized (10-30cm) hollows were recorded within habitat assessment quadrats 6 and 12 as well as during general field observations. No threatened fauna species dependent specifically on medium-sized hollows were recorded or are considered likely to occur within the subject site.

Small-sized (<10cm) hollows were recorded within habitat assessment quadrats 2, 6, 11 & 12. The maximum number of three (3) small-sized hollows was recorded within quadrat 2 which was the largest number of all hollows recorded in a single quadrat on-site. Threatened fauna species dependent on small-sized hollows that were recorded during surveys included the East-coast Freetail-bat (*Micronomus norfolkensis*) and Large-footed Myotis (*Myotis macropus*). All of the remaining seven quadrats contained no hollows.

4.13 Koala habitat assessment

Two Koala food tree species Forest Red Gum (*Eucalyptus tereticornis)* and Tallowwood (*Eucalyptus microcorys*) as listed on Schedule 2 of State Environmental Planning Policy No. 44 - Koala Habitat Protection were found within the subject site. Only Forest Red Gum exists naturally onsite which is recorded within the forest communities. These trees comprised of greater than 15% of the total number of trees within the Riverflat Eucalypt Forest and lower portions of *Cumberland Plain Woodland* and therefore are classified under SEPP 44 as 'Potential Koala Habitat'.

The Recovery Plan for the Koala (*Phascolarctos cinereus*) also supports the identification of suitable habitat. In this plan, two primary food tree species, being the same two listed above, and two Supplementary Stringybarks (*Eucalyptus eugenoides* and *Eucalyptus globoidea*) as listed in Appendix 1 of the Recovery Plan for the Koala (*Phascolarctos cinereus*) were recorded within the subject site. Koalas show a higher level of use for primary tree species, if these are absent secondary tree species may support Koala habitat at a lower carrying capacity.

Target searches were conducted within these vegetation communities along with other opportunistic methodologies throughout the subject site. No Koalas were observed during fauna surveys and there was no evidence of previous Koala habitation within the subject site. A search of the Atlas of NSW Wildlife (DECC 2009) database found 12 records of Koala habitation within a 10 km radius from the study area since 1934. The most recent record was 10km to the NNW in 2007. The closest record to the subject site is 3km to the north recorded in 2006. As such the subject site is not considered to comprise 'Core Koala Habitat' as defined under SEPP 44.

4.14 Riparian constraints

Based on a field assessment, the existing watercourses onsite include Currency creek on the southern boundary (Class 1 Watercourse – Environmental Corridor), and one minor unnamed watercourse located in the north western corner of the site (Class 3 – Water quality and Stream Protection). The Class 1 watercourse attracts a riparian buffer width of 50m not inclusive of the channel width. The Class 3 watercourse attracts a riparian buffer of 10m from top of bank.

The watercourses form part of an extended wildlife corridor network. The management of the watercourses will require significant rehabilitation works to meet DWE riparian management requirements but can be largely managed as a protect and regenerate rather than a revegetation exercise. The Currency Creek riparian corridor to a width of 50m from the top of bank contains most if not all of the remnant *River-flat Eucalypt Forest* found onsite (7.5 ha). Whilst the *River-flat Eucalypt Forest* is an endangered ecological community, it will be retained onsite within the riparian buffers. The proposed development of this site will not impact significantly on this community except for the provision of possible cross over points for site access. The total area of riparian buffer to be provided onsite is 13.2 ha.

The identified watercourses onsite are shown on Figure 3, is consistent with WorleyParsons recommended stream classifications.

Flooding constraints do however need to be taken into account when defining the extent of potential riparian corridors as the width of the riparian corridor may be extended beyond the minimum of 50 m for a category 1 Watercourse. Currency Creek is a significant environmental corridor in its own right but given that the existing uncleared vegetation is closely restricted to immediately adjoining the watercourse, we do not expect the riparian corridors to be expanded further than the minimum requirements.

An additional consideration is the provision of buffers against the major waterbodies onsite. The reason for this is that two largest dams onsite are high value habitat for migratory waterbirds and threatened micro-chiropteran species foraging and roosting onsite. They are also likely to provide habitat for aquatic species such as freshwater turtles and a fisheries assessment and permit would be required if removing or modifying the existing waterbodies.

To protect the water quality of these basins and to provide a protected environment for habitat purposes, the existing large waterbodies on site would attract a minimum buffer of 10 m from top of bank. Flooding considerations during a major storm event may require the upper reaches of the basins to be protected beyond 10 m. For habitat protection purposes this report recommends generally a 20 m vegetated buffer surrounding the two large water bodies. This will provide protection for migratory waterbirds and microbats. The eastern most of the two water bodies has been given a variable buffer width which approximately equates to the 42m AHD contour. This contour captures the upslope portion of the dam which is typically inundated at top water level in the existing dam.



Hawkesbury Council is required to consider the impact upon threatened species, populations and or endangered ecological communities from any development or activity via the process of a 7 part test of significance. The significance of the assessment is then used to determine the need for a more detailed Species Impact Statement (SIS).

There is currently no development proposal formulated for the subject site. A combined development layout will be produced for assessment and application purposes at a later date. A seven part test of significance can therefore not be assessed to a specific proposal. The following are points to consider relevant to future seven part test assessment.

5.1 Flora assessment

In summary and following the field habitat assessment it is considered that the subject site provides habitat for the following threatened flora species:

- *Acacia pubescens*
- *Cynanchum elegans*
- *Dillwynia tenuifolia*
- *Persoonia nutans*
- *Pimelea spicata (recorded onsite)*
- *Pultenaea parviflora*

Species indicated with a '*' were recorded within the subject site during surveys. Despite the presence of potential habitat, the remaining listed species were not recorded during the flora and fauna survey. It should be noted that *Pimelea spicata* was identified by *SKM. Travers bushfire & ecology* did not locate this specimen within the subject site.

An assessment of individual threatened species with available habitat present should consider if a proposed development is likely to place a local population at risk of extinction. Furthermore, in the assessment of these species, the seven part test requires consideration to the amount of habitat removed, the impact of isolation and further fragmentation and the importance of habitat removed.

There is one endangered flora population within the Hawkesbury LGA, namely, *Keraudrenia corrolata var. denticulata* in the Hawkesbury Local Government Area

Keraudrenia corrolata var. denticulata is unlikely to occur as it favours sandstone soils which are prominent north of the site, from Wilberforce. Despite searches undertaken for this species within the subject site, no specimens were located.

- The subject site does not constitute as 'Critical Habitat' as listed by the TSC Act (1995) for any threatened species (flora or fauna) or community.

- A seven-part test of significance will also require consideration as to whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

- Approved recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

    - *Acacia pubescens* (DECC 2003)
    - *Persoonia nutans* (DECC 2007)
    - *Pimelea spicata* (DECC 2006)

Of these species listed above, *Pimelea spicata* has been previously recorded within the subject site. Any proposed development would be considered consistent with the objectives or actions of these recovery plans if a suitable area of forested habitat is retained (and possibly restored) with a consideration of connectivity to adjacent resources.

Another ecological consideration of a seven-part test of significance is the potential for 'key threatening processes' listed under the TSC Act (1995). These are described in 5.2.

Two (2) EECs were recorded on site – *Cumberland Plain Woodland and River-flat Eucalypt Forest on Coastal Floodplains.*

- *Cumberland Plain Woodland* – Most vegetation remnants within *Jacaranda Ponds* not associated with the riparian vegetation are of this type. This EEC was preliminarily listed as a *critically endangered ecological community.* Removal of this vegetation type would also require a submission under the *EPBC Act* (1999) as it is nationally listed.

  Cumberland Plain Woodland remnants across the site occur in a wide range of conditions from simple regrowth of *Bursaria spinosa* (the most common shrub species in this community) to good condition. A preliminary condition assessment was conducted onsite as shown in Figure 2.

  The site planning will have to retain most of these nominated remnants due to preliminary listing for a critically endangered community, hosting potential for a number of threatened flora and fauna species and potential vegetation connectivity for fauna habitat such as the Yellow Bellied Glider and as a potential seed bank for various threatened flora species.

- *River-flat Eucalypt Forest on Coastal Floodplains* – The vegetation associated with this EEC primarily occurs on the banks of Currency Creek and its associated flood zone. The vegetation west of the existing southern site entrance is generally in poor condition with low native species diversity, grazing animals present and some invasive exotic weeds. The vegetation east of the southern entrance to the site is in a moderate condition with a higher diversity of native flora species. The vegetation is in part impeded by some invasive exotic weeds such as Moth Vine, Bridal Creeper and Lantana.

  The site planning will generally require a riparian zone off Currency Creek due to creek categorisation as a Class 1 – Environmental Corridor and the potential for flooding. This would ensure the protection of *River-flat Eucalypt Forest* insitu within those areas shown on Figure 3 apart from some very small and low quality remnants.

5.2 Fauna assessment

In summary and following the field habitat assessment it is considered that the subject site provides habitat for the following fauna species:

- Green and Golden Bell Frog
- Square-tailed Kite
- Black-necked Stork
- Comb-crested Jacana
- Painted Snipe
- Freckled Duck
- Bush Stone-curlew
- Glossy Black-Cockatoo
- Gang-gang Cockatoo
- Swift Parrot
- Turquoise Parrot
- Painted Honeyeater
- Regent Honeyeater
- Barking Owl
- Powerful Owl
- Masked Owl
- Speckled Warbler
- Black-chinned Honeyeater
- Brown Treecreeper
- Spotted-tailed Quoll
- Koala
- Squirrel Glider
- Yellow-bellied Glider
- Grey-headed Flying-fox
- Large-footed Myotis *
- Eastern Bentwing-bat *
- Greater Broad-nosed Bat
- East-coast Freetail Bat *
- Eastern Falsistrelle
- Large-eared Pied Bat
- Macquarie Perch
- Cumberland Plain Land Snail

Species indicated with a '*' were recorded within the subject site during surveys. Despite the presence of potential habitat, the remaining listed species were not recorded during the flora and fauna survey.

An assessment of individual threatened species with available habitat present should consider if a proposed development is likely to place a local population at risk of extinction. Furthermore, in the assessment of these species, the seven part test requires consideration to the amount of habitat removed, the impact of isolation and further fragmentation and the importance of habitat removed. Refer to Section 4.10 of this report for a preliminary assessment background of threatened species recorded on site. In essence:-

- There is no listed endangered fauna population within the Hawkesbury LGA;
- The subject site does not constitute as 'Critical Habitat' as listed by the TSC Act (1995) for any threatened species (flora or fauna) or community; and
- A seven-part test of significance will also require consideration as to whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Draft recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Barking Owl *(Ninox connivens)* (DECC, 2003)
- Green and Golden Bell Frog *(Litoria aurea)* (DECC, 2005)
- Koala *(Phascolarctos cinereus)* (DECC, 2003)

Approved recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Bush Stone Curlew (*Burhinus grallarius*) (DECC 2006)
- Large Forest Owls (Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*) (DECC 2006))
- Yellow-bellied Glider (*Petaurus australis*) (DECC 2003)

Of these species listed above, the Powerful Owl and Yellow-bellied Glider have been previously recorded within close proximity to the subject site. Any proposed development would be considered consistent with the objectives or actions of these recovery plans if a suitable area of forested habitat is retained with a consideration of connectivity to adjacent resources.

Another ecological consideration of a seven-part test of significance is the potential for 'key threatening processes' listed under the TSC Act (1995). The following threatening processes are considered likely relevant to proposed development within the subject site:-

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Clearing of native vegetation
- Infection of frogs by amphibian *chytrid* causing the disease *chytridiomycosis*
- Infection of native plants by *Phytophthora cinnamomi*
- Invasion and establishment of exotic vines and scramblers
- Invasion of native plant communities by exotic perennial grasses
- Invasion, establishment and spread of *Lantana camara*
- Loss of hollow-bearing trees
- Predation by the Feral Cat (*Felis catus*)
- Removal of dead wood and dead trees

None of these processes are likely to provide a significant constraint within this site.



6.1 Conclusions

It is concluded that any proposed development for the lots incorporated into the *Jacaranda Ponds* landscape would be constrained by the presence of the following ecological features:

- **Two (2) large dams** providing high quality aquatic habitat for a diversity of bird species including waterfowl, waders and migratory species of national significance. These habitats also have potential to be utilised seasonally by listed threatened species. The surrounding foreshore area of the dams will need to be protected by a minimum natural habitat buffer of 20m for the restoration of fringing vegetation, roosting and foraging habitat. The eastern most of the two water bodies has been given a variable buffer width which approximately equates to the 42m AHD contour.
- **Two (2) endangered ecological communities** – *Cumberland Plain Woodland* and *River-flat Eucalypt Forest on Coastal Floodplains* were recorded. It is likely that the *River-flat Eucalypt Forest on Coastal Floodplains* along Currency Creek will be fully retained due to riparian constraints imposed by DWE and flood prone land restrictions. Due to the preliminary critical habitat status listing for the *Endangered Ecological Community - Cumberland Plain Woodland,* the proponent will have to demonstrate an outcome which would achieve a no net loss of *Cumberland Plain Woodland.* Any removal of *Cumberland Plain Woodland* could be considered a significant impact requiring a protection offset and or a restoration offset at a minimum ratio of 3:1.
- **Hollow-bearing trees** providing suitable habitat for recorded threatened micro-chiropteran bats and other hollow-dependent species. A detailed hollow-bearing tree assessment based on land surveyed trees should be undertaken to determine actual locations and densities of hollows present. Planning provisions should retain representatives of mixed size classes of hollows within and in close proximity to medium and high quality vegetation remnants, water resources and connected vegetation.
- **Riparian Buffers** for the existing watercourses onsite including Currency Creek on the southern boundary (Class 1 Watercourse – Environmental Corridor), and one minor unnamed watercourse located in the north western corner of the site (Class 3 – Water quality and Stream Protection). The Environmental Corridor attracts a riparian buffer width of 50m not inclusive of the channel width. The Class 3 watercourses attract a riparian buffer of 10m from top of bank.

Based on the proposed vegetation management strategy (as illustrated on Figure 3), approximately 52 ha of land would need to be set aside for conservation purposes including the proposed wildlife corridors, riparian buffers, dams and associated buffers, and pockets of retained native vegetation.

The total area of land to be set aside for conservation purposes is dependent on whether development of the site is intended to remove vegetation. At this point the Vegetation

Management Strategy assumes that 7 ha of vegetation is removed which is to be offset with restoration at a ratio of 3:1, that is, 21 ha.

Environmental Planning & Assessment Act 1979 & Threatened Species Conservation Act 1995

In respect of matters required to be considered under the *Environmental Planning & Assessment Act* (1979) and relating to the species / provisions of the *Threatened Species Conservation Act* (1995);

- Three (3) threatened fauna species, East-coast Freetail-bat (*Micronomus norfolkensis*), Eastern Bentwing-bat (*Miniopterus schreibersii oceansis*) and Large-footed Myotis (*Myotis macropus*) were recorded within the subject site; one threatened mollusc – Cumberland Plain Land Snail (*Meridolum corneovirens*) was previously recorded onsite by SKM (2009).

- One (1) threatened flora species, *Pimelea spicata* was recorded (by SKM) within or in close proximity to the subject site; and

- Two (2) endangered ecological communities, *Cumberland Plain Woodland and River-flat Eucalypt Forest on Coastal Floodplains* were recorded within or in close proximity to the subject site.

In regard to the Cumberland Plain Land Snail (*Meridolum corneovirens*); this species was recorded by SKM within remnants of *Cumberland Plain Woodland,* being its typical host community. Samples were not independently verified. Snail Shells were collected by *Travers bushfire &ecology* for verification purposes and independently verified by Michael Shea (Australian Museum) that the samples were *Pommerhelix* species.

This is a very important issue as the presence of Cumberland Plain Land Snail raises the conservation value of the existing remnants significantly. Further targeted searches in more appropriated conditions (during and following rain) are recommended to provide a conclusive assessment of whether this species is present onsite.

Environment Protection and Biodiversity Conservation Act 1999

In respect of matters required to be considered under the *Environment Protection and Biodiversity Conservation Act* (1999):

- No threatened fauna species were recorded within the subject site;

- Two (2) migratory fauna species listed under the EPBC Act (1999) - Cattle Egret (*Ardea ibis*) and Great Egret (*Ardea alba*) were recorded within the subject site.

- One (1) threatened flora species, *Pimelea spicata* was recorded (by SKM) within or in close proximity to the subject site; and

- One (1) endangered ecological community, *Cumberland Plain Woodland were* recorded within or in close proximity to the subject site.

- No endangered populations were recorded on site or considered likely to occur.

Fisheries Management Act 1994

In respect of matters relative to the *Fisheries Management Act 1994*, the proposed activity is not located in an area identified as critical habitat. It is assumed there will be no detrimental effect on water quality, water quantity or any direct / indirect impacts upon threatened fish species habitat or Macquarie Perch, from the proposed action. Given this, a Species Impact Statement should not be required for the proposed development in regard to fish species.

6.2 Proposed vegetation management strategy

We have prepared a series of figures which identifies the existing flora and fauna constraints onsite, the condition of the remnant vegetation and a potential corridor strategy that promotes vegetative connectivity.

The importance of the vegetation management strategy is to maximise the retention of medium and high quality vegetation onsite (which cannot be removed under the TSC Act). The areas of low condition vegetation onsite (0.7 ha) ha can be removed.

The Vegetation Management Strategy as proposed has 4 components:-

- Protection of existing *Cumberland Plain Woodland* in either a wildlife corridor or retained vegetation and within lot habitat; Total Existing Area of *Cumberland Plain Woodland* – 18.4 ha
- If required, offset any removed *Cumberland Plain Woodland* by providing a high quality restoration outcome – Offset Ratio of 3:1;
- Protection and restoration of *River-flat Eucalypt Forest* within the designated riparian corridors – Total area of *River-flat Eucalypt Forest* will increase from 7.45 ha to 13 ha.
- Protection of the roosting and foraging habitat of the recorded threatened fauna within two major waterbird reserves – Total Area 6.5 ha.

Based on a preliminary offset analysis the optimum conservation area to achieve onsite would be in the order of 52 ha. This will enable up to 7 ha of existing *Cumberland Plain Woodland* to be removed to take advantage of location and ridgeline building positions for residential purposes. 13 ha of *River-flat Eucalypt Forest on Coastal Floodplains* can be provided along Currency Creek and 6.5 ha of Waterbird habitat on the two major water bodies. An estimated total area of 51.9 ha would be used for conservation purposes, which includes the two existing large water bodies, the riparian corridor and protected and restored vegetation onsite.

The provision of vegetated corridors is seen by the DECC and Hawkesbury Council as an important strategy to overcome restricted movement corridors for wildlife that require movement to expand their available foraging resources and to migrate in the event of progressive climate change. The proposed wildlife corridor aims to link external remnants surrounding the site with creeks and ridgeline vegetation. This means that a vegetated link is provided between the Currency Creek Catchment and the Howes Creek Catchment to the north.

The existing vegetation is generally found in discontinuous clumps on either side of the north-western ridgeline. Whilst there have been significant amounts of vegetation removed within and surrounding these remnants, they have a high level of natural resilience and will regenerate quickly if grazing pressures are removed. Weed management would be required to promote a natural condition.

The proposed corridors cover an area of 22 ha which includes a large portion of the existing *Cumberland Plain Woodland.* Figure 3 shows two corridors providing connectivity across the site. The first and more major corridor has been placed on the northern side of the existing ridge to take advantage existing native vegetation on adjoining lots to the north of the site. Connectivity is provided to the north and to the western boundary with a minimum width of 70m. The second corridor is 50 m in width and links the northern and southern boundaries of the site taking advantage of existing *Cumberland Plain Woodland* remnants in the eastern portion of the site.

Note these corridors would require bushfire asset protection. Consequently asset protection zones would impact into the developable area.

As shown on Figure 3 an additional 7 ha would also need to be protected insitu in the form of retained vegetation or within-lot habitat on large lots.

6.3 Recommendations

The following recommendations are made in order to promote an ecologically sustainable approach to the management of the site.

- To adopt a Vegetation Management Strategy that conserves approximate 51.9 ha of the site in the form of wildlife corridors, riparian corridors, retained vegetation and Waterbird Reserves (Figure 3). Areas of known threatened species records should be retained onsite within protected areas.

- Ongoing ecological site management of the site would need to be firmly incorporated within the sites development and managed in the form of a Vegetation Management Plan.

- Ecological site management would need to include restoration of native vegetation within the proposed riparian corridor, the two wildlife corridors, within a 20 m buffer adjoining the two large dams to be retained onsite and within natural retained vegetation to be retained. Restoration works will need to specifically restore *Cumberland Plain Woodland* and River-flat Eucalypt Forest vegetation communities' onsite.

- In regard to the Cumberland Plain Land Snail (*Meridolum corneovirens*); this species was recorded by SKM within remnants of *Cumberland Plain Woodland,* being its typical host community. Whilst there are records of Cumberland Plain Land Snail in the locality, Glossodia is considered to be on the extremity of the known range of Cumberland Plain Snail. The site is the within the known range of *Pommerhelix sp.*, another snail of similar appearance and closely related, however the two species are not typically found in sympatry (together) with Cumberland Plain Land Snail. Verification of previous samples collected by SKM was not obtained, as such further targeted searches in more appropriated conditions (during and following rain) is recommended to provide a conclusive assessment for this species.

- Subject to confirmation of Cumberland Plain Land Snail within the site, any proposed development within the subject site would be required to consider and ensure the longevity where a local population is present. This would require conserving representations of remnant communities where the species has been detected, restoring suitability of habitat within these and ensuring adequate connectivity to adjacent areas of more extensive suitable habitat is restored.

- A comprehensive assessment of hollow bearing trees will be required to identify the potential impact of the proposed development on threatened hollow dependent threatened species for the Section 5A assessment of the EPA Act - 7 part test.

- Stormwater management of the site will need to achieve a maintain or improve outcome in the management of water quality onsite. Given the migratory and threatened fauna habitat value of the two existing main dams onsite, the dams to be retained should not be seen as water quality or quantity treatment systems even though they will contribute to water quality and retention onsite. A general improvement in water quality would need to be achieved prior to the delivery of water into the two main dams.

Suitability of the site for development options is dependent on an iterative design process. However large portions (approximately 127 ha) of the site are ecologically unconstrained due to the lack of native vegetation (Figure 3).

The existing vegetation onsite has largely a medium to high quality condition classification and consequently large portions of the site's vegetation will need to be retained. A rigorous vegetation condition assessment based on the Biometric method would need to be undertaken to support the removal of any low quality stands of vegetation.

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F1 FLORA & FAUNA SURVEY EFFORT

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Flora and fauna survey locations are approximate and have not been fixed by land survey

*Subject Site boundary subject to final survey

Travers bushfire & ecology
38A, The Avenue, Mt. Penang Parklands,
Central Coast Highway, Kariong NSW 2250
Ph (02) 4340 5331 Fax (02) 4340 2151
e-mail: info@traversecology.com.au

0 100 200 300 400 500 m

1:8,000

Original produced in A3 colour

Drawing No.	9064	Date
Drawn By	TM/KF	04/09/09
Amendment		Date
A		
B		
C		

Figure 1 -

Flora & Fauna Survey Effort

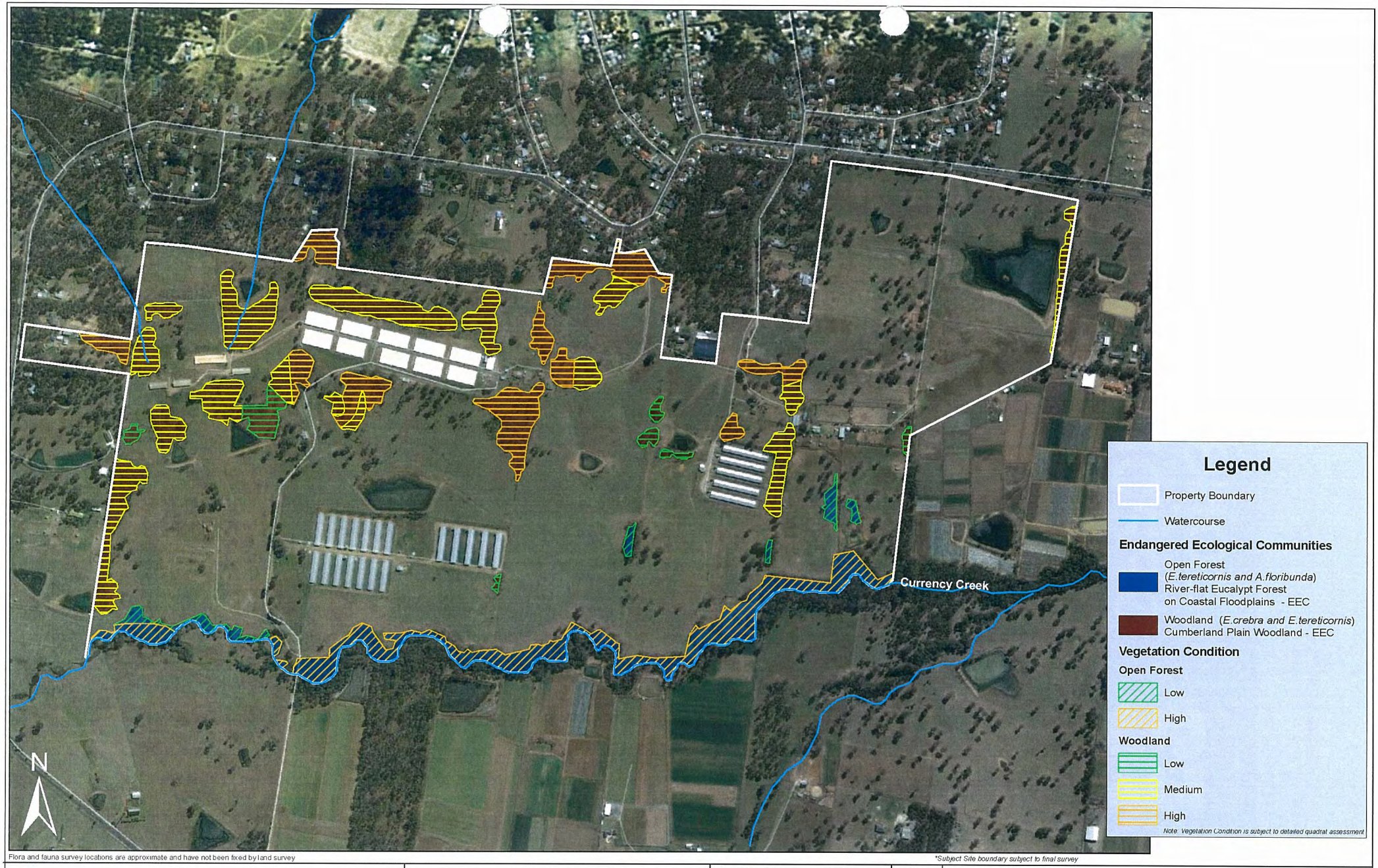
Jacaranda Ponds, Glossodia

Source: Google Earth Pro, Satellite Imagery

Location: N:\9064


F2
VEGETATION
CONDITION

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0 100 200 300 400 500 m

1:8,000

Original plan produced in A3 colour

Drawing No.	9064	Date
Drawn By	KF	1/09/09
Amendment		Date
A		
B		
C		

Figure 2 -

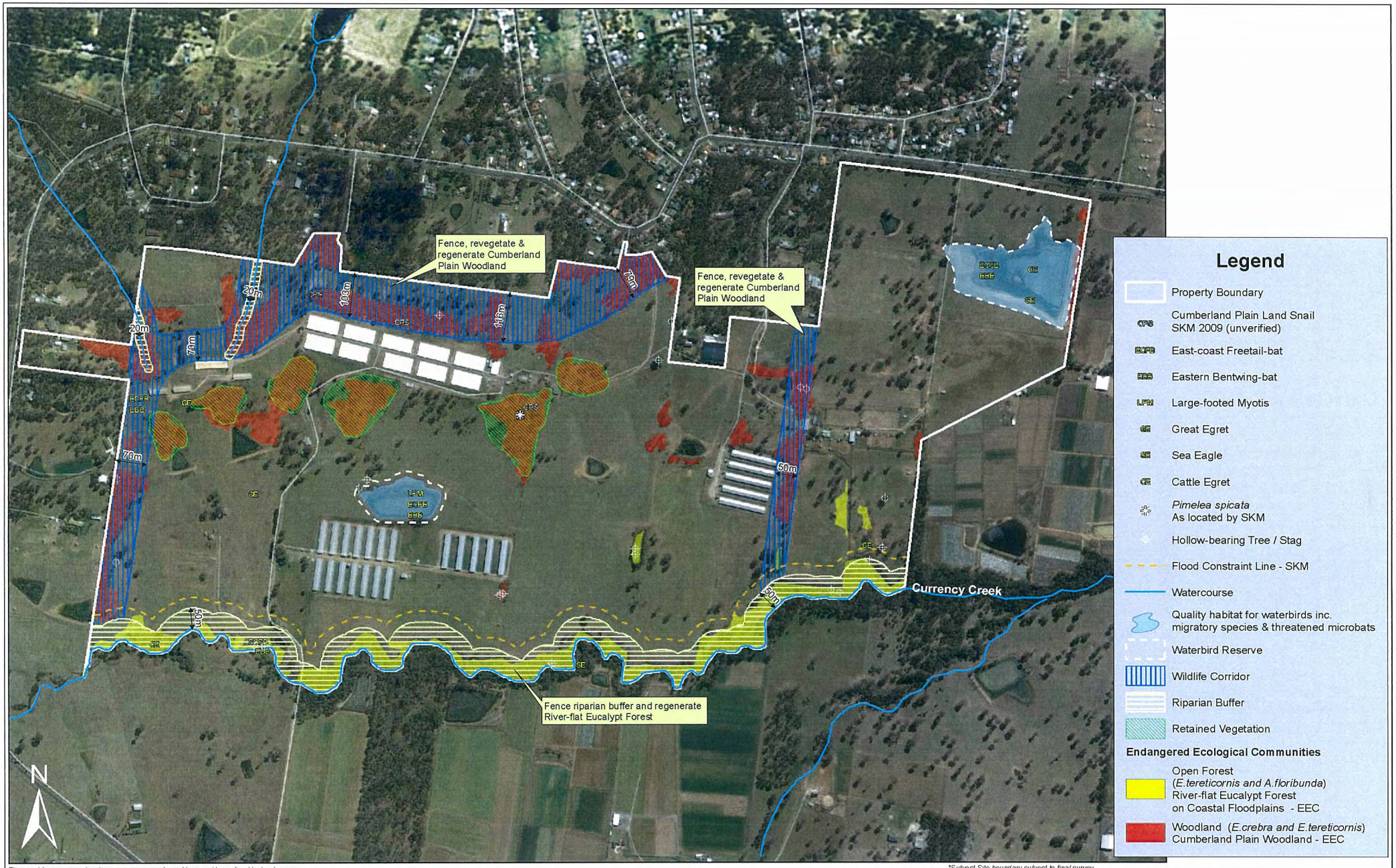
Vegetation Condition

Jacaranda Ponds, Glossodia

Source: Google Earth Pro, Satellite Imagery Location: N:/9064


F3
CONSTRAINTS/
OPPORTUNITIES

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Flora and fauna survey locations are approximate and have not been fixed by land survey

*Subject Site boundary subject to final survey

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0 100 200 300 400 500 m

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Original produced in A3 colour

Drawing No.	9064	Date
Drawn By	KF/TM	04/09/09
Amendment		Date
A		
B		
C		

Figure 3 -
Constraints / Opportunities
Jacaranda Ponds, Glossodia

Source: Google Earth Pro, Satellite Imagery

Location: N:\9064