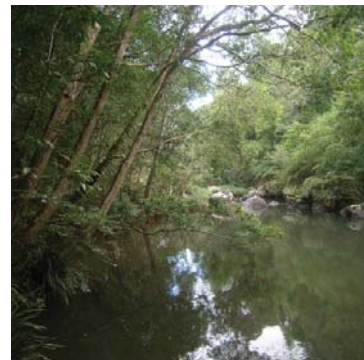


# Dunoon Dam Terrestrial Ecology Impact Assessment



Project Name:	Dunoon Terrestrial Ecology Impact Assessment
Project Number:	3001803
Report for:	Rous Water

#### PREPARATION, REVIEW AND AUTHORISATION

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# **Dunoon Terrestrial Ecology Impact Assessment**

**For: Rous Water**  
**NOVEMBER 22<sup>ND</sup> 2011**

## EXECUTIVE SUMMARY

Rous Water is investigating the feasibility of new water storage near Dunoon in north-eastern NSW. The proposed Dunoon Dam will cover an area of 253 hectares (ha) within a natural valley to the west of the Dunoon township. The dam area will be encompassed by a vegetated buffer zone that extends around the immediate dam catchment, approximately to the highest parts of the valley. The location of the proposed dam is on Rocky Creek, downstream from an existing water catchment dam, Rocky Creek Dam, and approximately 2.5 km west of the village of Dunoon, in north eastern NSW (Figure 1).

SMEC Australia Pty Ltd (SMEC) was commissioned to undertake a survey and assessment of the terrestrial ecology at the proposed Dunoon Dam study area. The study area encompassed the proposed footprint of the dam, the buffer region surrounding this footprint and associated access to the dam wall area. The assessment included the identification of ecological constraints, such as the occurrence of threatened terrestrial species, populations and communities to inform feasibility assessments and concept planning for the dam. It also assessed potential impacts of the proposed dam, should it proceed, to provide a technical supporting document for any subsequent environmental assessment prepared for the proposal.

The study consisted of a desktop assessment and seasonal flora and fauna surveys (Field surveys were undertaken April 2010 - October 2010). The surveys targeted threatened species within the study area, and were undertaken by the SMEC team with the assistance and expertise of local specialists. Meetings with the project reference group (PRG) were also undertaken to provide information on the project as well as obtain information for the study from the local community. Local landholders also provided valuable input on historical fauna records and access to the study area.

The study area is characterised by extensively cleared agricultural land containing remnant fragments of native vegetation occurring primarily along riparian corridors and a larger fragment within the sandstone escarpments of the west and south of the proposed dam wall. The condition of native vegetation and habitat varied from poor (areas infested with exotic species) to good (less accessible areas around the proposed dam wall), depending on the level of historic clearing and disturbance from agricultural activities.

One endangered ecological community (EEC), Lowland Rainforest which is listed under the *Threatened Species Conservation Act 1995* (TSC Act), was recorded during field investigations. In addition, nine flora and 17 fauna species (including one frog, one mammal, one fruit-bat, six microbats and eight birds) listed as threatened in NSW under the TSC Act were also recorded. Of these species, eight flora and one fauna species are also listed nationally under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An additional seven fauna species listed as migratory or marine under the EPBC Act as well as two Rare or Threatened Australian Plants (RoTAP) and three regionally significant plant species were also recorded.

The proposed dam would clear a total of 272 ha of vegetation, of which 57 ha is predominantly native. This accounts for 92 per cent of Warm Temperate Rainforest, 50 per cent of Subtropical Rainforest (a total of 34 ha of Lowland Rainforest EEC), 40 per cent of Tallowwood Open Forest and 30 per cent of Flooded Gum-Tallowwood-Brush box Open Forest within the study area. The loss of rainforest communities is considered to be particularly significant, given the regional history of clearance for timber and plantations and thus fragmented nature of the remnants of these communities.

The dam would remove important habitat features and local linkages for threatened fauna species. In particular, movement pathways for the threatened Koala will be impeded from the installation of the dam wall, spillway, and the inundation area. Loss of feeding

resources for the listed Grey-headed Flying Fox, Rose-crowned Fruit-dove and White-eared Monarch and nesting resources for migratory birds from the removal of rainforest and *Camphor laurel* communities is also likely to be significant within the study area. Further, the loss of foraging resources provided within the dry sclerophyll forests, which are rare in the region, will impact on the threatened Glossy-black Cockatoo and Scarlet Robin. Loveridge's Frog (*Philoria loveridgei*) was also found just outside the footprint of the proposed dam at a lower elevation and more southerly point than has been previously recorded. Habitat for this species may also be impacted by the proposal.

The works will also remove threatened flora species within the inundation and dam infrastructure areas and their habitat. There is also the potential for indirect impacts through key threatening processes such as the spread of *Lantana camera* and dieback caused by the root-rot fungus (*Phytophthora cinnamomi*).

Assessment of the impacts (without mitigation) has determined that the works will significantly impact all threatened flora species detected (nine species) and 15 of the recorded threatened fauna species and their habitat within the study area. These potentially significant impacts can be mitigated through:

- design considerations to avoid significant areas and maintaining flow regimes to the riparian ecosystems downstream via environmental flows;
- limiting the construction footprint where possible during construction;
- undertaking clearing works outside the main threatened fauna breeding and dispersal periods;
- surveys to locate all threatened flora species prior to clearing works, seed collection and translocation where appropriate;
- re-instate cleared fauna habitat features within the buffer (hollow logs, fruit-bearing tree, rocks etc);
- rehabilitate the buffer area prior to construction works;
- investigate the replacement of hollow-bearing trees to be removed within the buffer (e.g. nest boxes);
- a two-stage clearing approach should be adopted for hollow-bearing trees, with an ecologist onsite for fauna rescue;
- a Construction Environmental Management Plan (CEMP) with a dedicated Flora and Fauna Management Sub-plan (FFMS); and
- weed control undertaken prior to construction.

However, residual impacts that cannot be minimised to acceptable levels through mitigation will still be present. Significant impacts are still likely to occur as a result of:

- loss of Lowland Rainforest EEC;
- loss of threatened flora species and ROTAP species;
- loss of threatened fauna habitats; and
- Severance of local wildlife corridors.

Habitat and conservation offsets are an option to compensate for these significant impacts to terrestrial biodiversity as a result of the proposed dam. The buffer area surrounding the dam could be used as an offset for the dam, however additional areas may also be required to be reserved for conservation, managed and improved as part of an offset package for the dam, should it proceed. An Offset Strategy could be prepared detailing the location of offsets, ecological restoration requirements, and ongoing management requirements and to investigate opportunities to improve the habitat linkage between Nightcap National Park (5km to the north and a listed World Heritage Area) along Rocky Creek to the dam site.

Although the proposal is likely to have a significant impact on important vegetation within the study area (both endangered ecological communities and habitat for threatened species), there are also large areas within the study area and around it that were once rainforest or wet sclerophyll forest but are now infested with weeds. These areas could benefit from improved management as part of offsets for the project. This has the potential to reduce the significance of the impact of the dam, if managed appropriately. Further assessment of these options would be required prior to seeking project approval.

The report concludes that a Species Impact Statement would be required if the project was to proceed. An alternative to this is the use of the NSW BioBanking Scheme (DECCW 2009b). This scheme is a voluntary alternative to the traditional impact assessment system that calculates impacts (credits required) that the proponent then buys from a BioBanking credit provider. These must be “like for like” in terms of the potential impacts on the ecosystems. The NSW planning system is currently under review and the Part 3A major projects State Environmental Planning Policy (SEPP Infrastructure) is now no longer in operation. This was the system in which this report was originally commissioned. If the project was to proceed, it may be down a similar major projects pathway, and information in this report could be used to inform the terrestrial ecology component of an application within this framework, but this system may be quite different by the time this project moves forward.

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## ABBREVIATIONS AND DEFINITIONS

API	Aerial Photograph Interpretation
BioBanking	A market-based scheme that provides a streamlined biodiversity assessment process for development, a rigorous and credible offsetting scheme as well as an opportunity for rural landowners to generate income by managing land for conservation.
Bioregion	An area constituting a natural ecological community with characteristic flora, fauna, and environmental conditions and bounded by natural rather than artificial borders.
“the brief”	Terrestrial Ecology Impact Assessment for the Proposed Dunoon Dam: Consultants Brief (Rous Water December 2009).
BRS	Buffer Revegetation Sub-plan
CAMBA	China-Australia Migratory Bird Agreement
CAVS	Census of Australian Vertebrates
CMA	Catchment Management Authority
CRA	Comprehensive Regional Assessment
DECC	NSW Department of Environment and Climate Change (currently Office of Environment and Heritage)
DECCW	Department of Environment, Climate Change and Water, now Office of Environment and Heritage
DEWHA	Commonwealth Department of the Environment, Water, Heritage and the Arts (currently DSEWPC)
DI&I	NSW Department of Industries and Investment
DoP	NSW Department of Planning
DPI	NSW Department of Primary Industries (formerly NSW Fisheries, currently DI&I)
DSEWPC	Australian Government Department of Sustainability, Environment, Water, Population and Communities (formerly DEWHA)
Dunoon Dam	The proposed Dunoon Dam, located approximately 1.5 km north west of the town of Dunoon, near Lismore NSW, includes the maximum inundation area of the new dam.
Epiphytes	An epiphyte is a plant that normally grows on another plant for support. It is not parasitic, but uses the host plant for support only.
EIS	Environmental Impact Statement
EPandA Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
FFMP	Flora and Fauna Management Plan
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectares
Hot spot	Areas rich in endemic plants and animals and containing a high diversity of species.
IBRA	Interim Biogeographic Regionalisation of Australia
Potential impact area	The area likely to be impacted by construction works associated with the dam wall, spillway and access to the study area, as well as the maximum inundation area if the dam goes ahead.
IUCN	International Union for the Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
Km	Kilometre
KTP	Key Threatening Process listed under the TSC Act and EPBC Act
L	Litre
LGA	Local Government Authority
m	metre

MNES	Matters of National Environmental Significance (under the EPBC Act)
NPWS	NSW National Parks and Wildlife Service (part of OEH)
NW Act	<i>Noxious Weeds Act 1993</i>
OEH	Office of Environment and Heritage (as of 2011)
Offset (biodiversity)	A biodiversity offset is one or more appropriate actions that are put in place to counterbalance specific impacts on biodiversity. Appropriate actions are long-term management activities to improve biodiversity conservation. This can include legal protection of land to ensure security of management actions and remove threats.
ROKAMBA	Republic of Korea - Australia Migratory Bird Agreement
RoTAP	Rare or Threatened Australian Plant
SEPP	NSW State Environmental Planning Policy
SIS	Species Impact Statement
sp.	Species (singular)
SPOT Assessment	Koala activity indicator method using faecal pellet identification developed by Phillips and Callaghan (1995)
spp.	Species (plural)
ssp.	Subspecies
Study area	The study area encompasses the proposed Dunoon Dam and the buffer area as identified by Hydrosphere (2009).
TSC Act	<i>NSW Threatened Species Conservation Act 1995</i>
var.	Variety

## Acknowledgements

SMEC would like to thank all the community members (especially surrounding landholders) who have provided invaluable local knowledge and assistance for this project. We would like to also thank all the local residents of the study area who provided access to the field team throughout the study.

SMEC would also like to thank project manager Rob Cawley from Rous Water and Margaret Balandin from NSW Public Works for their assistance with the running of the project and access arrangements. Thanks also to Rous Water bushcare staff for sharing local knowledge of the site and its surrounds.

# 1 INTRODUCTION

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## 1.1 Background

Rous Water Regional Water Supply (Rous Water) is the regional water supply authority providing potable water in bulk to the Council areas of Lismore (excluding Nimbin), Ballina (excluding Wardell), Byron (excluding Mullumbimby) and Richmond Valley (excluding land to the west of Coraki).

The Rous Regional Water Supply Strategy, commissioned in the 1990's, identified the need for an additional dam for future water requirements in the Lismore area. The proposed dam, Dunoon Dam, is planned to be located on Rocky Creek west of the village of Dunoon on the New South Wales (NSW) North Coast.

The dam proposal is still in the feasibility stage, with environmental constraints currently being investigated to assist in viability assessment, and the development of a suitable concept design for the project. One of the environmental constraints being investigated for the viability assessment is the terrestrial ecosystems of the proposed dam area. This investigation aims to determine the presence of significant terrestrial flora, fauna and ecological communities within the proposed dam inundation area and its surrounds to feed into the concept planning process and subsequently be utilised should Rous Water endorse the proposed dam and then seek project approval.

The current document provides the required investigation in the form of a Terrestrial Ecology Impact Assessment (TEIA) for Rous Water. The key aims of the TEIA are to:

- Describe the terrestrial ecology of the study area;
- Identify the potential impacts on terrestrial ecology due to the proposal;
- Identify potential mitigation measures; and
- Assess the significance of the potential impacts for future planning approvals.

## 1.2 Planning Context

In October 2011, a new assessment system for projects of State significance commenced in New South Wales, replacing the former Part 3A process for major projects under the *Environmental Planning and Assessment Act 1979*.

The system establishes two separate assessment frameworks for State significant development (SSD) and State significant infrastructure (SSI). Projects that fall within these categories will be assessed by the Department of Planning and Infrastructure (DP&I) and determined by the Minister.

Schedule 3 of the State and Regional Development State Environmental Planning Policy (SEPP) lists the general categories of SSI and clause 4(1) comprises:

*“Development for the purpose of water storage or water treatment facilities (not including desalination plants) carried out by or on behalf of a public authority that has a capital investment value of more than \$30 million”.*

As Rous Water is a public authority, the proposed Dunoon Dam would be classified as SSI.

Part 10 of the Environmental Planning and Assessment Regulation 2000 sets out the application and notification process for SSI and content requirements for the application.

Summary of the SSI assessment process:

- Make a proposal application to DP&I for SSI in accordance with Section 5.1 of the EPandA Act and DP&I requirements listed on website.
- Once a proposal has been received by DP&I, it will consult with relevant public authorities including local councils to provide input to the preparation of the Director-General's environmental assessment requirements (DGRs) for an environmental impact statement (EIS).
- DP&I may also hold a Planning Focus Meeting with key agencies prior to finalising the DGRs.
- DGRs will be issued within 28 days of receiving the application.
- The proponent must adequately address the DGRs in the EIS.
- The department will publically exhibit the proposal for a minimum of 30 days, and advertise the exhibition in a locally distributed newspaper.

The new SSI process allows for the approval of infrastructure proposals to be staged. Under this process, an applicant may receive approval for an initial concept proposal, with subsequent stages of the infrastructure requiring separate applications and approvals.

SSI proposals are not integrated development and do not require the concurrence of other state agencies. Some approvals from state agencies under other legislation are not required and some other approvals must not be refused and must be substantially consistent with the SSI approval.

However it must be noted that the NSW government is currently undertaking a review of the entire planning system in NSW which is likely to result in a new act to replace the EPandA Act. Therefore it is highly probable that the planning pathway for the Dunoon Dam will alter and up to date advice should be sought closer to the time when planning approval is required.

### 1.2.3 Study Area Overview

The proposed Dunoon Dam occurs within the North-east Bioregion, within the Northern Rivers CMA and Richmond-Tweed (Qld - Scenic Rim) (Part A) CMA sub-region. It will be located on Rocky Creek, downstream from the an existing water catchment dam, Rocky Creek Dam, and approximately 2.5 km west of the village of Dunoon (**Figure 1**).

Rocky Creek is one of several streams draining the southern slopes of the Nightcap Range on the far North Coast of NSW. The waters of Rocky Creek flow via Terania, then Leycester creeks to join the Wilson River at Lismore. A few very small, unnamed streams also join Rocky Creek, which flows through the centre of the natural valley that forms the study area. The Little Rocky Creek tributary joins Rocky Creek below the proposed dam wall.

For the purposes of this project, the study area for this TEIA includes the:

- Proposed dam wall and surrounding areas required to be disturbed during construction works;

Figure 1: Location Map of the Study Area



Location: I:\projects\3001803 - Dunoon Dam Terrestrial Ecology Assessment\0\09\DATA\GIS\Report Maps

- Proposed inundation area during maximum operational level of the dam and any areas potentially subject to temporary inundation from the new flood level upstream;
- Riparian vegetation associated with Rocky Creek downstream of the proposed dam to the junction of Terania Creek;
- Terrestrial areas downstream of the proposed dam wall and outlet structure and any areas that may be impacted by release water from the dam during flood events;
- Buffer area surrounding the maximum operational level of the dam which will be vegetated (either already vegetated or to be revegetated as part of the project);
- Any areas linked by vegetation to the above which may provide corridors for wildlife movement and dispersal avenues for plant species; and
- Other areas likely to be disturbed by construction and operation of the dam.

The identified study area is shown on **Figure 2**.

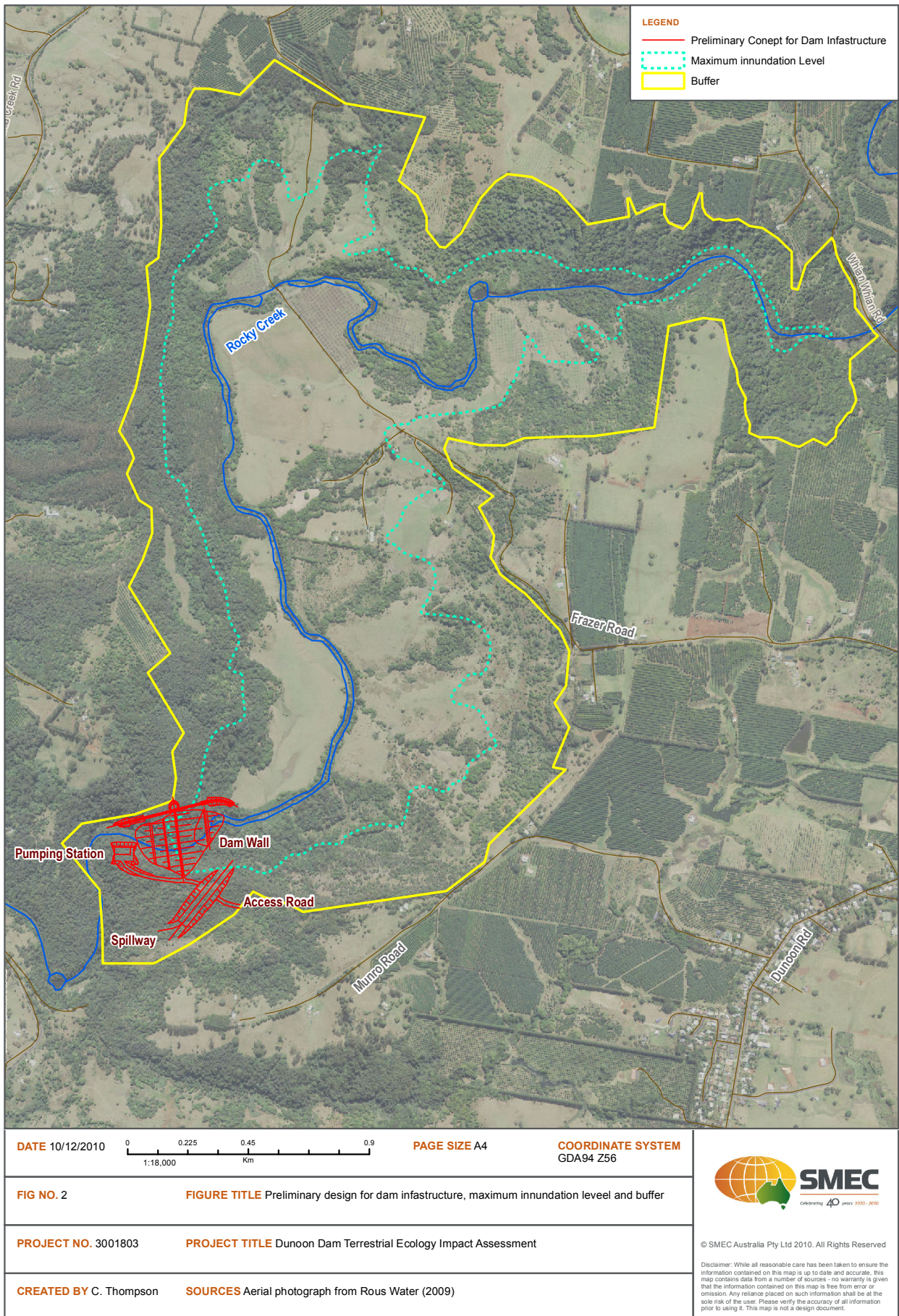
### 1.3 Project Description

The proposed dam occurs within a natural valley west of the township of Dunoon on Rocky Creek. The maximum inundation area (high water level) represents the 85 m AHD contour, covering an approximate area of 253 ha. The proposed dam wall will be approximately 40 m in height (current riverbed level is 45 m AHD). If it requires a spillway, it is likely to be on the south - western side of the dam wall as shown in **Figure 2**. Roller-compacted concrete (RCC) is also being considered (resembles a concrete staircase) for incorporation into the dam wall, however the design has not yet been developed to this stage.

The proposed buffer area surrounding the dam inundation zone will be another 234 ha. This area will be managed as a water supply catchment to ensure water quality within the storage is maintained. It is also likely that this area will be subject to ecological restoration using bush regeneration techniques to improve the condition and extent of existing vegetation communities and fauna habitats within this zone. The buffer area was delineated during a recent study by Hydrosphere (2009).

Details on the exact location of the dam wall, inundation area, spillway and access track were not available for inclusion at the time of writing. However the proposed inundation area shown in **Figure 2** is considered to represent an estimate of the highest possible inundation zone. In addition, approximate locations of dam infrastructure (dam wall and spillway) are included and are indicative only, until a detailed concept design of the dam is completed in 2012.

Figure 2: Proposed dam infrastructure, inundation area and buffer.



Location: I:\projects\3001803 - Dunoon Dam Terrestrial Ecology Assessment\09\DATA\GIS\Report Maps

## 1.4 Project Objectives

This terrestrial ecology study is one of five environmental constraints investigations underway for the proposed Dunoon Dam. The results of this and other studies will assist Rous Water to assess the viability of the proposed Dunoon Dam. If the dam is endorsed, this study will feed into the development of a suitable concept design for the proposed dam that minimises potential environmental impacts where possible.

In addition to the feasibility assessment for the dam, this report also aims to provide an impact assessment as a supporting document for any future planning proposal for the work. As such, it assesses the potential impacts of the proposed dam on the ecological features of the study area, suggests measures to minimise any potential impacts through changes to the design and to undertake during construction and operation of the dam, and strategies to compensate for any residual impacts.

This terrestrial ecology assessment specifically aims to:

- Provide a comprehensive desktop assessment of terrestrial species present in the proposed inundation area and its immediate surrounds, including the identification of threatened species, communities or populations listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Provide an inventory and discussion of the vegetation communities, habitats and flora and fauna species within the study area;
- Undertake field surveys to assess the impacts of the proposed dam on terrestrial ecology including undertaking vegetation mapping and allowing for seasonal requirements;
- Assess the significance of potential impacts on terrestrial species and communities to a standard that would meet the requirements under the EPandA Act and in accordance with the TSC Act and EPBC Act and appropriate Office of Environment and Heritage (OEH) and Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) policies and publications; and
- Identification of mitigation measures to minimise impacts during construction and operation of the proposed dam, including the need for monitoring and management before, during and after construction works, and the potential for ecological offsets.

## 1.5 Format of this Report

This report has been written in accordance with the *Guidelines for Threatened Species Assessment* (DEC and DPI 2005). In addition to the template chapters and sections included in this guideline, additional information on the biodiversity recorded within the study area has been provided in line with the requirements from Rous Water and the brief. An overview of the chapters within this report is provided below.

**Chapter 1 Introduction** –provides a background to the project, the study area and the aims of the study.

**Chapter 2 Methodology** –provides the methodology employed for the study including desktop review, field surveys and impact assessment.

**Chapter 3 Study Area Characterisation** – provides an overview of the history, geology and terrestrial ecology of the study area identified during the desktop review.



**Chapter 4 Survey Results** – provides an overview of the diversity and abundance of terrestrial biota recorded within the study area during the field surveys.

**Chapter 5 Discussion** – provides discussion of the findings of the survey and significance of the flora and fauna within the study area.

**Chapter 6 Impact Assessment** – provides a two-tier approach to identifying and determining the significance of potential impacts from the proposed dam as well as mitigation measures required for the project and a discussion of any additional residual impacts after mitigation is applied.

**Chapter 7 Conclusion** – provides a conclusion to the study including an assessment of the Part 3A key thresholds.

## 2 METHODOLOGY

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### 2.1 Database and Literature Review

#### 2.1.1 Information Sources

A comprehensive review and analysis of relevant literature was carried out prior to the commencement of surveys (February 2010). This review was revised during report preparation (September- December 2010) and then again as part of an update to this report (November 2011).

Point source information was retrieved from four scientific databases to determine the likelihood of threatened and non-threatened native species occurring within and adjacent to the study area. These databases were:

- The NPWS Wildlife Atlas Database for a preliminary flora and fauna list of the study area – NSW National Parks and Wildlife Service, Office of Environment and Heritage, Hurstville, accessed February 2010, September 2010 and November 2011;
- The NPWS Threatened Species Profiles, accessed online, <http://www.environment.nsw.gov.au/edresources/LINKINGDOCThreatenedSpeciesProfiles.htm>;
- Species Profiles and Threats (SPRAT) Database for threatened species listed under the *EPBC Act 1999* – Commonwealth Department of Environment and Heritage, accessed online, [www.environment.gov.au](http://www.environment.gov.au), accessed February 2010, September 2010 and November 2011; and
- A search of the Birds Australia database for the region <http://www.birdsaustralia.com.au/resources/databases.html> (carried out in February 2010 and again in November 2011).

In addition, relevant available scientific and natural resource management documents were reviewed. This included, but was not limited to the following:

- Ecos (2001) Proposed Dunoon Dam study area flora and fauna survey and revegetation concept plan. Eco Environmental Planning Mullumbimby, NSW.
- NPWS (1999) Forest Ecosystem Classification and Mapping for Upper and Lower North East CRA Regions. CRA Unit, Northern Zone NPWS, NSW.
- Keith, D. (2002) A compilation map of native vegetation for New South Wales. NSW Biodiversity Strategy Draft Report. NSW NPWS.
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- Hydrosphere (2009) Dunoon Dam Buffer Zone Strategic Plan. Hydrosphere Consulting Ballina, NSW.
- Sheringham, P. and Westaway, J. (1995) Significant vascular plants of Upper North East New South Wales. A report by the NSW National Parks and Wildlife Service for the Natural Resources Audit Council. NPWS, NSW.
- Landmark (1999) Byron flora and fauna study 1999. A report prepared for Byron Shire Council. Landmark Ecological Services Pty Ltd, Suffolk Park NSW.

In addition, the ecological setting of the study area, information on the geology, topography and soils of the area were also investigated and reviewed. This was undertaken to gain an appreciation of the study area, influences on the vegetation communities present and the region.

Table 1: Summary of candidate fauna as part of the literature review.

Subject Group	Taxa (if relevant)	Author/Date
Macroinvertebrates	Ants	Andersen 1983, Greenslade 1994
	Giant Dragonfly	Theischinger 1999
	General	Williams 2002
	Little Lorikeet	Courtney and Debus 2006
Birds	Alberts Lyrebird	Curtis 1998
	Regent Honeyeater	Oliver 1998
	Swift Parrot	Saunders and Heinsohn 2008
	Black-breasted Button-quail	Smith and Mathieson 2004
	Mixophyes	Corben and Ingram 1987 Mahony <i>et al.</i> 1997
Frogs	Wallum Sedge Frog	Ehmann 1997
	<i>Philoria</i> taxonomy	Knowles <i>et al.</i> 2004
	Status of rainforest Stream frogs	Goldingay <i>et al.</i> 1999
	Green-thighed Frog	Lemckert <i>et al.</i> 2006 Lemckert and Slatyer 2002
	Yellow-bellied Glider	Goldingay and Kavanagh 1991
Mammals	Long-nosed Potoroo	Mason 1997
	Fragmentation and Brush-tailed Rock-wallaby	Murray <i>et al.</i> 2008
	Koalas –Spot Assessment Technique	Phillips and Callaghan 1995
	Phascogale	Soderquist 1995
	Golden Tipped Bat	Law and Chidel 2004
Bats	Large-footed Myotis	Law and Anderson 1999
	Survey techniques	Law <i>et al.</i> 1998
	Eastern Long-eared Bat	Parnaby and Churchill 2008
	Bat fauna of rainforest and eucalypt forest in NSW	Parnaby 1984

## 2.1.2 Consultation and Local Knowledge

Presentations were given to the Project Reference Group (PRG) informing the local community of the TEIA project, our proposed method and facilitating a forum for information sharing. Local National Parks offices and Council biodiversity officers were also contacted to gain local knowledge and information on the biodiversity of the region and the study area. Surrounding landholders were consulted prior to undertaking work on and around their properties and some provided additional information on historical fauna records (detailed in Section 4 ).

## 2.2 Field Investigation

The field investigations undertaken for the purposes of this study were conducted in accordance with the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005) which identified the requirements for assessing biodiversity. These were complemented by threatened species profiles, and the *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities - working draft* (DEC 2004a). Where appropriate and available for the investigations, the SEWPaC threatened species survey guidelines were also used. The report includes the following ecological disciplines:

- Terrestrial flora;
- Terrestrial vertebrates; and
- Terrestrial invertebrates.

### 2.2.1 Flora Survey

The desktop review and a preliminary study area inspection guided the approach for flora survey at the community and species level. Combinations of plot-based and targeted surveys were used to sample the flora of the study area.

Three dedicated flora surveys were undertaken at the study area:

- Autumn Survey - vegetation communities and threatened flora surveys;
- Winter Survey - targeted orchid surveys and threatened flora surveys; and
- Spring Survey - threatened flora surveys.

#### 2.2.1.1 Vegetation Community Mapping

The vegetation of the study area was classified to describe homogenous patterns in the landscape and to document the floristic variation present. This was also undertaken to gain an understanding of the distribution of vegetation communities present in relation to surrounding areas and to determine the conservation significance of the communities within the wider locality and region.

An audit of all existing systematic vegetation survey data was undertaken for the study area. This included existing broad-scale predictive regional mapping (CRA Vegetation) and more specific study area-scale mapping (Ecos 2001). These formed a basis for a list of potential vegetation communities present within the study area and were used to verify and confirm likely vegetation associations identified during the Geographic Information System (GIS) work.

Vegetation patterns were detected using aerial photography, in combination with field experience and expert judgements. Vegetation communities were mapped within the GIS framework from aerial imagery supplied by Rous Water (November 2009) and initial study area reconnaissance information. Aerial Photograph Interpretation (API) and existing information (vegetation mapping, geology, soil and topographic information) was undertaken to determine the likely boundaries of the various vegetation communities within the study area. These were then ground-truthed using plot-based surveys.

Where possible, vegetation communities were compared and classified to the listed vegetation types known to occur within the CMA region within the Biometric database and other vegetation mapping studies undertaken within the region. This was undertaken to gain an appreciation of the extent and distribution of the vegetation communities regionally. It was also used as a comparison for determining if the vegetation types within the study area constituted an endangered ecological community, listed under State and Commonwealth legislation.

### **2.2.1.2 Vegetation Community Quadrat (Plot) Survey**

Ground-truthing of the vegetation community mapping was undertaken using plot-based surveys. Survey locations were stratified within the study area to direct sufficient resource effort to each vegetation community, though were concentrated within areas of native vegetation to ensure that vegetation community profiles could be differentiated within the mapping of the study area (*Figure 3*).

Quadrats were fixed to 0.04 hectares based on 20 m x 20 m quadrats. Modifications were made occasionally to the plot size (usually 10 x 40 m) to match patterns in vegetation. This was applied to features such as riparian vegetation. This quadrat size is the standard used by NPWS and the Sydney Royal Botanic Gardens (Wilson *et al.* 1997).

Methods to ensure appropriate sampling locations were chosen included:

- Avoiding boundaries of strata to prevent the sampling of ecotone communities;
- Avoiding local disturbances such as roads, settlement and other areas of gross disturbance; and
- Aligning the quadrat with the contour of hillsides or elongated vegetation communities (e.g. riparian) to avoid significant local environmental gradients.

Sampling for each vegetation community used standard field proformas. Completed survey forms provided:

- Lists of plant species;
- Quadrat location (GPS);
- Estimates of the height, projected foliage cover, and dominant species within each of the vegetation stratum (using a modified Braun-Blanquet cover-abundance rating (Walker and Hopkins 1990));
- Identification of parent material; and
- Qualitative notes on soil moisture, texture and depth, and disturbance history.

Plants that could not be identified in the field were recorded to the family or genus level. These were then collected, tagged and pressed with the appropriate study area code for later identification. All major features of the specimen were collected where possible such as fruit or flower. Where positive identifications could not be made, specimens were sent to the Botanic Gardens Trust plant identification service for resolution.

### 2.2.1.3 Targeted Flora Searches

Targeted searches for threatened flora (TSC Act and EPBC Act) and Rare or Threatened Australian Plant (ROTAP) species were undertaken within the study area. Rare or Threatened Australian Plants (RoTAP) (Briggs and Leigh 1996) are plants that are presumed extinct, endangered, vulnerable or poorly known at the national level. The RoTAP list has no legal status but is an important reference for the national status of threatened species, particularly those not recognised under the EPBC Act. These were undertaken to identify the location, extent and condition of any rare or threatened plant populations within the study area.

Native habitats were targeted, though were not the only areas searched for threatened flora species based on the identified potential habitat preferences of the species targeted (**Table 3**). Transects were undertaken along random meanders as per Cropper (1993) in association with plot-based surveys. All new flora species encountered during this search that were not previously recorded in vegetation plots were noted. Each transect was surveyed for approximately 30 minutes over three days during the autumn survey. Survey effort for each of the stratification units (vegetation communities) was in line with the recommended requirements (DEC 2004a) for all native vegetation communities and less disturbed habitats **Table 1**.

Table 2: Transect survey summary with comparison to DEC (2004a) survey requirements

Vegetation Community	Total Area in Study Area (ha)	Survey Requirements (DEC Guidelines)	Transects Undertaken
Subtropical Rainforest	83	3	5
Warm Temperate Rainforest	6	2	4
Tallowwood Open Forest	25	2	3
Flooded Gum – Tallowwood-Brush box Open Forest	70	3	5
Pasture	261	10*	6
Camphor Laurel Forest	249	10*	5
Plantations	59	3	3

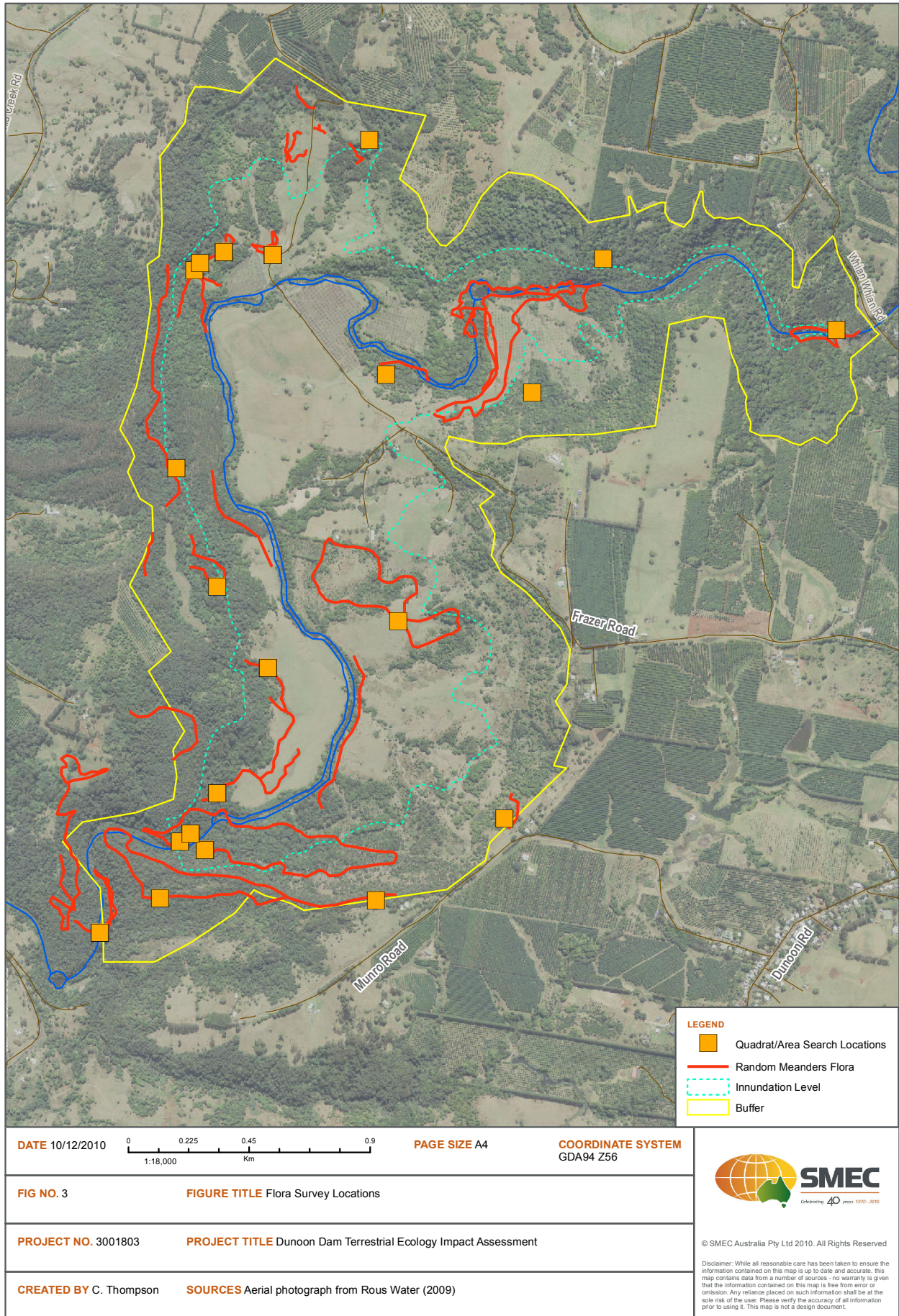
\*Note this is variable within the guidelines and due to the low potential for threatened species in these areas based on an assessment of habitat requirements; this level of effort was not undertaken.

Transect locations and the occurrences of any threatened or rare species were recorded using a hand-held GPS. Information about the flora species or population was gathered at each location including:

- an estimate of the number of individuals;
- the health and condition of the flora species;
- the location of the specimen and associated habitat features; and
- current threats (if any) to the flora species.

All flora species encountered during this search that were not previously recorded for the vegetation communities sampled were also noted at this time.

Figure 3: Location of Flora Transects and Quadrats



Location: I:\projects\3001803 - Dunoon Dam Terrestrial Ecology Assessment\009DATA\IGIS\Report Maps

Table 3: Target threatened flora species by type including preferred survey timing

Flora Type	Common Name (Scientific Name)	Status	Potential Habitat within the Study Area Targeted
Epiphytes and climbers	<i>Amyema plicatula</i>	TSC - E EPBC - E	Rainforest. Parasitic on Rosewood, <i>Dysoxylum fraserianum</i> .
	Northern Clematis ( <i>Clematis fawcettii</i> )	TSC - V EPBC - V	Dry rainforest and complex notophyll vine forest
	Tinospora Vine ( <i>Tinospora smilacina</i> )	TSC - E	Dry rainforest and along boundaries of dry rainforest and dry eucalypt forest
	Arrow-head Vine ( <i>Tinospora tinoporoides</i> )	TSC - V EPBC - V	Wet subtropical rainforest, littoral rainforest, complex notophyll vine forest
	White-flowered Wax Plant ( <i>Cynanchum elegans</i> )	TSC - E EPBC - E	Dry rainforest, littoral rainforest, coastal scrub, open forest and woodland
	Cryptic Forest Twiner ( <i>Tylophora woollsii</i> )	TSC - E EPBC - E	Wet sclerophyll forest and rainforest
Ferns and Cycads	Basket Fern ( <i>Drynaria rigidula</i> )	TSC - E	Rainforest, moist eucalypt and Swamp Oak forest
	Narrow-leaf Finger Fern ( <i>Grammitis stenophylla</i> )	TSC - E	Near streams, on rocks or in trees, in rainforest and moist eucalypt forest
	Short-footed Screw Fern ( <i>Lindsaea brachypoda</i> )	TSC - E	Near streams, on rocks or in trees, in rainforest and moist eucalypt forest
	Giant Fern ( <i>Angiopteris evecta</i> )	TSC - E	North-facing gully on a narrow floodplain in rainforest community
Herbs and Forbs	Hairy Jointgrass ( <i>Arthraxon hispidus</i> )	TSC - V EPBC - V	Edges of rainforest and in wet eucalypt forest, often near creeks or swamps
	Missionary Nutgrass ( <i>Cyperus semifertilis</i> )	TSC - E EPBC - V	Open forest dominated by White Mahogany ( <i>Eucalyptus acmenoides</i> ).
	Giant Spear Lily ( <i>Doryanthes palmeri</i> )	TSC - V	Along the cliff-tops and on steep cliff-faces or rocky ledges in montane heath next to subtropical rainforest, warm temperate rainforest or wet eucalypt forest
	Isoglossa ( <i>Isoglossa eranthemoides</i> )	TSC - E EPBC - E	Understorey of lowland subtropical rainforest, in moist situations on floodplains and slopes
	Pygmy Bishop's Hat ( <i>Mitrasacme pygmaea</i> )	TSC - E	Rocky outcrops in open habitats
	Pointed Trefoil ( <i>Rhynchosia acuminatissima</i> )	TSC - V	Dry rainforest dominated by Hoop Pine
	Austral Toadflax ( <i>Thesium austral</i> )	TSC - V EPBC - V	Grassland or grassy woodland in association with Kangaroo Grass ( <i>Themeda australis</i> )
	Water Nutgrass ( <i>Cyperus aquatilis</i> )	TSC - E	Swampland, moist open forest
	Square-stemmed Spike-rush ( <i>Eleocharis tetraquetra</i> )	TSC - E	Damp locations on stream edges and in and on the margins of freshwater swamps
Lemon-scented Grass ( <i>Elyonurus citreus</i> )	TSC - E	Sandy soils near rivers or along the coast in wallum areas or sand dune	
Shrubs	Acalypha ( <i>Acalypha eremorum</i> )	TSC - E	Subtropical rainforest, dry rainforest and vine thickets
	Jointed Baloghia ( <i>Baloghia marmorata</i> )	TSC - V EPBC - V	Subtropical rainforest/notophyll vine forest and wet sclerophyll forest (brush box woodland) with rainforest understorey
	Native Jute ( <i>Corchorus cunninghamii</i> )	TSC - E EPBC - E	Closely associated with the subtropical rainforest-open eucalypt forest ecotone



Flora Type	Common Name (Scientific Name)	Status	Potential Habitat within the Study Area Targeted
	Corokia ( <i>Corokia whiteana</i> )	TSC – V EPBC – V	Ecotones between wet sclerophyll forest and Coachwood ( <i>Ceratopetalum apetalum</i> ) warm-temperate rainforests, or in Brush Box ( <i>Lophostemon confertus</i> ) open forest with littoral rainforest understorey
	Thorny Pea ( <i>Desmodium acanthocladum</i> )	TSC – V EPBC – V	Dry rainforest and on the fringes of riverine subtropical rainforest
	Southern Fontainea ( <i>Fontainea australis</i> )	TSC – V EPBC – V	Subtropical rainforest and complex notophyll vine forest
	Sweet Myrtle ( <i>Gossia fragrantissima</i> )	TSC – E EPBC – E	Dry subtropical and riverine rainforest
	Tree Guinea Flower ( <i>Hibbertia hexandra</i> )	TSC – E	Heath, open forest or rainforest
	Brush Sauropus ( <i>Phyllanthus microcladus</i> )	TSC – E	Banks of creeks and rivers, in streamside rainforest
	Nightcap Plectranthus ( <i>Plectranthus nitidus</i> )	TSC – E EPBC – E	Rocky cliff faces and boulders, in the shelter and shade provided by the adjacent rainforest
	Spiny Gardenia ( <i>Randia moorei</i> )	TSC – E EPBC – E	Subtropical, riverine, littoral and dry rainforest and sometimes along moist scrubby watercourses
	Ripple-leaf Muttonwood ( <i>Rapanea</i> spp. 'Richmond River')	TSC – E EPBC – E	Alluvial subtropical and dry rainforest (lowland floodplain rainforest), swamp sclerophyll forests and tall woodland.
	Rainforest Cassia ( <i>Senna acclinis</i> )	TSC – E	Edges of subtropical and dry rainforest
	Border Ranges Nightshade ( <i>Solanum limitare</i> )	TSC – E	Open Blue Gum forest with a grassy understorey
	Brush Sophora ( <i>Sophora fraseri</i> )	TSC – V EPBC – V	Moist habitats, shallow soils along rainforest margins in eucalypt forests or in large canopy gaps in closed forest communities
	Small-leaved Hazelwood ( <i>Symplocos baeuerlenii</i> )	TSC – V EPBC – V	Subtropical and warm temperate rainforest
	Queensland Xylosma ( <i>Xylosma terrae-reginae</i> )	TSC – E	Littoral and subtropical rainforest on coastal sands or soils derived from metasediments
	Dwarf Heath Casuarina ( <i>Allocasuarina defungens</i> )	TSC – E EPBC – E	Coastal areas of wet to dry, dense, low, closed heath land
	Knicker Nut ( <i>Caesalpinia bonduc</i> )	TSC – E	Coastal scrub vegetation
	Gympie Stinger ( <i>Dendrocnide moroides</i> )	TSC – E	Lowland rainforest, especially in gaps or other disturbed study areas.
Trees	Marblewood ( <i>Acacia bakeri</i> )	TSC – V	Lowland subtropical rainforest, in adjacent eucalypt forest and in regrowth of both
	Rusty Plum ( <i>Amorphospermum whitei</i> )	TSC – V	Rainforest and the adjacent understorey of moist eucalypt forest.
	White Laceflower ( <i>Archidendron hendersonii</i> )	TSC – V	Riverine and lowland subtropical rainforest and littoral rainforest.
	Heart-leaved Bonewood ( <i>Bosistoa selwynii</i> )	TSC – V EPBC – V	Alluvial flats, particularly creek banks
	Yellow Satinheart ( <i>Bosistoa transversa</i> )	TSC – V EPBC – V	Rainforests and wet sclerophyll forest
	Brush Cassia ( <i>Cassia brewsteri</i> var. <i>marksiana</i> )	TSC – E	Littoral and riverine rainforest, and in regrowth vegetation on farmland and along roadsides
	Stinking Cryptocarya ( <i>Cryptocarya foetida</i> )	TSC – V	Littoral rainforest, usually on sandy soils

Flora Type	Common Name (Scientific Name)	Status	Potential Habitat within the Study Area Targeted
		EPBC - V	
	Smooth Tuckeroo ( <i>Cupaniopsis serrata</i> )	TSC - E	Subtropical and dry rainforest
	Davidson's Plum ( <i>Davidsonia jerseyana</i> )	TSC - E EPBC - E	Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300 m). Many trees are isolated in paddocks and on roadsides in former rainforest habitats
	Smooth Davidson's Plum ( <i>Davidsonia johnsonii</i> )	TSC - E EPBC - E	Wet sclerophyll forests, with a smaller number of study areas known from subtropical rainforest (complex notophyll vine forest)
	Red-fruited Ebony ( <i>Diospyros mabacea</i> )	TSC - E EPBC - E	Understorey tree in lowland subtropical rainforest, often close to rivers
	Small-leaved Tamarind ( <i>Diploglottis campbellii</i> )	TSC - E EPBC - E	Alluvial riverbanks to elevated rocky slopes
	Nightcap Oak ( <i>Eidothea hardeniana</i> )	TSC - E EPBC - CE	Upland warm temperate rainforest, usually near creeks
	Minyon Quandong ( <i>Elaeocarpus</i> spp. 'Rocky Creek')	TSC - E EPBC - E	Warm temperate or subtropical rainforest, and where rainforest and wet eucalypt forest meet
	Hairy Quandong ( <i>Elaeocarpus williamsianus</i> )	TSC - E EPBC - E	Subtropical to warm temperate rainforest, including regrowth areas where it has apparently regrown from root suckers after clearing.
	Crystal Creek Walnut ( <i>Endiandra floydii</i> )	TSC - E EPBC - E	Subtropical (including littoral) rainforest or wet sclerophyll forest, often with <i>Lophostemon confertus</i> (Brush Box) in the canopy and occasionally with <i>Araucaria cunninghamii</i> (Hoop Pine) emergents.
	Rusty Rose Walnut ( <i>Endiandra hayesii</i> )	TSC - V EPBC - V	Subtropical and warm temperate rainforests, and Brush Box ( <i>Lophostemon confertus</i> ) forests, including regrowth and highly modified forms of these habitats
	Green-leaved Rose Walnut ( <i>Endiandra muelleri</i> subsp. <i>bracteata</i> )	TSC - E	Subtropical rainforest or wet eucalypt forest, chiefly at lower altitudes
	Ball Nut ( <i>Floydia praealta</i> )	TSC - V EPBC - V	Riverine and subtropical rainforest
	Axebreaker ( <i>Geijera paniculata</i> )	TSC - E	Dry subtropical rainforest and vine scrub, often along rivers
	Red Boppel Nut ( <i>Hicksbeachia pinnatifolia</i> )	TSC - V EPBC - V	Margins of subtropical rainforest from near sea level to 700 m altitude, sometimes extending into wet sclerophyll forest
	Fine-leaved Tuckeroo ( <i>Lepiderema pulchella</i> )	TSC - V	Lowland subtropical rainforest in NSW.
	Rough-shelled Bush Nut ( <i>Macadamia tetraphylla</i> )	TSC - V	Rainforest and wet sclerophyll forest communities
	Southern Ochrosia ( <i>Ochrosia moorei</i> )	TSC - E EPBC - E	Lowland warm subtropical rainforest and complex notophyll vine forest
	Onion Cedar ( <i>Owenia cepiodora</i> )	TSC - V EPBC - V	Complex notophyll vine forest, dry Araucarian vine forest and wet sclerophyll or subtropical rainforest at altitudes ranging from 30 to 420 m
	Red Lilly Pilly ( <i>Syzygium hodgkinsoniae</i> )	TSC - V EPBC - V	Occurs mostly as scattered individuals along watercourses, where the habitat is frequently limited and degraded

Flora Type	Common Name (Scientific Name)	Status	Potential Habitat within the Study Area Targeted
	Durobby ( <i>Syzygium moorei</i> )	TSC – V EPBC - V	Occurs as isolated remnant paddock trees
	Cameron's Tarena ( <i>Tarena cameronii</i> )	TSC – E	Understorey of dry rainforest,
	Peach Myrtle ( <i>Uromyrtus australis</i> )	TSC – E	Mid stratum in warm temperate rainforest or in closed forest under taller emergent <i>Eucalyptus</i> spp. and Brush Box.
	Giant Ironwood ( <i>Choricarpia subargentea</i> )	TSC – E	Dry rainforest regrowth consisting of thickets growing in steeply sloping paddocks on basalt-derived soil

Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - *Threatened Species Conservation Act* (1995), EPBC – *Environment Protection and Biodiversity Conservation Act* (1999). E – Endangered, V - Vulnerable

#### 2.2.1.4 Winter Orchid Surveys

Suitable south and south-eastern facing slopes with sandstone geologies were targeted for the orchid surveys, as this was the preferred habitat for the target threatened orchid species. The surveys were undertaken using the random meander method within suitable habitat areas (**Figure 3**).

Table 4: Targeted Threatened Orchid Species

Common Name (Scientific Name)	Status	Habitat Requirements
Hoop Pine Orchid ( <i>Bulbophyllum globuliforme</i> )	TSC – V EPBC - V	Grows only on Hoop Pines ( <i>Araucaria cunninghamii</i> ), colonising the upper branches of mature trees in upland rainforest
Yellow-flowered King of the Fairies ( <i>Oberonia complanata</i> )	TSC – E	Grows on trees and rocks in littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes (including stabilised sands), stream-side areas, swampy forests and mangroves
Brown Fairy-chain Orchid ( <i>Peristeranthus hillii</i> )	TSC – V	An epiphyte, growing in clumps on tree trunks and thick vines in coastal and near-coastal environments, particularly Littoral Rainforest and the threatened ecological community Lowland Rainforest on Floodplain
Southern Swamp Orchid ( <i>Phaius australis</i> )	TSC – E EPBC - E	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas
Lady Tankerville Swamp Orchid ( <i>Phaius tankervilleae</i> )	TSC – E EPBC - E	Swampy grassland or swampy forest, including rainforest, eucalypt and paperbark forest
Ravine Orchid ( <i>Sarcochilus fitzgeraldii</i> )	TSC – V EPBC – V	Grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500 and 700 m. Occasional clumps are found on the bases of fibrous-barked trees.
Hartman's Sarcochilus ( <i>Sarcochilus hartmannii</i> )	TSC – V EPBC - V	Volcanic rocks, shallow soils and exposed cliffs in sclerophyll forests, rainforest margins or open areas at 500–1000 m altitude.
Blotched Sarcochilus ( <i>Sarcochilus weinthalii</i> )	TSC – V EPBC - V	Rainforest and drier scrubs, often in isolated patches, from 400 to 700 m in altitude
Pink Nodding Orchid ( <i>Geodorum densiflorum</i> )	TSC – E	Dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand.
Brown Butterfly Orchid ( <i>Sarcochilus dilatatus</i> )	TSC – E	Grows on trees in littoral rainforest, subtropical rainforest, dry rainforest and streamside forests, mainly at low to medium (up to 500 m) altitudes. Plants favour Hoop Pine as a host.

Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - *Threatened Species Conservation Act* (1995), EPBC – *Environment Protection and Biodiversity Conservation Act* (1999). E – endangered, V - vulnerable

### **2.2.1.5 Additional Vegetation Community Surveys**

Random meander surveys were undertaken to compare and ground-truth the composition within the mapped communities. This mainly centred on rainforest areas, which contained some weed growth. Results of the vegetation community surveys were utilised to refine the vegetation mapping.

## **2.2.2 Fauna Habitat Assessment**

An assessment of habitat types and habitat condition, especially for threatened species known to occur within the locality (10 km radius) or in similar habitat to the study area was undertaken. The habitat assessment was used to determine locations for targeted sampling for each of the fauna groups.

Specific information was collected for each vegetation community during the quadrat surveys described in Section 2, and at each of the fauna trapping study areas for habitat attributes (and scats). This included:

- Hollow-bearing trees, including dead stags;
- Bush rock and rocky outcrops;
- Logs and other artificial cover (discarded metal roofing etc);
- Wetlands, streams, rivers, dams and other water bodies;
- Nests, roosts, burrows and dens;
- Glider sap and koala feed trees;
- Areas that can act as corridors for plant or animal species.
- Winter-flowering eucalypts;
- Permanent soaks and seepages; and
- Distinctive scats;

## **2.2.3 Fauna Survey**

Three fauna field surveys were conducted between April and December 2010. The surveys were designed to assess fauna habitat and target threatened fauna predicted to occur in the study area.

Two primary issues were considered in designing the field survey: stratification according to habitat type to obtain an understanding of biodiversity distribution in the study area; and point source species data to be used in context with habitat information to determine the potential likelihood for species to occur.

The three dedicated fauna surveys were designed to consider seasonal variability and were therefore undertaken during autumn, spring and summer as described:

- Autumn Survey undertaken in autumn from 12th to 19th April 2010– all taxa excluding amphibians, macroinvertebrates and koalas;
- Spring Survey undertaken from the 24th to 29th October 2010– all taxa including koala activity assessments (modified SPOT Assessment Technique) but excluding macroinvertebrates; and
- Summer Survey – threatened amphibian, reptile (undertaken on 13th, 15th and 17th December 2010 with nocturnal road surveys only on 17th) and macroinvertebrate surveys (conducted 22-25th November 2010).

The fauna surveys were undertaken by SMEC's in-house fauna team, supplemented by local specialists. Details of the personnel and their qualifications are provided in Appendix 2 of this document. Appendix 1 provides an overview of the fauna survey effort for each of the targeted fauna surveys.

### 2.2.3.1 Targeted Surveys

Methods were applied at each survey study area based on the type of habitat present, the study areas location and the need to target specific threatened species in that habitat. All individuals observed during the survey were identified to species level unless there was uncertainty regarding their taxonomy, as is the case for some species of insectivorous bat when using ultrasonic call detection methods (Churchill 2008). Nomenclature used follows the NPWS Atlas listings for fauna.

#### (a) Mammals

An integrative approach was undertaken to target threatened mammal species within the study area. Direct detection surveys including spotlighting, cage and Elliot trapping or hair sampling surveys were conducted in conjunction with searches for traces like diggings, scats and tracks, baited camera traps and predator scat surveys. Survey techniques were based on the most appropriate methods to target threatened mammal species, using multiple methods where possible to maximise detection success (**Table 5**). Survey effort is provided in Appendix 1.

Table 5: Targeted threatened mammal species including specific method requirements

Common Name (Scientific Name)	Status	Survey Technique
Rufous Bettong ( <i>Aepyprymnus rufescens</i> )	TSC - V	Hair tubes, searches for scats
Eastern Pygmy-possum ( <i>Cercartetus nanus</i> )	TSC - V	Hair tubes and Elliot traps
Spotted-tailed Quoll ( <i>Dasyurus maculatus</i> )	TSC – E EPBC - V	Hair tubes, searches for scats and cage traps
Black-striped Wallaby ( <i>Macropus dorsalis</i> )	TSC – E	Hair tubes, searches for scats
Parma Wallaby ( <i>Macropus parma</i> )	TSC – V	Hair tubes, searches for scats
Yellow-bellied Glider ( <i>Petaurus australis</i> )	TSC – V	Arboreal hair tubes, call playback and stag watching
Squirrel Glider ( <i>Petaurus norfolcensis</i> )	TSC – V	Arboreal hair tubes, call playback and stag watching
Brush-tailed Rock-wallaby ( <i>Petrogale penicillata</i> )	TSC – E EPBC - V	Hair tubes, searches for scats
Brush-tailed Phascogale ( <i>Phascogale tapoatafa</i> )	TSC – V	Hair tubes and Elliot traps (semi-arboreal)
Koala ( <i>Phascolarctos cinereus</i> )	TSC – V	Call playback and scat searches in areas of suitable habitat (based on SPOT assessment)
Common Planigale ( <i>Planigale maculata</i> )	TSC – V	Hair tubes and Elliot traps/pitfall traps
Long-nosed Potoroo ( <i>Potorous tridactylus</i> )	TSC – V EPBC - V	Hair tubes and cage traps
Red-legged Pademelon ( <i>Thylogale stigmatica</i> )	TSC – V	Hair tubes, searches for scats
Eastern Chestnut Mouse ( <i>Pseudomys gracilicaudatus</i> )	TSC – V	Hair tubes and Elliot traps/ pitfall traps
Hastings River Mouse ( <i>Pseudomys oralis</i> )	TSC – E EPBC - E	Hair tubes and Elliot traps/ pitfall traps

Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - Threatened Species Conservation Act (1995), EPBC – Environment Protection and Biodiversity Conservation Act (1999). E – endangered, V - vulnerable

### (i) Mammal Trapping Transects

Ten small Elliot-style traps (Sherman traps (Type A)) were placed at each of five study areas during the autumn surveys. Traps were separated by a minimum of 10 m along a transect line. Three cage traps were placed along each of the mammal transect, 5-10 m from the Elliot traps at traps 1, 5 and 10. Elliot traps were left for four or five nights over the survey period. A summary of survey effort is provided in Appendix 1.

A combination of large and small, ground and arboreal (1.5-2m above ground level) hair tubes were placed a minimum 5-10 m from the Elliot transect. A total of 10 hair tubes were placed at each transect study area (**Figure 4**). Hair tubes were positioned in bushes, small trees or within dense groundcover. Hair tubes were left for four or five nights. Hair samples were sent to Barbara Triggs (author of "Scats, Tracks and Other Traces: a field guide to Australian Mammals" (Triggs 2004)) for expert analysis.

In addition, five Elliot traps and two cage traps were placed in a sixth location for three nights only. The location of each of the mammal transects is provided on **Figure 5**.

Bait consisted of a mixture of rolled oats, peanut butter and honey. In addition, arboreal hair tubes were sprayed with a honey water mixture, which was also sprayed high into the tree along the trunk (approximately 2-4 m above the ground). Bait within some of the cage traps and large ground-based hair tubes included sardines in the bait mixture to target marsupial predators (recommended within the EPBC Act Guidelines for the Spotted-tail Quoll) and omnivores.

Trapping occurred over four or five consecutive nights and animal handling was in line with appropriate animal care procedures as required by the Animal Care and Ethics Committee (NSW Industry and Investment (DPI&I)). Small mammals were not marked, so it was not possible to estimate population by mark-recapture methods or to rule out the possibility of multiple captures of the same animal.

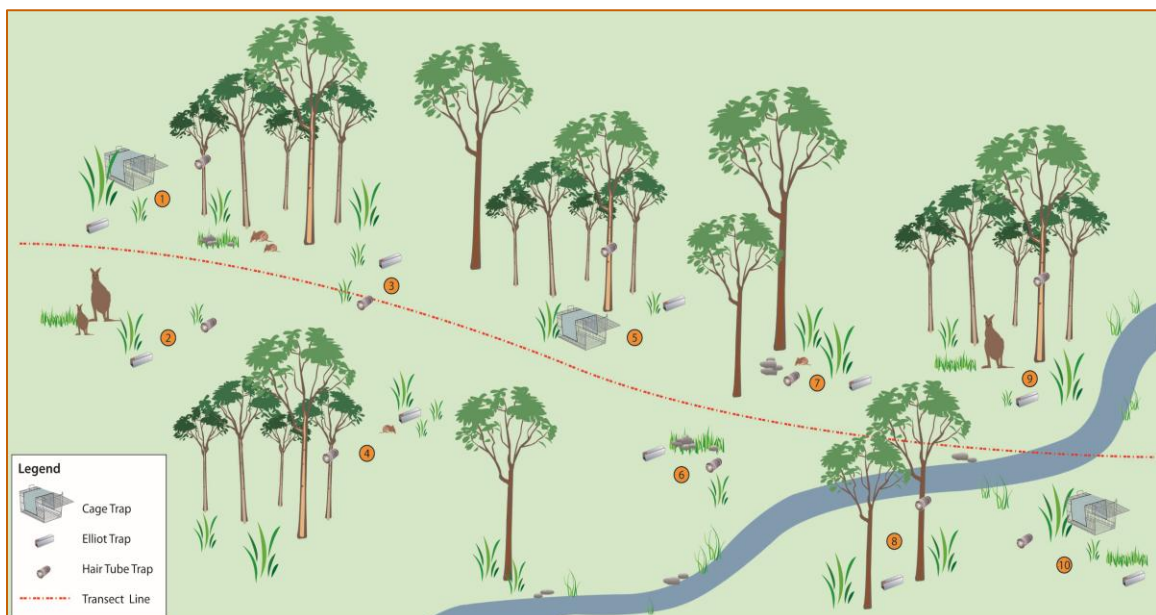


Figure 4: Indicative Mammal Trapping Transect for the Project

Six trap lines were undertaken in the autumn surveys, with a maximum of 235 trap nights for Elliot traps from Tuesday 14<sup>th</sup> until Saturday 17<sup>th</sup> April 2010. Five trap lines, with a total of 220 trap nights for Elliots, were undertaken for mammals for the spring surveys from Sunday 24<sup>th</sup> to Saturday 30<sup>th</sup> October 2010. For each survey period, different mammal trap lines were targeted to maximise representation of the various habitats across the study area. The locations of the mammal trap lines for the two seasons are shown in **Figure 5**. Survey effort is provided in Appendix 1.

Infrared motion detector cameras were also placed in two locations (**Figure 5**) during the spring survey. These were located within the regeneration area in the south of the study area where signs of use by ground-dwelling fauna had been identified during the autumn survey. Another was placed in a track on the western ridgeline in proximity to known Koala locations and the ecotone (boundary) between dry and wet sclerophyll forest areas.

### **(ii) Spot Lighting and Call Broadcasting**

Targeted spotlight searches were carried out for threatened nocturnal mammal species within the study area. Calls of nocturnal mammal species were broadcasted during the spotlighting events to elicit responses. Opportunistic sightings of terrestrial mammal fauna were also recorded during the rest of the fieldwork.

Nocturnal surveys were conducted over four nights during both the autumn and spring mammal survey periods. Where possible, nights with rainfall and greater moon influence were avoided (known to affect spotlight success (DEC 2004a)) during the trapping period during nocturnal survey period, and thus surveys were not conducted on every night of the survey period. Surveys were also conducted within the Rocky Creek Dam regeneration areas during the spring survey (see **Figure 5**).

Nocturnal mammal surveys were conducted in conjunction with the nocturnal bird surveys and included call playback (Squirrel Glider, Yellow-bellied Glider and Koala) and spotlighting **Figure 5**. These were undertaken by a two-person team for a period of two hours per survey night.

### **(iii) Tracks, Scats And Signs**

Tracks, scats and signs of mammalian study area use were searched for opportunistically while completing other survey tasks. These signs can sometimes lead to the identification of taxa to the species level and are therefore important presence indicators.

### **(b) Koala Survey**

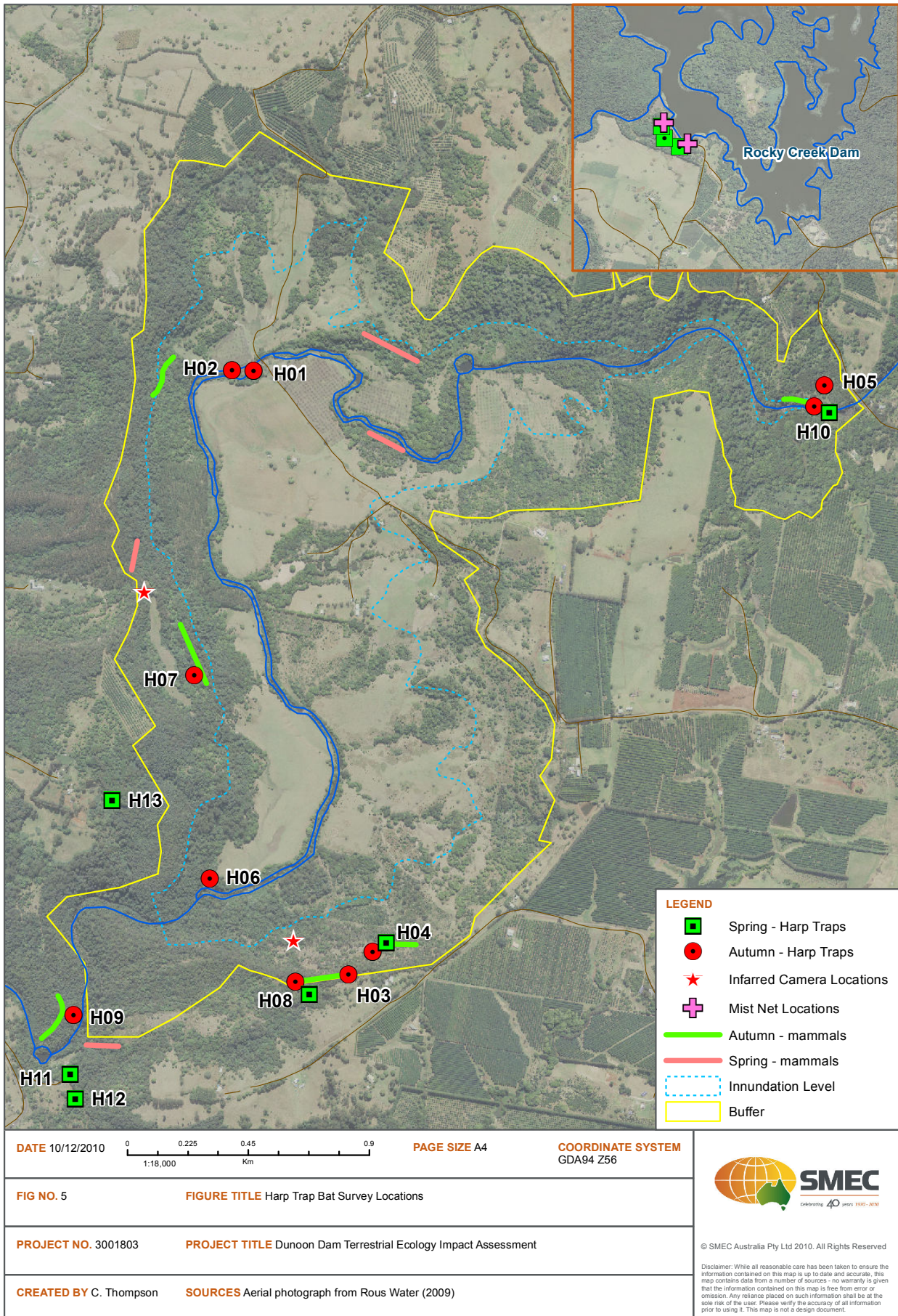
A feature of the ranging patterns of Koalas in a socially stable breeding population is the repeated use of a small number of trees (home range trees). As such, the location of high activity areas can be determined based on the location and distribution of faecal pellets in suitable habitat areas. Searches of suitable habitat for signs of Koalas (feeding marks and scats) were carried out, based on the spot assessment technique (SAT) developed by the Australian Koala Foundation (AKF). A full SPOT assessment was not carried out since the density of Koalas could be estimated by the availability of habitat trees. Known Koala habitat trees include:

- A tree of any species beneath which one or more Koala faecal pellets have been observed;
- A tree in which a Koala has been sighted; or
- Any other tree known or considered likely to be an important tree for Koalas in a particular area (Phillips and Callaghan 1995).

Tallowwood (*Eucalyptus microcorys*), the primary feed tree for Koalas in the north coast region, occurs within the study area. The areas containing this species were searched for signs of use to determine activity levels within the study area. A total of ten hours for each of the survey periods (autumn and spring) was spent searching for habitat signs including Koala pellets over the mammal trapping period and in areas of suitable habitat (Figure 5).

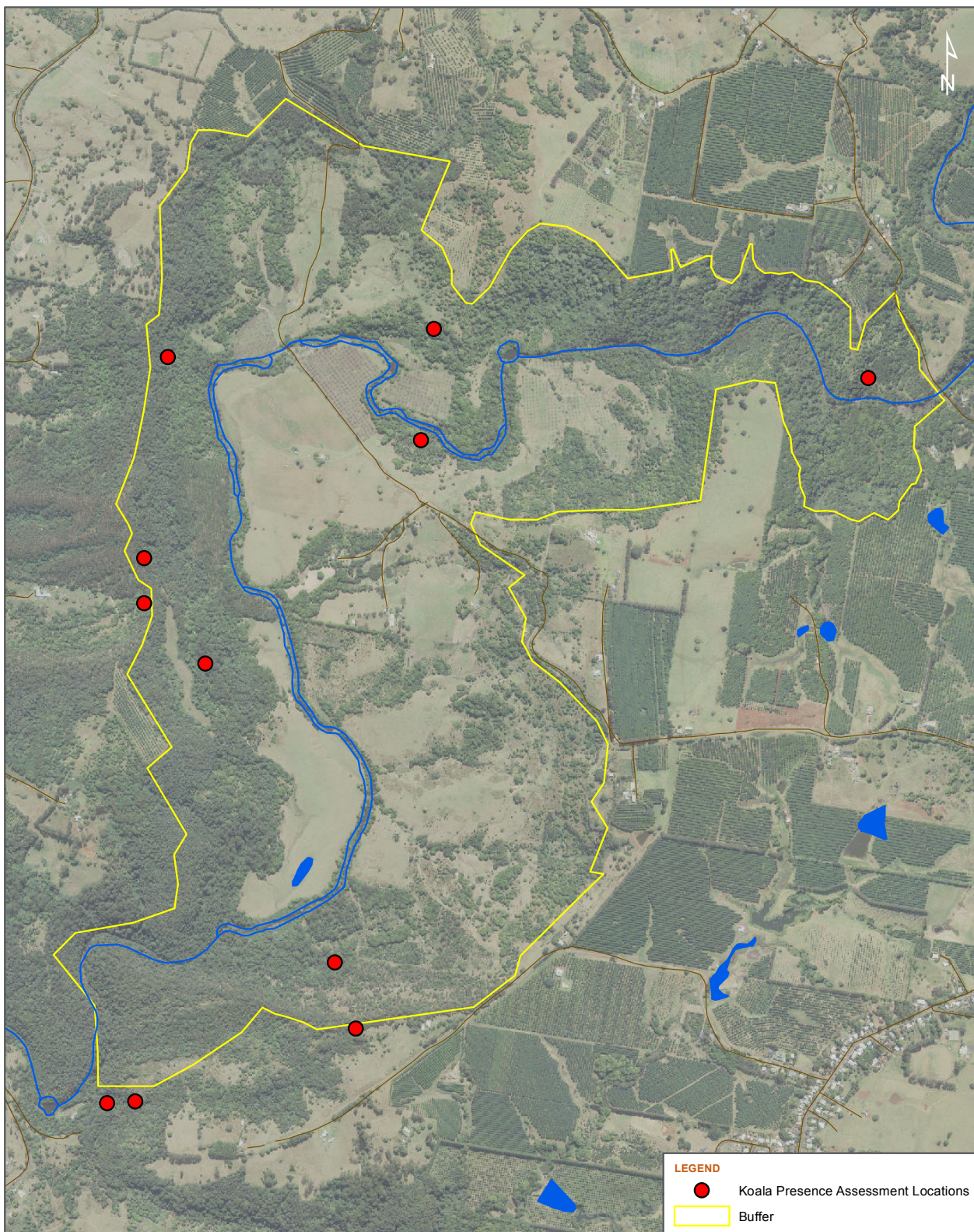


Figure 5: Location of Mammal Transects and Bat Harp Trap Locations



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Figure 6: Koala Presence Assessment Locations



**LEGEND**

- Koala Presence Assessment Locations
- Buffer

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FIG NO. 6 FIGURE TITLE Koala Presence Assessment Locations

PROJECT NO. 3001803 PROJECT TITLE Dunoon Dam Terrestrial Ecology Impact Assessment

CREATED BY D. Gunn SOURCES Aerial photograph from Rous Water (2009)

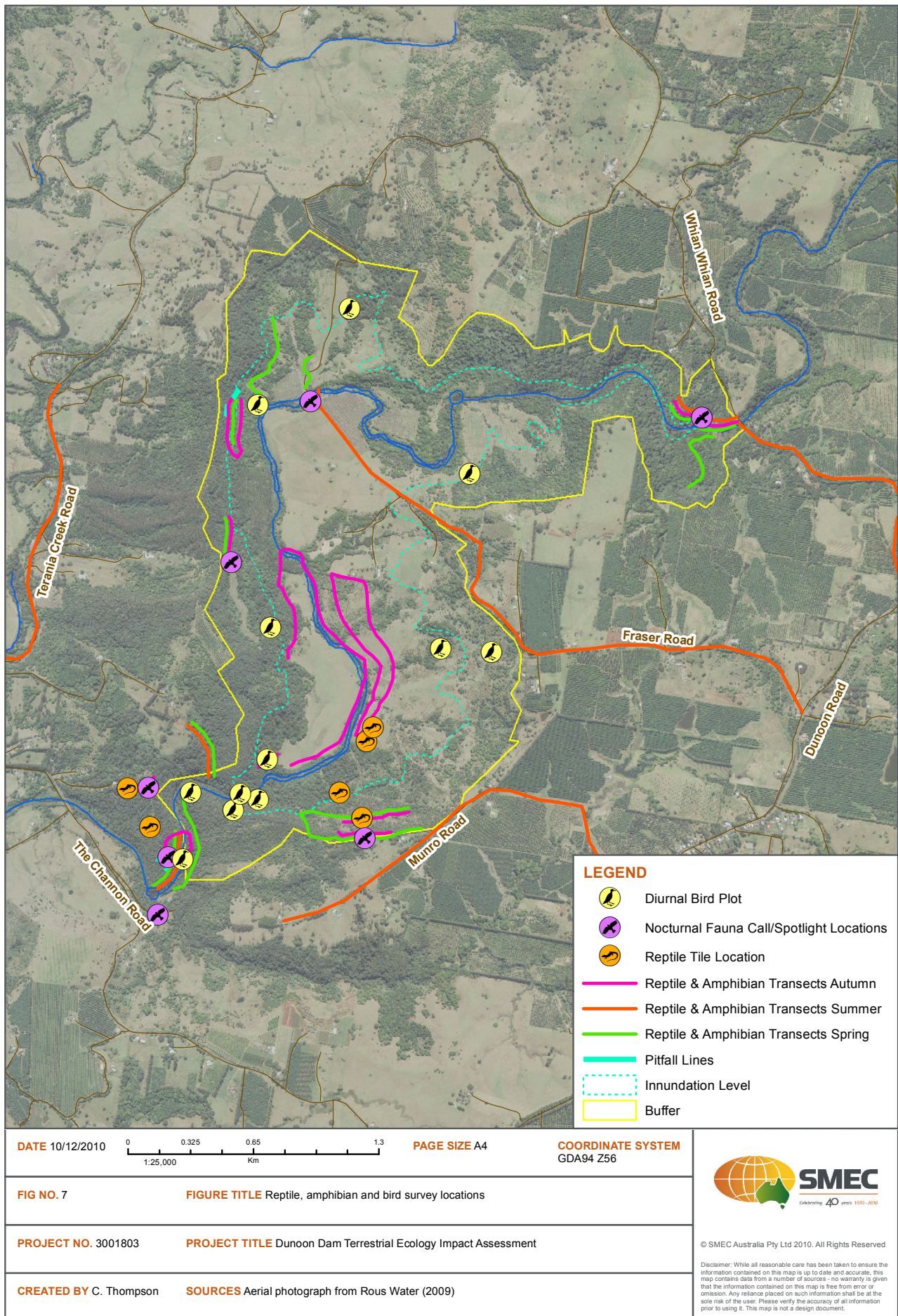


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Figure 7: Diurnal and Nocturnal Bird, Reptile and Amphibian Survey Locations



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### (c) Bats

A combination of methods was used to sample the bat species diversity and abundance at the study area. During the autumn surveys this included the use of call detection (Anabat) and harp trapping methods (**Table 6**) to detect insectivorous bats. It is important to use a range of techniques as some species are difficult to separate using call detection analysis and others fly high above the canopy and are unlikely to be trapped within harp traps. Mist netting was also undertaken in the summer surveys to target mega chiropterans (Common Blossom Bat and Eastern Tube-nosed bat). Spotlighting was undertaken in autumn and spring surveys to target Flying-foxes.

A list of target species and the methods employed for detection is provided in the following table (**Table 6**).

Table 6: Likely target bat species including preferred survey timing and specific method requirements

Common Name (Scientific Name)	Status	Survey Technique
Large-eared Pied Bat ( <i>Chalinolobus dwyeri</i> )	TSC - V	Call detection and harp trapping
Hoary Wattled Bat ( <i>Chalinolobus nigrogriseus</i> )	TSC - V	Call detection and harp trapping
Eastern False Pipistrelle ( <i>Falsistrellus tasmaniensis</i> )	TSC - V	Harp trapping
Golden-tipped Bat ( <i>Kerivoula papuensis</i> )	TSC - V	Harp trapping
Little Bentwing-bat ( <i>Miniopterus australis</i> )	TSC - V	Call detection and harp trapping
Eastern Bentwing-bat ( <i>Miniopterus schreibersii oceanensis</i> )	TSC - V	Harp trapping
Eastern Freetail-bat ( <i>Mormopterus norfolkensis</i> )	TSC - V	Call detection and harp trapping
Large-footed Myotis ( <i>Myotis macropus</i> (syn. <i>M. adversus</i> ))	TSC - V	Harp trapping
Eastern Tube-nosed Bat ( <i>Nyctimene robinsoni</i> )	TSC - V	Spotlight and mist nets*
Eastern Long-eared Bat ( <i>Nyctophilus bifax</i> )	TSC - V	Harp trapping
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	TSC - V EPBC - V	Spotlight and roost surveys
Yellow-bellied Sheath-tail-bat ( <i>Saccolaimus flaviventris</i> )	TSC - V	Call detection and harp trapping
Greater Broad-nosed Bat ( <i>Scoteanax rueppellii</i> )	TSC - V	Call detection
Common Blossom-bat ( <i>Syconycteris australis</i> )	TSC - V	Spotlight and mist nets*
Eastern Cave Bat ( <i>Vespadelus troughtoni</i> )	TSC - V	Harp trapping

Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - Threatened Species Conservation Act (1995), EPBC – Environment Protection and Biodiversity Conservation Act (1999). V – vulnerable \* - Undertaken at Rocky Creek Dam not the study area due to the lack of suitable habitat for this species.

### (i) Anabat Detection

Echolocation calls of microchiropteran bats were recorded at eleven locations within representative habitat on the study area during the autumn survey. Calls were recorded over the entire night using storage an electronic storage device (Zcain) via Anabat II bat detectors for subsequent computer analysis. During the autumn surveys, detectors were located adjacent to harp traps where possible and were placed in 10 study areas. In total, 15 detector nights of echolocation call sampling was undertaken on the study area.

Six study areas were surveyed within the study area in the spring surveys, with two additional locations surveyed at a reference study area (Rocky Creek Dam) to provide a basis for comparison for species found within the study area.

Detectors were located adjacent to harp traps where possible and were placed in a total of seven study areas during the spring surveys. One walking transect was also completed at the reference study area in spring. In total, nine detection nights of echolocation call sampling was undertaken on the study area.

### (ii) Harp Traps

Harp traps were placed at nine locations within the study area in appropriate flyways and to ensure that all major habitats were sampled over four nights during the autumn surveys and six locations in the spring surveys (**Table 7** and **Figure 5**). Three additional traps were placed at the reference study area in spring in order to provide a basis for comparison of species trapped within the study area.

Individuals captured were identified to species level and gender, together with other measurements and observations including sexual condition, weight, forearm length, and ear length for Long-eared Bats (*Nyctophilus spp.*) as this is a character used to distinguish species.

Table 7 Harp Trap Survey Effort

Trap Name	Nights Surveyed Autumn	Nights Surveyed Spring	Total Survey Effort
H01	12/4/2010 – 13/4/2010	n/a	2 trap nights
H02	12/4/2010 – 13/4/2010	n/a	2 trap nights
H03	12/4/2010 – 13/4/2010	n/a	2 trap nights
H04	12/4/2010 – 13/4/2010	25/10/10 – 26/10/10	4 trap nights
H05	12/4/2010 – 13/4/2010	n/a	2 trap nights
H06	14/4/2010	n/a	1 trap night
H07	14/4/2010 – 15/4/2010	n/a	2 trap nights
H08	15/4/2010	25/10/10 – 26/10/10	3 trap night
H09	15/4/2010	n/a	1 trap night
H10	n/a	26/10/10	1 trap night
H11	n/a	25/10/10 – 26/10/10	2 trap nights
H12	n/a	28/10/10	1 trap night
H13	n/a	28/10/10	1 trap night
<b>TOTAL</b>			<b>24 trap nights</b>

### **(iii) Mist Netting**

Mist netting for megachiropterans was undertaken during the spring surveys due to the lack of fruiting or flowering feed trees during autumn surveys. As no suitable locations for a mist net (large aggregations of fruiting/flowering feed trees) were observed within the study area, two (2) mist nets were erected at the reference study area in order to target the Eastern Tube-nosed Bat and the Common Blossom Bat during the spring surveys, and determine if they were present within the wider area. Mist nets were erected across access tracks at Rocky Creek Dam, and were targeted to areas where known feed trees were present. The nets were in operation for a total of eight hours (two nets).

### **(iv) Roost Surveys**

Surveys targeting cave dwelling species such as Large-eared Pied Bat, Little Bentwing Bat, Eastern Bentwing Bat, Large-footed Myotis and Eastern Cave Bat. A total of 4 person hours were spent during the autumn and spring surveys searching rocky outcrops and cliff faces to assess the likelihood of cave roosts within the study area.

### **(v) Spotlighting**

Spotlighting was undertaken to target Grey-headed Flying-foxes in conjunction with spotlight surveys for nocturnal birds and mammals. A total of 32 person-hours of spotlighting were completed over the autumn and spring survey periods.

## **(d) Birds**

### **(i) Spotlighting**

Targeted threatened bird species (Table 7) were determined from desktop searches (Appendix 9) and discussions with local ornithologists, particularly David Rohweder (see Appendix 2 for cv details) who provided background on the likely threatened species that would utilise the habitat provided by the study area. The method employed to survey diurnal (day active) birds was a 20 minute search of a 1 hectare area for each of 12 sites within the study area, in both autumn and spring, which is consistent with recognised methodology described by DEC (2004a). This involved actively searching the 1 ha study area in the allotted time. The presence and abundance of all birds that occurred at the study area during the 20-minutes were recorded, as well as the habitat that each species was heard/seen in, using microhabitat codes from the NPWS Wildlife Atlas. Birds were identified either visually, with the aid of binoculars, or by call identification. Birds detected on the survey plot were recorded as 'on-study area'. Those birds detected outside the plot or flying overhead were recorded as 'off-study area'.

Surveys commenced in the early morning, within an hour of sunrise when bird activity is greatest (Bibbly *et al.* 1992). The field study area number, coordinates of the study area using a handheld Global Positioning System (GPS) unit, location description, the start and finish time, as well as a brief vegetation description (plant species composition) were also recorded at each of the diurnal bird survey locations (**Figure 8**).

Call broadcasting was also undertaken in rainforest areas that provided potential suitable habitat for the Bush-hen (*Amaurornis moluccana*) and Black Bittern (*Ixobrychus flavicollis*).

Table 8: Target bird species including survey timing and specific method utilised

Common Name (Scientific Name)	Status	Survey Technique Utilised
Bush-hen ( <i>Amaurornis moluccana</i> )	TSC - V	Call broadcast, rainforest / wetland margins
Magpie Goose ( <i>Anseranas semipalmata</i> )	TSC - V EPBC - M	1 ha search
Red-tailed Black-Cockatoo ( <i>Calyptorhynchus banksii</i> )	TSC - V	1 ha search, woodland and forest
Glossy Black-cockatoo ( <i>Calyptorhynchus lathami</i> )	TSC - V	1 ha search, woodland and forest
Brown Treecreeper (eastern subspecies) ( <i>Climacteris picumnus victoriae</i> )	TSC - V	1 ha search, woodland and forest
Barred Cuckoo-shrike ( <i>Coracina lineata</i> )	TSC - V	1 ha search, woodland and forest
Double-eyed Fig-Parrot ( <i>Cyclopsitta diophthalma</i> )	TSC - CE EPBC - E	1 ha search, rainforest
Black-necked Stork ( <i>Ephippiorhynchus asiaticus</i> )	TSC - E	1 ha search, pasture
Red Goshawk ( <i>Erythrotriorchis radiatus</i> )	TSC - CE EPBC - V	1 ha search
Black Bittern ( <i>Ixobrychus flavicollis</i> )	TSC - V	1 ha search, riparian habitat and adjacent areas and call broadcast
Swift Parrot ( <i>Lathamus discolor</i> )	TSC - E EPBC - E	1 ha search, autumn and winter, forest and woodland
Square-tailed Kite ( <i>Lophoictinia isura</i> )	TSC - V	1 ha search
Albert's Lyrebird ( <i>Menura alberti</i> )	TSC - V	1 ha search, rainforest
White-eared Monarch ( <i>Monarcha leucotis</i> ) and Button Quails ( <i>Turnix</i> sp.)	TSC - V	1 ha search, forest and rainforest, habitat assessment and searches for bathing and feeding signs (platelets)
Barking Owl ( <i>Ninox connivens</i> )	TSC - V	Call broadcast
Powerful Owl ( <i>Ninox strenua</i> )	TSC - V	Call broadcast
Marbled Frogmouth ( <i>Podargus ocellatus</i> )	TSC - V	Spotlight and call broadcast
Grey-crowned Babbler (eastern subspecies) ( <i>Pomatostomus temporalis temporalis</i> )	TSC - V	1 ha search, woodland and forest
Wompoo Fruit-dove ( <i>Ptilinopus magnificus</i> )	TSC - V	1 ha search, rainforest
Rose-crowned Fruit-dove ( <i>Ptilinopus regina</i> )	TSC - V	1 ha search, rainforest
Superb Fruit-dove ( <i>Ptilinopus superbus</i> )	TSC - V	1 ha search, rainforest
Grass Owl ( <i>Tyto capensis</i> )	TSC - V	Call broadcast
Masked Owl ( <i>Tyto novaehollandiae</i> )	TSC - V	Call broadcast
Sooty Owl ( <i>Tyto tenebricosa</i> )	TSC - V	Call broadcast
Regent Honeyeater ( <i>Xanthomyza phrygia</i> )	TSC - E EPBC - E	1 ha search, autumn and winter, forest and woodland
Brolga ( <i>Grus rubicunda</i> )	TSC - V	1 ha search, pasture

Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - Threatened Species Conservation Act (1995), EPBC - Environment Protection and Biodiversity Conservation Act (1999). E - endangered, V - vulnerable

## (ii) Nocturnal Birds

Nocturnal bird spotlighting surveys commenced approximately one hour after sunset, during favourable weather and outside times of extreme wind and rain during the survey period. If more than one area was surveyed for nocturnal birds on the same night, the surveys were located a minimum of one kilometre apart to ensure that the same birds were not surveyed in multiple samples. Data recorded included the field study area number, coordinates of the study area using a handheld GPS unit, location description, the start and finish time, where owls were detected and the location of roost and nest trees. Appendix 1 details survey effort.

In addition to these nocturnal spotlight surveys, searches for any evidence of owls (e.g. pellets, wash on trees, used hollows etc) occurred during searches for fauna signs.

Call playback for threatened owl and frogmouth species was conducted. If an owl species was called in on more than two nights, call playback for that species was ceased.

## (e) Reptiles

Reptile survey methodology was selected to adequately sample the entire study area for common herpetofauna (reptiles and frogs), however the main aim of the surveys was to identify habitat for threatened species and to survey for them, so areas which were most likely to support threatened species were targeted. As such survey time was concentrated in these areas, rather than areas that were likely only to support common species.

A number of preliminary searches were undertaken of the entire site to identify the most suitable sites for the concentration of survey effort to increase the chances of detection of threatened reptile species (undertaken by Mark Fitzgerald in December 2009 and April 2010). Grazed pasture, camphor laurel/privet forest or plantation environments are considered poor habitats for threatened reptiles (and amphibians) due to their recorded dependence upon specific and uncommon habitat features such as: tree hollows, logs and leaf litter which are scarce and generally unsuitable in these areas.

A combination of techniques was used to sample animals with different life history characteristics (e.g. pit lines and active searches under logs and debris for fossorial (burrowing) species, nocturnal searches for species such as Brown Tree Snakes (*Boiga irregularis*) that are more active at night). Similarly, times of the year were selected to optimise the chance of detection of the full range of reptile species likely to occur and to target threatened species (**Table 9**). The common species of grazed and cleared habitats of the locality were adequately sampled during threatened species targeted surveys, during reconnaissance and other activities on the site.

Two main survey events were conducted in autumn and spring, where pit lines were opened and active searches were undertaken. This effort was supplemented by opportunistic surveys carried out when weather conditions were optimal for reptile surveys in midsummer. Summer surveys occurred on three nights in late December 2010 and targeted habitat most likely to support threatened reptiles, supplementing more general surveys to survey the full range of herpetofauna in the area.

Identification was made immediately in the field and taxonomy was as per Wilson and Swan (2010). Photographs were taken of any species where identification was in dispute so that species identification could be later confirmed.



Table 9: Target reptile species and survey technique requirements

Species	Status	Survey Technique
White-crowned Snake ( <i>Cacophis harriettae</i> )	TSC – V	Pitfall trapping; Diurnal and spotlight searches
Three-toed Snake-tooth Skink ( <i>Coeranoscincus reticulatus</i> )	TSC – V EPBC - V	Pitfall trapping; Diurnal searches
Pale-headed Snake ( <i>Hoplocephalus bitorquatus</i> )	TSC – V	Diurnal and spotlight searches
Stephens' Banded Snake ( <i>Hoplocephalus stephensii</i> )	TSC – V	Diurnal and spotlight searches

Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - Threatened Species Conservation Act (1995), EPBC – Environment Protection and Biodiversity Conservation Act (1999). E – endangered, V - vulnerable

### (i) Pit lines

Reptile surveys were conducted over five days during the autumn survey. Four pit lines were dug at two locations, selected for their potential habitat for fossorial reptiles (Figure 7). Each pit line consisted of four buckets of either 10 or 20 Litre (L) capacity. Damp coarse (a building material) of approximately 30 cm wide was used as a drift fence. Pits were checked daily from Tuesday 13th – Friday 16th April 2010.

Pit lines at the same locations were again open for the spring surveys from 25 - 29th October 2010. Due to the very wet conditions, only three lines were opened during this period (the fourth pit line being too waterlogged was subsequently removed). The line closest to this one was open, but was also waterlogged (buckets were cleared of water but water from the soil forced the buckets up out of the ground each night and were re-set).

### (ii) Active Searches

Diurnal and nocturnal searches were undertaken for reptiles during the period 12 - 16<sup>th</sup> April 2010 for the autumn surveys and during the period 25 - 29<sup>th</sup> October 2010 for the spring surveys. Searches were conducted by 1 - 4 ecologists, with survey effort shown in Appendix 1.

A hand search of suitable habitat within the study area with rocks, logs and other items of ground cover or shelter being searched and replaced, concentrating on fallen logs, any tin, bark and rock outcrops, which contain the most reptile habitat. Any sheltering reptiles were caught (if necessary), identified and released.

### (iii) Nocturnal Road and Targeted Searches

These occurred in December 2010 over three nights (13th, 15th and 17<sup>th</sup> December 2010 when conditions were warm and dry after a period of rain. Two of the surveys occurred along transects that were marked out during the day in high quality habitat (**Table 9**) On 17<sup>th</sup> December the roads surrounding the study area (Whian Whian, Fraser and Munro Roads) were searched by car.

Two transects were marked out in rainforest habitat on properties within the footprint of the dam or just outside this footprint. During these searches a spotlight (50W) and Petzl head torch were used to locate animals. Habitat attributes were again targeted within and immediately surrounding transects (Appendix 1). The locations of all active searches and pitlines are shown in **Figure 8**.

Potential habitat for these species was searched during nocturnal and diurnal surveys in Autumn, Spring and specifically during Summer surveys when targeted threatened reptile surveys were only carried out in optimal conditions (warm nights after rain), to maximise the likelihood of detection if the above four species were present in or around the study area.

Two areas with good rainforest habitat (in the south-west of the study area see **Figure 8**), were identified during the day and transects and were marked with flagging tape. These study areas were then revisited at night. Habitat attributes such as logs, trees, brush turkey mounds and cleared areas were all checked, with the biologist deviating from the transect to search nearby appropriate habitat where available. Road surveys were conducted on the same nights when driving between study areas and then specifically on 17<sup>th</sup> December when Whian Whian, Fraser and Munro Roads were slowly driven along to search for reptiles and amphibians (**Figure 1**). The survey involved the use of head lights to detect animals whilst listening for calling frogs. If an animal was detected it was identified from the car or the biologist pulled over and captured the animal to confirm identification.

#### **(iv) Opportunistic Observations**

Opportunistic reptile observations were recorded throughout the baseline study as reptiles can often be observed basking or may be disturbed during other survey activities.

#### **(v) Tiles**

Roof tiles (30 cm x 47cm) were placed in suitable habitat within the inundation area and in close proximity to the dam wall (Figure 6). Roof tiles are a long-term survey or monitoring tool, since it takes at least six months for the moisture level and other microclimatic conditions to be suitable for reptiles or other animals to utilise these sites (S. Sass pers. comm. 2011). Tiles were placed in April 2010 with the intention to begin monitoring in spring. Spring time conditions were extremely warm and wet and unsuitable for habitation of animals under tiles. During the cooler, drier months tiles will be checked and may be retained on the site for on-going monitoring.

#### **(f) Amphibians**

Searches were largely opportunistic during the autumn surveys, as these taxa were targeted in the spring surveys, when the greatest number of species was likely to be active. Opportunistic sightings occurred during night time spotlight searches for mammals. Autumn is not optimal time for breeding (and therefore calling) in amphibians and thus survey effort was not high for this taxon in autumn (Appendix1).

Amphibians were generally heard rather than seen, so surveys conducted during the breeding (and therefore calling) season are most likely to be successful. Most amphibians breed in the period from late August to early March (Cogger 2000), although several widespread and common species such as the Common Eastern Froglet (*Crinia signifera*) call and breed all year round, whenever environmental conditions are appropriate.

Frogs are most active on warm nights after rain. Searches for amphibians, particularly rare and threatened species were carried out in spring and summer, opportunistic recordings were made during autumn surveys, when frogs were heard or seen in the course of carrying out other surveys.

#### **(i) Active searches**

All appropriate amphibian habitats within the upland swamps were searched. Calling frogs were located and identified where appropriate (Frogs were only caught if necessary for

identification); all handling procedures conformed to NPWS Protocol 6 (NPWS 2001A) to minimise the spread of chytrid disease in frog communities.

Amphibian surveys were carried out during the day and night on the four days and nights from 25th – 29th October 2010 and then again as part of targeted threatened species searches in December 2010. Searches specifically targeted areas known or expected to be good amphibian habitat. This included searches along riparian corridors, farm dams, and areas of ephemeral inundation such as low-lying paddocks near watercourses.

Frogs were not handled unless necessary for identification purposes, and gloves were used in cases where frogs had to be handled. No collecting bags were used and no water or mud was transferred between study areas. Boots were washed and disinfected between study areas with different water influences

Tadpole surveys were not conducted since all common species expected to occur were found by call alone and appropriate habitat for the tadpoles of threatened species was not found in the study area. The common species of grazed and cleared habitats of the locality were adequately sampled during threatened species targeted surveys, during reconnaissance and other activities on the site.

## (ii) Threatened Amphibians

During both spring and summer surveys all amphibian species present were recorded, however the five threatened species below were targeted and habitat that might support them received additional survey effort (Appendix 1). These species were also targeted within the nocturnal reptile surveys.

Searches for these species were undertaken where preliminary habitat assessments identified suitable habitat features. These threatened species were considered unlikely to be found in the grazed pasture, camphor laurel/privet forest or plantation environments of the site due to their recorded dependence upon specific and uncommon habitat features: riparian rainforest soaks and litter for the frogs.

Table 10: Target threatened amphibian species including preferred survey timing and specific method requirements

Scientific Name	Status	Survey Technique
Pouched Frog ( <i>Assa darlingtoni</i> )	TSC - V	Nocturnal call surveys (spring/summer)
Green-thighed Frog ( <i>Litoria brevipalmata</i> )	TSC - V	Nocturnal surveys (after heavy rainfall in warmer months) and tadpole surveys
Fleay's Barred Frog ( <i>Mixophyes fleayi</i> )	TSC – E EPBC - V	Nocturnal call surveys (spring/summer)
Giant Barred Frog ( <i>Mixophyes iterates</i> )	TSC – E EPBC - E	Nocturnal call surveys (spring/summer)
Loveridge's Frog ( <i>Philoria loveridgei</i> )	TSC – E	Diurnal surveys (spring/summer)

Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - Threatened Species Conservation Act (1995), EPBC – Environment Protection and Biodiversity Conservation Act (1999). E – endangered, V - vulnerable

### 2.2.3.2 Macroinvertebrates

A targeted threatened macroinvertebrate survey was conducted on 22-25<sup>th</sup> November 2010 for eight threatened species listed in **Table 11**. Study areas were those considered to be 'least disturbed' and the most suitable for the presence of the target species, which included where vegetation was well established, weed infestation was low and an

understorey was highly likely to be present. Where access was possible, swampy habitats were also targeted.

Table 11: Likely target macroinvertebrate species including preferred survey timing and specific method requirements

Common Name (Scientific Name)	Status	Survey Technique
Atlas Rainforest Ground-beetle ( <i>Nurus atlas</i> )	TSC – E	Daytime searching for burrows and possible excavation
Shorter Rainforest Ground-beetle ( <i>Nurus brevis</i> )	TSC – E	Daytime searching for burrows and possible excavation
Mitchell's Rainforest Snail ( <i>Thersites mitchellae</i> )	TSC – E EPBC - CE	Daytime searching under logs and forest debris
Laced Fritillary ( <i>Argyreus hyperbius</i> )	TSC – E	Daytime field observations and hand netting
Pink Underwing Moth ( <i>Phyllodes imperialis</i> (southern subspecies))	TSC – E EPBC - E	Night-time light-trapping. Daytime searches for larval feed plant.
Coastal Petaltail ( <i>Petalura litorea</i> )	TSC – E	Day time field observations and hand netting
Giant Dragonfly ( <i>Petalura gigantean</i> )	TSC – E	Day time field observations and hand netting
Black Grass Dart ( <i>Ocybadistes knightorum</i> )	TSC – E	Day time field observations and hand netting

Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - Threatened Species Conservation Act (1995), EPBC – Environment Protection and Biodiversity Conservation Act (1999). E – endangered, V – vulnerable, CE – critically endangered.

Survey sites were chosen that were considered to be the ‘best available’ for the threatened species. That is, sites were chosen which appeared to fulfil species requirements, such as vegetation type and condition, altitude and locality. Macroinvertebrate surveys were undertaken using a range of techniques for each of the threatened species and all the searches were timed to ensure consistency between study areas. Opportunistic observations were also recorded. The surveys included daytime searches, nocturnal light traps, soil surveys and searches for feed plants. Appendix 1 details survey effort.

#### (a) Daytime Searches

Daytime searches targeted dragonflies and butterflies. The searches were undertaken in areas of open habitat where specimens were collected using a hoop net. A total of eight hours over three days was spent searching for flying macroinvertebrates.

#### (b) Light Traps

A UV light trap was used to attract the Pink Underwing Moth (*Phyllodes imperialis*) to gauge its presence in the area. The trap was set up in various locations throughout the study area, targeting threatened moth habitat areas (**Figure 8**).

#### (c) Soil Surveys

Diurnal and nocturnal searches were undertaken to detect target taxa that occur on the ground.

Targeted nocturnal surveys were undertaken for the Atlas Rainforest Ground beetle (*Nurus atlas*) and the Shorter Ground Beetle (*Nurus brevis*), as they are most active at night (Hangay and Zborowski 2010). Collecting techniques for the beetles comprised of searches for individuals and their burrows in known microhabitat (e.g. embankments, slopes). Since these beetles are difficult to confidently identify within the study area, the presence of any beetles within the family Carabidae was recorded.

Where diurnal searches for other ground-dwelling fauna occurred (e.g. Mitchell's Rainforest snail), observations on the potential for the target nocturnal beetles to occur were also made. For Mitchell's Rainforest Snail (*Thersites mitchellae*) collecting comprised of searching for known microhabitats e.g. under logs, rocks and other forest debris. The presence of both live snails and dead shells was recorded.

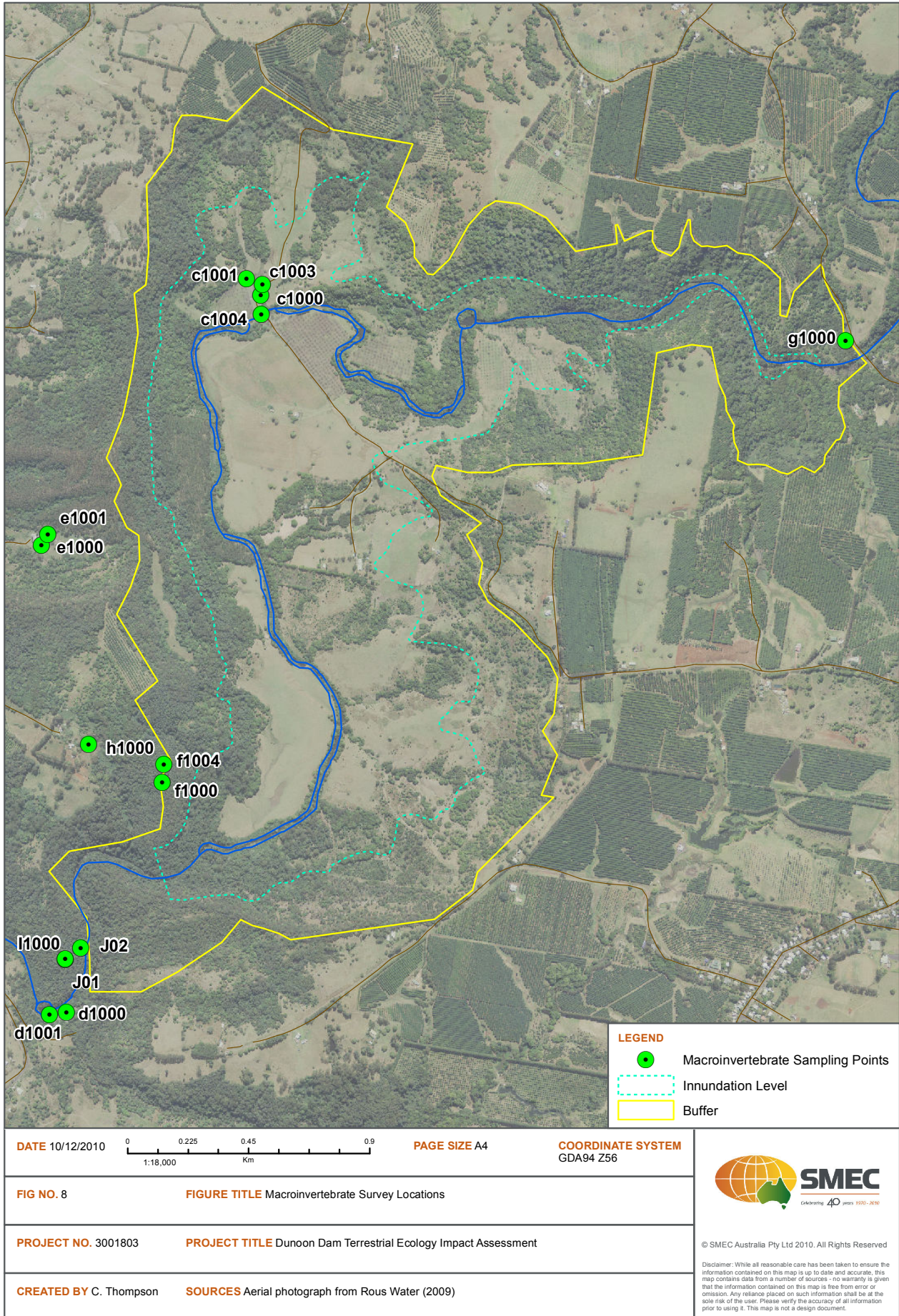
**(d) Searches for Feed Plants**

At each light trapping study area, searches for the larval feed plant of the Pink Underwing Moth, (*Carronia multisepealea*), were conducted during the day. Searches comprised of four 100 m transects placed in suitable habitat. Plant samples were collected for verification (e.g. Harden *et al.* 2007).

**(e) Verification of Specimen Identification**

To assist in the accuracy of the field identifications, a visit to the Australian Museum was undertaken to view actual specimens of the threatened macroinvertebrates targeted (**Table 11**). If the necessary morphological features could not be readily observed within the study area then a macroinvertebrate was identified to its lowest possible grouping. Where appropriate, macroinvertebrate identifications also considered observed behavioural or ecological characteristics; such as feed plants, flight patterns, or exhibited characteristic behaviours.

Figure 8: Macroinvertebrate Trapping Locations



## 2.3 Impact Assessment Approach

### 2.3.1 Identification of Potential Impacts

The impact assessment component for this TEIA has been approached using a two-tier assessment process to determine the significance of potential impacts. The first part of the impact assessment identifies the range of potential impacts as a result of the proposal. Potential impacts include:

- Loss of threatened species and communities;
- Loss of vegetation communities;
- Loss of biological diversity;
- Loss of fauna habitat and habitat features;
- Wildlife movement and connectivity;
- Introduction of pest species;
- Introduction of weeds;
- Increased key threatening processes; and
- Regional scale cumulative impacts.

The second part of the assessment process incorporates a risk-based framework, to quantify and evaluate the significance decisions relating to potential impacts on threatened entities and ecological functions.

### 2.3.2 Significance Assessment

To identify and determine any potentially significant or residual impacts, an impact significance matrix (*Figure 9*) was developed. The matrix quantifies the likelihood and consequence to identified potential impacts as a result of project activities. When combined within the matrix, this provides an overall significance outcome of one of the following:

- **Negligible** - the identified potential impact is extremely unlikely to constitute any significant impact and no specific management and mitigation will be required;
- **Low** - the identified potential impact is unlikely to constitute any significant impact and specific management and mitigation is unlikely to be required, however may still be applied to reduce the potential for impact further;
- **Moderate** - the identified potential impact has the potential to constitute a significant impact and specific management and mitigations should be applied to reduce the potential for impact further; and
- **High** – the identified potential impact is likely to constitute a significant impact and specific management and mitigation measures must be applied.

		Consequence					
Ecological Consequence Descriptions		No detectable change	Change is detectable but minor and confined	Change in ecosystem leading to short term damage; Possible trans-boundary effects; Possible contribution to cumulative effects	Change in ecosystem leading to damage with recovery likely; Trans-boundary effects expected; Moderate contribution to cumulative effects	Permanent ecological damage with possibility of long term recovery; Major trans-boundary effects expected; Moderate contribution to cumulative effects	Change in ecosystem leading to long term and widespread damage with poor potential for recovery; Major trans-boundary effects; Major contribution to cumulative effects
Likelihood		F	E	D	C	B	A
Expected to occur during the Project or beyond the Project	A	Moderate	Moderate	High	High	High	High
May occur during the Project or beyond the Project	B	Moderate	Moderate	Moderate	High	High	High
Possible under exceptional circumstances	C	Low	Moderate	Moderate	Moderate	High	High
Unlikely to occur during the Project	D	Low	Low	Moderate	Moderate	Moderate	High
Very unlikely to occur during the Project	E	Negligible	Low	Low	Moderate	Moderate	Moderate
Extremely rare or previously unknown to occur	F	Negligible	Negligible	Low	Low	Moderate	Moderate

<b>Negligible or Low Significance Outcome</b> Measures may be applied to further reduce significance	<b>Moderate Significance Outcome –Has the potential to constitute a significant impact</b> Measures should be applied to reduce significance	<b>High Significance Outcome</b> Measures must be applied to reduce significance
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Figure 9: Significant Assessment Matrix for Dunoon Dam Terrestrial Ecology Impact Assessment.

### 2.3.3 Mitigation Measures

The hierarchy of avoid, minimise, then manage (mitigate, offset and/or monitor) impacts is adopted in this study in accordance with six guiding principles under the Part 3A assessment process (DEC and DPI 2005). These principles are:

- Maintain or improve biodiversity values;
- Conserve biological diversity and promote ecologically sustainable development;
- Protect areas of high conservation value;
- Prevent the extinction of threatened species;
- Protect the long-term viability of local populations of a species, population or ecological community; and
- Protect aspects of the environment that are matters of national environmental significance.



Avoiding impacts to biodiversity, ecological values and ecological processes is the preferred approach and avoidance strategies have been adopted for the project wherever possible. Where project impacts are unavoidable, mitigation procedures and management safeguards have been defined to limit the degree of direct and indirect impact.

A system of ecological offsetting is proposed to counter impacts by providing in-situ and off study area benefits through ecological restoration. The effectiveness of the management measures applied for the project will be measured through a series of monitoring and evaluation programs.

## 3 STUDY AREA CHARACTERISATION

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### 3.1 Climate and altitude

Dunoon is one of the rainiest and most humid places in Australia, with very high rainfall (annual average of 2327mm/year) and humidity, and far below average wind speed. Maximum temperatures in summer are 25.7 - 26.5°C, with overnight minimums averaging between 16.6 - 17.5°C. Winter maximum daily temperatures average 17.3 - 18.7°C, with lows averaging 7.2 - 8.5°C. The altitude of the town of Dunoon is approximately 190 m, with a range of 50 - 220 m (metres) for the study area.

### 3.2 Geology and Landform

#### 3.2.1 Regional Geology

The North Coast Bioregion contains Devonian and Permian bedrocks that are part of the New England Fold Belt, which have been closely faulted. Small bodies of granite and granodiorite have intruded the sedimentary rocks and there are three centres of Tertiary basalt eruption. Sediments in this sequence are similar to those in the Sydney Basin and include some minor coal seams (Morand 1994).

The largest volcanic centre, resulting from Tertiary basalt eruption, is the Tweed volcano and the associated Mount Warning caldera (exploded crater) near the New South Wales/Queensland border. This complex is dated between 20 and 24 million years old, and at the time of eruption was a shield volcano with low slopes that covered an area 80 by 100 km (Morand 1994). Mount Warning itself is the remains of a large central feeding chamber, filled with coarser rock than the basalts, rhyolites and tuff on the caldera rim.

#### 3.2.2 Regional Soils

The soil patterns in the bioregion are complex due to different substrates, the topographic variation and the climatic differences encountered across and along the bioregion. In general, only the most fertile soils (normally from basalts) support rainforests, but exceptions to this are found in numerous protected pockets where nutrients from decaying plant matter have accumulated through organic cycling in litter (NPWS 2003a).

Soils are typically red, friable loams or clay loams with high fertility, good structure and excellent water-holding capacity on the basalts. On granites and most of the quartz rich sedimentary rocks, shallow yellow earths are found on hillcrests, yellow and brown texture contrast profiles are found on the slopes, and organic loams or sandy loams are found on the alluvial plains. In the coastal dunes, deep siliceous sands and very well developed podsols can be found (NPWS 2003a).

In the north of the bioregion, soils derived from basalts support sub-tropical and warm temperate rainforests, or wet sclerophyll forests (NPWS 2003a).

#### 3.2.3 Local Geology and Landform

Dunoon is located within an area known as the Lamington Volcanic Suite, a collection of igneous rock consisting of Lismore Basalts, Nimbin Rhyolites and Blue Knob Basalts, which were deposited by volcanic flows from Wollumbin (Mount Warning) between 23 and

8 million years ago. These volcanic rocks overlay a series of older sedimentary rocks, laid down during the Jurassic (Ainsworth Heritage 2011).

The proposed dam study area is located on a low basaltic plateau (Lismore Plateau), which is part of the residual slopes of the Mount Warning Shield volcano further to the north. The plateau is bound by the narrow coastal plain near Ballina to the east, the Nightcap range in the north, the Richmond River in the south and Lismore in the west (Austeco 1994). It primarily lies over a section of what are known as the Walloon Coal Measures and Kangaroo Creek Sandstones. The layers contain shales, sandstones, coal and ironstones and are from the Jurassic period (Ainsworth Heritage 2011).

The local landforms of the proposed dam site area are dominated by the effects of the local ridgeline complex, Rocky Creek and the Lismore Basalt/Sedimentary rock layers. The proposed dam area's perimeter is delineated by the surrounding ridges, in the north-east and south-west forming a natural bowl, with the slopes running off these ridges towards Rocky Creek initially quite steep (Ainsworth Heritage 2011).

The valley associated with Rocky Creek has been formed in basalt and softer sedimentary rocks, including claystone and siltstone with thin coal seams, with old alluvial terraces also present. To the south of the large valley is a narrow 'gorge' where Rocky Creek traverses a belt of quartz sandstone (Ecos 2001).

### **3.2.4 Local Soils**

Mitchell soil landscape mapping of the area (Morand 1994) shows that Rocky Creek and the associated floodplain contain the Terania alluvial soil landscape unit. This soil type is derived from the Quaternary sediments (river gravel, alluvium, sand and clay) with fine-grained sediments from surrounding basalt areas predominating. There is also considerable input from sediments of the Kangaroo Creek Sandstone, Walloon Coal Measures and the Nimbin Rhyolites. Soils are deep (>300 cm) where associated with alluvial clays and near sandstone areas, becoming shallower though still deep (>200 cm) and poorly drained black earths and with deep, rapidly draining earthy sands lining the channels (Morand 1994) (*Figure 10*).

Surrounding this soil landscape on the lower rolling hills of the inundation area is the Calico colluvial soil landscape unit. This unit is derived from the Walloon Coal Measures from grey claystones and shales, with fine to medium grain grey lithic sandstones and concretionary ironstone geology. Soils are generally moderately deep (100 - 150 cm), moderately well drained grey-brown podzolic soils and grey-brown podzolic soil/soloth intergrades, with yellow podzolic soils on sandstone/shale. Generally moderately deep and moderately well-drained red podzolic soils with grey-brown podzolic soil/soloth intergrade on shale/carbonaceous shale. Deep (100 - 250 cm) poorly drained soloths on lower slopes and shallow drainage depressions and alluvial soils in the drainage lines (Morand 1994).

On the eastern upper slopes and extending into the north-eastern part of the study area is the Coolamon colluvial soil landscape. This landscape comprises Lamington Volcanics: Lismore Basalts-tertiary basalts with bole and minor agglomerate geology. Soils are shallow (<100 cm) moderately well-drained stony chocolate soils and shallow well-drained krasnozems which create a mass movement hazard with steep slopes. This landscape intergrades with the Rosebank erosional landscape unit in the north-eastern corner of the inundation area. This landscape unit is also based on the Lamington Volcanics geology with shallow, well-drained krasnozems and brownish red krasnozems on crest margins, and moderately deep to deep (>100 cm) krasnozems and brownish red well-drained krasnozems on slopes. This landscape unit has very acidic soils with high aluminium toxicity potential (Morand 1994).

The western ridgeline contains the Georgica colluvial soil landscape unit. This unit is derived from the Lamington Volcanics: Lismore Basalts-tertiary basalts with bole and minor agglomerate geology. It contains shallow (50 - 100 cm) moderately well-drained chocolate soils and prairie soils on crests and upper slopes. Shallow to moderately deep (50 - 150 cm), moderately well-drained chocolate soils on upper slopes, with shallow to moderately deep (60 - 150 cm), well-drained prairie soils and chocolate soil/prairie soil integrate on midslopes. The lower slopes and foot slopes are deep poorly to moderately well-drained black earths (Morand 1994).

The surface geology and associated soils within the study area were found to be highly variable with changes between sedimentary, metamorphic and volcanics observed during the surveys. This apparent variation was most prominent through the southern areas of the study area, particularly within remnant and regenerating closed forest. The mixed surface geology and derived soils influence the vegetation species composition and distribution as a result of variations in fertility and other soil characteristics.

### 3.3 Vegetation Communities

#### 3.3.1 Regional Vegetation Communities

The north-eastern NSW and south-eastern QLD region is high in biological diversity and has been recognised as a 'hot spot' by the Commonwealth ([www.environment.gov.au/biodiversity/hotspots/national-hotspots.html](http://www.environment.gov.au/biodiversity/hotspots/national-hotspots.html)). The diversity comes from the combination of low to high fertility soils over a rugged topography with high rainfall and an equitable climate. It represents one of the two refugia for the old Gondwanan or Tumbunan rainforest biota which retreated to this area and north Queensland as the continent dried out at the end of the Tertiary and through the Quaternary Periods (CSIRO 1996).

The remaining patches of these diverse rainforests are known as the 'Big Scrub' remnants, which once covered an area of 75,000 ha, but is now scattered across 700 hectares between the towns of Byron Bay, Ballina and Lismore in NSW on the Lismore Basalt geologies. Most of these remnants are less than five hectares in area, with the majority occurring in protected areas (Rainforest Rescue 2008).

Nightcap National Park, with the highest annual rainfall in New South Wales, contains warm temperate rainforest on soils with a rhyolitic base, while sub tropical rainforest is supported by nutrient-rich basalt soils. The subtropical and warm temperate rainforest communities found in the park have links to the ancient supercontinent of Gondwana (Rainforest Rescue 2008). Further, a remnant of the big scrub is present around Rocky Creek Dam, with the study area lying on the edge of the Lismore Basalt geologies. The remnants are important genetic pools for seed dispersal between rainforests in north-eastern New South Wales.

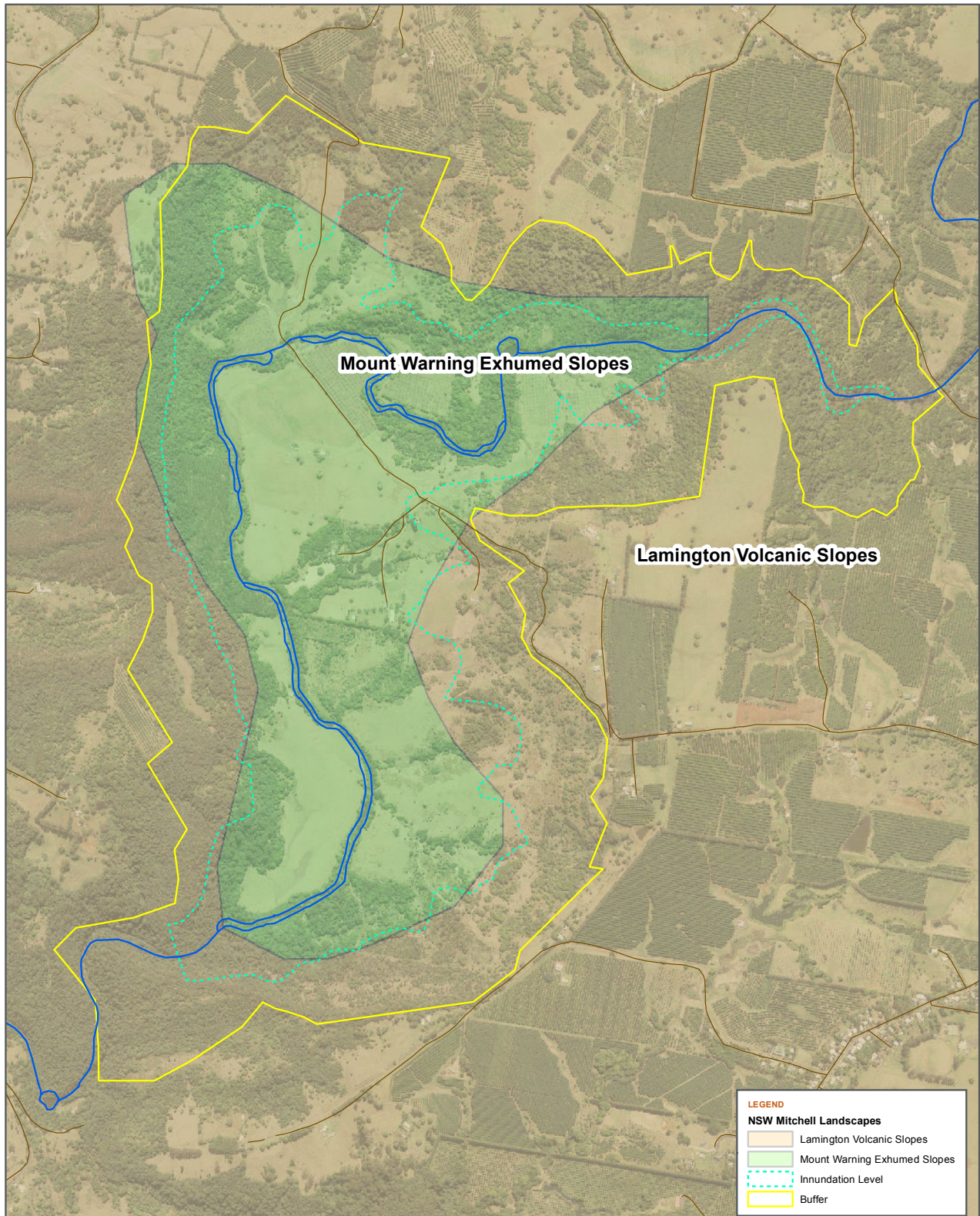
In general, the Richmond-Tweed CMA subregion is characterised by subtropical and warm temperate rainforest with wet sclerophyll forest communities. Within the alluvial and basalt-derived soils of the study area, it is likely that the vegetation communities that once occurred within the study area included rainforest communities, with the sandstone ridgelines and associated poorer soil types containing wet sclerophyll forests (DECCW 2010).

### **3.3.2 Disturbance History of the Study Area**

The first European use of the study area was as a camp for cedar getters in the early 1840's, which saw timber harvesting in the locality. Land clearing for dairy farming, with a co-operative butter factory formed in 1891 in Dunoon, as well as for crops such as maize and sugar cane, was undertaken soon after (Ainsworth Heritage 2011). The dairy industry continued through the first half of the twentieth century, forming many of the settlements in the area.

As a result of this history, the study area and its surrounds were almost fully cleared in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries. Only steep slopes and gullies on sandstone geology remained largely undisturbed with selective logging occurring through these areas. Decreasing agricultural activities within the study area have led to the regeneration and regrowth of forest communities in the heads of gullies, on steep slopes and along drainage lines (Ecos 2001), forming the vegetation communities within the study area today.

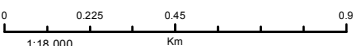
Figure 10: Soil Landscape Units within the Study Area (Mitchell Landscapes)



**LEGEND**

**NSW Mitchell Landscapes**

- Lamington Volcanic Slopes
- Mount Warning Exhumed Slopes
- Inundation Level
- Buffer

**DATE** 10/12/2010            **PAGE SIZE** A4      **COORDINATE SYSTEM** GDA94 Z56

**FIG NO.** 10      **FIGURE TITLE** Mitchell Landscapes within the Study Area

**PROJECT NO.** 3001803      **PROJECT TITLE** Dunoon Dam Terrestrial Ecology Impact Assessment

**CREATED BY** C. Thompson      **SOURCES** Aerial photograph from Rous Water (2009)



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## 3.4 Flora

More than half the identified vascular plant species in NSW occur in north-eastern NSW, with 148 plant species being recognised as endemic to the region. Many of these are of particular significance for their endemism, rarity, degree of threat, distributional limits and disjunctions and attributes to scientific interest such as primitiveness (Landmark 1999).

A total of 520 plant species are recorded in the nearby Whian Whian SCA, which represents nearly 10 per cent of the vascular species known to occur in NSW (Kooyman 2002 in NPWS 2010). Floristic diversity within the study area was also high with a total of 180 plant species being recorded, of which 90 per cent are native.

### 3.4.1 Threatened Flora Species

A variety of flora species, totalling 224 vascular species, found in the Northern Rivers CMA area are listed in the schedules of the TSC Act as threatened. Several of these species are endemic to the region, including *Zieria prostrata* and *Elaeocarpus* spp. Rocky Creek.

There are 21 threatened species listed under the TSC Act and 16 species listed as rare or threatened Australian plants (RoTAP) within the nearby Whian Whian State Conservation Area (SCA) area (NPWS 2010). As the study area contains similar habitats, though in a more disturbed state than the SCA, it is considered possible that a number of similar species occur within the study area.

There are 35 plant species known to occur in Nightcap National Park (NP) that are listed as threatened species under the TSC Act (NPWS 2004). Many of these species are restricted to and/ or have a major proportion of their occurrence in the region or are at their geographic limit of distribution. Endangered plant species essentially restricted to the Park include *Elaeocarpus* sp. *Minyon*, Southern Ochrosia (*Ochrosia moorei*), Red-fruited Ebony (*Diospyros mabacea*) and Peach Myrtle (*Uromyrtus australis*) found in rainforest and wet sclerophyll forest. An undescribed rainforest tree species, known as the Nightcap Oak, has also been recently discovered in the Nightcap Range. This species is thought to belong to the newly described *Eidothea* genus (NPWS 2004).

## 3.5 Fauna

The NSW North Coast/south-east QLD region supports the highest species diversity in Australia of marsupials, frogs, bats and non-ctenotus skinks; and the second highest diversity (after the wet tropics) of birds (Gilmore and Parnaby 1994). A number of zoogeographical zones converge in this area, resulting in this high diversity and a number of species occurring at their geographical limit (Gilmore and Parnaby 1994).

In NSW, this region is home to a range of fauna species and is an area where geographic boundaries for species occurrence overlap. The vast diversity of habitats within the region provides an array of ecological niches for the main terrestrial fauna groups.

The subtropical habitats of the region are rich in bird diversity, with many endemic species and species with restricted distributions, especially in rainforest habitats where there are also several threatened species (Sattler and Creighton 2002). The nearby Whian Whian SCA is known to support a diversity of native animal species, with a total of 276 native animal species being recorded (NPWS 2010).

### 3.5.1 Threatened Fauna Species

One hundred and sixty-one (162) fauna species recorded in the Northern Rivers CMA region are listed in the schedules of the TSC Act. Of these, 37 are listed as endangered, eight species are critically endangered and 116 are listed as vulnerable (**Table 12**).

Table 12: Number of threatened taxa for each category listed under the TSC Act

Status TSC Act	Taxa Groups and Number of Species Listed						
	Invertebrates	Amphibians	Reptiles	Birds	Mammals	Bats	Total
Critically endangered species	-	2	-	6	-	-	<b>8</b>
Endangered species	12	9	1	12	3	-	<b>37</b>
Vulnerable	-	7	11	70	12	16	<b>116</b>

A full list of these species is provided as Appendix 9 species included in assessment for potential to occur and for targeted survey are shown in Appendix 3. Species not included in these assessments were those that had minimal chance of potential habitat within the area. If there was a possibility of occurrence, then they were assessed in Appendix 3.

The nearby Whian Whian SCA contains a number of threatened species, with 35 species listed in NSW and four of these listed as threatened nationally (NPWS 2010). In addition, the Nightcap NP's subtropical rainforests support the threatened Rufous Scrub Bird, White-eared Monarch and the Marbled Frogmouth, as well as fruit-eating rainforest pigeons and other birds that pass the winter at lower altitudes. Mammal species such as the vulnerable Spotted-tailed Quoll and Parma Wallaby occur at mid-to-high level in these forests in the Park. Tall wet forest areas support the endangered Red Goshawk and vulnerable Sooty and Masked Owls. Open dry forest communities provide habitat for the threatened Masked Owl, Yellow-bellied Glider, Koala and Rufous Bettong (NPWS 2004b).



## 4 SURVEY RESULTS

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### 4.1 Vegetation Communities

Aerial photograph interpretation (using a 2009 aerial image) and subsequent field validation within the study area found that seven broad vegetation types occur. This includes three communities dominated by exotic and weed species. These are:

- Pasture;
- Plantations;
- Camphor Laurel Disturbed Woodland/Forest; and

Four native and regenerating vegetation communities:

- Tallowwood Open Forest;
- Flooded Gum-Tallowwood-Brush Box Moist Open Forest;
- Sub-tropical Rainforest; and
- Warm Temperate Rainforest.

An overview of these communities is provided below. A discussion of the regional status, similarities with recent mapping reports and characteristics for the native vegetation communities are included Section 5.1 .

#### 4.1.1 Pasture

The majority of the inundation area contains pasture with areas of weedy forest within the steeper drainage depressions. Pasture areas are dominated by introduced pasture improvement plants such as Paspalum (*Paspalum spp.*), Carpet Grass (*Axonopus affinis*), Clover (*Trifolium repens*), Kikuyu (*Pennisetum clandestinum*) and weed species such as Tobacco Bush (*Solanum mauritianum*) and Flatweed (*Hypocheirus radicata*) over the majority of the inundation area.

Areas of native Blady Grass (*Imperata cylindrica*) as well as other native and weed species such as Slender Knotweed (*Persicaria decipiens*) and Umbrella Grass (*Cyperus sanguinolentus*) occur in wetter areas and drainage depressions. Some small wetland-type depressions occur through the north-western part of the inundation area and buffer zone. These pasture areas contain a variety of swampy vegetation including *Schoenoplectus validus*, Slender Knotweed and Umbrella Grass. These areas provide habitat for the threatened *Arthraxon hispidus*, which was found throughout these depressions and intermittent drainage lines.

A small area dominated by Kangaroo Grass (*Themeda australis*), which is regularly slashed for access to regeneration areas, occurs near the Munro Road entrance to the study area, within the buffer area in the south-east. The remaining areas of pasture grassland contain a combination of non-native pasture improvement species and weeds with limited native flora.

Rotational crops including maize are grown in the north-western floodplain area, however very few cultivated areas are present within the study area. In addition, the pasture areas are only lightly grazed by cattle, with most of these areas retaining a vegetative height between 0.1 to 1 m in height.

Camphor Laurel (*Camphor laurel*) and Sally Wattle (*Acacia melanoxylon*) regrowth is encroaching on pasture areas, particularly within the drainage lines of the inundation area and the slopes on the eastern side of the study area where grazing practices have been relaxed. This is evident by the saplings and regrowth observed within these areas within the study area.



Plates 1 and 2: Swampy pasture area in the north-east and typical pasture grazing area within the inundation zone.

#### 4.1.2 Plantations

A number of plantation areas occur within the inundation area and buffer zone. These include eucalypt, pecan and hoop pine (interspersed with eucalypts) plantations. Some of the ridgeline areas on the western side of the buffer zone contain areas of trees of similar age. It is possible that these areas have been planted in the past.

Sydney Blue Gum (*Eucalyptus saligna*) plantations occur on the central western side of the inundation area and up onto the ridgeline within and beyond the buffer zone. These plantations are tall, approximately 15 years old, with few groundcovers and shrubs. Patches of weeds such as Lantana occur in areas where light is available through the canopy.

Hoop Pine (*Araucaria cunninghamii*) has been planted with Blue Gum's within the north-western part of the buffer area. Hoop Pine and Tallowwood (*Eucalyptus microcorys*) have also been planted in disturbed rainforest further to the east (20 - 30 years old).

Pecan plantations occur within the north of the study area, within the inundation and buffer zones. These plantations contain a grassy lower stratum, which is grazed by cattle.

In general, the floristic diversity of the plantation areas is low. With monoculture canopy species and managed groundcovers, few native plants occur in these areas. Active regeneration has occurred in some areas of the study area in line with Rous Water's Regeneration Program. As such, species characteristic of the probable previous floristic assemblages of the area prior to European disturbance have been planted in strategic locations.



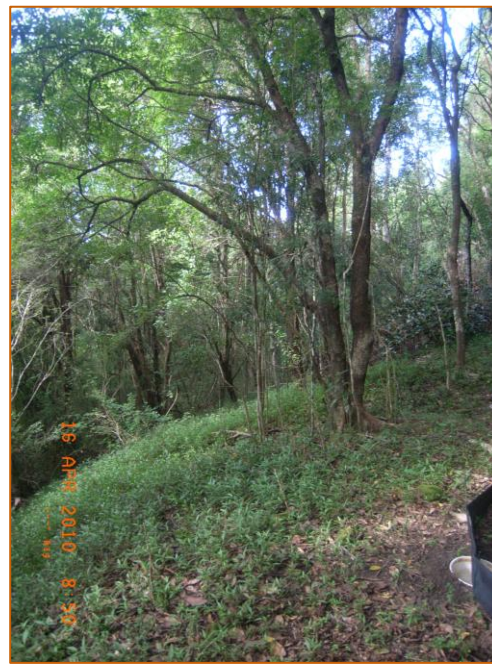
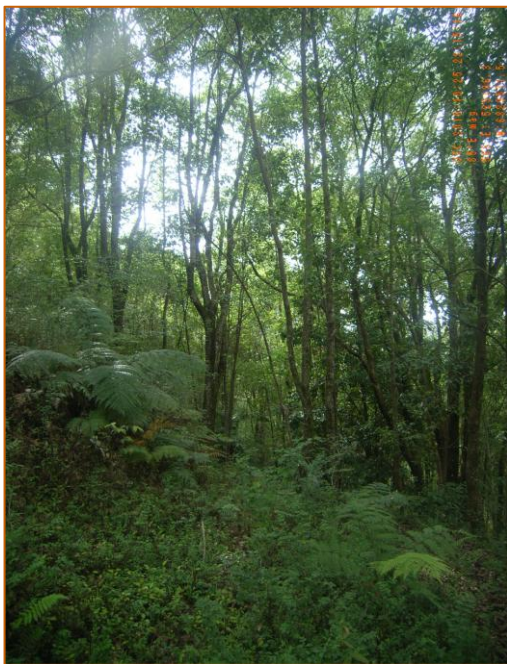
Plates 3 and 4: Pecan plantation area and Blue Gum and Hoop Pine plantation area.

### 4.1.3 Camphor Laurel Woodland/Forest

A number of small forest areas, and the boundaries of more intact vegetation, are dominated by Camphor Laurel woodland/forest within the study area. Camphor Laurel is an environmental weed within the region as it often hinders the regeneration of native rainforest species forming monoculture canopy stands (RBGT 2010). These areas mainly occupy previously cleared land and represent up to 50 year-old regrowth (Ecos 2001).

In areas where the community has been regenerating for a number of years, the canopy is tall and dense. Camphor Laurel provides a continuous canopy in most of these areas, which allows the colonization of shade-tolerant species into the lower stratum.

Vegetation in these areas is co-dominated by Sally Wattle a native colonizing species, though in some areas this community appears to be in poorer condition, and is co-dominated by Small-leaf Privet (*Ligustrum sinense*), another environmental weed. The understory of these areas is often disturbed, dominated by other common local weed species such as Lantana (*Lantana camara*). Other areas contain native fern species in the understorey such as Prickly Tree-fern (*Cyathea leichhardtiana*), Gristle Fern (*Blechnum cartilagineum*) and Rough Maidenhair Fern (*Adiantum hispidulum*), as well as groundcovers such as Creeping Christian (*Commelina cyanea*).



Plates 5 and 6: Camphor Laurel and Privet dominated woodland areas.

### 4.1.4 Tallowwood Open Forest

Tallowwood Open Forest is a dry sclerophyll forest community associated with the ridge tops and steeper ridge slopes in the western and southern parts of the study area. Typical species associated with this community favour poorer soils and drier conditions than other parts of the study area on the floodplain and within the volcanic/clay slopes. As such, this community is associated with the sandstone ridgelines that occur in the southern and western parts of the study area.

This community forms a tall open forest with a mid-stratum of smaller trees and an herbaceous lower stratum. The canopy is dominated by a mixture of Tallowwood, Turpentine (*Syncarpia glommifera*), Pink Bloodwood (*Corymbia intermedia*) with occasional White Mahogany (*Eucalyptus acmenoides*), Broad-leaved Mahogany (*Eucalyptus carnea*) and Red Ash (*Alphitonia excelsa*). Turpentine dominates the canopy in some areas, particularly on the southern ridgeline near the proposed dam wall.

Forest Oak (*Allocasuarina torulosa*), Sweet Pittosporum (*Pittosporum undulatum*), Cheese Tree (*Gleichidion ferdinandi*), Large-leaf Hop-bush (*Dodonaea triquetra*) and Tree Heath (*Trochocarpa laurina*) create an open midstorey, while Prickly Rasp Fern (*Doodia aspera*), Mat-rush (*Lomandra longifolia* and *Lomandra multiflora*), Wire Grass (*Entolasia stricta*) and Finger Grass (*Digitaria ramularia*) dominate the groundcover. Patches of Bracken (*Pteridium esculentum*), Climbing Guinea Flower (*Hibbertia scandens*), Lantana, Whiteroot (*Pratia purpurascens*) and Molasses Grass (*Melinis minutiflora*) also occur through these areas. In wetter and sheltered areas, some rainforest shrubs, climbers and groundcovers associated with damp conditions occur such as Rasp Fern (*Doodia aspara*), Banglaow Palm (*Archontophoenix cunninghamiana*), False bracken (*Calochaena dubia*), Water Vine (*Cissus hypoglauca*) and Guioa (*Guioa semiglauca*).



Plates 7 and 8: Tallowood Open Forest areas.

#### 4.1.5 Flooded Gum-Tallowwood-Brush Box Moist Open Forest

Flooded Gum-Tallowwood-Brush Box Moist Open Forest is a tall moist open forest, with an understorey of rainforest trees and shrubs. It is a wet sclerophyll forest found at the margin of rainforest and on the western slopes of the study area. This is a transitional community between the dry Tallowwood Open Forest on sandstone soils and the Sub-tropical Rainforest on the volcanic and clay soils. As such, throughout the study area it is associated with a variety of soil types with both volcanic and sandstone influence.

The canopy is dominated by Brush Box (*Lophostemon confertus*) and Flooded Gum (*Eucalyptus grandis*) with White Mahogany, Turpentine, Tallowwood and Red Ash, intergrading on the slopes between this community and the Tallowwood Open Forest.

The sub-canopy consists of a range of small rainforest trees and tall mesic shrubs including Grey Myrtle (*Backhousia myrtifolia*), Hairy Walnut (*Endiandra pubens*), Sweet Pittosporum, White Cedar (*Melia azedarach*), Red Ash, Guioa, Orange Kamala (*Mallotus philippensis*), Bangalow Palm, Cabbage Palm (*Livistona australis*), Blackwood, Foam Bark Tree (*Jagera pseudorhus*), Hairy-leaved Bolly Gum (*Neolitsea dealbata*), Native Guava (*Rhodomyrtus psidioides*). Other shrubs include Hop Bush (*Dodonaea spp.*), Tree Heath (*Trochocarpa laurina*), Native Ginger (*Alpinia caerulea*), Veiny Wilkiea (*Wilkiea huegeliana*) and Native Gardenia (*Atractocarpus benthamianu*).

Groundcovers are sparse to common depending on canopy cover and aspect and include Bracken, Gristle Fern, Flax Lilly (*Dianella caerulea*), Rough Maidenhair Fern, Pennywort (*Hydrocotyle pedicellosa*). Climbers including Native Yam Vine (*Dioscorea transversa*), Arrow-head Vine (*Tinospora tinosporoides*) and Water Vine, occur within this community.



Plates 9 and 10: Flooded Gum-Tallowwood-Brush Box Moist Open Forest areas.

#### 4.1.6 Warm Temperate Rainforest

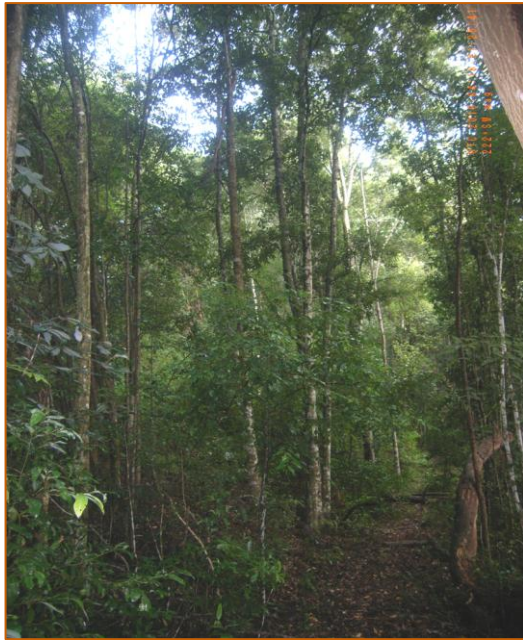
Warm Temperate Rainforest contains fewer species than the subtropical and dry rainforests of the region. It occurs in cool, moist areas which favour lichens and ground ferns rather than large epiphytic ferns and orchids (Floyd 1990).

Few patches of Warm Temperate Rainforest occur within the study area. Through the gorge in the south of the study area along the river an intact stand of this community occurs as well as a small patch adjacent to the river within the north-eastern part of the study area. Few protected remnants of this community occur throughout the Lismore LGA (Lismore City Council 2010).

The community forms a moderately tall to tall closed forest. Water Gum (*Tristaniaopsis laurina*) dominates the community along the creek line in the northern part of the study area. The structure of the community becomes more complex away from the creek line in the north where it is dominated by Giant Water Gum (*Syzygium francesii*). Small-leaf Privet appears to be encroaching on this community in this area (Ecos 2001).

Common canopy trees in the southern patch include Oliver's Sassafras (*Cinnamomum oliveri*), Bennett's Ash (*Flindersia bennettiana*), Black Teak (*Pentaceras australe*), Hairy-leaved Bolly Gum (*Neolitsea dealbata*), Jackwood (*Cryptocarya glaucescens*) and Coachwood (*Ceratopetalum apetalum*).

The sub-canopy contains Brush Pepperbush (*Tasmania insipida*) and *Atractocarpus benthamianus* as well as the climbers Hairy Supplejack (*Ripogonum elseyanum*) and Water Vine (*Cissus hypoglauca*). The shrub and ground stratum contain Rough Maidenhair (*Adiantum hispidulum*), Walking Stick Palm (*Linospadix monostachya*), Gristle Fern (*Blechnum cartilagineum*) and Hedraianthera (*Hedraianthera porphyropetala*).



Plates 11 and 12: Warm Temperate Rainforest areas along the creek line.

#### 4.1.7 Sub-Tropical Rainforest

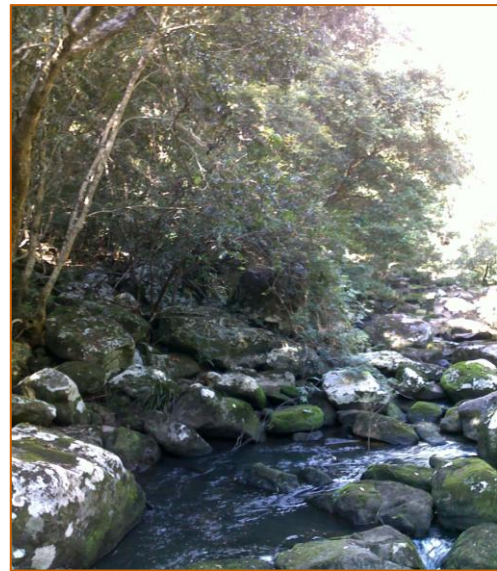
Sub-tropical Rainforest is the typical rainforest type of the north coast, in warmer areas from sea level to 900 m elevation, with high rainfall (>1300 mm), eutrophic parent rock such as basalt, rich shale and some granodiorites, and shelter (Lismore City Council 2010).

Sub-tropical Rainforest within the study area form a tall closed forest, and mainly consist of regrowth from previous disturbance such as intensive logging (approximately 40-60 years ago in the north of the study area) and clearing. Within the study area, this consists of older regrowth rainforest, perhaps pre-dating the Camphor infestation at the study area, and newly assisted regeneration areas which are actively managed and rehabilitated by the Rous team.

The canopy is dominated by secondary rainforest species such as Red Ash, Bennett's Ash, Jackwood, Native Tamarind (*Diploglottis cunninghamii*) and Native Frangipani (*Hymenosporum flavum*). The climber Hairy Supplejack also occurs throughout this stratum. The sub-canopy and mid-stratum is generally dominated by Socketwood (*Daphnandra* spp. *Mc Pherson Rg*), and the climbers Hairy-leaved Bolly Gum, Arrow-head vine and Hairy Supplejack and Wait-a-while (*Calamus muelleri*).

Along the creek line where the community occurs in linear strips 10 – 40 m wide, it is dominated by Water Gum, Red Ash, Native Tamarind, Pepperberry (*Cryptocarya obovata*), Socketwood, Giant Water Gum, Red Cedar, Cudgerie (*Flindersia schottiana*) with occasional Brush Box and White Bean (*Ailanthus triphysa*). Tallowwood and Hoop Pine have been planted into this community in such areas in the north-central study area surrounding the creek.

The lower stratum is characterised by Hairy Supplejack (*Ripogonum elseyanu*), *Ottochloa gracillima*, Veiny Wilkiea, Rough Maidenhair, Creeping Shield Fern (*Lastreopsis acuminata*), Red-fruited Laurel (*Cryptocarya laevigata*) and Walking Stick Palm. Weeds such as Small-leaf Privet often occur away from the river, closer to the edges of the community.



Plates 13 and 14: Sub-tropical Rainforest areas.

## 4.2 Flora

### 4.2.1 Threatened Flora Species

Nine threatened flora species were recorded within the study area. **Table 13** lists these with a description of the location and condition of recorded threatened flora species detected. The majority of these species were recorded within the rainforest and wet sclerophyll forest of the study area and the ecotonal areas between these. The location of the species detected during the surveys is also shown in **Figure 11**.

Table 13: Recorded Threatened Species with Status, Habitat Preference and Location Recorded

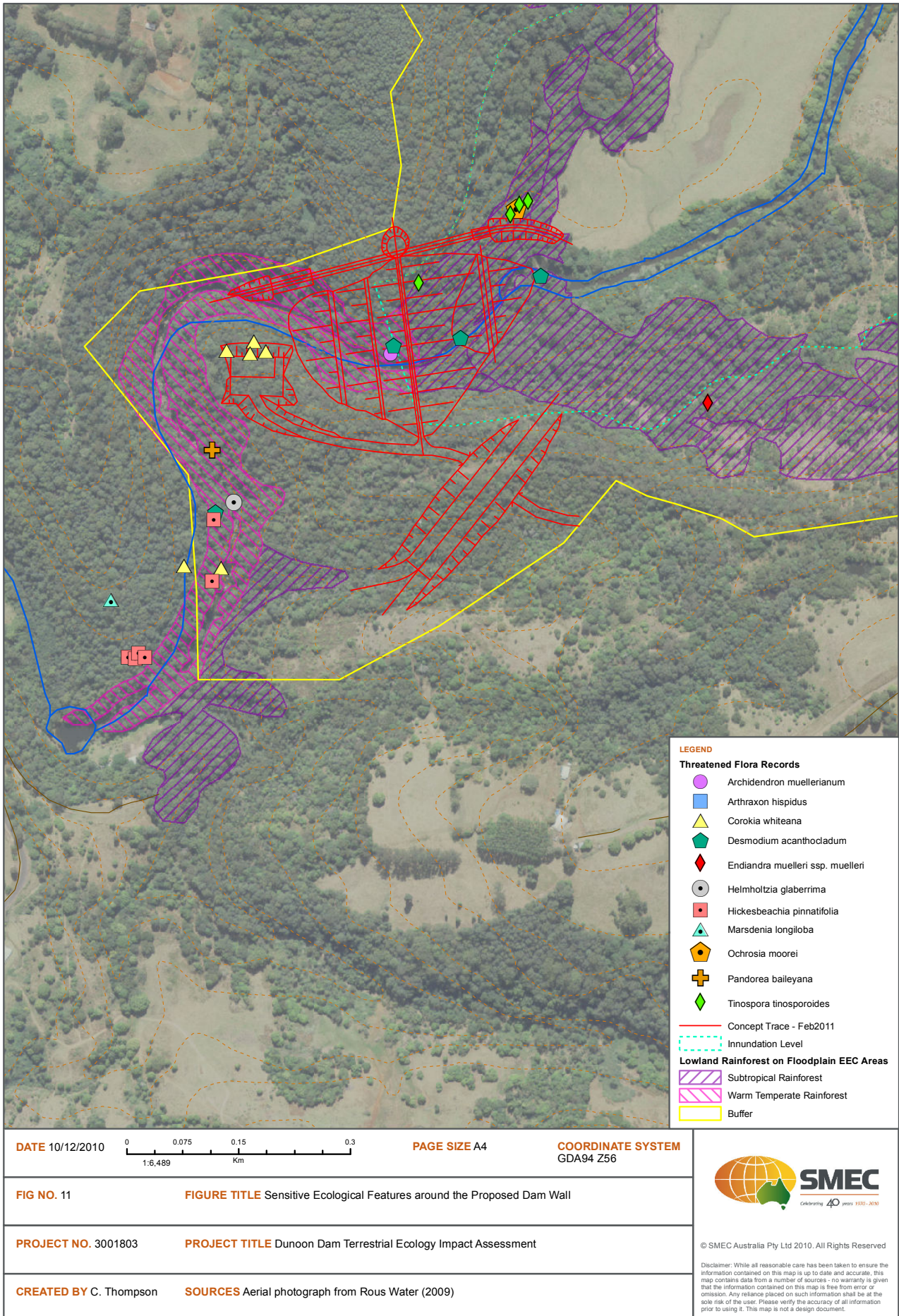
Species	Status	Habitat	Location Detected
Hairy Jointgrass ( <i>Arthraxon hispidus</i> )	TSC –V EPBC–V	Edges of rainforest and in wet eucalypt forest, often near creeks or swamps	Drainage lines and depressions in the north-western part of the study area, within and outside of the inundation area. A number of individuals occur in each location.
Corokia ( <i>Corokia whiteana</i> )	TSC –V EPBC – V	Occurs at altitudes of 10–800 m above sea level in ecotones between wet sclerophyll forest and warm-temperate rainforests, or in Brush Box ( <i>Lophostemon confertus</i> ) open forest with littoral rainforest understorey	On the southern ridgeline in Tallowwood Open Forest and near the creek line south of the dam wall within Warm Temperate Rainforest.
Spiny Desmodium ( <i>Desmodium acanthocladum</i> )	TSC –V EPBC – V	Only known from the Richmond-Tweed area inhabiting the riparian zone in rainforest country on richer alluvium.	Banks of Rocky Creek at Whian Whian Falls in the north-east of the study area. In the southern gorge near the dam wall along Rocky Creek and along Rocky Creek in the central northern area of the study area, near the pecan plantations. A couple of isolated records also occur in the north-western part of the study area. Associated with Subtropical Rainforest patches.

Species	Status	Habitat	Location Detected
Green-leaved Rose Walnut ( <i>Endiandra muelleri</i> subsp. <i>bracteata</i> )	TSC – E	Subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats.	A single location occurs for this species within a patch of Subtropical Rainforest to the north of the southern ridgeline.
Red Boppel Nut ( <i>Hicksbeachia pinnatifolia</i> )	TSC –V EPBC – V	Subtropical rainforest, moist eucalypt forest and Brush Box forest	Occurs in the central northern part of the study area near Rocky Creek within Subtropical Rainforest and a number of individuals occur in the southern gorge below the proposed dam wall associated with Warm Temperate Rainforest.
Southern Ochrosia ( <i>Ochrosia moorei</i> )	TSC –E EPBC – E	Grows in riverine and lowland warm subtropical rainforest and complex notophyll vine forest in soils of volcanic origin	Occurs on the edge of the Subtropical Rainforest patch in the south of the study area adjacent to pasture areas above the proposed dam wall location.
Rough shelled Bush Nut ( <i>Macadamia tetraphylla</i> )	TSC –V EPBC – V	Known from several regional ecosystems from complex notophyll vine forest to littoral rainforest to wet sclerophyll communities. It is often found on steep slopes, especially at ecotones	Planted within the regeneration areas in the southern part of the study area and planted within the properties surrounding the study area.
Slender Marsdenia ( <i>Marsdenia longiloba</i> )	TSC –E EPBC – V	Rainforest and wet sclerophyll forest – with few records in north-eastern NSW	Found on south-western facing slope on sandstone outside the inundation area. It occurs within an area of wetter Tallowwood Open Forest. Also recorded on the southern slope associated with the sandstone gorge area in wet sclerophyll forest dominated by Tallowwood (Ecos 2001).
Arrowhead Vine ( <i>Tinospora tinosporoides</i> )	TSC –V EPBC – V	Fertile basaltic and alluvial soils supporting lowland subtropical rainforest endemic to the Richmond-Tweed district	Found throughout the study area in association with Subtropical Rainforest, wet sclerophyll forest, particularly in the southern part of the study area. Also found in rainforest and Brush Box dominated areas near Whian Whian falls and near the proposed dam wall (Ecos 2001).

Note: it is likely that these species occur elsewhere throughout the study area and were not detected during recent surveys. Adapted from the CMA sub-region geographic search of the OEH Online Threatened Species Database [http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse\\_geo.aspx](http://threatenedspecies.environment.nsw.gov.au/tsprofile/browse_geo.aspx). TSC - *Threatened Species Conservation Act* (1995), EPBC – *Environment Protection and Biodiversity Conservation Act* (1999). E – Endangered, V - Vulnerable



Figure 11: Vegetation Communities and Threatened Flora Recorded within the Study Area



Location: I:\projects\3001803 - Dunoon Dam Terrestrial Ecology Assessment\009DATA\GIS\Report Maps

## 4.2.2 Rare Plants

Two RoTAP species were recorded within the study area during the surveys. The following table (**Table 14**) details their distribution and abundance identified within the study area during the surveys.

Table 14: Recorded RoTAP species with status, habitat preference and location recorded

Species	Status	Habitat	Location Detected
Veiny Laceflower ( <i>Archidendron muellerianum</i> )	RoTAP 3RCa	Lowland subtropical rainforest and wet sclerophyll forest	A couple of plants recorded in Brush Box near dam wall on eastern side (Ecos 2001)
Stream Lilly ( <i>Helmholtzia glaberrima</i> )	RoTAP: 2RCa	Grows on steep sides of damp rainforest gullies and along rocky streams; north from the McPherson Range	A single location occurs for this species within the Warm Temperate Rainforest associated with Rocky Creek within the southern gorge below the proposed dam wall.

Conservation Codes: 1: Known by one collection only; 2: Geographic range in Australia less than 100 km; 3: Geographic range in Australia greater than 100 km; R: Rare in Australia without any identifiable threat; C: Conserved with at least one population within a proclaimed conservation reserve; a: 1000 plants or more are known to occur within a conservation reserve.

The region also contains high numbers of species that have been identified as 'significant' according to criteria developed by Sheringham and Westaway (1995). Within the study area, three regionally significant species were identified (**Table 15**).

Table 15: Recorded regionally significant flora species with status, habitat preference and location recorded

Species	Status	Habitat	Location Detected
Hedraianthera ( <i>Hedraianthera porphyropetala</i> )	8S - Regionally Significant Species	Grows in subtropical and littoral rainforest, north from Ballina (Harden 2007)	Recorded in sub-tropical rainforest patches near Rocky Creek.
Red-fruited Laurel ( <i>Cryptocarya laevigata</i> )	8S - Regionally listed	Found in lowland subtropical rainforest on alluvial or rich basaltic soils north from Lismore (Harden 2007)	Recorded in sub-tropical rainforest patches near Rocky Creek.
Bennett's Ash ( <i>Flindersia bennettiana</i> )	8S - Regionally Significant Species	Grows in littoral, subtropical and warm-temperate rainforest, north from Iluka (Harden 2007)	Recorded in sub-tropical rainforest patches near Rocky Creek. Common in these areas within the study area.

Note: 8S – taxa reaching the limit of their natural geographic distribution in Upper North East NSW (southern limit).

## 4.2.3 Orchids

Winter orchid surveys were undertaken over two days in June and July. The first survey was conducted on 30<sup>th</sup> June 2010. Conditions were mild with a minimum of 4.4°C and a maximum of 19.6°C reached on the day (BOM 2010). A subsequent field visit was undertaken the following month (13<sup>th</sup> July 2010). Substantial rainfall had been received in the area between the survey periods, with the area receiving 33 mm of rainfall on the 24<sup>th</sup> June (BOM 2010).

All orchids recorded were common species within the region. The study area has an abundant ground orchid flora, particularly within the southern end on south-facing slopes, which is associated with the sandy soil and sedimentary geology. The following orchids were identified during the surveys within the study area (**Table 16**).

Table 16: Orchids recorded within the study area.

Species	Status	Habitat
Tall Greenhood ( <i>Pterostylis longifolia</i> )	Common	Common in moist areas of sclerophyll forest and coastal scrubs on the east coast of NSW.
King Greenhood ( <i>Pterostylis baptistii</i> )	Common	Grows in moist to wet soils on sheltered slopes in sclerophyll forest, chiefly coastal.
Small Nodding Greenhood ( <i>Pterostylis hispidula</i> )	Common	Grows in moist areas of dry sclerophyll forest and wet sclerophyll forest in coastal and near-coastal districts; north from Batemans Bay.
Parrots Beak Orchid ( <i>Pterostylis nutans</i> )  (sent to herbarium for identification – more material requested but unable to obtain any – end of flowering time)	Common	Common in moist areas of dry sclerophyll forest, wet sclerophyll forest and coastal scrub
<i>Bulbophyllum exiguum</i>	Common	Common on rocks and trees in rainforest, often in deep shade; from sea level to c. 1000 m alt., north from Conjola and inland to the Armidale district.
Lady's Tresses ( <i>Spiranthes australis</i> )	Common	Usually grows in marshy or boggy places; widespread, from coastal districts inland to Molong area.
<i>Chiloglottis</i> spp. (no flowers for identification)	Common	Unknown as species not determined – recorded within dry and wet sclerophyll forest within the study area
<i>Corybas</i> spp. (no flowers for identification)	Common	Unknown as species not determined – recorded within dry and wet sclerophyll forest within the study area

Scientific names provided for all, common names are also provided where applicable. Photos not taken within the study area from RBGT (PlantNet, <http://plantnet.rbg Syd.nsw.gov.au/> accessed November 2010).

## 4.3 Fauna

### 4.3.1 Overview

Faunal diversity within the study area was highest for avifauna, most likely as a result of the past disturbance of the study area and this groups mobility allowing species to re-colonise from nearby reserves and remnant habitat patches.

### 4.3.2 Fauna Habitats

Five main fauna habitats occur within the study area:

- Rainforest and Wet Sclerophyll Forest;
- Dry Sclerophyll Forest;
- Camphor Laurel Forest and Plantations; and
- Pasture;
- Watercourses and Dams (**Figure 12**).

These habitat types provide a mosaic of foraging, sheltering and nesting resources for a range of species. In addition, the transition zones between the habitat types provide a variety of habitat for edge dwellers. The main habitat types within the inundation zone and buffer area are described in detail in Section 5.2. An overview of the main fauna findings for each taxa group is included in the following section with the survey weather conditions.

### **4.3.3 Fauna Survey Weather Conditions**

#### **4.3.3.1 Autumn Survey**

The weather was mild to warm with an average minimum of 16.4°C, with the coldest day recording a minimum of 13.1°C on 16<sup>th</sup> April for the autumn surveys. Maximums averaged 25.8°C with the warmest day during the survey occurring on Monday 12<sup>th</sup> with a maximum temperature of 27.4°C (BOM 2010).

Overall, winds were moderate with a maximum of 46 km/hr recorded on Thursday 15<sup>th</sup> from an east-south-easterly direction (BOM 2010). Main wind gusts came from this direction, while milder breezes from the north were more common in the mornings of the survey period.

A total of 17.4 mm of rain fell over the survey period. 7.4 mm of rain fell on Saturday 17<sup>th</sup>, 5.6 mm on Sunday 18<sup>th</sup> and 4.4mm on Monday 19<sup>th</sup> April (BOM 2010). Rainfall was generally concentrated at night. The rest of the survey period was dry.

#### **4.3.3.2 Spring Survey**

The weather was sunny and warm with an average maximum temperature of 25.8 °C, with the warmest day recording a maximum of 28.2 °C on Sunday, 24<sup>th</sup> October for the spring surveys. Minimum temperature averaged 15.9 °C over the survey period (BOM 2010).

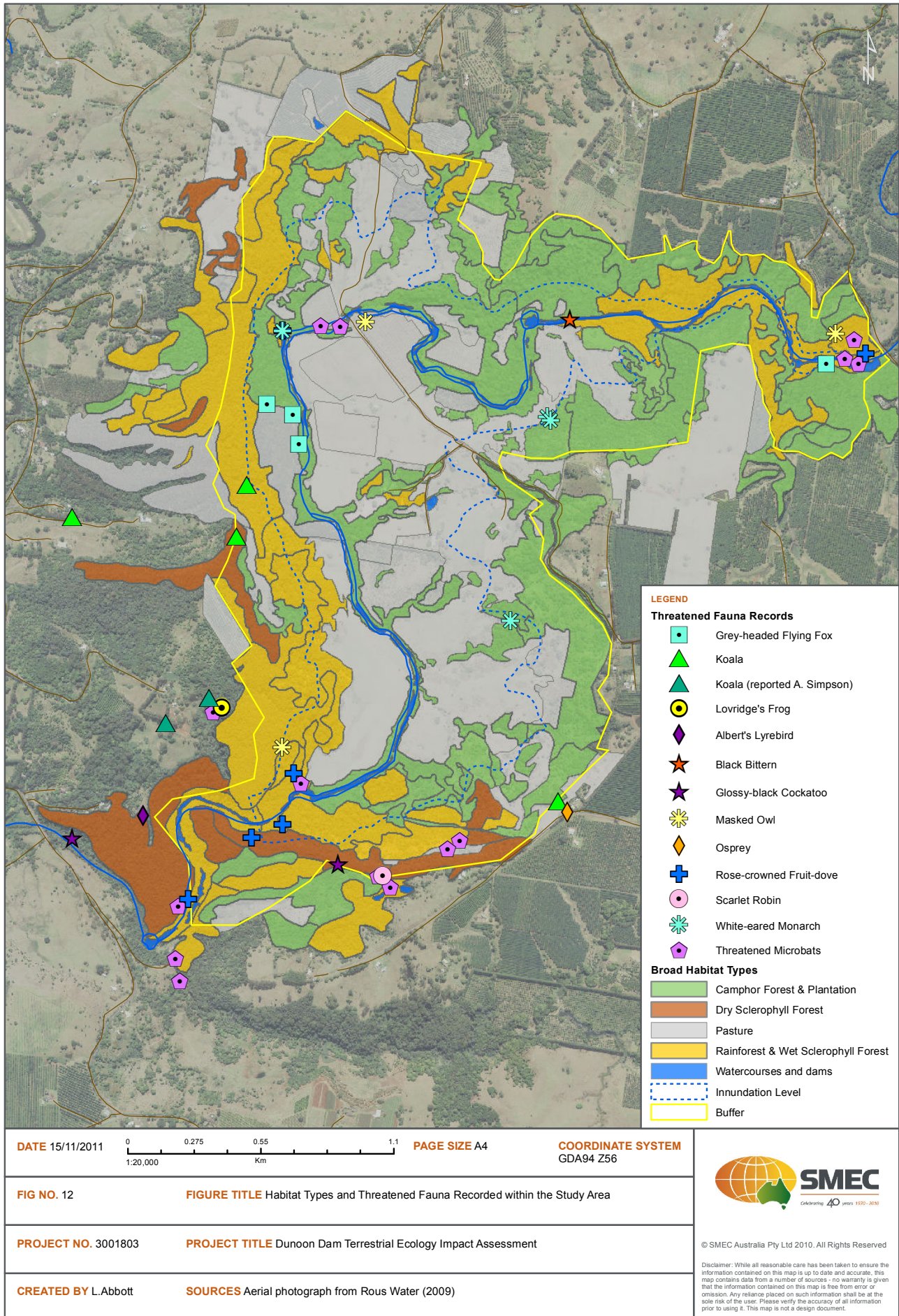
Winds were moderate (average 33 km/h), with a maximum of 44 km/h on Sunday the 24<sup>th</sup> October from a west-north-westerly direction. A total of 22.6 mm of rain fell over the survey period, the majority of which fell on Monday 25<sup>th</sup> October (BOM 2010). Other than some isolated showers (3.6 mm) on Friday 29<sup>th</sup> October, the remainder of the survey period was dry.

#### **4.3.3.3 Summer Survey**

The weather conditions were warm and sunny, but with frequent intermittent rain events for the macroinvertebrate surveys. Daily maximum temperatures over the sampling period were about 25.2°C, with a maximum of 26°C on Thursday, November 25<sup>th</sup>. The average humidity was about 90 per cent, and varied between 51 - 97 per cent. A total of 14.8 mm of rain fell over the entire sampling period, with a peak of 8 mm on Wednesday, November 24<sup>th</sup>. Night conditions were slightly cooler with a maximum temperature 17.2°C and a full moon was on November 21<sup>st</sup> (Richmond Hill weather station, 058221 (BOM 2010).

The weather was warm and sunny with average top temperatures of 25.2°C for the reptile and amphibian surveys. The maximum temperature was 31.4°C on Wednesday, 15<sup>th</sup> December 2010. The average humidity was 82 per cent and varied between 62 – 87 per cent. A total of 18.8 mm of rain fell over the entire sampling period and the majority fell on Friday, 17<sup>th</sup> December 2010. Winds averaged 40 km/h, with heavy westerly winds (50 km/h) occurring on Friday 17<sup>th</sup> December (BOM 2010).

Figure 12: Broad Fauna Habitats and Threatened Fauna Recorded within the Study Area



Location: I:\projects\3001803 - Dunoon Dam Terrestrial Ecology Assessment\009DATA\GIS\Report Maps

#### 4.3.4 Mammals

Twenty mammal species were recorded during the surveys (**Table 17**) (Appendix 1 details survey effort). This included 13 native species and seven introduced or pest species.

A diverse representation from both arboreal and ground-dwelling species was recorded including some species which are generally found in less disturbed habitats, such as the Fawn-footed Melomys (*Melomys cervinipes*) and the Mountain Brushtail Possum (*Trichosurus cunninghami*). This also includes a number of invasive pest species, which are described more in Section 5.2.2.7 .

In addition to the species recorded during the present study, Ecos (2001) also recorded the Short-beaked Echidna (*Tachyglossus aculeatus*) and the Water Rat (*Hydromys chrysogaster*) in the north east of the study area near Whian Whian falls. The mammalian diversity at the study area totals 15 native species when including these records.

One threatened species, the Koala, was identified within the study area. During the survey, Koalas were identified to be utilising both the Tallowwood Open Forest and Flooded Gum-Tallowwood-Brush Box Open Forest areas, which represent the main eucalypt-dominated areas of the study area. Highest activity was recorded in the southern and western ridge areas, where nearby residents often see individuals. Threatened species are discussed further in Section 5.2.2 .

Table 17: Mammal species recorded, detection methods and locations of records.

Species	Detection Method	Abundance Within the study area/ legislative status	Locations/Habitat
Bush Rat ( <i>Rattus fuscipes</i> )	Elliot trap, hair tubes	Common	Rainforest and wet sclerophyll forest near Whian Whian falls and on the western ridgeline
Black Rat* ( <i>Rattus rattus</i> )	Elliot trap, cage trap	Common	Plantation areas and camphor laurel forest areas near houses
Fawn-footed Melomys ( <i>Melomys cervinipes</i> )	Observed	Occasional	Wet sclerophyll forest and rainforest near the creek line
Cat* ( <i>Felis catus</i> )	Cage trap	Occasional	Wet sclerophyll forest in south-west of the study area and within the rainforest regeneration area in the south
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	Observed	Common	Along Rocky Creek in rainforest and camphor laurel forest areas, wet sclerophyll forest on the western ridgeline
Common Ringtail Possum ( <i>Pseudocheirus peregrinus</i> )	Observed	Rare	Dry sclerophyll forest on the western side of the western ridgeline
Sugar Glider ( <i>Petaurus breviceps</i> )	Call heard	Rare	Throughout the wet sclerophyll and dry sclerophyll habitats on the western ridgeline
Red-necked Wallaby ( <i>Macropus rufogriseus</i> )	Observed	Common	Southern ridgeline in dry sclerophyll forest and edge habitat between the western ridgeline and pasture areas, and camphor laurel forest and pasture on the south-eastern part of the study area
Koala ( <i>Phascolarctos cinereus</i> )	Observed	Common in south and west / TSC - V	Resting in Forest Oak on top of the western ridgeline, and in associated trees to the west, activity around Tallowwoods within the wet sclerophyll forest in this area, within the Tallowwoods on the south-eastern side of the study area. Little activity in the northern sections of the study area

Species	Detection Method	Abundance Within the study area/ legislative status	Locations/Habitat
Mountain Brushtail Possum ( <i>Trichosurus caninus</i> )	Observed	Rare	South of the southern ridgeline within wet sclerophyll forest/rainforest habitat along Little Rocky Creek
Platypus ( <i>Ornithorhynchus anatinus</i> )	Observed	Occasional	Within the large pool in the north-eastern part of Rocky Creek
Long-nosed Bandicoot ( <i>Perameles nasuta</i> )	Observed	Occasional	Rainforest area near Whian Whian falls
Northern Brown Bandicoot ( <i>Isodon macrourus</i> )	Cage trap, Infrared Camera and Signs	Occasional – though locally common in south and edge habitat	Diggings within the rainforest regeneration area and trapped near Munroes Road in pasture/camphor laurel forest (with Blackwoods). Sighted on Frazer Road.
Brown Antechinus ( <i>Antechinus stuartii</i> )	Pitfall trap	Rare	In wet/dry sclerophyll forest at the south of the western ridgeline
Swamp Wallaby ( <i>Wallabia bicolor</i> )	Hair tubes and observed	Occasional	Camphor laurel forest and pasture on the south-eastern part of the study area
Wild Dog* ( <i>Canis spp.</i> )	Heard	Rare	Near The Channon or western side of the study area
Cow* ( <i>Bos taurus</i> )	Observed	Common	Throughout the pasture areas and within the wet sclerophyll forests on the western ridgeline – these areas are used for grazing
Pig* ( <i>Sus scrofa</i> )	Signs	Rare	Throughout the southern ridgeline
House Mouse* ( <i>Mus musculus</i> )	Elliot Trap	Occasional – restricted to residential areas	Camphor laurel forest and pasture areas near houses on south-eastern side of study area
European Rabbit* ( <i>Oryctolagus cuniculus</i> )	Observed and Signs	Occasional	Camphor laurel forest and pasture areas near houses on south-eastern side of study area and pasture areas

\* - Pest/Introduced Species, TSC - *Threatened Species Conservation Act* (1995), V - vulnerable

#### 4.3.5 Bats

Bat surveys recorded 12 microbat species and one megachiropteran species during the April surveys, with an additional megachiropteran (fruit-bat) species recorded during spring, bringing the total species diversity to 14. Of the species recorded, six are listed as threatened (

Table 18). Threatened species are discussed further in Section 5.2.2 .

Table 18 Microbat species detected during surveys

Species	Trapped	Anabat	Status	Roost Habitat
Gould's Wattle Bat ( <i>Chalinolobus gouldii</i> )	-	Confidently Detected	-	In tree hollows within dry sclerophyll forest, rainforest and wet sclerophyll forest within the study area
Chocolate Wattle Bat ( <i>Chalinolobus morio</i> )	2 study areas (H04, H09)	Probable Detection	-	In tree hollows and under defoliating bark within dry sclerophyll forest, rainforest and wet sclerophyll forest within the study area. Under Simes Bridge.
Little Bentwing-bat ( <i>Miniopterus australis</i> )	-	Confidently Detected	TSC - V	Possible cave roosts in rocky escarpments (southern escarpment and along Rocky Creek)
Eastern Bentwing-bat ( <i>Miniopterus schreibersii oceanensis</i> )	-	Confidently Detected	TSC - V	Possible cave roosts in rocky escarpments (southern escarpment and along Rocky Creek)
Large-footed Myotis ( <i>Myotis macropus</i> )	2 study areas (H01, H05)	Probable Detection	TSC - V	Possible cave roosts in rocky escarpments (southern escarpment and along Rocky Creek)
Northern Long-eared Bat ( <i>Nyctophilus bifax</i> )	4 study areas (H08, H09, H05, H10)	Possibly detected, however Anabat calls of <i>Nyctophilus</i> spp. are indistinguishable	TSC - V	In regenerating rainforest at Rous Water bush regeneration study areas (below southern escarpment and near Simes Bridge on Rocky Creek)
Lesser Long-eared Bat ( <i>Nyctophilus geoffroyi</i> )	1 study area (H08)	Possibly detected, however Anabat calls of <i>Nyctophilus</i> spp. are indistinguishable	-	In regenerating rainforest at Rous Water bush regeneration study areas (below southern escarpment and near Simes Bridge on Rocky Creek). In tree hollows within dry sclerophyll forest, rainforest and wet sclerophyll forest within the study area
Gould's Long-eared Bat ( <i>Nyctophilus gouldi</i> )	4 study areas (H03, H04, H06, H08)	Possibly detected, however Anabat calls of <i>Nyctophilus</i> spp. are indistinguishable	-	In tree hollows within dry sclerophyll forest, rainforest and wet sclerophyll forest within the study area, particularly along Rocky Creek.
Eastern Horseshoe-bat ( <i>Rhinolophus megaphyllus</i> )	4 study areas (H01, H04, H08, H11)	Confidently Detected	-	Possible cave roosts in rocky escarpments (southern escarpment and along Rocky Creek)
Eastern Broad-nosed Bat ( <i>Scotorepens orion</i> )	1 study area (H09)	Confidently Detected	P	In tree hollows within dry sclerophyll forest, rainforest and wet sclerophyll forest within the study area
White-striped Mastiff-bat ( <i>Tadarida australis</i> )	-	Confidently Detected	-	In hollow branches of mature trees within dry sclerophyll forest, rainforest and wet sclerophyll forest within the study area
Eastern Forest Bat ( <i>Vespadelus pumilus</i> )	3 study areas (H05, H09, H13)	Confidently Detected	-	In tree hollows within dry sclerophyll forest, rainforest and wet sclerophyll forest within the study area
Black Flying-fox ( <i>Pteropus alecto</i> )	Many individual observed foraging in Canary Island Date Palms in various locations		-	Rainforest within the study area



Species	Trapped	Anabat	Status	Roost Habitat
Grey-headed Flying-fox ( <i>Pteropus poliocephalus</i> )	Observed foraging in Camphor laurel at various locations		TSC – V EPBC - V	Potential habitat in rainforest within the study area, particularly along Rocky Creek. As this rainforest is regenerating, it is likely to only be providing foraging habitat. Known roost study areas located in Booyong, approximately 16 km south-east of the study area which is permanently occupied, and 2 ephemeral camps located 13 and 11 km away from study area.

TSC - *Threatened Species Conservation Act* (1995), EPBC – *Environment Protection and Biodiversity Conservation Act* (1999), V – vulnerable

Several individuals of Grey-headed and numerous individuals of Black Flying-foxes were observed flying over the study area, and were commonly observed foraging in Camphor Laurel and Canary Island Date Palm (*Phoenix canariensis*). Due to the high number of Black Flying-foxes observed, flying in the one direction over the study area, it is likely that a camp is present nearby, in patches of remnant subtropical rainforest, though none were identified within the study area. Three known camps of Grey-headed Flying-foxes occur close to the study area at 11, 13 and 16 km away.

#### 4.3.6 Birds

A total of 95 bird species was recorded within the autumn survey event at the study area. This included three nocturnal species and 92 diurnal species. The spring survey resulted in a total of 71 bird species, 13 of which were not recorded in autumn. The autumn surveys also accounted for 37 species that were not observed in spring.

Overall, the bird species recorded within the study area totalled 108, of these 58 species were recorded in each survey period. Most commonly recorded species in standardised plots across both survey periods were:

- Lewin’s Honeyeater (present in 92 per cent of plots);
- Brown Thornbill (83 per cent);
- Eastern Whipbird (83 per cent);
- Grey Shrike-thrush (58 per cent);
- Pied Currawong (58 per cent); and
- Brown Gerygone (50 per cent).

These species are indicative of structured vegetation with a dense or closed understorey. Despite this, it is apparent that these species occurred throughout areas of both better and poorer quality vegetation, which included the camphor forests in addition to the native wet sclerophyll and closed forests.

Species that were recorded to a lesser extent and which were specific to habitat types included those as listed in the following table.

Table 19 Habitat specific avifauna recorded

Habitat	Species
Rainforest	Logrunner; Topknot Pigeon; Emerald Dove; Large-billed Scrubwren; Spectacled Monarch; Rufous Fantail; Little Shrike-thrush
Camphor Forest (edges)	White-eared Monarch
Pasture / Rank Grasses	Red-backed Fairywren, Chestnut-breasted Munia

Seasonal variation in the avifauna present was most notable in the rainforest pigeons whereby species such as Topknot Pigeon and Rose-crowned Fruit-dove were present in high numbers or observed with high frequency during autumn but were not seen or heard during the spring survey period. Notably, Topknot Pigeons were observed in flocks of in excess of 200 individuals during the autumn survey, foraging in the rainforest areas between the pasture and location of the proposed dam wall. Rose-crowned Fruit-doves were regularly seen and were heard to be calling throughout most of the day during the autumn survey period. The opportunistic inventory also resulted in a large variation in species recorded between autumn and spring. One likely explanation is the difference in available resources and preferential study area selection for breeding which may or may not include the study area.

Raptors occurring in the study area during the surveys included six Accipitridae species, one Falconidae and one Tytonidae. The following table lists all raptors recorded.

Table 20 Raptors observed within the study area

Family	Species	Preferred habitat on study area*
Accipitridae	Black-shouldered Kite	Grassland, pasture and open woodlands
	Brown Goshawk	Open forest, woodlands, farmland
	Collared Sparrowhawk	Open forest, woodlands, farmland
	Osprey (tentatively)	None present
	Grey Goshawk	Rainforest, forest, tall woodlands
	Wedge-tailed Eagle	Wide variety including forests and open plains
Falconidae	Brown Falcon	Open woodlands, farmland
Tytonidae	Masked Owl	Forests, open woodland, farmland with large trees

\*Pizzey and Knight (2003)

Eight listed threatened birds were identified within the study area. An additional seven migratory species were recorded which are listed under Commonwealth legislation. A discussion of these is provided in Section 5.2.2.3 .

Table 21 Threatened and migratory birds recorded within the study area

Species	Status	Habitat and Location Recorded within the study area
Alberts Lyrebird ( <i>Menura alberti</i> )	TSC-V	This species was glimpsed during October field surveys in good quality secondary growth rainforest just outside of the study area, near to the proposed dam wall. It is likely that this species would occur within the area of inundation
Cattle Egret ( <i>Ardea ibis</i> )	EPBC – M	Cattle Egrets were not observed within the study area during field surveys, however were present in the surrounding districts at the same time. Limited numbers of stock within the study area at that time are a possible explanation. Despite this, it is likely that given suitable stock numbers, Cattle Egrets would occur within the pastures of the study area.

Species	Status	Habitat and Location Recorded within the study area
Glossy Black Cockatoo ( <i>Calyptorhynchus lathami</i> )	TSC - V	Glossy Black Cockatoos were seen foraging in the drier, upper slope forests during Spring and Autumn survey periods.
White-throated Needletail ( <i>Hirundapus caudacutus</i> )	EPBC – Ma, M	White-throated Needletail were observed during the Spring survey period foraging over the study area.
Black Bittern ( <i>Ixobrychus flavicollis</i> )	TSC - V	A Black Bittern was recorded in the study area during the Autumn survey in a pool on Rocky Creek.
Rainbow Bee-eater ( <i>Merops ornatus</i> )	EPBC – M	Rainbow Bee-eaters were observed in the central section of the study area foraging in open areas and over the forest canopy.
White-eared Monarch ( <i>Monarcha leucotis</i> )	TSC - V	This species was recorded on several occasions throughout the privet and camphor infested sections of the study area during the Autumn survey period.
Spectacled Monarch ( <i>Monarcha trivirgatus</i> )	EPBC – M	Spectacled Monarch was observed during the Spring survey period engaged in breeding activity in the rainforest communities at the southern end of the study area.
Satin Flycatcher ( <i>Myiagra cyanoleuca</i> )	EPBC – M	The study area provides a range of habitats likely to be occupied by Satin Flycatchers
Osprey ( <i>Pandion haliaetus</i> )	TSC - V	A bird tentatively identified as an Osprey was observed during the Spring survey period. While the study area in its current form is unlikely to represent potential habitat, Osprey may fly over the area during its movements between other areas of habitat within the region.
Scarlet Robin ( <i>Petroica multicolor</i> )	TSC - V	A bird tentatively identified as a Scarlet Robin was observed within the dry ridge top sclerophyll forest on the southern ridgeline.
Rose-crowned Fruit-Dove ( <i>Ptilinopus regina</i> )	TSC - V	Rose-crowned Fruit-doves were seen and heard calling commonly during the Autumn survey period.
Rufous Fantail ( <i>Rhipidura rufifrons</i> )	EPBC – M	Rufous Fantails were observed in the rainforest areas adjacent to Rocky Creek during the Autumn survey period.
Channel-billed Cuckoo ( <i>Scythrops novaehollandiae</i> )	EPBC – Ma	Observed calling from dense vegetation and flying-over the study area during the survey.
Masked Owl ( <i>Tyto novaehollandiae</i> )	TSC - V	Masked Owls were observed and heard calling each night of survey during the Autumn survey period. The species was recorded mainly from the western side of Rocky Creek although it may also occupy other suitably vegetated parts of the study area.

TSC - Threatened Species Conservation Act (1995), EPBC – Environment Protection and Biodiversity Conservation Act (1999). E – endangered, V – vulnerable, M – migratory, Ma - Marine

### 4.3.7 Reptiles

#### 4.3.7.1 Survey Results

A total of 22 reptile species were detected throughout the study area and immediate surrounds during autumn, spring and summer surveys (Table 21), with a further species detected only at nearby Rocky Creek Dam (Saw-shelled Turtle). None of these species are listed as threatened under State or Commonwealth legislation. The Saw-shelled Turtle is significant in that it is at the southern extent of its range that extends along the coast to the Northern Territory (CSIRO 1996; Wilson and Swan 2010).

The most common reptile species detected was the Garden Skink (*Lampropholis delicata*). This species was found in most habitats but was particularly abundant in woodland and rainforest. More unusual finds included a Rough-scaled Snake foraging along the track near Simes Bridge in rainforest, a Three-toed Burrowing Skink and two

species of *Saproscincus* in rainforest. A number of Eastern Brown Snakes were located in paddocks near Rocky Creek, but other snakes, such as Red Belly Black Snake (*Pseudechis porphyriacus*) were expected to occur but were not detected. The Green Tree Snake and Brown Tree Snake were detected in the study area (in rainforest vegetation), but were not common. No threatened reptile species were identified during the surveys.

Table 22: Results of reptile surveys

Species	Detection Method	Abundance Within the study area	Locations/Habitat	Survey Recorded
Brown Tree Snake ( <i>Boiga irregularis</i> )	Observed	Occasional, more common at nearby Rocky Creek Dam	Woodlands and rainforests, arboreal and crevice dwelling	Sp and Su
Carpet Python ( <i>Morelia spilota</i> )	Observed	Occasional	Sandstone escarpment, rocky areas around water	Sp
Eastern Beared Dragon ( <i>Pogona barbata</i> )	Observed	Occasional	Woodlands and margins between cleared and wooded areas	Sp
Eastern Brown Snake ( <i>Pseudonaja textilis</i> )	Observed and captured	Occasional	All habitats but more common in open areas and ecotone between grassland and woodland.	Au
Eastern Small-eyed Snake ( <i>Rhinoplocephalus nigrescens</i> )	Captured and observed	Occasional	Sandstone escarpment and Rainforest	Sp and Sum
Eastern Striped Skink ( <i>Ctenotus robustus</i> )	Captured by hand	Occasional	Sandstone outcrop at McInnes property (outside study area)	Au
Eastern Water Dragon ( <i>Physignathus leseuerii</i> )	Observed	Common in appropriate habitat	Margins of water ways.	All
Garden Skink ( <i>Lampropholis delicata</i> )	Trapped and Observed	Common	Most habitats, particularly rainforest and woodland	All
Grass Skink ( <i>Lampropholis guichenoti</i> )	Captured by hand	Occasional	All habitats	Spring
Green Tree Snake ( <i>Dendrelaphis punctulata</i> )	Observed	Occasional	Woodland, wet sclerophyll, camphor laurel and rainforest.	Au
Lace Monitor ( <i>Varanus varius</i> )	Trapped and observed	Occasional	Any well timbered areas including, rainforest, camphor laurel and wet sclerophyll areas	All
Land Mullet ( <i>Bellatorias major</i> )	Observed and captured in cage trap	Occasional	Rainforest with large fallen timber present	Au and Sp
Orange-tailed Shade-skink ( <i>Saproscincus challenger</i> )	Captured by pit trap	Rare	Rainforest	Au
Pink-tongued Skink ( <i>Cyclodomorphus gerrardii</i> )	Observed	Occasional	Rainforest, near Rocky Creek (Simes Bridge)	Su
Roses Weasel Skink ( <i>Saproscincus rosei</i> )	Captured by pit trap	Occasional	Rainforest	Sp
Rough-scaled Snake ( <i>Tropidechis carinatus</i> )	Observed	Rare	Rainforest and wet sclerophyll	Su
Saw-shelled Turtle ( <i>Eiseya latisternum</i> )	Observed	Occasional	Off-study area: Rocky Creek Dam	Sp
Southern Dwarf Crowned Snake ( <i>Cacophis krefftii</i> )	Captured by resident	Rare	West sclerophyll forest and rainforest (found only just outside of inundation area adjacent to Rocky Creek)	Sp

Species	Detection Method	Abundance Within the study area	Locations/Habitat	Survey Recorded
Three Toed Burrowing Skink ( <i>Hemiergis decresiensis</i> )	Observed	Rare	Rainforest and sclerophyll forest.	Sp
Three Toed Skink ( <i>Saiphos equalis</i> )	Observed	Occasional	Red Stringybark plantation	Sp
Three-toed skink ( <i>Anomalopus verreauxii</i> )	Observed	Rare	Woodpile, outside of impact area	Sp
Wall Skink ( <i>Cryptoblepharus virgata</i> )	Observed	Occasional	All habitats	All
Yellow-faced Whip Snake ( <i>Demansia psammophis</i> )	Captured by hand	Occasional	Margins of rainforest and wet sclerophyll forest	Au and Sp

Au = Autumn Survey, Sp= Spring Surveys, Su = Summer targeted surveys.

#### 4.3.7.2 Landholder species list

Additional records of reptiles came from nearby landholders with an interest in the environment. They provided SMEC with observations of ten reptile species, recorded during 30 years of living in the area (A. Simpson unpublished data). Many of these species were also recorded during the surveys, with a few exceptions. The table below (Table 23) discusses the significance of those species that have been observed by the local community but not detected during the current survey. There were no additional confirmed sightings of species listed under threatened species legislation, however all observations were or could be additional species to add to the list of herpetofauna on or near the study area and as such are a valuable addition to the current survey effort.

The Crown Snake (see below) could be *Cacophis harrietae* (White-Crowned Snake), which is listed as vulnerable under the TSC Act. It is more likely to be one of the more common *Cacophis* species, *C. krefftii* (Dwarf Crowned Snake) or *C. squamulosus* (Golden Crowned Snake).

Table 23: Reptiles recorded by the community within the study area

Species	Significance	Comments
Gecko	Probably <i>Saltuarius swaini</i> (Southern Leaf-Tailed Gecko). This species is not listed under any threatened species legislation and is found in sclerophyll forest, heath land and under smaller exfoliating rocks on sandstone ridges. Often enters houses and garages in suburban areas (Cogger 2000).	Adds to diversity of herpetofauna within the area, but is a common species within its range from Border Ranges to central coast of NSW (Cogger 2000).
Bandy Bandy ( <i>Vermicella annulata</i> )	This species has a distinctive striped pattern and is a shy, nocturnal burrowing snake. They are active only during specific environmental conditions and are difficult to detect at other times (M. Fitzgerald pers. comm.)	Five records of this species occur in the Lismore LGA. It is considered that this record is correct and would extend the range of this species, based on current wildlife atlas records. However, this species is not listed under any threatened species legislations
Blue Tongue Lizard ( <i>Tiliqua scincoides</i> )	Common resident of most habitat types.	Not detected in current survey, and as such adds to overall diversity of herpetofauna.
Crown Snake ( <i>Cacophis sp.</i> )	There are three species of <i>Cacophis</i> this observation could be. <i>C. harrietae</i> would be the most significant finding since only one record exists for this species to the west of the study area and it is listed as vulnerable under the TSC Act.	One of these species <i>Cacophis krefftii</i> was detected during the current survey. Detection of one of the other <i>Cacophis</i> species increases the diversity of the herpetofauna on and near the study area. Detection of <i>C. harrietae</i> would be an additional threatened species and the only threatened reptile known to occur on the site.

### 4.3.8 Amphibians

Fifteen native species of frog were found within the study area and its surrounds including one threatened species (Loveridge's Frog *Philoria loveridgei* – discussed in Section 5.2.2.5 . One introduced species, the Cane Toad (*Rhinella marinus*) is a listed key threatening process under the EPBC Act and was found within the study area, particularly along and adjacent to the roads that run through pasture and plantation areas (e.g. Munro Road).

A suite of common species were often encountered at farm dams and inundated pastures, these included: Tusk Frog, Common Eastern Froglet, Peron's Tree Frog, Brown Striped Grass Frog and Dwarf Tree Frog (**Table 24**). The Stony Creek Frog occurred in most surveyed areas that were adjacent to Rocky Creek and contained sclerophyll or rainforest habitat, while the Great Barred Frog was also found in rainforest or wet sclerophyll forest at several locations throughout the study area.

Table 24 Results of amphibian surveys

Species	Detection Method	Abundance Within the study area/Status	Locations/Habitat**	Survey recorded
Barrington Tree Frog* ( <i>Litoria barringtonensis</i> )	Observed	Rare	Rocky stream with rainforest surrounds	Sp
Bleating Tree Frog ( <i>Litoria dentata</i> )	Observed	Occasional	Breeds in shallow grassy swamps, found in paperbark swamps, rainforest and sclerophyll forests and urban bushland. Found on study area on the road side adjacent to pasture and woodland.	Su
Broad-palmed Frog ( <i>Litoria latopalmata</i> )	Observed	Occasional	Forest or woodland floor or on coastal and river floodplains, can be some distance from water. Found on study area in pasture and dam study areas.	Sp
Brown Striped Grass Frog ( <i>Limnodynastes peronii</i> )	Observed	Common	Found in a variety of habitats, paddocks and dams primarily within the study area	All
Cane Toad* ( <i>Rhinella marinus</i> )	Observed	Occasional	All habitats, observed on Munro Road, which is near pasture and plantations - introduced	Su
Common Eastern Froglet ( <i>Crinia signifera</i> )	Observed	Common	Occurs in almost every habitat within its range. Detected regularly in the study area near dams and periodically inundated pasture areas as well as woodland.	All
Dwarf Tree Frog ( <i>Litoria fallax</i> )	Observed	Common	Varied, including vegetation in and beside small creeks, dams. In the study area this frog was often found in low-lying pasture areas and in ecotones between forest and cleared areas.	All
Great Barred Frog ( <i>Mixophyes fasciolatus</i> )	Observed	Occasional	Found in rainforest study areas in close proximity to water. Found in study area on the edges of rainforest and woodland areas.	Sp and Su
Laughing Tree Frog ( <i>Litoria tyleri</i> )	Observed	Occasional	Similar to <i>L. peronii</i> . Found in study area alongside the road surrounded by plantations and pasture.	Su
Leaf Green Tree Frog ( <i>Litoria pearsoniana</i> )	Observed	Occasional	Found among vegetation beside small streams, swamps and waterholes. Found near slower moving tributary of Rocky Creek.	Su

Species	Detection Method	Abundance Within the study area/Status	Locations/Habitat**	Survey recorded
<i>Loveridges Frog (Philoria loveridgei)</i>	Observed	Rare / TSC - E	Damp rocky areas in intact rainforest forest. Burrows in loos, moist soil or moss or sits in mossy cavities beside streams. These ones were found approximately 300 m from water but during a wet period and in an area of rocky outcrops containing pooled surface water.	Sp
<i>Perons Tree Frog (Litoria peronii)</i>	Observed	Common	Wide variety of habitat, often a long way from water. Found on the study area at farm dams, inundated pasture and woodland.	All
<i>Red-backed Toadlet (Pseudophryne coriacea)</i>	Observed	Occasional	Found on study area in the margins of rainforest and in Camphor and sclerophyll forest	Sp and Su
<i>Red-grained Toadlet (Uperoleia fusca)</i>	Observed	Common	Wide variety of habitats, reeds in grassy depressions after rain. Found in dams and inundated pasture near watercourses within the study area.	Sp
<i>Stoney Creek Frog (Litoria wilcoxi)</i>	Observed	Common	Water ways in rainforest and wet sclerophyll forest. This frog was common along Rocky Creek in woodland and forest areas	All
<i>Tusk Frog (Adelotus brevis)</i>	Observed	Common	Dams, damp depressions in paddocks	Sp

A = autumn survey, Sp= spring surveys, Su = summer targeted surveys. \*denotes introduced species. \*\* Habitat information from Cogger (2000). TSC - *Threatened Species Conservation Act* (1995). E – endangered \*There is little known about this species distribution and the Pearsoniana complex that it is a member of is undergoing taxonomic revision. Dr Arthur White has confirmed this record.

#### 4.3.9 Macroinvertebrates

Sixty-nine macroinvertebrate families were recorded during the field survey, with 29 specimens identified to species-level. Fifty-one insect taxa (groups) were recorded from the diurnal surveys; 36 of these being unique taxa only recorded using this survey method. Thirty-one taxa were recorded during the ground searches; 20 of which were unique to that particular survey method.

Light trapping recorded 24 taxa, including 16 unique invertebrates (Table 24). Eight orders of macroinvertebrates were recorded using light traps at study areas G1000 and J0, and five and three macroinvertebrate families were further identified respectively. Many of the macroinvertebrates recorded could not be confidently identified to species-level without a light microscope and/or their genitalia dissected and so are identified to family or higher levels of taxonomic classification.

Details on the macroinvertebrate collection data are provided in **Table 26**. The locations of all study areas where macroinvertebrate survey was carried out are shown in **Figure 8**.

Table 25: Invertebrates Recorded within the Study Area.

Survey	Site	Habitat Type	Total # orders	Total # macroinvertebrate families	Total # macroinvertebrate species identified from families
Daytime searches	E1000	Pasture dominated by exotic grasses. The field has a dam and a small wetland downstream of it.	6	16	8
	E1001	An existing farm dam. Numerous submerged macrophytes in the dam. A small intermittent stream flows into it. The stream substrate comprises of large boulders and moss. The stream and part of the dam is heavily shaded. The dam had minimal shade and was surrounded by pasture grasses	3	5	4
	H1000	An existing farm dam The dam had submerged, emergent and floating macrophytes comprising of, but not restricted to, water lilies and the Common Reed( <i>Phragmites australis</i> ). Vegetation surrounding the dam included; <i>Lantana</i> , pasture grasses, Camphor laurel ( <i>Cinnamomum camphora</i> ), native Rush ( <i>Lomandra</i> species), tobacco plants, Scotch Thistle ( <i>Onopordum acanthium</i> ) and native cedar species.	5	13	7
	D1000	Highly modified area. The area comprises of closely mown exotic grasses. <i>Lantana</i> patch ( <i>Lantana camara</i> ) present on stream bank of Rocky Creek. Small trees scattered over the whole sample area with a few mature trees The area is surrounded by warm temperate rainforest.	8	10	6
	C1000-C1003	Swampy grassland. Comprising of <i>Juncus</i> species, <i>Lomandra longifolia</i> , Camphor laurel ( <i>Cinnamomum camphora</i> ), and <i>Lantana</i> ( <i>Lantana camara</i> ).	5	7	2
	G1000	Subtropical Rainforest zone. Regeneration area for locally occurring native trees, such as native cedar. Most trees were over 5 metres high but not fully mature. Shrubs or plants that were less than 5 metres were scattered. Ground cover comprised of native grasses and some leaf litter.	1	1	1
Transect walk for larval feed plant	J01 – J02	Flooded Gum-tallowwood-Brush Box Moist Open Forest. Site comprised of native forest with a high degree of shading from mature trees. Shrubs occasionally occurred and the ground cover comprised of various well seasoned logs, leaf litter and some native grasses and ferns.	0	0	0
	G1000	Subtropical Rainforest zone. Regeneration area for locally occurring native trees, such as the native cedar. Most trees were over 5 metres high but not fully mature. Shrubs or plants that were less than 5 metres were scattered. Ground cover comprised of native grasses and some leaf litter.	8	5	0
Light trapping	J01	Flooded Gum-tallowwood-Brush Box Moist Open Forest.	8	3	
	F1000-F1004	Flooded Gum-tallowwood-Brush Box Moist Open Forest.	4	-	-
Direct search for soil fauna	G1000	Subtropical Rainforest zone. Regeneration area for locally occurring native trees, such as the native cedar. Most trees were over 5 metres high but not fully mature. Shrubs or plants that were less than 5 metres were scattered. Ground cover comprised of native grasses and some leaf litter.	10	5	-
	I1000	Flooded Gum-tallowwood-Brush Box Moist Open Forest. Site comprised of native forest with a high degree of shading from mature trees. Shrubs occasionally occurred and the ground cover comprised of various well seasoned logs, leaf litter and some native grasses and ferns.	6	3	1



Survey	Site	Habitat Type	Total # orders	Total # macroinvertebrate families	Total # macroinvertebrate species identified from families
	J01 – J02	Flooded Gum-tallowwood-Brush Box Moist Open Forest. Site comprised of native forest with a high degree of shading from mature trees. Shrubs occasionally occurred and the ground cover comprised of various well seasoned logs, leaf litter and some native grasses and ferns.	5	1	
	D1001	Warm temperate rain forest. Riparian zone of Rocky Creek. Warm Temperate Rainforest occurs in cool, moist areas which favour lichens and ground ferns rather than large epiphytic ferns and orchids (Floyd 1990). The community forms a mid-high to tall closed forest.	5	-	-

Most of the dragonflies and butterflies were recorded in open pasture habitats. Seventeen butterflies, representing nine species and one day-flying Magpie Moth (Arctiinae: Lepidoptera) was recorded in the field. Of the dragonflies seven individuals were recorded representing four species; the Fiery Skimmer (*Orthetrum villosovittatum*: Libellulidae), Common Bluetail (*Ischnura heterosticta*: Coenagrionidae), Yellow-striped Flutterer (*Rhyothemis phyllis*: Libellulidae) and *Austrogomphus (Pleiogomphus) amphiclitus* (Gomphidae: Odonata). Honey Bees, Wasps and Bullants were also recorded, as well as Robber Flies (Asilidae), Hover Flies (Syrphidae) and Houseflies (Calliphoridae). Other agriculturally important insects, such as the Lantana Leafmine Beetle (*Octotoma scabripennis*: Chrysomelidae) were also recorded feeding on stands of *Lantana* in the pastures.

The macroinvertebrate taxa recorded in this survey are found in various habitats and have a wide range of environmental tolerances. They often use open grassy areas for courtship, corridors to surrounding wooded areas and feeding on vegetation (e.g. Hover Flies) and predation on other insects as in the case for Dragonflies.

The survey did not identify any threatened dragonflies, dragonfly exuviae, moths, moth feed plants, butterflies or butterfly feed plants. Feed plants for the Black Grass-dart (*Ocybadistes knightorum*) and Laced Fritillary (*Argyreus hyperbius*) were not detected during the surveys and are unlikely to be present within the proposed dam inundation area and buffer zone. Similarly, neither the Giant Dragonflies (*Petalura gigantea* and *P. litorea*) were detected in this survey. These species prefer permanent swamps and bogs with some free water and open vegetation.

#### 4.3.10 Threatened Fauna Species

The study recorded 24 fauna species listed under either the NSW TSC Act and/or the EPBC Act that occur within the study area, one additional species was recorded at Rocky Creek Dam. Of these, seven bird species, seven bat species and one mammal species (Koala) were listed as Vulnerable under the TSC Act. One threatened frog species, Loveridges Mountain Frog, which is listed as Endangered under the TSC Act, was also recorded. One of the recorded bat species, the Grey-headed flying fox (*Pteropus poliocephalus*) is also listed as *Vulnerable* under the EPBC Act. There were a further eight species of birds recorded that are listed as *Migratory* or *Marine* under the EPBC Act. The location of these species is shown in **Figure 12**.

## 5 DISCUSSION

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### 5.1 Floral Significance

#### 5.1.1 Vegetation Community Significance

##### 5.1.1.1 Overview

Floral diversity at the proposed Dunoon Dam study area is relatively high, as a result of the varying geologies and subsequent vegetation communities within the area. However, a substantial part of the study area is dominated by invasive weeds, agricultural pasture plants and plantations.

The dominant disturbed nature of the study area is a result of the history of clearing and agriculture, however some small areas have regenerated to form floristically diverse communities. The unique variety of communities and species compositions has resulted from the study area occurring on the edge of the former 'Big Scrub', and therefore on the edge of the Lismore Basalt geologies that supported this vegetation. In particular, the rainforest and wet sclerophyll forest communities within the study area provide habitat for a range of rare and threatened plant species.

The similarity of the communities within the study area with other mapped vegetation communities from previous studies is described in this section to gain an understanding of the distribution and abundance of the vegetation types within the region and determine their significance within the study area.

##### 5.1.1.2 Tallowwood Open Forest

The Tallowwood Open Forest vegetation type is considered to be representative of CRA Vegetation Type 152 Wet Bloodwood-Tallowwood (NPWS 1999c), but is also floristically more similar to 49 Escarpment Tallowwood Bloodwood which occurs further down the coast. The former is estimated to have been 38 per cent cleared throughout the upper and lower north coast CRA region, while the latter is 14 per cent cleared.

This community is also comparable to the NSW Vegetation Types Database community Tallowwood open forest of the coastal ranges of the North Coast (Benson 2006). This community is approximately 15 per cent cleared throughout NSW.

The 'dry sclerophyll forest' (represented within the study area by Tallowwood Open Forest) in the Richmond-Tweed area is rare as the climate and geology of the area favours the development of rainforest and wet sclerophyll Forest. The community within the study area may represent an artefact of past habitat alteration and regrowth or as a result of other factors such as fire and altered drainage. However, its presence is still distinct within the study area and also within the locality. A study on the neighbouring Byron Shire found that in general, the drier Tallowwood communities were poorly conserved within the region (Hager and Benson 1994). The dry Tallowwood Open Forest areas are therefore considered to be of regional conservation significance but this community is not listed as threatened under any legislation.

##### 5.1.1.3 Flooded Gum-Tallowwood-Brush Box Moist Open Forest

This vegetation type is comparable to CRA Vegetation Type 154 – Wet Flooded Gum-Tallowwood, which is 34 per cent cleared throughout its distribution. It also corresponds to Benson (2006) Flooded Gum – Tallowwood – Brush Box moist open forest of the coastal ranges of the North Coast (55 per cent cleared) (NSW Vegetation Types Database).

Brush Box communities on well-drained, medium to high fertility soils in sheltered, less-fire-prone areas, were found to occur throughout the neighbouring Byron Shire in the Flora and Fauna Study of the Shire in 1999 (Landmark 1999). The study found that rainforest species were often present in the canopy on moist soils and that these areas appeared to be transitioning to rainforest. The community was mainly recorded on metasediments with smaller areas mapped on rhyolite, basalt, sediments, alluvium and sand. Brush Box communities are adequately conserved across the region, though Flooded Gum communities are inadequately conserved over all their range (Hager and Benson 1994).

While this is not considered to be an over-cleared vegetation type, this community provides habitat for a range of threatened flora species. While it is common within the region, its status within the locality of Dunoon is rarer due to clearing for agriculture and plantations. However, a substantial amount of such vegetation, in better condition than the study area, is present nearby within conservation areas. As such, it is not considered to be regionally significant. However it does provide habitat for threatened flora species.

#### **5.1.1.4 Warm Temperate Rainforest**

The Warm Temperate Rainforest community within the study area does not equate very well with any vegetation type listed in the NSW Vegetation Types Database (Benson 2006), due to its general lack of characteristic emergent species, possibly as a result of past logging activities in the area. Further the sandstone geology makes the rainforest type fairly unique and rare for the area.

The community within the study area is most comparable with Coachwood – Soft Corkwood – Crabapple. This vegetation type is estimated to be 30 per cent cleared throughout its distribution in NSW (Benson 2006). The Coachwood – Soft Corkwood – Crabapple community from the vegetation types database is based on the *Ceratopetalum apetalum* Alliance of Floyd (1990). Within this alliance are several sub-alliances, however few equate to the community observed within the study area.

Floyd (1990) describes gully rainforests of the North Coast in sheltered localities with moist soils enriched by alluvium as containing Warm Temperate Rainforest due to the sub-optimal conditions for the development of the more typical Sub-tropical Rainforest, often resulting in a merging of species from both communities. Further, he describes the lack of both typical emergents from this alliance, *Ceratopetalum* and *Schizomeria*, on the basaltically enriched metasediments in the lower Tweed, which is similar to the findings within the study area.

A study of the biodiversity of the Byron Shire describes the Warm Temperate Rainforest community in the Shire, however these have been found on less fertile rhyolitic soils and contained a combination of subtropical and warm temperate rainforest elements (Landmark 1999). No areas on metasediments were recorded during the study.

The Warm Temperate Rainforest patches, particularly the area within the sandstone gorge at the south of the study area, around the proposed dam wall is considered to be regionally significant. The sandstone geology in this area makes the rainforest type fairly unique in the region, with the Tucki Tucki area, south of Lismore and also on the edge of the Big Scrub, being similar to the study area (A. Benwell, pers. comm.). This community is also part of the Lowland Rainforest EEC (see Section 5.1.2 ) and as such is State significant (listed under the TSC Act)

#### **5.1.1.5 Sub-Tropical Rainforest**

This vegetation type is considered to be most comparable to the White Booyong-Fig subtropical rainforest of the North Coast Bioregion vegetation type (Benson 2006), however only a few White Booyong (*Heritiera trifoliolata*) or figs were recorded within the rainforest patches, with only secondary emergent and canopy species associated with the community present. This vegetation type is 75 per cent cleared across its distribution in

NSW and is associated with low altitudes on fertile soils near sea level, in sheltered mid altitude valleys or on basalt terraces. This community relates to the *Argyrodendron trifoliolatum* (now *Heritiera trifoliolata*) Alliance (Floyd 1990).

The Byron Flora and Fauna Study found a number of Subtropical Rainforest remnants on metasediments within the neighbouring local government area, similar to those found at the study area (Landmark 1999). The study found that the remnants generally contained a high percentage of Brush Box in the over storey, as well as species such as Hoop Pine, Bennett's Ash, Australian Teak, Red Ash and Cudgerie in the mid storey (Landmark 1999). These observations more typically relate to the community found within the study area on the higher-nutrient alluviums further from the creek, and metasediments associated with the sandstone geology of the western and southern parts of the study area.

Due to past clearing, this vegetation type is considered to be rare within the locality and region and thus of conservation significance. This community is also part of the Lowland Rainforest EEC (see Section 5.1.2 ) and as such is State significant.

#### **5.1.1.6 Vegetation Community Summary**

The native vegetation communities of the site are diverse and important from a local and regional context. In particular, regionally significant vegetation communities within the study area include:

- Tallowwood Open Forest;
- Warm Temperate Rainforest (also State significant); and
- Sub-tropical Rainforest (also State significant).

Locally significant vegetation communities which provides habitat for threatened flora:

- Flooded Gum-Tallowwood-Brush Box Moist Open Forest.

### **5.1.2 Endangered Ecological Communities**

Mapped vegetation communities were compared to threatened communities listed under the *Threatened Species Conservation Act* 1995 as endangered in NSW. Seven endangered ecological communities which are known to occur within the Richmond-Tweed (Qld – Scenic Rim) (Part A) CMA sub-region are described below. Their potential for occurrence is also assessed.

No nationally threatened ecological communities under the EPBC Act are known to occur within the area and the habitats present. However one ecological community, which has been nominated and is likely to occur, Lowland Subtropical Rainforest on Basalt Soils and Alluvium within North Eastern NSW and South Eastern Queensland. This is discussed further below in line with the associated NSW listed community.

#### **5.1.2.1 Freshwater Wetlands on Coastal Floodplains of the NSW North Coast; Sydney Basin and South East Corner Bioregions**

Freshwater Wetlands on Coastal Floodplains are associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. It typically occurs on silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, back swamps, lagoons and lakes but may also occur in back barrier landforms where floodplains adjoin coastal sand plains (DECCW 2008d)

'Key Indicators' have been provided within the identification guidelines for this community. The following table uses these as a basis to determine if the community occurs within the study area (**Table 26**).

Table 26: Freshwater Wetlands Key Indicator Questions

Key Indicator Question	Assessment
Is the study area on the coastal floodplain of the NSW North Coast, Sydney Basin or South East Corner bioregion (see map and box)?	Yes
Is the study area periodically inundated with or does it maintain a body of semi-permanent or permanent freshwater?	Small areas within the north-western pasture areas are periodically inundated within the study area - Yes
Does the study area consist of relatively few woody plants?	Yes
Are more than a few of the species present at the study area listed as characteristic of Freshwater Wetlands in the table?	Only a few of the species are present (White Eclipta ( <i>Eclipta prostrata</i> ), Slender Knotweed ( <i>Perscaria decipiens</i> ) and Club Sedge ( <i>Schoenoplectus mucronatus</i> )) and the study areas contain a number of weeds and pasture grass species - No
Likelihood of occurrence: While some species and suitable habitat occurs within the study area, the majority of these areas are depressions and intermittent waterways, some potentially man-made, and therefore it is considered that the community does not occur within the study area.	

### 5.1.2.2 Littoral Rainforest in the NSW North Coast; Sydney Basin and South East Corner Bioregions

Littoral Rainforest is generally a closed forest, the structure and composition of which is strongly influenced by its proximity to the ocean. The plant species of this community are predominantly rainforest species. Several species have compound leaves, and vines may be a major component of the canopy. Littoral Rainforest is very rare and occurs in many small stands. In total, it comprises less than one percent of the total area of rainforest in NSW (DECCW 2007a).

'Key Indicators' have been provided within the identification guidelines for this community. The following table uses these as a basis to determine if the community occurs within the study area (**Table 27**).

Table 27: Littoral Rainforest Key Indicator Questions

Key Indicator Question	Assessment
Is the study area in close proximity to the ocean or marine environment and is north of Bega?	Yes
Is the study area on a coastal headland, hind dune or other place subject to the marine environment and climatic influences?	No
Does the study area have a closed canopy (i.e. ~70 per cent of the sky obscured by tree leaves and limbs - per cent cover may be lower if disturbed)?	Yes
Is it evident that there has been a low occurrence of fire (i.e. few burnt tree trunks, well developed shrub layer; few sclerophyllous plants)?	Yes
Is the shrub and tree layer made up of rainforest plants and vines (i.e. evergreen, moist, leathery type leaves)?	Yes
Does the study area consist of a combination of the characteristic species (check with local botanist, consult reference books or see plantnet.rbgnsy.nsw.gov.au)?	Yes
Likelihood of occurrence: As the study area does not occur on habitat influenced by the marine environment or in close proximity to any such areas, it is considered that the community does not occur within the study area.	

### 5.1.2.3 Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion

This community represents a structurally complex form of subtropical rainforest and some related dry rainforest forms. It has a closed canopy with a diversity of species and includes emergents, sub-canopy and canopy strata (NSW SC 2008a). This is consistent with the Subtropical Rainforest community within the study area.

There are currently no identification guidelines for this ecological community; however the NSW Scientific Committee's Final Determination for the community (NSW SC 2008a) provides information on the community sufficient to determine its presence within the study area.

The community is associated with a range of high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks in coastal plains and plateaux, footslopes and foothills. Within the North Coast region, it is found up to 600 m above sea level (NSW SC 2008a). The occurrence of the Subtropical Rainforest community within the study area within the study area is consistent with the occurrence of the listed community.

Quadrat surveys were undertaken within the rainforest areas to assist in the identification of EECs within the study area. Quadrats 1, 2, 6 and 7 were undertaken rainforest where the vegetation was indicative of subtropical rainforest, with varying elements of dry and warm temperate rainforest, reflecting the predominantly riparian habitat (**Table 28**). Lowland Rainforest in the listed EEC can contain elements of dry and warm temperate rainforest (NSW SC 2008a) .

Table 28: Rainforest Quadrat Result Comparison

Quadrat	Topography and altitude	Soil	Tree height and strata	Tree diversity (native)	Vines	Species composition	Species in FD for LR and LRF	Identification of rainforest community
1	Lower slope of gully 66 m	Brown loam sandstone	10-25 m 2 or 3 strata	21	9	Dominance of subtropical rainforest species	LR = 23 52 per cent LRF = 5	Lowland Rainforest EEC with minor floodplain influence
2	Lower slope of gully, 60 m	Brown loam sandstone	10-30 m 2 or 3 strata	17	11	Subtropical and dry rainforest elements	LR = 14 36 per cent LRF =4	Lowland Rainforest EEC with dry rainforest influence
6	Lower slope of gully, 71 m	Red soil	12-25 m 2 strata	18	15	Subtropical, warm temperate and dry rainforest elements	LR = 18 46 per cent LRF =2	Lowland Rainforest EEC with other influences
7	Riparian strip below dam wall, 46 m	Brown loam	20-40 m 2 or 3 strata	22	10	Subtropical and warm temperate (riparian) elements	LR = 18 37 per cent LRF =3	Lowland Rainforest EEC with warm temperate influence

\* Species in Final Determination (FD) for LR and LRF: Number and percent of total native species in plot. LR = Lowland Rainforest EEC; LRF = Lowland Rainforest on Floodplain EEC.

Species composition of plots indicates significantly higher representation of species listed in the Final Determination for Lowland Rainforest in NSW (**Table 28**). A total of 36, or 33 per cent, of the 108 characteristic species listed in the scientific determination occur within the study area within the rainforest areas. The community within the study area also occurs on fine-grained sedimentary rocks at lower elevations, which is indicative of the EEC. Further, a number of the threatened species (flora and fauna) associated with the community within the final determination were found to occur within the study area.

Therefore it is considered that the areas of Subtropical Rainforest and Warm Temperate Rainforest areas within the study area are consistent with the listed Lowland Rainforest ecological community. Thus **the endangered ecological community occurs within the study area (Figure 13).**

This community has been nominated for listing as an endangered ecological community nationally under the EPBC Act as 'Lowland Subtropical Rainforest on Basalt and Alluvium in NE NSW and SE QLD'. If the nomination proceeds, the community will be listed under the EPBC Act, and the potential impacts will need to be assessed further if the proposed dam should go ahead.

#### **5.1.2.4 Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion**

There are currently no identification guidelines for this ecological community; however the NSW Scientific Committee's Final Determination for the community (NSW Scientific Committee 2008b) provides information on the community sufficient to determine its presence within the study area.

The presence of a core assemblage of species is the main determinant for the occurrence of Lowland Floodplain Rainforest. Out of the flora species recorded rainforest 14 of the listed 38 characteristic species, or 37 per cent were present.

However, given the following factors, the community is considered to correlate with Lowland Subtropical Rainforest EEC and therefore **does not meet the description of Lowland Subtropical Rainforest on Floodplains EEC** as:

- The community within the study area occurs on fine-grained sedimentary rocks at lower elevations, not the required floodplain alluvium substrate of Lowland Rainforest on Floodplain;
- The species composition of quadrats indicates significantly higher representation of species listed in the Final Determination for Lowland Rainforest EEC than the Lowland Rainforest on Floodplain EEC; and
- The Lowland Rainforest on Floodplain EEC is not known to contain elements of both Subtropical Rainforest and Warm Temperate Rainforest communities.

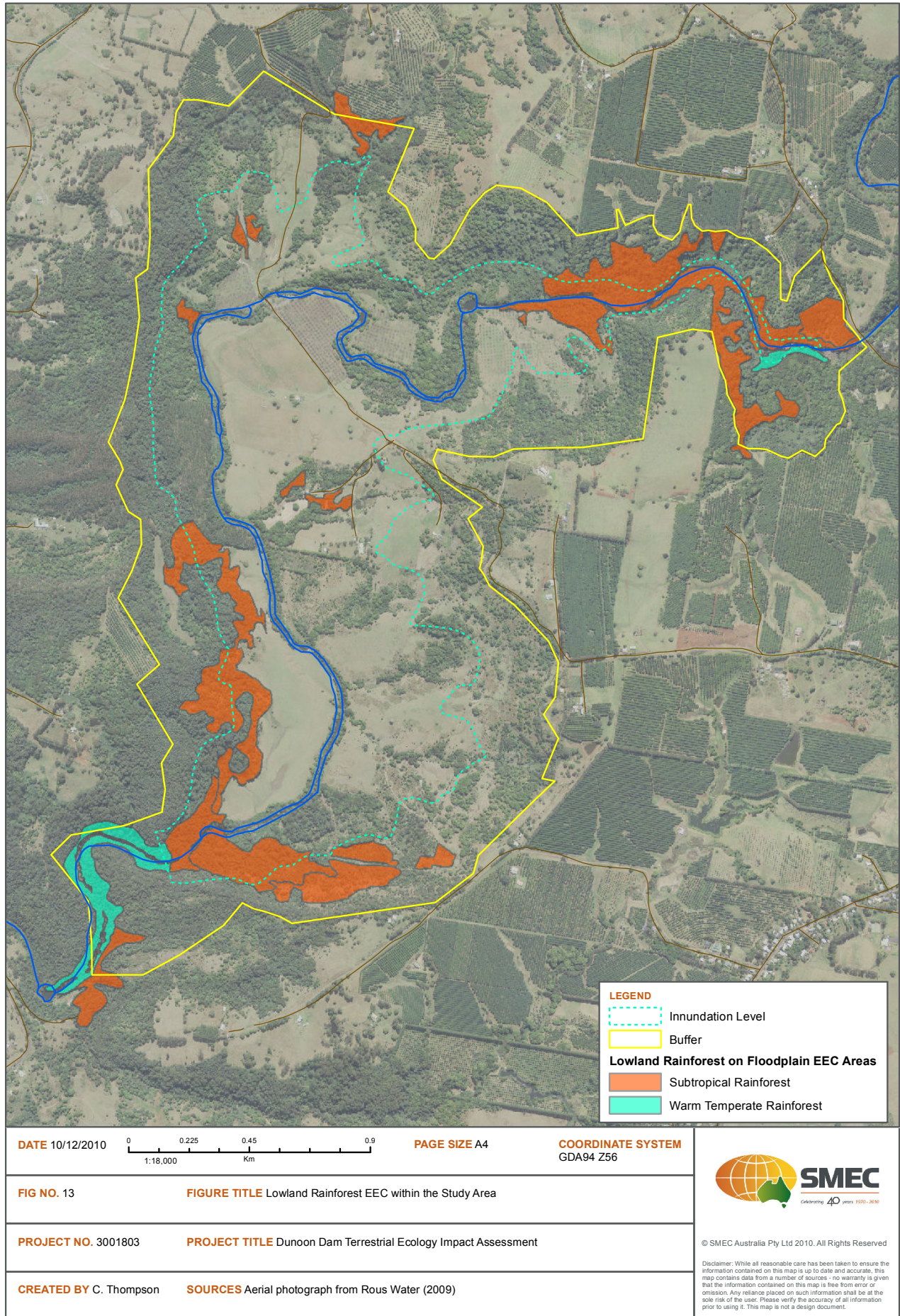
#### **5.1.2.5 Sub-Tropical Coastal Floodplain Forest of the NSW North Coast Bioregion**

Sub-tropical Coastal Floodplain Forest is a tall mixed forest occurring on coastal floodplains on the north coast of NSW. The most widespread and abundant dominant trees include Forest Red Gum (*Eucalyptus tereticornis*), Grey Ironbark (*E. siderophloia*), Pink Bloodwood (*Corymbia intermedia*) and, north of the Macleay floodplain, Swamp Turpentine (*Lophostemon suaveolens*).

A layer of small trees may be present, with scattered shrubs and occasional vines. The groundcover is composed of abundant herbs, scramblers and grasses. Sub-tropical Coastal Floodplain Forest occurs north from Port Stephens. It has been recorded from all coastal and near-coastal local government areas (DECCW 2007a).

'Key Indicators' have been provided within the identification guidelines for this community. The following table uses these as a basis to determine if the community occurs within the study area (Table 29).

Figure 13: Lowland Rainforest on Floodplain EEC within the Study Area



Location: I:\projects\3001803 - Dunoon Dam Terrestrial Ecology Assessment\09\DATA\GIS\Report Maps



Table 29: Sub-Tropical Coastal Floodplain Forest Key Indicator Questions

Key Indicator Question	Assessment
Is the study area north of Port Stephens?	Yes
Is the study area on the coastal floodplain (see "What is the Coastal Floodplain" on previous page)?	<p>Floodplains are level landform patterns on which there may be active erosion and deposition by flooding where the average interval is 100 years or less. Coastal floodplains include coastal river valleys, alluvial flats and drainage lines below the escarpment of the Great Dividing Range (DECCW 2007a).</p> <p>While most floodplains are below 20 m in elevation, some may occur on localised river flats up to 250 m elevation. Compared with the surrounding landscape, floodplains are generally quite flat. However, there may be local variation associated with river channels, local depressions, natural levees and river terraces. The latter are areas that rarely flood anymore due to deepening or widening of streams (DECCW 2007a).</p> <p>According to the description above from the guidelines it is considered that the study area contains a coastal floodplain and associated depressions. The study area is also shown on the guideline distribution map as potentially containing the ecological community.</p>
Is the tree layer made up of mixed eucalypts?	No
Does the tree layer contain any of the following: Forest Red Gum, Grey Ironbark, Pink Bloodwood or, north of the Macleay floodplain, Swamp Turpentine?	No
Are rainforest trees or shrubs scattered throughout?	No – these dominate the floodplain areas
Are there relatively low numbers of Casuarina species, Melaleuca species and Swamp Mahogany?	Yes – as these areas are dominated by rainforest species
Likelihood of occurrence: Due to the lack of eucalypt species within the canopy of the floodplain areas, it is considered that <b>the community does not occur within the study area.</b>	

#### 5.1.2.6 Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions

Swamp Sclerophyll Forest is a community that is structurally diverse; it includes trees, shrubs, groundcovers and wetland plants such as reeds and sedges. It is a community of plants that are generally found close to standing water on soils that are either waterlogged or subject to periodic flooding or inundation. It is usually an open to closed forest with a shrubby or reedy/ferny understorey, although in some areas the tree layer is low and dense and the community takes on the structure of scrub (DECCW 2007b).

Swamp Sclerophyll Forest is associated with humic clay and sandy loam soils on waterlogged or periodically flooded areas. These soils are generally deposited during flood events and occur on the flats, drainage lines and river terraces of the Coastal Floodplain. The community is usually found below 20 m in elevation although sometimes up to 50 m elevation on small floodplains or where the larger floodplains adjoin lithic (rocky) substrates or coastal sand plains (DECCW 2007b).

'Key Indicators' have been provided within the identification guidelines for this community. The following table uses these as a basis to determine if the community occurs within the study area (**Table 30**).

Table 30: Swamp Sclerophyll Forest Key Indicator Questions

Key Indicator Question	Assessment
Is the study area on the coastal floodplain of the NSW North Coast, Sydney Basin or South East Corner bioregion (see map)?	Yes – see <b>Table 29</b> above for description of coastal floodplain.
Is the study area associated with humic clay or sandy loams soils (refer to soil maps)?	Yes
Is the study area subject to water logging and/or below the highest flood level	Yes
Are any of the tree species present at the study area listed as characteristic of Swamp Sclerophyll Forest in the table?	No - Swamp Mahogany ( <i>Eucalyptus robusta</i> ), <i>Melaleuca quinquenervia</i> and other key indicator canopy species are not present within the study area.
Are any of the shrub and/or ground layer species listed as characteristic in the table present?	Some understorey and shrub species are present, although are common through a number of the vegetation communities within the area.
Likelihood of occurrence: Due to the lack of characteristic eucalypt species within the canopy of the floodplain areas, it is considered that <b>the community does not occur within the study area.</b>	

### 5.1.2.7 White Gum Moist Forest in the NSW North Coast Bioregion

White Gum Moist Forest occurs on the escarpment slopes and foothills of north-east NSW. It is associated with relatively fertile soils and is typically found in gullies and lower slopes. It has also been found on upper slopes and basalt ridges. White Gum (*Eucalyptus dunnii*) dominates the tall canopy in the community with occurrences of Sydney Blue Gum (*Eucalyptus saligna*), Tallowwood and/or Brush Box (DECCW 2009).

'Key Indicators' have been provided within the identification guidelines for this community. The following table uses these as a basis to determine if the community occurs within the study area (**Table 31**).

Table 31: Freshwater Wetlands Key Indicator Questions

Key Indicator Question	Assessment
Is the study area in the upper northern reaches of the Richmond River catchment or in the north-eastern foothills of the Dorrigo plateau?	No
Is the vegetation open forest with a diverse moist understorey or a disturbed understorey?	No – the area contains closed wet sclerophyll forest, dry open forest and rainforest remnants.
Does the tree layer contain White Gum?	No
Likelihood of occurrence: Due to the lack of the characteristic White Gum, the study area occurring outside the known distribution of the ecological community and the lack of open forest with a moist understorey, it is considered that <b>the community does not occur within the study area.</b>	

### 5.1.2.8 EEC Assessment Summary

One endangered ecological community, listed in NSW under the TSC Act was found to occur within the study area. Lowland Rainforest in the NSW North Coast and Sydney basin Bioregions is associated with the floodplain areas in the north - east and southern parts of the study area adjacent to Rocky Creek. This ecological community has been nominated for listing nationally under the EPBC Act and thus any potential impacts will need to be assessed under this Act should the listing be finalised.

### 5.1.3 Weeds and Disease

Weeds and exotic pasture and plantation species occur within the study area. Most of these species are attributed to the agricultural and clearing history at the study area, with the pasture and adjacent areas containing the highest amount of exotic species.

Seven of the weed species identified within the study area are listed under the *Noxious Weeds Act 1993* (NW Act) in the Lismore Local Government Area (LGA). Noxious weeds are required to be monitored and controlled because of the potential damage they can do to the environment. The NW Act defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds. The Act sets up categorisation and control actions for the various noxious weeds, according to their potential to cause harm to our local environment. The following weed control classes apply to noxious weeds:

- C1 Class 1 - State Prohibited Weed. Class 1 weeds are also notifiable weeds.
- C2 Class 2 - Regionally Prohibited Weed. Class 2 weeds are also notifiable weeds.
- C3 Class 3 - Regionally Controlled Weed.
- C4 Class 4 - Locally Controlled Weed.
- C5 Class 5 - Restricted Weed. Class 5 weeds are also notifiable weeds.

Noxious weeds listed within the Lismore Local Government Area, that were recorded within the study area, with control classes include:

- Crofton Weed (*Ageratina adenophora*) (C4);
- Camphor Laurel (*Cinnamomum camphora*) (C4);
- Lantana (*Lantana* spp.) (C4);
- Mistflower (*Ageratina riparia*) (C4);
- Nodding Thistle (*Carduus nutans*) (C4);
- Narrow-leaf/small-leaf Privet (*Ligustrum sinense*) (C4); and
- Large Leaved Privet (*Ligustrum lucidum*) (C4).

In addition a number of environmental weeds were found to occur, particularly in the most disturbed parts of the study area such as the pasture areas. Of the weed species recorded, it is considered that Camphor Laurel, Lantana and Small-leaf Privet are having the most impact on the biota of the study area. These plants shade-out native understorey and groundcover species and form thick stands and monocultures. This is particularly the case in the north-eastern end of the study area where Lantana dominates the slopes.

Camphor Laurel has naturalised in the region and is most common within areas receiving over 1400 mm annual rainfall on fertile soils such as those derived from basalt and on floodplains. This species has been noted as increasingly invading eucalypt forests on hillsides as well as less fertile areas. They are, however, restricted by water logging, frost and dense shade (NSW North Coast Weeds Advisory Committee 2004).

Camphor Laurel generally occurs in previously cleared areas of the study area where disturbance has been the greatest. This does not include the Warm Temperate Rainforest areas in the south and only scattered individuals within the sclerophyll forest areas. It appears that the majority of patches of Sub-tropical Rainforest and those areas regenerating are infested with this species to differing levels, particularly on the edges. As such, this is considered to be a significant weed within the study area and the locality.

Privet is associated with the creek lines and other weedy areas within the study area, particularly those with a Camphor Laurel canopy. Few groundcovers and understorey species were found in areas infested with this species within the study area. Due to its competitive and

opportunistic nature, this weed is considered to be a significant threat to the study area and the locality.

Recent studies within the Whian Whian SCA identify Lantana, Camphor Laurel and Mistflower (*Ageratina riparia*) as key weed species. Mistflower, while present in the study area, does not appear to be such a concern within the study area as with the nearby reserve.

The SCA is also one of only two known locations where *Phytophthora cinnamomi* (a soil borne pathogen) has been reported within the Northern Rivers Region (NPWS 2010). It is listed as key threatening process under State and Commonwealth legislation. This fungus is known to attack nearly 1000 plant species throughout the world and spores of the fungus spread rapidly through water and moist soil (NPWS 2010). In addition, the region is one of the areas of highest risk in New South Wales for Myrtaceae - dominated communities of heath, woodland and forest for infection from Myrtle Rust and other exotic rust fungi. No evidence was observed of any of these fungi being present within the study area, or affecting any species. Mitigation measures have been incorporated to prevent its spread into the area during any potential construction works.

## 5.2 Faunal Significance

### 5.2.1 Fauna Habitats

The fauna habitats within the study area provide habitat opportunities for a range of common and threatened fauna species. The habitat types within the study area, the features present within these for the species identified and the important habitat components are discussed below.

#### 5.2.1.1 Rainforest and Wet Sclerophyll Forest

The dense canopy and abundance of fruiting plants and foliage within the rainforest and wet sclerophyll forest provide resources for frugivores and leaf foragers, particularly birds, fruit bats and ground-dwelling mammals. These areas provide habitat for a diverse range of fauna species. These dense areas provide sheltering and roosting habitat for larger birds of prey as well as microbats, and birds belonging to the Columbidae (pigeon) family.

Ground-dwelling fauna such as the Fawn-footed Melomys (*Melomys cervinipes*), Bush Rat (*Rattus fuscipes*) and Long-nosed Bandicoot (*Perameles nasuta*) were recorded within this habitat type. Such species are likely to be foraging on the abundant leaves, shoots, fruits, and leaf litter, logs and fertile soils, which contain various macroinvertebrates.

Arboreal mammals such as the Mountain Brushtail Possum occur within the dense canopy and sub-canopy vegetation during the study, whilst Koalas (*Phascolarctos cinereus*) roost in Brush Box and forage within the Tallowwoods of the wet sclerophyll forest areas.

The few suitable tree hollows within the wet sclerophyll forest areas provide roosting and nesting resources for arboreal mammals such as the Mountain Brushtail Possum (*Trichosurus cunninghami*). These resources also provide roosting habitat for Gould's Long-eared Bat (*Nyctophilus gouldi*) and Lesser Long-eared Bat (*N. geoffroyi*). Roosting opportunities are abundant within regenerating rainforest habitats for the Lesser Long-eared Bat that shelters in epiphytes and under peeling bark. Tube-shaped palm fronds were also abundant which this species is likely to roost in.

A variety of pigeons and fruit-doves were recorded within this habitat type including White-headed Pigeon (*Columba leucomela*), Top-knot Pigeon (*Lopholaimus antarcticus*), Rose-crowned Fruit Dove (*Ptilinopus regina*), Wonga Pigeon (*Leucosarcia melanoleuca*), Emerald Dove (*Chalcophaps indica*) and Brown Cuckoo-dove (*Macropygia amboinensis*). Many of these species were present in high numbers as evidenced by observation and in many cases, constant calling across the valley between areas of suitable habitat. While a number of

rainforest fruit bearing tree species occur through the area, the extent of Camphor Laurel, Small-leaved Privet and Lantana are likely to represent the main food source for frugivorous birds.

The rainforest regeneration areas, being restored by Rous Water, also provided a range of habitat opportunities for avifauna not evident in other parts of the study area. Birds occurring in these habitats included a mixture of species associated with either rainforest or more dry and open forest types. This was most notable at the regeneration area near Simes Bridge, at the upper part of the proposed buffer zone area, where Rose-crowned Fruit-doves and Superb Fairy wrens (*Malurus cyaneus*) were regularly seen.

The entire project study area was, at one point cleared except for very small pockets of rainforest and wet sclerophyll forest on steep slopes. The secondary growth rainforest, while weed free and well established in many areas does not provide the foraging and sheltering resources required by species such as *Coranascincus reticulatus*. It is also likely that these small areas of rainforest habitat have been isolated by surrounding land clearance from larger tracts of similar vegetation for some time (more than 150 years), reducing the chance of finding rarer rainforest species that require large contiguous tracts of suitable habitat. Despite targeted searches within these areas, no threatened reptiles were found.

However, there are rainforest areas with a weed free shrub layer and large, fallen, rotting logs within and surrounding the study area. In particular, two study areas in proximity to the proposed dam wall ( 5.2.1.5 ) provided the most pit line reptile captures as well as observations of species such as Land Mullet (*Bellatorias major*), Rough-scaled Snake (*Tropidechis carinatus*), Roses Weasel Skink (*Saproscincus rosei*) and Three-toed Skink (*Anomalopus verreauxii*).

Much of the remnant rainforest and wet sclerophyll forest in close proximity to waterways contained many species of amphibians. The most significant finding was the endangered Loveridge's Frog (*Philoria loveridgei*) in wet sclerophyll forest habitat in the south-west of the study area (within approximately 700 m of the proposed dam wall). This species is known to shelter in close proximity to water in constantly moist conditions under rock outcrops where surface water is present (DEC 2005). Commonly occurring frog species in wet areas of rainforest and wet sclerophyll forest included; Stony Creek Frog (*Litoria wilcoxi*), Dusky Toadlet (*Uperoleia fusca*) and Tusk Frog (*Adelotus brevis*).

A high diversity of insectivorous bats was recorded within regenerating rainforest in the south of the study area. The Eastern Forest Bat, White-striped Freetail Bat (*Tadarida australis*), Eastern Horseshoe Bat, Gould's Wattled Bat (*Chalinolobus gouldii*) and Bentwing Bats (*Miniopterus australis* and *M. schreibersii oceanensis*) were found in regenerating rainforest dominated by a dense cover of Nasturtium Tree (*Macaranga tanarius*), a pioneer species of rainforest tree (Botanic Gardens Trust 2011).

Bat species in the 'gleaning forager' guild, which catch insects from the ground or from vegetation, were found in rainforest and wet sclerophyll forest within the study area. Such species typically have a low aspect ratio and low wing loading, which allows them to fly slowly within dense vegetation. Their large tail membrane, broad wings and rounded wing tips also enable them to hover and make tight turns within dense vegetation (Churchill 2008). Such species recorded include the Eastern Horseshoe Bat (*Rhinolophus megaphyllus*), Eastern Long-eared Bat (*Nyctophilus bifax*), Gould's Long-eared Bat and Lesser Long-eared Bat.

Two species belonging to the 'edge space aerial forager' guild, with moderately long and broad wings enable these species to vary their flight speed and give a high degree of agility and manoeuvrability (Churchill 2008), were recorded in these habitats. Such species utilise the edge of rainforest and wet sclerophyll forest patches, particularly along the creek line and adjacent to open pasture areas within the study area. Edge space aerial foragers recorded include the Eastern Forest Bat (*Vespadelus pumilus*), and Chocolate Wattled Bat (*Chalinolobus morio*).

Foraging opportunities are present within rainforest habitats for the Black Flying-fox (*Pteropus alecto*), and Grey-headed Flying-fox (*Pteropus poliocephalus*), which were observed flying over this habitat type. No substantial foraging habitat in the form of rainforest fruits were observed during the survey period for the Common Blossom Bat (*Syconycteris australis*) or the Eastern Tube-nosed Bat (*Nyctimene robinsoni*).

The diversity and ubiquity of insects across a range of habitat types makes it difficult to single out particular groups that might dominate a particular habitat. However, broad generalisations can be made based on the habitat resources that are most likely to be present in a healthy habitat. For rainforest and wet sclerophyll forests insects involved in the decomposition of organic matter are commonly found. Various types of scarab beetles (e.g. Lucanidae) can be found feed on decaying wood, while other insects can be found in forest canopies including; ants, flies, beetles and wasps (Kitching *et al.* 2005). Species that are commonly found under tree bark in rainforests and wet sclerophyll forests are; ants, flies and springtails. The degree to which any one group predominates is largely depends on its geographic region, local habitat health and its resources.

Rainforest areas, in particular within this habitat type, are considered to constitute significant habitat for a diverse range of common and threatened species. To a lesser extent, the wet sclerophyll forest within the study area is also important for local fauna species, although it is not as diverse in its fauna assemblages.

#### 5.2.1.2 Dry Sclerophyll Forest

The dry sclerophyll forests of the study area provide a unique habitat for local fauna species, due to the dominance of wet sclerophyll forest and rainforest within the region. As such, the rocky outcrops, shallow sandstone soils and associated vegetation contain abundant habitat resources for a range of reptile, bird and mammal species.

Ground-dwelling mammals including Red-necked Wallabies (*Macropus rufogriseus*) forage on the grassy understorey provided in this habitat, sheltering in denser habitat nearby. Arboreal species associated with the wet sclerophyll areas were also recorded within the dry sclerophyll forest areas, particularly Koalas with the abundance of Tallowwood throughout these areas.

Arboreal mammals such as the Sugar Glider (*Petaurus breviceps*) feed on the nectar, pollen, eucalypt sap and insects associated with the sclerophyllous vegetation present. The few remnant over-mature trees provide roosting hollows for such species, however these are not common through the area due to past clearing. As such, hollow-dependant fauna are sparse throughout the study area.

The drier forest areas support habitat for a range of relatively common and widespread avifauna species. However as a result of the limited diversity in understorey vegetation, floristics and structure, the majority of birds observed in these habitats typically occupy the canopy. White-browed Treecreeper (*Corombates leucophaea*) was one species in particular, that was restricted to the upper-slope dry forest community's during the surveys. Also seen in the dry forest along the southern ridgeline was a bird determined most likely to be a Scarlet Robin (*Petroica boodang*). Locally this species is not commonly recorded (M. Fitzgerald, pers. comm.) and given its recent listing as a vulnerable species in NSW, this sighting is of significance.

Dry sclerophyll forest, particularly the ecotone between this community and more open or pasture areas provided good habitat for foraging for many species of common reptiles including: Eastern Brown Snake (*Pseudonaja textilis*), Lace Monitor (*Varanus varius*), Yellow-faced Whip Snake (*Demansia psammophis*) and Garden Skink (*Lampropholis delicata*). During a survey of the *E. macrorhyncha* regeneration area, six species of common reptile and amphibian were detected including the Three Toed Skink (*Saiphos equalis*) and Dwarf Tree Frog (*Litoria fallax*).

A number of sandstone escarpments are located within this type of habitat, but outside of the study area. This type of habitat is suitable for species such as the Yellow-faced Whip Snake

(*Demansia psammophis*) and Eastern Striped Skink (*Ctenotus robustus*). Generally this type of habitat did not contain a diverse array of amphibian species, but common, generalist species could be found in moist locations throughout, particularly in and around the ecotone of this habitat and pasture or paddocks or in or near farm dams. Such species included: Dwarf Tree Frog (*Litoria fallax*), Common Froglet (*Crinia signifera*) and Tusk Frog (*Adelotus brevis*).

The Eastern Forest Bat, Gould's Wattled Bat, Chocolate Wattled Bat and Little Bentwing Bat, aerial space foragers, were found within dry sclerophyll forest habitat. These bats would utilise canopy gaps within the dry sclerophyll forest for foraging. Further, clutter tolerant bats belonging to the gleaning foraging guild were also found in these habitats including Gould's Long-eared Bat, Eastern Long-eared Bat and Eastern Horseshoe Bat.

Rocky outcrops on the southern escarpment within dry sclerophyll forest are likely to provide roosting opportunities for the cave roosting Large-footed Myotis, Chocolate Wattled Bat, Eastern Horseshoe Bat and Little Bentwing Bat (*Miniopterus australis*). Sandstone overhangs also provide roosting opportunities for the Eastern Cave Bat (*Vespadelus troughtoni*).

Insects that are commonly found in Dry Sclerophyll Forests are usually those that can utilise tree canopies, litter layers, tree bark, soils as well as various plants, trees and grasses. In this survey insects that were caught from light trapping include; scarab beetles (Scarabaeidae: Coleoptera), termites (Isoptera), Lacewings (Neuroptera), Craneflies (Brachycera: Diptera), crickets (Gryllidae: Orthoptera) and Leaf Hoppers (Cicadellidae: Orthoptera). Other insects that were recorded during the searches for Mitchell's Rainforest Snail and the Atlas Rainforest Ground Beetle and the Shorter Rainforest Ground Beetle include: Centipedes, Collembola, Reduviidae (Hemiptera) and Slaters. The insects that are listed here are indicative of the diversity that occur in a Dry Sclerophyll forest. Their activities include (but are not limited to) decomposition, mutualism, parasitism, pollination, herbivory and predation. The dry sclerophyll areas provide a unique habitat for species uncommon within rainforest and wet sclerophyll forest communities. This includes some threatened species (e.g. Scarlet Robin), which were not found to occur elsewhere within the study area. As such, it is considered to represent a significant habitat for local fauna species within the locality as well as the region.

### 5.2.1.3 Camphor Forest and Plantations

The monoculture plantation and camphor forest areas provide limited habitat for fauna species, however some of the resources, such as the camphor and privet fruits provide important foraging resources for bird and fruit bat species, within a largely cleared and altered landscape. The pecan plantation areas contained introduced species such as the Black Rat (*Rattus rattus*), which provide foraging resources for raptors and owls within the study area. This was likely a factor contributing to the presence of Masked Owls (*Tyto novaehollandiae*) both in the plantations and in the numbers they were observed and otherwise recorded.

Camphor forests that contained a dense understorey of Small-leaved Privet, providing a dense and prolifically fruiting tall shrub layer, afforded greater opportunities for foraging, shelter and concealment for smaller bird species. This included White-browed Scrubwren (*Sericornis frontalis*), Red-browed Firetail (*Neochima temporalis*), Grey Fantail (*Rhipidura albiscapa*) and notably, the White-eared Monarch (*Carterornis leucotis*), which is a vulnerable species in NSW.

Understorey within the timber and food plantations was more open than the Camphor forests, such as the Pecan plantations with pasture understorey. As a result, avifauna diversity was limited in these areas, with the exception of those areas where scattered shrubs (mostly Privet) were interspersed, with species such as Red-backed Fairywren (*Malurus melanocephalus*) and Chestnut-breasted Mannikin (*Lonchura castaneothorax*) observed.

In areas of camphor close to water (especially in proximity to Rocky Creek Dam), reptile and amphibian diversity was low but some common species were still observed (e.g. Land Mullet and Stony Creek Frog).

Due to the strong association of Privet dominated forest with streams, the Large-footed Myotis (*Myotis macropus*) was abundant within this habitat type. The Eastern Horseshoe Bat was also recorded from Camphor and Privet-dominated forest. This species commonly forages along tracks and waterways and avoids cleared areas (Churchill 2008). Foraging opportunities were also present within Camphor habitats for the Black Flying-fox and Grey-headed Flying-fox, which were often recorded feeding on the Camphor fruits along the creek line.

It is difficult to generalise as to what insects are likely to be found in Camphor Laurel (*Cinnamomum camphora*) forests. This is because Camphor crystals are often used to deter insects and prevent damage to insect collections. In Australia, Camphor Laurel is an introduced species and there are few significant native insect predators. Camphor Laurel grows and spreads rapidly, invading agricultural areas and restricting regeneration of native vegetation. In 1971 a native butterfly (Blue-triangle, *Graphium choredon*) was considered to be able to use Camphor Laurel trees as a primary host (McCubbin 1970). Indeed, Camphor trees were known to commonly support a big 'display' of frequently visiting fertile adult butterflies near Bellingen, on the NSW North Coast (<http://www.camphorlaurel.com/factfile2.html>). However, observations on the Camphor Laurel trees around Lismore (NSW) indicate that its presence on these trees has declined (Camphor Laurel Research Centre Environmental Consultants, Lismore [www.camphorlaurel.com/57reasons.html](http://www.camphorlaurel.com/57reasons.html)). In this study the Blue Triangle butterfly (*Graphium sarpedon*: Papilionidae) was detected just outside the buffer zone in open pastures (study areas E1000 and H1000). This species is found in Eastern Australia, from Torres Strait and Cape York in Queensland to about 160 km south of Sydney.

While these areas are dominated by exotic and invasive species, they provide important habitat particularly for frugivores, within a landscape constrained by such resources, due to clearing of native fruit-bearing trees. As such, removal needs to be managed so that alternative resources are available. It is considered to be of lesser value than established native forest habitat.

#### 5.2.1.4 Pasture

The pasture areas, though dominated by exotic and introduced species, provide important habitat for edge-dwelling species and open areas for foraging by birds of prey. The wetter depressions and drainage lines also provide important habitat for semi-aquatic species and watering resources for terrestrial species.

Ground-dwelling mammals like the Red-necked Wallaby and the Northern-brown Bandicoot (*Isodon macrourus*) that prefer areas of tall grass and dense shrubbery, were often recorded foraging within the pasture areas.

Pasture areas provide limited habitat for most avifauna as a result of the lack of shelter however, a number of raptors were observed soaring over the study area and for these species the pasture and adjacent shrubby weed infested areas are likely to be a regular source of prey. Despite this, raptors also were seen to forage over vegetated parts of the study area. Other birds recorded principally from the pasture areas included Australian Magpie, Masked Lapwing and Red-browed Finch.

In places where remnant trees or stags occurred in open areas surrounded by pasture, a range of other species were regularly observed including White-breasted Woodswallow, Crested Pigeon, Rainbow Bee-eater and Figbird. In the southern section of the study area where the pasture also contained localised depressions that fill with water during high rainfall or flood, White-faced Herons were also observed.

Particularly during spring and summer surveys after a long period of wetter than average conditions, grassy depressions in paddocks and soaks contained up to eight species of frog in one evening. Common species included: Tusk Frog, Perons Tree Frog (*Litoria peronii*), Striped Marsh Frog (*Limnodynastes peroni*) and Dwarf Tree Frog were commonly found in this type of habitat. Common reptiles found in paddocks, particularly in ecotonal areas around water ways



or near woodland included Yellow-faced Whip Snake, Eastern Brown Snake and Garden Skinks (*Lampropholis delicata*).

Bat species that hunt for insects while flying in open spaces away from vegetation were recorded within this habitat type. This included the White Striped Freetail Bat (*Tadarida australis*) and the Eastern Freetail Bat (*Mormopterus* spp.2). It is likely that these species are using adjoining tree hollows in wet sclerophyll or dry sclerophyll forest as roosting habitat.

A variety of insects use the open areas for courtship (e.g. display), migration (e.g. butterflies and moths), foraging or feeding. For this survey, agriculturally significant species, such as Lantana Leafmine beetle (*Octotoma scabripennis*), as well as others that are known in various habitats over eastern Australia. In pasture habitats, ground dwelling insects usually predominate. Such insects include but are not limited; ants, beetles and spring tails (Collembola). Particular feed plants, or other insects, that are present in the pasture may influence the occurrence of some species. Indeed, the Wanderer Butterfly (*Danaus plexippus*) was recorded as feeding on a cotton seed plant.

Other insects that were present in the pasture habitats include Long-horned grasshoppers (Tettigonidae), the European Honey Bee (*Aphis mellifera*) and a suite of butterfly species. These butterfly species included: the Blue Triangle butterfly (*Graphium sarpedon*: Papilionidae), Grey Swift (*Parnara bada*: Hesperidae), *Hypocysta pseudirius/metirius* species (Nymphalidae) and the Blue Tiger Butterfly (*Tirumala hamata*: Nymphalidae). This survey indicates that despite the degraded nature of some pastures, these habitats can support a variety of macroinvertebrates species. This finding may be due to the close proximity of native woodlands, such as subtropical rainforest and Flooded Gum-Tallowood-Brush Box forest, to the pasture habitats as well as having some aquatic habitat from overflows of nearby dams. Such habitats would provide refugia from a variety of weather conditions and a broad suite of resources for various macroinvertebrates.

Pasture areas provide edge habitat as well as open areas, particularly for grazing species and their predators. This habitat type is well represented within the locality and region, though not always in conjunction with dense sheltering and nesting habitat nearby. This habitat type may be important for edge species, although it is not significant habitat within the study area or locality.

#### 5.2.1.5 Watercourses and Dams

Rocky Creek runs through much of the study area and several species of common frogs (e.g. *Litoria wilcoxi* and *Limnodynastes peronii*) were located along it, especially in proximity to the track from Simes Bridge. Due to the relatively fast flowing nature of the creek, and areas of white water, it was not ideal for rarer species, however some slower moving pools were more appropriate for some frog species not detected elsewhere on the study area e.g. *Litoria barringtonensis*.

Snakes such as the Brown Tree Snake (*Boiga irregularis*) and Rough-scaled Snake (*Tropidechis carinatus*) were found foraging at a number of locations along Rocky Creek, particularly in rainforest or wet sclerophyll.

Farm dams in the study area contained up to eight species of common frogs, occurring primarily in pasture areas. The Tusk Frog, Perons Tree Frog, Red-Groined Toadlet (*Uperoleia fusca*) and Dwarf Tree Frog were frequently heard at all dams surveyed within and adjacent to the study area.

The Large-footed Myotis (*Myotis macropus*) was found in rainforest-lined streams of the study area. Foraging for this species is restricted to streams, and typically those that contain still, deep pools. The Large-footed Myotis forages for insects and small fish from the surface of pools within streams.

The Yellow-striped Flutterer (*Rhyothemis phyllis*), Common Bluetail (*Ischnura heterosticta*) and Fiery Skimmer (*Orthetrum villosovittatum*) were found on the edges of farm dams and boggy seepages. These dragonflies are commonly found in north east New South Wales and characteristically skim low over still or sluggish waters where larvae live among aquatic plants, or as in the case for gomphids, burrow into the dam sediment (Watson and O'Farrell 1991; Theischinger and Hawking 2006). The only exception here was *Austrogomphus (Pleiogomphus) amphiplitus*, which was recorded at Rocky Creek. This species is commonly recorded in flowing freshwater rivers and streams along the east coast of New South Wales and Queensland and inland of southern Queensland (Theischinger and Hawking 2006).

The waterways and small dams of the study area provide important habitat, particularly for amphibians and insects. However, as this habitat is present in abundance within the locality, it is not considered to be of conservation significance for terrestrial biota.

#### **5.2.1.6 Fauna Habitats Summary**

Rainforest areas are considered to be the most diverse and significant habitat feature of the study area, providing habitat for a range of common and threatened fauna species. The dry sclerophyll forest areas were also considered to provide significant unique habitat within the study area and region for fauna species.

To a lesser extent, the wet sclerophyll forests were also considered to be important within the area for local fauna. The Camphor dominated areas provide some foraging and roosting resources, but these along with pasture and plantation areas provide only limited resources for fauna within the study area.

### **5.2.2 Fauna Species**

#### **5.2.2.1 Mammals**

The mammal surveys show that the diversity of native mammals within the study area is average for the area (15 species), when compared to nearby conservation areas. Fourteen native mammal species were recorded within the nearby Whian Whian SCA and 20 species recorded within the Nightcap NP (NPWS Database 2010).

It appears that the study area lacks a number of mid-sized ground-dwelling mammals including Spotted-tail Quoll (*Dasyurus maculatus*), Parma Wallaby (*Macropus parma*), Red-legged Pademelon (*Thylogale stigmatica*), Red-necked Pademelon (*Thylogale thetis*) and the Long-nosed Potoroo (*Potorous tridactylus*), which are locally common, though some are listed as threatened in NSW (see **Table 5**), within nearby areas including Whian Whian SCA and Nightcap NP.

Due to the lack of large, mature and over-mature eucalypts within the study area, hollow-dependent arboreal species such as the Greater Glider (*Petauroides volans*) were not identified within the study area. This is also likely to be a result of the lack of connectivity and suitability of nearby habitat areas, with the only current linkage through a narrow and disturbed riparian corridor associated with Rocky Creek to Nightcap NP and Whian Whian SCA to the north.

#### **(i) Threatened Mammals (Koala)**

The only threatened mammal detected was the Koala. It is listed as a vulnerable species in NSW. The most important factor influencing Koala occurrence within the study area is feed tree species availability. The only recognised feed tree for the Koala within the study area is Tallowood, a primary feed tree. As this species occurs in quite low densities, though scattered throughout the study area (as part of remnant vegetation and plantings), the carrying capacity of the habitat is lower (DEC 2008). However, Brush Box is known to represent an important shelter tree species (Phillips 2000b in DEC 2008).

Tallowood Open Forest and Flooded Gum-Tallowood-Brush Box Open Forest provide habitat for Koalas within the study area. Densities of Koala within the inundation area are low to moderate due to the lack of suitable foraging habitat. However, it is likely that some individuals may move through these areas between suitable habitat patches.

According to the categories of koala habitat, the study area is considered to be Secondary Habitat (Class A) where between 30 – 50 per cent of the canopy in these sclerophyll dominated areas contain the primary feed tree, Tallowood (DEC 2008). These areas are considered capable of supporting low to medium density koala populations (between 0.1 and 0.75 koala/ha).

### **5.2.2.2 Bats**

Species detection rates for this study (total of 12 microbat and two fruit-bats) are considered to be comparable with surveys undertaken in the NSW Upper North East region where 11 species were recorded (NPWS 1995). This is also comparable with diversity in the Murwillumbah Management Area (CSIRO 1996) which covers an area of 3000 square kilometres in north eastern NSW and recorded a total of 22 bat species (CSIRO 1996), given that the study area only covers approximately 2.5 square kilometres. Activity levels for microbats were particularly high in regenerating rainforest adjacent to Rocky Creek; southwest of Sims Bridge, at a total of 147 passes.

#### **(a) Roosting Sites**

Roosting opportunities exist in tree hollows within the wet sclerophyll forest and rainforest habitats of the study area for the Eastern Broad-nosed Bat, Eastern Forest Bat and Chocolate Wattled Bat. The Chocolate Wattled Bat may also roost in caves within rocky outcrops on the southern escarpment and along Rocky Creek. Roosting opportunities are also available for the Large-footed Myotis and other cave-roosting species within rocky outcrops and associated caves and fissures along Rocky Creek. This species may also roost in the small spaces underneath bridges on Rocky Creek.

#### **(b) Threatened Bats**

The Little Bentwing Bat was detected in several habitats across the study area including plantations, dry sclerophyll forest, wet sclerophyll forest and rainforest, including in areas of regeneration. The Eastern Bentwing Bat was detected in regenerating rainforest, riparian rainforest along Rocky Creek and tall wet sclerophyll forest environments within the study area. The range of vegetation types present provide a wide range of foraging opportunities including abundant moths, flies, cockroaches and beetles, and spiders (Churchill 2008).

Possible cave roosts exist for these two species in rocky escarpments along the southern escarpment located in a mix of regenerating rainforest and wet sclerophyll forest, and along rainforest lined parts of Rocky Creek. The Bentwing bats were not captured in a harp trap within the study area, indicating that they may be occurring in lower densities to other bat species. It is unlikely that breeding habitat is present within the study area for the Little Bentwing Bat; as they require large limestone caves to provide a suitable microclimate for their young to survive (Churchill 2008). Further, no known maternity caves for the Eastern Bentwing Bat have been recorded in this area and the survey of rocky outcrops present did not locate any suitable maternity caves.

Several individuals of the Large-footed Myotis were captured along Rocky Creek. A total of nine individuals were captured in a single trap near a large still pool, which provides foraging opportunities for this species. Several of these large still pools are present along Rocky Creek that would provide this species a still surface to detect and capture prey items such as small fish and aquatic insects. As with the Bentwing bats, potential cave roosts are available for the Large-footed Myotis in rocky outcrops along Rocky Creek and the southern escarpment. Alternative

roosting habitat is also available in tree hollows in wet and dry sclerophyll forest, and in spaces under bridges such as Simes Bridge.

The Eastern Long-eared Bat was captured in the rainforest habitats of the study area such as along Rocky Creek, and appeared to show a particular preference for the regenerating rainforest below the southern escarpment with the most individuals of this species being captured at this location. In the rainforest, roosting opportunities are available in tree hollows however within regenerating rainforest; foraging opportunities are provided in foliage roosts including inside vine thickets and senescing palm fronds that had curled to form a tubular shape. The cleared edge of this regenerating rainforest would also provide foraging opportunities for this species that prefers to forage along the edge of the tree canopy rather than within foliage (Churchill 2008). Many females that were captured during the spring survey period were either pregnant, indicating that they are breeding in the area.

Several individuals of the Grey-headed Flying-fox were observed during the autumn survey period. Grey-headed Flying-foxes were frequently encountered foraging on Camphor Laurel. Rainforest habitats within the study area provide foraging opportunities for this species in the form of rainforest fruits and eucalyptus blossom. Known camps of the Grey-headed Flying-fox occur at Terania Creek (11km from the study area), Booyong (16.5km away), Boat Harbour (13km away) and Currie Park (14km away). Booyong is the only camp that is occupied on a permanent basis, whereas the other camps are ephemeral. It is likely that Grey-headed Flying-foxes observed within the study area originate from these camps, as this species is known to forage up to 50 km from their camp (Churchill 2008).

### **5.2.2.3 Birds**

Factors potentially affecting the use of the study area for breeding by a number of species would relate to the structure and age of vegetation. A large number of species including birds that require hollows for breeding and shelter (e.g. Glossy Black Cockatoo, Masked Owl, Dusky Woodswallow, White-throated Treecreeper), and those reliant on mixed age and structurally diverse vegetation (e.g. Spectacled Monarch, Rufous Fantail) were recorded. From observations made during the field surveys, it was apparent that there were few areas that supported trees of a sufficient age to provide a ready supply of hollows for the full range of fauna likely to occupy them. This is a function of the history of extensive land clearing, agriculture, horticulture and silviculture that has defined the current vegetation communities and habitat opportunities.

Several aerial foragers were recorded during the survey including White-throated Needletail, Welcome Swallow and Tree Martin. White-throated Needletail would have little relationship with the terrestrial habitat of the study area given they breed in the northern hemisphere and spend extensive periods of time on the wing. Regardless, roosting habitat in the form of mature trees is offered within the study area. The other aerial foragers would have a closer relationship to the study area for breeding, foraging and shelter habitat which would include hollow trees, culverts and bridges, caves and rock overhangs, all of which are habitat features represented within the study area.

One bird was tentatively identified as an Osprey, a listed threatened species, during the autumn survey period however could not be confirmed due to poor light at the time it was seen. While this possible species' presence is not improbable it is unexpected. This is due to the lack of ideal foraging habitat in the immediate vicinity of the study area. The closest area of foraging habitat is likely to be Rocky Creek Dam, approximately 6.7 kilometres north east of where the sighting was made, alternately, sections of the Richmond River near Lismore may also represent potential foraging habitat for this species. The other diurnal raptors present an indication of the range of habitat types both within the study area and in the locality.

The most notable raptor species observed was the nocturnal Masked Owl. During the autumn survey period Masked Owls were recorded concurrently from three separate locations in the study area, they responded to call broadcast surveys and were also calling independently. It

was estimated that there were potentially three pairs of Masked Owls between the proposed location of the dam wall and the Simes Bridge crossing over Rocky Creek at the upstream end of the study area. This high concentration of Masked Owls is presumed to have been in part due to an abundance of prey, however as previously noted, the apparently low numbers of trees of a size likely to support hollows suitable for nesting suggests that the study area is a seasonal food resource. It is also likely that during the autumn survey period, breeding activity was occurring or had recently concluded with the apparent numbers the result of recent recruitment or dispersal. On one occasion during the autumn survey period, two individuals that responded together to call broadcast included a pale morph adult and a juvenile. During this response, both individuals were calling and interacting peaceably while perched in the same tree.

The diversity of raptors is also indicative of a good supply of prey species of a range of sizes in each of the habitats represented.

Another nocturnal raptor, Sooty Owl has been reported as occurring within the study area (A. Simpson, pers. comm.). While Sooty Owls were not detected during field surveys, there are selected areas with characteristics that are not inconsistent with the habitat requirements of this species. The most likely areas of habitat would be the moist forest communities in sheltered locations, however the extent of fragmentation in the local area may preclude Sooty Owls from commonly occurring in the study area.

The Byron Biodiversity Study identified 283 bird species within the Shire, five of which were naturalised species. Within the study area 115 birds were recorded with only one naturalised species, Common Myna (*Sturnus tristis*) observed. The record of this species came from the farmland areas in the central section and was of a pair of birds that appeared to be attempting to nest in a hollow stag during the spring survey period.

#### **(a) Threatened Birds**

Glossy-Black Cockatoos were observed foraging on *Allocasuarina* sp. in tallowood open forests on the upper slopes of the study area during the Autumn survey period. It is likely that tree hollows within the dry sclerophyll forests (however an uncommon resource) provide roosting and breeding opportunities for this species. The Scarlet Robin was also recorded in this drier habitat type. Breeding opportunities are present for this species on the drier ridgelines of the study area (DEC 2005).

A Black Bittern was recorded during Autumn survey along Rocky Creek, upstream of the pecan plantation in the north-east of the study area (see **Figure 12**). Masked Owls were observed and heard calling each night of the survey during the Autumn survey period from the western side of Rocky Creek. These species are considered to occupy similarly vegetated parts of Rocky Creek.

Suitable foraging habitat for Sooty Owls occurs throughout the study area and this species has reportedly been heard near the western ridgeline within the study area (A. Simpson, pers. comm 2010).

The White-eared Monarch was recorded on several occasions throughout the privet and camphor infested sections in the centre of the study area during the Autumn survey period. Foraging opportunities are present within rainforest, wet and dry sclerophyll forests throughout the study area (DEC 2005).

Black-faced Monarch (migratory species under the EPBC Act) was observed during the spring survey period in the small remnant and highly disturbed patches of rainforest on the steep, west facing slopes of the study area. Rose-crowned Fruit Doves were seen and heard commonly in this habitat type during the autumn survey period. In addition, a sighting of Albert's Lyrebird near a rainforest area within wet sclerophyll forest in the south-west of the study area was recorded.

A bird tentatively identified as an Osprey was observed during the spring survey period in dry forest in the south of the study area. The study area in its current form is unlikely to represent potential habitat for this species, and it is likely that this individual was flying over the area during its movement to other areas of habitat within the region.

### **(b) Migratory Species**

A large number of bird species undertake seasonal movements either attitudinally or latitudinally. This is in addition to nomadic species that follow the abundance of food resources such as flowering of nectar producing plants and the ripening of fruit or seeds. The nomadic species are considered separately to the migrants as their movements are generally inconsistent between seasons and dependent while linked to seasonal variations also vary more according to the distribution of resources.

The maintenance of diverse habitat that can support migratory species is important in ensuring temporal and spatial connectivity. The simplification of vegetation that removes selected species could lead to the reduction in habitat connectivity for species that rely on the availability of specific resources in a given location, at a particular time of year. This is of particular significance for migratory species that expend substantial amounts of energy and rely on a chain of suitable habitat throughout the extent of their migratory path.

Australia is signatory to a number of international treaties and agreements for migratory species. This includes:

- Japan-Australia Migratory Bird Agreement text (JAMBA);
- China-Australia Migratory Bird Agreement text (CAMBA);
- Republic of Korea - Australia Migratory Bird Agreement (ROKAMBA); and
- Convention on the Conservation of Migratory Species of Wild Animals - (Bonn Convention).

All species on the list of migratory species are Matters of National Environmental Significance (MNES) under the EPBC Act. The listed migratory birds identified within the surveys within the study area include:

- Cattle Egret;
- White-throated Needletail;
- Rainbow Bee-eater;
- Spectacled Monarch;
- Satin Flycatcher;
- Rufous Fantail; and
- Channel-billed Cuckoo.

#### **5.2.2.4 Reptiles**

The survey adds significantly to previous records of reptiles within the study area (just two species were recorded by Ecos (2001), the Eastern Water Dragon and Garden Skink), with a total of 26 reptile species recorded. In comparison with the region as a whole, a survey of the Murwillumbah Management Area, which includes the study area, by CSIRO (1996) found 44 species of reptile during fauna surveys of representative state forests within the area. It is estimated, that at that time there were approximately 54 species in the area. Nearby Nightcap National Park has 26 species of reptile recorded, including one threatened reptile species (*Hoplocephalus stephensii*) which was not found within the study area.

North-east NSW and the south-east of Queensland are known to support 12 reptile species that are endemic to the area (NPWS 1994). Two of these species were found within the inundation area during the current surveys. The Rough-scaled Snake and Orange-tailed Shade-skink were both recorded only once in rainforest vegetation located toward the north-western limit of the inundation area. Both species are endemic to the forests of north-east NSW and south-east QLD (Gilmore and Parnaby 1994).

#### **(a) Threatened Reptiles**

No threatened reptiles were recorded during the surveys. A species list submitted by a nearby landholder includes a reference to a *Cacophis* spp. which could be the vulnerable *Cacophis harrietae*, but it is more likely it is a more common *Cacophis* species.

#### **5.2.2.5 Amphibians**

Fifteen amphibian species were recorded in the study area. In comparison nearby protected areas, Nightcap NP and Whian Whian SCA have had 23 and 20 species of amphibian recorded. The main differences between the amphibian species found on and near the study area and the species found in these two protected areas, are the number of threatened species, with four threatened species recorded at Nightcap NP and three at Whian Whian SCA, and only a total of 14 species, of which one is threatened, recorded within the study area.

The only species not recorded at either of these protected areas, but recorded within the study area was the Barrington Tree Frog (*Litoria barringtonensis*). This species is closely related to *Litoria phyllochroa* and *L. pearsoniana* and its taxonomy is currently under review (Tyler and Knight 2009). Little is known about its distribution but it has been found regularly on the north coast, away from where it was originally discovered in the Barrington Tops area (A. White, pers. comm. 2011)

North-east NSW and south - east Queensland which encompasses the study area supports ten amphibian species that are endemic to the area (NPWS 1994). One of these species was recorded within the inundation area (Leaf Green Tree Frog -rainforest habitat in close proximity to Rocky Creek) and one was recorded just outside of the study area (Loveridge's Frog -rocky outcrop, in wet sclerophyll forest habitat, approximately 700 m from the proposed dam wall). As well as being endemic to the region, this frog is also listed as endangered under the TSC Act (Section 3.5.1 ).

#### **(a) Threatened Amphibians (Loveridges Frog)**

The only threatened frog detected during surveys was Loveridges Frog. It is a small, squat, ground-dwelling frog closely associated with high rainfall rainforest predominantly in the boggy headwaters of rainforest streams or soaks on the forest floor. It is a habitat specialist occurring in Antarctic beech forests, rainforests and wet sclerophyll forest, above 550 m altitude (Cogger 2000; Knowles *et al.* 2004). Frogs burrow into moist, loose soil or moss in cavities on stream banks. Males construct moist, smooth-walled breeding chambers in the ground where eggs are deposited. Tadpoles are nourished by the yolk and do not go through an aquatic tadpole stage (Moore 1961, cited by Knowles *et al.* 2004).

Three individuals were located during the spring surveys in the south-east of the study area, within the buffer zone. The frogs were calling from a rock outcrop within rainforest habitat after unseasonably wet conditions in October 2010. This area is approximately 700 m from the site of the proposed dam wall. It ranges in colour from brown and reddish-brown to light grey above with a dark brown or black band along the snout (Cogger 2000); there is a black stripe through the nose and eye that curves behind the arm (Tyler and Knight 2009).

Loveridges Frog is part of a group of five species of *Phyloria* with similar habitat requirements and limited distribution occurring in north-east NSW (Knowles *et al.* 2004). Prior to 2004, *P.*

*loveridgei* was listed as vulnerable under the TSC Act. In 2004 a review by Knowles *et al.*, split this species into three groups, significantly reducing *P. loveridgei*'s range to the area between Nightcap National Park and north-west to Border Ranges National Park on the NSW-QLD border. It was subsequently upgraded to an endangered species listing (DECCW 2008a).

The study area is to the south of previous records for this frog, and as such this record on the periphery of the study area, is potentially a slight range extension for this species.

#### 5.2.2.6 Macroinvertebrates

Overall, the macroinvertebrate fauna observed in the study area appears to be typical of disturbed habitats that are representative of various parts of New South Wales. The highest diversity of families identified within any study area during the diurnal searches was at study area E1000 (Figure 7), which is located in pasture. Six orders representing 16 macroinvertebrate families and eight macroinvertebrate species were recorded at E1000. These findings were followed by H1000, which is the riparian zone of a dam (Figure 8). Five orders, 13 families and seven macroinvertebrate species were found at this study area.

Two factors may be influencing the high degree of biodiversity at these study areas:

- both of these study areas have a mix of aquatic and terrestrial habitat possibly representing a comparatively high number of habitat opportunities for macroinvertebrate use; and
- most of the insects that were identified to species were butterflies. This group of insects is well documented and several useful for field identification tools exist (e.g. Braby 2004; Common and Waterhouse 1981; Orr and Kitching 2010).

Study areas which had the lowest degree of diversity were D1000 and J01-J02. D1000 had a high proportion of closely mown exotic grasses. J01-J02 comprised of Flooded Gum-tallowood-Brush Box Moist Open Forest. Direct searches for soil fauna were conducted at these study areas. It is likely that four issues are influencing the low degree of biodiversity for soil environments:

- homogeneous environments are less likely to support high biodiversity levels than heterogeneous (structurally complex) environments;
- the study areas were heavily shaded and disturbance was minimal;
- direct searches *per se* may not yield a high degree of macroinvertebrate diversity with respect to effort; and
- the macroinvertebrate soil fauna can be difficult to identify within the study area as little is known of their taxonomy (particularly spiders, slaters and earthworms).

#### (a) Threatened Macroinvertebrates

No threatened macroinvertebrates were detected during the survey.

#### 5.2.2.7 Pest Species

Whilst all the ecological impacts of introduced animals are not fully understood, a range of impacts can be attributed to some of these animals. The Fox (*Vulpes vulpes*), Wild Dog (*Canis* spp.) and Feral Cat (*Felis catus*) compete with and prey on native animals, which can stress native animal populations, particularly mammals, birds and reptiles (NPWS 2010). The fox and rabbit can cause soil erosion from disturbance of vegetation and digging of dens and burrows respectively. They can also compete with native ground dwelling animals for shelter (NPWS 2010).



Introduced pest animals known to occur in the nearby Whian Whian SCA include the Fox, Wild Dog, Feral Cat, Black Rat and House Mouse (NPWS 2010). Similar species are also known to occur within the Nightcap Range NP with the addition of the European Rabbit (*Oryctolagus cuniculus*) and the Cane Toad (*Rhinella marinus*) (NPWS 2004).

Little evidence of the presence of foxes was recorded at the study area, though they are likely to be present. Predation by Foxes is listed as a key threatening process in NSW under the TSC Act and Nationally. Wild dogs were heard calling on several occasions on the western ridgeline and areas closer to The Channon. Dingoes or their hybrids are also known to occur within the Whian Whian SCA and the Nightcap Range NP. A Dingo genetic sampling program is proposed within the SCA to improve the understanding of the population's genetic composition and the level of in-breeding with wild dogs (NPWS 2010).

Cane toads are thought to compete with and prey on native frogs and may poison frog-eating native animals (NPWS 2004). This species is listed as a key threatening process under the TSC and EPBC Act. It appears that the abundance of this species within the study area is low at present, but has the potential to increase.

Two feral cats were trapped during recent surveys of the study area. Further, a number of House Mice and Black Rats were recorded, likely prey sources for this species. In bushland areas, the Bush Rat is known to out-compete the Black Rat (research by UNSW and Taronga Zoo) and as such, the latter species was only found within the study area in very disturbed areas and in association with the pecan plantations.

Rabbits are also likely to be present within the study area, though limited evidence was observed of their use of the study area. No burrows were identified, though it is likely that the pasture areas provide ample habitat for this introduced species. This species is a common agricultural pest in the region.

### **5.2.3 Fauna Species Summary**

Mammal and bat diversity was comparable to nearby habitat areas including conservation areas. However the number of pest species included within the assessment of mammals was high.

Bird diversity was high with a range of aerial foragers, raptors, frugivores, insectivores and migratory species recorded. Reptile and amphibian diversity was also high in comparison to nearby conservation area records, though the study area lacked the occurrence of a number of threatened species present at nearby Whian Whian SCA and NightCap NP.

Significant fauna species identified within the study area include:

- Koala;
- Threatened microbats;
- Grey-headed Flying-fox;
- Glossy-black Cockatoo;
- Black Bittern;
- Masked Owl;
- White-eared Monarch;
- Rode-crowned Fruit-dove;
- Osprey;
- Albert's Lyrebird;

- Migratory birds; and
- Loveridges Frog.

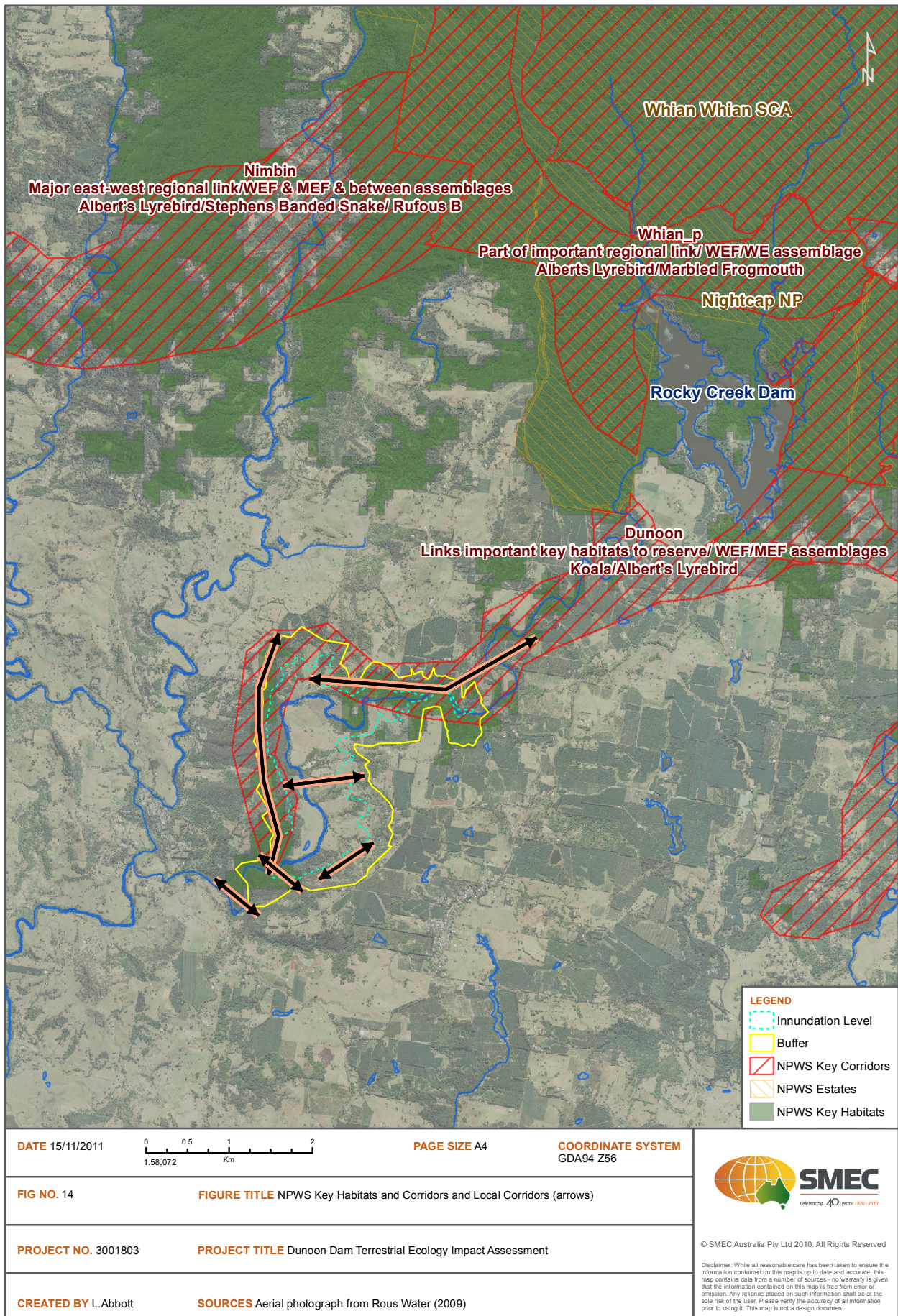
### 5.3 Wildlife Corridors

The corridors of north-east of NSW have been mapped between key habitat areas by the NSW National Parks and Wildlife Service (NPWS 2008). The north-east of the study area and western ridgelines are identified as key habitat areas within this mapping. The study area is linked to Nightcap NP and the Whian Whian SCA in the north along the riparian corridor surrounding Rocky Creek (Figure 14). The corridor is associated with the movement of Koala's and Albert's Lyrebird's between important key habitat areas. Both these threatened species were recorded within the study area and are likely to be sub-populations of the larger nearby national park areas. Nightcap National Park, a listed World Heritage Area, which was added to the Central Eastern Rainforest Reserves of Australia (CERRA) group in 1989, is located approximately 5 km upstream along Rock Creek from the study area. This link is the only vegetated area currently connected to the study area, forming a linear strip along the creek line (riparian corridor) and surrounded by macadamia plantations and agricultural land. Vegetation within the area, is very degraded and is likely to only provide limited habitat for disturbance-tolerant species in its current state as a movement corridor (Plate 15). A number of local corridors occur through the study area, linking areas of habitat for wildlife species, particularly the Koala. These are shown in Figure 14. The main corridors extend along the western ridgeline and the north of the study area, following the NPWS regional corridor. There is also likely to be a significant corridor at the south of the gorge area, south of the proposed dam wall. Smaller linkages occur across the river and between areas of degraded habitat.



*Plate 15: Regional corridor linking the study area to Nightcap NP and Rocky Creek Dam.*

Figure 14: Key Habitats and Corridors (NPWS) and Local Connectivity



Location: I:\projects\3001803 - Dunoon Dam Terrestrial Ecology Assessment\09DATA\GIS\Report Maps

## 6 IMPACT ASSESSMENT

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### 6.1 Background

This chapter assesses the likelihood and degree of impact resulting from the proposal on a range of biodiversity values and ecological functions within the study area. It is noted that the concept design has not been finalised and that any impacts assessed within this section are preliminary at this stage.

The potential for impacts has been assessed in accordance with the Part 3A *Guidelines for Threatened Species Assessment* (DEC and DPI 2005), and the *Matters of National Environmental Significance - Significant Impact Guidelines* under the EPBC Act (Commonwealth of Australia 2009) using the methods outlines in Section 2.3 to provide an indication of the likely impacts should the dam proceed. It is noted that Part 3A under the EP and A Act has now been repealed (22<sup>nd</sup> June 2011) and new laws governing state significant projects are currently being developed. This assessment was prepared under Part 3A since this was the law when the project was undertaken and the directive from the brief (Appendix 6). However, this may need to be updated prior to submission of approval for this project.

### 6.2 Potential Impacts

A number of potential impacts may arise from the following activities associated with the proposal including but not limited to:

- construction works associated with the dam wall construction and access;
- changes to the amount and connectivity of habitat areas;
- inundation of habitat (operation of the dam), creation of habitat (buffers);
- changes to water resources and availability within the locality; and
- introduction and spread of pest species.

The impacts of such activities are discussed for each of the components of the terrestrial biota within the study area and its surrounds, to determine the significance of any potential impact.

#### 6.2.1 Loss of Threatened Species and Communities

##### 6.2.1.1 Threatened Flora

Nine listed threatened flora species were identified within the study area. An assessment of the significance of potential impacts of the proposed dam under the Part 3A guidelines and Matters of National Environmental Significance (MNES) guidelines was undertaken for these species. The results are summarised in the following table (Table 32).

Table 32: Potential Impact Summary on Threatened Flora Recorded within the Study Area

Species	Status	Location Recorded (Buffer, Inundation or Construction Footprint)	Outcome of Significance Assessment (Appendix 4)
Hairy Jointgrass ( <i>Arthraxon hispidus</i> )	TSC -V, EPBC - V	Inundation and buffer	Significant impact likely
Corokia ( <i>Corokia whiteana</i> )	TSC -V, EPBC - V	Construction footprint and downstream	Significant impact likely
Spiny Desmodium ( <i>Desmodium acanthocladum</i> )	TSC -V, EPBC - V	Inundation, one area in buffer	Significant impact likely
Green-leaved Rose Walnut ( <i>Endiandra muelleri</i> subsp. <i>bracteata</i> )	TSC - E	Buffer	Significant impact likely
Red Boppel Nut ( <i>Hicksbeachia pinnatifolia</i> )	TSC -V, EPBC - V	Inundation and downstream	Significant impact likely
Southern Ochrosia ( <i>Ochrosia moorei</i> )	TSC -E, EPBC - E	Inundation	Significant impact likely
Rough shelled Bush Nut ( <i>Macadamia tetraphylla</i> )	TSC -V, EPBC - V	Buffer*	Significant impact likely
Slender Marsdenia ( <i>Marsdenia longiloba</i> )	TSC -E, EPBC - V	Downstream	Significant impact likely
Arrowhead Vine ( <i>Tinospora tinosporoides</i> )	TSC -V, EPBC - V	Inundation and one area in buffer	Significant impact likely

Status =TSC – Threatened Species Conservation Act 1995, EPBC – Environment Protection and Biodiversity Conservation Act 1999, V – Vulnerable, E – Endangered, CE – Critically Endangered \* - Planted in regeneration areas and as plantations in surrounding agricultural land.

In addition to the threatened flora species identified onsite, potential habitat was considered to be present for 21 threatened species known to occur within the region but not recorded. Assessments to determine the significance of any potential impacts from the dam were undertaken for such species (Appendix 4). The assessments found that no significant impacts will occur as a result of the proposed dam should it go ahead, for any of those threatened flora species or their habitat.

### 6.2.1.2 Threatened Fauna

Twenty four threatened fauna species were recorded within the study area and one species (Greater Broad-nosed Bat) was found outside of the study area. An assessment of the significance of potential impacts under the Part 3A guidelines and matters of National Environmental Significance (NES) guidelines was undertaken for these species. The results are summarised in the following table (table 33). Assessments for fifteen species determined that there was potential for significant impacts.

Table 33: Potential Impact Summary on Threatened Fauna Recorded within the Study Area

Species	Status	Outcome of Significance Assessment (Appendix 4)
Cattle Egret ( <i>Ardea ibis</i> )	EPBC – M	Not significant
Glossy Black Cockatoo ( <i>Calyptorhynchus lathami</i> )	TSC - V	Significant impact likely
White-throated Needletail ( <i>Hirundapus caudacutus</i> )	EPBC – Ma, M	Not significant
Black Bittern ( <i>Ixobrychus flavicollis</i> )	TSC - V	Significant impact likely
Albert's Lyrebird ( <i>Menura alberti</i> )	TSC - V	Significant impact likely
Rainbow Bee-eater ( <i>Merops ornatus</i> )	EPBC – M	Not significant
White-eared Monarch ( <i>Monarcha leucotis</i> )	TSC - V	Significant impact likely
Spectacled Monarch ( <i>Monarcha trivirgatus</i> )	EPBC – M	Not significant
Satin Flycatcher ( <i>Myiagra cyanoleuca</i> )	EPBC – M	Not significant
Osprey ( <i>Pandion haliaetus</i> )	TSC - V	Not significant
Scarlet Robin ( <i>Petroica multicolor</i> )	TSC - V	Significant impact likely
Rose-crowned Fruit-Dove ( <i>Ptilinopus regina</i> )	TSC - V	Significant impact likely
Rufous Fantail ( <i>Rhipidura rufifrons</i> )	EPBC – M	Not significant
Channel-billed Cuckoo ( <i>Scythrops novaehollandiae</i> )	EPBC – M	Not significant
Masked Owl ( <i>Tyto novaehollandiae</i> )	TSC - V	Significant impact likely
Koala ( <i>Phascolarctos cinereus</i> )	TSC - V	Significant impact likely
Little Bent-wing Bat ( <i>Miniopterus australis</i> )	TSC - V	Significant impact likely
Eastern Bentwing-bat ( <i>Miniopterus schreibersii oceanensis</i> )	TSC - V	Significant impact likely
Large-footed Myotis ( <i>Myotis macropus</i> )	TSC - V	Significant impact likely
Eastern Long-eared Bat ( <i>Nyctophilus bifax</i> )	TSC - V	Significant impact likely
Grey-headed flying fox ( <i>Pteropus poliocephalus</i> )	TSC, EPBC - V	Significant impact likely
Loveridges Mountain Frog ( <i>Philoria loveridgei</i> )	TSC - E	Significant impact likely

Status =TSC – Threatened Species Conservation Act 1995, EPBC – Environment Protection and Biodiversity Conservation Act 1999, V – Vulnerable, E – Endangered, CE – Critically Endangered, M – Migratory.

In addition to the threatened fauna species identified onsite, potential habitat was considered to be present for 40 additional threatened species known to occur within the region but not recorded during the current survey. Assessments to determine the significance of any potential impacts from the dam were undertaken for such species (Appendix 4). Significant potential impacts were determined for 16 of the 40 species (Table 33).

Table 34: Species with potential to occur in the study area that may be impacted by the proposal (as Assessed in Appendix 4)

Species	Status	Outcome of Significance Assessment (Appendix 4)
Double-eyed Fig Parrot ( <i>Cyclopsitta diophthalma</i> )	TSC – CE, EPBC E, Mi	Potentially significant
White crowned snake ( <i>Cacophis harrietae</i> )	TSC - V	Potentially significant
Green-thighed frog ( <i>Litoria brevipalmata</i> )	TSC - V	Potentially significant
Marbled Frog mouth ( <i>Podargus ocellatus</i> )	TSC - V	Potentially significant
Barred Cuckoo Shrike ( <i>Coracina lineata</i> )	TSC - V	Potentially significant
Bush hen ( <i>Amaurornis olivaceus</i> )	TSC - V	Potentially significant
Sooty Owl ( <i>Tyto tenebricosa</i> )	TSC - V	Potentially significant
Powerful Owl ( <i>Ninox strenua</i> )	TSC - V	Potentially significant
Eastern False Pipistrelle ( <i>Falsistrellus tasmaniensis</i> )	TSC - V	Potentially significant
Yellow-bellied Sheath-tail Bat ( <i>Saccolaimus flaviventris</i> )	TSC - V	Potentially significant
Greater Broad-nosed Bat ( <i>Scoteanax rueppellii</i> )	TSC - V	Significant impact likely (found at Rocky Creek dam but not on site)
Eastern Cave Bat ( <i>Vespadelus troughtoni</i> )	TSC - V	Potentially significant
Red-backed Button-quail ( <i>Turnix maculosa</i> )	TSC - V	Potentially significant
Wompoo Fruit-dove ( <i>Ptilinopus magnificus</i> )	TSC - V	Potentially significant
Flame Robin ( <i>Petroica phoenicea</i> )	TSC - V	Potentially significant
Varied Sitella ( <i>Daphoenositta chrysoptera</i> )	TSC - V	Potentially significant

### 6.2.1.3 Endangered Ecological Communities

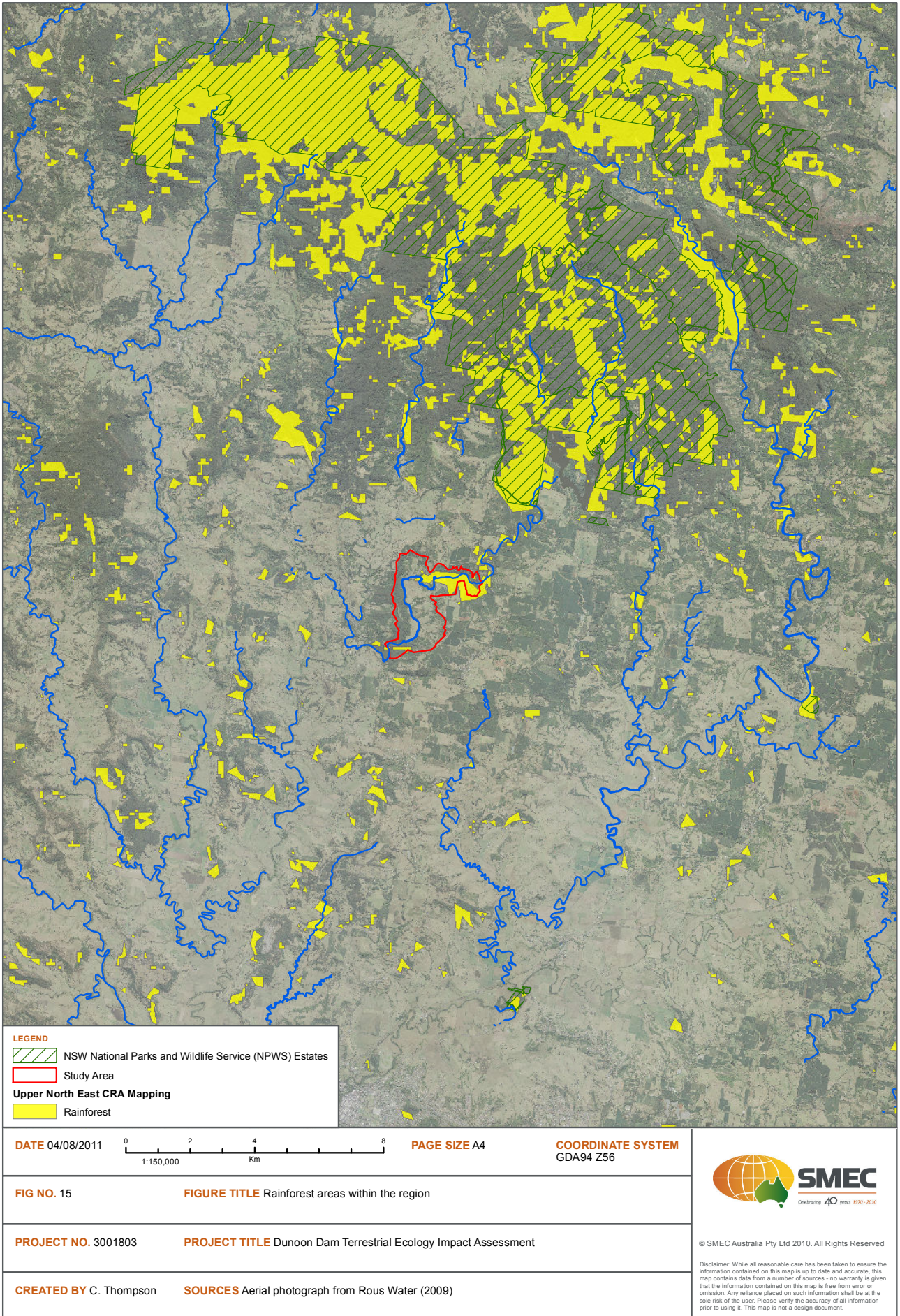
A total of 12 per cent of the area to be cleared for construction and inundation of the dam contains the Lowland Rainforest EEC. This includes approximately 6 ha of Warm Temperate Rainforest, which is 92 per cent of this community's distribution within the study area (**Table 35**). This community is considered to be rare in the locality, due to its reliance on sandstone geology (A. Benwell pers. comm. 2010). It also includes 28 ha of Subtropical Rainforest, which represents 50 per cent of this community's distribution within the study area (**Table 35**).

A regional perspective of the presence of rainforest communities (as mapped as part of the DEC Comprehensive Regional Assessment process) is provided in **Figure 14**. This map is indicative of mapping undertaken in 1998 and has not been ground-truthed for the current study. A vast majority of vegetation identified as rainforest is present within the Nightcap and Whian Whian conservation areas to the north of the study area. It is also clear a number of scattered rainforest remnants, like those along the riparian zone at the proposed dam location, occur throughout the locality. As such, this loss is not likely to be significant on a regional scale for rainforest areas.

The assessment of significance under the Part 3A guidelines (DEC and DPI 2005), found that this impact is likely to be significant on this endangered ecological community, due to the loss of more than 55 per cent of its distribution within the study area and loss of potential habitat as a result of the proposed dam.



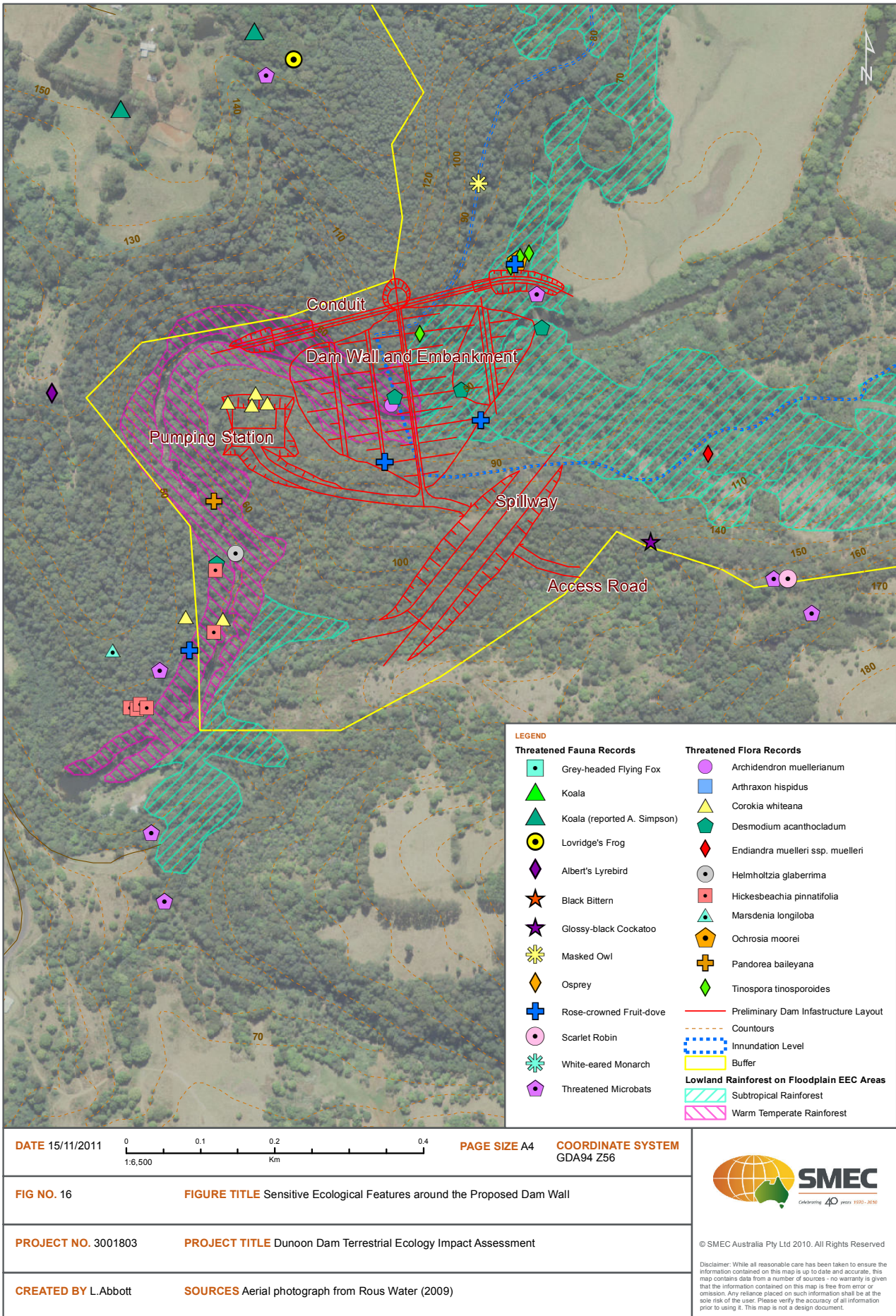
Figure 15: Regional distribution of rainforest



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Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this map is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

Figure 16: Sensitive ecological features around the proposed dam wall



Location: I:\projects\3001803 - Dunoon Dam Terrestrial Ecology Assessment\009\DATA\GIS\Report Maps

## 6.2.2 Loss of Vegetation Communities

Vegetation communities and flora species within the study area will be impacted directly from construction works, rising water levels associated with the inundation area and subsequent indirect impacts to seed dispersal, landscape connectivity and changes to water regimes and availability.

Construction of the dam will require direct removal of vegetation within the dam wall area and proposed spillway. At present a preliminary concept design has been developed which would require the removal of 57 hectares of native vegetation, which consists of Subtropical Rainforest, Warm Temperate Rainforest, Tallowwood Open Forest and Flooded Gum – Tallowwood-Brushbox Open Forest communities. However, the exact amount of native vegetation to be removed is unknown, as the concept design is still being refined.

Additional vegetation clearing is required within the inundation area prior to filling to ensure water quality is maintained within the proposed new storage. Combined with the construction area, this is termed the 'impact area' which is shown in **Figure 16**. The total area containing native vegetation communities to be directly impacted is 57 ha.

A calculation of the amount of each vegetation community within the impact area is provided in **Table 35** below. This includes a summary of the percentage of each community within the study area (impact area and buffer area) that will be directly impacted by the works as shown in **Table 35**.

Approximately half of the Subtropical Rainforest will be removed, with more than 90 per cent of the Warm Temperate Rainforest to be impacted for the dam works in the study area (based on a precautionary, worse-case scenario). Few areas of Warm Temperate Rainforest are known to occur within the locality on sedimentary geologies, such as those within the study area, and therefore this loss is considered to be regionally significant. The loss of these communities represents a significant loss within the locality; region and state as these are part of the Lowland Rainforest EEC (see Section 5.1.2 ).

*Table 35: Estimated amount of each vegetation community to be removed for dam construction*

Vegetation Community	Conservation Significance	Total Area in Study Area <sup>^</sup> (ha)	Area to be Removed (ha)	per cent Community to be Removed from Study Area <sup>^</sup>
Warm Temperate Rainforest	Lowland Rainforest EEC- State significance	7	6	92 per cent
Subtropical Rainforest	Lowland Rainforest EEC –state significance	55	28	50 per cent
Tallowwood Open Forest	Dry representations of this community are poorly conserved within the region – regional significance.	18	7	40 per cent
Flooded Gum – Tallowwood-Brushbox Open Forest	Common in locality, significant in terms of presence of threatened and rare flora species and floristic diversity	54	16	30 per cent
Plantation*	Low	32	27	84 per cent
Pasture*	Low	147	114	77 per cent
Camphor Laurel*	Low	175	74	42 per cent

\*Vegetation communities dominated by exotic vegetation. Note: areas of some of these vegetation communities also occur outside of the study area in the locality. <sup>^</sup>Study area is the buffer and impact area as defined in Section 1.2.3

Approximately 40 per cent of Tallowood Open Forest within the study area will be directly impacted by the works. The dry nature of this forest within the study area is relatively uncommon within the locality and within the region, which is dominated by wet sclerophyll forests. These components provide a unique habitat for a range of flora species not common to other areas of the study area and the locality. In some areas, the dominance of Turpentine in the canopy is also considered locally significant (A. Benwell, pers. comm.), as this is an over-cleared vegetation type under the Comprehensive Reserve Assessment (CRA) listings for the upper north - east (DUAP 1999).

The majority of this community occurs on the sandstone ridgelines at the west and south of the study area, which are generally outside the inundation zone (**Figure 11**). The main impacts will be direct impacts from construction of the dam wall and spillway, and access to the study area and this loss is likely to be significant not only locally, but regionally due to the community's rarity. However, such impacts can be minimised through appropriate design and environmental management within the study area during construction works.

Thirty percent of the study area's Flooded Gum – Tallowood-Brushbox Open Forest community will be cleared by the dam works. This community is generally well represented in surrounding conservation reserves and is a dominant community within the region. Within the study area it is floristically diverse, with components of rainforest as well as sclerophyllous attributes and provides habitat for a range of threatened and rare flora species.

The vegetation communities of the study area that are not directly impacted by clearing may be indirectly impacted as a result of the proposed dam. This may be as a result of runoff from construction areas associated with the dam wall and spillway locations or traffic accessing the study area along the access track. There is also the potential for hazardous and toxic materials used during construction to enter the downstream environment and therefore impact on the riparian vegetation communities downstream of the dam study area.

### **6.2.3 Potential Impacts Associated with Dam Overtopping**

There is the potential for indirect impacts on the downstream riparian zone of Terania Creek include changes in the amount, velocity and timing of flows from the dam. Such changes, particularly those associated with flash flooding, could result in local creek and bank scour leading to excessive sediment smothering of local biota and habitat. This means that the local aquatic community and the floristic characteristics of the downstream vegetation are at risk of being permanently altered. For example, depending on how the dam change, the current water regime local riparian vegetation communities that occur downstream could either dry-out or become inundated or both, but at different times,. In particular, water-dependent systems, such as wetlands, which would receive flows on regular (or seasonal) basis, may be vulnerable to any changes in the local water regimes. This is because increased flows and/or local flooding, are likely to increase the risk of scour to wetland bed and banks; causing subsequent degradation of the wetland biodiversity and function.

Similarly, changes in local flooding and drying regimes over the local flood zone of Terania Creek are likely to lead to an over-abundance of either water or drought-tolerant species; subsequently changing the structure and composition of the community within the study area. In particular, the Warm Temperate Rainforest that occurs within this area is strongly associated with the metasediments and thus is likely to have some dependence on the moisture levels associated with the riparian environment and flows from the creek. Although this is generally a drier rainforest community, it is likely that the dependence on stream-based flows within the hyporheic zone (region beneath and lateral to a stream bed, where there is mixing of shallow groundwater and surface water, the flow

dynamic and behaviour in this zone is important for surface water/groundwater interactions) is important to provide water to this community in dry periods to maximise the chance of its continued survival in the area.

Additionally, changes in the water regime including flooding events from dam overtopping, will also impact on the downstream riparian vegetation communities. In the case of the significant Warm Temperate Rainforest, this may cause gaps in the canopy and therefore open areas within the rainforest, which may encourage the growth of invasive weed species or disrupt the structural formation and thus function of the community.

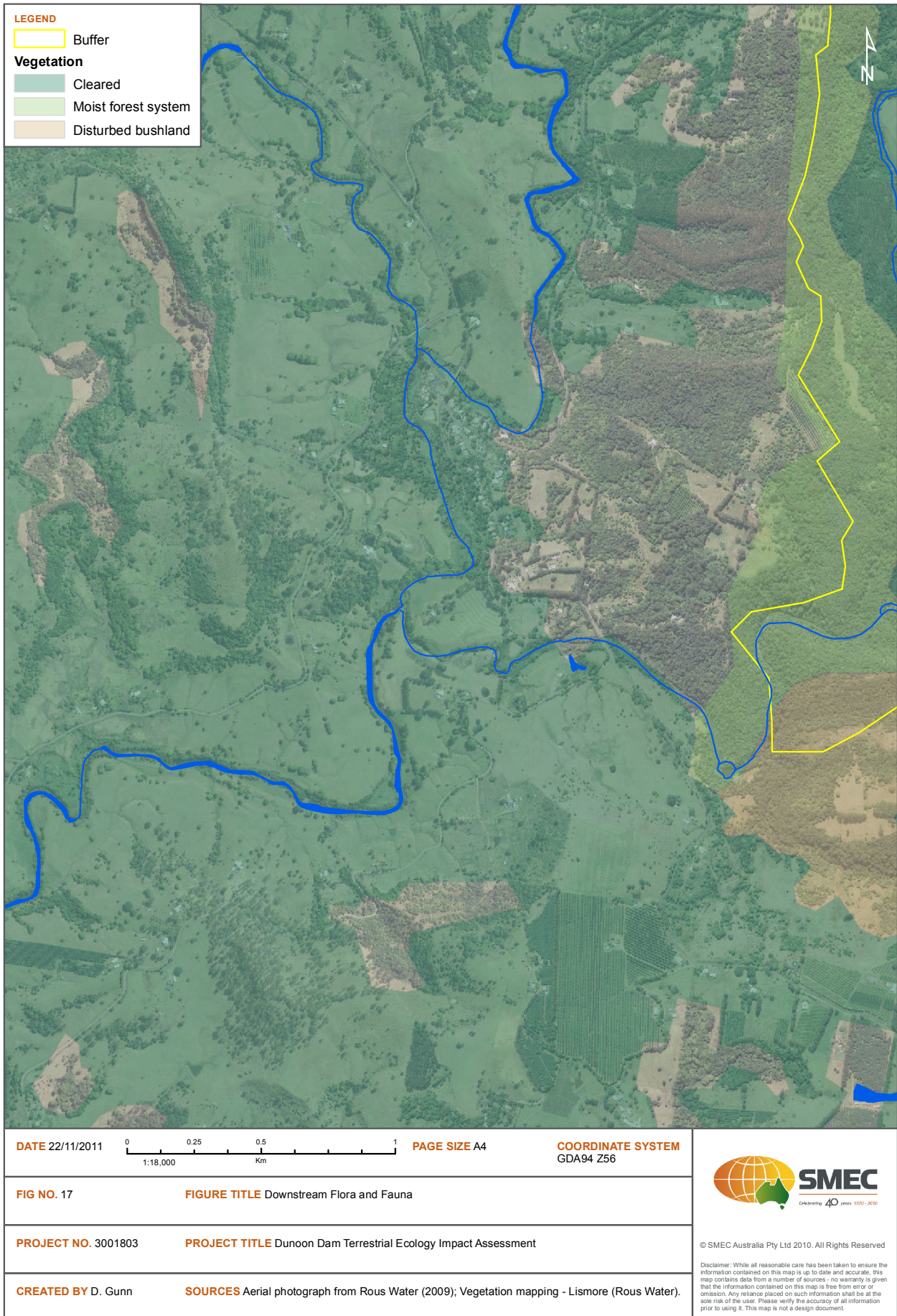
The vegetation communities downstream of the proposed dam consist mainly of cleared agricultural land, a riparian zone and woodland and rainforest areas. They are mapped broadly as “moist forest” (Figure 17). Changes in the hydrological regimes as a result of the above events could change the composition of these communities, promote further weed invasion or potentially dry out some of the moister forest areas, which provide habitat for rare fauna in the area.

It is noted that a separate study is being conducted presently to determine suitable environmental flows from the proposed dam should it proceed (EcoLogical 2011). As such, it is assumed that these potential impacts will be covered in more detail within that study.



*Plate 16: Rocky Creek Dam spillway showing vegetation in between the high water and mean water mark*

Figure 17: Downstream Vegetation



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## 6.2.4 Loss of Biological Diversity

### 6.2.4.1 General

This section provides an overview of potential impacts on the flora and fauna (biodiversity) of the study area and surrounds. More detail is provided in the next section.

### 6.2.4.2 Flora

The floristic diversity of the study area is relatively high given the history of disturbance and small area of native vegetation remaining within the inundation zone. This is largely due to the rainforest communities that occur chiefly within the inundation area along Rocky Creek. The loss of this diversity within the Dunoon locality as a result of the direct removal of plants within the construction and inundation zones will be significant given the lack of such areas nearby.

Due to the area of floristically diverse Subtropical Rainforest and Warm Temperate Rainforest communities within the study area to be impacted by the works, the impacts on floristic diversity will be the greatest where these communities occur. In addition, the loss of plants associated with the drier sclerophyll forest areas for the dam wall and construction works will be significant in both the locality and region due to the rarity in these communities in the region.

Two Rare or Threatened Australian Plants (ROTAP) species were identified within the study area. These were recorded in Brush Box forest and Warm Temperate Rainforest in proximity to the proposed dam wall and are likely to be directly impacted by dam construction and inundation works. It is likely that other individuals of these species and other ROTAP species may occur within the study area and thus be impacted by the works. Loss of legislatively significant flora species and the effects on biodiversity is another potential impact, this is discussed further in Section 6.2.1

Three regionally significant plants were identified within the study area within the Subtropical Rainforest community. All were relatively common in this type of vegetation, particularly Bennett's Ash (*Flindersia bennettiana*). This vegetation type will be directly and indirectly impacted by the proposed dam, with 50 per cent of this community being removed by the proposed dam works. As such, habitat for regionally significant plant species within the study area will be reduced. Further, as this vegetation type is rare within the locality and region also, being listed as an endangered ecological community, this may have an effect on the distribution and abundance of such species in the north-east region.

The dam will fragment the already patchy distribution of flora communities within the study area. It may also cause an impediment to plant dispersal, with decreases in pollination potential for plant species with poorly developed dispersal mechanisms (wind, insects etc that may not be able to travel the distance of the water level of the new dam), reducing the long-term survival of such species in the locality. Conversely, water-dispersed seed and subsequent plant species may benefit from the works.

The floristic diversity within the study area could be enhanced with regeneration works of the buffer area. Species that have been removed within the study area from past land clearing, grazing and other disturbance regimes could be reinstated within suitable habitat areas. It is also possible that strong-holds for rare and threatened flora species could be established where suitable natural habitat above the inundation zone occurs within the buffer area.

### 6.2.4.3 Fauna

There is the potential for both direct and indirect impacts on fauna habitat and fauna species as a result of the construction and operation of the proposed dam. Such impacts include loss of habitat, direct mortality during clearing works and from machinery movements and the loss of vegetated links and corridors for wildlife movement. It is also possible that the inundation of the area may leave some animals stranded, causing them to drown if water levels rise too quickly. There is also the potential for injuries to animals as a result of taking fright from construction noise or movement of workers and plant within the study area.

## 6.2.5 Loss of Fauna Habitat and Habitat Features

### 6.2.5.1 Overview

The habitat type that will be most affected by the construction and inundation of the dam will be Pasture, with almost 80 per cent of the occurrence within the study area to be removed (**Figure 12** and **Table 36**). The conservation significance of this habitat type is low due to the quality and range of habitat provided for local fauna, and as this habitat type is relatively common within the locality, with a range of grazing areas surrounding the study area. The remaining Camphor Forest and Plantation, Dry Sclerophyll Forest, and Rainforest and Wet Sclerophyll Forest will each lose approximately 40 per cent of occurrence within the study area.

Table 36: Estimated amount of each habitat type to be removed for dam construction

Habitat Type	Area to be Removed (ha)	Total Area in Study Area <sup>^</sup> (ha)	per cent to be Removed from Study Area	Conservation Significance
Camphor Forest and Plantation	101	207	48 per cent	Lower - important for foraging for frugivores
Dry Sclerophyll Forest	7	18	40 per cent	Locally Significant due to lack of similar habitat nearby
Pasture	114	147	78 per cent	Low
Rainforest and Wet Sclerophyll Forest	50	116	43 per cent*	State –significant – listed ecological communities (rainforest) and rare in the region

<sup>^</sup>Study Area is the buffer area as defined in Section 1.2.3 . \* -note that this represents almost 55 per cent of rainforest habitat

Fruits of weed species within the Camphor Forest habitats (Camphor Laurel and Privet) provide foraging resources or a range of bird and fruit-bat species (Section 5.2 ). In addition to the likely regeneration works in the buffer area to remove such species, the overall loss of this habitat resource for such species could be significant within the study area. However, as the areas in the buffer are likely to be replaced with fruiting rainforest and native species, habitat for roosting, nesting and foraging resources for most of these fauna species will be improved.

The Dry Sclerophyll Forest habitat is important as it provides unique foraging opportunities for local wildlife, not found within the locality and rarely within the region. The loss of almost half of this habitat from the construction works will minimise the habitat available within the locality and region for more mobile fauna species.

Wet Sclerophyll Forest habitats contain foraging, roosting and nesting resources similar to both the rainforest and drier sclerophyll forest habitat areas. As such, these areas are



important for a range of fauna species within the study area. In addition, the rainforest habitats provide important habitat for a range of uncommon and less disturbance-sensitive fauna species. This habitat type (rainforest) is restricted locally and within the region for such species and thus the loss of a substantial amount of the local occurrence is considered to be significant.

It is likely that the indirect impacts on fauna habitats from the dam works may affect the quality and quantity of potential foraging, roosting and nesting habitat within the study area for wildlife. As discussed for vegetation communities, invasion of weeds, changes to hydrological regimes and the potential for runoff and pollution could impact on the condition of fauna habitat within the buffer area and surrounding the construction areas during construction, and upon completion of the works.

The loss of habitat features for local fauna is a considerable impact as a result of the proposed dam. The loss of such resources may limit the carrying capacity of the study area for certain fauna groups and may result in the loss of viability of the fauna populations present. Resources such as breeding habitat and sheltering habitat to avoid predation (e.g. logs and fallen timber) are examples of limiting resources within the study area.

#### **6.2.5.2 Loss of Tree Hollows and Roosting Resources**

Only a small number of hollow-bearing trees were identified within the study area, including a number of emergent dead stags within the sclerophyll forest areas. As the majority of these occur within the eucalypt woodlands of the study area, some of these are within the proposed dam construction areas. The loss of any hollow-bearing trees will have an impact on arboreal mammal and bird species that require this habitat for breeding and roosting, as the area is already constrained by a general lack of hollow resources.

The loss of roosting resources as a result of clearing works for the proposed dam will impact on birds and bats, which utilise the dense vegetation that currently occurs within the Rainforest and Wet Sclerophyll Forest habitats of the study area, which will be largely removed by the works.

#### **6.2.5.3 Loss of Foraging Resources**

Loss of grassland areas will impact on foraging resource availability for bird species and/or small mammals and reptiles that rely on this resource and the edge habitats surrounding grassland areas within the study area. Foraging resources for species such as the Northern Brown Bandicoot as well as microbats that forage aerially in open areas will be removed by construction and inundation of the dam. However, the newly formed 'dead zone', between the average water level of the dam and maximum water level, will provide edge habitat and additional foraging resources. While it may not replace all the habitat values of the existing pasture areas, this will provide some limited habitat for such species. Further, additional foraging habitat could be created for the Large-footed Myotis, a threatened microbat, within the still pools at the edge of the dam.

Loss of Camphor Laurel and Privet as a bird and fruit-bat foraging resource within the study area is also a potential impact of the project. The abundance of avifauna within these areas was high, with a number of threatened species identified in this habitat type. Over 40 per cent of this habitat type's occurrence within the study area will be directly modified or lost from the dam works. It is likely that future bush regeneration activities in the buffer area surrounding the dam, will add to the reduction of these fruiting weed species. However, it is anticipated that the restoration process will include planting of native fruiting trees, which over time, will replace the foraging resource lost in the removal of these invasive weeds and potentially improve appropriate habitat for frugivorous species.

Rainforest areas and associated foraging resources such as fruits, macroinvertebrates and foliage will be lost from the locality due to the works. Approximately 58 per cent of all rainforest habitats in the study area will be directly impacted by the works, with additional areas likely to also be impacted indirectly. This is a substantial loss of foraging resources for those fauna species dependant on this habitat type.

#### **6.2.5.4 Loss of Fallen Timber, Rock Crevices and other Sheltering Habitat**

Fallen timber, rock crevices and sheltering habitat associated with ledges and imbedded rocks provide habitat for a range of small mammals, reptiles and macroinvertebrates within the study area. The loss of such habitat will limit available habitat within the study area for breeding, sheltering and foraging, causing pressure on the resources that will remain within the buffer area and beyond. This may have implications for the viability of populations of such fauna species due to competition for such resources.

#### **6.2.5.5 Fauna Mortality**

Wildlife species may be directly injured or killed whilst clearing works and construction works are underway for the dam. It is also possible that the inundation of the area may leave some animals stranded, causing them to drown if water levels rise too quickly.

There is also the potential for animals to be injured when indirectly disturbed as a result of construction noise or movement of workers and plant within the study area.

### **6.2.6 Wildlife Movement and Connectivity**

Wildlife corridors have been identified within the area on a regional and local basis. The study area is linked, via a degraded corridor along Rocky Creek, to a significant area of wildlife habitat within the Nightcap NP and Whian Whian SCA. However, the proposed works will not increase the fragmentation or decrease connectivity of the study area to the conservation areas to the north. The dam could improve existing habitat within the buffer into the future through the planned revegetation works, which could facilitate and improve the movement of fauna through the recognised regional corridors within the north and western parts of the study area. The project also presents an opportunity to improve the quality of habitat within the Rocky Creek riparian area upstream of the inundation area, and outside of the study area, to maintain and improve the condition of links with the conservation areas.

The dam and associated infrastructure will cause fragmentation of the existing habitat within the study area. This is particularly the case on the southern ridgeline and the gorge area where the proposed dam wall and spillway will be located. It is likely that the dam and subsequent dam wall and associated infrastructure will create a barrier for fauna movement, severing some of these existing linkages. This is particularly the case for the large dam storage area, which will cause a large obstruction to ground-dwelling and less mobile arboreal species. It is also possible that the spillway will also create a barrier to fauna that can currently cross over Rocky Creek, which is narrow and rocky in some locations allowing for movement, such as the Koala particularly near the proposed dam wall where potential habitat will be severed for this species, potentially splitting the population present.

## 6.2.7 Introduction of Pest Species

The introduction and spread of pest species into the study area from surrounding areas and the condensing of habitat for such species to the buffer area may have some effects on local fauna as a result of competition and predation. In particular, roads are known to open up areas for movement of feral predators (May and Norton 1996).

Generally, dingoes prey upon large to medium-sized prey species (e.g. wallabies, common wombats and possums), foxes prey upon medium-sized to small prey (e.g. possums and rats) and consume a significant component of scavenged material and vegetation, while cats also prey upon medium-sized to small prey, but may have a greater proportion of reptiles and birds in their diet (May and Norton 1996). As such, changes to the abundance and distribution of such species from an increase in feral predators may occur as a result of the works into the future.

## 6.2.8 Introduction of Weeds

Construction works are likely to promote the introduction and spread of weeds. The spread of weeds into natural vegetation is a threat to the flora and fauna species present, for which habitat would already be reduced as a result of the dam. If not managed appropriately, the potential for noxious and environmental weeds to spread into such areas is high.

As the majority of the inundation area currently contains pasture and Camphor Laurel and Privet dominated woodland and forest, it is possible that flooding the area will mobilise weed seed and encourage the spread of species downstream of the proposed dam. However, clearing of vast areas of noxious and environmental weeds within the study area also presents an opportunity to treat and remove weed propagules and seed from the catchment area and minimise the potential for spread downstream of the dam.

## 6.2.9 Increased Key Threatening Processes

A number of key threatening processes listed under the TSC and EPBC Acts are likely to be present within the study area as a result of the works, or currently present. The potential exists for the works to increase the likelihood or extent of six key threatening processes as shown in **Table 37**.

Table 37: Summary of Key Threatening Processes

Relevant Key Threatening Process	Discussion of Likely Resultant Impact	Significance of Threat (unmitigated)
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	The dam will alter the natural flow of Rocky Creek both upstream and downstream of the proposed dam wall. The resultant impact is considered will be long-term and irreversible.	Potentially significant threat to Lowland Rainforest EEC and all recorded threatened flora and fauna.
Bush rock removal	Construction works of the dam wall and the access track, spillway, study area compound and other works on the ridgeline and gorge area will require the removal of bush rock and outcrops.	Potentially significant threat to potentially occurring threatened reptile species.
Clearing of native vegetation	57 ha of native vegetation is to be cleared within the impact area. This accounts for 21 per cent of the vegetation within the impact area (which includes pasture and weed-dominated communities).	Potentially significant threat to threatened flora and fauna habitat, and EECs.
Competition and grazing by the feral European	While rabbits occur within the study area, this species does not appear to be a large threat to the fauna species	No significant threat

Relevant Key Threatening Process	Discussion of Likely Resultant Impact	Significance of Threat (unmitigated)
rabbit ( <i>Oryctolagus cuniculus</i> )	identified within the study area. It is considered that the proposed works will not significantly increase the level of this threat.	
Dieback caused by the root-rot fungus ( <i>Phytophthora cinnamomi</i> )	This fungus is known to occur in nearby conservation areas. It could be spread to the site from machinery and workers vehicles, shoes and tools.	Potentially significant threat to EECs and threatened flora as well as threatened fauna habitat.
Introduction and establishment of Exotic Rust Fungi of the order Uredinales pathogenic on plants of the family Myrtaceae	The area of highest risk in New South Wales is the coastal zone from the Illawarra north to the Queensland border, particularly Myrtaceae-dominated communities of heath, woodland and forest. Occurrence within the locality is currently unknown but it has been recorded in the Lismore LGA.	Potentially significant threat to EECs and threatened flora as well as threatened fauna habitat. Impacts on plants from the Myrtaceae family (e.g. eucalypts, paperbarks etc).
Invasion and establishment of the cane toad ( <i>Rhinella marina</i> )	The Cane Toad occurs within the study area, but at low densities, which do not pose a significant threat to the fauna species identified within the study area at this time. It is difficult to know how the works may impact on their invasive potential, but it may increase their numbers in areas where vegetation is cleared (but outside of the inundation area).	The potential impact of the works on the local cane toad is difficult to predict with certainty, taking a precautionary approach, it is concluded that a potential impact is possible.
Invasion, establishment and spread of <i>Lantana camara</i>	Lantana already presents a threat to the floristic diversity and abundance at the study area. If managed appropriately, the proposed works represent an opportunity to reduce this threat through regeneration works within the buffer area..	No significant threat
Loss of hollow-bearing trees	Hollow-bearing trees are currently a limiting habitat feature within the study area. The loss of any hollow-bearing trees therefore represents a significant threat to local hollow-dependent fauna.	Potentially significant threat to common fauna species and threatened owls (habitat and prey).
Predation and hybridisation of feral dogs ( <i>Canis lupus familiaris</i> )	Wild dogs (possible dingoes or dingo hybrids) have been identified within the study area however; these do not appear to be threatening fauna species within the study area. It is considered that the proposed works will not significantly increase the level of this threat.	No significant threat
Predation by the feral cat ( <i>Felis catus</i> )	While cats occur within the study area, this species does not appear to be a large threat to the fauna species identified within the study area. It is considered that the proposed works will not significantly increase the level of this threat.	No significant threat
Removal of dead wood and dead trees	The proposed works will remove dead wood and dead trees for the construction area and inundation zone.	Potentially significant threat to common small mammals, reptiles and amphibians.

### 6.2.10 Regional Scale Cumulative Impacts

The areas surrounding the proposed dam contain plantations, grazing and agricultural land, with the remaining rainforest remnants being small, isolated and fragmented. The proposal would contribute to regional scale land clearing and habitat fragmentation.

Of particular note is the proposed clearing or inundation of 28 ha of Subtropical Rainforest and 6 ha of Warm Temperate Rainforest. These communities are increasingly under threat from past and present management practices, particularly logging, land clearing and related activities. The proposal is therefore potentially significant for two reasons:

- the already fragmented and contracting regional rainforest landscape which is nationally renowned as a biodiversity hotspot; and
- the connectivity of adjacent vegetation (direct linkage through degraded habitats) with Nightcap National Park, a listed World Heritage Area.

The presence of high quality, diverse rainforest remnants along Rocky Creek are now limited to the areas surrounding the Rocky Creek Dam within conservation areas and those which have been rehabilitated over time by Rous Water. Such remnants also occur within the study area, particularly within the gorge area (proposed dam wall) where there has been limited past disturbance.

Further, past dam works for Rocky Creek Dam may have impacted such communities associated with Rocky Creek. As such, the additional loss of rainforest communities as a result of the inundation of the current proposed Dunoon Dam, and associated loss of habitat for flora and fauna species, may lead to cumulative impacts on already restricted and rare communities and species within the locality and region

### **6.3 Mitigation**

A combination of general purpose and targeted management measures are proposed to avoid and minimise project impacts on biodiversity and ecological functions and services. The overall efficacy of these strategies and actions will be measured according to key monitoring indicators proposed in accordance with identified management aims. These are:

- Maintain or improve existing biodiversity;
- Maintain or improve threatened species populations and communities of national and state conservation significance;
- Minimise the loss of in-situ vegetation and habitat;
- Address potential impacts on fauna movement and dispersal; and
- Minimise fauna mortality and injury and damage to individual plant species.

Key values, the potential for impact to these values and the proposed mitigation measures are appraised in the context of the avoidance and minimisation hierarchy and discussed in **Table 38**.

Table 38: Significance assessment for potential negative impacts

REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
<b>1.</b>	<b>Threatened Species and Communities</b>				
1.1	Direct impact from loss of endangered ecological communities listed under the TSC Act from construction works and clearing of the inundation area.	A	A	High	<p>Reduce any clearing for access to the inundation area for clearing works and dam infrastructure where possible.</p> <p>Investigate the potential to regenerate areas of the buffer adjoining or containing EEC's to improve the overall condition and extent of the community within the study area.</p>
1.2	Indirect impacts on EECs from runoff, potential spills of hazardous materials, traffic access, introduction and spread of weeds etc.	B	D	Moderate	<p>Minimise works surrounding areas where EECs are to be retained.</p> <p>Appropriate erosion and sedimentation controls should be instated around any clearing or construction areas and included in the CEMP (Section 6.3.2.1).</p> <p>Hazardous substances should be stored in bunded areas and used, if required, within the study area according to best practice methods to minimize the risk of spills and included in the CEMP (Section 6.3.2.1).</p> <p>Where possible, seal access roads that will be regularly used for the construction period, to minimize runoff from unsealed roads and dust generation.</p> <p>Initiate weed control within the study area prior to clearing works to ensure that all weed seed is infertile where possible.</p> <p>Take weed waste off-site to an approved waste facility.</p> <p>All machinery entering the study areas should be washed down to minimize the potential for weeds to be introduced and spread at the study area. This includes washing down machinery within the study area when moving between areas. This will also prevent the spread of any soil fungi which may affect native vegetation, should it be present and should be included in the CEMP (Section 6.3.2.1).</p> <p>Minimise the amount of soil imported to the study area where possible, and if required, ensure that it is certified weed free.</p>

REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
1.3	Direct loss of threatened flora species listed under the TSC Act and EPBC Act from clearing works and their habitat.	A	B	High	<p>Minimise impacts in areas of known threatened flora populations where possible.</p> <p>Undertake targeted threatened flora surveys within the impact areas prior to clearing to determine the location of species to be impacted, demarcate areas that will be retained to prevent worker and machinery access and to determine translocation options into the buffer areas (Section 6.3.1 ).</p> <p>Collect seed and parent material from threatened plants, during known fruiting periods, prior to clearing works to send to the NSW Seed Bank and to use for propagation of new individuals for planting within the buffer area.</p> <p>Investigate opportunities to maximize habitat for such species within the buffer zone.</p> <p>Engage a suitably qualified botanist to prepare a Threatened Flora Translocation Plan (Section 6.3.1 ).</p>
1.4	Indirect impacts to retained threatened flora and fauna habitat and endangered communities from clearing and construction works for the dam( e.g. increased weed infestation, changes to hydrological regimes etc).	B	D	Moderate	See 1.2.
1.4	Loss of threatened fauna species during construction from mortality	B	C	High	<p>Undertake clearing works outside the main breeding and dispersal seasons (e.g. Koala dispersal from June – December) for the threatened fauna species within the study area.</p> <p>Implement a FFMP including a two-stage clearing protocol during all clearing works.</p>
1.5	Loss of threatened fauna habitat	A	B	High	<p>Reduce any vegetation clearing for access, construction works and other infrastructure associated with the dam wall and spillway where possible.</p> <p>Locate study area compounds in already cleared areas and prevent clearing additional native vegetation for the establishment of compounds and storage areas.</p> <p>Prior to instating the access track to the dam wall study area, it is recommended that the route be determined in consultation with an ecologist to minimize the impact on fauna habitats and minimize</p>

REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
					<p>edge effects on native remnants to be retained.</p> <p>The extent of clearing should be pegged out prior to works to ensure that only those areas necessary for the works are cleared. No machinery, vehicles or equipment should be permitted during the construction period outside of these areas.</p>
<b>2.</b>	<b>Vegetation Communities</b>				
2.1	Direct impact from loss of native vegetation in the construction footprint including locally and regionally significant vegetation communities.	A	B	High	<p>Reduce any clearing for access, construction works and other infrastructure associated with the dam wall and spillway where possible.</p> <p>Locate compounds in already cleared areas and prevent clearing additional native vegetation for the establishment of compounds and storage areas.</p> <p>See 1.5.</p>
2.2	Direct impact from loss of native vegetation within the inundation area including locally and regionally significant vegetation communities.	A	B	High	<p>Reduce any clearing for access to the inundation area for clearing works where possible.</p> <p>Locate study area compounds in already cleared areas and prevent clearing additional native vegetation for the establishment of compounds and storage areas.</p> <p>The extent of clearing should be pegged out prior to works to ensure that only those areas necessary for the works are cleared. No machinery, vehicles or equipment should be permitted during the construction period outside of these areas.</p>
2.3	Indirect impacts to the composition, floristics and structural integrity of the vegetation communities present from runoff, potential spills of hazardous materials, traffic access, introduction and spread of weeds etc.	B	E	Moderate	<p>Appropriate erosion and sedimentation controls should be instated around any clearing or construction areas.</p> <p>Hazardous substances should be stored in bunded areas and used, if required, within the study area according to best practice methods to minimize the risk of spills.</p> <p>Where possible, seal access roads that will be regularly used for the construction period, to minimize runoff from unsealed roads and dust generation.</p> <p>Initiate weed control within the study area prior to clearing works to ensure that all weed seed is</p>



REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
					<p>inactive where possible.</p> <p>Take weed waste off-site area to an approved waste facility.</p> <p>All machinery entering the study areas should be washed down to minimize the potential for weeds to be introduced and spread at the study area. This includes washing down machinery within the study area when moving between areas. This will also prevent the spread of any soil fungi which may affect native vegetation, should it be present.</p> <p>Minimise the amount of soil imported to the study area where possible, and if required, ensure that it is certified weed free.</p>
2.4	Changes in the hydrology for vegetation communities downstream of the dam between the dam wall and spillway entrance on Rocky Creek, impacting on the availability of soil and ground water along the riparian system.	B	B	High	<p>Environmental flows assessment should consider any spillway diversions and allow for the flow of some water down the existing Rocky Creek channel below the dam to assist in maintaining existing flow regimes.</p> <p>Proposed environmental flows should aim to mimic the current (though altered from Rocky Creek Dam) regime.</p>
<b>3.</b>	<b>Introduction of Weeds</b>				
3.1	Mobilisation of weed seed and propagules from the study area into downstream areas during clearing works from the construction area and inundation zone.	B	E	Moderate	<p>Initiate weed control within the study area prior to clearing works to ensure that all weed seed is infertile where possible.</p> <p>Take weed waste off-site area to an approved waste facility.</p> <p>All machinery entering the study areas should be washed down to minimize the potential for weeds to be introduced and spread at the study area. This includes washing down machinery within the study area when moving between areas.</p>
3.2	Invasion of weeds reducing floristic diversity and abundance within the study area.	B	E	Moderate	<p>Implement weed control prior to clearing works to minimize propagules and seed spread during clearing works.</p> <p>Implement an appropriate weed treatment program during clearing works and ensure all weeds are</p>

REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
					<p>taken off-site for management or seed material is made infertile prior to works.</p> <p>Cleared and disturbed areas should be stabilized as soon as possible with locally native or sterile ground covers and grasses to prevent the establishment of weeds. Such areas should be monitored regularly for weed invasion and treated appropriately if infestations are found.</p>
<b>4.</b>	<b>Biological Diversity</b>				
4.1	Overtopping may result in direct and indirect impacts on the presence, structure and floristics of downstream riparian communities, including the Warm Temperate Rainforest community. Unexpected large releases impact on downstream ecosystems close to the spillway and within the riparian zone.	B	D	Moderate	<p>Appropriate dissipation methods should be instated within the spillway and emergency release areas to minimize erosion and vegetation loss downstream of the dam should an overtopping event occur.</p> <p>Where possible, aim to provide discharges from the dam similar to the natural water levels within the creek, allowing for both flood events (some species require floods for seed dispersal and propagation) and drier times.</p>
4.2	Direct removal of rare or threatened and regionally significant plant species and their habitat.	A	E	Moderate	<p>Investigate the potential for relocating ROTAP species within the buffer zone to form source populations within the buffer zone and other suitable habitat in conservation reserves nearby.</p> <p>Investigate opportunities to maximize habitat for such species within the buffer zone.</p> <p>Minimise clearing of native vegetation where possible.</p>
4.3	Loss of floristic diversity within the study area, locality and region associated with the proposed works.	A	C	High	<p>Local seed material should be collected for propagation for regeneration works within the buffer area to maintain floristic diversity and local genetics.</p> <p>Regeneration works within the buffer area should aim to maximize the diversity and abundance of remnant vegetation communities within the study area prior to dam construction.</p>
4.4	Potential for disruption to pollination and plant dispersal mechanisms from the barrier caused by the dam.	C	D	Moderate	Rare and threatened species translocated and propagated and planted should be located in proximity to other population areas within the buffers in suitable habitat to maximize pollination potential.
<b>5.</b>	<b>Fauna Habitat and Habitat Features</b>				

REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
5.1	Direct loss of the amount of fauna habitat and condition of habitat present by construction activities.	A	B	High	See 1.5
5.2	Removal of logs and fallen timber providing sheltering, nesting and roosting habitat for fauna.	B	D	Moderate	Felled mature trees should be retained within the study area as fauna habitat within the buffer areas. Fallen logs and timber from the construction area should be moved to the buffer area within retained habitat areas where possible.
5.3	Indirect impacts from inappropriate construction environmental management on fauna habitats outside the construction area.	B	D	Moderate	See 1.2
5.4	Loss of hollow-bearing trees as a habitat resource	A	C	High	Undertake a detailed survey for the number of hollow bearing trees to be removed when the design is finalized for the access track, spillway and dam wall and associated areas to be disturbed by the works prior to clearing when the limit of works has been pegged within the study area. Investigate opportunities for compensatory habitat such as the use of artificial nest boxes to compensate for the hollows to be removed.  Prior to instating the access track to the dam wall study area, it is recommended that the route be determined in consultation with an ecologist to minimize the impact on mature and hollow-bearing trees.
5.5	Impact to animals from injuries from construction works	B	D	Moderate	Pre-clearing surveys should be undertaken before any clearing works on the study area to mark hollow-bearing trees and other habitat features. This should be completed by a suitably qualified ecologist.  A two-stage clearing approach (see Section 6.3.2.1 ) is to be followed for all clearing for the dam.  A qualified fauna ecologist should be within the study area during all clearing works for fauna salvage.
5.6	Loss of fruiting weed species from removal for inundation and regeneration works of the buffer as foraging resources for birds	A	C	High	Ensure that fruiting rainforest species are planted within the buffer areas to replace foraging resources removed from weed control and clearing activities.

REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
					Start bush regeneration within the buffer area prior to works to allow for the establishment of fruiting species and minimize lag time between weed removal and fruiting of planted species.
5.7	Potential loss of habitat features for less mobile fauna species leading to population declines from reduction in carrying capacity of the habitat present.	B	D	Moderate	<p>Maximise habitat opportunities within the buffer area that will be lost from the proposed dam works where possible. This may require areas to be regenerated and rehabilitated.</p> <p>Ensure that fauna have ample opportunity to move away from proposed construction areas and the inundation area to find other suitable habitat by investigating the potential for a staged approach to clearing works over a long time period (at least a month if not more).</p> <p>Minimise clearing during significant breeding periods, such as spring.</p>
5.8	Indirect impacts on fauna species and populations within the locality as a result of the works (e.g. noise, disruption of breeding etc.).	A	D	High	<p>Fit noisy machinery with noise mitigating devices and ensure all machinery within the study area is serviced regularly.</p> <p>Avoid noisy activities adjacent to habitat (native vegetation areas) to be retained during the works where possible, particularly within spring.</p> <p>Demarcate the construction boundaries so that machinery and workers do not access retained habitat areas.</p> <p>Investigate instating pest and feral animal controls within the buffer area in line with nearby conservation area strategies.</p>
5.9	Drowning/death of animals due to inundation	B	D	Moderate	<p>Appropriate two stage clearing with appropriately training fauna rescue ecologists in attendance to rescue and relocate animals</p> <p>Filling of the dam is to use a slow process if possible and feasible with visual checks to ensure that animals are not trapped on islands being formed by the filling works.</p>
<b>6.</b>	<b>Wildlife Corridors</b>				
6.1	Impact of loss of connectivity by severing local wildlife corridors	A	C	High	Investigate opportunities to restore connectivity downstream of the dam wall for terrestrial fauna (minimizing spillway width, incorporating fauna crossings etc.). This is particularly the case for Koalas

REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
	on fauna populations				<p>whose habitat areas will be severed by the infrastructure associated with the dam wall and spillway.</p> <p>Draft a revegetation strategy for the buffer area and rehabilitate the regional corridor within the buffer area as well as investigating the potential for rehabilitation of Rocky Creek upstream of the study area to maximize the use of the corridor into the future (particularly for habitat-confined species resulting from the dam works).</p> <p>Investigate the opportunity to include fauna movement structures across dam infrastructure around the spillway, should this design proceed, during concept design and detailed design stages.</p>
<b>7.</b>	<b>Pest Species</b>				
7.1	Competition and predation from introduction and increase of pest species	C	D	Moderate	Consider the implementation of a long-term feral predator control strategy within the buffer in line with nearby conservation areas. Include in BRS (Section 6.3.1 ).
<b>8.</b>	<b>Key Threatening Processes</b>				
8.1	Alteration of river flow	A	B	High	Investigate options for minimizing river flow changes to the area downstream of the proposed dam wall within Rocky Creek during design of the dam and spillway to maintain hydrology in these areas
8.2	Removal of bush rock, dead wood and dead trees	B	D	Moderate	See 5.2 and 5.7.
8.3	Clearing of native vegetation	A	B	High	See 2.
8.4	Removal of hollows	A	D	High	See 5.4.
8.5	Dieback from <i>Phytophthora</i>	B	D	Moderate	<p>Include monitoring for <i>Phytophthora</i> within the FFMP as well as information on this fungus within the induction/toolbox for construction personnel.</p> <p>Ensure all machinery brought to the study area, particularly from nearby known <i>Phytophthora</i> areas,</p>

REFERENCE	POTENTIAL IMPACT	LIKELIHOOD	CONSEQUENCE	SIGNIFICANCE OUTCOME	MITIGATION, MANAGEMENT MEASURES OR FURTHER ASSESSMENT REQUIRED
					are washed down prior to entering the construction area.
<b>9.</b>	<b>Regional Cumulative Impacts</b>				
9.1	Loss and fragmentation of rainforest regionally	B	C	High	Investigate opportunities to retain rainforest onsite during design of the proposed dam. Investigate opportunities to ensure that the retained rainforest communities are enhanced and increased within the buffer where possible through regeneration works and the maintenance of hydrological cycles to these areas. Include within the BRS (Section 6.3.1 ).

### 6.3.1 Mitigation for Concept Design

In addition to the broad mitigation measures for the proposed dam detailed within Table 32 and Table 33 above, some specific mitigation measures have been determined that can be incorporated into the concept design of the project to reduce any potential ecological impacts. Specifically these include measures to minimise wildlife connectivity impacts, removal of threatened flora and endangered ecological communities and minimising impacts on fauna habitat.

#### 6.3.1.1 Wildlife Connectivity

The new dam and associated infrastructure are likely to present a barrier to wildlife connectivity within the study area. The main species of concern will be Koalas, which are known to occur on the southern and western ridgelines, connectivity between these two areas will be severed by the proposed dam wall and spillway.

Potential mitigation measures for this impact include investigating the inclusion of fauna movement structures across the proposed dam infrastructure around the spillway. Possible structures could include vegetated sections of the spillway crossing (fauna bridges), rope crossing etc. Suggestions for an appropriate fauna bridge are as follows, this could be better developed during the concept design for the dam.

Fauna bridges are one way to ensure that fauna are not significantly impacted by the barrier caused by the new dam infrastructure and inundation area. These have been used on major roads in NSW and QLD to minimise the barrier effects of large highways and are known to be used by Koalas and other fauna species. Such a structure could be incorporated into the access track and bridge over the spillway. Details on the requirements of a fauna bridge are provided below (also see *Figure 18*):

- The bridge is not to be hourglass shaped, with a narrow strip down one 'set-aside' for use by wildlife.
- The main limiting feature of these overpasses is the width of the area set aside for wildlife. A minimum of 5 m is required for the set aside area.
- Maximum effectiveness will be achieved if human access is minimised. This can be achieved by restricting human access to one side and by using vegetation as a shield; preventing mortality if the overpass includes a road (e.g. fauna fencing, reducing vehicle speed) and minimising disturbance (e.g. lighting).
- Approach embankments should be 1 in 3 gradient and revegetated.
- Set aside area should be planted with indigenous trees, shrubs and grasses that match surrounding habitat. Plant species should preferably be hardy and drought tolerant.
- The depth of soil required on the bridge depends on the type of vegetation planned. Soil depth can also be used to limit the maximum height to which vegetation will grow (e.g. 0.3 m soil for grasses, 0.7 m soil for shrubs and 1.5 – 2 m soil for trees).
- Additional features such as leaf litter, logs, rocks, boulders, and artificial habitat (roofing tiles, concrete pavers) will improve the suitability of the habitat and may encourage use (Transport and Main Roads 2010).

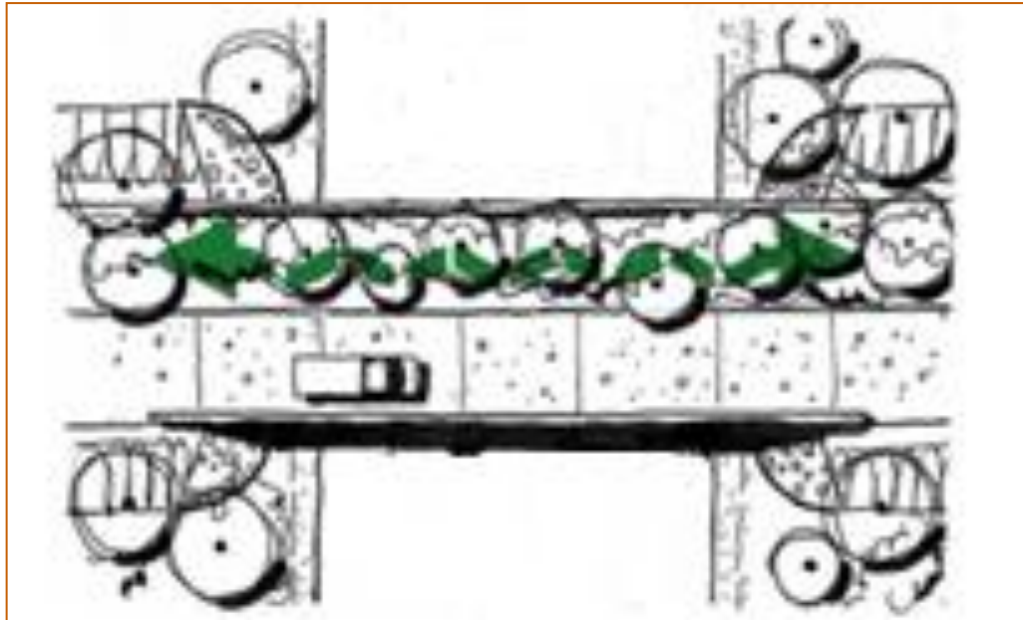


Figure 18: Indicative structure of traffic/fauna bridge (taken from Transport and Main Roads (2010)).

### 6.3.1.2 Infrastructure Footprints

Infrastructure and clearing associated with its installation for the dam will require the removal of significant vegetation and flora species (see *Figure 18*). It will also impact on threatened fauna habitat. Minimising the required footprint through design efficiencies will reduce the potential impacts on these sensitive ecological features of the study area.

The sighting of the various parts of the dam are not likely to be able to be moved significantly from the existing preliminary locations, however the movement for example, of the pumping station to the south to miss a patch of *Corokia whiteana* would minimise potential impacts. It is likely that a number of other threatened plant species occur within the proposed infrastructure areas, and detailed survey is recommended when the concept design has been finalised to determine their location within the likely impact areas.

The disturbance of downstream areas during construction and within the design should be minimised within the valley of Rocky Creek, so that potential impacts on the Lowland Rainforest remnants (Warm Temperate Rainforest) are minimised.

### 6.3.1.3 Access Track Arrangements

The access track to the dam wall and the pumping station runs along the southern ridgeline. This area contains the dry sclerophyll forest which provides habitat for a range of species that are uncommon in the wet sclerophyll and rainforest dominated landscape. As such, design considerations to minimise the impact of the access track on these important habitat areas is recommended.

It is likely that if the access track is aligned to the south of the existing arrangement, particularly to the east of the spillway, it will traverse disturbed Camphor dominated areas instead of the native vegetation community on the ridge top. It is recommended that ecological constraints are incorporated into the design to minimise any potential impacts on ecologically significant features of the study area (see *Figure 18*).



### 6.3.2 Recommended Management Plans

A series of management plans and sub-plans are proposed that will guide project actions to ensure ecologically sustainable, best practice commitments are delivered. Recommended plans and sub-plans for the project are shown in **Table 39**. An overview of the likely content of the plans is included in the following sections.

Table 39: Recommended management plans

Recommended Management Plan	Recommended Management Sub-plans to be included
Construction Environmental Management Plan (CEMP)	-
Flora and Fauna Management Plan (FFMP)	Threatened Flora Translocation Sub-plan Offset Management Sub-plan Buffer Revegetation Sub-plan

#### 6.3.2.1 Construction Environmental Management Plan

A construction environmental management plan (CEMP) is to be drafted for the project with a specific sub-section for terrestrial flora and fauna. The plan should be written according to the *Guideline for the Preparation of Environmental Management Plans* (DIPNR 2004).

The CEMP and all sub-plans need to utilise the SMART framework such that each recommended measure and its implementation is: Specific; Measurable; Attainable; Realistic; and Timely. This will ensure that the adaptive management framework will be easily applied to the project during construction works.

To ensure that the project will continue its 'maintain or improve' status throughout the construction and operation of the proposed dam, the effectiveness of the mitigation strategies recommended need to be monitored and reported within the CEMP and all sub-plans.

#### 6.3.2.2 Flora and Fauna Management Plan

The Flora and Fauna Management Plan (FFMP) is to include the following:

- Details on the implementation of the mitigation measures outline within this TEIA;
- Details of the two-stage clearing protocol (non-habitat trees, then habitat trees after 72 hour) to be followed;
- Requirements for within the study area fauna salvage during clearing works;
- Details of work practices to minimise damage to vegetation outside work areas;
- Requirements for demarcating the clearing limits;
- Information for toolbox meetings with the clearing and construction teams to educate about terrestrial flora and fauna within the study area, methods and practices within the CEMP and reporting requirements (e.g. for threatened species etc.);
- Weed management measures;
- Records to be kept and adaptive management practices to be followed by the construction team; and
- Timeframes to undertake each of the management measures within the study area.

## Threatened Flora Translocation Sub-plan

The translocation of threatened flora species should be investigated further prior to clearing works being undertaken. If considered a viable option for the species to be impacted by the works, then a Threatened Flora Translocation Sub-plan (TFTS) should be prepared by a suitably qualified botanist for the project. The plan should be prepared in accordance with the *Guidelines for the Translocation of Threatened Plants 2nd Edition, Australian Network for Plant Conservation* (2004).

Further dedicated surveys surrounding known individual plants should be undertaken to gain an estimate of the population present within the study area. Notes should be taken on the microhabitat features of each of the specimens and the condition of each plant and location (using a differential GPS) should be noted. This information will assess the potential likelihood of translocating individuals into the buffer area or other nearby population locations to supplement these. If plants are to be located within the buffer, appropriate regeneration of the translocation study areas needs to be undertaken in advance of the move.

## Buffer Revegetation Sub-plan

A total area of 139 ha within the buffer contains degraded, low quality vegetation and habitat (Camphor Laurel Forests, Pasture and Plantations). While some of these areas are important for threatened species, such as the Hairy Jointgrass area in the north of the study area, the majority of these areas can be improved by active rehabilitation and regeneration works. This will improve the amount and condition of habitat present within the study area for significant species recorded or likely to utilise the study area.

The Buffer Revegetation Sub-plan (BRS) should take into consideration the geologies and soil types of the buffer area, existing vegetation communities, floristics and condition and the location of weed species. Where possible, the vegetation communities most affected by the proposed works should be incorporated into the plan and rehabilitation of suitable areas within the study area that do not contain native vegetation. Rehabilitation should also consider the habitat requirements of significant species which may be impacted by the works, such as Koala feed trees, and maximise such habitat components within the regeneration areas.

A staged process using accepted bush regeneration techniques should be included within the plan, breaking the study area into zones according to the regeneration works required and communities present. This minimises temporary impacts of removing resources provided by weed species.

## 6.4 Residual Impacts

### 6.4.1 Overview

Residual effects can be considered as those that remain significant following the application of mitigation measures. A number of residual impacts that cannot be minimised to insignificant levels as a result of the proposed dam construction and operations are present. These include:

- Loss of Lowland Rainforest EEC;
- Loss of threatened flora species and ROTAP species;
- Loss of threatened fauna habitats; and
- Severance of local wildlife corridors.

In order for the project to have a 'maintain or improve' outcome, there must be no residual impacts remaining as a result of the proposed dam. As such, residual impacts will be required to be offset to ensure that this outcome is achieved.

Habitat offsets are therefore required to maintain or improve the biodiversity values identified above to ensure no net loss occurs as a result of the proposal and any associated actions.

#### 6.4.2 Offsets

The full extent of the clearing is not able to be quantified until the dam concept has been further developed and finalised. In the interim, based on available preliminary concept designs, potential impacts have been assessed. Significant vegetation communities and associated microhabitats including one endangered ecological community, nine threatened flora species and the habitat for a number of threatened fauna species are likely to be directly impacted on by the proposal. The potential for loss needs to be offset to ensure that the project complies with the 'maintain or improve' principles of Part 3A of the EPandA Act should the proposal be assessed as being viable and proceed to the approval phase.

Offset areas could be identified within the buffer zone surrounding the proposed dam and the surrounding land acquired by Rous Water. Given the disturbed nature of these areas (and surrounding properties which could also be included within the conservation areas set up for offsets), the potential generation of BioBanking credits from their rehabilitation and regeneration are likely to be significant.

Since all of the vegetation communities and thus fauna habitats likely to be directly impacted by the dam works do not occur within the buffer area (particularly the Warm Temperate Rainforest), the requirement to either using BioBanking (to determine the amount of credits required to offset the development in excess of the credits gained from the buffer; or the offset ratio) or consulting with OEH to determine an appropriate offset ratio with negotiation of potential land acquisitions, is considered likely.

As a detailed assessment has not been undertaken to determine offsets for this study, an estimate of the offsets required has been determined to ensure that biodiversity can be maintained within the study area. The estimate has been based on endangered ecological communities (EEC) impacted by the project being offset at a ratio of 4:1 and non-EEC vegetation communities impacted by the project being offset at a ratio of 2:1 (**Table 40**). The estimate is indicative only and will be further developed in line with the concept and detailed design if the project proceeds.

Table 40: Estimated amount of each vegetation community to be removed for dam construction

Vegetation Community	Area to be Removed (ha)	Amount within Buffer Area (ha)	Offset Ratio / Additional Area Required
Subtropical Rainforest	28	27	4:1 – 85 ha
Warm Temperate Rainforest	6	1	4:1 – 23 ha
Tallowwood Open Forest	7	11	2:1 – 3 ha
Flooded Gum – Tallowwood-Brushbox Open Forest	16	38	2:1- 26 ha
<b>Total</b>	<b>57 ha</b>	<b>77 ha</b>	<b>137 ha</b>

An offset strategy is recommended to be prepared for the project to determine the amount and level of offsetting required. This strategy could investigate opportunities to reduce any residual significant impacts on species and communities. It is recommended this be completed alongside concept planning to ensure that land acquisitions, BioBanking credit availability and credit costs (if BioBanking is undertaken) can be factored into the detailed feasibility and scoping works.

Within the buffer area and other areas identified within the offset strategy, vegetation communities and fauna habitat will be improved through active revegetation and rehabilitation works. For the buffer area, the management and methodology of such works will come under the Buffer Revegetation Plan (Section 6.3.2.2). An additional strategy will be required for any additional offset areas negotiated for the project.

## 7 CONCLUSION

### 7.1 Overview

The study area of the proposed Dunoon Dam contains a variety of terrestrial flora and fauna species, populations and communities. The majority of these are common within the locality and region, which is known for its rich basalt soils and subsequent high species diversity. In addition to these, a number of important and listed flora and fauna species and one ecological community were recorded within the study area.

The main impacts to terrestrial biota from the proposed dam will be the loss of significant vegetation communities, flora and fauna habitat and loss of connectivity between habitat patches for significant fauna species. The proposed works, based on the current preliminary footprint, will directly impact on a total of 272 ha of vegetation, 57 ha of this is native vegetation and 215 ha is highly disturbed and exotic. This calculation is based on the current concept design and may change as the design is refined.

Significant impacts (unmitigated and without offsets considered, which will be re-assessed as part of the proposed offset strategy) have been identified for the following threatened entities that were found on or in proximity to the study area as a result of the proposed dam (**Table 41**).

Table 41: Unmitigated impact significance summary for threatened entities recorded within the study area.

Threatened Entity	Status	Outcome of Significance Assessment
Glossy Black Cockatoo ( <i>Calyptorhynchus lathami</i> )	TSC - V	Significant impact likely
Black Bittern ( <i>Ixobrychus flavicollis</i> )	TSC - V	Significant impact likely
White-eared Monarch ( <i>Monarcha leucotis</i> )	TSC - V	Significant impact likely
Osprey ( <i>Pandion haliaetus</i> )	TSC - V	Not significant
Scarlet Robin ( <i>Petroica multicolor</i> )	TSC - V	Significant impact likely
Rose-crowned Fruit-Dove ( <i>Ptilinopus regina</i> )	TSC - V	Significant impact likely
Masked Owl ( <i>Tyto novaehollandiae</i> )	TSC - V	Significant impact likely
Koala ( <i>Phascolarctos cinereus</i> )	TSC - V	Significant impact likely
Little Bent-wing Bat ( <i>Miniopterus australis</i> )	TSC - V	Significant impact likely
Eastern Bentwing-bat ( <i>Miniopterus schreibersii oceanensis</i> )	TSC - V	Significant impact likely
Large-footed Myotis ( <i>Myotis macropus</i> )	TSC - V	Significant impact likely
Eastern Long-eared Bat ( <i>Nyctophilus bifax</i> )	TSC - V	Significant impact likely
Grey-headed flying fox ( <i>Pteropus poliocephalus</i> )	TSC, EPBC - V	Significant impact likely
Loveridges Mountain Frog ( <i>Philoria loveridgei</i> )	TSC - E	Significant impact likely

Threatened Entity	Status	Outcome of Significance Assessment
Hairy Jointgrass ( <i>Arthraxon hispidus</i> )	TSC -V, EPBC - V	Significant impact likely
Corokia ( <i>Corokia whiteana</i> )	TSC -V, EPBC - V	Significant impact likely
Spiny Desmodium ( <i>Desmodium acanthocladum</i> )	TSC -V, EPBC - V	Significant impact likely
Green-leaved Rose Walnut ( <i>Endiandra muelleri</i> subsp. <i>bracteata</i> )	TSC - E	Significant impact likely
Red Boppel Nut ( <i>Hicksbeachia pinnatifolia</i> )	TSC -V, EPBC - V	Significant impact likely
Southern Ochrosia ( <i>Ochrosia moorei</i> )	TSC -E, EPBC - E	Significant impact likely
Rough shelled Bush Nut ( <i>Macadamia tetraphylla</i> )	TSC -V, EPBC - V	Significant impact likely
Slender Marsdenia ( <i>Marsdenia longiloba</i> )	TSC -E, EPBC - V	Significant impact likely
Arrowhead Vine ( <i>Tinospora tinosporoides</i> )	TSC -V, EPBC - V	Significant impact likely
Lowland Rainforest EEC	TSC - EEC	Significant impact likely

Status =TSC – Threatened Species Conservation Act 1995, EPBC – Environment Protection and Biodiversity Conservation Act 1999, V – Vulnerable, E – Endangered, CE – Critically Endangered, M – Migratory.

There are also the potential for significant impacts on up to 16 of 40 species that were not found, but could potentially occur on or near the site (Table 33). While these impacts will be mitigated utilising the measures outlined in this report should the dam proceed, there are likely to be residual impacts that cannot be mitigated. A number of these measures will include the avoidance of sensitive areas during concept designing, minimising impacts where this is feasible and mitigating impacts through translocation, fauna salvage during clearing and other measures onsite during construction and operation of the dam.

In order to reach a stage where the overall potential impacts of the proposed dam can be understood in the context of the functioning of the ecosystem as a whole, and how this area fits into the catchment, it would be useful to review this report and that undertaking looking at the aquatic impacts, as well as previous reports and develop a conceptual model of the ecosystem. This may also benefit from input from experts and those with specialist local knowledge, as well as the community to integrate the current knowledge of this area and determine how it fits into the catchment as a whole. This would assist in determining the overall impact of the proposed dam, not just on the terrestrial ecology but on the social and ecological systems that are in place.

If the dam design was advanced, it is likely that offsetting will also be required to ensure the 'maintain or improve' outcome of the project for terrestrial biota and to compensate for residual impacts. Offsets are likely to include regeneration within the proposed buffer zone, such as that completed around Rocky Creek Dam which now supports a diversity of species, as well as off-site conservation and ecological improvement of suitable habitat areas. An offset strategy would need to be developed to determine the best methods to compensate for these impacts. It is recommended that this is undertaken using the scientifically based and approved BioBanking scheme (DECCW 2009). This scheme ensures that compensatory habitat is equal to that being impacted and within the same catchment management area. If this approach is not undertaken, a Species Impact Statement will be required to further assess the potential impacts on species, populations and communities.

## 8 REFERENCES

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## APPENDIX 1: SURVEY EFFORT & LICENCE INFORMATION

Table 42 Survey Effort for each taxa group for the study

Taxa Group	Method	Autumn	Winter	Spring	Summer
<b>Amphibians</b>	Nocturnal searches in optimal habitat	4 person hours over 2 nights	n/a	17 person hours over four nights	8.25 person hours for targeted threatened species in optimal conditions
	Night watercourse search	2 person hours on one night	n/a	4 person hours over two nights	0.75 person hours
<b>Reptiles</b>	Diurnal searches	24 person hours over 5 days	n/a	38 person hours over 5 days	3 hours (incidental, as part of set up of transects)
	Nocturnal searches	13 person hours over 4 nights	n/a	17 person hours over four nights	3 person hours road survey along Fraser, Munro and Whian Whian Roads and when travelling between threatened species survey study areas.
	Pit lines	64 trap nights, comprising 4 pitlines with 4 pitfall traps over 4 nights	n/a	48 trap nights, comprising 3 pitlines with 4 pitfall traps over 4 nights	n/a
	Targeted nocturnal transect searches	n/a	n/a	n/a	8.25 person hours for targeted threatened species in optimal conditions
<b>Terrestrial Mammals</b>	Sherman/Elliott trapping	235 trap nights	n/a	220 trap nights	n/a
	Search for tracks/scats/sign (including Koala pellet searches)	10 hours over 5 days	n/a	10 hours over 5 days	n/a
	Hair tubes	220 trap nights	n/a	220 trap nights	n/a
	Cage traps	69 trap nights	n/a	60 trap nights	n/a
	Spotlighting/Call playback	16 person-hours over 4 nights	n/a	16 person-hours over 4 nights	n/a

Taxa Group	Method	Autumn	Winter	Spring	Summer
	Infrared motion-dector cameras	n/a	n/a	2 camers for 3 days and 2 nights	n/a
<b>Bats</b>	Anabat ultrasonic detection	15 detector nights	n/a	9 detector nights	n/a
	Harp Trapping	15 trap nights	n/a	9 trap nights	
	Mist Netting	n/a	n/a	2 net nights	
	Roost Surveys	2 person hours	n/a	2 person hours	
<b>Inverts</b>	Daytime searching under logs and forest debris in optimal habitat	n/a	n/a	n/a	8 person hours over 3 days
	Night-time light-trapping. Daytime searches for larval feed plant.	n/a	n/a	n/a	4.5 person hours over nights
	Day time field observations and hand netting	n/a	n/a	n/a	11 person hours over 3 days
	Day and night searches for burrows and possible excavation in optimal habitat	n/a	n/a	n/a	8 person hours over 3 days
<b>Birds</b>	Opportunistic / inventory	30 person hours over 7 days	n/a	18 person hours over 4 days	n/a
	2 Ha Seach	4 person hours	n/a	4 person hours	n/a
	Call broadcast (nocturnal)	8 person hours over 4 nights	n/a	4 person hours over 2 nights	n/a
	Call broadcast (diurnal)	3 person hours over 3 days	n/a	n/a	n/a

Work undertaken for the field investigation was performed in accordance with the licence requirements under Clause 22 of the *National Parks and Wildlife Regulations 2002*, Section 132 C of the *National Parks and Wildlife Act 1974*. Ethical considerations have been addressed to the satisfaction of the DII Director-General's Animal Care and Ethics Committee under the protocol titled General Fauna Surveys for Impact Assessment and investigations were performed in accordance with an Animal Research Authority issued by the DII.

## APPENDIX 2: QUALIFICATIONS & EXPERIENCE OF THE AUTHORS

Table 43 Qualification and Experience of the Authors

Name/Role on the project	Qualifications	Summary of Relevant Experience
<p>Dr Peter Gehrke (SMEC) Project Director – QA</p>	<p>PhD, University of Queensland, 1987, BSc (Hons), University of Queensland, 1982</p>	<p>Peter Gehrke has 27 years experience in conservation of aquatic habitats, fish, and freshwater ecosystems exposed to various impacts of water resource development, and is recognised as a national and international leader in this field. He has worked in roles including Research Director – Rivers and Estuaries for CSIRO Land &amp; Water; Theme Leader, Wetlands and Aquatic Ecosystem Processes for the Coastal CRC; Director (Aquatic Ecosystems) for the Consortium for Integrated Resource Management, and Principal Scientist ( Conservation) with NSW Fisheries. He is currently National Manager Natural Resources for SMEC Australia. Peter has a long history of involvement in environmental flows and conservation of environmental values in the context of water resource development, climate change, and water allocation in all mainland States of Australia and internationally. He also has direct local experience in the Richmond River and Rocky Creek catchments through leading the NSW Rivers Survey fish assessments, platypus surveys, and endangered eastern freshwater cod surveys. He is skilled in river rehabilitation and wetland protection, assessing drought impacts, conceptual and quantitative ecological modelling of river ecosystems, aquatic sampling methods and survey design, aquatic conservation management, methods for determining environmental flows, fish passage requirements, and methods for mitigating impacts of dam construction and operation. He has served on numerous Local, State and Federal government environmental flow and river health panels, including coastal river catchments of New South Wales. Peter has also served as a Ministerial appointee to aquatic conservation and environmental flows committees in New South Wales. He has written over 120 scientific papers, reports and book chapters on fish and aquatic conservation, and is an active reviewer of ecological research for several international journals.</p>
<p>Dr Elvira Lanham (SMEC) Project Manager and Reptile and Amphibian surveys</p>	<p>Doctor of Philosophy (Reptile Ecology); Bachelor of Environmental Science (Life Sciences) (Hons); Practicing Member, Ecological Consultants Association of NSW; Scientific Member, Royal Zoological Society of NSW; Member International Association for Ecology (Intecol).</p>	<p>Elvira has been working in the field of ecology, in consultancy and research for the past 15 years. She has been involved in a variety of ecological projects, with an emphasis on ecological assessment and project management. She has worked on a number of environmental assessments for linear infrastructure developments including upgrades to electricity transmission lines and the construction of new roads. She has experience in flora and fauna assessment, particularly of the east coast area of Australia. Elvira has managed and been the field team leader for a number of large biodiversity assessment projects, including projects for Forests NSW, the Sydney Catchment Authority, RTA and QLD Main Roads.</p> <p>Prior to becoming a consultant, Elvira worked as a researcher and field ecologist in Virginia USA, where she undertook surveys of the national battlefields for reptiles and amphibians. She completed her PhD on the ecology of a semi-arid skink in the Flinders Ranges of South Australia in 2002 while working as an Associate Lecturer in the Biological Sciences Department at Flinders University of SA. Her honours research investigated the impact of habitat fragment on the bird population at Cumberland State Forest in Sydney's</p>

Name/Role on the project	Qualifications	Summary of Relevant Experience
		<p>north-west.</p> <p>Elvira has experience with common ecological field techniques such as vegetation survey, pitfall and Elliot trapping; hair tube sampling, active searches for reptiles and amphibians, visual encounter surveys, Anabat survey and spotlighting. She has also taught in a diverse range of biological subjects at all levels of university.</p>
<p>Matthew Jones (SMEC) Technical Reviewer</p>	<p>Bachelor of Applied Science (Charles Sturt University), 2003 Associate Diploma in Applied Science – Natural Resource Management (Northern Rivers College of Advanced Education), 1985</p>	<p>Matthew has 25 years experience in natural resource management, conservation planning and ecological survey, monitoring, evaluation, reporting and research. He has authored strategic level reports including the Natural Heritage Values of the Great Eastern Ranges 2008 (Alps to Atherton) for the DECCW and the biodiversity component of the Queensland South West Region Natural Resource Management Plan 2008-2013. He contributed to a report entitled Assessment of the Direct and Indirect Risks from Human Induced Climate Change to Key Ecosystems in Northern Australia for WWF Australia.</p> <p>Matthew has led alliance based terrestrial and aquatic biodiversity team surveys for comprehensive environmental assessment purposes at concept, preliminary and detailed design stages including a number of Part 3A major infrastructure projects (EP&amp;A Act 1979). He has undertaken construction and post construction ecological monitoring, evaluation, reporting and improvement works and independently peer reviewed ecological assessments and monitoring works for major infrastructure developments. Matthew has authored numerous flora and fauna assessment reports for a range of clients including central and local government departments.</p>
<p>Peter Cowper (SMEC) Fauna Manager</p>	<p>B NatRes 1998; Practicing Member, Ecological Consultants Association of NSW, Member Birds Australia, Member Southern Oceans Seabird Study Association.</p>	<p>Peter is a natural resource manager with extensive experience in ecological survey and assessment of terrestrial flora and fauna, threatened species and ecological communities. He has a diversity of experience in project management and client liaison on a wide range of projects. Peter is also experienced in the application of GIS technology to the analysis of geo-spatial data for rural and urban planning, ecological assessment and the management of public assets. He has successfully applied these skills to numerous environmental assessment projects for large infrastructure and for land development projects including river rehabilitation projects, rezonings, development concept plans, master plans and land use capability assessments.</p>
<p>Dr Andrew Benwell Botanist</p>	<p>Diploma of Horticulture; Bachelor of Arts with Honours (Biogeography); Doctor of Philosophy (Plant Ecology).</p>	<p>Andrew is a flora consultant with over 25 years experience in the flora of the NSW north coast region. He is particularly experienced in the identification, assessment and management of threatened flora species. He has worked on a number of large infrastructure projects assessing vegetation and threatened flora populations, undertaking translocation and monitoring of threatened flora species, and mapping vegetation communities. Andrew has worked extensively on large infrastructure projects with the SMEC team including the Tugun Bypass, and has worked on a number of water-related infrastructure projects as a botanist.</p>
<p>Dr David Rohweder Avifauna Specialist</p>	<p>PhD, waterbird ecology; B. App. Sci (Hons), Coastal Management; Dip App. Sci, Resource Management; Member,</p>	<p>Dave has worked on a number of major infrastructure projects (such as road projects) and a number of more minor water infrastructure projects such as pipelines and flood mitigation works. Dave's expertise is in vertebrate fauna, particularly wetland and threatened fauna communities. He is experienced in ecological</p>

Name/Role on the project	Qualifications	Summary of Relevant Experience
	Royal Australasian Ornithologists Union; Member, Royal Zoological Society of NSW (RZS).	monitoring, impact assessment, survey design and data analysis. His speciality is in wetland and water bird survey and assessment, however he has explicit local knowledge of all avifauna likely to occur within the study area.
Dr Liza Miller (SMEC) Invertebrate Specialist	Doctor of Philosophy in Zoology and Genetics. University of Queensland. Bachelor of Science with Honours in Animal Ecology. La Trobe University. Research Fellow (Level A) in Genetics. Monash University. Research Associate in Entomology. University of Western Sydney.	Liza is an entomologist. She has completed a variety of projects ranging from insect conservation to integrated insect pest management. Liza has conducted targeted and quantitative insect surveys for insects of agricultural and conservation importance. In particular, she has extensive experience in collecting aquatic macroinvertebrates within freshwater ecosystems and has a broad knowledge of various natural resource and environmental management issues, processes, policies and legislation. Liza holds a PhD in systematic entomology and has specialist knowledge in beetles and aquatic insects.
Dr Arthur White Biosphere Environmental Consultants Amphibian Specialist	B Sc (Hons) 1973, PhD 1982, Dip Ed 1984. Fellow of the Royal Zoological Society of NSW, President Frog and Tadpole Study Group of NSW, Research Associate School of Biological Sciences, University of NSW, Honorary Research Fellow Australian Museum, Member Australian Society of Herpetologists	Arthur has been involved in field surveys and studies of native fauna since 1978. His area of expertise is herpetofauna (frogs and reptiles). He has been fundamental in various aspects of frog research in Australia since 1979 and is well known within ecological circles as a leading frog expert in Australia. Arthur is also an advisor to the NSW Scientific Committee and is president of the NSW based Frog and Tadpole Study Group (FATS) which conducts research and community education on amphibians.
Glenn Hoye Fly By Night Bat surveys Bat Specialist	B Eng 1981 and B Sc (Hons) 1994	Glenn Hoye (Fly By Night Bat Surveys), a leading bat specialist, would lead the bat surveys. Glenn has been researching bats throughout Australia for the past 25 years. While following his earlier career as a Mining Engineer, Glenn pursued his hobbies of wildlife research and photography in his spare time. Early on he began to focus on bats, as they were a mammal group on which limited research had been conducted within Australia. When Glenn accepted an offer of redundancy from the mine where he was employed, his fifteen years of amateur research were the inspiration for the formation of his company in 1992; Fly By Night Bat Surveys.  He completed a Bachelor of Science (Honours) Degree with the University of Newcastle, graduating in 1994. Since leaving the mines, Glenn has remained self-employed as an Ecological Consultant and enjoys working in the environmental field as a bat expert. He has worked on a variety of projects assessing the impact of development proposals on bats and formulating plans to minimise potential impacts of these proposals on resident bat communities.
Dr Mark Fitzgerald Reptile Specialist	Bachelor of Applied Science (Conservation Technology) (1992);	Mark Fitzgerald is an independent ecological consultant based in Mullumbimby Creek in Northern NSW. Mark is a specialised snake ecologist with extensive experience of conducting fauna survey

Name/Role on the project	Qualifications	Summary of Relevant Experience
	Doctor of Philosophy by research (2004).	activities in the state forests and national parks of New South Wales. Mark completed his PhD thesis on the ecology of Stephen's Banded Snakes ( <i>Hoplocephalus stephensii</i> ), one of the threatened species likely to occur within the study area.
Cassandra Thompson (SMEC) Senior Ecologist	Masters of Applied Science (Environmental Science); Bachelor of Science (Environmental Science and Ecology); Member of the Ecological Society of Australia; Scientific Member of Royal Zoological Society, NSW; Practicing Member Ecological Consultants Association of NSW.	Cassandra is a senior ecologist, with over five years experience in the ecological consulting environment. She has been involved in a diverse range of ecological assessments including ecological impact assessment, and constraints analysis ecological management plans, threatened species monitoring programs and numerous flora & fauna assessments. Cassandra is also the principal investigator for SMEC's NSW NPWS and ACT scientific licence and animal ethics approvals for conducting flora and fauna surveys.  Cassandra has detailed knowledge of impact assessment, ecological management planning and ecological monitoring. She has experience with both flora and fauna field survey techniques with particular expertise in targeted threatened species searches. She also has experience in the use of GIS in particular working with ecological and constraints mapping.
Katie Whiting (SMEC) Senior Ecologist	B.Sc (Environmental Science); M.Sc (Wildlife Management – Habitat); Member, Ecological Consultants Association of NSW	Katie has a wide variety of flora and fauna survey, assessment and reporting experience. However, Katie's expertise lies in the survey of microchiropteran bats including hands on techniques such as harp trapping, and also remote survey methods such as ultrasonic bat detection. Katie is also skilled in the identification of ultrasonic bat call signatures.  Katie completed a masters research project in 2007 in partnership with Forests NSW in the Hunter Region. The aim of the research project was to undertake a monitoring program in order to determine the required sampling effort for threatened forest microbats. A secondary aim of the project was to undertake monitoring to determine the occupancy and rate of detection of the threatened Golden-tipped Bat ( <i>Kerivoula papuensis</i> ) in Chichester State Forest. To undertake the monitoring program, Katie using a variety of detection techniques including intensive harp trapping both on trails and in riparian areas, and also ultrasonic detection using an Anabat detector.
Daniela Binder (SMEC) Graduate Ecologist	Bachelor of Adv Science, Hons (Ecology)	Daniela is a graduate ecologist and has been involved in a range of ecological surveys and assessments for threatened species, including general survey for flora, taxa such as macroinvertebrates, birds, frogs and small mammals.  Daniela completed an honours research program in 2009 in partnership with the Birds Australia and NSW DECCW, developing techniques to translocate threatened seabird species from Lord Howe Island. Daniela also has experience in the survey of waterbirds, shorebirds and seabirds.
Simone d'Unienville (SMEC) Ecologist	B.Sc (Environmental Biology); M.Sc (Wildlife Management – Habitat); Member, the Frog and Tadpole Study Group (FATS); Member, the International Forum for Ecology (INTECOL); Scientific Member, Royal Zoological Society of	Simone is an ecologist with experience in flora and fauna survey, project management, bush regeneration and water quality testing. Since joining SMEC she has gained experience in environmental impact assessment, environmental compliance, and has refined her flora and fauna survey, habitat assessment and ecological assessment and monitoring skills.  As part of her previous consulting experience Simone has extensively liaised with local councils, government departments and key community organisations. She has also written educational material for members of the local government



Name/Role on the project	Qualifications	Summary of Relevant Experience
	NSW (RZS).	community. Simone was also involved in the planning of rehabilitation of natural bushland areas.
Rob Chatfield (SMEC) GIS specialist	MSc Geographical Information Systems University of Leicester (2003); BSc Physical Geography University of London (2001)	<p>Rob is a trained GIS professional, who has been working in the field for 6 years. He will be responsible for the preparation of maps and analysing spatial correlations within the data for the Monitoring Program.</p> <p>Coming from a physical geography and environmental background, Rob has branched out over his career to cover all uses of GIS, and specialises in providing consultancy, training and high-level project work. Within SMEC, Rob works across teams, providing GIS input and direction to projects as required, as well as assisting the development of GIS assets within teams. Rob is also responsible for the development of a cohesive GIS strategy within SMEC NSW.</p>

## APPENDIX 3: THREATENED SPECIES ASSESSMENT TABLES

Table 44: Habitat assessment for threatened fauna recorded within 10 km of the study area or known to occur in similar habitat in the CMA sub-region

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
<b>Invertebrates</b>				
<i>Argyreus hyperbius</i> Laced Fritillary	E	-	<i>A. hyperbius</i> is found in open swampy coastal habitat (Braby 2004). Adults feed from flowers of various plants in vegetation surrounding breeding habitat (possibly up to 1km). Larval food plant is <i>Viola betonicifora</i> . This plant occurs in ground level vegetation in swampy areas, beneath grasses and Lomandra (Braby 2004).	Not likely to occur as estuarine areas are not present in the Dunoon region. The larval food plant, <i>Viola betonicifora</i> , has also not been recorded in this area. This species was not recorded in the targeted surveys and no prior records exist. No further assessment is required.
<i>Phyllodes imperalis</i> Pink Underwing Moth	E	E	Subtropical rainforest below 600 m elevation. Potential breeding habitat is restricted to areas where the caterpillar's food plant, a native rainforest vine, <i>Carronia multisepealea</i> , occurs in subtropical rainforest. Adult <i>P. imperalis</i> require the darkness supplied by the vine and high quality rainforest vegetation in order to breed. Prefers undisturbed habitat.	Not likely to occur as the study area is disturbed and lacks high quality rainforest. The vegetation in the study study area is a mostly a mix of weedy forest growth, cleared areas, plantation. Some rainforest is present; however, this vegetation is in a state of regrowth and is unlikely to sustain the Pink Underwing Moth. This species was not recorded in the targeted surveys and no prior records exist. No further assessment required.
<i>Ocybadistes knightorum</i> Black Grass-dart	E	-	The Black Grass Dart is confined to areas of Swamp Oak or Paperbark swamp forest and coastal headlands where the larval food plant, <i>Alexfloydia repens</i> occurs (Braby 2004). Coastal lowland she-oak open-forest with an open grassy understorey, comprising of extensive patches of larval food plant, in semi-saline areas of the king tide zone above mangrove (Braby 2004). <i>O. knightorum</i> is found on the Mid North Coast between Digger's Headland and Warrell Creek (just south of Macksville). The main occurrence is just south of Coffs Harbour, where it is restricted to areas where its sole food plant, <i>Alexfloydia repens</i> occurs; this species is also listed as an Endangered species in NSW.	The species is found between Digger's Headland and Warrell Creek in northeast NSW. It prefers estuarine areas and is strongly associated with Floyd's grass. This species was not recorded in the targeted surveys and no prior records of it occurring in the Dunoon area exist. No further assessment is required.
<i>Nurus atlas</i> Atlas Rainforest Ground Beetle	E	-	Historically widespread in heavily timbered high rainfall areas east of the Great Dividing Range on the north coast of NSW. The species had not been seen for many years and was thought to be extinct until it was rediscovered at Victoria Park near Lismore in 1973. Presently it is only known from this location and a few others on the Alstonville Plateau (Technical Reports of the Australian Museum 2002, number 16). The species prefers low elevation rainforest and wet Eucalypt forest with a well developed rainforest understorey, litter and humic layer with a high	Not likely to occur as the Study Area is outside this species known occurrence. This species prefers low elevation rainforest and wet Eucalypt forest with a well developed rainforest understorey on highly productive soils with consistently high moisture levels (NPWS 2002). In particular, this species prefers a well developed humic and litter layer. No further assessment required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			moisture content (NPWS 2002). <i>N. atlas</i> is only known from Lumley Park (Alstonville) and Victoria Park Nature Reserve (Technical Reports of the Australian Museum 2002, number 16).	
<i>Nurus brevis</i> Rainforest Ground Beetle	E	-	<i>Nurus brevis</i> appears to be confined to heavily timbered areas east of the Great Dividing Range on the north coast of NSW, including the "Big Scrub". <i>Nurus brevis</i> appeared to be restricted to Rotary Park, Lismore (but has not been encountered despite recent extensive rainforest restoration works (R. Joseph, pers. comm. as cited in Greensland 1994) (BP Moore pers. comm. Australian Museum records, Greenslade 1994, In Technical Reports of the Australian Museum 2002, number 16). There are now only two known populations of <i>N. brevis</i> , both of which are near Mellanganee are very isolated (G. Monteith, C, Reid pers. comm. In Greensland 1994)	Not likely to occur as the Study Area is outside this species known occurrence. That is, Rotary Park at Lismore and Mellanganee. Further since this species is only found in heavily timbered, high quality areas and much of the study study area either is in a state of regrowth or is cleared, this species is unlikely to be found at the study study area. This species was not recorded in the targeted surveys and no prior records exist. No further assessment is required.
<i>Thersites mitchellae</i> Mitchell's Rainforest Snail	E	CE	<i>Thersites mitchellae</i> lives in lowland subtropical rainforest and swamp sclerophyll forest (Murphy 2002; Stanisic 1998). This species occupies undisturbed moist forest. It requires a well-developed leaf litter layer, providing food, shelter and breeding study areas, and an intact forest canopy to maintain a moist climate (NSW National Parks and Wildlife Service, 2001). Areas with leaf litter, or land within 40m of wetland edges, particularly lowland rainforest and swamp sclerophyll forest (NSW National Parks and Wildlife Service, 2001). This species is typically found amongst leaf litter on the forest floor, and occasionally under bark in trees. Feeds on leaf litter, fungi and lichen.  This species is found on the coastal plain between Richmond and Tweed Rivers in northern NSW. It's current area of occupancy is estimated to be less than 5 km <sup>2</sup> (Murphy 2002; Stanisic <i>et al.</i> 2010). Between 1955 and 1995, Mitchell's Rainforest Snail was recorded at only two to three study areas, despite the Queensland Museum extensively collecting for the snails in littoral rainforests of the area. Since 1995 the National Parks and Wildlife Service has conducted surveys for Mitchell's Rainforest Snail that targeted suitable habitat. These surveys have found species at Stott's Island, Banora Point, Bytron BaySuffolk Park and Lennox Head (TSSC 2002i).	This species is unlikely to occur at the study study area. This species is found on the coastal plain between the Richmond and Tweed Rivers, which is some distance away from the proposed Dunoon dam. The vegetation in the study study area is a mostly a mix of weedy forest growth, cleared areas, plantation. Some rainforest is present, however, this vegetation is in a state of regrowth and is unlikely to sustain Mitchell's Rainforest Snail. This species was not recorded in the targeted surveys and no prior records exist. No further assessment is required.
<i>Petalura gigantea</i> Giant dragonfly	E	-	<i>P. gigantea</i> is restricted to coastal habitats and near coastal lowlands between Coffs Harbour and Ballina (Theischinger and Hawking 2006). This species lives in permanent swamps and bogs with some free water and open vegetation (Theischinger and Hawking 2006). This species uses boggy areas comprising of moist litter and humic soils; often adjacent to the open water wetlands (Theischinger and Hawking 2006).	Unlikely to occur as <i>P. gigantea</i> is restricted to coastal habitats and near coastal lowlands between Coffs Harbour and Ballina (Theischinger pers. comm.). No permanent high quality swamps were found in the Dunoon study study area. This species was not recorded in the targeted surveys and no prior records exist. No further assessment

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
				is required.
<i>Petalura litorea</i> Giant dragonfly	E	-	<i>P. litorea</i> is known to occur from southeast Queensland and a population at Brooms Head, New South Wales Ballina (Theischinger and Hawking 2006). This species lives in permanent swamps and bogs with some free water and open vegetation. This species does not utilise areas of standing water in a wetland, although it may use boggy areas adjacent to the open water wetlands Ballina (Theischinger and Hawking 2006).	Not likely to occur as <i>P. litorea</i> is only known from south east Queensland and a population at Brooms Head, New South Wales (Theischinger pers. comm.). Its distribution is outside the study area. No further assessment required.
<b>Frogs</b>				
<i>Assa darlingtoni</i> Pouched Frog	V	-	This Australian endemic has disjunctive distributions from the Conondale and Blackall Ranges in southeastern Queensland south to the Dorrigo Plateau in northeastern New South Wales. Populations also occur on the D'Aguilar, Main, Gibraltar and Border Ranges (NSW NPWS 2002).  The species is generally found in wet forest environments amongst leaf-litter. About 10 eggs are laid in a large mass of jelly on the ground in late summer. The male approaches hatching tadpoles and allows them to wriggle up onto his back and into hip pouches where they remain for about 2 months before emerging as tiny frogs. There is evidence to suggest that logging has had a negative impact on this species (Hero et al. 2004).  This species is known to occur in Whian Whian SCA and Nightcap NP.	This species was in found in nearby Whian Whian NP and Night Cap NP. Despite searches during optimal condions and in reasonable habitat this frog was not detected on study area during the survey period. Since habitat is present, <b>further assessment is required.</b>
<i>Crinia tinnula</i> Wallum Froglet	V	-	This species is restricted to the coastal areas of southern QLD and northern NSW (Cogger 2002). The species is confined to acid paperbark swamps in wallum country. Males make a high pitched squeaking noise and call at any time of the year, when water is available. Males normally call from hidden positions in grass, while floating in the water (Robinson 2002). Breeding happens mostly during autumn and winter and occurs in large swamps and temporary ponds fringing the swamp. Eggs are laid singly on twigs and leaves in still water. Tadpoles are brown with arched tail fins, reaching almost 40mm in size (Robinson 2002)	This species is very unlikely to occur at the study area. Although swamp habitats are present at the study area, they are not the characteristic acid paperbark swamps dominated by coastal Wallum species such as the Wallum Banksia ( <i>Banksia robur</i> ). This species was not recorded during targeted surveys of the alignment. No further assessment is required.
<i>Litoria brevipalmata</i> Green-thighed Frog	V	-	Distribution of this species of frog encompasses isolated localities along the coast and ranges from the NSW central coast to south-east Queensland (NSW NPWS 2002). Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. The species is thought to forage in leaf-litter (NSW NPWS 2002).	This species was not recorded during surveys however these frogs occur in low numbers and are not always easy to detect. Potential habitat for this species does occur on study area and one record occurs in nearby Night Cap NP. <b>Further assessment for this species is required.</b>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			The species inhabits the leaf-litter and low vegetation of forests and prefers wetter forest types in the southern half of its range, but extends also into open and drier forests in north-east New South Wales and south-east Queensland (Lemckert et al. 2006). It breeds after heavy rains anywhere from September to May (spring to autumn in the southern hemisphere), preferring larger temporary pools, and flooded areas for breeding (Lemckert and Slatyer 2002).	
<i>Mixophyes fleayi</i> Fleay's Barred Frog	E	V	<p>Fleay's Frog is narrowly and disjunctly distributed in wet forests from the Conondale Range in south-east Queensland, south to Yabbra Scrub in north-east New South Wales. While the majority of records for the species are from altitudes above 400 m, Fleay's Frog is also known from lowland rainforest; 200 m 90 and 150 m (Goldingay et al. 1999).</p> <p>In New South Wales the species is known from Lever's Plateau (Border Ranges), Yabbra and Tooloom Scrubs, Mt Warning, Terania Creek in Nightcap Range and Sheepstation Creek in the Border Ranges (Hines et al. 1999; Mahony et al. 1997). Fleay's Frog has disappeared from some locations, though whether populations have declined at other locations is difficult to assess due to a lack of information on the abundance of the species at historical study areas (Hines et al. 1999). The very low numbers recorded from many well surveyed study areas suggests that declines in abundance may have occurred (Goldingay et al. 1999; Hines et al. 1999).</p> <p>The extent of occurrence of the species is approximately 7000 km<sup>2</sup> (Hines et al. 1999). Fleay's Frog is associated with montane rainforest (Corben &amp; Ingram 1987) and open forest communities adjoining rainforest. The species occurs along stream habitats from first to third order streams (i.e. small streams close to their origin through to permanent streams with grades of 1 in 50) and is not found in ponds or ephemeral pools. Adults may be found in leaf litter and along watercourses in rainforest and adjoining wet sclerophyll forests (Cogger 2000). At some locations where the species has been recorded, riparian vegetation has been disturbed and replaced by weeds, however this is considered marginal habitat (Mahony et al. 1997). Tadpoles do occur with several species of native fish, however no introduced fish species have been observed in sympatry with this species (Mahony et al. 1997).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	This species was not recorded during surveys however these frogs occur in low numbers and are not always easy to detect. Potential habitat for this species does occur on study area and one record occurs in nearby Night Cap NP. <b>Further assessment for this species is required.</b>
<i>Mixophyes iteratus</i> Giant Barred Frog	E	E	The Southern Barred Frog is distributed from Belli Creek near Eumundi, south-east Queensland, south to Warrimoo, mid-eastern NSW (Hines et al. 1999). The Southern Barred Frog is currently known from mid to low altitudes below 610 m asl (Hines et al. 2004). In far north-east NSW this species is known from three broad	This species was not detected but habitat for it does occur. <b>Further assessment is required for this species.</b>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>areas (Mebbin, Nightcap Range and Richmond Range) (Goldingay et al. 1999). A population was located in the southern Nambucca River catchment (NSW NPWS 1994).</p> <p>The extent of occurrence of the Southern Barred Frog is approximately 110 000 km<sup>2</sup> (Hines et al. 1999). The density of the northern NSW populations is relatively low with an average abundance of 4.2 individuals per 100 m of stream transect in 1997–98 and an average of 3.4 individuals over the same transects in 1999 (Goldingay et al. 1999).</p> <p>The Southern Barred Frog occurs in uplands and lowlands in rainforest and wet sclerophyll forest, including farmland (Ingram &amp; McDonald 1993). Populations have been found in disturbed areas with vegetated riparian strips on cattle farms and in regenerated logged areas (Hines et al. 2004). Many study areas where the Southern Barred Frog is known to occur are the lower reaches of streams which have been affected by major disturbances such as clearing, timber harvesting and urban development in their headwaters (Hines et al. 1999).</p>	
<i>Litoria longburensis</i> Wallum Sedge Frog	V	V	<p><i>L. longburensis</i> is known from a number of mainland and island conservation reserves and public lands in Qld and NSW. In Qld, <i>L. longburensis</i> has been recorded from Great Sandy, Cooloola, Noosa, Bribie I., Moreton I. and Blue L. NP, Beerwah, Tuan and Toolara SF, crown lands N of Coolool and W of Maroola (Sunshine Coast) and North Stradbroke I. (Tyler 1997). In NSW, the species has been recorded from Broadwater, Bundjalung, and Yuraygir NP, Tyagarah and Broken Head NRs, crown lands S of Yamba and W of Brunswick Heads, and Cape Byron Headland Reserve. As well as these conservation areas, <i>L. longburensis</i> is known from the following areas in NSW: west of Tyagarah NR, Round Mountain near L. Cudgen, Jali Council land at Newrybar, Cobaki L. and Hastings Point and in the Gold Coast Airport land on the NSW - Qld border (Tyler 1997),.</p> <p>The species occurs in sedgeland, Banksia and Melaleuca woodland in sandy coastal areas of south-east Qld and northern NSW (Hines et al. 1999). This species is commonest in/around ephemeral acid swamps. It may, however, also occur along slow-flowing creeks and acid lakes in wallum (Ehmann 1997). During wet periods, <i>L. longburensis</i> may be found clinging to emergent vegetation including reeds and Bungwall Fern (<i>Blechnum indicum</i>) (Liem &amp; Ingram 1977). During dry periods individuals may be found at the base of sedges, grass clumps and/or Bungwall Fern (Cogger 2000).</p>	This species occurs in lowlands in Wallum habitat with a slightly acidic pH with primarily Banksia and Melaleuca dominant vegetation. Such habitat is not present within the study area. No further assessment is required.
<i>Philoria loveridgei</i>	E	-	Loveridge's Frog occurs in far north-east NSW on the top of the eastern escarpment of the Great Dividing Range. Records of Loveridge's Frog are almost	Recorded in survey. <b>Further assessment is required for this species.</b>

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Loveridge's Frog			<p>all from National Parks and Wildlife Service estate, and are now distributed from Nightcap National Park, 20km north of Lismore, north-west to Border Ranges National Park on the NSW-Queensland border (Cogger 2000).</p> <p>Loveridge's Frog is a habitat specialist associated with mountain streams. It inhabits boggy headwaters of streams and soaks in Antarctic beech forests, rainforests and wet sclerophyll forests above altitudes of approximately 550 m (Cogger 2000; Knowles et al. 2004). Individuals burrow into loose, moist soil or moss and sit in mossy cavities on stream banks. Breeding occurs between November and January. Males construct moist, smooth-walled breeding chambers in the ground, into which jelly-encapsulated eggs are deposited. Unlike other Philoria species, liquefied jelly rather than a foam mass is deposited with the eggs and each egg contains sufficient yolk to nourish a tadpole through to the juvenile stage. The offspring of this species have no aquatic stage (Knowles et al. 2004).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	
<b>Reptiles</b>				
<i>Cacophis harriettae</i> White-crowned Snake	V	-	<p>This species occurs in coastal and near-coastal areas from central eastern Queensland south to the vicinity of Coffs Harbour in north-east NSW (Cogger 2000). The species is nocturnal, secretive and spend the days sheltering under lead litter, fallen timber etc. <i>C.harriettae</i> favours low to mid-elevation dry eucalypt forest and woodland. They are also occasionally found in moist eucalypt forest and coastal heathland. Their prey consists largely of small lizards (Cogger 2000).</p>	<p>Habitat for this species present within the study area and immediate surrounds. A few records exist in nearby Whian Whian SCA. This species is quite common in Queensland and is found in disturbed sites. Therefore, <b>further assessment is required.</b></p>
<i>Coeranoscincus reticulatus</i> Three-toed Snake-tooth Skink	V	V	<p>This species occurs in the ranges and lowlands between Cooloola in south-eastern Qld and Grafton in north-eastern NSW (Cogger 1985 et al. 1993). In NSW, it is known to occur in the following localities: Clarence R., Tweed R., Richmond Range, Beaury SF, Koreelah SF, Whian Whian SF (now National Park), Grafton, Grady's Ck Flora Reserve Wiangaree SF, Yabba SF, and Mt Lion Rd 0.5km S Qld border (Cogger 2000).</p> <p>Found mostly in closed forest and possibly open layered Eucalyptus forest. They are generally recorded in moist layered forest on loamy basaltic soils, but also found in closed forest overlying silica sand dunes. There are two published records of individuals in logged forest which had tall softwood regrowth (Cogger et al. 1993). Within forests, this species is found in well-mulched, loose, friable rainforest soil in leaf litter, often immediately adjacent to fallen tree trunks (Cogger et al. 1993). Much of the lowland closed forest within its range has been cleared for</p>	<p>Habitat for this species present within the study area and immediate surrounds. <b>Further assessment is required.</b></p>

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			<p>agriculture and grazing, pasture improvement, crop production, tropical fruit production, and native forest logging. Suitable habitat has generally been reduced to patches, especially in lowland areas (Cogger et al. 1993). The species forages subterraneously, on insects and earthworms. Possesses pointed, recurved teeth which may be adapted for capturing earthworms (Cogger 2000).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	
<p><i>Hoplocephalus bitorquatus</i> Pale-headed Snake</p>	V	-	<p>This species has a patchy distribution along the coast ranges and western slopes of eastern Australia, from about 80 kilometres north of Sydney, NSW to Cape York Peninsular, Qld. <i>H. bitorquatus</i> is found in a wide range of habitats, including wet sclerophyll forest to the drier eucalypt forests of western slopes of NSW and inland Qld. The species is a nocturnal and a partly arboreal snake that feeds on lizards, birds and small mammals.</p>	<p>No records exist for this species exist for the Lismore LGA with the closest recorded individuals being south in the Richmond Valley and north-west near Tenterfield. It has not been recorded in Whian Whian SCA or Night Cap NP and was not detected during survey work, even during targeted searches in suitable habitat. It is unlikely to be present in the study area and therefore no further assessment is required.</p>
<p><i>Hoplocephalus Stephensii</i> Stephens' Banded Snake</p>	V		<p>This species occurs along the coast and ranges from Southern Queensland to Gosford in NSW (NSW NPWS 2002). It prefers rainforest, eucalypt forests and rocky areas up to 950 m in altitude. Stephens' Banded Snake is nocturnal, and shelters between loose bark and tree trunks, amongst vines, or in hollow trunks limbs, rock crevices or under slabs during the day. At night it hunts frogs, lizards, birds and small mammals (Cogger 2000).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP.</p>	<p>This species was not detected during surveys and usually requires large tracts of contiguous suitable vegetation to maintain viable populations, such as that offered in nearby Night Cap NP. Only patches of appropriate habitat are present on within the study area which would be unlikely to sustain viable populations of this species. Therefore no further assessment for this species is required.</p>
<b>Birds</b>				
<p><i>Amauromis moluccana</i> Pale vented Bush-hen</p>	V	-	<p>In NSW, Bush-hens are an apparently uncommon resident from the Queensland border south to the Clarence River, though the species appears to be expanding its range southwards with recent records as far south as the Nambucca River (Muranyi and Baverstock 1996). The Bush-hen inhabits tall dense understorey or ground-layer vegetation on the margins of freshwater streams and natural or artificial wetlands, usually within or bordering rainforest, rainforest remnants or forests. It has also been recorded away from water in dense low vegetation, including Blady Grass and Lantana. Key elements of their habitat are dense undergrowth 2-4 m tall and within 300 m of water (Muranyi and Baverstock 1996). Their diet consists of seeds, plant matter, earthworms, insects and some frogs, taken from ground cover or by wading at edges of streams or wetlands. The breeding season is from spring to early autumn, October to April. The nest is a shallow bowl or cup of grass stems, often partly hooded, built close to water in thick</p>	<p>Occurrence of this species within the study area is possible given potentially suitable habitat, mainly at the upstream and downstream extents. However, the narrow and rocky profile of the valley through these areas suggests the extent of potential habitat is limited. Regardless, <b>further assessment is required.</b></p> <p>The central sections of the study area are likely to have historically been the core of any local habitat prior to the advent of clearing for cropping and other agricultural pursuits.</p>



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			ground vegetation such as dense Blady Grass <i>Imperata cylindrica</i> or mat rush or reeds, often under or growing through shrubs or vine or beneath a tree (Marchant and Higgins 1993). The Bush-hen is shy and usually first comes to notice when the loud, distinctive braying, shrieking call is heard (NSW NPWS 2002). This species is known to occur in Whian Whian SCA and Nightcap NP.	
<i>Anseranas semipalmata</i> Magpie Goose	V	M	<p>Magpie Geese are still relatively common in the Australian northern tropics, but had disappeared from south-east Australia by 1920 due to drainage and overgrazing of reed swamps used for breeding. Since the 1980s there have been an increasing number of records in central and northern NSW. Vagrants can follow food sources to south-eastern NSW.</p> <p>Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges (Higgins 1999). Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes (Pizzey and Knight 2003).</p> <p>Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW (Higgins 1999). Often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains; roosts in tall vegetation (Pizzey and Knight 2003).</p>	<p>The areas of potential habitat within the study area are generally too small and ephemeral to be suitable for Magpie Geese. Accordingly it is unlikely that species would occur.</p> <p>No further assessment is required.</p>
<i>Anthomyza phrygia</i> Regent Honeyeater	E	E, Mi	<p>The Regent Honeyeater is endemic to south-eastern Australia, where it is widespread but very sparsely scattered, mostly on the inland slopes of the Great Dividing Range (Higgins et al. 2001). In NSW, most records are scattered on and around the Great Dividing Range, mainly on the North-West Plains, North-West Slopes and adjacent Northern Tablelands, to west of Armidale; the Central Tablelands and Southern Tablelands regions; and the Central Coast and Hunter Valley regions. The species is concentrated around two main locations, the Capertee Valley and the Bundarra-Barraba area, but Honeyeaters are also regularly recorded at Warrumbungle National Park and around Canberra (Higgins et al. 2001; Oliver et al. 1999). There are also scattered records along the coast in the Northern Rivers and Mid-North Coast Regions (Higgins et al. 2001).</p> <p>Regent Honeyeaters mostly occur in dry box-ironbark eucalypt woodland and dry sclerophyll forest associations, wherein they prefer the most fertile study areas available, e.g. along creek flats, or in broad river valleys and foothills. In NSW, riparian forests containing <i>Casuarina cunninghamiana</i> (River Oak), and with</p>	<p>No suitable foraging habitat present within the affected parts of the study area. Ridgeline and upper-slope forest communities may support potential foraging habitat however the presence of Regent Honeyeaters is unlikely due to the limited quality of potential habitat.</p> <p>No further assessment is required.</p>

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			<p>Amyema cambagei (Needle-leaf Mistletoe), are also important for feeding and breeding. At times of food shortage (e.g. when flowering fails in preferred habitats), Honeyeaters also use other woodland types and wet lowland coastal forest dominated by Eucalyptus robusta (Swamp Mahogany) or E. maculata (Spotted Gum) (Oliver et al. 1999).</p> <p>Regent Honeyeaters occur typically in associations that support species which reliably produce copious amounts of nectar, such as Eucalyptus sideroxylon (Mugga Ironbark), E. melliodora (Yellow Box), White Box and E. leucoxylon (Yellow Gum) , but also in associated woodlands supporting E. microcarpa (Grey Box), E. polyanthemos (Red Box), E. blakelyi (Blakely's Red Gum), E. camaldulensis (River Red Gum), E. melanophloia (Silver-leaved Ironbark), E. crebra (Narrow-leaved Ironbark), E. caleyi (Caley's Ironbark) and Angophora floribunda (Rough-barked Apple) (Higgins et al. 2001; Webster &amp; Menkhorst 1992). They sometimes use native pine Callitris woodlands, usually where mixed with eucalypts. They regularly occur in remnant trees or patches of woodland in farmland, partly cleared agricultural land and riverine forest of River Sheoak, usually infested by mistletoe, and sometimes mixed with eucalypts (Oliver et al. 1999). Regent Honeyeaters sometimes occur in coastal forest, especially in stands dominated by Swamp Mahogany and Spotted Gum, but also in those with Southern Mahogany E. botryoides, and in those on sandstone ranges with banksias Banksia in the understorey (Higgins et al. 2001). It is possible that these habitats are used predominantly as a refuge when the preferred box-ironbark habitats are affected by drought (Menkhorst et al. 1998).</p> <p>Regent Honeyeaters usually nest in the canopy of forests or woodlands, and usually in the crowns of tall trees. Studies in the Bundarra-Barraba region indicate that birds actively select the tallest trees available to nest in (Oliver et al. 1999). Nests are usually built in rough-barked trees, mostly eucalypts such as ironbarks, stringybarks or River Sheoak, or sometimes in smooth or box-barked species (e.g. Blakely's Red Gum, White Box, Yellow Box) if rough-barked trees are not available (Oliver et al. 1998). Nests are often also built amongst mistletoes in trees (Oliver et al. 1998; Webster &amp; Menkhorst 1992).</p>	
<p><i>Apus pacificus</i> Fork-tailed Swift</p>	-	Mi, M	<p>The Fork-tailed Swift leaves its breeding grounds in Siberia from August–September. They usually arrive in Australia around October. They leave southern Australia from mid-April and departs the Darwin area by the end of April (Higgins 1999). In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining</p>	<p>As an aerial feeder and migratory species, Fork-tailed Swifts can occur over a very wide range of habitats. Accordingly it is not unlikely that this species may occur occasionally within the study area. As large trees are potential roosting study areas for Fork-tailed Swifts the study area may also provide this opportunity.</p>

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			<p>Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs (Higgins 1999).</p> <p>They mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. They sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines (Higgins 1999). The Fork-tailed Swift is an aerial eater, flying anywhere from 1 m to 300 m above the ground to forage. They forage along the edge of low pressure systems and for that reason are considered a precursor to unsettled weather. The low pressure system helps to lift prey, such as insects, from the ground and assists in flight. Feeding flight is characterized by circular flight patterns throughout areas of high prey concentration. They feed in flocks ranging from 10 to 1000 birds (Higgins 1999).</p>	<b>Further assessment is required for this species.</b>
<p><i>Ardea alba</i> Great Egret, White Egret</p>	-	Mi, M	<p>Great Egrets occur throughout most of the world. They are common throughout Australia, with the exception of the most arid areas. They prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups (Pizzey and Knight 2003).</p> <p>The Great Egret usually feeds alone. It feeds on molluscs, amphibians, aquatic insects, small reptiles, crustaceans and occasionally other small animals, but fish make up the bulk of its diet. The Great Egret usually hunts in water, wading through the shallows, or standing motionless before stabbing at prey. Birds have also been seen taking prey while in flight (Pizzey and Knight 2003). The species breeds in colonies, and often in association with cormorants, ibises and other egrets. Both sexes construct the nest, which is a large platform of sticks, placed in a tree over the water. The previous years' nest may often be re-used. Both sexes also incubate the eggs and care for the young (usually two or three) (Pizzey and Knight 2003).</p>	<p>Areas of potential foraging habitat in the study areas would be limited to the ephemeral wetlands near Rocky Creek and farm dams. The channel profile along the creek did not appear to support sufficient shallow areas and was generally too vegetated to satisfy the foraging habits of Great Egrets. Accordingly, while this species may occur, the quality of potential habitat and its extent is limited.</p> <p><b>Further assessment is required.</b></p>
<p><i>Ardea ibis</i> Cattle Egret</p>	-	Mi, M	<p>The Cattle Egret is widespread and common according to migration movements and breeding localities surveys. In south-east Australia it is found from Bundaberg, inland to Roma, Thargominda, and then down through Inverell, Walgett, Nyngan, Cobar, Ivanhoe, Balranald to Swan Hill, and then west to Pinnaroo and Port</p>	<p>Cattle Egrets were not observed within the study area during field surveys, however were present in the surrounding districts at the same time. Limited numbers of stock within the study area at that time are a possible</p>

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			<p>Augusta (Marchant &amp; Higgins 1990).</p> <p>The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation (Marchant &amp; Higgins 1990).</p> <p>The Cattle Egret often forages away from water on low lying grasslands, improved pastures and croplands. It is commonly found in cattle fields and other farm areas that contain livestock. The Cattle Egret has also been observed foraging in rubbish tips. It is becoming more frequent in drier regions; consuming the ticks of livestock in the absence of other food sources. This inland spread is believed to be due to the construction of artificial waterways (Marchant &amp; Higgins 1990). The species roosts in trees, or amongst ground vegetation in or near lakes and swamps. It has also been recorded roosting near human settlement and industrial areas in Murwillumbah, NSW (Marchant &amp; Higgins 1990).</p>	<p>explanation. Despite this, it is likely that given suitable stock numbers, Cattle Egrets would occur within the pastures of the study area.</p> <p><b>Further assessment is required for this species.</b></p>
<p><i>Ardea modesta</i> Eastern Great Egret</p>		Mi, M	<p>The Eastern Great Egret has been recorded in a variety of wetland habitats (eg permanent and ephemeral freshwater areas, open and vegetated, and natural and artificial. It usually frequents shallow waters, including farm dams. This breeding season of this species is variable, depending largely on rainfall, but is most often November to April. They nest in colonies located in wooded and shrubby swamps and feed on a diverse diet that includes fish, insects, frogs snakes and small birds and mammals (SEWPaC 2011).</p>	<p>This species is likely to use the site opportunistically but it would not be an important area of habitat, containing little breeding resources. Further assessment for this species is not required.</p>
<p><i>Botaurus poiciloptilus</i> Australasian Bittern</p>	V	-	<p>The Australasian Bittern occurs from southern Queensland to Tasmania and south eastern South Australia, including most of NSW and Victoria (Marchant &amp; Higgins 1990). It also occurs in the south-western corner of Western Australia, although these populations have declined in numbers and range (Smith et al. 1995). In NSW, the species has been observed along the coast as well as in wetlands of the Murrumbidgee and Lachlan Rivers and is frequently recorded in the Murray-Darling Basin (Marchant &amp; Higgins 1990; NPWS 1999).</p> <p>The Australasian Bittern inhabits terrestrial and estuarine wetlands, generally</p>	<p>Habitat for Australasian Bittern is not present within the study area. Further assessment for this species is not required.</p>

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			where there is permanent water. The species prefers wetlands with dense vegetation, including sedges, rushes and reeds (Marchant & Higgins 1990; Garnett 1992). Freshwater is generally preferred, although dense saltmarsh vegetation in estuaries and flooded grasslands are also used by the species (Smith et al. 1995).	
<i>Calyptorhynchus lathami</i> Glossy Black-cockatoo	V	-	<p>The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia (Foreshore 2003)</p> <p>This species inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of she-oak species, particularly Black She-oak (<i>Allocasuarina littoralis</i>), Forest She-oak (<i>A. torulosa</i>) or Drooping She-oak (<i>A. verticillata</i>) occur. In the Riverina area, inhabits open woodlands dominated by Belah (<i>Casuarina cristata</i>) (Foreshore 2003). It feeds almost exclusively on the seeds of several species of she-oak (<i>Casuarina</i> and <i>Allocasuarina</i> species), shredding the cones with the massive bill. This species is dependent on large hollow-bearing eucalypts for nest study areas. One or two eggs are laid between March and August (Higgins 1999).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP.</p>	<p>Glossy Black Cockatoos were seen foraging in the drier, upper slope forests during the Autumn survey period.</p> <p><b>Further assessment is required for this species.</b></p>
<i>Circus assimilis</i> Spotted Harrier	V	-	<p>This species occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is usually found in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands (DECC 2005).</p> <p>The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population (DECC 2005).</p>	<p>Potential habitat for this species occurs in the study area with one record in Dunoon and Night Cap NP.</p> <p>This species would use the study area opportunistically, following potential prey but it is unlikely to provide important habitat, being part of a large mosaic of areas for this species. Further assessment is not required for this species.</p>
<i>Climacteris picumnus victoriae</i> Brown Treecreeper (eastern subspecies)	V	-	<p>The Brown Treecreeper in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges (DEC 2005).</p> <p>The eastern subspecies lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. The population density of this subspecies has been greatly reduced over much of its range, with major declines recorded in central NSW and</p>	<p>The study area's drier forests and woodland on the upper slopes and ridgelines represents the only potential habitat. Given the limited extent and connectivity of this habitat, the occurrence of Brown Treecreepers is unlikely.</p> <p>Further assessment is not required for this species.</p>

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			<p>the northern and southern tablelands (NSW Scientific Committee 2001)</p> <p>The species is found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range. It mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (<i>Eucalyptus camaldulensis</i>) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer. Fallen timber is an important habitat component for foraging (NSW Scientific Committee 2001).</p> <p>Hollows in standing dead or live trees and tree stumps are essential for nesting. The species breeds in pairs or co-operatively in territories which range in size from 1.1 to 10.7 ha (mean = 4.4 ha). Each group is composed of a breeding pair with retained male offspring and, rarely, retained female offspring. Often in pairs or cooperatively breeding groups of two to five birds (NSW Scientific Committee 2001).</p>	
<i>Coracina lineata</i> Barred Cuckoo-shrike	V	-	<p>This species occurs in coastal eastern Australia from Cape York to the Manning River in NSW. Barred Cuckoo-shrikes are generally uncommon in their range, and are rare in NSW (DEC 2005). This species is an active bird, usually seen in pairs, though rarely observed in NSW. It utilises a variety of habitats including rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses (DEC 2005).</p>	<p>As a nomadic species that follows the ripening of rainforest fruits, Barred Cuckoo-shrikes may occur sporadically in the study area.</p> <p><b>Further assessment is required for this species.</b></p>
<i>Cyclopsitta diophthalma</i> Double-eyed (or Coxen's) Fig-parrot	CE	E,Mi	<p>This species is limited to about five populations scattered between Bundaberg in QLD and the Hastings River in NSW. The total number is thought to be less than 200 individuals, which makes it one of Australia's most endangered birds. In NSW, the species has been recorded in the Tweed, Brunswick, Richmond Ranges and Clarence valleys (Pizzey and Knight 2003). It is now only rarely recorded in NSW, with the total population probably comprising less than 50 individuals fragmented into two sub-populations (Garnett 1992). The Koreelah and Richmond Ranges and Lever's Plateau are now the areas most likely to support local remnant populations (Holmes 1990).</p> <p>The preferred habitat is subtropical rainforest, in the canopy of dense rainforest. However, substantial loss of this forest type has resulted in most populations now inhabiting dry rainforest and cool subtropical rainforest. Flocks of up to 8 birds have</p>	<p>While the study area supports small areas of sub-tropical and warm temperate rainforest that contain a range of potential forage tree species, the limited extent and connectivity of the habitat suggests this area is unlikely to represent a significant local resource for this species. Regardless, as this species is critically endangered, <b>further assessment is required.</b></p>

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			<p>been seen in recent decades but most observations are of pairs or single individuals. (Holmes 1990). The cryptic Coxen's Double-eyed Figparrot is often difficult to detect as individuals feed quietly, moving swiftly and silently within the canopy (Holmes 1990). This species shows a preference for fig trees, but also feeds on other fruiting rainforest species (Pizzey and Knight 2003). Breeding occurs from</p> <p>October to January with a normal clutch size of 2 (Holmes 1990).</p>	
<p><i>Daphoenositta chrysoptera</i> Varied Sittella</p>	V	-	<p>The distribution of the Varied Sittella is nearly continuous from the coast to the far west. However it is only known or predicted to occur in the Lower Murray/Darling Catchment Management Region. This species is sedentary and inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. It feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.</p>	<p>Potential habitat for this species occurs in the study area with one record in the Whian Whian State Conservation Area.</p> <p><b>Further assessment for this species is required.</b></p>
<p><i>Dasyornis rachypterus</i> Eastern Bristlebird</p>	E	E	<p>The Eastern Bristlebird is endemic to Australia and occurs in three geographically-separate regional populations in south-eastern Australia. The northern population occurs in south-eastern Queensland and north-eastern NSW. The second, a central population, occurs on the central coast of NSW, and consists of extant local populations at Budderoo National Park and adjoining Barren Grounds Nature Reserve, in the Morton National Park-Red Rocks Nature Reserve area, and at Jervis Bay (Barrett et al. 2003). The third, a southern population, occurs in south-eastern NSW and eastern Victoria (NSW NPWS 1999)</p> <p>This species is a cover-dependant and fire-sensitive species, inhabiting a wide range of vegetation communities including rainforest, eucalypt forest, woodland, mallee, shrubland, heathland and sedge land where there is low dense cover (Baker 2009). It occurs near the coast, on tablelands and in ranges (Baker 2009). The Eastern Bristlebird is found in habitats with a variety of species compositions, but are defined by a similar structure of low, dense, ground or understorey vegetation (Baker 2009).</p>	<p>Eastern Bristlebirds are present in the Border Ranges National Park within habitat while not too dissimilar from the study area in places, is substantially more intact, connected and diverse. While it is unlikely that Eastern Bristlebirds occur within the study area, <b>further assessment is required.</b></p>
<p><i>Ephippiorhynchus asiaticus</i> Black-necked Stork</p>	E	-	<p>Black-necked Storks are widespread across coastal northern and eastern Australia, becoming increasingly uncommon further south into NSW, and rarely south of Sydney (Pizzey and Knight 2003). Some birds may move long distances and can be recorded well outside their normal range. This species inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally</p>	<p>Suitable habitat for Black-necked Storks is highly limited within the study area and as a result it is considered unlikely that this species occurs.</p> <p>Further assessment is not required.</p>

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			on inter-tidal shorelines, mangrove margins and estuaries (NSW NPWS 2002). It feeds in shallow, still water on a variety of prey including fish, frogs, eels, turtles, crabs and snakes (Pizzey and Knight 2003). This species breeds in late summer in the north, and early summer further south. It constructs a large nest, up to 2 m in diameter, is made in alive or dead trees, in or near a freshwater swamp. Two to four eggs are laid; incubation is by both parents (NSW NPWS 2002)	
<i>Erythrotriorchis radiates</i> Red Goshawk	CE	V	<p>Red Goshawk are distributed across northern Australian south through eastern Queensland to far north-east NSW. The species is very rare in NSW. Most records are from the Clarence River Catchment, with a few about the lower Richmond and Tweed Rivers. In NSW, the Red Goshawk is mainly found along or near watercourses, in swamp forest and woodlands on the coastal plain (NSW NPWS 2002).</p> <p>The Red Goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia (NSW NPWS 2002b). Riverine forests are also used frequently. Such habitats typically support high bird numbers and biodiversity, especially medium to large species which the goshawk requires for prey. The Red Goshawk nests in large trees, frequently the tallest and most massive in a tall stand, and nest trees are invariably within one km of permanent water (Aumann &amp; Baker-Gabb 1991). This species prefers forest and woodland with a mosaic of vegetation types, large prey populations (birds), and permanent water. The vegetation types include eucalypt woodland, open forest, tall open forest, gallery rainforest, swamp sclerophyll forest, and rainforest margins. In NSW favoured habitat is mixed subtropical rainforest and Melaleuca forest along coastal rivers, often in rugged terrain (NSW NPWS 2002b).</p>	The study area provides a range of potential foraging habitats for Red Goshawk and is situated within the known distribution for this species. While it is rarely recorded in NSW, the study area does represent suitable habitat and accordingly <b>further assessment is required</b> .
<i>Gallinago hardwickii</i> Latham's Snipe, Japanese Snipe	-	Mi, M	This species of medium sized wading bird occurs in permanent and ephemeral wetlands up to 2000 m above sea-level, usually inhabiting open, freshwater wetlands with low, dense vegetation such as swamps, flooded grasslands or heathlands, around bogs and other water bodies (Higgins and Davies 1996). This species can also occur in habitats with saline or brackish water and in modified or artificial habitats. It feeds in mud, either exposed or in very shallow water with low, dense vegetation. Roosting occurs on the ground near or in foraging areas beside or under clumps of vegetation, among dense tea-tree, in forests, in drainage ditches or plough marks, among boulders, or in shallow water if cover is unavailable. They feed on a variety of seeds, plant material, and insects (Higgins and Davies 1996).	<p>The current pastoral land management regime limits the likelihood of Latham's Snipe occurring in the study area despite the presence of an ephemeral wetland towards the southern end of the pastures. A limited amount of tall grasses and rushes for cover and concealment around the ephemeral wetland as a result of grazing and its small size suggest this species is unlikely to be present.</p> <p>Further assessment is not required.</p>



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<i>Glossopsitta pusilla</i> Little Lorikeet	V	-	Distributed in dry, open eucalypt forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri (Higgins 1999). Usually forage in small flocks, often with other species of lorikeet. They feed primarily on nectar and pollen of profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box Eucalyptus albens and Yellow Box E. meliodora are particularly important food sources for pollen and nectar respectively. Nest hollows have small openings (approximately 3cm diameter) and are mostly found in living, smooth-barked eucalypts, especially Manna Gum Eucalyptus viminalis, Blakely's Red Gum E. blakelyi and Tumbledown Gum E. dealbata (Higgins 1999). Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest study areas are often used repeatedly for decades, suggesting that preferred study areas are limited. Riparian trees often chosen, including species like Allocasuarina (Courtney and Debus 2006).	The drier eucalypt forests and woodlands of the ridgelines and upper slopes represent the only likely or potential habitat for Little Lorikeet within the study area. While this habitat is limited in its extent and connectivity, Little Lorikeets are highly mobile and may occur in the study area occasionally. <b>Further assessment is required.</b>
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	-	Mi, M	This species of large bird occurs along the coastline of Australia and also range inland over large rivers and wetlands, favouring forested coasts and forested margins of inland waterways (Barrett et al. 2003). Nests are usually near water, in tall live or dead trees or on remote coastal cliffs. River Red Gum (Eucalyptus camaldulensis), Forest Red Gum ( <i>E. tereticornis</i> ) and Southern Mahogany ( <i>E. botryoides</i> ) are commonly used as nest trees. On islands free of predators, nests may be close to the ground in shrubs or rocky platforms (Marchant & Higgins 1993). Threats include habitat loss resulting in direct loss of nesting study areas, noise and other disturbance causing abandonment of nests and young, poisoning through ingestion of wild dog baits and poisoned rabbits, Shooting, heavy metal contamination through the food chain, and thinning egg shell from past DDT exposure (Marchant and Higgins 1993).	White-bellied Sea-eagle are unlikely to occur in the study area in its current condition although they may occasionally be seen flying over the area <i>en route</i> to other proximate habitat such as Rocky Creek Dam, the Richmond River or other areas closer to the coast. Further assessment is not required.
<i>Hieraetus morphnoides</i> Little Eagle	V	-	This species occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests are made in tall living rees within remnant patches, where breeding pairs build a large stick nest in winter (DECC 2005).  The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW (DECC 2005).	These species are very territorial with pairs remaining in a breeding area year after year. The two records ( one record in the Dunoon area and Night Cap NP) are likely to be dispersing juveniles flying over. The site is unlikely to support a breeding pair and therefore further assessment is not required

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<i>Hirundapus caudacutus</i> White-throated Needletail	-	Mi, M	This species migrates from Siberia, the Himalayas, and Japan to Australia in Summer, arriving mid-October and departing mid-April. The White-throated Needletail is widespread in eastern and south-eastern Australia (Barrett et al. 2003). In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground, nevertheless, certain the species are recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland (Higgins 1999). The White-throated Needletail nests in tree hollows and feeds on insects during flight, chiefly ahead of weather changes. In Australia this species is nomadic, responding to local weather changes (Higgins 1999).	White-throated Needletail were observed during the Spring survey period foraging over the study area. <b>Further assessment is required for this species.</b>
<i>Irediparra gallinacean</i> Comb-crested Jacana	V	-	This species of bird occurs throughout coastal Australia and well inland in the north from the Kimberley to Sydney. Vagrants occasionally appear further south, possibly in response to unfavourable conditions further north in NSW (Pizzey and Knight 2003). Comb-crested Jacanas are found in tropical and subtropical freshwater wetlands, including lagoons, billabongs, swamps, lakes, rivers, sewage ponds and dams, providing there is adequate floating vegetation (Marchant and Higgins 1993). They inhabit permanent wetlands with a good surface cover of floating vegetation, especially water-lilies with pairs and family groups forage across floating vegetation, walking with a characteristic bob and flick, or flying low with toes dangling behind. They feed primarily on insects and other macroinvertebrates, as well as some seeds and other vegetation. Breeds in spring and summer in NSW, in a nest of floating vegetation (Pizzey and Knight 2003).	The study area in its current condition supports no habitat suitable for this species. No further assessment is required.
<i>Ixobrychus flavicollis</i> Black Bittern	V	-	Black Bitterns have a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia (Pizzey and Knight 2003). In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. This species inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. It feeds on frogs, reptiles, fish and macroinvertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night (Marchant and Higgins 1990).  During the day, roosts in trees or on the ground amongst dense reeds. When disturbed, freezes in a characteristic bittern posture (stretched tall, bill pointing up, so that shape and streaked pattern blend with upright stems of reeds), or will fly up	A Black Bittern was recorded in the study area during the Autumn survey. <b>Further assessment for this species is required.</b>

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			to a branch or flush for cover where it will freeze again. It is generally solitary, but occurs in pairs during the breeding season, from December to March. They are like other bitterns, but unlike most herons, nesting is solitary (Marchant and Higgins 1990). Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. Between three and five eggs are laid and both parents incubate and rear the young (Marchant and Higgins 1990).	
<i>Lathamus discolor</i> Swift Parrot	E	E	The Swift Parrot breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes (Higgins 1999). Favoured feed trees include winter flowering species such as Swamp Mahogany <i>Eucalyptus robusta</i> , Spotted Gum <i>Corymbia maculata</i> , Red Bloodwood <i>C. gummifera</i> , Mugga Ironbark <i>E. sideroxylon</i> , and White Box <i>E. albens</i> . Commonly used lerp infested trees include Grey Box <i>E. microcarpa</i> , Yellow Box <i>E. moluccana</i> and Blackbutt <i>E. pilularis</i> and Swift Parrots will return to some foraging study areas on a cyclic basis depending on food availability (Kennedy and Tzaros 2005). Following winter they return to Tasmania where they breed from September to January, nesting in old trees with hollows and feeding in forests dominated by Tasmanian Blue Gum <i>E. globules</i> (Saunders and Heinsohn 2008).  This species is known to occur in Whian Whian SCA and Nightcap NP.	The drier eucalypt forests and woodlands of the ridgelines and upper slopes represent the only likely or potential habitat for Little Lorikeet within the study area. While this habitat is limited in its extent and connectivity Swift Parrots are highly mobile and may occur in the study area occasionally.  <b>Further assessment is required.</b>
<i>Lophoictinia isura</i> Square-tailed Kite	V	-	The Square-tailed Kite is distributed sparsely throughout most of NSW, except inland treeless parts and the highest alpine areas, as a single population (Stowe 2009).  The Square-tailed Kite forages over coastal and subcoastal, eucalypt-dominated open forests and woodlands, and inland riparian woodland. It particularly favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains (Marchant & Higgins 1993). It also forages over coastal heathlands, and often near openings and edges of forest. The Square-tailed Kite will forage around suburban trees and shrubs, and nest in urban bushland. On the Mid-north Coast of NSW, landscapes within a 2 km radius of the nest study areas of 11 pairs of Square-tailed Kites had a high proportion of young and older-aged regrowth Blackbutt forest, when compared with random study areas (Kavanagh et al. 2001).	The study area provides a range of potential foraging habitats for Square-tailed Kite and is situated within the known distribution for this species. While it is sparsely distributed throughout its range, the study area does represent suitable habitat and accordingly <b>further assessment is required.</b>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
<i>Menura alberti</i> Albert's Lyrebird	V	-	<p>Albert's Lyrebird is restricted to a small area of far south-eastern Queensland and north-eastern NSW. In NSW, it is mainly found in the McPherson and Tweed Ranges, but occurs west to the Acacia Plateau in the Border Ranges and south to the Koonyum and Nightcap Ranges, and with an isolated population at the species' eastern and southern limit in the Blackwall Range, between Alstonville and Bagotville (NSW NPWS 2002).</p> <p>Mainly occur in the wettest rainforests or wet sclerophyll forests with a wet understorey, often of rainforest plants. Higher densities of Albert's Lyrebirds occur in association with a canopy of eucalypts compared with rainforest lacking eucalypts (for equivalent climate), and in wet sclerophyll forest with greater weights of litter and logs and slower rates of litter decomposition. In optimum habitat, forage up to major ridges whereas in mid-quality habitat tend to forage only on lower slopes and in gullies, and do not forage in dry sclerophyll forest (Curtis 1998).</p> <p>Feed on the ground, usually where there is a deep, moist layer of leaf-litter, and fallen logs. In NSW, usually forage in rather open areas without a dense layer but with a well-developed taller strata (Curtis 1998). Eat macroinvertebrates that live in soil and leaf-litter, particularly insects and their larvae, but, fairly surprisingly, they have not yet been observed to eat earthworms. Albert's Lyrebirds are solitary birds, and at least the males are territorial and it is likely that the females are too. Occasionally two or three birds may be seen close together (NSW NPWS 2002). Breed over winter, with clutches found between late May and mid-August. The nest is built on a rocky ledge, in fissures in rocks, between rocks, or occasionally in caves on steep rock faces or cliffs. Females lay a single egg, and do all the parental care, with the male taking no role (NSW NPWS 2002).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<p>Albert's Lyrebirds are present in the Border Ranges National Park in addition to the Nightcap Ranges within habitat not too dissimilar from the study area in places, is substantially more intact, connected and diverse. This species was sighted in the south-western part of the study area and thus <b>further assessment is required</b>.</p>
<i>Merops ornatus</i> Rainbow Bee-eater	-	Mi, M	<p>This species of small bird occurs in a variety of habitat but seems to prefer open forests and woodlands, shrublands, and various cleared or semi-cleared habitats, including farmland and areas of human habitation often located close to permanent water (Higgins 1999). It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in heathland, sedgeland, vine forest and vine thicket, and on beaches. Breeding occurs from August to January, nesting in enlarged chambers at the end of long burrow or tunnel excavated by both sexes in flat or sloping ground, in the banks of rivers, creeks or dams, in roadside cuttings, in the walls of gravel pits or quarries, in mounds of gravel, or in cliff-faces. Nest study areas are often re-used. This species primarily feeds on insects including bees, wasps, beetles, moths, butterflies, damselflies, dragonflies, flies, ants and bugs, and will occasionally eat earthworms,</p>	<p>Rainbow Bee-eaters were observed in the central section of the study area foraging in open areas and over the forest canopy.</p> <p><b>Further assessment is required for this species.</b></p>

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			spiders and tadpoles. This species migrates north for the winter months within Australia after breeding has occurred. Threats include predation of nests by other animals, and nest destruction by flooding or trampling (Higgins 1999).	
<i>Monarcha leucotis</i> White-eared Monarch	V	-	Restricted to eastern Queensland and the NSW north coast from Cape York south to Iluka at the mouth of the Clarence River and occur west only as far as the Richmond Range. Occasionally found further south in the vicinity of Coffs Harbour and Port Macquarie (NSW NPWS 2002). In NSW this species occurs primarily in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest (NSW NPWS 2002). It appears to favour ecotone between rainforest and other open vegetation types or the edges of rainforest, such as along roads. They breed from about September to March, usually nesting high in the canopy, and often at the edge of patches of rainforest (Higgins et al. 2006). They are highly active when foraging, characteristically sallying, hovering and fluttering around the outer foliage of rainforest trees. They are usually observed high in the canopy or subcanopy (Higgins et al. 2006).  This species is known to occur in Whian Whian SCA and Nightcap NP	This species was recorded on several occasions throughout the privet and camphor infested sections of the study area during the Autumn survey period.  <b>Further assessment is required for this species.</b>
<i>Monarcha melanopsis</i> Black-faced Monarch	-	Mi, M	The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. This species of bird usually inhabits dense gullies of rainforest, sclerophyll forests and eucalypt woodlands along the coastal regions from Victoria to Cape York and is migratory over much of its range (Pizzey and Knight 2003).	Black-faced Monarch was observed during the Spring survey period in the small remnant and highly disturbed patches of rainforest on the steep, west facing slopes.  <b>Further assessment is required for this species.</b>
<i>Monarcha trivirgatus</i> Spectacled Monarch	-	Mi	The Spectacled Monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales (Pizzey and Knight 2003). It is a resident species in Queensland to Rockhampton and spends summer breeding further south. It is much less common in the south. They prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves. The species feeds on insects, foraging mostly below the canopy in foliage and on tree trunks or vines. The Spectacled Monarch builds a small cup nest of fine bark, plant fibres, moss and spider web in a tree fork or in hanging vines, 1 m - 6 m above the ground, often near water (Pizzey and Knight 2003).	Spectacled Monarch was observed during the Spring survey period engaged in breeding activity in the rainforest communities at the southern end of the study area. <b>Further assessment is required for this species.</b>
<i>Myiagra cyanoleuca</i> Satin Flycatcher	-	Mi, M	The Satin Flycatcher is widespread in eastern Australia and vagrant to New Zealand Satin Flycatchers are widespread in south-eastern Queensland, in the area from Fraser Island, west to Goombi and south to the NSW border (Blakers et	The study area provides a range of habitats likely to be occupied by Satin Flycatchers.  <b>Further assessment of this species is required.</b>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>al. 1984). In NSW, they are widespread on and east of the Great Divide and sparsely scattered on the western slopes, with very occasional records on the western plains (Blakers et al. 1984).</p> <p>Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (Blakers et al. 1984). The species mainly inhabit eucalypt forests, often near wetlands or watercourses. They generally occur in moist, tall forests, often occurring in gullies (Pizzey and Knight 2003). They also occur in eucalypt woodlands with open understorey and grass ground cover, and are generally absent from rainforest. In south-eastern Australia, they occur at elevations of up to 1400 m above sea level ((Blakers et al. 1984).</p>	
<i>Ninox connivens</i> Barking Owl	V	-	<p>Barking Owls are found throughout Australia except for the central arid regions and Tasmania. They are quite common in parts of northern Australia, but generally considered uncommon in southern Australia. The species has declined across much of its distribution across NSW and now occurs only sparsely. They are most frequently recorded on the western slopes and plains and is only rarely recorded in the far west or in coastal and escarpment forests (Higgins 1999)</p> <p>Barking Owls inhabit eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Dense vegetation is used occasionally for roosting. During the day they roost along creek lines, usually in tall understorey trees with dense foliage such as Acacia and Casuarina species, or the dense clumps of canopy leaves in large Eucalypts (Higgins 1999).</p> <p>They feed on a variety of prey, with macroinvertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. They live alone or in pairs, territories range from 30 to 200 hectares and birds are present all year. Three eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (<i>Eucalyptus camaldulensis</i>), White Box (<i>Eucalyptus albens</i>), Red Box (<i>Eucalyptus polyanthemos</i>) and Blakely's Red Gum (<i>Eucalyptus blakelyi</i>). Breeding occurs during late winter and early spring (Garnet and Crowley 2000).</p>	<p>Habitat within the study area and on surrounding land is highly fragmented and generally unsuitable for Barking Owls. It is unlikely that this species would occur within the study area.</p> <p>Further assessment is not required.</p>
<i>Ninox strenua</i> Powerful Owl	V	-	<p>The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains. Now uncommon throughout its range where it occurs at low densities (Higgins 1999).</p>	<p>A range of foraging habitat is present in the study area that is suitable for Powerful Owls. While the availability of suitable tree hollows for nesting is unknown, it is highly likely that Powerful Owls would occupy the study area at various times throughout their life cycle.</p>

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			<p>Powerful Owls inhabit a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest and require large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine (<i>Syncarpia glomulifera</i>), Black She-oak (<i>Allocasuarina littoralis</i>), Blackwood (<i>Acacia melanoxylon</i>), Rough-barked Apple (<i>Angorophora floribunda</i>), Cherry Ballart (<i>Exocarpus cupressiformis</i>) and a number of eucalypt species (Higgins 1999).</p> <p>The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. As most prey species require hollows and a shrub layer, these are important habitat components for the owl (Pizzey and Knight 2003). Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400-1450 ha. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. During the breeding season, the male Powerful Owl roosts in a "grove" of up to 20-30 trees, situated within 100-200 metres of the nest tree where the female shelters (Higgins 1999). Powerful Owls are monogamous and mate for life. Nesting occurs from late autumn to mid-winter, but is slightly earlier in north-eastern NSW (late summer – mid autumn). Clutches consist of two dull white eggs and incubation lasts approximately 38 days (Higgins 1999).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<b>Further assessment of this species is required.</b>
<i>Petroica boodang</i> Scarlet Robin	V	-	<p>The Scarlet Robin is found from SE Queensland to SE South Australia and also in Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Scarlet Robin habitat usually contains abundant logs and fallen timber: these are important components of its habitat (DEC 2005).</p>	<p>A bird tentatively identified as a Scarlet Robin was observed within the dry ridgetop sclerophyll forest on the southern ridgeline. It is important to note that this species appears superficially similar to <i>P. boodang</i> and may have been confused.</p> <p><b>Further assessment required.</b></p>
<i>Petroica phoenicea</i> Flame Robin	V	-	<p>This species breeds in upland tall moist eucalypt forests and woodlands; often on ridges and slopes. It prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense. The Flame Robin occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and</p>	<p>A range of foraging habitat is present in the study area that is suitable for the Flame Robin. It is highly likely that Flame Robins would occupy the study area at various times throughout their lifecycle.</p> <p><b>Further assessment is required.</b></p>

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			sedgelands at high altitudes. In winter, birds migrate to drier more open habitats in the lowlands (i.e. valleys below the ranges, and to the western slopes and plains) (DEC 2005).	
<i>Pandion haliaetus</i> Osprey	V	M, Mi	Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas (Marchant and Higgins 1993). This species favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breed from July to September in NSW (Marchant and Higgins 1993). Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea. Incubation of 2-3 eggs, usually by the female, is about 40 days. Female remains with young almost until they fly, usually after about nine weeks in the nest (Hollands 2003).	A bird tentatively identified as an Osprey was observed during the Spring survey period. While the study area in its current form is unlikely to represent potential habitat, Osprey may fly over the area during its movements between other areas of habitat within the region. <b>Further assessment of this species is required.</b>
<i>Podargus ocellatus</i> Marbled Frogmouth	V	-	This species of bird occurs in subtropical rainforest in deep, wet, sheltered gullies frequently containing stands of Bangalow Palms and less frequently in higher elevation temperate rainforests and wet eucalypt forest with well-developed rainforest understoreys (NSW NPWS 2002). In NSW its range occurs in the far north east of the state, where it is most often found in moist, lowland, mesophyll vine forest. Less often, they are found in the ecotone between rainforest and wet <i>Eucalyptus</i> forests, or occasionally in cool rainforest and higher elevation temperate rainforests (NSW NPWS 2002). Rarely in wet eucalypt forest (Holland 1991). The species is nocturnal and hunts at night and roosting by day. Their diet consists mainly of large nocturnal insects. They hunt from large perches, such as stumps or low branches, and sallying out to take their prey from the ground or from the foliage of plants. Birds breed from about August to December. The usual clutch is one, but is sometimes two eggs. Both parents incubate the eggs (Higgins 1999). This species is known to occur in Whian Whian SCA and Nightcap NP.	The study area supports some areas of potential habitat for Marbled Frogmouth at the northern and southern ends where rainforest is more prevalent and adjacent to Rocky Creek. <b>Further assessment of this species is required.</b>
<i>Poephila cincta cincta</i> Black-throated Finch (southern)	E	E	This species is very rare in NSW, occurring in the far north of the state near Inverell-Ashford. There have been few published records since the 1960s and only three since 1992 (Higgins et al. 2006). The lack of recent records from NSW and southern Queensland suggests that the Black-throated Finch (southern) may now be extinct in NSW (Higgins et al. 2006). The Black-throated Finch (southern) occurs mainly in grassy, open woodlands and forests, typically dominated by <i>Eucalyptus</i> , <i>Corymbia</i> and <i>Melaleuca</i> , and occasionally in tussock grasslands or other habitats (for example freshwater wetlands), often along or near watercourses,	Habitat for this species is generally not present within the study area. Further assessment of this species is not required.



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			or in the vicinity of water Almost all recent records of the finch from south of the tropics have been in riparian habitat (Higgins et al. 2006) The subspecies is thought to require a mosaic of different habitats in which it can find seed during the wet season (Higgins et al. 2006).	
<i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (eastern subspecies)	V	-	The eastern subspecies ( <i>temporalis</i> ) occurs from Cape York south through Queensland, NSW and Victoria. In NSW, it occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW (DEC 2005). The species inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. They feed on macroinvertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses. Their territories range from one to fifty hectares (usually around ten hectares) and are defended all year. Territorial disputes with neighbouring groups are frequent and may last up to several hours, with much calling, chasing and occasional fighting (Reid 1999).	Habitat for this species is generally not present within the study area. Further assessment of this species is not required.
<i>Ptilinopus magnificus</i> Wompoo Fruit-dove	V	-	This species is a large and dramatically beautiful rainforest pigeon, almost twice the size of other coloured fruit-doves. It occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests, feeding on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit; some of its feed trees rely on species to distribute their seeds. The Wompoo fruit-dove is most often seen in mature forests, but also found in remnant and regenerating rainforest (Pizzey and Knight 2003). Wompoo Fruit-Doves feed on a variety of rainforest fruits. The fruits are eaten whole and may be quite large in size. The birds are hard to see when feeding, and are best located by their calls or the sound of falling fruit. They may form large feeding flocks where food is plentiful, and the birds acrobatically pluck the fruit from trees and vines high up in the canopy area (Chrome and Shields 1992). This species is known to occur in Whian Whian SCA and Nightcap NP.	It is highly likely that Wompoo Fruit-dove would occur within the study area during seasons where fruiting of forage trees is suitable for their requirements. <b>Further assessment is required for this species</b>
<i>Ptilinopus regina</i> Rose-crowned Fruit-dove	V	-	This species is a small colourful rainforest pigeon found on the coast and ranges of eastern NSW and QLD (NSW NPWS 2002). Rose-crowned Fruit-Doves are found in coastal tall tropical and sub-tropical forests, particularly with dense vine growth, in monsoon rainforest and tall woodlands near rainforest with many fruiting trees (Crome and Shields 1992). They are sometimes found in mangroves. The species are partly migratory and partly resident, maybe with local dispersal for feeding. In	Rose-crowned Fruit-doves were seen and heard calling commonly during the Autumn survey period. <b>Further assessment is required for this species.</b>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>eastern Australia, there is some north-south seasonal migration (Crome and Shields 1992).</p> <p>Rose-crowned Fruit-Doves feed in the canopy of rainforest, mainly in the morning or late afternoon. They swallow fruit whole and particularly like figs and the fruit of other species of rainforest trees, palms and vines and are known to also use Camphor Laurel as a food source (Higgins et al. 2006). They feed singly or in pairs or small parties and take water from leaves or from dew, not from the ground. Rose-crowned Fruit-Doves breed in rainforests with a dense growth of vines. Courting is the typical bowing display of pigeons, tucking in the head and displaying the pink cap. The nest is a frail loosely woven cup of twigs and tendrils. Both birds incubate, but predators often take the single egg (Higgings et al. 2006).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	
<i>Ptilinopus superbus</i> Superb Fruit-dove	V	-	<p>The Superb Fruit-dove occurs in northeastern Queensland to north-eastern NSW. They are less common further south and are largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania (DEC 2005).</p> <p>Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (Pizzey and Knight 2003). Part of the population is migratory or nomadic. There are records of single birds flying into lighted windows and lighthouses, indicating that birds travel at night. Breeding takes place from September to January. The nest is a structure of fine interlocked forked twigs, giving a stronger structure than its flimsy appearance would suggest, and is usually 5-30 metres up in rainforest and rainforest edge tree and shrub species (Pizzey and Knight 2003).</p> <p>This species occurs in Whian Whian SCA and Nightcap NP.</p>	<p>It is highly likely that Superb Fruit-dove would occur within the study area during seasons where fruiting of forage trees is suitable for their requirements.</p> <p><b>Further assessment is required for this species</b></p>
<i>Rhipidura rufifrons</i> Rufous Fantail	-	Mi, M	<p>This species is a summer breeding migrant to SE Australia (Pizzey &amp; Knight, 2006). They occur in the undergrowth of rainforests/wetter Eucalypt forests/gullies, monsoon forests, paperbarks, sub-inland and coastal swamps, mangroves, watercourses, parks and gardens. During migration can occur on farms, streets and in buildings. The species prefers deep shade, and is often seen close to the ground. During migration, it may be found in more open habitats or urban areas. Strongly migratory in the south of its range, the species moves northwards in winter, and virtually disappears from Victoria and New South Wales at this time (Pizzey and Knight 2003). The Rufous Fantail feeds on insects, which it gleans from the middle and lower levels of the canopy. It is a very active feeder and</p>	<p>Rufous Fantails were observed in the rainforest areas adjacent to Rocky Creek during the Autumn survey period.</p> <p><b>Further assessment is required for this species.</b></p>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			constantly fans tail and flicks wings and body while foraging. The Rufous Fantail builds a small compact cup nest, of fine grasses bound with spider webs, that is suspended from a tree fork about 5 m from the ground. The bottom of the nest is drawn out into a long stem. Both sexes share nest-building, incubation and feeding of the young. One or two broods may be raised in a season (Pizzey and Knight 2003).	
<i>Rostratula benghalensis</i> s. lat. Painted Snipe	E	V, Mi	<p>The Australian Painted Snipe has been recorded at wetlands in all states of Australia (Barrett et al. 2003). It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia (Marchant and Higgins 1993).</p> <p>The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical study areas include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum <i>Muehlenbeckia</i> or canegrass or sometimes tea-tree (<i>Melaleuca</i>).</p> <p>The Australian Painted Snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (Marchant and Higgins 1993). This cryptic species nests on the ground amongst tall reed-like vegetation near water. It emerges from the dense growth at dusk to feed on mudflats and the water's edge taking insects, worm and seeds (Marchant and Higgins 1993).</p>	<p>Habitat for this species is generally not present within the study area.</p> <p>Further assessment of this species is not required.</p>
<i>Ptilinopus superbus</i> Superb Fruit-dove	V	Mi	<p>A small pigeon occurs principally in NE Qld to NE NSW, becoming much less common further south and is largely confined to pockets of suitable habitat as far south as Moruya, with vagrants as far south as Tasmania (DEC 2005). Part of the population is migratory or nomadic. There are records of single birds flying into lighted windows and lighthouses, indicating that birds travel at night. At least some of the population, particularly young birds, moves south through Sydney, especially in autumn (Higgins and Davies 1996)</p> <p>The species inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees.</p>	<p>While habitat within the study area is sub-optimal for this species, given it's occurrence in local reserves <b>further assessment for is required.</b></p>

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			reeding takes place from September to January. The nest is a structure of fine interlocked forked twigs, giving a stronger structure than its flimsy appearance would suggest, and is usually 5-30 metres up in rainforest and rainforest edge tree and shrub species. The male incubates the single egg by day, the female incubates at night (Pizzey and Knight 2003).	
<i>Scythrops novaehollandiae</i> Channel-billed Cuckoo	-	Ma	The Channel-billed Cuckoo migrates to northern and eastern Australia from New Guinea and Indonesia between August and October each year. The birds leave Australia in February or March. The Channel-billed Cuckoo is found in tall open forests, usually where host species occur. The favoured foods of the Channel-billed Cuckoo are native figs and native fruits, though some seeds, insects and even baby birds are also taken. The birds take figs from the tree with their massive bills. The Channel-billed Cuckoo lays its eggs in the nests of the Australian Magpie, <i>Gymnorhina tibicen</i> , the Pied Currawong, <i>Strepera graculina</i> and members of the crow family (Corvidae).	Observed calling from dense vegetation and flying-over the study area during the survey. <b>Further assessment required.</b>
<i>Turnix maculosa</i> Red-backed Button-quail	V	-	<p>The Red-backed Button-quail extends discontinuously from the Kimberley region of Western Australia, through the Top End of the Northern Territory and the southern Gulf of Carpentaria, to Cape York Peninsula and eastern Queensland and central-eastern and north-eastern NSW. This species is usually found in coastal and subcoastal regions. The Red-backed Button-quail is recorded infrequently in NSW, with most records from the North Coast Bioregion. From 1980 to 1995, the reporting rate per year has been about two birds per year, six more sightings were made from 1996 to 2005. There have been no further records within reserves in NSW since August 1994.</p> <p>This species inhabits grasslands, heath and crops close to water in areas such as grasslands and sedgeland near creeks, swamps and springs and wetlands. The species has been observed associated with the following grasses (in various vegetation formations): speargrass <i>Heteropogon</i>, Blady Grass <i>Imperata cylindrica</i>, <i>Triodia</i>, Sorghum, and Buffel Grass <i>Cenchrus ciliaris</i>. Red-backed Button-quail are nocturnal and crepuscular in their activity, and forage on the ground. They eat seeds and insects, but otherwise little is known of their diet.</p>	This species was not recorded during surveys. It is possible that the study area may represent some areas of suitable habitat around Rocky Creek. Since little is known about the specific habitat requirements of the Red-backed Button-quail, <b>further assessment of this species is required.</b>
<i>Turnix melanogaster</i> Black-breasted Button-quail	CE	V	The Black-breasted Button-quail is endemic to eastern Australia. It is restricted to coastal and near-coastal regions of south-eastern Queensland and north-eastern New South Wales. The main populations occur within south-east Queensland. In north-eastern New South Wales, they are restricted to the Northern Rivers and	This species has similar habitat requirements to White-eared Monarchs which were found at the site. Habitat assessment included searches for platelets

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			<p>Tablelands (Marchant &amp; Higgins 1993). There have been only 10 confirmed records from New South Wales in the past 20 or so years, these from six areas in the far north-east (Garnett &amp; Crowley 2000). In New South Wales the species is found as far south as the Walcha-Yarrowitch area and near Dorrigo (DEC 2005).</p> <p>This small species of ground-dwelling bird is found usually within drier rainforests and viney scrubs, often in association with Hoop Pine and is restricted to rainforests and forests, mostly in areas with 770-1200 mm rainfall per annum (Marchant &amp; Higgins 1993). They prefer drier low closed forests, particularly semi-evergreen vine thicket, low microphyll vine forest, araucarian microphyll vine forest and araucarian notophyll vine forest (Marchant &amp; Higgins 1993). They may also be found in low, dense acacia thickets and, in littoral area, in vegetation behind sand dunes (Smith &amp; Mathieson 2004). Many areas of optimum habitat are located on highly fertile soils. It is believed that the highly fertile soils promote rapid leaf growth on plants. During dry periods, much of the foliage then drops to the ground thus maintaining the deep leaf litter layer which is crucial to the foraging requirements of the species (Smith &amp; Mathieson 2004).</p> <p>Known to occur in NP national park and Nightcap NP</p>	Further assessment for this species is not required.
<i>Tyto capensis</i> Grass Owl	V	-	<p>Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues (NSW NPWS 2002).</p> <p>These are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. They rest by day in a 'form' - a trampled platform in a large tussock or other heavy vegetative growth. If disturbed they burst out of cover, flying low and slowly, before dropping straight down again into cover. Always breeds on the ground. Nests are found in trodden grass, and often accessed by tunnels through vegetation (NSW NPWS 2002).</p>	<p>Under the current pastoral land management regime, areas of the study area that may represent potential habitat are generally unsuitable. Further to this, the extent of potential habitat within the study area is very limited and unlikely to be sufficient to support this species.</p> <p>Further assessment for this species is not required.</p>
<i>Tyto novaehollandiae</i> Masked Owl	V	-	<p>The Masked Owl extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution (DEC 2005).</p> <p>The Masked Owl inhabits forests, woodlands, timbered waterways and open country on the fringe of these areas at altitudes from sea level to 1100 m. The main requirements are tall trees with suitable hollows for nesting and roosting and adjacent areas for foraging. Masked Owls are territorial, and pairs remain in or near</p>	<p>Masked Owls were observed and heard calling each night of survey during the Autumn survey period. The species was recorded mainly from the western side of Rocky Creek although it may also occupy other suitably vegetated parts of the study area.</p> <p><b>Further assessment is required for this species.</b></p>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>the territory all year round. It hunts along the edges of forests and roadsides and has a home range covering between 500 ha and 1000 ha (Kavanagh and Murray 1996). Masked Owls feed mainly on small mammals, such as rodents, rabbits and bandicoots. Other prey animals include possums, reptiles, birds and insects, with hunting taking place in the early hours of night. The birds sit on low perches listening for prey which, once detected, is taken from the ground or from the tree branches. Masked Owls breed when conditions are favourable and food items are plentiful. They breed in hollows and sometime caves in moist eucalypt forested gullies (Pizzey and Knight 2003). The nest is a bare chamber located deep in a tree hollow, which is lined with soil, sand or soft wood mulch. The eggs are incubated solely by the female, while the male provides the food. The female also tears up the food for the chicks. The young birds remain in the vicinity of the nest and are fed by the parent birds for a further month after fledging (Kavanagh and Murray 1996).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	
<i>Tyto tenebricosa</i> Sooty Owl	V	-	<p>The Sooty Owl occupies the eastern most one-eighth of NSW, occurring on the coast, coastal escarpment and eastern tablelands. There is no seasonal variation in its distribution (DEC 2005). Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Roosts by day in the hollow of a tall forest tree or in heavy vegetation; hunts by night for small ground mammals or tree-dwelling mammals. Nests in very large tree-hollows (Newton et al. 2002).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<p>Suitable foraging habitat for Sooty Owls occurs throughout the study area and this species has reportedly been heard near the western ridgeline within the study area (A. Simpson, pers. comm., 2010).</p> <p><b>Further assessment of this species is required.</b></p>
<b>Mammals</b>				
<i>Aepyprymnus rufescens</i> Rufous Bettong	V	-	<p>The original range from Coen in north Queensland to central Victoria has been reduced to a patchy distribution from Cooktown, Queensland, to north-eastern NSW as far south as Mt Royal National Park. In NSW it has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts (Burnett and Winter 2008).</p> <p>Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter (Strahan 1995). They sleep during the day in cone-shaped nests constructed of grass in a shallow depression at the base of a tussock or fallen log. At night they feed on grasses, herbs, seeds, flowers, roots, tubers, fungi and occasionally insects (NPWS NSW 2002).</p>	<p>While potential suitable habitat occurs for this species within the study area, it was not found within the study area during recent surveys. Due to the lack of connectivity of the study area to known populations of this species and the disturbed nature of the majority of the study area, it is considered unlikely that this species would be present. No further assessment required.</p>

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<i>Cercartetus nanus</i> Eastern Pygmy-possum	V	-	<p>The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes (DEC 2005).</p> <p>Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. The species shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (<i>Pseudocheirus peregrinus</i>) dreys or thickets of vegetation, (eg. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks (Bowen and Goldingay 2000).</p> <p>Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests (Bowen and Goldingay 2000).</p>	Potential suitable habitat occurs within the rainforest and eucalypt forests of the study area, however the lack of connectivity to known habitat and occurrences, lack of tree hollows and lack of banksias and bottlebrushes within the study area, it is considered unlikely to occur. It was not recorded during recent surveys and thus no further assessment is required.
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	<p>The current distribution of this species is also poorly known. Records exist from Shoalwater Bay, north of Rockhampton, Queensland, through to the vicinity of Ulladulla, NSW in the south (Hoye 2005). Much of the known distribution of the Large-eared Pied Bat occurs in NSW. In the north-east of the state at Coolah Tops, Mt Kaputar and the Warrumbungle National Park, it is present in areas of volcanic strata. It is more widely distributed, but still uncommon and patchy within its distribution, in the sandstone areas of the Sydney Basin and the western slopes and plains including Pilliga Nature Reserve. The current extent of occurrence is approximately 570 000 km<sup>2</sup> (Hoye and Dwyer 1995).</p> <p>Lactating and pregnant females have been captured adjacent to sandstone escarpments near Ulan, NSW (Fly By Night 2004) and adjacent to rhyolite cliffs near Lismore (Parnaby 1984). Breeding females have also recently been recorded in sandstone caves near Coonabarabran, NSW (Pennay 2008). Available roosts are not evenly distributed throughout the range of the Large-eared Pied Bat. Populations occur where suitable roosts are present. In particular, the populations in north-eastern NSW and south-east Queensland, Shoalwater Bay and Blackdown Tablelands are likely to be isolated with little interaction with their nearest populations (Hoye 2005).</p>	<p>This species is known from nearby Whian Whian State Conservation Area. The absence of suitable roosts in the study area may limit its occurrence; however individuals may visit the study area from time to time.</p> <p><b>Further assessment is required.</b></p>

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			<p>Little is known about the habitat and roosting requirements of the Large-eared Pied Bat, but natural roosts may depend heavily on sandstone outcrops. It has been found roosting in disused mine shafts, caves, overhangs and disused Fairy Martin (<i>Hirundo ariel</i>) nests for shelter and to raise young (Hoye &amp; Dwyer 1995). It also possibly roosts in the hollows of trees (Duncan et al. 1999). In NSW this species has been recorded from a large range of vegetation types including: dry and wet sclerophyll forest; Cyprus-pine dominated forest; tall open eucalypt forest with a rainforest sub-canopy; sub-alpine woodland; and sandstone outcrop country. In south-eastern Queensland the species has primarily been recorded from higher altitude moist tall open forest adjacent to rainforest (Duncan et al. 1999). Pied Bat is largely restricted to the interface of sandstone escarpment (for roost habitat) and relatively fertile valleys (for foraging habitat) (Pennay 2008).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	
<p><i>Chalinolobus nigrogriseus</i> Hoary Wattled Bat</p>	V	-	<p>The species occurs across northern Australia from the Kimberley to Cape York and down the eastern coast to northern NSW. They occur in a range of habitat types, including monsoon forest, tall open forest, open woodland, vine thickets, coastal scrub, sand dunes, grasslands and floodplains. They commonly forage along watercourses and in swampy areas, isolated dams and waterholes feeding on moths and beetles (Churchill 1998). They fly fast below the canopy so forests with naturally sparse understorey layers may provide the best habitat (Churchill 2008).</p>	<p>It is unlikely that this species would occur in the dense vegetation communities at the study area including tall wet forest and rainforest, as they prefer foraging habitat with a naturally sparse understorey. No further assessment is required.</p>
<p><i>Dasyurus maculatus</i> Spotted-tailed Quoll</p>	V	E	<p>There are two subspecies of the Spotted tailed Quoll: <i>Dasyurus maculatus gracilis</i> occurs in a small isolated population in north Queensland, while <i>D. m. maculatus</i> occurs along the remainder of the east coast from south-east Queensland to Tasmania. This subspecies previously ranged over both sides of the Great Dividing Range from Queensland to South Australia and Tasmania (Edgar &amp; Belcher 1995). However, following a dramatic decline in range and numbers, it is now distributed over a restricted range in isolated areas that may be too small to support long-term viable populations (Edgar &amp; Belcher 1995). The species is probably extinct in South Australia and uncommon to rare in Queensland, NSW and Victoria, but numbers appear to have increased in Tasmania (Edgar &amp; Belcher 1995). In NSW, the Spotted-tailed Quoll occurs on both sides of the Great Dividing Range. The north-east of the state represents a stronghold for the species, as numbers in the south-east of the state have dramatically declined (NSW NPWS 2002). The western division of NSW has a number of scattered but unconfirmed records (Ayers et al. 1996).</p> <p>The Spotted-tailed Quoll utilises a variety of habitats including sclerophyll forest</p>	<p>There is potential for this species to occur in the rainforest and sclerophyll forest habitat within the study area, however denning habitat such as hollow-bearing trees or fallen logs are notably absent from the area generally. This species was not recorded during the survey and no evidence of their presence such as latrine study areas were observed. It is possible that this species may utilize the study area as a movement corridor from time to time, however as there is a general lack of connected suitable habitat, this is also considered to be very limited, with such connections likely to be retained within the buffer area of the proposed dam. No further assessment is required.</p>



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			<p>and woodlands, coastal heathlands and rainforests (Edgar &amp; Belcher 1995). Occasional sightings have been made in open country, grazing lands, rocky outcrops and other treeless areas. This species' habitat requirements include suitable den study areas (such as hollow logs, tree hollows, rock outcrops or caves) and an abundance of food (such as birds and small mammals). Individuals also require large areas of relatively intact vegetation through which to forage (NSW NPWS 2002).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	
<p><i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle</p>	V	-	<p>The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania (Churchill 1998). This species is found in tall, mature, wet forest and the species have been recorded roosting in stem holes in Eucalyptus and in buildings. Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings (Law <i>et al.</i> 2008). Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter. Females are pregnant in late spring to early summer (Churchill 1998).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<p>This species is unlikely to occur throughout much of the year within the study area as it occurs at altitude in the northern parts of its range. It is possible that individuals may move to lower altitudes in winter (such as in the study area) when conditions are more favourable.</p> <p><b>Further assessment is required.</b></p>
<p><i>Kerivoula papuensis</i> Golden-tipped Bat</p>	V	-	<p>The species has been recorded from sea level to over 1200m altitude in scattered localities ranging from Mumbulla State Forest, east of Bega in southern New South Wales north to Cape York Peninsula (Woodside 1995). It appears to have localised distributions and/or sparsely distributed within its range (Law and Chidel 2004). The majority of records have been collected in the north-east New South Wales and south-east Queensland biogeographical regions (NSW NPWS 1994).</p> <p>This species has been recorded predominantly from a variety of rainforest types, ranging from tropical mesophyll vine forest to semi-evergreen vine thickets, and rainforest ecotone areas, where it feeds on a range of both gleaned and aerially acquired dietary items (Schulz and Wainer 1997). There are a small number of records from dry and wet sclerophyll forests lacking a rainforest subcanopy, riparian <i>Casuarina cunninghamiana</i> dominated forest, coastal Melaleuca forests, and several individuals have been recorded inside houses on the edge of residential areas (Churchill 2008). However the majority of such records are situated within 1 km of rainforest patches (Churchill 2008).</p> <p>Roosts have predominantly been recorded from the disused suspended nests of the Yellow-throated Scrubwren <i>Sericornis citreogularis</i> and the Brown Gerygone <i>Gerygone mouki</i> (Schulz 1995). Individuals have also been recorded roosting in</p>	<p>Found at Rocky Creek dam outside the study area. Not likely to be present in the study area due to the absence of rainforest lined 1st and 2nd order streams.</p>

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			tree hollows and on the side of branches, and in suspended dead foliage of treeferns (Churchill 2008). This species is known to occur in Whian Whian SCA and Nightcap NP	
<i>Macropus dorsalis</i> Black-striped Wallaby	E	-	The Black-striped Wallaby occurs in mid-eastern Australia from Townsville, Qld to the Liverpool Plains in northern NSW (Kirckpatrick 1995). Within NSW, the species occurs on both sides of the Great Dividing Range in small remnant populations. These populations occur south-west of Narrabri, north-east of Moree in the upper Namoi and Gwydir Valleys, in the upper Clarence River catchment area and on the western edge of Richmond Valley (DEC 2005). The species occurs in open forest with thick regrowth brigalow, <i>Acacia harpophylla</i> or other shrub understory woodland, closed forest margins and dense wet sclerophyll forests with a viney understorey (Gilmore & Parnaby 1994). Colonies use dense vegetation for shelter during the day and open forest and grassland edges at night for feeding (Kirckpatrick 1995). The species grazes on a wide range of monocotyledonous species with grasses, Cyperaceae, Juncaceae and <i>Lomandra</i> spp., forming 80% of their diet. Sedges and rushes may also form part of their diet. The monocot species that are eaten may vary situationally and can include both indigenous and exotic grass species and crop cereals (Kirckpatrick 1995).	No known populations of the species occur in close proximity to the study area. This species was not recorded during recent surveys, it is considered that the study area lacks the structural diversity that this species required in wet sclerophyll forest and thus the study area is not considered to contain suitable habitat. No further assessment required.
<i>Macropus parma</i> Parma Wallaby	V	-	The species once occurred from north-eastern NSW to the Bega area in the southeast. Their range is now confined to the coast and ranges of central and northern NSW from the Gosford district to the Queensland border (Strahan 1995). The species preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest (NSW NPWS 1994). Typically feed at night on grasses and herbs in more open eucalypt forest and the edges of nearby grassy areas. During the day they shelter in dense cover (Strahan 1995). This species is known to occur within Whian Whian SCA and Nightcap NP	This species is known to occur within the region in conservation areas. While suitable habitat potentially occurs within the study area for this species, it was not found within the study area during recent surveys. Due to the lack of connectivity of the study area to known populations of this species and the disturbed nature of the majority of the study area, it is considered unlikely that this species would be present. No further assessment required.
<i>Miniopterus australis</i> Little Bentwing-bat	V	-	Coastal north-eastern NSW and eastern Queensland. This species occurs in moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bent-wing Bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats (Churchill 2008). They often share roosting study areas with the Common Bent-wing Bat and, in winter, the two species may form mixed clusters (Dwyer 1995). In NSW the largest maternity colony is in close association with a large	This species was recorded by an Anabat detector in the rainforest and wet sclerophyll forest habitat within the study area. <b>Further assessment is required.</b>

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			<p>maternity colony of Common Bent-wing Bats (<i>M. schreibersii</i>) and appears to depend on the large colony to provide the high temperatures needed to rear its young (Dwyer 1995).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP.</p>	
<p><i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat</p>	V	-	<p>Eastern Bent-wing Bats occur along the east and north-west coasts of Australia (Churchill 2008). Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. They form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young (Dwyer 1995).</p> <p>Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops (Churchill 2008).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP.</p>	<p>This species was recorded by an Anabat detector in the rainforest and wet sclerophyll forest habitat within the study area.</p> <p><b>Further assessment is required.</b></p>
<p><i>Mormopterus beccarii</i> Beccari's Freetail-bat</p>	V	-	<p>The species is distributed across northern Australia from Western Australia to Queensland, extending south to the north-east corner of NSW. The only confirmed record in NSW is of a colony found in the roof of a house in Murwillumbah, however, calls have been detected from a few other locations in the far north east of the State (DEC 2005).</p> <p>The species has been recorded from a range of vegetation types in northern Australia, from rainforests to open forests and woodlands, and are often recorded along watercourses. They can also occur in towns and cities. Roost mainly in tree hollows but relatively large colonies have been found under house roofs in urban areas in Queensland (Churchill 1998).</p>	<p>This species has not been recorded as far south as Dunoon, its limit at the north-east corner of NSW. No records of this species occur within 20 km of the study area, and as such, no further assessment is required.</p>
<p><i>Mormopterus norfolkensis</i> Eastern Freetail-bat</p>	V	-	<p><i>M. norfolkensis</i> is thought to be 'uncommon' and distributed east of the Great Dividing range to the coastline, and ranging in latitude from Picton (New South Wales) in the south, as far north as south-east Queensland. Most recent records come from north-eastern New South Wales (Churchill 2008). Habitat can be inferred from the few collecting localities, represented by about 12 confirmed records in New South Wales (Parnaby 1995). Such habitats include dry eucalypt forest and coastal woodlands but individuals have been captured in riparian zones in rainforest and wet sclerophyll forest (Allison and Hoye 1995). Forages above the forest canopy or at forest edges (Allison 1983). Known to roost in tree hollows but occasionally found in buildings (Allison and Hoye 1995).</p>	<p>North-eastern NSW is known to be a stronghold for this species. Despite the high level of survey effort, this species was not detected during surveys. Therefore, it is likely to be absent from the study area.</p>

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			This species is known to occur in Whian Whian SCA and Nightcap NP.	
<i>Myotis macropus</i> Southern Myotis	V	-	Occurs in a wide coastal band in eastern and northern Australia from northern Western Australia, across the Northern Territory, Queensland, New South Wales, Victoria and into far south-eastern South Australia. The distribution also extends inland from coastal South Australia along the Murray River (Ayers et al. 1996). This species is always associated with permanent, usually slow-flowing, water bodies. It has been recorded foraging over small creeks, coastal rivers, estuaries, lakes and inland rivers (Law and Anderson 1999). Records come from a wide range of vegetation communities associated with water. This species can utilise farm dams and other smaller water bodies (Law et al. 1998).  This species is known to occur in Whian Whian SCA and Nightcap NP.	This species was recorded in the rainforest and wet sclerophyll forest habitat within the study area.  <b>Further assessment is required.</b>
<i>Nyctimene robinsoni</i> Eastern Tube-nosed Bat	V	-	This species of small bat is a relative of the Flying-fox, and occurs predominately in streamside habitats within coastal subtropical rainforest and moist eucalypt forests with a well-developed rainforest understorey (Hall 1995). Occurs in north-eastern Australia from Cape York south to the far north-east NSW. Few records from NSW, including the Nightcap, Tweed and Burringbar Ranges and in the vicinity of Mt Warning (Churchill 2008).  Known to occur in Nightcap NP	This species was not detected during the surveys. Habitat opportunities are limited for this species due to the high degree of regeneration in the rainforest, and the paucity of rainforest fruits for foraging habitat. It is likely that these species occur in limited numbers and on a sporadic basis, such as when feed trees including Moreton Bay Figs ( <i>Ficus macrophylla</i> ) are fruiting.  <b>Further assessment is required.</b>
<i>Nyctophilus bifax</i> Eastern Long-eared Bat	V	-	Found from Cape York through eastern Queensland to the far north-east corner of NSW. In NSW they appear to be confined to the coastal plain and nearby coastal ranges, extending south to the Clarence River area, with a few records further south around Coffs Harbour (Parnaby and Churchill 2008). The species can be locally common within its restricted range. They occur in lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. This species forages for insects in rainforest and sclerophyll woodland, and it is often associated with waterbodies in these habitats (Parnaby and Churchill 2008). Animals roost communally in hollow trees, dense foliage, or in houses. Females often give birth to twins (Parnaby and Churchill 2008).  This species is known to occur in Whian Whian SCA and Nightcap NP	This species was recorded in the rainforest and wet sclerophyll forest habitat within the study area.  <b>Further assessment is required.</b>
<i>Petaurus australis</i> Yellow-bellied Glider	V	-	The Yellow-bellied Glider has a patchy distribution along the east coast and adjacent ranges of Australia from south-eastern South Australia to North Queensland (Russell 1995). Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows and year round	Call playback for this species did not elicit any responses during the study area surveys. Further, no evidence of the presence of this species was found to occur within the study area (including feeding marks). While potential

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>food resources are available from a mixture of eucalypt species (Goldingay &amp; Kavanagh 1991). The patchy distribution of this species is perhaps determined by the local availability of a variety of suitable flowering trees with overlapping blossoming periods (Russell 1995). Critical elements of habitat include sap-study area trees, winter flowering eucalypts, mature trees suitable for den study areas and a mosaic of different forest types (Russell 1995).</p> <p>The Yellow-bellied Glider is nocturnal, resting during the day in leaf-lined dens in hollow tree limbs or trunks of living, smooth-barked eucalypts (Russell 1995). Yellow-bellied Gliders utilise a variety of tree species, including <i>Eucalyptus maculata</i>, <i>E. viminalis</i>, <i>E. ovata</i>, <i>E. cypellocarpa</i>, <i>E. obliqua</i>, <i>E. propinqua</i>, <i>E. punctata</i>, <i>E. fastigata</i>, <i>E. radiata</i>, <i>E. intermedia</i>, <i>E. gummifera</i>, <i>E. globoidia</i>, <i>E. muellerana</i>, <i>E. agglomerata</i>, <i>E. bosistoana</i>, <i>E. elata</i>, <i>E. signata</i>, <i>E. teriticornis</i>, <i>E. amgophiroides</i>, <i>E. pilularis</i>, <i>E. maidenii</i> and <i>Acacia</i> spp (Russell 1995).</p> <p>The species is agile and very active, travelling for over 2km from the den to forage (Russell 1995). Foraging occurs across the topographic sequence, within a wide range of canopy heights and foraging patterns are related to phenological changes in eucalypts. A very high proportion of nocturnal activity (90%) is dedicated to foraging (Goldingay &amp; Kavanagh 1991). A single young is born between May and September, with the variation likely to reflect the abundance of food resources (Goldingay &amp; Kavanagh 1991).</p> <p>Known to occur in Nightcap NP.</p>	<p>foraging habitat occurs for this species within the study area, there are few nesting and roosting resources present and a lack of known feed tree species. As such, it is considered unlikely to occur within the study area and no further assessment required.</p>
<p><i>Petaurus norfolcensis</i> Squirrel Glider</p>	V	-	<p>The Squirrel Glider is sparsely distributed along the east coast and immediate inland districts from western Victoria to north Queensland. The species is found inland as far as the Grampians in Victoria and the Pilliga and the Coonabarabran areas of NSW (Quin 1995; NPWS 1999). Suitable habitat also exists in the River Red Gum Forests and Yellow Box woodlands of the Murray Darling Basin (Quin 1995).</p> <p>The Squirrel Glider inhabits dry sclerophyll forest and woodland and is generally absent from rainforest and closed forest (Menkhorst et al. 1988). In NSW, potential habitat includes Box-Ironbark forests and woodlands in the west, the River Red Gum forests of the Murray Valley and the eucalypt forests of the northeast. Individuals have also been recorded in a diverse range of vegetation communities, including Blackbutt, Forest Red Gum and Red Bloodwood forests, Coastal Banksia heathland and Grey Gum/Spotted Gum/Grey Ironbark dry hardwood forests of the Central NSW Coast (Quin 1995).</p>	<p>Call playback for this species did not elicit any responses during the study area surveys. Further, no evidence of the presence of this species was found to occur within the study area (including feeding marks). While potential foraging habitat occurs for this species within the study area, there are few nesting and roosting resources present. As such, it is considered unlikely to occur within the study area and no further assessment required.</p>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>The Squirrel Glider is nocturnal, shelters in tree hollows and lives in family groups of between 2 and 10, generally comprising of one male, at least 2 females and juveniles (Quin 1995). Births occur throughout the year and are likely to reflect the availability of food, particularly pollen and nectar. Home-ranges have been estimated as between 0.65 and 8.55ha and movements tend to be greater for males than females. The home-range of a family group is likely to vary according to habitat quality and availability of resources (Quin 1995).</p>	
<p><i>Petrogale penicillata</i> Brush-tailed Rock-wallaby</p>	-	V	<p>The range of the Brush-tailed Rock-wallaby extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. However the distribution of the species across its original range has declined significantly in the west and south and has become more fragmented. In NSW they occur from the Queensland border in the north to the Shoalhaven in the south, with the population in the Warrumbungle Ranges being the western limit (Eldridge and Close 1995).</p> <p>This species prefers rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes, cliffs, gorges and isolated rock stacks (Murray et al. 2008). It also utilises tree limbs (Eldridge and Close 1995). While it appears that most Brush-tailed Rock-wallaby colonies are on north-facing slopes and cliff lines, colonies have been found on south-facing cliffs (Eldridge and Close 1995).</p> <p>In many parts of their range, including at the Warrumbungles, rock-wallabies are closely associated with dense arboreal cover, especially fig trees (NSW NPWS 2003a). The vegetation on and below the cliff appear to be important to this species as a source of food and shelter and in some cases may provide some protection from predation. A range of vegetation types are associated with Brush-tailed Rock-wallaby habitat, including dense rainforest, wet sclerophyll forest, vine thicket, dry sclerophyll forest, and open forest (Murray et al. 2008).</p>	<p>While suitable habitat potentially occurs within the study area for this species, it was not found within the study area during recent surveys. Due to the lack of connectivity of the study area to known populations of this species and the disturbed nature of the majority of the study area, it is considered unlikely that this species would be present. No further assessment required.</p>
<p><i>Phascogale tapoatafa</i> Brush-tailed Phascogale</p>	V	-	<p>The Brush-tailed Phascogale has a patchy distribution around the coast of Australia, from near sea level up to 1500m (Soderquist 1995). Within NSW, the species appears to be most abundant in the north-east and south-east of the State, particularly within forest habitats on the Great Dividing Range (Ayers et al. 1996). The preferred habitat of the Brush-tailed Phascogale is dry sclerophyll open forest, with a sparse ground cover of herbs, grasses, scleromorphic shrubs or leaf litter (Soderquist 1995). However, individuals may also inhabit heathland, swamps, rainforest and wet sclerophyll forest. The species occurs primarily where the annual rainfall exceeds 500mm (Traill &amp; Coates 1993).</p> <p>The small, mainly arboreal Brush-tailed Phascogale is an agile climber and often</p>	<p>While suitable habitat potentially occurs within the study area for this species, it was not found within the study area during recent surveys. Due to the lack of connectivity of the study area to known populations of this species and the disturbed nature of the majority of the study area, it is considered unlikely that this species would be present. No further assessment required.</p>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>observed clinging head-down below branches. Individuals forage preferentially in rough-barked trees of 25cm DBH or greater, where available (Soderquist 1995). The species is nocturnal and carnivorous, feeding on macroinvertebrates and arthropods (such as spiders, centipedes, beetles and cockroaches), nectar and occasionally small vertebrates (Soderquist 1995). The females inhabit territories of approximately 20-60ha, while the males maintain territories of up to 100ha. The territory of a female is exclusive, however, the territory of a male may overlap with other females and males (Soderquist 1995).</p> <p>The Brush-tailed Phascogale nests and shelters in tree hollows, utilising many different hollows over a short time span. Suitable hollows are 25-40mm wide (Ayers et al. 1996) lined with leaves and shredded bark and covered with pungent faeces which serves as a territorial marker (Soderquist 1995). Mating occurs between May and July, during which time males can travel long distances well beyond their territories. Males die soon after the mating season. The gestation period is around 30 days and the litter size is usually between 3 and 8. At 7 weeks, juveniles leave the pouch but remain in the nest until they are weaned at approximately 20 weeks. Mortality is usually high prior to and following weaning (Soderquist 1995). After weaning, juvenile males disperse while females establish their home-range nearby, or remain within the natal range. Females can live for up to 3 years, but generally produce only one litter (Soderquist 1995).</p>	
<i>Phascolarctos cinereus</i> Koala	V	-	<p>It currently ranges from northeastern, central, and southeastern Queensland with patchy populations in western areas, to eastern New South Wales including the coastal strip and highlands of the Great Dividing Range, the western plains and related riparian environments where suitable habitat occurs, Victoria, and southeastern South Australia (Martin <i>et al.</i> 2008).</p> <p>Koalas occupy forests and woodlands where there are acceptable food trees. They are largely nocturnal and feed almost exclusively on eucalypts, but preferred food tree species vary with locality and there are quite distinct regional preferences (Martin <i>et al.</i> 2008). They are able to persist in fragmented habitats, and even survive in isolated trees across a predominantly agricultural landscape. Females reach sexual maturity at two years of age and usually give birth to a single young per year. Individual Koalas have been known to live up to 18 years in the wild, but most live between 10 and 14 years (Martin <i>et al.</i> 2008).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	Recorded. <b>Further assessment is required.</b>
<i>Planigale maculata</i>	V	-	<p>Occur in coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its confirmed southern distribution limit on the NSW lower</p>	While suitable habitat potentially occurs within the study area for this species, particularly in the areas where the

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
Common Planigale			<p>north coast however there are reports of its occurrence as far south as the central NSW coast west of Sydney (Menkhorst and Knight 2001).</p> <p>Common Planigales inhabit rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water (NSW NPWS 2002). They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. They are fierce carnivorous hunters and agile climbers, preying on insects and small vertebrates, some nearly their own size. They breed from October to January. The female builds a nest lined with grass, eucalypt leaves or shredded bark (NSW NPWS 2002).</p>	<p>understorey is dense throughout the wet sclerophyll forest, it was not found within the study area during recent surveys. Due to the lack of connectivity of the study area to known populations of this species and the disturbed nature of the majority of the study area, it is considered unlikely that this species would be present. No further assessment required.</p>
<i>Potorous tridactylus</i> Long-nosed Potoroo	V	V	<p>The Long-nosed Potoroo (SE Mainland) is sparsely distributed along the coast and Great Dividing Range of south-east Queensland through NSW (Van Dyck &amp; Strahan 2008). While the Queensland populations are considered to be reasonably secure, the status and security of other NSW populations is uncertain. It is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm (Van Dyck and Strahan 2008).</p> <p>Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature (Mason 1997). The main factors affecting habitat use would appear to be access to some form of dense vegetation for shelter and the presence of an abundant supply of fungi for food (Claridge et al. 1992). They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil (Claridge et al. 1992). The species often digs small holes in the ground in a similar way to bandicoots. It is mainly nocturnal, hiding by day in dense vegetation - however, during the winter months animals may forage during daylight hours. Individuals are mainly solitary, non-territorial and have home range sizes ranging between 2-5 ha. Breeding peaks typically occur in late winter to early summer and a single young is born per litter. Adults are capable of two reproductive bouts per annum (Van Dyck and Strahan 2008).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<p>Suitable habitat potentially occurs within the study area for this species, particularly in the areas where the understorey is dense throughout the wet sclerophyll forest, however it was not found within the study area during recent surveys. Due to the lack of connectivity of the study area to known populations of this species and the disturbed nature of the majority of the study area, it is considered unlikely that this species would be present. No further assessment required.</p>
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	<p>Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria (DEC 2005). They occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops (Tidemann 1995). Roosting camps are generally located within 20 km of a regular</p>	<p>This species was observed flying over the study study area during targeted surveys. No roost study areas are present within the study study area. Potential foraging habitat is present in the disturbed pockets of rainforest within to the study study area.</p>



Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, birth and the rearing of young (Tidemann 1995).</p> <p>Annual mating commences in January and a single young is born each October or November. Study area fidelity to camps is high with some caps being used for over a century (Tidemann 1995). They travel up to 50 km to forage, on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines. They also forage in cultivated gardens and fruit crops and can inflict severe crop damage (Churchill 2008).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<b>Further assessment is required.</b>
<p><i>Pseudomys gracilicaudatus</i></p> <p>Eastern Chestnut Mouse</p>	V	-	<p>In NSW, the Eastern Chestnut Mouse occurs north of the Hawkesbury River along to coast and eastern fall of the Great Dividing Range extending north into Queensland (DEC 2005).</p> <p>The Eastern Chestnut Mouse is mostly found in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is common in grassy woodlands. Optimal habitat appears to be regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again. The species feeds at night via runways through the grassy and sedge understorey, within an area of less than half a hectare. It has a broad diet of grass stems, macroinvertebrates, fungi and seeds (Menkhorst and Knight 2001).</p>	No suitable habitat for this species occurs within the study area. No further assessment is required.
<p><i>Pseudomys oralis</i></p> <p>Hastings River Mouse</p>	E	E	<p>The species has a patchy distribution spanning the Great Dividing Range from the Hunter Valley, south of Mt Royal, north to the Bunya Mountains near Kingaroy in south-east Queensland, at elevations between 300 m and 1100 m (NSW NPWS 2002).</p> <p>The Hastings river mouse exists in dry open forests with dense, low ground cover and a diverse mixture of ferns, grass, sedges and herbs. Access to seepage zones, creeks and gullies is important, as is permanent shelter such as rocky outcrops. The species nests in gully areas or ridges and slopes (Menkhorst and Knight 2001).</p>	Potential habitat for this species occurs within the study area, however the study area is below the known altitudinal occurrence and no known populations occur in close proximity to the study area. No further assessment is required.
<p><i>Pseudomys novaehollandiae</i></p> <p>New Holland Mouse</p>	-	V	<p>The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, NSW and Queensland. In 2006, there were six to eight metapopulations of the species based on data from the NSW Atlas of Wildlife, the Victorian Atlas of Wildlife and the Tasmanian Natural Values Atlas (TSSC 2010j). At a landscape scale, the species appears to have a clumped in its distribution, most likely due to its specific</p>	The study area is outside this species' range of distribution. In addition, favourable habitat for the New Holland mouse is absent in the study area. Therefore this species is unlikely to occur in the study area. No further assessment is required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>habitat requirements (Braithwaite &amp; Gullan 1978; Fox &amp; Fox 1978; Fox &amp; Mckay 1981; Posamentier &amp; Recher 1974).</p> <p>In NSW, the New Holland Mouse is known from: Royal National Park (NP) and the Kangaroo Valley (Posamentier &amp; Recher 1974); Kuringai Chase NP (Prosser et al. 2007); and Port Stephens to Evans Head near the Queensland border (Prosser et al. 2007). Across the species' range, the New Holland Mouse is known to inhabit the following types of habitat open heathland, open woodland with a heathland understorey and vegetated sand dunes (Fox &amp; Fox 1978; Fox &amp; Mckay 1981; Hocking 1980; Keith &amp; Calaby 1968; Lazenby et al. 2008; Norton 1987; Posamentier &amp; Recher 1974; Pye 1991; Wilson 1991):</p>	
<p><i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat</p>	V	-	<p>The Yellow-bellied Sheath-tail Bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range – most of Victoria, south-western NSW and adjacent South Australia – it is a rare visitor in late summer and autumn (Lumsden and Menkhorst 1995). There are scattered records of this species across the New England Tablelands and North West Slopes (Richards 2008).</p> <p>The species roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory (Churchill 2008). Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn (Richards 2008).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<p>This species was not detected during the surveys. Although optimal habitat is not present, it is likely that this species may occasionally visit the study area.</p> <p><b>Further assessment is required.</b></p>
<p><i>Scoteanax rueppellii</i> Greater Broad-nosed Bat</p>	V	-	<p>The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m (Hoye and Richards 1995).</p> <p>The species utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. It forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m (Hoye and Richards 1995). Open woodland</p>	<p>This species was detected outside the study area at Rocky Creek Dam. A possible sonogram belonging to this species was recorded in rainforest habitat along Rocky Creek within the study area, and as such it is likely to occur.</p> <p><b>Further assessment is required.</b></p>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species (Churchill 2008). Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity study areas located in suitable trees, where they appear to exclude males during the birth and raising of the single young (Churchill 2008).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	
<p><i>Syconycteris australis</i> Common Blossom-bat</p>	V	-	<p>Coastal areas of north-east NSW and eastern Queensland. Common Blossom-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps (Churchill 2008). They roost individually in foliage of the sub-canopy, changing roost study areas daily, and return to favoured feeding study areas on consecutive nights. They require a year round supply of nectar and pollen which is gathered from a mosaic of coastal complex vegetation types. When these vegetation types are in short supply of nectar and pollen (Nov/Dec in northern NSW) (Law and Spencer 1995).</p> <p>Common Blossom-bats have been known to utilise riverine areas containing Black Bean, Silky Oak and Weeping Bottlebrush. They have also been recorded in a range of subtropical forest types, rainforest, wet sclerophyll forest and coastal Eucalypt forest (NSW NPWS 2002).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<p>This species was not detected during the surveys. Habitat opportunities are limited for this species due to the high degree of regeneration in the rainforest, and the paucity of rainforest fruits for foraging habitat. It is likely that these species occur in limited numbers and on a sporadic basis, such as when suitable feed trees including Bottlebrush (<i>Callistemon</i> spp.) are fruiting.</p> <p><b>Further assessment is required.</b></p>
<p><i>Thylogale stigmatica</i> Red-legged Pademelon</p>	V		<p>Red-legged Pademelons are patchily distributed along coastal and subcoastal eastern Australia from Cape York to the Hunter Valley in NSW. Southern range records are from the Watagan Mountains and the Wyong district. There are unconfirmed records from the western New England Tablelands (e.g. west of Emmaville). The species inhabits forest with a dense understorey and ground cover, including rainforest, moist eucalypt forest and vine scrub (Strahan 1995). They inhabit wet gullies with dense, shrubby ground cover provide shelter from predators. In NSW, they are rarely found outside forested habitat. They disperse from dense shelter areas to feed from late afternoon to early morning, favouring native grasses and herbs on the edge of the forest and are also known to feed on fruits, young seedling leaves and stems, fungi and ferns (NSW NPWS 2002).</p> <p>This species is known to occur in Whian Whian SCA and Nightcap NP</p>	<p>This species is known to occur nearby within conservation areas. While suitable habitat potentially occurs within the study area for this species, particularly in the areas where the understorey is dense throughout the wet sclerophyll forest, it was not found within the study area during recent surveys. Due to the lack of connectivity of the study area to known populations of this species and the disturbed nature of the majority of the study area, it is considered unlikely that this species would be present. No further assessment required.</p>
<p><i>Vespadelus troughtoni</i> Eastern Cave Bat</p>	V	-	<p>The Eastern Cave Bat is found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. The western limit appears to be the</p>	<p>Potential habitat exists for this species in sandstone overhangs in rocky cliff faces of the study area.</p> <p><b>Further assessment is required.</b> Possibly occurs in small</p>

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			<p>Warrumbungle Range, and there is a single record from southern NSW, east of the ACT (Churchill 1998)</p> <p>This cave-roosting species inhabits tropical mixed woodland and wet sclerophyll forest on the coast and the dividing range but extends into the drier forest of the western slopes and inland areas. It has occasionally been recorded roosting in disused mine workings and along cliff-lines in wet eucalypt forest and rainforest. (Churchill 1998)</p>	<p>numbers.</p>

\* Further assessment means that assessment under the TSC Act (and EP&A Act) (seven-part test of significance) or the EPBC Act (Assessment of Significance) is required (depending on listing source of species) to determine the potential significance of impacts from the proposed dam, for those species that are known to occur or have a high likelihood of occurrence within the study area. The significance assessment will determine if additional work is required in the form of a Species Impact Statement (SIS under TSC Act) or a Referral to DSEWPC (under the EPBC Act) is required as part of the future environmental assessment for the proposed dam.

Table 45: Assessment for threatened flora recorded within 10km of the study area or known to occur in similar habitat in the CMA sub-region

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
<i>Acalypha eremorum</i> Acalypha	E	-	Though widespread and moderately common in south-east Queensland, in NSW it occurs in only a few localities, including the Chaelundi, Lismore and Burringbar areas (DEC 2005). The species occurs at an altitudinal range from near sea level to 600 m. It grows in open forest but more commonly found in monsoon forest and vine thickets (Briggs and Leigh 1996).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Acacia bakeri</i> Marblewood	V	-	<i>Acacia bakeri</i> has a restricted distribution in north-east New South Wales and south-east Queensland, where it occurs north from Mullumbimby. Specimens have been collected from Mt Banks (in the Blue Mountains) and Yennora, which may be the result of escape from cultivation. Most plants are on private property (NSW NPWS 2002). <i>Acacia bakeri</i> is one of the few rainforest acacias. Its habitat is in or near lowland subtropical rainforest, in adjacent eucalypt forest and in regrowth of both. It usually occurs in the understorey but may occur as a large canopy tree. Rainforest in lowland north-east New South Wales has been extensively cleared and remaining habitat for <i>Acacia bakeri</i> is fragmented. Other threats include weed invasion and visitor impacts (NSW NPWS 2002).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Acronychia littoralis</i> Scented Acronychia	E	E	Scented Acronychia is found between Fraser Island in Queensland and Port Macquarie NSW within 5 km of the north coast of NSW (DECC 2005). This species grows in littoral rainforest on sand..	The study area is more than 5 km from the coast and no suitable habitat present. No further assessment required.
<i>Allocasuarina defungens</i> Dwarf Heath Casuarina	E	E	The Dwarf Heath Casuarina is confined to the north coast region of NSW, between Raymond Terrace and Port Macquarie. The majority of known plants are found near Nahiack and at Crowdy Bay National Park (Benwell & Steed 1997). The Dwarf Heath Casuarina grows in a humid warm-temperate to sub-tropical climate. The average annual rainfall at nearby Forster is 1238 mm. The Dwarf Heath Casuarina is found in coastal areas of wet to dry, dense, low, closed heath land growing on Pleistocene marine aeolian derived soils (Wilson & Johnson 1989). A few populations occur in coastal clay heath on bedrock soils, and on hinterland sandstone (Benwell & Steed 1997). These soils are humus podzols. The drier heath is on podzols with a sub-soil hard pan. Both soil types are subject to a high watertables during the rainy season (Benwell 1993). Commonly associated species at the Saltwater population include <i>Banksia aemula</i> , <i>Leptospermum polygalifolium</i> , <i>L. semibaccatum</i> , <i>Epacris pulchella</i> , <i>Baeckea diosmifolia</i> , <i>Melaleuca nodosa</i> , <i>Caustis recurvata</i> , <i>Petrophile pulchella</i> and <i>Lepyrodia interrupta</i> (Benwell 1993). In the moist heath habitat at Nahiack, common species are <i>Banksia ericifolia</i> , <i>B. oblongifolia</i> , <i>Melaleuca nodosa</i> , <i>Schoenus brevifolius</i> , <i>Pseudanthus orientalis</i> , <i>Leptospermum polygalifolium</i> , <i>L. semibaccatum</i> , <i>Hypolaena fastigata</i> and <i>Boronia saefrolifera</i> (Benwell 1993). In dry heath, common associated species include <i>Banksia aemula</i> , <i>Leptospermum polygalifolium</i> , <i>L. semibaccatum</i> , <i>Eriostemon australasica</i> , <i>Caustis recurvata</i> , <i>Leucopogon deformis</i> , <i>Hypolaena fastigata</i> , <i>Phyllota phyllicoides</i> , <i>Epacris microphylla</i> and <i>Schoenus brevifolius</i> (Benwell 1993).	No suitable habitat present. No further assessment required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
<i>Amyema plicatula</i> (formerly <i>scandens</i> )	E	E	<i>A. plicatula</i> is endemic to New South Wales and is known from only one location. This population occurs within a remnant rainforest fragment on cleared farmland within the Rocky Creek area, north of Lismore, northern New South Wales (Sheringham & Westaway 1995). <i>A. plicatula</i> is not known to occur within any conservation reserves (NPWS 1999). The species occurs within a remnant rainforest fragment on cleared undulating farmland at the foothills of the Nightcap Range (Quirico 1992). Very little is known of the ecology of <i>A. scandens</i> . It is parasitic on Rosewood, <i>Dysoxylum fraserianum</i> and flowers in summer (Quirico 1992).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Angiopteris evecta</i> Giant Fern	E	-	In Australia the Giant fern occurs in the Northern Territory and along the east coast from the Queensland wet tropics to north-eastern New South Wales. The Giant Fern was thought to be extinct in NSW until it was recorded from the Tweed Valley in the far north-east of the State in 1978 (NSW NPWS 2001). The population of the Giant Fern recorded from the Tweed region consists of a single known individual. For the purposes of this recovery plan this individual is referred to the Tweed Giant Fern. There are unconfirmed reports of occurrences of the Giant Fern in the upper Tweed Valley, Round Mountain, Burringbar, and the Byron Bay and Broken Head areas. Detailed searches of the Broken Head area have failed to locate any individuals. The historic distribution of the Giant Fern in NSW is currently unknown (NSW NPWS 2001). The microhabitat of the Tweed Giant Fern consists of a north-facing gully on a narrow floodplain. The individual is growing about 5 metres from a creek, against the base of a slope. The Tweed Giant Fern forms part of a rainforest community. The rainforest is currently represented by a simplified community dominated by Red Ash (NSW NPWS 2001).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Archidendron hendersonii</i> White Laceflower	V	-	Occurs in riverine and lowland subtropical rainforest and littoral rainforest. From north Queensland south to the Richmond River in north-east NSW. It is found on a variety of soils including coastal sands and those derived from basalt and metasediments (DECC 2005).	The study area is likely to have some suitable habitat requirements which support the white laceflower, although it was not detected in suitable habitat during vegetation surveys. <b>Further assessment is required.</b>
<i>Arthraxon hispidus</i> Hairy Jointgrass	V	V	In Australia, the species has been recorded from scattered locations throughout Queensland and on the northern tablelands and north coast of NSW. In NSW, the species occurs as far south as Kempsey, and west to Glen Innes (NSW NPWS 2002). Hairy-joint Grass is found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps as well as woodland.	Recorded. <b>Further assessment required.</b>
<i>Baloghia marmorata</i> Marbled Balogia, Jointed Baloghia	V	V	Marbled Balogia has a geographically disjunct distribution (Quinn et al., 1995) confined to the Lismore district, in north-east NSW, and the Tamborine Mountains and Springbrook, in south-east Queensland (NSW NPWS 2002). Although definitive population estimates are unavailable, the largest is Tamborine Mountain NP with 175 individuals and another three locations have 100	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.

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			individuals (Quinn et al., 1995). This species occurs within the Northern Rivers (NSW) and South East Queensland Natural Resource Management Regions (NSW NPWS 2002). Marbled Balogia is found in subtropical rainforest/notophyll vine forest and wet sclerophyll forest (brush box woodland) with rainforest understorey between 150 and 550 m above sea level (Harden et al. 2005). Soils are rich black or dark brown clay and loam derived from basalt (DECC 2005). Associated species can include Eucalyptus microcorys, Archontophoenix cunninghamiana, Aphananthe philippinensis, Capparis arborea, Planchonella australis, Ficus spp., Olea paniculata, Planchonella myrsinoides, Brachychiton discolor, Mallotus claoxyloides, Drypetes deplancheri, and Calamus muelleri (Harden et al. 2005).	
<i>Bosistoa selwynii</i> Heart-leaved Bosistoa	V	V	Occurs from Maryborough in Queensland south to the Tweed River district in north-east NSW in rainforest up to 300 m in altitude. Occurs on deep asaltic soils. In NSW, it prefers alluvial flats, particularly creek banks (DEC 2005).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Bosistoa transversa</i> Yellow satinheart	V	V	Occurs from Maryborough in Queensland south to the Nightcap Range north of Lismore in north-east NSW in lowland subtropical rainforest up to 300 m in altitude. This species is identifiable all year round. In the Northern Rivers, Yellow Satinheart is known to be associated with rainforests and wet sclerophyll forest (DEC 2005).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Brachyscome ascendens</i> Border Ranges Daisy	E	-	This specis is restricted to southeast Queensland and north-east NSW. Currently known from only one location in NSW, on the Tweed Escarpment in the Border Ranges National Park. Additional populations may occur at other clifftop sites along the Tweed Escarpment (DECC 2005). This species is associated with montane shrubland on clifftops and benches in thin, rocky soils of basaltic origin.	Not within a known population area, limited suitable habitat occurs within the study area therefore, it is unlikely to occur. No further assessment required.
<i>Bulbophyllum globuliforme</i> Miniature Moss-orchid	V	V	Miniature Moss-orchid occurs in the McPherson Range of north-east NSW and south-east Queensland; in the Maleny and Noosa areas of the Wide Bay district of Queensland and in the Calliope Range inland from Gladstone, Queensland. This species occurs within the Northern Rivers (NSW), Burnett Mary, Fitzroy, Burdekin and South East Queensland Natural Resource Management Regions (NSW NPWS 2002). The species grows only on Hoop Pines ( <i>Araucaria cunninghamii</i> ), colonising the upper branches of mature trees in upland rainforest (Harrison, 2002). It is conserved in Noosa National Park, Lamington National Park and Bunya Mountains National Park, Queensland, and Border Ranges National Park, NSW (Briggs & Leigh, 1996).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Caesalpinia bonduc</i> Knicker Nut	E	-	Knicker Nut is found in the northern part of Lord Howe Island, in the vicinity of Ned's Beach. It is also found on the north coast of NSW, and is distributed widely in the tropics and subtropics. This species grows on sandy, coral-derived soil close to the shoreline, in coastal scrub vegetation, in full sun or light shade (NSW NPWS 2002).	No suitable habitat present. No further assessment required.

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<i>Cassia brewsteri</i> var. <i>marksiana</i> Brush Cassia	E	-	This species occurs north from Brunswick Heads, around Murwillumbah, and north into south-east Queensland. It is found in littoral and riverine rainforest, and in regrowth vegetation on farmland and along roadsides. Brush Cassia prefers more fertile soil-types and is often found in low and flat study areas (DEC 2005).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Chamaesyce psammogeton</i> Sand Spurge	E	-	The Giant ironwood grows on fore-dunes and exposed headlands; often with spinifex ( <i>Spinifex sericeus</i> ). Sand spurge is found sparsely along the NSW coast from south of Jervis Bay (at Currarong, Culburra and Seven Mile Beach National Park) to Queensland (and Lord Howe Island). Populations are recorded in Wamberal Lagoon Nature Reserve, Myall Lakes National Park and Bundjalung National Park (DECC 2005).	This species is unlikely to occur in the study area as its distribution is restricted to 1 km of the coast in the Northern Rivers region. In addition, no suitable habitat is present, therefore, no further assessment required.
<i>Choricarpia subargentea</i> Giant Ironwood	E	-	Giant Ironwood is known in NSW only from Mount Chincogan near Mullumbimby and one recent record at Jiggi north-west of Lismore, and in Queensland from Boonah to Imbil. Giant Ironwood is found in dry rainforest regrowth consisting of thickets growing in steeply sloping paddocks on basalt-derived soil (Harden 2002)	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Clematis fawcettii</i> Stream Clematis	V	V	Stream Clematis occurs from the Richmond River in north-east NSW to the Bunya Mountains in south-east Queensland. This species is conserved within the Richmond Range National Park (NP), Toonumbar NP, Lamington NP, Main Range NP and Mt Barney NP (Briggs & Leigh, 1996). This species occurs over a range of 65 000 km <sup>2</sup> and herbaria collections have been made from about 35 locations. This species occurs within the Northern Rivers (NSW), Condamine (Queensland) and South East Queensland Natural Resource Management Regions (Briggs & Leigh, 1996). Stream Clematis prefers canopy gaps on loam soils derived from basalt and mixed volcanic rocks usually near streams (Harden, 1990). Associated vegetation communities include dry rainforest, complex notophyll vineforest (warm and cool subtropical rainforest), on the margins of semi-evergreen vine thickets and, at one study area, in eucalypt open forest with scattered vine forest species (Harden, 1990).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Corchorus cunninghamii</i> Native Jute	E	E	This species was previously found in an area ranging from Brisbane in Queensland to Lismore in New South Wales (Saunders 2001). There are now only four locations with extant <i>C. cunninghamii</i> populations. These were at Brookfield, Ormeau (Darlington Range) and Wongawallan in Queensland, and at Toonumbar in NSW. In general populations of <i>C. cunninghamii</i> occur on upper hillslopes or hillcrests with a south-easterly or easterly aspect (due to moist, cool conditions) (Saunders 2001). The species is closely associated with the subtropical rainforest-open eucalypt forest ecotone and common canopy species that occur alongside <i>C. cunninghamii</i> include <i>Eucalyptus propinqua</i> (grey gum), <i>Lophostemon confertus</i> (brush box) and <i>Eucalyptus siderophloia</i> (grey ironbark). The vegetative composition and density of the understorey is variable between study areas. However, at most study areas introduced weed species such as <i>Lantana</i>	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.



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			<i>camara</i> (lantana), <i>Rivina humilis</i> (coral berry) and <i>Ageratina adenophora</i> (crofton weed) are present. The location of <i>C. cunninghamii</i> populations show no association with a particular elevation or geology, although soils are shallow, stony and well drained with a loam or clay consistency (Saunders 2001).	
<i>Corokia whiteana</i> Corokia	V	V	<i>Corokia whiteana</i> has a restricted distribution in north-east NSW (DECC 2005). Three distinct occurrences of the species are known: Nightcap Range, Tweed Valley, and near Brunswick Heads (DECC 2005) within the Mt Jerusalem National Park (NP), Nightcap NP, and Whian Whian State Forest (Sheringham & Westerway, 1995). Population counts range from 10 to 23, generally with scattered individuals (Quinn et al., 1995). <i>Corokia whiteana</i> occurs at altitudes of 10–800 m above sea level in ecotones between wet sclerophyll forest and Coachwood ( <i>Ceratopetalum apetalum</i> ) warm-temperate rainforests, or in Brush Box ( <i>Lophostemon confertus</i> ) open forest with littoral rainforest understorey (DECC, 2005). Common vegetation associations include Black Wattle ( <i>Callicoma serratifolia</i> ) and Mountain Water Gum ( <i>Tristaniopsis collina</i> ) (Quinn et al., 1995). The species usually occurs on substrate derived from rhyolite and basalt, and also on quartzite sands (Quinn et al., 1995). This species occurs within the Northern Rivers (NSW) Natural Resource Management Region.	Recorded. <b>Further assessment required.</b>
<i>Cryptocarya foetida</i> Stinking Cryptocarya, Stinking Laurel	V	V	Stinking <i>Cryptocarya</i> is known from Iluka, NSW, to Fraser Island and east of Gympie, southern Queensland. This species is conserved within the Cooloolo National Park (NP), Noosa NP, Burleigh Heads NP, Lamington NP, Broken Head Nature Reserve (NR), Brunswick Heads NR, Ukerebagh NR and Tyagarah NR (Briggs and Leigh, 1996). Stinking <i>Cryptocarya</i> grows in littoral rainforest, usually on sandy soils, with mature trees also growing on basalt soils. This species occurs within the Northern Rivers (NSW), Burnett Mary and South East Queensland Natural Resource Management Regions (Briggs and Leigh 1996).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Cryptostylis hunteriana</i> Leafless Tongue-orchid	V	V	Leafless Tongue-orchid occurs in Victoria, NSW, and Queensland. This species occurs within Hawkesbury–Nepean, Hunter–Central Rivers and Northern Rivers in NSW. It is recorded mainly on coastal and near coastal ranges north to near Forster, with two isolated occurrences inland north-west of Grafton. Leafless Tongue-orchid occurs singly or more often in highly localised loose colonies and inhabits a range of habitats (Jones 2006). The species occurs mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest (Jones, 2006). It prefers open areas in the understorey of forested communities (DECC, 2005). The soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves (Jones 2006).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Cupaniopsis serrata</i> Smooth Tuckeroo	E	-	The species occurs in Queensland and reaches its southern distributional limit in New South Wales. Within New South Wales, an historical collection of <i>Cupaniopsis serrata</i> has been made from the Tweed River valley. There are no other specimen-backed records in NSW, although there	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further

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			have been a few unconfirmed reports of the species (NSW Scientific Committee 2003) The preferred habitat in New South Wales for <i>Cupaniopsis serrata</i> appears to be sub-tropical and dry rainforest. It is likely that historical decline of the species has occurred due to the reduction of the extent of rainforest in the region (NSW Scientific Committee 2003).	assessment required.
<i>Cynanchum elegans</i> White-flowered Wax Plant	E	E	This species occurs within the Hawkesbury–Nepean, Hunter–Central Rivers, Northern Rivers, Southern Rivers and Sydney Metro (NSW) Natural Resource Management Regions (DEC 2005). It has been recorded from the Gloucester district to the Wollongong area and inland to Mt Dangar (NSW NPWS 2002). The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree <i>Leptospermum laevigatum</i> – Coastal Banksia <i>Banksia integrifolia</i> subsp. <i>integrifolia</i> coastal scrub; Forest Red Gum <i>Eucalyptus tereticornis</i> aligned open forest and woodland; Spotted Gum <i>Eucalyptus maculata</i> aligned open forest and woodland; and Bracelet Honey Myrtle <i>Melaleuca armillaris</i> scrub to open scrub. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific. Seeds are wind dispersed. Seed production is variable and unreliable and it is unlikely that a soil seed bank exists for this species (NSW NPWS, 2002).	No suitable habitat present, no further assessment required.
<i>Cyperus aquatilis</i> Water Nutgrass	E	-	In NSW, Water Nutgrass is known only from a few study areas north from Grafton. It also occurs in Queensland, Northern Territory, Western Australia and New Guinea. The species grows in ephemerally wet study areas, such as roadside ditches and seepage areas from small cliffs, in sandstone areas (DEC 2005).	Potential habitat is present, though given grazing and disturbance history in suitable habitat it is unlikely to occur. No further assessment required.
<i>Cyperus rupicola</i> Cliff Sedge	V	-	Cliff Sedge grows among rocks on the exposed tops of cliffs and on cliff faces or at the base of cliffs, near forest. This species is found in southern Queensland and northeast NSW. It is known from only two locations in NSW; near Mount Warning and within Nightcap National Park (DECC 2005).	No suitable habitat is present in the study area. Therefore, no further assessment is required.
<i>Cyperus semifertilis</i> Missionary Nutgrass	E	V	<i>C. semifertilis</i> occurs on the NSW north coast and south-east Queensland. In NSW, the species is known from one study area near Mullumbimby, with an estimated population of about 50 plants (DEC 2005). The species occurs in open forest dominated by White Mahogany ( <i>Eucalyptus acmenoides</i> ). <i>Cyperus semifertilis</i> is conserved in Maiala National Park (Briggs & Leigh, 1996).	Not within a known population area, limited suitable habitat occurs within the study area though it is unlikely to occur. No further assessment required.
<i>Davidsonia jerseyana</i> Davidson's Plum	E	E	The Davidson's Plum is restricted to the Brunswick and Tweed River catchments of the north coast of NSW. The southern-most confirmed record of the species is located near Mullumbimby (DEC 2004b). The Davidson's Plum is found in coastal and lowland subtropical rainforest and wet sclerophyll forest, often with an overstorey including <i>Lophostemon confertus</i> (Brush Box), <i>Araucaria cunninghamii</i> (Hoop Pine) and/or eucalypt species. Several sub-populations of the Davidson's Plum are known from areas of regrowth rainforest with a high percentage of Camphor Laurel, <i>Lantana camara</i> (Lantana) and other exotic weeds. Some trees are isolated in paddocks or	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>

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			in road reserves (DEC 2004b).	
<i>Davidsonia johnsonii</i> Smooth Davidsonia	E	E	The Smooth Davidsonia is distributed from the Tallebudgera and Numinbah Valleys in Queensland to Tintenbar, near Ballina in NSW. Most locations are close to the coast, but two isolated locations are 25–30 km inland at Nimbin and Terania Creek (DEC 2004). Current records suggest that the Smooth Davidsonia is found mainly in wet sclerophyll forests, with a smaller number of study areas known from subtropical rainforest (complex notophyll vine forest) (DEC 2004). Records of individuals have also been made from land that has been cleared in the past. Plants still persist in these areas as isolated clumps in paddocks or in regrowth dominated by Lantana ( <i>Lantana camara</i> ) and other weed species (DEC 2004). Occurrences of the Smooth Davidsonia are known from an altitudinal range of 15–270 m, with the highest locations being in NSW at Wilsons Creek (260 m) and Huonbrook (250 m). The Smooth Davidsonia occurs on landforms that include moderate to gentle slopes, creek flats and gullies. Aspect is most commonly south-western to south-eastern, although at least one known study area is in a north-facing location (DEC 2004). The Smooth Davidsonia occurs on soil derived from a variety of parent materials. In the Tweed and Broken Head areas, the Smooth Davidsonia occurs on shallow, clay-loam podzol, with surface rocks, weathered from metasediments of the Neranleigh-Fernvale complex. Other study areas are on soils derived from basalts and rhyolites of the Lamington volcanics. Occurrences at the boundaries of basalt and rhyolite are common (DEC 2004).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Dendrocnide moroides</i> Gympie Stinger	E	-	Occurs from north Queensland, where it is fairly common, south to the Clarence River in north-east NSW. It is very rare in the southern-most part of its range. The species can be found in lowland rainforest, especially in gaps or other disturbed study areas (NSW NPWS 2002).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Desmodium acanthocladum</i> Thorny Pea	V	V	The Thorny Pea occurs mainly in the Lismore area of north-eastern NSW, but there are also records of the species from near Grafton, Coraki, Casino and the Mount Warning area (DECC, 2005). The species has been recorded in two reserves —the Mount Warning National Park (though this is a very old record) and Andrew Johnston Big Scrub Nature Reserve (NSW NPWS, 2007). The Thorny Pea occurs on basalt-derived soils at low elevations, mainly along rivers (Harden, 2002), in dry rainforest and on the fringes of riverine subtropical rainforest (DECC, 2005).	Recorded. <b>Further assessment required.</b>
<i>Diospyros mabacea</i> Red-fruited Ebony	E	E	This species occurs only in north-east NSW. It is found in a few stands on the Tweed and Oxley Rivers, upstream from Murwillumbah, on Stotts Island in the lower Tweed River and one other small population west of Mullumbimby on the Brunswick River. The largest population is in Limpinwood Nature Reserve. Usually grows as an understorey tree in lowland subtropical rainforest, often close to rivers. Soils are generally basalt-derived or alluvial (Harden 2000).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>

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<i>Diploglottis campbellii</i> Small-leaved Tamarind	E	E	<i>D. campbellii</i> is found from the coastal lowlands of the Richmond River on the far north coast of NSW to the Nerand River on the Gold Coast of Queensland. <i>D. campbellii</i> survives at nearly all locations as only one, two or three mature individuals. It is considered likely that undiscovered populations exist (Hunter et al. 1992). The habitat of <i>D. campbellii</i> has been largely modified through land clearing. The majority of individuals exist within small rainforest remnants, along road verges, or as remnant trees upon cleared land. The habitat of this species is not narrowly defined as it ranges from low altitude alluvial riverbanks to elevated rocky slopes. Soils are derived from volcanic material, and range from mixed alluvium to skeletal soils on steep slopes. The forest types in which the species occurs similarly vary from lowland subtropical rainforest to drier subtropical rainforest with a <i>Lophostemon confertus</i> open overstorey (Hunter et al. 1992). The species flowers from November until March and the fruit ripens from February to April. Fruit is not produced each year by all trees. The dispersal mechanism of the succulent fruit is unknown. The seeds do not possess a dormancy mechanism and germinate readily. <i>D. campbellii</i> would therefore not maintain a persistent soil seedbank and the total population would be entirely represented by above ground individuals (Hunter et al. 1992).	No within a known population area, limited potential habitat present, though unlikely to occur. No further assessment required.
<i>Diuris sp. aff. chrysantha</i> Byron Bay Diuris	E	-	The Byron Bay Diuris occurs in low-growing grassy heath on clay soil. This orchid is known from a single location at Byron Bay in north-east NSW where only about 20 plants have been recorded (DECC 2005). In the Northern Rivers sub-region this species is predicted to occur within 2 km of the coast.	Not a known population area and further than 2km from the coast. Therefore unlikely to occur. No further assessment required.
<i>Doryanthes palmeri</i> Giant Spear Lily	V	-	The Giant Spear Lily occurs in far north-east NSW and south-east Queensland. In NSW, it occurs on the coastal ranges that are part of the Mt Warning Caldera. Its southern distributional limit is Mount Billen (DEC 2005). The species is currently known from eleven study areas within NSW, five of which are conservation reserves. Most populations consist of only a few hundred individuals. Giant Spear Lily occurs on exposed rocky outcrops on infertile soils or on bare rock. It grows in a narrow band of vegetation along the cliff-tops and on steep cliff-faces or rocky ledges in montane heath next to subtropical rainforest, warm temperate rainforest or wet eucalypt forest (NSW NPWS 2002).	No within a known population area, limited potential habitat present, though unlikely to occur. No further assessment required.
<i>Drynaria rigidula</i> Basket Fern	E	-	This species occurs widely in eastern Queensland as well as islands of the Pacific and parts of south-east Asia. In NSW it is only found north of the Clarence River, in a few locations at Maclean, Bogangar, Byron Bay, Mullumbimby, in the Tweed Valley and at Woodenbong (DEC 2005). The Basket Fern grows on plants, rocks or on the ground. It is usually found in rainforest but also in moist eucalypt and Swamp Oak forest (NSW NPWS 2002).	No within a known population area, limited potential habitat present, though unlikely to occur. No further assessment required.
<i>Eidothea hardeniana</i> Nightcap Oak	CE	E	The Nightcap Oak is known from a very limited area in the Nightcap Range on the upper north coast of NSW, north east of Lismore. The trees are scattered across a few hectares. The Nightcap Oak grows in simple notophyll/microphyll vine forest (warm temperate rainforest) on rhyolite	No suitable habitat present. No further assessment required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			geology (DEC 2005).	
<i>Elaeocarpus sedentarius</i> Minyon Quandong	E	E	This species is now known to occur in Whian Whian State Conservation Area and Nightcap National Park north of Lismore, and in Mount Jerusalem National Park west of Mullumbimby (Harden 2000). Many of the known individuals occur at the boundary between rainforest and <i>Lophostemon confertus</i> forest type. Almost all populations occur on rhyolite-derived soil or soils derived from rhyolite and basalt (McKinley <i>et al.</i> 1998). The main Whian Whian State Forest and Mt Jerusalem National Park populations are on rhyolite, while the Snows Gully Nature Reserve population is on rhyolite with basalt influence (Maynard <i>et al.</i> 2008). Species associated with <i>E. sedentarius</i> include include <i>Ceratopetalum apetalum</i> , <i>Schizomeria ovata</i> , <i>Flagelleria indica</i> , <i>Cyathea leichhardtiana</i> , <i>Hicksbeachia pinnatifolia</i> , <i>Helicia ferruginea</i> , <i>Caldcluvia paniculosa</i> , <i>Sloanea australis</i> , <i>S. woollsii</i> , <i>Archontophoenix cunninghamiana</i> , <i>Calamus muelleri</i> , <i>Cordyline rubra</i> , <i>Linospadix monostachya</i> , <i>Synoum glandulosum</i> and <i>Ripogonum elseyanum</i> . Most study areas are in proximity to or include <i>Lophostemon confertus</i> or sclerophyll species such as <i>Eucalyptus pilularis</i> , <i>Euc. microcorys</i> , <i>Euc. grandis</i> and <i>Corymbia intermedia</i> (McKinley <i>et al.</i> 1996). Little is known of the phenology of this species and, only 32 trees have been observed in fruit (McKinley <i>et al.</i> 1996). Whian Whian State Forest and Nightcap National Park and Mt Jerusalem support relatively large populations (McKinley <i>et al.</i> 1996).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Elaeocarpus williamsianus</i> Hairy Quandong	E	E	Hairy Quandong is known from nine populations in far north-east NSW, extending from the Tweed Valley south to the Byron Bay area. The known range covers an area of approximately 50 km north-south by 30 km east-west (DEC 2005). The species is confined to regrowth subtropical/warm temperate rainforest on palaeozoic metamorphics on old landslips on steep hillsides (Floyd 1989). The species is typically found on steep and eroding slopes at low altitude in gullies, toe slopes, steep drops adjacent to creeks and the headwater areas of creeks (DEC NSW, 2004). The species is commonly associated species include Brush Box ( <i>Lophostemon confertus</i> ), Flooded Gum ( <i>Eucalyptus grandis</i> ) and Black Apple ( <i>Planchonella australis</i> ) and the introduced Camphor Laurel ( <i>Cinnimomum camphora</i> ) and Lantana ( <i>Lantana cammara</i> ) (DEC NSW, 2004).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Eleocharis tetraquetra</i> Square-stemmed Spike-rush	E	-	This species was thought to be extinct in NSW until it was rediscovered in 1997 at Boambee near Coffs Harbour. It has since been found in other north coast localities near Grafton and Murwillumbah. The species also occurs in south-east Queensland. It can be found in damp locations on stream edges and in and on the margins of freshwater swamps (NSW NPWS 1999b).	No suitable habitat present. No further assessment required.
<i>Elyonurus citreus</i> Lemon-scented Grass	E	-	Lemon-scented Grass occurs north from Grafton in NSW. It is only known from localities south of Casino, north-west of Grafton, near Cudgen Lake on the Tweed coast and in Yuraygir National Park (DEC 2005). The species grows in sandy soils near rivers or along the coast in wallum areas or sand dunes. At the NSW locations, the species has been found growing in infertile white sands	No suitable habitat within the study area. No further assessment required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			(NSW NPWS 2002).	
<i>Endiandra floydii</i> Floyd's Walnut	E	E	This species is known from Pimpama, just north of the Queensland Gold Coast, south to Byron Hills, six km south of Cape Byron, NSW (NSW NPWS 2004). All known occurrences are within 30 km of the coast (Floyd 1989). The species occurs in subtropical (including littoral) rainforest or wet sclerophyll forest, often with <i>Lophostemon confertus</i> (Brush Box) in the canopy and occasionally with <i>Araucaria cunninghamii</i> (Hoop Pine) emergents. Disturbed and regrowth study areas may include <i>Cinnamomum camphora</i> (Camphor Laurel) and <i>Lantana camara</i> (Lantana) as weed components. Most locations are on soils derived from paleozoic metamorphics, sometimes with basalt nearby. A small number of study areas are on alluvium or sand. Sheltered locations are apparently preferred, and landforms including ridgelines, slopes, gullies and creek flats have been documented. The altitude varies between close to sea level up to 430 m above sea level (NSW NPWS 2004).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Endiandra hayesii</i> Rusty Rose Walnut	V	V	Rusty Rose Walnut is known from a restricted distribution in northern NSW and southern Queensland (NSW NPWS 2002). Records of this species are clustered in the Border Ranges and Nightcap Ranges area, and at a few scattered near-coastal locations (NSW NPWS 2004b). The species occurs on poorer soils derived from sedimentary, metamorphic, or acid volcanic rocks. Vegetation includes subtropical and warm temperate rainforests, and Brush Box ( <i>Lophostemon confertus</i> ) forests, including regrowth and highly modified forms of these habitats. The altitude varies from near sea level to 800 m (NSW NPWS 2004b)).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Endiandra muelleri</i> <i>subsp. bracteata</i> Green-leaved Rose Walnut	E	-	The Green-leaved Rose Walnut is known from north-eastern NSW, north from the Clarence River to southern and central Queensland. In NSW, records nominally of this taxon are concentrated on the Tweed and Byron coasts, but also extend inland to the hinterland ranges, and south to Tuckean, Bungawalbin and Maclean (NSW NPWS 2004b). Records for the combined taxa are usually from the poorer soils derived from sedimentary, metamorphic or acid volcanic rocks. Vegetation includes subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats (NSW NPWS 2004b).	Recorded. <b>Further assessment required.</b>
<i>Eucalyptus microcodon</i> Boarder Mallee	E	-	Occurs on shallow infertile soils on mountain tops. This species is predicted to occur within 10 km of NSW-Queensland border where four populations are recorded. Three of these occur in Queensland and one occurs in NSW at Mount Glennie near Mount Lindesay (DECC, 2005).	Not within a known population area. No further assessment required.
<i>Euphrasia bella</i> Pretty Eyebright	V	V	On the edge of cliffs near cool temperate rainforest with Antarctic Beech ( <i>Nothofagus moorei</i> ). This species is known to occur only on the McPherson Range, on Mount Merino in Limpinwood Nature Reserve.	Not within a known population area and study area does not contain suitable associated species and habitat, no further assessment required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
<i>Floydia praealta</i> Ball Nut	V	V	The Ball Nut occurs in small, scattered populations from Gympie, Queensland, southwards to the Clarence River in north-east NSW, where it inhabits riverine and subtropical rainforest, usually on soils derived from basalt (DECC 2005) or in coastal scrub (Foreman 1995).	Potential limited habitat within the study area, though not detected during surveys and unlikely to occur. No further assessment required
<i>Fontainea australis</i> Southern Fontainea	V	V	Southern Fontainea is known from the Tweed Valley and a few locations in the upper reaches of the Richmond Valley in NSW (DECC, 2005), north to Currumbin Valley and Springbrook National Park (NP) in southern Queensland (Barry and Thomas 1994). Recorded occurrences in NSW include Nightcap NP, Numinbah Nature Reserve (NR), Goonengerry State Forest, Limpinwood NR, Mount Warning NP, Inverell Shire, and the Border Ranges (Floyd, 1989). Southern Fontainea occurs in lowland subtropical rainforest and complex notophyll vine forest on basaltic alluvial flats and well drained, bright reddish-brown alluvial clay loam (Floyd, 1989). It has been recorded at higher altitudes in the Nightcap Range (NSW NPWS, 2002). Southern Fontainea has been recorded growing in White Booyong ( <i>Heritiera trifoliolata</i> ) Subtropical Rainforest Alliance (Floyd, 1989), and in vine forests with <i>Eucalyptus grandis</i> emergents (Barry & Thomas, 1994). Associated species include <i>Caldcluvia paniculosa</i> , <i>Dendrocnide excelsa</i> , <i>Dysoxylum fraserianum</i> , <i>Mischocarpus lachnocarpus</i> , <i>Planchonella australis</i> , <i>Sloanea woollsii</i> , and <i>Syzygium francisii</i> at Natural Bridge NP. White Booyong, <i>Syzygium hodgkinsoniae</i> , <i>Endiandra pubens</i> , <i>Dendrocnide photinophylla</i> , <i>Acmena ingens</i> , <i>Diploglottis cunninghamii</i> , and <i>Diospyros mabacea</i> at Oxley River (Barry and Thomas 1994).	Not within a known population area and study area does not contain suitable associated species and habitat, no further assessment required.
<i>Gaultherai viridicarpa</i> subsp. <i>Merinoensis</i> Mount Merino Waxberry	V	-	Grows in crevices and cliff faces in high altitude woodland. Known populations are restricted to Mount Merino in Limpinwood Nature Reserve on the NSW-Qld border (DECC 2005).	Not within a known population area and the study area does not contain suitable associated species and habitat. No further assessment required.
<i>Geijera paniculata</i> Axebreaker	E	-	The species is moderately common in restricted habitat in Queensland between the Brisbane River and the central Queensland coast, but very rare in north-east NSW, where it is known from the Tweed, Lismore and Wardell areas. Axebreaker is found in dry subtropical rainforest and vine scrub, often along rivers (NSW NPWS 2002).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Geodorum densiflorum</i> Pink Nodding Orchid	E	-	There are thought to be less than 10 populations of Pink Nodding Orchid in NSW, all north of Bundjalung National Park, and including Tweed Shire. The species grows in dry sclerophyll forest, often on coastal sand, at lower altitudes, north from the Macleay River on the north coast of NSW. It also occurs in open eucalypt forest and heathland, favouring sandy soils, often on grassy hillsides in loose colonies (NSW NPWS 2002).	Not within known population area, possible limited habitat present though unlikely to occur. No further assessment required.
<i>Gossia fragrantissima</i>	E	E	This species occurs in south-east Queensland and in north-east NSW south to the Richmond River. It is mainly found on basalt-derived soils occurring on dry subtropical and riverine rainforest.	Possible habitat occurs within the study area for this species, and it has the potential to

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
Sweet Myrtle			As it can coppice from roots left in the ground when rainforest is cleared, it is found at several study areas as isolated plants in paddocks or regrowth (NSW NPWS 2002).	occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Grammitis stenophylla</i> Narrow-leaf Finger Fern	E	-	The narrow-lead finger fern occurs in eastern Queensland and eastern NSW. In NSW it has been found on the south, central and north coasts and as far west as Mount Kaputar National Park near Narrabrai. It prefers moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest (Harden 2000).	Potential limited habitat within the study area, though not detected during surveys and unlikely to occur. No further assessment required.
<i>Hibbertia hexandra</i> Tree Guinea Flower	E	V	The main occurrence of Guinea Flower Tree is in the coastal ranges of the Mount Warning area of north-east NSW including Mt Warning and Nightcap national parks. However, there is an important separate occurrence in the Wauchope–Kendall area, which may be a new species. Tree Guinea Flower typically grows in heath, open forest or rainforest (DEC 2005).	Potential limited habitat within the study area, though not detected during surveys and unlikely to occur. No further assessment required.
<i>Hicksbeachia pinnatifolia</i> Monkey Nut	V	V	This species occurs from Tamborine Mountain, south-east Queensland, to the Bellinger and Nambucca Valleys, in north-east NSW (Floyd 1989). It occurs in and on the margins of subtropical rainforest from near sea level to 700 m altitude, sometimes extending into wet sclerophyll forest ((Floyd 1989). In NSW, Monkey Nut was originally a common tree in subtropical rainforest of the Richmond River and has been recorded at Missabotti, Upper Bellinger River, Dorrigo National Park, Buffer Creek, Never Never State Forest, Kyogle, Terania Creek, Whian Whian State Forest, Boomerang Falls, Durrroughby, Rosebank, Rotary Park, Alstonville, Billinudgel, Mooball, Chillingham and Murwillumbah (Floyd 1989). It is conserved within Nightcap National Park and the Mount Cougal section of Springbrook National Park (Briggs and Leigh 1996). The species occurs in Subtropical rainforest, moist eucalypt forest and Brush Box forest ((Briggs and Leigh 1996).	Recorded. <b>Further assessment required.</b>
<i>Isoglossa eranthemoides</i> Isoglossa	E	E	This species has a very restricted distribution in north-east NSW from the Tweed to the Lismore area, with a single uncertain historical report from south-east Queensland. Isoglossa occurs in the understorey of lowland subtropical rainforest, in moist situations on floodplains and slopes. It occurs in areas where underlying soils are derived from basalt, metasediments or gabbro (NSW NPWS 2002).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Lepiderema pulchella</i> Fine-leaved Tuckeroo	E	-	This species occurs on the NSW north coast north of Brunswick Heads, and in Queensland. Most records in NSW are from the Tweed Valley, and the majority of known populations are on private land. Preferential habitat is Lowland subtropical rainforest in NSW. Fine-leaved Tuckeroo is found on infertile metasediments and on fertile basalts in the Tweed Valley (NSW NPWS 2002).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Lindsaea brachypoda</i> Short-footed screw fern	E	-	In NSW, short footed screw fern is mainly found in a few locations north from Minyon Falls in Nightcap National Park. Records exist for Tumbulgum, Mullumbimby and Mooball. It also occurs in the Northern Territory and eastern Queensland. The species prefers very moist habitats in subtropical or warm-temperate rainforest or palm forest (NSW NPWS 2002).	Possible limited habitat occurs for this species, though its occurrence within the study area is considered unlikely. No further assessment required.



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<i>Macadamia tetraphylla</i> Rough-shelled Macadamia	V	V	<i>Macadamia tetraphylla</i> is endemic to eastern Australia, with a known national distribution of scattered populations extending from the Coomera River south of Brisbane to the Richmond River in northern New South Wales, and an altitudinal range of 100-800m (Floyd 1989). Populations at any given location tend to be small, with fewer than 20 individuals. The geographic range of the Rough-shelled Bush Nut is estimated to be less than 100 km (Briggs and Leigh 1996). The species is endemic to rainforest and wet sclerophyll forest communities found within the northeast New South Wales-southeast Queensland coastal region. It is found in several regional ecosystems from complex notophyll vine forest to littoral rainforest to wet sclerophyll communities. It is often found on steep slopes, especially at ecotones (NSW NPWS 2002). In NSW, <i>M. tetraphylla</i> occurs in several Endangered Ecological Communities, including lowland rainforest in the NSW North Coast and Sydney Basin Bioregions, littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions, and lowland rainforest on floodplain in the NSW North Coast Bioregion. Seed dispersal is by small rodents and gravity fall, probably with some assistance from local stream flooding (NSW NPWS 2002).	Recorded. <b>Further assessment required.</b>
<i>Marsdenia longiloba</i> Clear Milkvine	E	V	This species occurs at scattered study areas on the NSW north coast from Hastings River northwards to Mount Nebo in Queensland (NSW NPWS 2002). It is conserved within the Lamington National Park (NP), Main Range NP, Mt Barney NP, and Toonumbar NP (Briggs & Leigh, 1996). Clear Milkvine grows in open eucalypt forest, or margins of subtropical and warm temperate rainforest, and in areas of rocky outcrops. Associated species include <i>Eucalyptus crebra</i> , <i>E. microcorys</i> , <i>E. acmenoides</i> , <i>E. saligna</i> , <i>E. propinqua</i> , <i>Corymbia intermedia</i> and <i>Lophostemon confertus</i> .	Recorded. <b>Further assessment required.</b>
<i>Melicope vitiflora</i> Coast Euodia	E	-	Coast <i>Euodia</i> grows in subtropical and littoral rainforest. Coast <i>Euodia</i> occurs in Queensland and with its southern limit in NSW, where it is largely restricted to coastal areas around Brunswick Heads and Ocean Shores, Broken Head, also in the Tweed Valley and Nightcap Range. In NSW, it is known from a small number of locations. It is reserved in Broken Head Nature Reserve, Brunswick Heads Nature Reserve and Whian Whian State Conservation Area (DECC 2005).	The study area may support potential habitat in the form of moist eucalypt forest is present, so its presence cannot be discounted. <b>Further assessment is required.</b>
<i>Mitrasacme pygmaea</i> Pygmy Bishop's Hat	E	-	In NSW, Pygmy Bishop's Hat is only found in Mt Warning National Park. This species grows amongst rock outcrops in open habitat. Each plant lives for one year and dies after flowering and fruit-set has finished resulting in wide fluctuations in annual population size. This would be dependent upon such variables as rainfall, fire, seed-bank etc. The species flowers and fruits February to September (NSW NPWS 2002).	Potential habitat for this species occurs within the dry forest areas of the study area, though was not recorded during targeted searches during its flowering and fruiting period and is unlikely to occur. No further assessment required.
<i>Myrsine richmondensis</i> Ripple-leaf Muttonwood	E	E	Ripple-leaf Muttonwood occurs in subtropical and dry rainforest and swamp forest on creek flats and slopes on basalt derived soil. It is known only from a few populations at Coraki, Boatharbour	The study area is outside the species known range of occurrence. No further assessment

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			near Lismore, and the Cherry Tree area west of Casino (DECC 2005).	required.
<i>Niemeyera chartacea</i>	E	-	Occurs in littoral and subtropical rainforest on coastal sands or soils derived from metasediments. The species occurs in Queensland and reaches its southern limit at the Brunswick River in north-eastern NSW, where it is known from only one site at Brunswick Heads. This population comprises only a few individuals (DECC 2005).	The study area is outside the species known range of occurrence. No further assessment required.
<i>Niemeyera whitei</i> Rusty Plum	V	-	Occurs in rainforest and the adjacent understorey of moist eucalypt forest. Rusty Plum occurs in the coast and adjacent ranges of northern NSW from the Macleay River into southern Queensland. Its distributional stronghold is on the mid north coast around Coffs Harbour (DECC 2005) and one specimen was recorded in Night Cap NP in 1992.	Potential habitat for this species occurs within the moist eucalypt forest of the study area. <b>Further assessment is required.</b>
<i>Oberonia complanata</i> Yellow-flowered King of the Fairies	E	-	Within NSW, there are several historical collections (all pre 1917) of this species from Byron Bay and Lismore, and a collection from Coffs Harbour from 1961. More recent observations of this species have been made from Lismore and Wollumbin (NSW NPWS 2002). This species grows on trees and rocks in littoral rainforest, subtropical rainforest, dry rainforest, wet or dry eucalypt forests, dunes (including stabilised sands), stream-side areas, swampy forests and mangroves (Floyd, 1989).	Potential habitat present, though considered unlikely to occur. No further assessment required.
<i>Ochrosia moorei</i> Southern Ochrosia	E	E	This species occurs in north-east NSW and south-east Queensland, extending from the Richmond River in NSW through to the McPherson Ranges, Queensland (Forster 1996). Populations are reserved in Victoria Park Nature Reserve (NR), Booyong NR, Wollumbin Wildlife Refuge, Liminwood NR, Boatharbour NR, Big Scrub NR, Rotary Park NR, Wilson Park NR, Davis Scrub NR, Currie Park, Numinbah NR, Amaroo Flora Reserve and Snows Gully NR (Quinn et al. 1995). The current distribution is very sparse due to land clearing (Barry & Thomas, 1994). Southern Ochrosia grows in riverine and lowland warm subtropical rainforest (Floyd 1989) and complex notophyll vine forest in soils of volcanic origin (Forster 1996). This species is often found on hillsides near drainage lines, at elevations of 100–1000 m above sea level. Soils are deep, alluvial or basalt derived, well-drained, and reddish-brown to dark brown. Associated species include: <i>Argyrodendron trifoliolatum</i> , <i>Dysoxylum fraserianum</i> , <i>Dendrocnide excelsa</i> , <i>Syzygium crebrinerve</i> , <i>Aphananthe philippinensis</i> , <i>Capparis arborea</i> , <i>Pouteria australis</i> , <i>Ficus spp.</i> , <i>Citriobatus spp.</i> , <i>Caldcluvia paniculosa</i> , <i>Diploglottis australis</i> , <i>Polyscias elegans</i> , <i>Orites excelsa</i> , <i>Sloanea woollsii</i> , <i>Rapanea subsessilis</i> , <i>Ardisia bakeri</i> , <i>Triunia youngiana</i> and <i>Wilkiea austroqueenslandica</i> (Quinn et al., 1995).	Recorded. <b>Further assessment required.</b>
<i>Owenia cepiodora</i> Onionwood	V	V	Onionwood occurs in the border region of north-east New South Wales and south-east Queensland, within both the Northern Rivers (NSW) and South East Queensland Natural Resource Management Regions (McKinley et al. 1996). The eastern most extant record is Hayters	Not within a known population area and not recorded within the study area, limited habitat available, no further assessment

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			Hill Nature Reserve, near Byron Bay (Floyd, 1989). Onionwood grows in complex notophyll vine forest, dry Araucarian vine forest and wet sclerophyll or subtropical rainforest at altitudes ranging from 30 to 420 m The population of Onionwood in NSW is known to consist of about 40 mature individuals and at least 400 immature individuals, including seedlings (McKinley et al.1996).	required.
<i>Peristeranthus hillii</i> Brown Fairy-chain Orchid	V	-	This species is found in north-eastern NSW, north from Port Macquarie, extending to north-eastern Queensland (DEC 2005). The species is an epiphyte, growing in clumps on tree trunks and thick vines. Preferential habitat occurs in coastal and near-coastal environments, particularly Littoral Rainforest and the threatened ecological community Lowland Rainforest on Floodplain (Jones 2006).	No suitable habitat within the study area, no further assessment required.
<i>Phaius australis</i> Southern Swamp Orchid	E	E	Southern Swamp Orchid is found in Queensland and north-east NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie (DEC 2005). It exists in swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas (Jones 2006).	No suitable habitat within the study area, no further assessment required.
<i>Phaius tankervilleae</i> Lady Tankerville Swamp Orchid	E	E	This species is widespread, though seriously depleted, through Asia, New Guinea and Queensland and at least formerly, in north-east NSW. It may be extinct in north-east NSW (DEC 2005). It is found in swampy grassland or swampy forest, including rainforest, eucalypt and paperbark forest (Jones 2006).	No suitable habitat within the study area, no further assessment required.
<i>Phyllanthus microcladus</i> Brush Sauropus	E	-	In NSW, this species is confined to a few locations in the Tweed, Brunswick, Richmond and Wilson River Valleys with an outlying population near Grafton. It also occurs in south-east Queensland. It is mostly found on banks of creeks and rivers, in streamside rainforest (NSW NPWS 2002).	Potential habitat within the study area, though despite targeted searches was not identified, not known in proximity to the study area, thus unlikely to occur, no further assessment required.
<i>Plectranthus nitidus</i> Nightcap Plectranthus	E	E	<i>P. nitidus</i> occurs within NSW and Queensland. In NSW the species was previously known only from pre 1945 collections from Nightcap National Park near Terania Creek in northern NSW. However, the species was recently collected from the Nullum and Richmond Range State Forests by A. Benwell (pers comm). <i>P. nitidus</i> grows on rocky cliff faces and boulders, in the shelter and shade provided by the adjacent rainforest. It co-occurs with <i>P. graveolens</i> and Crofton Weed (NPWS 1999).	No suitable habitat occurs within the study area for this species, although it has been recorded nearby. No further assessment is required.
<i>Pomaderris notata</i> McPherson Range Pomaderris	V	-	McPherson Range Pomaderris is known from rocky basalt ranges in montane heaths and scrubs or in scrubby rainforest. The McPherson Range Pomaderris occurs mainly in Queensland. In NSW it is known from five sites in the McPherson and Tweed Range areas, including Mount Warning National Park, Mebbin National Park and Limpinwood Nature Reserve. The total population size is thought to be small (DECC 2005).	Outside of area of occurrence and little habitat present. No further assessment required.

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<i>Psilotum complanatum</i> Flat Fork Fern	E	-	The flat fork fern grows in moist tropical or subtropical rainforest, or moist eucalypt forest. It is restricted to moist tropical areas in Queensland, the Pacific and tropical America. In NSW, there is a historic record for Ballina but it has not been seen for many years and may be extinct in NSW (DECC 2005).	Not known to occur in the study area; therefore unlikely to occur. No further assessment required.
<i>Pterostylis nigricans</i> Dark Greenhood	V	-	The dark Greenhood is restricted to occur within 10 km of the coast. It occurs on coastal heathland with Heath Banksia ( <i>Banksia ericifolia</i> ), and lower-growing heath with lichen-encrusted and relatively undisturbed soil surfaces, on sandy soils. The Dark Greenhood occurs in north-east NSW north from Evans Head, and in Queensland (DECC 2005).	The study area is outside the species known range of occurrence. No further assessment required.
<i>Pultenaea maritime</i> Coast Headland Pea	V	-	The Coast Headland Pea is restricted to 1 km of the coast. It occurs in grasslands, shrublands and heath on exposed coastal headlands in New South Wales and Queensland. Within NSW, the species has been recorded from Newcastle north to Byron Bay on 16 headlands. The number of individuals at each of these sites is unknown. Five sites occur within conservation reserves. (DECC 2005)	The study area is outside the species known range of occurrence. No further assessment required.
<i>Randia moorei</i> Spiny Gardenia	E	E	This species occurs from Lismore on the north coast of NSW, northwards to the Logan River, southern Queensland. Most known records of the Spiny Gardenia are in the Tweed and Brunswick LGAs in NSW (Quinn et al. 1995). The Spiny Gardenia occurs in subtropical, riverine, littoral and dry rainforest and sometimes along moist scrubby watercourses. In NSW the species is often found in Hoop Pine ( <i>Araucaria cunninghamii</i> ) - Brush Box ( <i>Lophostemon confertus</i> ) forest with other rainforest elements present in the understorey. Although plants are typically found within rainforest or in Hoop Pine - Brush Box forest, at Terranora in Tweed Shire and on the southern slopes of Mount Chincogan in Byron Shire, the Spiny Gardenia occurs as a scattered remnant shrub in open grazing land that was formerly rainforest. At a study area on the Brunswick River near Mullumbimby, a plant was located in an open situation on the river bank. Slope and aspect of known study areas vary, however, the majority of records are from creek or river flats or on south and east facing slopes (DEC 2004b).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Rapanea</i> spp. 'Richmond River' Ripple-leaf Muttonwood	E	E	The Ripple-leaf Muttonwood occurs only within the NSW North Coast Bioregion. There are three extant populations of the Ripple-leaf Muttonwood, which occur within the Richmond River and Clarence River catchments. The Ripple-leaf Muttonwood is known to occur in tall open forest dominated by Brush Box ( <i>Lophostemon confertus</i> ), Blue Gum ( <i>Eucalyptus saligna</i> ) and Tallowwood ( <i>E. microcorys</i> ) with a rainforest subcanopy (NPWS 2002). The Ripple-leaf Muttonwood is currently known to grow on the margins of lowland floodplain rainforest, where a rainforest subcanopy or understorey is maintained. The Endangered Ecological Community of Lowland Rainforest on Floodplain is part of the habitat of the Ripple-leaf Muttonwood. The Ripple-leaf Muttonwood is found in areas with high light levels (Horton 2000). Of the two populations of the Ripple-leaf Muttonwood that occur on floodplain areas, one is known to occur in open swamp sclerophyll forest dominated by Prickly Paperbark ( <i>Melaleuca stypheloides</i> ) (Floyd 1990).	Not within a known population area and study area does not contain suitable associated species and habitat, no further assessment required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
<i>Rhynchosia acuminatissima</i> Pointed Trefoil	V	-	This species occurs in Queensland and NSW and is known from only nine locations north of Lismore, six of which occur within National Parks and Nature Reserves, and three in State Forests. Populations are generally small, comprising few individuals scattered over a wide area. Pointed Trefoil is found in or near dry rainforest dominated by Hoop Pine. Other species with which Pointed Trefoil is associated include Brush Box <i>Lophostemon confertus</i> , Grey Ironbark <i>Eucalyptus siderophloia</i> , Rough-leaved Elm <i>Aphananthe philippinensis</i> and Native Holly <i>Alchornea ilicifolia</i> (NSW NPWS 2002).	Potential habitat within the study area, though despite targeted searches was not identified, not known in proximity to the study area, thus unlikely to occur, no further assessment required.
<i>Sarcochilus dilatatus</i> Brown Butterfly Orchid	E	-	Brown Butterfly Orchid occurs in Queensland and north-east NSW. In NSW it is very rare, with the only recent record being from a single location near Hortons Creek. It grows on trees in littoral rainforest, subtropical rainforest, dry rainforest and streamside forests, mainly at low to medium (up to 500m) altitudes. The plants favour Hoop Pine as a host (Jones 2006).	Potential habitat within the study area, though despite targeted searches was not identified, not known in proximity to the study area, thus unlikely to occur, no further assessment required.
<i>Sarcochilus fitzgeraldii</i> Ravine Orchid	V	V	Ravine Orchid occurs in north-east NSW, north of the Macleay River, to Maleny in south-east Queensland (DEC 2005). The Ravine Orchid grows mainly on rocks, amongst organic matter, in cool, moist, shady ravines, gorges and on cliff faces in dense subtropical rainforest at altitudes between 500 and 700 m. Occasional clumps are found on the bases of fibrous-barked trees (Jones 2006).	Study area occurs below known altitudinal limit, no further assessment required.
<i>Sarcochilus hartmannii</i> Waxy Sarcochilus	V	V	This species is known from the Richmond River in northern NSW to Main Range National Park in south-eastern Queensland. It occurs on volcanic rocks, shallow soils and exposed cliffs in sclerophyll forests, rainforest margins or open areas at 500–1000 m altitude. It is also sometimes found at the base of fibrous trunks of trees, including cycads and grass-trees (DECC 2005). Waxy Sarcochilus is conserved in Lamington National Park (NP), Main Range NP, Tambourine Mountain NP, Mount Warning NP, and Nightcap NP (Briggs and Leigh 1995).	Study area occurs below known altitudinal limit, no further assessment required.
<i>Sarcochilus weinthalii</i> Blotched Sarcochilus	V	V	This species occurs in coastal and sub-coastal ranges north from the Richmond River in north-east NSW, and also in Queensland (DEC 2005). It exists in rainforest and drier scrubs, often in isolated patches, from 400 to 700 m in altitude (NSW NPWS 2002).	Study area occurs below known altitudinal limit, no further assessment required.
<i>Senna acclinis</i> Rainforest Cassia	E	-	Rainforest Cassia occurs in coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland (DEC 2005). The species prefers habitat in or on the edges of subtropical and dry rainforest (Floyd 1989).	Potential habitat within the study area, though despite targeted searches was not identified, thus unlikely to occur, no further assessment required.
<i>Solanum limitare</i> Border Ranges Nightshade	E	-	Border Ranges Nightshade occurs from the Bunya Mountains in southern Queensland south to the Kyogle and Urbenville areas in northern NSW. The species has been recorded from about six locations within NSW. The majority of these records are pre-1974 (DEC 2005), with few	No suitable habitat, no further assessment required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			populations found in recent times, including between Mt Glennie and Mt Lindesay on the edge of the Border Ranges National Park. The species generally occurs in open Blue Gum forest with a grassy understorey. Typically, the population numbers consist of very few plants at each study area (Floyd 1990).	
<i>Sophora fraseri</i> Brush Sophora	V	V	<i>Sophora fraseri</i> is found from south-east Queensland to Northern NSW. It is rare in NSW (north of Casino) and widespread but not common in QLD. <i>Sophora fraseri</i> is conserved in Lamington National Park (NP) and Mount Mistake NP (Briggs and Leigh 1995). The species grows in moist habitats, often in hilly terrain at altitudes from 60–660 m on shallow soils along rainforest margins in eucalypt forests or in large canopy gaps in closed forest communities (DEC 2005).	Potential habitat within the study area, though despite targeted searches was not identified and not known in close proximity to the study area, thus unlikely to occur, no further assessment required.
<i>Sophora tomentosa</i> <i>subsp. Australis</i> Silverbush	E	-	Silverbush occurs on coastal dunes. Silverbush occurs in coastal areas in Queensland and northern NSW within 2 km of the coast. It was previously common north from Port Stephens but is now uncommon and found only north of Old Bar, near Taree. The largest known population, at Port Macquarie, is estimated at up to 500 plants, other populations are of less than 20 plant (DECC 2005).	The study area is outside the species known range of occurrence and no suitable habitat is present. No further assessment required.
<i>Symplocos baeuerlenii</i> Small-leaved Hazelwood	V	V	Small-leaved Hazelwood occurs in NSW and Queensland. In NSW, it occurs in Nightcap National Park (NP), Mount Jerusalem NP, Mount Warning NP, Numinbah Nature Reserve, Nullum State Forest, and the Tweed and Brunswick Valleys. In Queensland, it occurs in the Gold Coast Local Government Area, Mount Cougal NP, and Natural Arch NP (Briggs and Leigh 1995). Small-leaved Hazelwood grows in subtropical and warm temperate rainforest on less fertile soils derived from rhyolite (Harden 2002).	Suitable geology no present, not recorded within the study area and unlikely to occur, no further assessment required.
<i>Syzygium hodgkinsoniae</i> Smooth-bark Rose Apple	V	V	Smooth-bark Rose Apple occurs in riverine rainforest on rich alluvial or basaltic soils, from the Richmond River in NSW to Gympie, Queensland, with a disjunct occurrence in north Queensland (NSW NPWS 2002). Recorded occurrences in NSW include Toonumbar and Unumgar State Forests, Big Scrub, and Minyon Falls Forest Reserves, Davis Scrub and Brunswick Heads Nature Reserves, as well as study areas at Lismore, Alstonville, Wardell, Hayters Hill, Mullumbimby, Billinudgel, Crabbes Creek, Burringbar, Eungella, Upper Oxley and Couch Creek (Floyd 1989). The species occurs mostly as scattered individuals along watercourses, where the habitat is frequently limited and degraded (DEC 2005).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Syzygium moorei</i> Coolamon Rose Apple	V	V	Rose Apple is most commonly found in subtropical and riverine rainforest at low altitude. It is found along sections of the Richmond, Brunswick and Tweed Rivers in NSW and in south-east Queensland (Floyd 1989). The species often occurs as isolated remnant paddock trees. Associated species include <i>Argyrodendron trifoliatum</i> (Floyd 1989).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Taeniophyllum muelleri</i>	-	V	Grows on outer branches and branchlets of rainforest trees; coast and coastal ranges, from sea level to 250 m alt., north from the Bellinger NSW subdivisions. Flowers from June–October (DEC	Possible, but unlikely and not known to occur in close proximity, no further assessment

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
Minute Orchid			2005).	required.
<i>Tarenna cameronii</i> Cameron's Tarenna	E	-	This species is rare in south-east Queensland. In NSW only one very small population is known in Lismore. It occurs in the understorey of dry rainforest, on rocky basalt-derived soils (DEC 2005).	Dry rainforest within the study area is on metasediments/ sedimentary geology therefore no suitable habitat, no further assessment required.
<i>Thesium austral</i> Austral Toadflax	V	V	Austral Toad-flax is a root parastudy area that takes water and some nutrient from other plants, especially Kangaroo Grass. It is found along the NSW coast, from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia (Briggs and Leigh 1996). The species has a wide ecological tolerance having been recorded from subtropical, temperate and sub-alpine climates, and on soils derived from sedimentary, igneous and metamorphic (Briggs and Leigh 1996). The species is largely confined to grasslands, grassy woodlands or sub-alpine grassy heathlands, often in damp study areas in association with Kangaroo Grass ( <i>Themeda australis</i> ). and (less frequently) with <i>Poa</i> spp. (Briggs and Leigh 1996).	No damp areas of Kangaroo Grass occur within the site, with the only patch recorded on a hillslope. No suitable habitat present, no further assessment required.
<i>Tinospora smilacina</i> Tinospora Vine	E	-	This species occurs north from the Coffs Harbour district in north-east NSW, where it is rare. Its distribution also includes Queensland, Northern Territory and Western Australia. It prefers dry rainforest and along the boundaries of dry rainforest and dry eucalypt forest (NSW NPWS 2002).	Possible habitat occurs within the study area for this species, and it has the potential to occur, though it was not recorded. <b>Further assessment is required.</b>
<i>Tinospora tinoporoides</i> Arrow-head Vine	V	V	This species occurs north of the Richmond River in north-east NSW, where it is locally common in some parts of its range. It is also recorded from a single location (Burleigh Heads National Park) in south-east Queensland. This species is conserved within the Toonumbar NP, Nightcap NP, Mt Warning NP, Bongil Bongil NP, Snows Gully Nature Reserve (NR), Numinbah NR, Boat Harbour NR, Davis Scrub NR, Johnsons Scrub NR, Victoria Park NP, Minyon Falls Flora Reserve, and the Springbrook Conservation areas (Briggs & Leigh 1996). Arrow-head Vine is locally common in wetter subtropical rainforest, including littoral rainforest, on fertile, basalt-derived soils. It also occurs in complex notophyll vine forest (Forman 2007).	Recorded. <b>Further assessment required.</b>
<i>Tylophora woollsii</i> Cryptic Forest Twiner	E	E	This species occurs from the northern and central western slopes of NSW and into southern Queensland. It has been recorded from a number of locations including; Bald Rock National Park, Marengo State Forest, Sheas Nob State Forest, Clouds Creek State Forest, Ewingar State Forest, Kangaroo River State Forest, Boonoo State Forest, Gibraltar Range National Park and Barrington Tops National Park (NPWS 1999). <i>T. woollsii</i> grows in wet sclerophyll forest and rainforest (Harden & Williams 1992). Associated species include <i>Acacia melanoxylon</i> , <i>A. binervata</i> , <i>Caldcluvia paniculata</i> , <i>Ehretica acuminata</i> , <i>Eucalyptus microcorys</i> , <i>E. saligna</i> , <i>Schizomera ovata</i> , and <i>Syncarpia</i> spp. (Quinn et al. 1995). A number of populations also occur along disturbed	Lack of characteristic associate species and unknown with proximity to the study area, thus unlikely to occur, no further assessment required.

Species Name	TSC Act Status	EPBC Act Status	Habitat Requirements	Likelihood of Occurrence & Determination of Further Assessment Requirements*
			roadside verges (NPWS 1999). <i>T. woolsii</i> has been recorded flowering in January to April. (Quinn et al. 1995).	
<i>Uromyrtus australis</i> Peach Myrtle	E	E	This species is restricted within Nightcap and Mount Jerusalem national parks and Whian Whian State Conservation Area, west of Mullumbimby in far north-east NSW (Briggs and Leigh 1996). Peach Myrtle occurs in a very specialised habitat, being restricted to high rainfall areas on Nimbin Rhyolite geology from 400-770m altitude. The species occupies the mid stratum in warm temperate rainforest or in closed forest under taller emergent Eucalyptus spp. and Lophostemon confertus (Brush Box). Other associated species include; <i>Ceratopetalum apetalum</i> (Coachwood), <i>Callicoma serratifolia</i> (Crabapple) and <i>Caldcluvia paniculosa</i> (Briggs and Leigh 1996). Peach Myrtle flowers during November and December. The species is likely to be pollinated by insects and the fleshy fruit, which ripens in April/May is likely to be dispersed by birds. The species possesses the ability to sucker from the roots following physical disturbance, and prolific suckering has been observed following damage from logging (Quinn et al. 1995).	Lack of suitable geology for this species occurrence within the study area. Unlikely to occur, no further assessment required.
<i>Wahlenbergia scopulicola</i> Rock-face Bluebell	E	-	Rock-face Bluebell is found in crevices in cliffs at high altitudes. This Bluebell occurs only in the McPherson Range (DECC 2005).	No suitable habitat is within the study area, and outside of habitat range. Therefore, no further assessment required.
<i>Xylosma terrae-reginae</i> Queensland Xylosma	E	-	This species occurs in the Richmond River district in north-east NSW, north to the Maryborough region in Queensland. It is rare in NSW, with only restricted habitat. It occurs on littoral and subtropical rainforest on coastal sands or soils derived from metasediments (NSW NPWS 2002).	Lack of metasediments with Subtropical Rainforest (more commonly related to Warm Temperate Rainforest), no known populations in close proximity thus unlikely to occur, no further assessment is required.
<i>Zieria adenodonta</i> Wollumbin Zieria	E	-	The Wollumbin Zieria occurs in dense shrubby vegetation on steep rocky slopes, with tea-tree, bottlebrushes and grass-trees. It is restricted to Mount Warning NP where it is recorded (DECC 2005)	The study area is outside the species known distribution and habitat. Therefore, its occurrence is unlikely. No further assessment is required.

\* Further assessment means that assessment under the TSC Act (and EP&A Act) (seven-part test of significance) or the EPBC Act (Assessment of Significance) is required (depending on listing source of species) to determine the potential significance of impacts from the proposed dam, for those species that are known to occur or have a high likelihood of occurrence within the study area. The significance assessment will determine if additional work is required in the form of a Species Impact Statement (SIS under TSC Act) or a Referral to DSEWPC (under the EPBC Act) is required as part of the future environmental assessment for the proposed dam.



## APPENDIX 4: THREATENED SPECIES AND COMMUNITY ASSESSMENTS UNDER PART 3A AND EPBC ACT GUIDELINES

### Assessments of Significance under the Part 3A of the *Environmental Planning and Assessment Act 1979* (NSW)

The draft *Guidelines for Threatened Species Assessment* by the then Department of Environment and Conservation & Department of Primary Industries (2005) outline the assessment process for threatened species populations, or ecological communities or their habitats for development applications assessed under Part 3A of the *Environment Planning and Assessment Act* (1979).

Appendix 3 of the Guidelines details the questions to assess potential impacts of a proposal on threatened species, populations or ecological communities or their habitat (as listed under the TSC Act). The questions are included below and the tables below (Table 47) assess these criteria for each species identified within the study area or considered likely to occur. The assessment represents an unmitigated impact assessment for each of the species concerned.

For ease of assessment (and review), species with similar ecology/life history have been grouped. The taxa in the following table have been grouped (**Table 46**). Other taxa recorded or likely to occur were assessed separately.

Table 46: Species grouping for assessments

Taxa	Grouping	Species Included in Assessment
Bats	Tree/foilage-roosting microbat	Eastern False Pipistrelle; Yellow-bellied Sheath-tail Bat; Greater Broad-nosed Bat; Large-footed Myotis; and Eastern Long-eared Bat.
	Cave-roosting microbat	Little Bentwing Bat; Eastern Bentwing Bat; Large-footed Myotis; and Eastern Cave Bat.
	Frugivorous megabats	Grey-headed Flying-fox; Eastern Tube-nosed Bat; and Common Blossom Bat.
Birds	Wetland Birds	Black Bittern, Osprey, Red Goshawk, Square-tailed Kite
	Woodland/Forest Birds	Little Lorikeet, Swift Parrot, Scarlet Robin, Eastern Bristlebird, Albert's Lyrebird, Varied Sitella & Flame Robin
	Hollow-dependent forest birds	Masked Owl, Powerful Owl, Sooty Owl and Glossy Black Cockatoo
	Button-Quails	Red-backed Button-quail, Black-breasted Button-quail
	Fruit-Doves	Wompoo Fruit-dove, Rose-crowned Fruit-dove, Superb Fruit-dove
Frogs	Barred Frogs	Giant Barred Frog ( <i>Mixophyes iteratus</i> ), Fleay's Barred Frog ( <i>M. fleayi</i> )
Flora	Rainforest flora recorded within the study area	<i>Corokia whiteana</i> , Southern Ochrosia ( <i>Ochrosia moorei</i> ), Arrow-head Vine ( <i>Tinospora tinosporoides</i> ), Red Boppel Nut ( <i>Hicksbeachia pinnatifolia</i> ), Rough-shelled Macadamia ( <i>Macadamia tetraphylla</i> ).
	Rainforest flora not recorded within the study area	Marblewood ( <i>Acacia bakeri</i> ), Rusty Plum ( <i>Amorphospermum whitei</i> ), <i>Amyema plicatula</i> (formerly <i>scandens</i> ), Davidson's Plum ( <i>Davidsonia jerseyana</i> ), Smooth Davidsonia ( <i>Davidsonia johnsonii</i> ), Gympie Stinger ( <i>Dendrocnide moroides</i> ), Thorny Pea ( <i>Desmodium acanthocladum</i> ), Red-fruited Ebony ( <i>Diospyros mabacea</i> ), Minyon Quandong ( <i>Elaeocarpus</i>

Taxa	Grouping	Species Included in Assessment
		<i>sedentarius</i> ), Hairy Quandong ( <i>Elaeocarpus williamsianus</i> ), Floyd's Walnut ( <i>Endiandra floydii</i> ), Rusty Rose Walnut ( <i>Endiandra hayesii</i> ), Green-leaved Rose Walnut ( <i>Endiandra muelleri</i> subsp. <i>bracteata</i> ), Axebreaker ( <i>Geijera paniculata</i> ), Sweet Myrtle ( <i>Gossia fragrantissima</i> ), Isoglossa ( <i>Isoglossa eranthemoides</i> ), Fine-leaved Tuckeroo ( <i>Lepiderema pulchella</i> ), Spiny Gardenia ( <i>Randia moorei</i> ), Smooth-bark Rose Apple ( <i>Syzygium hodgkinsoniae</i> ), Coolamon Rose Apple ( <i>Syzygium moorei</i> ), Tinospora Vine ( <i>Tinospora smilacina</i> ) Coast Euodia ( <i>Melicope vitiflora</i> ) and White Laceflower ( <i>Archidendron hendersonii</i> )

### Part 3A Assessment of Significance

The following points for consideration are included as the table headings for the discussion within **Table 47**. These are from the Part 3A Guidelines.

1. *How is the proposal likely to affect the lifecycle of a threatened species and/or population?*
  - a) *Displaces or disturbs threatened species and/or populations*
  - b) *Disrupts the breeding cycle*
  - c) *Disturbs the dormancy period*
  - d) *Disrupts roosting behaviour*
  - e) *Changes foraging behaviour*
  - f) *Affects migration and dispersal ability*
  - g) *Disrupts pollination cycle*
  - h) *Disturbs seed banks*
  - i) *Disrupts recruitment (ie germination and establishment of plants)*
  - j) *Affects the interaction between threatened species and other species in the community (eg pollinators, host species, mychorrhizal associations)*
  
2. *How is the proposal likely to affect the habitat of a threatened species, population or community?*
  - a) *Disturbs any permanent, semi-permanent or ephemeral water bodies*
  - b) *Degrades soil quality*
  - c) *Clears or modifies native vegetation*
  - d) *Introduces weeds, vermin or feral species or provides conditions for them to increase and/or spread*
  - e) *Removes or disturbs key habitat features such as trees with hollows, caves and rock crevices, foraging habitat*
  - f) *Affects natural revegetation and recolonisation of existing species following disturbance*
  
3. *Does the proposal affect any threatened species or populations that are at the limit of its known distribution?*
  
4. *How is the proposal likely to affect current disturbance regimes?*
  - a) *Modifies the intensity and frequency of fires*
  - b) *Modifies flooding flows*
  
5. *How is the proposal likely to affect critical habitat?*
  - a) *Removes or modifies key habitat features*
  - b) *Affects natural revegetation or recolonisation of existing species following disturbance*
  - c) *Introduces weeds, vermin or feral species*
  - d) *Generates or disposes of solid, liquid or gaseous waste*
  - e) *Uses pesticides, herbicides, other chemicals.*

Table 47: Part 3a Assessments of Significance for Threatened and Migratory Fauna Species

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Loveridges Frog	<p>Breeds in nests in the ground in loose soil or in cavities on stream banks. Males construct breeding chambers where eggs are deposited. Tadpoles do not require water for metamorphosis (Knowles <i>et. al.</i>, 2004).</p> <p>Found just to the west of the buffer area. Although this area will not be cleared or inundated, potential impacts from noise, dust and reduction in dispersal opportunities are potential impacts on the lifecycle of this species</p>	<p>Found in secondary growth wet sclerophyll forest, under an outcrop of rocks a few days after rain. This frog is unlikely to use Rocky Creek but may use one or more of the tributary streams and its range may extend into the western part of the buffer and inundation area which will be cleared and inundated.</p>	<p>This record represents a range extension for this species and as such is at the southern limit of its known range. The nearest records are to the north in Whian Whian SCA and Night Cap NP.</p>	n/a	<p>No critical habitat has been declared for this species</p>	<p>This species has recently undergone taxonomic review and a subsequent reduction in range and elevation to endangered listing under the TSC. During surveys conducted for this TEIA, 3 individuals were located in secondary wet sclerophyll forest to the west of the buffer area. This record represents a potential range extension for this specie and is definitely at the southern limit of its range. Although the proposed works will not directly impact on the immediate habitat, similar habitat occurs in the buffer and inundation areas which will be removed. Indirect impacts from construction and operation of the dam are also possible. Revegetation of the buffer would mitigate this impact and noise, vibration and traffic control measures could mitigate indirect impacts on the surrounding populations. Significant impact likely.</p>
Pouched Frog	<p>Breeds in damp leaf litter, under rocks and logs, tadpoles do not need water for metamorphosis. Removal of wet sclerophyll forest from the tops of the ridges in the west of the study area has the potential to impact on this species, if they do occur in this area.</p>	<p>Prefers moist rainforest, Antarctic Beech or wet sclerophyll forest (DEC 2005). Wet sclerophyll forest is located within the buffer along the western ridge of the study area. Marginal habitat may be present although The Pouched Frog was not detected in the study area on a night when it was calling in nearby Whian Whian SCA</p>	<p>Five isolated populations occur between Dorrigo Plateau in the south and two in south-east Queensland. The study area is not at the limit of this species range.</p>	n/a	<p>This species is listed as vulnerable under the TSC Act and as such no Critical Habitat has been declared.</p>	<p>This species was not detected on site even on nights when it was calling at Whian Whian SCA at the same time. Marginal habitat for this species (lower elevation, secondary growth wet sclerophyll forest) occurs along the ridges of the study area in proximity to the buffer zone. It cannot be concluded at this stage that the species does not occur and if it does (likely to be around the dam wall area), then the dam would be a significant impact. Further targeted searches would increase certainty about occurrence of this species. If present, a significant impact is likely, although revegetation in the buffer zone could improve habitat availability for this species and reduce impact</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Green – Thighed Frog	Breeding follows heavy rainfall in grassy semi-permanent ponds, ditches and flood-prone areas (Tyler and Knight 2009). Breeding biology is poorly understood but frogs form aggregations and females lay up to 600 eggs (Tyler and Knight 2009). Foraging is also poorly known but thought to occur in leaf litter. The proposal would inundate areas of breeding and foraging habitat.	Occurs in a range of habitats from moist rainforest to dry sclerophyll and heath (DEC 2005). The study area provides rainforest and both wet and dry sclerophyll forest that constitutes appropriate habitat, despite no frogs being detected  The proposal will inundate up to 70 hectares of potential habitat for this species. There is potential for the buffer area to include appropriate habitat for this species in revegetation works.	Green-thighed frogs are patchily distributed from Ourimbah NSW to into southeastern Qld.  Likely to occupy in just 500km <sup>2</sup> , in total area. Only two records exist for the species in the Lismore LGA. However the study area is not near the limit of this species range	n/a	This species is listed as vulnerable under the TSC Act and as such no Critical Habitat has been declared.	This species was not detected during surveys of the site however it has a patchy distribution and often requires much survey effort to locate within an area therefore it cannot be ruled out as occurring, since appropriate habitat is available within the study area. The proposal will remove potential breeding and foraging habitat for this species so there is potential for a significant impact if present. However, careful revegetation of the buffer area could reduce the impact on this species by providing compensatory habitat in the medium to long term. Taking a precautionary approach, a significant impact is possible.

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Barred Frogs	<p>The Giant Barred Frog (GBF) Breeds around shallow, flowing rocky streams (DEC 2005) and lives in deep leaf litter in rainforest, wsf and dry sclerophyll forest. It has also been found in farmland and other disturbed areas at altitudes below 610m (Hines et al. 1999).</p> <p>Fleay's Barred Frog (FBF) has a much more restricted distribution and generally occurs at higher altitudes than the GBF and in a more restricted type of habitat (stream habitats in leaf litter in rainforest and wsf). Weedy riparian areas are considered to be marginal habitat (Mahony et. al. 1997).</p> <p>Proposal will displace any frogs that do occur within the inundation area; however none were detected in surveys, even in optimal conditions during targeted surveys over seven visits, including some call playback in October. Marginal habitat only occurs for FBF.</p>	<p>Habitat is present within the study area (warm temperature rainforest and wet sclerophyll forest) for both species however much of it is secondary growth and fragmented with less moist leaf litter which is preferred by these species.</p> <p>Shallow streams for breeding do occur and would be inundated by the proposed dam, however it is considered unlikely that a viable population of either of these species occurs in the study area (particularly FBF).</p>	<p>This area is well within the known range of the GBF and as such this species is not at its distribution limit, if it were to occur here. There is a record of this species just north of the township of Dunoon, in close proximity to the study area.</p> <p>There are no records this far south for FBF (although it occurs nearby in Nightcap NP. If it were to occur, it would be at the limit of its range.</p>	n/a	<p>At time of writing, no critical habitat for these species had been declared under the TSC Act</p>	<p>Neither of these species were recorded during the current surveys. The GBF occurs in nearby Whian Whian. One old record (1967) exists approximately one kilometre to the south of the study area but none have been recorded in the area since. The study area does contain marginal habitat for this species, however much of it is secondary growth rainforest and sclerophyll forest that does not appear to have the thick layer of leaf litter favoured by this species, There is a low probability of significant impact on this species.</p> <p>The FBF has more specialised requirements that the GBF and generally occurs at higher altitudes (although it has been recorded at an altitude of 90m (Goldingay et al. 1999). There is only marginal habitat available for this species and therefore it is unlikely that there would be a significant impact on this species either.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Three-toed Snake-tooth Skink	<p>Feeds on earthworms and beetle grubs, occurs in high quality rainforest vegetation. Breeds in same areas, fossorial (DEC 2005).</p> <p>Proposal will inundate a limited area of primarily secondary growth rainforest that has some potential breeding and foraging areas for this species. However it is considered likely that this habitat has been cut off from nearby populations for so long as to make these populations non-viable and that this habitat is only low to moderate quality.</p>	<p>Despite targeted surveys in optimal conditions for this species, no individuals were detected. This species occurs in rainforest and adjacent wet sclerophyll forests. It is found in rotting logs or in soil under fallen timber (Cogger 2000). Patches of habitat occur within the study area and larger, better quality habitat occurs on the outskirts of the study area. Up to 34 hectares of potential, but low quality habitat will be removed for this species. There may be opportunities as part of offsetting to improve surrounding or buffer areas for this species, by the use of removed fallen timber in offset or buffer areas</p>	<p>This species only occurs in the Northern Rivers area of NSW and into south-eastern QLD. It extends south to Hat Head near Kempsey, but is centred on the NSW/QLD border. Three records for this species occur in nearby Night Cap NP and Whian Whian SCA. The study area is not at the limit of its distribution</p>	n/a	<p>This species is listed as vulnerable under the TSC Act and as such no Critical Habitat has been declared.</p>	<p>This species was not recorded during the current surveys, despite targeted searches in the highest quality habitat within the vicinity of the study area. It occurs in nearby Whian Whian SCA and Night Cap NP where high quality rainforest vegetation is available. A limited amount of low to moderate quality habitat is present within the study area, with better quality habitat found just outside the buffer area. It is likely that this area has been cut off from nearby populations for more than 150 years which has meant that any populations that occur in the study area are now non-viable. There is a low probability of significant impact on this species.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
White-crowned Snake	<p>This species occupies woodlands, coastal heathland and also suburban gardens. They are secretive and nocturnal, foraging on lizards and sheltering under fallen timber and leaf litter. They have similar habitat requirements to those of <i>C. krefftii</i> which was found just outside the study area.</p> <p>The proposal would inundate areas of potential habitat for this species, with potential habitat occurring in the woodland and rainforest parts of the study area. Inundation would impact on all aspects of the life cycle of this species, although re-vegetation in the buffer areas would provide partial compensation in the form of new habitat, for some of these impacts.</p>	<p>Despite targeted surveys in optimal conditions for this species, no individuals were detected, however habitat is present for this species and a similar species, will similar requirements was detected.</p>	<p>If present, this species would be toward the southern most part of its range.</p>	N/A	<p>This species is listed as vulnerable under the TSC Act and as such no Critical Habitat has been declared.</p>	<p>This species has a relatively wide range of potential habitats, with much of the woodland and rainforest parts of the study area providing potential habitat. This species was not found despite targeted searches in optimal conditions, however it may still occur. The proposal would impact on much of the habitat in the area and as such there is a high risk of significant impact to this species.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Koala	<p>Koala's peak breeding period is between September and February with dispersal of young after about 12 months or more of age (DECC 2008b). During these times, Koalas can travel large distances to find a mate or new home range, often coming to the ground to move across fragmented landscapes. Individuals have home ranges of approximately 13 – 15 ha (Phillips 1994; Callaghan and Phillips 1998 <i>in</i> DECC 2008b).</p> <p>Movement across the study area between habitat patches may be disrupted by the dam wall and inundation area with connectivity of the eastern/southern individuals and western ridgeline individuals (both known to contain Koalas) severed. This is likely to impact the genetics of the local population, dispersal, breeding success and therefore the long-term survival of the species.</p>	<p>Tallowood, primary feed tree for the species in the area, will be removed within two vegetation communities in the impact zone. This includes a loss of 7 ha of Tallowood Open Forest (40% of occurrence in study area) and 16 ha of Flooded Gum – Tallowood-Brushbox Open Forest (a loss of 30% of occurrence in study area). However, it is likely that this will be mitigated and offset by revegetation works within disturbed areas of the buffer (includes 139 ha of low-quality and weedy vegetation), which may improve the quality of habitat present and revegetate these disturbed areas with suitable feed and resting trees for this species.</p>	<p>The study area is not near distributional limit of the Koala.</p>	<p>The inundation of the dam will remove the floodplain area, however this largely contained unsuitable habitat for the Koala (rainforest and Camphor Laurel forest). As such fires and flows will not affect the Koala.</p>	<p>No critical habitat has been declared for the Koala.</p>	<p>Significant impact likely on the lifecycle of this species due to loss of connectivity of habitat patches and therefore isolation of individuals within the population, loss of genetic exchange and decline in long-term viability of the population. As long as measures identified within this report are implemented, losses to habitat will be mitigated and offset.</p>



Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Tree/foliage-dwelling microbats	<p>The proposal displaces local populations of threatened tree and foliage-dwelling microbats through the permanent removal of dry sclerophyll forest, rainforest and wet sclerophyll forest habitats. The proposal may disturb the breeding cycle of these species if works are carried out during pregnancy (spring –summer), birth (December - March) and lactation (January – April), leading to an overall reduction in recruitment rates for the year. If tree clearing works are carried out during the winter months, they may also disrupt bats during torpor, reducing the likelihood of successful dispersal to other areas of suitable habitat.</p> <p>Tree clearing will also disrupt roosting behaviour by causing bats to relocate to other areas of suitable habitat and increasing competition for shelter resources. The proposal also affects migration and dispersal ability, by removing part of a key habitat and key corridor running in a north/south direction to large conservation reserves such as Whian Whian SCA and Nightcap NP in the western part of the study area. It also removes a number of local corridors within the study area by removing habitat.</p>	<p>The proposal involves the clearing of dry sclerophyll forest, rainforest and wet sclerophyll forests in which these species occur, or are predicted to occur. Within these habitat types, the proposal removes key habitat features including tree hollows which provide roosting and breeding opportunities for these species. Foraging habitat including the ecotone between forest and open habitats, inter-canopy gaps and tracks will be permanently removed for the proposal. As the construction of the dam will permanently remove native vegetation communities within the study area, it will prevent the recolonisation of these existing species following disturbance.</p>	N/A	N/A	N/A	<p>Impacts to tree-roosting bats are considered to be significant as the proposal displaces local populations, removes breeding and foraging habitat, may disturb the breeding cycle, may disturb a dormancy period (torpor), disrupts roosting behaviour, and affects migration and dispersal activity.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Cave-roosting microbats	<p>The proposal displaces local populations of threatened cave-roosting microbats through the flooding of caves along Rocky Creek and the southern ridgeline. The proposal may disturb the breeding cycle of these species if works are carried out during pregnancy (spring –summer), birth (December - March) and lactation (January – April), leading to an overall reduction in recruitment rates for the year. If tree clearing works are carried out during the winter months, they may also disrupt bats during torpor, reducing the likelihood of successful dispersal to other areas of suitable habitat.</p> <p>The filling of the dam will also disrupt roosting behaviour by causing bats to relocate to other areas of suitable habitat and increasing competition for shelter resources. The proposal also affects migration and dispersal ability, by removing part of a key habitat and key corridor running in a north/south direction to large conservation reserves such as Whian Whian SCA and Nightcap NP in the western part of the study area. It also removes a number of local corridors within the study area by removing habitat.</p>	<p>The proposal disturbs key habitat features including caves, which provide roosting and breeding opportunities for the Large-footed Myotis and Eastern Cave Bat. Foraging habitat for the Little and Eastern Bentwing Bat will be significantly removed including inter-canopy gaps and tracks within dry and wet sclerophyll forest habitats, and pasture will be permanently removed for the proposal. The filling of the dam could increase foraging habitat for the Large-footed Myotis, by creating deep still pools at the edges of the dam suitable for foraging. As the construction of the dam will likely inundate the caves with water within the study area, it will prevent the recolonisation of these existing species following disturbance.</p>	N/A	N/A	N/A	Impacts to cave-roosting bats are considered to be significant. The proposal may displace local populations, may disturb the breeding cycle, or disrupt roosting behaviour, migration or the ability of these species to disperse.

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Frugivorous megabats	Grey-headed Flying-foxes are a known pollinator of <i>Eucalyptus spp.</i> and fruiting rainforest trees. The removal of rainforest, wet and dry sclerophyll habitats will affect the interaction between this pollinator and native vegetation communities by reducing available foraging habitat. These impacts may occur outside the study area. This species will not be able to pollinate surrounding areas with seed from the proposed dam area.	The proposal requires the clearing of native vegetation that constitutes known foraging habitat for the Grey-headed Flying-fox, and potential foraging habitat for the Common Blossom Bat and Eastern Tube-nosed Bat. The flooding of the dam may create conditions suitable for the spread of Camphor Laurel in the buffer area (Australian Bat Society 2001). This may create additional foraging habitat for the Grey-headed Flying-fox as they will feed on the fruits of Camphor Laurel, however may degrade foraging habitat in the buffer area for the Common Blossom Bat and Eastern Tube-nosed Bat. As the construction of the dam will likely inundate the caves with water within the study area, it will prevent the recolonisation of these existing species following disturbance.	N/A	N/A	N/A	Significant impact at a regional level for the Grey-headed Flying-fox as the proposal removes over half of the available good quality foraging habitat (Tallowood Open Forest) for Grey-headed Flying-foxes in the study area, and this is the eastern limit of this vegetation type's distribution in the region. Not a significant impact to Common Blossom Bat or Eastern as these species would only occasionally use the study area due to a paucity of habitat resources, and would frequent Whian Whian SCA and Nightcap NP from which they have been recorded.

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Wetland birds	<p>The proposal is unlikely to affect the Osprey as it is an unconfirmed record, and was recorded in an unassociated habitat type. The proposal would displace any local populations of Black Bitterns through the removal of riparian vegetation around various permanent and semi permanent water bodies. This is because both bird species depend on riparian vegetation for roosting.</p> <p>The proposal may also disturb the breeding cycle of the Black Bittern, the breeding cycle may be disrupted if works occur from Spring when nests are built, or between December to March when breeding occurs. This means that recruitment for both species in the Dunoon region could be reduced for that year.</p>	<p>The vegetation that will be cleared comprises of dry sclerophyll forest, rainforest, and wet sclerophyll forests. The Black bittern inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.</p> <p>Rous Water could endeavour to provide suitable habitat for foraging through native fish stocking. For the Black Bittern, Rous Water could ensure that locally occurring native trees and shrubs are planted along the proposed dam's riparian zone and that aquatic plants are planted on the edges and in the proposed dam. These measures would assist in supporting the viability of both species.</p>	N/A	N/A	N/A	<p>The proposal is unlikely to affect the Osprey as this was an unconfirmed record, and it was recorded in a habitat type not normally associated with the requirements of this species. Significant impacts are likely for the Black Bittern, as the proposal removes potential foraging and breeding habitat. Further disturbance to remaining individuals could occur if works are carried out between September to March when breeding is occurring.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Forest and woodland birds	<p>The proposal is unlikely to affect the lifecycle of the Eastern Bristlebird as the study area provides limited habitat for this species. Additionally, given the degree of fragmentation of the site from Border Ranges NP and the species sedentary nature, it is unlikely that individuals could colonise the study area. The study area does not contain primary overwintering feed species for the Swift Parrot, which also breeds in Tasmania, and as such its lifecycle is unlikely to be affected. The Little Lorikeet, a highly nomadic species, may occasionally visit the study area to forage in the drier woodland habitats, and as such the clearing and modification of these habitats may change their foraging behaviour, and make them seek alternative foraging habitat in other areas. The proposal is likely to displace the Scarlet Robin from the study area, and disrupt the breeding cycle if works are undertaken between July and January. Potential breeding habitat for Albert's Lyrebird will be impacted around the area of sighting with works likely to disturb breeding if undertaken between May and August.</p> <p>Impacts to Flame Robin and Varied Sitella habitat are also likely, since they occur in a variety of habitats and could potentially occur within the study area, although they were not detected.</p>	<p>As limited habitat, fragmentation and the sedentary nature of the Eastern Bristlebird give it a low likelihood of occurrence in the study area, the proposal is unlikely to affect habitat important to its survival. The proposed dam will remove significant areas of habitat (rainforest and wet sclerophyll forest) around the sighting of the Albert's Lyrebird near the dam wall. The proposal is unlikely to affect Swift Parrot habitat, as only limited foraging habitat exists for this species. The proposal removes nesting opportunities such as hollow trees and foraging opportunities including dry sclerophyll forests for the Little Lorikeet. This dry sclerophyll forest on ridgelines also provides habitat to the Scarlet Robin. As this vegetation type is rare in the region, its removal is likely to be significant to the Little Lorikeet and Scarlet Robin.</p> <p>The more generalist species, (Flame Robin and Varied Sitella) have a larger extent of potential habitat within the study area and could be significantly impacted if they occur.</p>	N/A	N/A	N/A	<p>The proposal is unlikely to have a significant impact on the Eastern Bristlebird or the Swift Parrot as the study area provides limited habitat for these species. However, the proposal may have significant impacts for the Flame Robin, Varied Sitella, Little Lorikeet, Albert's Lyrebird and Scarlet Robin as the removal of vegetation may change their foraging behaviour and cause them to seek alternative foraging areas. The proposal also removes nesting and foraging opportunities for these species in dry sclerophyll forests present within the study area, which are a rare vegetation type in the region.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Hollow-dependent forest birds	<p>The study area contains foraging and breeding opportunities for the Glossy Black Cockatoo and Masked Owl which were observed during the survey, and the Sooty Owl for which anecdotal evidence of occurrence exists. Clearing works for the proposal and subsequent inundation would displace populations of these threatened species by reducing available habitat. Clearing may disrupt the breeding cycle of the Glossy-Black Cockatoo (March to August), Masked Owl (April to September) and Sooty Owl (when resources are plentiful) through the removal of hollow trees, as these species are all hollow-dependent. Noise disturbance during the breeding season may also reduce breeding success of Powerful Owls (April to September) and the Masked Owls that breed at times of year when resources are plentiful. The proposal may also disrupt the roosting behaviour of these species by causing them to migrate to other areas in search of roosting habitat, increasing competition for resources in other areas.</p>	<p>The proposal clears native vegetation within the inundation area and will have indirect effects modifying the condition of vegetation within the buffer area if not appropriately managed. The proposal also removes key habitat features including trees with hollows. These hollow trees contain the prey of the owl species. The proposal also removes foraging habitat for the Glossy-black Cockatoo by removing dry forests containing Allocasuarina spp.</p>	N/A	N/A	N/A	<p>The proposal is likely to have significant impacts for hollow-dependent birds Glossy Black Cockatoo, Masked Owl, and Sooty Owl. The proposal may displace these threatened species, disrupt the breeding cycle and cause noise disturbance if construction coincides with this period. The proposal may change roosting behaviour by causing birds to migrate to other areas seeking shelter/nesting sites and increasing competition in these areas for these resources. The proposal also removes key habitat features such as hollows for nesting, and those which contain their prey species including arboreal mammals.</p> <p>Revegetation measures in the buffer zone would assist in restoring some habitat but the time lag would be significant.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Double-eyed fig parrot	<p>The proposal would displace local populations of the double-eyed fig parrot through the permanent removal of subtropical rainforest and warm temperate rainforest. That is, habitat and foraging opportunities would be disrupted over the inundation zone if rainforest fruiting trees are removed over the inundation zone. The proposal may also disrupt the reproductive cycle of these species if works are carried out between October to January when breeding occurs (Holmes 1990), thus reducing the likelihood of successful dispersal to other areas with key habitat.</p>	<p>Historically this species may have occurred prior to large-scale clearing for cropping and other agricultural pursuits. Therefore it is likely that vegetation clearing would be a significant impact.</p> <p>The proposal involves clearing subtropical rainforest and warm temperate rainforest in which these species may occur. Within these habitat types key habitat features such as rainforest fruiting trees would be removed. Foraging rainforest habitat would also be removed for the proposal. As the construction of the dam would permanently remove native vegetation communities within the study area, it will prevent the recolonisation of these species following disturbance.</p> <p>To promote opportunities for foraging and breeding, the condition of the existing rainforest and wet sclerophyll forest over the proposed buffer zone could be improved and developed as a habitat corridor over the species range.</p>	N/A	N/A	N/A	Significant impact likely using the precautionary principle as little is known of the species, and it is unknown whether its habitat will be adversely impacted.

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Albert's Lyrebird	<p>The proposal could displace local populations of Albert's Lyrebird through the permanent removal of wet sclerophyll forest over the proposed inundation area. The proposal may also disrupt the breeding cycle of the local lyrebird populations if works are carried out during the breeding season (winter). Tree clearing will disrupt foraging behaviour by causing lyrebirds to seek other suitable areas of habitat and increase competition for local resources. This competition would be further exacerbated as the males are territorial; therefore, the likelihood of populations in the inundation zone successfully dispersing to nearby suitable habitats during construction is low.</p>	<p>The proposal involves clearing wet sclerophyll rainforest in which these species occur or are predicted to occur. Within this habitat, the proposal would remove key habitat features such as leaf litter and the associated dense canopy of eucalyptus trees, which provides foraging opportunities for lyrebirds. The construction of the dam will permanently remove native vegetation communities within the study area and it will prevent the recolonisation of the local populations following disturbance.</p>	N/A	N/A	N/A	<p>Significant impact likely as potential foraging and breeding habitat is removed by the proposal for this species, may cause disruptions if construction is carried out during the breeding season, and may change foraging behaviour causing individuals to relocate to other areas. The proposal also severs linkages to Whian Whian SCA and Nightcap National Park, which is an important corridor for this species.</p>



Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
White-eared monarch	<p>The proposal would displace local populations of White-eared Monarchs through the removal of wet and dry sclerophyll forests and regrowth forest (NSW NPWS 2002). This species is known to favour the ecotone between rainforest and other open vegetation types or the edges of rainforest, such as along roads. Such characteristics are typical of the proposed Dunoon dam inundation zone.</p> <p>The proposal may disturb the breeding cycle of this species if works are carried out between September to March leading to a reduction in overall recruitment rates for the year. Tree clearing will also disrupt foraging behaviour as they are highly active in the canopies and have been observed sallying, hovering and fluttering high in the canopy or sub canopy (Higgins et al. 2006).</p>	<p>The proposal involves the clearing of wet and dry sclerophyll forests and regrowth forests over the proposed Dunoon dam inundation zone. Within these habitat types key habitat features such as ecotones between rainforest and other open vegetation types or the edges of rainforest will be cleared. Such clearing would reduce opportunities for foraging and breeding. As the construction of the dam would permanently remove native vegetation communities within the study area, it could prevent the recolonisation of this species. However, since this species prefers the ecotones between vegetation types, the vegetation around the buffer zone of the proposed Dunoon dam could be improved to provide opportunities for foraging and roosting.</p>	<p>The proposal may affect the southern limit of the White-eared monarch. This species is distributed to eastern Queensland and the NSW north coast from Cape York south to Iluka at the mouth of the Clarence River and occur west only as far as the Richmond Range. Occasionally it is found further south in the vicinity of Coffs Harbour and Port Macquarie (NSW NPWS 2002).</p>	N/A	N/A	<p>Significant impacts are likely as the proposal will remove known foraging and potential breeding habitat for this species, may cause disturbances if construction is carried out during the breeding season, and the study area is located at the southern limit of this species distribution.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Black-breasted Button-quail	<p>The Black-breasted Button-quail has been located only ten times in the past 20 years in NSW. If present on the site, the proposal has the potential to remove a very small area of potential habitat (approximately 6 hectares of warm temperature forest near the proposed dam wall).</p> <p>The breeding cycle, foraging behaviour and all other aspects of the proposal would be disturbed, however it is very unlikely that the species would occur and no evidence was found during targeted searches.</p>	<p>Closed forest, especially vine thickets are favoured by these species, and areas of rainforest on fertile soils which promote rapid growth and therefore leaf litter fall which is crucial. The proposal would remove a small area of marginal habitat for the Black-breasted Button Quail</p>	<p>Towards the southern limit of its range, but not at the limit</p>	N/A	N/A	<p>There is a very small chance that this species would occur in the warm temperature rainforest near the dam wall, where there may be sufficient leaf litter. However, despite targeted searches no signs of these Button-quails were found. The impact of the proposal is likely not to be significant.</p>
Red-backed Button-quail	<p>The Red-backed Button-quail is found in coastal and subcoastal regions but in a much larger geographic range from Cape Yorke down to north-eastern NSW. There are still very few records, with an average of only two confirmed sightings. This species inhabits a wider variety of habitats than the Black-breasted Button-quail, with grasslands, heath and other areas close to water included.</p> <p>The proposal would disrupt foraging and breeding habitat such as that the lifecycle would be significantly impacted. This species was not detected during surveys, despite targeted searches for signs such as platelets used for dust bathing, but there is potential for its occurrence.</p>	<p>There is potential for this species to occur in a wide range of habitats that will be impacted by the proposal. Much of this potential habitat will be removed and inundated, however this could be somewhat mitigated by appropriate plantings in the buffer areas.</p>	<p>Towards the southern limit of its range</p>	N/A	N/A	<p>Although not recorded despite targeted searches, this species has the potential to occur in many parts of the study area and could be significantly impacted.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Fruit Doves	<p>The proposal would displace local populations of the Superb Fruit Dove and Rose-crowned Fruit-Doves through the permanent removal of dry sclerophyll rainforest, rainforest and wet sclerophyll forest habitats. This is because these species forage high in the canopy eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees (Pizzey and Knight 2003).</p> <p>The proposal may disrupt the breeding cycle of these species if clearing works are performed over the breeding season in September to January as they nest 5-30 metre up in rainforest and rainforest edge tree and shrubs (Pizzey and Knight 2003). Large-scale vegetation clearing would create local competition for suitable habitat and shelter resources.</p> <p>The proposal could also affect migration and dispersal ability as parts of some populations can be migratory or nomadic (Pizzey and Knight 2003) and key habitat and key habitat corridor would be removed as part of the Dunoom dam proposal.</p>	<p>The proposal involves the clearing of dry sclerophyll forest, rainforest, and wet sclerophyll forests in which these species occur, or are predicted to occur. Within these habitat types, the proposal would remove key habitat features including fruit-bearing trees, such as figs and palms, which provide food and breeding opportunities for these species.</p> <p>As the construction of the dam will permanently remove native vegetation communities within the study area, it will prevent the recolonisation of these existing species following disturbance.</p>	N/A	N/A	N/A	<p>Significant impacts are likely as the proposal removes foraging and breeding habitat for these species, may disrupt the breeding cycle, and could potentially sever the linkage to Whian Whian SCA and Nightcap NP which this species uses for migration and dispersal. The Superb and Rose-crowned Fruit dove were recorded as occurring and the Wompoo Fruit-dove is likely to occur.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Bush hen	<p>The proposal would displace local populations of the Bush hen through the removal of rainforest and wet sclerophyll forest. The proposal may disturb the breeding cycle of this species if works are carried out between October and April, leading to a reduction in recruitment rates for the year. Tree clearing would also disrupt foraging behaviour as the dense undergrowth would also be cleared. Various biota, such as earthworms, insects and frogs, rely on such undergrowth for their viability and are also preyed upon by the Bush hen. Such clearing would increase competition for foraging and sheltering resources.</p>	<p>The proposal involves the clearing of rainforest and wet sclerophyll forest in which this species might occur. Within these habitat types, the proposal would remove key habitat features including understorey or ground-layer vegetation on the margins of freshwater streams and natural or artificial wetlands. Key elements of their habitat are dense undergrowth 2-4 m tall and within 300 m of water (Muranyi and Baverstock 1996). As the construction of the dam will permanently remove native vegetation communities within the study area, it will prevent the recolonisation of the Bush hen following disturbance.</p> <p>However, since this species prefers riparian areas with dense undergrowth it is possible that the vegetation around the buffer zone of the proposed Dunoon dam could be improved to provide opportunities for foraging and roosting for this species.</p>	<p>The proposal may affect the species as the Dunoon region would be at its distribution limit. In NSW, Bush-hens are an apparently uncommon resident from the Queensland border south to the Clarence River, though the species appears to be expanding its range southwards with recent records as far south as the Nambucca River (Muranyi and Baverstock 1996). This species is known to occur in Whian Whian SCA and Nightcap NP.</p>	N/A	N/A	<p>The proposed dam may have some indirect impacts on this species and its habitat within the study area. While no individuals were detected, the study area represents the southern distribution limit for this species and as such is likely to be significant. To promote foraging, breeding and roosting opportunities for this species, the riparian zone around the dam could be developed to provide dense undergrowth 2-4m tall.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Barred Cuckoo-Shrike	The proposal would displace local populations of the Barred Cuckoo Shrike through the permanent removal of dry sclerophyll forest, wet sclerophyll forest and rainforest. However, since this bird can utilise a variety of habitats including rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses (DEC 2005), it is likely that opportunities for foraging and breeding could be promoted by improving the condition of the existing vegetation over the proposed buffer zone and planting rainforest fruit trees over the zone. This zone could then be used as a habitat corridor over the species range.	The proposal involves clearing dry sclerophyll forest, wet sclerophyll forest and rainforest vegetation in which this species might occur. Within these habitat types opportunities for roosting, foraging and breeding will be permanently removed for the proposal. As the construction of the dam will permanently remove native vegetation communities within the study area, it will prevent the recolonisation of these existing species following disturbance. However, the buffer zone could be improved as it could meet the habitat requirements of the Barred Cuckoo Shrike as it favours riparian vegetation in its range.	The Barred Cuckoo Shrike is a nomadic species and may occur sporadically in the study area. Further assessment is required for this species.	N/A	N/A	The proposed dam may have significant impacts on this species and its habitat within the study area. While no individuals were detected, there is a possibility that some specimens could use the resources within the proposed impact area. However, such impacts could be offset by improving the condition of the buffer zone and planting rainforest fruit trees.

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Marbled Frogmouth	<p>The proposal would displace local populations of the Marbled Frogmouth through the permanent removal of subtropical rainforest. Such habitat is fairly patchy but could assist in species' dispersal to larger areas such as Whian Whian SF and Nightcap NP. The proposed dam may also disturb the breeding cycle of this species if works were carried during the breeding season from about August to December, leading to an overall reduction in recruitment rate for that year. Tree clearing would also disrupt foraging behaviour as this species hunts from large perches, and sallies out to take their prey from the ground or from the foliage of plants. Such clearing would also disrupt roosting behaviour by causing Marbled Frogmouths to relocate to other areas of suitable habitat and increasing competition for shelter resources.</p>	<p>The proposal involves clearing subtropical rainforest in which this species occurs or is predicted to occur. Within these habitat types, the proposal would remove key habitat features including wet, sheltered gullies, temperate rainforests and wet eucalypt forest with well-developed rainforest understorey (NSW NPWS 2002). As the construction of the dam will permanently remove native vegetation communities within the study area, it will prevent recolonisation of this species following disturbance. Such construction may also influence its viability over the region as its ability to disperse to Whian and Whian SCA and Nightcap NP may be compromised.</p>	<p>In NSW its range occurs in the far north east of the state. This species is known to occur in Whian Whian SCA and Nightcap NP. If the Marbled Frogmouth relies on patches of rainforest habitat in the Dunoon inundation area to forage and breed in Whian Whian SCA and Nightcap NP, then the local population over the Dunoon region could be threatened.</p>	N/A	N/A	<p>Significant impact likely as potential foraging and breeding habitat is removed by the proposal for this species, may cause disruptions if construction is carried out during the breeding season, and may change foraging behaviour causing individuals to relocate to other areas. The proposal also severs linkages to Whian Whian SCA and Nightcap National Park, which is an important corridor for this species.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Hairy Jointgrass	<p>Arthraxon hispidus flowers from summer through autumn (PlantNet 2011). The majority of individuals present within the study area will be inundated by the proposed dam. A small population was identified above the inundation zone in the north-west of the study area. The isolation of this area from any other known populations after the works are complete and the low number of individuals present are likely to impact on its long-term survival within the study area. The potential for translocation of individuals from the different localities may increase genetic diversity within the population that will remain.</p>	<p>The study area will remove areas of known occurrence as well as potential habitat, including wet depressions typical of its occurrence within the study area as well as rainforest, which is this species preferred habitat. Some small areas of potential habitat will remain and may be colonized by this species into the future.</p>	<p>Occurs in the North Coast bioregion into QLD. Not at limit of distribution in the study area.</p>	<p>Grazing may decrease within the remnant population in the buffer, which may impact on this species from competition with weeds and pasture species.</p>	<p>No critical habitat has been identified.</p>	<p>The loss a large proportion of the individuals of this species, including two out of the three discrete populations within the study area is considered significant for this species as it likely to result in a loss in population viability. Changes in grazing regimes could also impact on this species if not monitored appropriately. It is likely that the project will have a significant impact on this species within the study area.</p>
Rainforest flora recorded	<p>The various rainforest species recorded within the study area each have specific lifecycle requirements. Fruit dispersal is a key to the lifecycles of these plants, with mammals and birds the main dispersal routes for the fleshy fruits. Thus changes in the mammal and bird assemblages within the study area could impact on successful seed dispersal for these species as well as loss of habitat, especially around the proposed dam wall.</p>	<p>Of the species, <i>Corokia</i>, which requires warm temperate rainforest, will have the largest loss in occurrence of habitat from works in the study area. However both this community and subtropical rainforest will be substantially cleared from the study area and the majority of these species habitat will be removed by inundation of the dam. There is also the potential for indirect impacts on habitat for these species as a result of the works.</p>	<p>These species all have limited distributions in north-eastern NSW into QLD on big scrub rainforest remnants</p>	<p>N/A</p>	<p>No critical habitat has been identified for these species.</p>	<p>Significant loss of individuals and habitat from the proposed works result in a significant impact of the proposed dam on these rainforest flora species.</p>

Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Clear Milk vine	<i>Marsdenia longiloba</i> occurs in subtropical and warm temperate rainforest, lowland moist eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops (DECCW 2011). This species was recorded outside of the inundation area and is unlikely to be directly impacted by the works. Indirect impacts on the lifecycle of this species may include disruptions of pollination success and seed dispersal due to the proposed dam and associated infrastructure and fragmentation of potential habitat for this species within the locality.	The proposed dam will remove areas of subtropical and warm temperate rainforest, moist eucalypt forest and some areas with rock outcrops. As such it will impact on all potential habitat types within the study area. While it was only recorded outside the impact area, it is likely to occur elsewhere within the study area including within the areas to be impacted by the works. There is also the potential for indirect impacts on habitat for this species as a result of the works.	The study area is not near the known distribution limits of this species.	N/A	No critical habitat has been declared for this species.	The proposed dam may have some indirect impacts on this species and its habitat within the study area. While no individuals detected will be removed by the works, there is a high potential that some specimens occur within the impact areas. As such, it is likely that the proposed works will have a significant impact on this species within the locality.
Rainforest flora not recorded	The various rainforest species not recorded within the study area each have specific lifecycle requirements. Fruit dispersal is a key to the lifecycles of these plants, with mammals and birds the main dispersal routes for the fleshy fruits. Thus changes in the mammal and bird assemblages within the study area could impact on successful seed dispersal for these species, should they occur.	The rainforest habitats within the study area will be substantially cleared for the proposed dam. As such, the works will decrease the amount and possibly the condition of available habitat for these species. There is also the potential for indirect impacts on habitat for these species as a result of the works.	These species all have limited distributions in north-eastern NSW into QLD within big scrub rainforest remnants	N/A	No critical habitat has been identified for these species.	Only a small area of potential habitat occurs for these species and they were not detected in these areas, despite targeted surveys. Significant impacts are unlikely, but further targeted surveys as part of further assessment of the proposal are recommended to confirm this.



Species	1 – Lifecycle Impacts	2 – Habitat Impacts	3 – Distribution Limits	4 – Disturbance Regimes	5 – Critical Habitat	Conclusion
Lowland Rainforest EEC	N/A	The proposed works for the dam will remove a large area of known and potential habitat for this EEC associated with the alluvial areas surrounding Rocky Creek within the dam inundation area, and sedimentary geology within the dam wall area. There is also the potential for indirect impacts on nearby potential habitat upstream and downstream of the dam as a result of the works. It is estimated that the dam works will remove 55% of the known occurrence of this EEC within the study area.	Not at the limit of its distribution	The proposed works will alter flooding flows to the community downstream of the dam wall.	No critical habitat has been identified for the community.	Due to the removal of more than half of this community's occurrence within the study area, and potential removal of additional areas of suitable habitat, the proposed works are considered to constitute a significant impact to this endangered ecological community.

## Assessments of Significance under the EPBC Act (National)

These assessments of significance have been undertaken in accordance with the *Matters of National Environmental Significance (NES) significant impact guidelines* (DEWHA 1999). Species considered include:

- 1. Migratory/Marine Species: Cattle Egret, White-throated Needletail, Rainbow Bee-eater, Spectacled Monarch, Satin Flycatcher, Rufous Fantail, Eastern Great Egret, Channel-billed Cuckoo;
- 2. Vulnerable Flora Recorded Within the Study Area: Hairy Jointgrass, Corokia, Spiny Desmodium, Red Boppel Nut, Rough shelled Bush Nut, Slender Marsdenia, and Arrowhead Vine;
- 3. Vulnerable Species Not Recorded but Considered Likely to Occur: Smooth-bark Rose Apple, Coolamon Rose Apple, Rusty Rose Walnut;
- 4. Endangered Species Not Recorded but Considered Likely to Occur: Spiny Gardenia, Isoglossa, Sweet Myrtle, Floyd's Walnut, Hairy Quandong, Minyon Quandong, Red-fruited Ebony, Smooth Davidsonia, Davidson's Plum, *Amyema plicatula*;
- 5. Endangered Flora Recorded Within the study area: Southern Ochrosia;
- 6. Grey-headed Flying-Fox;
- 7. Three-toed Snake-tooth Skink;
- 8. Giant Barred Frog; and
- 9. Endangered Birds: Double-eyed Fig Parrot, Eastern Bristlebird, Swift Parrot.

**1. Migratory/Marine Species:** Cattle Egret, White-throated Needletail, Rainbow Bee-eater, Spectacled Monarch, Satin Flycatcher, Rufous Fantail, Channel-billed Cuckoo and Eastern Great Egret

*An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:*

- *substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;*

The definition of an area of 'important habitat' for a migratory species includes:

- a. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- b. habitat that is of critical importance to the species at particular life-cycle stages, and/or
- c. habitat utilised by a migratory species which is at the limit of the species range, and/or
- d. habitat within an area where the species is declining.

The migratory species that were identified within the study area or with potential to occur are relatively common to the region and the study area has not been recognised as a particular area of significance that supports these species.. It is likely that the study area is utilised in an opportunistic fashion by these migratory species. In addition, the study area is not at the known limit of any migratory species ranges to in an area where the species is in decline.

- *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*

A number of invasive species are already known to occur within the study area and its surrounds, and the proposed works is considered unlikely to promote or increase the abundance of such species such that habitat for migratory species would be minimised by pest animals.

- *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

The migratory species recorded are relatively common in the locality and while the proposed works may limit the amount of viable habitat for such species, this impact is not considered to constitute a serious disruption to the species such that the lifecycles of an ecologically significant proportion is impacted. Breeding, roosting and feeding habitat is also available nearby within conservation areas for these species.

**Conclusion:** The proposed dam will not have a significant impact on migratory bird species.

**2. Vulnerable Flora Recorded Within the Study Area:** Hairy Jointgrass (*Arthraxon hispidus*), Corokia (*Corokia whiteana*), Spiny Desmodium (*Desmodium acanthocladum*), Red Boppel Nut (*Hicksbeachia pinnatifolia*), Rough shelled Bush Nut (*Macadamia tetraphylla*), Slender Marsdenia (*Marsdenia longiloba*), and Arrowhead Vine (*Tinospora tinoporoides*).

*An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of an important population of a species*

Within this assessment, an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

No populations for the vulnerable flora recorded within the study area have been identified as important within recovery plans under the EPBC Act. The population's within the study area are isolated from nearby known populations of these species, and therefore may be important for maintaining genetic diversity, particularly where the nearest population is some distance from the study area. Most of these species are also near the edge of their range, generally being confined to the rich basaltic soils and associated habitats of the 'Big scrub' remnants within the region. Thus the occurrence within the study area may constitute important populations of the species.

- *reduce the area of occupancy of an important population*

The proposal will reduce the area of occupancy and habitat for these vulnerable species.

- *fragment an existing important population into two or more populations*

Most of the individuals of these species were recorded within the inundation and construction areas for the new dam and are likely to be removed by the works. As such, the works are unlikely to fragment the populations within the study area, but may fragment habitat for such species within the study area.

- *adversely affect habitat critical to the survival of a species*

Critical habitat has not been identified for these species. However, the works will remove the habitat within the study area associated with their occurrence and therefore their survival within the study area will adversely affected.

- *disrupt the breeding cycle of an important population*

The removal of a number of individuals will disrupt the breeding cycle of these species within the study area. It is also possible that the instatement of the dam could limit and affect pollination and seed dispersal for these plants, due to the large volume of water between potential habitat areas, where these occur outside the impact zone.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The works will permanently remove a significant amount of habitat available for these species within the study area, with remaining habitat isolated by the inundation of the dam area.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

It is possible that weed species could invade habitat areas for these species, as weeds are a common problem and threat within the study area. As the habitat areas occupied by these vulnerable species, particularly the rainforest species, currently shelter out and prevent the invasion of weeds into these areas, any changes to the vegetation communities within the study area, such as fragmentation and increased influence from edge effects, could result in the spread of weed species.

- *introduce disease that may cause the species to decline, or*

While a number of measures will be implemented to minimise the potential spread of plant disease to the study area, there is the potential for such diseases to be introduced by the works. These diseases could affect both the flora species as well as their habitat within the study area.

- *interfere substantially with the recovery of the species.*

No recovery actions are being undertaken within the study area for these species. However, the loss of a number of individuals of these species and their habitat is considered to be inconsistent with the recovery of these species.

**Conclusion:** The proposed works are likely to have a significant impact on vulnerable flora species recorded within the study area, due to the direct removal of individuals and their habitat, as well as the potential for removal of entire populations within the locality as a result of clearing and construction works.

A referral is required in accordance with the EPBC Act to the Minister for Sustainability, Environment, Water, Population and Communities.

**3. Vulnerable Species Not Recorded but Considered Likely to Occur:** Smooth-bark Rose Apple (*Syzygium hodgkinsoniae*), Coolamon Rose Apple (*Syzygium moorei*), Rusty Rose Walnut (*Endiandra hayesii*).

*An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of an important population of a species*

Within this assessment, an 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

No populations for the vulnerable flora with the potential to occur within the study area have been identified as important within recovery plans under the EPBC Act. As none of these species were recorded despite targeted surveys, it is likely that any populations present, would have limited significance due to their likely low numbers.

- *reduce the area of occupancy of an important population*

The proposal will not reduce the area of occupancy and habitat for these vulnerable species, as these were not recorded within the study area.

- *fragment an existing important population into two or more populations*

Due to their lack of occurrence within the study area, the proposed works will not fragment existing known populations.

- *adversely affect habitat critical to the survival of a species*

Critical habitat has not been identified for these species. However, the works will remove potential habitat within the study area for these species.

- *disrupt the breeding cycle of an important population*

The proposed works will not disrupt the breeding cycles of any important populations of these flora species, due to the lack of occurrence of important populations within the study area and its surrounds.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The works will remove a significant amount of potential habitat available for these species within the study area, with remaining habitat isolated by the inundation of the dam area.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

It is possible that weed species could invade potential habitat areas for these species, as weeds are a common problem and threat within the study area.

- *introduce disease that may cause the species to decline, or*

While a number of measures will be implemented to minimise the potential spread of plant disease to the study area, there is the potential for such diseases to be introduced by the works. These diseases could affect potential habitat within the study area.

- *interfere substantially with the recovery of the species.*

No recovery actions are being undertaken within the study area for these species.

**Conclusion:** While the proposed works will remove some potential habitat for vulnerable flora species not detected within the study area, any potential impacts are considered to be insignificant due their lack of known occurrence within the study area or in close proximity.

**4. Endangered Species Not Recorded but Considered Likely to Occur:** Spiny Gardenia (*Randia moorei*), Isoglossa (*Isoglossa eranthemoides*), Sweet Myrtle (*Gossia fragrantissima*), Floyd's Walnut (*Endiandra floydii*), Hairy Quandong (*Elaeocarpus williamsianus*), Minyon Quandong (*Elaeocarpus sedentarius*), Red-fruited Ebony (*Diospyros mabacea*), Smooth Davidsonia (*Davidsonia johnsonii*), Davidson's Plum (*Davidsonia jerseyana*), *Amyema plicatula*.

*An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of a population*

No populations of these species are known to occur within the study area and therefore the proposed works will not lead to a long-term decrease in the size of a population of these species.

- *reduce the area of occupancy of the species*

The proposed dam will reduce the area of potential occupancy of this species by removing potential habitat.

- *fragment an existing population into two or more populations*

The proposal will not fragment any known populations of these species.

- *adversely affect habitat critical to the survival of a species*

Critical habitat has not been identified for these species.

- *disrupt the breeding cycle of a population*

The proposal will not disrupt the breeding cycle of these flora species.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposed works will reduce the amount of potential habitat within the study area for these flora species within the locality.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

It is possible that weed species could invade potential habitat areas for this species, as weeds are a common problem and threat within the study area.

- *introduce disease that may cause the species to decline, or*

While a number of measures will be implemented to minimise the potential spread of plant disease to the study area, there is the potential for such diseases to be introduced by the works. These diseases could affect potential habitat within the study area.

- *interfere substantially with the recovery of the species.*

No recovery actions are being undertaken within the study area for these species.

**Conclusion:** While the proposed works will remove some potential habitat for endangered flora species not detected within the study area, any potential impacts are considered to be insignificant due their lack of known occurrence within the study area or in close proximity.

**5. Endangered Flora Recorded within the study area:** Southern Ochrosia (*Ochrosia moorei*)

*An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of a population*

The occurrence of this species was recorded in only one location during the surveys, within the proposed inundation area, through it is likely to occur nearby this record in suitable habitat also. As the inundation of the dam area will remove this individual and a significant area surrounding it, it is possible that the population will be removed from the site as a result of the works.

- *reduce the area of occupancy of the species*

The proposal will reduce the occupancy of the species within the site by inundating the only known occurrence and other potential habitat surrounding this individual.

- *fragment an existing population into two or more populations*

The proposal will not fragment, but is likely to remove the population within the study area.

- *adversely affect habitat critical to the survival of a species*

Critical habitat has not been identified for this species, however within the study area, it occurs within subtropical rainforest, which will be largely removed in proximity to its occurrence. This habitat is considered to represent habitat that is critical for the survival of the population within the study area and therefore for its local survival in the long-term.

- *disrupt the breeding cycle of a population*

The removal of individuals and potentially the population within the study area will prevent future breeding of this species within the study area and its surrounds. If other occurrences occur nearby and outside the impact area, the proposed works are likely to reduce breeding through pollination potential of these plants.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposed works will remove 50% of the occurrence of subtropical rainforest within the study area. It will also isolate and fragment the current occurrences of this habitat within the study area from the inundation of the dam and construction works associated with the dam wall.

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

It is possible that weed species could invade habitat areas for this species, as weeds are a common problem and threat within the study area. As the habitat areas occupied by this species currently shelter out and prevent the invasion of weeds into these areas, any changes to the vegetation communities within the study area, such as fragmentation and increased influence from edge effects, could result in the spread of weed species.

- *introduce disease that may cause the species to decline, or*

While a number of measures will be implemented to minimise the potential spread of plant disease to the study area, there is the potential for such diseases to be introduced by the works. These diseases could affect both individuals of this species as well as its habitat within the study area.

- *interfere substantially with the recovery of the species.*

No recovery actions are being undertaken within the study area for this species. However, the loss of individuals of this species and its a portion of habitat is considered to be inconsistent with the recovery of these species.

**Conclusion:** The proposed works are likely to have a significant impact on the Southern Ochrosia, due to the direct removal of individuals and their habitat, as well as the potential for removal of the entire population in proximity to the recorded individual as a result of clearing and construction works.

A referral is required in accordance with the EPBC Act to the Minister for Sustainability, Environment, Water, Population and Communities.

## **6. Grey-headed Flying-Fox**

*An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of an important population of a species*

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

There is no national recovery plan for the Grey-headed Flying-fox and as such no important populations have been formally identified. No camps of Grey-headed Flying-foxes occur within the study area, although a permanently occupied camp of this species is located at Booyong, approximately 16km west of the study area. As this camp is permanently occupied, it is assumed that it is a maternity study area where Grey-headed Flying-foxes migrate to during the breeding season to give birth, and as such could be considered an important population of this species.

The proposal requires the removal of a large tract of high quality foraging habitat (Tallowood Open Forest) that provides foraging resources for the Grey-headed Flying-fox year round. The patch of Tallowood Open Forest in the study area is the eastern limit of this vegetation type in the region, and as such would have impacts at a regional scale. The reduction of foraging resources in the region may lead part of this population of Grey-headed Flying-foxes to migrate to alternative areas where more foraging resources are available.

- *reduce the area of occupancy of an important population*

The proposal does not reduce the area of occupancy, as the important camp study area is located 16km west of the study area.

- *fragment an existing important population into two or more populations*

The proposal does not fragment the existing population, as the important camp study area is located 16km west of the study area.

- *adversely affect habitat critical to the survival of a species*

No critical habitat has been listed for the Grey-headed Flying-fox.



- *disrupt the breeding cycle of an important population*

The proposed works will be carried out approximately 16km to the east of the important population, and will be carried out during the day. As such, construction noises are not considered to pose a threat to the breeding cycle of this species.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposed activity requires the removal of over half the high-quality foraging resources from within the study area. It is the eastern distribution of this vegetation type in the region, and as such may have impacts at a regional scale. The reduction of foraging resources in the region may lead part of this population of Grey-headed Flying-foxes to migrate to alternative areas where more foraging resources are available, and increasing competition for food resources. This may lead to a small-scale decline in the wider Grey-headed Flying-fox population.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

The construction of the dam may increase the spread of exotic plants including Camphor Laurel and Privet in the buffer area. However, Grey-headed Flying-foxes are known to feed on the fruits of these two trees, and as such is not considered to be harmful to the species establishment in this habitat.

- *introduce disease that may cause the species to decline, or*

Grey-headed Flying-foxes are susceptible to Australian Bat Lyssavirus (spread from bat to bat) and Hendravirus (spread from horse to bat). This species has a high degree of mobility and as such mixes with other individuals of its species on a regular basis. The construction of the proposed dam is not considered to put this species at a greater risk of catching these diseases.

- *interfere substantially with the recovery of the species.*

A national recovery plan has not been prepared for the Grey-headed Flying-fox, and as such no recovery actions have been drafted. The proposed activity requires the removal of over half the high-quality foraging resources from within the study area. It is the eastern distribution of this vegetation type in the region, and as such may have impacts at a regional scale. The reduction of foraging resources in the region may lead part of this population of Grey-headed Flying-foxes to migrate to alternative areas where more foraging resources are available, and increasing competition for food resources. This may lead to a small-scale decline in the wider Grey-headed Flying-fox population.

**Conclusion:** The proposal is considered to have a significant impact to the Grey-headed Flying-fox as it requires the clearing of over half the high-quality foraging habitat from the study area that provides foraging resources on a year-round basis. As this patch of foraging habitat is at the eastern limit of its distribution in the region, impacts are expected to occur at a regional scale. This is expected to reduce foraging habitat at the regional scale, potentially causing groups of individuals to seek alternative habitat outside the study area, and placing increased competition on foraging resources. This may cause a small-scale decline in the wider Grey-headed Flying-fox population.

A referral is required in accordance with the EPBC Act to the Minister for Sustainability, Environment, Water, Population and Communities.

## 7. Three-toed Snake-tooth Skink

*An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of an important population of a species*

*Coeranoscincus reticulatus* occurs from the Macleay Valley in NSW through to South Eastern QLD. Populations are known from nearby Whian Whian SCA, the Richmond Range, several other reserves and near the Tweed River (DEWHA 2007). The Whian Whian SCA contains a known population of this species which is about 5km north west of the study area.

Despite targeted surveys in optimal conditions (up to 7 visits per site during Spring and Summer 2010) in reasonable, but fragmented habitat within and adjacent to the study area, no individuals were detected. From SMEC's surveys and literature review it is considered that there are no important populations of *C. reticulatus* either on or near the site.

- *reduce the area of occupancy of an important population*

An important population does not occur on or near the study area.

- *fragment an existing important population into two or more populations*

An important population does not occur on or near the study area.

- *adversely affect habitat critical to the survival of a species*

The proposal will inundate a limited area of primarily secondary growth rainforest that has some potential breeding and foraging areas for this species. However, since no individuals have been detected and the habitat is limited and fragmented, it is not considered to be habitat critical to the survival of *C. reticulatus*.

- *disrupt the breeding cycle of an important population*

An important population does not occur on or near the study area.

- *modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The proposal will inundate a limited area of primarily secondary growth rainforest that has some potential breeding and foraging areas for this species. However it is considered likely that this habitat has been cut off from nearby populations for so long as to make any individuals that might be there, but not detected, a non-viable population and that this habitat is only low to moderate quality. As such, it is highly unlikely that the proposal will significantly impact on habitat important for *C. reticulatus*.

- *result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat and introduce disease that may cause the species to decline*

The proposal will be designed and re-vegetated in such a way as to minimise the chance of the introduction of pest species and disease and as such is unlikely to impact on the nearest populations of *C. reticulatus* in Whian Whian SCA.

- *interfere substantially with the recovery of the species.*

Since it does not impact on key habitat or important populations of this species, it is unlikely to substantially interfere with measures to conserve and recover this species.

**Conclusion:** Despite targeted surveys in optimal conditions (up to 7 visits per site during Spring and Summer 2010) in reasonable, but fragmented habitat within and adjacent to the study area, no individuals were detected. It is highly unlikely that an important population of *C. reticulatus* occurs on or near the study area. Further, the proposal will be designed and re-vegetated in such a way as to minimise the chance of the introduction of pest species and disease and as such is unlikely to impact populations of *C. reticulatus* in

nearby Whian Whian SCA. In summary, the proposal will not have a significant impact on this vulnerable species.

## **8. Giant Barred Frog (*Mixophyes iteratus*) and Fleay's Barred Frog (*Mixophyes fleayi*)**

*An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:*

- *lead to a long-term decrease in the size of a population*

The distribution of *Mixophyes iteratus* stretches from the coast and ranges of south-eastern Queensland to the Hawkesbury River in NSW. The Coffs Harbour and Dorrigo areas to the south of the study area are now strongholds for this species (DEC 2005). *M. iteratus* has been detected in nearby Night Cap NP, but is not widespread or abundant there (M. Fitzgerald *pers.comm*). One very old record (1967) exists for the species approximately one kilometre from the study area, but it has not been recorded in the vicinity, except for Night Cap NP and Whian Whian SCA since. It is unlikely that there are any populations within the vicinity of that record at the present time (M. Fitzgerald *pers.comm*).

*Mixophyes fleayi* has a narrow and disjunct distribution from the Conondale Range in south-east Queensland down to Yabbra National Park in north-east NSW (NSW Scientific Committee 2011). It has been found in nearby Nightcap NP, but is restricted to rainforest and wsf, usually at altitudes above 400m (Goldingay et al. 1999). The ecology of the species is largely unstudied, however it is thought that disturbed riparian areas offer only marginal habitat for this species (Mahony et al. 1997). Despite targeted surveys in suitable but low quality habitat in optimal conditions, both within the study area and on the outskirts, no *M. iteratus* or *M. fleayi* individuals were located. These species often requires up to six visits in low quality habitat for it to be positively identified (M. Fitzgerald *pers.comm*). Seven survey nights were undertaken and no individuals were found, some call back was also undertaken during October surveys. It is unlikely that a viable population of *M. iteratus* or *M. fleayi* occurs within the study area and as such the proposal is unlikely to have a significant impact on the size of a population of *M. iteratus*.

- *reduce the area of occupancy of the species*

It is unlikely that a viable population of *M. iteratus* or *M. fleayi* occurs on or near the study area.

- *fragment an existing population into two or more populations*

It is unlikely that a viable population of *M. iteratus* or *M. fleayi* occurs on or near the study area.

- *adversely affect habitat critical to the survival of a species*

No critical habitat for these species will be impacted by the proposal.

- *disrupt the breeding cycle of a population*

It is unlikely that a viable population of *M. iteratus* or *M. fleayi* occurs on or near the study area.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The Giant Barred Frog lives in deep leaf litter in rainforest, wsf and dry sclerophyll forest and breeds around shallow, flowing rocky streams (DEC 2005). Habitat is present within

the study area (warm temperature rainforest and wet sclerophyll forest, however much of it is secondary growth with less moist leaf litter which is preferred by this species). Given that no individuals were detected in optimal conditions, and habitat is limited, fragmented and sub-optimal, it is considered highly unlikely that the proposal will significantly impact on the habitat of this species.

Habitat requirements for *M. fleayi* are more specialised than *M. iteratus* so there is less chance of a viable population in the area, and less potential habitat that will be impacted

- *result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat or introduce disease that may cause the species to decline;*

The proposal will be designed and re-vegetated in such a way as to minimise the chance of the introduction of weed and pest species or disease and as such is unlikely to impact on populations of *M. iteratus* in nearby Night Cap NP or in Dunoon.

- *interfere substantially with the recovery of the species.*

Since it is unlikely that a viable population of these species occurs within the study area and that the proposal will be designed and re-vegetated in such a way as to minimise the chance of the introduction of pest species and disease, it is unlikely that the proposal will substantially interfere with the recovery of this species.

Despite targeted surveys in suitable but low quality habitat in optimal conditions, both within the study area and on the outskirts, no *M. iteratus* or *M. fleayi* individuals were located. These species often requires up to six visits in low quality habitat for it to be positively identified. Seven survey nights were undertaken and no individuals were found, some call play back was also undertaken during October surveys.

Several individuals of closely related, but more common *M. fasciolatus* were located during surveys within and surrounding the study area. This species distribution overlaps with *M. iteratus* and has similar habitat requirements (Cogger 2000), although less restricted than *M. fleayi*.

The study area is well within the known range of the species and as such is not at its distribution limit.

The study area contains some marginal habitat for these two species, however much of it is secondary growth rainforest and sclerophyll forest that does not appear to have the thick layer of leaf litter favoured by these species. Most records for *M. fleayi* are also at higher altitudes.

**Conclusion:** It is considered unlikely that a viable population of either of these two species exists within the study area, better quality habitat does occur in nearby Night Cap NP and Whian Whian SCA, where they have both been recorded. The proposal will not have an impact on these populations. As such, there will be no significant impact from the proposal on these species within the local area.

## **9. Endangered Birds:** Double-eyed Fig Parrot, Eastern Bristlebird, Swift Parrot

An action is likely to have a significant impact upon an endangered species if there is a real chance or possibility that it will:

- *lead to a long-term decrease in the size of a population;*

A 'population of a species; is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to endangered species, occurrence includes but is not

limited to a geographically distinct regional population or collection of local populations; or a population, or collection of local populations that occurs within a particular bioregion.

The study area offers potential habitat for the three threatened birds. The likelihood of occurrence is low for the Eastern Bristlebird due to the limited extent and connectivity of this habitat, and the Swift Parrot may visit the area occasionally to forage, however the area does not contain any of the significant overwintering feed species. Due to their low likelihood of occurrence within the habitats offered by the study area, it is unlikely that the construction of the dam would lead to a long-term decrease in the size of the population. There is potential foraging habitat for the Double-eyed Fig Parrot within figs that are present within the study area, although these were rarely encountered. This species has been recorded in Whian Whian SCA recently (1992 and 1993). Little is known of the ecology of the Double-eyed Fig Parrot, and as such it is unknown whether the action will lead to a long-term decrease in the size of the population.

- *reduce the area of occupancy of the species;*

The Eastern Bristlebird and Swift Parrot have a low likelihood of occurrence within the study area due to the limited extent and quality of habitat. For this reason, it is unlikely that the study area forms part of their normal area of occupancy or core habitat area. Therefore, the construction and operation of the dam are unlikely to reduce the area of occupancy for these species. The area of occupancy is unknown for the Double-eyed Fig Parrot, and as such it is unknown whether the proposal will reduce the species area of occupancy.

- *fragment an existing population into two or more populations;*

There is a low likelihood that the Eastern Bristlebird occurs within the study area, and the Swift Parrot may only occasionally visit to utilise foraging resources available on a sporadic basis. As such, it is unlikely that there are existing populations of these species within the study area. However, should the Eastern Bristlebird be present in low densities at the site, the removal of vegetation for the dam's construction would provide an impermeable barrier given their sedentary nature. Due to their quiet foraging habits, the Double-eyed Fig Parrot is quite difficult to detect. It is unknown whether there is an existing population within the study area. This species has been recorded from Whian Whian SCA (1992 and 1993) so there is a possibility that a population exists in the study area, which may be fragmented by the proposal.

- *adversely affect habitat critical to the survival of a species;*

Critical habitat has not been identified for the Eastern Bristlebird. Critical habitat for the Swift Parrot refers to breeding and foraging habitat located in Tasmania. Critical habitat features for the Double-eyed Fig Parrot would consist of areas that have a high density of fruiting figs that occur across moisture and altitudinal gradients (Coxen's Fig Parrot Recovery Team, 2001). Few figs were observed within the rainforest patches of the study area, and as such the study area is unlikely to constitute habitat critical to its survival. However, the ecology of this species is largely unknown, and as such it is not known whether the proposal will adversely affect habitat critical to its survival. Habitats critical to the survival of the Eastern Bristlebird would include areas of dense grassy groundcover at the ecotone with subtropical rainforest for breeding habitat (DSEWPC 2011). Although these habitat opportunities are present for the Eastern Bristlebird in parts of the study area where these vegetation communities meet, it is unlikely that they are providing habitat critical to the survival of the species as they are fragmented from the Border Ranges National Park, and the Eastern Bristlebird is a sedentary species, incapable of making large-scale movements in fragmented habitats.

- *disrupt the breeding cycle of a population;*

Important parts of the breeding cycle of the Swift Parrot focus upon their breeding habitat and foraging in Tasmania, and as such their breeding cycle will not be affected by the construction or operation of the dam. Breeding for the Eastern Bristlebird occurs in August

to February and is unlikely to be disrupted by the construction of the dam as the area is not considered to contain significant breeding habitat for the species. Nest construction for the Double-eyed Fig Parrot is known to occur in August with breeding occurring between October and January. The area is not considered to constitute significant breeding habitat due to the paucity of foraging resources for this species to sustain them during the breeding season. Little is known of the breeding cycle of the Double-eyed Fig Parrot, and as such it is not known whether the proposal will disrupt their breeding cycle.

- *modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;*

It is considered that potential habitats offered for the Eastern Bristlebird and Swift Parrot in the study area are not sufficient to sustain populations of these species. Therefore, the construction of the dam is unlikely to modify, destroy, isolate or decrease the availability or quality of habitat to the extent that these species are likely to decline further. Little is known of the habitat of the Double-eyed Fig Parrot, and as such it is not known whether the proposal will cause the modification, destruction, removal, isolation or decrease the availability or quality of habitat to the extent that they will decline.

- *result in invasive species that are harmful to an endangered species becoming established in the endangered species habitat;*

The Double-eyed Fig Parrot is currently threatened by degradation of feeding and nesting habitat by weeds, particularly in the lowland riparian subtropical rainforest remnants where figs and other fleshy-fruited rainforest trees are concentrated (Coxen's Fig Parrot Recovery Team 2001). The proposed works are likely to increase the threat of weeds within the buffer area. As little is known of Double-eyed Fig Parrot ecology, it is unknown whether these invasive species are harmful to the species becoming established in their habitat.

- *introduce disease that may cause the species to decline; or*

The Double-eyed Fig Parrot is known to suffer from diseases in captivity, and the Eastern Bristlebird is threatened by habitat degradation through the Root-rot Fungus (*Phytophthora cinnamomi*). The construction and operation of the dam is not considered to introduce a disease the three species are susceptible to.

- *interfere with the recovery of the species.*

Although no formal recovery plan has been drafted for the Eastern Bristlebird, a number of recovery actions have been implemented and proposed. Recovery actions for the Eastern Bristlebird focus upon appropriate fire management, continuous monitoring, and protection of known populations. The construction and operation of the dam do not interfere with these recovery actions as no known populations occur in the study area (DSEWPC 2011). Recovery objectives within the Swift Parrot Recovery Plan include the identification of priority habitats and trends within the breeding range, a reduction in the incidence of collisions, the quantification of improvements in carrying capacity by monitoring changes and extent in habitat quality, and increasing public awareness and involvement in the recovery plan (Swift Parrot Recovery Team 2001). The construction of the dam is unlikely to interfere with these recovery actions as the habitat offered in the study area is not likely to be identified as a priority habitat for the species. As little is known of the life history and ecology of the Double-eyed Fig Parrot, its recovery objectives are focussed upon the identification of remaining populations, increasing the understanding of their ecology and improving their preferred habitats. Therefore, it is not known whether the proposal will interfere with the species recovery or the identification of its preferred habitats.

**Conclusion:** Due to the limited habitat and the degree of fragmentation from other more intact habitats such as Border Ranges National Park, the study area is unlikely to support a population of the Eastern Bristlebird, and as such is unlikely to be impacted by the proposal. Limited foraging habitat exists for the Swift Parrot, and the study area does not

contain any of its primary overwintering feed species. As such it is also unlikely to be impacted by the proposal. The Double-eyed Fig Parrot has been recently recorded from Whian Whian SCA, which is located in close proximity to the study area. Little is known of the life history or ecology of this species, and as such it is not known if the proposal constitutes a significant impact to the species.

A referral is required in accordance with the EPBC Act to the Minister for Sustainability, Environment, Water, Population and Communities.

## APPENDIX 5: FLORA AND FAUNA RECORDS

Table 48: Flora species recorded within the study area

Family	Common Name (Scientific name)	Status
ADIANTACEAE	Rough Maidenhair Fern ( <i>Adiantum hispidulum</i> )	
ANNONACEAE	<i>Rauwenhoffia leichhardtiana</i>	
APIACEAE	Pennywort ( <i>Hydrocotyle pedicellosa</i> )	
APOCYNACEAE	<i>Marsdenia longiloba</i>	TSC: E, EPBC: V, ROTAP: 3RC
	Milk Vine ( <i>Marsdenia rostrata</i> )	
	Southern Melodinus ( <i>Melodinus australis</i> )	
	Southern Ochrosia ( <i>Ochrosia moorei</i> )	TSC: E, EPBC: E, ROTAP: 2EC
	Banana Bush ( <i>Tabernaemontana pandaqui</i> )	
ARACEAE	Boorgay ( <i>Gymnostachys anceps</i> )	
	<i>Pothos longipes</i>	
ARAUCARIACEAE	Hoop Pine ( <i>Araucaria Cunninghamii</i> )	(plantation)
ARECACEAE	Banglaow Palm ( <i>Archontophoenix cunninghamiana</i> )	
	Southern Lawyer Cane ( <i>Calamus muelleri</i> )	
	Walking Stick Palm ( <i>Linospadix monostachys</i> )	
	Cabbage Palm ( <i>Livistona australis</i> )	
ARGOPHYLLACEAE	<i>Corokia whiteana</i>	TSC: V, EPBC: V, ROTAP: 2VCi
ASCLEPIADACEAE	*Narrow-Lead Cotton Bush ( <i>Gomphocarpus fruticosus</i> )	
ASPLENIACEAE	Bird's Nest Fern ( <i>Asplenium australasicum</i> )	
ASTELIACEAE	Palm-lily ( <i>Cordyline rubra</i> )	
ASTERACEAE	*Mistflower ( <i>Ageratina riparia</i> )	Declared Noxious Weed
	*Nodding Thistle ( <i>Carduus nutans</i> )	Declared Noxious Weed
	*Crofton Weed ( <i>Ageratina adenophora</i> )	Declared Noxious Weed
	Flatweed ( <i>Aypocheirus radicata</i> )	
BIGNONIACEAE	Large-leaved Wonga Vine ( <i>Pandorea baileyana</i> )	
	Wonga Wonga Vine ( <i>Pandorea pandorana</i> )	
BLECHNACEAE	Gristle fern ( <i>Blechnum cartilagineum</i> )	
	Prickly Rasp Fern ( <i>Doodia aspera</i> )	
	Small Rasp Fern ( <i>Doodia caudata</i> )	
CAPPARACEAE	Native Pomegranate ( <i>Capparis arborea</i> )	
CASURINACEAE	Forest Oak ( <i>Allocasuarina torulosa</i> )	
CELASTRACEAE	Hedraianthera ( <i>Hedraianthera porphyropetala</i> )	Regionally Significant
	Knot Vine ( <i>Hippocratea barbata</i> )	
COMMELINACEAE	Creeping Christian ( <i>Commelina cyanea</i> )	
CUONIACEAE	Coachwood ( <i>Ceratopetalum apetalum</i> )	
CYATHEACEAE	Prickly Tree Fern ( <i>Cyathea leichhardtiana</i> )	
CYPERACEAE	Umbrella Grass ( <i>Cyperus sanguinolentus</i> )	
	<i>Cyperus tetraphyllus</i>	
	<i>Schoenoplectus validus</i>	



Family	Common Name (Scientific name)	Status
DAVALLIACEAE	*Fishbone Fern ( <i>Nephrolepis cordifolia</i> )	
	<i>Arthropteris tenella</i>	
DENNSTAEDTIACEAE	Bracken ( <i>Pteridium esculentum</i> )	
DICKSONIACEAE	False Bracken ( <i>Calochaena dubia</i> )	
DILLENACEAE	Climbing Guinea Flower ( <i>Hibbertia scandens</i> )	
DIOSCOREACEAE	Native Yam ( <i>Dioscorea transversa</i> )	
DRYOPTERIDACEAE	Creeping Shield Fern ( <i>Lastreopsis acuminata</i> )	
EBENACEAE	Black Myrtle ( <i>Diospyros pentamera</i> )	
ELAEOCARPACEAE	Maiden's Blush ( <i>Sloanea australis</i> )	
	Yellow Carabeen ( <i>Sloanea woollsii</i> )	
ERICACEAE – STYPHELOIDEAE	Tree Heath ( <i>Trochocarpa laurina</i> )	
EUPHORBIACEAE	Omega ( <i>Cleistanthus cunninghamii</i> )	
	Orange Kamala ( <i>Mallotus philippensis</i> )	
FABACEAE	Blackbean ( <i>Castanospermum austral</i> )	
FABACEAE – FABOIDEAE	*White Clover ( <i>Trifolium repens</i> )	
	Sprague ( <i>Derris involuta</i> )	
	Thorny Pea/Spiny Desmodium ( <i>Desmodium acanthocladum</i> )	TSC & EPBC : V ROTAP: 2VC-
	Native Wisteria ( <i>Millettia megasperma</i> )	
FABACEAE – MINOSOIDEAE	Blackwood/White Sally Wattle ( <i>Acacia melanoxylon</i> )	
	Veiny Lace Flower ( <i>Archidendron muellerianum</i> )	ROTAP: 3RCa
FLAGELLARIACEAE	Whip Vine ( <i>Flagellaria indica</i> )	
LAURACEAE	*Camphor laurel ( <i>Cinnamomum camphora</i> )	Declared Noxious Weed
	Grey Walnut ( <i>Beilschmiedia elliptica</i> )	
	Oliver's Sassafras ( <i>Cinnamomum oliveri</i> )	
	Jackwood ( <i>Cryptocarya glaucescens</i> )	
	Red-fruited Laurel ( <i>Cryptocarya laevigata</i> )	8S - Regionally listed
	Murrogun ( <i>Cryptocarya microneura</i> )	
	Pepperberry ( <i>Cryptocarya obovata</i> )	
	Rose Walnut ( <i>Endiandra discolour</i> )	
	Green-leaved Rose Walnut ( <i>Endiandra muelleri</i> ssp. <i>bracteata</i> )	TSC: E
	Green-leaved Rose Walnut ( <i>Endiandra muelleri</i> ssp. <i>muelleri</i> )	
	Hairy Walnut ( <i>Endiandra pubens</i> )	
	Brown Bolly Gum ( <i>Litsea australis</i> )	
	Hairy-leaved Bolly Gum ( <i>Neolitsea dealbata</i> )	
LOBELIACEAE	Whiteroot ( <i>Pratia purpurascens</i> )	
LOMANDRACEAE	Spiny-headed Mat-rush ( <i>Lomandra longifolia</i> )	
	Many-flowered Mat-rush ( <i>Lomandra multiflora</i> )	
	<i>Lomandra spicata</i>	
LUZURIAGACEAE	Scrambling Lily ( <i>Geitonoplesium cymosum</i> )	
MELIACEAE	White Cedar ( <i>Melia azedarach</i> )	

Family	Common Name (Scientific name)	Status
	Scentless Rosewood ( <i>Synoum glandulosum</i> )	
MENISPERMACEAE	<i>Carronia multisejala</i>	
	Round-leaf Vine ( <i>Legnephora moorei</i> )	
	Snake Vine ( <i>Stephania japonica</i> )	
	Arrow-head Vine ( <i>Tinospora tinosporoides</i> )	TSC & EPBC: V, ROTAP: 3RC-
MONIMIACEAE	Socketwood ( <i>Daphandra sp.'McPherson Range'</i> )	
	Red-flowered Socketwood ( <i>Daphandra tenuipes</i> )	
	Anchor Vine ( <i>Palmeria scandens</i> )	
	Veiny Wilkiea ( <i>Wilkiea huegeliana</i> )	
	Large- leaved Wilkiea ( <i>Wilkiea macrophylla</i> )	
MORACEAE	Sandpaper Fig ( <i>Ficus coronate</i> )	
	Cockspur Thorn ( <i>Maclura cochinchinensis</i> )	
	Burny Vine ( <i>Malaisia scandens</i> )	
	Burny Vine ( <i>Trophis scandens</i> )	
MYRSINACEAE	<i>Embelia Australiana</i>	
MYRTACEAE	Lilly Pilly ( <i>Acmena smithii</i> )	
	Grey Myrtle ( <i>Backhousia myrtifolia</i> )	
	Pink Bloodwood ( <i>Corymbia intermedia</i> )	
	Silky Myrtle ( <i>Decaspermum humile</i> )	
	White Mahogany ( <i>Eucalyptus acmenoides</i> )	
	Broad-leaved Mahogany ( <i>Eucalyptus carnea</i> )	
	Flooded Gum ( <i>Eucalyptus grandis</i> )	
	Tallowwood ( <i>Eucalyptus microcorys</i> )	(plantation and non-plantation)
	Sydney Blue Gum ( <i>Eucalyptus saligna</i> )	(plantation)
	Brush Box ( <i>Lophostemon confertus</i> )	
	Plum Myrtle ( <i>Ptilidostigma glabrum</i> )	
	Native Guava ( <i>Rhodomyrtus psidioides</i> )	
	Turpentine ( <i>Syncarpia glommifera</i> )	
	Sour Cherry ( <i>Syzygium corynanthum</i> )	
	Giant Water Gum ( <i>Syzygium francesii</i> )	
	Blue Lilly Pilly ( <i>Syzygium oleosum</i> )	
	Water Gum ( <i>Tristaniopsis laurina</i> )	
	*Large Leaved Privet ( <i>Ligustrum lucidum</i> )	Declared Noxious Weed
	*Small Leaved Privet ( <i>Ligustrum sinense</i> )	Declared Noxious Weed
	Large Mock-olive ( <i>Notelaea longifolia</i> )	
	<i>Bulbophyllum exiguum</i>	
	<i>Chiloglottis sp.</i>	
	<i>Corybas sp.</i>	
	King Greenhood ( <i>Pterostylis baptistii</i> )	
	Small Nodding Greenhood ( <i>Pterostylis hispidula</i> )	
	Tall Greenhood ( <i>Pterostylis longifolia</i> )	
ORCHIDACEAE	Parrots Beak Orchid ( <i>Pterostylis nutans</i> )	

Family	Common Name (Scientific name)	Status
	Ladies' Tresses ( <i>Spiranthes australis</i> )	
PHYLYDRACEAE	Flax Lily/Stream Lily ( <i>Helmholtzia glaberrima</i> )	ROTAP: 2RCa
PHORMIACEAE	Blue Flax-lily ( <i>Dianella caerulea</i> )	
PHYLLANTHACEAE	Actephila ( <i>Actephila grandiflora</i> )	
	Cheese Tree ( <i>Glochidion ferdinandi</i> )	
PITTOSPORACEAE	Native Frangipani ( <i>Hymenosporum flavum</i> )	
	Orange Thorn ( <i>Pittosporum multiflorum</i> )	
	Native Daphne/Sweet Pittosporum ( <i>Pittosporum undulatum</i> )	
POACEAE	*Narrow-leaved Carpet Grass ( <i>Axonopus fissifolius</i> )	
	*Kikuyu ( <i>Pennisetum clandestinum</i> )	
	Hairy Jointgrass ( <i>Arthraxon hispidus</i> )	TSC & EPBC:V, ROTAP: 3VC-+
	Finger Grass ( <i>Digitaria ramularia</i> )	
	Wire Grass ( <i>Entolasia stricta</i> )	
	Blady Grass ( <i>Imperaria cylindrica</i> )	
	Molasses Grass ( <i>Melinis minutiflora</i> )	
	<i>Oplismenus imbecilis</i>	
	<i>Ottochloa gracillima</i>	
	<i>Paspalum sp.</i>	
	Kangaroo Grass ( <i>Themeda australis</i> )	
POLYGONACEAE	Slender Knotweed ( <i>Persicaria decipiens</i> )	
PROTACEAE	Hairy Honeysuckle ( <i>Helicia ferruginea</i> )	
	Red Bopple Nut ( <i>Hicksbeachia pinnatifolia</i> )	TSC & EPBC: V, ROTAP: 3RC-
	Rough shelled Bush Nut ( <i>Macadamia tetraphylla</i> )	TSC & EPBC: V
	Spice Bush ( <i>Triunia youngiana</i> )	
RHAMNACEAE	Red Ash ( <i>Alphitonia excels</i> )	
RIPOGONACEAE	White Supplejack ( <i>Ripogonum album</i> )	
	Hairy Supplejack ( <i>Ripogonum elseyanum</i> )	
ROUSSEACEAE	Elderberry ( <i>Cuttsia viburnea</i> )	
RUBIACEAE	<i>Atractocarpus benthamianus</i>	
	Coastal canthium ( <i>Cyclophyllum coprosmoides</i> )	
	Sweet Morinda ( <i>Morinda jasminoides</i> )	
	Native Gardenia ( <i>Randia benthamiana</i> )	
RUTACEAE	Bennett's Ash ( <i>Flindersia bennettiana</i> )	Regionally Significant
	Southern Silver Ash/Cudgerie ( <i>Flindersia schottiana</i> )	
	Bastard Crow's Ash/Black Teak ( <i>Pentaceras austral</i> )	
SAPINDACEAE	Rose Tamarind ( <i>Arytera divaricata</i> )	
	Native Tamarind ( <i>Diploglottis australis cunninghamii</i> )	
	Large-leaf Hop-bush ( <i>Dodonea triquetra</i> )	
	Guioa ( <i>Guioa semiglauca</i> )	
	Foam Bark Tree ( <i>Jagera pseudorhus</i> )	
	Yellow Pear-fruit ( <i>Mischocarpus pyriformis</i> )	

Family	Common Name (Scientific name)	Status
	Steelwood ( <i>Sarcopteryx stipitata</i> )	
SAPOTACEAE	Black Apple ( <i>Planchonella australis</i> )	
SIMAROUBACEAE	White Bean ( <i>Ailanthus triphysa</i> )	
SOLANACEAE	*Wild Tobacco Bush ( <i>Solanum mauritianum</i> )	
STERCULIACEAE	Brown Kurrajong ( <i>Commersonia bartramii</i> )	
	<i>Heritiera trifoliolata</i>	
ULMACEAE	Rough-leaved Elm ( <i>Aphananthe philipensis</i> )	
UVULARIACEAE	Bush Lily ( <i>Tripladenia cunninghamii</i> )	
VERBENACEAE	*Lantana ( <i>Lantana camara</i> )	Declared Noxious Weed
VITACEAE	Kangaroo Vine ( <i>Cissus Antarctica</i> )	
	Water Vine ( <i>Cissus hypoglauca</i> )	
	Yaroong ( <i>Cissus sterculiifolia</i> )	
WINTERACEAE	Brush Pepperbush ( <i>Tasmannia inspida</i> )	
ZINGIBERACEAE	Native Ginger ( <i>Alpina arundelliana</i> )	
	Native Ginger ( <i>Alpina caerulea</i> )	

Status =TSC – Threatened Species Conservation Act 1995, EPBC – Environment Protection and Biodiversity Conservation Act 1999, Vul – Vulnerable, E – Endangered, CE – Critically Endangered. \*Introduced Species

Table 49: Fauna species recorded within the study area

Family	Common Name (Scientific name)	Status
<b>Birds</b>		
ACANTHIZIDAE	Striated Thornbill ( <i>Acanthiza lineata</i> )	-
	Brown Thornbill ( <i>Acanthiza pusilla</i> )	-
	Brown Gerygone ( <i>Gerygone mouki</i> )	-
	White-browed Scrubwren ( <i>Sericornis frontalis</i> )	-
	Large-billed Scrubwren ( <i>Sericornis magnirostris</i> )	-
ACCIPITRIDAE	Collared Sparrowhawk ( <i>Accipiter cirrocephalus</i> )	-
	Brown Goshawk ( <i>Accipiter fasciatus</i> )	-
	Grey Goshawk ( <i>Accipiter novaehollandiae</i> )	-
ACCIPITRIDAE	Wedge-tailed Eagle ( <i>Aquila audax</i> )	
	Black-shouldered Kite ( <i>Elanus axillaris</i> )	
	Osprey ( <i>Pandion haliaetus</i> )	TSC: V
AEGOTHELIDAE	Australian Owlet-nightjar ( <i>Aegotheles cristatus</i> )	-
ALCEDINIDAE	Laughing Kookaburra ( <i>Dacelo novaeguineae</i> )	-
ANATIDAE	Pacific Black Duck ( <i>Anas superciliosa</i> )	
APODIDAE	White-throated Needletail ( <i>Hirundapus caudacutus</i> )	EPBC: Ma, M
ARDEIDAE	Cattle Egret ( <i>Ardea ibis</i> )	EPBC: M
	Little Egret ( <i>Egretta garzetta</i> )	
	White-faced Heron ( <i>Egretta novaehollandiae</i> )	-
	Black Bittern ( <i>Ixobrychus flavicollis</i> )	TSC: V
ARTAMIDAE	Dusky Woodswallow ( <i>Artamus cyanopterus</i> )	
	White-breasted Woodswallow ( <i>Artamus leucorhynchus</i> )	
	Pied Butcherbird ( <i>Cracticus nigrogularis</i> )	-
	Australian Magpie ( <i>Cracticus tibicen</i> )	
	Grey Butcherbird ( <i>Cracticus torquatus</i> )	-
	Australian Magpie ( <i>Gymnorhina tibicen</i> )	-
	Pied Currawong ( <i>Strepera graculina</i> )	-
CACATUIDAE	Sulphur-crested Cockatoo ( <i>Cacatua galerita</i> )	
	Galah ( <i>Cacatua roseicapilla</i> )	-
	Glossy Black Cockatoo ( <i>Calyptorhynchus lathamii</i> )	TSC: V
	Yellow-tailed Black-Cockatoo ( <i>Calyptorhynchus funereus</i> )	-
CAMPEPHAGIDAE	Black-faced Cuckoo-shrike ( <i>Coracina novaehollandiae</i> )	-
	Cicadabird ( <i>Coracina tenuirostris</i> )	-
	Varied Triller ( <i>Lalage leucomela</i> )	-
	White-winged Triller ( <i>Lalage tricolor</i> )	-
CHARADRIIDAE	Masked Lapwing ( <i>Vanellus miles</i> )	-
CLIMACTERIDAE	White-throated Treecreeper ( <i>Cormobates leucophaeus</i> )	-
COLUMBIDAE	Emerald Dove ( <i>Chalcophaps indica</i> )	-
	Horsfield's Bronze-Cuckoo ( <i>Chrysococcyx basalii</i> )	-
	Shining Bronze-Cuckoo ( <i>Chrysococcyx lucidus</i> )	-
	Bar-shouldered Dove ( <i>Geopelia humeralis</i> )	-
	Wonga Pigeon ( <i>Leucosarcia melanoleuca</i> )	-

Family	Common Name (Scientific name)	Status
	Topknot Pigeon ( <i>Lopholaimus antarcticus</i> )	-
	Brown Cuckoo-Dove ( <i>Macropygia amboinensis</i> )	-
	Crested Pigeon ( <i>Ocyphaps lophotes</i> )	-
	Rose-crowned Fruit-Dove ( <i>Ptilinopus regina</i> )	TSC: V
CORVIDAE	Australian Raven ( <i>Corvus coronoides</i> )	-
	Torresian Crow ( <i>Corvus orru</i> )	-
CUCULIDAE	Fan-tailed Cuckoo ( <i>Cacomantis flabelliformis</i> )	-
	Brush Cuckoo ( <i>Cacomantis variolosus</i> )	
	Pheasant Coucal ( <i>Centrops phasianinus</i> )	-
	Shining Bronze- cuckoo ( <i>Chalcites lucidus</i> )	-
	Pacific Koel ( <i>Eudynamys orientalis</i> )	
	Common Koel ( <i>Eudynamys scolopaceae</i> )	-
	Dollarbird ( <i>Eurystomus orientalis</i> )	-
	Channel-billed Cuckoo ( <i>Scythrops novaehollandiae</i> )	EPBC: Ma
DICAEIDAE	Mistletoebird ( <i>Dicaeum hirundinaceum</i> )	-
DICRURIDAE	Spangled Drongo ( <i>Dicrurus bracteatus</i> )	-
	Magpie-lark ( <i>Grallina cyanoleuca</i> )	-
	Satin Flycatcher ( <i>Myiagra cyanoleuca</i> )	EPBC: M
	Restless Flycatcher ( <i>Myiagra inquieta</i> )	-
	Leaden Flycatcher ( <i>Myiagra rubecula</i> )	-
ESTRILIDIDAE	Red-browed Finch ( <i>Neochmia temporalis</i> )	-
FALCONIDAE	Brown Falcon ( <i>Falco berigora</i> )	-
HALCYONIDAE	Sacred Kingfisher ( <i>Todiramphus sanctus</i> )	-
HIRUNDINIDAE	Welcome Swallow ( <i>Hirundo neoxena</i> )	-
	Tree Martin ( <i>Hirundo nigricans</i> )	-
MALURIDAE	Superb Fairy-wren ( <i>Malurus cyaneus</i> )	-
	Variegated Fairy-wren ( <i>Malurus lamberti</i> )	-
	Red-backed Fairy-wren ( <i>Malurus melanocephalus</i> )	-
MEGALURIDAE	Tawny Grassbird ( <i>Megalurus timoriensis</i> )	-
MEGAPODIIDAE	Australian Brush-turkey ( <i>Alectura lathami</i> )	-
MELIPHAGIDAE	Eastern Spinebill ( <i>Acanthorhynchus tenuirostris</i> )	-
	Brown Honeyeater ( <i>Lichmera indistinct</i> )	
	Noisy Miner ( <i>Manorina melanocephal</i> )	-
	Lewin's Honeyeater ( <i>Meliphaga lewinii</i> )	-
	Scarlet Honeyeater ( <i>Myzomela sanguinolenta</i> )	-
	Noisy Friarbird ( <i>Philemon corniculatus</i> )	-
MENURIDAE	Albert's Lyrebird ( <i>Menura alberti</i> )	TSC: V
MEROPIDAE	Rainbow Bee-eater ( <i>Merops ornatus</i> )	EPBC: M
MONARCHIDAE	White-eared Monarch ( <i>Monarcha leucotis</i> )	TSC: V
	Black-faced Monarch ( <i>Monarcha melanopsis</i> )	
	Spectacled Monarch ( <i>Monarcha trivirgatus</i> )	EPBC: M
ORIOIDAE	Figbird ( <i>Sphecotheres viridis</i> )	-

Family	Common Name (Scientific name)	Status
ORTHONYCHIDAE	Logrunner ( <i>Orthonyx temminckii</i> )	-
PACHYCEPHALIDAE	Grey Shrike-thrush ( <i>Colluricincla harmonica</i> )	-
	Little Shrike-thrush ( <i>Colluricincla megarhyncha</i> )	-
	White-headed Pigeon ( <i>Columba leucomela</i> )	-
	Golden Whistler ( <i>Pachycephala pectoralis</i> )	-
	Rufous Whistler ( <i>Pachycephala rufiventris</i> )	-
PARDALOTIDAE	White-throated Gerygone ( <i>Gerygone olivacea</i> )	-
	Spotted Pardalote ( <i>Pardalotus punctatus</i> )	-
	Striated Pardalote ( <i>Pardalotus striatus</i> )	
PASSERIDAE	Chestnut-breasted Mannikin ( <i>Lonchura castaneothorax</i> )	-
PETROICIDAE	Eastern Yellow Robin ( <i>Eopsaltria australis</i> )	-
	Scarlet Robin ( <i>Petroica multicolor</i> )	TSC: V
	Rose Robin ( <i>Petroica rosea</i> )	-
PODARGIDAE	Tawny Frogmouth ( <i>Podargus strigoides</i> )	-
PSITTACIDAE	Australian King-Parrot ( <i>Alisterus scapularis</i> )	-
	Crimson Rosella ( <i>Platycercus elegans</i> )	
	Eastern Rosella ( <i>Platycercus eximius</i> )	-
	Scaly-breasted Lorikeet ( <i>Trichoglossus chlorolepidotus</i> )	-
	Rainbow Lorikeet ( <i>Trichoglossus haematodus</i> )	-
PSOPHODIDAE	Eastern Whipbird ( <i>Psophodes olivaceus</i> )	-
PTILONORHYNCHIDAE	Green Catbird ( <i>Ailuroedus crassirostris</i> )	-
	Satin Bowerbird ( <i>Ptilonorhynchus violaceus</i> )	-
	**Regent Bowerbird ( <i>Sericulus chrysocephalus</i> )	-
RALLIDAE	Dusky Moorhen ( <i>Gallinula tenebrosa</i> )	-
	Purple Swamphen ( <i>Porphyrio porphyrio</i> )	-
RHIPIDURIDAE	Grey Fantail ( <i>Rhipidura fuliginosa</i> )	-
	Willie Wagtail ( <i>Rhipidura leucophrys</i> )	-
	Rufous Fantail ( <i>Rhipidura rufifrons</i> )	EPBC: M
STRURNIADAE	*Common Myna ( <i>Acridotheres tristis</i> )	Int
SULIDAE	Little Pied Cormorant ( <i>Phalacrocorax melanoleucos</i> )	-
TIMALIIDAE	Silvereeye ( <i>Zosterops lateralis</i> )	-
TYTONIDAE	Masked Owl ( <i>Tyto novaehollandiae</i> )	TSC: V
	**Sooty Owl ( <i>Tyto tenebricosa</i> )	TSC : V
<b>Non-flying Mammals</b>		
BOVIDAE	*Domestic Cow ( <i>Bos Taurus</i> )	Int
CANIDAE	*Feral Dog ( <i>Canis lupus familiaris</i> )	Int
DASYURIDAE	Brown Antechinus ( <i>Antechinus stuartii</i> )	-
FELIDAE	*Feral Cat ( <i>Felis catus</i> )	Int
LEPORIDAE	*Brown Hare ( <i>Lepus capensis</i> )	-
	*European Rabbit ( <i>Oryctolagus cuniculus</i> )	Int

Family	Common Name (Scientific name)	Status
MACROPODIDAE	Red-necked Wallaby ( <i>Macropus rufogriseus</i> )	-
	Swamp Wallaby ( <i>Wallabia bicolor</i> )	-
MURIDAE	Fawn-footed Melomys ( <i>Melomys cervinipes</i> )	-
	*House mouse ( <i>Mus musculus</i> )	Int
	Bush Rat ( <i>Rattus fuscipes</i> )	-
	*Black Rat ( <i>Rattus rattus</i> )	Int
ORNITHORHYNCHIDAE	Platypus ( <i>Ornithorhynchus anatinus</i> )	-
PERAMELIDAE	Northern Brown Bandicoot ( <i>Isodon macrourus</i> )	-
	Long-nosed Bandicoot ( <i>Perameles nasuta</i> )	-
PETAURIDAE	Sugar Glider ( <i>Petaurus breviceps</i> )	-
PHALANGERIDAE	Mountain Brushtail possum ( <i>Trichosurus cunninghami</i> )	-
	Common Brushtail Possum ( <i>Trichosurus vulpecular</i> )	-
PHASCOLARCTIDAE	Koala ( <i>Phascolarctos cinereus</i> )	TSC: V
PSEUDOCHEIRIDAE	Common Ringtail Possum ( <i>Pseudocheirus peregrines</i> )	-
SUIDAE	*Feral Pig ( <i>Sus scrofa</i> )	Int
TACHYGLOSSIDAE	*Echidna ( <i>Tachyglossus aculeatus</i> )	-
<b>Reptiles</b>		
AGAMIDAE	Eastern Water Dragon ( <i>Physignathus lesueurii</i> )	-
	Eastern Bearded Dragon ( <i>Pogona barbata</i> )	-
CHELIDAE	Saw-shelled Turtle ( <i>Elseya latisternum</i> )	-
COLUBRIDAE	Brown Tree Snake ( <i>Boiga irregularis</i> )	-
	Green Tree Snake ( <i>Dendrelaphis punctulata</i> )	-
ELAPIDAE	Yellow-faced Whip Snake ( <i>Demansia psammophis</i> )	-
	Southern Dwarf Crowned Snake ( <i>Cacophis krefftii</i> )	-
	Eastern Brown Snake ( <i>Pseudonaja textilis</i> )	-
	Eastern Small-eyed Snake ( <i>Rhinoplocephalus nigrescens</i> )	-
	Rough-scaled Snake ( <i>Tropidechis carinatus</i> )	-
	**Bandy bandy ( <i>Vermicella annulata</i> )	-
GEKKONIDAE	**Southern Leaf-Tailed Gecko ( <i>Saltuarius swaini</i> )	-
PYTHONIDAE	Carpet Python ( <i>Morelia spilota</i> )	-
SCINCIDAE	Three-toed Skink ( <i>Anomalopus verreauxii</i> )	
	Pink-tongued Skink ( <i>Cyclodomorphus gerrardii</i> )	-
	Wall Skink ( <i>Cryptoblepharus virgata</i> )	
	Striped Skink ( <i>Ctenotus robustus</i> )	-
	Land Mullet ( <i>Egernia major</i> )	-
	Three Toed Burrowing Skink ( <i>Hemiergis decresiensis</i> )	-
	Garden Skink ( <i>Lampropholis delicata</i> )	-
	Grass Skink ( <i>Lampropholis guichenoti</i> )	-



Family	Common Name (Scientific name)	Status
	Three Toed Skink ( <i>Saiphos equalis</i> )	-
	Orange-tailed Shade-skink ( <i>Saproscincus challenger</i> )	-
	Roses Weasel Skink ( <i>Saproscincus rosei</i> )	-
	**Blue-tongue Lizard ( <i>Tiliqua scincoides</i> )	-
VARANIDAE	Lace Monitor ( <i>Varanus varius</i> )	-
<b>Bats</b>		
MINIOPTERIDAE	Little Bent-wing Bat ( <i>Miniopterus australis</i> )	TSC : V
	Eastern Bentwing-bat ( <i>Miniopterus schreibersii oceanensis</i> )	TSC : V
MOLOSSIDAE	White-striped Mastiff Bat ( <i>Tadarida australis</i> )	-
PTEROPODIDAE	Black Flying-fox ( <i>Pteropus alecto</i> )	-
	Grey-headed flying fox ( <i>Pteropus poliocephalus</i> )	TSC & EPBC: V
RHINOLOPHIDAE	Eastern Horseshoe Bat ( <i>Rhinolophus megaphyllus</i> )	-
VESPRTLIONIDAE	Gould's Wattled Bat ( <i>Chalinolobus gouldii</i> )	-
	Chocolate Wattled Bat ( <i>Chalinolobus morio</i> )	-
	Fishing Bat ( <i>Myotis macropus</i> )	TSC : V
	Eastern Long-eared Bat ( <i>Nyctophilus bifax</i> )	TSC : V
	Gould's Long-eared Bat ( <i>Nyctophilus gouldi</i> )	-
	Unidentified Long-eared Bat ( <i>Nyctophilus sp.</i> )	-
	Greater Broad-nosed Bat ( <i>Scoteanax rueppellii</i> )	TSC : V+
	Eastern Broad-nosed Bat ( <i>Scotorepens orion</i> )	-
	Eastern Forest Bat ( <i>Vespadelus pumilus</i> )	-
<b>Amphibians</b>		
RHINELLANIDAE	*Cane Toad ( <i>Rhinella marinus</i> )	Int
HYLIDAE	Barrington Tree Frog ( <i>Litoria barringtonensis</i> )	-
	Bleating Tree Frog ( <i>Litoria dentata</i> )	
	Dwarf Green Tree Frog ( <i>Litoria fallax</i> )	-
	Broad-palmed Frog ( <i>Litoria latopalmata</i> )	-
	Leaf Green Tree Frog ( <i>Litoria pearsoniana</i> )	-
	Perons Tree Frog ( <i>Litoria peronii</i> )	-
	Laughing Tree Frog ( <i>Litoria tyleri</i> )	-
Stoney Creek Frog ( <i>Litoria wilcoxi</i> )	-	
MYOBATRACHIDAE	Tusk Frog ( <i>Adelotus brevis</i> )	-
	Common Eastern Froglet ( <i>Crinia signifera</i> )	-
	Striped Marsh Frog ( <i>Limnodynastes peronii</i> )	-
	Great Barred Frog ( <i>Mixophyes fasciolatus</i> )	-
	Loveridges Mountain Frog ( <i>Philoria loveridgei</i> )	TSC: E
	Red-backed Toadlet ( <i>Pseudophryne coriacea</i> )	-

Family	Common Name (Scientific name)	Status
	Dusky Toadlet ( <i>Uperoleia fusca</i> )	-
<b>Macroinvertebrates</b>		
ASILIDAE	Robber flies	-
CAELIFERA	Short-horned grasshopper	-
CALLIPHORIDAE	House flies	-
CHRYSOMELIDAE	Lantana leafmine beetle ( <i>Octotoma scabripennis</i> )	-
CURCULIONIDAE	Weevil beetle	-
FORMICIDAE	Bull ant ( <i>Myrmecia</i> sp.)	-
GOMPHIDAE	<i>Austrogomphus</i> ( <i>Pleiogomphus</i> ) <i>amphiclitus</i>	-
GRYLLIDAE	Orthoptera	-
HERSPERIIDAE	<i>Ocybadistes flavoitta / walkeri</i>	-
LIBELLUIDAE	Fiery skimmer ( <i>Orthetrum villosovittatum</i> )	-
NYMPHALIDAE	Wanderer butterfly ( <i>Danaus plexippus</i> )	-
PENTATOMIDAE	Sucking insect	-
PIERIDAE	Cabbage White ( <i>Pieris rapae</i> )	-
SYRPHIDAE	Hover flies	-
	Syrphid flies	-
TETTIGONIIDAE	Orthoptera	-

Status =TSC – Threatened Species Conservation Act 1995, EPBC – Environment Protection and Biodiversity Conservation Act 1999, Vul – Vulnerable, E – Endangered, CE – Critically Endangered

\*Introduced Species, \*\*Record from local resident (pers comm. Andy Simpson), + Recorded by Ecos (2001). \$ *Pearsoniana* species complex taxonomy under review. This record was confirmed by Dr Arthur White, an amphibian specialist.+ Recorded at Rocky Creek Dam, but not on the study site

## **APPENDIX 6 CONSULTANT'S BRIEF FOR THE PROJECT**



# **Terrestrial Ecology Impact Assessment for the Proposed Dunoon Dam**

## **Consultant's Brief**

Contract Number – 869j

December 2009

## 2 The Project

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### 2.1 Background

Rous Water is a county council on the North Coast of NSW. Rous Water provides bulk water supply services to over 94,000 people within Lismore, Byron, Ballina and Richmond Valley local government areas.

During the 1990's Rous Water commenced work on the Rous Regional Water Supply Strategy to develop a long term planning strategy to secure water supply sources to serve the Rous Water supply area to the year 2050 and beyond.

At the conclusion of the Planning Study Rous Water resolved to:

- Develop and implement a comprehensive water-use Demand Management program to reduce per capita water consumption,
- Adopt a policy to monitor and implement emerging water reuse and alternative supply strategies,
- Develop the "Lismore Source" as the next new supply source for the Rous Regional Water Supply,
- Nominate the Dunoon Dam site as Rous Water's future water source in anticipation of demand exceeding the combined capacity of the Lismore Source plus existing sources.

The Dunoon Dam proposal involves the construction of a new across stream water storage on Rocky Creek downstream of the existing Rocky Creek Dam. The dam would be approximately 2.5 kilometres west of the village of Dunoon, from which it takes its name (Figure 1).

Rous Water has now commenced work to determine the technical viability and likely cost of the proposed Dunoon Dam.

In 2008 Rous Water engaged NSW Water Solutions (NSW Public Works) to lead the development of the Concept Design for the proposed Dunoon Dam. The current engagement will work to provide a Terrestrial Ecology impact assessment to assist in the development of the Concept Design of the proposed Dunoon Dam. The work is to be of a standard and format that would allow the information to be incorporated into any future environmental assessment activities associated with the proposed dam.

The work is to be undertaken to a standard that will allow Rous Water to thoroughly assess the social, economic and environmental costs associate with the Dunoon Dam proposal and to weigh these costs against the benefits provided by the proposal.

In addition, the successful consultant will be required to present their project to the Project Reference Group, established to ensure community and stakeholder participation in the proposed Dunoon Dam concept design.

## **2.2 Planning for Dunoon Dam**

The timing required for the completion of the proposed Dunoon Dam remains uncertain. Rous Water has adopted a procurement strategy that is capable of completing the dam in accordance with existing worst case scenario. However, this is an adaptive approach that involves ongoing assessment of the projected need for the proposed dam.

NSW Water Solutions has been engaged to develop the conceptual design for Dunoon Dam. This requires a range of studies and activities to be undertaken, including significant consultation with stakeholders, water users and regulators.

The development of the concept will require a range of supporting studies. This includes the study subject to this tender, being the terrestrial ecology impact assessment. The successful consultant will be required to liaise closely with NSW Water Solutions to ensure the project outputs are consistent with the needs of the Dunoon Dam concept design.

## **2.3 Work Undertaken to Date**

A number of studies have been completed for the proposed Dunoon Dam.

Work already completed includes: the identification of an appropriate site for the dam; community and landholder liaison; rezoning of land subject to potential inundation associated with the dam and within the water catchment area, and; a voluntary property acquisition program between Rous Water and landholders directly impacted by the development of the proposed dam.

Preliminary technical studies have been completed for:

- Site selection and justification (CMPS&F, 1995; Public Works, 1994)
- Hydrology (DNR, 2007)
- Flora and fauna (Austeco, 1994; Ecos Environmental Planning, 2001; Bishop 1998)
- Population growth estimates (Geolink, 2006)
- Impacts of climate change on Rous Water supplies (CSIRO, 2006)
- Environmental buffer zone strategic plan (Hydrosphere Consulting, 2009)

## **2.4 Dam Concept**

The studies undertaken to date indicate the proposed Dunoon Dam is technically feasible. However, these studies were preliminary in their nature and can not necessarily be relied upon to justify further development of the concept without specific detailed investigations.

Initial planning suggests that the Dunoon Dam shall comprise of:

- An across stream storage (dam) on Rocky Creek, downstream of the existing Rocky Creek Dam, approximately 2.5 kilometres west of the village of Dunoon.
- A dam lake of approximately 50,000 megalitres (ML) with a surface area of 220 hectares (see Figure 2).

- An environmental buffer zone surrounding the dam of approximately 225 hectares.
- Pumps and a rising main connecting the dam to existing raw water mains at Doroughby, from which water shall be transferred to Rous Water's existing Nightcap Water Treatment Plant.
- Various plant and facilities associated with the operation of the dam.

These details remain subject to confirmation during the concept development phase being undertaken by NSW Water Solutions.

## **2.5 Hydrology**

NSW Water Solutions will be undertaking the hydrological modelling and yield studies for the proposed works.

## 3 Services Required

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### 3.1 Statement of Purpose

This statement of purpose is not intended to be an exhaustive list of the purposes required by this Agreement. The purpose of the consultancy covered by this tender is for the preparation of the following for Dunoon Dam proposal:

- Undertake a Terrestrial Ecology Impact Assessment of Dunoon Dam that is of a suitable standard to be a specialist study for potential future environmental assessment and that can help inform the development of the concept design by NSW Water Solutions.

### 3.2 Scope of Work

Undertake a specialist terrestrial ecology assessment for the proposed Dunoon Dam. The assessment study area is to include;

- The area directly surrounding the proposed dam wall, including sufficient footprint to consider the construction works area;
- The area inundated by the proposed storage;
- Consideration of areas potentially subject to temporary inundation from the new flood level;
- Adopted environmental buffer zone
- Riparian vegetation downstream of the proposed dam wall. This assessment should extend to Terania Creek junction.

The assessment would be prepared to a standard where the report may be a specialist study for the environmental assessment of the proposed dam.

The terrestrial ecology assessment would be required to be undertaken by suitably qualified ecologists and should include the following:

- Review known records of species and communities by reviewing literature, previous reports and undertaking relevant database searches (including DECCW Wildlife Atlas, EPBC Act Protected Matters Report etc);
- Identify terrestrial flora and fauna species, and communities likely to occur in the study area. This is to include areas of construction and operation covered and influenced by the project;
- Identify potential for threatened species, communities or populations listed under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999* to occur in the study area;
- Prepare a safe work method statement for field work;
- Prior to undertaking the surveys, access arrangements are to be confirmed with NSW Water Solutions. Landowner notification will be undertaken by Rous Water;
- Undertake field surveys and habitat assessments, in accordance with DECCW survey assessment guidelines (Draft *Threatened Biodiversity Survey and Assessment* DECC 2004) taking into account any seasonal requirements;



- Undertake mapping of vegetation communities identified in the study area. Map any identified threatened species, endangered ecological communities or sensitive areas and provide AMG GPS co-ordinates. Produce map/s showing ecological communities in the area and location of any significant species or communities;
- Provide details on the location, composition, quality and quantity and conservation status of habitat, species and communities to be impacted;
- Assess impacts on species and communities due to the proposed dam development. The assessment is to be undertaken to a standard that would meet the requirements of a supporting specialist study under Part 3A of the *Environmental Planning and Assessment Act 1979*. The assessment would include any impacts as a result of habitat fragmentation, clearing, edge effects, and loss of habitat. Identify any potential habitat created by the proposed storage;
- Review the presence of weeds and potential for the introduction of weeds;
- Assess the ecological impacts in accordance with the *Environment Protection and Biodiversity Conservation Act 1999*, *Threatened Species Conservation Act 1995*, *Environmental Planning and Assessment Act 1979* and relevant publications and policies by DECCW;
- Ascertain impacts on threatened species, communities or populations listed under the *Threatened Species Conservation Act 1995* and the *Environment Protection and Biodiversity Conservation Act 1999*. This to be undertaken in consideration of the DECC (2007) *Threatened Species Assessment Guidelines* and Department of Environment, Water, Heritage and Arts guidelines for the assessment of significance on matters of National Environmental Significance;
- Recommend whether referral is required to the Department of Environment, Water, Heritage and Arts for a decision on whether the proposed dam proposal is a controlled action under the EPBC Act;
- Identify mitigation measures and safeguards to minimise impacts during construction and operation of the dam. Mitigation measures should include recommendations on clearing requirements for within the proposed inundation area, offset requirements for clearing, weed management and revegetation. Identification of appropriate clearing methodologies should include consideration of any significant species identified;
- Identify any ecological considerations that need to be taken into account in the development for the concept design for the proposed Dunoon Dam. The consultant would be required to work in a collaborative manner with NSW Water Solutions in regards to the concept development;
- Identify any ecological monitoring requirements prior to and post commissioning of the proposed dam. Cost estimates for monitoring are to be provided;
- Document the above in an assessment report.

### 3.3 Key deliverables

Outputs are to include:

- Project delivery plan;
- Safe Work Method Statements
- Draft terrestrial ecology assessment report (electronic and hard copy);
- Final draft terrestrial ecology assessment report (electronic);
- Final terrestrial ecology assessment report (electronic and hard copy);
- Presentation to Rous Water of findings of the terrestrial ecology assessment.

### **3.4 Program**

A program of not more than 60 weeks has been allowed for the completion of this engagement.

### **3.5 Progress Reporting**

A monthly progress email is to be submitted to the NSW Water Solutions (NSW Public Works) project manager for this engagement.

## APPENDIX 7 PART 3A THRESHOLDS

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### **Response to Key Thresholds as part of Part 3A (Draft Guidelines for Threatened Species Assessment DEC and DPI 2005).**

#### **Whether or not the proposal, including actions to avoid or mitigate impacts or compensate to prevent unavoidable impacts will maintain or improve biodiversity values.**

The proposed dam will maintain biodiversity values, provided that appropriate mitigation during design and construction and appropriate offsets for the works are negotiated. This will require that some of the unavoidable impacts are offset for the study area due to the residual impacts remaining after mitigation is applied.

Initial calculations using 4:1 for native vegetation and 2:1 for exotics show that an approximate total of 214 ha, of which 77 ha currently occurs within the buffer area, will be required to offset the proposed works, unless an assessment under the BioBanking Scheme is undertaken to determine offsetting requirements for the project.

#### **Whether or not the proposal is likely to reduce the long-term viability of a local population of the species, population or ecological community.**

The long-term viability of local threatened flora populations is likely to be affected by the proposed dam. Potential impacts to individuals and habitat of the following threatened flora species are likely to be significant: Hairy Jointgrass (*Arthraxon hispidus*), Corokia (*Corokia whiteana*), Spiny Desmodium (*Desmodium acanthocladum*), Green-leaved Rose Walnut (*Endiandra muelleri* subsp. *bracteata*), Red Boppel Nut (*Hicksbeachia pinnatifolia*), Southern Ochrosia (*Ochrosia moorei*), Rough shelled Bush Nut (*Macadamia tetraphylla*), Slender Marsdenia (*Marsdenia longiloba*), Arrowhead Vine (*Tinospora tinosporoides*). Investigation into the translocation of such species into areas of suitable habitat will be undertaken, though success may be low.

The long-term viability of the endangered Lowland Subtropical Rainforest community onsite will be greatly reduced from the loss of over 55% (34 ha) of its local occurrence within the study area and indirect impacts on remaining patches resulting from the works.

The long-term viability of threatened fauna populations within the study area could be compromised from the works, the barrier effects of the proposed infrastructure and inundation area, and the loss of threatened fauna habitat and habitat features as a result of the proposed dam. Potentially significant impacts are likely for a number of threatened fauna species that utilise the study area and the habitat it provides.

Therefore, the proposed dam is likely to reduce the long-term viability of local populations of species and communities within the study area. The potential impact can be mitigated through the implementation of the measures described in this report, and recommended offsets will ameliorate some of the unavoidable potential impacts of the dam, should it proceed.

#### **Whether or not the proposal is likely to accelerate the extinction of the species, population or ecological community or place it at risk of extinction.**

Potential impacts to threatened species, populations and ecological communities are considered to be significant locally and regionally. However, given the occurrence of many of the species and communities identified within nearby conservation areas, the proposed dam is unlikely to accelerate the potential for extinction for these threatened entities within the region. Given that the proposed dam, should it proceed, may also improve the existing habitat within the buffer area and linkages to conservation areas, it may also provide some benefits to promote the movement and available habitat for such species.

#### **Whether or not the proposal will adversely affect critical habitat.**

The proposed upgrade will not impact on any areas identified as critical habitat under the TSC and/or EPBC Act.

## APPENDIX 8 EXAMPLES OF RAW FIELD DATA

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DUNOON AUTUMN SURVEY		TALLY	Opp.	PLOT								
				1	2	6	7	B1	B2	B3	B4	
		88	70	13	10	12	11	18	15	12	11	
<i>Pachycephala pectoralis</i>	Golden Whistler	1	1					1		1		3
<i>Pachycephala rufiventris</i>	Rufous Whistler	1	1									1
<i>Pandion haliaetus</i>	Osprey	1	1									1
<i>Pardalotus punctatus</i>	Spotted Pardalote	1	1					1				2
<i>Petroica multicolor</i>	Scarlet Robin	1	1									1
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	1	1									1
<i>Philemon corniculatus</i>	Noisy Friarbird	1	1									1
<i>Platycercus eximius</i>	Eastern Rosella	1	1									1
<i>Podargus strigoides</i>	Tawny Frogmouth	1	1									1
<i>Porphyrio porphyrio</i>	Purple Swamphen	1	1									1
<i>Psophodes olivaceus</i>	Eastern Whipbird	1			1	1		1	1	1	1	6
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	1		1		1	1	1		1		5
<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	1	1						1			2
<i>Rhipidura fuliginosa</i>	Grey Fantail	1			1	1	1	1	1			5
<i>Rhipidura leucophrys</i>	Willie Wagtail	1	1									1
<i>Rhipidura rufifrons</i>	Rufous Fantail	1		1		1						2
<i>Sericornis frontalis</i>	White-browed Scrubwren	1						1			1	2
<i>Sericornis magnirostris</i>	Large-billed Scrubwren	1	1				1					2
<i>Sphecotheres viridis</i>	Figbird	1	1									1
<i>Strepera graculina</i>	Pied Currawong	1	1			1	1	1	1	1		6
<i>Todiramphus sanctus</i>	Sacred Kingfisher	1	1									1
<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	1	1									1
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	1	1						1			2
<i>Tyto novaehollandiae</i>	Masked Owl	1	1									1
<i>Vanellus miles</i>	Masked Lapwing	1	1									1
<i>Zosterops lateralis</i>	Silvereye	1	1									1

migratory under EPBC Act

Threatened

Year	Month	Day	Easting	Northing	Site	Family	Scientific Name	Common Name	Listed Status	Number of Individuals	Comments
2010	October	25	528768	6829510	Causeway	Elapidae	<i>Demansia psammophis</i>	Yellow-faced Whip Snake		1	
2010	October	25	528700	6829535	Causeway	Myobatrachidae	<i>Adelotus brevis</i>	Tusk Frog		1	
2010	October	25	528756	6829541	Causeway	Hylidae	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		2	
2010	October	25	528756	6829541	Causeway	Myobatrachidae	<i>Crinia signifera</i>	Common Eastern Froglet		2	
2010	October	25	528818	6829506	Coopers	Hylidae	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		1	
2010	October	25	528818	6829506	Coopers	Myobatrachidae	<i>Crinia signifera</i>	Common Eastern Froglet		4	
2010	October	25	529023	6829548	Causeway	Myobatrachidae	<i>Adelotus brevis</i>	Tusk Frog		6	
2010	October	25	529023	6829548	Causeway	Myobatrachidae	<i>Limnodynastes peronii</i>	Striped Marsh Frog		2	
2010	October	25	529023	6829548	Causeway	Myobatrachidae	<i>Uperoleia fusca</i>	Dusky Toadlet		3	
2010	October	25	529023	6829548	Causeway	Hylidae	<i>Litoria latopalmata</i>	Broad-palmed Frog		1	
2010	October	25	529023	6829548	Causeway	Hylidae	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		2	
2010	October	25	529023	6829548	Causeway	Macropodidae	<i>Macropus rufogrisea</i>	Red-necked Wallaby		3	
2010	October	25	529023	6829548	Causeway	Lepidae	<i>Lepus capensis</i>	Brown Hare		4	
2010	October	25	528818	6829506	Coopers	Hylidae	<i>Litoria wilcoxi</i>	Stoney Creek Frog		1	
2010	October	25	528818	6829506	Coopers	Hylidae	<i>Litoria barringtonensis</i>	Barrington Tree Frog		2	
2010	October	25	528818	6829506	Coopers	Muridae	<i>Melomys cervinipes</i>	Fawn-footed Mouse		2	
2010	October	25	528818	6829506	Coopers	Pseudecheiridae	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum		1	
2010	October	25	528818	6829506	Coopers		<i>Oryctilagus cuniculus</i>	Rabbit		1	
2010	October	25	528818	6829506	Coopers	Pterodidae	<i>Pteropus alecto</i>	Black Flying-fox		1	
2010	October	26	528172	6827476	Coopers	Psophodidae	<i>Psophodes olivaceous</i>	Eastern Whipbird		8	
2010	October	26	528172	6827476	Coopers	Menuridae	<i>Menura superba</i>	Superb Lyrebird		1	
2010	October	26	528172	6827476	Coopers	Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		1	
2010	October	26	528172	6827476	Coopers	Psittacidae	<i>Platycercus eximia</i>	Eastern Rosella		1	
2010	October	26	528172	6827476	Coopers	Rhipiduridae	<i>Rhipidura fuliginosa</i>	New Zealand Fantail		2	
2010	October	26	528172	6827476	Coopers	Corvidae	<i>Corvus coronoides</i>	Australian Raven		1	
2010	October	26	528172	6827476	Coopers	Columbidae	<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove		1	
2010	October	26	528172	6827476	Coopers	Campephagidae	<i>Lalage tricolor</i>	White-winged Triller		3	
2010	October	26	528172	6827476	Coopers	Scincidae	<i>Lampropholis delicata</i>	Grass Skink		1	
2010	October	26	528172	6827476	Coopers	Scincidae	<i>Cryptoblepharus virgata</i>	Wall Skink		1	
2010	October	26	528172	6827476	Coopers	Scincidae	<i>Anomalopus verreauxii</i>	Three-toed Skink		1	
2010	October	26	528334	6827380	Coopers	Monarchidae	<i>Dicrurus bracteatus</i>	Spangled Drongo		1	
2010	October	26	528334	6827380	Coopers	Campephagidae	<i>Coracina tenuirostris</i>	Cicadabird		1	
2010	October	26	528334	6827380	Coopers	Cuculidae	<i>Centropus phasianinus</i>	Pheasant Coucal		1	
2010	October	26	528334	6827380	Coopers	Scincidae	<i>Lampropholis delicata</i>	Grass Skink		1	
2010	October	26	528334	6827380	Coopers	Scincidae	<i>Cryptoblepharus virgata</i>	Wall Skink		1	
2010	October	26	528334	6827380	Coopers	Scincidae	<i>Hemiergis decresiensis</i>	Three Toed Burrowing Skink		1	
2010	October	26	531176	6829266	Simes Bridge	Scincidae	<i>Egernia major</i>	Land Mullet		2	
2010	October	26	531176	6829266	Simes Bridge	Scincidae	<i>Lampropholis delicata</i>	Grass Skink		1	
2010	October	26	531176	6829266	Simes Bridge	Scincidae	<i>Saproscincus rosei</i>	Roses Weasel Skink		1	
2010	October	26	528710	6829558	Causeway	Columbidae	<i>Columba leucomela</i>	White-headed Pigeon		1	
2010	October	26	528710	6829558	Causeway	Columbidae	<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove		1	
2010	October	26	528710	6829558	Causeway	Columbidae	<i>Leucosarcia melanoleuca</i>	Wonga Pigeon		1	
2010	October	26	528710	6829558	Causeway	Columbidae	<i>Geopelia humeralis</i>	Bar-shouldered Dove		1	
2010	October	26	528710	6829558	Causeway	Cuculidae	<i>Eudynamys scolopacea</i>	Common Koel		1	



Year	Month	Day	Easting	Northing	Site	Family	Scientific Name	Common Name	Listed Status	Number of Individuals	Comments
2010	October	26	528710	6829558	Causeway	Cuculidae	Scythrops novaehollandiae	Channel-billed Cuckoo		1	
2010	October	26	528710	6829558	Causeway	Cuculidae	Centrops phasianinus	Pheasant Coucal		3	
2010	October	26	528710	6829558	Causeway	Ptilorhynchidae	Ptilorhynchus violaceus	Satin Bowerbird		2	
2010	October	26	528710	6829558	Causeway	Psophodidae	Psophodes olivaceous	Eastern Whipbird		1	
2010	October	26	528710	6829558	Causeway	Cuculidae	Cuculus flabelliformis	Fan-tailed Cuckoo		2	
2010	October	26	528710	6829558	Causeway	Campephagidae	Coracina novaehollandiae	Black-faced Cuckoo-shrike		1	
2010	October	26	528710	6829558	Causeway	Artamidae	Gymnorhina tibicens	Magpie		1	
2010	October	26	528710	6829558	Causeway	Corvidae	Corvus coronoides	Australian Raven		1	
2010	October	26	528710	6829558	Causeway	Coraciidae	Eurystomus orientalis	Dollarbird		3	
2010	October	26	528710	6829558	Causeway	Petroicidae	Eopsaltria australis	Eastern Yellow Robin		2	
2010	October	26	528710	6829558	Causeway	Pachycephalidae	Pachycephala pectoralis	Golden Whistler		1	
2010	October	26	528710	6829558	Causeway	Campephagidae	Coracina tenuirostris	Cicadabird		2	
2010	October	26	528710	6829558	Causeway	Meliphagidae	Meliphaga lewinii	Lewins Honeyeater		1	
2010	October	26	529368	6829740	Causeway	Elapidae	Pseudonaja textilis	Eastern Brown Snake		1	
2010	October	26	529040	6829516	Causeway	Agamidae	Physignathus lesueurii	Eastern Water Dragon		1	
2010	October	26	529638	6827362	Munro	Agamidae	Pogona barbata	Eastern Bearded Dragon		1	
2010	October	26	529463	6827336	Macrorhyncha Plantation	Scincidae	Saiphos equalis	Three Toed Skink		1	
2010	October	26	529463	6827336	Macrorhyncha Plantation	Hylidae	Litoria fallax	Eastern Dwarf Tree Frog		1	
2010	October	26	529463	6827336	Macrorhyncha Plantation	Scincidae	Lampropholis delicata	Grass Skink		1	
2010	October	26	529463	6827336	Macrorhyncha Plantation	Scincidae	Cryptoblepharus virgata	Wall Skink		1	
2010	October	26	529463	6827329	Macrorhyncha Plantation	Scincidae	Saproscincus rosei	Roses Weasel Skink		2	
2010	October	26	529463	6827329	Macrorhyncha Plantation	Scincidae	Lampropholis delicata	Grass Skink		5	
2010	October	26	529418	6827305	Sandstone Escarpment	Elapidae	Rhinoplocephalus nigrescens	Eastern Small-eyed Snake		1	
2010	October	26	529418	6827305	Sandstone Escarpment	Scincidae	Ctenotus robustus	Robust Skink		1	
2010	October	26	529647	6827225	Top Escarpment	Pythonidae	Morelia spilota	Carpet Python		1	
2010	October	26	528616	6839609	McGuinness	Phascolasctidae	Phascolarctos cinereus	Koala		1	
2010	October	26	528586	6839490	McGuinness	Scincidae	Lampropholis delicata	Grass Skink		6	
2010	October	26	528586	6839490	McGuinness	Scincidae	Lampropholis guichenoti	Garden Skink		1	
2010	October	26	527830	6828695	68 Terania Ck Rd	Phascolasctidae	Phascolarctos cinereus	Koala		1	
2010	October	26	527941	6828646	68 Terania Ck Rd	Myobatrachidae	Adelotus brevis	Tusk Frog		3	
2010	October	26	527941	6828646	68 Terania Ck Rd	Myobatrachidae	Crinia signifera	Common Eastern Froglet		10	
2010	October	26	527941	6828646	68 Terania Ck Rd	Myobatrachidae	Uperoleia fusca	Red-groined Toadlet		7	
2010	October	26	527941	6828646	68 Terania Ck Rd	Hylidae	Litoria peronii	Perons Tree Frog		2	
2010	October	26	527941	6828646	68 Terania Ck Rd	Hylidae	Litoria latopalmata	Broad-palmed Frog		3	
2010	October	26	527941	6828646	68 Terania Ck Rd	Hylidae	Litoria fallax	Eastern Dwarf Tree Frog		12	
2010	October	26	527941	6828646	68 Terania Ck Rd	Myobatrachidae	Limnodynastes peronii	Striped Marsh Frog		8	
2010	October	26	528125	6828615	68 Terania Ck Rd	Myobatrachidae	Adelotus brevis	Tusk Frog		3	
2010	October	26	528125	6828615	68 Terania Ck Rd	Myobatrachidae	Crinia signifera	Common Eastern Froglet		8	
2010	October	26	528125	6828615	68 Terania Ck Rd	Myobatrachidae	Uperoleia fusca	Red-groined Toadlet		10	
2010	October	26	528125	6828615	68 Terania Ck Rd	Hylidae	Litoria peronii	Perons Tree Frog		2	
2010	October	26	528125	6828615	68 Terania Ck Rd	Hylidae	Litoria latopalmata	Broad-palmed Frog		4	
2010	October	26	528125	6828615	68 Terania Ck Rd	Hylidae	Litoria fallax	Eastern Dwarf Tree Frog		15	
2010	October	26	528125	6828615	68 Terania Ck Rd	Myobatrachidae	Limnodynastes peronii	Striped Marsh Frog		6	
2010	October	26	528125	6828615	68 Terania Ck Rd	Myobatrachidae	Mixophyes fasciolatus	Great Barred Frog		4	x

Year	Month	Day	Easting	Northing	Site	Family	Scientific Name	Common Name	Listed Status	Number of Individuals	Comments
2010	October	26	528377	6828690	68 Terania Ck Rd	Myobatrachidae	Adelotus brevis	Tusk Frog		2	x
2010	October	26	528377	6828690	68 Terania Ck Rd	Myobatrachidae	Limnodynastes peronii	Striped Marsh Frog		4	x
2010	October	26	528377	6828690	68 Terania Ck Rd	Myobatrachidae	Uperoleia fusca	Red-groined Toadlet		7	x
2010	October	26	528377	6828690	68 Terania Ck Rd	Hylidae	Litoria peronii	Perons Tree Frog		1	x
2010	October	26	528377	6828690	68 Terania Ck Rd	Hylidae	Litoria latopalmata	Broad-palmed Frog		2	x
2010	October	26	528377	6828690	68 Terania Ck Rd	Hylidae	Litoria fallax	Eastern Dwarf Tree Frog		11	x
2010	October	26	528356	6828620	68 Terania Ck Rd	Myobatrachidae	Adelotus brevis	Tusk Frog		3	x
2010	October	26	528356	6828620	68 Terania Ck Rd	Myobatrachidae	Mixophyes fasciolatus	Great Barred Frog		2	x
2010	October	26	528356	6828620	68 Terania Ck Rd	Hylidae	Litoria peronii	Perons Tree Frog		4	x
2010	October	26	528356	6828620	68 Terania Ck Rd	Hylidae	Litoria fallax	Eastern Dwarf Tree Frog		12	x
2010	October	26	528356	6828620	68 Terania Ck Rd	Myobatrachidae	Uperoleia fusca	Red-groined Toadlet		6	x
2010	October	26	528356	6828620	68 Terania Ck Rd	Myobatrachidae	Limnodynastes peronii	Striped Marsh Frog		6	x
2010	October	27	528231	6826788	Cherie's	Cacatuidae	Calyptorhynchus lathami	Glossy Black Cockatoo		4	
2010	October	27	528108	6826855	Cherie's	Agamidae	Physignathus lesueurii	Eastern Water Dragon		1	
2010	October	27	528108	6826855	Cherie's	Myobatrachidae	Pseudophryne coriacea	Red-backed Toadlet		3	x
2010	October	27	531108	6826788	Coppetts	Pythonidae	Morelia spilota	Carpet Python		1	
2010	October	27	531108	6826788	Coppetts	Varanidae	Varanus varius	Lace Monitor		1	
2010	October	27	531108	6826788	Coppetts	Scincidae	Saproscincus rosei	Roses Weasel Skink		1	
2010	October	27	531108	6826788	Coppetts	Agamidae	Physignathus lesueurii	Eastern Water Dragon		5	
2010	October	27	531108	6826788	Coppetts	Scincidae	Lampropholis delicata	Grass Skink		4	
2010	October	27	531950	6825900	Cedarville	Hylidae	Litoria revelata	Whirring Tree Frog		1	
2010	October	27	528050	6827900	Andie Simpson	Myobatrachidae	Limnodynastes peronii	Striped Marsh Frog		2	
2010	October	27	528050	6827900	Andie Simpson	Myobatrachidae	Uperoleia fusca	Red-groined Toadlet		3	
2010	October	27	528050	6827900	Andie Simpson	Hylidae	Litoria peronii	Perons Tree Frog		2	
2010	October	27	528050	6827900	Andie Simpson	Myobatrachidae	Adelotus brevis	Tusk Frog		2	x
2010	October	27	528050	6827900	Andie Simpson	Hylidae	Litoria fallax	Eastern Dwarf Tree Frog		14	x
2010	October	27	528050	6827900	Andie Simpson	Myobatrachidae	Mixophyes fasciolatus	Great Barred Frog		2	x
2010	October	27	528450	6827850	Andie Simpson	Myobatrachidae	Philoria loveridgei	Loveridges Mountain Frog		3	
2010	October	27	533400	6832250	Rocky Ck Dam	Colubridae	Boiga irregularis	Brown Tree Snake		2	
2010	October	27	533400	6832250	Rocky Ck Dam	Chelidae	Elseya latisternum	Saw-shelled Turtle		1	
2010	October	27	533400	6832250	Rocky Ck Dam	Hylidae	Litoria fallax	Eastern Dwarf Tree Frog		4	
2010	October	27	533400	6832250	Rocky Ck Dam	Myobatrachidae	Limnodynastes peronii	Striped Marsh Frog		4	
2010	October	27	533400	6832250	Rocky Ck Dam	Myobatrachidae	Mixophyes fasciolatus	Great Barred Frog		1	x
2010	October	27	533400	6832250	Rocky Ck Dam	Myobatrachidae	Adelotus brevis	Tusk Frog		1	
2010	October	27	533400	6832250	Rocky Ck Dam	Hylidae	Litoria peronii	Perons Tree Frog		3	x
2010	October	28	528172	6827476	Coopers	Scincidae	Saproscincus rosei	Roses Weasel Skink		1	

Task	Site	GPS Coordinates	Date	Time	Person hours	Weather Conditions	Habitat	Insects sighted	Lifestage	Listed' (Y/N)	EPBC	TSC	Notes
walked 2 transects	Sime's Bridge		25-Nov-10	15-1515h	0.5h		native cedar identified, about 100m from a river	Wanderer butterfly ( <i>Danaus plexippus</i> : Nymphalidae)	adult	Y	Y		following light trapping, walked two transect through the site in daylight for <i>Carronia</i> vine. No <i>Carronia</i> vine was found.
Light trapping	Sime's Bridge	G1000	24-Nov-10	2000-2200h	2	clear night with increasing humidity	native cedar identified, about 100m from a river	moths (Lepidoptera)	adult	N	N	N	
								day flying moth (Agaristinae: Noctuidae: Lepidoptera)	adult	N	N	N	
								Mosquitoes (Culicidae: Diptera)	adult	N	N	N	
								small flies (Diptera)	adult	N	N	N	
								Stoneflies (Plecoptera)	adult	N	N	N	
								Craneflies (Brachycera: Diptera)	adult	N	N	N	
								leaf hopper (Cicadellidae: Orthoptera)	adult	N	N	N	
								Mayflies (Ephemeroptera)	adult	N	N	N	
								scarab beetles (Scarabaeidae: Coleoptera)	adult	N	N	N	
								alate termite (Isoptera)	adult	N	N	N	
								Lacewings (Neuroptera)	adult	N	N	N	
								possible big-headed fly (Pipunculidae: Diptera)	adult	N	N	N	
								Short horned grasshopper (Caelifera: Orthoptera)	adult	N	N	N	
Grasshopper from the family Tettigoniidae	adult	N	N	N									
Light trapping	Coopers	JOI	25-Nov-10	1950 - 2150h	2			scarab beetles (Scarabaeidae: Coleoptera)	adult	N	N	N	
								alate termite (Isoptera)	adult	N	N	N	
								Lacewings (Neuroptera)	adult	N	N	N	
								Craneflies (Brachycera: Diptera)	adult	N	N	N	
								moths (Lepidoptera)	adult	N	N	N	
								leaf hoppers (Cicadellidae: Orthoptera)	adult	N	N	N	
								crickets (Gryllidae: Orthoptera)	adult	N	N	N	
Stoneflies (Plecoptera)	adult	N	N	N									

total person hours

4.50h

Task	Site	GPS Coordinates	Date	Time	People hours	Weather Conditions	Habitat	Insects sighted	Lifestage	Listed' (Y/N)	EPBC	TSC	Notes
Direct search for snails	Andi Simpsons	F1000-F1004	24-Nov-10	1550-1650	2h	intermittent light rain, sunny, warm conditions.	Rainforest, riparian zone for Rocky Creek	Centipedes Collembola Reduviidae (Hemiptera) Slaters	adult adult adult adult	N N N N	N N N N	N N N N	
Direct search for snails	Sime's Bridge	G1000	24-Nov-10	2000-2200	2h	Clearing, slightly humid	native cedar identified, about 100m from a river	Pill millipedes (Sphaerotheriida) Beetles from the subfamily Scarabaeinae Beetles from the family Chrysomelidae Cockroaches (Blattodea) Crickets (Orthoptera) Earthworm (Oligochaeta) Ant ( <i>Consobrina</i> species: Formicidae) Bug from the family Pentatomidae Grasshopper from the family Tettigoniidae springtails (Collembola)	adult adult adult adult adult adult adult adult adult adult	N N N N N N N N N N	N N N N N N N N N N	N N N N N N N N N N	
snail search	Coopers	I1000	24-Nov-10	1310 - 1420	2.16h	clear		Centipedes Cockroaches (Blattodea) spider (Araneae) ants (Formicidae: Hymenoptera) Red triangle slug ( <i>Triboniophorus graeffei</i> : Athoracophoridae: Mollusca) Stick Insect (Phasmatidae: Phasmatodea)	adult adult adult adult adult	N N N N N	N N N N N	N N N N N	
snail search	Coopers	JO1 - JO2	25-Nov-10	1950 - 2150h	2h	clear, slightly h		cicadas (Hemiptera) moths (Lepidoptera) Cockroaches (Blattodea) ants (Formicidae: Hymenoptera) spiders (Araneae)	adult adult adult adult adult	N N N N N	N N N N N	N N N N N	possible <i>Carronia</i> species, sample taken (JO1)
snail search	Shazza's (Plot D)	D1000	23-Nov-10	1400 - 1520h	1.66h			millipedes slater Earthworm (Oligochaeta) springtails (Collembola) spider (Araneae)	adult adult adult adult adult	N N N N N	N N N N N	N N N N N	depauparate fauna

Total people hours: 9.82h

Task	Site	GPS		Time	People hours	Weather		Habitat	Insects sighted	Lifestage	Listed'			Notes
		Coordinates	Date			Conditions					(Y/N)	EPBC	TSC	
Direct search for 'sunny stuff'	MacInnes at Upper Dam	E1000	24-Nov-10	1300-1345	1.5h	Sunny, clear conditions, slightly humid with a light wind.	on the edge of lightly wooded forest comprises of grassland and lantana. Some slow water from the dam. 'Swampy' vegetation	Wanderer butterfly ( <i>Danaus plexippus</i> : Nymphalidae)	adult	Y	Y	N	Milkweed plant ( <i>Asclepias</i> species) found with Wanderer larvae present	
								Lantana leafmine beetle ( <i>Octotoma scabripennis</i> : Chrysomelidae)	adult			N	Found feeding on <i>Lantana camara</i>	
								Orthoptera (superficially appear to be long-horned Grasshoppers (Tettigoniidae)	immature	N	N	N	Found on vegetation by sweep netting.	
								Wasps from the superfamily Ichneumonoidea (Hymenoptera)	adult	N	N	N	Found on <i>Lantana camara</i>	
								<i>Aphis mellifera</i> (European Honey bee)	adult	N	N	N	Found on <i>Lantana camara</i>	
								butterflies from the family Pieridae	adult	N	N	N		
								waterspider (Araneae)	adult	N	N	N	found in dam	
								Leafhopper from the family Cicadelloidea (Hemiptera)	adult	N	N	N	Found on grass by sweep netting	
								Yellow-striped Flutterer ( <i>Rhyothemis phyllis</i> : Libellulidae)	adult	N	N	N		
								Dragonfly from the family Libellulidae (Odonata)	adult	N	N	N		
								Butterfly from the subfamily Hesperinae (Hesperiidae: Lepidoptera)	adult	N	N	N	Found on <i>Lantana camara</i>	
								Chrysomelidae/Coccinellidae (Coleoptera)	adult	N	N	N	Found on <i>Lantana camara</i>	
								Blue Triangle butterfly ( <i>Graphium sarpedon</i> : Papilionidae)	adult	N	N	N		
								Grey Swift ( <i>Parnara bada</i> : Hesperidae)	adult	N	N	N	Found on <i>Lantana camara</i>	
<i>Hypocysta pseudirius/metirius</i> species (Nymphalidae)	adult	N	N	N	Probably <i>H. pseudirius</i> as various grasses were present									
Blue Tiger Butterfly ( <i>Tirumala hamata</i> : Nymphalidae)	adult	N	N	N										
Direct search for 'sunny stuff'	MacInnes	E1001	24-Nov-10	1355-1415h	2.16h	Sunny, clear conditions	Submerged macrophytes in the dam. A small intermittent stream flows into the dam. The stream substrate comprises of large boulders and moss. The stream and part of the dam is heavily	Water bugs from the family Notonectidae (Hemiptera)		N	N	N		
								Fiery skimmer ( <i>Orthetrum villosovittatum</i> : Libellulidae)	adult	N	N	N		
								Orchard Swallowtail ( <i>Papilio aegaeus</i> : Papilionidae)	adult	N	N	N		
								Common bluetail ( <i>Ischnura heterosticta</i> : Coenagrionidae)	adult	N	N	N		
							Dragonfly from the family Coenagrionidae, possibly the Aurora Bluetail ( <i>Ischnura aurora</i> )	adult	N	N	N			
Direct search for	Andi Simpsons	H1000	25-Nov-10	1040-1110	1h	sunny, humid,	Dam has submerged,	day flying magpie moths (possible <i>Nyctemera</i> species(Arctiinae: Lepidoptera))	adult	N	N	N		

Task	Site	GPS Coordinates	Date	Time	People hours	Weather Conditions	Habitat	Insects sighted	Lifestage	Listed' (Y/N)	EPBC	TSC	Notes
'sunny stuff'						clearing from recent rain	emergent and floating macrophytes comprising of, but not restricted to water lillies and <i>Phragmites</i> . Vegetation surrounding the dam includes; <i>Lantana</i> , pasture grasses, camphour laurel, native lamandra thickets, tobacco plants, scottish thistle and native cedar.	<i>Hypocysta pseudirius/metirius</i> species (Nymphalidae) Yellow-striped Flutterer ( <i>Rhyothemis phyllis</i> : Libellulidae) Auchenorrhyncha (superficially appears to be a leaf hopper (Cicadellidae: Hemiptera) Wasps from the superfamily Ichneumonoidea (Hymenoptera) Blue Triangle butterfly ( <i>Graphium sarpedon</i> : Papilionidae) Wanderer butterfly ( <i>Danaus plexippus</i> : Nymphalidae) syrpid flies (Syrphidae: Diptera) Fiery skimmer ( <i>Orthetrum villosovittatum</i> : Libellulidae) European Honey Bee ( <i>Aphis mellifera</i> : Aphidae: Hymenoptera) Orthoptera (superficially appear to be long-horned grasshoppers (Tettigoniidae)) Bull ant ( <i>Myrmecia</i> species: Formicidae: Hymenoptera) Cabbage White ( <i>Pieris rapae</i> Pieridae: Lepidoptera)	adult adult adult adult adult adult adult adult adult adult adult adult	N N N N N Y N N N N N N	N N N N N Y N N N N N N	N N N N N N N N N N N N	Probably <i>H. pseudirius</i> as various grasses were present at the site.       Milkweed plant ( <i>Asclepias</i> species) found with Wanderer larvae present
Direct search for 'sunny stuff'	Shazza's (P)	D1000	23-Nov-10	1330 - 1340 1530 - 1550	0.5h	field work ended due to rain	highly modified area that is typical of a suburban backyard, bordering rocky creek. <i>Lantana</i> present on stream bank	syrphid flies (Syrphidae: Diptera) house flies ( Calliphoridae: Diptera) <i>Ocybadistes flavoitta/walker</i> (Hesperiidae: Lepidoptera) Cabbage White ( <i>Pieris rapae</i> Pieridae: Lepidoptera) Bullant ( <i>Myrmecia</i> species: Formicidae: Hymenoptera) Lantana leafmine beetle ( <i>Octotoma scabripennis</i> : Chrysomelidae) Short-horned grasshopper (Caelifera: Orthoptera)	1 1 adult adult adult adult adult	N N N N N N N	N N N N N N N	N N N N N N N	
Direct search for 'sunny stuff'	Causeway off Fraser's road at wetland	C1000 - C1003	23-Nov-10	1000 - 1100	2h	humid, cloudy with intermittent rain	Swampy grassland. Comprising of <i>Juncus</i> species, <i>Lomandra longifolia</i> , Camphor laurel and <i>Lantana</i> .	Wanderer butterfly ( <i>Danaus plexippus</i> : Nymphalidae)   hover flies (Syrphidae: Diptera)	adult   adult	Y   N	Y   N	N   N	4 adults sighted at 1000h 1020 7 Wanderer larvae sighted on feed plant. Sample taken for further identification.

Task	Site	GPS Coordinates	Date	Time	People hours	Weather Conditions	Habitat	Insects sighted	Lifestage	Listed' (Y/N)	EPBC	TSC	Notes	
Direct search for 'sunny stuff'	Rocky Creek at Causeway (Shazza's) Plot D		23-Nov-10	1245 - 1315	1h	humid, cloudy with intermittent rain		Robber flies (Asilidae: Diptera)	1	adult	N	N	N	Milkweed plant ( <i>Asclepias</i> species) found with Wanderer larvae present 1020h 3 adult Wanderers sighted
								sucking insect (Pentatomidae: Hemiptera)		adult	N	N	N	
								Orthoptera (superficially appeared to be a long-horned grasshopper (Tettigoniidae))		adult	N	N	N	
								Orthoptera (superficially appeared to be a ground cricket (Gryllidae))		adult	N	N	N	
								Fiery skimmer ( <i>Orthetrum villosovittatum</i> : Libellulidae)	1	adult	N	N	N	
								Wanderer butterfly ( <i>Danaus plexippus</i> : Nymphalidae)						
Weevil beetle (Curculionidae: Coleoptera)		adult	Y	Y	N									
Austrogomphus (Pleiogomphus) amphilictus (Gomphidae: Odonata)		adult	N	N	N									
								6						

Total number of hours 8.16h

<b>Project #:</b> 3001803	<b>Site:</b> Trap Line 1.	<b>Date:</b> 27/10/10
<b>GPS:</b>	<b>Elevation:</b>	<b>Accuracy:</b>

<b>Wind</b>	<u>calm</u>	leaves rustle	branches moving	strong	
<b>Moon</b>	<u>none</u>	1/4 moon	1/2 moon	3/4 moon	full moon
<b>Cloud</b>	<u>none</u>	partial	complete		
<b>Rain</b>	<u>none</u>	drizzle	rain	heavy rain	thunder storms

<b>Vege Type</b>	<u>1, 2 Disturbed</u>	1 Sclerophyll 2 Rainforest 3 Mosaic 4 Plantation 5 Pasture 6 Aquatic 7 Grassland 8 Heath 9 Wetland
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**Dominant Species:** Camphor, Euc <sup>tall moose</sup> ~~micro~~, Ground ferns, Lantana

**Tree Age Structure: (circle)**  
 Young                      mature over-mature multiple

<b>Disturbance History Type:</b>	<b>Severity (0-3):</b>
<b>Fire History:</b>	unknown
<b>Logging/Clearing:</b> was prob cleared in past	1-2
<b>Grazing:</b>	1

<b>Soils: (circle)</b>	<u>Clay</u>	Loam <sup>to sandy</sup>	Sand / Gravels	Organic
<b>Drainage:</b>	Waterlogged	<u>Damp</u>	Moist	Well Drained
<b>Depth:</b>	<u>Deep (&gt;1m)</u>	Shallow (0.3-1m)	Skeletal (<0.3m)	
<b>Geology:</b>	Sedimentary	<u>Volcanic</u>	Alluvial	
<b>Surface Rocks:</b>	Rock outcrops	Boulders	Pebbles	surface rocks.
<b>Aspect:</b>	<u>East</u>			

<b>Water bodies:</b>	Creek	River	Dam	Wetland	Wet Depression	<u>None</u>
<b>Depth of Water:</b>	<b>Size of Channel:</b>					

Add → leaf litter

20m CC. - 25m

Links to other forms here

[Vegetation Surveys](#)

[Fauna Surveys](#)

[Aquatic Surveys](#)

Quadrat  
Random Meander

Fauna Habitat  
Fauna Trapping

*Alloc. torulosa*

*Euc. camelia*



<b>Project #:</b> 3001803	<b>Site:</b> Trap line 2	<b>Date:</b> 26/10/10
<b>GPS:</b>	<b>Elevation:</b>	<b>Accuracy:</b>

<b>Wind</b>	calm	leaves rustle	branches moving	strong
<b>Moon</b>	none	1/4 moon	1/2 moon	3/4 moon full moon
<b>Cloud</b>	none	partial	complete	fog
<b>Rain</b>	none	drizzle	rain	heavy rain thunder storms

<b>Vege Type</b>	2-1 Riparian	1 Sclerophyll 2 Rainforest 3 Mosaic 4 Plantation 5 Pasture 6 Aquatic 7 Grassland 8 Heath 9 Wetland
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<b>Dominant Species:</b>	Brushbox, Broad leaf Mahoe, Allocasuarina, Rainf. sub-canopy.	Water gums.
<b>Tree Age Structure: (circle)</b>	Young mature	over-mature multiple

<b>Disturbance History Type:</b>	<b>Severity (0-3):</b>
<b>Fire History:</b>	-
<b>Logging/Clearing:</b> May have been logged.	1-2
<b>Grazing:</b>	minimal.

<b>Soils: (circle)</b>	Clay	Loam	Sand / Gravels	Organic
<b>Drainage:</b>	Waterlogged	Damp	Moist	Well Drained
<b>Depth:</b>	Deep (>1m)	Shallow (0.3-1m)	Skeletal (<0.3m)	
<b>Geology:</b>	Sedimentary	Volcanic	Alluvial	
<b>Surface Rocks:</b>	Rock outcrops	Boulders	Pebbles	
<b>Aspect:</b>	Nth			

<b>Water bodies:</b>	Creek	River	Dam	Wetland	Wet Depression
<b>Depth of Water:</b>	0.3-1m	<b>Size of Channel:</b>	2m	Rocky	

Tributary of Rocky Creek.

Links to other forms here

Vegetation Surveys

Fauna Surveys

Aquatic Surveys

Quadrat

Random Meander

Fauna Habitat

Fauna Trapping

Smudge paper fig  
Tree Meath.

Und.  
Birds nest ferns.  
Native ginger  
leaf litter ~ 2cm.  
Lomandra logs  
Blechnum fern.  
Lots moss, lichens + fungi.  
Crofton weed.  
Muh weed influence.  
Across stream Lantana.

<b>Project #:</b> 3007803	<b>Site:</b> Trapeline #	<b>Date:</b> 26/10/10
<b>GPS:</b> 529460.7, 682964.9.	<b>Elevation:</b>	<b>Accuracy:</b>

<b>Wind</b>	<u>calm</u>	leaves rustle	branches moving	strong
<b>Moon</b>	<u>none</u>	1/4 moon	1/2 moon	3/4 moon full moon
<b>Cloud</b>	none	partial	<u>complete</u>	<u>fog/mist</u>
<b>Rain</b>	<u>none</u>	drizzle	rain	heavy rain thunder storms

<b>Vege Type</b>	<u>2 ✓</u> disturbed.	1 Sclerophyll 2 Rainforest 3 Mosaic 4 Plantation 5 Pasture 6 Aquatic 7 Grassland 8 Heath 9 Wetland
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<b>Dominant Species:</b>	<u>Campor, sm Lpivet, Watergum,</u>
<b>Tree Age Structure: (circle)</b>	
Young <u>          </u>	mature over-mature multiple

<b>Disturbance History Type:</b>	<b>Severity (0-3):</b>
<b>Fire History:</b>	-
<b>Logging/Clearing:</b>	<u>been completely cleared in part</u> 2-3
<b>Grazing:</b>	2.

<b>Soils: (circle)</b>	<u>Clay</u>	<u>Loam</u>	Sand / Gravels	Organic
<b>Drainage:</b>	<u>Waterlogged</u>	<u>Damp</u>	Moist	Well Drained
<b>Depth:</b>	<u>Deep (&gt;1m)</u>	Shallow (0.3-1m)	Skeletal (<0.3m)	
<b>Geology:</b>	Sedimentary	<u>Volcanic</u>	<u>Alluvial</u>	
<b>Surface Rocks:</b>	Rock outcrops	Boulders	Pebbles	<u>none</u>
<b>Aspect:</b>	<u>North-east</u>			

<b>Water bodies:</b>	<u>Creek</u>	River	Dam	Wetland	Wet Depression
<b>Depth of Water:</b>	<u>1m</u>	<b>Size of Channel:</b>	<u>5-6m. - 8-10.</u>		

Rocky.

Links to other forms here

- Vegetation Surveys
- Fauna Surveys
- Aquatic Surveys
- Quadrat
- Random Meander
- Fauna Habitat
- Fauna Trapping

nettles  
planted trees →  
walnuts?  
Lantana.  
Vines-  
crofton weeds.

Tradescantia.  
Native creep  
chick  
more native spp  
near ~~the~~ creek.

<b>Project #:</b> 3001903	<b>Site:</b> Trapline 3	<b>Date:</b> 26/10/10
<b>GPS:</b> 529935.9, 6827542.5.	<b>Elevation:</b>	<b>Accuracy:</b> 3m.

<b>Wind</b>	<u>calm</u>	leaves rustle	branches moving	strong	
<b>Moon</b>	<u>none</u>	1/4 moon	1/2 moon	3/4 moon	full moon
<b>Cloud</b>	none	partial	<u>complete</u>	→ mist/fog.	
<b>Rain</b>	<u>none</u>	drizzle	rain	heavy rain	thunder storms

<b>Vege Type</b>	<u>S-10.</u>	1 Sclerophyll 2 Rainforest 3 Mosaic 4 Plantation 5 Pasture 6 Aquatic 7 Grassland 8 Heath 9 Wetland 10. Disturbed.
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**Dominant Species:** Camphor Laurel; grasses, Acacia melanoxylon.

<b>Tree Age Structure: (circle)</b>	<u>Young</u>	mature	over-mature	multiple
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<b>Disturbance History Type:</b>	<b>Severity (0-3):</b>
<b>Fire History:</b>	—
<b>Logging/Clearing:</b>	3
<b>Grazing:</b>	2-3

<b>Soils: (circle)</b>	<u>Clay</u>	Loam	Sand / Gravels	Organic
<b>Drainage:</b>	Waterlogged	<u>Damp</u>	Moist	Well Drained
<b>Depth:</b>	Deep (>1m)	<u>Shallow (0.3-1m)</u>	Skeletal (<0.3m)	
<b>Geology:</b>	Sedimentary	<u>Volcanic</u>	Alluvial	
<b>Surface Rocks:</b>	Rock outcrops	<u>Boulders</u>	volcanic secondary Pebbles	
<b>Aspect:</b>	<u>West.</u>			

<b>Water bodies:</b>	Creek	River	Dam	Wetland	Wet Depression
<b>Depth of Water:</b>	<b>Size of Channel:</b>				

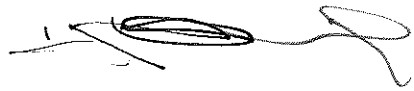
Links to other forms here

Vegetation Surveys      Fauna Surveys      Aquatic Surveys

Quadrat      Fauna Habitat  
Random Meander      Fauna Trapping

Lantana  
Croftonweed  
Sm leaf fire  
Scotch thistle.  
Purple top grass.

No hollows.  
No Eucalypts.  
Disturbed pasture ~ regen weeds / Acacia.  
Bandicoot diggings.  
Signs of macropods - likely Red-necked Wallaby.  
Viewed.



<b>Project #:</b> 3001803	<b>Site:</b> Trapline 4.	<b>Date:</b> 26/10/10
<b>GPS:</b> 529192.8, 6829567.9	<b>Elevation:</b>	<b>Accuracy:</b>

<b>Wind</b>	<input checked="" type="radio"/> calm	leaves rustle	branches moving	strong	
<b>Moon</b>	<input checked="" type="radio"/> none	1/4 moon	1/2 moon	3/4 moon	full moon
<b>Cloud</b>	<input type="radio"/> none	<input type="radio"/> partial	<input checked="" type="radio"/> complete	fog/mist	
<b>Rain</b>	<input checked="" type="radio"/> none	drizzle	rain	heavy rain	thunder storms

<b>Vege Type</b>	<input checked="" type="radio"/> 2 disturbed.	1 Sclerophyll 2 Rainforest 3 Mosaic 4 Plantation 5 Pasture 6 Aquatic 7 Grassland 8 Heath 9 Wetland
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<b>Dominant Species:</b>	Camphor, Sm/privet, bracken, tree ferns, myrtles, Acacia mel.		
<b>Tree Age Structure: (circle)</b>			
<input checked="" type="radio"/> Young	<input type="radio"/> mature	<input type="radio"/> over-mature	<input type="radio"/> multiple

<b>Disturbance History Type:</b>	<b>Severity (0-3):</b>
<b>Fire History:</b>	—
<b>Logging/Clearing:</b>	has been cleared in past 1-2
<b>Grazing:</b>	1

<b>Soils: (circle)</b>	<input checked="" type="radio"/> Clay	<input type="radio"/> Loam	<input type="radio"/> Sand / Gravels	<input type="radio"/> Organic
<b>Drainage:</b>	<input type="radio"/> Waterlogged	<input checked="" type="radio"/> Damp	<input type="radio"/> Moist	<input type="radio"/> Well Drained
<b>Depth:</b>	<input checked="" type="radio"/> Deep (>1m)	<input type="radio"/> Shallow (0.3-1m)	<input type="radio"/> Skeletal (<0.3m)	
<b>Geology:</b>	<input type="radio"/> Sedimentary	<input checked="" type="radio"/> Volcanic	<input type="radio"/> Alluvial	
<b>Surface Rocks:</b>	<input type="radio"/> Rock outcrops	<input type="radio"/> Boulders	<input type="radio"/> Pebbles	<input checked="" type="radio"/> none
<b>Aspect:</b>	South West			

<b>Water bodies:</b>	<input type="radio"/> Creek	<input checked="" type="radio"/> River	<input type="radio"/> Dam	<input type="radio"/> Wetland	<input type="radio"/> Wet Depression
<b>Depth of Water:</b>	2-3m		<b>Size of Channel:</b>	8-10m.	

Lots of privet saplings in understorey.

Links to other forms here

[Vegetation Surveys](#)

[Fauna Surveys](#)

[Aquatic Surveys](#)

Quadrat

Random Meander

Fauna Habitat

Fauna Trapping

cleared forest structures  
few ferns + herbs in understorey

couple bangalow palms + tree ferns throughout.

Grassland nr trapline 4.

529 044, 68 29576.

Down Carex

Scotch Broom

Flowerweed

Takemeo bush

Meth bush white flower.

Clarex

-> Wetlands nearby down Carex.

## Weather

Sun - showers afternoon + rain night  
warm day - moon full but cloudy

Mon - showers, mild morning, foggy morning  
lifting @ 10:50 AM

Tue - cloud cover all day → mist morning  
humid. → breeze.

Wed - Warm day no cloud cover  
mist in morning.

Elliot Trap Field Sheet



Swamp:

Site:

Date:

Recorder:

25/10/10

Cattleyard Property, Trapline 2

Trap Number	Species Caught	Notes
E10	1 R. fuscipes	
C2	2 closed no animal	
	3	
T2	Rocky Creek - Andi's Place?	Trapline 2
	5	
E1	6 R. fuscipes	
E2	7 R. fuscipes	
E6	8 closed bait gone	
E9	9 R. fuscipes	
	10	
	11	
T3	12 Munnies Trapline 3	
C2	13 Ash Brown Bandicoot	
E2	14 Mus musculus	1 euthanased
E3	15 Mus musculus	
	16	
T4	17 Cameray Trapline 2 & 4	
E2	18 R. fuscipes	
E6	19 R. fuscipes	
E10	20 R. fuscipes.	
	21	
T6	22 Cattlepen cameray Trapline 5	
C1	23 R. fuscipes	
E2	24 R. fuscipes	
	25	
	26 26/10/10.	27/10/10
	27	
T1	28 E4 R. fuscipes	E1 E2 R. fuscipes
<del>T2</del>	29 E8 R. fuscipes	E6 R. fuscipes
<del>T3</del>	30 E2 R. fuscipes	T2 E9 R. fuscipes
	31 E3 R. fuscipes	T3 E1 Mus musculus - euthanased.
	32 E5 R. fuscipes	T4 E2 R. fuscipes
	33 E6 R. fuscipes	E6 R. fuscipes
	34 E10 R. fuscipes	E7 R. fuscipes
T4	35 E2 R. fuscipes	T5 E3 R. fuscipes
	36 E3 R. fuscipes	C2 R. fuscipes
T5	37 E2 R. fuscipes	
	38 E5 R. fuscipes	
	39 E9 R. fuscipes	
	40	
	41	
	42	
	43	
	44	
	45	
	46	
	47	
	48	
	49	
	50	

# Spotlighting

25/10/10

Coopers Rd to water hole

Ringtail Possum

Rabbit

Sugar Glider

Fawn-footed Melomys

*Litoria wilcoxii*

GHFF

26/10/10

Dennis @ M'Kinnis

Great tree frog

Koala on highway

Thicket Frog

*Urosalix fusca*

*Litoria peronii*

*Litoria peronii*

*Crinia signifera*

*Mixophyes fasciatus*

Causeway wet depression

Dwarf tree frog

Broad-palmed frog

Striped Marsh frog

-

-

Sinclair's Bridge

Long-nosed bandicoot

Ringtail Possum



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to:

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Tel. (02) 9925 5578  
Fax. (02) 9925 5566

8<sup>th</sup> November, 2010

Hi Katie

Following are the bat call IDs and measurement for captured bats for the October survey of the Rous Water site near Dunoon, New South Wales. If you have any queries do not hesitate to contact me.

All the best



Glenn Hoye

November, 2010



*Fly By Night Bat Surveys Pty Ltd*

Bat call analysis for October Survey of the Rous Water, near Dunoon, NSW, for SMEC.

SITE	DATE	T.au	M.sp2	R.me	C.go	C.mo	K.pa	M.au	M.sc	M.ma	N.sp	S.ru	S.or	V.pu	Total Passes
Escarpment (holes in pants)	26/10/2010	C	C	C	P	Po		C			P			C	85
Causeway Rocky Ck	27/10/2010			C						Po					4
Sheree's (Dog house)	26/10/2010							C		P				Po	12
Simpsons	28/10/2010			C				P			P				5
Rocky Creek Dam Walking Transect	27/10/2010		P	C	P			P	C			Po		C	41
Rocky Ck below Simes Bridge	26/10/2010							P		Po				P	14
Rocky Creek Dam Stationary Detector	27/10/2010		C	C	C		Po	C	C	C		Po		C	109
Regen below escarpment	26/10/2010	C		C	P			P	P		C		Po		24

Species

<b>T.au</b>	White-striped Mastiff Bat	<i>Tadarida australis</i>
<b>M.sp2</b>	Eastern Freetail Bat	<i>Mormopterus sp.2</i>
<b>R.me</b>	Eastern Horseshoe Bat	<i>Rhinolophus megaphyllus</i>
<b>C.go</b>	Gould's Wattled Bat	<i>Chalinolobus gouldii</i>
<b>C.mo</b>	ChocolateWattled Bat	<i>Chalinolobus morio</i>
<b>P.pa</b>	Golden-tipped Bat*	<i>Phoniscus papuensis</i>
<b>M.au</b>	Little Bent-wing Bat*	<i>Miniopterus australis</i>
<b>M.sc</b>	Eastern Bent-wing Bat*	<i>Miniopterus schreibersii oceanensis</i>
<b>M.ma</b>	Fishing Bat*	<i>Myotis macropus</i>
<b>N.sp</b>	Unidentified Long-eared Bat	<i>Nyctophilus sp.</i>
<b>S.ru</b>	Greater Broad-nosed Bat*	<i>Scoteanax rueppellii</i>
<b>S.or</b>	Eastern Broad-nosed Bat	<i>Scotorepens orion</i>
<b>V.pu</b>	Eastern Forest Bat	<i>Vespadelus pumilus</i>

Certainty of Identification

C	Confident	P	Probable	Po	Possible
*	Listed as Vulnerable on Schedule 2 of the TSC Act 1995				

November, 2010



Fly By Night Bat Surveys Pty Ltd

## Bat Measurements

SPECIES	SITE	DESCRIPTION	DATE	DECLAT	DECLONG	SEX	AGE	SEX COND	FA	WT
Nyctophilus gouldi	DUNOONH04	Partway along track on ridge above southern escarpment.	25/10/2010	-28.682000	153.300603	F	A	PL	44.80	10.7
Rhinolophus megaphyllus	DUNOONH04	Partway along track on ridge above southern escarpment.	25/10/2010	-28.682000	153.300603	M	A		49.56	11.5
Rhinolophus megaphyllus	DUNOONH04	Partway along track on ridge above southern escarpment.	25/10/2010	-28.682000	153.300603	F	A	PREG	50.20	15.3
Nyctophilus gouldi	DUNOONH04	Partway along track on ridge above southern escarpment.	26/10/2010	-28.682000	153.300603	F	A	LACT	45.00	12.3
Nyctophilus gouldi	DUNOONH04	Partway along track on ridge above southern escarpment.	26/10/2010	-28.682000	153.300603	F	A	LACT	43.32	11.0
Nyctophilus gouldi	DUNOONH04	Partway along track on ridge above southern escarpment.	26/10/2010	-28.682000	153.300603	M	A		42.92	10.7
Nyctophilus gouldi	DUNOONH04	Partway along track on ridge above southern escarpment.	26/10/2010	-28.682000	153.300603	F	A	LACT	44.56	12.0
Nyctophilus gouldi	DUNOONH08	Regeneration below southern escarpment.	25/10/2010	-28.680958	153.301756	M	A		42.76	8.8
Nyctophilus bifax	DUNOONH08	Regeneration below southern escarpment.	26/10/2010	-28.680958	153.301756	F	A	PREG	43.56	14.0
Nyctophilus bifax	DUNOONH08	Regeneration below southern escarpment.	26/10/2010	-28.680958	153.301756	F	A	PREG	44.00	15.6
Nyctophilus bifax	DUNOONH08	Regeneration below southern escarpment.	26/10/2010	-28.680958	153.301756	F	A	PREG	43.60	15.6
Nyctophilus bifax	DUNOONH10	Rainforest at edge of Rocky Creek below Sims Bridge.	26/10/2010	-28.680958	153.301756	F	A	PREG	43.10	14.6
Rhinolophus megaphyllus	DUNOONH11	On track to Sheree's (Dog house).	26/10/2010	-28.685400	153.289739	M	A		48.80	10.8
Vespadelus pumilus	DUNOONH13	Along track in Brushbox regrowth.	28/10/2010	-28.676472	153.293178	M	A		30.56	4.3
Nyctophilus bifax	ROCKYCKDAMH01	Along walking track in rainforest.	27/10/2010	-28.636819	153.344972	F	A	PREG	44.96	16.5
Rhinolophus megaphyllus	ROCKYCKDAMH01	Along walking track in rainforest.	27/10/2010	-28.636819	153.344972	M	A		49.40	10.8
Rhinolophus megaphyllus	ROCKYCKDAMH01	Along walking track in rainforest.	27/10/2010	-28.636819	153.344972	F	A	PREG	51.14	15.7
Rhinolophus megaphyllus	ROCKYCKDAMH01	Along walking track in rainforest.	27/10/2010	28.636819-	153.344972	M	A		50.22	11.8
Vespadelus pumilus	ROCKYCKDAMH01	Along walking track in rainforest.	27/10/2010	-28.636819	153.344972	M	A		29.94	4.4
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	M	A		40.60	10.9
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	M	A		39.70	12.3
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	F	A	PL	41.50	11.6

November, 2010



Fly By Night Bat Surveys Pty Ltd

Bat call analysis for October Survey of the Rous Water, near Dunoon, NSW, for SMEC.

Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	F	A	PREG	41.44	13.6
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	M	A		40.60	12.0
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	M	A		40.40	11.5
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	M	A		39.36	10.4
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	M	A		39.34	10.1
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	M	A		40.20	10.8
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	F	A	LACT	40.63	11.5
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	F	A	LACT	41.40	10.2
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	F	A	PREG	41.80	12.7
Myotis macropus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	F	A	LACT	40.56	10.8
Vespadelus pumilus	ROCKYCKDAMH02	Along walking track in rainforest.	27/10/2010	-28.636236	153.343917	M	A		29.30	4.2
Miniopterus australis	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	40.64	9.1
Myotis macropus	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	LACT	42.40	12.2
Myotis macropus	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	LACT	40.00	14.1
Myotis macropus	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	LACT	41.80	12.7
Myotis macropus	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	M	A		39.60	11.0
Nyctophilus bifax	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	44.16	14.6
Nyctophilus bifax	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	44.10	15.2
Nyctophilus bifax	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	44.58	14.7
Nyctophilus bifax	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	43.70	14.4
Vespadelus pumilus	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	32.10	8.9
Vespadelus pumilus	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	32.40	7.5
Vespadelus pumilus	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	32.70	7.6
Vespadelus pumilus	ROCKYCKDAMH03	Along track in rainforest.	27/10/2010	-28.635381	153.343725	F	A	PREG	31.36	7.6



Date	Activity	Species
13/12/10	Diurnal recce, flag transects in Simpson's and then in Cooper's	Catbird-Cooper's <i>Ailuroedus crassirostris</i>
	Nocturnal spotlight transect Cooper's 24°C, calm 1/2moon 50% cloudcover	Cane Toad on track, upper ridge and around house <i>Rhinella marina</i>
		Red-backed Toadlet calling on drive to Simpson's <i>Pseudophyrne coriacea</i>
	Nocturnal spotlight transect Simpson's Conditions as above	Brown tree snake climbing dead camphor laurel with elkhorn, ridge top <i>Boiga irregularis</i>
		Mountain Brushtail possum Mid-slope <i>Trichosurus caninus</i>
		Black Rat; upper slope in rocks <i>Rattus rattus</i>
	Nocturnal spotlight transect, Simes Bridge walking trail	Pink-tongued Skink climbing tree <i>Cyclodomorphus gerrardii</i>
	Whian Whian Falls making a lot of noise; turbulent and rapid streamflow	<i>Litoria wilcoxi</i> on walking track and perched on rocks near stream
15/12/10	Nocturnal spotlight transect Simpson's 23°C, calm, rain previous day	<i>Litoria wilcoxi</i> on log 20m from stream
	Nocturnal spotlight transect Simpson's	<i>Mixophyes fasciolatus</i> , <i>Adelotus brevis</i> , <i>Litoria fallax</i> , <i>Litoria latopalmata</i> choruses at dam
		Long-nosed bandicoot <i>Perameles nasuta</i> , mid-slope
		Blackish Blind Snake Channon Road <i>Rhamphotyphlops nigrescens</i>
	Nocturnal spotlight transect, Simes Bridge walking trail	Cane Toads on Whian Whian Road
		Rough-scaled Snake foraging slowly on walking track <i>Tropidechis carinatus</i>
		<i>Litoria wilcoxi</i> on walking track and perched on rocks near stream
		Pink-tongued Skink climbing

		tree <i>Cyclodomorphus gerrardii</i>
		<i>Litoria pearsoniana</i> calling from edge of stream: Rocky Creek
		Long-nosed bandicoot in boulders <i>Perameles nasuta</i>
17/12/10	Slow road driving 23 <sup>0</sup> C, 50% cloudcover	
	Whian Whian Road	Blackish Blind Snake <i>Rhamphotyphlops nigrescens</i>
		<i>Litoria latopalmata</i>
	Fraser Road	Red-backed Toadlet calling <i>Pseudophyrne coriacea</i>
		Northern Brown bandicoot <i>Isodon macrourus</i>
		Bleating Tree Frog chorus <i>Litoria dentata</i>
		Great barred Frog chorus <i>Mixophyes fasciolatus</i>
		Laughing Tree Frog chorus <i>Litoria tyleri</i>
	Munro Road	Cane Toads <i>Rhinella marina</i>

Nocturnal spotlight technique: slow walk down the transect using a Petzl head torch and checking with 50W spotlight on trees and around logs. At Cooper's this was a circuit with a riparian section, deviate from the transect to examine larger logs, brush turkey mounds.

At Simpson's the transect follows track, descending to near toe of slope above creek, then ascend in a zig-zag course crossing the transect to check large logs, cleared areas, turkey nests.

At Sime's Bridge I just followed the walking track then deviated on the return section to check out rock faces, the stream edge and soaks.

Each transect took ~ 45 minutes, and I looked for fauna on the roads when driving between sites.

Let me know if you have any queries; the attached figure shows approximate location of transects at Simpson's and Cooper's.

## APPENDIX 9 THREATENED SPECIES SEARCHES

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# Dunoon Dam – Ecology Desktop Review

## Endangered Ecological Communities within CMA Bioregion

The following table is a list of Endangered Ecological Communities listed within the Northern Rivers (Richmond-Tweed) geographic region, the CMA subregion for the proposed Dunoon Dam.

Scientific Name	Common Name	Level of Threat
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Freshwater wetlands on coastal floodplains	Endangered Ecological Community
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Endangered Ecological Community
Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	Lowland Rainforest on Floodplain	Endangered Ecological Community
Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion	Sub-tropical Coastal Floodplain Forest	Endangered Ecological Community
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Swamp sclerophyll forest on coastal floodplains	Endangered Ecological Community
White Gum Moist Forest in the NSW North Coast bioregion	White Gum Moist Forest in the NSW North Coast bioregion	Endangered Ecological Community

## Threatened Flora species within CMA Bioregion

The following table is a list of 96 threatened flora listed within the Northern Rivers (Richmond-Tweed) geographic region, the CMA subregion for the proposed Dunoon Dam.

Scientific Name	Common Name	Level of Threat
<b>Epiphytes and Climbers</b>		
<i>Amyema plicatula</i>	Amyema plicatula	Endangered
<i>Clematis fawcettii</i>	Northern Clematis White-flowered Wax	Vulnerable
<i>Cynanchum elegans</i>	Plant	Endangered



<i>Tinospora smilacina</i>	Tinospora Vine	Endangered
<i>Tinospora tinosporoides</i>	Arrow-head Vine	Vulnerable
<i>Tylophora woollsii</i>	Cryptic Forest Twiner	Endangered
<b>Aquatic Plants</b>		
<i>Aldrovanda vesiculosa</i>	Waterwheel Plant	Endangered
<b>Ferns and Cycads</b>		
<i>Angiopteris evecta</i>	Giant Fern	Endangered
<i>Drynaria rigidula</i>	Basket Fern	Endangered
<i>Grammitis stenophylla</i>	Narrow-leaf Finger Fern	Endangered
<i>Lindsaea brachypoda</i>	Short-footed Screw Fern	Endangered
<i>Psilotum complanatum</i>	Flat Fork fern	Endangered
<b>Herbs and Forbs</b>		
<i>Arthraxon hispidus</i>	Hairy Jointgrass	Vulnerable
<i>Brachyscome ascendens</i>	Border Ranges Daisy	Endangered
<i>Chamaesyce psammogeton</i>	Sand Spurge	Endangered
<i>Cyperus aquatilis</i>	Water Nutgrass	Endangered
<i>Cyperus rupicola</i>	Cliff Sedge	Vulnerable
<i>Cyperus semifertilis</i>	Missionary Nutgrass	Endangered
<i>Doryanthes palmeri</i>	Giant Spear Lily	Vulnerable
<i>Eleocharis tetraquetra</i>	Square-stemmed Spike-rush	Endangered
<i>Elyonurus citreus</i>	Lemon-scented Grass	Endangered
<i>Euphrasia bella</i>	Pretty Eyebright	Vulnerable

<i>Isoglossa eranthemoides</i>	Isoglossa	Endangered
<i>Mitrasacme pygmaea</i>	Pygmy Bishop's Hat	Endangered
<i>Rhynchosia acuminatissima</i>	Pointed Trefoil	Vulnerable
<i>Thesium australe</i>	Austral Toadflax	Vulnerable
<i>Wahlenbergia scopulicola</i>	Rock-face Bluebell	Endangered
<b>Mallee</b>		
<i>Eucalyptus microcodon</i>	Border Mallee	Endangered
<b>Orchids</b>		
<i>Bulbophyllum globuliforme</i>	Hoop Pine Orchid	Vulnerable
<i>Diuris</i> sp. aff. <i>chrysantha</i>	Byron Bay <i>Diuris</i>	Endangered
<i>Geodorum densiflorum</i>	Pink Nodding Orchid	Endangered
<i>Oberonia complanata</i>	Yellow-flowered King of the Fairies	Endangered
<i>Peristeranthus hillii</i>	Brown Fairy-chain Orchid	Vulnerable
<i>Phaius australis</i>	Southern Swamp Orchid	Endangered
<i>Phaius tanকারvilleae</i>	Lady Tankerville's Swamp Orchid	Endangered
<i>Pterostylis nigricans</i>	Dark Greenhood	Vulnerable
<i>Sarcochilus dilatatus</i>	Brown Butterfly Orchid	Endangered
<i>Sarcochilus fitzgeraldii</i>	Ravine Orchid	Vulnerable
<i>Sarcochilus hartmannii</i>	Hartman's <i>Sarcochilus</i>	Vulnerable
<i>Sarcochilus weinthalii</i>	Blotched <i>Sarcochilus</i>	Vulnerable
<b>Shrubs</b>		
<i>Acalypha eremorum</i>	<i>Acalypha</i>	Endangered

<i>Allocasuarina defungens</i>	Dwarf Heath Casuarina	Endangered
<i>Baloghia marmorata</i>	Jointed Baloghia	Vulnerable
<i>Caesalpinia bonduc</i>	Knicker Nut	Endangered
<i>Corchorus cunninghamii</i>	Native Jute	Endangered
<i>Corokia whiteana</i>	Corokia	Vulnerable
<i>Dendrocnide moroides</i>	Gympie Stinger	Endangered
<i>Desmodium acanthocladum</i>	Thorny Pea	Vulnerable
<i>Fontainea australis</i>	Southern Fontainea	Vulnerable
<i>Gaultheria viridicarpa</i> subsp. <i>merinoensis</i>	Mt Merino Waxberry	Vulnerable
<i>Gossia fragrantissima</i>	Sweet Myrtle	Endangered
<i>Hibbertia hexandra</i>	Tree Guinea Flower	Endangered
<i>Myrsine richmondensis</i>	Ripple-leaf Muttonwood	Endangered
<i>Phyllanthus microcladus</i>	Brush Sauropus	Endangered
<i>Plectranthus nitidus</i>	Nightcap Plectranthus	Endangered
<i>Pomaderris notata</i>	McPherson Range Pomaderris	Vulnerable
<i>Pultenaea maritima</i>	Coast Headland Pea	Vulnerable
<i>Randia moorei</i>	Spiny Gardenia	Endangered
<i>Senna acclinis</i>	Rainforest Cassia	Endangered
<i>Solanum limitare</i>	Border Ranges Nightshade	Endangered
<i>Sophora fraseri</i>	Brush Sophora	Vulnerable

<i>Sophora tomentosa</i> subsp. <i>australis</i>	Silverbush	Endangered
<i>Symplocos baeuerlenii</i>	Small-leaved Hazelwood	Vulnerable
<i>Xylosma terrae-reginae</i>	Queensland Xylosma	Endangered
<i>Zieria adenodonta</i>	Wollumbin Zieria	Endangered
<b>Trees</b>		
<i>Acacia bakeri</i>	Marblewood	Vulnerable
<i>Acronychia littoralis</i>	Scented Acronychia	Endangered
<i>Archidendron hendersonii</i>	White Laceflower	Vulnerable
<i>Bosistoa selwynii</i>	Heart-leaved Bonewood	Vulnerable
<i>Bosistoa transversa</i>	Yellow Satinheart	Vulnerable
<i>Cassia brewsteri</i> var. <i>marksiana</i>	Brush Cassia	Endangered
<i>Choricarpia subargentea</i>	Giant Ironwood	Endangered
<i>Cryptocarya foetida</i>	Stinking Cryptocarya	Vulnerable
<i>Cupaniopsis serrata</i>	Smooth Tuckeroo	Endangered
<i>Davidsonia jerseyana</i>	Davidson's Plum	Endangered
<i>Davidsonia johnsonii</i>	Smooth Davidson's Plum	Endangered
<i>Diospyros mabacea</i>	Red-fruited Ebony	Endangered
<i>Diploglottis campbellii</i>	Small-leaved Tamarind	Endangered
<i>Eidothea hardeniana</i>	Nightcap Oak	Endangered
<i>Elaeocarpus</i> sp. 'Rocky Creek' ( <i>sedentarius</i> )	Minyon Quandong	Endangered

Elaeocarpus williamsianus	Hairy Quandong	Endangered
Endiandra floydii	Crystal Creek Walnut	Endangered
Endiandra hayesii	Rusty Rose Walnut	Vulnerable
Endiandra muelleri subsp. bracteata	Green-leaved Rose Walnut	Endangered
Floydia praealta	Ball Nut	Vulnerable
Geijera paniculata	Axebreaker	Endangered
Hicksbeachia pinnatifolia	Red Boppel Nut	Vulnerable
Lepiderema pulchella	Fine-leaved Tuckeroo	Vulnerable
Macadamia tetraphylla	Rough-shelled Bush Nut	Vulnerable
Melicope vitiflora	-	Endangered
Niemeyera chartacea	-	Endangered
Niemeyera whitei	Rusty Plum	Vulnerable
Ochrosia moorei	Southern Ochrosia	Endangered
Owenia cepiodora	Onion Cedar	Vulnerable
Syzygium hodgkinsoniae	Red Lilly Pilly	Vulnerable
Syzygium moorei	Durobby	Vulnerable
Triflorensia cameronii	Cameron's Tarena	Endangered
Uromyrtus australis	Peach Myrtle	Endangered

### Flora under TSC Act – 10 km Buffer

The following 23 flora species have been listed under the TSC Act as occurring within 10 km of the proposed site, including five species listed as *endangered*. Those highlighted are listed as occurring within 2.5 km of the proposed site.

Scientific Name	Common Name	Status
Amyema Plicatula	-	Endangered
Choricarpia Subargentea	Giant Ironwood	Endangered
Corokia Whiteana	Corokia	Vulnerable
Davidsonia Johnsonii	Smooth Davidson's Plum	Endangered
Desmodium acanthocladum	Thorny Pea	Vulnerable
Diploglottis Campbellii	Small-leaved Tamarind	Endangered
Eidothea Hardeniana	Nightcap Oak	Endangered
Elaeocarpus Sp. Rocky Creek	Minyon Quandong	Endangered
Endiandra Hayesii	Rusty Rose Walnut	Vulnerable
Floydia Praealta	Ball Nut	Vulnerable
Fontainea Australis	Southern Fontainea	Vulnerable
Gossia Fragrantissima	Sweet Myrtle	Endangered
Hibbertia Hexandra	Tree Guinea Flower	Endangered
Hicksbeachia Pinnatifolia	Red Boppel Nut	Vulnerable
Isoglossa Eranthemoides	Isoglossa	Endangered
Lindsaea Brachypoda	Short-footed Screw Fern	Endangered
Macadamia Tetraphylla	Rough-shelled Bush Nut	Vulnerable
Niemeyera Whitei	Rusty Plum, Plum Boxwood	Vulnerable
Ochrosia Moorei	Southern Ochrosia	Endangered
Owenia Cepiodora	Onion Cedar	Vulnerable
Plectranthus Nitidus	Nightcap Plectranthus	Endangered
Symplocos Baeuerlenii	Small-leaved Hazelwood	Vulnerable
Syzygium Hodgkinsoniae	Red Lilly Pilly	Vulnerable
Tinospora Tinosporoides	Arrow-head Vine	Vulnerable
Uromyrtus Australis	Peach Myrtle	Endangered

## Flora under EPBC Act – 10 km Buffer

The following flora species are listed under the EPBC Act as occurring within 10 km of the proposed site.

Scientific Name	Common Name	Status
Allocasuarina defungens	Dwarf Heath Casuarina	Endangered
Amyema scandens	Marbled Balogia	Endangered
Arthraxon hispidus	Hairy-joint Grass	Vulnerable
Baloghia marmorata	Jointed Baloghia	Vulnerable
Bosistoa selwynii	Heart-leaved Bosistoa	Vulnerable
Bosistoa transversa	Three-leaved Bosistoa	Vulnerable
Bulbophyllum globuliforme	Miniature Moss-orchid	Vulnerable
Clematis fawcettii	Stream Clematis	Vulnerable

<i>Corchorus cunninghamii</i>	Native Jute	Endangered
<i>Corokia whiteana</i>		Vulnerable
<i>Cryptocarya foetida</i>	Stinking Cryptocarya, Stinking Laurel	Vulnerable
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	Vulnerable
<i>Davidsonia johnsonii</i>	Smooth Davidsonia, Smooth Davidson's Plum, Small-leaved Davidson's Plum	Endangered
<i>Desmodium acanthocladum</i>	Thorny Pea	Vulnerable
<i>Diploglottis campbellii</i>	Small-leaved Tamarind	Endangered
<i>Elaeocarpus sedentarius</i>	Minyon Quandong	Endangered
<i>Endiandra floydii</i>	Floyd's Walnut	Endangered
<i>Endiandra hayesii</i>	Rusty Rose Walnut, Velvet Laurel	Vulnerable
<i>Floydia praealta</i>	Ball Nut, Possum Nut, Big Nut, Beefwood	Vulnerable
<i>Fontainea australis</i>	Southern Fontainea	Vulnerable
<i>Gossia fragrantissima</i>	Sweet Myrtle, Small- leaved Myrtle Monkey Nut, Bopple Nut, Red Bopple, Red Bopple Nut, Red Nut, Beef Nut, Red Apple Nut, Red Boppel Nut, Ivory Silky Oak	Endangered
<i>Hicksbeachia pinnatifolia</i>		Vulnerable
<i>Isoglossa eranthemoides</i>	Isoglossa Rough-shelled Bush Nut, Macadamia Nut, Rough-shelled Macadamia, Rough- leaved Queensland Nut	Endangered
<i>Macadamia tetraphylla</i>		Vulnerable
<i>Marsdenia longiloba</i>	Clear Milkvine	Vulnerable
<i>Ochrosia moorei</i>	Southern Ochrosia	Endangered
<i>Owenia cepiodora</i>	Onionwood, Bog Onion, Onion Cedar	Vulnerable
<i>Randia moorei</i>	Spiny Gardenia	Endangered
<i>Sarcochilus hartmannii</i>	Waxy Sarcochilus, Blue Knob Orchid	Vulnerable
<i>Sophora fraseri</i>		Vulnerable
<i>Symplocos baeuerlenii</i>	Small-leaved Hazelwood, Shrubby Hazelwood	Vulnerable
<i>Syzygium hodgkinsoniae</i>	Smooth-bark Rose	Vulnerable

	Apple, Red Lilly Pilly Rose Apple, Coolamon, Robby, Durobby, Watermelon Tree,	
Syzygium moorei	Coolamon Rose Apple	Vulnerable
Taeniophyllum muelleri	Minute Orchid, Ribbon- root Orchid	Vulnerable
Tinospora tinoporoides	Arrow-head Vine	Vulnerable
Uromyrtus australis	Peach Myrtle	Endangered

## Threatened Fauna Species within CMA Bioregion

The following table is a list of the 102 threatened fauna listed within the Northern Rivers (Richmond-Tweed) geographic region, the CMA subregion for the proposed Dunoon Dam.

Scientific Name	Common Name	Level of Threat
<b>Amphibians</b>		
<u>Asa darlingtoni</u>	<u>Pouched Frog</u>	Vulnerable
<u>Crinia tinnula</u>	<u>Wallum Froglet</u>	Vulnerable
<u>Litoria brevipalmata</u>	<u>Green-thighed Frog</u>	Vulnerable
<u>Litoria olongburensis</u>	<u>Olongburra Frog</u>	Vulnerable
<u>Mixophyes fleayi</u>	<u>Fleay's Barred Frog</u>	Endangered
<u>Mixophyes iteratus</u>	<u>Giant Barred Frog</u>	Endangered
<u>Phyloria kundagungan</u>	<u>Mountain Frog</u>	Endangered
<u>Phyloria loveridgei</u>	<u>Loveridge's Frog</u>	Endangered
<b>Bats</b>		
<u>Chalinolobus dwyeri</u>	<u>Large-eared Pied Bat</u>	Vulnerable
<u>Chalinolobus nigrogriseus</u>	<u>Hoary Wattled Bat</u>	Vulnerable
<u>Falsistrellus tasmaniensis</u>	<u>Eastern False Pipistrelle</u>	Vulnerable



<u>Kerivoula papuensis</u>	<u>Golden-tipped Bat</u>	Vulnerable
<u>Miniopterus australis</u>	<u>Little Bentwing-bat</u>	Vulnerable
<u>Miniopterus schreibersii oceanensis</u>	<u>Eastern Bentwing-bat</u>	Vulnerable
<u>Mormopterus beccarii</u>	<u>Beccari's Freetail-bat</u>	Vulnerable
<u>Mormopterus norfolkensis</u>	<u>Eastern Freetail-bat</u>	Vulnerable
<u>Myotis macropus (formally Myotis adversus)</u>	<u>Large-footed Myotis</u>	Vulnerable
<u>Nyctimene robinsoni</u>	<u>Eastern Tube-nosed Bat</u>	Vulnerable
<u>Nyctophilus bifax</u>	<u>Eastern Long-eared Bat</u>	Vulnerable
<u>Pteropus alecto</u>	<u>Black Flying-fox</u>	Not listed
<u>Pteropus poliocephalus</u>	<u>Grey-headed Flying-fox</u>	Vulnerable
<u>Saccolaimus flaviventris</u>	<u>Yellow-bellied Sheath-tail-bat</u>	Vulnerable
<u>Scoteanax rueppellii</u>	<u>Greater Broad-nosed Bat</u>	Vulnerable
<u>Syconycteris australis</u>	<u>Common Blossom-bat</u>	Vulnerable
<u>Vespadelus troughtoni</u>	<u>Eastern Cave Bat</u>	Vulnerable
<b>Birds</b>		
<u>Amaurornis olivaceus</u>	<u>Bush-hen</u>	Vulnerable
<u>Anseranas semipalmata</u>	<u>Magpie Goose</u>	Vulnerable
<u>Anthochaera phrygia</u>	<u>Regent Honeyeater</u>	Vulnerable
<u>Atrichornis rufescens</u>	<u>Rufous Scrub-bird</u>	Vulnerable
<u>Botaurus poiciloptilus</u>	<u>Australasian Bittern</u>	Vulnerable
<u>Calidris alba</u>	<u>Sanderling</u>	Vulnerable

<u>Calidris tenuirostris</u>	<u>Great Knot</u>	Vulnerable
<u>Calyptorhynchus banksii banksii</u>	<u>Red-tailed Black-Cockatoo (Coastal subspecies)</u>	Critically Endangered
<u>Calyptorhynchus lathami</u>	<u>Glossy Black-cockatoo</u>	Vulnerable
<u>Charadrius leschenaultii</u>	<u>Greater Sand-plover</u>	Vulnerable
<u>Charadrius mongolus</u>	<u>Lesser Sand-plover</u>	Vulnerable
Circus assimilis	Spotted Harrier	Vulnerable
<u>Climacteris picumnus victoriae</u>	<u>Brown Treecreeper (eastern subspecies)</u>	Vulnerable
<u>Coracina lineata</u>	<u>Barred Cuckoo-shrike</u>	Vulnerable
<u>Cyclopsitta diophthalma coxeni</u>	<u>Double-eyed Fig-Parrot</u>	Critically Endangered
<u>Dasyornis brachypterus</u>	<u>Eastern Bristlebird</u>	Endangered
<u>Ephippiorhynchus asiaticus</u>	<u>Black-necked Stork</u>	Endangered
<u>Erythrorhynchus radiatus</u>	<u>Red Goshawk</u>	Critically Endangered
<u>Esacus neglectus</u>	<u>Beach Stone-curlew</u>	Critically Endangered
Glossopsitta pusilla	Little Lorikeet	Vulnerable
<u>Grus rubicunda</u>	<u>Brolga</u>	Vulnerable
<u>Haematopus fuliginosus</u>	<u>Sooty Oystercatcher</u>	Vulnerable
<u>Haematopus longirostris</u>	<u>Pied Oystercatcher</u>	Vulnerable
Hieraaetus morphnoides	Little Eagle	Vulnerable
<u>Irediparra gallinacea</u>	<u>Comb-crested Jacana</u>	Vulnerable
<u>Ixobrychus flavicollis</u>	<u>Black Bittern</u>	Vulnerable

<u>Lathamus discolor</u>	<u>Swift Parrot</u>	Endangered
<u>Lichenostomus fasciularis</u>	<u>Mangrove Honeyeater</u>	Vulnerable
<u>Lophoictinia isura</u>	<u>Square-tailed Kite</u>	Vulnerable
<u>Menura alberti</u>	<u>Albert's Lyrebird</u>	Vulnerable
<u>Monarcha leucotis</u>	<u>White-eared Monarch</u>	Vulnerable
<u>Ninox connivens</u>	<u>Barking Owl</u>	Vulnerable
<u>Ninox strenua</u>	<u>Powerful Owl</u>	Vulnerable
<u>Oxyura australis</u>	<u>Blue-billed Duck</u>	Vulnerable
<u>Pachycephala olivacea</u>	<u>Olive Whistler</u>	Vulnerable
<u>Pandion haliaetus</u>	<u>Osprey</u>	Vulnerable
<u>Petroica boodang</u>	<u>Scarlet Robin</u>	Vulnerable
<u>Petroica phoenicea</u>	<u>Flame Robin</u>	Vulnerable
<u>Podargus ocellatus</u>	<u>Marbled Frogmouth</u>	Vulnerable
<u>Pomatostomus temporalis temporalis</u>	<u>Grey-crowned Babbler (eastern subspecies)</u>	Vulnerable
<u>Ptilinopus magnificus</u>	<u>Wompoo Fruit-dove</u>	Vulnerable
<u>Ptilinopus regina</u>	<u>Rose-crowned Fruit-dove</u>	Vulnerable
<u>Ptilinopus superbus</u>	<u>Superb Fruit-dove</u>	Vulnerable
<u>Rostratula benghalensis</u>	<u>Painted Snipe</u>	Endangered
<u>Stictonetta naevosa</u>	<u>Freckled Duck</u>	Vulnerable
<u>Turnix maculosa</u>	<u>Red-backed Button-Quail</u>	Vulnerable
<u>Turnix melanogaster</u>	<u>Black-breasted Button-quail</u>	Critically Endangered
<u>Tyto capensis</u>	<u>Grass Owl</u>	Vulnerable
<u>Tyto novaehollandiae</u>	<u>Masked Owl</u>	Vulnerable

<u>Tyto tenebricosa</u>	<u>Sooty Owl</u>	Vulnerable
<u>Xenus cinereus</u>	<u>Terek Sandpiper</u>	Vulnerable
<b>Invertebrates</b>		
<u>Argyreus hyperbius</u>	<u>Laced Fritillary</u>	Endangered
<u>Nurus atlas</u>	<u>Atlas Rainforest Ground-beetle</u>	Endangered
<u>Nurus brevis</u>	<u>Shorter Rainforest Ground-beetle</u>	Endangered
<u>Phyllodes imperialis southern subspecies</u>	<u>Pink Underwing Moth</u>	Endangered
<u>Thersites mitchellae</u>	<u>Mitchell's Rainforest Snail</u>	Endangered
<b>Marsupials</b>		
<u>Aepyprymnus rufescens</u>	<u>Rufous Bettong</u>	Vulnerable
<u>Cercartetus nanus</u>	<u>Eastern Pygmy- possum</u>	Vulnerable
<u>Dasyurus maculatus</u>	<u>Spotted-tailed Quoll</u>	Vulnerable
<u>Macropus dorsalis</u>	<u>Black-striped Wallaby</u>	Endangered
<u>Macropus parma</u>	<u>Parma Wallaby</u>	Vulnerable
<u>Petaurus australis</u>	<u>Yellow-bellied Glider</u>	Vulnerable
<u>Petaurus norfolcensis</u>	<u>Squirrel Glider</u>	Vulnerable
<u>Petrogale penicillata</u>	<u>Brush-tailed Rock- wallaby</u>	Endangered
<u>Phascogale tapoatafa</u>	<u>Brush-tailed Phascogale</u>	Vulnerable
<u>Phascolarctos cinereus</u>	<u>Koala</u>	Vulnerable
<u>Planigale maculata</u>	<u>Common Planigale</u>	Vulnerable

<u>Potorous tridactylus</u>	<u>Long-nosed Potoroo</u>	Vulnerable
<u>Thylogale stigmatica</u>	<u>Red-legged Pademelon</u>	Vulnerable
<b>Reptiles</b>		
<u>Cacophis harriettae</u>	<u>White-crowned Snake</u>	Vulnerable
<u>Caretta caretta</u>	<u>Loggerhead Turtle</u>	Endangered
<u>Coeranoscincus reticulatus</u>	<u>Three-toed Snake-tooth Skink</u>	Vulnerable
<u>Dermochelys coriacea</u>	<u>Leathery Turtle</u>	Vulnerable
<u>Hoplocephalus bitorquatus</u>	<u>Pale-headed Snake</u>	Vulnerable
<u>Hoplocephalus stephensii</u>	<u>Stephens' Banded Snake</u>	Vulnerable
<b>Rodents</b>		
<u>Pseudomys gracilicaudatus</u>	<u>Eastern Chestnut Mouse</u>	Vulnerable
<u>Pseudomys oralis</u>	<u>Hastings River Mouse</u>	Endangered

## Threatened Fauna Species under TSC Act - 10 km Buffer

The following 53 fauna species have been listed under the TSC Act as occurring within 10 km of the proposed site, including six endangered and three critically endangered species. Those highlighted are listed as occurring within 2.5 km of the proposed site.

Class	Scientific Name	Common Name	Status
<b>Amphibia</b>	<i>Assa Darlingtoni</i>	Pouched Frog	Vulnerable
	<i>Litoria Brevipalmata</i>	Green-thighed Frog	Vulnerable
	<i>Mixophyes Fleayi</i>	Fleay's Barred Frog	Endangered
	<i>Mixophyes Iteratus</i>	Giant Barred Frog	Endangered
	<i>Phyloria Loveridgei</i>	Loveridge's Frog	Endangered
<b>Aves</b>	<i>Amaurornis Olivaceus</i>	Bush-hen	Vulnerable
	<i>Botaurus Poiciloptilus</i>	Australasian Bittern	Vulnerable
	<i>Calyptorhynchus Lathamii</i>	Glossy Black-cockatoo	Vulnerable

	<i>Circus Assimilis</i>	Spotted Harrier	Vulnerable
	<i>Coracina Lineata</i>	Barred Cuckoo-shrike	Vulnerable
	<i>Cyclopsitta Diophthalma Coxeni</i>	Double-eyed Fig-parrot	Critically Endangered
	<i>Daphoenositta chrysoptera</i>	Varied Sittella	Vulnerable
	<i>Dasyornis Brachypterus</i>	Eastern Bristlebird	Endangered
	<i>Ephippiorhynchus Asiaticus</i>	Black-necked Stork	Endangered
	<i>Glossopsitta Pusilla</i>	Little Lorikeet	Vulnerable
	<i>Hieraaetus Morphnoides</i>	Little Eagle	Vulnerable
	<i>Irediparra Gallinacea</i>	Comb-crested Jacana	Vulnerable
	<i>Ixobrychus Flavicollis</i>	Black Bittern	Vulnerable
	<i>Menura Alberti</i>	Albert's Lyrebird	Vulnerable
	<i>Monarcha Leucotis</i>	White-eared Monarch	Vulnerable
	<i>Ninox Connivens</i>	Barking Owl	Vulnerable
	<i>Ninox Strenua</i>	Powerful Owl	Vulnerable
	<i>Pandion Haliaetus</i>	Osprey	Vulnerable
	<i>Erythrotriorchis Radiatus</i>	Red Goshawk	Critically Endangered
	<i>Podargus Ocellatus</i>	Marbled Frogmouth	Vulnerable
	<i>Ptilinopus Magnificus</i>	Wompoo Fruit-dove	Vulnerable
	<i>Ptilinopus Regina</i>	Rose-crowned Fruit-dove	Vulnerable
	<i>Ptilinopus Superbus</i>	Superb Fruit-dove	Vulnerable
	<i>Turnix Melanogaster</i>	Black-breasted Button-quail	Critically Endangered
	<i>Tyto Novaehollandiae</i>	Masked Owl	Vulnerable
	<i>Tyto Tenebricosa</i>	Sooty Owl	Vulnerable
	<i>Anthochaera Phrygia</i>	Regent Honeyeater	Endangered
<b>Mammalia</b>	<i>Aepyprymnus Rufescens</i>	Rufous Bettong	Vulnerable
	<i>Chalinolobus Dwyeri</i>	Large-eared Pied Bat	Vulnerable
	<i>Dasyurus Maculatus</i>	Spotted-tailed Quoll	Vulnerable
	<i>Falsistrellus Tasmaniensis</i>	Eastern False Pipistrelle	Vulnerable
	<i>Kerivoula Papuensis</i>	Golden-tipped Bat	Vulnerable
	<i>Macropus Parma</i>	Parma Wallaby	Vulnerable
	<i>Miniopterus Australis</i>	Little Bentwing-bat	Vulnerable
	<i>Miniopterus Schreibersii Oceanensis</i>	Eastern Bentwing-bat	Vulnerable
	<i>Mormopterus Norfolkensis</i>	Eastern Freetail-bat	Vulnerable
	<i>Myotis Macropus</i>	Southern Myotis	Vulnerable
	<i>Nyctimene Robynsoni</i>	Eastern Tube-nosed Bat	Vulnerable
	<i>Nyctophilus Bifax</i>	Eastern Long-eared Bat	Vulnerable
	<i>Petaurus Australis</i>	Yellow-bellied Glider	Vulnerable
	<i>Petaurus Norfolcensis</i>	Squirrel Glider	Vulnerable

	<i>Phascogale Tapoatafa</i>	Brush-tailed Phascogale	Vulnerable
	<i>Phascolarctos Cinereus</i>	Koala	Vulnerable
	<i>Planigale Maculata</i>	Common Planigale	Vulnerable
	<i>Potorous Tridactylus</i>	Long-nosed Potoroo	Vulnerable
	<i>Pteropus Poliocephalus</i>	Grey-headed Flying-fox	Vulnerable
	<i>Saccolaimus Flaviventris</i>	Yellow-bellied Sheathtail-bat	Vulnerable
	<i>Scoteanax Rueppellii</i>	Greater Broad-nosed Bat	Vulnerable
	<i>Syconycteris Australis</i>	Common Blossom-bat	Vulnerable
	<i>Thylogale Stigmatica</i>	Red-legged Pademelon	Vulnerable
<b>Reptilia</b>	<i>Coeranoscincus Reticulatus</i>	Three-toed Snake-tooth Skink	Vulnerable
	<i>Hoplocephalus Stephensii</i>	Stephens' Banded Snake	Vulnerable

## Threatened Fauna under EPBC Act – 10 km Buffer

A further 16 fauna species are listed as occurring within 10km of the proposed site under the EPBC Act. Those listed as occurring within 2.5 km of the site are highlighted.

Class	Scientific Name	Common Name	Status
<b>Amphibia</b>	<i>Litoria olongburensis</i>	Wallum Sedge Frog	Vulnerable
	<i>Mixophyes fleayi</i>	Fleay's Frog	Endangered
	<i>Mixophyes iteratus</i>	Southern Barred Frog	Endangered
<b>Aves</b>	<i>Anthochaera phrygia</i>	Regent Honeyeater	Endangered
	<i>Botaurus poiciloptilus</i>	Australian Bittern	Endangered
	<i>Cyclopsitta diophthalma coxeni</i>	Coxen's Fig-Parrot	Endangered
	<i>Dasyornis brachypterus</i>	Eastern Bristlebird	Endangered
	<i>Lathamus discolor</i>	Swift Parrot	Endangered
	<i>Poephila cincta cincta</i>	Black-throated Finch (southern)	Endangered
	<i>Rostratula australis</i>	Australian Painted Snipe	Vulnerable
	<i>Turnix melanogaster</i>	Black-breasted Button-quail	Vulnerable
<b>Mammalia</b>	<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat, Large Pied Bat	Vulnerable
	<i>Dasyurus maculatus maculatus</i> (SE mainland population)	Spotted-tail Quoll, Tiger Quoll	Endangered
	<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Vulnerable
	<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE mainland)	Vulnerable
	<i>Pseudomys novaehollandiae</i>	New Holland Mouse	Vulnerable
	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Vulnerable
<b>Reptilia</b>	<i>Coeranoscincus reticulatus</i>	Three-toed Snake-tooth Skink	Vulnerable

<i>Delma torquata</i>	Collared Delma	Vulnerable
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Migratory/Marine overfly species listed as occurring within 10km of the proposed site under the EPBC Act.

Migratory Terrestrial Species		
Birds		
Cyclopsitta diophthalma coxeni Coxen's Fig-Parrot	Migratory	Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Migratory	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Migratory	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Migratory	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Migratory	Breeding likely to occur within area
Rhipidura rufifrons Rufous Fantail	Migratory	Breeding may occur within area
Xanthomyza phrygia Regent Honeyeater	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe	Migratory	Species or species habitat may occur within area
Migratory Marine Birds:		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area



Listed Marine Species		
Birds		
Anseranas semipalmata Magpie Goose	Listed - overfly marine area	Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
Lathamus discolor Swift Parrot	Listed - overfly marine area	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Monarcha melanopsis Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
Monarcha trivirgatus Spectacled Monarch	Listed - overfly marine area	Breeding likely to occur within area
Myiagra cyanoleuca Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
Rhipidura rufifrons Rufous Fantail	Listed - overfly marine area	Breeding may occur within area
Rostratula benghalensis s. lat. Painted snipe	Listed - overfly marine area	Species or species habitat may occur within area

## Birds Australia Atlas List

Below is a total list of bird species (162) for the proposed site (Dunoon) obtained from the Birds Australia Bird Atlas 'Birdata'.

Polygon coordinates:

(153.22379, -28.74041, NaN)

(153.2221, -28.59206, NaN)

(153.40895, -28.58526, NaN)

(153.40669, -28.7455, NaN)

(153.22379, -28.74041, NaN)

Common Name	Scientific Name	Survey Count
Australian Brush-turkey	<i>Alectura lathami</i>	23
Black Swan	<i>Cygnus atratus</i>	11
Australian Wood Duck	<i>Chenonetta jubata</i>	6
Grey Teal	<i>Anas gracilis</i>	1
Pacific Black Duck	<i>Anas superciliosa</i>	27
Hardhead	<i>Aythya australis</i>	7
	<i>Tachybaptus</i>	
Australasian Grebe	<i>novaehollandiae</i>	2
Rock Dove	<i>Columba livia</i>	1
White-headed Pigeon	<i>Columba leucomela</i>	51
Spotted Dove	<i>Streptopelia chinensis</i>	5
	<i>Macropygia</i>	
Brown Cuckoo-Dove	<i>amboinensis</i>	70
Emerald Dove	<i>Chalcophaps indica</i>	40
Common Bronzewing	<i>Phaps chalcoptera</i>	1
Crested Pigeon	<i>Ocyphaps lophotes</i>	23
Bar-shouldered Dove	<i>Geopelia humeralis</i>	34
Wonga Pigeon	<i>Leucosarcia picata</i>	40
Wompoo Fruit-Dove	<i>Ptilinopus magnificus</i>	35
Superb Fruit-Dove	<i>Ptilinopus superbus</i>	9
Rose-crowned Fruit-Dove	<i>Ptilinopus regina</i>	21
	<i>Lopholaimus</i>	
Topknot Pigeon	<i>antarcticus</i>	38
Tawny Frogmouth	<i>Podargus strigoides</i>	11
Marbled Frogmouth	<i>Podargus ocellatus</i>	2
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	1
	<i>Hirundapus</i>	
White-throated Needletail	<i>caudacutus</i>	2
	<i>Anhinga</i>	
Australasian Darter	<i>novaehollandiae</i>	3
	<i>Microcarbo</i>	
Little Pied Cormorant	<i>melanoleucos</i>	11

Great Cormorant	<i>Phalacrocorax carbo</i>	1
	<i>Phalacrocorax</i>	
Little Black Cormorant	<i>sulcirostris</i>	11
Pied Cormorant	<i>Phalacrocorax varius</i>	1
White-necked Heron	<i>Ardea pacifica</i>	1
Eastern Great Egret	<i>Ardea modesta</i>	3
Intermediate Egret	<i>Ardea intermedia</i>	3
Cattle Egret	<i>Ardea ibis</i>	20
	<i>Egretta</i>	
White-faced Heron	<i>novaehollandiae</i>	18
Nankeen Night-Heron	<i>Nycticorax caledonicus</i>	3
Australian White Ibis	<i>Threskiornis molucca</i>	4
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	8
Black-shouldered Kite	<i>Elanus axillaris</i>	7
Pacific Baza	<i>Aviceda subcristata</i>	14
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	11
Whistling Kite	<i>Haliastur sphenurus</i>	3
Brown Goshawk	<i>Accipiter fasciatus</i>	7
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	4
	<i>Accipiter</i>	
Grey Goshawk	<i>novaehollandiae</i>	15
Wedge-tailed Eagle	<i>Aquila audax</i>	6
Nankeen Kestrel	<i>Falco cenchroides</i>	1
Peregrine Falcon	<i>Falco peregrinus</i>	5
Purple Swamphen	<i>Porphyrio porphyrio</i>	12
Lewin's Rail	<i>Lewinia pectoralis</i>	2
Buff-banded Rail	<i>Gallirallus philippensis</i>	4
Dusky Moorhen	<i>Gallinula tenebrosa</i>	25
Eurasian Coot	<i>Fulica atra</i>	4
Masked Lapwing	<i>Vanellus miles</i>	23
Comb-crested Jacana	<i>Irediparra gallinacea</i>	7
	<i>Calyptorhynchus</i>	
Glossy Black-Cockatoo	<i>lathamii</i>	2
	<i>Calyptorhynchus</i>	
Yellow-tailed Black-Cockatoo	<i>funereus</i>	38
Galah	<i>Eolophus roseicapillus</i>	4
Little Corella	<i>Cacatua sanguinea</i>	2
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	53
	<i>Trichoglossus</i>	
Rainbow Lorikeet	<i>haematodus</i>	30
	<i>Trichoglossus</i>	
Scaly-breasted Lorikeet	<i>chlorolepidotus</i>	25
Australian King-Parrot	<i>Alisterus scapularis</i>	55
Crimson Rosella	<i>Platyercus elegans</i>	40

Eastern Rosella	<i>Platycercus eximius</i>	42
Pale-headed Rosella	<i>Platycercus adscitus</i>	1
Pheasant Coucal	<i>Centropus phasianinus</i>	15
Eastern Koel	<i>Eudynamys orientalis</i>	21
	<i>Scythrops</i>	
Channel-billed Cuckoo	<i>novaehollandiae</i>	4
Horsfield's Bronze-Cuckoo	<i>Chalcites basalis</i>	1
Shining Bronze-Cuckoo	<i>Chalcites lucidus</i>	29
Pallid Cuckoo	<i>Cacomantis pallidus</i>	1
	<i>Cacomantis</i>	
Fan-tailed Cuckoo	<i>flabelliformis</i>	39
Brush Cuckoo	<i>Cacomantis variolosus</i>	11
Southern Boobook	<i>Ninox novaeseelandiae</i>	4
Sooty Owl	<i>Tyto tenebricosa</i>	1
Azure Kingfisher	<i>Ceyx azureus</i>	18
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	81
	<i>Todiramphus</i>	
Forest Kingfisher	<i>macleayii</i>	1
Sacred Kingfisher	<i>Todiramphus sanctus</i>	9
Rainbow Bee-eater	<i>Merops ornatus</i>	5
Dollarbird	<i>Eurystomus orientalis</i>	9
Noisy Pitta	<i>Pitta versicolor</i>	26
Albert's Lyrebird	<i>Menura alberti</i>	3
	<i>Cormobates</i>	
White-throated Treecreeper	<i>leucophaea</i>	49
Red-browed Treecreeper	<i>Climacteris erythroptis</i>	1
Green Catbird	<i>Ailuroedus crassirostris</i>	48
	<i>Sericulus</i>	
Regent Bowerbird	<i>chrysocephalus</i>	27
	<i>Ptilonorhynchus</i>	
Satin Bowerbird	<i>violaceus</i>	46
Superb Fairy-wren	<i>Malurus cyaneus</i>	33
	<i>Malurus</i>	
Red-backed Fairy-wren	<i>melanocephalus</i>	15
Variiegated Fairy-wren	<i>Malurus lamberti</i>	15
Yellow-throated Scrubwren	<i>Sericornis citreogularis</i>	21
White-browed Scrubwren	<i>Sericornis frontalis</i>	59
Large-billed Scrubwren	<i>Sericornis magnirostra</i>	42
Brown Gerygone	<i>Gerygone mouki</i>	38
White-throated Gerygone	<i>Gerygone albogularis</i>	5
Striated Thornbill	<i>Acanthiza lineata</i>	6
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	1
Brown Thornbill	<i>Acanthiza pusilla</i>	68

Spotted Pardalote	<i>Pardalotus punctatus</i>	10
Striated Pardalote	<i>Pardalotus striatus</i>	12
	<i>Acanthorhynchus</i>	
Eastern Spinebill	<i>tenuirostris</i>	25
Lewin's Honeyeater	<i>Meliphaga lewinii</i>	85
	<i>Lichenostomus</i>	
Yellow-faced Honeyeater	<i>chrysops</i>	14
	<i>Manorina</i>	
Noisy Miner	<i>melanocephala</i>	48
	<i>Anthochaera</i>	
Little Wattlebird	<i>chrysoptera</i>	2
Regent Honeyeater	<i>Anthochaera phrygia</i>	2
	<i>Myzomela</i>	
Scarlet Honeyeater	<i>sanguinolenta</i>	30
Brown Honeyeater	<i>Lichmera indistincta</i>	4
White-cheeked Honeyeater	<i>Phylidonyris niger</i>	1
Noisy Friarbird	<i>Philemon corniculatus</i>	28
Little Friarbird	<i>Philemon citreogularis</i>	4
Australian Logrunner	<i>Orthonyx temminckii</i>	51
Eastern Whipbird	<i>Psophodes olivaceus</i>	84
	<i>Daphoenositta</i>	
Varied Sittella	<i>chrysoptera</i>	1
	<i>Coracina</i>	
Black-faced Cuckoo-shrike	<i>novaehollandiae</i>	41
White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	5
Barred Cuckoo-shrike	<i>Coracina lineata</i>	5
Cicadabird	<i>Coracina tenuirostris</i>	24
Varied Triller	<i>Lalage leucomela</i>	36
Crested Shrike-tit	<i>Falcunculus frontatus</i>	19
	<i>Pachycephala</i>	
Golden Whistler	<i>pectoralis</i>	68
	<i>Pachycephala</i>	
Rufous Whistler	<i>rufiventris</i>	10
	<i>Colluricincla</i>	
Little Shrike-thrush	<i>megarhyncha</i>	45
	<i>Colluricincla</i>	
Grey Shrike-thrush	<i>harmonica</i>	70
Australasian Figbird	<i>Sphecotheres vieilloti</i>	51
Olive-backed Oriole	<i>Oriolus sagittatus</i>	27
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	2
Grey Butcherbird	<i>Cracticus torquatus</i>	51
Pied Butcherbird	<i>Cracticus nigrogularis</i>	32
Australian Magpie	<i>Cracticus tibicen</i>	53
Pied Currawong	<i>Strepera graculina</i>	87
Spangled Drongo	<i>Dicrurus bracteatus</i>	40

Rufous Fantail	<i>Rhipidura rufifrons</i>	22
Grey Fantail	<i>Rhipidura albiscapa</i>	62
Willie Wagtail	<i>Rhipidura leucophrys</i>	25
Australian Raven	<i>Corvus coronoides</i>	1
Torresian Crow	<i>Corvus orru</i>	69
Leaden Flycatcher	<i>Myiagra rubecula</i>	13
Restless Flycatcher	<i>Myiagra inquieta</i>	2
White-eared Monarch	<i>Carternornis leucotis</i>	18
Black-faced Monarch	<i>Monarcha melanopsis</i>	20
	<i>Symposiachrus</i>	
Spectacled Monarch	<i>trivirgatus</i>	25
Magpie-lark	<i>Grallina cyanoleuca</i>	21
Paradise Riflebird	<i>Ptiloris paradiseus</i>	24
Rose Robin	<i>Petroica rosea</i>	7
Pale-yellow Robin	<i>Tregellasia capito</i>	39
Eastern Yellow Robin	<i>Eopsaltria australis</i>	69
Golden-headed Cisticola	<i>Cisticola exilis</i>	2
Tawny Grassbird	<i>Megalurus timoriensis</i>	4
Silvereye	<i>Zosterops lateralis</i>	56
Welcome Swallow	<i>Hirundo neoxena</i>	30
Fairy Martin	<i>Petrochelidon ariel</i>	1
	<i>Petrochelidon</i>	
Tree Martin	<i>nigricans</i>	1
Bassian Thrush	<i>Zoothera lunulata</i>	2
Russet-tailed Thrush	<i>Zoothera heinei</i>	6
Common Starling	<i>Sturnus vulgaris</i>	5
	<i>Dicaeum</i>	
Mistletoebird	<i>hirundinaceum</i>	40
Red-browed Finch	<i>Neochmia temporalis</i>	46
House Sparrow	<i>Passer domesticus</i>	1
	<i>Anthus</i>	
Australasian Pipit	<i>novaeseelandiae</i>	2
Crow & Raven species		3

