

Summary

The principal purpose of this Species Impact Statement (SIS) is to assess the likely impacts on threatened species that could arise from the proposed expansion of the Tharbogang landfill and quarry, via Griffith, New South Wales. This SIS has been prepared in accordance with Sections 109 and 110 of the New South Wales *Threatened Species Conservation Act 1995* (TSC Act) and the New South Wales National Parks and Wildlife Service Director-General's requirements pursuant to Section 111 of the *TSC Act 1995*.

Griffith City Council (GCC) is seeking to obtain an overall approval for the extension of the quarry and the landfill, at Tharbogang, to meet the region's needs for the next 40 – 50 years, based upon estimates obtained from the GCC Landfill Environmental Management Plan (Griffith LEMP 1995). The Council currently requires 50,000 to 80,000 tonnes of gravel per annum, primarily for road construction and engineering works, and approximately 30,000 m³ for landfill space.

Other than the McPherson Range, the locality is characterised by relatively flat alluvial formation and, as a consequence of the geology and intense irrigation (the City of Griffith is located centrally within the Murrumbidgee Irrigation Area (MIA)), the high groundwater level increases the risk of interaction with landfill leachate. Similarly, the only areas of hard rock suitable for road base production are restricted to the McPherson Range which has been classified as an environmentally sensitive area on the basis of flora, fauna, scenic and heritage values and, thus, it has been recommended that all remaining areas of the McPherson Range above the 145 m contour be left undisturbed. It is considered that the relocation of the landfill and quarry site provides a greater potential threat to the environment than the expansion of the current site existing site.

A review of relevant literature and databases identified 48 threatened species, two threatened populations and one endangered ecological community that are known to occur within the locality. It was considered that 37 species and the two endangered populations from the locality are also known from the within the study area or have potentially suitable habitat within the study area that could be directly or indirectly impacted upon by the proposed development.

A flora and fauna assessment was conducted with the specific purpose of targeting threatened species and their habitats within the study area. The potential impacts upon other non-threatened native flora and fauna of the study area was also taken in to consideration during this assessment. The assessment revealed the presence of one threatened bird (Grey-crowned Babbler, previously known from the subject site), and three threatened microchiropteran bat species (Inland Forest Bat, Little Pied Bat and the Fishing Bat). It was also concluded that the subject site provided potentially suitable habitat for an additional seven threatened species which have been previously recorded within the study area and McPherson Range. The subject site and surrounding vegetation also forms important habitat for a variety of declining woodland bird species not listed as threatened species. Although no threatened flora were recorded within the subject site during this assessment, regionally significant vegetation in the form of Bimble Box-White Cypress Pine woodland was recorded. The subject site also provides potentially suitable habitat for *Lomandra patens*, a locally significant plant species from the McPherson Range.

The proposed expansion of the Tharbogang landfill and quarry will result in the removal of approximately 50 ha or 59% of the 85 ha of existing native vegetation of the subject site. As part of this process all vegetative layers and associated habitat features will be removed. As a consequence, at least 70% of known habitat utilised by Grey-crowned Babbler will be removed and up to 60% of known foraging habitat and potential roosting habitat for the three threatened bat species recorded within the subject site will also be removed.

The 8-part test of significance (Section 5A *Environmental Planning & Assessment Act 1979*) was applied to each of the threatened species potentially affected by the proposed development. From the assessment it was concluded that the proposed development is 'likely' to impose a 'significant effect' upon the Grey-crowned Babbler and the three threatened microchiropteran bat species. The proposed development would also result in the loss of locally important habitat, further fragmentation of an important wildlife corridor, and the removal of locally and regionally significant vegetation.

In order to avoid a significant impact upon threatened species at any level a suite of mitigation measures have been devised to ameliorate potential impacts of the proposed development. Specific impact amelioration measures include the retention and preservation of known and potential habitat, establishment of vegetation corridors through the subject site and implementation of a introduced predator control program. Only by adhering to the impact amelioration measures in this report could it be considered unlikely that a significant effect on any of the species of conservation significance mentioned in this report will occur.

Through regulatory actions imposed upon the development proposal process a detailed study has been undertaken of an important component of the natural environment of the Griffith region. Consequently, regionally significant vegetation, threatened species and habitats have been identified. GCC is now required to consider the conservation of these species in regards to the proposed development and ensure that the proposed development will in no way significantly affect these species.

The economic costs likely to be incurred as a result of the conservation of threatened species and other biodiversity attributes within the subject site and study area are considered nominal in comparison to the alternative. The largest social impact will result from the loss of some of the scenic value derived from the native vegetation of the subject site as a result of clearing for various stages of the proposed development. The proposed impact amelioration measures in conjunction with the site rehabilitation process have been designed to negate this impact.

The challenge is for the development of this site to encompass the biodiversity constraints within an efficient and environmentally responsible framework. The proposed development should in no way negatively impact upon the threatened species and other species of conservation significant. It is important for this development along with future potential developments of this area to consider the broader biodiversity implications, particularly the overall reduction of native vegetation and loss of habitat.

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1. INTRODUCTION

This section provides the purpose and background for the SIS. The reasons for the SIS are outlined, along with the statutory approvals process required for the development process. Definitions are provided for key words used throughout the document.

Ettamogah Research Consultants (ERC) was engaged by Griffith City Council (GCC) to complete a Species Impact Statement (SIS) for the proposed Tharbogang landfill and quarry expansion via Griffith, New South Wales. It has been proposed by the GCC to continue to use and extend the existing Tharbogang site to provide for the city's projected waste disposal and quarry requirements for at least the next fifty years.

GCC purchased Lot 202 DP756035 in 1984 from the Crown for quarry and landfill purposes. Council sought and was granted a permit or licence for a landfill from the Department of Health, which administered landfills at the time. The approval was restricted to a footprint covering an existing valley, although further extension was envisaged at the time.

In 1991, GCC, after investigation of alternative sites, concluded that the site would be developed as a quarry, providing the council's major source of road building materials. An Environmental Impact Statement (EIS) (Coffey 2000) and Development Application for Stage 1 of the Quarry was lodged and approved.

GCC now wishes to obtain an overall approval for extension of the quarry and the landfill to meet their needs for the next 40 to 50 years. GCC currently requires 50,000 to 80,000 tonnes of gravel per year and needs approximately 30,000 m³ for landfill space.

1.1. PURPOSE

The main purpose of this SIS is to assess the likely impacts upon threatened species that could arise from the proposed expansion of the Tharbogang landfill and quarry. This report has been prepared in accordance with Sections 109 and 110 of the New South Wales *Threatened Species Conservation Act 1995 (TSC Act)* and the NSW National Parks and Wildlife Service Director-General's requirements pursuant to Section 111 of the *TSC Act 1995*. These requirements appear in Appendix C.

In conjunction with further developing the site for use as a landfill, it is proposed to expand the existing quarrying operation to provide for the council's road construction and engineering works. The quarrying operation will effectively benefit the overall development by increasing the capacity of the site, in terms of landfill volumes, together with providing pavement materials necessary for the maintenance and construction of roads in the area. Details of the proposed landfill and quarry operations are discussed in Section 3.1 of this report.

Other purposes of this SIS include:

- § describing the existing biodiversity of the subject site and surrounding lands, and predict impacts of the project on non-threatened (protected) native flora and fauna species and communities; and
- § providing recommendations for a suite of mitigation measures that are intended to minimise the impacts of the proposed development upon native flora and fauna, particularly threatened species.

Within this report, ‘threatened species’ are generally considered to be those that are specified by Parts 1 and 4 of Schedule 1 or in Schedule 2 of the *TSC Act 1995*, the *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, or the Rare or Threatened Australian Plants Database (ROTAP 1995).

1.2. REASON FOR SPECIES IMPACT STATEMENT

GCC submitted a proposed amendment to the original designs for the expansion of the existing Tharbogang landfill and quarry development (report produced by SMEC Australia Pty Ltd. (2001)).

Planning New South Wales (formerly the Department of Urban Affairs and Planning) advised the Department of Land and Water Conservation (DLWC) that Section 90(1)(b) of the *Environmental Planning and Assessment Regulation 2000* applies to the amended design for this development. This section requires that the consent authority (in this case DLWC) be satisfied that the amendment differs only in minor respects from the original application.

DLWC considers the amendment to the site layout and rehabilitation design is not minor in terms of potential impacts on remnant native vegetation and consequences for habitat conservation. DLWC recognises that the remnant native vegetation at the site has conservation, aesthetic and habitat value.

These design variations, produced by SMEC Australia (2001), failed to recognise the findings of the EIS (Coffey 2000). The EIS found that no significant impact on flora and fauna of the area would occur based upon the design and staging of the development shown in Appendix 6 of the threatened species assessment report and Appendix G of the EIS (see Appendix E of this report). The layout and staging of the proposal shown in these figures did provide for conservation of remnant vegetation areas and vegetated corridors throughout the site. The reserved areas, landscape buffer zones and wildlife corridors of the previous design are fundamental to the conservation of vegetation and habitat (DLWC 2002).

In summary, the DLWC (2002) found that:

- § the amended proposal changes the layout of the site so that a significant impact upon remnant vegetation communities and disruption to the connectivity and habitat value of the site would occur;
- § the design variations represent a major change to the potential for impact on flora and fauna of the site and surrounding region. The impact of the design changes cannot be adequately assessed by the threatened species assessment and EIS prepared for the original proposal;
- § the amendment to site design invalidates the findings of the threatened species assessment; and
- § the extensive removal of vegetation and alteration to geological features of the site will significantly impact on the visual amenity value that the range provides to the environment of Griffith.

With the extent of habitat removal and alteration to the environment proposed by the amended development on part of the landscape that exhibits environmentally sensitive features, DLWC recommend that the application for development consent be rejected. The basis of this conclusion is that the amendment significantly differs from the design proposed in the original application (DLWC 2002).

1.3. COMPLIANCE

1.3.1. Matters which have been limited or modified

According to the Director General's Requirements (see Appendix C) it is considered that the following Section 110 matters need not be addressed by this SIS:

- Section 110(2)(e). This section is a replication of 110(2)(a);
- All reference to critical habitat. There is currently no declared critical habitat in the area likely to be affected by the application; and
- Section 110(2)(g). The matters raised in this section of the act have been clarified by the requirements below.
- All reference to threat abatement plans. No threat abatement plans have currently been approved in accordance with the *TSC Act 1995*, which are relevant to this proposal.
- All reference to recovery plans. No recovery plans have been approved that are likely to be relevant to this proposal.
- All reference to key threatening processes. No key threatening processes have been listed which are likely to be relevant to this proposal.
- All reference to critical habitat. At the time of printing, the areas of declared critical habitat are not relevant to this proposal.

The approval of any recovery plans, preliminary determinations of threatened species, declaration of critical habitat and listing of key, threatening processes between the issue of the Director General's Requirements and the present have been addressed in this SIS to be considered by the consent, determining or concurrence authority.

1.3.2. Matters to be addressed by the SIS

This SIS addresses all the matters specified in Sections 109 and 110 of the *TSC Act 1995* with the exception of those matters listed above. In addition to these sections all matters of the NSW National Parks and Wildlife Service Director-General's requirements pursuant to Section 111 of the *TSC Act 1995* are also addressed (see Tables 1.1 and 1.2).

1.4. ADDITIONAL INFORMATION AND REQUIRED APPROVALS

A range of other approvals may be required for the development to proceed. Section 110(2)(j) of the *TSC Act 1995* requires that the SIS list the range of other approvals along with the administering authority and the controlling act. It is not however the role of the SIS to further address these approvals.

The proposed landfill and quarry operation has been classified as integrated development and as such requires consideration under the following acts:

- § Protection of the Environment Operations Act 1997;
- § Roads Act 1993;
- § Environmental Planning and Assessment Act 1979;
 - Environmental Planning and Assessment Regulation 1994 "Extractive Industries."
- § Native Vegetation Conservation Act 1997 ;
- § Threatened Species Conservation Act 1995;
- § National Parks and Wildlife Act 1974;
- § Native Title Act 1994;
- § Public Health Act 1991; and
- § Soil Conservation Act 1938.

In addition to the approvals from the integrated bodies, other approvals and considerations will be required in respect to the:

- § GCC for compliance with the Griffith Local Environmental Plan 2002;
- § SEPP. No. 11 Traffic Generating Developments; and
- § SEPP. No. 33 Hazardous and Offensive Development.

The Development will require an extension to the existing pollution control licence No. 5875 from the Environmental Protection Authority.

A permit granting approval to employ 1080 poison for the fox baiting program proposed as part of the impact amelioration measures must be obtained from the Rural Lands Protection Board.

1.5. REPORT STRUCTURE

The remainder of this SIS is structured according to Section 110 of the *TSC Act 1995* and by reference to the Director General's Requirements as follows:

- § Section 2 provides information about the locality, study area and subject site;
- § Section 3 provides information about the nature, duration and timing of the proposed development;
- § Section 4 describes the assessment methodology used for the selection of subject species, information review and general and targeted flora and fauna surveys;
- § Section 5 presents the results of the flora, habitat and fauna assessment;
- § Section 6 describes the potential impacts of the proposed development on subject species, other flora and fauna and the local environment;
- § Section 7 assesses the significance of these potential impacts on subject species;
- § Section 8 discusses proposed impact amelioration measures and alternative development options;
- § Section 9 discusses matters of social and economic impacts;
- § Section 10 discusses the implications for ecologically sustainable development; and
- § Section 11 provides a conclusion to the SIS and summarises the recommendations made for the proposed development.

The report has been divided into two Volumes. Volume 1 contains the report and Volume 2 contains all appendices.

1.6. DEFINITIONS

The definitions given below are relevant to these requirements and will be used in this report.

development - has the same meaning as in the *Environmental Planning and Assessment Act 1979 (EP&A Act)*.

activity - has the same meaning as in the *EP&A Act 1979*.

subject site - the area which is proposed for development/activity. For the purpose of this assessment the subject site is defined as the area containing lot 280 DP44532 (0.1477 ha), lot portion 202 DP756035 (122 ha) and additional crown land boundary adjustment for a roadway (1.778 ha) and is defined by Figure 1.1 (aerial photograph in pocket attached to the inside back cover of this volume).

study area - is the subject site and any additional area which is likely to be affected by the proposal, either directly or indirectly. For the purpose of this assessment the study area includes all land within 5 km of the subject site as defined by Figure 1.1.

locality - means the area within a 50 km radius of the subject site (see Figure 2.1).

region - means a biogeographical region that has been recognised and documented such as the Interim Biogeographical Regions of Australia (IBRA).

subject species - means those threatened species, endangered populations or endangered ecological communities which are considered known or likely to occur in the study area.

Table 1.1. Compliance with requirements of the Director General's Requirements

Section	Issue	Location in report
	The SIS must meet all the matters specified in Sections 109 and 110 of the TSC Act with the exception of those matters limited above. In addition to these sections (Appendix 1) I require the matters described below to be addressed. Previous surveys and assessments may be used to assist in addressing these requirements. All references used throughout the SIS must be cited and listed in a bibliography.	Full Report
1. Description		
	The SIS must include the information requested below:	
	<i>The proposal and surrounding areas</i>	
1.1	A topographic map of the locality at the most detailed scale available should be provided. This map should detail the location of the proposed mine, any locally significant areas for threatened species such as parks and reserves, and areas of high activity such as townships, regional centres and major roads.	Figure 2.3
1.2	The type of action proposed shall be detailed, including the timetable for the carrying out of the proposed clearing and the number of hectares affected. This shall include details of the location of any auxiliary infrastructure such as water storage areas or roads.	Section 3 Figure 3.1
1.3	A plan of the subject area will be provided. This plan will show the location and type of vegetation communities present within the subject area and the scale of the plan.	Sections 3, 5.3-5.5 Figures 1.1, 2.2, 5.1 & 5.2
1.4	A colour aerial photograph of the locality (or reproduction of such a photograph) shall be provided. This aerial photograph should clearly show the subject site and the scale of the photograph.	Figure 1.1 study area
	<i>Initial site assessment</i>	
1.5	A list of subject species must be provided. In determining these species, consideration must be given to the habitat types present within subject site, recent records of threatened species in the locality and the known distribution of threatened species. Databases such as the NPWS Atlas of NSW Wildlife and information from the Royal Botanic Gardens and Australian Museum may be used to assist in compiling the list. The following species must be included in the list of subject species:	Appendix F. Tables 5.1 – 5.4
	Flora <i>Acacia curranii</i> <i>Austrostipa (Stipa) metatoris</i> <i>Austrostipa (Stipa) wakoolica</i> <i>Brachyscome papillosa</i> <i>Caladenia arenaria</i> <i>Diuris tricolor</i> <i>Lepidium aschersonii</i> <i>Swainsona murrayana</i> <i>Swainsona sericea</i>	

Section	Issue	Location in report
Fauna <i>Burhinus grallarius</i> Bush Stone-curlew <i>Ardeotis australis</i> Australian Bustard <i>Falco hypoleucos</i> Grey Falcon <i>Lophoictinia isura</i> Square-tailed Kite <i>Rostratula beghalensis</i> Painted Snipe <i>Grus rubicundus</i> Brolga <i>Stictonetta naevosa</i> Freckled Duck <i>Oxyura australis</i> Blue-billed Duck <i>Anseranus semipalmata</i> Magpie Goose <i>Botaurus poiciloptilus</i> Australasian Bittern <i>Limosa limosa</i> Black-tailed Godwit <i>Cacatua leadbeateri</i> Pink Cockatoo <i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo <i>Polytelis swainsonii</i> Superb Parrot <i>Neophema pulchella</i> Turquoise Parrot <i>Ninox connivens</i> Barking Owl <i>Tyto novaehollandiae</i> Masked Owl <i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (eastern ssp.) <i>Drymodes brunneopygia</i> Southerly Scrub-robin <i>Melanodryas cucullata</i> Hooded Robin <i>Pachycephala inornata</i> Gilbert's Whistler <i>Pachycephala rufogularis</i> Red-lored Whistler <i>Cinclosoma castanotus</i> Chestnut Quail-thrush <i>Sericornis cautus</i> Shy Hylacola <i>Pyrrholaemus sagittatus</i> Speckled Warbler <i>Melithreptus gularis</i> Black-chinned Honeyeater <i>Grantiella picta</i> Painted Honeyeater <i>Certhionyx variegatus</i> Pied Honeyeater <i>Stagonopleura guttata</i> Diamond Firetail <i>Chalinolobus picatus</i> Little Pied Bat <i>Vespadelus baverstocki</i> Inland Forest Bat <i>Nyctophilus timoriensis</i> Greater Long-eared Bat <i>Socolaimus flaviventris</i> Yellow-bellied Sheath-tail Bat <i>Litoria raniformis</i> Southern Bell Frog <i>Tiliqua occipitalis</i> Western Blue-tongued Lizard Endangered Ecological Communities White Box, Yellow Box, Blakely's Redgum Woodland Endangered Populations Glossy Black-Cockatoo Riverina Endangered Population		
1.6	In defining the subject site consideration shall be given to possible indirect effects of the action on the area surrounding the subject site: for example altered hydrology regimes, air pollution or increased traffic.	Section 6
1.7	In describing the subject site, consideration shall be given to the previous land uses and the effect of such land uses on the subject site. Relevant historical events may include fire history, cropping and other agricultural activities.	Sections 2.1 – 2.2 Sections 5.3 – 5.6

Section	Issue	Location in report
1.8	A description of fauna habitat components such as the frequency of tree hollows, presence of logs and other groundcover, density and structure of vegetation, soil types and presence of water points etc. shall be given. The condition of the habitat within the subject site shall be discussed, including the prevalence of introduced species. Where relevant the habitat of the subject species shall be described with particular reference to the various components of their habitat (i.e., feeding, roosting, nesting, etc.).	Section 5.4 – 5.6
<i>Subject species survey methods</i>		
1.9	A fauna and flora survey is to be conducted in the study area. Targeted surveys shall be conducted for all subject species where suitable habitat for these has been identified as occurring within the subject site. Species of taxonomic uncertainty shall be confirmed by a recognised authority such as the Australian Museum for animals and the Royal Botanic Gardens for plants.	Section 5
1.10	A full description of the methodology used in the fauna and flora surveys and habitat assessment shall be provided, including survey techniques and effort employed, number and location of traps, size of survey sites, date/s of surveys, the time spent on surveys and weather conditions. Surveys should be undertaken during seasons and climatic conditions during which the subject species are most likely to be detected. Flora survey will be conducted in the spring and surveys must be preceded by climatic conditions such that the likelihood of the subject species being identifiable is maximised. The subject area will be “spelled” from grazing for a period no less than one month prior to the survey.	Section 4 Appendices I & J
1.11	Any areas that may act as corridors or habitat links between the subject site and adjacent areas of likely habitat for subject species shall be identified and described.	Section 5.4 – 5.5
1.12	A full list of the flora and fauna found during the course of surveys shall be included. Such information is indicative of the habitat quality of the site.	Appendices A & B
1.13	The effect of the season and weather shall be considered with respect to the results of the survey.	Sections 4.2 – 4.3
1.14	The methodology of surveys is the responsibility of the consultant and as stated in 1.12 above must be fully documented in the SIS. Suggested methodologies for certain aspects of the field survey are: - the subject site should be stratified to reflect natural variation across the area and the intensity of direct and indirect effects as a result of the proposed development. - a map of the attributes (e.g. vegetation) used to stratify the subject site should be included. - each unit of land delineated by the stratification should be sampled for flora and fauna. - survey effort should be concentrated on, but not restricted to, those areas likely to be most impacted on by direct and indirect effects of the development. The <i>Interim Guidelines for Targetted and General Flora and Fauna Surveys under the Native Vegetation Conservation Act 1997</i> (DLWC 1999) provide a guide as to the minimum survey effort required.	Section 4.6 Figure 1.1, 5.2 5.1 Table 4.2 & Appendices I & J Table 4.2 & Appendices I & J Table 4.2 & 4.3

Section	Issue	Location in report
<i>The habitat of threatened species</i>		
1.15	The location of any threatened species recorded during the SIS survey shall be represented on a map of the study area.	Figure 5.3 & Appendix K
1.16	A description of the habitats occupied within the region by each of the subject species should be provided. This description should include not only floristic and structural information but also information on the condition of the habitats.	Section 2.3 Appendices G & K
1.17	In the same way a description of the habitats occupied within the study area by each of the subject species should be provided. A comparison of the available habitats within the subject site in relation to the region should then be undertaken.	Section 5.5, table 5.6 Appendices G & K
1.18	The habitat of each of the subject species within the study area shall be represented on a map.	Figures 5.1, 5.2, 5.3
1.19	An effort should be made to determine the distribution of the local population of each threatened species recorded from the study area. Targeted surveys within the locality may be necessary to adequately assess the distribution of a local population.	Appendices G & K
1.20	The condition of the habitats should be determined, described and recorded (e.g. structural complexity of the vegetation, evidence of grazing/browsing damage, presence of flora species susceptible to grazing, fire history). The condition and regional distribution of similar habitats outside the study area should also be recorded.	Appendices G & K
<i>Matters of social and economic impact</i>		
1.21	The economic costs likely to be incurred and the benefits likely to accrue to the proponent as a result of this development shall be addressed in the SIS. This shall include a discussion of the sensitivity of the analysis to any assumptions made in the calculation of the benefits/costs.	Section 9
1.22	An evaluation of the social consequences of the development shall be carried out. This will consider who gains and who loses from the action and where those people are located (i.e. distributional considerations). Social impacts may include those that affect the net welfare of society and those that impact on the individual or group. With respect to the proponent, this analysis may require consideration of the management of other lands under his control.	Section 9
<i>Matters of ecologically sustainable development</i>		
1.23	The principles of ecologically sustainable development are described in Section 6(2) of the <i>Protection of the Environment Administration Act 1991</i> . The SIS must seek to demonstrate how this development satisfies these principles or how the development could be modified to address these principles.	Section 10
1.24	The regional context of the effects of this development on the ESD principles (i.e. off-site must also be considered).	Sections 9 & 10

Section	Issue	Location in report
2. Assessment of likely impacts		
The assessment matters listed below shall be addressed:		
2.1	For all subject species, the SIS shall state the following: - the location, nature and extent of habitat removal or modification which may result from the proposed action; - the potential impact of the removal of habitat on the species, population or ecological community; and - the likely contribution of the proposed action to the threatening processes acting on populations of those species in the locality. - measures proposed to ameliorate the impacts of the proposal.	Section 6.2 & Table 6.1 Section 7 & Appendix G Sections 6.2 & 7 & Appendix G Section 8
2.2	A discussion of other populations of subject species in the region shall be provided. The long-term security of the other habitats shall be examined as part of this discussion. The relative significance of the subject site for subject species in the local context shall be provided.	Section 6.2, 7 & Appendix G
2.3	If movement corridors for subject species are present within the subject site, the impact of the proposal on these areas shall be discussed.	Sections 6.2 & 7
2.4	Where an Approved Recovery Plan exists for a subject species, discussion shall be provided as to whether the proposal is consistent with the actions and objectives of the plan.	No recovery plan exists for any species which may potentially be affected by the proposed development.
3. Amelioration		
The following issues shall be addressed:		
3.1	In discussing alternatives to the proposal, and the measures proposed to mitigate the effect of the proposal, consideration shall be given to developing long-term management strategies to protect areas within the study area which are of particular importance for the subject species. This may include proposals to restore or improve habitat.	Section 8
3.2	Any proposed on-going monitoring of the effectiveness of the mitigation measures shall be provided.	Section 8
4. Additional Information		
4.1	In providing a list of other approvals the following shall be included; - any consent required under Part 4 of the <i>EP&A Act 1979</i> including the name of the consent authority and when it is proposed to make the development application; or - any approvals required under Part 5 of the <i>EP&A Act 1979</i> including the name of the determining authority(ies), the basis for the approval and when these approvals are proposed to be obtained.	Section 1.4 Section 1.4

Table 1.2. Compliance with the requirements of the TSC Act 1995

Section	Issue	Location in report
109	Form of species impact statements	
1.	A species impact statement must be in writing.	Compliance certification inserted at front of document.
2.	A species impact statement must be signed by the principal author of the statement and by: (a) the applicant for the licence, or (b) if the species impact statement is prepared for the purposes of the Environmental Planning and Assessment Act 1979, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires).	
110	Content of species impact statements	
1.	A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout and, to the fullest extent reasonably practicable, the information referred to in this section.	Section 3
2.	A species impact statement must include the following information as to threatened species and populations:	
(a)	a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action,	Section 5 Appendices F & G
(b)	an assessment of which threatened species or populations known or likely to be present in the area are likely to be affected by the action,	Section 5
(c)	for each species or population likely to be affected, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or threat abatement plan applying to it,	Section 7 Not applicable
(d)	an estimate of the local and regional abundance of those species or populations,	Appendices F, G & K Not applicable
(e)	a general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action,	
(f)	a full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region,	Sections 2 & 5 Appendix F, G & K
(g)	a full assessment of the likely effect of the action on those species and populations, including, if possible, the quantitative effect of local populations in the cumulative effect in the region,	Not applicable
(h)	a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development,	Section 8
(i)	a full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations, including a compilation (in a single section of the statement) of those measures,	Section 8
(j)	a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population.	Section 1.4

Section	Issue	Location in report
3.	A species impact statement must include the following information as to ecological communities: (a) a general description of the ecological community present in the area that is the subject of the action and in any area that is likely to be affected by the action, (b) for each ecological community present, details of its local, regional and State-wide conservation status, the key threatening processes generally affecting it, its habitat requirements and any recovery plan or any threat abatement plan applying to it, (c) a full description of the type, location, size and condition of the habitat of the ecological community and details of the distribution and condition of similar habitats in the region, (d) a full assessment of the likely effect of the action on the ecological community, including, if possible, the quantitative effect of local populations in the cumulative effect in the region, (e) a description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development, (f) a full description and justification of the measures proposed to mitigate any adverse effect of the action on the ecological community, including a compilation (in a single section of the statement) of those measures, (g) a list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the ecological community.	No ecological community was relevant to this assessment process
4.	A species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement.	Appendix O
5.	The requirements of subsections (2) and (3) in relation to information concerning the State-wide conservation status of any species or population, or any ecological community, are taken to be satisfied by the information in that regard supplied to the principal author of the species impact statement by the National Parks and Wildlife Service, which information that Service is by this subsection authorised and required to provide.	Appendix G

2. STUDY AREA, LOCALITY & REGIONAL CONTEXT

This section provides a description of the environmental context in which the proposed development would occur. The biophysical, built environment and climate characteristics of the subject site, study area and locality will be discussed. The study area will also be discussed in terms of its regional context in relation the International Biogeographical Regions of Australia (IBRA).

2.1. SUBJECT SITE

The subject site is located via Tharbogang, off Hillside Drive, approximately 8 km north-west of Griffith and encompasses a total area of 124 ha (refer to Figure 2.1). This area includes lot 280 DP44532 (0.1477 ha), lot portion 202 DP756035 (122 ha) and additional crown land boundary adjustment for a roadway (1.778 ha). The area numbers assigned to the current features of the subject site are discussed further in Section 3.1. The subject site currently features:

- § a hard rock quarry, covering an area of approximately 6.9 ha adjacent to the existing landfill. The quarrying operation involves the extraction of rock to produce road and pavement materials for the GCC (Area 3);
- § a speedway complex covering approximately 12 ha in the south-eastern part of the subject site, including a race circuit and other public amenities (included in Area 5);
- § an existing council operated landfill which occupies the central portion of the subject site in a natural gully. The existing landfill covers an area of approximately 11.8 ha, including a public landfill for domestic waste, a leachate retention dam, area for stormwater and sedimentation basin and modified surface drainage (Areas 1 and 2); and
- § a putrescible waste burial site, covering an area of approximately 7.5 ha north of the existing landfill (Area 4); and

The remaining part of the subject site (approximately 85 ha) is well vegetated in the form of native woodland and forest. Previously, naturally occurring gravels were sourced and removed from the majority of this area and, hence, most of the vegetation is predominately natural regeneration (proposed Areas 6, 7, 8 & 9).

The subject site is predominately located on a north-easterly orientated slope with the western boundary following the western ridge line of the McPherson Range. Natural surface drainage of the site occurs as sheet flows in the upper slope areas accumulating in a series of ephemeral gullies and drainage depressions, eventually discharging into the Tharbogang Swamp during peak flows (Coffey 2000). A natural gully traverses the centre of the subject site (current landfill site, Areas 1 & 2). Natural surface drainage has been modified around the landfill to minimise stormwater drainage flows from entering the landfill areas and the leachate control system (Coffey 2000).

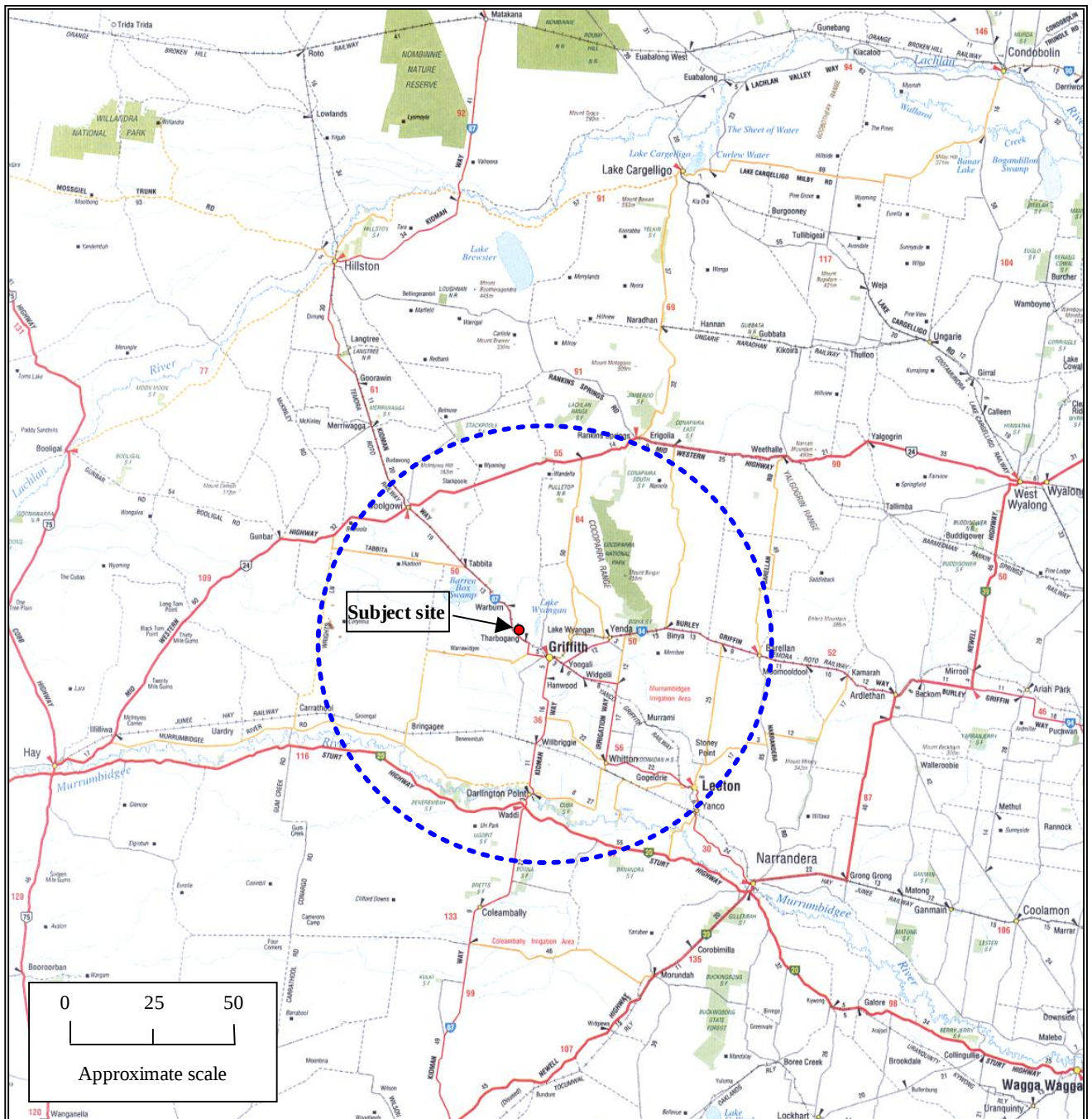


Figure 2.1. Griffith locality map.

Broken line represents the 'locality' of the subject site.

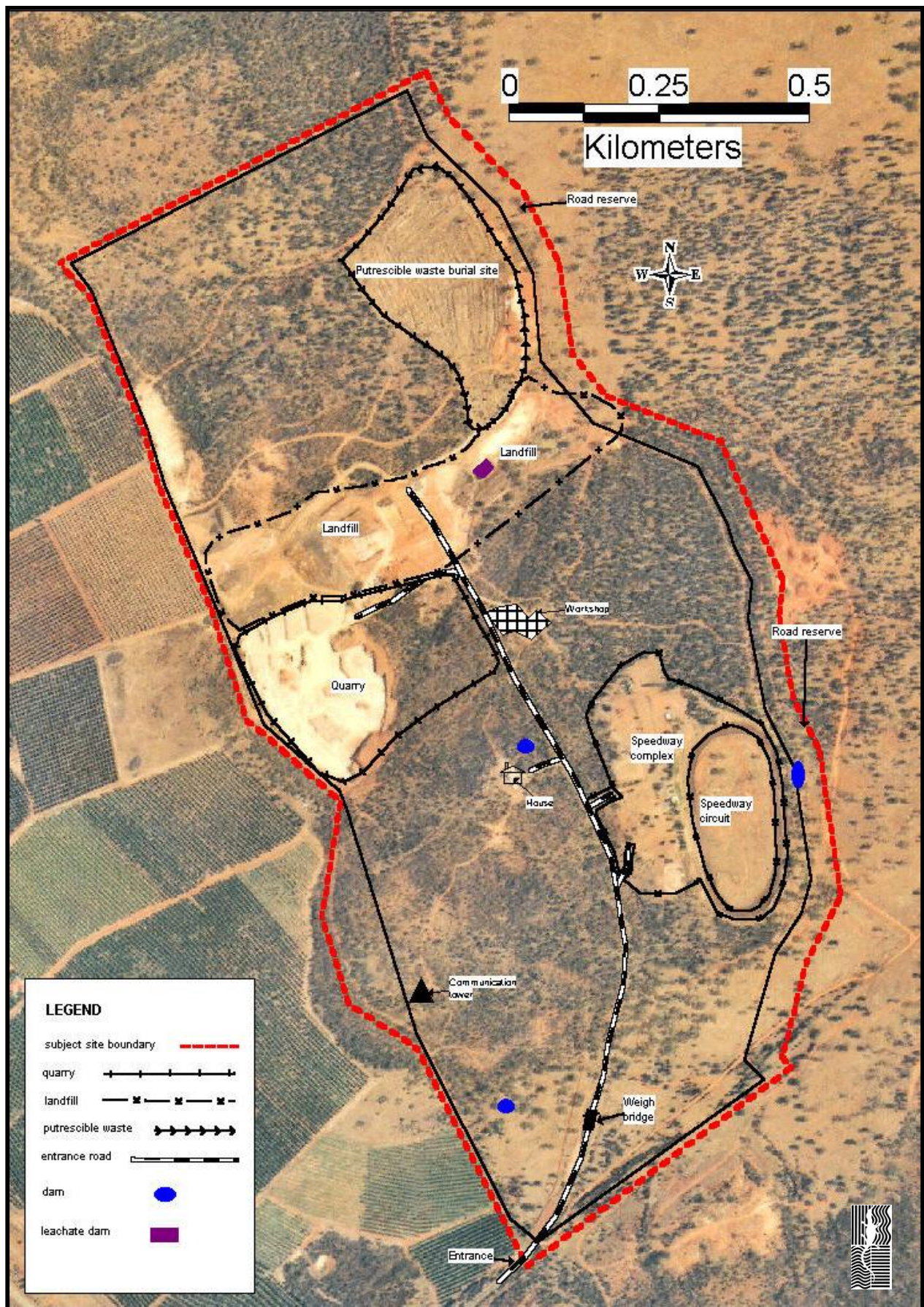


Figure 2.2 Aerial photograph of the subject site with main features.

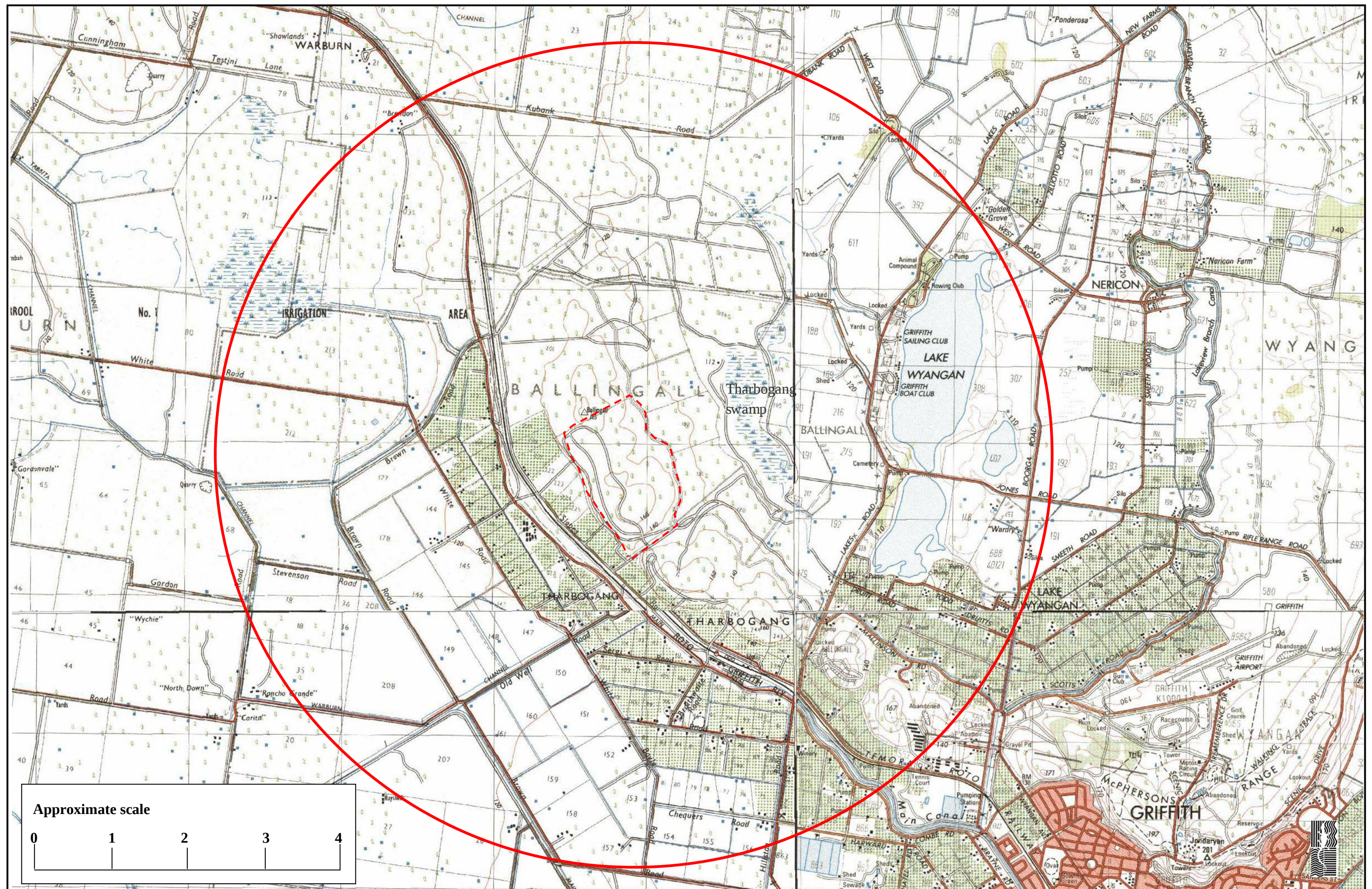


Figure 2.3 Topographic map of subject site and study area. Broken line represents subject site. Circle represents approximate extent of study area.

Map sourced from 1:50 000 scale topographical map.

The natural vegetation of the subject site has been modified by the operations of the landfill, speedway, putrescible waste dump, the existing quarry and the past removal of surface gravels. The vegetation of the subject site comprises a mixture of woodland and forest vegetation types, consisting of remnant vegetation and natural regrowth. Ground cover consists of a mixture of native and introduced species, with introduced species dominating around the immediate tip area. Vegetation of the subject site will be discussed in greater detail in Section 5.3.

The council operated landfill occupies the central portion of the subject site and has been developed in a natural, northerly sloping gully. This area also contains a leachate retention dam and modified surface drainage. The waste depot infrastructure consists of a caretaker's cottage, a plant garage and amenities.

The existing rock quarry is located between the landfill and western boundary. The current operation includes drilling and blasting to extract materials, and crushing and screening to produce road and pavement materials for the GCC.

The speedway complex is located in the south-eastern portion of the site, including a race circuit, canteen, public amenities, miscellaneous garages and shelters. This area also includes native regrowth vegetation and remnant vegetation in the form of mature and old growth Bimble Box, White Cypress Pine and patches of native shrubs and grasses.

The putrescible waste burial area is located north of the existing landfill. This operation has consisted of progressive excavation of trenches as required and then covering the putrescible waste with excavated materials. This section of landfill has been completed and is currently being considered for re-use by GCC (pers comm. Higgins 2002). This section also contains a number of scattered and isolated mature and old growth remnant Bimble Box trees, where many bird species (including the threatened Grey-crowned Babbler) were observed.

2.1.1. Landform and soils

Topographic relief over the subject site ranges from approximately 174 m AHD along the western boundary ridgeline to approximately 128 m along the lower ground at the northern boundary (Coffey 2000).

A program of shallow drilling, conducted across the site in 1996, assessed the nature and thickness of the soil cover over the Devonian basement rocks. These superficial materials generally comprised slope wash and residual sandy clay, clayey sand, gravely sandy clays and clayey sandy gravels ranging in thickness from 0.2 m on the upper hill slopes to 3.0 m in the lower foot slopes where accumulated colluvial deposits are present (Coffey 2000).

2.1.2. Geology and hydrogeology

The Department of Mines Geological Survey of NSW Services identifies the geology of the site as being part of the Griffith Syncline, comprising sandstone and siltstone with conglomerate bands. The geological sequence is Devonian in age and underlies the topographic high forming the McPherson Range, which extends to the north-west of the City of Griffith (Coffey 2000).

Boreholes drilled along the upper ridgeline, along the southern boundary of the site, revealed a lack of groundwater to a depth of at least 18 m in the vicinity of the existing quarry. A lack of groundwater occurrence in the superficial soil materials, to at least 3 m (including the colluvial deposits of the lower slopes) was also recorded (Coffey 2000).

Groundwater flow is expected to generally follow topography and concentrate below surface drainage features. Boreholes drilled to monitor groundwater levels have suggested a north-east dipping hydraulic gradient of approximately 0.04, with groundwater flowing towards the Tharbogang Swamp (Coffey 2000). Although Australian and New Zealand Environment and Conservation Council (ANZECC 1992) Water Quality Guidelines do not generally apply to groundwater, they are considered relevant in this case as the Tharbogang Swamp is likely to be the receiving water body for groundwater from the site (refer to Section 6.2).

2.1.3. Cultural history

The heritage survey carried out by the Griffith Local Aboriginal Land Council during May 2000 advised, “that no evidence of Aboriginal artefacts or sites was discovered during the investigation”.

2.1.4. Disturbance history

Other than the clearing that has been carried out associated with the existing quarry, landfill and speedway the site has been significantly disturbed in the past by sourcing of surficial gravel. Approximately 30% of the subject site was scraped for surficial gravels during the 1940s. The gravels were used for a number of purposes including local road base (pers. comm. Peter Higgins 2002). These areas are now characterised by dense regrowth of White Cypress Pine and Currawang. A discussion of the existing ecological impacts is provided in Section 6.1.

Portions of the site not disturbed by scraping have retained most of their remnant vegetation, including the woodland areas immediately east and west of the weighbridge at the entrance. Many large Bimble Box, White Cypress Pine and some Dwyer’s Mallee Gum remain as isolated scattered remnant trees amongst a forest of regrowth. Apparently, the bulldozers were unable to push these trees over at the time or the area was naturally too rocky (pers comm. Peter Higgins 2002). A more detailed description of the vegetation is provided in Section 5.3. The conservation value of this natural ‘regrowth’ vegetation is considered very important.

It is unclear if the subject site has been grazed. McPherson Range has a long grazing history, with some areas still being grazed. However, because of the current climatic conditions grazing kangaroos have heavily impacted upon the area. Most of the edible grasses and other ground cover plants have been grazed by kangaroos and, to a lesser extent, rabbits, hares and other herbivores.

The subject site, in many areas, is already disturbed mainly as a result of the impacts caused by the existing quarrying and landfill operations. These activities have contributed directly to the reduction and fragmentation of habitat and indirectly to a range of continual disturbances such as changes to the hydrological regimes, increased edge effects and weed infestation. Removal of quarrying material as of 2000 has resulted in the removal of approximately 4 ha of White Cypress Pine/ Currawang regrowth.

Scattered plastic bags and other waste refuse were commonly recorded throughout the site and adjacent private land. Apart from degrading the aesthetic appeal of the native vegetation of the subject site and surrounding area, plastic bags and other materials scattered by wind could potentially pose a threat to wildlife. Considering how long the landfill has been operating and left unchecked in regards to wind blown debris, some native species could have been displaced from the study area.

2.1.5. Zoning of the subject site and surrounding land

The zoning of the subject site and surrounding area was recently changed by the new Griffith Local Environment Plan (Griffith LEP 2002), which has replaced the 1994 LEP. The subject site is zoned 5 (a) special use according to the 2002 LEP. Appendix H contains a map of the 2002 zoning scheme for the subject site and surrounding area and a summary table of the zoning scheme objectives for the subject site and surrounding land.

Since the completion of the EIS at least 10 ha of land adjoining the subject site to the south within the area now zoned 1(b) Rural Agricultural Protection, formerly Rural (General) and 4 ha of land along the boundary of the subject site north of the speedway with area now zoned 1(b) Rural Agricultural Protection, formerly Rural (General) has been cleared of most vegetation (see various aerial photographs in this report).

The majority of land surrounding the subject site, excluding the forestry block immediately north of the site is zoned for rural agricultural protection purposes. The main purpose of this zoning is to preserve areas of high quality agriculture and to permit a range of activities that support the agricultural industries being conducted on the land and limit development that may reduce the agricultural potential of the land. Environmental conservation amongst other forms of development including agriculture, forestry and bushfire hazard reduction are allowed without development consent within this zone.

A strip of land along the western ridgeline of the subject site is zoned 'Environmental Protection – Scenic'. Two of the main objectives of this zoning are to preserve the prominent landforms that contribute to the visual quality of the City and ensure that environmentally sensitive land is appropriately protected from development likely to detrimentally affect its preservation. Development is allowed within this zone only where it can be shown that it will not destroy, damage or compromise the ecological, scenic or scientific attributes of the locality. Only development for the purpose of bushfire prevention is allowed without development consent. The clearing of land, destruction of trees and environmental conservation is allowed with development consent.

The area immediately south of the subject site zoned 'Environmental Protection – Rural' is afforded some protection. The main objectives of this zone are to protect and conserve land within the zone as habitat for diverse species of flora and fauna, encourage protection of native vegetation and establishing and maintaining wildlife corridors and to ensure that rural residential development is integrated with environmental protection. Some agricultural development is allowed within this zone without development consent, however clearing of vegetation and development of dwellings is only allowed with development consent.

It is unclear if the proposed zoning scheme will provide any additional protection to vegetation, associated habitats and general environmental quality of the surrounding area. The land north of the subject site is zoned for forestry purposes and therefore not considered secure. The vegetation east of the subject site could not be considered secure as forms of land clearing and tree removal are allowed within limits without development consent. The proposed environmental scenic protection zone along the western ridgeline is approximately 50 m wide, but probably less and has yet to be secured. The section between the existing quarry and landfill and site boundary is very narrow (less than 15 m and in some places probably less than 10 m) and devoid of most native vegetation. It is unclear if this area is to comprise existing crown land in combination with sections of the subject site and/or adjacent private property.

2.2. STUDY AREA & LOCALITY

The study area is defined as the subject site and any additional area, which is likely to be affected by the proposal, either directly or indirectly. For the purpose of this assessment, the study area includes all land within a 5 km radius of the subject site as defined by Figure 1.1. For the purpose of this section 'locality' is referred to as the Murrumbidgee Irrigation Area (MIA), although it still maintains its same definition.

Griffith is a major town in the (MIA) and service centre for the surrounding orchards and vineyards. Located 613 km west of Sydney via the Great and Mid Western Highways and 131 m above sea-level, Griffith emerged out of the construction of the MIA early this century. With a population of 24,000 it is the third-largest population centre in the Riverina.

The study area incorporates a diversity of land use types including a built environment of agriculture, horticulture, light industry, recreational areas, water storage (lake) and rural and urban residential areas. The study area includes the township of Tharbogang located along Slopes Road approximately 2.5 km south-east of the subject site and north-west fringe area of Griffith city. The natural environment of the study area is very diverse consisting of rangeland (McPherson Range), drainage basin, natural and modified wetland systems (Lake Wyangan wetland system) and contains some of the least modified vegetation and habitat types within the locality and region.

Ten main vegetation types have been identified within the locality. Seven of these vegetation types occur within the study area (GBNEG 2000; Eldridge 2002; WRRVC 2002; ERC *this study*), including:

1. Bimble Box/White Cypress woodland;
2. Dwyer's Mallee Gum/Currawang woodland;
3. Cypress Pine open forest;
4. Boree woodland;
5. Mallee woodland;
6. Wetland/swamp vegetation association; and
7. revegetation.

Bimble Box/White Cypress Pine woodland is the dominant vegetation community (see Figure 5.2). the majority of this vegetation is confined to the gentle slopes and foothill areas of McPherson Range and the basin of the range within the study area.

Dwyer's Mallee Gum/Currawang dominates the steeper slopes and hill crests of McPherson Range. The vegetation and associated habitat types of the study area will be discussed in more detail in Section 5.5.

2.2.1. Climate

The Griffith region is generally hot and dry. Data provided by the Bureau of Meteorology during 1914 – 1989 (the Griffith weather station, site number 075028) suggest a mean daily maximum temperature ranging from 14.3 °C in July to 31.5 °C in January. Mean daily minimum temperature ranges from 2.9 °C in July to 16.4 °C in February. The mean number of 'rain days' ranges from 3.6 in February to 11.0 in July. Mean monthly precipitation is low and variable, ranging from 27.8 mm in February to 41.3 mm in October, and mean annual precipitation of 405.4 mm. Data for the mean monthly evaporation, collected during 1962 to 1989, is highly variable, ranging from 42.0 mm in June to 265.9 mm in December, and mean annual evaporation of 1767.9 mm. The mean annual evaporation is over 4 times greater than the mean annual precipitation (Bureau of Meteorology 1999).

2.2.2. McPherson Range

McPherson Range has significant vegetation and habitat values in the local, regional and even the broader ecosystem context. The vegetation communities of the range, one of the largest areas of remnant vegetation within the Mirrool Irrigation Area, have been recognised as being locally and regionally significant for conservation (Grose and Holics 1995).

McPherson Range is located along the boundary between the Cobar Peneplain Bioregion and Riverina Bioregion (Morgan and Terrey 1992). The conservation significance of native vegetation in boundary areas is increased with remnant vegetation forming a link between bioregions. The significance of this will be further discussed in Section 2.3.

McPherson Range is a small isolated reserve without connection to other fragments of natural ecosystems in the region. Within the range itself, there are already developments that fragment parts of the range, such as roads, residential subdivisions, orange groves and other agricultural land use. Apart from fragmentation of habitat, these developments have also removed habitat area, increased the weed infestation, and increased the risk of mortality of native fauna due to human disturbances.

Scenic Hill comprises the southern most section of the McPherson Range and includes a reservation area (no. 56353) and crown reserve, managed by GCC, of approximately 650 ha. The hill is considered one of the few remaining examples of remnant vegetation in the local region (GBNEG 2000). The conditions of the hill have change considerably since European settlement, with early descriptions suggesting that the area comprised woodlands with a grassy understorey. Heavy grazing pressures, soil compaction, ring barking, scrub clearing, rabbits, anthropogenic disturbances and altered fire regimes have resulted in significant modifications to the Scenic Hill environment and much of the McPherson Range. The prevention of frequent grass fires has enabled the development of shrubs and seed setting. The range is also an important recharge area for the local groundwater systems (GBNEG 2000).

Vegetation of McPherson Range

The general vegetation of McPherson Range is classified as an Open Woodland of Bimble Box and White Cypress Pine association on gentle slopes, while the steeper slopes support a Dwyer's Gum and Currawang association. This vegetation association is also typical of the subject site.

Tree cover occurs over approximately 50% of Scenic Hill, with a projective foliage cover probably less than 10%, and small shrub species occur in dense patches over approximately 20% of the hill (GBNEG 2000). The higher slopes and hillcrest areas contain perennial grasses and forbs, whilst the northern footslopes have a considerable build up of exotic grasses, most probably due to the deeper soils, greater run-on and even past soil disturbances. The rare and endangered Irongrass (*Lomandra patens*) is extensively represented on the hill (GBNEG 2000).

Values and issues

McPherson Range is an important landmark in the Griffith landscape, forming a natural backdrop to the city of Griffith. It is one of the few largely unmodified natural areas within the MIA. The range holds significant environmental, heritage, recreational, scientific and ecological values for the Griffith and broader community.

Fire is probably the most significant issue affecting McPherson Range. However, increasing pressures from urban expansion and competing land uses are becoming more significant. With reductions in occupancy rates and renewed development pressures on the City, including the need for various recreational experiences, there is a risk to the continued preservation of Scenic Hill (GBNEG 2000). Further issues include weed naturalisation, pests, feral animals, erosion, grazing, habitat destruction, vandalism, visitor usage, recreation, access, tourism, and heritage conservation (GBNEG 2000).

2.2.3. Roadside vegetation

There are a number of significant roadside vegetation sites within the study area (see Figure 5.2), particularly those roadsides located along the northern section of the study area (Kubank and West Roads) and Lakes Road that runs north-south along the western edge of Lake Wyangan. The floristics of these areas is described according to McHugh (1998).

Along Kidman Way at Tharbogang the eastern side of the road adjoins a large railway reserve which has good regeneration. The Mallee and Bimble Box/White Cypress Pine woodland vegetation of Kubank and Wests Road is considered to be of high conservation value (Toscan 2000). To the west of this road there is a sandhill with several locally rare mallee species including the Sandhill Bitter-pea, Mallee Rosemary, Slender Rice-flower, Mallee Forget-me-not and Mallee Bush-pea (McHugh 1998).

Lakes Road is an important link between the Lake Wyangan wetland system and McPherson Range. The vegetation along this roadside is considered to have medium and high conservation value (Toscan 2000). Large Bimble Box and White Cypress Pine were recorded at the junction of the road and McPherson Range. Further to the north along the road there is dense Yarran and Miljee regrowth

west of the road and many of the wattle species that are common to this area (McHugh 1998). The majority of remnant vegetation along this stretch of roadside is mallee, yet extensive revegetation along the western edge of Lake Wyangan links the roadside vegetation and the lake. The mallee vegetation gradually becomes denser towards the end of Lakes Road/Wests Road junction.

The Boree and Mallee vegetation communities recorded within the study area have been described according to Eldridge (2002). Neither of these vegetation communities was recorded within the subject site although a few individuals found in these communities were recorded.

2.2.4. Lake Wyangan wetland system

The Lake Wyangan Wetland system accounts for the many of the threatened species recorded within the study area. It is a closed drainage basin with inflows (both natural and irrigation drainage) exceeding natural evapotranspiration rates. The entire system has undergone considerable alteration during the past several decades as the influence of the surrounding agricultural activity, particularly since the introduction of irrigation, has become more pronounced. The area has been subject to a significant rise in the watertable and salinity, with water levels in the two larger lakes not controlled by pumping (MFN 2003). The system consists of six wetlands known as:

- § Lake Wyangan North (North Lake) – largest lake used for recreation purposes;
- § Lake Wyangan South (South Lake) is set-aside as a wildlife refuge. There has been significant revegetation works carried out on the associated lands to the west of the lake;
- § Tharbogang Swamp - an ephemeral wetland currently leased for grazing;
- § Little Swamp - a small ephemeral wetland, on private property, is lightly grazed;
- § Campbell's Swamp; and
- § Nericon Swamp.

The wetlands are of local, national and international conservation significance. Fieldwork done by the Murrumbidgee Field Naturalists (MFN) in co-operation with Birds Australia (RAOU - Murray Darling Basin Water Bird Project) and studies conducted by the NSW NPWS, has demonstrated that Nericon and Campbell's Swamps are of national and international conservation significance and meet the criteria for determining:

- § Internationally Important Wetlands (RAMSAR Sites) - meets criteria 2(b) & 3(b&c);
- § Nationally Important Wetlands - qualifies for listing in "A Directory Important Wetlands in Australia", meets criteria 3,4&5; and
- § Qualifies for recognition as a flyway network site under the "East Asian-Australasian Shorebird Network" (MFN 2003).

2.2.5. Vegetation of the MIA area

A study of the condition and biodiversity of vegetation remnants within the MIA by Eldridge (2002) revealed that remnant vegetation is generally restricted to hills and isolated depressions, or in areas set aside for forestry. East of Barren Box Swamp, intensive irrigation restricts the area of remnants. However, west of Barren Box Swamp, larger areas of native vegetation remain (e.g. McPherson Range). These larger remnants are generally located on soils that are not suitable for agricultural purposes.

Five vegetation communities occurring within the MIA have been identified as of some conservation concern (WRRVMC 2002). Table 2.1 identifies the regional status of these communities and the current extent of each vegetation type.

Table 2.1. Status of vegetation communities within the MIA (source: Eldridge 2002 & WRRVC 2002)

Vegetation community	Locality status (MIA)	Current extent MIA (ha)	Regional status (WRRVMP)	Regional extent (ha)
Bimble Box woodland**	A (considered endangered)	A	Endangered	25,093
Bimble Box-Pine mixed woodland ^{A*}	Endangered	10,829	Well retained	108,739
Boree woodland**	Endangered	794	Endangered	74,518
Rosewood-Belah woodland **	Vulnerable	4220	Depleted	56,681
Blackbox woodland **	Depleted	9997	Depleted	338,145
Mallee woodland **	Depleted	303	Depleted	180,550
Dwyer's Mallee Gum-Currawang*	Well Retained	B	N/A	N/A

Key to table 2.1

Endangered =<10% of pre-European extent remaining, Vulnerable = 10-30% pre-European extent remaining, Depleted = 30-50% of pre-European extent remaining, and Well retained = >50% pre-European extent remains.

A = included in Bimble Box-Pine communities and also includes Dwyer's Mallee Gum communities

B = included in Bimble Box-Pine statistics

* = vegetation community recorded in subject site ** = vegetation community recorded in study area

Figures are based on calculations taken by the GIS unit, Murrumbidgee Irrigation, August 2001 for current extent in MIA and from the WRRVC 2002 for the regional extent.

The MIA encompasses a much greater area than the area defined as the locality within this report.

Chenopod shrubland and Grassland vegetation communities have not yet been mapped as part of this study.

The general vegetation community of the subject site comprises of Bimble Box-Pine community, although this can be further separated within the site itself. A description of this community according to Eldridge (2002) is provided below.

The Bimble Box-Pine community of the MIA region occurs over extensive areas of slightly to gently undulating plains, sand plains, foot-slopes and mid-slopes. The soils are predominantly deep, loamy calcareous earths sometimes with calcareous material at depth. Adjacent to the ranges, soil profiles are dominated by colluvial material eroded from the higher country. In many places, rock outcropping occurs over 5-10% of the site (Eldridge 2002).

The dominant trees in this community are Bimble Box and Cypress Pine. Tree densities range from nil to 2700 trees/ha (mean = 362 trees/ha), reflecting the dense pine regeneration in some areas (Eldridge 2002). Generally, trees are healthy with few infested with Mistletoe, and have an average density of 1.3 hollows per tree. There are few shrub species and shrub cover is very low (Eldridge 2002).

Often bordering the Bimble Box-Pine vegetation communities are areas characterised by rocky hills of Devonian Conglomerate and Sandstone outcrops, covered by dry woodlands often comprising of Cypress Pine, Currawang, Drooping She-oak, Dwyer's Gum and Bimble Box. These often overlap with the Bimble Box-Pine community, providing edges of significant habitat value (Eldridge 2002).

2.3. REGIONAL CONTEXT (RIVERINA AND COBAR PENEPLAIN BIOREGIONS)

For the purpose of this report, region means a biogeographical region that has been recognised and documented such as the Interim Biogeographical Regions of Australia (Thackway and Creswell 1995).

The subject site is located along the western ridge of the McPherson Range, which in turn is located along the boundary between the Cobar Peneplain Bioregion and Riverina Bioregion (Morgan and Terrey 1992). The conservation significance of native vegetation and habitats in boundary areas is increased with remnant vegetation forming a link between bioregions. Areas where biogeographic assemblages intersect are of significant conservation value as they represent areas of high species richness, often across many taxonomic groups (Spector 2002).

2.3.1. Region description

The Riverina Bioregion lies within New South Wales and Victoria, occupying 68,000 square kilometres. It extends from Narrandera in the east to Balranald in the west, and from Bendigo in the south to Ivanhoe in the north. This bioregion encompasses outlying fragments from the Murray Darling Depression Bioregion in the west, and the Victorian Midlands Bioregion in the south. The Riverina Bioregion has been identified as a high priority area for additional conservation assessment and action under the Commonwealth Government's National Reserve System Program (NSW NPWS 2002), as less than one per cent of the bioregion is protected by conservation reserves.

The Cobar Peneplain Bioregion lies within the Central West of New South Wales, occupying over 73,000 square kilometres, or approximately one-tenth of the area of New South Wales. It includes parts of the Western and Central Divisions, extending from near Bourke in the north, through to Griffith in the south, and includes the towns of Cobar, Nyngan, Condobolin, and Lake Cargelligo. The Cobar Peneplain Bioregion has been identified as a high priority area for additional conservation assessment and action under the Commonwealth Government's National Reserve System Program (NSW NPWS 2002), as less than five per cent of the bioregion is protected by conservation reserves.

Approximately 28% of the woody native vegetation within the Riverina Bioregion has been cleared since European settlement. The Cobar Peneplain Bioregion has also suffered substantial vegetation

losses, with 33% of the woody native vegetation cleared since European settlement. Current annual clearing rates for the Cobar Peneplain Bioregion are much higher (13,000 ha/year) compared to the Riverina Bioregion (5,800 ha/year) (SOE 2000).

2.3.2. Vegetation

The most threatened vegetation types within the Riverina Bioregion have been identified as: native grasslands, Chenopod shrublands, Myall woodlands, Grey Box woodlands, Black Box woodlands, Callitris mixed woodlands (including Yellow Box and Belah/Rosewood), riparian and wetlands. Bimble Box woodlands and the Belah/Rosewood and Leopardwood communities have been identified as the most threatened vegetation types within the Cobar Peneplain Bioregion (Benson 1999).

Five major vegetation associations have been identified within the Riverina Bioregion (ANRA 2002): Grey Box, River Red Gum, Black Box, Bimble Box and White Cypress Pine complex; mallee and Belah/Rosewood woodland communities; Bladder Saltbush and Black Bluebush shrublands; native grasslands; and wetlands. The generally treeless plains communities of Bladder Saltbush and Black Bluebush, and native grasslands dominate and provide the characterisation of this bioregion.

Eucalypt and Pine woodlands consist of four main communities:

1. Grey Box (*Eucalyptus microcarpa*) dominated communities occur on level to undulating country on the red-brown earths. The groundcover generally consists of perennial grasses such as Whitetop (*Danthonia caespitosa*), together with annual and perennial forbs;
2. River Red Gum (*E. camaldulensis*) communities occur along the rivers and creeks and where the watertable is high enough to saturate the root zone. A variety of groundcover occurs including grasses, sedges and forbs as well as low shrubs such as Ruby Saltbush (*Enchylaena tomentosa*);
3. Black Box (*E. largiflorens*) communities are found on the grey clay soils associated with watercourses and depressions that experience less inundation than those with River Red Gum; and
4. Bimble Box (*E. populnea*) and White Cypress Pine (*Callitris glaucophylla*) communities are found on the red earths and red-brown earths particularly in the north east of the bioregion.

The Cobar Peneplain Bioregion has a number of distinct vegetation communities (ANRA 2002). The northern areas of the region (south of the Darling River) are characterised by open woodlands and woodlands of Bimble Box. The more arid Bimble Box / Red Box (*Eucalyptus intertexta*) woodlands form communities with mulga (*Acacia aneura*).

The arid north-western parts of the bioregion are dominated extensively by mulga communities, interspersed with Bimble Box along the lowlands. Horse Mulga (*Acacia ramulosa*) and Belah-Rosewood (*Casuarina pauper* - *Alectryon oleifolius*) communities occur along the north-western bioregional boundary.

The ridges and low rises in the central-south eastern parts of the region are characterised by White Cypress Pine (*Callitris glaucophylla*) communities, often in conjunction with Red Box on the rises and Bimble Box on the flats. The White Cypress Pine often develops into dense stands of 'whipstick' regrowth. Mallee communities occupy many of the rocky hills and ridges throughout the region.

South of the Lachlan River, the vegetation communities are comparatively complex when compared to those of the northern parts. The south is typically dominated by Grey Box (*Eucalyptus microcarpa*), which blends with White Box (*Eucalyptus conica*) towards the east. Mugga Ironbark (*Eucalyptus sideroxylon*) occurs on the stony ridge-tops.

2.3.3. Fauna

The Riverina Bioregion contains a rich and diverse fauna. There are a variety of habitats due to the combination of grasslands, shrublands woodlands and wetlands in close proximity in a relatively fertile region. The area was considered highly desirable for agriculture and the changed circumstances that have occurred means that many of the original fauna can no longer be found in the bioregion. Twelve species of plants and forty-six species of birds and mammals listed as threatened under the *TSC Act 1995* have been identified in this bioregion. The Plains-wanderer (*Pedionomus torquatus*) is an example of one of the threatened fauna species. It was once widespread but now has its core distribution within the bioregion (ANRA 2002).

The diverse landscape and vegetation of the Cobar Penepplain Bioregion supports a wide variety of fauna species. Of the 658 vertebrate fauna species identified in the Western Zone of New South Wales, some 405 have been recorded within this bioregion. Thirty-six vulnerable and seven endangered fauna species occur within the bioregion. An additional sixty-four birds, twelve mammals, twenty-three reptiles and eight frogs are of conservation concern because they are declining, or locally extinct within the bioregion (ANRA 2002).

Birds dependent on woodlands are threatened throughout this bioregion because of land clearing, habitat change such as woody weed invasion and grazing. The Pink Cockatoo (*Cacatua leadbeateri*), the Turquoise Parrot (*Neophema pulchella*) and the Painted Honeyeater (*Grantiella picta*) are significantly threatened by the loss of Bimble Box and White Cypress Pine (*Callitris glaucophylla*) woodlands. Other species of threatened birds are the Striated Grasswren (*Amytornis striatus*), the Shy Heathwren (*Hylacola cauta*), the Pied Honeyeater (*Grantiella picta*), the Southern Scrub-robin (*Drymodes brunneopygia*), the Red-lored Whistler (*Pachycephala rufogularis*), Gilbert's Whistler (*Pachycephala inornata*), the Masked Owl (*Tyto novaehollandiae*), the Swift Parrot (*Lathamus discolor*) and the Superb Parrot (*Polytelis swainsonii*).

The Kultarr (*Antechinomys laniger*) has declined markedly in this bioregion. Other species that have declined are the Koala (*Phascolarctos cinereus*), the Southern Bell Frog (*Litoria raniformis*), the Narrow-banded Snake (*Simoselaps fasciolatus*), the Stripe-faced Dunnart (*Sminthopsis macroura*), the Brush-tailed Rock-wallaby (*Petrogale penicillata*) and the Greater Long-eared Bat (*Nyctophilus timoriensis*).

2.3.4. Biodiversity loss & land degradation issues

Within the Riverina Bioregion the major causes of land degradation are over-grazing, river water quality decline and increased salinity, which have resulted from the extensive development of irrigation districts within the bioregion. Extensive clearing of native vegetation has also occurred. This does not only involve tree clearing but also includes the clearing of shrublands and grasslands.

Some water erosion does occur in the eastern parts of the bioregion. Soil structure decline is a problem on the extensive dryland cropping areas and these require appropriate management (ANRA 2002).

Clearing controls on the leasehold Western Division lands has resulted in less clearing of native vegetation on the rangelands portion of the Cobar Peneplain Bioregion than has occurred elsewhere in New South Wales. However, a number of applications to clear for cropping are approved which may result in blocks of cleared country referred to as window-pane clearing. Grazing is extensive and, whilst many woodland communities have intact over-storey vegetation, the under-storeys may often be non-existent. Soil structure decline and erosion are significant problems in both Divisions, particularly in the north-west, where sheet erosion and gullyng are common (ANRA 2002).

2.3.5. Western Riverina Regional Vegetation Management Plan

The Western Riverina Regional Vegetation Management Plan (WRRVMP) (WRRVC 2002) applies to the study area as it falls within the Griffith Local Government Area and does not come under any of the sections of land excluded from the plan (Section A1.2 land excluded from the plan). Although still in draft form the proposed development and associated activities should aim to comply with the specific aims and associated objectives of the plan.

The plan aims to maintain, enhance and restore a comprehensive network of native vegetation across the Region, in order to maximise biodiversity conservation for this and future generations, and to provide for continued rural business development in an environmentally sustainable manner. More specifically, aims 1 & 2 of the plan are most relevant to the proposed development and vegetation of the study area:

Aim 1. To maintain and improve the quality and extent of native vegetation in the region.

Objectives

- 1.1. Build awareness in the community about the importance of healthy and diverse native vegetation in ensuring ecological sustainability.
- 1.2. Assess the current status of native vegetation and the likely changes since European settlement.
- 1.3. The protection and management of existing native vegetation.
- 1.4. To revegetate appropriate areas with suitable species of locally native vegetation.

Aim 2. Ensure the protection of native vegetation, especially that of high conservation value, significant habitat or cultural significance.

Objectives

- 2.1. The protection of native vegetation.
- 2.2. Protect areas of high conservation value.
- 2.3. Protect areas of cultural significance.
- 2.4. Protect areas of significant habitat, including that for threatened species (source: WRRVC 2002).

Conservation, revegetation and clearing targets are utilised in the WRRVMP to assist in meeting the above aims and objectives. These targets are defined in terms of quantity, and timeframe and will form the basis for monitoring the outcomes of the entire plan.

Objectives of the targets (source: WRRVC 2002):

- a) Use management, regeneration and revegetation to increase the area and quality of native vegetation.
- b) Manage each vegetation type according to its current status (refer to Table 2.1)
- Regionally restricted – no loss;
 - Regionally endangered or vulnerable – net gain; and
 - Regionally depleted or well retained – no net loss.

Targets for the Western Riverina (source: WRRVC 2002):

1. All areas of high conservation will be managed for conservation by 2012.
2. Depleted and well-retained vegetation types will have a *minimum* of 30% of the area of pre-European distribution managed for conservation by 2012.
3. Using regeneration and revegetation, all regionally restricted, endangered and vulnerable vegetation types will be restored to 10% of their pre-European distribution by 2012 and to 30% of their pre-European distribution by 2032.
4. Manage for conservation all culturally significant vegetation inclusive of and within the immediate vicinity of a cultural heritage site by 2012.
5. 15% of native grasslands (including where they exist as a structural component of existing vegetation types) will be managed for conservation by 2012.
6. Increase the quality and habitat value of mapped wetlands throughout the Region with management focused primarily on conservation and ensuring successful ecosystem functioning, by 2012.

It is the responsibility of the GCC to ensure that the proposed development complies with the aims and targets set by the WRRVMP for the native vegetation within the subject site.

3. PROPOSED DEVELOPMENT

This section provides a description of the proposed development including information about the nature, duration and timing of the proposed activities of the development.

3.1. NATURE, DURATION AND TIMING OF THE PROPOSED DEVELOPMENT

The subject site, as previously mentioned, encompasses a total area of 124 ha and includes lot 280 DP44532 (0.1477 ha), lot portion 202 DP756035 (122 ha) and additional crown land boundary adjustment for a roadway (1.778 ha) running along the eastern boundary of the subject site. It currently features within an area of 39 ha: an existing hard rock quarry, speedway complex, existing council landfill operations, waste depot with caretaker cottage and putrescible waste burial area. The remaining land, approximately 85 ha, consists predominantly of natural vegetation.

It is proposed that the development be implemented in 11 separate stages and anticipated to operate for 50 years. GCC wishes to obtain an overall approval for extension of the quarry and the landfill to meet Council's needs for the next 40 to 50 years based upon estimates obtained from the GCC Landfill Environmental Management Plan (Griffith LEMP 1995). Council currently requires 50,000 to 80,000 tonnes of gravel per year and needs approximately 30,000m³ for landfill space. The development will be ongoing, operating throughout each of the fifty years, encompassing all seasons.

The subject site has been broken up into nine separate areas, each discussed below in regards to their nature, timing and area. An estimate of the extent of vegetation removal and modification of habitat will be given during each sequence of the proposed development in Section 3.2. Figure 3.1 portrays each of the nine areas in relation to the sequence of activities of the proposed development and vegetation of the subject site. The proposed development area is based upon the footprint deigned by SMEC Australia (2001) for GCC. A copy of the development brief proposed by GCC and SMEC Australia (2001) is provided in Appendix E.

The nine separate areas will be used for the following activities:

- Area 1.** Existing landfill footprint (9 ha)
- Area 2.** Area for Stormwater and Sedimentation Basins (includes possible landfill) (2.8 ha)
- Area 3.** Existing approved quarry (6.9 ha)
- Area 4.** Past landfill for putrescible waste (may be reworked) (7.5 ha)
- Area 5.** Landfill (includes existing speedway) (28.5 ha)
- Area 6.** Quarry and landfill (15.1 ha)
- Area 7.** Quarry and landfill (20.4 ha)
- Area 8.** Recycling depot and access corridor (4.5 ha)
- Area 9.** Buffer and reserve areas (27.8 ha).

GCC have expressed that the development sequence may change over time, as each new section will be considered as a separate application under Part 5 of the *EP&A Act 1979*. Table 3.1 provides a summary of the proposed sequence of activities.

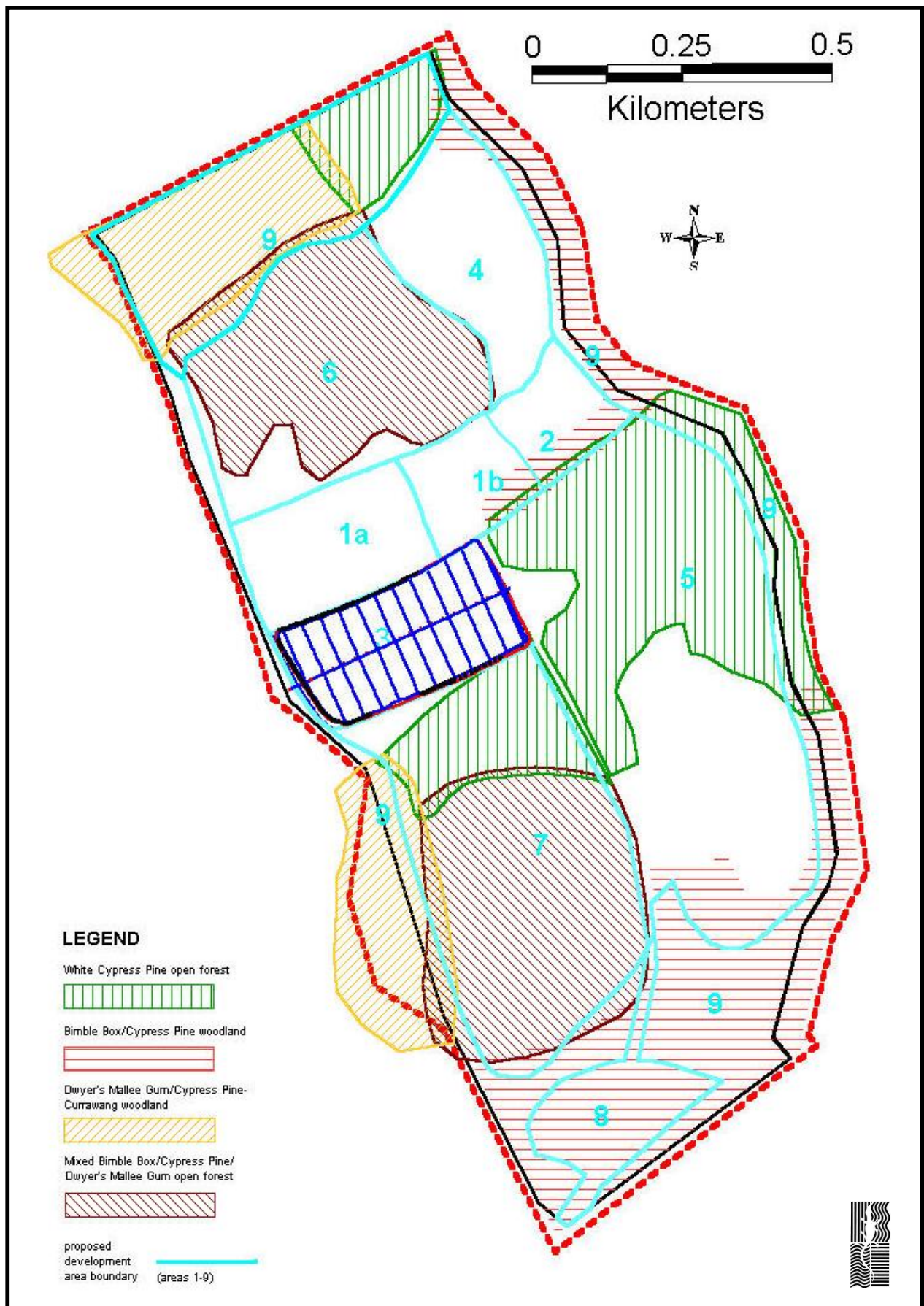


Figure 3.1. Proposed development area boundaries and vegetation of the subject site

Table 3.1. Proposed sequence of activities and nature of each activity.

No.	Nature of proposed activity
1.	Complete Landfill Area 1 to final design levels. Maintain security fence and service track around whole property. Design and complete sedimentation and stormwater basins, including landscape vegetation of Part Area 2 in 50 metre wide corridor. Continue quarrying in Area 3. It is proposed that activities 1 to 5 will commence upon approval and take place over approximately 7 to 10 years (between 2003 to 2010) depending upon the yield of suitable gravel and waste reduction and recycling methods.
2.	Extend a vegetation corridor 30 metres wide from the north-eastern boundary fence across the bottom of Area 4. Commence rehabilitation of Area 1. Develop Recycling facilities Area 8.
3.	Rework remainder of Area 4 as a landfill.
4.	Complete quarry in Area 3 and commence quarry operations in Area 6.
5.	Commence lining and landfill operations in Area 3. Rehabilitate Area 4.
6.	Commence quarry operations in Area 7. Commence rehabilitation of Area 3. Activities 6 and 7 will take approximately another 10 years from 2010 to 2020.
7.	Landfill Area 6.
8.	Landfill Area 7. Rehabilitate Area 6. Activities 8 to 10 will take 15 to 20 years to complete from 2020 to 2040.
9.	Rehabilitate Area 7. Landfill Area 5.
10.	Rehabilitate Area 5 and restore, remove or reuse recycling facilities in Area 8. Clean up of whole site.
11.	Monitor site. Restoration of the site and monitoring of the completed landfill will continue for approximately 20 years from 2040 to 2060.

Six dams will be constructed within the subject site. Three of these dams will account for stormwater flows, and act to minimise the risk of clay and particulate material being washed into surface drainage off site and provide water for fire fighting. The three remaining dams will allow for the drainage of leachate, collected from leachate drains which will run from the base of the landfill cells (Coffey 2000).

Leachate drains will be developed over the site to gravity feed leachate to the catchment dams where it can be treated. Temporary cut off drains and/or diversion banks will be constructed across the landfill site to divert surface water run-off away from the active tipping face. Stormwater diversion drains will be constructed around the perimeter of the site and directed into natural drainage gullies (Coffey 2000).

All weather access roads shall be constructed within the subject site. A minor road network is to be constructed within the subject site, running within the proposed landscape buffer zones. A 20 meter wide landscaped buffer zone will be developed around the entire landfill site (this corridor is to be included within the proposed vegetation corridors as discussed in Section 8.2 of this report). This will improve the aesthetic appeal of the site. It is assumed that this buffer zone will consist of vegetation planted during the proposed development and not existing vegetation (Coffey 2000).

According to Coffey (2000), there is an anticipated shortfall of clay on the site (approximately 236,887 m³) for the lining of the landfills. It is anticipated that this clay will be imported from an off site source. A portion of the existing speedway site will also be excavated for daily cover and final capping material until the current sublease expires.

It has been proposed in the EIS that in order to minimise the impacts of the future landfill operation the following procedures are to be implemented:

- § Forward tree planting along the north-eastern boundary to visually screen the area and reduce the impact of wind from that direction;
- § Progressive revegetation of the landfill as it is filled and capped to its design limits;
- § Progressive daily covering of the landfill to minimise the exposure of the waste which will reduce odours, airborne litter and the activities of vermin; and
- § Tree and vegetation planting along designated drainage lines to reduce erosion and improve the amenity of the area.

3.2. SITE REHABILITATION

3.2.1. Site rehabilitation process proposed in EIS (2000)

The site rehabilitation process and associated activities as proposed by Coffey (2000) is provided below. As part of the rehabilitation process, revegetation and restoration works will be progressively carried out as each landfill stage has been filled and capped to its acceptable capacity. Rehabilitation works will also continue after each of the stage of the development has been completed.

The EIS proposes that rehabilitation of the site will need to follow the guidelines as set out in the Griffith LEMP (1995). In summary rehabilitation will involve the following:

- § submission to the EPA for approval of the final contour plan of the site and capping design before undertaking rehabilitation works;
- § construction of a clay cap over the landfill site to prevent the infiltration of water into waste and including sand, venting gas pipe, topsoil and seed;
- § construction of appropriate diversion drainage to direct stormwater run-off away from the site; and
- § post closure care of the site will involve the following:
 - landfill gas monitoring (if cracks appear in the clay cap);
 - leachate collection (to continue five years post closure and review); and
 - groundwater monitoring and water quality testing until the landfill poses no threat to the groundwater quality.

Prior to clearing of native vegetation from proposed landfill areas an audit of vegetation species and density should be carried out in a representative area. This will allow final revegetation of the areas after completion of landfill works to be carried out with a balance of indigenous vegetation which will also encourage, over time native fauna (Coffey 2000).

Ground surfaces that have been disturbed during the development of the site and which will not be included in the final rehabilitation for three months or more should be topsoiled and revegetated with native grasses to minimise wind and water erosion. Areas of final level landfill that have been capped and topsoiled should be cultivated with native grasses as soon as possible to reduce erosion, improve site amenity and to reduce water infiltration into the fill. Native grass species should reflect those determined from the initial flora audit of the area and should be sown and maintained in accordance with advice from the local DLWC office (Coffey 2000).

Tree and shrub planting will be progressively carried out over the site as areas have deemed to have stabilised in terms of settlement and gas venting. Tree and shrub species and densities will be planted similar to that established in the initial flora audit and again in consultation with the local DLWC office (Coffey 2000). The final site rehabilitation will flow on from the ongoing rehabilitation program and will include areas other than the landfill such as roads, drains, dams and works areas (Coffey 2000).

3.2.2. Site rehabilitation process proposed by SMEC (2001)

The site rehabilitation process does differ in some respects to the original process proposed in the EIS. The ‘Tharbogang Landfill Design Variations Report’ produced by SMEC (2001) recognises that it is difficult to establish trees on completed landfill surfaces due to the generally arid conditions that develop and the necessity to provide long term watering.

SMEC have proposed that a locally wooded area will be included down portions of the centre of the “valley” area shown on the final landform, above Stages 1 and 2 (Areas 1 and 2, Figure 3.1 of this report), to improve the visual amenity adjoining the natural “saddle” (depression) in the southern natural ridge feature. This will require deepening the final cover in these areas by at least 1 m and the provision of a gas/interception diversion blanket to prevent oxygen being displaced from the growing medium. The remainder of the site will be planted with suitable shrubs, established near the site (SMEC 2001).

No site rehabilitation plans have been provided to display the proposed areas described above in the SMEC (2001) design variation report.

4. ASSESSMENT METHODOLOGY

This section summarises the methods used for flora and fauna surveys, mapping and data interpretation in providing data for the assessment of impacts on subject species. Flora and fauna surveys were conducted pursuant to Sections 1.9 – 1.14 subject species survey methods of the Director General’s requirements.

A general flora and fauna survey and targeted survey for all subject species was conducted at the subject site, with particular reference to subject species and subject species habitat. A full description of the methodologies used to survey habitat types and flora and fauna including survey techniques, effort and survey sites is provided.

The surveys were conducted by suitably qualified persons with prior knowledge of the subject site and surrounding area. Qualifications of the consultant including licence details are provided in Appendix O. Assessment of the potential impacts, the significance of such impacts on subject species, proposed alternatives and impact amelioration are provided in subsequent sections based on the results provided by the flora, fauna and habitat assessment of the study area.

4.1. SELECTION OF SUBJECT SPECIES

The Director-General’s Requirements requested that thirty-five threatened fauna, nine threatened flora, one endangered population and one endangered ecological community be considered for inclusion as subject species. Additional threatened species were investigated from a review of relevant databases and other sources (e.g. NSW NPWS Wildlife Atlas). A list of threatened species and their conservation status was compiled from this review and, as a result, five additional threatened species were found to occur within the Griffith region. The findings of the review are summarised in Appendix F.

The Griffith region contains known habitat for numerous threatened species, however, only a subset of these are likely to reside or utilise the habitats of the study area. In assessing which of the species, populations and communities listed in Appendix F will be determined as subject species, the following criteria was applied:

- § Has the species been recorded in the study area within the last 10 years?
- § Does the subject site support known or potentially suitable habitat required by the species?
- § Does the study area support known or potentially suitable habitat required by the species?
- § Is the species likely to occur within the study area on other than a transitory basis (fauna only)?

The White-browed Treecreeper population within the Griffith LGA was preliminary listed as an ‘endangered population’ and subsequently received a final determination as an ‘endangered population’ under Part 3 of Schedule 1 of the *TSC Act 1995*. This population was therefore considered a subject species as part of this SIS.

4.2. TIME FRAME AND POTENTIAL LIMITATIONS

Flora and fauna surveys were conducted by ERC during 28th October – 3rd of November 2002, in mid spring. Section 1.10 of the Director-General's requirements states that "surveys should be undertaken during seasons and climatic conditions during which the subject species are most likely to be detected. Flora surveys will be conducted in the spring and surveys must be proceeded by climatic conditions such that the likelihood of the subject species being identifiable is maximised. The subject area will be "spelled" from grazing for a period no less than one month prior to the survey".

The survey was completed within the general period considered to be the optimum time of the year (spring) to conduct flora and fauna assessment, particularly for native flora and taking the range of subject species to be assessed into consideration. However, the ongoing drought conditions have adversely affected the ability to detect many species of fauna and the majority of flora, particularly native ground cover species.

A number of fauna groups are also affected by adverse weather conditions. These groups include amphibians, reptiles, some birds and small mammals. To overcome the major constraints of the adverse weather conditions and other potential limitations, particularly upon flora an extensive literature review, database search and review of the results from the ERC (2000) assessment was conducted.

The ERC (2000) survey was conducted mid-March (late summer), during more favourable climatic conditions—a year of near average rainfall. Surface water was also recorded during this period within the subject site. The condition, diversity and abundance of flora species varied when compared to the most recent assessment, particularly for ground cover species. Combining the results of the earlier ERC assessment with the most recent survey, an extensive literature review and database search it is considered that the limitations imposed by the adverse weather conditions at the time of this assessment can be overcome.

To overcome further limitations the habitat of subject species was extensively researched and documented using database records and general literature. Known subject species records and habitat locations within the study area, locality and region were identified and documented. Specific survey techniques were used to target subject species and give maximum results considering the season and time limitations imposed upon the survey.

Active diurnal searches were conducted for both reptiles and amphibians under rocks, logs and other ground substrate, however no targeted call playback surveys were conducted for the Southern Bell Frog (*Litoria raniformis*) during this investigation. This species was eliminated as a subject species during the preliminary assessment after an extensive review of records from the region and prior knowledge of the conditions and potentially suitable habitat available on site. After an extensive review of the Southern Bell Frog's habitat requirements, it was decided that the subject site does not offer suitable habitat for this species.

A limitation of the Anabat bat survey was the inability to distinguish some threatened species from calls of other species of the same genus. The threatened Greater Long-eared Bat (*Nyctophilus timoriensis*) could potentially be recorded during the survey, yet is not readily distinguishable from

other species of its genus. Similarly, it is difficult to be specific with the *Vespadelus* species of this area as there is considerable overlap between Southern Forest Bat (*V. regulus*) and the threatened Inland Forest Bat (*V. baverstocki*). Harp trapping in combination with the Anabat surveys should overcome this limitation of call analysis.

No detailed fauna or flora surveys were conducted for the remainder of the study area. General flora and habitat surveys were conducted for the area adjacent the eastern and northern boundary of the subject site. Incidental records of all fauna species observed during these surveys were used as part of this assessment. Limited targeted diurnal bird and herpetofauna surveys were also conducted in this area to determine the presence of any of the subject species in the immediate vicinity of the subject site. In order to overcome some of the potential limitations of not conducting detailed targeted fauna and flora surveys for the entire study area, database records (e.g. NSW NPWS Wildlife Atlas), existing vegetation maps, relevant literature and information collected during the surveys was used to map and discuss the broad vegetation and associated habitat types of the study area (see Section 4.9).

4.3. SURVEY PERIOD AND WEATHER CONDITIONS

Weather conditions recorded for the survey period are provided in Table 4.1. Weather conditions during the survey period were obtained from the Bureau of Meteorology Griffith Airport weather station. No rain was recorded during the survey. More specific weather conditions were documented during each survey task including wind direction, cloud cover and phase of the moon.

Table 4.1 Weather conditions recorded during survey period.

Day	Max temp °C	Min temp °C	Rainfall mm	Wind conditions	
				day	night
28 Oct	26	6	0	calm	calm
29 Oct	29	8	0	calm	light
30 Oct	36	11	0	calm	calm
31 Oct	27	12	0	calm	calm
1 Nov	30	10	0	light	moderate
2 Nov	32	15	0	light	strong

4.4. LITERATURE REVIEW

Various sources of information and data available on flora and fauna from the various studies and other surveys conducted in the Griffith region over the past 10 years were review and utilised in the production of this SIS. Sources of information included:

- § Eldridge, D.J. (2002) Condition and Biodiversity of Vegetation Remnants in the Murrumbidgee Irrigation Area: a baseline survey and recommendations for future monitoring.
- § Griffith Built & Natural Environment Group of Griffith City Council (GBNEG 2000) Scenic Hill Plan of Management.
- § Landscape Architects (n/d) McPherson Range Visual Assessment & Wildlife Corridor Study.
- § Ettamogah Research Consultants (2000) Proposed Expansion of Existing Waste Management Facility, Tharbogang Via Griffith NSW: Threatened Species Assessment.
- § Coffey Geosciences (2000) Griffith City Council Tharbogang Landfill Environmental Impact Statement.
- § Murrumbidgee Field Naturalist (MFN) Inc. (various dates from 1996 – 2002) The Murrumbidgee Naturalist (Journal). The majority of MFN records have been included in the NSW NPWS Wildlife Database Atlas.

4.5. DATABASE SEARCHES

A search of all relevant databases available was conducted to obtain records of subject species within the region and additional records of threatened species, populations and ecological communities known from the region of state and national significance. Databases searched included:

- § NSW NPWS Wildlife Database Atlas (22/10/02) – licensed version all species of flora and fauna (1:100,000 map sheet search Griffith 8129 and Kooroongal 8029);
- § Birds Australia Atlas Database (22/10/02) – 30 minute block search centred on the subject site;
- § Environment Australia Online Database (22/10/02) – interactive map searcher <http://www.environment.gov.au/epbc/db/interact.html>; and
- § Rare or Threatened Australian Plant Species database (ROTAP 1995).

All records of threatened species and populations extracted from these databases were plotted to create a threatened species map of the general locality. The dates and sources of these records were reviewed in order to assess the accuracy and relevance of the locations of each record compared to the subject site.

4.6. SURVEY STRATIFICATION, SAMPLING AND REPLICATION

Considering the size of the survey area, current land use, disturbance history and previous flora and fauna surveys, the subject site was stratified based on biophysical attributes (e.g. landform, elevation, etc.), vegetation structure (e.g. woodland) and the desired area to be developed. Stratification units were then named according to the known vegetation type (i.e. Cypress Pine forest or Bimble Box woodland). Table 4.2 details the type of survey methodology and survey effort employed for each stratification unit.

The following methodologies for general and targeted flora and fauna surveys of threatened species are adopted from the *Interim guidelines for Targeted and General Flora and Fauna Surveys under the Native Vegetation Conservation Act 1997* (DLWC 1999) and guidelines as used by the NSW NPWS for the Comprehensive Regional Assessment (CRA) vertebrate fauna surveys. Table 4.3 provides a comparison of the survey effort employed during this assessment compared to the minimum survey effort required by the *Interim guidelines for Targeted and General Flora and Fauna Surveys under the Native Vegetation Conservation Act 1997* (DLWC 1999).

4.7. FLORA ASSESSMENT METHODOLOGY

4.7.1. Objectives of the flora assessment

The primary objectives of the flora assessment were to:

- § identify threatened flora species known or likely to occur in the study area (Appendix F);
- § provide information on the distribution and abundance of threatened flora species known or likely to occur in the study area (Appendix G);
- § identify and describe the vegetation of the subject site and assess its conservation significance (Section 5.3);
- § assess the impacts of the proposed development on threatened flora species and the vegetation of the subject site (Section 6.2); and
- § develop amelioration measures which will mitigate the effects of the proposed development on threatened flora species and vegetation and other vegetation of conservation concern within the subject site (Section 8.2).

Two methods were employed to determine all flora species, vegetation types, communities and associated habitat types within the subject site and surrounding area:

1. Aerial photograph interpretation, preliminary database search and literary review; and
2. Field surveys of the vegetation of the subject site and surrounds.

A review of the relevant literature and databases (e.g., NSW NPWS Wildlife Atlas) was conducted to develop a preliminary flora species list of the subject site and surrounding area. This review, in combination with aerial photograph interpretation allowed for the mapping of basic vegetation community boundaries and the initial location of traverses and quadrats to be identified. Vegetation surveys were then conducted to ground truth and verify the vegetation types and species list determined from preliminary studies.

A general and targeted flora and habitat survey was conducted during 28th October – 3rd November 2002. To ensure that the subject site was appropriately sampled, both quadrat and traverse sampling were employed during the flora survey. A targeted flora survey was employed as it has the specific objective of collecting information on given threatened plant species, populations, or ecological communities and their habitats. Traverse sampling is the recommended technique to sample the species and populations, and where an ecological community is identified, quadrat sampling should be used (DLWC 1999).

A quantitative description of the flora species, the diagnosed plant communities (assemblages of flora species) and an assessment of the habitat value of the area was recorded. Sites chosen to conduct traverses represented a range of visually different landforms (e.g. gully areas, lower-lying marshy areas, slopes, drainage lines, etc.). Other factors taken into consideration included the possible association with threatened fauna and flora species.

Four field survey methods were employed to sample the vegetation of the subject site:

1. Quadrat sampling (20 x 50m);
2. Traverse sampling (100 x 20m or 20 min 1 ha);
3. Traverse sampling (random flora/habitat searches); and
4. Habitat hollow-bearing tree surveys.

A full description of the flora survey methodology can be found in Appendix I.

4.8. FAUNA ASSESSMENT METHODOLOGY

4.8.1. Objectives of the fauna assessment

The primary objectives of the fauna assessment were to:

- § identify and describe threatened fauna known or likely to occur in the study area (Section 5.6, Appendice F & G);
- § identify and describe threatened fauna habitat known or likely to occur in the study area (Section 5.4, Appendix G);
- § provide information on the distribution and abundance of threatened fauna and their habitat known or likely to occur in the study area (Appendix G);
- § assess the impacts of the proposed development on threatened fauna and their habitat of the subject site (Section 6.2); and
- § develop amelioration measures which will mitigate the effects of the proposed development on threatened fauna and the habitat of threatened fauna within the subject site (Section 8.2).

General and targeted fauna and habitat surveys were conducted during 28th October – 3rd November 2002. Specific survey techniques were used to give maximum results considering the season and time limitations imposed upon the survey. Searches were conducted for habitat or resources of relevance to threatened fauna species known from the general locality, or which might be anticipated to occur at the subject site.

Opportunistic records and indirect searches of fauna species were also maintained throughout the survey period. Where applicable, survey methodology followed guidelines as used by the NSW NPWS for the CRA vertebrate fauna surveys and the *Interim Guidelines for Targeted and General Flora and Fauna Surveys under the Native Vegetation Conservation Act 1997* (DLWC 1999). A preliminary fauna survey list was developed from relevant databases (e.g. NSW NPWS Wildlife Atlas, Birds Australia Atlas), previous reports of the area (e.g. ERC (2000)) and local sources (e.g. Murrumbidgee Field Naturalists).

The following field survey methods were employed to sample the fauna of the subject site:

- § Reptiles and amphibians – active diurnal searches;
- § Avifauna – diurnal bird surveys and nocturnal bird call playback surveys;
- § Arboreal mammal - nocturnal spotlighting surveys;
- § Ground dwelling mammal – Elliott trapping;
- § Nocturnal animal stag watching;
- § Microchiropteran bat – ultrasonic bat detector (anabat) and harp trapping;
- § General fauna habitat search; and
- § Dedicated scat, track and other animal sign searches.

A full description of the fauna survey methodology can be found in Appendix I.

4.9. ASSESSMENT OF VEGETATION AND HABITAT TYPES OF THE STUDY AREA

General flora surveys adopting random traverse and general habitat assessment methodology were conducted for most of the area between the subject site and Tharbogang Swamp and the northern tip of the western ridgeline of McPherson's Range. This involved recording most flora species, identification and extent of vegetation communities and habitat features. The vegetation types/communities for the subject site and surrounds were classified according to Specht's classification system (1981). Incidental records of all fauna species observed during these surveys were used as part of this assessment. Limited targeted diurnal bird and diurnal herpetofauna surveys were conducted in this area to determine the presence of any of the subject species in the immediate vicinity of the subject site.

Vegetation types within the study area were interpreted and mapped using aerial photography and broad vegetation mapping provided by GCC and Murrumbidgee Irrigation (Eldridge 2002). Database records, relevant literature and information collected during the surveys was used to verify vegetation and habitat types within the study area.

All records of threatened species and populations extracted from the relevant databases were plotted to create a threatened species map of the study area. The presence of subject species within the study area indicated known habitat of these species. The habitat requirements for each of these subject species was reviewed with respect to the vegetation and associated habitat types within the study area. Mapping of vegetation types within the study area allowed for the recognition of preferred habitats of subject species within the study area and enabled overall vegetation and associated habitat types to be quantified and compared with the extent of same vegetation and habitat types within the subject site.

Limited ground truthing was conducted for the remainder of the study area (28th October & 3rd of November 2002, & 7th February 2003) with drive-by assessments conducted for the main roads within the study area, particularly along McPherson Range and around the Lake Wyangan wetlands system. Short random walks were conducted in areas of interest at Scenic Hill, along the eastern Ridgeline of McPherson Range and the northern portion of Tharbogang Swamp, and particularly where subject species had been previously recorded.

Table 4.2. Flora and fauna survey effort.

Survey Method	Stratification unit						Total survey effort
	White Cypress Pine Forest (21 ha)	Bimble Box – Cypress Pine woodland (18 ha)	Dwyer's Mallee Gum/Cypress Pine - Currawang woodland (14 ha)	Mixed forest (28 ha)	Road reserve (6 ha)	Adjacent land	
Flora - (20 x 50m) quadrats	2	2	2	3	no	no	9
Flora - (100 x 20 m) traverses	6	4	4	6	no	no	20
Flora – random traverse (30 min)	3	3	2	3	duration (see Appendix J)	(see Appendix J)	11
Dedicated habitat, animal sign search (random 1 ha/30 min)	3	3	2	3	duration	(see Appendix J)	11
Elliott trapping (25 traps per site)	1 site x 3 nights	1 site x 3 nights	1 site x 3 nights	1 site x 3 nights	no	no	300 trap nights
Nocturnal bird call playback 1 session @ 30 min	-	1 session (1 night) 06/02/03	-	-	-	-	2 sessions/2 nights including broadcast from above landfill
Spotlighting (20 min 1 ha search)	4 (3 nights)	4 (3 nights)	4 (3 nights)	5 (3 nights)	2 (2 nights)	4 (3 nights)	23
Stag watching	2 (2 nights)	2 (2 nights)	2 (2 nights)	2 (2 nights)	-	2 (2 nights)	10
Harp trapping	1 trap (2 nights)	1 trap (2 nights)	1 trap (2 nights)	1 trap (2 nights)	no	no	8 nights
Anabat Recording	1 detector (2 nights)	1 detector (2 nights)	1 detector (2 nights)	1 detector (2 nights)	no	no	8 nights
Diurnal Herpetofauna (20 min 0.5 ha search)	3 (2 days)	3 (2 days)	3 (2 days)	3 (2 days)	1 (1 day)	2 (2 days)	15
Diurnal Bird (20 min 1 ha search)	10 (5 days)	8 (5 days)	8 (5 days)	10 (5 days)	4 (3 days)	3 (3 days)	43

NOTES: - Anabat detectors were placed in each stratification unit for 2 nights each, however successful recordings were only made on one night in each stratification unit with the exception of the Dwyer's Mallee Gum/Currawang woodland stratification unit where no successful recordings were made.

- Diurnal bird surveys were sometimes replicated for more than one survey site within each stratification unit (see survey site map Appendix J).
- Figures in brackets represent the number of days over which the surveys were completed.
- Stag watching was conducted as a precursor to spotlighting where suitable habitat was available.

Table 4.3. Minimum survey effort requirements for the subject site.

Flora or fauna group	Survey Method	Recommended survey period/effort	Effort achieved during assessment	Justification for not meeting minimum requirement
Vascular flora	(20 x 50m) quadrats (100 x 20 m) traverses - Random traverse (30 min)	- All year. At least 2 quadrats per 2-50 ha of stratification unit. - All year. At least 2 x 100 m traverse per 2-50 ha of stratification unit. 30 minutes for each quadrat stratification within same stratification unit.	- YES – at least 2 quadrats were completed for each stratification unit. No stratification unit exceeded 28 ha within the subject site. - YES – at least 4 traverses were conducted for each stratification unit. - YES – at least 1 traverses was conducted for each quadrat within each stratification unit.	-
Diurnal birds	20 min 1 ha search - Wetland census - Water course census	Method 1 was employed during this assessment. All year, with at least two 20 min census at (1 dawn and 1 dusk) up to 50 ha of stratification unit.	YES – at least 8 census (4 at dawn 4 at dusk) were conducted for each stratification unit over at least 3 days.	-
Nocturnal birds	Call playback	All year – two sites per 50 ha stratification unit, plus additional session for every additional 100 ha. Each site must have the playback session repeated on each of two different nights.	NO – two sessions were conducted only, each on different nights and at different sites within the subject site.	Although minimum survey effort was not achieved, dedicated habitat & animal sign searches were conducted for nocturnal birds within the subject site. Additional spotlighting searches were also used to overcome this potential limitation.
Small terrestrial mammals	- Small Elliott trapping - Hair tubes - Pitfall traps	Method 1 was employed during this assessment. All year, 100 trap nights preferably using 25 traps for a minimum of 4 nights per stratification unit up to 50 ha.	YES – 25 traps were placed within each stratification unit for 3 nights. No stratification unit exceeded 28 ha. Traps were strategically placed within each unit where suitable habitat was present.	Although minimum survey effort was not achieved for methods 2 & 3 dedicated habitat and animal sign searches, and flora traverses and quadrats also incorporating habitat assessment were completed for each stratification unit.
Medium to large terrestrial mammals	- Large Elliott trapping - Wire cages - Arboreal hair tubes - Scats and sign search - Track search	Methods 4 & 5 were employed during this assessment. - All year - 30 minute searching each relevant habitat - All year – 1 km of track search	YES – At least 2 dedicated habitat, animal sign searches (random 1 ha/30 min) incorporating methods 4 & 5 were completed for each stratification unit. In addition to spotlighting stag watching, and detailed habitat assessments were conducted for each unit.	No threatened medium to large mammals excluding common arboreal and macropods have been recorded within the study area previously. Dedicated habitat, animal sign searches, flora traverses and quadrats also incorporating habitat assessment were completed for each stratification unit.

Table 4.3 cont.

Flora or fauna group	Survey Method	Recommended survey period/effort	Effort achieved during assessment	Justification for not meeting minimum requirement
Arboreal mammals	1. Arboreal hair tubes 2. Call playback 3. Spotlighting on foot 4. Spotlighting from vehicle	Method 3 was employed during this assessment. All year - 2 x 1 hour and 1 km per 200 ha of stratification unit, walking at approximately 1 kph, on 2 separate nights.	YES – At least 3 x 20 minute 1 ha area searches over 3 nights was completed for each unit. A total of 7.6 hours spotlighting over 4 nights was completed for the subject site. In addition to spotlighting stag watching, and detailed habitat assessments were conducted for each unit. Random vehicle spotlight searches were also conducted for 4 nights of the survey period.	No threatened arboreal mammals excluding common species have been recorded within the study area previously.
Microchiropteran bats	1. Harp trapping 2. Ultrasonic call recording	All methods were employed. 1. October to March – 3 consecutive trap nights, each at least 2 hours duration 2. October to March – 45 minutes recording after dusk on each 3 nights per 100 ha of stratification unit targeting preferred habitat.	YES – microchiropteran bat survey were conducted during October and November. 1 harp trap was placed within each sample unit for 2 consecutive nights (for at least a 10 hour period overnight). 1 detector was placed within each sample unit for 2 consecutive nights (for at least a 10 hour period overnight).	Although the minimum number of trap/sample nights was not achieved, total survey effort exceeded the minimum requirements given the small size of the subject site and stratification units.
Reptiles	1. Pitfall traps 2. Habitat search 3. Spotlighting on foot	Methods 2 & 3 were employed during this assessment. 2. November to March – 30 minutes on two separate days targeting specific habitat 3. November to March – 30 minutes on two separate days targeting specific habitat per 100 ha of stratification unit on coast and ranges and 200 ha west of the ranges.	YES – at least 3 (20 minute 0.5 ha) diurnal herpetofauna surveys were conducted for each unit over 3 days. Spotlighting searches were conducted as part of the arboreal mammals spotlighting surveys.	Pitfalls were not used during this assessment given the condition of the ground—albeit difficulty to dig pitfall holes. Additional habitat and spotlighting surveys were conducted to compensate.
Amphibians	1. Systematic day habitat search 2. Night habitat search 3. Day/night water course search 4. Nocturnal call playback	Methods 1 and 2 were employed during this assessment. 1. mid-September to February – 1 hour per stratification unit 2. mid-September to February – 30 minutes on two separate nights per stratification unit. survey effort targeting specific habitat.	At least 3 (20 minute 0.5 ha) diurnal herpetofauna surveys were conducted for each unit over 3 days. Nocturnal searches were conducted as part of the arboreal mammal spotlighting surveys.	No targeted call playback surveys were conducted for the Southern Bell Frog during this investigation. This species was eliminated as a subject species during the preliminary assessment after an extensive review of records from the region and prior knowledge of the condition and potentially suitable habitat available on site.

NOTE: recommended survey method, effort and period from the *Interim guidelines for Targeted and General Flora and Fauna Surveys under the Native Vegetation Conservation Act 1997* (DLWC 1999).

5. ASSESSMENT RESULTS

This section presents the findings of the flora, fauna and habitat investigation conducted by ERC of the subject site and surrounding area. Subject species considered as part of this SIS and justification for those species, populations and ecological communities not considered is also provided. Results of the original flora and fauna investigation conducted as part of the EIS by ERC in 2000, other ecological investigations of the area and database searches are also incorporated into the findings. All protected and threatened species recorded during the investigation will be discussed. Emphasis will be placed upon subject species, other threatened species and species of conservation significance recorded during the investigation.

5.1. THREATENED SPECIES, POPULATION AND ECOLOGICAL COMMUNITIES CONSIDERED AS SUBJECT SPECIES

From the criteria presented in Section 4.1, 39 subject species have been considered for inclusion in the SIS from the 51 threatened species, populations and ecological communities known to occur within the locality. Tables 5.1 – 5.4 provides a summary of each of the 51 threatened species, populations and ecological communities known to occur within the locality and justification for their inclusion or exclusion as subject species for this SIS. Detailed justification for those threatened species, populations and ecological communities not included as subject species is provided in Section 5.2.

In accordance with Section 110 of the *TSC Act 1995* and the NPWS Director-General's requirements, species profiles have been prepared for each potentially affected species. Species profiles provide detailed information on ecological requirements and other characteristics; state wide, regional, and local abundance and conservation status; habitat requirements, including home range, feeding, roosting and breeding requirements; and discussion of the likely impact of the project on each species. This information has been used to assist the assessment of the impacts of the proposed development on affected subject species and also to develop appropriate ameliorative measures. Species profiles are provided in Appendix G.

Table 5.1. Threatened fauna species considered to be subject species.

Habitat requirements not recorded within subject site during previous ERC 2000 survey.

Threatened Species	Habitat requirements in the region	Recorded within		Habitat present within		Considered a subject species
		Locality	Study area	Subject site	Study area	
Southern Bell Frog <i>Litoria raniformis</i> (Endangered)	Aquatic vegetation at the edge of permanent water/billabongs.	YES	NO	NO #	YES (potential)	NO
Western Blue-tongued Lizard <i>Tiliqua occipitalis</i> (Vulnerable)	Preferred habitat appears to be mixed mallee/spinifex communities and mallee/ <i>Triodora</i> woodland communities. Recorded in Carrathool shire.	YES	NO	YES - Dwyer's Mallee Gum & Bimble Box Woodland	YES (potential)	YES
Australasian Bittern <i>Botaurus poiciloptilus</i> (Vulnerable)	Favour wetlands with large areas (>5 ha) of tall dense vegetation.	YES	NO	NO#	YES (potential)	YES
Magpie Goose <i>Anseranas semipalmata</i> (Vulnerable)	Prefers large shallow swamps or dams with rushes and adjacent grassland. Formerly probably an abundant bird in the region. Now only a rare vagrant.	YES	YES	NO#	YES (known)	YES
Freckled Duck <i>Stictonetta naevosa</i> (Vulnerable)	Large permanent and intermittent wetlands and swamps. Nests in Cumbungi or similar.	YES	YES	NO#	YES (known)	YES
Blue-billed Duck <i>Oxyura australis</i> (Vulnerable)	Large permanent and intermittent wetlands and swamps. Nests in Cumbungi or similar.	YES	YES	NO#	YES (known)	YES
Square-tailed Kite <i>Lophoictinia isura</i> (Vulnerable)	Rare bird in the Riverina, preferring open forests and woodlands. Breeds along wooded watercourses, mainly in the south. Occupy large territories, therefore require large areas of wooded country.	YES	NO	YES (foraging habitat)	YES (potential)	YES

Table 5.1 cont.

Threatened Species	Habitat requirements in the region	Recorded within		Habitat present within		Considered a subject species
		Locality	Study area	Subject site	Study area	
Grey Falcon <i>Falco hypoeucos</i> (Vulnerable)	Recorded in Griffith, Leeton, Conargo and Carrathool shires. Observed along watercourses, plains and woodlands. Population stronghold is in arid and semi-arid areas.	YES	YES McPherson Range	YES (foraging and nesting habitat)	YES (known)	YES
Malleefowl <i>Leipoa ocellata</i> (Endangered)	Mallee woodlands in Carrathool Shire. Majority of NSW population is west of the Lachlan River, south to around Goolgowi.	YES	NO	NO	NO	NO
Bush Stone-curlew <i>Burhinus grallarius</i> (Endangered)	Open grassy woodlands, riparian forests with low sparse native grasses and fallen timber.	YES	NO	NO	YES (potential)	NO
Brolga <i>Grus rubicundus</i> (Vulnerable)	Open swamplands. Frequently on plains in Urana, Lachlan River, from Condobolin to Lake Cargelligo. Once common in region.	YES	NO	NO#	YES (potential)	YES
Australian Bustard <i>Ardeotis australis</i> (Endangered)	Occurs in grasslands, light scrubland and woodlands. Apparently moves in response to rainfall. Preferred habitat is grassland. Once common, now a vagrant.	YES	NO	NO#	YES (potential)	NO
Painted Snipe <i>Rostratula benghalensis</i> (Vulnerable)	Very shy bird. Inhabits fringes of swamps and marshy areas where there is sufficient cover. Most often seen in freshly flooded areas.	YES	NO	NO#	YES (potential)	YES
Black-tailed Godwit <i>Limosa limosa</i> (Vulnerable)	Visits Australia during summer, "passes through" Riverina using exposed muddy shores around large lakes. Recorded in Fivebough and Nericon swamps.	YES	YES	NO#	YES (known)	YES

Table 5.1 cont.

Threatened Species	Habitat requirements in the region	Recorded within		Habitat present within		Considered a subject species
		Locality	Study area	Subject site	Study area	
Glossy Black-cockatoo <i>Calyptorhynchus lathami</i> (Vulnerable)	Range includes the Lachlan, Cocparra and Narrandera ranges. Occurs in hilly rocky country where casuarinas occur and requires hollows to nest in.	YES	YES McPherson Range	YES (foraging and some roosting)	YES (known)	YES
Pink Cockatoo <i>Cacatua leadbeateri</i> (Vulnerable)	Commonly seen in the NW of the region, lives mainly in dry woodlands with mallee, pine and belah.	YES	YES McPherson Range	YES (foraging and some roosting)	YES (known)	YES
Superb Parrot <i>Polytelis swainsonii</i> (Vulnerable)	Nesting largely restricted to the Murrumbidgee and Edwards rivers. Nests in large mature healthy Red Gums. Requires feeding sites within 10 km of nesting sites. Feeds in Box and Boree woodlands and associated grasslands. Prefers to fly along wooded corridors.	YES	YES	YES (foraging and nesting sites)	YES (known)	YES
Swift Parrot <i>Lathamus discolor</i> (Endangered)	Irregular winter migrant to Murray Shire. Communities that feature winter flowering eucalypts. Ironbark communities, lower Grey Box / Yellow Box / White Box woodlands and Black Box. At western edge of range.	YES	NO	YES (limited habitat, species transitory)	YES (potential)	YES
Turquoise Parrot <i>Neophema pulchella</i> (Vulnerable)	Grassy forests and woodlands. At western edge of range.	YES	NO	YES (foraging and nesting sites)	YES (potential)	YES
Barking Owl <i>Ninox connivens</i> (Vulnerable)	Large, old growth, hollow bearing eucalypts. South / west Riverina. Formerly common along the Murrumbidgee and Lachlan Rivers. Also in East and almost certainly in north.	YES	YES McPherson Range	YES (foraging and nesting habitat)	YES (known)	YES

Table 5.1 cont.

Threatened Species	Habitat requirements in the region	Recorded within		Habitat present within		Considered a subject species
		Locality	Study area	Subject site	Study area	
Masked Owl <i>Tyto novaehollandiae</i> (Vulnerable)	Large, old growth, hollow bearing eucalypts. South / west Riverina. Formerly common along the Murrumbidgee and Lachlan Rivers.	YES	NO	YES (foraging and nesting habitat)	YES (potential)	YES
Grey-crowned Babbler <i>Pomatostomus temporalis</i> (Vulnerable)	Open woodlands dominated by mature eucalypts with regenerating trees, tall shrubs and native groundcover.	YES	YES (recorded on site during ERC 2000 survey)	Yes (known habitat)	YES (known)	YES
Southern Scrub-robin <i>Drymodes brunneopygia</i> (Vulnerable)	Distributed in disjunct populations. Recorded in Nombinnie, Cocoparra and The Charcoal Tank Reserves. Inhabits mallee usually with dense shrubs in the understorey. Sedentary.	YES	NO	NO#	YES (potential)	NO
Hooded Robin <i>Melanodryas cucullata</i> (Vulnerable)	Eucalypts, Acacia shrublands, Belah woodlands, Rosewood and Cypress Woodlands.	YES	NO	YES (foraging and breeding habitat)	YES (potential)	YES
Gilbert's Whistler <i>Pachycephala inornata</i> (Vulnerable)	In mallee, eucalypt woodland and pine forest always with a dense understorey. Feeds on or near the ground.	YES	NO	YES (foraging and breeding)	YES (potential)	YES
Red-lored Whistler <i>Pachycephala rufogularis</i> (Endangered)	Rarest extant bird species in the Riverina. Currently confined to Mallee communities with low dense cover and mixed plant communities aged between 5-30 years. Requirements poorly known. Still found in Round Hill NR and Nombinnie NR.	YES	NO	NO	YES (potential)	NO

Table 5.1 cont.

Threatened Species	Habitat requirements in the region	Recorded within		Habitat present within		Considered a subject species
		Locality	Study area	Subject site	Study area	
Chestnut Quail-thrush <i>Cincoloma castanotus</i> (Vulnerable)	This species prefers a shrub layer or areas of heath in Mallee, Mulga scrub, native pine and eucalypt woodland areas. Sedentary.	YES	NO	YES (limited foraging and nesting habitat)	YES (potential)	YES
Shy Heathwren <i>Hylacola cautus</i> (Vulnerable)	Sedentary species. Mallee woodlands with dense low heathy understorey.	YES	Not within study area but within McPherson Range	NO	YES (potential)	YES
Speckled Warbler <i>Pyrrholaemus sagittatus</i> (Vulnerable)	Woodlands with grassy understorey.	YES	NO	YES (foraging and nesting habitat)	YES (potential)	YES
Black-chinned Honeyeater <i>Melithreptus gularis</i> (Vulnerable)	River Red Gum forest woodland.	YES	NO	YES (foraging and nesting habitat)	YES (potential)	YES
Pied Honeyeater <i>Certhionyx variegatus</i> (Vulnerable)	Widespread but nomadic and irregularly seen. Inhabits primarily acacia scrub, mallee, spinifex and eucalypt woodlands, usually when shrubs (particularly <i>Eremophila</i>) are flowering.	YES	YES	YES (foraging and nesting habitat)	YES (known)	YES
Painted Honeyeater <i>Grantiella picta</i> (Vulnerable)	Migratory species. Associated with mistletoe in woodlands particularly Boree, Mulga, Yarran, Mallee, and Buloke. Also dry forest including box / pine. Specialist feeder on mistletoe fruit.	YES	YES McPherson Range	YES (very limited foraging and nesting habitat)	YES (known)	YES

Table 5.1 cont.

Threatened Species	Habitat requirements in the region	Recorded within		Habitat present within		Considered a subject species
		Locality	Study area	Subject site	Study area	
Diamond Firetail <i>Stagonopleura guttata</i> (Vulnerable)	Eucalypt woodlands, forests and mallee with a grassy understorey.	YES	NO	YES (foraging and nesting habitat)	YES (potential)	YES
Little Pied Bat <i>Chalinolobus picatus</i> (Vulnerable)	Very little is known about this species. Recorded in the southern Riverina. Occurs exclusively in arid and semi-arid areas in a range of habitat types.	YES	NO	YES (foraging and roosting habitat)	YES (potential)	YES
Inland Forest Bat <i>Vespadelus baverstocki</i> (Vulnerable)	Very little is known about this species. They live in many different habitats across inland Australia from savannah to woodlands. Roost in small tree hollows.	YES	NO	YES (foraging and roosting habitat)	YES (potential)	YES
Greater Long-eared Bat <i>Nyctophilus timoriensis</i> (Vulnerable)	Dry open woodlands and around red gums that line watercourses and lakes on the inland plains of semi-arid zone.	YES	NO	YES (foraging and roosting habitat)	YES (potential)	YES
Yellow-bellied Sheath-tail Bat <i>Saccolaimus flaviventris</i> (Vulnerable)	Occur in most wooded habitats, roosting in large tree hollows. Forage for airborne insects above canopy, although in open woodlands and mallee they also feed closer to ground.	YES	NO	YES (foraging and roosting habitat)	YES (potential)	YES

Table 5.2. Threatened flora species considered to be subject species.

Threatened Species	Habitat requirements in the region	Recorded within Locality	Study area	Potential habitat present within the subject site	Considered a subject species
<i>Acacia curranii</i> (Vulnerable)	Prefers rocky outcrops found in both mallee and pine woodlands. Grows in Acacia shrubland and mallee, occurring on acidic skeletal soils on the north-facing crests of rocky outcrops of sandstone and acid igneous sediments. Also recorded growing in clearings in mallee communities	YES	NO	YES	NO
<i>Austrostipa metatoris</i> (Vulnerable)	Recorded in Carrathool and Wakool shires in a variety of sandy habitats in both grassland and woodland	YES	NO	YES	YES
<i>Austrostipa wakoolica</i> (Vulnerable)	Grows on Murray River tributaries, usually on grey silty clay or sandy loamy soils in a variety of open woodlands. Recorded around Jerilderie and Finley.	YES	NO	NO	NO
<i>Brachyscome papillosa</i> (Vulnerable)	Occurs from Mossgiel to Urana and recorded in grassland areas around Jerilderie. Recorded from annual chenopod shrublands, growing on red-brown cracking clays and on fine white puffy clay, on intermittent lakes and from irrigated paddocks on black soil, it is often associated with saltbush communities	YES	NO	NO	NO
<i>Diuris tricolor (sheaffiana)</i> (Vulnerable)	Two recordings in western NSW. Bimble Box community on red earth soil. Under Pine, Yellow Box and Grey Box in the east Riverina	YES	NO	YES	YES
<i>Caladenia arenaria</i> (Endangered)	Known mainly from the Narrandera-Griffith region where it is extremely rare. It grows in sclerophyll forest on Callitris covered sandy ridges and dunes, especially in the vicinity of watercourses.	YES	NO	YES	YES

Table 5.2 cont.

Threatened Species	Habitat requirements in the region	Recorded within Locality	Study area	Potential habitat present within the subject site	Considered a subject species
<i>Lepidium aschersonii</i> (Vulnerable)	Occurs mainly in or around swamps and salt marshes on heavy black or clay soil in localities receiving between 500 to 700mm of rainfall annually and usually experience seasonal water-logging or inundation. Population numbers fluctuate greatly but appear to increase during drought periods.	YES	NO	NO	NO
<i>Swainsona murrayana</i> (Vulnerable)	Scattered throughout western NSW, recorded at Deniliquin, Hay extending north to Willandra NP. It has been recorded growing in grasslands, on inland floodplains and discharge areas, and also in eucalypt forests, preferring grey and brown heavy clay and clay loam soils in Bladder Saltbush, Black Box and grassland communities	YES	NO	NO	NO
<i>Swainsona sericea</i> (Vulnerable)	Grassland and eucalypt woodland, sometimes with Callitris.	YES	NO	YES	YES
<i>Lomandra patens</i> (ROTAP)	Tall open scrub on rocky hillsides and flowering mainly through June and July.	YES	YES McPherson Range	YES	YES

Table 5.3. Endangered Populations considered to be subject species.

Endangered Population	Habitat requirements in the region	Recorded within Locality	Study area	Habitat present within Subject site	Study area	Considered a subject species
Glossy Black Cockatoo Riverina Endangered Population	This population is largely restricted to hills and low ridges where suitable assemblages of its food plant Drooping She-Oak remain within the Narrandera Range and to the north-west in the Brobenah Hills, McPhersons Range, Cocoparra Range, Lachlan Range and Jimberoo State Forests, and the Naradhan Range. Requires trees with suitable large hollows to breed, normally Grey Box or Dwyer's Gum, within close proximity to feeding habitat.	YES	Yes McPherson Range	YES	YES (known)	YES
White-browed Treecreeper Population in Carrathool (south of the Lachlan River) and Griffith Local Government Areas	White-browed Treecreepers inhabit shrublands and woodlands of arid and semi-arid regions. They mainly occur in tall shrublands and low woodlands dominated by acacias, such as Mulga, Gidgee and She-oaks, such as Buloke, Belah and <i>Casuarina pauper</i> ; and in woodlands dominated by native pine <i>Callitris</i> sp. Understorey characteristics of occupied habitats vary greatly; vegetation may be open and dominated by grasses; or closed and dominated by a lower layer of low to tall shrubs; the ground-layer may also be bare ground, with no understorey present	YES	NO	YES	YES (potential)	YES

Table 5.4. Endangered Ecological Communities considered to be subject species.

Endangered Population	Habitat requirements in the region	Recorded within the locality/study area		Potential habitat present within the subject site	Considered a subject species
White Box, Yellow Box, Blakely's Red Gum Woodland	White Box Yellow Box Blakely's Red Gum Woodland includes those woodlands where the characteristic tree species include one or more of these species in varying proportions and combinations. Grass and herbaceous species generally characterise the ground layer. In some locations, the tree overstorey may be absent as a result of past clearing or thinning and at these locations only an understorey may be present. Shrubs are generally sparse or absent, though they may be locally common	YES	NO	NO	NO

5.2. THREATENED SPECIES POPULATIONS AND ECOLOGICAL COMMUNITIES NOT INCLUDED AS SUBJECT SPECIES

From the criteria presented in Section 4.1, six threatened fauna, five threatened flora and one endangered ecological community were not included as subject species for this SIS.

The Southern Bell Frog was eliminated as a subject species during the preliminary assessment. An extensive review of database records and relevant literature (e.g. MFN various dates) from the region revealed that this species has not been recorded within the study area. Furthermore, the absence of potentially suitable habitat within the subject site (ERC 2000) and lack of known habitat within the study area further supports this finding.

Five threatened terrestrial bird species were eliminated as subject species after applying the criteria presented in Section 4.1. These species included the Malleefowl, Bush Stone-curlew, Australian Bustard, Southern Scrub-robin, and Red-lored Whistler. Each of these species has specific habitat requirements, and are known to associate with particular vegetation communities and/or have minimum range extents. All species have been recorded within the locality, yet no records exist for these species within the study area. Furthermore, not one of these species was considered to have potentially suitable habitat within the subject site or known habitat within the study area. Although, some of these species may have potentially suitable habitat within the study area, removal of vegetation and habitat will be entirely confined to the subject site and no potential habitat for any of these species will be removed or modified as a result of the proposed development.

The five threatened flora species eliminated as subject species each have specific habitat requirements not represented within the subject site. The study area could contain potential habitat for these species, however, considering that vegetation and habitat modification will be entirely restricted to the subject site it is very unlikely that these species will be affected by potential direct or indirect effects of the proposed development. Furthermore, the lack of any records within the study area for these species and the modified nature of the majority of the subject site and study area further supports this finding.

The endangered ecological community (EEC) White Box, Yellow Box, Blakely's Red Gum Woodland was also eliminated as a subject species. This community is characterised by the presence of one or more of the above tree species and/or where the tree overstorey is absent the presence of a predominately native shrub/and or grassy understorey. No such characteristic tree species was recorded during either ERC assessment. Furthermore, no such characteristic tree species has been recorded within the study area. The characteristic tree species of the subject site and surrounding area comprised Bimble Box/White Cypress Pine Woodland and therefore this EEC would never have existed within the subject site or surrounding area.

5.3. VEGETATION OF THE SUBJECT SITE

Overall, 155 species of flora from 45 families were recorded during the two field investigations. More than 100 of these were native species (including cosmopolitan species) with the remaining species consisting predominantly of pasture and weeds of disturbed areas. Eight noxious weeds as declared by the NSW Department of Agriculture were recorded on site. A full flora species list can be found in Appendix A.

Approximately 85 ha of the subject site is covered by native vegetation. White Cypress Pine is the dominant overstorey species, occurring largely in the form of single stand natural regrowth and is an indication of areas previously scraped for gravel. Patches of Currawang regrowth and Dwyer's Mallee Gum in association with White Cypress Pine tend to dominate ridge areas and higher slopes. Currawang is particularly more dominant adjacent to the existing landfill and quarry. Bimble Box and White Cypress Pine dominate lower slopes and flatter areas. Remnant Bimble Box, White Cypress Pine and Dwyer's Mallee Gum dominate the overstorey in areas not previously scraped for surficial gravels but mature and old growth specimens are also found scattered throughout the White Cypress Pine and Currawang regrowth.

The shrub layer was generally absent, sparse or dominated by regrowth of White Cypress Pine. Patches of Hop-bush (*Dodonaea spp.*) were recorded in most woodland areas associated with Bimble Box. An opportunity exists to increase this particular vegetation layer through the enhancement of the roadside corridor and the rehabilitation process of the existing landfill and quarry areas.

Ground cover diversity was also characterised by past disturbance history, with diversity generally poorer in areas previously scraped of surficial gravels, especially areas on the upper slopes west of the speedway. Native species generally dominated the ground cover of woodland and forested areas, especially native grasses. Woodland areas recorded high ground cover diversity and were dominated by native species, whereas areas of dense White Cypress Pine regrowth recorded poorer ground cover diversity. Highly modified, disturbed areas were characterised by high diversity of introduced species, especially the landfill area. The immediate area of the landfill displays a high abundance of cosmopolitan and garden weeds, which can be attributed to the dumping of garden and other green waste matter. A small portion of the site (<2 ha) east of the weighbridge is used as a green waste recycling area and is consequently dominated by introduced overstorey species and Prickly Pear.

Despite the site being modified from its original state, a great deal of remnant vegetation was recorded and is under threat from the proposed development. The subject site overall displays a high level of structural and floristic diversity, which is reflected by the high diversity of bird species recorded.

Four main vegetation communities were identified during the original ERC 2000 assessment and confirmed during the 2002 investigations. For the purpose of this report and to keep current nomenclature vegetation communities have been named according to Eldridge (2002) and WRRVC (2002).

1. White Cypress Pine forest
2. Bimble Box/White Cypress Pine woodland
3. Dwyer's Mallee Gum/White Cypress Pine-Currawang woodland
4. Mixed Bimble Box/Dwyer's Mallee Gum/White Cypress Pine open forest

No flora subject species or other species of conservation significance were recorded during either investigation. A map of the vegetation types of the subject site is displayed in Figure 5.1.

5.3.1. White Cypress Pine forest

Flora survey sites 1 - 3 (see Appendix J)

Photographs 8 – 10 (Plates 2 & 3).

White Cypress Pine forest covers approximately 21 ha (17 %) of the subject site and was almost entirely dominated by White Cypress Pine. Most of this forest is the result of natural regeneration in the form of advance regrowth (2 – 4 meters in height). Occasional remnant Bimble Box or Dwyer's Mallee Gum were recorded and accounted for maximum tree heights. Three areas of the subject site were dominated by this vegetation type: south of the existing quarry, north of the speedway and north of the landfill area in the north-east corner of the subject site. The threatened Grey-crowned Babbler and many declining woodland bird species were observed foraging in this vegetation type, especially the portion north of the speedway and along the road reserve.

The portion of this vegetation type south of the quarry was dominated by a younger age structure, consisting of early regrowth trees (2 – 3 m tall) with scattered remnant Bimble Box and Dwyer's Mallee Gum. The portion of this vegetation type north of the speedway was generally dominated by advanced regrowth (2 m +), with some mature trees and scattered remnant Bimble Box.

Overall within this community tree height ranged from 2 – 20 m ('tree' is defined as a woody plant > 2 m tall). White Cypress Pine height ranged from 1 – 15 m representing all age structures (early regrowth – old growth), but predominately advance regrowth. Stem density ranged from 0 – 5,000 + stems/ha, reflecting the dense regeneration in some areas.

Understorey largely consisted of juvenile White Cypress Pine with occasional Wilga and Currawang. Ground cover was sparse, consisting predominately of native forbs and grasses. Common ground cover species recorded include: Common Everlasting (*Helichrysum appiculatum*), Clustered Everlasting (*Helichrysum semipapposum*), Wallaby Grass (*Austrodanthonia sp.*), Brush Wire Grass (*Aristida behriana*), *Calotis sp.*, Mulga fern (*Cheilanthes austrotenuifolia ssp. seeberi*), Variable Sida (*Sida corrugata*), Tufted Bluebell (*Whalenbergia communis*) and introduced species. Overall, ground cover abundance was much greater during the ERC (2000) survey.

A largely remnant portion of this community in the north-east corner of the subject site (3 ha) is dominated by mature and old growth White Cypress Pine, with all categories of age structure represented. The occasional remnant Bimble Box was also recorded. Tree height ranged from 10 – 22 m. Understorey almost entirely consisted of juvenile White Cypress Pine with some Hop-bush. Ground cover was predominately native grasses including Brush Wire Grass, Three-awned Grass and Corkscrew Grasses (*Aristida spp.*), Mulga Fern, Common Everlasting, Tall Raspwort (*Gonocarpus*

elatus), Grassland Wood Sorrel (*Oxalis perennans*), Quena (*Solanum esuriale*) and few introduced pasture species.

5.3.2. Bimble Box/White Cypress Pine woodland

Flora survey sites 4 – 5 (see Appendix J)

Photographs 1 – 3 (Plate 1).

Bimble Box/White Cypress Pine woodland covered approximately 18 ha (15%) of the subject site, dominated by Bimble Box and White Cypress Pine ranging from 2 – 23 m in height and almost entirely restricted to the southern portion of the subject site. Bimble Box dominated the overstorey, with White Cypress Pine dominating the lower strata (represented in all age structures), although was generally scattered and patchy as the woodland became more open.

This area contained many remnant, old growth Bimble Box (approximately 50 trees), with dbh ranging from 1 – 2.8 m ('old growth' or habitat trees are remnant trees not removed as result of past disturbance and characterised by old age 40+ years and large dbh > 80 cm). Twenty trees recorded had a dbh > 1.5 m, most of which were located west of the weighbridge. Tree crown diameter ranged from 7 – 18 m, averaging 10.5 m. Tree health was generally very good, with few trees showing signs of dieback or stress. No Mistletoe was recorded in Bimble Box in this area.

Understorey (shrub layer) was generally sparse and largely in the form of White Cypress Pine regrowth with the occasional patch of Wedge-leaf or Narrow-leaf Hop-bush (*Dodonaea cuneata* and *D. viscosa ssp angustissima*). Currawang became more prominent as slope increased. Wilga (*Geijera parviflora*) as tall shrub was recorded below most old growth Bimble Box. Regeneration of Bimble Box was generally sparse, but common in small patches.

Ground cover species covered up to 70 % of the area and up to 100% of the area at the time of the ERC (2000) survey. Curly Windmill Grass (*Enteropogon acicularis*), mixed Saltbush (including Buckbush *Salsola kali*, Climbing Saltbush *Rhagodia nutans*, *Atriplex sp.* and Ruby Saltbush *Enchylaena tomentosa*) and Clustered Everlasting were most abundant beneath the Bimble Box. Areas lacking overstorey were generally dominated by Curly Windmill Grass and/or Saltbush mix.

Groundcover diversity was dominated by native grasses, some forbs and some introduced species including: Common Everlasting, Bluebell, Yellow Rush-lily (*Tricoryne elatior*), Mulga Fern, *Aristida spp.*, Blown Grass (*Agrostis aemula*), Wallaby Grass, *Austrostipa sp.*, Variable Sida, Wilcannia Lily (*Calostemma purpurea*), Peppergrass (*Lepidium sp.*), Wild Oats (*Avena fatua*), Barnyard Grass (*Echinochloa crus-galli*), Stinkgrass (*Eragrostis cilianensis*), Barley Grass (*Hordeum leporinum*).

A small patch of Buloke (< 0.50 ha) was recorded at the entrance of the subject site. The patch consisted of four old growth Buloke trees approximately 22 m tall and dbh ranging from 2 – 2.6 m. Most trees were of good health with some minor dieback and good regeneration. This species was not recorded elsewhere in the subject site. Three old-growth White Cypress Pine were also recorded within this area.

Scattered remnant mature and old growth Bimble Box trees formed part of the road reserve and a large proportion of the vegetation community on adjacent land to east of the subject site. These trees were largely confined to the road reserve, with some occurring as isolated trees and small clumps between the road reserve, existing landfill and putrescible waste areas. The Grey-crowned Babbler was observed on three occasions foraging within these Bimble Box trees.

5.3.3. Dwyer's Mallee Gum/White Cypress Pine-Currawang woodland

Flora survey sites 6 & 7 (see Appendix J).

Photographs 4 – 7 (Plates 1 & 2).

Dwyer's Mallee Gum/White Cypress Pine-Currawang woodland covered approximately 14 ha (12%) of the subject site, generally being associated with rocky outcrops, ridgeline and upper slope areas. This community was restricted to two areas, the southerly facing hillside of the northern portion of the subject site (8 ha) and a smaller portion, also including crown land area along the western boundary of the subject site (6 ha).

The overstorey ranged from 2 – 20 m, largely dominated by Dwyer's Mallee Gum largely dominated the overstorey, with some areas dominated by patches of White Cypress Pine. Currawang and White Cypress Pine dominated the lower strata (3 – 8 m), particularly White Cypress Pine on lower and south facing slopes. Currawang as shrub and advanced regrowth dominated sections of the ridgeline and mid-slopes, particularly immediately north and south of the landfill. An old growth Kurrajong was recorded in each portion of this community. This species was not recorded elsewhere.

Understorey consisted largely of juvenile White Cypress Pine and Dwyer's Mallee Gum, with some Currawang, Weeping Pittosporum (*Pittosporum phillyreoides*) and the occasional Bimble Box. White Cypress Pine became dominant in the lower lying mid section forming a significant ecotone.

Ground cover was generally sparse, covering up to 30 % of the area of this community north of the landfill, yet was abundant and covered up to 100% of the area at the time of the ERC (2000) survey. Highest ground cover diversity was recorded within this community during the ERC (2000) survey. A natural ephemeral drainage line running west-east, traversed this community north of the landfill, and supported native rush/sedge species and other riparian zone plants. Discharge areas were also noted along the drainage line suggesting a spring (ERC 2000).

Ground cover predominantly consisted of native grasses and forbs. Common species included Mulga Fern, Common Everlasting, Tufted Bluebell, Yellow Rush-lily, *Aristida* sp., Three-awned and Corkscrew Grasses, Winter Grass, Buckbush, Ridge Sida, Variable Sida, Climbing Saltbush, Wilcannia Lily and Peppergrass.

5.3.4. Mixed Bimble Box/ White Cypress Pine / Dwyer's Mallee Gum open forest

Flora survey sites 3, 8 & 9 (see Appendix J).

Photographs 11 & 12 (Plate 3).

Mixed Bimble Box/Dwyer's Mallee Gum/White Cypress Pine open forest covers approximately 28 ha (23%) of the subject site. Largely dominated by White Cypress Pine, but sometimes co-dominated by two or more overstorey species ranging from 2 – 25 m. This community occurred in two areas, north of the landfill and south of the quarry.

The mixed open forest north of the tip lies in a natural gully resembling an open valley floor. A natural drainage line runs through the centre of this area. The gully area and natural drainage line provide for more fertile growing conditions, reflected by the high overstorey and understorey species diversity. White Cypress Pine was well represented throughout all age structures. A high proportion of remnant vegetation was recorded along the gully floor and drainage line. Numerous old growth and mature Bimble Box, White Cypress Pine and Dwyer's Mallee Gum were recorded in this area. Dwyer's Mallee Gum and Currawang became dominant as slope increased. White Cypress Pine and Currawang regrowth dominated the southern part of this community as a result of past disturbance.

Early to advanced regrowth of White Cypress Pine and Currawang dominated the understorey (shrub) stratum. Shrub species recorded include: Weeping Pittosporum, Broad-leaf and Narrow-leaf Hop-bush and Wilga. The shrub layer apart from the White Cypress Pine was patchy with most species recorded along the drainage line and in association with Bimble Box. Regeneration of Bimble Box and Dwyer's Mallee Gum was common, particularly in open areas.

Ground cover comprised a mixture of predominately native grasses, with some forbs and introduced species. This layer was sparse and generally lacked the diversity of grasses that other sites recorded. Groundcover species included: Saltbush mix, Three-awned Grass and Corkscrew Grass, Annual Winter Grass, Common Everlasting, Clustered Everlasting, Mulga Fern, Variable Sida and Peppercreess.

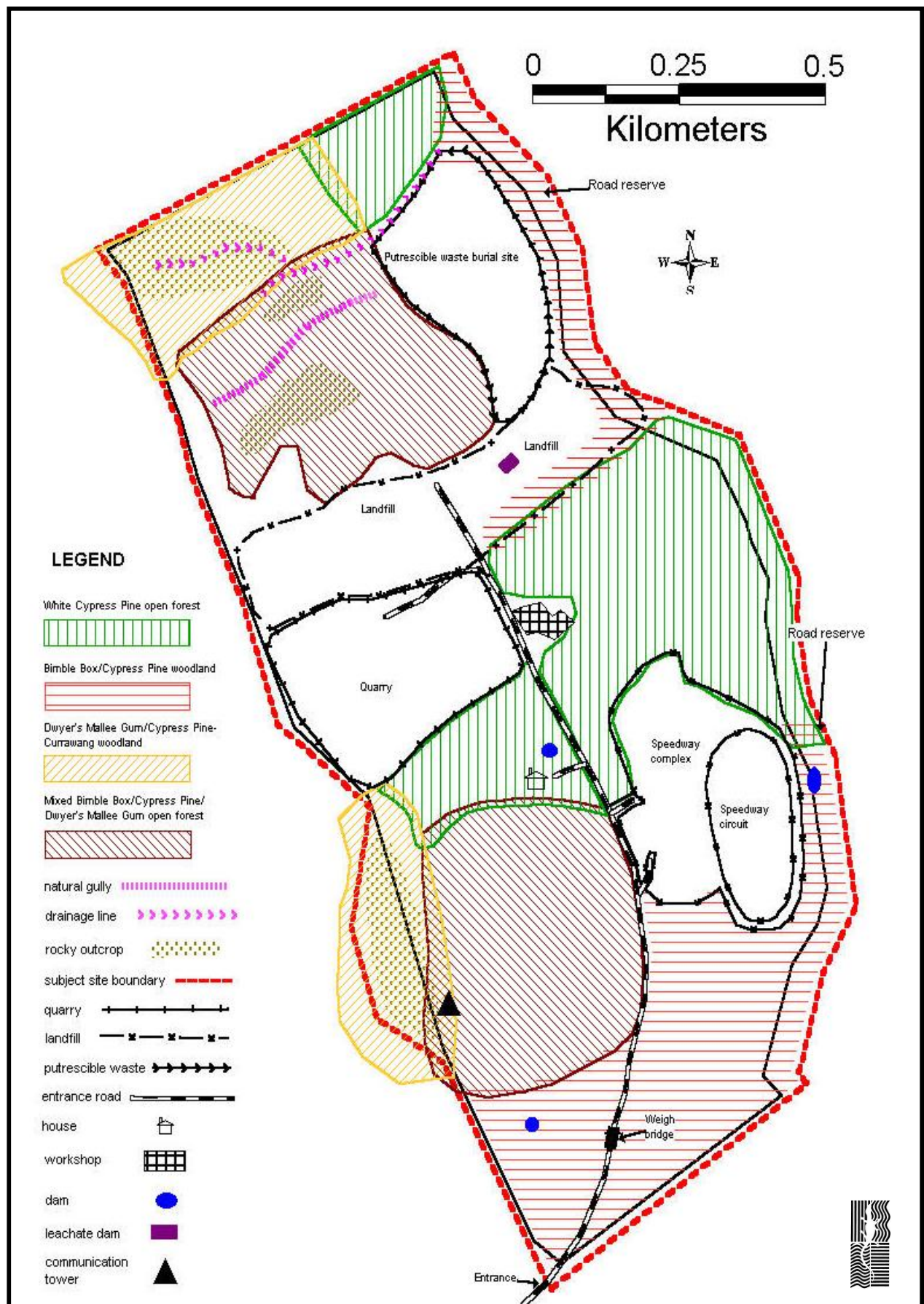


Figure 5.1. Vegetation types and habitat features of the subject site .

PLATE 1 (PHOTOGRAPHS 1 – 4)

Photo 1. Bimble Box/White Cypress Pine woodland east of weighbridge with Hop-bush shrub layer (Area 5 & 9). 80% of all bird species included the Grey-crowned Babbler were recorded within this woodland (November 2002).



Photo 2. Bimble Box/Cypress Pine woodland east of weighbridge (Area 9). Note diverse age structure of Bimble Box (November 2002).



Photo 3. Bimble Box/White Cypress Pine woodland (Area 5 & 9). Note extensive ground cover layer (March 2000).



Photo 4. Mature Currawang regrowth south of the quarry (Area 7). Part of the Dwyer's Mallee Gum/Currawang association.

PLATE 2 (PHOTOGRAPHS 5 – 8)

Photo 5. Dwyer's Mallee Gum/White Cypress Pine-Currawang woodland north of landfill (Area 9). Note abundant ground layer coverage (March 2000).



Photo 6. Dwyer's Mallee Gum/White Cypress Pine-Currawang woodland north of landfill (Area 9). Note rocky outcrop, fallen timber and lack of ground cover (November 2002).



Photo 7. Three White-browed Babbler nests and 5 other declining woodland bird species were recorded within this section of White Cypress Pine in the Dwyer's Mallee Gum woodland association north of land fill (Area 9). (November 2002).



Photo 8. Remnant Bimble Box amongst White Cypress Pine forest north of speedway. Note abundant ground layer coverage (March 2000).

PLATE 3 (PHOTOGRAPHS 9 – 12)

Photo 9. White Cypress Pine forest (Area 5). Habitat of Grey-crowned Babbler and other declining woodland birds. Note shrub layer and abundant ground layer coverage (March 2000).



Photo 10. White Cypress Pine regrowth forest Area 7 (November 2002).



Photo 11. Mixed open forest (Area 6), just west of putrescible waste burial site. Note mature & old growth eucalypt and White Cypress Pine trees



Photo 12. Mixed open forest (Area 6) with shrub layer and mature trees.

PLATE 4 (PHOTOGRAPHS 13 – 16)

Photo 13. Mature Bimble Box trees part of the road reserve east of Area 2. Grey-crowned Babblers were recorded foraging within these trees on four occasions (November 2002).



Photo 14. White Cypress Pine of road reserve east of Area 5. Grey-crowned Babblers were recorded foraging within this area on four occasions (November 2002).



Photo 15. Landfill (Area 1b and 2). Looking south at remnant Bimble Box and Currawang/White Cypress Pine regrowth in background (November 2002).



Photo 16. Dry dam immediately east of speedway, also used as part of the road reserve/bush fire track (November 2002).

5.4. HABITAT TYPES OF THE SUBJECT SITE

This assessment details the type and quality of fauna habitat features and resources present within the subject site. General fauna attributes were noted and habitat features specific to threatened species were targeted. Seven major habitat types were identified within parts of the study area that are likely to be affected by the project. These habitats offer resources for a range of native flora and fauna.

These habitats are:

1. White Cypress Pine forest
2. Bimble Box-White Cypress Pine woodland
3. Dwyer's Mallee Gum-Currawang woodland
4. Mixed Bimble Box-Dwyer's Mallee Gum-White Cypress Pine open forest
5. Rocky outcrops
6. Natural gully
7. Dams and other water bodies

The structural and floristic characteristics of the vegetation of these habitat types have been discussed in Section 5.3. Their extent and condition, along with other important fauna habitat characteristics will be discussed below (summarised in Table 5.5).

5.4.1. White Cypress Pine forest

The Cypress Pine forest provided various foraging, roosting and breeding opportunities for many bird species. Areas where all age structures were present, especially in combination with isolated Bimble Box remnants and small clearings provided a structurally diverse environment. Standing dead trees were common (natural thinning) and provided resting and foraging opportunities for many birds (e.g. ten bird species were recorded at one White Cypress Pine stag during a 5 minute period). Fallen timber was common, but not abundant and largely in the form of small branches and stems of White Cypress Pine regrowth. Fallen hollow logs were almost completely absent in this vegetation type. Other non-vascular ground cover in the form of litter (includes leaf litter, twigs, branches and bark) was common and in some places covering up to 80%, but generally only covering 20%. Soil cracks were uncommon.

Exposed bedrock in the form of small – medium rocks were common throughout this vegetation type, covering up to 50% of the ground in some areas. Rocky outcrops (i.e. large boulders, singularly or stacked containing cracks and crevices) were not recorded. Surficial gravel (fist size and smaller free floating rocks on top of the sub-soil) were common, particularly where tracks/roads passed through this vegetation type.

The loose bark of the larger White Cypress Pine and Bimble Box provide potential roosting habitat for microchiropteran bat species, particularly in vegetation around the edge of this community. High bat activity and diversity was recorded along flyways of this community in the eastern part of the subject site, with all bat species recorded being captured during harp trapping. These flyways, along tracks and between gaps in the vegetation, provided important corridors for movement between habitats and foraging areas, which is reflected through the high bat activity. The predominantly

grassy understorey found in this community provided foraging and sheltering habitat for the Eastern Grey Kangaroo.

Few invertebrates were recorded during the 2002 survey, yet many invertebrates were recorded in the forest areas, especially Golden Orb and Jewell Spiders during the 2000 survey. Natural thinning and dieback, in combination with some logging, has contributed to a more diverse community through clearings and increased ground layer components. A more structurally diverse environment is developing for native fauna species, especially woodland birds, with the combination of the diverse age structure and dense branches of the White Cypress Pine.

5.4.2. Bimble Box-White Cypress Pine woodland

This vegetation community supported the highest fauna species diversity, especially birds. The woodland type community contains open grassy areas, patchy shrub layer and numerous mature and old growth trees providing for a wide range of foraging, sheltering and breeding opportunities. Most mature and all old growth (habitat trees) Bimble Box contained small to large hollows, crevices and some loose bark, which provide suitable foraging, nesting and roosting sites for some bird species (e.g. Chestnut-rumped Thornbill) and microchiropteran bat species. A few stag trees (dead standing habitat trees) were also recorded and provided suitable foraging and roosting sites.

Fallen timber was common but not abundant, and largely in the form of small branches and twigs confined to areas beneath Bimble Box, as were the few fallen hollow logs recorded. Other non-vascular ground cover in the form of leaf litter was common but not abundant, generally covering up to 30% of the area. The various grasses and other native ground cover species provided foraging opportunities for native fauna and soil cracks were generally absent. Rocky outcrops were absent, yet exposed bedrock in the form of small – medium rocks were common throughout this vegetation type. Surficial gravels were common, particularly adjacent to roads/tracks and along watercourses

More than 80% of bird species were regularly recorded within this community. Four nests of the threatened Grey-crowned Babbler were recorded in White Cypress Pine of this community during the 2000 assessment.

5.4.3. Dwyer's Mallee Gum-Currawang woodland

This vegetation type was largely confined to mid-slopes, ridgelines and areas associated with rocky outcrops (i.e. large boulders, singularly or stacked containing cracks and crevices). Figure 5.1 displays the distribution of rocky outcrops throughout the subject site. The Dwyer's Mallee Gum/Rocky outcrop association provides important habitat features, such as small caves and rock fissures, not available within other habitat types. Two Lace Monitors (*Varanus varius*) inhabited the rocky outcrops of this community south of the quarry. Both were observed daily resting in the outcrop or moving through the associated vegetation. Remnant Dwyer's Mallee Gum were largely confined to these rocky outcrop areas, obviously where bulldozers were unable to clear.

Exposed bedrock in the form of small – medium rocks was common throughout this vegetation type, covering up to 70% of the ground in some areas. The occurrence of surficial gravel was largely confined to the area located south of the quarry. The dense Currawang and White Cypress Pine

regrowth characteristic of this area is a reflection of past disturbances (i.e. the scraping of surficial gravels). Several rock piles were also recorded within this portion of this vegetation type, further evidence of scraping for surface gravel.

A natural ephemeral drainage line running west-east, traversed this community north of the landfill, supporting native rushes and other riparian zone plants. At the time of the 2000 survey no flowing water was present, yet the soils were damp and some places saturated (ERC 2000). Discharge areas were also noted along the drainage line suggesting a spring. This area is likely to provide resources for some amphibian species (ERC 2000).

Many of the mature and all of the old growth Dwyer's Mallee Gum supported hollows, with the larger old growth trees providing a full range of hollow sizes. Fallen timber was uncommon and largely in the form of small branches and twigs, confined to areas beneath Dwyer's Mallee Gum and mature White Cypress Pine. Very few fallen hollow logs were recorded. Other non-vascular ground cover in the form of litter was common but not abundant, generally covering up to 30% of the area. Soil cracks were recorded but uncommon.

5.4.4. Mixed Bimble Box-Dwyer's Mallee Gum-White Cypress Pine

Although floristically similar, the two areas of mixed forest provided different habitat values for fauna—reflected through the age structure of the vegetation and position in the landscape. The younger mixed forest community south of the quarry is structurally less diverse, containing fewer mature and only the occasional old growth tree. Non-vascular ground cover was generally sparse or completely absent, with many areas (probably up to 40%) having bare earth. Many mature White Cypress Pine and Bimble Box occurred in this area, providing suitable shelter and roosting habitat for some bird, arboreal mammal and microchiropteran bat species.

In contrast, the mixed woodland north of the landfill provided a wide array of habitat features including: a natural gully, drainage line, rocky outcrops and a diverse age structure of the overstorey species. Non-vascular ground debris in the form of small branches, twigs and leaves was common, ranging from 0 - 80%. More large fallen logs were recorded in this area than any other habitat type.

Rocky outcrops were a prominent feature of this area, especially on the mid to upper slopes, in association with Dwyer's Mallee Gum and Bimble Box. These features provide suitable habitat for reptiles and small ground dwelling mammals. At the time of this assessment a family of foxes was recorded using the rocky outcrop network through this area as a den site. The eroded drainage line running west-east was dry at the time of the assessment. Rainbow Bee-eaters were observed using the walls of this drainage line as a breeding site. This species was also observed nesting in the same area during the 2000 survey. A number of tracks and dug out areas suggested that Eastern Grey Kangaroos were using the drainage line as refuge and cover. The gully and drainage area probably provide some suitable habitat for amphibians during wetter periods.

5.4.5. Dams and other water bodies

Three small dams were recorded in the subject site, each dry at the time of the current assessment. The function of the house dam is to serve as a capture pond for waste-water runoff from the house.

Although the dam supported some semi-aquatic vegetation, largely in the form of a stand of Cumbungi (*Typha sp.*), no surface water was recorded during the assessment. A vehicle cleaning area behind the workshop is used to clean garbage trucks and other vehicles at least several times a week. An evaporative drainage line captures the runoff. This drainage line supports a high diversity of weed species, probably because of the increased nutrients washed from the trucks. No other places within the subject site supported water during the 2002 assessment.

During the ERC (2000) investigation, the dams east of the speedway and near the entrance of the subject site both contained water, with a small patch of Cumbungi recorded at the speedway dam. No other aquatic vegetation was recorded during that assessment. Both dams are artificial but, when available, provide an important source of water. These dams probably provide some suitable habitat for amphibians during wetter periods.

Table 5.5. Summary of the key characteristics of the major fauna habitats occurring in the subject site.

Habitat	Main features	Comments
White Cypress Pine forest	Diverse age structure (portion north of speedway & north-east corner). Structurally diverse with some ground layers.	Diverse age structure (mainly northern area). Declining woodland bird habitat. Grey-crowned Babbler habitat.
Bimble Box/White Cypress Pine woodland	Old growth (habitat trees) & mature hollow bearing Bimble Box trees. Diverse understorey & good ground cover. Relatively undisturbed.	Highest fauna diversity. Declining woodland bird habitat. Grey-crowned Babbler habitat.
Dwyer's Mallee Gum/White Cypress Pine-Currawang woodland	Some old growth & mature hollow bearing Dwyer's Mallee Gum trees. Rocky outcrops & drainage line (northern area only).	High diversity of reptiles. Declining woodland bird habitat. Grey-crowned Babbler habitat. Arboreal mammal habitat (along western ridgeline only).
Mixed Bimble Box-Dwyer's Mallee Gum-White Cypress Pine open forest	Diverse overstorey with old growth & mature hollow bearing trees (north of landfill). Natural gully, drainage line & rocky outcrops (north of landfill).	Arboreal mammal habitat (north of landfill only). Woodland bird habitat. Contains remaining largely unmodified gully area.
Dams & other water bodies	Some water provided, no surface water recorded. House & vehicle cleaning area.	Potentially drought refuge area for amphibian species. Native birds observed drinking at house dam & cleaning area.
Ecotones	Meeting of vegetation types creating a mixture of different habitat types, providing high structural and floristic diversity.	High species diversity of flora and fauna. High diversity of reptiles. Declining woodland bird habitat. Grey-crowned Babbler habitat.

5.5. VEGETATION OF THE STUDY AREA

This section provides a description of the main vegetation types within the study area, excluding the subject site. This description is based upon results from the general vegetation and habitat surveys conducted within the immediate area of the subject site, and vegetation mapping, and limited ground truthing for the remainder of the study area. Vegetation mapping in combination with known records of threatened species within the study area and McPherson Range was used as a surrogate in order to determine the potential habitat of subject species within the study area.

Seven main vegetation types have been identified within the study area (GBNEG 2000; Eldridge 2002; WRRVC 2002; ERC *this study*) including:

1. Bimble Box/White Cypress woodland;
2. Dwyer's Mallee Gum/Currawang woodland;
3. Cypress Pine open forest;
4. Boree woodland;
5. Mallee woodland;
6. Wetland/swamp vegetation association; and
7. revegetation.

Figure 5.2 displays the spatial distribution of these vegetation types within the study area. Bimble Box/White Cypress Pine woodland is the dominant vegetation community accounting for the majority of vegetation within the study area. The majority of this vegetation is confined to the gentle slopes and foothill areas of McPherson Range and the basin of the range within the study area. Dwyer's Mallee Gum/Currawang woodland generally dominates the steeper slopes and hill crests of McPherson Range.

Table 5.6 provides the current extent of each vegetation community within the subject site and study area. Given that the study area is approximately 9273 ha, less than 12% (excluding wetland/riparian vegetation and revegetation) is vegetated. Very little remnant vegetation remains west of the subject site. The extent of habitat types associated with each of these vegetation types and general quality compared to the habitats within the subject site was also estimated. Given the size of the subject site, each of the various vegetation and associated habitat types are well represented within the study area, particularly Bimble Box/Cypress Pine woodland and Dwyer's Mallee Gum/Cypress Pine woodland vegetation associations.

Habitat for the threatened Grey-crowned Babbler is well represented within the study area, particularly along McPherson range and Scenic Hill area where this species has been previously recorded. Although habitat for this species is well represented in the form of adjoining Bimble Box/White Cypress Pine woodland, the quality of the habitat is more degraded as a result of grazing and other agricultural practices. The Grey-crowned Babbler was recorded moving between the subject site and adjoining vegetation on several occasions and it is likely that the subject site forms part of the overall habitat used by this species.

The Boree and Mallee vegetation communities recorded within the study area have been described according to Eldridge (2002). Neither of these vegetation communities was recorded within the subject site although a few individuals found in these communities were recorded.

General flora and habitat surveys for the area between the subject site and Tharbogang Swamp and the northern tip of the western ridgeline of McPherson Range revealed similar vegetation types to those found in the subject site and for the remainder of the study area. The land within this area is almost entirely rural, consisting primarily of mixed farming including grazing, cropping and horticultural practices. The area of land from the north-east through to the south-east of the subject site is predominately flat grazing country with Bimble Box/White Cypress Pine woodland/open woodland and to a lesser extent White Cypress Pine open forest. Dwyer's Mallee Gum/Currawang woodland dominated the steeper slopes and hill crests of this area.

The White Cypress Pine forest displayed in Figure 5.2 is a continuation of the vegetation from the subject site. Tree height ranged from 2 – 20 m with all age structures generally well represented. Understorey and ground layer diversity was sparse to patchy, as a result of grazing and clearing and was completely absent in most areas (< 20%). Ground cover was generally associated with open areas and where Bimble Box became dominant. Overstorey health ranged from complete dieback (uncommon) to excellent, generally being good.

Bimble Box/White Cypress Pine woodland dominated the vegetation of this area. Progressing further east (Tharbogang Swamp area) and north-east of the subject site Bimble Box open woodland became dominant. The age structure was dominated by numerous mature and old growth Bimble Box. Tree height ranged from 2 – 22 m with all age structures well represented, except for early regeneration (< 2 m), which was sparse and patchy. Like the Cypress Pine open forest, understorey and ground layer diversity was sparse to patchy, as a result of grazing and clearing and was generally absent in most areas (< 30%). Ground cover was generally associated with open areas. Overstorey health ranged from complete dieback (uncommon) to excellent, generally being good.

Land south of the subject site consists of a mixture of Bimble Box/White Cypress Pine woodland, regrowth of the same vegetation types, cleared land and orchards. Remnant Bimble Box woodland generally dominated the flatter areas, with Dwyer's Mallee Gum/White Cypress Pine/Currawang regrowth becoming more dominant as slope increased. A 10 ha patch of White Cypress Pine/Currawang regrowth vegetation immediately south-east of the subject site was recently cleared for rural residential development.

Native vegetation on private property along the south-western boundary of the subject site consisted of Dwyer's Mallee/White Cypress Pine-Currawang woodland and Currawang regrowth. Currawang regrowth dominated adjoining private land, as a result of past clearing and burning. The area along the western boundary adjacent to the quarry and landfill is almost completely cleared for orange orchards. A few Bimble Box and Currawang constitute a very fragmented linear (< 5 m) corridor. Orange orchards and other horticulture practices dominate the landscape from the western boundary of the subject site, extending south-west through to Slopes Road. Beyond Slopes Road the study area is almost entirely dominated by cropping, grazing and various horticultural practices. Little native vegetation with the exception of some minor roadside remnants and revegetation exists.

Vegetation north of the subject site is an extension of the Dwyer's Mallee Gum/Cypress Pine-Currawang woodland and White Cypress Pine open forest of the northern section of the subject site. This area is approximately 150 ha and represents the northern tip of the western ridgeline of McPherson Range. The area is constantly grazed and portions were also harvested for natural surface

gravels. Tree height ranged from 2 – 20 m with all age structures generally represented. Understorey and ground layer diversity was sparse to patchy, as a result of grazing and clearing and was generally associated with open areas. The ground layer was absent for most of this area. Overstorey health for both Dwyer's Mallee Gum and White Cypress Pine ranged from complete dieback (common) to excellent, with most trees showing some signs of dieback.

The Bimble Box/White Cypress Pine woodland/open woodland vegetation found from the south-east to the north-east of the subject site represents a significant vegetation community which is largely absent from the foot slopes of the McPherson Range. This woodland acts as a fragmented corridor linking the northern tip of the western ridgeline to the southern ridgeline and other parts of the range, and to Lake Wyangan via remnant and revegetated roadside vegetation.

Table 5.6. Current extent of vegetation types within the subject site and study area.

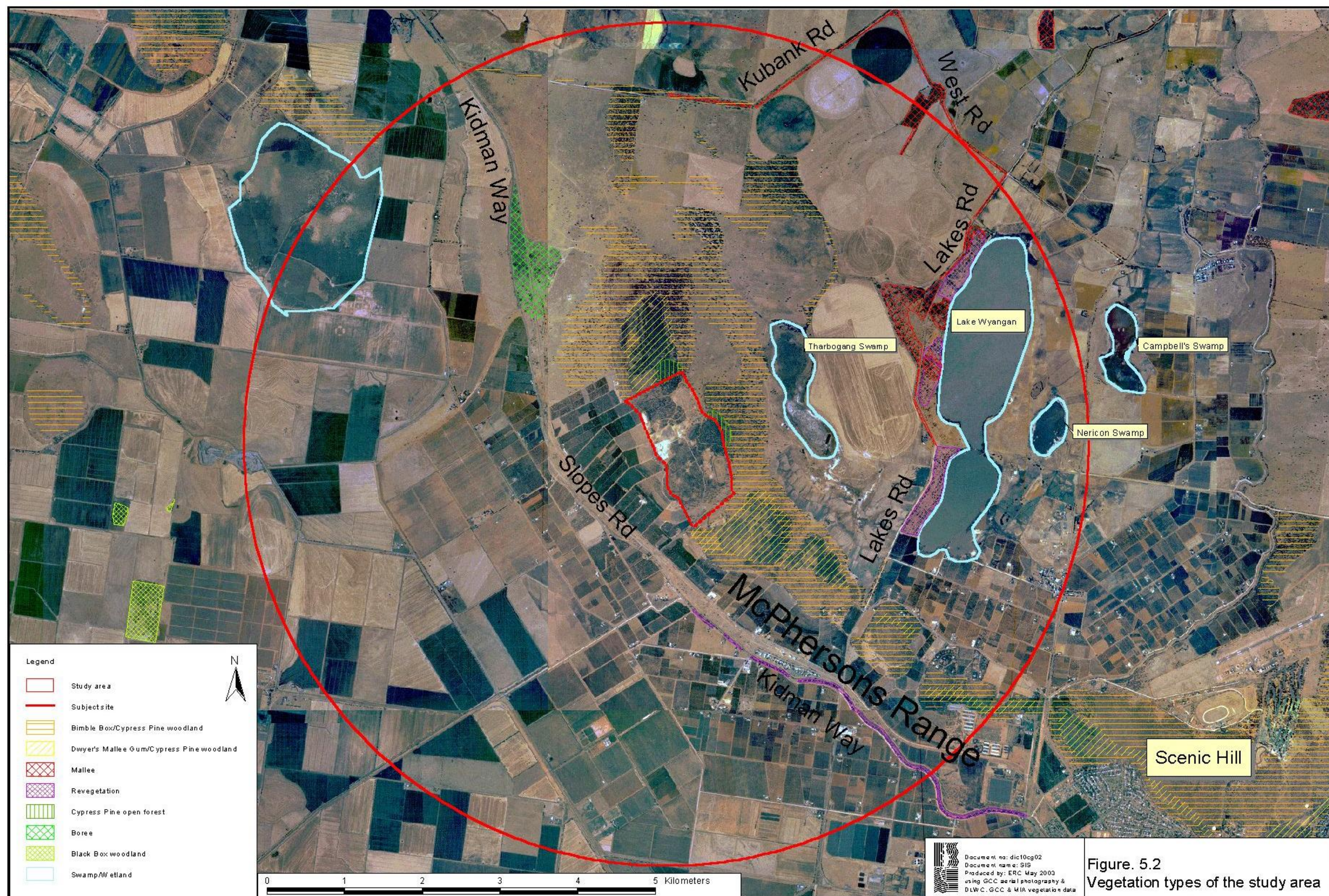
Vegetation type	Current extent of vegetation type (ha)	
	Subject site	Study area (not including subject site)
Bimble Box/White Cypress Pine woodland *	18	755
Dwyer's Mallee Gum/Currawang woodland	14	188
White Cypress Pine forest	21	11
Boree	0	39
Mallee	0	32
Wetlands/swamp vegetation association	0	N/A
Revegetation	0	49
Mixed Bimble Box-Dwyer's Mallee Gum-White Cypress Pine open forest	28	Subject site only

NOTE:

N/A - Wetlands/swamp vegetation association was not mapped. However there is approximately 20 km of foreshore of wetlands and lakes combined within study area.

* - includes Bimble Box/White Cypress Pine & Bimble Box woodland

All figures within the study area excluding the subject site are approximate and based upon calculations completed by ERC for canopy cover of the main vegetation types mapped from aerial photograph interpretation and existing vegetation mapping. Limited ground truthing was conducted to verify vegetation types, species composition, extent of each vegetation type and associated habitat types. All figures calculated for the subject site are based upon extensive ground truthing and aerial photograph interpretation.



5.6. FAUNA OF THE SUBJECT SITE

The subject site supports a high diversity of native fauna, despite some areas being severely disturbed. Native fauna was most abundant within the woodland, mixed forest type vegetation and ecotone areas. A total of 104 native and six introduced vertebrate fauna species were recorded on the subject site during surveying times and incidental observations. All species recorded during this assessment have been previously recorded in the McPherson Range and Griffith region (NSW NPWS Wildlife Atlas Database, Murrumbidgee Field Naturalists and the Griffith Built and Natural Environment Group (GBNEG 2000)). A full fauna species list can be found in Appendix B.

Additional species have been recorded in the Griffith region as a result of previous studies and database searches (e.g. NSW NPWS Wildlife Atlas & ERC). These records are from an extensive area and it is possible that some of these species, including threatened species, could use the subject site on occasions.

The subject site is most probably used as a sanctuary by the kangaroos due to the pressures of shooters in adjacent farmland and orchards. This is likely for many of the more mobile native vertebrates including the Echidna, Brushtail Possum and Lace Monitor, all of which were recorded within the subject site. Lace monitor tracks were recorded each day leading from a rocky outcrop along the western boundary of the subject site into nearby orchard and farmland. Tracks for all the above species were recorded along fence lines and under gaps in fences, most commonly adjacent to the irrigated orchards to the west, which probably provides an important, reliable water source in times of drought. It is likely the subject site and other parts of McPherson Range provide important drought refuge areas. The range is one of the most prominent areas of native vegetation remaining within the Griffith region and has nearby permanent water in the form of Lake Wyangan and associated water bodies.

5.6.1. Birds

A total of 77 native and three introduced species were recorded within the subject site. The majority of species were revealed during diurnal bird survey transects, with the woodland vegetation types recording the greatest species diversity and abundance. The avifauna recorded within the subject site are characteristic of the assemblages found within the forest, woodland, open woodland and fragmented agricultural lands of McPherson Range and the Griffith region.

Eleven bird of prey were recorded during the current field investigation. The Black Kite was most frequently recorded, with a total of twenty-eight individuals recorded hovering above the tip during one observation. The White Cypress Pine woodland, both north and south of the landfill, provided ideal roosting sites and two nests were recorded in each locality for this species. The subject site boasts high diversity of raptors probably due to the abundance of prey associated with the landfill. It is likely that the proposed development will have an adverse affect upon the raptors within the subject site. Whilst the development may possibly increase the foraging habitat and availability for some species, it will also remove or modify a significant proportion of their roosting and breeding sites.

Nocturnal surveys revealed the presence of three nocturnal bird species; Southern Boobook (*Ninox novaeseelandiae*), Barn Owl (*Tyto alba*) and the Australian Owlet Nightjar (*Aegotheles cristatus*). The Barn Owl was frequently sighted during spotlighting transects in White Cypress Pine forest south-west and south-east of the landfill and the Bimble Box woodland (ERC 2000). Call playback revealed the presence of an Australian Owlet Nightjar, which was heard near the edge of the White Cypress Pine in the north-east portion of the subject site (ERC 2000 & 2002) and the Southern Boobook, which was heard offsite. The Southern Boobook was also heard during spotlighting transects.

It is likely that a number of common bird species from the region may frequent the site, particularly during different seasons and when different plant species are in flower. A total of twenty-seven threatened bird species, as listed under the *TSC Act 1995*, were recorded in previous studies from the region. However, apart from the Grey-crowned Babbler, none of these species were recorded, or have previously been recorded within the subject site. Many declining woodland bird species not listed under the *TSC Act 1995* were recorded on site. These species will be further discussed below.

Several of subject species have been recorded in the McPherson Range area from previous studies including the Grey Falcon, Pink Cockatoo, Barking Owl and the Painted Honeyeater (threatened species map, Appendix K). As a result of this field investigation and preliminary research it has been found that the subject site does provide potential resources for seven bird species (including the Grey-crowned Babbler) listed under the *TSC Act 1995*. These species have the potential to occur within the subject site on occasions or may actually use the subject site as part of their overall habitat. The potential impacts of the proposed development upon these species including the Grey-crowned Babbler will be further discussed in Sections 6 and 7.

5.6.2. Declining woodland birds

Woodland birds have declined significantly in the wheat/sheep belt of New South Wales over the past 50 years. Woodland birds rely on the habitat found in bushland remnants such as McPherson Range for their continued survival. The area, condition and isolation of those remnants are important factors in the survival of bird populations, as is the total amount of habitat remaining in the landscape (Bennett 1999; Ford *et al.* 2001). Nine declining woodland birds, including the threatened Grey-crowned Babbler, as listed by Reid (1999 and 2000) and The Action Plan for Australian Birds (Garnett and Crowley 2000), were recorded by ERC during the 2000 and 2002 investigations. Five pairs of Red-capped Robins were recorded within the subject site. A pair was found in each of the vegetation types, with at least two pair recorded within White Cypress Pine forest and Dwyer's Mallee Gum/White Cypress Pine woodland vegetation types.

Table 5.7 lists each of these birds and provides a summary of the vegetation types where these species were recorded. Although, apart from the Grey-crowned Babbler, these species are not listed under the *TSC Act 1995*, most are listed as of some conservation concern and/or near threatened and likely to become threatened if appropriate management of remaining habitat is not undertaken. It is important to note that a number of bird species listed as subject species (e.g. Hooded Robin and Diamond Firetail) not recorded within the subject site are declining woodland birds identified by Reid (1999 and 2000) and Garnett and Crowley (2000). The assessment concluded that the subject site does have potentially suitable habitat for these species.

Table 5.7. Declining woodland birds recorded within the subject site.

Species name	Vegetation/habitat recorded			
	White Cypress Pine forest	Bimble Box/White Cypress Pine woodland	Mixed Bimble Box/Dwyer's Gum/ Cypress Pine open forest	Dwyer's Mallee Gum/Cypress Pine-Currawang woodland
Brown Treecreeper	X	√	√	X
Chestnut-rumped Thornbill	√	√	√	√
Southern Whiteface	√	√	√	X
Grey-crowned Babbler	√	√	X	X
White-browed Babbler	√	X	X	√
Red-capped Robin	√	√	X	√
Eastern Yellow Robin	√	√	X	X
White-browed Woodswallow	√	√	√	√
Dusky Woodswallow	√	√	√	√

The vulnerable Grey-crowned Babbler was recorded on the subject site during the ERC 2000 and 2002 field investigations. Figure 5.3 displays the known records of this species within the subject site and adjacent land during the ERC 2000 & 2002 investigations. This species was frequently recorded within the Bimble Box/White Cypress Pine woodland, White Cypress Pine forest and numerous old growth and mature Bimble Box trees in the road reserve and between the road reserve and land fill area. During the 2000 assessment four nests, two of which were active were recorded for this species in two White Cypress Pine within the Bimble Box/White Cypress woodland. Remnants of babbler nests were recorded during the 2002 assessment within the same area suggesting that the species was not using the subject site for nesting at the time of the assessment. Furthermore, only individual birds or pairs of birds, but no juvenile birds were recorded during the most recent assessment.

The Grey-crowned Babbler lives in groups of between 2 – 13 birds (Davidson and Robinson 1992) and a home ranges that varies from 2 – 53 ha (Blakers et al. 1984), which increases with group size. Territory and group size varies accordingly with the quality of habitat (Brown et al. 1983). Although it was difficult to differentiate between individuals of this species it is estimated that between 4 – 6 individuals were recorded within the subject site and on adjacent land east of the subject site during the most recent assessment.

Given the availability of suitable habitat within the subject site, intense targeted searches and previous records within the subject site and adjoining vegetation it is considered likely that the subject site forms an important component of the overall habitat used by this species. No records exist for this species within the study area despite the availability of suitable habitat, particularly along McPherson Range. However several records exist for this species in the Scenic Hill area and Griffith Golf Course. A family of six were recently recorded at the Griffith Golf Course foraging in the middle of a fairway (pers. Comm. Grabham 2003). The 'eight part test' will be applied to this species (see Section 7.1 and Appendix L.).

It is likely that a number of other declining woodland bird species from the region may frequent the site, particularly during different seasons and when different plant species are in flower. More than twenty-five declining woodland bird species have been recorded from the Griffith region, with at least twelve of these species being recorded within the McPherson Range and associated areas (NSW NPWS Wildlife Atlas; MFN various dates).

5.6.3. Ground dwelling and arboreal mammals

Targeted surveys failed to reveal any small ground dwelling mammals within the subject site. Despite conducting 300 Elliott trap nights during the current survey, no native or introduced fauna was captured.

The Eastern Grey Kangaroo was recorded frequently in all vegetation types of the subject site. The White Cypress Pine forests provided suitable shelter and limited foraging, whilst adjacent woodland/grassland provided foraging opportunities.

The Brushtail Possum was recorded during spotlighting transects, but only in mixed forest vegetation and Dwyer's Mallee Gum woodland. It is likely that predation from foxes and cats may limit the number of arboreal mammals within the subject site. Both the Fox and Feral Cat were frequently recorded around the existing tip area during spotlighting transects and bird surveys in the mornings. Four fox cubs were recorded using a network of dens amongst the rocky outcrop in the mixed forest vegetation.

No threatened arboreal or ground dwelling mammal species as listed under the *TSC Act 1995* were recorded during this survey or during previous surveys of the study area. It is considered '*unlikely*' that the proposed development will have a '*significant effect*' upon any of the arboreal or ground dwelling mammals that may be found within the subject site. The potential impacts of the proposed development upon threatened mammal species will be further discussed in Sections 6 and 7.

5.6.4. Microchiropteran bats

Microchiropteran bats comprised all but two of the native mammal species recorded. Harp trapping and anabat surveys revealed the presence of ten bat species from the subject site. Anabat analysis was conducted by Glen Hoye of 'Fly By Night Bat Surveys' (see Appendix M). A rating of confidence was given for each of the species recorded, as 'confident', 'probable' or 'possible'.

During the 2000 survey, the anabat was placed within the woodland area south of the speedway for a single night. Species recorded included: Forest Bat (*Vespadelus spp.*), White-striped Mastiff Bat (*Tadarida australis*), Gould's Wattled Bat (*Chalinolobus gouldii*) and Chocolate Wattled Bat (*C. morio*)—all relatively common throughout the Griffith region.

The anabat was placed in all vegetation types, except for the Dwyer's Mallee Gum woodland during the current survey. Ten bat species including two threatened species (i.e. Little Pied Bat and Fishing Bat *Myotis macropus/adversus*) were recorded from anabat analysis. Four species were '**confidently**' identified including the White-striped Mastiff Bat, *Mormopterus planiceps* (large penis form), *Mormopterus planiceps* (short penis form) and Gould's Wattled Bat. Two species were identified as '**probable**' including the threatened Fishing Bat and *Vespadelus spp.*, and four species were identified as '**possible**' including the threatened Little Pied Bat, Chocolate Wattled Bat, *Nyctophilus sp.* and Inland Broad-nosed Bat.

Harp trapping conducted as part of targeted surveys for the threatened Greater Long-eared Bat, Inland Forest Bat and Little Pied Bat during the 2002 investigation recorded 95 individuals of six species including the *Mormopterus planiceps* (large penis form), *Mormopterus planiceps* (short penis form), Gould's Wattled Bat, Little Forest Bat, Inland Broad-nosed Bat and the threatened Inland Forest Bat all of which were recorded from anabat analysis with the exception of the Inland Forest Bat. This species was captured at all harp trap sites with the exception of the Bimble Box/White Cypress Pine woodland site where overall bat species diversity and abundance was lowest. This is most likely due to the lack of clearly defined fly ways/corridors to place the harp trap, which is a reflection of the relatively open structure of this vegetation type.

The Inland Forest Bat represented only 5 individuals (5%) of the 95 bats captured. The majority of bats captured were Little Forest Bat (38 individuals or 40%) followed by *Mormopterus planiceps* (long penis form) (25 individuals or 26%). All Inland Forest Bats captured were alike. Characteristics recorded used to distinguish this species from the Southern Forest Bat and Little Forest Bat included: forearm length ranging from 29 – 31.5 mm with an average of 29.8 mm; upperparts with light brown fur and grey hair base (bi-coloured); underparts were notably lighter, creamy white; and tragus was lighter than the colour of the ear but not white.

All Inland Forest Bats had larger forearm lengths than those of all the Little Forest Bats captured and were also different in colour, overall body size and facial appearance. All Little Forest Bats were alike and recorded same diagnostic characteristics. Churchill (1998) and Parnaby (1992) were used to confirm the identity of all microchiropteran bat species. Lumsden and Bennett (1995) was used to help aid the identification of the Inland Forest Bat.

Many bats were observed leaving roosting trees in the Bimble Box/White Cypress Pine woodland during stag watching surveys and incidental observations during spotlighting. Microchiropteran bats can be found roosting in tree hollows, under bark slabs and deep fissures. These resources are generally only offered by mature and old growth trees and stags found within the subject site. It is considered '*likely*' that the proposed development will have an adverse affect upon bat species inhabiting the subject site as it will require the removal of large remnant trees and stags and subsequently potential roosting sites, foraging areas and the modification of flight paths and

corridors. The potential impacts of the proposed development upon the threatened bat species identified during this assessment will be discussed further in Sections 6 and 7.

5.6.5. Reptiles

Ten reptile species were recorded within the subject site. Table 5.8 lists each of the reptile species recorded and provides a summary of the vegetation types where these species were recorded. All species were recorded during the current survey, with the exception of the Yellow-faced Whip Snake, which was recorded only during the 2000 survey. All ten species were recorded within the Dwyer's Mallee Gum/rocky outcrop habitat, with most species recorded in the mixed forest habitat and ecotone areas associated with Dwyer's Mallee Gum woodland and White Cypress Pine forest. Seven of the ten species were recorded within all vegetation/habitat types with the exception of White Cypress Pine habitat, where only three species (Shingle-back Lizard, Pale-flecked Garden Skink and Thick-tailed Gecko) were recorded. These species were nearly always recorded around the edges of this community and near ecotones. No species were recorded in dense White Cypress Pine regrowth areas. These areas provided little suitable habitat for reptile species, compared with the more structural diverse ground layer found in other vegetation types. All species recorded are considered secure and common within the Griffith region.

Intensive diurnal reptile and amphibian searches within each vegetation type revealed the presence of only three species of the ten recorded; Wood Gecko, Tree Dtella and Grey's Skink. However, all species were recorded during spotlighting surveys. The Tree Dtella and Thick-tailed Gecko were both recorded frequently during spotlighting surveys, especially along the tracks surrounding the landfill and amongst the mixed forest and Dwyer's Mallee Gum woodland vegetation.

Rocky outcrops, some fallen timber and other ground debris especially in the mixed open forest and woodland vegetation types of the subject site provided habitat features for reptiles. Considering the relatively high number of reptile species recorded, it is likely that the subject site supports a number of more common reptile species including the Eastern Brown Snake and Common Scaly-foot Lizard.

No threatened reptile species as listed under the *TSC Act 1995* were recorded during this survey or during previous surveys of the study area. It is considered '*unlikely*' that the proposed development will have a '*significant effect*' upon any of the reptile species that may be found within the subject site. The potential impacts of the proposed development upon threatened reptile species will be further discussed in Sections 6 and 7.

Table 5.8. Reptiles recorded within the subject site.

Reptiles	Vegetation/habitat recorded			
	White Cypress Pine forest	Bimble Box/White Cypress Pine woodland	Mixed Bimble Box/Dwyer's Gum/ Cypress Pine open forest	Dwyer's Mallee Gum/Cypress Pine-Currawang woodland
Eastern Spiny-tailed Gecko	X	√	√	√
Wood Gecko	X	√	√	√
Tree Dtella	X	√	√	√
Thick-tailed Gecko	√*	√	√	√
Bearded Dragon	X	√	√	√
Lace Monitor	X	√	√	√
Pale-flecked Garden Skink	√*	√	√	√
<i>Menetia greyii</i>	X	√	√	√
Shingle-back	√*	√	√	√
Yellow-faced Whip Snake	X	√	√	√

NOTE:

* These species were nearly always recorded around the edges of this community and near ecotones. No species were recorded in dense White Cypress Pine regrowth areas.

5.6.6. Amphibians

The Common Froglet and the Striped Marsh Frog were the only amphibian species recorded within the subject site. During the 2000 investigation both species were frequently heard calling during the day whilst conducting vegetation surveys and at night when conducting spotlighting surveys. Only a single record for each species was recorded during the most recent survey, despite additional sampling. However, both species were recorded frequently west of the subject site in the irrigated orange orchards during the day and night. Both species are adaptable, common and can be found throughout the Griffith region.

No call playback sessions were conducted for the threatened Southern Bell Frog or other frog species as part of the most recent surveys. It is considered that the three dams of the subject site provide habitat in the form of breeding and foraging areas for frog species and probably provide important habitat in the form of drought refuge, despite the lack of surface water in all dams. It is likely that these areas will serve as important breeding sites as they are the only areas capable of storing water at depth for the development of tadpoles and subsequent feeding areas.

No threatened amphibian species as listed under the *TSC Act 1995* were recorded during this field study or previous studies of the area. It is considered ‘*unlikely*’ that any threatened amphibian species occur within the subject site, given the condition and lack of the suitable resources offered by the subject site. The potential impacts of the proposed development upon threatened amphibian species will be further discussed in Sections 6 and 7.

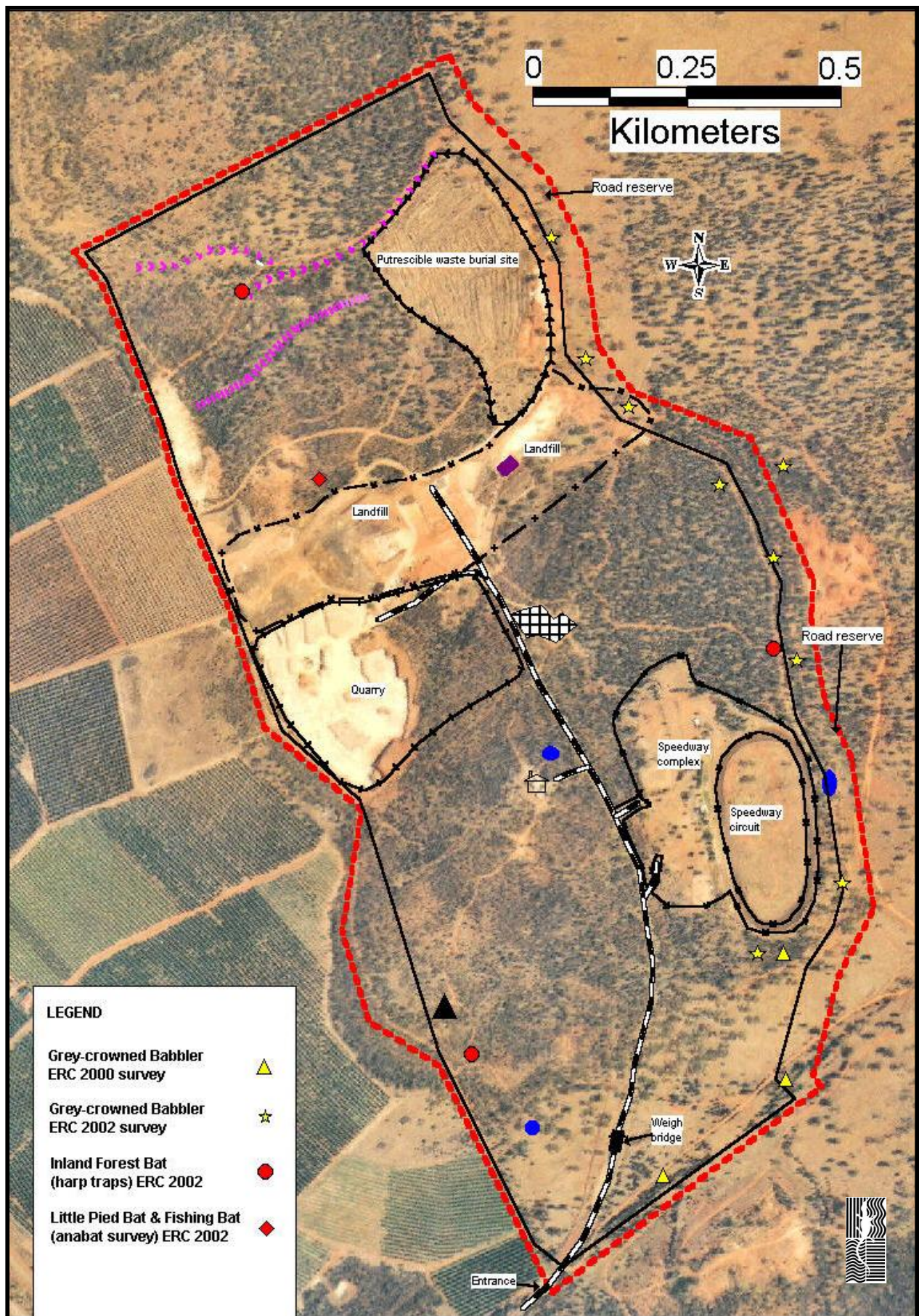


Figure 5.3 Threatened species recorded during 2000 and 2002 ERC surveys.

6. ASSESSMENT OF POTENTIAL IMPACTS

The purpose of this section is to identify the potential direct and indirect impacts of the proposed development and the subject species that are most likely to be impacted. There is a range of potential impacts that could affect threatened and regionally significant species that occur in the study area. These impacts are predicted to vary in magnitude depending upon the species and their dependence on habitats within the study area. The existing impacts of the current landfill and quarry operations will also be discussed.

6.1. EXISTING ECOLOGICAL IMPACTS

The subject site in many areas is already disturbed as a result of the impacts caused by the existing quarrying and landfill operations. These activities have contributed directly to the reduction and fragmentation of habitat and indirectly to a range of continual disturbances such as changes to the hydrological regimes, increased edge effects and weed infestation.

It is likely that the existing operations negatively affect most native flora and fauna, whilst few have positively benefited (e.g. birds of prey). The landfill operations have probably benefited the introduced Feral cat and Fox by providing a constant food supply despite the drought conditions. These introduced predators are likely to have a detrimental impact upon the native wildlife of the area, especially particularly ground dwelling vertebrates and some bird species.

The existing quarry and landfill operations have significantly fragmented the subject site. The road network throughout the site has contributed to internal fragmentation, and the development of the quarry and landfill areas have divided the site into two main portions, which are only connected by a fragmented linear road reserve and scattered remnant vegetation. The closest distance across the divide of the existing landfill is at least 150 m. Fragmentation directly limits the ability of some species, particularly many woodland birds, to move or disperse from one area to another and increases the probability of chance events further reducing population numbers. It is also likely that because of the road network, species of the subject site are probably killed or injured by vehicles, particularly reptiles.

The subject site is surrounded by agriculture and horticultural land. All vegetation west of the subject site has been removed for orchards and other horticultural practices. Land to the east and north is intensively grazed and cropped, and some areas are being cleared for rural residential development and reasons unknown. In any case, land surrounding the subject site is not protected for the benefit of conservation or biodiversity. This places further emphasis on the significance of the native vegetation of the subject site.

Further reducing and fragmenting the vegetation and associated habitat of the subject site through the activities of the proposed development will further decrease the ecological value of the area.

6.2. POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT

There is a range of potential impacts that could affect threatened and regionally significant flora and fauna that occur in the study area. The potential impacts are predicted to vary in magnitude depending upon the species and their dependence on habitats within the study area. There is also potential for indirect impacts upon native flora and fauna within the study area and surrounding lands through erosion, sediment discharge and deposition, reduction in water quality, and dust, chemical and noise pollution. Potential dust and noise pollution are of particular concern in relation to impacting upon native flora and fauna.

6.2.1. Removal of vegetation and habitat

Approximately 50 ha (59%) of the 85 ha of existing native vegetation of the subject site will be removed as a result of the proposed development. As part of this process, all vegetative layers and habitat features of the proposed landfill and quarrying areas will be removed. Table 6.1 summarises the extent of the removal of vegetation and associated habitat by the proposed development in order of the proposed sequence of events and the associated areas.

In regional terms, the removal of this amount of vegetation is not regarded as of particular consequence, particularly in regards to the rate of removal (i.e. approximately 50 ha over a 40 year period). However, the removal of the ‘type of vegetation’ is of particular concern at a local and regional level. Eldridge (2002) described the regional status of the Bimble Box-Pine woodland community (described as Bimble Box-White Cypress Pine woodland in this report) within the MIA (locality) as ‘endangered’, with less than 10% of the pre-European extent of this vegetation community remaining. At a regional level (bioregion as defined for the purpose of this assessment), Callitris mixed woodlands within the Riverina and Bimble Box woodland within the Cobar Penepplain are both considered to be part of the most threatened vegetation communities within these two bioregions (Benson 1999). The WRRVMP (2002) overlaps with these two bioregion areas and describes the Bimble Box-Pine woodland community as well retained, yet the Bimble Box woodland community is ‘endangered, with less than 10% of the pre-European extent of this vegetation community remaining.

Within the Griffith locality, removal of the Bimble Box-Pine woodland vegetation from the subject site conflicts with the targets set by the Draft WRRVMP (2002) in regards to the remaining extent of this vegetation type. The objectives for these targets (as outlined in Section 2.3.5) state that regionally endangered or vulnerable vegetation must have net gain. Specifically the target states using regeneration and revegetation, all regionally restricted, endangered and vulnerable vegetation types will be restored to 10% of their pre-European distribution by 2012 and to 30% of their pre-European distribution by 2032. The Bimble Box-Pine community is considered to be ‘endangered’, within the Griffith locality (MIA) (Eldridge 2002). This community also includes the regionally endangered Bimble Box woodland community as described in the WRRVMP (2002). The impact amelioration measures will ensure that this regionally significant vegetation within the subject site is protected from the impacts of the proposed development.

In local terms, the removal of this vegetation should be regarded seriously. The subject site constitutes a 124 ha portion of the western ridgeline of McPherson Range. Further vegetation removal will place significant pressure upon the ridge as an effective wildlife corridor. Despite the site already being fragmented, it does serve to form a significant corridor, connecting the western tip of the McPherson Range with the southern ridgeline/Scenic Hill area. This in turn will affect the movement of some groups and individual species of fauna, which rely upon the vegetation for cover and temporary refuge in order to move from one section of the range to another.

Many fauna species will be directly affected by the removal of this vegetation, especially declining woodland birds and the threatened Grey-crowned Babbler. Already this species is affected by fragmentation and the size of the remaining remnant vegetation. Home range size for this species varies from 2 – 53 ha (Blakers et al. 1984), which increases with group size. Territory and group size varies accordingly with the quality of habitat (Brown et al. 1983). Like the Grey-crowned Babbler, the majority of declining woodland birds (section 5.6.2) are affected by patch size and fragmentation, with most species disappearing from remaining remnants below 100 – 200 ha. Approximately 40% of the existing habitat suitable for declining woodland birds will be removed by the proposed development. More than 70% of the original ‘known’ Grey-crowned Babbler habitat within the subject site will be removed by the end of Activity 9.

Known foraging and roosting habitat in the form of the Bimble Box-White Cypress Pine woodland area for microchiropteran bat species and potential foraging and roosting habitat across the remainder of the subject site for three threatened bat species recorded during the current survey will also be affected by the proposed development.

Clearing of native vegetation (as defined and described in the final determination of the Scientific Committee) is listed as a Key Threatening Process under Schedule 3 of the *TSC Act 1995*. In New South Wales, since 1788, at least 61% of the original native vegetation has been cleared, thinned or substantially or significantly disturbed (Environment Protection Authority 1997). Clearing of any area of native vegetation, including areas less than two hectares in extent, may have significant impacts on biological diversity.

The subject site provides resources and habitat features required by other native flora and fauna considered common within the region. Consequently, some of the more common native flora and fauna species of the subject site will be adversely affected by the proposed development.

Table 6.1. Extent of removal of vegetation and associated habitat per proposed sequence of activity and relevant area.

Activity	Area no.	Removal of vegetation and time frame	Rehabilitation and revegetation	Potential impact
1.	1 (a & b) and 2	In order to complete landfill Area 1 and 2, up to 10 mature & old growth Bimble Box, & Currawang and White Cypress Pine advanced regrowth will be removed constituting an area of < 1 ha. (NOTE: Council have the necessary approval to complete this stage). Up to 10 mature & old growth remnant Bimble Box may also be removed from between the road reserve and eastern boundary of landfill Area 2.	A 50 m wide corridor will be revegetated, along part of Area 2.	Removal of 'known' Grey-crowned Babbler foraging habitat (i.e. remnant Bimble Box located between the road reserve and eastern boundary of landfill, Area 2). Otherwise, potential impacts to other threatened species are 'unlikely'.
2.	1, 4 & 8	The development of recycling facilities in Area 8 will remove at least 10 remnant old growth & as many mature Bimble Box from the woodland area constituting the removal of 2.5 ha of vegetation. All native vegetation layers will be removed as part of the proposed works for this activity. A few mature White Cypress Pine & regrowth within the existing green waste area will also be removed. Development of Area 8 will remove all 'buffer vegetation' from around the Buloke stand.	Rehabilitation of Area 1 will commence. The vegetation corridor started during Activity 1 will be extended to include a 30 m wide corridor across the north-east boundary from the bottom of Area 4.	Removal of important habitat (regionally significant - Bimble Box woodland), not well represented within the subject site and remaining habitat modified. Potential impacts upon declining woodland bird species are 'likely' (Area 8). Increased edge effect and fragmentation (Area 8). Removal of potential threatened bat habitat and 'known' Grey-crowned Babbler foraging and breeding habitat (Area 8).
3.	4	Up to six scattered remnant Bimble Box along the boundary of Area 4 will be removed.	-	Removal of 'known' Grey-crowned Babbler foraging habitat (i.e. remnant Bimble Box woodland). Otherwise, potential impacts upon threatened species 'unlikely'.
4.	3 & 6	Completion of the quarry in Area 3 will constitute the removal of approx. 2 ha of Currawang and Cypress Pine dominated regrowth with the occasional remnant Cypress Pine & Bimble Box. (NOTE: Council have the necessary approval to complete this stage). All vegetation layers will be removed as part of the proposed works for this activity.	-	Potential impacts of completion of quarrying in Area 3 upon threatened species 'unlikely'.

Table 6.1. cont.

Activity	Area no.	Removal of vegetation and time frame	Rehabilitation and revegetation	Potential impact
5.		Quarry operations in Area 6 will involve the removal of all mixed forest vegetation (13 ha) north of the landfill. All vegetation layers and associated habitat including the natural gully, rocky outcrops, drainage line and numerous old growth trees will be removed as part of the proposed works for this activity.		Important habitat in the form of the natural gully, drainage line & mixed open forest vegetation dominated by mature & old growth overstorey will be removed from the subject site (Area 6). Removal of potential threatened bat habitat (Area 6).
6.	3 & 4	No native vegetation should be removed as part of this activity.	Rehabilitation of Area 4 will commence.	Potential impacts upon threatened species considered 'unlikely'.
7.	7 & 3	Quarry operations in Area 7 will involve the removal of 11 ha of mixed forest, 4 ha of Cypress Pine forest & 1.5 ha of Dwyer's Mallee Gum woodland & all associated habitat features. Completion of quarrying in Area 6 & 7 will remove all mixed forest vegetation from the subject site by 2020. All vegetation layers and associated habitat including the natural gully, rocky outcrops, drainage line and numerous old growth trees. Area 8 in combination with completion of quarrying in Area 7 will remove approx. 2.5 & 1.5 ha respectively of the original Bimble Box woodland within 20 years. All vegetation layers will be removed as part of the proposed works for this activity.	Rehabilitation of Area 3 will commence.	Important habitat in the form of the natural gully, drainage line & mixed open forest vegetation dominated by mature & old growth overstorey will be removed from the subject site. Removal of important ecotone areas (Area 6, 7 & 8). Removal of potential threatened bat habitat (i.e. remnant Bimble Box woodland and mixed forest, Areas 7 & 8) and 'known' Grey-crowned Babbler foraging and breeding habitat. (i.e. remnant Bimble Box woodland, Area 8). Important habitat (Bimble Box woodland), not well represented within the study area will be modified and reduced (Area 8). Potential impacts upon declining woodland bird species are considered 'likely'.
8.	6	Completion of landfill Area 6 will not involve the removal of any vegetation.	-	Potential impacts upon threatened species considered 'unlikely'.

Table 6.1. cont.

Activity	Area no.	Removal of vegetation and time frame	Rehabilitation and revegetation	Potential impact
9.	7 & 6	Completion of landfill (Area 7) will not involve the removal of any vegetation.	Area 6 will be rehabilitated.	Potential impacts upon threatened species considered 'unlikely'.
10.	7 & 5	All vegetation of the White Cypress Pine forest (14 ha) north of the existing speed (excluding vegetation within the road reserve approx. 3 ha) will be removed by the completion of landfill in Area 5. Completion of Area 5 & 7 will result in the removal of all White Cypress Pine forest (17 ha) south of the existing landfill by 2035. All vegetation layers and associated habitat will be removed as a result of these activities. Completion of landfill in Area 5 will also remove 1.5 ha of Bimble Box woodland south of the existing speedway. This will include the removal of a large proportion of the shrub layer (Hop-bush) of this community and numerous mature (at least 15) and some old growth Bimble Box and White Cypress Pine.	Area 7 will be rehabilitated.	Removal of potential threatened bat habitat (Areas 5 & 7) and 'known' Grey-crowned Babbler foraging habitat (White Cypress Pine forest, Area 5). Removal of younger age structure of Cypress Pine (Area 5 & 7) and mixed open forest (Area 7). Potential impacts upon declining woodland bird species are considered 'likely'. Important habitat (Bimble Box woodland), and shrub layer not well represented within the study area will be modified and reduced (Area 7). Removal of important ecotone area. Potential impacts upon declining woodland bird species are considered 'likely'.
11.	5 & 8	No vegetation should be removed as part of this activity.	Area 5 will be rehabilitated.	Potential impacts upon threatened species considered 'unlikely'.
12.	All areas	No vegetation should be removed as part of this activity.	Restoration and site monitoring	Potential impacts upon threatened species considered 'unlikely'.

6.2.2. Edge effects and potential to introduce exotic species

Edge effects, caused by vegetation removal and modification, already occur throughout the subject site, particularly areas divided by the existing landfill and quarry and the internal road network. The proposed development will exacerbate edge effects by removing vegetation, thus increasing fragmentation and create additional edges within an area already largely disturbed. In small remnant patches in highly fragmented landscapes, such as the subject site, isolation between remnant patches decreases the chance of species recolonising from elsewhere. Furthermore, random chance effects are particularly likely to depress species diversity (Bennett 1999; Ford *et al.* 2001).

Large quantities of soil and other substrates used to cap the proposed landfill sites will have to be brought onto the study area. This could degrade the quality of the existing soil by introducing foreign substrate and exotic plant species. This could in turn affect the natural diversity of the site by modifying the existing native seed bank and providing more suitable habitat for exotic species, as exotic species will adapt to disturbed areas more readily than native species. These potential impacts can be managed through the implementation of appropriate measures to be addressed in Section 8.2.

6.2.3. Predation by introduced species

Further landfill operations will probably benefit the introduced Feral Cat and Fox by providing both with a constant food supply. It is likely that these impacts will persist at a similar or increased level in response to the expansion of landfill activities. These introduced predators probably have a detrimental impact upon the native wildlife of the area, particularly small ground dwelling animals, ground-nesting birds and reptiles. Predation by the European Red Fox and Feral Cat are both listed as a key threatening process under the Commonwealth *EPBC Act 1999* and the NSW *TSC Act 1995*, with threat abatement plans prepared under guidelines set by each Act (Environment Australia 1999; NSW NPWS 2001a).

The European Red Fox is an adaptable and elusive predator and scavenger that is now common throughout most of the southern half of mainland Australia (NSW NPWS 1998). There is abundant evidence to suggest that fox predation is a major threat to the survival of native fauna (Saunders *et al.* 1995), with small to medium sized ground-dwelling mammals and ground-nesting birds, many of which are endangered or vulnerable, at greatest risk. Research conducted by Burbidge and McKenzie (1989) found that non-flying mammals weighing between 35 g and 500 g and ground-nesting birds are at greatest risk. The high occurrence of severe declines and extinctions within this 'Critical Weight Range' for non-volant mammals was first described by and is now recognised Australia-wide. Reptiles, amphibians and invertebrates are also preyed upon by the fox.

The Feral Cat is carnivorous and capable of killing vertebrates up to 2 – 3 kg. Preference is shown for mammals weighing less than 220 g and birds less than 200 g, but reptiles, amphibians and invertebrates are also eaten. Carrion and other scavenged material is taken if live prey is not available (NSW NPWS 2000). Predation by Feral Cats has been implicated in the extinction and decline of many species of mammals and birds on islands around Australia and in other parts of the world, and in the early extinction of up to seven species of small mammals on the Australian mainland (NSW NPWS 2000). In New South Wales, predation by Feral Cats has been linked to the disappearance by 1857, of thirteen species of mammal and four species of birds from the Western Division. Current

impacts on native species are most likely in modified, fragmented environments and where alternative prey, such as Rabbits or House Mice, fluctuate in abundance (NSW NPWS 2000).

6.2.4. Water quality impacts – altered hydrological regime

The proposed development will result in considerable changes to the hydrological regime of the subject site, despite already being largely modified. These alterations have the potential to affect the native fauna and important habitats for native species recorded within the subject site, however the extent of these impacts will vary across the study area.

Of particular concern are the proposed alterations to the existing site drainage through the natural gully of Area 6 and around and through the Bimble Box woodland of Area 9. The natural gully and drainage line of Area 6 are the only remaining, largely unmodified natural drainage areas of the subject site and potentially for the western ridgeline of McPherson Range. It is not clear how the drainage in each of the two areas will be modified, particularly in regards to the removal of vegetation—albeit this will be made redundant if both areas are to be cleared of their natural vegetation as proposed above.

Potential for indirect effects upon subject species which may occur within the subject site and study area from ground water contamination through leachate is a concern. The existing leachate pond is an open evaporation system with no form of covering to prevent native wildlife from using it as a drinking source or even as temporary refuge for some waterbirds. Some consideration should be given to minimising the access native animals have to this water source, particularly since it was the only source of water on the site during the time of the assessment.

Tharbogang Swamp, considered an important ephemeral saline wetland, is probably most at risk from contamination through leachate. Groundwater flow is expected to generally follow topography and concentrate below surface drainage features. Boreholes drilled to monitor groundwater levels have suggested a north-east dipping hydraulic gradient of approximately 0.04, with groundwater flowing towards the Tharbogang Swamp. Although ANZECC (1992) Water Quality Guidelines do not generally apply to groundwater, they are considered relevant in this case as the Tharbogang Swamp is likely to be the receiving water body for groundwater from the subject site (Coffey 2000).

Coffey (2000) found that the quality of groundwater in boreholes adjacent to and down-gradient of the landfill is of concern to the catchment as several parameters exceed the guidelines provided by ANZECC (1992). That the quality of groundwater appears to be within the general range, based on previous reports, of that within the local region provides little comfort as variation in local rainfall and areas of high irrigation may cause changes to level of each parameter within the region. Levels of the groundwater concentration of these parameters should be examined elsewhere within the McPherson Range for comparison to those obtained from the study site (Coffey 2000).

Although not substantiated there is potential for the hydrology of Tharbogang swamp to be connected with Lake Wyangan and, as such, leachate contamination of the lake should be considered possible. Lake Wyangan and the wetlands of this system support known habitat for a variety of threatened species and are of national and international conservation importance.

6.2.5. Noise and air pollution

Noise pollution will obviously increase as a result of blasting and digging operations of the quarry, possibly deterring native fauna from utilising the study area and potentially disrupting the breeding cycle, foraging and roosting behaviour of some species. Given the noise levels emitting from existing quarry operations (which include some occasional blasting operations), vehicle traffic and nearby road, it is considered unlikely that the proposed quarry expansion will increase noise levels beyond levels already experienced. Some above normal noise levels will be experienced for short periods during blasting operations, which may result in the temporary disruption to the lifecycle of some species. Yet, it is considered unlikely that it will cause a significant affect to the survival of any of the native species mentioned in this report or those that may otherwise use the site as part of their overall habitat area.

Excessive dust from landfill, quarrying and roadwork operations could potentially disrupt the pollination cycle and the ability of native plants to regenerate (i.e. germination, revegetation and recolonisation of existing plants). The rehabilitation process of the landfill areas could also be disrupted by dust pollution.

7. SIGNIFICANCE OF POTENTIAL IMPACTS ON SUBJECT SPECIES

This section reviews the significance of the potential impacts of the proposed development on subject species or other threatened species that have been recorded within the study area and the habitat or resources of relevance recorded for these species within the study area.

7.1. NSW LEGISLATION - SECTION 5A OF THE ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

The *EP&A Act 1979* includes in Section 5A, eight factors which are to be considered when determining if the proposed development or activity ‘*is likely to have a significant effect on the threatened species, populations or ecological communities, or their habitats*’. These eight factors must be taken into account by consent or determining authority when considering a development proposal or development application.

7.1.1. Threatened species recorded during the assessment

Thirty-nine subject species are considered for this SIS, out of the total of 51 threatened species, populations and ecological communities known to occur within the locality (see Tables 5.1 – 5.4). Each of these subject species has been previously recorded within the study area or thought to have potentially suitable habitat within the study area (see Tables 7.1 – 7.3 and Appendix K).

The threatened Grey-crowned Babbler and Inland Forest Bat were both identified during the current survey of the subject site. The threatened Little Pied Bat and Fishing Bat were both tentatively identified as a result of anabat analysis. The Grey-crowned Babbler was also recorded during the ERC 2000 surveys. The Fishing Bat is listed under Schedule 2 of the *TSC Act 1995* but was not considered a subject species during the preliminary investigations. Figure 5.3 displays the records of threatened species recorded within the subject site and adjacent land during the 2000 and 2002 ERC surveys. A formal Section 5A (8 part test) was conducted for each of these in order to determine if the proposed development ‘*is likely to have a significant effect*’ upon these species (see Appendix L).

7.1.2. Subject species considered to have suitable habitat within the study area

The habitat requirements for each of the subject species not recorded during current or previous investigations of the subject site were reviewed in regards to the extent and quality of potentially suitable habitat within the subject site and study area.

It has been determined that potentially suitable habitat does occur within the subject site for seven subject species that have been previously recorded within the McPherson Range and surrounding area including the Grey Falcon, Glossy Black-cockatoo, Pink Cockatoo, Superb Parrot, Barking Owl, Painted Honeyeater and Greater Long-eared Bat. Each of these species could potentially utilise the subject site on a seasonal or permanent basis or as part of their overall habitat area, thus a formal Section 5A will be conducted for each of these species (Appendix L.)

It is considered that if the proposed development is to continue as planned up to 70% of habitat, including potential habitat, utilised by these species will be removed and it is ‘*likely*’ that a ‘*significant effect*’ upon these species will occur. However, if the proposed impact amelioration measures (e.g. proposed native vegetation reserve areas) and site rehabilitation works are implemented it is ‘*unlikely*’ that the proposed development will have a ‘*significant effect*’ upon any of the recorded threatened species or other threatened species which may utilise the subject site as part of their overall habitat area or on an occasional basis.

The habitat requirements and historical records for the remaining subject species were again reviewed and assessed in regards to the extent and quality of potential habitat within the subject site and study area. It was concluded that despite some species being recorded within the study area, most do not have potential habitat within the subject site. It was found that the subject site lacked the habitat requirements for most of these species and/or the extent of potentially suitable habitat was either too disturbed or fragmented, and/or too small to support the survival of a local population of these species. The absence of these species within the subject site despite targeted surveys and lack of records from similar habitats in the study area, particularly within the vicinity of the subject site and McPherson Range also supports the above findings. However, the significance of potential indirect ‘off-site’ impacts (i.e. ground water pollution through leachate, and fox predation) as discussed in Section 6.2 have been considered for each of these species.

Although not substantiated there is potential for the hydrology of Tharbogang Swamp to be connected with Lake Wyangan and, as such, leachate contamination of the lake should be considered possible. Lake Wyangan and the wetlands of this system support known habitat for a variety of threatened species and are of national and international conservation importance. Although there is potential for leachate to escape from the subject site and enter groundwater it is considered unlikely that it would occur at such a magnitude to significantly affect those subject species or their habitats within the study area. Only during rare events, will there be infiltration of rainfall into the landfill site to add to the possibility of leachate generation. The management of the landfill ensures that only a small area of the site is exposed to rainfall and the rest is covered with clayey soils to prevent significant infiltration. Furthermore, in compliance with EPA license conditions, GCC will continue to monitor ground water for contamination and shall continue to manage the site to reduce, to a minimum, the generation of leachate at the site.

The significance of the potential impact as a result of an increased fox and cat population is specifically addressed in Part G of the following 8-part test. The significance of the potential impacts of the proposed development on each of these species is provided with each subject species profile (see Appendix G).

Although a formal Section 5A was not conducted for each of these subject species, the eight factors were considered with respect to their potentially suitable habitat within the subject site. The assessment below indicates that the proposed development is ‘*unlikely*’ to impose a “*significant effect*” upon the habitats and those species not recorded during current or previous investigations of the subject site or known to occur within the study area, excluding the subject site (these species are marked with # in Tables 7.1 – 7.3). With respect to Section 5A of the *EP&A Act 1979* and in concurrence with the impact amelioration measures of this report:

Part A – No threatened species or populations were recorded within the subject site during the current assessment other than the four species discussed in Section 7.1.1. No evidence for the presence of a “*viable local population*” occurring within the subject site exists and there is no evidence that any such population in the vicinity of the study area would be resident in or dependent upon the resources of the subject site for their survival. Consequently, there is no likelihood that the proposed development would render any such populations, if they existed “*at risk of extinction*”. Furthermore, the proposed impact amelioration measures provided in Section 8.2 of this report will ensure that potential habitat for each of these species is adequately protected within the subject site.

Part B - No evidence exists for the presence of “*an endangered population*” occurring within the subject site. The Glossy Black-Cockatoo (Riverina Endangered Population) and White-browed Treecreeper (Population in Carrathool south of the Lachlan River and Griffith Local Government Areas) are the only two endangered populations relevant to the proposed development. A formal Section 5A will be written for the Endangered Population of the Glossy Black-Cockatoo (see Appendix L). No individuals of the above mentioned population were recorded within the subject site during current or previous investigations. No records exist of the White-browed Treecreeper within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations as “*likely to be significantly compromised*” even if individuals of that population use the subject site. Furthermore, the proposed impact amelioration measures provided in Section 8.2 of this report will ensure that potential habitat for each of these species is adequately protected.

Part C - Given the small size of the area of potential resources offered by the subject site, extent of potential habitat in the study area, the proposed development is unlikely to involve “*a significant area of known habitat*” for any of these subject species being “*removed or modified*”. The reference of regional within this factor refers to the regions as defined in the Interim Biogeographic Regionalisation of Australia (IBRA). Following the IBRA, the study area located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within NSW, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the study area cannot be construed as comprising “*a significant area of known habitat*” in respect of the “*regional distribution of habitat*” for any of these subject species. Furthermore, the proposed impact amelioration measures provided in Section 8.2 of this report will ensure that the potential habitat for each of these species is adequately protected.

Part D - The proposed development will not involve “*an area of known habitat*” becoming “*isolated from currently interconnecting or proximate areas of habitat*”. The proposed development will involve the removal and modification of much of the existing vegetation within the subject site over a 40-year period. However, considering the lack of known records of these subjects species within the subject site it is unlikely that the proposed development will involve any resources or known habitat for these subject species becoming “*isolated from current or interconnecting areas of habitat*”. Furthermore, appropriate amelioration measures have been proposed to ensure that the subject site maintains its current connectivity with the McPherson Range, involving the protection of designated areas of existing vegetation and the implementation of effective vegetation corridors in order to facilitate the movement of native fauna. These impact amelioration measures will ensure that

the subject site will maintain its connectivity with McPherson Range regardless of the loss of any native vegetation in adjacent areas to the subject site.

Part E - The land where the proposed development is to occur is not part of any “*critical habitat*” as designated under Part 3 of the *TSC Act 1995*. Subsequently no “*critical habitat*” as declared within NSW, under the register of critical habitat, will be affected by the proposed development.

Part F - It is considered “*unlikely*” that any of these subject species or other threatened species that may occur in the Griffith region are “*adequately represented*” within “*conservation reserves and or similar protected areas*” in the locality or Griffith region. Many of these species are recorded within these conservation reserves, yet there is insufficient information to determine if these species are “*adequately represented*”. The subject site does not form part of any conservation reserve, however it forms part of a corridor (McPherson Range), which contains environmentally sensitive areas (e.g. Scenic Hill area). The proposed impact amelioration measures will ensure that it maintains its connectivity with these areas.

Part G - A key threatening process is a process that threatens, or may threaten, the survival or evolutionary development of a species, population or ecological community. The proposed development is not “*of a class of development or activity that is recognised as a threatening process*”, pursuant to the *TSC Act 1995*. However, there are a number of key threatening processes pursuant to Schedule 3 of the *TSC Act 1995* which could be considered relevant to the proposed development including:

- § Clearing of native vegetation (as defined and described in the final determination of the Scientific Committee to list the key threatening process);
- § Predation by the European Red Fox *Vulpes Vulpes* (Linnaeus, 1758); and
- § Predation by the Feral Cat, *Felis catus* (Linnaeus, 1758).

Clearing of native vegetation is of particular importance as it has been identified as a threatening process to most of the subject species. Considering the extent of relevant vegetation to be removed, the 40-year period it will take to remove this vegetation and the proposed impact amelioration measures (i.e. native vegetation reserve areas and revegetation works) it is considered ‘unlikely’ that the proposed development including removal of native vegetation will “*threaten the survival or evolutionary development*” of any of the subject species.

The landfill operations probably benefit the introduced Feral Cat and European Red Fox by providing both with a constant food supply despite the drought conditions. These introduced predators have already had a detrimental impact upon the native wildlife of the area, particularly reptiles and bird species. Numerous native species are potentially at risk of becoming threatened from fox and cat predation. It is considered likely that increasing the landfill area will provide additional resources for both of these introduced predators.

It is likely that native species of the subject site will become more susceptible to predation by the Feral Cat and European Red Fox if the proposed development area is allowed to expand. An appropriate pest control program (as outlined under the impact amelioration measures, Section 8.2) should be implemented in conjunction with monitoring to ensure that the proposed development will not “*threaten the survival or evolutionary development*” of any of the subject species and other

native fauna of the subject site. This program should be implemented in conjunction with existing pest control programs of the area, including the existing Lake Wyangan Fox baiting program conducted by GCC.

Part H - The Western Blue-tongue Lizard and Pink Cockatoo are the only subject species considered to be at the limit of its known distribution within the vicinity of the subject site. No other “*threatened species, population or ecological community is at the limit of its known distribution*” on or in the vicinity of the subject site. The subject site is probably considered to be at the eastern limit of this species range. This species is distributed across south-western and south-central Australia (Cogger 2000). In the Western Zone of NSW, it occurs in the central parts from Broken Hill to Condobolin and south to the Victorian border (Swan 1990). Preferred habitat for this species was not recorded within the subject site and no records exist for this species within the study area despite intensive targeted surveys. It is considered that this species does not occur within the subject site and, therefore, the proposed development is ‘*unlikely*’ to result in the “*regional extinction and range contraction of this species*”. Furthermore, potential habitat within the subject site will be protected by the proposed impact amelioration measures. The 8-part test of significance will be applied to the Pink Cockatoo (Appendix L).

Tables 7.1 – 7.3 provide a review of each subject species considered during this assessment, a summary of the known or potentially suitable habitats recorded within the subject site and brief assessment of the likely outcome of the proposed development on each species. It is determined that the proposed development is ‘*unlikely*’ to have a “*significant effect*” upon any of the threatened species mentioned in this report, in concurrence with the proposed impact amelioration measures as outlined in Section 8.2.

Table 7.1. Fauna subject species most likely to be impacted

Threatened Species	Habitat recorded within study area	Species recorded within study area	Test of Significance	Significant Impact
Western Blue-tongued Lizard <i>Tiliqua occipitalis</i> (Vulnerable) #	No preferred habitat was recorded within subject site. Limited potential habitat occurs in the form of Bimble Box & Dwyer's Mallee Gum woodland. The subject site is at the eastern limit of this species range.	NO Not recorded within the subject site despite intensive targeted surveys. No records of this species within the study area or McPherson Range area.	NO	'unlikely'
Australasian Bittern <i>Botaurus poiciloptilus</i> (Vulnerable) #	No preferred habitat was recorded within the subject, however potential habitat occurs within the study area in the form of the Lake Wyangan wetland system. Habitat for this species will not be directly affected, however potential indirect impacts from landfill leachate contamination is a concern. This impact is not considered to be significant.	YES Lake Wyangan wetland system.	NO	'unlikely'
Magpie Goose <i>Anseranas semipalmata</i> (Vulnerable) #	No preferred habitat was recorded within the subject, however known habitat occurs within the study area in the form of the Lake Wyangan wetland system. Habitat for this species will not be directly affected, however potential indirect impacts from landfill leachate contamination is a concern. This impact is not considered to be significant.	YES Lake Wyangan wetland system.	NO	'unlikely'
Freckled Duck <i>Stictonetta naevosa</i> (Vulnerable) #	No preferred habitat was recorded within the subject, however known habitat occurs within the study area in the form of the Lake Wyangan wetland system. Habitat for this species will not be directly affected, however potential indirect impacts from landfill leachate contamination and fox predation is a concern. These impacts are not considered to be significant.	YES Lake Wyangan wetland system.	NO	'unlikely'
Blue-billed Duck <i>Oxyura australis</i> (Vulnerable) #	No preferred habitat was recorded within the subject, however known habitat occurs within the study area in the form of the Lake Wyangan wetland system. Habitat for this species will not be directly affected, however potential indirect impacts from landfill leachate contamination and fox predation is a concern. These impacts are not considered to be significant.	YES Lake Wyangan wetland system.	NO	'unlikely'

Table 7.1 cont.

Threatened Species	Habitat recorded within study area	Species recorded within study area	Test of Significance	Significant Impact
Square-tailed Kite <i>Lophoictinia isura</i> (Vulnerable) #	Subject site offers potential foraging habitat. Potential breeding resources within subject site are limited and considered sub-optimal. Overall, the subject site offers a small portion of suitable foraging habitat of the large area needed by this species. It is also likely that competition from the high numbers of other raptor species would prevent this species from utilising the site on a permanent basis.	NO Not recorded within subject site despite intensive targeted surveys. No records of this species within the study area or McPherson Range area.	NO	‘unlikely’
Grey Falcon <i>Falco hypoeucos</i> (Vulnerable)	Subject site offers potential foraging habitat. Potential breeding resources within subject site are limited and considered sub-optimal. The subject site lacks the specific roosting and breeding resources required by this species. Furthermore these resources are well represented within the surrounding area including McPherson Range.*	YES Recorded within Scenic Hill area and eastern ridgeline of McPherson Range. Not recorded within subject site despite intensive targeted surveys.	YES (Appendix L)	‘unlikely’
Brolga <i>Grus rubicundus</i> (Vulnerable) #	No preferred habitat was recorded within the subject, however potential habitat occurs within the study area in the form of the Lake Wyangan wetland system. Habitat for this species will not be directly affected, however potential indirect impacts from landfill leachate contamination is a concern. This impact is not considered to be significant.	NO	NO	‘unlikely’
Painted Snipe <i>Rostratula benghalensis</i> (Vulnerable) #	No preferred habitat was recorded within the subject, however potential habitat occurs within the study area in the form of the Lake Wyangan wetland system. Habitat for this species will not be directly affected, however potential indirect impacts from landfill leachate contamination and fox predation is a concern. These impacts are not considered to be significant.	NO Species recorded outside study area, south of McPherson Range.	NO	‘unlikely’
Black-tailed Godwit <i>Limosa limosa</i> (Vulnerable) #	No preferred habitat was recorded within the subject, however known habitat occurs within the study area in the form of the Lake Wyangan wetland system. Habitat for this species will not be directly affected, however indirect impacts from landfill leachate contamination and fox predation is a concern. These impacts are not considered to be significant.	YES Recorded at Nericorn and Campbell’s Swamp.	NO	‘unlikely’

Table 7.1 cont.

Threatened Species	Habitat recorded within study area	Species recorded within study area	Test of Significance	Significant Impact
Glossy Black-cockatoo <i>Calyptorhynchus lathami</i> (Vulnerable) (Endangered Population)	Potential foraging habitat in form of small Bulloke patch (< 1ha) and White Cypress Pine vegetation. Potential roosting/breeding habitat restricted to Bimble Box woodland area, considered sub-optimal. The subject site lacks adequate specific foraging and breeding habitat required by this species. Habitat considered to form part of overall foraging habitat of this species within the McPherson Range area.	YES Recorded within Scenic Hill area. Not recorded within subject site despite intensive targeted surveys.	YES (Appendix L)	‘unlikely’
Pink (Major Mitchell’s) Cockatoo <i>Cacatua leadbeateri</i> (Vulnerable)	Potential foraging and in form of White Cypress Pine vegetation and nesting habitat in the form of Bimble Box and Dwyer’s Mallee Gum woodland. The site does not contain fresh surface water, even during more favourable climate conditions, however it is close to permanent water source (i.e. Lake Wyangan and Campbells Swamp).	YES Recorded within Scenic Hill area, along eastern Ridgeline of McPherson Range and regularly at Lake Wyangan. Not recorded within subject site despite intensive targeted surveys.	YES (Appendix L)	‘unlikely’
Superb Parrot <i>Polytelis swainsonii</i> (Vulnerable)	Potential foraging habitat in form of Bimble Box and Dwyer’s Mallee Gum woodland areas, particularly with grassy ground layer. Potential roosting/breeding habitat restricted to Bimble Box and Dwyer’s Mallee Gum woodland areas, considered sub-optimal. The subject site lacks specific breeding resources required by this species. Potential habitat considered to form part of the overall foraging habitat within the McPherson Range area.	YES Recorded along eastern ridgeline of McPherson Range, at Lake Wyangan and Griffith city locality. Not recorded within subject site despite intensive targeted surveys.	YES (Appendix L)	‘unlikely’
Swift Parrot <i>Lathamus discolor</i> (Endangered) #	Limited potential foraging and roosting habitat in form of Bimble Box and Dwyer’s Mallee Gum woodland areas. Potential foraging habitat considered sub-optimal, and more likely to be used as a ‘stop over’ than as an area of permanent or even semi-permanent place of foraging. Species nomadic and only breeds in Tasmania.	NO Not recorded within subject site despite intensive targeted surveys.	NO	‘unlikely’
Turquoise Parrot <i>Neophema pulchella</i> (Vulnerable) #	Potential foraging and roosting habitat in form of Bimble Box and Dwyer’s Mallee Gum woodland areas. Site does not contain permanent fresh surface water, even during more favourable climate conditions, however site is close to permanent water source (i.e. Lake Wyangan). Subject site likely to be used as a part of an overall foraging area.	NO Not recorded within subject site despite intensive targeted surveys.	NO	‘unlikely’

Table 7.1 cont.

Threatened Species	Habitat recorded within study area	Species recorded within study area	Test of Significance	Significant Impact
Barking Owl <i>Ninox connivens</i> (Vulnerable) #	Potential limited foraging habitat in the form of woodland areas and mixed open forest vegetation. Favoured roosting and foraging habitat of this species was not recorded within the site. Low abundance of native mammal prey items recorded, however introduced prey species were common.	YES Recorded within Scenic Hill area. Not recorded within subject site despite intensive targeted surveys.	YES (Appendix L)	‘unlikely’
Masked Owl <i>Tyto novaehollandiae</i> (Vulnerable) #	Potential limited foraging habitat in the form of woodland areas and mixed open forest vegetation. Favoured roosting and foraging habitat of this species was not recorded within the site. Low abundance of native mammal prey items recorded, however introduced prey items were common. Overall, the subject site offers a small portion of the large home range (500 – 1000 ha) and diversity of habitats required by this species.	NO Not recorded within subject site despite intensive targeted surveys.	NO	‘unlikely’
Grey-crowned Babbler <i>Pomatostomus temporalis temporalis</i> (Vulnerable)	YES Known habitat within subject site and study area. White Cypress Pine forest and Bimble Box/White Cypress Pine woodland provide known foraging, roosting and breeding habitat for this species.	YES Recorded with subject site 2000 & 2002 ERC & Scenic Hill area	YES (Appendix L)	‘unlikely’
Hooded Robin <i>Melanodryas cucullata</i> (Vulnerable) #	Potential foraging and breeding habitat within subject site and adjacent land in the form of White Cypress Pine forest, mixed open forest and Bimble Box/White Cypress Pine woodland. Other declining woodland birds recorded during survey. This species requires a relatively large home range and is apparently unable to survive in remnants smaller than 100 ha.	YES Recorded eastern ridgeline of McPherson Range and scenic Hill area. Not recorded within subject site despite intensive targeted surveys.	NO	‘unlikely’
Gilbert’s Whistler <i>Pachycephala inornata</i> (Vulnerable) #	Limited potential foraging and breeding habitat. The subject site lacks the preferred habitat of this species. Potential habitat restricted to shrubby understorey areas within woodland, open forest and cypress pine vegetation, mainly Bimble Box woodland area of subject site, therefore considered sparse and sub-optimal.	NO Not recorded within subject site despite intensive targeted surveys.	NO	‘unlikely’

Table 7.1 cont.

Threatened Species	Habitat recorded within study area	Species recorded within study area	Test of Significance	Significant Impact
Chestnut Quail-thrush <i>Cinclosoma castanotus</i> (Vulnerable) #	Potential habitat for this species is restricted to areas of vegetation containing a shrub layer within the Cypress Pine forest, mixed open forest and Bimble Box woodland areas and is therefore very limited and considered sub-optimal. The subject site lacks the preferred habitat of this species. A sedentary species, which nests on the ground and is therefore susceptible to predation.	NO Not recorded within subject site despite intensive targeted surveys.	NO	‘unlikely’
Shy Heathwren <i>Hylacola cautus</i> (Vulnerable) #	Potential foraging and breeding habitat within subject site and adjacent land in the form of Dwyer’s Mallee woodland, White Cypress Pine forest, mixed open forest and Bimble Box/White Cypress Pine woodland.	NO Not recorded within subject site despite intensive targeted surveys. Recorded in the Scenic Hill area.	NO	‘unlikely’
Speckled Warbler <i>Pyrholaemus sagittatus</i> (Vulnerable) #	Potential foraging and breeding habitat within subject site and adjacent land in the form of White Cypress Pine forest, mixed open forest and Bimble Box/White Cypress Pine woodland. Largely a sedentary species, which nests on the ground and is therefore susceptible to predation. Other declining woodland birds recorded during survey.	NO Not recorded within subject site despite intensive targeted surveys. Recorded in the Scenic Hill area.	NO	‘unlikely’
Black-chinned Honeyeater <i>Melithreptus gularis</i> (Vulnerable) #	Although potential habitat in the form of the Bimble Box woodland vegetation of the subject site was recorded, no preferred habitat for this species was recorded within the subject site or adjacent land. Potential habitat is restricted to the Bimble Box woodland area and is therefore considered limited and only part of the overall habitat for this species if it was to occur within the study area.	NO Not recorded within subject site despite intensive targeted surveys. No records within the study area.	NO	‘unlikely’
Pied Honeyeater <i>Certhionyx variegatus</i> (Vulnerable) #	Potential foraging and breeding resources are limited and restricted to woodland and Currawang dominated areas. Subject site lacks specific foraging resources required by this species in the form of flowering plants, predominantly <i>Eremophila</i> spp. mistletoe and various. <i>Brachysema</i> and <i>Grevillea</i> shrubs. Potential habitat offered by the subject site considered sub-optimal.	NO Not recorded within subject site despite intensive targeted surveys. No records within the study area.	NO	‘unlikely’

Table 7.1 cont.

Threatened Species	Habitat recorded within study area	Species recorded within study area	Test of Significance	Significant Impact
Painted Honeyeater <i>Grantiella picta</i> (Vulnerable)	Potential habitat in the form of Currawang woodland areas. The specific foraging resources required by this species (i.e. mistletoe) lacking from the subject site. This species is a specialist mistletoe feeder and is highly nomadic and migratory.	YES Recorded within Scenic Hill area, Lake Wyangan and Nericorn Swamp.	YES (Appendix L)	‘unlikely’
Diamond Firetail <i>Stagonopleura guttata</i> (Vulnerable) #	Potential foraging and breeding habitat within subject site and adjacent land in the form of White Cypress Pine forest, mixed open forest and Bimble Box/White Cypress Pine woodland Other declining woodland birds recorded during survey.	NO Not recorded within subject site despite intensive targeted surveys. No records from within study area. Recorded from Scenic Hill area.	NO	‘unlikely’
Little Pied Bat <i>Chalinolobus picatus</i> (Vulnerable)	YES Known habitat within subject site. The vegetation of the subject site provides known foraging and potential roosting and breeding habitat for this species. Subject site considered part of the overall foraging habitat of this species. No fresh water areas recorded within subject site.	YES Species tentatively recorded within subject site.	YES (Appendix L)	‘unlikely’
Inland Forest Bat <i>Vespadelus baverstocki</i> (Vulnerable)	YES Known habitat within subject site. The vegetation of the subject site provides known foraging and potential roosting and breeding habitat for this species. Subject site considered part of the overall foraging habitat of this species. No fresh water areas recorded within subject site.	YES Species positively recorded within subject site.	YES (Appendix L)	‘unlikely’
Greater Long-eared Bat <i>Nyctophilus timoriensis</i> (Vulnerable)	Potential foraging and breeding habitat within the subject site. Roosting habitat probably confined to large tree hollows found in Bimble Box, Dwyer’s Mallee Gum woodland areas. Subject site considered part of the overall foraging habitat of this species. No fresh water areas recorded within subject site.	NO Not recorded within subject site despite intensive targeted surveys.	YES (Appendix L)	‘unlikely’

Table 7.1 cont

Threatened Species	Habitat recorded within study area	Species recorded within study area	Test of Significance	Significant Impact
Yellow-bellied Sheathtail Bat <i>Saccolaimus flaviventris</i> (Vulnerable) #	Potential foraging and breeding habitat within the subject site. This species occurs in most wooded habitats. Potential roosting habitat probably confined to large tree hollows found in Bimble Box, Dwyer's Mallee Gum woodland areas. Subject site considered part of the overall foraging habitat of this species. No fresh water areas recorded within subject site.	NO Not recorded within subject site despite intensive targeted surveys.	NO	'unlikely'

Table 7.2. Flora subject species most likely to be impacted

Threatened Species	Habitat recorded within study area	Species recorded within study area	Test of Significance	Significant Impact
<i>Austrostipa metatoris</i> (Vulnerable) #	Potential habitat restricted to Bimble Box woodland area. Associate species not recorded within subject site.	NO Not recorded within subject site despite surveys. No records of species within study area.	NO	‘unlikely’
<i>Diuris tricolor (sheaffiana)</i> (Vulnerable) #	Potential habitat in the form of Bimble Box woodland community and to a lesser extent beneath White Cypress Pine, especially on red earth soils.	NO Not recorded within subject site despite targeted flora surveys conducted during appropriate flowering season. No records of species within study area.	NO	‘unlikely’
<i>Caladenia arenaria</i> (Endangered) #	Very limited potential habitat in the form of Callitris covered ridges, No preferred habitat recorded within subject site. Areas of potential habitat have been heavily disturbed in the past by scarping for surficial gravels and complete removal of all vegetation layers, especially ground cover layer.	NO Not recorded within subject site despite targeted flora surveys conducted during appropriate flowering season. No records of species within study area.	NO	‘unlikely’
<i>Swainsona murrayana</i> (Vulnerable) #	Limited potential habitat restricted to grassy areas within Bimble Box woodland areas of the subject site. No preferred habitat recorded within the subject site. A number of associate species were recorded within the subject site and were also largely confined to the Bimble Box woodland areas.	NO Not recorded within subject site despite targeted flora surveys conducted during appropriate flowering season. No records of species within study area.	NO	‘unlikely’
<i>Swainsona sericea</i> (Vulnerable) #	Potential habitat in the form of woodland areas and to a lesser extent Callitris vegetation, but only areas with a grassy understorey.	NO Not recorded within subject site despite targeted flora surveys conducted during appropriate flowering season. No records of species within study area.	NO	‘unlikely’
<i>Lomandra patens</i> (ROTAP) #	Potential habitat throughout subject site, especially along western ridgeline area of subject site in association with rocky outcrops.	YES Recorded with Scenic Hill area and other areas of McPherson Range. Not recorded within subject site despite targeted flora surveys.	NO	‘unlikely’

Table 7.3. Endangered Populations most likely to be impacted.

Endangered Population	Habitat recorded within study area	Population or species recorded within study area	Test of Significance	Significant Impact
Glossy Black Cockatoo Riverina Endangered Population	Potential foraging habitat in form of small Bulloke patch (< 1ha) and White Cypress Pine vegetation. Potential roosting/breeding habitat restricted to Bimble Box woodland area, considered sub-optimal. The subject site lacks adequate specific foraging and breeding habitat required by this species. Potential habitat considered to form part of overall foraging habitat of this species within the McPherson Range area. Subject site likely to support potential resources for a few individuals, however not for an entire population	YES McPherson Range, Scenic Hill area.	YES (Appendix L)	‘unlikely’
White-browed Treecreeper Population in Carrathool (south of the Lachlan River) and Griffith Local Government Areas #	Preferred habitat recorded within the subject site in the form of White Cypress Pine dominated woodland areas including Bimble Box woodland and to a lesser extent Dwyer’s Mallee Gum woodland and mixed open forest vegetation. Subject site likely to support potential resources for a few individuals, however not for an entire population.	NO Not recorded within subject site despite targeted surveys for this species. No records within study area.	NO*	‘unlikely’

8. PROPOSED ALTERNATIVES AND IMPACT AMELIORATION

The purpose of this section is to discuss the proposed alternatives available to the Tharbogang site in regards to landfill and quarrying, and provide a range of mitigation measures to ensure that no 'significant impact' will occur to any threatened species or populations that may inhabit or at some time utilise the subject site. Impact amelioration measures will also be provided to minimise the impacts upon other native flora and fauna inhabiting the subject site and the general environment.

8.1. PROPOSED ALTERNATIVES FOR THE LANDFILL AND QUARRY OPERATIONS

The City of Griffith is located centrally within the MIA. Other than the McPherson Range, in which the subject site is located, the surrounding irrigation area comprises a relatively flat alluvial formation and, as a consequence of the geology and intense irrigation, the groundwater level in the region is generally quite high (often within 2 m of the ground surface). It is not considered environmentally feasible to establish a landfill in the alluvial irrigation area as a consequence of the relatively high level of ground water and the associated difficulties in preventing interaction with landfill leachate and the groundwater (Coffey 2000).

Similarly, hard rock of suitable quality for road base production is restricted in the Griffith area to the Cocoparra group sediments found in the McPherson Range. A large part of this range has been classified as an environmentally sensitive area on the basis of flora, fauna, scenic and heritage values. With the exclusion of the area involved in this study, it has been recommended that remaining areas of the McPherson Range above the 145 m contour be left undisturbed (Griffith City Council Environmental Study 1991).

In consideration of the potential impacts of relocating the existing quarry to another site with rock of appropriate quality and establishing a new landfill outside the MIA, the EIS considers that these optional sites provide a greater potential threat to the environment within the MIA than the existing site. The only other existing landfill within the city area is Yenda. The site does not have the capacity to meet the long-term projected needs of the city nor is it considered environmentally suitable (Coffey 2000).

Incineration of waste

Incineration of waste was investigated during the EIS process. However, it is considered an inappropriate method because landfill area will still be needed to dispose of the by product (ash) of this process.

Reuse of putrescible waste burial area

GCC have suggested that the putrescible waste burial area (Area 4) could be reused for the same purposes. During Activity 3, the remainder of this area will be reworked, presumably for the same purpose. This is considered a very desirable option, as no native vegetation will need to be removed as part of this proposed activity.

Waste recycling facility

The main purpose of developing the proposed waste recycling depot in Area 8 is reduce the amount of reusable waste entering the landfill. It is intended that when the proposed development is in full operation all recyclables will be deposited at the proposed Tharbogang transfer station located in Area 8 and no recyclable material will be delivered to the landfill. The waste-recycling depot has the ability to greatly reduce the volume of landfill at the site, particularly over the longer term. However, the proposed location and size of the depot will involve the removal of a significant amount of Bimble Box/White Cypress Pine woodland which is not well represented within the subject site. This community is also part of the known habitat for the threatened Grey-crowned Babbler.

Despite advances in waste recycling and waste minimisation techniques the City of Griffith still needs a landfill to accommodate for waste generation. Improvements in these techniques will ensure that the landfill life will be expanded as waste generation by the City of Griffith falls in time.

8.2. IMPACT AMELIORATION

Considering the nature and extent of the proposed works, the following amelioration measures should be implemented prior to, during and after each stage of the proposed development. These measures should be implemented to ensure that no '*significant effect*' will occur upon any threatened species, or their habitats that are known to occur within the study area, or threatened species or endangered populations that may inhabit the study area on an occasional basis. These measures will also ensure that the impacts upon other native flora and fauna and the general environment of the study area will be minimised. Table 8.1 summarises the measures to be undertaken prior to, during and after the proposed development. Each of these measures is described in detail below.

8.2.1. Amelioration measures to be undertaken prior to any proposed development

Amelioration measures to be implemented prior to any of the proposed activities (excluding existing Area 1, 3 & 4).

1. Existing boundary

The development should not extend beyond the existing boundaries of the proposed development area (see Figure 8.1). Extension of these boundaries will involve the removal and modification of valuable habitat along the road reserve to the east and crown reserve to the west.

2. Vegetation corridors

Vegetation corridors should be established along the eastern and western boundaries and both sides of the main entrance road of the subject site prior to any of the proposed activities being undertaken. These corridors will consist of native vegetation enhancement plantings and native vegetation reserve areas (see Figure 8.1).

The proposed enhancement corridors of the eastern and western boundaries are to consist of existing native vegetation enhanced by native revegetation. These corridors are to be at least 40 m wide and consist of local indigenous species, ultimately aiming to form a continuation of the vegetation types this corridor will be connecting (for example, the enhancement corridor proposed for east of Area 2 and 4 should comprise of species found within the Bimble Box/White Cypress Pine community).

Indigenous plant species should be used to provide habitat features for native fauna and to supplement the local and regional genetic resource. Native species to be used are included in the flora list Appendix A. It is important to ensure overstorey, understorey and ground-layer species are all included in revegetation programs to address the decline of vegetation communities. All layers are vital. Structural and floristic diversity will in turn provide for greater faunal species diversity as opposed to a structurally simple area of vegetation.

The development of a 40 m wide enhancement corridor adjacent to Areas 1, 3 and 6 along the western ridgeline may require the reclamation of some of the existing quarry and landfill area and/or the purchase of private property.

The potential for Area 7 to be developed to the full extent of the proposed western boundary exists (see Figure 8.1), however GCC must preserve the small crown reserve and maintain a 40 m wide vegetation corridor along this section of the western ridgeline. Under no circumstances is the proposed development allowed to extend beyond the area boundaries as displayed in Figure 8.1.

The proposed native vegetation reserve areas along the boundaries and through the middle of the subject site involve the preservation of existing vegetation to partially form a vegetation corridor and buffer zone around the subject site and Areas 5 and 7. The native vegetation reserve on the western side of the sealed road entrance is to be at least 50 m wide and extend the full length of the existing road to the start of the existing quarry. The native vegetation reserve on the eastern side of the sealed road entrance is to be at least 40 m wide and extend the full length of the road as displayed in Figure 8.1.

Griffith City Council have expressed concern with the proposed vegetation corridors extending through area 1b, up along the boundary of area 6 and 4 and the corridor between areas 1a and 3. These areas are covered by the approved existing use areas and at this point in time the proposed enhancement corridor of areas 1a and 1b have already been worked and there is still considerable landfill to take place in those locations. The 20 m wide proposed native vegetation reserve area between areas 4 and 6 must be filled as it slopes to area 2 and will become a trapped low point otherwise. These corridors have been implemented to ensure that connectivity within the site will be maintained at all times. There is potential for the implementation of these corridors to be delayed with the condition that the proposed corridors along the eastern and western boundaries and through the centre of the subject site (excluding the proposed corridors through area 1b and between 4 and 6) are implemented prior to any of the proposed activities.

The road reserve of the eastern boundary is not considered to be a suitable wildlife corridor largely due to its degraded condition and potential to be used as a regular vehicle access track for potential rural residential subdivisions east of the subject site. The vegetation corridor has been placed on the inside of the road reserve for the section south of Area 2 to ensure preservation of the wildlife corridor and known habitat for the threatened Grey-crowned Babbler. Furthermore, the proposed boundary for Area 5 has intruded into the road reserve along a section of the eastern boundary of the speedway. Reclamation of some part of the speedway area may be necessary to maintain a 40 m wide corridor along this section.

3. Native vegetation reserve area

The area designated as proposed native vegetation reserve area (see Figure 8.1) should be protected. Native vegetation should not be removed or modified in any way from this area. The proposed wildlife corridors running along the eastern and western boundaries of the subject site should be included within this reserve area, particularly road reserve and proposed wildlife corridor along the eastern ridgeline as this area is known habitat for the Grey-crowned Babbler and many declining woodland bird species.

The main purposes of the native vegetation reserve area is to partially provide for a continuous corridor of vegetation linking the northern and southern sections of the subject site and also conserve known threatened species habitat, declining woodland bird habitat, and regionally significant vegetation of the subject site.

4. Pest and weed control program

A pest control program should be implemented and targeted at the introduced Fox and Feral Cat. Both species were recorded in abundance within the subject site. The program probably should involve baiting, destruction of suitable refuge within the immediate landfill area (Area 1 and 2) and some form of monitoring to ensure non-target species particularly native species are not harmed. The main aim of the pest control program is to reduce the impact of predation upon the native animals of the study area, particularly those threatened species recorded within the subject site and previously recorded within the study area or that could potentially occur within the study area and are susceptible to predation. The program should work in cooperation with the existing Fox baiting program undertaken by GCC around Lake Wyangan. A detailed baiting program targeted at the Fox is provided in Appendix N. This program can also be readily used and modified for the control of Feral Cats.

A weed control program should be implemented for the entire subject site, specifically focussing upon the removal of noxious weeds and reducing further weed invasion. Particular attention should be focussed upon removing existing noxious weeds from the Bimble Box/White Cypress Pine woodland area. Weed invasion can also be prevented by halting any further dumping of green waste within the Bimble Box/White Cypress Pine woodland area near the entrance.

It is also important to deter the growth of weeds in newly constructed areas, and the transportation of weeds into the subject site. Planting fast growing indigenous native grasses to minimise potential weed invasion will protect exposed areas. Planting of these natives can be incorporated into the site rehabilitation plan.

8.2.2. Amelioration measures to be undertaken during the proposed development.

Prior to clearing further areas for landfill and quarrying operations the following amelioration measures should be undertaken:

1. Site management and rehabilitation plan

A site management and rehabilitation plan should be prepared for the subject site prior to any works being undertaken in order to document all impact amelioration measures and also to provide response

protocols for problems that may arise. Key issues to include in the plan include the planting of indigenous plant species and use of mature seeds collected from native trees and shrubs felled during the initial clearing process.

Part of this plan will involve marking all working area boundaries clearly on a map and ensuring that no access is permitted outside the defined areas. Machinery and staff are to be restricted from areas of known Grey-crowned Babbler habitat (see Figure 5.3), within the Bimble Box/White Cypress Pine woodland area, road reserve along eastern boundary through to south of Area 2 in order to minimise the direct disturbance to individuals and impacts to known habitat.

2. Pre-clearance survey and hollow bearing tree inspection

Immediately before the clearing of vegetation, an appropriately qualified person such as a NPWS officer or WIRES representative will be employed to survey for and encourage the dispersal of native fauna species. This will involve mammal trapping the previous night including harp trapping for microchiropteran bat species.

Where unavoidable all mature and hollow bearing trees should be inspected prior to removal for arboreal mammals, microchiropteran bats, nests, eggs and fledglings. Where animals are found, they should be encouraged to leave, or captured and released in an appropriate area. Any injured fauna should be transferred to the care of a WIRES representative.

During landfill and quarrying operations the following amelioration measures should be undertaken:

- § Ensure all developments and associated activities are planned, overseen, and monitored by shire employees or other appropriate persons (i.e. NPWS officer well versed in environmental issues);
- § Any infrastructure required for the proposed works should be positioned to avoid retained native vegetation or revegetation works comprising wildlife corridors, landscape buffer zones and associated reserved areas;
- § Where clearing of native vegetation is unavoidable, mature seed from native trees and shrubs felled should be collected and used for the rehabilitation of the site. The rehabilitation program may consist of 20 indigenous trees planted for every tree removed (minimum requirement);
- § Where mature and old growth Bimble Box, Dwyer's Mallee Gum and White Cypress Pine are removed, any trees/limbs could be placed elsewhere to provide important habitat. This will increase valuable ground layer components, creating additional habitat, which is generally absent within the pastureland and other areas within the general area.
- § Any noxious weed and other weed material encountered, should be destroyed and/or removed from the site using appropriate methods to ensure weeds do not spread to other sites, especially in regards to invasion of drainage lines and dams;
- § Drainage and runoff should be controlled in such a way as that no foreign substrates or materials leave the site, especially in regards to flows into the Tharbogang Swamp and surrounding areas;
- § Retention, revegetation and stabilisation of the drainage lines and dam sites should be conducted. This may constitute part of the landscape design of the proposed developments;
- § Sediment and erosion control structures, which conform with the relevant Environmental Protection Authority and/or Department of Land and Water Conservation guidelines, should be installed; and

- § Exposed surface soil should be stabilised as soon as possible to avoid potential erosion (by mulching, covering or replanting with native species).

8.2.3. Amelioration measures to be undertaken after the development has been completed.

Rehabilitation, restoration and monitoring measures, which should be undertaken:

- § Promote ecologically sound bush fire control practices while not compromising the protection of lives and property. Consider bush fire hazard when designing planting patterns, such as breaks in the vegetation to retard the spread of fire. Consider including some indigenous fire retardant species;
- § Locally indigenous plant species should be used to provide habitat features for native fauna. Ensure overstorey, understorey and ground-layer species are all included in revegetation programs to address the decline of vegetation communities. All layers are vital.
- § Progressive revegetation of landfill sites and surrounding areas should be conducted following the revegetation and restoration guidelines as recommended by Coffey (2000) and SMEC (2001);
- § Stormwater catchment zones (including ponds/dams) and drainage lines should be rehabilitated in a manner to provide riparian zone habitat. Revegetation should be undertaken using species as listed on approval from the DWLC and in order to replicate naturally occurring riparian zones which once would have existed on the site prior to development;
- § Reduce or avoid the disturbance of dam sites and drainage lines. Encourage the existing dams to be developed into waterholes in conjunction with revegetation works to encourage wildlife and discourage wildlife movement across roads;
- § Sediment and erosion control structures, which conform with the relevant Environmental Protection Authority and or Department of Land and Water Conservation guidelines should be installed;
- § Exposed surface soil should be stabilised as soon as possible to avoid potential erosion (by mulching, covering or replanting with native species);
- § Any wastes associated with the proposed works should be appropriately managed to prevent the discharge of pollutants off-site or associated areas of vegetation; and
- § Ongoing monitoring should be conducted of
 - Water flows, surface and ground water
 - Soil testing
 - Air pollution, wind direction
 - Noise pollution

8.2.4. Provision of compensatory habitat

It is considered very unlikely that any part of the site used for landfill can be converted back to its former state, despite the best intentions of rehabilitation efforts. SMEC (2001) recognises that it is difficult to establish trees on completed landfill surfaces due to the generally arid conditions that develop and the necessity to provide long term watering. Furthermore, the soil layer would not be deep enough to support the growth of large Bimble Box and White Cypress Pine.

SMEC (2001) proposed that a locally wooded area will be included through portions of the centre of the “valley” area shown on the final landform, above Stages 1 and 2, to improve the visual amenity adjoining the natural “saddle” (depression) in the southern natural ridge feature. This will require

deepening the final cover in these areas by at least 1 m and the provision of a gas/interception diversion blanket to prevent oxygen being displaced from the growing medium. The remainder of the site will be planted with suitable shrubs, established near the site (SMEC 2001).

No site rehabilitation plans have been provided to display the proposed areas described above. However, it is considered that the above rehabilitation process, in combination with the impact amelioration measures proposed in this report, will adequately compensate for any lost native vegetation and associated habitats resulting from the proposed development.

8.2.5. Mitigation measures to control water quality impacts

Griffith City Council has installed ground water monitoring stations to intercept ground water at the site boundary. The level of ground water falls rapidly across the site from west to east (Coffey Geosciences 2000b). This fall is associated with perched water tables on impervious rock platforms. The monitoring results at the boundary indicate that there is only background or undetectable levels of the pollutants required to be tested by the EPA license. Between the site and Lake Wyangan there is significant irrigation by pumped water from the lake, which is a man-made lake in an old Gypsum quarry, which is supplied with water from the irrigation system. The effect of this massive input of water from outside the catchment is that the ground water from natural rainfall on the landfill site is insignificant in volume compared to the total volume at Tharbogang Swamp and the Lake Wyangan. This is reinforced by the fact that the rainfall at the site is approximately 410 mm, approximately one quarter of the evaporation rate. Only during rare events will there be infiltration of rainfall into the landfill site to add to the possibility of leachate generation. The management of the landfill ensures that only a small area of the site is exposed to rainfall and the rest is covered with clayey soils to prevent significant infiltration.

In compliance with EPA license conditions, GCC will continue to monitor ground waters for contamination and shall continue to manage the site to reduce, to a minimum, the generation of leachate at the site.

8.3. CONCLUSION

In no way is the proposed development allowed to proceed without the implementation of the above impact amelioration measures (Sections 8.2.1 – 8.2.3) and the proposed site rehabilitation process (Section 3.2). These measures should be implemented to ensure that ‘*no significant impact*’ upon any threatened species or their habitats recorded within the study area or threatened species which may occur at the subject site, will transpire.

Table 8.1. Impact amelioration measures and outcomes.

Amelioration measures to be undertaken prior to any proposed development		
Number	Impact measure	Outcome
1	Existing boundary	§ protection of road reserve along eastern boundary and crown land along western ridgeline; and § preserve known Grey-crowned Babbler and habitat along eastern boundary of subject site.
2	Vegetation corridors	§ protection and enhancement Grey-crowned Babbler and threatened bat habitat along eastern boundary of subject site; § provide connectivity between southern and northern portions of subject site and western ridgeline of McPherson Range (between northern tip and southern ridgeline) to facilitate the movement of wildlife through the subject site and along the western ridgeline; § create a buffer zone between adjacent land and the subject site; and § create a buffer zone around existing and proposed developed areas within the subject site.
3	Native vegetation reserve area	§ provide for a continuous corridor of vegetation linking the northern and southern sections of the subject site; § preserve known Grey-crowned Babbler, threatened bat and potential threatened species habitat; § preserve declining woodland bird habitat; § retain natural gully and mixed forest vegetation of Area 6; § ensure that all age structures of each vegetation type are protected; § preserve regionally significant vegetation of the subject site (i.e. Bimble Box/White Cypress Pine woodland).
4	Pest and weed control program	§ control pest numbers and reduce the risk of threatening process upon native species, particularly threatened species; § prevent further weed invasion of important habitat areas, especially the Bimble Box/White Cypress Pine woodland area; and § deter weeds from establishing in newly developed areas.
Amelioration measures to be undertaken during the proposed development		
Number	Impact measure	Outcome
1	Site management and rehabilitation plan	§ document all impact amelioration measures and display on map available at the site; § detail site rehabilitation process including collection of native seeds and implementation; § clearly define all proposed area boundaries; and § clearly define areas of known habitat for the Grey-crowned Babbler, native vegetation reserve areas and vegetation corridors.

Table 8.1 cont.

Amelioration measures to be undertaken during the proposed development		
Number	Impact measure	Outcome
2	Pre-clearance survey and hollow bearing tree inspection	§ ensure that no threatened species will be ‘significantly affected’ by the proposed development; and § ensure that impacts of the proposed development to other native fauna will be minimised;
	Other impact measures	§ avoid removal or modification of native vegetation by machinery; § collect all seeds from native trees and shrubs felled; § create valuable ground layer habitat components; § control indirect impacts of runoff from subject site; § provide some riparian vegetation and potential habitat along drainage lines and around dams and other water bodies; § control potential erosion and prevent potential sedimentation.
Amelioration measures to be undertaken after the development has completed		
Number	Impact measure	Outcome
	Rehabilitation and other measures	§ rehabilitate site and provide compensatory habitat in conjunction with above impact measures; § ensure impacts will be controlled and mitigated through ongoing monitoring of water, soil, air and noise pollution.

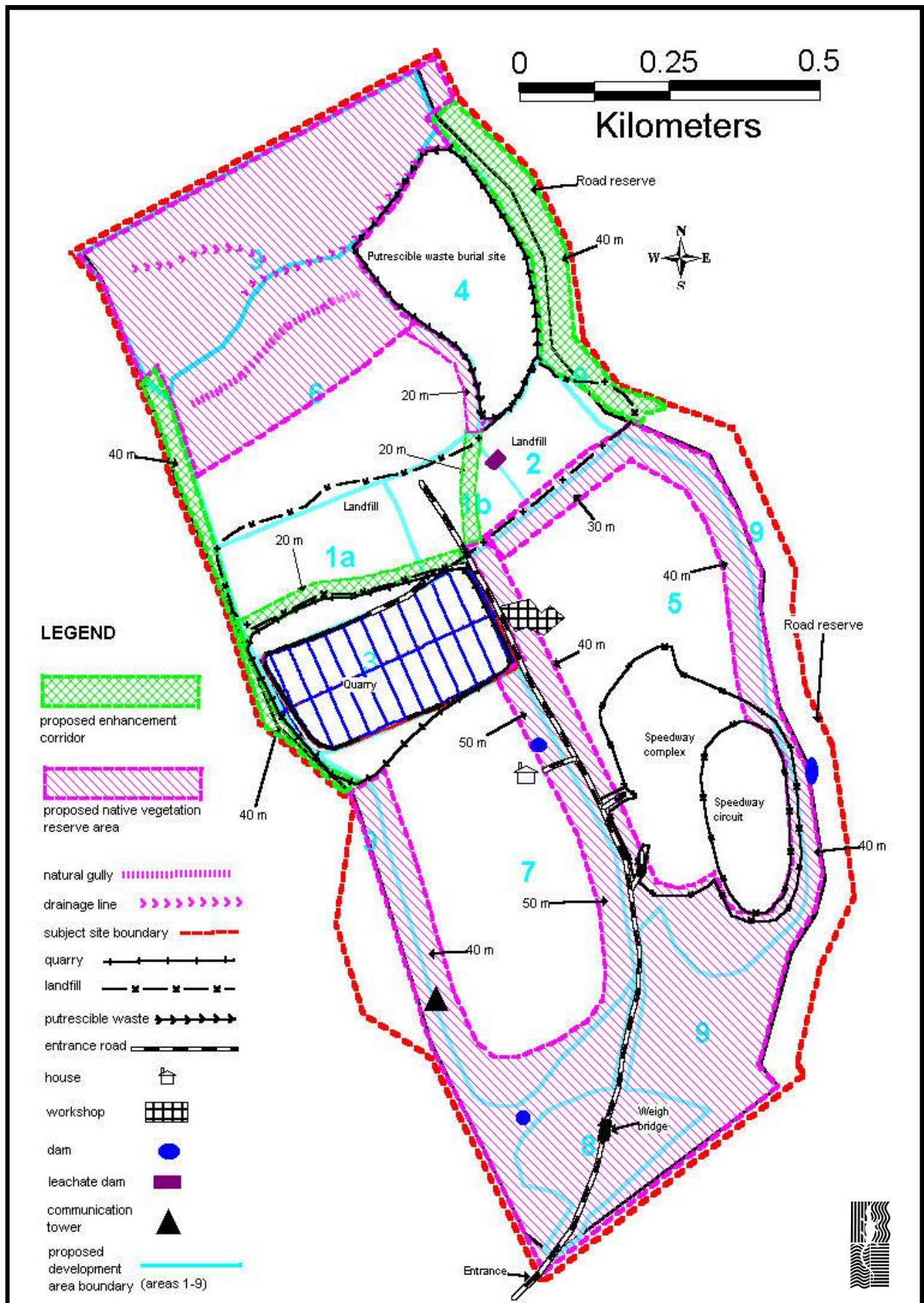


Figure 8.1. Proposed impact amelioration measures for the subject site.

9. MATTERS OF SOCIAL AND ECONOMIC IMPACT

The purpose of this section is to discuss the social and economic impacts of the proposed development on the biodiversity and social values of the subject site to the general community with particular reference to threatened species and their habitats, that are known to or potentially occur within the study area.

9.1. CONSEQUENCES OF EXTENDING THE EXISTING LANDFILL

There are numerous potential economic costs and social consequences associated with the proposed development. The majority of these impacts are linked with the removal of native vegetation from the subject site. Removal of native vegetation from the subject site will ultimately result in the loss of some biodiversity for the study area and McPherson Range, which may result in a number of economic and social costs flowing through to the GCC and general Griffith community.

The benefits derived from threatened species recorded within the subject site to the community are largely indirect benefits. Some value may be gained directly from experiencing these species (i.e. bird watching), however the greatest value is obtained from the aesthetic (scenic value) derived from threatened species habitat and the native vegetation that forms this habitat. It is widely understood that native vegetation has many economic and social values (WRRVC 2002). The main economic values associated with native vegetation relevant to the proposed development are:

- § aesthetic – natural landscape;
- § tourism and recreation;
- § protection of water resources;
- § soil formation and protection;
- § pollution breakdown and absorption; and
- § biodiversity.

Of particular consequence to this assessment are the associated impacts upon the indirect values, particularly biodiversity and the aesthetic values of the subject site. Indirect use values include functional benefits derived from the alliance on natural ecosystems for life support functions through the provision of clean water, air and other resources and the conservation of biodiversity (DEST 1995).

Although four threatened species and potential habitat for other threatened species was recorded within the subject site, the potential impacts of the proposed development are not likely to cause significant impacts to threatened species at a national, state or regional scale. It is not possible and beyond the scope of this assessment to quantify the economic costs associated with the loss of habitat of threatened species due to the lack of useful data. However, considering the area of habitat that would be affected by the proposed development (< 85 ha of native vegetation), the rate of removal over a 40-year period and the proposed rehabilitation process and native vegetation reserve areas it is considered minimal. The proposed development is unlikely to contribute to the economic costs associated with recovery planning or threatened species conservation to the community.

Implementation of the native vegetation reserve areas will ultimately preserve regionally significant vegetation, threatened species habitat and the biodiversity values of the subject site at a zero cost to the GCC and the community. Implementation of the proposed revegetation areas, and pest and weed control programs will amount to some costs to the GCC and community. Although a cost estimate for the implementation of these measures is not provided in this report it is considered that resulting costs are nominal when compared to the economic and social costs of replacing threatened species habitat and compensating for the loss of regionally significant vegetation. Retaining native vegetation is also considered the preferred choice for maintaining biodiversity values, particularly in such a fragmented landscape where the majority of native vegetation is cleared.

The aesthetic values of the subject site in relation to its place in the surrounding landscape could be significantly compromised by the proposed development. McPherson Range is a significant landform providing a scenic backdrop to the city of Griffith in an otherwise flat cleared landscape. Existing development already fragments the visual and biodiversity values of the range. The proposed development will probably further degrade the aesthetic value of the range and consequently affect the scenic values held by the Griffith community. The proposed native vegetation reserve areas, revegetation works and rehabilitation process aim to not only preserve the biodiversity values of the subject site but also minimise the visual impacts of the proposed development upon the surrounding landscape.

9.2. CONSEQUENCES OF NOT EXTENDING THE EXISTING LANDFILL AND QUARRY

The City of Griffith currently produces an estimated 55,000 m³ of waste and uses approximately 60,000 tonnes of crushed rock (road base for the construction and maintenance of its roads) per annum. Based on current waste generation and road base usage, the current landfill and quarry have life expectations of only 2 and 3 years respectively (Coffey 2000).

Road base materials will be required for city road construction and maintenance, however some reductions may occur in the future with further advances in stabilization of existing pavement materials and the crushing and processing of waste concrete (Coffey 2000).

Despite advances in recycling and irrigation techniques, it is not foreseeable that waste production can be reduced to zero. Although the incineration of waste is practiced to a limited extent in Australia, it is often found to be an expensive process and it too requires a landfill for the disposal of ash products. The only other existing landfill within the City area is at Yenda. However, the council does not consider this site to have the capacity to meet the long-term projected requirements of the City, nor do they consider it environmentally suitable (Coffey 2000). Council could stop collecting commercial waste but it is a function of councils to manage domestic waste. The consequence of not providing a licensed disposal site is likely to lead to an unhealthy environment, loss of habitat and native vegetation in other areas and aesthetic values if waste is disposed of by uncontrolled means (Coffey 2000).

Through regulatory actions imposed upon the development proposal process a detailed study has been undertaken of an important component of the natural environment of the Griffith region. Consequently, regionally significant vegetation, threatened species and habitats have been identified. GCC is now required to consider the conservation of these species in regards to the proposed development and ensure that the proposed development will in no way significantly affect these species. In doing so specific measures will be implemented to ensure that and threatened species habitat and regionally significant vegetation is preserved within the subject site. These measures have been specifically targeted towards the conservation threatened species whilst recognising the need for a landfill and quarry to the Griffith community.

Although no economic costs analysis was conducted as part of this assessment the economic costs likely to be incurred as a result of the conservation of threatened species and other biodiversity attributes within the subject site and study area are considered nominal in comparison to the alternative. There are few significant social consequences likely to result from the proposed development. The largest social impact will result from the loss of some of the scenic value derived from the native vegetation of the subject site as a result of clearing for various stages of the proposed development. The proposed impact amelioration measures in conjunction with the site rehabilitation process have been designed to negate this impact.

10. IMPLICATIONS FOR ECOLOGICALLY SUSTAINABLE DEVELOPMENT

10.1. DEFINITION OF ESD

Ecologically sustainable development (ESD) seeks to achieve the integration of environmental and economic considerations into the decision-making process. ESD has been defined by the Commonwealth Government (1990) as “using, conserving and enhancing the community’s resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased”. The concept of ESD has developed from the concern that insufficient weight has been placed on environmental considerations when making decisions about resource use.

Schedule 2 of the *Environmental Planning and Assessment Regulation 1994* states that the SIS must include “*the reasons for justifying the carrying out of the development or activity in the manner proposed, having regard to biophysical, economic and social considerations and the principles of ecologically sustainable development*”.

The principles of ESD defined in the *Protection of the Environment Administration Act 1991* and the *Environmental Planning and Assessment Regulation 1994*, are described below.

The precautionary principle: This principle states that if there are any threats of serious or irreversible environmental damage, lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

Intergenerational equity: This principle states that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

Conservation of biological diversity and ecological integrity: This principle is not described in the Regulation, although it means that the diversity of genes, species, populations and the communities, as well as the ecosystems and habitats to which they belong, must be maintained or improved to ensure their survival.

Improved valuation and pricing of environmental resources: This principle is not described in the Regulation. However, the following description is provided by Harding (1990).

“Traditionally pricing and resources have not reflected their scarcity, replacement costs in the long-term, or future cost of irreversible and cumulative damage to natural systems. This principle requires that the true costs to the environment be factored into the cost of production or use of the resource. Those who pollute or degrade the environment should be held accountable for the restoration of the environment to its previous natural condition.”

10.2. ESD AND THE PROPOSED ACTIVITY

Whilst the previously listed principles provide a broad indication of what ESD involves, their implications for development at a particular location, such as the expansion of the Griffith quarry and landfill, are more difficult to determine. This report considers why the preferred option has been selected and how it contributes towards ESD in the Griffith area.

The precautionary principle

The expansion of the Griffith quarry and landfill provides a necessary development to the existing site to prevent the alteration of other, more environmentally sensitive, sites in the surrounding areas.

Although the clearing of existing native vegetation is unavoidable, the proposal is unlikely to cause serious or irreversible environmental damage on a regional scale. Providing the proposed impact amelioration measures are followed, the proposal should be allowed to proceed.

Intergenerational equity

Justification of the proposed activity in upholding the objectives of the principle for intergenerational equity can be met by the necessity of the activities and the alternative sites in the local area. The proposal would provide benefits to the existing and future populations of the area through the prevention of illegal dumping and quarrying at alternative, more environmentally sensitive sites. Degradation of the remnant vegetation at other sites provides a higher risk of negative impacts upon the local diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong.

Conservation of biodiversity and ecological integrity

The conservation of biodiversity and ecological integrity is not a priority of the proposed works. Vegetation within the study area will be directly and/or indirectly affected by the proposed activity by the removal of essential habitats for the species and populations that currently exist at the site.

Improved valuation and pricing of environmental resources

The proposed works approaches the principle of improved valuation and pricing of environmental resources by providing a managed site for the dumping of rubbish and essential quarrying activities. The consequences of not expanding the existing quarry and landfill are likely to provide more significantly detrimental results to the ecosystem of other, less disturbed local sites.

10.3. CONCLUSION

In terms of the principles of ESD set out in the *Protection of the Environment Administration Act 1991* and the *Environmental Planning and Assessment Regulation 1994*, it is anticipated that the implementation of the quarry and landfill expansion would help to move towards ESD in the Griffith area. Although the proposed activities do not specifically approach all the principles of ESD, the consequences of not undertaking the expansion of this site would be likely to result in greater implications for regional biodiversity.

11. CONCLUSION

The proposed expansion of the Tharbogang landfill and quarry will result in the removal of approximately 50 ha or 59% of the 85 ha of existing native vegetation of the subject site. As part of this process all vegetative layers and associated habitat features will be removed. The habitat of four threatened fauna species and potential habitat for at least seven subject species recorded within the subject site will also be affected.

If the proposed development is to continue as planned without the implementation of the proposed impact amelioration measures at least 70% of 'known' habitat utilised by Grey-crowned Babbler will be removed and it is '*likely*' that a '*significant effect*' upon this species will occur within the study area. In addition, up to 60% of 'known' foraging habitat and potential roosting habitat for the three threatened bat species recorded within the subject site will also be removed. However, if the proposed impact amelioration measures and site rehabilitation works are implemented (e.g. proposed native vegetation reserve areas) it is considered '*unlikely*' that the proposed development will have a '*significant effect*' upon any of the recorded threatened species or other threatened species which may utilise the subject site as part of their overall habitat area or on an occasional basis.

It is not possible to quantify the effect of local habitat loss on a regional scale due to a lack of useful data, particularly with regards to more mobile species like microchiropteran bats. However, considering the area of habitat that would be affected by the proposed development, the rate of removal over a 40-year period and the proposed rehabilitation process and native vegetation reserve areas it is considered minimal. Potential impacts to threatened species and their habitat are not likely to significantly contribute to the cumulative loss of habitat at a national, state or regional level.

There were no threatened or ROTAP listed plant species recorded within the subject site during the time of this assessment or during the ERC 2000 investigation. However, the ROTAP listed *Lomandra patens* may occur within the subject site considering that it has previously been found within the McPhersons Range. It is '*unlikely*' that the proposed development will have a '*significant effect*', as discussed in Table 7.2 (Section 7.1), on *Lomandra patens* or any other threatened plant species. The potential lies to increase the local population of this species within the subject site as part of the rehabilitation process.

Overall the potential impacts of the proposed development are generally limited to individuals and local populations of threatened species and are not likely to represent significant impacts to threatened species at a national, state or regional scale. Habitat for subject species that may be impacted by the proposed development is considered to also occur, within McPherson Range and land east of the subject site. However, it is noted that most of this vegetation and associated habitat, particularly within land east and north of the subject site is not considered secure and could be developed in the future.

Although the removal of vegetation from the study site will not constitute a significant loss of vegetation in regional terms, the proposed development should be conducted in a manner, which minimises or ideally avoids the imposition of adverse impacts on retained native vegetation within the subject site. The social and economic impacts of the proposed development on the community

and biodiversity of the Griffith area are considered minimal compared to the consequences of not proceeding with the proposed development. The proposed impact amelioration measures are designed to minimise many of these costs to the community, whilst preserving the aesthetic and biodiversity values of the subject site.

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APPENDIX A.

FLORA SPECIES LIST

* denotes introduced species # denotes noxious weed			
Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
Adiantaceae			
<i>Cheilanthes austrotenuifolia ssp. seiberi</i>	Mulga Fern	x	x
Cupressaceae			
<i>Callitris glaucophylla</i>	White Cypress Pine	x	x
MONOCOTS			
Amaryllidaceae			
<i>Calostemma purpurea</i>	Wilcannia Lily		x
Cyperaceae			
<i>Cyperus eragrostis</i>	*		x
<i>Cyperus exaltatus</i>	*		x
<i>Cyperus rotundus</i>	Nutgrass		x
Juncaceae			
<i>Juncus bufonius</i>	Toad Rush	x	
<i>Juncus usitatus</i>	Common Rush	x	
Liliaceae			
<i>Dianella revoluta</i>	Spreading Flax-lily	x	
<i>Tricoryne elatior</i>	Yellow Rush-lily		x
Poaceae			
<i>Agropyron scabrum</i>	Common Wheat Grass	x	x
<i>Agrostis aemula var. aemula</i>	Blown Grass		x
<i>Agrostis sp.</i>		x	x
<i>Anthoxanthum odoratum</i>	Sweet Vernal Grass*		x
<i>Aristida behriana</i>	Brush Wire Grass	x	x
<i>Aristida sp.</i>	Three-awned Grass	x	x
<i>Aristida sp.</i>	Corkscrew Grass		x
<i>Austrodanthonia caespitose</i>	Common Wallaby Grass	x	x
<i>Austrodanthonia monticola</i>		x	
<i>Austrodanthonia sp.</i>		x	x
<i>Austrostipa scabra</i>	Rough Spear Grass	x	x
<i>Austrostipa nodosa</i>			x
<i>Austrostipa verticillata</i>	Slender Grass	x	
<i>Austrostipa sp.</i>		x	x
<i>Avena fatua</i>	Wild Oats*	x	x
<i>Axonopus affinis</i>	Carpet Grass*	x	x
<i>Briza maxa</i>	Quaking Grass*	x	x
<i>Bromus catharticus</i>	Prairie Grass*	x	x
<i>Bromus rubens</i>			x
<i>Bromus molliformis</i>	Soft Brome*		x

Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
<i>Chloris truncata</i>	Windmill Grass	x	x
<i>Chloris virgata</i>	Feathertop Rhodes Grass*		x
<i>Cortaderia selloana</i>	Pampas Grass*		x
<i>Cynodon dactylon</i>	Couch Grass*	x	x
<i>Echinochloa crus-galli</i>	Barnyard Grass*		x
<i>Enneapogon avenaceus</i>	Common Bottlewashers	x	
<i>Enneapogon sp.</i>	Bottlewashers	x	
<i>Enteropogon acicularis</i>	Curly Windmill Grass	x	x
<i>Eragrostis brownii</i>	Common Love-grass	x	x
<i>Eragrostis cilianensis</i>	Stinkgrass*		x
<i>Hordeum leporinum</i>	Barley Grass*	x	x
<i>Lolium perenne</i>	Perennial Ryegrass*	x	
<i>Panicum effusum</i>	Hairy Panic		x
<i>Paspalum dilatatum</i>	Paspalum*		x
<i>Paspalum distichum</i>	Water Couch		x
<i>Pennisetum spp.</i>	Kikuyu*	x	x
<i>Pentapogon quadrifidus</i>	Five-awned Spear-grass	x	x
<i>Phalaris aquatica</i>	Phalaris*		x
<i>Poa annua</i>	Winter Grass		x
<i>Poa sp.</i>			
<i>Setaria glauca</i>	Pale Pigeon Grass*		x
<i>Sporobolus sp.</i>		x	
<i>Tragus australis</i>	Small Burr Grass		x
Typhaceae			
<i>Typha orientale</i>	Cumbungi	x	x
Xanthorrhoeaceae			
<i>Lomandra effusa</i>	Scented Matrush	x	x
DICOTS			
Amaranthaceae			
<i>Alternanthera laxiflora</i>	Common Joyweed*		x
<i>Alternanthera pungens</i>	Khaki Weed*#		x
<i>Amaranthus sp.</i>	Amaranth*		x
<i>Amaranthus macrocarpus</i>	Dwarf Amaranth*		x
<i>Gomphrena celosiodes</i>	Gomphrena Weed*		x
<i>Pilotus exaltatus var semilanatus</i>	Lambs Tail	x	
Apiaceae			
<i>Daucus glochidiatus</i>	Australian Carrot		x
<i>Foeniculum vulgare</i>	Fennel*	x	x
<i>Hydrocotyle sp.</i>	Pennywort*		x
Asteraceae			
<i>Ageratina adenophora</i>	Crofton Weed*		x
<i>Ambrosia artemisiifolia</i>	Annual Ragweed*		x

Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
<i>Bidens subalternans</i>	Cobbler's Peg		x
<i>Brachyscome</i> sp.	Daisy		x
<i>Calotis</i> sp.	Daisy		x
<i>Carduus nutans</i>	Nodding Thistle*		x
<i>Carthamus lanatus</i>	Saffron Thistle*	x	
<i>Chicorium intybus</i>	Chicory*	x	
<i>Chondrilla juncea</i>	Skeleton Weed*		x
<i>Cirsium vulgare</i>	Spear Thistle*		x
<i>Conyza albida</i>	Tall Fleabane*		x
<i>Conyza bonariensis</i>	Flaxleaf Fleabane*	x	x
<i>Crepis capillaries</i>	Smooth Hawkesbeard*		x
<i>Cynara cardunculus</i>	Cardoon*		x
<i>Helichrysum apiculatum</i>	Common Everlasting	x	x
<i>Helichrysum semipapposum</i>	Clustered Everlasting	x	x
<i>Helichrysum viscosum</i>	Sticky Everlasting	x	
<i>Hypochoeris glabra</i>	*		x
<i>Hypochoeris radicata</i>	Catsear Flatweed*		x
<i>Lactuca saligna</i>	Willow Leaf Lettuce*		x
<i>Lactuca serriola</i>	Prickly Lettuce*		x
<i>Pseudognaphalium luteoalbum</i>	Jersey Cudweed		x
<i>Schkuhria pinnata</i>	Dwarf Marigold		x
<i>Senecio</i> sp.	*		x
<i>Silybum marianum</i>	Variegated Thistle*	x	x
<i>Sonchus oleraceus</i>	Common Milk Thistle*		x
<i>Taraxum officinale</i>	Dandelion*		x
<i>Vittadinia triloba</i>	Purple Fuzz Weed	x	x
<i>Xanthium spinosum</i>	Bathurst Burr*#	x	x
Bignoniaceae			
<i>Pandorea pandorana</i>	Wonga Vine	x	
Boraginaceae			
<i>Echium plantagineum</i>	Paterson's Curse*#	x	x
<i>Echium vulgare</i>	Viper's Bugloss*	x	x
<i>Heliotropium europaeum</i>	Common Heliotrope*		x
Brassicaceae			
<i>Brassica juncea</i>	Mustard*	x	
<i>Lepidium africanum</i>	Common Peppercress*	x	x
<i>Lepidium latifolium</i>	Field Cress*		x
Cactaceae			
<i>Opuntia aurantiaca</i>	Common Prickly Pear*	x	x
Caesalpinioideae			
<i>Cassia artemisioides</i>	Silver Cassia	x	x
<i>Cassia eremophila</i> var <i>eremophila</i>	Punty Bush	x	

Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
Campanulaceae			
<i>Whalenbergia communis</i>	Tufted Blubell	x	x
Casuarinaceae			
<i>Allocasuarina luehmannii</i>	Bull-oak	x	x
<i>Allocasuarina verticillata</i>	Drooping She-oak	x	
Chenopodiaceae			
<i>Atriplex elacophylla</i>	Saltbush	x	
<i>Atriplex leptocarpa</i>	Slender-fruited Saltbush	x	
<i>Atriplex semibaccata</i>	Creeping Saltbush	x	
<i>Enchylaena tomentosa</i>	Ruby Saltbush	x	x
<i>Rhagodia nutans</i>	Climbing Saltbush	x	x
<i>Salsola kali</i>	Buckbush	x	x
<i>Sclerolaena muricate</i>	Black Roly Poly	x	x
Clusiaceae			
<i>Hypercium perforatum</i>	St. John's Wort*#		x
Convolvulaceae			
<i>Convolvulus erubescens</i>	Australian Bindweed	x	x
<i>Convolvulus sp.</i>			x
Cucurbitaceae			
<i>Citrullus myriocarpus</i>	Wild Melon*		x
<i>Citrullus sp.</i>	*		x
Cunoniaceae			
<i>Pittosporum phillyreoides</i>	Weeping Pittosporum		x
Euphorbiaceae			
<i>Chamaesyce drummondii</i>	Caustic Weed		x
<i>Euphorbia peplus</i>	Petty Spurge*		x
<i>Ricinus communis</i>	Castor Oil Plant*		x
Fabaceae			
<i>Medicago sp.</i>	*		x
<i>Trifolium sp.</i>	*		x
<i>Trifolium repens</i>	*		x
Gentianaceae			
<i>Centaurium terifolium</i>	Branched Centaury*		x
Geraniaceae			
<i>Erodium crinitum</i>	Blue Crowsfoot		x
<i>Erodium botrys</i>	Long Storksbill*	x	
Haloragaceae			
<i>Gonocarpus elatus</i>	Tall Raspwort		x
Juncaceae			
<i>Juncus acutus</i>	Spiny Rush*		x
<i>Juncus usitatus</i>	Common Rush	x	x

Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
Lamiaceae			
<i>Marrubium vulgare</i>	Horehound*#		x
<i>Metha pulegium</i>	Pennyroyal*		x
<i>Salvia verbenaca</i>	Wild Sage		x
Lobeliaceae			
<i>Isotoma petraeae</i>	Rock Isotome	x	
Loranthaceae			
<i>Amyema sp.</i>	Mistletoe	x	
Malvaceae			
<i>Hibiscus strurtii</i>	Hill Hibiscus	x	
<i>Malva parviflora</i>	Marshmallow*	x	x
<i>Sida corrugata</i>	Variable (Corrugated) Sida	x	x
<i>Sida cunninghamii</i>	Ridge Sida	x	
Mimosaceae			
<i>Acacia doratoxylon</i>	Currawang	x	x
<i>Acacia calamifolia</i>	Wallowa	x	x
<i>Acacia oswaldii</i>	Miljee	x	
<i>Acacia paradoxa</i>	Kangaroo Thorn	x	
<i>Acacia pendula</i>	Weeping Myall	x	x
Myrtaceae			
<i>Eucalyptus dwyeri</i>	Dwyers Mallee Gum	x	x
<i>Eucalyptus populnea ssp bimbil</i>	Bimble Box	x	x
Orobanchaceae			
<i>Orobancha australiana</i>	Australian Broomrape	x	
Oxalidaceae			x
<i>Oxalis perennans</i>	Grassland Wood Sorrel		x
<i>Oxalis pes-caprae</i>	*		x
Plantaginaceae			
<i>Plantago lanceolata</i>	Ribwort, Plantain*		x
Polygonaceae			
<i>Acetosella vulgaris</i>	Sheep Sorrel	x	x
<i>Rumex brownii</i>	Slender Dock	x	
<i>Rumex crispus</i>	Curled Dock	x	
Portulacaceae			
<i>Portulaca oleracea</i>	Pigweed*		x
Ranunculaceae			
<i>Ranunculus sp.</i>			x
Rosaceae			
<i>Rosa rubiginosa</i>	Sweet Briar*#		x
<i>Rubus fruticosus</i>	Blackberry*#		x
Rutaceae			
<i>Geijera parviflora</i>	Wilga	x	x

Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
Sapindaceae			
<i>Dodonaea cuneata</i>	Wedge-leaf Hop-bush	x	x
<i>Dodonaea viscosa ssp angustissima</i>	Narrow-leaf Hop-bush	x	x
<i>Dodonaea viscosa ssp arborescens</i>	Broad-leaf Hopbush	x	
Solanaceae			
<i>Lycium ferocissimum</i>	African Boxtorn*#		x
<i>Solanum esuriale</i>	Quena	x	x
<i>Solanum nigrum</i>	Blackberry Nightshade	x	x
<i>Solanum sturtianum</i>	Sturt's Nightshade	x	
<i>Solanum sp.</i>		x	
Stackhousiaceae			
<i>Stackhousia monogyna</i>	Creamy Candles		x
Sterculiaceae			
<i>Brachychiton populneus</i>	Kurrajong	x	x

APPENDIX B.

FAUNA SPECIES LIST

* denotes introduced species

Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
REPTILES			
<i>Diplodactylus intermedius</i>	Eastern Spiny-tailed Gecko	x	
<i>Diplodactylus vitatus</i>	Wood Gecko	x	x
<i>Gehyra variegata</i>	Tree Dtella	x	
<i>Underwoodisaurus milii</i>	Thick-tailed Gecko	x	
<i>Pogona barbata</i>	Bearded Dragon	x	
<i>Varanus varius</i>	Lace Monitor	x	
<i>Lampropholis guichenoti</i>	Pale-flecked Garden Skink	x	x
<i>Menetia greyii</i>		x	
<i>Trachydosaurus rugosus</i>	Shingle-back	x	
<i>Demansia psammophis</i>	Yellow-faced Whip Snake		x
AMPHIBIANS			
<i>Lymnodynastes tasmaniensis</i>	Spotted Marsh Frog	x	x
<i>Crinia parainsignifera</i>	Plains Froglet		x
BIRDS			
<i>Vanellus miles</i>	Masked Lapwing (Plover)		x
<i>Milvus migrans</i>	Black Kite	x	x
<i>Milvus sphenurus</i>	Whistling Kite	x	x
<i>Hieraaetus morphnoides</i>	Little Eagle		x
<i>Aquila audux</i>	Wedge-tailed Eagle	x	
<i>Accipiter fasciatus</i>	Brown Goshawk	x	x
<i>Accipter cirrhocephalus</i>	Collared Sparrowhawk	x	x
<i>Falco subniger</i>	Black Falcon	x	
<i>Falco peregrinus</i>	Peregrine Falcon	x	
<i>Flaco longipennis</i>	Australian Hobby		x
<i>Falco berigora</i>	Brown Falcon	x	x
<i>Falco cenchroides</i>	Australian Kestrel	x	x
<i>Geopelia placida</i>	Peaceful Dove	x	x
<i>Geopelia cuneata</i>	Diamond Dove		x
<i>Phaps chalcoptera</i>	Common Bronzewing	x	x
<i>Geophaps laphotes</i>	Crested Pigeon	x	x
<i>Eolophus roseiapilla</i>	Galah	x	x
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	x	x
<i>Barnardius barnardi</i>	Australian Ringneck	x	x
<i>Psephotus varius</i>	Red-rumped Parrot	x	x
<i>Northiella haemotogaster</i>	Blue Bonnet	x	x

Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
BIRDS cont.			
<i>Chalcites osculans</i>	Black-eared Cuckoo	x	
<i>Chalcites basalis</i>	Horsfield's Bronze-cuckoo	x	
<i>Ninox novaeseelandiae</i>	Southern Boobook	x	x
<i>Tyto alba</i>	Barn Owl	x	x
<i>Podargus strigoides</i>	Tawny Frogmouth	x	
<i>Eurostopodus argus</i>	Spotted Nightjar	x	
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar		x
<i>Hirundapus caudactis</i>	White-throated Needletail	x	
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	x	x
<i>Todiramphus sanctus</i>	Sacred Kingfisher	x	
<i>Merops ornatus</i>	Rainbow Bee-eater	x	
<i>Climacteris picumnus picumnus</i>	Brown Treecreeper	x	
<i>Malurus cyaneus</i>	Superb Fairy-wren		x
<i>Pardalotus striatus</i>	Striated Pardalote	x	x
<i>Smicrornis brevirostris</i>	Weebill	x	
<i>Gerygone fusca</i>	Western Gerygone	x	x
<i>Acanthiza apicalis</i>	Inland (Broad-tailed) Thornbill	x	
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	x	x
<i>Acanthiza nana</i>	Yellow (Little) Thornbill	x	x
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	x	
<i>Aphelocephala leucopsis</i>	Southern Whiteface	x	
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	x	x
<i>Philemon corniculatus</i>	Noisy Friarbird	x	
<i>Philemon citreogularis</i>	Little Friarbird	x	x
<i>Manorina flavigula</i>	Yellow-throated Minor	x	x
<i>Lichenostomus pensillatus</i>	White-plumed Honeyeater	x	
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	x	
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler	x	x
<i>Pomatostomus spencilio</i>	White-browed Babbler	x	
<i>Petroica goodenovii</i>	Red-capped Robin	x	x
<i>Eopsaltria australis</i>	Eastern Yellow Robin		x
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	x	x
<i>Pachycephala rufiventris</i>	Rufous Whistler	x	x
<i>Myiagra inquieta</i>	Restless Flycatcher		x
<i>Rhipidura fuliginosa</i>	Grey Fantail	x	x
<i>Rhipidura leucophrys</i>	Willie Wagtail	x	x
<i>Grallina cyanoleuca</i>	Australian Magpie-lark	x	x
<i>Oriolus sagittatus</i>	Olive-backed Oriole	x	x
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	x	
<i>Artamus personatus</i>	Masked Woodswallow	x	

Scientific Name	Common Name	Recorded	
		ERC 2002	ERC 2000
BIRDS cont.			
<i>Artamus superciliosus</i>	White-browed Woodswallow	x	
<i>Artamus cyanopterus</i>	Dusky Woodswallow	x	
<i>Cracticus torquatus</i>	Grey Butcherbird	x	x
<i>Cracticus nigrogularis</i>	Pied Butcherbird	x	x
<i>Gymnorhina tibicen</i>	Australian Magpie	x	x
<i>Corvus coronoides</i>	Australian Raven	x	x
<i>Corvus mellori</i>	Little Raven	x	x
<i>Corcorax melanorhamphos</i>	White-winged Chough	x	x
<i>Struthidea cinerea</i>	Apostlebird	x	x
<i>Hirundoneoxena</i>	Welcome Swallow	x	
<i>Mirafra javanica</i>	Singing Bushlark	x	
<i>Passer domesticus</i>	House Sparrow*	x	x
<i>Carduelis carduelis</i>	European Goldfinch	x	
<i>Taeniopygia bichenovii</i>	Double-barred Finch	x	x
<i>Taeniopygia guttata</i>	Zebra Finch		x
<i>Zosterops lateralis</i>	Silvereye		x
<i>Turdus merula</i>	Common Blackbird	x	
<i>Sturnus vulgaris</i>	Common Starling*	x	x
MAMMALS			
<i>Trichosurus vulpecular</i>	Common Brushtail Possum	x	x
<i>Macropus giganteus</i>	Eastern Grey Kangaroo	x	x
<i>Vulpes vulpes</i>	Fox*	x	x
<i>Oryctolagus cuniculus</i>	Rabbit*	x	x
<i>Felis catus</i>	Cat*	x	x
<i>Vespadelus vulturnus</i>	Little Forest Bat	x	x
<i>Vespadelus baverstocki</i>	Inland Forest Bat	x	
<i>Vespadelus sp.</i>			x
<i>Scotoropens balstoni</i>	Inland Broad-nosed Bat	x	
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	x	x
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	x	x
<i>Chalinolobus picatus</i>	Little Pied Bat	x	
<i>Myotis macropus</i>	Fishing Bat	x	
<i>Mormopterus planiceps (lpf)</i>	Southern Freetail Bat	x	
<i>Mormopterus planiceps (spf)</i>	Inland Freetail Bat	x	
<i>Tadarida australis</i>	White-striped Mastiff Bat	x	x

APPENDIX C.

DIRECTOR-GENERAL'S REQUIREMENTS

APPENDIX D.

GRIFFITH CITY COUNCIL CORRESPONDENCE

APPENDIX E.

DLWC CORRESPONDENCE

APPENDIX F.

THREATENED SPECIES, POPULATIONS AND ECOLOGICAL COMMUNITIES KNOWN FROM THE GRIFFITH REGION

Fauna Species	Source	Legal Status	
		NSW	National
<i>Litoria raniformis</i> Southern Bell Frog	DG NP1	Endangered (Schedule 1-part 1)	Vulnerable
<i>Tiliqua occipitalis</i> Western Blue-tongued Lizard	DG NP1	Vulnerable (Schedule 2)	
<i>Burhinus grallarius</i> Bush Stone-curlew	DG NP1	Endangered (Schedule 1-part 1)	
<i>Ardeotis australis</i> Australian Bustard	DG NP1	Endangered (Schedule 1-part 1)	
<i>Falco hyoleucos</i> Grey Falcon	DG NP1	Vulnerable (Schedule 2)	
<i>Lophoictinia isura</i> Square-tailed Kite	DG NP1	Vulnerable (Schedule 2)	
<i>Rostratula beghalensis</i> Painted Snipe	DG NP1	Vulnerable (Schedule 2)	WSMP
<i>Grus rubicundus</i> Brolga	DG NP1	Vulnerable (Schedule 2)	
<i>Stricktonetta naevosa</i> Freckled Duck	DG NP1	Vulnerable (Schedule 2)	
<i>Oxyura australis</i> Blue-billed Duck	DG NP1	Vulnerable (Schedule 2)	
<i>Anseranas semipalmate</i> Magpie Goose	DG NP1	Vulnerable (Schedule 2)	
<i>Botaurus poiciloptilus</i> Australasian Bittern	DG NP1	Vulnerable (Schedule 2)	
<i>Limosa limosa</i> Black-tailed Godwit.	DG NP1	Vulnerable (Schedule 2)	
<i>Cacatua leadbeateri</i> Pink Cockatoo	DG NP1	Vulnerable (Schedule 2)	
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo	DG NP1	Endangered Population (Schedule 1-part 2)	
<i>Calyptorhynchus lathami</i> Glossy Black-Cockatoo	DG NP1	Vulnerable (Schedule 2)	
<i>Polytelis swainsonii</i> Superb Parrot	DG NP1	Vulnerable (Schedule 2)	Vulnerable
<i>Neophema pulchella</i> Turquoise Parrot	DG NP1	Vulnerable (Schedule 2)	
<i>Ninox connivens</i> Barking Owl	DG NP1	Vulnerable (Schedule 2)	
<i>Tyto novaehollandiae</i> Masked Owl	DG	Vulnerable (Schedule 2)	
<i>Pomatostomus temporalis</i> <i>temporalis</i> (eastern subspecies) Grey-crowned Babbler	DG NP1 ERC	Vulnerable (Schedule 2)	

<i>Drymodes brunneopygia</i> Southern Scrub-robin	DG NP1	Vulnerable (Schedule 2)	
<i>Melanodryas cucullate</i> Hooded Robin	DG NP1	Vulnerable (Schedule 2)	
<i>Pachycephala inornata</i> Gilbert's Whistler	DG NP1	Vulnerable (Schedule 2)	
<i>Pachycephala fogularis</i> Red-lored Whistler	DG NP1	Endangered (Schedule 1-part 1)	Vulnerable
<i>Cinclosoma castanotus</i> Chestnut Quail-thrush	DG NP1	Vulnerable (Schedule 2)	
<i>Hylacola cauta</i> Shy Heathwren	DG NP1	Vulnerable (Schedule 2)	
<i>Chthonicola sagittate</i> Speckled Warbler	DG NP1	Vulnerable (Schedule 2)	
<i>Xanthomyza phrygia</i> Regent Honeyeater	DG NP1	Endangered (Schedule 1-part 1)	Endangered TSMP
<i>Melithreptus gularis</i> Black-chinned Honeyeater	DG	Vulnerable (Schedule 2)	
<i>Certhionyx variegatus</i> Pied Honeyeater	DG NP1	Vulnerable (Schedule 2)	
<i>Grantiella picta</i> Painted Honeyeater	DG NP1	Vulnerable (Schedule 2)	
<i>Stagonopleura guttata</i> Diamond Firetail	DG NP1	Vulnerable (Schedule 2)	
<i>Leipoa ocellata</i> Malleefowl	NP1	Endangered (Schedule 1-part 1)	Vulnerable
<i>Amytornis striatus</i> Striated Grasswren	NP1	Vulnerable (Schedule 2)	
<i>Pedionomus torquatus</i> Plains Wanderer	NP1	Endangered (Schedule 1-part 1)	Vulnerable
<i>Phascolarctos cinereus</i> Koala	DG	Vulnerable (Schedule 2)	
<i>Chalinolobus picatus</i> Little Pied Bat	DG	Vulnerable (Schedule 2)	
<i>Vespadelus baverstocki</i> Inland Forest Bat	DG	Vulnerable (Schedule 2)	
<i>Nyctophilus timoriensis</i> Greater Long-eared Bat	DG NP1	Vulnerable (Schedule 2)	Vulnerable
<i>Socolaimus flaviventris</i> Yellow-bellied Sheath-tail Bat	DG	Vulnerable (Schedule 2)	
<i>Acacia curranii</i>	DG NP1	Vulnerable (Schedule 2)	Vulnerable
<i>Austrostipa metatoris</i>	DG NP1	Vulnerable (Schedule 2)	Vulnerable
<i>Austrostipa wakoolica</i>	DG NP1	Endangered (Schedule 1-part 1)	Endangered

<i>Brachyscome papillosa</i>	DG NP1	Vulnerable (Schedule 2)	Vulnerable
<i>Caladenia arenaria</i>	DG NP1	Endangered (Schedule 1-part 1)	Endangered
<i>Diuris sheaffiana</i>	DG NP1	Vulnerable (Schedule 2)	Vulnerable
<i>Lepidium aschersonii</i>	DG	Vulnerable (Schedule 2)	Vulnerable
<i>Swainsona murrayana</i>	DG	Vulnerable (Schedule 2)	Vulnerable
<i>Swainsona sericea</i>	DG	Vulnerable (Schedule 2)	
<i>Lomandra patens</i>	GFN	3Rca	

LEGEND TO APPENDIX F**Source:**

NP1 - NSW NPWS Wildlife Database Atlas (22/10/02) – licensed version (1:100,000 map sheet search Griffith 8129 and Kooroongal 8029);

BA - Birds Australia Atlas Database (22/10/02) – 30 minute block search centred on the subject site;

EA - Environment Australia Online Database (22/10/02) – interactive map searcher <http://www.environment.gov.au/epbc/db/interact.html>; and

RT - Rare or Threatened Australian Plant Species database (ROTAP).

DG – Director General’s requirements.

Legal Status:

NSW: identifies the legal status of species as listed under the NSW *Threatened Species Conservation Act 1995*.

National: identifies the legal status of species as listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

FMA: identifies the species as listed under the NSW *Fisheries Management Act*.

TSMP: Terrestrial species covered by migratory provisions of the EPBC Act 1999.

WSMP: Wetland species covered by migratory provisions of the EPBC Act 1999.

APPENDIX G.

THREATENED SPECIES PROFILES

THREATENED FLORA SPECIES PROFILES

Lomandra patens

A robust, tufted perennial herb, growing in tall open scrub on rocky hillsides and flowering mainly through June and July (Harden 1993). Occurring in the MacDonnell and adjacent ranges of Central Australia and the Northern Territory. It is found in scattered locations in south-central Queensland. In central Australia it grows in gorges, elsewhere on rocky hillsides (George 1986). Found in scattered locations in inland NSW and is distributed from Wellington to Mootwingee National Park (Harden 1993; George 1986). Particular attention was paid to areas of the subject site that may have supported suitable habitat for this species during the field assessment. Although this specimen was not found it has been recorded in the Scenic Hill area of MacPherson Range (GBNEG 2000). It is ‘unlikely’ that the proposed development will have a “significant effect” upon this species even if it is present within the subject site. Potential does exist for this species to be included as part of the proposed rehabilitation works for the study area.

Caladenia arenaria

This species occurs south from the Mudgee district, with collections from the Blue Mountains, the Richmond River, Burrinjuck Dam and Carrabost. It is known mainly from the Narrandera-Griffith region where it is extremely rare (Bishop 2000). Only a total of approximately 25 plants are known and none occur in a reserve (NSW NPWS 1997b). It grows in sclerophyll forest on *Callitris*-covered sandy ridges and dunes, especially in the vicinity of watercourses. Despite targeted surveys conducted during the appropriate flowering season this species was not recorded within the subject site. There were no species of orchid recorded within the study site during surveys, possibly due to the unusually dry conditions at the time of the survey. Potential habitat in the form of *Callitris* covered ridgeline areas and upper slopes was recorded, however no preferred habitat was recorded (i.e. *Callitris*-covered sandy ridges and dunes) especially in the vicinity of watercourses. It is *unlikely* that this species occurs within the subject site. It is ‘unlikely’ that the proposed development will have a “significant effect” upon this species considering the lack of preferred habitat, and small extent and disturbed nature of potential habitat (i.e. scraped previously scraped for surficial gravels).

Diuris sheaffiana (tricolor)

Diuris tricolor has been recorded from two sites in western NSW; from near Girilambone in 1886, and from a red earth soil in a Bimble Box community near Tottenham in 1978 (Cunningham *et al.* 1992), but has also been recorded in the Blue Mountains (Carolin and Tindale 1994). Subsequently, very little is known about the habitat and distribution of this species. No species of orchid were recorded within the study site during surveys, possibly due to the unusually dry conditions at the time of the surveys. There are no records of this species within the study area, McPherson Range or Griffith area. Potential habitat in the form of Bimble Box woodland area was recorded. It is considered *unlikely* that this species occurs within the subject site. It is ‘unlikely’ that the proposed development will have a “significant effect” upon this species considering the limited area and disturbance history of the potential habitat. Furthermore, potential habitat of this species within the subject site will be protected by the implementation of the proposed impact amelioration measures.

Austrostipa metatoris

A perennial grass of variable habitats (Jacobs and Everett 1993). It grows in flat open mallee country on red-brown loamy sands to sandy loam (ROTAP 1995) within the Murray Valley, from the central western slopes to the south-western plains and the far south western plains of NSW (Jacobs and Everett 1993; ROTAP 1995). Associate species include *Casuarina cristata*, *Hakea ivoryii*, *Austrostipa drummondii* and *Austrostipa eremophila*. Despite extensive flora and habitat surveys neither the target species or species associated with it were recorded within the subject site. Although potential habitat in the form of Bimble Box woodland area was recorded, it is unlikely that this species occurs within the subject site. Potential habitat for this species will be protected by the proposed impact amelioration

measures. It is ‘*unlikely*’ that the proposed development will have a “*significant effect*” upon this species or any potential habitat of this species within the subject site.

Swainsona murrayana

Occurs on the north and central western slopes, north, south and far south western plains of NSW (Thompson and James 1991). Considered widespread on the Riverine plain (Cunningham *et al.* 1992), collections of this species have been made between Silverton and east of Tambar Springs (ROTAP 1995) and near Jerilderie (Foreman *et al.* 1994). It has been recorded growing in grasslands, on inland floodplains and discharge areas, and also in eucalypt forests (Thompson and James 1991; ROTAP 1995), preferring grey and brown heavy clay and clay loam soils in bladder saltbush, black box and grassland communities (Cunningham *et al.* 1992). Despite extensive flora and habitat surveys of the subject site, this species was not recorded. Limited potential habitat was restricted to grassy areas within Bimble Box woodland of the subject site. No preferred habitat was recorded within the subject site. Although a number of associate species were recorded within the subject site, they were also largely confined to the Bimble Box woodland. Potential habitat for this species will be protected by the proposed impact amelioration measures. It is ‘*unlikely*’ that the proposed development will have a “*significant effect*” upon this species or any potential habitat of this species within the subject site.

Swainsona sericea

In NSW, this species has been collected from the northern tablelands to the southern tablelands and Monaro region and further inland in the slopes and plains. There has been one isolated collection from the far north west of NSW. Outside NSW, it occurs in Victoria and South Australia where it is also considered to be threatened. Many collections are from the 1800s or early 1900s, and recent collections indicate that the species has declined significantly across its former range. Extensive surveys in the northern wheatbelt and southern box woodlands have failed to find the species, whilst it has been found very rarely in surveys of the northern tablelands and Riverina areas. It grows in grassland and eucalypt woodland, sometimes with *Callitris* species. Estimates of abundance are largely unknown, but where known vary from 50 – 1000 plants. It is likely that less than 10,000 mature individuals remain in NSW. It is sometimes confused with *S. reticulata* and *S. oroboides*, but can be distinguished by the presence of medifixed hairs. Clearing of remnant habitat has been mostly responsible for the decline of this species, which may also be sensitive to grazing pressure. As a number of remaining sites for the species occur on roadsides, they are also susceptible to disturbance associated with the maintenance of these roads (NSW NPWS 1999a). Despite extensive flora and habitat surveys of the subject site this species was not recorded. Limited potential habitat was restricted to grassy areas within Bimble Box woodland areas and, to a lesser extent, grassy area beneath *Callitris* vegetation of the subject site. Potential habitat for this species will be protected by the proposed impact amelioration measures. It is ‘*unlikely*’ that the proposed development will have a “*significant effect*” upon this species or any potential habitat of this species within the subject site.

THREATENED FAUNA SPECIES PROFILES

***Tiliqua occipitalis* (Western Blue-tongued Lizard)**

This species is distributed across south western and south central Australia (Cogger 2000), inhabiting plains, swales, ranges and sometimes dunes of loamy or clayey/sandy soils (Ayers *et al.* 1996). Preferred vegetation types appear to be mixed mallee/*Triodia* woodland communities (Cogger 2000), although it is also found in shrublands (including chenopods), heaths and hummock grasslands. In the Western Zone of NSW, it occurs in the central parts from Broken Hill to Condobolin and south to the Victorian border (Swan 1990). A terrestrial and diurnal species, it is known to utilise rabbit warrens for shelter (Swanson 1987) and has a diet comprising insects, snails, native vegetation and carrion (Swan 1990). Although the specific causes of decline are unknown, Sadler and Pressey (1994) suggest that fragmentation of habitat through clearing and grazing, the ripping of rabbit warrens, predation by foxes and cats, and baits used for pest control are all likely to be detrimental to this species.

The Western Blue-tongue Lizard is considered to be at the limit of its known distribution within the vicinity of the subject site. The subject site is probably considered to be at the eastern limit of this species range. No records exist for this species within the study area or the McPherson Range area. This species was not recorded within the subject site despite targeted surveys conducted in potentially suitable habitat. It is therefore considered unlikely that this species would occur within the study area, given the lack of preferred resources and potential impact of predators. It is therefore ‘*unlikely*’ that the proposed development would have a “*significant effect*” on the Western Blue-tongued Lizard. Furthermore, the proposed impact amelioration measures will protect potential habitat areas within the subject site of this species.

***Falco hypoleucos* (Grey Falcon)**

Infrequently seen over much of arid and semi-arid Australia, including the Murray-Darling basin, Eyre basin, central Australia and north-western Australia (Blakers *et al.* 1984; Olsen and Olsen 1986; Marchant and Higgins 1993). The distribution of the Grey Falcon is centred on inland drainage systems where there is <500 mm rainfall per year. There it frequents timbered lowland plains, particularly *Acacia* shrublands, that are crossed by tree-lined watercourses. It also hunts far out into treeless areas and frequents tussock grassland and open woodland, especially in winter. Though recorded from most Australian deserts, it generally avoids them (Olsen and Olsen 1986). It is also found near and over swamps and waterholes (Olsen *et al.* 1993). Evidence exists of regular seasonal movements between the arid zone and northern Australia, and possibly New Guinea (Olsen and Olsen 1986), and from the west to the east in Queensland (G. Czechura in Garnett 1992b).

Always at low densities, the total population is estimated at less than 5000 individuals and 1,000 pairs (P. Olsen in Brouwer and Garnett 1990). Nests are usually separated by many kilometres (Olsen and Olsen 1986); in the Pilbara adjacent pairs built nests between 16 and 23 km apart (A. Sutton in Garnett 1992b). It is still not known whether Grey Falcons build their own nests or rely on the adoption of nests built by other birds (Czechura and Debus 1985). They prey on birds, mostly granivorous parrots and pigeons (Marchant and Higgins 1993), and mammals, including dead lambs (Olsen and Olsen 1986). Probably breed throughout arid zone area (Marchant and Higgins 1993). Species may have been eliminated early in 20th century from some former breeding areas, particularly those with more than 250 mm annual rainfall in NSW (Olsen and Olsen 1986; Olsen 1998). Records from the Griffith region include Fivebough Swamp and Tuckerbil Swamp in Leeton (Taylor and Glazebrook 1998), Brobenah Hills southeast of Leeton (MFN 1999a) and Scenic Hill, part of the McPherson Range (GBNEG 2000). Considering the known records of this species within the study area and locality and potential habitat within the subject site the ‘8-part test’ of significance will be applied to the Grey Falcon (Appendix L).

***Lophoictinia isura* (Square-tailed Kite)**

Distributed widely but sparsely across much of Australia. Formerly considered an “inland bird” (Marchant and Higgins 1993), recently it has been found predominantly in coastal and subcoastal areas. In western NSW, it has been recorded along the Barwon and Culgoa Rivers in the north-east and the Darling and Murray Rivers in the south-west. In western NSW, it is most commonly seen in riparian eucalypt woodlands (River Red gum and Coolabah) and nearby chenopod- and grass-covered plains, in acacia scrublands (Mulga and Myall), and in patches of open eucalypt woodland with large areas of habitat such as the Pilliga Scrub being major strongholds (Debus *et al.* 1993; Marchant and Higgins 1993). It has also been recorded in rocky hills and gorges (Slater *et al.* 1986). Probably never abundant in the rangelands, it is generally absent from extensive treeless areas, ‘waterless deserts’ and farming regions (Marchant and Higgins 1993).

They prey on small living animals from the outer foliage of the tree canopy, particularly honeyeaters, miners and friarbirds, nestlings, eggs and foliage insects (Schodde and Tidemann 1986; Marchant and Higgins 1993). Small mammals, tree-frogs and reptiles may also be consumed (Marchant and Higgins 1993). Usually solitary outside the breeding season, they are migratory across much of its range, moving to northern Australia during non-breeding periods (Marchant and Higgins 1993).

The clearing of mature eucalypts along watercourses has reduced the number of potential nest sites and habitat fragmentation has reduced the densities of prey species, limiting the opportunities for breeding (Marchant and Higgins 1993). The population of Square-tailed Kites in NSW appears to have at least halved through habitat loss since European settlement (Debus *et al.* 1993). Grazing as well as logging and burning are also likely to deplete the abundance of prey (Garnett 1992a; Marchant and Higgins 1993), whilst egg-collecting and shooting may also threaten the long-term survival of particular populations (Garnett 1992a; Marchant and Higgins 1993). This species was not identified during this assessment despite intensive targeted surveys. No records exist for this species within the study area or McPherson range area.

The subject site offers some potential foraging habitat, however potential breeding resources within the subject site are limited and considered sub-optimal. Overall, the subject site offers a small portion of suitable foraging habitat of the large area needed by this species. It is also likely that competition from the high numbers of other raptor species would prevent this species from utilising the site on a permanent basis. Considering the extent and rate of removal of relevant vegetation within the subject site and the proposed impact amelioration measures which will protect preferred potential habitat areas, it is considered ‘*unlikely*’ that the proposed development will impose a “*significant effect*” upon the Square-tailed Kite. Furthermore, potential resources for this species are well represented within the general area surrounding the subject site.

***Rostratula benghalensis* (Painted Snipe)**

This species primarily occurs along the east coast of Australia, from north Queensland (excluding Cape York) to the Eyre Peninsula in South Australia, including the majority of Victoria and NSW (Marchant and Higgins 1990). There are also a few recent records from south-western Australia where it was once more common (Johnstone and Storr 1998). This species usually has to be flushed from vegetation otherwise it will remain hidden (Ayers *et al.* 1996). This trait is reinforced by fewer than 100 records throughout Australia during the 1990’s (Lane and Rogers 2000). It inhabits the fringes of shallow, vegetated, temporary or infrequently filled wetlands (Leach *et al.* 1987), generally where there is a cover of samphire, grasses, Lignum, low scrub and open timber (Slater *et al.* 1986; Smith 1991). The Painted Snipe emerges from cover at dusk to feed at the water’s edge on aquatic plants and seeds, and invertebrates such as insects, worms, molluscs and crustaceans (Schodde and Tidemann 1986; Kingsford 1991).

The Painted Snipe has probably suffered primarily from wetland drainage and changed flooding regimes, which means that their preferred or suitable habitat (shallow wetlands) rarely forms. Major water resource developments have coincided with a significant decline in the number of observations (Lane and Rogers 2000). Other threats include overgrazing of vegetative cover used for shelter (Johnstone and Storr 1998) and predation by Feral Cats and Foxes.

Within the Griffith region, the Painted Snipe has been observed at Fivebough Swamp and Tuckerbill Swamp in Leeton (MFN various dates) and west of the Griffith township near the sewerage works. Suitable habitat was absent from the subject site for this species and there are no records for this species within the study area. The study area does provide potentially suitable habitat in the form of the Lake Wyangan wetland system. Given the lack of known records within the study area, and few records within the Griffith region it is only likely that this species would utilise the potential of the study area on an occasional basis. Furthermore, the potential impact of indirect effects from the proposed development (i.e. effects of leachate upon the potential habitat of this species) is considered nominal in regards to this species. Predation by Foxes and Feral Cats is of greater concern. It is considered ‘*unlikely*’ that the proposed development would have a ‘*significant effect*’ on the Painted Snipe.

***Grus rubicundus* (Brolga)**

The Brolga is distributed throughout terrestrial wetlands, grasslands and woodlands of tropical and temperate Australia, although is less common in arid and semi-arid regions (Marchant and Higgins 1993). During the northern Australian ‘dry season’ it is concentrated on coastal and sub-coastal swamps dominated by spikerush upon which it feeds on tubers and those of other sedges (Marchant and Higgins 1993). Pairs mate for life and vigorously defend their substantial breeding territory of up to 2.5 km², with breeding stimulated by flooding (Arnol. *et al.* 1984; Briggs

1990). Formerly abundant throughout south eastern Australia, however, has been displaced from most settled districts and is now either locally extinct or rare casual visitor to this region (Pizzey and Knight 1997).

The Brolga occurs on extensive open wetlands, including shallow swamps, their margins and floodplains; grasslands, paddocks and ploughed fields, irrigated pastures, stubble crops and salt flats (Serventy 1985; Marchant and Higgins 1993; Pizzey and Knight 1997). Although most feeding occurs near water, they are also known to forage in grasslands, dry wetlands or cultivated areas (Kingsford 1991). Their diet includes seeds, roots, sedges, tubers, aquatic plants, invertebrates and their larvae, small vertebrates and rarely fish (Arnol. *et al.* 1984; Serventy 1985; Siepen 1987; Pizzey and Knight 1997).

Changes to hydrological regimes, such as the drainage of wetland areas or the alteration of their flooding patterns have significantly reduced the availability of suitable habitat for breeding and flocking, especially in Victoria and NSW (Arnol *et al.* 1984; Pizzey and Knight 1997). The density of food items is also severely affected by trampling and grazing by domestic stock, which also reduces nesting opportunities (Arnol *et al.* 1984). There is a high rate of early mortality (egg or chick stages) due to illegal egg collecting, trampling by stock, natural flooding of nest sites, and predation (Arnol *et al.* 1984; Serventy 1985). Large numbers of Brolgas were shot and poisoned, especially in the wheat areas of NSW and Victoria, which has led to their decline in these areas. Records from the Griffith region include Tuckerbil Swamp and Fivebough Swamp in Leeton, Widgiewa (65 kms south of Griffith), Morundah (south-west of Narrandera), Jeriderie, Willbriggie Swamp (south of Griffith), Whitton (south of Griffith), and Round Hill Nature Reserve (MFN various dates). Although there are no records for this species within the study area, potential habitat in the form of the Lake Wyangan wetland system, and ploughed, stubble and irrigated crops does occur. Despite this the proposed development does not pose any threat to this species as it will not result in the loss or modification to any potential Brolga habitat in the study area through direct or indirect impacts. It is therefore considered ‘*unlikely*’ that the proposed development would have a ‘*significant effect*’ on the Brolga.

***Stictonetta naevosa* (Freckled Duck)**

The Freckled Duck has been recorded across southern and central Australia. Primarily considered an inland species, during times of drought it apparently seeks refuge in the Murray River Basin, and coastal regions of south eastern Queensland, eastern NSW and southern South Australia (Jaensch and Vervest 1990; Marchant and Higgins 1990; Jaensch and Bellchambers 1997). This species is likely to occur on wetlands in any part of western NSW when conditions are suitable. In inland eastern Australia, it utilises a variety of plankton-rich wetland types, including brackish to hyposaline wetlands that are heavily vegetated with Cumbungi, Lignum, Canegrass (Braithwaite 1976) or Ti-tree (in coastal areas), large open lakes and their shores, rivers, creeks, farm dams, sewage ponds and floodwaters (Marchant and Higgins 1990; Pizzey and Knight 1997). Outside the breeding season, they can be found on permanent open water bodies (fresh and saline), or resting on fallen trees, flood debris and sand spits (Frith 1982; Martindale 1986), moving to the edge of the water body at dusk to feed (Marchant and Higgins 1990).

Changes to the hydrological sequences which affect flooding patterns through river regulation, water harvesting and other water conservation schemes pose a major threat to the Freckled Duck. A further threat is the loss of habitat and potential breeding sites through the drainage of swamps for irrigation, flood mitigation works, increased salinity and increased inundation, along with the burning, grazing and clearing of Cumbungi, Lignum and other wetland vegetation that is required by these birds (Marchant and Higgins 1990; Kingsford 1991). The illegal hunting of this species, especially during dry periods when birds are concentrated in a few large groups, also has the potential to remove a large proportion of the population very quickly as this species has the unfortunate tendency to circle low after it has been disturbed (Martindale 1986, Marchant and Higgins 1990; Loyn 1991). There has however been no correlation identified between the abundance of the Freckled Duck and hunting effort (Kingsford *et al.* 1999).

Within the Griffith region, the Freckled Duck has been recorded at Willbriggie Swamp (south of Griffith), the Sewerage Ponds at Tharbogang and at Lake Wyangan. Despite recent records of this species within the study area and therefore the recognition of known habitat, the likelihood of leachate contamination of Lake Wayangan is considered to be nominal and in the event of it occurring it would be considered to have an insignificant effect on this species. It is therefore considered ‘*unlikely*’ that the proposed development would have a “*significant effect*” on

this species or the habitat of this species. Furthermore, the proposed impact amelioration measures particularly those directed at the mitigation of leachate contamination are aimed at protecting the habitat of this species within the study area.

***Oxyura australis* (Blue-billed Duck)**

The Blue-billed Duck occurs regularly within the temperate wetlands of south eastern and south western Australia (Frith 1982; Marchant and Higgins 1990). Although they occur on any of the large deeper lakes throughout the NSW Western Zone, they are more common in the south. Breeding occurs in the Murray-Darling Basin, along Willandra Creek and the other distributaries of the Lachlan River, Narran Lake and in Lignum swamps along the Paroo (Pizzey and Knight 1997). This species is almost wholly aquatic and is rarely seen on land (Kingsford 1991), occupying temperate, fresh to saline, terrestrial wetlands, including sewerage ponds, rivers, salt lakes and saltpans (Marchant and Higgins 1990). They prefer deep, permanent open water, within or near dense vegetation, and nest in dense Cumbungi, Lignum, sedges, Spike-rush or Canegrass usually over water far away from the edge of the wetland or on small islands (Frith 1982; Serventy 1985). They generally feed close to shore at dusk and dawn on aquatic insect larvae, and aquatic plants (seeds, buds, stems, leaves and fruit) (Frith 1977; Schodde and Tidemann 1986; Marchant and Higgins 1990; Kingsford 1991).

Changes to hydrological sequences which affect flooding patterns through river regulation, water harvesting and other water conservation schemes pose a major threat to the Blue-billed Duck. Although non-breeding populations may be advantaged by some irrigation developments, most artificial wetlands are too unstable to develop the dense vegetation that is required for breeding (Marchant and Higgins 1990). A further threat is the destruction or modification of habitat through drainage works, increased salinity and groundwater extraction, along with the introduction of exotic fish species, grazing and clearing of Cumbungi, Lignum and other wetland vegetation that is required by these birds (Marchant and Higgins 1990; Kingsford 1991). The illegal hunting of this species by inexperienced hunters also poses a problem (Loyn 1991).

Records of the Blue-billed Duck within the Griffith region include Tuckerbil Swamp and Fivebough Swamp at Leeton, and Lake Wyangan. Despite recent records of this species within the study area and therefore the recognition of known habitat, the likelihood of leachate contamination of Lake Wyangan is considered to be nominal and in the event of it occurring it would be considered to have an insignificant effect on this species. It is therefore considered ‘*unlikely*’ that the proposed development would have a “*significant effect*” on this species or the habitat of this species. Furthermore, the proposed impact amelioration measures particularly those directed at the mitigation of leachate contamination are aimed at protecting the habitat of this species within the study area.

***Anseranas semipalmate* (Magpie Goose)**

Magpie Geese occur primarily in coastal and sub-coastal areas within northern Australia and southern Papua New Guinea (Pizzey and Knight 1997). Although this species formerly bred throughout southern Australia, including along the Murray and Murrumbidgee Rivers (Frith 1982), these populations disappeared by about 1920 (Garnett and Crowley 2000). Natural increases and small introductions (they have been re-introduced successfully to Victoria) have led to greater numbers being seen in southern areas since the early 1980’s, especially following drought in northern Australia (Serventy 1985; Marchant and Higgins 1990). However, this species remains a rare vagrant in NSW despite these increases. They are restricted to terrestrial wetlands and associated grasslands, with the presence of surface water and food (seeds or tubers and green grass) being the principal determinants of their distribution (Frith and Davies 1961; Whitehead and Tschirner 1992; Ayers *et al.* 1996; Wilson 1997). The timing of breeding is strongly influenced by water level, with extensive colonies reducing the effects on breeding success of predation on eggs and goslings (Harper 1990; Ayers *et al.* 1996).

Much of the considerable decline in the distribution of the Magpie Goose can be attributed to large pastoral leases, intensive stock grazing and dams, and through the drainage of wetlands (Frith 1982). Poisoning and shooting was once common in the southern part of their range and still continues within northern and western Australia due to their tendency to graze on crops and rice fields (Schodde and Tidemann 1986; Marchant and Higgins 1990). Other

detrimental influences include hydrological modifications, expansions of uranium mining (in the Northern Territory, agricultural land uses (especially rice-growing), predation by Feral Cats and Foxes, and the invasion of breeding habitat by environmental weeds such as Para Grass, Giant Sensitive Weed and *Hymenachne amplexicaulis* (Serventy 1985; Marchant and Higgins 1990; Wilson 1997).

The Magpie Goose has been recorded at Fivebough Swamp at Leeton, and within the study area near lake Wyangan. No suitable habitat for this species was recorded within the subject site. Known habitat for this species within the study area is the Lake Wyangan area and potential habitat includes the Lake Wyangan wetland system. Despite this the proposed development does not pose any threat to this species or its known habitats within the study area as it will not result in the loss or modification to any potential habitat through direct or indirect impacts. It is therefore considered ‘*unlikely*’ that the proposed development would have a ‘*significant effect*’ on the Magpie Goose.

***Limosa limosa* (Black-tailed Godwit)**

The Black-tailed Godwit is a migratory, wading bird that breeds in the northern hemisphere (Mongolia and Siberia) and visits Australia during the summer, arriving in August and departing in March (Kingsford 1991; Higgins and Davies 1996). Although most common in Australia on the northern coast between Weipa and Darwin, the Black-tailed Godwit has been recorded within the Murray-Darling Basin from Narran Lake in the north, to the Riverina in the south, and west to Fletcher’s Lake and Gol Gol Swamp (Higgins and Davies 1996). This species is primarily found along the coast on sand spits, lagoons and mudflats, but also occurs inland on mudflat and in those areas of large muddy lakes and swamps (freshwater or brackish) where the water is less than 10 cm deep during suitable conditions (Higgins and Davies 1996; Pizzey and Knight 1997). Individuals have also been recorded using wet meadows and sewerage treatment works (Kingsford 1991). Its diet includes a variety of invertebrates, spawn and tadpoles of frogs, and fish eggs (Schodde and Tidemann 1986; Higgins and Davies 1996). Post-breeding in the northern hemisphere (before migration), seeds and berries become especially important food sources (Higgins and Davies 1996).

In the Western Zone of NSW, the Black-tailed Godwit has probably suffered primarily from wetland drainage and changed flooding regimes, which means that their preferred or suitable habitat (shallow wetlands) rarely forms. Within the Griffith region, it has been recorded almost annually at Fivebough Swamp at Leeton, and Nericon Swamp and is also known from Campbell’s Swamp (MFN various dates). Considering that the direct impacts resulting from ten proposed development are entirely limited to the subject site and no habitat for this species was recorded within the subject site it is considered ‘*unlikely*’ that the proposed development would have a ‘*significant effect*’ on this species. Furthermore, the proposed development will not result in the loss or modification to any known or potential habitat through direct or indirect impacts.

Hylacola cauta* (Shy Heathwren or Shy Hylacola) – previously *Sericornis cautus

The Shy Heathwren is distributed in central NSW, between Hay, Griffith, West Wyalong and Cobar (Smith *et al.* 1995; Schodde and Mason 1999), including the Charcoal Tank Nature Reserve where it is common (Ayers *et al.* 1996). They are most abundant in the regrowth that occurs after disturbances, such as fire, but persist at lower densities in unburnt areas (Blakers *et al.* 1984; Smith *et al.* 1995). This species is restricted to dense mallee and feed on the ground, almost entirely on insects and rarely on seeds, including those of saltbush (Garnett and Crowley 2000). They nest near the ground in prickly shrubs or on the ground amongst plants at the base of a shrub or tree (Beruldsen 1980; Schodde and Tidemann 1986). They also appear to have specialised habitat requirements that are yet to be identified because the species is absent from many mallee areas with apparently suitable habitat (Ayers *et al.* 1996).

The distribution of the Shy Heathwren has become severely fragmented, with local extinctions, due to the degradation of suitable mallee habitat caused by clearing, grazing, weed invasion and ill-timed burning (Smith *et al.* 1995; Garnett and Crowley 2000). The ground-dwelling habits of this species also make it vulnerable to predation by Feral cats and foxes (Smith *et al.* 1995), although they have persisted in their presence for over 150 years. Within

the Griffith region, the Shy Heathwren has been recorded at Cocoparra National Park, Erigolia Mining Lease, and Stackpoole State Forest (MFN various dates).

Despite intensive diurnal bird surveys this species was not recorded during current or previous ERC surveys. No records exist for this species within the study area, however it has been recorded within the Scenic Hill area, part of McPherson Range. The vegetation and habitat of this record was compared to habitat within the subject site. From this comparison and review of habitat requirements it was determined that the subject site lacked the preferred habitat (mallee) for this species. It is therefore considered ‘*unlikely*’ that the proposed development would have a ‘*significant effect*’ on the Shy Heathwren. Furthermore, habitat removal and modification is entirely confined to the limits of the subject site, therefore any potential habitat within the study area will not be affected by the proposed development.

***Cacatua leadbeateri* (Pink Cockatoo or Major Mitchell’s Cockatoo)**

This species is distributed from the Murray-Darling, Eyre and Bulloo River Basins as far north as Isisford and Roma in Queensland, through western NSW to north-west Victoria and west to Adelaide and Mt Mary Plains (Schodde and Mason 1997; Higgins 1999). Disappeared from the Adelaide and Mt Mary Plains by the 1950s (Boehm 1961) and density greatly reduced in north-west Victoria (Emison *et al.* 1987) and western NSW (Cooper and McAllan 1995).

The eastern subspecies of Pink Cockatoo is found in arid and semi-arid zone woodlands dominated by Mulga (*Acacia aneura*), mallee and box eucalypts, Cypress Pine *Callitris* or Belah (*Casuarina cristate*) where it feeds primarily on seeds, roots and fruits. The main requirements of the species are trees with suitable nesting hollows and fresh surface water (Higgins 1999). Breeding pairs of the western subspecies occupy nests at least 1 km apart with densities of about one pair per 30 km² (Saunders *et al.* 1985; Rowley and Chapman 1991).

It has been observed at Round Hill Nature Reserve (T. Quested pers.obs; N. Kuehn pers.obs) and west of Ardlathan, 80 km east of Griffith (I. Fraser pers.obs). Closer to Griffith, they have been observed at Cocoparra National Park, 25 km north east of Griffith (NSW NPWS 1997a), at the Brobenah Hills (MFN 1999a) and at Pulletop Nature Reserve, 35 km north of Griffith (MFN 1999b). Twenty-eight birds use Campbells Swamp as a regular watering site (MFN various dates). Considering the known records of this species within the study area and locality and potential habitat within the subject site, the ‘8-part test’ of significance will be applied to the Pink Cockatoo (Appendix L).

***Calyptorhynchus lathami* (Glossy Black-Cockatoo) and Endangered Riverina Population**

Patchy distribution from the Mitchell, Qld, to Mallacoota and possibly Melbourne, Victoria and King Island, Bass Strait (Baird 1986; Schodde *et al.* 1993; Schodde and Mason 1997). Thinly distributed throughout range, with the highest densities east of Great Dividing Range; more scattered distribution inland, to as far west as the Riverina and the Pilliga Scrub (McAllan and Bruce 1988; Ayers *et al.* 1996). Probably breeding throughout range. In Victoria it is no longer found regularly west of Mallacoota (Baird 1986; Schodde *et al.* 1993).

The Glossy Black-Cockatoo is dependent upon *Allocasuarina*. They prefer woodland dominated by *Allocasuarina*, or open sclerophyll forests or woodlands, with middle stratum of *Allocasuarina* below *Eucalyptus* or *Angophora*; often confined to remnant patches in hill and gullies, surrounded by cleared agricultural land. Also in mixed *Allocasuarina*, *Casuarina*, *Callitris* or Brigalow *Acacia harpophylla* woodland assemblages or dense sclerophyll forests. Rarely observed away from *Allocasuarina* (Higgins 1999). Often in coastal or subcoastal area, but also occurring farther inland in foothills, mountain ranges and plains, especially in *Allocasuarina* associations fringing watercourses or on stony ridges (Higgins 1999). They breed in hollow stumps or limbs, living or dead, or a hole in the trunk of tall trees (usually in eucalypt). Mainly within woodland or remnant woodland, but also recorded within dead, ringbarked eucalypt in cleared country (Higgins 1999). They forage arboreally among branches of fruiting *Allocasuarina*. Prefer mature sparse trees, between 2 and 10 m tall with dense regrowth. Mostly roost in canopy of live leafy trees, preferring eucalypts but will use other species. Usually found less than one kilometre from feeding site and during breeding season within 30 m of nesting tree (Higgins 1999).

The main habitat of the eastern subspecies of Glossy Black-Cockatoo *Calyptorhynchus lathami lathami* is eucalypt woodlands and forests in which there is a sub-canopy or understorey of casuarinas *Allocasuarina/Casuarina*, but Brigalow is also used in south-eastern Queensland. The subspecies diet is primarily restricted to the seeds of *Allocasuarina/Casuarina*, with seeds of other species (e.g. *Callitris*) locally important (Higgins 1999). The cockatoos must forage for long hours each day to gain sufficient food, particularly during the breeding season, and not all apparently suitable habitat provides adequate food value to support the cockatoos (Clout 1989; Crowley *et al.* in press).

The Endangered Riverina population of the Glossy Black-Cockatoo is largely restricted to hills and low ridges where suitable assemblages of Drooping She-Oak *Allocasuarina verticillata* remain within the Narrandera Range and to the north-west in the Brobenah Hills, McPherson Range, Cocoparra Range, Lachlan Range and Jimberoo State Forests, and the Naradhan Range (NSW NPWS 1999b). The Riverine population is disjunct and at the western edge of the range for the species in NSW. There is some evidence that these western populations are more closely related to the Kangaroo Island subspecies *Calyptorhynchus lathami halmaturinus* than to more easterly populations indicating that this population is of significant conservation value.

Anecdotal evidence from the Narrandera Range during the 1930s estimated aggregations to number in their hundreds, and flocks of more than 40 birds were not uncommon during the 1940s and 1950s. In recent times, the greatest aggregation of this species recorded in the ranges is between 20 and 30 birds, following the completion of the breeding season (NSW NPWS 1999b). Considering the known records of this species within the study area and locality and potential habitat within the subject site, the '8-part test' of significance will be applied to the Glossy Black-Cockatoo and the endangered population Riverina Population of the Glossy Black-Cockatoo (Appendix L).

***Polytelis swainsonii* (Superb Parrot)**

The Superb Parrot breeds only in the Riverina and south-west slopes of NSW, and in northern Victoria (Webster and Ahern 1992). Virtually restricted to the interior of NSW, it is confined as a breeding bird to River Red Gum forests along the Murray and Edwards Rivers near Deniliquin and Mathoura, along the Murrumbidgee River from Wagga Wagga to Darlington Point (Schrader 1980; Higgins 1999; Lindsey 1992). In Victoria, they are now largely confined to the Barmah Forest area of northern Victoria, rarely to Wangaratta (Higgins 1999), having disappeared from central and southern Victoria in the early 1900s, and from northern Victoria by 1930 (Webster and Ahern, 1992). All but disappeared in the ACT in the 1950s and, in NSW, have declined in the Parkes district since 1960s. However, it may have extended its range to Deniliquin and in northern NSW over the same period (Schrader 1980; Higgins 1999). The breeding population is estimated at fewer than 5,000 pairs (Davidson and Chambers 1992). Counts in December 1998 found 200 birds at Nathalia, Victoria, 60 at Deniliquin and 100 near Wagga Wagga, both NSW (Anon 1999).

In the Riverina, Superb Parrots nest in loose colonies in riparian woodland of River Red Gum *Eucalyptus camaldulensis* and forage in box woodland, particularly that dominated by Yellow Box *E. melliodora*, on seeds of herbaceous plants, switching to lerp, mistletoe berries, eucalypt flowers and grass seed in winter (Webster 1988; Higgins 1999). On the inland slopes of the Great Dividing Range, Superb Parrots forage and nest within box woodland (Webster 1988). They forage up to 15 km from the nest, particularly on inland slopes where suitable nesting trees are widely dispersed, but rarely cross extensive open ground, using woodland remnants as corridors (Webster 1988; Davidson and Chambers 1992; Webster and Ahern 1992; Anon 1999; Higgins 1999).

Recently observed west of Griffith (10-12 birds), east to Binalong and west of Temora (J. Leonard unpub.). One individual has also been observed at Cocoparra National Park, 25 km north east of Griffith (NSW NPWS 1997a). There are eight known nest sites located along the Murrumbidgee River from Narrandera to west of Darlington Point, 30 km south of Griffith. Another nest site is found at Goolgowi, 46 km north-west of Griffith (Webster and Ahern 1992) and sightings have also been made within the Brobenah Hills (MFN 1999a). This species has also been recorded within the McPherson range area and Griffith City locality (MFN various dates). Considering the known

records of this species within the study area and Griffith area and potential habitat within the subject site, the ‘8-part test’ of significance will be applied to the Superb Parrot (Appendix L).

***Lathamus discolor* (Swift Parrot)**

This species breeds only in Tasmania (Lindsey 1992; Brereton 1998), mostly along the south eastern coast and in small numbers between Launceston and Smithton (Brereton 1998). Post-breeding dispersal throughout Tasmania occurs from January. Most birds migrate to the mainland in autumn, with the majority over-wintering on inland slopes of Great Dividing Range, particularly in Victoria and central and eastern NSW (Higgins 1999). Migrants return in spring, forming flocks of up to 70 birds in breeding areas (Brereton 1996). In both Queensland and South Australia recent records are irregular and all from the far south-east corner of each state. On the mainland Swift Parrots occupy eucalypt forests and woodlands, particularly box-ironbark forests, and feed primarily on nectar, though they will also take lerps (Higgins 1999). They show a preference for sites of high soil fertility where tall trees have high nectar production, such as along drainage lines or in isolated rural or urban remnants (Emison *et al.* 1987; Tzaros 1996, 1997). They have been sighted near West Wyalong and Junee (Birds Australia Atlas) and at Cocoparra National Park, although not sighted in this area for some time (MFN 1999c). As the Swift Parrot is nomadic, it would only feed occasionally within the study area. This species was not recorded within the subject site during the current assessment. Considering the nomadic nature of this species and lack of known records within the study area and McPherson Range it is considered unlikely that this species inhabits the subject site. Resources required by the Swift Parrot are more abundant on adjacent land to the east of the subject site. The proposed impact amelioration measures will also protect potential habitat areas within the subject site of this species. It is therefore ‘*unlikely*’ that the proposed development would have a “*significant effect*” on the Swift Parrot even if it did occur within the study area on occasions.

***Neophema pulchella* (Turquoise Parrot)**

Early in the 19th century, the Turquoise Parrot was found throughout south eastern Australia from the Suttor River, inland from Mackay in eastern Queensland and through eastern NSW, including suburban Sydney, to Melbourne, Victoria. It declined rapidly in the 1890s with no reports of substantial numbers until 1920s (Jarman 1973; Higgins 1999). It is now a widespread species, erratically distributed through south eastern Australia from south-east Queensland to northern Victoria, mainly west of the Great Dividing Range, but locally extended to the south-east coast (Higgins 1999; Lindsey 1992). In Queensland, it now occurs no further north than Maryborough and Fraser Island, distribution in NSW is patchy and in Victoria is largely confined to north-east and east Gippsland (Higgins 1999).

The Turquoise Parrot lives in the foothills of the Great Dividing Range in open eucalypt woodlands and forests with a grassy or sparsely shrubby understorey. It forages on the ground, feeding on the seeds of native grasses or introduced weeds and sometimes shrubs and herbaceous plants, preferring to roost and shelter in trees. Breeding occurs between August and December. It nests in tree hollows, stumps or even fence posts (Quin 1990; Quin and Baker-Gabb 1993; Higgins 1999). Nesting sites are located within a few kilometres of their foraging sites, in forests within 100 m from cleared land and 250 m from surface water (Quin and Baker-Gabb 1993). Four individuals have been observed at Cocoparra National Park, 25 km north east of Griffith (NSW NPWS 1997a) and within the Brobenah Hills (MFN 1999a).

This species was not recorded within the subject site despite targeted surveys conducted in potentially suitable habitat during the known breeding season. Considering the lack of known records within the study area and McPherson Range it is considered *unlikely* that this species inhabits the study area. Resources required by this species are more abundant on adjacent land to the east of the subject site. The proposed impact amelioration measures will also protect potential habitat within the subject site for this species. It is therefore ‘*unlikely*’ that the proposed development would have a “*significant effect*” on this species even if it did occur within the study area on occasions.

***Ninox connivens* (Barking Owl)**

Found sparsely distributed through temperate and semi-arid regions from Cooktown, Qld, to Flinders Ranges, S. A., extending inland to the Lake Eyre, Bulloo and Murray Darling Basins. The present general distribution is as above but local declines or extinctions have been recorded in the Herbert River district, Qld (Young and de Lai 1997) and through much of NSW (Debus 1997), Victoria (Silveira 1997) and South Australia (Parker 1988; Higgins 1999) as well as in south-west Australia (Johnstone and Storr 1998). Population in Victoria estimated at 50 pairs (Silveira *et al* 1997).

The Barking Owl mainly inhabits dry open sclerophyll forests and woodlands, favouring dense riparian vegetation along watercourses or round wetlands. Also inhabits dry sclerophyll forests and woodlands, of tropical, temperate and semi-arid zones, often dominated by *Eucalyptus* and containing many large trees suitable for roosting or breeding. Also occurring in open communities on plains and in foothills, often dominated by *Eucalyptus* or *Angophora*, and including remnant patches of forest or woodlands, or clumps of trees in partly cleared land, such as farmland or denser riparian or gallery communities near rivers, creeks, lakes or swamps, also usually dominated by *Eucalyptus* (Higgins 1999). Breeds in hollows in large trees, mainly *Eucalyptus* in woodland or open forest, usually near watercourses or wetlands, occasionally nest in other large trees. Usually roosts in large, densely foliated trees; either among foliage or on bare branches beneath canopy and shaded foliage, often near watercourses or wetlands (Higgins 1999). The southern subspecies of Barking Owl *Ninox connivens connivens* occurs primarily in dry sclerophyll woodland, nesting in large hollows in live eucalypts, often near open country (Higgins 1999; NSW NPWS 1999c) where it hunts primarily for mainly hollow dwelling birds and mammals, but including rabbits (Higgins 1999). Documented sighting include the Brobenah Hills situated from south of Narranderra to the north of Leeton, although it hasn't been sighted in recent years (MFN 1999d) and Scenic Hill, McPhersons Range (GBNEG 2000). Considering known records of this species within the study area and locality and potential habitat within the subject site, the '8-part test' of significance will be applied to the Barking Owl (Appendix L).

***Tyto novaehollandiae* (Masked Owl)**

Distributed widely across Australia, this species is almost endemic to this country, with a population also in southern New Guinea. Although considered predominantly a coastal species, it is sparsely distributed inland although is absent from the most arid central regions (Higgins 1999). It is rare on the inland NSW slopes and plains but has been located as far west as Mootwingee National Park and Fowlers Gap near Broken Hill (Debus and Rose 1994; Higgins 1999).

It appears to require a diversity of habitat, including eucalypt forests for roosting and nesting, and forest edges and open woodlands for hunting, with a large home range of 500 – 1000 ha per pair in coastal and forested areas (Kavanagh and Murray 1996; Higgins 1999). They roost in tree hollows, caves, sink-holes or crevices in cliffs, and in or under dense foliage (Debus 1997; Higgins 1999). They also nest in tree hollows or crevices in cliffs, and possibly within caves (Debus and Rose 1994; Mooney 1997; Higgins 1999).

Nest sites in trees are generally located 10 – 30 m above ground within vertical hollows, 40 – 500 cm deep, and lined with decayed debris and the discarded remains of prey items (Debus and Rose 1994; Kavanagh 1996; Mooney 1997; Higgins 1999). Pairs mate permanently and hold the same territory all year round, and may use the same nest site over successive years (Kavanagh and Murray 1996; Higgins 1999). They eat a variety of small terrestrial mammals up to the size of a rabbit, the occasional possum, various birds and some insects such as beetles and moths (Debus and Rose 1994; Kavanagh 1996; Kavanagh and Murray 1996; Higgins 1999).

Clearing and timber harvesting not only removes potential nest and roost sites, but may also affect the availability of prey species by removing logs and ground cover (Debus and Rose 1994; Higgins 1999). Dense regeneration at ground level may also hinder the owl's foraging (Debus and Rose 1994). Grazing has degraded habitat and caused regional extinctions of native prey species, and the predation by foxes of fledglings in disturbed areas may also be significant (Debus and Rose 1994; Debus 1997). Masked Owls are often killed or injured accidentally by collisions with vehicles, barbed-wire fences and overhead wires, and even occasionally drowning in water tanks (Debus and

Rose 1994; Debus 1997; Higgins 1999). Secondary poisoning by rodenticides based on brodifacoum may also cause a significant threat to all owl species that eat rodents in croplands (Young and De Lai 1997).

This species was not recorded within the subject site during the current assessment. Although potential foraging habitat in the form of woodland areas and mixed open forest vegetation was recorded, favoured roosting and foraging habitat of this species was not recorded within the subject site. The subject site probably forms a small portion of the large home range (500 – 1000 ha) and diversity of habitats required by this species. Considering the lack of known records within the study area and McPherson Range, small area to be affected (< 80ha) and rate of removal of relevant habitat area it is considered ‘*unlikely*’ that the proposed development would have a “*significant effect*” on this species even if it did occur within the study area on occasions. Furthermore, the proposed impact amelioration measures will also protect potential habitat within the subject site for this species.

***Pomatostomus temporalis temporalis* (Grey-crowned Babbler)**

This species formerly ranged throughout eastern Australia from South Australia, through Victoria and broadly through NSW and central Queensland up into southern New Guinea. It is now extinct in South Australia, coastal Victoria and the ACT. Grey-crowned Babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs and an intact ground cover of grass and forbs. This species is insectivorous, foraging in leaf litter and the bark of trees, and breeds cooperatively in sedentary family groups of 2 – 13 birds, building conspicuous dome-shaped nests (Davidson and Robinson 1992) and a home ranges that varies from 2 – 53 ha (Blakers et al. 1984), which increases with group size. Territory and group size varies accordingly with the quality of habitat (Brown et al. 1983).

The Grey-crowned Babbler has declined in numbers and disappeared from large parts of its range. Occupying woodlands on fertile soils of plains and undulating terrain, the habitat of this species has been disproportionately cleared for agriculture, including the removal of dead timber. The apparent reluctance of birds to traverse tracts of cleared land exacerbates the isolation of populations. Via stochastic events and the loss of long-term genetic viability, the reduced family groups in small isolated populations are vulnerable to extinction (NPWS 2001b).

The degradation of habitat, particularly as a result of grazing and weed infestation, also threatens this species. It is also likely that the increased abundance of competitors, such as Noisy Miners, and nest predators, from species such as the Pied Currawong and Australian Raven, threaten the foraging efficiency and breeding success of the Grey-crowned Babbler (Major *et al.* 1996).

This species was frequently recorded within the Bimble Box/White Cypress Pine woodland, White Cypress Pine forest and numerous old growth and mature Bimble Box trees in the road reserve and between the road reserve and land fill area during the ERC 2002 investigation. During the 2000 assessment four nests, two of which were active were recorded for this species in two White Cypress Pine within the Bimble Box/White Cypress woodland. Remnants of babbler nests were recorded during the 2002 assessment within the same area suggesting that the species was not using the subject site for nesting at the time of the assessment. Furthermore, only individual birds or pairs of birds, but no juvenile birds were recorded during the most recent assessment. Although it was difficult to differentiate between individuals of this species it is estimated that between 4 – 6 individuals were recorded within the subject site and on adjacent land east of the subject site during the most recent assessment.

Given the availability of suitable habitat within the subject site, intense targeted searches and previous records within the subject site and adjoining vegetation it is considered likely that the subject site forms an important component of the overall habitat used by this species. No records exist for this species within the study area despite the availability of suitable habitat, particularly along McPherson Range. However several records exist for this species in the Scenic Hill area and Griffith Golf Course. A family of six were recently recorded at the Griffith Golf Course foraging in the middle of a fairway (pers. Comm. Grabham 2003). Considering the known records of this species within the subject site and locality, the ‘8-part test’ of significance will be applied to the Grey-crowned Babbler (Appendix L).

***Melanodryas cucullata cucullata* (Hooded Robin south-eastern form)**

The Hooded Robin is distributed throughout south eastern Australia, from central Queensland to Spencer Gulf in South Australia. The south eastern form occurs throughout NSW except for the north-west of the state where it intergrades with the smaller northern form of the Hooded Robin *M. cucullata picata* (Schodde and Mason 1999). They occupy a wide range of eucalypt woodlands, *Acacia* shrublands and open forests (Blakers *et al.* 1984). In semi-arid western NSW, the species favours open woodlands of Belah, Rosewood, Mulga and Cypress. In temperate woodlands, they favour open areas adjoining large woodland blocks, with areas of dead timber and sparse shrub cover (Fitri and Ford 1997). It has declined significantly in both range and population, and was identified by Reid (1999) as a 'decliner' in a review of bird status in the NSW sheep-wheatbelt.

The Hooded Robin is threatened by clearance and fragmentation of habitat, including the removal of dead timber, and is apparently unable to survive in remnants smaller than 100 – 200 ha (Egan *et al.* 1997). Via stochastic events and loss of long-term genetic viability, the isolation of populations in small remnants increases their vulnerability to local extinction. Low population densities and relatively large home ranges also exacerbate their vulnerability within a highly fragmented and predominantly cleared landscape. The degradation of their habitat by stock grazing and weed invasion may reduce the availability of prey, and the increasing populations of nest predators such as Pied Currawongs and Australian Ravens is likely to cause a reduction in their breeding success (Major *et al.* 1996).

This species was not recorded within the subject site despite targeted surveys conducted in potentially suitable habitat (i.e. woodland, mixed open forest and edge areas of White Cypress Pine Forest). Considering the lack of known records within the study area and McPherson Range it is considered unlikely that this species inhabits the subject site. The extent of relevant vegetation and associated habitat (i.e. woodland, mixed open forest and edge areas of White Cypress Pine Forest) within the subject site is less than 60 ha, highly fragmented and in some areas disturbed. The proposed impact amelioration measures will also protect potential habitat within the subject site for this species. It is therefore 'unlikely' that the proposed development would have a "significant effect" on this species even if it did occur within the subject site on occasions.

***Pachycephala inornata* (Gilbert's Whistler)**

The Gilbert's Whistler occurs in the broombrush and whipstick mallee required by the Red-lored Whistler, but also occupies a much wider range of habitats, showing a special fondness for lignum (Lindsey 1992). It is locally common across interior southern Australia from the Lachlan River in NSW, westward to the vicinity of Northam in Western Australia. In the Western Zone this species is known from Scotia mallee west of the Darling (including Tarawi Nature Reserve), in the mallee around Yathong and Round Hill Nature Reserves, in thick Belah patches between Dareton and Burgonga and especially on "Sunnyside" around Abbots Tank Rd, north-east of Euston (Franklin 1993). This species also occurs on shrubby sandhills along the Murray River and extends east into the heathy upper reaches of the Lachlan River (Schodde and Tidemann 1986). It has been recorded in Bimble Box/Pine or Ironbark/Pine woodlands where associated with a shrubby understorey in the Charcoal Tank Nature Reserve, Weddin Mountain National Park and Cocopara Nature Reserve (Brickhill pers comm. n/d). It lives in pairs that together defend apparently permanent territories. Breeding extends from September to December, with nests usually found in an upright fork, on a dead stump or, occasionally in the disused nest of some other bird.

Gilbert's Whistler preferred habitat appears to be mallee, often in association with spinifex, although it utilises shrubby mulga or taller eucalypt woodlands, Belah, riverine Black Box and Lignum, or partly cleared country (Pizzey and Knight 1997). Within these habitats, this species occurs patchily where mixed shrubs, particularly *Melaleuca* occur in dense stands (Schodde and Tidemann 1986). It forages mainly on the ground, feeding largely on insects (Lindsey 1992). It was observed at Round Hill Nature Reserve on 9 October 1997 (T. Quedstedt pers. obs). Six individuals also observed at Cocoparra National Park, 25 km north east of Griffith (NSW NPWS 1997a). Other localities include Pulletop Nature Reserve and the Brobenah Hills (MFN 1999a, 1999b).

This species was not recorded within the subject site despite targeted surveys conducted in potentially suitable habitat. Potential habitat was restricted to woodland areas with a shrub layer. The subject site lacks the preferred

habitat of this species. Considering the lack of known records within the study area and McPherson Range it is considered unlikely that this species inhabits the subject site. It is likely that the study area supports potential habitat for this species. The proposed impact amelioration measures will also protect potential habitat within the subject site for this species. It is therefore ‘*unlikely*’ that the proposed development would have a “*significant effect*” on this species even if it did occur within the subject site on occasions.

***Cinclosoma castanotus* (Chestnut Quail-thrush)**

Occurs in the southern interior of Australia from central NSW westward to the coast of Western Australia (Lindsey 1992). The eastern subspecies *Cinclosoma castanotus castanotus* occurs through the eastern mallee regions, including Flinders Ranges, Eyre Peninsula, Ninety Mile Plain and Murray Mallee, SA, Big and Little Deserts and Sunset Country, Victoria, and central and south western NSW (Schodde and Mason, unpubl. manuscript). It has disappeared from those areas that have been cleared for agriculture but is still broadly distributed through its former range (Blakers *et al.* 1984; Emison *et al.* 1987; Smith *et al.* 1995). In the Western Zone this species is known in and around the mallee of Round Hill Nature Reserve, the Mandleman mallee in the Willandra World Heritage Area, the Riverina mallee remnants and in thick mallee with *Triodia* north-east of Euston. Also recorded from the Mulga west of Byrock and in the Scotia mallee west of the Darling River, including Tarawi Nature Reserve (Franklin 1993).

Mainly sedentary and fairly common, it is somewhat local in distribution. Breeding occurs mainly from July to December, but is influenced by local rainfall (Lindsey 1992). This species is shy and often difficult to see. It occurs in mallee (including mallee with spinifex *Triodia* as an understorey), acacia (Mulga) scrub, native pine and eucalypt woodland areas, preferably those with a shrub layer and in areas of heath (Pizzey and Knight 1997), especially mallee and mulga scrub, and almost always on substrates of sand (Lindsey 1992). The eastern subspecies of Chestnut Quail-thrush feeds primarily on insects and seeds (Blakers *et al.* 1984). Observed at Round Hill Nature Reserve on 9 of October 1997 (T. Quested pers.obs) and 29 of October 1997 (N. Kuehn pers.obs). Two individuals were observed at Cocoparra National Park, 25km north east of Griffith (NSW NPWS 1997a) and Pulletop Nature Reserve, 35 km north of Griffith (MFN 1999b). This species was not recorded within the subject site despite targeted surveys conducted in potentially suitable habitat. It is unlikely that this species would occur within the subject site, given the lack of preferred habitat, potential impact of predators and associated disturbances of the area. It is therefore ‘*unlikely*’ that the proposed development would have a “*significant effect*” on the Chestnut Quail-thrush. Furthermore, the proposed impact amelioration measures will protect the potential habitat of this species.

***Pyrholaemus sagittatus* (Speckled Warbler)**

It is distributed from south-eastern Queensland, through central and eastern NSW to Victoria. In NSW, they occupy eucalypt and cypress woodlands on the slopes west of the Great Dividing Range, with an extension of range into the cypress woodlands of the northern Riverina. Populations also occur in drier coastal areas such as the Cumberland Plain, Western Sydney and the Hunter and Snowy River Valleys (Blakers *et al.* 1984; Schodde and Mason 1999).

They inhabit woodlands with a grassy understorey, often on ridges or gullies, with a home range varying from 6 – 12 ha. It is a sedentary species, lives in pairs or trios and nests on the ground in grassy tussocks, dense litter and fallen branches. They forage on the ground and in the understorey for arthropods and seeds (Ford *et al.* 1986). It has declined in numbers from large parts of its range, and was identified by Reid (1999) as a ‘*decliner*’ in a review of bird status in the NSW sheep-wheatbelt.

The Speckled Warbler is threatened by clearance and fragmentation of habitat, including the removal of dead timber. It decreases in abundance as woodland area decreases, and appears to be extinct in districts where no fragments larger than 100 ha remain (Barrett *et al.* 1994). Via stochastic events and loss of long-term genetic viability, the isolation of populations in small remnants increases their vulnerability to local extinction. Low population densities and relatively large home ranges also exacerbate their vulnerability within a highly fragmented and predominantly cleared landscape. Their preferred foraging habitat, a combination of open grassy patches, leaf

litter and shrub cover, is susceptible to degradation by stock grazing and weed invasion. Nesting on the ground also makes them susceptible to predation by foxes and cats (NPWS 2001c).

This species was not recorded within the subject site despite targeted surveys conducted in potentially suitable habitat. Considering the sedentary nature of this species, lack of known records within the study area and McPherson Range it is considered unlikely that this species inhabits the subject site. The extent of relevant vegetation and associated habitat within the subject site is less than 85 ha, fragmented and disturbed. The proposed impact amelioration measures will also protect potential habitat within the subject site for this species. It is therefore ‘unlikely’ that the proposed development would have a “significant effect” on this species even if it did occur within the subject site on occasions.

***Melithreptus gularis gularis* (Black-chinned Honeyeater eastern subspecies)**

This species is predominantly distributed west of the Great Dividing Range in a narrow belt through NSW and into southern Queensland, and south into Victoria and South Australia where it occupies woodlands within an approximate annual rainfall range of 400 – 700 mm (Blakers *et al.* 1984). In NSW, it is most commonly found in woodlands containing box-ironbark associations and River Red Gum. They are also found in drier coastal woodlands of the Cumberland Plain, Western Sydney and in the Hunter, Richmond and Clarence Valleys.

They build compact, cup-shaped nests and feed on arthropods, nectar and lerp from eucalypt foliage and bark (Blakers *et al.* 1984). They are widely distributed and occur naturally at low densities, ranging from 0.02 to 0.26 per hectare in box-ironbark forests in Victoria (Traill 1995) and 0.28 per hectare in northern NSW (Oliver *et al.* 1999). It has declined in numbers and has disappeared from parts of its former range, apparently not persisting in remnants less than 200 ha. Reid (1999) identified it as a ‘decliner’ in a review of bird species’ status in the NSW sheep-wheatbelt.

The Black-chinned Honeyeater (eastern spp.) is threatened by clearance and fragmentation of habitat. Via stochastic events and loss of long-term genetic viability, the reduction in size of remnant habitat leads to the isolation of populations and increases their vulnerability to local extinction. Low population densities also exacerbate their vulnerability within a highly fragmented and predominantly cleared landscape. They are also likely to experience high levels of competition from more aggressive species, such as Noisy Miners and White-plumed Honeyeaters, which occur at relatively high densities in small remnants of box-ironbark associations and River Red Gum. Also, the increasing populations of nest predators such as Pied Currawongs and Australian Ravens is likely to cause a reduction in their breeding success, particularly in small remnants (Major *et al.* 1996).

This species was not recorded during the most recent assessment. Although potential habitat in the form of the Bimble Box woodland was recorded in the subject site, no preferred habitat for this species was recorded within the subject site or adjacent land. Potential habitat is restricted to the Bimble Box woodland area and is therefore considered limited and only part of the overall habitat for this species if it was to occur within the study area. The proposed impact amelioration measures will also protect potential habitat within the subject site for this species. It is therefore ‘unlikely’ that the proposed development would have a “significant effect” on this species even if it did occur within the subject site on occasions.

***Grantiella picta* (Painted Honeyeater)**

Sparsely distributed from southern Victoria and south-eastern South Australia to far northern Queensland and eastern Northern Territory (Blakers *et al.* 1984; Schodde and Mason, unpubl. manuscript). Greatest concentrations and almost all breeding occurs south of 26°S, on the inland slopes of the Great Dividing Range between the Grampians, Victoria, and Roma, Queensland (Morris *et al.* 1981; Blakers *et al.* 1984). After April, it migrates to semi-arid regions, including north eastern South Australia, central and western Queensland and central Northern Territory (Hall 1974; Matheson 1981; Morris *et al.* 1981; Blakers *et al.* 1984; Keast 1985; McNamara 1986; Emison *et al.* 1987). The present range and distribution is mostly as above but no recent records from southern South Australia (Blakers *et al.* 1984) and has declined in abundance in western NSW (Maher 1988; Smith *et al.* 1995),

central Victoria (Bridley 1991) and probably from north-central Queensland where once relatively common near Cloncurry (McGillivray 1901). In the Western Zone, this species has been recorded along the Warrego, Culgoa and Bogan Rivers, west of Byrock, on the Fletchers Creek Floodplain near Dareton and in Willandra National Park (Brickhill pers comm. n/d).

The Painted Honeyeater lives in dry forests and woodlands. Its primary food is the fruit of mistletoes in the genus *Amyema*, though it will also take some nectar and insects (Eddy 1961; Reid 1986; Oliver *et al.* 1998). The bird helps disperse mistletoe seed, and sometimes all trees in areas where it breeds repeatedly are infected and some die (Reid 1986). Its distribution is dictated by distribution of mistletoes, which are largely restricted to older trees, and the seasonality of their fruiting. However, extent of vegetation is also important, with birds being less likely to be found in strips of remnant woodlands, such as found in roadside vegetation and windbreaks, than in wider blocks (Robinson 1994). In the Western zone, this habitat is mainly along floodplains or drainage lines (Pizzey and Knight 1997; Slater *et al.* 1986). It is locally nomadic and strongly migratory, breeding mainly in the interior south-east and dispersing northward to northern Queensland and the Northern Territory over the winter period (Lindsey 1992). Observed at Round Hill Nature Reserve (N. Kuehn pers.obs), near Griffith (C. Gladwin pers.obs). Two individuals observed at Cocoparra National Park 25km north east of Griffith (NSW NPWS 1997a) and also at Pulletpop Nature Reserve (MFN 1999a, 1999b). Other records although not in conservation reserves or other similar protected areas include the Brobenah Hills (MFN 1999a, 1999b) and Scenic Hill, McPhersons Range (GBNEG 2000). Considering the known records of this species within McPherson range and Griffith area and potential habitat within the subject site, the '8-part test' of significance will be applied to the Painted Honeyeater (Appendix L).

***Certhionyx variegatus* (Pied Honeyeater)**

The Pied Honeyeater is widespread across the arid interior and mainland Australia but, like the Black Honeyeater, it is strongly nomadic and erratic in occurrence, following the flowering cycle of eremophilas and similar plants (Slater *et al.* 1986; Schodde and Tiedemann 1986). It is generally more common in the west than in the east. In the Western Zone, it frequents stands of *Eremophila maculata* near Buronga and Dareton in the south, common on *Grevillea juncifolia* in spring in the west of the Culgoa River, also recorded on *Eremophila duttoni* west of the Paroo River. Recorded amongst *G. huegelii* and *Acacia colletioides* within Tarawi Nature Reserve (NSW NPWS 1996). Pied Honeyeaters inhabit acacia shrub (primarily Mulga), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering (Pizzey and Knight 1997). These birds feed in nectar, predominantly from various species of *Eremophila*; also from mistletoe and various *Brachysema* and *Grevillea* shrubs (Schodde and Tiedemann 1986). Travelling in small groups it forages mainly in the crowns of bushes and trees, and feeds largely on nectar supplemented by flying insects. Breeding is strongly influenced by local rainfall but occurs mainly from September to February. Nests are small, loose cups of twigs and grass bound by cobweb and suspended in a slender horizontal fork within a few meters from the ground (Lindsey 1992). One individual observed at Cocoparra National Park, 25km north east of Griffith (NSW NPWS 1997a).

This species was not recorded during the most recent assessment. Potential foraging and breeding resources are limited and restricted to woodland and Currawang dominated areas. The subject site lacks specific foraging resources required by this species in the form of flowering plants, predominantly *Eremophila* spp. mistletoe and various *Brachysema* and *Grevillea* shrubs. The potential habitat offered by the subject site is considered sub-optimal. Given the strongly nomadic nature of the Pied Honeyeater and lack of preferred habitat within the subject site, it is unlikely that it would occur within the study area, even on an occasional basis. It is therefore 'unlikely' that the proposed development would have a "significant effect" on this species even if it did occur within the subject site on occasions.

***Stagonopleura guttata* (Diamond Firetail)**

This species is distributed through central and eastern NSW, extending north into southern and central Queensland and south through Victoria to the Eyre Peninsula, South Australia. In NSW, it is predominantly distributed west of the Great Dividing Range, although they are also found in drier coastal woodlands of the Cumberland Plain,

Western Sydney and in the Hunter, Richmond, Clarence Valleys and Snowy River Valleys (Blakers *et al.* 1984; Schodde and Mason 1999).

This species occupies eucalypt woodlands, forests and mallee where there is a grassy understorey. They build bottle-shaped nests in trees and bushes, and forage on the ground for grass seeds and other plant material and also insects (Blakers *et al.* 1984; Read 1994). It has declined in numbers in many areas and has disappeared from parts of its former range. Reid (1999) identified it as a 'decliner' in a review of bird species' status in the NSW sheep-wheatbelt.

The Diamond Firetail is threatened by clearance and fragmentation of habitat, apparently unable to persist in districts that lack remnants of native vegetation larger than 200 ha. Via stochastic events and loss of long-term genetic viability, the reduction in size of remnant habitat leads to the isolation of populations, inhibits dispersal, and increases their vulnerability to local extinction (Barrett *et al.* 1994). Habitat degradation, particularly stock grazing, threatens the food availability of this granivorous species. Also, the increasing populations of nest predators such as Pied Currawongs and Australian Ravens is likely to cause a reduction in their breeding success, particularly in small remnants (Major *et al.* 1996).

This species was not recorded within the subject site despite targeted surveys conducted in potentially suitable habitat. Although potential habitat for this species was recorded within the subject site, there are no known records within the study area and McPherson Range. It is considered *unlikely* that this species inhabits the subject site. Furthermore, the area of relevant vegetation and associated habitat within the subject site is highly fragmented and in some areas disturbed. Considering the small area of relevant vegetation, fragmented nature of the subject site, lack of known records within the study area and proposed impact amelioration measures which will protect potential habitat within the subject site for this species, it is '*unlikely*' that the proposed development would have a "*significant effect*" on this species even if it did occur within the subject site on occasions.

***Nyctophilus timoriensis* (Greater Long-eared Bat)**

This species is distributed across southern mainland Australia, generally associated with the semi-arid environment (Churchill 1998), but as this taxon has recently been shown to be comprised of three species with allopatric distributions, the former distribution is therefore unclear. The biology and taxonomy of this bat remains poorly understood (Churchill 1998). Known current distribution is from southern central Queensland, central western NSW, north western Victoria and South Australia. There are only four records of this species from Victoria, all from the north-west of the state (Lumsden 1994). There have been no records from central western Victoria since 1888 (a single specimen). In South Australia, records are confined to north of the Murray River, east of Canegrass Station and south of the Barrier Highway, but the northern range limit in this state remains unclear.

The preferred habitat of this species is River Red Gum forest, semi-arid woodlands and savannahs. It also occurs in box/ironbark/*Callitris* open forests and Buloke woodland in northern New South Wales and inland south-east Queensland. In South Australia, it is confined to tall mallee shrublands north of the Murray River and is known to roost in hollows in *Eucalyptus gracilis*. Victorian records are from *E. gracilis* mallee, Buloke and Black Box woodlands (Churchill 1998; Strahan 1995; Lumsden 1994). It roosts in tree hollows, fissures in branches and under loose bark (Churchill 1998; Strahan 1995; Lumsden 1994).

Although this species was not identified during this assessment, potentially suitable habitat and resources does exist for this species within the subject site. Considering the known records of this species within the Griffith area and potential habitat within the subject site, the '8-part test' of significance will be applied to the Greater Long-eared Bat (Appendix L).

***Myotis macropus* (Fishing Bat or Large-footed Myotis)**

The Fishing Bat is primarily a coastal species (rarely extending further than 100 km inland) and range from the Kimberley to Victoria and South Australia. They occur farther inland along major rivers, such as the Murray River

in south eastern Australia and the Fitzroy River in the Kimberley (Churchill 1998). This species will live in most habitat types as long as they are near water. They have been caught in mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland (Churchill 1998; Strahan 1995). Colonies of the Fishing Bat are found close to permanent water bodies in riparian and coastal forest habitats. Colonies of several hundred are known but more commonly they roost in groups of 10 to 15 (Churchill 1998; Strahan 1995). This species is a common cave dweller but is also known to roost in tree hollows, amongst vegetation, in clumps of *Pandanus*, under bridges, in mines, tunnels and stormwater drains. Roosts are usually selected close to water. Fishing Bat's most commonly forage over water, feeding on insects and small fish they catch by raking their long feet across the surface of the water. They are also aerial foragers, with prey items including terrestrial and aquatic insects (Churchill 1998).

This species was tentatively identified as 'Probable' from anabat analysis during the current surveys. No other records exist for this species within the study area or locality. No preferred habitat for this species occurs within the subject site. It is likely that this species is using the site as part of its overall foraging area and probably in response to the drought conditions which may have reduced the availability of preferred foraging habitat (i.e. fresh water surfaces). The '8-part test' of significance will be applied to the Fishing Bat (Appendix L).

***Cahlinobolus picatus* (Little Pied Bat)**

The Little Pied Bat ranges from coastal and south eastern Queensland, extending across south western Queensland, western NSW and far north eastern South Australia. Despite having largely an inland distribution (Duncan *et al.* 1999), and most records being west of the Great Dividing Range (Churchill 1998) there are a number of records from south eastern Queensland within 50 km of the coast. No evidence exists that the range of this species has contracted (Duncan *et al.* 1999). Originally thought to be an obligate cave-dwelling species and therefore thought rare due to the scattered and infrequent occurrence of suitable roosting and maternity sites across its range. However, colonies are now known from tree hollows and disused buildings (Duncan *et al.* 1999). In caves and mines they occur in small colonies of fewer than 10 individuals. A colony of 38 males and females was recorded in an abandoned house (Churchill 1998).

This species occurs most frequently in dry, open woodland communities throughout its range, but also has been recorded in dry sclerophyll forests, chenopod shrublands, *Callitris* forest, mallee (Churchill 1998; Duncan *et al.* 1999), and vine forests (Duncan *et al.* 1999). In the more arid parts of its range in NSW it has been recorded from mulga (*Acacia aneura*) woodlands, patches of Black Box Woodlands and riverine River Red Gum dominated communities. Surveys have indicated that in arid and semi-arid environments the species may be locally common near permanent or semi-permanent water (Duncan *et al.*, 1999). The Little Pied Bat was tentatively identified as 'Possible' from anabat analysis during the current surveys. No other records exist for this species within the study area or McPherson Range area. The '8-part test' of significance will be applied to the Little Pied Bat (Appendix L).

***Vespadelus baverstocki* (Inland Forest Bat)**

Widely distributed in inland arid and semi-arid parts of Australia (Churchill 1998). This species inhabits *Acacia*, *Callitris* and *Casuarina* woodlands, mallee, open eucalypt woodland, River Red Gum woodland, shrub and grassland communities across its range (Churchill 1998; Strahan 1995). Inland Forest Bats roost in tree hollows and abandoned buildings. Much of their distribution occurs in areas where large trees are absent. In adaptation they can roost in extremely small tree hollows in stunted trees only a few metres high (Churchill 1998; Strahan 1995). This species usually forages over a wide area (Strahan 1995). This species was captured from harp trapping within the subject site. It was recorded in all vegetation types except for the Bimble Box/White Cypress Pine woodland area although it is considered to occur within this area. The '8-part test' of significance will be applied to the Inland Forest Bat (Appendix L).

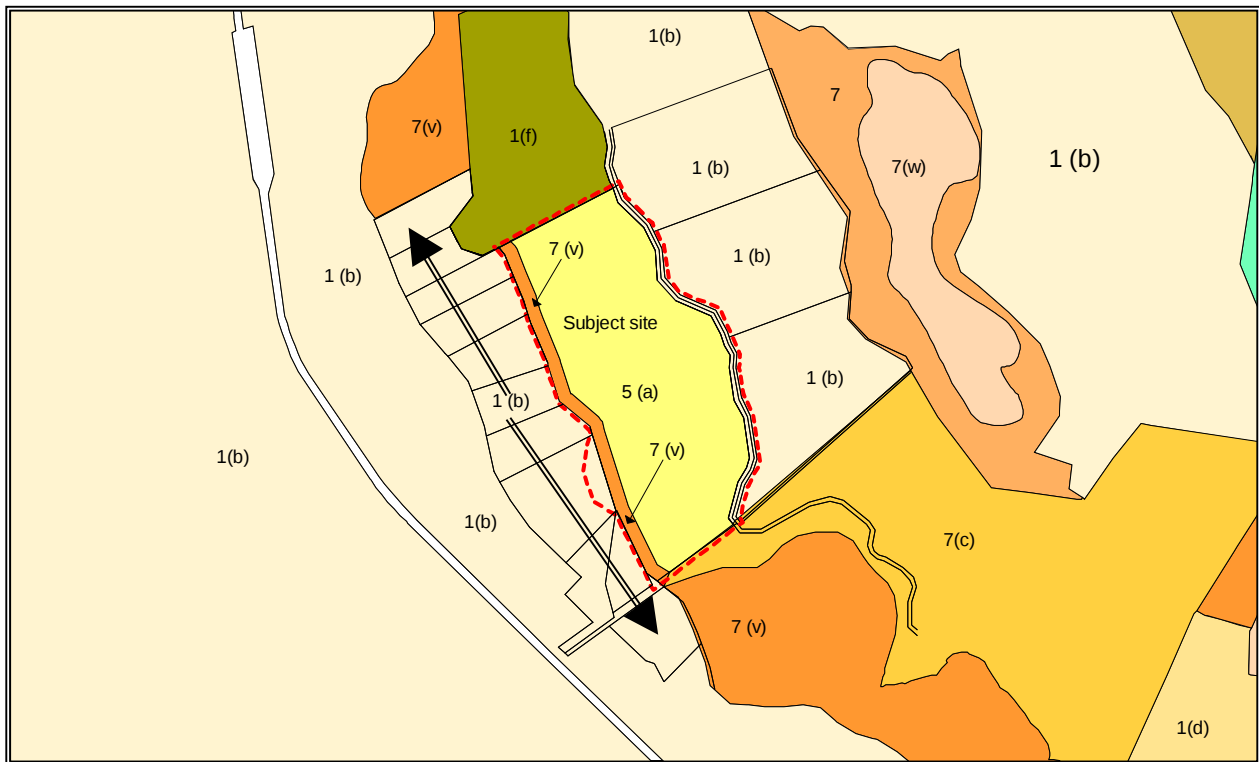
***Saccolaimus flaviventris* (Yellow-bellied Sheathtail Bat)**

A wide-ranging species occurring throughout tropical Australia with many records extending into south eastern Australia (Churchill 1998) but rarely recorded because of its high and rapid flying habit (Richards 1995a). Occurs in most habitat types, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert (Churchill 1998). This species roosts in large tree hollows and, sometimes, the abandoned nests of Sugar Gliders (Richards 1995a; Churchill 1998) and occasionally have been found hanging from the outside walls of buildings in broad daylight (Churchill 1998). Within NSW, this species has been caught around watering points in a variety of semi-arid woodlands east of Enngonia and at several sites between Bourke, Walgett and Collarenebri (Richards 1995a). The Yellow-bellied Sheathtail Bat forages for airborne insects (largely beetles and moths) above the canopy with foraging height varying with height of the canopy (Richards 1995a; Churchill 1998), although in open woodlands and mallee country they feed closer to the ground (Hall and Richards 1979; Richards 1995a).

Although this species was not identified during this assessment, potentially suitable habitat and resources do exist for this species within the subject site. No records exist for this species within the study area or McPherson Range area. Considering the rate of removal of some of the relevant vegetation within the subject site and the proposed impact amelioration measures which will protect preferred potential habitat areas, it is ‘*unlikely*’ that the proposed development will impose a “*significant effect*” upon the Yellow-bellied Sheathtail Bat. Furthermore, potential resources for this species are well represented within the general area surrounding the subject site.

APPENDIX H.

ZONING OF THE SUBJECT SITE AND SURROUNDING AREA



Proposed zoning of subject site and surrounding area according to GCC LEP 2002.

Summary table of main objectives for the various zones.

ZONE	2002 LEP
1 (b)	Rural Agricultural Protection § To preserve areas of higher quality agricultural land; § To permit a range of activities that support the agricultural industries being conducted on the land and limit development that may, in the opinion of the Council, reduce the agricultural production potential of the land; § To control development that may restrict the function of or create traffic hazards along classified roads; § To enable tourist facilities to be provided that promote an appreciation of the rural environment and associated agricultural and horticultural activities, while ensuring the continued economic viability of the land; and § To establish appropriate buffer zones between high quality agricultural land and land not used for agriculture, particularly near the perimeter of such lands.
1 (c)	Rural Residential § To provide for a range of lifestyles to cater for all socio-economic groups, without causing adverse effects on the character and amenity of the City of Griffith; § To promote orderly and economic development of land identified as being suitable for rural residential development; § To ensure that rural residential development is integrated with the rural landscape and is compatible with the capability of the site on which it is carried out to accommodate such development; § To enable the development of land within this zone for rural residential purposes; § To enable the development of some land within this zone for the purpose of other appropriate land uses where the scale, height, type and traffic-generating characteristics of the development are compatible with the character and amenity of the surrounding rural residential uses and the existing or proposed nearby development.
1(f)	Rural (forest) § To identify land that is presently being used for forestry and should be retained for forestry and associated activities; § To enable the development of land within this zone for forestry purposes; and § To enable the development of extractive industries and mines.

5(a)	Special Uses (a) The principal objective of this zone is to identify land that, immediately before this plan commenced, was the site of development or required to be developed for a specific purpose (generally of a public nature) and that, because of the particular features or characteristics of that purpose, requires special planning consideration to protect its function and to avoid conflict with other land uses. (b) The particular objectives of this zone are: (i) To safeguard the role and efficiency of development for specific special purposes against intrusion by other land uses, and (ii) To ensure that the location of development for certain specific purposes may be easily identified and the impact upon development in adjoining zones may be readily appreciated, and (iii) To enable the development of land for other purposes where it can be demonstrated that the development will not adversely affect the usefulness of the land for the purpose for which the land is zoned, and (iv) To allow use of land for community facilities that are compatible with the principal use of the land.
7 (v)	Environmental Protection—Scenic § To preserve the prominent landforms that contribute to the visual quality of the City of Griffith; § To ensure environmentally sensitive land is appropriately protected from development likely to detrimentally affect its preservation; § To ensure that significant areas capable of contributing to the character of the City of Griffith are maintained for the benefit of the community and tourism potential; § To assist in the prevention of land degradation; and § To enable development of land within this zone only where it can be shown that the development will not destroy, damage or compromise the ecological, scenic or scientific attributes of the locality.

APPENDIX I.

SURVEY METHODOLOGY

FLORA SURVEY METHODOLOGY

Quadrat sampling

Quadrat based sampling (20 x 50 m) was employed to systematically sample flora. Quadrats were placed within representative vegetation within the vegetation type, away from road edges, disturbed areas such as the quarry, and boundaries of other plant communities. The vegetation's structure and floristics were described for the entire quadrat. The number of quadrats sampled is a function of the area occupied by each stratification unit within the survey area. A field recording form was used to identify:

- § sample site identification;
- § disturbances (e.g. grazing, weeds, clearing etc);
- § description of the native vegetation (structure and floristic classification, identification and extent vegetation communities, age structure, canopy health, all species, cover abundance);
- § non-vascular groundcover;
- § flora of conservation significance; and
- § habitat features (standing/fallen dead trees, availability of foraging substrate, feed trees, suitable shelter, hollows etc).

A GPS reading was recorded wherever a species of conservation significance was identified. All species recorded during the flora surveys were reported in the species list in the survey report along with the habitat and vegetation type within which they were recorded. Any rare, threatened, or significant species found on site or in the immediate area surrounding the site was marked on a map of the site in relation to the proposed works.

Traverse sampling

100 x 20 m traverses – two of these traverses were conducted for each quadrat. Traverses were placed across the stratification unit using knowledge of likely habitat for the threatened or other species of conservation significance. The traverses, which were single straight lines or staggered depending upon the shape of the stratification unit and direction were walked while recording all species along the traverse.

Random traverses - the observer walked “randomly” inside the stratification unit for approximately 20 minutes using expert knowledge to search likely habitat for noteworthy species and any other species not recorded in the quadrats surveyed in that stratification unit. The ‘Random Meander’ technique (Cropper 1993) was employed. As rare plants often exist in discrete populations in specific areas, a random search can increase the probability of finding rare plant populations. A random search effort also encompasses a greater portion of the landscape, as the search is not limited to specific areas (only the stratification unit), and is useful in surveying difficult terrain and irregular shaped search areas. Information recorded included the identification and extent of vegetation communities; all flora species observed, habitat features (standing/fallen dead trees, availability of foraging substrate, feed trees, suitable shelter, hollows etc), and flora of conservation significance.

HABITAT SURVEY METHODOLOGY

General habitat assessment

General habitat characteristics and diversity for native fauna was assessed during flora survey traverses and quadrats. The following habitat characteristics were documented:

- § the presence of nesting/shelter sites such as tree hollow, hollows logs, decorticated bark and rocks;
- § abundance of ground, shrub and canopy layers and flowering characteristics of shrubs and trees;
- § emergent vegetation within and around wetlands and the presence of free water; and
- § rocks and basking sites for reptiles.

Habitat hollow-bearing tree survey

The survey also targeted the hollow characteristics and habitat value of isolated paddock trees, clumps of isolated paddock trees and most areas containing any mature/old growth Bimble Box, Dwyer's Mallee Gum and White Cypress Pine. The value of hollow-bearing trees as critical habitat is well documented for hollow dependant fauna. Therefore information regarding the number of hollow-bearing trees across the study site is important to determine the effect of any clearing operation on threatened and protected species. Habitat hollow-bearing tree surveys were conducted during flora surveys transects and dedicated scat, tack and other animal sign surveys where appropriate.

Habitat For Subject Species

The preferred habitat for each subject species was researched and compared with the distribution of habitat types in the subject site. This comparison was used to determine if preferred habitat is present for each subject species in the subject site and adjacent land, particular bordering the subject site to the south, east and north. More specifically, this comparison was used to determine if suitable habitat for subject species exists in areas where native vegetation and fauna habitat are most likely to be affected by the project.

FAUNA SURVEY METHODOLOGY**Reptiles and Amphibians**

Active diurnal searches - at least two 0.5 ha area searches were conducted for each sample unit or otherwise where appropriate in suitable habitat. Searches were only conducted from mid-morning to late afternoon, when temperature and insolation are sufficient to ensure maximum reptile activity. This technique was not conducted on overcast or rainy days. Potential reptile and frog microhabitats were actively searched within the 0.5 ha sample unit. Active or basking reptiles were identified by sight or by capture and keying out where possible. Sheltering or cryptic species were detected by destructively searching fallen logs, litter, decorticating and fallen bark, rock outcrops and other likely substrates.

Bird surveys

Diurnal bird surveys - at least three 30-minute 1 ha diurnal bird censuses were conducted within each sample unit. Censuses were conducted only during periods of relatively high bird activity (early morning, late afternoon) and reasonable detectability. All bird species and individuals seen or heard were recorded. Individuals were scored as 'on-site' if they are detected within the 1 ha plot. Individuals recorded outside the plot, in adjacent vegetation types or flying overhead, will be recorded as either 'off-site' or 'on-site' within that particular vegetation type. Sample plot configurations varied according to the nature of the habitat being sampled.

Nocturnal bird surveys - one nocturnal bird call-playback census was conducted for the subject site. Censuses were conducted following the methodology of Kavanagh and Peake (1993) and NPWS (1997). Nocturnal bird investigations were conducted within the first two hours following sunset. No surveys were conducted on nights with rainfall and/or strong winds, as these conditions adversely affect the detectability of all nocturnal bird species. Following dusk a quiet listening period for a duration of 15 minutes was undertaken to determine the presence of any nest or roost sites in, or in close proximity to, the subject site. Spotlighting surveys were conducted for nocturnal birds in association with arboreal mammal spotlighting. Following the completion of spotlighting surveys pre-recorded calls of Barking Owl and Masked Owl and other native nocturnal bird species were broadcast through a 16-watt portable amplifier over the subject site and adjacent bushland. Calls of each species were broadcast for a period of 2 - 3 minutes, coupled with short periods of quiet listening for any vocal responses and stationary spotlighting. Following the final broadcast, spotlighting searches were undertaken.

Arboreal mammal nocturnal surveys

At least three 20-min 1 ha area spotlighting searches were undertaken by foot across the subject site. Searches were followed by quiet listening to detect any animal movements or vocalisations. Habitat providing trees with large hollows were targeted, especially immediately after dark because of the increased chance of animal activity around

that time. Particular attention was paid to any tree in flower, as these provide a reliable source of blossom and nectar. Arboreal mammal investigations were conducted within the first two hours following sunset. No surveys were conducted on nights with rainfall and/or strong winds, as these conditions adversely affect the detectability of all arboreal mammal species.

Ground dwelling mammal – Elliott trapping

Elliott grids consisting of 25 traps were placed at four different sample units for three consecutive nights. It was considered that 300 trap nights was sufficient to sample the subject site. Grids were placed where suitable habitat for ground dwelling fauna was found within each sample unit. Trapped animals were identified by species and sex, then either released or retained as voucher specimens, if necessary.

Nocturnal bird/bat/arboreal mammal - Stag watching

Stag watching was usually conducted as a precursor to arboreal mammal spotlighting. Stag watching was conducted to detect the presence of bats or nocturnal birds emerging from tree hollows at dusk. The number and identity of emerging animals following dusk was recorded for a period of 20 minutes.

Microchiropteran bat surveys

Ultrasonic Bat Detector - the Anabat II bat detector was placed for one night at the four main sample sites. The detector is used to record the presence of microchiropteran (insectivorous) bat species through the detection of echolocation calls. Censuses begin at or soon after dusk and are conducted all night or for the duration of the tape. The calls were analysed by Glen Hoyer of 'Fly By Night' Bat Survey consultant. A report detailing the call analysis and Glen Hoyer's contact details is provided in Appendix M.

Harp trapping - two Harp traps were used for two nights at four main sample units to capture microchiropteran bat species. Traps were placed along potential flight paths, corridors and other areas utilised by microbat species. Traps were checked each morning and all individuals identified by external morphology, forearm measurement and body weight, and keyed using Parnaby (1992) and Churchill (1998). Animals were released either immediately after identification or on the following night at the point of capture.

Dedicated habitat scat, track and other animal sign searches

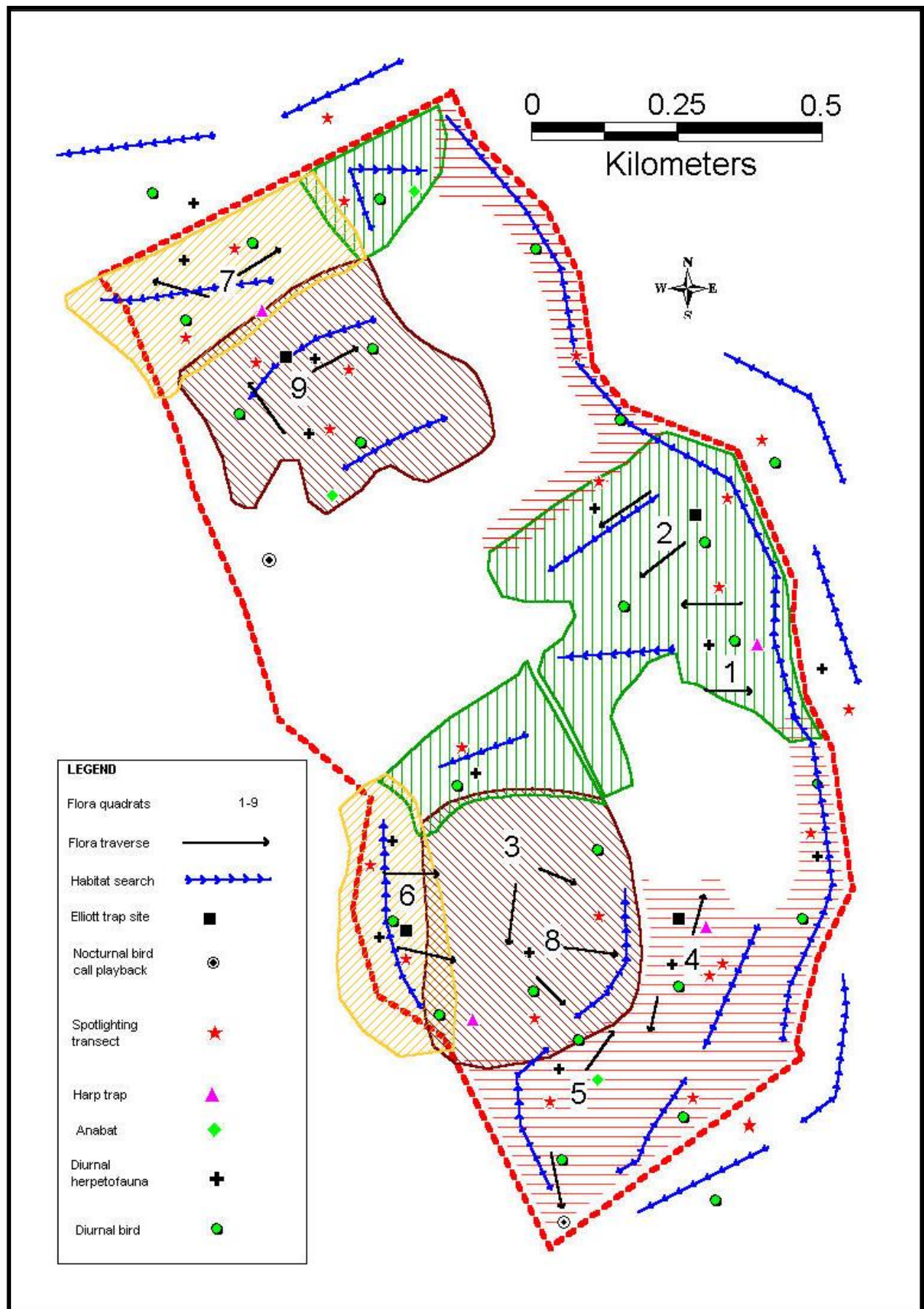
Dedicated scat, track and other animal sign searches were conducted for each sample unit where animal signs were recorded. All predator scats and unassigned scats of other fauna were collected for analysis. Samples of other animal remains (e.g. feathers, bones, skulls, owl pellets, carcasses etc) were collected whether on site or observed opportunistically. Searches for tracks, scratchings (particularly around hollows, base of tree), diggings and other animal signs (e.g. feed trees) were also recorded. Where suitable, habitat hollow-bearing trees surveys were also conducted during these searches.

Opportunistic species sightings

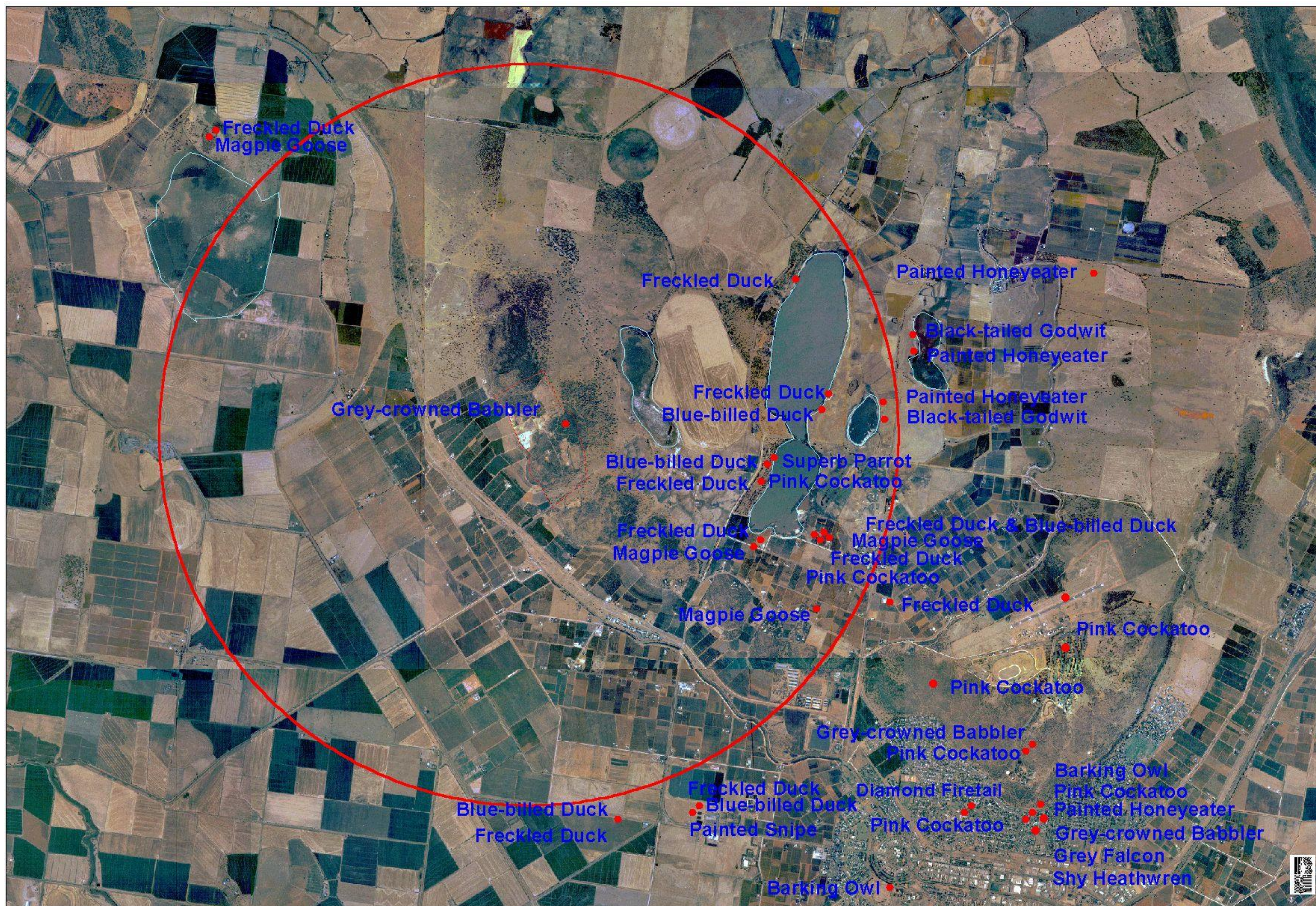
While travelling around the survey area, all fauna observed were recorded even if not being targeted by the particular survey occurring at the time. This particularly included species of conservation significance (threatened species, new records and edge of range based on the Atlas of NSW Wildlife and regionally significant species as identified in regional vegetation management plans or identified in a Consultant's Technical Brief). The habitat within which the species was observed and its location was also recorded. This is especially important for sparsely distributed species such as owls and raptors, which are difficult to survey.

APPENDIX J.

SURVEY SITE MAP



APPENDIX K. THREATENED SPECIES MAP OF THE STUDY AREA



APPENDIX L.

SECTION 5A ‘8 PART TEST’ OF SIGNIFICANCE

Assessment of Significance Pursuant to 5A (Significant effect on threatened species, populations or ecological communities, or their habitats) of the EP&A Act 1979.

The *Environmental Planning and Assessment Act 1979* includes in Section 5A, eight factors which are to be considered when determining if the proposed development or activity “is likely to have a significant effect on the threatened species, populations or ecological communities, or their habitats”. These eight factors must be taken into account by a consent or determining authority when considering a development proposal or development application, particularly in administering Sections 78, 79C and 112 of the EP&A Act 1979.

Threatened Avifauna Species

Grey Falcon (*Falco hypoeucos*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The distribution of the Grey Falcon is centred on inland drainage systems where there is <500 mm rain per year. There it frequents timbered lowland plains, particularly *Acacia* shrublands that are crossed by tree-lined watercourses. It also hunts far out into treeless areas and frequents tussock grassland and open woodland, especially in winter. Though recorded from most Australian deserts, it generally avoids them (Olsen and Olsen 1986). This species requires large trees (eucalypt) near or overhanging water or dry watercourse for nesting sites (NSW NPWS 1996). Nests are usually separated by many kilometres (Olsen and Olsen 1986); in the Pilbara adjacent pairs build nests between 16 and 23 km apart (A. Sutton in Garnett 1992b). They prey on birds, mostly granivorous parrots and pigeons (Marchant and Higgins 1993) and mammals, including dead lambs (Olsen and Olsen 1986). Probably breeding throughout arid zone area (Marchant and Higgins 1993). Species may have been eliminated early in 20th century from some former breeding areas, particularly those with more than 250 mm annual rainfall in New South Wales (Olsen and Olsen 1986; Olsen 1998). Records from the Griffith region include Fivebough Swamp and Tuckerbil Swamp in Leeton (Taylor and Glazebrook 1998), Brobenah Hills southeast of Leeton (MFN 1999a) and Scenic Hill, part of the McPherson Range (GBNEG 2000).

Although not recorded within the subject site despite targeted surveys, potential habitat in the form of hunting areas and limited roosting and breeding sites was recorded. A high number of prey species were recorded within the study area, including parrots, pigeons and doves. The subject site lacks the specific breeding habitat required by this species (i.e. large trees (eucalypt) near or overhanging water or dry watercourse for nesting sites). The study area provides very few nesting opportunities for the Grey Falcon, which are largely restricted to the Bimble Box woodland area in the southern portion of the subject site. More suitable breeding and roosting habitat is found on the land east of the subject site and around Tharbogang Swamp. Potential hunting area is well represented on land east of the subject site and McPherson Range area.

Given the high mobility, wide ranging habits and the lack of specific breeding resources within the subject site it is more likely that the subject site is part of the overall hunting habitat area used by this species. It is also likely that competition from the high abundance of other raptor species recorded within the subject site would prevent the Grey Falcon from utilising the subject site on a permanent basis. It is considered ‘unlikely’ that the “life cycle” of the Grey Falcon will be “disrupted” by the proposed development, and no “viable local population” of this species will be “placed at risk of extinction” as a result of the proposed development. Furthermore, proposed impact amelioration measures will ensure that potential habitat for this species is adequately protected.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no ‘endangered population’ of the Grey Falcon listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations even if individuals of such a population use the subject site.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The reference of regional within this factor refers to the regions as defined in the Interim Biogeographical Regionalisation of Australia (IBRA). The *TSC Act 1995* defines “region” as “a bioregion defined in a national system of bioregionalisation that is determined by the Director-General under subsection (4) to be appropriate for those purposes”. If the bioregion occurs partly within and partly outside New South Wales, the region consists only of so much of the bioregion as occurs within New South Wales. The IBRA has been published by Environment Australia.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the study area cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for the Grey Falcon. Given the mobility of the Grey Falcon and lack of specific breeding and roosting resources within the subject site and relatively small size of the area of potential resources within the subject site in terms of regional distribution of habitat, the proposed development is unlikely to involve “a significant area of known habitat” for the Grey Falcon to be “removed or modified”.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed development will involve the removal of some of the potential foraging and roosting habitat of the Grey Falcon. However, considering the small extent and rate of removal of this habitat and the highly mobile nature of the Grey Falcon it is unlikely that the proposed development will involve any resources or known habitat for the Grey Falcon becoming “isolated from current or interconnecting areas of habitat”. Furthermore, appropriate recommendations have been implemented to ensure that the study area maintains its current connectivity with McPherson Range including native vegetation reserve areas and the implementation of effective vegetation corridors in order to facilitate the movement of native fauna, including prey species of the Grey Falcon.

(e) Whether critical habitat will be affected.

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the *TSC Act 1995*. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Records from conservation reserves in the locality include Fivebough Swamp and Tuckerbil Swamp in Leeton (Taylor and Glazebrook 1998). Other records from the locality, although not designated conservation reserves or similar area include sightings from the Brobenah Hills southeast of Leeton (MFN 1999a) and Scenic Hill, part of McPherson Range (GBNEG 2000). There is insufficient information to assess whether the species is “adequately represented in conservation reserves or other similar protected area in the region”. Given this species is always at low densities, has an estimated total population of less than 5000 individuals and 1,000 pairs and is highly mobile in nature and possibly seasonal in movement it is considered ‘unlikely’ that the Grey Falcon or its habitat are “adequately represented in conservation reserves or other similar protected areas in the region”.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

The *TSC Act 1995* defines a “threatening process” as a “process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”. Schedule 3 of the *TSC Act 1995* provides a list of key threatening processes. Under “Section 110 Matters which have been limited or modified” of The Director-General’s Requirements “no key threatening processes have been listed which are likely to be relevant to this proposal”.

Whilst the proposed development is not of a class of development or activity that is recognised as a key threatening process as listed in Schedule 3 of the *TSC Act 1995*, clearing of native vegetation and associated habitats generally is. Current threats to the Grey Falcon’s habitat include continued overgrazing of arid zone rangelands and clearance of the semi-arid zone for marginal farming. Other threats include pesticide use in marginal farmland. Localized DDT-related eggshell thinning of up to 14% has been detected (Olsen and Olsen 1985). Nest site availability, particularly in sparsely treed parts of the inland, may eventually become limiting, especially where grazing by exotic herbivores is preventing regeneration of trees (G. Czechura in Garnett 1992b). Although all threats are speculative and are largely at the wetter margins of the species range, this may be the part of the range where nesting productivity is at its highest. Given the lack of specific breeding habitat within the subject site, relatively small area of land to be affected and extent of potential breeding and foraging habitat available within the study area, and McPherson Range the proposed development including the removal of native vegetation will not “threaten the survival or evolutionary development” of the Grey Falcon.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

It is considered unlikely that the Grey Falcon is at “the limit of its known distribution” within the study area, locality or region. This species is infrequently seen over much of arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and north western Australia (Blakers *et al.* 1984; Olsen and Olsen 1986; Marchant and Higgins 1993). The distribution of the Grey Falcon is centred on inland drainage systems where there is <500 mm rain per year. There it frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined watercourses. It also hunts far out into treeless areas and frequents tussock grassland and open woodland, especially in winter. Though recorded from most Australian deserts, it generally avoids them (Olsen and Olsen 1986). It is also found near and over swamps and waterholes (Olsen *et al.* 1993). Evidence exists of regular seasonal movements between the arid zone and northern Australia, and possibly New Guinea (Olsen and Olsen 1986) and from the west to the east in Queensland (G. Czechura in Garnett 1992b).

Conclusion

Given the highly mobile nature of the Grey Falcon, lack of specific breeding and roosting resources within the subject site and availability of potential breeding and roosting resources in the locality, it is considered unlikely that the proposed development will impose a “significant effect” on the Grey Falcon. Furthermore the lack of visual evidence of this species despite targeted surveys within the study area also supports the above findings.

Glossy Black-Cockatoo (*Calyptorhynchus lathami*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Glossy Black-Cockatoo is dependent upon *Allocasuarina*, preferring woodland dominated by *Allocasuarina*, or open sclerophyll forests or woodlands, with middle stratum of *Allocasuarina* below *Eucalyptus* or *Angophora*; often confined to remnant patches in hill and gullies, surrounded by cleared agricultural land. Also in mixed

Allocasuarina, *Casuarina*, *Callitris* or Brigalow *Acacia harpophylla* woodland assemblages or dense sclerophyll forests (Higgins 1999). Often found in coastal or subcoastal areas, but also occurring farther inland in foothills, mountain ranges and plains, especially in *Allocasuarina* associations fringing watercourses or on stony ridges (Higgins 1999). Breeding in hollow stumps or limbs, living or dead, or a hole in the trunk of tall trees; usually in eucalypt, mainly within woodland or remnant woodland, but also recorded within dead, ringbarked eucalypt in cleared country (Higgins 1999). Forage among branches of fruiting *Allocasuarina*, preferring mature sparse trees, between 2 and 10 m tall with dense regrowth. Mostly roost in canopy of live leafy trees, preferring eucalypts but will use other species. Usually found less than one kilometre from feeding site and during breeding season within 30 m of nesting tree (Higgins 1999).

The main habitat of the eastern subspecies of Glossy Black-Cockatoo *Calyptorhynchus lathami lathami* is eucalypt woodlands and forests in which there is a sub-canopy or understorey of casuarinas *Allocasuarina/Casuarina*, but Brigalow is also used in south eastern Queensland. The subspecies' diet is primarily restricted to the seeds of *Allocasuarina/Casuarina*, with seeds of other species (e.g. *Callitris*) locally important (Higgins 1999). The cockatoos must forage for long hours each day to gain sufficient food, particularly during the breeding season, and not all apparently suitable habitat provides adequate food value to support the cockatoos (Clout 1989; Crowley *et al.* in press).

This species was not recorded within the subject site despite targeted surveys. The subject site lacks specific foraging resources for the Glossy Black-Cockatoo. A small stand consisting of a few old growth Bull-oak (*Allocasuarina luehmannii*) trees and some regeneration within a 1 ha area was recorded near the entrance of the subject site. Five juvenile Drooping She-oak (*A. verticillata*) were also recorded along the entrance road opposite the speedway entrance. However it could hardly be construed that these trees could support adequate foraging resources for the Glossy Black-Cockatoo. Limited potential nesting and roosting opportunities are offered within the Bimble Box and Dwyer's Mallee Gum woodland areas and some stag trees of the site. Potential competition for nest resources may also exist from other hollow dwelling birds (i.e. Blue Bonnet, Red-rumped Parrot, Galahs and Cockatoos).

Given the lack of specific foraging requirements (i.e. *Allocasuarina* sp.) within the subject site and lack of adequate nesting resources it is considered unlikely that the Glossy Black-Cockatoo frequents the subject site. It is 'unlikely' that the "life cycle" of the Glossy Black-Cockatoo will be "disrupted" by the proposed development, and no "viable local population" of this species will be "placed at risk of extinction" as a result of the proposed development. Furthermore, if this species did occasionally occur within the subject site proposed impact amelioration measures will ensure the protection of potential foraging and roosting resources.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

The Riverina population of the Glossy Black-Cockatoo is listed under Part 2 of Schedule 1 of the *TSC Act 1995* as an "endangered population". This population is eligible for listing as an endangered population because its numbers have been reduced to such a critical level that it is in immediate danger of extinction, it is disjunct and at the limit of its geographic range, and the population is of significant conservation value (NSW NPWS 1999b).

The Riverina population is largely restricted to hills and low ridges where suitable assemblages of its food plant Drooping She-oak remain within the Narrandera Range and to the north-west in the Brobenah Hills, McPhersons Range, Cocoparra Range, Lachlan Range and Jimberoo State Forests, and the Naradhan Range (NSW NPWS 1999b). This population now occurs west of longitude 146° 40' E, within Cobar, Carrathool, Narrandera and Leeton Local Government Areas. This line runs through an area, which is extensively cleared and this cleared area now seems to isolate the western population. This population requires trees with suitable large hollows to breed, normally Grey Box or Dwyer's Gum, within close proximity to feeding habitat (NSW NPWS 1999b).

This species was not recorded within the subject site despite targeted surveys. The subject site lacks the specific resources for the Glossy Black-Cockatoo. Given that only few juvenile Drooping She-oak were recorded within the subject site, lack of suitable large hollows and potential competition from other hollowing dwelling birds, it is considered very unlikely that the “lifecycle of the species (Glossy Black-Cockatoo) that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised”. Furthermore, if this species did occasionally occur within the subject site proposed impact amelioration measures will ensure the protection of potential foraging and roosting resources.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. The Riverina population of Glossy Black-Cockatoo is largely restricted to hills and low ridges where suitable assemblages of its food plant Drooping She-oak remain within the Narrandera Range and to the north-west in the Brobenah Hills, McPherson Range, Cocoparra Range, Lachlan Range and Jimberoo State Forests, and the Naradhan Range (NSW NPWS 1999b). Although the subject site is part of the McPherson Range, it cannot be construed that the subject site is part of “known habitat” for the Glossy Black-Cockatoo given lack of visual evidence, lack of specific feed trees, limited potential roosting and nesting sites and relatively small size of the area of potential habitat in terms of the regional distribution of habitat. It is therefore considered the proposed development is unlikely to involve “a significant area of known habitat” for the Glossy Black-Cockatoo to be “removed or modified”. On this basis, the study area cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for Glossy Black-Cockatoo or the endangered Riverina population of the Glossy Black-Cockatoo.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed development will involve the removal and modification of the majority of existing vegetation within the study area over a 40-year period. Considering the rate of removal of the relevant vegetation, lack of suitable foraging habitat and nesting sites it is ‘unlikely’ that the proposed development will involve any resources or habitat for the Glossy Black-Cockatoo or the endangered Riverina population of the Glossy Black-Cockatoo becoming “isolated from current or interconnecting areas of habitat”. Furthermore, proposed impact amelioration measures ensure that the subject site maintains its current connectivity within McPherson Range.

(e) Whether critical habitat will be affected.

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the *TSC Act 1995*. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Isolated populations of Glossy Black-Cockatoo exist in the Griffith area. Five individuals have been observed at Cocoparra National Park, 25km north east of Griffith (NSW NPWS 1997a). Although not designated conservation reserves or similar areas, Glossy Black-Cockatoos have been recorded breeding within the Narranderra Ranges near Leeton (MFN 1999a). Anecdotal evidence from the Narrandera Range during the 1930s estimated aggregations of Glossy Black-Cockatoos to number in their hundreds, and flocks of more than 40 birds were not uncommon during the 1940s and 1950s. The greatest number recorded in the ranges in recent times is between 20 and 30 birds, following completion of the breeding season (NSW NPWS 1999b).

There is insufficient information to make an accurate assessment it is unlikely that habitat and associated resources are “adequately represented in conservation reserves or other similar protected areas in the region” within the area of occupancy of the Glossy Black-Cockatoo or the endangered Riverina population of the Glossy Black-Cockatoo. However given the declining status of the Glossy Black-Cockatoo, current threats and lack of suitably protected habitat within conservation reserves or other similar protected areas, it is unlikely to be “adequately represented in conservation reserves or other similar protected area in the region”.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Whilst the proposed development is not of a class of development or activity that is recognised as a key threatening process as listed in Schedule 3 of the *TSC Act 1995*, clearing of native vegetation and associated habitats generally is. Clearance of habitat has reduced the range of the Glossy Black-Cockatoo, particularly south and west of the Great Dividing Range (Baird 1986). Burning of fire sensitive species of casuarinas (e.g. *A. littoralis*, *A. verticillata*) can render feeding habitat unsuitable for several years (Joseph 1982; Crowley 1986). Regeneration may be impeded by grazing and fragmentation of habitat, especially when associated with agriculture, leading to the penetration of competitors from more open habitats and/or ecotones (notably Common Brushtail Possums, Little Corellas and Galahs) and increasing competition for hollows (Blakers *et al.* 1984; Downes *et al.* 1997; Crowley *et al.* 1998). Without nests being protected against such competitors, recruitment to the adult population may be minimal.

Habitat loss is seen as the major reason for the historical decline of the endangered Riverina population of the Glossy Black-Cockatoo population (NSW NPWS 1999b). Much of the vegetation within the range of this species has been cleared, predominantly for agricultural purposes. Threatening processes currently affecting this population include altered fire regimes and the grazing of Drooping She-oak seedlings by rabbits, sheep and goats. These processes affect the availability of the critical food source of these birds. Suitable breeding sites for the Riverina population of Glossy Black-Cockatoos have been affected by firewood collecting, and nest hollow pressure from predators and competitors, including feral European Honeybees and Brush-tailed Possums. There is anecdotal evidence to suggest that illegal nest robbing has affected the Riverina population in the past. Nest hollows are often damaged or destroyed during this process. The full impact of these threatening processes may not be observed for some years due to the long lifespan of these birds and the low rate of recruitment into the population (NSW NPWS 1999b).

The removal and or modification of native vegetation of the subject site is not considered of particular consequence in regards to the loss of habitat and associated resources for the Glossy Black-Cockatoo. Given the lack of specific foraging resources and suitable roosting and breeding habitat it is considered ‘unlikely’ that the removal of vegetation from the subject site will “threaten the survival or evolutionary development” of the Glossy Black-Cockatoo.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

It is considered unlikely that the eastern subspecies of Glossy Black-Cockatoo is “at the limit of its known distribution”. It has a patchy distribution from the Mitchell, Queensland, to Mallacoota and possibly Melbourne, Victoria and King Island, Bass Strait (Baird 1986; Schodde *et al.* 1993; Schodde and Mason 1997). Thinly distributed throughout its range, with the highest densities east of Great Dividing Range; more scattered distribution inland, to as far west as the Riverina and the Pilliga Scrub (McAllan and Bruce 1988; Ayers *et al.* 1996). Probably breeding throughout range. In Victoria, it is no longer regularly found west of Mallacoota (Baird 1986; Schodde *et al.* 1993).

The Riverina population of the Glossy Black-Cockatoo is largely restricted to hills and low ridges within the Narrandera Range and to the north-west in the Brobenah Hills, McPhersons Range, Cocoparra Range, Lachlan

Range and Jimberoo State Forests, and the Naradhan Range (NSW NPWS 1999b). This population now occurs west of longitude 146° 40' E, within Cobar, Carrathool, Narrandera and Leeton Local Government Areas. This line runs through an area that has been extensively cleared and this cleared area now seems to isolate the western population. The population is disjunct and at the western edge of the range for the Glossy Black-Cockatoo in New South Wales. There is some evidence to suggest that individual birds move over considerable distances within the region. However, the genetic relationships between the Riverina population and the nearest easterly occurrences (The Charcoal Tank Nature Reserve near West Wyalong; Weddin Mountains and Conimbla National Parks; north from the Hervey Range to Goonoo State Forest and the Pilliga forests near Coonabarrabran) have yet to be clarified. There is some evidence that these western populations are more closely related to the Kangaroo Island subspecies *Calyptrorhynchus lathamii halmaturinus* than to more easterly populations indicating this population is of significant conservation value (NSW NPWS 1999b). Although it is considered likely that the endangered Riverina population of the Glossy Black-Cockatoo is “at the limit of its known distribution” the proposed development and its subsequent activities are not of particular concern in regards to the range contraction of this population.

Conclusion

Given the lack of *Allocasuarina* species upon which the Glossy Black-Cockatoo is dependent, the lack of appropriate nesting and roosting resources, potential competition from existing hollow dwelling animals and absence of visual records of this species within the subject site, it is considered unlikely that the proposed development will impose a “significant effect” upon the Glossy Black-Cockatoo or the endangered Riverina population of Glossy Black-Cockatoo. Furthermore, proposed impact amelioration measures will ensure that the limited potential resources offered by the subject site will be protected.

Pink Cockatoo (*Cacatua leadbeateri leadbeateri*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The eastern subspecies of the Pink Cockatoo is found in arid and semi-arid zone woodlands dominated by Mulga, mallee and box eucalypts, Cypress Pine or Belah where it feeds primarily on seeds, roots and fruits. The main requirements of this species are trees with suitable nesting hollows and fresh surface water (Higgins 1999). Breeding pairs of the western subspecies occupy nests at least 1 km apart with densities of about one pair per 30 km² recorded (Saunders *et al.* 1985; Rowley and Chapman 1991). It has been observed at Round Hill Nature Reserve (T. Quested pers.obs; N. Kuehn pers.obs) and west of Ardlethan, 80 km east of Griffith (I. Fraser pers.obs). Closer to Griffith, they have been observed at Cocoparra National Park, 25 km north east of Griffith (NSW NPWS 1997a), at the Brobenah Hills (MFN 1999a) and at Pulletop Nature Reserve, 35 km north of Griffith (MFN 1999b). Twenty-eight birds use Campbells Swamp as a regular watering site (MFN various dates). This species is also known to commonly frequent the Griffith Airport and golf course area (Mills pers comm. 2002; Grabham pers comm. 2003).

The subject site supports potential resources for the Pink Cockatoo, largely in the form of foraging habitat provided by the existing *Callitris* vegetation. Whilst the site does offer some nesting and roosting opportunities (i.e. Bimble Box woodland area) it does not offer any fresh water surfaces. The closest freshwater body, Lake Wyangan, lies approximately four kilometres east of the subject site. The proposed development will require the removal and modification of at least 50% of the existing White Cypress Pine forest within the study area over a 40-year period. White Cypress Pine is also common and mostly co-dominant in each of the vegetation communities present within the subject site and therefore well represented throughout the study area. It can also be found in association with woodland vegetation to the east of the site and in other parts of McPherson Range.

Given that the lack of specific resources (i.e. fresh surface water) required by the Pink Cockatoo and available habitat found in close proximity to the subject site it is likely that this species would only use the subject site as part of their foraging habitat. Proposed impact amelioration measures will also ensure that potential habitat within the subject site is adequately protected. It is considered unlikely that the “life cycle” of the Pink Cockatoo will be

“disrupted” by the proposed development, and no “viable local population” of this species will be “placed at risk of extinction” as a result of the proposed development.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no ‘endangered population’ of the Pink Cockatoo listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations even if individuals of such a population use the study area.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the subject site cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for the Pink Cockatoo. Furthermore, given the absence of freshwater, lack of adequate roosting and nesting sites and relatively small size of the area of potential resources within the subject site in terms of regional distribution of habitat, the proposed development is unlikely to involve “a significant area of known habitat” for the Pink Cockatoo to be “removed or modified”.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed development will involve the removal of some of the potential foraging and roosting habitat of the Pink Cockatoo. However, given the small extent and rate of removal of this vegetation, and lack of specific resources it is unlikely that the proposed development will involve any resources or known habitat for the Pink Cockatoo becoming “isolated from current or interconnecting areas of habitat”. Furthermore, appropriate recommendations have been implemented to ensure that the subject site maintains its current connectivity with McPherson Range including native vegetation reserve areas and the implementation of effective vegetation corridors in order to facilitate the movement of native fauna.

(e) Whether critical habitat will be affected.

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the *TSC Act 1995*. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The Pink Cockatoo has been observed at Round Hill Nature Reserve (T. Quested pers.obs; N. Kuehn pers.obs). Closer to Griffith, they have been observed at Cocoparra National Park, 25 km north-east of Griffith (NSW NPWS 1997a) and at Pulletop Nature Reserve, 35 km north of Griffith (MFN 1999b). Other records from the Griffith region, although not designated conservation reserves or similar areas, include sightings west of Ardlethan and 80 km east of Griffith (I. Fraser pers.obs), Brobenah Hills (MFN 1999a). Some twenty-eight birds use Campbells Swamp approximately 4 km east of the subject site as a regular watering site (MFN various dates). This species is also known to commonly frequent the Griffith Airport and golf course area (Mills pers comm. 2002; Grabham pers comm. 2003).

Although potential habitat is likely to be “adequately represented” in the conservation reserves and or similar protected areas including the above mentioned, there is insufficient information to assess whether the species is “adequately represented in conservation reserves or other similar protected areas in the region”.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Whilst the proposed development is not of a class of development or activity that is recognised as a key threatening process as listed in Schedule 3 of the *TSC Act 1995*, clearing of native vegetation and associated habitats generally is. The proposed development will involve the clearing of native vegetation and the associated potential foraging resources of the Pink Cockatoo.

The continual clearance of feeding and breeding habitat has substantially reduced the population of Pink Cockatoos in the southern and eastern parts of its range. Grazing and weed invasion are also impeding recruitment of trees that will be used for breeding in the future (Emison *et al.* 1987; Ayers *et al.* 1996; Higgins 1999). Nest robbing and trapping for aviculture are thought to have been a major cause of decline in South Australia and may be a significant threat elsewhere in the range (Ayers *et al.* 1996; Higgins 1999). Considering the small extent and rate of removal of the potential habitat and the availability of potential habitat within areas adjacent to the subject site, the removal of this vegetation from the subject site will not “threaten the survival or evolutionary development” of the Pink Cockatoo. Furthermore, the proposed impact measures will ensure that potential habitat for this species is adequately protected within the subject site.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

This species occurs in the Murray-Darling, Eyre and Bulloo River basins as far north as Isisford and Roma in Queensland, through western New South Wales to north-west Victoria and west to Adelaide and Mt Mary Plains (Schodde and Mason 1997; Higgins 1999). It had however disappeared from the Adelaide and Mt Mary Plains by the 1950s (Boehm 1961) and density greatly reduced in north-west Victoria (Emison *et al.* 1987) and western New South Wales (Cooper and McAllan 1995). The eastern subspecies of the Pink Cockatoo is found in arid and semi-arid zone woodlands dominated by Mulga, mallee and box eucalypts, Cypress Pine Callitris or Belah. It is considered unlikely that the Pink Cockatoo is at “the limit of its known distribution” within the study area, locality or region.

Conclusion

It is unlikely that the proposed development will impose a “significant effect” on the Pink Cockatoo as the site lacks the specific resources required by this species (i.e. freshwater surfaces). Furthermore, potential foraging areas offered by the site will be adequately protected and the lack of visual evidence supports the above findings.

Superb Parrot (*Polytelis swainsonii*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Superb Parrot breeds only in the Riverina and south-west slopes of New South Wales and in northern Victoria (Webster and Ahern 1992). Virtually restricted to the interior of New South Wales, it is confined as a breeding bird to River Red Gum forest along the Murray and Edwards Rivers near Deniliquin and Mathoura, along the Murrumbidgee River from Wagga Wagga to Darlington Point (Schrader 1980; Higgins 1999; Lindsey 1992). In Victoria it is now largely confined to Barmah Forest area in the north, rarely to Wangaratta (Higgins 1999), having disappeared from central and southern Victoria in the early 1900s, and from northern Victoria by 1930 (Webster and Ahern, 1992). All but disappeared in the Australian Capital Territory in the 1950s and in New South Wales declined

in the Parkes district since 1960s. However, it may have extended its range to Deniliquin and in northern New South Wales over the same period (Schrader 1980; Higgins 1999). Breeding population estimated at fewer than 5,000 pairs (Davidson and Chambers 1992). Counts in December 1998 found 200 birds at Nathalia, Victoria, 60 at Deniliquin and 100 near Wagga Wagga, both New South Wales (Anon 1999).

In the Riverina, Superb Parrots nest in loose colonies in riparian woodland of River Red Gum. A typical nest tree in the Riverina has a dbh of 1.57 m, a height of 33 m and a maximum crown width of 11m. The typical nest hollow is 17 m above the ground and around 26 m from a watercourse. Black Box, White Cypress Pine and Boree are often associated with many breeding areas (Greening Australia 1995). The majority of foraging occurs within box woodlands, particularly that dominated by Yellow Box and Black Box, on seeds of herbaceous plants, switching to lerp, mistletoe berries, eucalypt flowers and grass seed in winter (Webster 1988; Higgins 1999). On the inland slopes of the Great Dividing Range, Superb Parrots forage and nest within box woodland (Webster 1988). They forage up to 15 km from a the nest, particularly on inland slopes where suitable nesting trees are widely dispersed, but rarely cross extensive open ground, using woodland remnants as corridors (Webster 1988; Davidson and Chambers 1992; Webster and Ahern 1992; Anon 1999; Higgins 1999).

Observed west of Griffith (10-12 birds), east to Binalong and west of Temora (J. Leonard unpub.). One individual has also been observed at Cocoparra National Park, 25 km north east of Griffith (NSW NPWS 1997a). There are eight known nest sites located along the Murrumbidgee River from Narrandera to west of Darlington Point, 30 km south of Griffith. Another nest site is found at Goolgowi, 46 km north-west of Griffith (Webster and Ahern 1992) and sightings have also been made within the Brobenah Hills (MFN 1999a). This species has also been recorded within the McPherson Range area and Griffith City locality including the Golf Course, Nericorn Swamp and Lake Wyangan areas (MFN various dates).

The subject site does offer potential preferred foraging habitat for the Superb Parrot in the form of the Bimble Box woodland areas, associated native and introduced grass species and grassy ground cover of the Dwyer's Mallee Gum woodland. Potential nesting habitat is largely restricted to the Bimble Box woodland in the southern portion of the subject site in the form of old-growth, hollow-bearing Bimble Box trees. The proposed development would involve the removal of approximately 70% of the relevant vegetation for the Superb Parrot within the subject site. This species has not been recorded within the subject site or study area despite targeted surveys. However, considering this species has been recorded within four kilometres of the subject site it is likely that the potential habitat identified within the subject site could be used as part of the overall foraging habitat for this species within the Griffith area.

Although preferred foraging habitat was recorded and known records of this species exist within the vicinity it is considered 'unlikely' that the "life cycle" of the Superb Parrot will be "disrupted" by the proposed development, and no "viable local population" of this species will be "placed at risk of extinction" as a result of the proposed development. The extent of the relevant vegetation (<26 ha) to be removed and rate of removal over a 40-year period is 'unlikely' to effect the "life cycle" of the Superb Parrot. Furthermore, relevant resources in the form of Bimble Box woodland is well represented on land adjacent to the subject site and the McPherson Range area. The proposed impact amelioration measures will also protect potential habitat of this species.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no 'endangered population' of the Superb Parrot listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations even if individuals of such a population use the study area.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Penneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the subject site cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for the Superb Parrot. Given the small extent of the area of relevant resources offered by the subject site (<26 ha), rate of removal and lack of records within the subject site for this species the proposed development is ‘unlikely’ to involve “a significant area of known habitat” for the Superb Parrot to be “removed or modified”. Furthermore, proposed impact amelioration measures will ensure that foraging and nesting habitat is well protected within the subject site.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Although the subject site is fragmented, it still remains connected to the McPherson Range as part of the western ridgeline and it is also connected via vegetation east of the subject site. The proposed activity will involve the removal and or modification of a small extent of vegetation (<26 ha), which supports potential relevant resources for the Superb Parrot. The removal of this vegetation will occur over a 40-year period and involve associated rehabilitation and proposed revegetation works. The removal of this vegetation will not isolate any “known habitat” from any areas of potential habitat. It is therefore considered unlikely that the proposed development will involve any resources or “known habitat” of the Superb Parrot becoming “isolated from current or interconnecting areas of habitat”. Furthermore, proposed impact amelioration measures will ensure that the subject site maintains its current connectivity with McPherson Range and adjacent areas via native vegetation reserve areas including the Bimble box woodland and proposed native vegetation corridors.

(e) Whether critical habitat will be affected.

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the *TSC Act 1995*. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Observed west of Griffith (10-12 birds), east to Binalong and west of Temora (J. Leonard unpub.). One individual has also been observed at Cocoparra National Park, 25 km north east of Griffith (NSW NPWS 1997a). There are eight known nest sites located along the Murrumbidgee River from Narrandera to west of Darlington Point, 30 km south of Griffith. Another nest site is found at Goolgowi, 46 km north-west of Griffith (Webster and Ahern 1992) and sightings have also been made within the Brobenah Hills (MFN 1999a). This species has also been recorded within the McPherson Range area and Griffith City locality including the Golf Course, Nericorn Swamp and Lake Wyangan areas (MFN various dates).

Although this species has been recorded within conservation reserves of the locality (e.g. Cocoparra National Park), there is insufficient information to assess whether the species is “adequately represented in conservation reserves or other similar protected areas in the region”. It is likely that habitat is represented within conservation reserves, however there is insufficient information to determine if habitat of the Superb Parrot is “adequately represented” in the conservation reserves and or similar protected areas of the locality and region.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

The proposed development is not of a class of development or activity that is recognised as a threatening process as listed in Schedule 3 of the TSC Act 1995, however clearing of native vegetation and associated habitats generally is. The proposed development will involve the clearing and or modification of a small area of potential nesting and foraging resources of the Superb Parrot.

The greatest threat to the Superb Parrot is habitat clearance. The contraction of this species range has largely resulted from clearing for agriculture (Higgins 1999). Within the Murray-Riverina area, clearing of habitat has resulted for the development of orchards and firewood supplies (Anon 1988; Webster 1988). Much of the remaining habitat is degraded with the regeneration of nest trees prevented by overgrazing of stock and rabbits, and by inappropriate fire regimes (Webster and Ahern 1992). Live nest trees are threatened by logging, particularly on private land and artificially high water levels as a result of irrigation. Dead nest trees may not be replaced when they fall and these are also removed for firewood. Irrigation is also causing high water tables and along with drainage schemes and salinisation also degrading non-breeding habitat (Webster 1988). Competition for nesting hollows, particularly with the Common Starling may become limiting and substantial numbers of birds are killed on roadsides, particularly during periods when grain is being transported (Webster 1988).

Given the extent of suitable habitat available within the study area and McPherson Range and small extent of potential habitat of the subject site, the activities of the proposed development including the removal of native vegetation will not “threaten the survival or evolutionary development” of the Superb Parrot. Furthermore, proposed native vegetation reserve areas will adequately protect potential habitat for this species within the subject site.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

The Superb Parrot is not at “the limit of its known distribution” in the locality of the subject site or the Riverina/Cobar Peneplain Bioregions. The Superb Parrot is distributed primarily on the upper and middle reaches of the Murray, Murrumbidgee and Lachlan Rivers, as well as some of their tributaries (e.g. Edwards River). During winter this species can be found in central northern New South Wales from both breeding areas and along the Namoi and Castlereagh Rivers in north western New South Wales (Greening Australia 1995).

Conclusion

It is ‘unlikely’ that the proposed development will impose a “significant effect” on the Superb Parrot. Although, preferred foraging habitat in the form of Bimble Box woodland and associated grassy areas was recorded within the subject site, this habitat is considered part of the overall potential foraging habitat utilised by this species within the area and it will be protected through the implementation of the proposed native vegetation reserve areas. This species was not recorded within the subject site despite targeted surveys conducted during a suitable time of the year to detect the presence of this species. Potential foraging and nesting habitat is also well represented on land east of the subject site and within the McPherson Range area.

Barking Owl (*Ninox connivens*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Barking Owl mainly inhabits dry open sclerophyll forests and woodlands, favouring dense riparian vegetation along watercourses or round wetlands. Also inhabits dry sclerophyll forests and woodlands, of tropical, temperate and semi-arid zones, often dominated by *Eucalyptus* and containing many large trees suitable for roosting or breeding. It also occurs in open communities on plains and in foothills, often dominated by *Eucalyptus* or

Angophora, and including remnant patches of forest or woodlands, or clumps of trees in partly cleared land, such as farmland or denser riparian or gallery communities near rivers, creeks, lakes or swamps, also usually dominated by *Eucalyptus* (Higgins 1999). Breeds in hollows in large trees, mainly *Eucalyptus* in woodland or open forest, usually near watercourses or wetlands, occasionally nest in other large trees. Usually roosts in large, densely foliated trees, either among foliage or on bare branches beneath canopy and shaded foliage, often near watercourses or wetlands (Higgins 1999). The southern subspecies of Barking Owl *Ninox connivens connivens* occurs primarily in dry sclerophyll woodland, nesting in large hollows in live eucalypts, often near open country (Higgins 1999; NSW NPWS 1999c) where it hunts primarily for mainly hollow dwelling birds and mammals but also including rabbits (Higgins 1999).

Potential foraging habitat is provided throughout the subject site and adjacent land to the east. Although a low number of native prey species was recorded, introduced mammals (e.g. rabbits and hares) were relatively common. The ERC 2000 survey recorded a large numbers of introduced rodents within the immediate area of the tip. Although the subject site lacks favoured breeding resources (i.e. hollows in large trees near watercourses), potential roosting and nesting resources were recorded, although these were restricted to the woodland areas. It is also not characteristic of the Bimble Box or Dwyer's Mallee Gum to develop dense foliage. Potential competition for nest resources may also prevent the Barking Owl from breeding within the site.

Given the wide ranging habits of the Barking Owl and the lack of favoured roosting and breeding resources offered by the subject site it is most likely that the Barking Owl uses the subject site as part of its overall foraging habitat. It is considered unlikely that the Barking Owl is confined to the subject site for its foraging purposes and probably only utilises the subject site on an occasional basis. It is considered 'unlikely' that the "life cycle" of the Barking Owl will be "disrupted" by the proposed development, and no "viable local population" of this species will be "placed at risk of extinction" as a result of the proposed development.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no 'endangered population' of the Barking Owl listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations even if individuals of such a population use the study area.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the subject site cannot be construed as comprising "a significant area of known habitat" in respect of the "regional distribution of habitat" for the Barking Owl. Given the small size of the area of potential foraging resources offered by the subject site and lack of favoured breeding resources, the proposed development is unlikely to involve "a significant area of known habitat" for the Barking Owl to be "removed or modified". Furthermore, proposed impact amelioration measures will ensure that adequate foraging and the already limited breeding habitat is protected within the subject site.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

The proposed activity will involve the removal and or modification of a small extent of the existing vegetation that may support potential resources for the Barking Owl. The removal of this vegetation will occur over a 40-year

period and involve associated rehabilitation and proposed revegetation works. Furthermore, proposed impact amelioration measures will ensure that the subject site maintains its current connectivity with McPherson Range and adjacent areas. It is therefore considered unlikely that the proposed development will involve any resources or “known habitat” of the Barking Owl becoming “isolated from current or interconnecting areas of habitat”.

(e) Whether critical habitat will be affected.

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the TSC Act 1995. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

The Barking Owl has not been recorded in any of the conservation reserves or other similar protected areas of the Griffith region. Documented sightings include the Brobenah Hills situated from south of Narranderra to the north of Leeton, although it hasn’t been sighted in recent years (MFN 1999d) and Scenic Hill, McPhersons Range (GBNEG 2000). Although there is insufficient information to make an assessment, it is considered unlikely that the Barking Owl or its habitat and associated resources are “adequately represented in conservation reserves or other similar protected areas” within the region.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

The proposed development is not of a class of development or activity that is recognised as a threatening process as listed in Schedule 3 of the TSC Act 1995, however clearing of native vegetation and associated habitats generally is. The proposed development will involve the clearing and or modification of some native vegetation and potential nesting and roosting resources. Much of the habitat of the southern subspecies of Barking Owl has been cleared (Silveira 1997; Higgins 1999; NSW NPWS 1999c) and forestry practices, particularly those that include the felling of old-growth forests or over-mature trees, further threaten this species (Kavanagh *et al.* 1995). On private land, much of the remaining habitat is fragmented and subject to further clearing, firewood collection and grazing, and there has been little regeneration (Barrett *et al.* 1994; Robinson and Traill 1996; Debus 1997; NSW NPWS 1999c). In north Queensland the species declined as a result of the use of Kleerat as a rodenticide around cane farms (Young and de Lai 1997). Given the extent of suitable habitat available within the region of the study site, the relatively small area of land to be affected and lack of suitable nesting and roosting resources available on site, the activities of the proposed development including the removal of native vegetation will not “threaten the survival or evolutionary development” of the Barking Owl.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

The Barking Owl is not at “the limit of its known distribution” in the vicinity of the Griffith region or the Riverina IBRA. Found sparsely distributed through temperate and semi-arid regions from Cooktown, Qld, to Flinders Ranges, S. A., extending inland to the Lake Eyre, Bulloo and Murray Darling Basins. The present general distribution of the Barking Owl is as above but local declines or extinctions have been recorded in the Herbert River district, Qld (Young and de Lai 1997) and through much of New South Wales (Debus 1997), Victoria (Silveira 1997) and South Australia (Parker 1988; Higgins 1999) as well as in south-west Australia (Johnstone and Storr 1998). Population in Victoria estimated at 50 pairs (Silveira *et al.* 1997).

Conclusion

Given the lack of visual evidence of the Barking Owl on site, lack of favoured breeding habitat and wide ranging habit of this species it is considered ‘unlikely’ that the proposed development will impose a “significant effect” on the Barking Owl.

Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

This species formerly ranged throughout eastern Australia from South Australia, through Victoria and broadly through New South Wales and central Queensland up into southern New Guinea. It is now extinct in South Australia, coastal Victoria and the ACT. In New South Wales, the Grey-crowned Babbler occurs on the western slopes and plains but is less common at the higher altitudes of the tablelands. Isolated populations are known from coastal woodlands on the North Coast, in the Hunter Valley and from the South Coast near Nowra (Blakers *et al.* 1984, Schodde and Mason 1999). Grey-crowned Babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs and an intact ground cover of grass and forbs. This species is insectivorous, foraging in leaf litter and the bark of trees, and breeds cooperatively in sedentary family groups of 2 – 13 birds, building conspicuous dome-shaped nests (Davidson and Robinson 1992).

The Grey-crowned Babbler has declined in numbers and disappeared from large parts of its range. The species is extinct in the Orange area (Heron 1973) and possibly also from around Bathurst, where A. Fisher (pers.comm.) has made no record of the species in a study of almost 300 sites. Recent surveys (NSW NPWS 2001b) show a decline in the number of family groups that remain in the southern portion of its range, such that approximately five groups remain in Boorowa Shire, less than 10 around Wagga Wagga, and less than 30 groups in the shires of Young, Junee and Harden. A survey of 96 woodland sites in Holbrook Shire revealed only four groups (NSW NPWS 2001b). Further, the species has apparently disappeared from the Shires of Gundagai, Gunning, Yass and Yarrowlumla. Occupying woodlands on fertile soils of plains and undulating terrain, the habitat of this species has been disproportionately cleared for agriculture, including the removal of dead timber. The apparent reluctance of birds to traverse tracts of cleared land exacerbates the isolation of populations. Via stochastic events and the loss of long-term genetic viability, the reduced family groups in small isolated populations are vulnerable to extinction (NSW NPWS 2001b).

This species has been recorded within the Griffith area, with sightings from the Griffith Golf Course, Lake Wyangan area (MFN various dates) and Scenic Hill, part of McPherson Range (GBNEG 2000). Figure 5.3 displays the known records of this species within the subject site and adjacent land during the ERC 2000 and 2002 investigations. This species was frequently recorded within the Bimble Box/White Cypress Pine woodland, White Cypress Pine forest and numerous old growth and mature Bimble Box trees in the road reserve and between the road reserve and land fill area. During the 2000 assessment four nests, two of which were active were recorded for this species in two White Cypress Pine within the Bimble Box/White Cypress woodland. Remnants of babbler nests were recorded during the 2003 assessment within the same area suggesting that the species was not using the subject site for nesting at the time of the assessment. Furthermore, only individual birds or pairs of birds, but no juvenile birds were recorded during the most recent assessment.

The Grey-crowned Babbler lives in groups of between 2 – 13 birds (Davidson and Robinson 1992) and have home ranges varying from 2-53 ha (Blakers *et al.* 1984), which increases with group size. Territory and group size varies accordingly with the quality of habitat (Brown *et al.* 1983). Although it was difficult to differentiate between individuals of this species it is estimated that between 4 – 6 individuals were recorded within the subject site and on adjacent land east of the subject site during the most recent assessment.

The subject site provides “known habitat” for this species in the form of the Bimble Box/White Cypress Pine woodland area, White Cypress Pine forest and scattered remnant Bimble Box trees of the road corridor. The presence of a number of 4 – 6 individuals within the subject site indicates the likely presence of “a viable local

population” of Grey-crowned Babbler within the study area. Individuals were also recorded foraging within Bimble Box/White Cypress Pine on adjacent land along the eastern boundary of the subject site.

The proposed development will remove the majority (approximately 70%) of the “known habitat” of this species within the subject site, including partial removal and modification to known nesting habitat within the subject site. It is considered that the preferred habitat of this species is not well represented within the subject site (i.e. Bimble Box/White Cypress Pine woodland) and that the proposed development is likely to remove and/or modify the majority of this habitat. Known habitat and potential habitat is also well represented on land east of the subject site in the form of Bimble Box/White Cypress Pine woodland, however this land is constantly grazed and at least four hectares of vegetation has been removed from this area within the past two years.

It is likely that the local population of the Grey-crowned Babbler probably relies on the resources of the subject site and adjacent land for its survival. The subject site is an important foraging area providing an intact ground cover of grasses and forbs, which is generally absent from adjacent land because of grazing. The subject site is probably also an important drought refuge area because it is not subject to the pressures of ongoing grazing and clearing unlike adjacent land.

The removal of the majority of “known habitat” within the subject site is ‘likely’ to ‘disrupt’ the “life cycle” of the Grey-crowned Babbler within the study area and a “viable local population” of this species will be “placed at risk of extinction” as a result of the proposed development. However, considering it will be at least another 15 years before a significant portion of vegetation constituting “known habitat” (with the exception of up to 10 scattered remnant Bimble Box between the road corridor and Area 2, and a few mature White Cypress Pine Area 5) is removed or modified it is unlikely that the Grey-crowned Babbler will be adversely effected by the proposed development in the immediate future. Furthermore, the proposed impact amelioration measures (i.e. native vegetation reserve areas and vegetation corridors) will protect areas of “known habitat” and potential habitat within the subject site. If these measures are implemented it is ‘unlikely’ that the “life cycle” of the Grey-crowned Babbler will be “disrupted” by the proposed works, and no “viable local population” of this species will be “placed at risk of extinction” as a result of the proposed development.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no ‘endangered population’ of Grey-crowned Babbler listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations even if individuals of such a population use the study area.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the subject site cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for the Grey-crowned Babbler. The subject site does support “known habitat” and resources for the Grey-crowned Babbler, however given the availability of known habitat in the study area and McPherson Range area and proposed impact amelioration measures the proposed development is unlikely to involve “a significant area of known habitat” for the Grey-crowned Babbler to be “removed or modified”.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

It is 'unlikely' that the activities of the proposed development, including the removal of relevant vegetation will impose a movement barrier to the Grey-crowned Babbler. Considering it will be at least another 15 years before vegetation constituting "known habitat" (with the exception of up to 10 scattered remnant Bimble Box between the road corridor and Area 2) is removed or modified it is unlikely that the Grey-crowned Babbler will be adversely effected by the proposed development in the immediate future. Furthermore, removal of other vegetation within the subject site will take place over a 40-year period. The retention of vegetation within the road reserve, proposed native vegetation reserve areas and vegetation corridors will prevent "an area of known habitat" within the subject site becoming "isolated from current or interconnecting areas of habitat". Native vegetation reserve areas and vegetation corridors will protect areas of interconnecting habitat within the subject site to areas of vegetation on adjacent land. It is therefore considered 'unlikely' that the proposed works will involve any resources or "an area of known habitat" for the Grey-crowned Babbler from becoming "isolated from current or interconnecting areas of habitat".

(e) Whether critical habitat will be affected.

There is currently no declared "critical habitat" in the area likely to be affected by the proposed development as designated under Part 3 of the *TSC Act 1995*. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

No known records of this species occur within "conservation reserves and or similar protected areas" in the locality. It is likely that the Grey-crowned Babbler occurs within conservation reserves from the locality, including Cocoparra National Park, however given the threatened status of this species it is considered 'unlikely' that it is "adequately represented" within "conservation reserves and or similar protected areas" in the locality or region. There is insufficient information to determine if the habitat of the Grey-crowned Babbler is "adequately represented" within these same "conservation reserves and or similar protected areas". Considering that more than 90% of woodland and open woodland vegetation types (i.e. preferred habitat type of this species) has been cleared within New South Wales alone it is 'unlikely' that the habitat of the Grey-crowned Babbler is "adequately represented" within these same "conservation reserves and or similar protected areas".

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Whilst the proposed development is not of a class of development or activity that is recognised as a key threatening process as listed in Schedule 3 of the *TSC Act 1995*, clearing of native vegetation and associated habitats generally is. Clearing of native vegetation is of particular importance as it has been identified as a threatening process to this species. The Grey-crowned Babbler is threatened by clearance and the fragmentation of habitat including removal of dead timber. Grey-crowned Babbler habitat has been disproportionately cleared for agriculture. Isolation of populations in scattered remnants is exacerbated by the apparent reluctance of birds to traverse tracts of cleared land. As reduced family groups, these isolated small populations are vulnerable to extinction via stochastic events and to loss of genetic viability in the long term. Habitat degradation threatens Grey-crowned Babblers, particularly as a result of weed invasion and grazing by stock. In addition, it is likely that increased abundance of competitors, such as Noisy Miners, and nest predators, including the Pied Currawong and Australian Raven (Major *et al.* 1996) threaten Babbler foraging efficiency and breeding success.

It is considered 'unlikely' that the proposed development including removal of native vegetation will "threaten the survival or evolutionary development" of the Grey-crowned Babbler. Considering it will be at least another 15 years

before vegetation constituting “known habitat” (with the exception of up to 10 scattered remnant Bimble Box between the road corridor and Area 2) is removed or modified it is unlikely that the Grey-crowned Babbler will be adversely effected by the proposed development in the immediate future. Also, removal of other vegetation within the subject site will take place over a 40-year period. The proposed impact amelioration measures (i.e. native vegetation reserve areas and vegetation corridors) will protect areas of “known habitat” and potential habitat within the subject site and therefore mitigate any potentially significant impacts of the proposed development upon this species.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

The eastern form of the Grey-crowned Babbler formerly ranged throughout eastern Australia from South Australia, through Victoria and broadly through New South Wales and central Queensland up into southern New Guinea. The Grey-crowned Babbler is now extinct in South Australia, coastal Victoria and the ACT. In NSW, the Grey-crowned Babbler occurs on the western slopes and plains but is less common at the higher altitudes of the tablelands. Isolated populations are known from coastal woodlands on the North Coast, in the Hunter Valley and from the South Coast near Nowra (Blakers *et al.* 1984; Schodde and Mason 1999). This species has been recorded within the Griffith area, with sightings from the Griffith Golf Course, Lake Wyangan area (MFN various dates) and Scenic Hill, part of McPherson Range (GBNEG 2000). It is considered ‘unlikely’ that the Grey-crowned Babbler is at “the limit of its known distribution” within the locality or Riverina/Cobar Peneplain Bioregion.

Conclusion

It is considered ‘unlikely’ that the proposed development will impose a “significant effect” on the Grey-crowned Babbler. The proposed impact amelioration measures (i.e. native vegetation reserve areas and vegetation corridors) will protect areas of ‘known habitat’ and ‘potential habitat’ within the subject site. If these measures are implemented it is ‘unlikely’ that the proposed development will impose a “significant effect” on the Grey-crowned Babbler. Furthermore, known habitat for this species (with the exception of up to 10 scattered remnant Bimble Box between the road corridor and Area 2, and a few mature White Cypress Pine Area 5) will not be removed or modified for at least another 15 years.

Painted Honeyeater (*Grantiella picta*)

a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Sparsely distributed from southern Victoria and south eastern South Australia to far northern Queensland and eastern Northern Territory (Blakers *et al.* 1984; Schodde and Mason, unpubl. manuscript). Greatest concentrations and almost all breeding occurs south of 26°S, on the inland slopes of the Great Dividing Range between the Grampians, Victoria, and Roma, Queensland, (Morris *et al.* 1981; Blakers *et al.* 1984). After April, it migrates to semi-arid regions, including north-eastern South Australia, central and western Queensland and central Northern Territory (Hall 1974; Matheson 1981; Morris *et al.* 1981; Blakers *et al.* 1984; Keast 1985; McNamara 1986; Emison *et al.* 1987). The present range and distribution is mostly as above but no recent records from southern South Australia (Blakers *et al.* 1984) and has declined in abundance in western New South Wales (Maher 1988; Smith *et al.* 1995), central Victoria (Bridley 1991) and probably from north-central Queensland where once relatively common near Cloncurry (McGillivray 1901). In the Western Zone, this species has been recorded along the Warrego, Culgoa and Bogan Rivers, west of Byrock, on the Fletchers Creek Floodplain near Dareton and in Willandra National Park (Brickhill pers comm. n/d).

The Painted Honeyeater lives in dry forests and woodlands. Its primary food is the fruit of mistletoes in the genus *Amyema*, though it will also take some nectar and insects (Eddy 1961; Reid 1986; Oliver *et al.* 1998). The bird helps disperse mistletoe seed, and sometimes all trees in areas where it breeds repeatedly are infected and some die (Reid

1986). Its distribution is dictated by distribution of mistletoes, which are largely restricted to older trees, and the seasonality of their fruiting. However, extent of vegetation is also important, with birds being less likely to be found in strips of remnant woodlands, such as found in roadside vegetation and windbreaks, than in wider blocks (Robinson 1994). In the Western Zone, habitat is mainly along floodplains or drainage lines (Pizzey and Knight 1997; Slater *et al.* 1986). It is locally nomadic and strongly migratory, breeding mainly in the interior south-east and dispersing northward to northern Queensland and the Northern Territory over the winter period (Lindsey 1992). Observed at Round Hill Nature Reserve (N. Kuehn pers.obs) and near Griffith (C. Gladwin pers.obs). Two individuals observed at Cocoparra National Park 25km north east of Griffith (NSW NPWS 1997a) and also at Pulletop Nature Reserve (MFN 1999a, 1999b). Other records although not in conservation reserves or other similar protected areas include the Brobenah Hills (MFN 1999a, 1999b) and Scenic Hill, McPherson Range (GBNEG 2000).

This species was not recorded within the study area despite targeted surveys conducted during the appropriate time of the year. No records exist of this species within the study area. The subject site lacks the specific foraging requirements of this species (i.e. mistletoe). Few mistletoe plants (only three were recorded during the 2002 surveys) were recorded for the entire subject site. Considering the nomadic and migratory nature of the Painted Honeyeater and its dependency on mistletoe, particularly of the genus *Amyema*, it is considered unlikely that this species occurs within the subject site on a permanent basis. It is ‘unlikely’ that the “lifecycle” of the Painted Honeyeater will be “disrupted” by the proposed development even if it did occur within the subject site occasionally and no “viable local population” of this species will be “placed at risk of extinction” as a result of the proposed development. Furthermore, adequate areas of habitat, which could potentially support mistletoe, will be protected as part of the proposed native vegetation reserve areas.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no ‘endangered population’ of the Painted Honeyeater listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations even if individuals of such a population use the subject site.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the study area cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for the Painted Honeyeater. Given lack of specific foraging resources (i.e. mistletoes) available within the subject site, the proposed development is unlikely to involve “a significant area of known habitat” for the Painted Honeyeater to be “removed or modified”. Furthermore, known habitat is represented within McPherson Range (i.e. Scenic Hill) and potential habitat is well represented on land adjacent the subject site.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Although the subject site is fragmented and lacks the specific resources required by the Painted Honeyeater, the vegetation of the site does form part of a corridor connecting McPherson Range and adjacent vegetation. The proposed development will involve the removal and or modification of most of this vegetation, which could consequently affect the connectivity of the range and nearby vegetation. However, it is considered ‘unlikely’ that the

proposed development will involve any resources or “known habitat” of the Painted Honeyeater becoming “isolated from current or interconnecting areas of habitat”. Furthermore, the removal of this vegetation will occur over a 40-year period and involve associated revegetation works. Proposed impact amelioration measures will also ensure that the subject site maintains its current connectivity with McPherson Range and adjacent areas.

(e) Whether critical habitat will be affected.

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the TSC Act 1995. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Observed at Round Hill Nature Reserve (N. Kuehn pers.obs), near Griffith (C. Gladwin pers.obs). Two individuals observed at Cocoparra National Park, 25 km north east of Griffith (NSW NPWS 1997a) and also at Pulletpop Nature Reserve (MFN 1999a, 1999b). Other records although not in conservation reserves or other similar protected areas include the Brobenah Hills (MFN 1999a, 1999b) and Scenic Hill, McPhersons Range (GBNEG 2000). Although this species has been recorded within conservation reserves of the locality (e.g. Cocoparra National Park), there is insufficient information to assess whether the species is “adequately represented in conservation reserves or other similar protected areas in the region”. It is likely that habitat of this species is also represented within conservation reserves, however there is insufficient information to determine if habitat of the Painted Honeyeater is “adequately represented” in the conservation reserves and or similar protected areas of the locality and region.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

The proposed development is not of a class of development or activity that is recognised as a threatening process as listed in Schedule 3 of the TSC Act 1995, however clearing of native vegetation and associated habitats generally is. Much of the woodland used by the Painted Honeyeater during the breeding season has been cleared altogether or has been reduced to ageing, widely-spaced trees (Robinson 1994). Considering that the subject site lacks the specific habitat requirements for this species, the activities of the proposed development including the removal of native vegetation will not “threaten the survival or evolutionary development” of the Painted Honeyeater. Furthermore, suitable habitat is well represented within the general area of the subject site (i.e. McPherson Range and adjacent land).

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

Sparsely distributed from southern Victoria and south eastern South Australia to far northern Queensland and eastern Northern Territory (Blaker's *et al.* 1984; Schodde and Mason, unpubl. manuscript). Greatest concentrations and almost all breeding occurs south of 26°S, on the inland slopes of the Great Dividing Range between the Grampians, Victoria, and Roma, Queensland, (Morris *et al.* 1981; Blakers *et al.* 1984). After April, it migrates to semi-arid regions, including north eastern South Australia, central and western Queensland and central Northern Territory (Hall 1974; Matheson 1981; Morris *et al.* 1981; Blakers *et al.* 1984; Keast 1985; McNamara 1986; Emison *et al.* 1987). The present range and distribution is mostly as above but no recent records from southern South Australia (Blakers *et al.* 1984) and has declined in abundance in western New South Wales (Maher 1988; Smith *et al.* 1995), central Victoria (Bridley 1991) and probably from north-central Queensland where once relatively common near Cloncurry (McGillivray 1901). In the Western Zone, this species has been recorded along the Warrego, Culgoa and Bogan Rivers, west of Byrock, on the Fletchers Creek Floodplain near Dareton and in Willandra National Park (Brickhill pers comm. n/d). It is therefore considered that the painted Honeyeater is not at “the limit of its known distribution” in the locality or Riverina/Cobar Peneplain Bioregion.

Conclusion

Given the lack of specific foraging resources within the subject site, nomadic and highly migratory nature of the Painted Honeyeater it is considered 'unlikely' that the proposed development will impose a "significant effect" on the Painted Honeyeater. Furthermore, suitable resources are well represented within the general area of the subject site (i.e. McPherson Range and adjacent land).

Threatened Microchiropteran Bat Species

Greater Long-eared Bat (*Nyctophilus timoriensis*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

This species has a very extensive distribution, however it is now recognised to be more than one species, and is currently under taxonomic revision (Dickman *et al.* 1993). The eastern subspecies is probably a distinct species with about half of its range in the southern and eastern parts of the Western Zone. Preferred habitat of the Greater Long-eared Bat is River Red Gum forest, semi-arid woodlands and savannahs. It also occurs in box/ironbark/*Callitris* open forests and Buloke woodland in northern New South Wales and inland south-east Queensland. In South Australia, it is confined to tall mallee shrublands north of the Murray River and is known to roost in hollows in *Eucalyptus gracilis*. Victorian records are from *E. gracilis* mallee, Buloke and Black Box woodlands (Churchill 1998; Strahan 1995; Lumsden 1994). It roosts in tree hollows, fissures in branches and under loose bark (Churchill 1998; Strahan 1995). In Tasmania, they eat mainly non-flying prey: caterpillars, scorpions and moths, most likely captured by gleaning in the understorey. In the Banksia woodlands of Western Australia, their diet consists predominantly of beetles. They are thought to spend part of their time foraging on the ground as they have been captured in pitfall traps (Churchill 1998).

The subject site provides potential habitat for the Greater Long-eared Bat. The Bimble Box/*Callitris* woodland offers potential feeding in and around the canopy and on the ground. Potential roosting and breeding opportunities in tree hollows, fissures in branches and under loose bark are also offered. Potential habitat offered by the subject site is more than adequately represented within the locality, especially the Bimble Box/White Cypress Pine woodland to the east. Given the extent of suitable habitat and key resources within the locality and the proposed impact amelioration measures which will ensure that the potential habitat within the subject site is protected it is considered unlikely that if the Greater Long-eared Bat would rely exclusively on the resources of the subject site. It is 'unlikely' that the "life cycle" of the Greater Long-eared Bat will be "disrupted" by the proposed development, and no "viable local population" of this species will be "placed at risk of extinction" as a result of the proposed development.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no 'endangered population' of the Greater Long-eared Bat listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed works can be regarded to involve any such populations even if individuals of such a population use the subject site.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the study area cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for the Greater Long-eared Bat. The subject site does not support “known habitat” and resources for the Greater Long-eared Bat. Given the mobile nature of microchiropteran bat species, availability of resources in the locality and proposed impact amelioration measures the proposed development is unlikely to involve “a significant area of known habitat” for the Greater Long-eared Bat to be “removed or modified”.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

It is unlikely that the activities of the proposed development, including the removal of vegetation will impose a movement barrier to the Greater Long-eared Bat. Furthermore appropriate measures have been undertaken to ensure that the subject site maintains its current connectivity with McPherson Range, involving the protection of designated areas of existing native vegetation and the implementation of effective vegetation corridors in order to facilitate the movement of native fauna. It is therefore considered ‘unlikely’ that the proposed development will involve any resources or potential habitat for the Greater Long-eared Bat becoming “isolated from current or interconnecting areas of habitat”.

(e) Whether critical habitat will be affected.

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the TSC Act 1995. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

Conservation reserves in which the Greater Long-eared Bat occurs within New South Wales include Goulburn River National Park, Monabulai Nature Reserve, Yathong Nature Reserve Budigower Nature Reserve, Woggon Nature Reserve, Mungo National Park, Cocoparra National Park where four individuals were observed (NSW NPWS 1997a), Ben Halls Gap National Park, Pilliga Nature Reserve, Goobang National Park, Warrumbungle National Park and The Rock Nature Reserve. Other public land in New South Wales on which the species occurs includes Crown Land near Ulan, Binya State Forest, Benambra State Forest, Warraderry State Forest, Leard State Forest. Although the Greater Long-eared Bat occurs within conservation reserves from the region (e.g. Cocoparra National Park) it is considered ‘unlikely’ that this species is “adequately represented” within “conservation reserves and or similar protected areas” in the locality or region. There is insufficient information to determine if this species is “adequately represented” within these “conservation reserves and or similar protected areas”. The subject site does not form part of any conservation reserve or similar protected area and is therefore of no relevance in this regard.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Whilst the proposed development is not of a class of development or activity that is recognised as a key threatening process as listed in Schedule 3 of the TSC Act 1995, clearing of native vegetation and associated habitats generally is. Extensive loss of habitat is the main reason for the decline of the Greater Long-eared Bat. Clearing for agriculture and, in the remaining uncleared areas, timber harvesting, grazing and altered fire regimes are suspected threats. In New South Wales 75% of the eastern part of the species range has been cleared (Duncan *et al.* 1999). Considering the small extent of the existing relevant vegetation to be removed and or modified, the 40 year period it will take to remove this vegetation and availability of potential habitat existing off site, it is unlikely that the activities of the

proposed development including the removal of native vegetation from the study site will “threaten the survival or evolutionary development” of the Greater Long-eared Bat.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

It is considered unlikely that the Greater Long-eared Bat is at “the limit of its known distribution” within the study area, locality or Riverina/Cobar Penneplain Bioregion. This species is distributed across southern mainland Australia, generally associated with the semi-arid environment (Churchill 1998), but as this taxon has recently been shown to be comprised of three species with allopatric distributions, the former distribution is therefore unclear. The biology and taxonomy of this bat remains poorly understood (Churchill 1998). Known current distribution is from southern central Queensland, central western New South Wales, north western Victoria and South Australia. There are only four records of this species from Victoria, all from the north-west of the state (Lumsden 1994). There have been no records from central western Victoria since 1888 (a single specimen). In South Australia, records are confined to north of the Murray River, east of Canegrass Station and south of the Barrier Highway, but the northern range limit in this state remains unclear.

Fishing Bat (*Myotis macropus*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Fishing Bat or Large-footed Myotis was recorded as ‘probable’ as a result of the anabat analysis on during the most recent ERC assessment. Colonies of the Fishing Bat are found close to permanent water bodies in riparian and coastal forest habitats. Colonies of several hundred are known but more commonly they roost in groups of 10 to 15 (Churchill 1998; Strahan 1995). This species is a common cave dweller but is also known to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains. Roosts are usually selected close to water. This species will live in most habitat types as long as they are near water. They have been caught in mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland (Churchill 1998; Strahan 1995). The Fishing Bat most commonly forage over water, feeding on insects and small fish they catch by raking their long feet across the surface of the water. They are also aerial foragers, with prey items including terrestrial and aquatic insects (Churchill 1998).

Although the Fishing Bat was recorded tentatively within the subject site during this assessment no other records exist for this species within the study area or locality and no preferred habitat for this species (i.e. freshwater surfaces) occurs within the subject site. It is likely that this species is using the site as part of its overall foraging area and probably in response to the drought conditions which may have reduced the availability of preferred foraging habitat. The Bimble Box, Dwyer’s Mallee Gum woodland areas and mixed open forest provide feeding, roosting and breeding opportunities. The White Cypress Pine forest also provides abundant foraging area. Although preferred roosting habitat (i.e. roosts close to water) for this species was not recorded, the subject site could be considered an important drought refuge area for this species and other species of microchiropteran bat.

Considering the extent of relevant vegetation to be removed, rate of removal and proposed native vegetation reserve areas it is considered unlikely that a significant portion of any habitat or resources of the Fishing Bat will be removed or modified. Given the highly mobile nature of this species, the extent of suitable habitat and key resources within the general area (i.e. Lake Wyangan area and McPherson Range), it is considered ‘unlikely’ that individuals comprising a “viable local population” of the Fishing Bat are confined to the subject site. It is therefore considered ‘unlikely’ that the “life cycle” of the Fishing Bat will be “disrupted” by the proposed works, and no “viable local population” of this species will be “placed at risk of extinction” as a result of the proposed works.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no 'endangered population' of the Fishing Bat listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed works can be regarded to involve any such populations even if individuals of such a population use the study area.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the study area cannot be construed as comprising "a significant area of known habitat" in respect of the "regional distribution of habitat" for the Fishing Bat. The subject site does support "known habitat" and resources for the Fishing Bat, however given the mobile nature of microchiropteran bat species, availability of resources in the locality and proposed impact amelioration measures the proposed development is unlikely to involve "a significant area of known habitat" for the Fishing Bat to be "removed or modified".

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Microchiropteran bats are highly mobile and wide-ranging, and generally non-reliant on continuous tracts of forest and woodland for movement. It is 'unlikely' that the activities of the proposed development, including the removal of relevant vegetation will impose a movement barrier to the Fishing Bat. Furthermore, no preferred habitat for this species will be affected by the proposed development. The proposed native vegetation reserve areas and vegetation corridors will ensure that the subject site maintains its current connectivity with adjoining land and McPherson Range. It is therefore considered 'unlikely' that the proposed works will involve any resources or "an area of known habitat" for the Fishing Bat becoming "isolated from current or interconnecting areas of habitat".

(e) Whether critical habitat will be affected.

There is currently no declared "critical habitat" in the area likely to be affected by the proposed development as designated under Part 3 of the *TSC Act 1995*. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

No known records of this species occur within "conservation reserves and or similar protected areas" in the locality. Although it is likely that the Fishing Bat occurs within conservation reserves from the region it is considered 'unlikely' that the Fishing Bat is "adequately represented" within "conservation reserves and or similar protected areas" in the locality or region. There is insufficient information to determine if the Fishing Bat is "adequately represented" within these "conservation reserves and or similar protected areas". The subject site does not form part of any conservation reserve or similar protected area and is therefore of no relevance in this regard.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

Whilst the proposed works is not of a class of development or activity that is recognised as a threatening process as listed in Schedule 3 of the *TSC Act 1995*, clearing of native vegetation and associated habitats generally is. Current threats to the Fishing Bat identified in the Action Plan for Australian Bats (Duncan *et al.* 1999) include: susceptibility to changes in water quality as a result of vegetation clearing and logging (sedimentation), sewage and fertilizer run-off (eutrophication), pesticide/herbicide leakage (chemical pollution) and altered flow regimes (changes to river ecology). Where populations concentrate in roosts that are susceptible to disturbance, human activities such as recreational use of caves and removal of old wooden bridges would also be a threat (Duncan *et al.* 1999). Given that no preferred habitat for this species was recorded within the study area and none of the above threats are relevant to the proposed development it is considered “unlikely” that if the proposed development will “threaten the survival or evolutionary development” of the Fishing Bat. Furthermore, known foraging and potential habitat within the subject site will be protected by the proposed impact amelioration measures.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

It is considered unlikely that the Fishing Bat is at “the limit of its known distribution” within the study area, locality or Riverina/Cobar Penepain Bioregion. The Fishing Bat is primarily a coastal species and range from the Kimberley to Victoria and South Australia. They occur farther inland along major rivers, such as the Murray River in south-eastern Australia and the Fitzroy River in the Kimberley (Churchill 1998). This species will live in most habitat types as long as they are near water. They have been caught in mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland (Churchill 1998; Strahan 1995).

Little Pied Bat (*Chalinolobus picatus*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Little Pied Bat was identified as ‘possible’ as a result of anabat analysis during the most recent ERC assessment. Originally thought to be an obligate cave-dwelling species and therefore thought rare due to the scattered and infrequent occurrence of suitable roosting and maternity sites across its range, colonies are now known from tree hollows and disused buildings (Duncan *et al.* 1999). In caves and mines, they occur in small colonies of fewer than 10 individuals. A colony of 38 males and females was recorded in an abandoned house (Churchill 1998). This species occurs most frequently in dry, open woodland communities throughout its range, but also has been recorded in dry sclerophyll forests, chenopod shrublands, Callitris forest, mallee (Churchill 1998; Duncan *et al.* 1999) and vine forests (Duncan *et al.* 1999). In the more arid parts of its range in New South Wales it has been recorded from Mulga woodlands, patches of Black Box Woodlands and riverine River Red Gum dominated communities. Surveys have indicated that in arid and semi-arid environments the species may be locally common near permanent or semi-permanent water (Duncan *et al.* 1999).

The subject site does support suitable habitat and resources for the Little Pied Bat and other microchiropteran bat species. The Bimble Box, Dwyer’s Mallee Gum woodland areas and mixed open forest provide foraging, roosting and breeding opportunities. Ten species of bat including the Little Pied Bat were recorded during the most recent ERC survey. Individual bats were frequently observed whilst conducting spotlighting surveys of the subject site. All species of microchiropteran bat recorded during this assessment rely upon tree hollows, fissures in branches or trunks or loose bark for roosting and breeding resources, which are generally only offered by mature and remnant trees and/or stag trees of the subject site.

Considering the extent of relevant vegetation to be removed, rate of removal and proposed native vegetation reserve areas it is considered “unlikely” that a significant portion of any habitat or resources of any species of microchiropteran bat will be “removed or modified”. Furthermore, the Little Pied Bat is an adaptable species, being able to use a variety of resources for its roosting requirements (i.e. colonies are now known from tree hollows and

disused buildings). Given the highly mobile nature of most microchiropteran bat species and the extent of suitable habitat within the subject site and surrounding areas it is considered ‘unlikely’ that individuals comprising a “viable local population” of the Little Pied Bat are confined to the subject site. It is therefore considered ‘unlikely’ that the “life cycle” of the Little Pied Bat will be “disrupted” by the proposed works, and no “viable local population” of this species will be “placed at risk of extinction” as a result of the proposed works.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no ‘endangered population’ of Little Pied Bat listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations even if individuals of such a population use the study area.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The reference of regional within this factor refers to the regions as defined in the Interim Biogeographical Regionalisation of Australia (IBRA). The *TSC Act 1995* defines “region” as “a bioregion defined in a national system of bioregionalisation that is determined by the Director-General under subsection (4) to be appropriate for those purposes”. If the bioregion occurs partly within and partly outside New South Wales, the region consists only of so much of the bioregion as occurs within New South Wales. The IBRA has been published by Environment Australia.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the north of Hay. On this basis, the study area cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for the Little Pied Bat. The subject site does support “known habitat” and resources for the Little Pied Bat, however given the mobile nature of microchiropteran bat species, availability of resources in the locality and proposed impact amelioration measures the proposed development is unlikely to involve “a significant area of known habitat” for the Little Pied Bat to be “removed or modified”.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community.

Microchiropteran bats are highly mobile and wide-ranging, and generally non-reliant on continuous tracts of forest and woodland for movement. It is ‘unlikely’ that the activities of the proposed development, including the removal of relevant vegetation will impose a movement barrier to the Little Pied Bat. Furthermore, the proposed native vegetation reserve areas and vegetation corridors will ensure that the subject site maintains its current connectivity with adjoining land and McPherson Range. It is therefore considered ‘unlikely’ that the proposed works will involve any resources or “an area of known habitat” for the Little Pied Bat becoming “isolated from current or interconnecting areas of habitat”.

(e) Whether critical habitat will be affected.

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the *TSC Act 1995*. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region.

No known records of this species occur within “conservation reserves and or similar protected areas” in the locality. Although it is likely that the Little Pied Bat occurs within conservation reserves from the region it is considered ‘unlikely’ that the Little Pied Bat or any other threatened microchiropteran bat species are “adequately represented” within “conservation reserves and or similar protected areas” in the locality or region. There is insufficient information to determine if the Little Pied Bat is “adequately represented” within these “conservation reserves and or similar protected areas”. The subject site does not form part of any conservation reserve or similar protected area and is therefore of no relevance in this regard.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

The *TSC Act 1995* defines a “threatening process” as a “process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”. Schedule 3 of the *TSC Act 1995* provides a list of key threatening processes. Under “Section 110 Matters which have been limited or modified” of The Director-General’s Requirements “no key threatening processes have been listed which are likely to be relevant to this proposal”.

Whilst the proposed development is not of a class of development or activity that is recognised as a key threatening process as listed in Schedule 3 of the *TSC Act 1995*, clearing of native vegetation and associated habitats generally is. Current threats to the Little Pied Bat include: loss of habitat in timber production forests and as a result of large scale clearing for agriculture and in uncleared areas, timber harvesting, grazing and altered fire regimes (Duncan *et al.* 1999). Clearing of native vegetation is of particular importance as it has been identified as a threatening process to this species. Given the extent of relevant vegetation to be removed, the 40-year period it will take to remove this vegetation and the proposed impact amelioration measures (i.e. native vegetation reserve areas and revegetation works) it is considered ‘unlikely’ that the proposed development including removal of native vegetation will “threaten the survival or evolutionary development” of the Little Pied Bat.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

It is considered unlikely that the Little Pied Bat is at “the limit of its known distribution” within the study area, locality or region. The Little Pied Bat ranges from coastal and south eastern Queensland, extending across south-western Queensland, western New South Wales and far north eastern South Australia. Despite having largely an inland distribution (Duncan *et al.* 1999), and most records being west of the Great Dividing Range (Churchill 1998) there are a number of records from south eastern Queensland within 50 km of the coast. No evidence exists that the range of this species has contracted (Duncan *et al.* 1999).

Inland Forest Bat (*Vespadelus baverstocki*)

(a) In the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

The Inland Forest Bat was identified from harp trapping conducted as part of targeted surveys for this species and other threatened microchiropteran bat species during the most recent ERC assessment. Widely distributed in inland arid and semi-arid parts of Australia (Churchill 1998), this species inhabits *Acacia*, *Callitris* and *Casuarina* woodlands, mallee, open eucalypt woodland, River Red Gum woodland, shrub and grassland communities across its range (Churchill 1998; Strahan 1995). Inland Forest Bats roost in tree hollows and abandoned buildings. Much of their distribution is in areas where large trees are absent. In adaptation they can roost in extremely small tree hollows

in stunted trees only a few metres high (Churchill 1998; Strahan 1995). This species usually forages over a wide area (Strahan 1995).

This species was captured at all harp trap sites with the exception of the Bimble Box/White Cypress Pine woodland site where overall bat species diversity and abundance was at its lowest. This is most likely due to the lack of clearly defined fly ways/corridors to place the harp trap, which is a reflection of the relatively open structure of this vegetation type. Ten species of bat including the threatened Little Pied Bat and Fishing Bat were recorded during the most recent ERC survey. The Inland Forest Bat represented only 5 individuals (5%) of the 95 bats captured during harp trapping. The majority of bats captured were Little Forest Bat (38 individuals or 40%) followed by *Mormopterus planiceps* (long penis form) (25 individuals or 26%).

The subject site therefore provides “known habitat” for this species. Because of the adaptability of this species to roost in extremely small hollows, nearly all vegetation types of the subject site could provide roosting habitat for this species. However, it is likely that larger, hollow-bearing trees provide more suitable roosting and particularly breeding sites. These trees can be found scattered throughout the subject site but are largely concentrated in the woodland areas and the mixed open forest vegetation, particularly mature and old-growth Bimble Box and Dwyer’s Mallee Gum.

The presence of a number of individuals within the subject site indicates the likely presence of “a viable local population” of the Inland Forest Bat within the locality. However, it is unlikely that any such populations of the Inland Forest Bat would be dependent on or reliant exclusively on the resources to be affected by the proposed development. Considering the extent of relevant vegetation to be removed (<40 ha) and rate of removal over a 40-year period it is considered unlikely that a significant portion of any habitat or resources of the Inland Forest Bat will be removed. Also, the Inland Forest Bat is an adaptable species, being able to roost in very small hollows, and is highly mobile and therefore likely to forage and roost in vegetation of the surrounding landscape. It is therefore considered ‘unlikely’ that the “life cycle” of the Inland Forest Bat will be “disrupted” by the proposed works, and no “viable local population” of this species will be “placed at risk of extinction” as a result of the proposed works. Furthermore, proposed impact amelioration measures will protect key resources for this species in the form of native vegetation reserve areas.

(b) In the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised.

There is no ‘endangered population’ of Inland Forest Bat listed under Part 2 of Schedule 1 of the *TSC Act 1995*. No evidence exists for the presence of an endangered population occurring within the study area. Consequently, there is no likelihood that the proposed development can be regarded to involve any such populations even if individuals of such a population use the study area.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed.

The reference of regional within this factor refers to the regions as defined in the Interim Biogeographical Regionalisation of Australia (IBRA). The *TSC Act 1995* defines “region” as “a bioregion defined in a national system of bioregionalisation that is determined by the Director-General under subsection (4) to be appropriate for those purposes”. If the bioregion occurs partly within and partly outside New South Wales, the region consists only of so much of the bioregion as occurs within New South Wales. The IBRA has been published by Environment Australia.

Following the IBRA, the subject site located at Tharbogang occurs within the Riverina IBRA and Cobar Peneplain IBRA (see Section 2.3). The Riverina IBRA alone covers an area greater than 69,000 km within New South Wales, including most of the Murrumbidgee Irrigation Area, stretching from the Murray River in the south through to the

north of Hay. On this basis, the study area cannot be construed as comprising “a significant area of known habitat” in respect of the “regional distribution of habitat” for the Inland Forest Bat. The subject site does support “known habitat” and resources for the Inland Forest Bat, however given the mobile nature this species, availability of resources in the locality and proposed impact amelioration measures the proposed development is unlikely to involve “a significant area of known habitat” for the Inland Forest Bat to be “removed or modified”.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

It is ‘unlikely’ that the activities of the proposed development, including the removal of relevant vegetation will impose a movement barrier to the Inland Forest Bat. Microchiropteran bats are highly mobile and wide-ranging, and generally non-reliant on continuous tracts of forest and woodland for movement. Furthermore, the proposed native vegetation reserve areas and vegetation corridors will ensure that the subject site maintains its current connectivity with adjoining land and McPherson Range. It is therefore considered ‘unlikely’ that the proposed works will involve any resources or “an area of known habitat” for the Inland Forest Bat becoming “isolated from current or interconnecting areas of habitat”.

(e) Whether critical habitat will be affected

There is currently no declared “critical habitat” in the area likely to be affected by the proposed development as designated under Part 3 of the TSC Act 1995. No area of declared critical habitat is relevant to this proposed development.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

No known records of this species occur within “conservation reserves and or similar protected areas” in the locality. Although it is likely that the Inland Forest Bat occurs within conservation reserves from the region, given the threatened status and mobile, wide-ranging habits it is considered ‘unlikely’ that this species is “adequately represented” within “conservation reserves and or similar protected areas” in the locality or region. There is insufficient information to determine if the habitat of the Inland Forest Bat is “adequately represented” within these same “conservation reserves and or similar protected areas”. The subject site does not form part of any conservation reserve or similar protected area and is therefore of no relevance in this regard.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process.

The *TSC Act 1995* defines a “threatening process” as a “process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities”. Schedule 3 of the *TSC Act 1995* provides a list of key threatening processes. Under “Section 110 Matters which have been limited or modified” of The Director-General’s Requirements “no key threatening processes have been listed which are likely to be relevant to this proposal”.

Whilst the proposed development is not of a class of development or activity that is recognised as a key threatening process as listed in Schedule 3 of the *TSC Act 1995*, clearing of native vegetation and associated habitats generally is. Clearing of native vegetation is of particular importance as it has been identified as a threatening process to this species. Current threats to the Inland Forest Bat includes the clearing of old trees, which eliminates roosting sites and predation by feral cats at roost sites, which may affect local abundance (NPWS 1996). Given the extent of relevant vegetation to be removed, the rate of removal and the proposed impact amelioration measures (i.e. native vegetation reserve areas and revegetation works) it is considered ‘unlikely’ that the proposed development including removal of native vegetation will “threaten the survival or evolutionary development” of the Inland Forest Bat.

Furthermore, it is unlikely that the Inland Forest Bat is dependent on or reliant exclusively on the resources to be affected by the proposed development and it is likely to forage and roost in vegetation of the surrounding landscape.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution.

Widely distributed in inland arid and semi-arid parts of Australia (Churchill 1998). This species is present throughout most of South Australia, north-western Victoria, southern Northern Territory and western New South Wales (Richards 1995b; Cole and Gibson pers comm. n/d). This species inhabits *Acacia*, *Callitris* and *Casuarina* woodlands, mallee, open eucalypt woodland, River Red Gum woodland, shrub and grassland communities across its range (Churchill 1998; Strahan 1995). It could be considered likely that this species is at the south-eastern limit of its range within the Griffith area. However given the mobile, widely-ranging habits of this species and widespread distribution within the arid and semi-arid regions it is considered ‘unlikely’ that the inland Forest Bat is at “the limit of its known distribution” within the locality or region.

Conclusion

The proposed development involves the removal and/or modification of native vegetation, which supports known and potential roosting, breeding and foraging resources of at least three threatened microchiropteran bat species. Given the small extent and rate of removal of the known and potential resources, and availability of suitable habitat within the study area and McPherson Range it is ‘unlikely’ that the proposed development will impose a “significant effect” on any threatened microchiropteran bat species known from the subject site or that may use the subject site as part of their overall habitat. It is also ‘unlikely’ that any microchiropteran bat is at “the limit of its known distribution” within the locality or region of the subject site. Furthermore, the proposed impact amelioration measures will protect known and potential habitats of all microchiropteran bats species within the subject site.

APPENDIX M.

ANABAT ANALYSIS RESULTS

APPENDIX N

FOX BAITING PROGRAM

1. Introduction

Predation by the European Red Fox (*Vulpes vulpes*) is listed as a key threatening process under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Threatened Species Conservation Act 1995*, with threat abatement plans prepared under guidelines set by each Act (Environment Australia 1999; NSW NPWS 2001a).

1.1 Objectives of the program:

- § Formulate and implement a 3-year fox management program;
- § Monitor the program to ensure an effective evaluation of the control activities can be undertaken during the implementation of the plan; and
- § Re-evaluate the success of the plan after 3-years and adapt future control programs according to the evaluation of the current program.

2. Baiting methods

The most commonly used method of fox baiting over relatively small areas involves the use of bait stations. It is considered unnecessary to employ additional control methods at the subject site based upon the constraints of baiting over a relatively small area and the risk and/or restriction of non-target species. The method of shooting individuals may be adopted if considered appropriate according to the results provided by the monitoring of bait stations.

2.1 Assessment of control methods

Control method	Activity detail	Advantages	Constraints
Bait stations	Earth mound buried poison baits 15 cm depth	§ Opportunity to free-bait; § Target takes visible (easily measurable); § Minimal non-target risk; § Bait stations visible in field.	§ Labour intensive and time consuming to establish and maintain; § Bait shy individuals of target species.
Trail baiting	Poison baits laid along trails (buried/unburied)	§ Cost effective (cover relatively large areas).	§ Risk to non-target species; § Target takes unknown; § Bait shy individuals of target species.
Trapping	Softjaw traps	§ Target specific; § Site specific; § Minimal risk to non-target species.	§ Expensive; § Specialist skills required.
Fencing	Barrier fencing	§ Exclude fox impacts on subject site.	§ Expense of erection and maintenance; § Restricts movement of non-target species; § Only controls fox predation at subject site (not study area).
Shooting	Firearms used to shoot individual target species	§ Target specific.	§ Not effective as primary control; § Very opportunistic.

3. Control program

- § Identify native species (particularly subject species) that may be at risk from the baiting program and investigate control techniques that limit possible impact upon these species;
- § Establish a system of monitoring the sites to allow effective evaluation of the program;
- § Establish, mark and map bait stations in the field;
- § Monitor bait stations for a 4-6 week 'free-baiting' monitoring program;
- § Advertise 1080 notifications in local press, erect 1080 signs in the field, and notify all neighboring land-holders of baiting activities; and
- § Commence baiting.

3.1 Identification of native species (non-target species) that may be at risk

- § From survey results and subject species profiles.

3.2 Establish system to monitor program

- § Sand traps placed around bait stations;
- § Target species and non-target species activity at bait stations recorded through identification of scats and tracks recorded during bait replacement.
- § Baiting to be suspended if non-target species present.
- § Review of bait stations if classed 'inactive' (no target species for 3 months). Options include temporary shut down of bait station, removal of bait station or return to free baiting.

3.3 Establish, mark and map bait stations

- § Establish free-baiting stations for the determination of the location of poison bait stations according to target species activity.
- § Mark location of bait stations (free-bait and poison) on site (flagging tape, star pickets, etc).
- § Map the locations of bait stations (free-bait and poison) and known 'active' fox dens on map of subject site.

3.4 Free baiting monitoring program

- § Establish a number of free-baiting stations throughout subject site. This will include small earth mounds surrounded by sand traps to facilitate identification of areas of high target and non-target species activity.
- § Prepare and bury free-baits (no poison) within earth mounds to a depth of approximately 10-15 cm.
- § Record all activity (target and non-target species) at free-bait stations on a weekly basis for a period of 4-6 weeks.
- § Determine the location of poison bait stations according to the areas of highest target species activity (and lowest non-target species activity) recorded during free-baiting period.

3.5 Notification of baiting program

- § Advertise baiting notification in local press.
- § Erect 'notification of baiting' signs appropriately throughout subject site (including entrance to site, roadside, landfill and quarry site, speedway entrance, and border fences surrounding subject site).

3.6 Baiting program

- § Bury poison baits 10-15 cm within establish earth mounds.
- § Under the Off-label Permit for the Use of 1080 Baits for the Control of Foxes, bait stations cannot be placed less than 100 m apart.
- § Check/replace bait stations weekly to increase the exposure of foxes to baits. Checking baits regularly will also provide a coarse measure of target species activity (bait uptake rates).
- § Bait type should be varied occasionally in the expectation of individual foxes showing aversion to specific bait types. The Off-label Permit for the Use of 1080 Baits for Control of Foxes lists the bait materials that may be used with 1080 poison.
- § Record activity of target and non-target species at bait stations (and sand traps) on prepared field data sheets.

As the nature of the subject site (landfill) will continually provide a resource/food base for the target species, the baiting program should also be maintained continually. After 3-6 months, it may be necessary to re-establish the free-baiting program at each of the initial free-bait stations to determine changes to the areas of high target species activity within the subject site. If target species activity at free-bait stations is higher than at those stations used during the most recent poison baiting program, location of the poison bait stations should be changed accordingly.

APPENDIX O. TEAM RESUMES

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EDUCATION and QUALIFICATIONS

2002 **Sole Owner of Ettamogah Research Consultants (ERC)** Specialising in Flora and Fauna Survey, and Assessment (established 1999).

Bachelor of Applied Science (Honours) to be completed May 2004

2001 Certificate in GPS/GIS LINKS
Riverina Institute of TAFE
Thurgoona Campus NSW

1999 Certificate IV in Small Business Management
NEIS – National Training Register

1998 TAFE Rural Practice Certificate
Riverina Institute of TAFE
Thurgoona Campus NSW

Senior First Aid Certificate, Red Cross No: 82998 valid for 4 years.

1998 **Bachelor of Applied Science (Parks, Recreation and Heritage)**

Major: Ecosystem Management

Minor: Sustainable Tourism

Charles Sturt University Thurgoona Campus NSW

Major Subject Areas:

- Vegetation Ecology
- Vegetation Management
- Wildlife Ecology
- Wildlife Management
- Catchment Management
- Natural Resources Management

NSW Rural Fire Service, Certificate of Proficiency - Basic Fire Fighter.

PLACEMENTS AND PROJECTS

1998

- § *Research Assistant* - White-footed Dunnart and other small mammal surveys of Eurobodalla National Park and surrounding State Forests as part of an honours project for The Johnstone Centre, Charles Sturt University.
- § *Research Assistant* - Microchiroptera Bat Surveys of the Burrumbuttock region in N.S.W for The Johnstone Centre, Charles Sturt University.

- § *Research Assistant* - Foredune Vegetation Surveys of Myall Lakes National Park as part of an honours project for The Johnstone Centre, Charles Sturt University.
 - § *Field Researcher* - Riparian Vegetation Assessment of proposed Regional Parklands site at Thurgoona for Charles Sturt University.
- 1997**
- § *Research Assistant* - **Little Penguin and Seabird Study** on Montague Island National Park as part of an honours project for The Johnstone Centre, Charles Sturt University.
 - § *Field Researcher* - **Fauna Survey and Assessment** of Eurobodalla National Park for NSW NPWS on behalf of The Johnstone Centre, Charles Sturt University.
- 1996**
- § *Field Officer* - **NSW National Parks and Wildlife Service**. Kosciuszko National Park, Khancoban.
- 1992**
- § *Field Officer* - **NSW National Parks and Wildlife Service**. Kosciuszko National Park, Khancoban.

EMPLOYMENT HISTORY

2002 and 2001

- § *Terrestrial Ecologist SMEC Victoria (Snowy Mountain Engineering Corporation)* - Ettamogah Research Consultants (ERC) is currently contracted by SMEC Victoria to conduct flora and fauna assessments and advise on other environmental needs on a project basis.
- § *Terrestrial Ecologist/ Planning Advisor (SMEC)* - **Bethanga Bridge Planning Process** (current) of proposed upgrade to Bethanga Bridge for SMEC Victoria on behalf of the Murray Darling Basin Commission.
- § *Terrestrial Ecologist/Project Assistant (SMEC)* - **Glenelg-Hopkins Biodiversity Monitoring Strategy** (current) involving benchmarking existing biodiversity monitoring programs and strategies for SMEC Victoria.
- § *Project Officer (ERC)* **Flora and Fauna Assessment** (current) of proposed development options for Packards Quarry via Tumut, as part of an EIS in association with Habitat Planning for Tumut Council.
- § *Project Officer (ERC)* – **Threatened Species Survey: Squirrel Glider Surveys** (ongoing) of private land and TSR's in the Burrumbuttock Region in association with Charles Sturt University.
- § *Project Officer (ERC)* - **Full Fauna Survey** of Private Property, Jindera Gap at Albury (ongoing).
- § *Project Officer (ERC)* - **Full Fauna Surveys** of Upper Billabong Catchment for Holbrook Landcare (October 2001 – July 2002).
- § *Terrestrial Ecologist (SMEC)* – **Reference of Environmental Factors (REF) Assessments** of existing Transgrid powerlines for SMEC Australia on behalf of Transgrid, Wollongong – Dapto region (April – June 2002).
- § *Terrestrial Ecologist (SMEC)* - **Flora and Fauna Assessment** of Tocumwal Levee Upgrade for SMEC Victoria as part of a supplementary EIA for Berrigan Shire Council (May 2002).
- § *Project Officer (ERC)* - **Threatened Species Survey of vertebrate fauna** at Rutherglen Institute Farm for Jirakee Flora and Fauna (May 2002).
- § *Project Officer (ERC)* - **Avifauna Surveys** of isolated Eucalyptus remnants in native hardwood plantation (as part ongoing study of biodiversity in Eucalyptus plantations on private farmland) in the north-east Victoria region in association with Natural Resources and Environment and Charles Sturt University (December 2000 and November 2001).
- § *Terrestrial Ecologist (SMEC)* - **REF Assessment** of proposed Orange Telecommunications Tower for SMEC Australia on behalf of Orange Telecommunications, Ingleburn NSW (April 2002).
- § *Terrestrial Ecologist (SMEC)* - **Goulburn Vegetation Enhancement Strategy** for Wollondilly and Mulwaree Rivers as part of a Floodplain Management Strategy for SMEC Australia on behalf of the Goulburn City Council (April – May 2002).

- § *Project Officer (ERC) - **Flora and Fauna Assessment*** of proposed land use rezoning, Gilmore area via Tumut as part of an Environmental Study in association with Habitat Planning for Tumut Council (February – May 2002).
- § *Terrestrial Ecologist (SMEC) - **Flora and Fauna Assessment*** of proposed upgrade to existing reservoirs in the Ballarat region for SMEC on behalf of Central Highlands Water (February 2002).
- § *Terrestrial Ecologist (SMEC) - **Threatened Species Assessment for *Litoria raniformis**** (Southern Bell Frog) of proposed Booroobanilly Stormwater Escape Channel, Finley NSW as part of an EIS for SMEC on behalf of Murray Irrigation Ltd (March 2002).
- § *Terrestrial Ecologist (SMEC) - **Flora and Fauna Assessment*** of proposed Booroobanilly Stormwater Escape Channel, Finley NSW as part of an EIS for SMEC on behalf of Murray Irrigation Ltd (January - May 2002).
- § *Project Officer (ERC) - **Avifauna Surveys*** in association with Charles Sturt University as part of an ongoing two year study of biodiversity in Eucalyptus plantations on private farmland in the Benalla region for Natural Resources and Environment Victoria (July 1999 – January 2002).

2001

- § *Project Officer (ERC) – **Annual Full Fauna Survey and Bi-monthly Avifauna Surveys*** as part of an ongoing six year study into the biodiversity of *Pinus radiata* plantations and surrounding reserve lands for the Johnstone Centre, Charles Sturt University on behalf of Norske Skog (formerly Fletcher Challenge Paper Mills) Albury (January 1994-December 2001).
- § *Terrestrial Ecologist (SMEC) - **Flora and Fauna Assessment*** of proposed Burraboi Stormwater Escape Channel, Burraboi NSW as part of an EIS for SMEC on behalf of Murray Irrigation Ltd (June 2001).
- § *Project Officer (ERC) - **Flora and Fauna Assessment*** for creek restoration project (de-silting and de-snagging works), Eagle Creek, Barham NSW as part of an EIS in association with Habitat Planning, Coffey Geosciences and R. & J. Frankenberg Ecologists on behalf of the Wakool Shire Council and Eagle Creek pumping Syndicate (May-June 2001).
- § *Project Officer (ERC) - **Flora and Fauna Assessment*** of proposed *Pinus radiata* plantations near Holbrook NSW; on behalf of Burgess Rural Pty Ltd. to satisfy the requirements of a native vegetation clearing permit as requested by the Department of Land and Water Conservation under the *Native Vegetation Conservation Act 1997*, (April 2001).
- § *Terrestrial Ecologist (SMEC) – **Assessment of Stream Health in the Sugarloaf/Sunday Creek Catchment*** for the Goulbourn Broken Catchment Management Authority (April-May 2001).

2000

- § *Research Assistant - Providence Petrel population and foraging studies, Lord Howe Island* as part of a PhD project for Charles Sturt University Albury.
- § *Project Officer (ERC) - Avifauna Surveys* of isolated Eucalyptus remnants in native hardwood plantation (as part ongoing study of biodiversity in Eucalyptus plantations on private farmland) in the north-east Victoria region in association with Natural Resources and Environment and Charles Sturt University (December 2000).
- § *Project Officer (ERC) - Flora and Fauna Assessment* of proposed waste oil recycling facility, Culcairn NSW as part of an EIS for David Thurley Environmental Consulting (November 2000).
- § *Interpretation Officer and Wildlife Carer - Ettamogah Wildlife Sanctuary*
- § *Field Assistant (ERC) - Flora and Fauna Assessment* of proposed alternate bridgeworks and associated roadworks, Cobram Victoria and Barooga NSW in association with Gunninah Environmental Consultants for the Roads and Traffic Authority and Vic Roads.
- § *Project Officer (ERC) - Flora and Fauna Assessment/Threatened Species Assessment* of proposed expansion of the existing waste management facility Griffith as part of an EIS in association with Coffey Geosciences.
- § *Project Officer (ERC) - Flora and Fauna Assessment* of a proposed food processing plant at Griffith NSW as part of an EIS in association with Coffey Geosciences.
- § *Project Officer (ERC) - Fauna and Flora Assessment* of proposed drainage works west Albury NSW on behalf of the Albury City Council.

- § *Project Officer* (ERC) - Fauna and Flora Assessment of a proposed rural residential subdivision at Talmalmo NSW as part of an environmental study in association with Fisher, Armstrong and Windsor, Land Surveying Consultants.
- § *Project Officer* (ERC) - Fauna and Flora Assessment of a proposed rural residential development at Wagga Wagga NSW as part of an Environmental Study in association with Habitat Planning. Employer: Assorted private land owners.
- § *Project Officer* (ERC) - Fauna and Flora Assessment of the proposed Powertel Fibre Optic Cable from Sydney to Melbourne in association with Gunninah Environmental Consultants, Bethungra NSW.

1999

- § *Project Officer* (ERC) - **Fauna and Flora Assessment/Threatened Species Assessment** of a proposed Sawmill Complex at Bombala NSW as part of an EIS in association with Coffey Geosciences.
- § *Field Assistant* - **Full Fauna Surveys** of Mt.Granya State Park and State Forest, Jarvis Creek Regional Park and Wises Creek Flora Reserve Victoria for Charles Sturt University.
- § *Project Officer* (ERC) - **Fauna and Flora Assessment** of proposed rezoning scheme of Red Light Hill and Ettamogah Area at Albury for Habitat Planning.
- § *Field Researcher* - **Wetland Bird Surveys of Wonga Wetlands**, Albury sewerage treatment works. Employer: Charles Sturt University.
- § *Discovery Ranger* - **Small Mammal Surveys** of Blue Waterholes camping area and **Campground Host/Interpretation Guide** Blue Water Holes, Kosciuszko National Park. Employer: NSW, National Parks and Wildlife Service.
- § *Field Researcher* - **Wetland Bird Surveys of Five Bough Swamp** in Leeton N.S.W, including migratory waders as part of a PhD. Employer: Charles Sturt University.

Personal Interests and Associations

- § Natural resource conservation and wildlife management
- § Ornithology
- § Bushwalking and hiking
- § Member of the Ecological Society of Australia
- § Member of Birds Australia
- § Member of Australian Bat Society

Referees

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Education

1999 – 2002 Charles Sturt University Albury, NSW

Doctor of Philosophy

Title: Comparative ecology of two sympatric shearwater species breeding on Montague Island, southern NSW.

Award: Writing-up Award for further publication of research.

1998 Charles Sturt University Albury, NSW

Bachelor of Applied Science (Parks, Recreation & Heritage)

– First Class Honours

Title: Chick provisioning and fledging in two shearwater species breeding on Montague Island, NSW.

Award: Dean's Award for Academic Excellence.

1994 – 1997 Charles Sturt University Albury, NSW

Bachelor of Applied Science

Major: Wildlife Ecology

Minor: Horticulture

Employment History

Charles Sturt University Albury, NSW

Subject coordinator and lecturer

2003 - Coordinator of 1 internal and 4 distance education subjects.

Subject moderator

2003 - Moderation of 5 CSU subjects offered by international partnership organisations.

Subject design

2003 - Designed and compiled new subject: Data analysis and modelling.

Casual Lecturer

2002 – Subject: Wildlife Management

2001 – Subject: Wildlife Management

2000 – Subject: ITC162 Biomaths (statistics)

Tutorial Coordinator & Marker

2000 – Subject: ITC162 Biomaths (statistics)

1999 – Subject: ITC162 Biomaths (statistics)

Marker

2003 – Subject: Interpretive planning

2002 – Subject: Wildlife Management

2002 – Subject: Protected Area Planning and Management

Associate Supervisor

2002 – Honours student: Michael Ramsey: Ecology of the egg-laying period in shearwaters.

2001 – Honours student Brooke Ryan: Volunteer fire fighters' level of knowledge and awareness of the ecological consequences of fire and fire management.

2001 – Honours student Amy Jorgensen: The effects of kikuyu on breeding Little Penguins.

Residential School Assistant

2000 – Subject: ITC162 Biomaths (statistics)

1998 – Subject: Wildlife Management

**Research related
experience**
Ettamogah Research Consultants**(ERC)****2003 – Fauna research**

Bat and invertebrate activity in remnant and revegetation areas within a rural landscape.

2003 – Habitat assessment

Habitat assessment in Thurgoona for the proposed development of a community centre at a known Regent Honeyeater (Threatened Species) breeding site.

2002 – Fauna research

Trapping of Agile Antechinus and Yellow-footed Antechinus around the Albury and the Riverine districts.

NPWS / CSU**Montague Island, NSW****2002 – Revegetation coordinator and supervisor**

Supervisor to 9 students on a week-long tree planting exercise.

2001 – Little Penguin population survey & Island vegetation survey

Supervisor to 10 undergraduate students conducting surveys on Montague Island.

2001 – Revegetation coordinator and supervisor

Supervisor to 15 undergraduate students on a week-long tree planting exercise.

1998-2002 – Tour Guide Assistant

Explaining the ecology of Montague Island to tour groups.

CSIRO**Montague Island, NSW****1998-2003 – Long-term study of fledgling production**

Assisting Dr Peter Fullagar and Dr Petrus Heyligers conduct the long-term study of annual fledgling production on Montague Island.

Audio-visual assistant Albury, NSW

1998 – Bushfire 99 Conference

Research assistant

2000 – Providence Petrel population surveys on Lord Howe Island, Australia, with Dr Adam Bester, Charles Sturt University.

1999 – Satellite tracking of shearwaters from Montague Island, NSW, with Dr Mark Schultz, Charles Sturt University.

1999 – Radio-tracking of Barking Owl in north-east Victoria with Indre Kirsten, Charles Sturt University.

1999 – Survey of habitat requirements of waterbirds at Leeton, NSW, with Dr Adam Bester, Charles Sturt University.

1999 – Radio-tracking White-footed Dunnarts on south coast, NSW, with Robyn Korn, Charles Sturt University.

1998 – Research on Little Penguins on Montague Island, NSW, with Neil Trezise, Charles Sturt University.

1998 – Fauna surveys for CSU and Australian Newsprint Mills in Ettamogah Forest, NSW, with Craig Grabham, ERC.

1997 – Long-footed Potaroo population surveys in Victorian Alpine Areas with Nigel Jones, Department of Natural Resources and Environment.

1996 – Vegetation surveys in Box-Ironbark National Park, Victoria, Dr Brian Lord, Charles Sturt University.

1996 – Radio-tracking of shearwaters and penguins on Montague Island, NSW, with Dr Mark Schultz, Charles Sturt University.

1995 – Fauna surveys of north-east Victoria, with Dr Nick Klomp, Charles Sturt University.

Revegetation volunteer

1996 – Assisting NRE with revegetation works at Mt. Granya State Park, Victoria, with Bob Schultz, Department of Natural Resources and Environment.

Referees

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