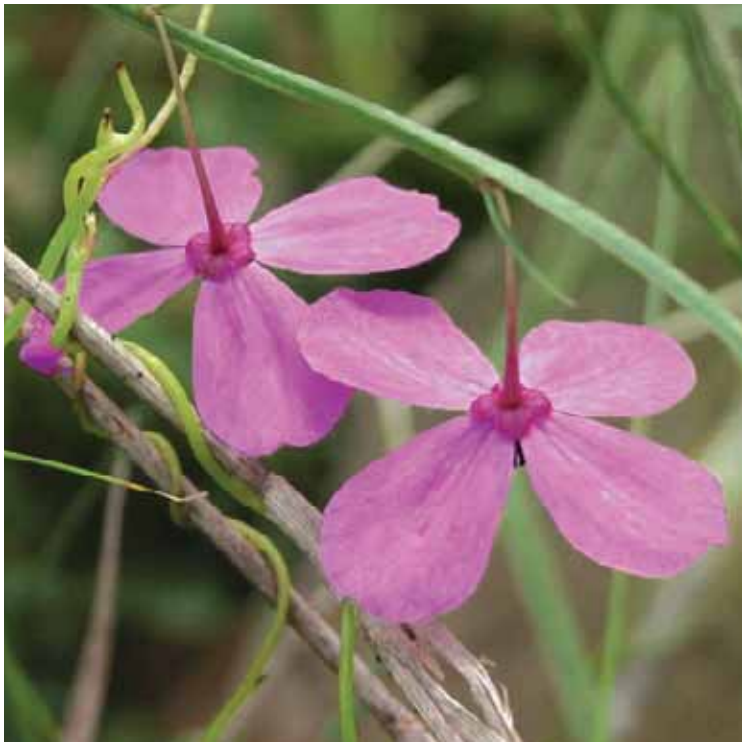
New South Wales Government

RTA

F3 Freeway to Branxton link

Threatened Species Assessment for Proposed Design Changes

MARCH 2007



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January 2007

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Natural & Cultural Heritage Consultants 15-17 Henrietta St Chippendale NSW 2008

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Report for Roads and Traffic Authority of NSW

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ABBREVIATIONS

ANW	*Atlas of NSW Wildlife*
CoA	Conditions of Approval (DIPNR)
CoC	Conditions of Concurrence (DEC)
DEC	NSW Department of Environment and Conservation (formerly NPWS)
DEH	Commonwealth Department of the Environment and Heritage
DIPNR	Department of Infrastructure, Planning and Natural Resources (formerly Planning NSW)
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EP&A Act	NSW *Environmental Planning and Assessment Act* 1979
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999
GIS	Geographic Information System
LGA	Local Government Authority
NPWS	NSW National Parks and Wildlife Service (now DEC)
SIS	Species Impact Statement
TSC Act	NSW *Threatened Species Conservation Act* 1995
sp.	species (singular)
spp.	species (plural)
ssp.	subspecies
var.	variety

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SUMMARY

Biosis Research Pty. Ltd. was commissioned by the Roads and Traffic Authority of NSW (RTA) to investigate the flora and fauna aspects of the F3 to Branxton Link. This report is an addendum to the Updated Additional Flora and Flora Assessment (UAFFA) report (Harrington *et al.* 2005b), which assessed the impacts on threatened species and communities of the approved F3 to Branxton Link ("Approved Project"). This report assesses what will be hereafter referred to as the "Proposed Project", which includes 15 design changes and road-related ancillary infrastructure (fencing, construction and maintenance access and water quality controls), not included in the Approved Project. This report assesses the impacts on threatened flora and fauna, following the assessment processes of the *Threatened Species Conservation Act* 1995 (TSC Act) and *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

Vegetation Clearing

The 15 design changes for the Proposed Project, excluding road-related ancillary infrastructure, would reduce the area of native vegetation to be cleared by about 11 ha to about 157 ha, including a reduction in Kurri Sand Swamp Woodland of 1.9 ha to 26.6 ha, compared to the Approved Project (Table 5). However, when road-related ancillary infrastructure is taken into account, the Proposed Project would result in about 182 ha being cleared, including 33.7 ha of Kurri Sand Swamp Woodland. The Proposed Project would increase the area of native vegetation to be cleared by about 25 ha to about 182 ha and the area of Kurri Sand Swamp Woodland by 7.1 ha to 33.7 ha when compared to the Approved Project. The area of native vegetation cleared by the Proposed Project (182 ha) exceeds the 168 ha limit in the Minister's Condition of Approval 60. The increase in clearing for the Proposed Project is caused by road-related ancillary infrastructure (25 ha), rather than an increase in the size of the F3 to Branxton Link footprint itself, which has decreased considerably when compared with the Approved Project.

Flora

This report assessed ten plant species (*Corybas dowlingii, Eucalyptus fracta*, *E. glaucina*, *E. parramattensis* ssp. *decadens*, *Grevillia montana*, *G. parviflora* ssp. *parviflora*, *Macrozamia flexuosa*, *Persoonia pauciflora*, *Tetratheca juncea* and *Cryptostylis hunteriana*) and three ecological communities (Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest and Lower Hunter Spotted Gum – Ironbark Forest). Seven part tests determined that Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest, *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea* were likely to be significantly affected by the Proposed Project (Appendix 2). Although the design changes and utility adjustments discussed in this report have increased vegetation clearing overall compared with the Approved Project, the magnitude of the project has not changed, and as such, the results of the assessments of threatened plant species and communities for the Proposed Project

remain unchanged compared with the Approved Project.

Fauna

This report assessed 58 animal species listed on the TSC Act and determined that none were likely to be significantly impacted. Sixty-one migratory and twelve threatened species listed on the EPBC Act were also assessed. Although Eight Part Tests for the Approved Project determined that woodland birds and the Olive Whistler would be significantly impacted by causing a barrier to movement (Harrington *et al.* 2005b), Seven Part Tests for the Proposed Project determined that the provision of viaducts had maintained sufficient connectivity that these species would now not be significantly impacted. Although Connell Wagner's AFFA report (2001) determined that six listed bat species (Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat and Large-eared Pied Bat) were likely to be significantly impacted by the Approved Project, assessments of bats for the Proposed Project determined that a significant impact was unlikely due to proposed mitigation measures. Therefore, no threatened animal species listed on the TSC Act would be significantly impacted by the Proposed Project. No threatened or migratory EPBC Act-listed species were determined likely to be significantly impacted by the Proposed Project.

Aquatic

A separate aquatic assessment report is attached to the end of this report. No threatened aquatic species, populations or Endangered Ecological Communities were located during this survey. In addition, there are no threatened aquatic species, populations or Endangered Ecological Communities listed under the *Fisheries Management Act* 1994 and *Environment Protection and Biodiversity Conservation Ac*t 1999, that have potential habitat within the proposed F3 to Branxton Link study area.

Conclusion

Seven Part Tests (under the TSC Act) and significance assessments (as recommended under the EPBC Act 'Guidelines on Significance Assessment') were carried out for species with known potential habitat within the study area. The Proposed Project is likely to have a significant impact on a range of plant species and communities. The provision of viaducts in the Sugarloaf Range section has significantly reduced the barrier affect of the Approved Project and as such, animal species (woodland birds and Olive Whistler) that were considered likely to be significantly impacted for the Approved Project are now unlikely to be significantly impacted. Although the implementation of suitable mitigation measures during the design, construction and operational phases of the F3 to Branxton Link will reduce the impacts on threatened species, the Proposed Project is still likely to have a significant impact on three threatened plant species and two Endangered Ecological Communities (EECs).

Summary of threatened species and communities significantly impacted by the proposed F3 to Branxton Link according to assessment

	Approved Project			Proposed Project
	AFFA May 2001	**NPWS Conditions October 2001**	**UAFFA October 2005**	**Design Change Report January 2007**
EECs	Kurri Sand Swamp Woodland	Kurri Sand Swamp Woodland	Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest	Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest
Flora	*Eucalyptus parramattensis* ssp. *decadens*, *Persoonia pauciflora*	*Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora ssp. parviflora*, *Persoonia pauciflora*	*Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, *Tetratheca juncea*	*Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, *Tetratheca juncea*
Fauna	Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Green and Golden Bell Frog	Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Green and Golden Bell Frog, Powerful Owl, Masked Owl	Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Woodland Birds (Brown Treecreeper, Speckled Warbler, Hooded Robin, Diamond Firetail and Grey-crowned Babbler), Olive Whistler	
Total	One community, three plants, seven animals	One community, three plants, nine animals	Two communities, three plants, 12 animals	Two communities, three plants

1.0 INTRODUCTION

The Roads and Traffic Authority of NSW (RTA) is proposing to construct a new dual carriageway roadway extending in a northwest direction for about 40 km from the F3 Freeway near Seahampton to the New England Highway at Black Creek, west of Branxton (Figure 1). This project is referred to as the F3 to Branxton Link.

Biosis Research Pty. Ltd. was commissioned by the RTA to investigate the flora and fauna aspects of the F3 to Branxton Link. This report is an addendum to the Updated Additional Flora and Flora Assessment (UAFFA) report (Harrington *et al.* 2005b), which assessed the impacts on threatened species and communities of the approved F3 to Branxton Link ("Approved Project"). This report assesses what will be hereafter referred to as the "Proposed Project", which includes 15 design changes and ancillary infrastructure not included in the Approved Project. This report assesses the impacts on threatened flora and fauna, following the assessment processes of the *Threatened Species Conservation Act* 1995 (TSC Act) and *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

1.1 Background

The F3 to Branxton Link was first proposed in the early 1990s and was subject to a detailed Environmental Impact Statement (EIS) that was exhibited in 1995 (Connell Wagner 1995). Following exhibition of the EIS, a Fauna Impact Statement (FIS) was prepared by Connell Wagner for the RTA in January 1997 (Connell Wagner 1997), which was deemed a Species Impact Statement (SIS) under transitional arrangements under the TSC Act. As a result of changes in legislation regarding flora and fauna an *Additional Flora and Fauna Assessment* report (AFFA; (Connell Wagner 2001) and an assessment of the impact of the Approved Project on the endangered Kurri Sand Swamp Woodland (KSSW;(Predavec *et al.* 2001) were prepared in 2001.

In these studies it was determined that approximately 168 hectares of native vegetation would be cleared as a result of the Approved Project and a further 203 hectares would be impacted by edge effects (see Table 5). In addition, one Endangered Ecological Community (KSSW), three threatened plant species and 10 threatened animal species would be significantly impacted by the development of the Approved Project.

The Director-General of the Department of Environment and Conservation (DEC) granted concurrence for threatened species, populations and communities in October 2001 and the NSW Minister for Planning granted conditional approval for the F3 to Branxton Link in November 2001. A requirement of the Conditions of Approval (CoA) and DEC's Conditions of Concurrence (CoC) was that the AFFA report (Connell Wagner 2001) be updated to address terrestrial flora and fauna issues not previously assessed adequately. A report titled the *Updated Additional Flora and Fauna Assessment* report (UAFFA; (Harrington *et al.* 2005b) was written which identified

terrestrial flora and fauna issues not previously assessed by Connell Wagner (1995, 1997, 2001) associated with the Approved Project. The UAFFA included targeted surveys under the entire F3 to Branxton Link footprint for threatened flora and fauna as well as impact assessments for species, populations and communities recorded, or with habitat within the Approved Project (Harrington *et al.* 2005b). The UAFFA report was initially submitted to the RTA and DEC Metro Conservation Programs and Planning Branch in September 2003, but due to recent listings on the TSC Act this report was updated in October 2005.

CoA 53 requires the RTA to employ an independent road designer and ecologist to review the detailed design (Acacia Environmental Planning 2007). The review determined whether additional measures could be incorporated to reduce direct and/or indirect impacts on threatened species, populations and ecological communities and their habitats, and/or improve the effectiveness of proposed mitigation measures. As part of this process 15 changes to the Approved Project have been proposed. In order to ensure that these changes adopted best practice guidelines in environmental management, the changes were designed during a detailed consultation process involving RTA design engineers, an independent road design specialist, an independent ecologist, an environmental planner, cultural heritage consultants, landscape architects, DEC and Department of Planning.

The Approved Project will result in clearing of native vegetation, including the Endangered Ecological Communities (EECs) Central Hunter Riparian Forest (as a part of River-Flat Eucalypt Forest on Coastal Floodplain), Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest and Lower Hunter Spotted-Gum Ironbark Forest. At the time of approval only Kurri Sand Swamp Woodland was listed as EEC. Condition of Approval 61 limits the area of Kurri Sand Swamp Woodland that can be cleared to 33.7 ha. Condition of Approval 60 limits the area native vegetation that can be cleared to 168 ha.

At the time that the approval was granted, the extent of clearing of native vegetation, and in particular Kurri Sand Swamp Woodland, was based on vegetation mapping prepared for the Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS; (NPWS 2000e). The clearing limits for the Approved Project (CoA 60 and 61) were based on calculations made in the EIS (Connell Wagner 1995) and other flora and fauna assessments (Connell Wagner 1995, 1997, 2001) and did not include erosion and sedimentation controls, fencing or utility adjustments (road-related ancillary infrastructure) because the concept design was not sufficiently detailed to determine the extent of clearing required.

This report discusses the impacts of the individual design changes and addresses the impacts of the Proposed Project as a whole (including road-related ancillary infrastructure) on threatened terrestrial flora and fauna. An assessment of the impacts of

the Proposed Project on threatened aquatic flora and fauna is also considered in this report and is included as an appendix.

1.2 Design Changes

Since the completion of the UAFFA report (Harrington *et al.* 2005b), 15 design changes to the Approved Project have been proposed to reduce ecological impacts such as clearing and habitat fragmentation. In addition, clearing for road-related ancillary infrastructure has been identified (see Figure 2Figure 14). Preliminary assessment of these design changes determined that not all of them required further assessment. The proposed design changes to the F3 to Branxton Link are detailed below in order of chainage from the F3 Freeway in the southeast to Branxton in the northwest.

1.2.1 Design Parameters

Road design standards the design parameters for the Approved Project were changed as summarised in Table 1.

Table 1: Changes to design parameters of the concept design

Design Parameter	Approved Project	Proposed Design Change	Reason
Design speed	100 km/h	110 km/h	Current standard
Stopping sight distance	100 km/h @ 1.5 sec	110 km/h @ 2.5 sec	Current standard
Minimum curve radius	600 m	700 m	Higher design speed
Vertical grade			
Main carriageway	5%	5%	No change
Ramps	7%	8%	Reduce costs
Pavement widths			
Travel lanes	3.5 m	3.5 m	No change
Inner shoulder	1.0 m	0.5 m	Overall width unchanged
Outer shoulder	2.0 m	2.5 m	Overall width unchanged
Median width			
Sugarloaf section	3.6 m & Type F barrier	5.0 m and WRSB	Safety and design constraints
Remaining sections	17 m depressed	12 m depressed and WRSB	Safety and reduced vegetation clearing
Flooding	1% annual exceedance probability	1% annual exceedance probability	No change
Vertical clearance			
Over roads	5.3 m	6.5 m	Clearance for haulage to heavy industry in Hunter and beyond
Over rail	4.7 m	7.3 m	Clearance for double stacked containers

WRSB: wire rope safety barrier

1.2.2 Median Narrowing

The Approved Project generally adopted a 17 m median between Buchanan and Branxton, although in the Sugarloaf Range section, between the F3 Freeway and Buttai Hills, about five kilometres would have a narrow median of 3.6 m with a Type-F concrete barrier. The proposed changes involve reducing the width of the median along some sections of the F3 to Branxton Link so that the overall footprint is reduced. The median width between Buchanan Interchange and Branxton would be reduced from 17 to 12 m. In the Sugarloaf Range section (approximately the first 6.3 km of the F3 to Branxton Link), the median width would increase from 3.6 to 5.0 m, with a barrier such as a wire rope safety fence being located within the median. Increasing the medium width in the Sugarloaf Range section was necessary to allow split level carriageways and viaducts, which in turn will reduce the size of fill and batters, thus further reducing vegetation clearing.

1.2.3 Newcastle Interchange (Ch -500 to 900)

The proposed changes to the Newcastle Interchange include the replacement of roundabouts at the ramp terminals with a free flow intersection for all movements except F3 to Branxton Link eastbound to F3 northbound and F3 southbound to F3 to Branxton Link (Figure 2). The proposed design change would replace a culvert with four bridges over Minmi Creek to protect Aboriginal and non-indigenous heritage in Minmi Creek. As the area of the interchange has been previously surveyed it was not considered necessary to conduct further flora surveys with respect to this design change.

1.2.4 Sugarloaf Realignment (Ch 900 to 4500)

The proposed alterations in the Sugarloaf Range section includes the replacement of three embankment batters with three viaducts spanning Burnt Creek and three unnamed gullies between Stockrington Road ridge and Blue Gum Creek (Figure 3). The Proposed Project would follow a shorter and straighter alignment through this section, reducing the length by 250 m. The horizontal grade line would be raised to reduce the magnitude of cuts between Stockrington Road and Skyline Ridge. Targeted surveys for *Tetratheca juncea* and *Cryptostylis hunteriana* were necessary under the footprint of the new alignment.

The proposed cut and cover tunnel at Stockrington Road would be replaced by a single span bridge over the F3 to Branxton Link that would not function as a fauna overpass.

1.2.5 Surveyors Creek Realignment (Ch 5300 to 8700)

The proposed alterations in the Surveyors Creek area include shifting the alignment 200 m (at its maximum separation) to the southwest, off the slopes of the Buttai Hills,

onto flatter ground closer to Surveyors Creek (Figure 4). When compared to the Approved Project, it would be approximately 70 m longer. However, it would reduce the volume of earthworks and the height of the fill centred at Ch 7300. A combined heavy and light vehicle rest area is proposed on both sides of the Proposed Project at this location. The provision of water pondages/sedimentation basins for animals, as discussed in the EIS (Connell Wagner 1995), is not required due to the proximity of existing water supplies and the difficulties in maintaining suitable water quality. Targeted surveys for *Tetratheca juncea* and *Cryptostylis hunteriana* were necessary under the footprint of the new alignment.

1.2.6 Buchanan Interchange (Ch 9900)

At the Buchanan Interchange under the Approved Project, the F3 to Branxton Link passes under John Renshaw Drive and provides onload and offload ramps to a roundabout, a T-junction and a slip lane at John Renshaw Drive. Buchanan Road passes over the F3 to Branxton Link and connects to John Renshaw Drive and George Booth Drive at a roundabout (Figure 5). The design of Buchanan Interchange has been adjusted to create a large elliptical roundabout interchange, with the roundabout at the intersection of George Booth Drive, John Renshaw Drive and Buchanan Road being moved slightly north to provide a suitable alignment for new bridges on John Renshaw Drive over Wallis and Surveyors Creeks (Figure 5). Buchanan Road would cross under the F3 to Branxton Link to join the roundabout at the intersection of John Renshaw Drive and George Booth Drive. Targeted surveys for *Tetratheca juncea* and *Cryptostylis hunteriana* were necessary under areas that were previously not impacted.

1.2.7 Averys Lane Overpass (Ch 11500)

The alignment of Averys Lane Overpass would be moved about 5 to 10 m to the west to facilitate construction under traffic (Figure 6). After completion of the bridge, the approaches from Averys Lane would be diverted and its existing formation between the approaches and the F3 to Branxton Link would be closed. As a small amount of addition vegetation will require clearing, further surveys were necessary.

1.2.8 Kurri Kurri Interchange (Ch 13800)

The proposed design changes to the Kurri Kurri Interchange include the removal of the original double-roundabout diamond interchange, including the deviation of Stanford Road, and replacement with a large elliptical roundabout (two lanes) and the closure of Stanford Road (Figure 7). Construction of the modified Kurri Kurri Interchange would require the relocation of a range of overhead electricity transmission lines and poles (see Section 1.3 below). As this intersection impacts Kurri Sand Swamp Woodland further surveys were necessary.

1.2.9 McLeod Road Overpass (Ch 15000)

The original design consisted of the deviation of McLeod Road south of the F3 to Branxton Link, ending in a T-junction north of the F3 to Branxton Link with a new road, which links to McLeod Road in the west and the road to Kurri Kurri TAFE in the east. The proposed change consists of moving the deviation of McLeod Road further to the southeast to reduce ramp earthworks (Figure 8). The relocation of overhead electricity lines would require additional clearing of Kurri Sand Swamp Woodland. On site surveys were considered necessary as Kurri Sand Swamp Woodland would be impacted.

1.2.10 South Maitland Railway and Swamp Creek (Ch 15800)

In the Approved Project a single bridge for each carriageway crosses South Maitland Railway and Swamp Creek. Due to a requirement by the railway owners it was necessary to increase the minimum clearance on the railway owners to move double-stacked containers it was necessary for the RTA to increase the clearance above the railway from 5.3 m to 7.3 m. Therefore, the design was adjusted so that South Maitland Railway crossed above the F3 to Branxton Link, rather than underneath. The adjustments would require the South Maitland Railway to be raised over a length of 900 m and a rail bridge over the F3 to Branxton Link to be constructed (Figure 9). A separate impact assessment has been conducted for this design change (Harrington and Gorrod 2005), the results of which are summarised in this report.

To accommodate the proposed design changes for South Maitland Railway the length of the bridges over Swamp Creek would decrease from 150 m to 55 m, reducing the height of the embankments on Swamp Creek and the extent of bridge abutments (Figure 9).

1.2.11 Loxford Interchange (Ch 16600)

The changes to the Loxford Interchange involve moving the alignment of Hart Road about 20 m to the northwest to facilitate construction under traffic and moving the alignment of the two ramps to the southwest by 20 m to provide suitable intersection geometry (Figure 10). As this intersection impacts Kurri Sand Swamp Woodland, the proposed interchange required re-surveying to fully assess the impacts.

1.2.12 Sawyers Gully Realignment (Ch 20000 to 22300)

The Approved Project crosses 132 kV and 66 kV powerlines that will need to be relocated. The proposed alterations in the Sawyers Gully area include shifting the alignment to the north by up to 70 m into the existing powerline easement and relocating the powerlines south of the F3 to Branxton Link (Figure 11). This design change would eliminate all power line crossings of the F3 to Branxton Link at this location. The alignment of the Old Maitland Road Bridge would be moved by approximately 25 m to

the east to facilitate construction under traffic. The new alignment was surveyed to fully assess the impacts.

1.2.13 Allandale Interchange (Ch 27500)

Allandale Interchange on the Proposed Project would have a dumbbell configuration with two roundabouts, southeast-facing ramps, and a bridge over the F3 to Branxton Link connecting the roundabouts. The northeast roundabout would be located on the existing alignment of Lovedale Road; the southwest roundabout would be offset about 140 m south of the existing alignment of Lovedale Road (Figure 12). Lovedale Road would be realigned to the southwest and cross over the F3 to Branxton Link on a shorter bridge where the F3 to Branxton Link is in a cutting. The southeast-facing ramps would connect to the roundabouts and accommodate the same traffic movements as the Approved Project. The existing T-junction of the Allandale Quarry Road would be connected to the southwest roundabout and provide access to either carriageway of the F3 to Branxton Link or Lovedale Road. It was necessary to survey these changes to determine their overall impact.

1.2.14 Camp Road Underpass (Ch 30000)

Camp Road would be re-aligned to cross under the F3 to Branxton Link at a less acute angle, reducing the bridge length under the F3 to Branxton Link from about 150 m to 35 m (Figure 2o). The proposed re-alignment of Camp Road will impact mostly farmland, although isolated trees of the Hunter Lowland Redgum Forest and Lower Hunter Spotted Gum-Ironbark Forest communities will be impacted at the north and south end of the re-alignment respectively (Figure 13). It was considered necessary to survey the new alignment to determine the full impacts on Hunter Lowland Redgum Forest and Lower Hunter Spotted Gum-Ironbark Forest.

1.2.15 Tuckers Lane to Black Creek (Ch 31800 to 39500)

The proposed alterations in the Tuckers Lane to Black Creek section include the removal of the original trumpet type interchange (connecting to Greta) and its replacement with a two-lane elliptical roundabout closer to Branxton, and the re-alignment of the F3 to Branxton Link immediately west of Branxton (Figure 14). The alignment of the proposed Tuckers Lane Bridge would be moved about 30 m to the north to facilitate construction under traffic. The northern arm of the Branxton Interchange would cross the Main Northern Railway Line and Anvil Creek and connect to the New England Highway east of Branxton.

The southern arm of the Branxton Interchange would connect to Wine Country Drive via an at-grade roundabout. Wine Country Drive would cross over the F3 to Branxton Link on a new bridge while the Main Northern Railway Line would use the existing bridge.

The alignment of the Wine Country Drive Bridge would be moved about 10 m to the west to facilitate construction under traffic.

Between Wine Country Drive and west Branxton, the F3 to Branxton Link would be moved to the south to allow it to cross the Main Northern Railway Line and a private spur line at a less acute angle, resulting in shorter and lower bridges than the Approved Project. After crossing the Main Northern Railway Line, the F3 to Branxton Link would traverse the former coal loading site and cross Black Creek via new bridges before joining the existing dual carriageways of the New England Highway near Standen Drive. A combined heavy and light vehicle rest area is proposed on both the eastern and western sides of the F3 to Branxton Link, to the north of the Main Northern Railway Line. The new interchange and off ramps required survey to determine the likely impacts.

Longitudinal fauna corridors proposed at bridges over the F3 to Branxton Link at Tuckers Lane and Wine Country Drive would not be provided. The proposed longitudinal fauna corridor under the Tuckers Lane overbridge is unlikely to increase connectivity as Tuckers Lane is a narrow gravel country road, providing a small likelihood of roadkills and a lesser hindrance to wildlife movements than the longitudinal fauna corridor. Fauna species that may cross Tuckers Lane at this location include macropods, gliders and birds, none of which would use the longitudinal fauna corridor. Given the poor condition and existing fragmentation of fauna habitat on either side of Tuckers Lane, it is unlikely that smaller animals would move through this area. A longitudinal fauna corridor at Tuckers Lane is not supported.

The proposed longitudinal fauna corridor at the Wine Country Drive overbridge is also unlikely to increase connectivity, as agricultural land lies to the east of Wine Country Drive at this point, separating the woodland patches on either side of Wine Country Drive and causing a hindrance to fauna movements. Additionally, like the situation at Tuckers Lane, no threatened species are present in the immediate vicinity. The only species likely to move throughout the area are macropods, gliders and birds, which are unlikely to use the longitudinal fauna corridor on Wine Country Drive. The longitudinal fauna corridor is unlikely to reduce roadkills as the majority of fauna crossing Wine Country Drive would do so to the south of the proposed structure where the woodland is continuous (although thin) immediately north of North Rothbury. A longitudinal fauna corridor at Wine Country Drive is not supported.

1.3 Road-related Ancillary Infrastructure

The Approved Project did not identify the location or scope of fencing, water quality controls or construction and maintenance access within the road corridor (called road-related ancillary infrastructure). Road-related ancillary infrastructure would extend clearing of native vegetation and habitat and which was not considered in the Approved Project.

To satisfy Condition of Concurrence 4, the independent ecologist and the RTA road designer have examined opportunities to reduce the area that requires clearing for road-related ancillary infrastructure wherever possible.

The vegetation clearing areas for road-related ancillary infrastructure include a constructability margin for potential site-specific constraints and give a realistic assessment of the clearing of native vegetation required to construct and operate the F3 to Branxton Link.

1.3.1 Construction and maintenance access

The Approved Project did not include modelled intersections, interchanges or ramps, or construction and maintenance access adjoining the top of cuts and the toe of fill embankments. Consequently, it understates the construction footprint of the Approved Project.

The clearing footprint of the Proposed Project (which includes the 15 design changes) includes modelled intersections, interchanges and ramps. The clearing footprint also accommodates a construction and maintenance access area four metres wide at the toe of fill embankments and the top of cuts. Fauna exclusion fencing, when it is required, would be constructed in this access area and would not require additional clearing of native vegetation.

1.3.2 Boundary and fauna exclusion fencing

The Approved Project did not consider clearing for fencing along the road reserve boundary or provide detail on fauna exclusion fencing. Consequently, it understates the construction footprint of the Approved Project.

The clearing footprint of the Proposed Project (which includes the 15 design changes) includes boundary and fauna exclusion fencing. An area three metres in from the road reserve boundary would be cleared to install and maintain boundary fences. Fencing would generally be located 0.3 m in from the road reserve boundary.

1.3.3 Water quality controls

The Approved Project did not consider the location of construction and operational water quality controls. Consequently, it understates the construction footprint of the Approved Project.

Sedimentation basins and their associated drainage systems are essential to manage construction and operational impacts on stormwater discharge quality. The clearing footprint of the Proposed Project (which includes the 15 design changes) includes all sedimentation basins needed to manage operational stormwater quality, based on the

RTA Road Design Guide, the RTA Water Policy and the Department of Housing's guideline *Managing Urban Stormwater - Soils and Construction*.

Due to topography, some sedimentation basins would need to be located on land that has high conservation significance to allow gravity discharges to natural watercourses or drainage lines. Most, if not all, of the permanent basins would also be used by the construction contractor to manage construction water quality.

2.0 METHODS

2.1 Flora

Targeted flora surveys for *Cryptostylis hunteriana* and *Tetratheca juncea* for the design changes were undertaken using the methodology outlined in the previous assessment of the F3 to Branxton Link (Harrington *et al.* 2005b). Both species are cryptic and difficult to detect outside of their flowering periods, hence surveys took place during November (*T. juncea*) and January (*C. hunteriana* and *T. juncea*). The design change surveys and dates are outlined in Table 2.

Table 2: The design changes to the F3 to Branxton Link at which targeted flora surveys were conducted and the dates of those surveys.

Design Change	Targeted Surveys Conducte	Date Surveyed
1. Design Parameters	No	-
2. Median Narrowing	No	-
3. Newcastle Interchange	No	-
4. Sugarloaf Realignment	Yes	5 Nov 2003 & 14 Jan 2004
5. Surveyors Creek Realignment	Yes	12 Nov 2003 & 15 Jan 2004
6. Buchanan Interchange	Yes	19 Nov 2003 & 15 Jan 2004
7. Averys Lane Overpass	Yes	19 Nov 2003
8. Kurri Kurri Interchange	Yes	19 Nov 2003
9. McLeod Road Overpass	Yes	19 Nov 2003
10. South Maitland Railway & Swamp Creek	Yes	29 Nov 2004
11. Loxford Interchange	Yes	19 Nov 2003
12. Sawyers Gully Realignment	Yes	19 Nov 2003
13. Allandale Interchange	Yes	19 Nov 2003
14. Camp Road Underpass	Yes	19 Nov 2003
15. Tuckers Lane to Black Creek	Yes	19 Nov 2003

During the targeted flora surveys the LHCCREMS mapping was ground truthed and updated (for both classification and spatially) based on January 2004 aerial photography. This updated LHCCREMS mapping is hereafter referred to as the updated 2005 vegetation mapping.

2.1.1 Vegetation Clearing Calculations

Previous calculations of vegetation clearing required for the Approved Project (Connell Wagner 1995, 1997, 2001) did not include road-related ancillary infrastructure because the concept design was not sufficiently detailed. Additionally, these calculations were based on aerial photography, not LHCCREMS data, and although the vegetation polygons within the Approved Project footprint were delineated, the vegetation polygons for the surrounding areas were not. These vegetation polygons are referred to as the

2001 mapping. Hence, it was not possible to compare the areas of vegetation to be cleared in the Approved Project with the Proposed Project using the vegetation mapping of the Approved Project.

Since 2001, the LHCCREMS vegetation mapping has been updated using 2003/2004 high resolution aerial photography to better define vegetation community boundaries. The mapping has also been updated to incorporate:

- The results of targeted flora surveys and selected ground-truthing.
- Threatened species and endangered ecological communities that have been gazetted since the approval in 2001.

The updated LHCCREMS vegetation mapping is referred to as the *2005 mapping*.

To allow a like-with-like comparison, vegetation clearing for the Approved Project footprint was re-calculated using NPWS (2000) LHCCREMS mapping and the updated 2005 vegetation mapping and compared with the 2001 mapping.

The footprint of the Approved Project included a construction allowance of 5 m from the edge of the footprint (Connell Wagner 1995, 1997, 2001). The clearance footprint for the Proposed Project includes a construction and maintenance access areas 4 m wide at the toe of fill embankments and the top of cuts. Additionally, the interchanges and on/off ramps for the interchanges on the Approved Project did not model the cut and fill batters required for their construction. Interchanges on the Proposed Project are fully modelled to include cut and fill batters. Hence, vegetation clearing calculations of interchanges on the Approved Project are an underestimate. Clearing calculations under the viaducts in the Sugarloaf Range section of the proposed project assumed that the full width of the viaducts would be cleared, although in reality, only clearing for the pylons, which would be approximately 50 m apart, and a 3 m access track would be required. In addition to the F3 to Branxton Link's footprint, vegetation-clearing calculations for road-related ancillary infrastructure included a 3 m wide access track for boundary fencing and sedimentation basins (plus a 2 m buffer for construction).

2.2 Fauna

No trapping, spotlighting or call play back for threatened fauna species was conducted for this study. Instead, a list and maps of threatened fauna species present within the vicinity of the design changes was created based on DEC Atlas of NSW Wildlife database (accessed on 12 May 2006) and previous surveys undertaken by Connell Wagner (Connell Wagner 1995, 1997, 1998, 2000, 2001) and Biosis Research (Bali and Predavec 2003, Harrington *et al.* 2005a).

3.0 RESULTS

3.1 Vegetation communities

The vegetation communities within the study area include Alluvial Tall Moist Forest, Central Hunter Ironbark-Spotted Gum-Grey box Forest, Central Hunter Riparian Forest, Coastal Foothills Spotted Gum – Ironbark Forest, Coastal Plains Smooth-barked Apple Woodland, Hunter Lowlands Redgum Forest, Hunter Valley Moist Forest, Kurri Sand Swamp Woodland and Lower Hunter Spotted Gum – Ironbark Forest (Figure 21). Seven of these communities have been described in detail in the previous UAFFA report (Harrington *et al.* 2005b).

3.2 Flora

Data were compiled from the earlier assessments and reports in the local area (Connell Wagner 1995, 2001, Anderson *et al.* 2002, Gunninah Environmental Consultants 2002, Bali and Predavec 2003, Harrington *et al.* 2005b), the DEC *Atlas of NSW Wildlife* and from discussions with DEC.

Figure 22 shows the distribution of the 10 plant species listed as threatened on the TSC Act and recorded within a ten kilometre radius of the study area (DEC 2006). Each of these species are listed in Table 3 below, along with *Cryptostylis hunteriana* and *Eucalyptus camfieldii*, which have not been previously recorded within a ten kilometre radius of the study area. Potential habitat within the study area was also identified for one preliminarily listed species, *Corybas dowlingii* which has also been included in table 3 below.

Table 3: Threatened plant species or their habitat previously recorded within a 10 km radius of the study site (based on Dec Atlas of NSW Wildlife and the EPBC Online Database). *Key: E1 – Endangered (TSC Act); V – Vulnerable (TSC Act and EPBC Act); Z – Critically Endangered (EPBC Act); 8PT – Eight Part Test; CoC – Condition of Concurrence; * Preliminarily listed on the TSC Act.*

Latin Name	TSC Act	EPBC Act	Habitat	Mapped in Figure 16	Potential Habitat	Impact Assessment
Acacia bynoeana	E1	V	Sandstone ridgetop and Castlereagh Woodlands on sandy clay soil, often with ironstone gravels (NSW Scientific Committee 1998a). **ROTAP -** 3V	Yes	Yes	EP&A Act 7PT and EPBC Act AoS required
Angophora inopina	V	V	Grows in open woodland with a dense shrub understorey. Restricted to Charmhaven- Wyee area where it occurs on deep white sandy soils over sandstone (NSW Scientific Committee 1998b). **ROTAP -** 2R-	Yes	No	No – potential habitat not found in study area
Callistemon linearifolius	V	-	Occurs chiefly from Georges River to the Hawkesbury River where it grows in dry sclerophyll forest, open forest, scrubland (Fairley and Moore 2000) or woodland on sandstone. Found in damp places, usually in gullies (Harden 2002). **ROTAP -** 2Ri	Yes	Yes	EP&A Act 7PT and EPBC Act AoS required

Latin Name	TSC Act	EPBC Act	Habitat	Mapped in Figure 16	Potential Habitat	Impact Assessment
*Corybas dowlingii**	E	-	Known from 3 localities including Port Stephens, Bulahdelah and Freemans Waterhole south of Newcastle. It forms clonal colonies and grows in gullies in tall open forest on well-drained gravely soil at elevations of 10-200 m above sea level (Jones 2004).	No	Yes	EP&A Act 7PT
Cryptostylis hunteriana	V	V	This species typically grows in swamp-heath on sandy soils chiefly in coastal districts (Harden 1993b) but has also been recorded on steep bare hillsides (Bishop 1996). Within the Central Coast bioregion, this species has been recorded within Coastal Plains Smooth-barked Apple Woodland (mu 30) and Coastal Plains Scribbly Gum Woodland (mu 31) (Bell 2001). **ROTAP -** 3V	No	Yes	EP&A Act 7PT and EPBC Act AoS required. CoC 5.
Eucalyptus camfieldii	V	V	Shallow soiled sandstone or lateric tops amongst *Angophora hispida*, *Eucalyptus haemastoma*, and *E. oblonga* (Robinson 2003). **ROTAP -** 2Vi	No	No	No – potential habitat not found in study area
Eucalyptus glaucina	V	V	Occurs near Casino and from Taree to Broke where it is locally common but very sporadic. Found in grassy woodland on deep, moderately fertile and well watered soil (Harden 2002). Previously recorded within Central Hunter Riparian Forest (mu13) . **ROTAP -** 3Va	Yes	Yes	EP&A Act 7PT and EPBC Act AoS required
Eucalyptus parramattensis ssp. *decadens*	V	V	Found in dry sclerophyll woodland on sandy soils, often in low damp sites (Harden 2002). **ROTAP -** 2V	Yes	Yes	EP&A Act 7PT and EPBC Act AoS required.
Grevillea parviflora ssp. *parviflora*	V	V	Known to occur from Arcadia to North Maroota and in the Camden-Bargo-Appin area where it grows in sandy or light clay soils usually over thin shales in heath or shrubby woodlands (Harden 2002). **ROTAP** - na	Yes	Yes	EP&A Act 7PT and EPBC Act AoS required
Persoonia pauciflora	E1	Z	*Persoonia pauciflora* was recognised as a species in 1999. It occurs in dry open-forest or woodland habitats, generally with a projected foliage cover ranging between 10 to 40% and tree height range of between 6 to 18 metres. Vegetation is dominated by *Corymbia maculata*, *Eucalyptus fibrosa* and *E. crebra*. Common understorey shrubs include *Acacia parvipinnula*, *Daviesia ulicifolia* and *Bursaria spinosa*. The majority of the population is known to occur on silty sandstone soils derived from the Farley Formation. *Persoonia pauciflora* habitat is disturbed at each of the sub-populations to varying degrees, as a result of unrestricted access, frequent underscrubbing, and/or proximity to roadside edges (NPWS 1999f).	Yes	Yes	EP&A Act 7PT and EPBC Act AoS required
Rutidosis heterogama	V	V	Occurs mostly in coastal districts from Maclean to the Hunter Valley where it grows mostly in heath, often along disturbed roadsides (Stevenson 2004b). **ROTAP -** 2Va	Yes	Yes	EP&A Act 7PT and EPBC Act AoS required
Syzygium paniculatum	V	V	Subtropical and littoral rainforest on sandy soils or stabilised dunes near the sea (Harden 2002). **ROTAP -** 3Ri	Yes	No	No – potential habitat not found in study area
Tetratheca juncea	V	V	Grows in sandy or swampy heath and dry sclerophyll forests (Harden 1993a). Most populations occur in woodland on poor nutrient soils with good drainage and low moisture levels. Typically found in dense understorey of grasses and canopy species including *Angophora costata*, *Corymbia gummifera*, *Eucalyptus haemastoma* and *E. capitellata* (NPWS 2000c). **ROTAP -** 3Vi	Yes	Yes	EP&A Act 7PT and EPBC Act AoS required. CoC 5.

3.2.1 TSC Act

Nine species with potential habitat in the study area are listed as either endangered or vulnerable under the TSC Act. They include *Acacia bynoeana*, *Callistemon linearifolius*, *Cryptostylis hunteriana*, *Eucalyptus glaucina*, *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, *Persoonia pauciflora*, *Rutidosis heterogama* and *Tetratheca juncea*. Potential habitat for one preliminarily listed species, *Corybas dowlingii* was also identified in the study area.

Seven Part Tests are found in Appendix 2 and conclude that the Proposed Project, including the design changes and road-related ancillary infrastructure, will have a significant impact on *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea*.

3.2.2 EPBC Act

Seven threatened species listed as either vulnerable under the EPBC Act have potential habitat in the study area. These include *Acacia bynoeana*, *Cryptostylis hunteriana*, *Eucalyptus glaucina*, *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, *Rutidosis heterogama* and *Tetratheca juncea. Persoonia pauciflora* is listed as critically endangered under the EPBC Act and has potential habitat in the study area. Assessments under the Significant Impact Criteria have been prepared for each of the aforementioned species listed on the EPBC Act.

Of these species, *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea* were determined likely to be significantly impacted by the Proposed Project.

3.3 Fauna

Previous records of threatened animal species were compiled from the earlier assessment reports (Connell Wagner 1995, 1997, 2001, Harrington *et al.* 2005b), from the DEC Atlas of NSW Wildlife and from discussions with DEC. Fifty-eight threatened species or their habitat listed on the schedules of the TSC Act have been recorded in the local area of the F3 to Branxton Link (Table 4). According to the DEC Atlas of NSW Wildlife, 50 threatened animal species listed on the TSC Act have been previously recorded in the vicinity of the F3 to Branxton Link, although only three of these species (Masked Owl *Tyto novaehollandiae*, Powerful Owl *Ninox strenua* and Squirrel Glider *Petaurus norfolkensis*) were recorded within the Kurri Kurri Corridor (Figure 23).

Sixty-one migratory species as listed under the EPBC Act have been recorded or have potential habitat in the local area, including three species listed as both migratory and threatened, under the EPBC Act.

Threatened animal species detected during previous surveys by Biosis Research (Harrington *et al.* 2005b) include six TSC Act listed species (Grey-crowned Babbler *Pomatostomus temporalis*, Masked Owl, Olive Whistler *Pachycephala olivacea*, Sooty Owl *Tyto tenebricosa*, Speckled Warbler *Pyrrholaemus sagittata* and Squirrel Glider) but no EPBC Act listed species (Figure 24).

Of the 112 threatened and/or migratory animal species considered in this assessment, 100 have potential habitat within the study area and hence may be present (Table 4). There are 58 threatened species of animal that are assessed under the TSC Act and 70 threatened and/or migratory species that are assessed under the EPBC Act. There are 16 species that fall under both Acts. Due to the presence of habitat, potential impacts of the Proposed Project on these threatened species were assessed under Seven Part Tests and by the EPBC Act Guidelines on Significance (Environment Australia 2000). A brief paragraph about the habitat requirements of each of the 112 threatened fauna species is included in Table 4.

Table 4: Threatened and/or migratory animal species or their habitat previously recorded within a 10 km radius of the study site (based on Dec Atlas of NSW Wildlife and the EPBC Online Database)

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Amphibians						
Heleioporus australiacus	Giant Burrowing Frog	V	V	Prefers hanging swamps on sandstone shelves adjacent to perennial non-flooding creeks (Daly 1996, Recsei 1996). Can also occur within shale outcrops within sandstone formations. In the southern part of its range can occur in wet and dry forests, montane sclerophyll woodland and montane riparian woodland (Daly 1996). Individuals can be found around sandy creek banks or foraging along ridge-tops during or directly after heavy rain. Males often call from burrows located in sandy banks next to water (Barker *et al.* 1995).	No	No
Litoria aurea	Green and Golden Bell Frog	E1	V	Found in marshes, dams and stream sides, particularly those containing bulrushes or spikerushes (NPWS 1999e). Preferred habitat contains water bodies that are unshaded, are free of predatory fish, have a grassy area nearby and have diurnal sheltering sites nearby such as vegetation or rocks (White and Pyke 1996, NPWS 1999e).	Yes	Yes
Litoria brevipalmata	Green-thighed Frog	V		The habitat for this species is poorly known. Has been found during October in flooded paddocks next to rainforest and are known to also breed in open forest. Breeding occurs in flooded paddocks or waterholes near to forest (Barker *et al.* 1995).	Yes	No, see fauna paragraphs (Appendix 3)

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Litoria littlejohni	Heath Frog	V	V	Occurs in wet and dry sclerophyll forests associated with sandstone outcrops between 280 and 1000 m on the eastern slopes of the Great Dividing Range (Barker *et al.* 1995). Prefers rock flowing streams, but individuals have also been collected from semi-permanent dams with some emergent vegetation (Barker *et al.* 1995). Forages both in the tree canopy and on the ground, and has been observed sheltering under rocks on high exposed ridges during summer. It is not known from coastal habitats.	Yes	Yes
Mixophyes balbus	Stuttering Frog	E1	V	This species is usually associated with mountain streams, wet mountain forests and rainforests (Barker *et al.* 1995). It rarely wanders very far from the banks of permanent forest streams, although it will forage on nearby forest floors. Eggs are deposited in leaf litter on the banks of streams and are washed into the water during heavy rains (Barker *et al.* 1995).	No	No
Mixophyes iteratus	Giant Barred Frog	E1	E	Usually found in coastal riverine rainforest and upland areas such ass the Border Ranges (Barker *et al.* 1995).	Yes, but suboptimal	No, no records within 10 km radius of study area
Pseudophryne australis	Red-crowned Toadlet	V		Occurs on wetter ridge tops and upper slopes of sandstone formations on which the predominant vegetation is dry open forests and heaths. This species typically breeds within small ephemeral creeks that feed into larger semi-perennial streams. These creeks are characterised after rain by a series of shallow pools lined by dense grasses, ferns and low shrubs (Thumm and Mahony 1996, Thumm and Mahoney 1997).	No	No
Reptiles						
Hoplocephalus bitorquatus	Pale-headed Snake	V		Found in a variety of habitats from wet sclerophyll forest to dry eucalypt forest on the western slopes of NSW (Swan 1990, Cogger 1992). Feeds largely on frogs and lizards (Cogger 1992).	Yes, but suboptimal	No, no records within 10 km radius of study area
Hoplocephalus stephensii	Stephen's Banded Snake	V		This nocturnal species is partly arboreal and is usually found in wet sclerophyll forest or rainforest. It feeds on lizards, birds and small mammals (Cogger 1992).	Yes, but suboptimal	No, no records within 10 km radius of study area
Birds						
Accipiter cirrhocephalus	Collared Sparrowhawk		M	Occurs in woodland and forest where there is suitable vegetation cover for ambushing prey. Prefer woodland habitats with leaf trees for nesting (Marchant and Higgins 1993b).	Yes	Yes
Accipiter fasciatus	Brown Goshawk		M	Prefer woodland and pen forest habitat. Although have been recorded in wet and dry eucalypt forest, Melaleuca swamp forest mallee and coastal heath (Marchant and Higgins 1993b).	Yes	Yes
Accipiter novaehollandiae	Grey Goshawk		M	Woodland, forest and coast lands with cover for hunting from perches. Prefers mature forest with strong stable branches for hunting. Hunt in within forested area and open country (Marchant and Higgins 1993b).	Yes	Yes
Acrocephalus stentoreus	Clamorous Reed-Warbler		M	This species lives singly or in pairs usually in wetlands with reeds. It feeds on insects (Blakers *et al.* 1984).	Yes	Yes

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Anas castanea	Chestnut Teal		M	Inhabits terrestrial wetlands and estuarine habitats mainly in coastal regions (Marchant and Higgins 1990b).	Yes	Yes
Anas gracilis	Grey Teal		M	Widespread species on terrestrial wetlands, sheltered estuarine and marine waters. Also recorded on farm dams in grasslands (Marchant and Higgins 1990b).	Yes	Yes
Anas rhynchotis	Australasian Shoveler		M	Aquatic species which is mainly found in wetlands in the Temperate Zone and sometimes in sheltered estuarine and inshore waters (Marchant and Higgins 1990b).	Yes	Yes
Anas superciliosa	Pacific Black Duck		M	Occurs in temperate and tropical terrestrial wetlands and sheltered estuarine and marine waters (Marchant and Higgins 1990b).	Yes	Yes
Anseranas semipalmata	Magpie Goose	V		Found in floodplains and swamps dominated by sedges and rushes (Simpson and Day 1996).	Yes	Yes
Apus pacificus	Fork-tailed Swift		M	Almost exclusively aerial (Higgins 1999).	No	No
Aquila audax	Wedge-tailed Eagle		M	Occur in a range of open or lightly wooded habitats including regenerating woodland, grasslands, alpine herbfields and mallee (Marchant and Higgins 1993b). Breed in woodland and forest away from roads or settlements, often in dense woodlands (Marchant and Higgins 1993b).	Yes	Yes
Ardea ibis	Cattle Egret		M	Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands (Marchant and Higgins 1993b).	Yes	Yes
Aviceda subcristata	Pacific Baza		M	In tropical and warm-temperate forested and wooded lands, particularly dense forest, but not rainforest; occasionally grasslands, farmlands and urban areas (Marchant and Higgins 1993a). In NSW to about Newcastle, but rare south of Grafton (Pizzey and Knight 1997b).	Yes	Yes
Aythya australis	Hardhead		M	Prefers large deep freshwater lakes and wetlands with abundant aquatic vegetation. Breed in permanent freshwater wetlands or floodwaters that area densely vegetated (Marchant and Higgins 1990a). Avoid main streams and rivers except where there are calm reaches where aquatic vegetation is present (Marchant and Higgins 1990a).	Yes	Yes
Biziura lobata	Musk Duck		M	Widespread species occurring in terrestrial wetlands, estuarine habitats and sheltered inshore waters (Marchant and Higgins 1993b).	Yes	Yes
Botaurus poiciloptilus	Australian Bittern	V		Inhabits terrestrial and estuarine wetlands, generally where there is permanent water. Prefers wetlands with dense vegetation including rushes and reeds (NPWS 1999a).	Yes	Yes
Burhinus grallarius	Bush Stone-curlew	E1		Terrestrial and estuarine wetlands where there is permanent water and lightly timbered, open forest or woodland habitat (Pizzey 1983). Dry, open grassland and cropland, with cover nearby, may also provide habitat for this species (Marchant & Higgins 1993).	Yes, but suboptimal	No, no records within 10 km radius of study area

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Callocephalon fimbriatum	Gang-gang Cockatoo	V		In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests (Higgins 1999). Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest (Forshaw and Cooper 1981). In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands, particularly in bo-ironbark assemblages, or in dry forest in coastal areas (Shields and Crome 1992). It requires tree hollows in which to breed (Gibbons and Lindenmayer 1997).	Yes	Yes
Calyptorhynchus banksii	Red-tailed Black-cockatoo	V		Occur in a wide variety of habitats, but prefer eucalypt forest and woodland, and often in adjacent Acacia or casuarina woodland or proteaceous woodland or shrubland, especially if recently burnt (Higgins 1999). In the arid zone they usually occur on open riverine plains, mainly near eucalypts along major watercourses, but also associated with casuarina woodlands nearby. They breed in the hollows of large trees, mainly dead eucalypts (Higgins 1999).	No	No
Calyptorhynchus lathami	Glossy Black-Cockatoo	V		Inhabits forest with low nutrients, characteristically with key Allocasuarina species. Tends to prefer drier forest types (NPWS 1999d) with a middle stratum of *Allocasuarina* below *Eucalyptus* or *Angophora*. Often confined to remnant patches in hills and gullies (Higgins 1999). Breed in hollows stumps or limbs, either living or dead (Higgins 1999).	Yes	Yes
Chenonetta jubata	Australian Wood Duck		M	Widespread in grasslands, woodlands and terrestrial wetlands (Marchant and Higgins 1993b).	Yes	Yes
Cinclorhamphus cruralis	Brown Songlark		M	This species lives on plains vegetated with grasses, crops or low shrubs acacia scrub and spinifex. It forages on the ground, mainly taking insects but also some seeds (Blakers *et al.* 1984).	No	No
Cinclorhamphus mathewsi	Rufous Songlark		M	This species lives on plains dominated by grass in woodland, acacia scrub and spinifex. It feeds on seeds and insects caught on the ground (Blakers *et al.* 1984).	No	No
Circus approximans	Swamp Harrier		M	Occur in terrestrial wetlands and open country. Mainly found in fresh or salt water with tall emergent vegetation (Marchant and Higgins 1993b). Nest in deep water with tall reed beds such as *Phragmites* or *Typha* (Marchant and Higgins 1993b).	Yes	Yes
Circus assimilis	Spotted Harrier		M	Open and wooded country with grassland nearby for hunting. Nest in open or remnant woodland (Marchant and Higgins 1993b)	Yes	Yes
Cisticola exilis	Golden-headed Cisticola		M	This species lives near lowland swamps in dense stands of native grass along the borders of rivers and in grain crops (Blakers *et al.* 1984)..	Yes	Yes
Climacteris picumnus	Brown Treecreeper (eastern subspecies)	V		Live in eucalypt woodlands, especially areas of relatively flat open woodland typically lacking a dense shrub layer, with short grass or bare ground and with fallen logs or dead trees present (Traill and Duncan 2000).	Yes	Yes

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Coracina tenuirostris	Cicadabird		M	In south-eastern Australia this species is found in eucalypt forest and woodland. It feeds on large insects collected from the leaves and bark (Blakers *et al.* 1984).	Yes	Yes
Cygnus atratus	Black Swan		M	Widespread species occurring in temperate and tropical terrestrial wetlands, sheltered estuarine and maritime habitats (Marchant and Higgins 1993b).	Yes	Yes
Dendrocygna arcuata	Wandering Whistling-duck		M	Occurs in tropical and subtropical regions in terrestrial wetlands and occasionally estuarine and littoral habitats (Marchant and Higgins 1993b).	Yes	Yes
Dendrocygna eytoni	Plumed Whistling-duck		M	Associated with tropical and temperate grasslands in coastal and inland areas. The stronghold for this species occurs in open grassland of western Qld (Marchant and Higgins 1993b).	Yes	Yes
Elanus axillaris	Black-shouldered Kite		M	Occurs over open country and grasslands, although less come in arid areas (Marchant and Higgins 1993b). Prefer tall open grass plains where the understorey is accessible from above for hunting (Marchant and Higgins 1993b). Nest in leafy tree in open woodland or grassland (Marchant and Higgins 1993b).	Yes	Yes
Elseyornis melanops	Black-fronted Dotterel		M	Occurs on the margins of terrestrial wetlands, dams, tanks, reservoirs, lakes and drainage channels (Marchant and Higgins 1993a). Prefers areas with shallow freshwater and muddy substrate such as receding floodwaters (Marchant and Higgins 1993a).	Yes	Yes
Ephippiorhynchus asiaticus	Black-necked Stork	E1		Found in swamps, mangroves and mudflats. Can also occur in dry floodplains and irrigated lands and occasionally forages in open grassy woodland. Nests in live or dead trees usually near water (Pizzey 1983).	Yes	Yes
Erythrogonys cinctus	Red-kneed Dotterel		M	Occurs on the margins of terrestrial wetlands. Prefers temporary or permanent freshwater wetlands, particularly those inundated by rain or floodwaters (Marchant and Higgins 1993b).	Yes	Yes
Erythrotriorchis radiatus	Red Goshawk	E1	VM	Occur in forest and woodland habitat near permanent water. In NSW prefer Melaleuca swamp forest and open eucalypt woodland (Marchant and Higgins 1993b). Require greater than 20 m tall for nesting (Marchant and Higgins 1993b).	Yes, but suboptimal	No, no records within 10 km radius of study area
Falco berigora	Brown Falcon		M	Occur in woodland and forest areas with open country nearby for hunting. Prefer pen habitats such as grassland and low shrublands (Marchant and Higgins 1993b).	Yes	Yes
Falco cenchroides	Nankeen Kestrel		M	Although found in a range of habitats is most commonly recorded from open country with low vegetation cover (Marchant and Higgins 1993b). Often in grasslands, low shrublands near water (Marchant and Higgins 1993b).	Yes	Yes
Falco hypoleucos	Grey Falcon	V	M	Found over open country and wooded lands of tropical and temperate Australia. Mainly found on sandy and stony plains of inland drainage systems with lightly timbered acacia scrub (Marchant and Higgins 1993b).	Yes, but suboptimal	No, no records within 10 km radius of study area

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Falco longipennis	Australian Hobby		M	Occur in lightly timbered country, preferring dry open forest and woodland (Marchant and Higgins 1993b). Nest in tall trees in or near woodland area (Marchant and Higgins 1993b).	Yes	Yes
Falco peregrinus	Peregrine Falcon		M	Wide variety of habitats including rainforest, woodland, forest, heath, alpine and coastal plains. Often nest in artificial cliffs such as quarries, railway cuttings and mine shafts (Marchant and Higgins 1993b)	Yes	Yes
Falco subniger	Black Falcon		M	Mainly occur in woodlands and open country where can hunt. Often associated with swamps, rivers and wetlands (Marchant and Higgins 1993b). Nest in tall trees along watercourses (Marchant and Higgins 1993b).	Yes	Yes
Falcunculus frontatus	Crested Shrike-tit		M	Occurs mainly in eucalypt forest and woodlands and occasionally in rainforest (Higgins and Peter 2002).	Yes	Yes
Gallinago hardwickii	Latham's Snipe		M	Typically found on wet soft ground or shallow water with good cover of tussocks. Often found in wet paddocks, seepage areas below dams (Pizzey and Knight 1997b).	Yes	Yes
Grantiella picta	Painted Honeyeater	V		Found mainly in dry open woodlands and forests, where it is strongly associated with mistletoe (Higgins *et al.* 2001). Often found on plains with scattered eucalypts and remnant trees on farmlands.	Yes	Yes
Haliaeetus leucogaster	White-bellied Sea-eagle		M	A migratory species that is resident to Australia. Found in terrestrial and coastal wetlands; favouring deep freshwater swamps, lakes and reservoirs; shallow coastal lagoons and saltmarshes (English and Predavec 2001).	Yes	Yes
Haliastur sphenurus	Whistling Kite		M	Occur in open to moderately dense woodlands and forest near wetlands. Habitats may include farmland, open forest, mallee, and grassland (Marchant and Higgins 1993b).	Yes	Yes
Hieraaetus morphnoides	Little Eagle		M	Most abundant in lightly timbered areas with open areas nearby. Often recorded foraging in grasslands, crops, treeless dune fields, and recently logged areas (Marchant and Higgins 1993b). May nest in farmland, woodland and forest in tall trees (Marchant and Higgins 1993b)	Yes	Yes
Himantopus himantopus	Black-winged Stilt		M	Prefers shallow, open freshwater wetlands especially those with dense growth of short grass or similar emergent vegetation (Marchant and Higgins 1993b).	Yes	Yes
Hirundapus caudacutus	White-throated Needletail		M	An aerial species found in feeding concentrations over cities, hilltops and timbered ranges (Pizzey 1983).	Yes	Yes
Irediparra gallinacea	Comb-crested Jacana	V		Occurs in freshwater wetlands, lagoons, Billabongs, swamps, lakes, rivers and reservoirs, generally with abundant floating aquatic vegetation (Marchant and Higgins 1993b).	Yes	Yes
Ixobrychus flavicollis	Black Bittern	V		Usually found on coastal plains below 200 m. Often found along timbered watercourses, in wetlands with fringing trees and shrub vegetation. The sites where they occur are characterised by dense waterside vegetation (NPWS 1999b).	Yes	Yes

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Lathamus discolor	Swift Parrot	E1	EM	The Swift Parrot occurs in woodlands and forests of New South Wales from May to August, where it feeds on eucalypt nectar, pollen an associated insects (Forshaw and Cooper 1981). The Swift Parrot is dependent on flowering resources across a wide range of habitat in its wintering grounds in New South Wales (Shields and Crome 1992). This species is migratory breeding in Tasmania and also nomadic moving about in response to changing food availability (Pizzey 1983).	Yes	Yes
Lichenostomus melanops	Yellow-tufted Honeyeater		M	Mainly occurs in open dry sclerophyll forest and woodland, usually dominated by eucalypts and a well-developed understorey and often near water (Higgins *et al.* 2001).	Yes	Yes
Malacorhynchus membranaceus	Pink-eared Duck		M	Widespread species in terrestrial wetlands. The stronghold of this species is in the inland plains (Marchant and Higgins 1993b).	Yes	Yes
Megalurus gramineus	Little Grassbird		M	Lives and breeds mainly in reedbeds and lignum swamps but is sometimes present in saltmarsh and on lake shores in woodland dominated by teatree and on Bass Straight Islands. It feeds on insects, terrestrial and aquatic molluscs and spiders (Blakers *et al.* 1984).	Yes	Yes
Megalurus timoriensis	Tawny Grassbird		M	This species lives in pairs and usually occurs in heath, reedbeds or on the edge of large, deep wetlands that contain open water and reeds. Sometimes recorded in drier areas (Blakers *et al.* 1984)..	Yes	Yes
Melanodryas cucullata	Hooded Robin	V		This species lives in a wide range of temperate woodland habitat, and a range of woodlands and shrublands in semi-arid areas (Traill and Duncan 2000).	Yes	Yes
Merops ornatus	Rainbow Bee-eater		M	Usually occurs in open or lightly timbered areas, often near water (Higgins 1999).	Yes	Yes
Milvus migrans	Black Kite		M	Open woodland and forest often favouring agricultural area. Roost in trees (Marchant and Higgins 1993b).	Yes	Yes
Monarcha melanopsis	Black-faced Monarch		M	A migratory species found during the breeding season in damp gullies in temperate rainforests. Disperses after breeding into more open woodland (Pizzey 1983).	Yes	Yes
Monarcha trivirgatus	Spectacled Monarch		M	Found in darker parts of mountain and lowland rainforest, adjacent to thickly wooded gullies (Pizzey 1983).	Yes	Yes
Myiagra cyanoleuca	Satin Flycatcher		M	Migratory species that occurs in coastal forests woodlands and scrubs during migration. Breeds in heavily vegetated gullies (Pizzey 1983).	Yes	Yes
Neophema pulchella	Turquoise Parrot	V		Occurs in open woodlands and eucalypt forests with a ground cover of grasses and understorey of low shrubs (Morris 1980). Generally found in the foothills of the Great Divide, including steep rocky ridges and gullies (Higgins 1999). Nest in hollow-bearing trees, either dead or alive; also in hollows in tree stumps. Prefer to breed in open grassy forests and woodlands, and gullies which are moist (Higgins 1999).	Yes	Yes

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Ninox connivens	Barking Owl	V		Generally found in open forests, woodlands, swamp woodlands and dense scrub. Can also be found in the foothills and timber along watercourses in otherwise open country (Pizzey 1983).	Yes	Yes
Ninox strenua	Powerful Owl	V		Occupies wet and dry eucalypt forests and rainforests. Can occupy both un-logged and lightly logged forests as well as undisturbed forests where it usually roosts on the limbs of dense trees in gully areas. It is most commonly recorded within Red Turpentine in tall open forests and Black She-oak within open forests (Debus and Chafer 1994). Large mature trees with hollows at least 0.5 m deep are required for nesting (Garnett 1992). Tree hollows are particularly important for the Powerful Owl because a large proportion of the diet is made up of hollow-dependent arboreal marsupials (Gibbons and Lindenmayer 1997). Nest trees for this species are usually emergent with a diameter at breast height of at least 100 cm (Gibbons and Lindenmayer 1997).	Yes	Yes
Numenius madagascariensis	Eastern Curlew		M	Occurs in sheltered coasts, especially estuaries, embayments, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats often with beds of seagrass (Higgins and Davies 1996).	No	No
Pachycephala olivacea	Olive Whistler	V		Found in a range of habitats including alpine thickets, wetter rainforest/woodlands, riparian vegetation and heaths (Pizzey and Knight 1997b).	Yes	Yes
Pandion haliaetus	Osprey	V	M	Found in coastal waters, inlets, estuaries and offshore islands. Occasionally found up larger rivers (Pizzey 1983).	Yes, but suboptimal	No, species only previously recorded near coast
Pomatostomus temporalis	Grey-crowned Babbler	V		Found in a range of habitats including open forests, woodlands, scrublands, farmlands and outer suburbs (Pizzey and Knight 1997b).	Yes	Yes
Ptilinopus magnificus	Wompoo Fruit-dove	V		Mainly occurs in large undisturbed patches of tall tropical or subtropical rainforest. Occasionally occurs in patches of monsoon forest, closed gallery forest, wet sclerophyll forest, tall open forest, open woodland or vine thickets near rainforest (Higgins and Davies 1996).	No	No
Ptilinopus regina	Rose-crowned Fruit-dove	V		Occurs in tall tropical and subtropical, evergreen or semi-deciduous rainforest, especially with dense growth of vines. Prefers large patches of rainforest, but sometimes occurs in remnant patches surrounded by sub-optimal habitat including farmlands (Higgins and Davies 1996).	No	No
Ptilinopus superbus	Superb Fruit-dove	V		Mostly closed forests, including monsoon rainforests and mesophyll vine forests (Higgins and Davies 1996).	No	No

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Pyrrholaemus sagittata	Speckled Warbler	V		This species occurs in eucalypt and cypress woodlands on the hills and tablelands of the Great Dividing Range. They prefer woodlands with a grassy understorey, often on ridges or gullies (Blakers *et al.* 1984, NSW Scientific Committee 2001). The species is sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. They forage on the ground and in the understorey for arthropods and seeds (Blakers *et al.* 1984, NSW Scientific Committee 2001). Home ranges vary from 6-12 hectares (NSW Scientific Committee 2001).	Yes	Yes
Recurvirostra novaehollandiae	Red-necked Avocet		M	Occur in a variety of wetland habitats but generally prefers shallow ephemeral inland wetlands. Breed mainly in vicinity of inland salt lakes (Marchant and Higgins 1993b).	Yes	Yes
Rhipidura rufifrons	Rufous Fantail		M	Migratory species that prefers dense, moist undergrowth of tropical rainforests and scrubs. During migration it can stray into gardens and more open areas (Pizzey 1983).	Yes	Yes
Rostratula benghalensis australis	Painted Snipe	V	M	Found in the fringes of swamps, dams, sewage farms, marshy areas, generally with cover of grasses, lignum or open timber (Pizzey and Knight 1997b).	Yes	Yes
Stagonopleura guttata	Diamond Firetail	V		Found in a range on habitat types including open Eucalypt forest, mallee and acacia scrubs (Pizzey and Knight 1997b).	Yes	Yes
Stictonetta naevosa	Freckled Duck	V	M	The freckled duck breeds in permanent fresh swamps that are heavily vegetated. Found in fresh or salty permanent open lakes, especially during drought. Often seen in groups on fallen trees and sand spits (Simpson and Day 1996).	Yes	Yes
Tyto capensis	Grass Owl	V		Occurs mainly in open tussock grassland, usually in treeless areas. Can also occur in marshy areas with tall dense tussocks of grass. Occasionally occurs in densely vegetated agricultural lands such as sugarcane fields (Higgins 1999).	Yes	Yes
Tyto novaehollandiae	Masked Owl	V		Inhabits a diverse range of wooded habitat that provide tall or dense mature trees with hollows suitable for nesting and roosting (Higgins 1999). Mostly recorded in open forest and woodlands adjacent to cleared lands. Nest in hollows, in trunks and in near vertical spouts or large trees, usually living but sometime dead (Higgins 1999). Nest hollows are usually located within dense forests or woodlands (Gibbons and Lindenmayer 1997). Masked owls do prey upon hollow-dependent arboreal marsupials, but terrestrial mammals make up the largest proportion of the diet (Gibbons and Lindenmayer 1997, Higgins 1999).	Yes	Yes

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Tyto tenebricosa	Sooty Owl	V		Often found in tall old-growth forests, including temperate and subtropical rainforests. In NSW mostly found on escarpments with a mean altitude <500 m. Nests and roosts in hollows of tall emergent trees, mainly eucalypts (Higgins 1999) often located in gullies (Gibbons and Lindenmayer 1997). Nests have been located in trees 125 to 161 centimetres in diameter (Gibbons and Lindenmayer 1997).	Yes	Yes
Vanellus miles	Masked Lapwing		M	Occurs in a wide range of natural and modified open habitats, usually near water (Marchant and Higgins 1993b).	Yes	Yes
Vanellus tricolor	Banded Lapwing		M	Occurs in open short grasslands, agricultural land, saline herbland and open savanna in dry and semi-arid regions (Marchant and Higgins 1993b).	Yes	Yes
Xanthomyza phrygia	Regent Honeyeater	E1	EM	A semi-nomadic species occurring in temperate eucalypt woodlands and open forests. Most records are from box-ironbark eucalypt forests associations and wet lowland coastal forests (Pizzey 1983, NPWS 1999g).	Yes	Yes
Zoothera dauma	Scaly Thrush		M	Shady areas and damp gullies of wet woodlands, rainforests and coastal scrubs; in winter to scrubs, woodlands, secondary growth in sub-inland (Pizzey and Knight 1997b).	Yes	Yes
Mammals						
Cercartetus nanus	Eastern Pygmy-possum	V		Inhabits rainforest through sclerophyll forest to tree heath. Banksias and myrtaceous shrubs and trees are a favoured food source. Will often nest in tree hollows, but can also construct its own nest (Turner and Ward 1995). Because of its small size it is able to utilise a range of hollow sizes including very small hollows (Gibbons and Lindenmayer 1997). Individuals will use a number of different hollows and an individual has been recorded using up to 9 nest sites within a 0.5ha area over a 5 month period (Ward 1990).	Yes, but suboptimal	No, no records within 10 km radius of study area
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Located in a variety of drier habitats, including the dry sclerophyll forests and woodlands to the east and west of the Great Dividing Range (Hoye and Dwyer 1995). Can also be found on the edges of rainforests and in wet sclerophyll forests (Churchill 1998). This species roosts in caves and mines in groups of between 3 and 37 individuals (Churchill 1998).	Yes	Yes
Dasyurus maculatus	Spotted-tailed Quoll	V	V	Uses a range of habitats including sclerophyll forests and woodlands, coastal heathlands and rainforests (Dickman and Read 1992). Habitat requirements include suitable den sites, including hollow logs, rock crevices and caves, and abundance of food and an area of intact vegetation in which to forage (Edgar and Belcher 1995).	Yes, but suboptimal	No, no records within 10 km radius of study area

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		Inhabit sclerophyll forests, preferring wet habitats where trees are more than 20 m high (Churchill 1998). Two observations have been made of roosts in stem holes of living eucalypts (Phillips 1995). There is debate about whether or not this species moves to lower altitudes during winter, or whether they remain sedentary but enter torpor (Menkhorst and Lumsden 1995). This species also appears to be highly mobile and records showing movements of up to 12 km between roosting and foraging sites (Menkhorst and Lumsden 1995).	Yes	Yes
Macropus parma	Parma Wallaby	V		Occurs in wet and dry sclerophyll forest with a thick, shrubby understorey associated with grassy patches. They may also occur in rainforest but prefer the wet sclerophyll forest (Strahan 1995). This species feed on grasses and herbs (Strahan 1995).	No	No
Miniopterus australis	Little Bent-wing Bat	V		Shows a preference for well timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests. Roost in caves, congregating into maternity colonies in summer months (Churchill 1998).	Yes	Yes
Miniopterus schreibersii	Common Bent-wing Bat	V	C	Uses a broad range of habitats including rainforests, wet and dry sclerophyll forests, open woodlands and open grasslands (Churchill 1998). Roosts in caves, but can also use man made structures such as mines and road culverts (Dwyer 1995, Churchill 1998). Specific caves are used as nursery caves, containing a large number of individuals, which can be used year after year (Dwyer 1995, Churchill 1998).	Yes	Yes
Mormopterus norfolkensis	East Coast Freetail Bat	V		Most records are from dry eucalypt forests and woodlands to the east of the Great Dividing Range. Appears to roost in trees, but little is known of this species habits (Allison and Hoye 1995, Churchill 1998).	Yes	Yes
Petaurus australis	Yellow-bellied Glider	V		Restricted to tall nature forests in regions of high rainfall. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows. Critical elements of habitat include sap-site trees, winter flowering eucalypts, mature trees suitable for den sites and a mosaic of different forest types (NPWS 1999h).	Yes	Yes
Petaurus norfolcensis	Squirrel Glider	V		Generally occurs in dry sclerophyll forests and woodlands but is absent from dense coastal ranges in the southern part of its range (Suckling 1995). Requires abundant hollow bearing trees and a mix of eucalypts, banksias and acacias (Quin 1995). There is only limited information available on den tree use by Squirrel gliders, but it has been observed using both living and dead trees as well as hollow stumps (Gibbons and Lindenmayer 1997). Within a suitable vegetation community at least one species should flower heavily in winter and one species of eucalypt should be smooth barked (Menkhorst *et al.* 1988).	Yes	Yes

Scientific Name	Common Name	TSC Act[a]	EPBC Act[b]	Habitat	Potential habitat	Impact Assessment
Petrogale penicillata	Brush-tailed Rock-wallaby	E1	V	Found in rocky areas in a wide variety of habitats including rainforest gullies, wet and dry sclerophyll forest, open woodland and rocky outcrops in semi-arid country. Commonly sites have a northerly aspect with numerous ledges, caves and crevices (Eldridge and Close 1995).	Yes, but suboptimal	No, no records within 10 km radius of study area
Phascogale tapoatafa	Brush-tailed Phascogale	V		Occurs in dry sclerophyll open forest, with a sparse ground cover of herbs, grasses, shrubs or leaf litter (Soderquist 1995, NPWS 1999c). Individuals may also inhabit heathland, swamps, rainforest and wet sclerophyll forest (NPWS 1999c). Nests and shelters in tree hollows, utilising many different hollows over a short period of time. Suitable hollows are 25-40 mm wide (NPWS 1999c).	Yes	No, no records within 10 km radius of study area
Phascolarctos cinereus	Koala	V		Inhabits eucalypt forests and woodlands. The suitability of these forests for habitation depends on the size and species of trees present, soil nutrients, climate and rainfall (Reed and Lunney 1990, Reed *et al.* 1990).	Yes	No, see fauna paragraphs (Appendix 3)
Planigale maculata	Common Planigale	V		Inhabits a range of habitats from rainforest, sclerophyll forest and grasslands to marshlands and rocky areas (Redhead 1995).	Yes	Yes
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, Melaleuca swamps and Banksia woodlands. Bats commute daily to foraging areas, usually within 15 km of the day roost (Tidemann 1995) although some individuals may travel up to 70 km (Augee and Ford 1999).	Yes	Yes
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V		Restricted to tall nature forests in regions of high rainfall. Preferred habitats are productive, tall open sclerophyll forests where mature trees provide shelter and nesting hollows. Critical elements of habitat include sap-site trees, winter flowering eucalypts, mature trees suitable for den sites and a mosaic of different forest types (NPWS 1999h).	Yes	Yes
Scoteanax rueppellii	Greater Broad-nosed Bat	V		Prefer moist gullies in mature coastal forests and rainforests, between the Great Dividing Range and the coast. They are only found at low altitudes below 500 m (Churchill 1998) In dense environments they utilise natural and human-made opening in the forest for flight paths. Creeks and small rivers are favoured foraging habitat (Hoye and Richards 1995). This species roosts in hollow tree trunks and branches (Churchill 1998).	Yes	Yes

a: V = Vulnerable, E1 = Endangered

b: V = Vulnerable, E = Endangered, C = Conservation Concern, M = Migratory

3.4 Potential impacts

3.4.1 Vegetation Clearing and Edge Effects

The proposed design changes will affect the same communities as the Approved Project. Using the 2005 mapping, the Approved Project removes about 167 ha of native vegetation (Table 5), which is similar to the 168 ha stated by Connell Wagner (1995, 1997, 2001) based on the 2001 mapping, but the relative proportion of clearing in each of the vegetation communities is different. The Proposed Project, excluding road-related ancillary infrastructure, would result in about 157 ha being cleared, including 26.6 ha of Kurri Sand Swamp Woodland. This would reduce the area of native vegetation to be cleared by about 11 ha and the area of Kurri Sand Swamp Woodland to be cleared by 1.9 ha when compared to the Approved Project (Table 5). However, when road-related ancillary infrastructure is taken into account, the Proposed Project would result in about 182 ha being cleared, including 33.7 ha of Kurri Sand Swamp Woodland. The Proposed Project, including road-related ancillary infrastructure not considered in the Approved Project, would increase the area of native vegetation to be cleared by about 25 ha and the area the of Kurri Sand Swamp Woodland to be cleared by 7.1 ha when compared to the Approved Project (Table 5). The increase in clearing is caused by the increase in vegetated areas present within the clearing footprint and recognition of clearing for road-related ancillary infrastructure, not an increase in the size of the road footprint itself, which has decreased.

The area of native vegetation cleared by the Proposed Project (182 ha) would exceed the 168 ha limit in Condition of Approval 60. A comparison of vegetation clearing calculations using both the 2001 and 2005 vegetation mapping is shown in Table 5.

Table 5: Vegetation communities removed and edge-affected by the Approved and Proposed Projects

Vegetation Community	2001 Vegetation Mapping[a]		Updated 2005 Vegetation Mapping					Difference in area to be cleared, excluding ancillary works (ha)
	Approved Project (Concept Design)		Approved Project (Concept Design)		Proposed Project (Concept Design with 15 design changes)		Proposed with ancillary works	
	Area to be cleared (ha)	Area edge effected (ha)	Area to be cleared (ha) [1]	Area edge effected (ha)[1]	Area to be cleared (ha)[2]	Area edge effected (ha)[2]	Area to be cleared (ha)[2]	
Alluvial Tall Moist Forest (Regional Significance)	9.1	10.2	6.6	9.5	7.6	12.5	8.6	+1.0
Central Hunter Ironbark-Spotted Gum Grey Box Forest	N/A	N/A	8.8	4.7	7.7	7.5	8.8	-1.1
Central Hunter Riparian Forest (EEC)	0.6	4.2	6.2	2.1	4.9	2.1	5.9	-1.3
Coastal Foothills Spotted Gum – Ironbark Forest	22.5	21.1	13.3	17.8	9.7	12.3	10.2	-3.6
Coastal Plains Smooth Barked Apple Woodlands	19.4	21.9	12.1	17.3	16.9	19.6	17.9	+4.8
Hunter Lowlands Redgum Forest (EEC)	16.1	17.0	15.6	16.6	13.7	16.7	16.8	-1.9

Vegetation Community	2001 Vegetation Mapping[a]		Updated 2005 Vegetation Mapping					Difference in area to be cleared, excluding ancillary works (ha)
	Approved Project (Concept Design)		Approved Project (Concept Design)		Proposed Project (Concept Design with 15 design changes)		Proposed with ancillary works	
	Area to be cleared (ha)	Area edge effected (ha)	Area to be cleared (ha) [1]	Area edge effected (ha)[1]	Area to be cleared (ha)[2]	Area edge effected (ha)[2]	Area to be cleared (ha)[2]	
Hunter Valley Moist Forest	N/A	N/A	1.0	1.3	0.9	0.9	1.2	-0.1
Kurri Sand Swamp Woodland (EEC)	33.7	41.4	28.5	15.2	26.6	13.3	33.7	-1.9
Lower Hunter Spotted Gum-Ironbark Forest (EEC)	67.0	87.1	75.0	69.2	68.5	62.0	78.3	-6.5
Total	168	203	167	154	157	147	182	-11

a: Calculated from the AFFA (Connell Wagner 1995, 1997, 2001).
All figures in hectares have been rounded to the nearest tenth. Column totals are rounded to the nearest hectare.

3.4.2 Design Changes

3.4.2.1 Design Parameters

Apart from the change to median widths, the other design parameters would have a minor change to vegetation clearing when compared to the Approved Project and are reflected in the vegetation clearing summary in Table 5. The impacts of the change to median widths would reduce vegetation clearing and are discussed in Section 3.4.2.2. Overall, these design changes would reduce vegetation clearing.

3.4.2.2 Median Narrowing

The narrowing of the median would reduce clearing in seven vegetation communities. It is estimated that the proposed changes would reduce the construction footprint by about 16 ha. Based on approximately 50% native vegetation cover over the length of the Project, the proposed design change would reduce clearing of native vegetation by approximately 8 ha. Narrowing the median width would also have a positive ecological outcome by reducing the length of fauna crossing structures.

3.4.2.3 Newcastle Interchange (Figure 2)

Although targeted surveys were not conducted on the changes to the Newcastle Interchange during this study, no threatened plant species were previously recorded within this area (Harrington *et al.* 2005b). No Endangered Ecological Communities (EECs) were recorded within the footprint of the new interchange design. No threatened fauna species were previously recorded in this location, although the Sooty Owl was located approximately 1 km northwest along the alignment on the Stockrington Road ridge (Harrington *et al.* 2005b). The Masked Owl has been previously recorded approximately 500 m west of this location (DEC Atlas of NSW Wildlife). Squirrel Gliders have also been detected in the vicinity of the Sugarloaf Range Section (Connell Wagner 1997).

The new interchange design will impact moderate quality Coastal Plains Smooth-barked Apple Woodland (previously logged, mid-storey sparse, ground cover limited, transected by tracks and easements, and subject to rubbish dumping). The new design will result in an increase in vegetation clearing (9.0 ha compared with 5.2 ha; see Figure 3). However, and more importantly, the impact on Minmi Creek is reduced, with the replacement of a 130 m long culvert with four bridges. This area falls within a DEC regional corridor, which is located from east of Mount Sugarloaf to the 'Tank Paddock' and is described as the ridge running east north-east from Mount Sugarloaf together with the waterways and riparian areas north (Blue Gum Creek) and south (Minmi Creek) of the ridge. The proposed bridges over Minmi Creek will allow uninterrupted wildlife movements under the F3 to Branxton Link within this recognised corridor, providing greater connectivity than the Approved Project. The improved connectivity in this area is considered to be more important than a slight increase in vegetation clearing of moderate quality Coastal Plains Smooth-barked Apple Woodland. The Newcastle Interchange design changes are considered likely to have a decreased impact on ecological values compared with the Approved Project.

3.4.2.4 Sugarloaf Realignment (Figure 3)

The realignment will avoid a significant population of *Tetratheca juncea* (>100 clumps), although it will result in the loss of a new population of 33 clumps. No EECs were recorded within the footprint of the new alignment. The Sooty and Masked Owls (TSC Act) have been previously located in this section (Harrington *et al.* 2005b). Squirrel Gliders have also been detected in the vicinity of the Sugarloaf Range Section (Connell Wagner 1997).

The most significant impact on fauna from the Approved Project was the disruption to connectivity in the Sugarloaf Range. This is particularly pertinent as DEC has identified the ridge running east north-east from Mount Sugarloaf together with the waterways and riparian areas north (Blue Gum Creek) and south (Minmi Creek) of the ridge as a regional wildlife corridor. Burnt Creek and the three unnamed gullies between Stockrington Road ridge and Blue Gum Creek provide important riparian habitat within this regional corridor. The Proposed Project would significantly increase connectivity, when compared with the Approved Project, as uninterrupted riparian vegetation along the creek lines would be maintained. The inclusion of high (up to about 40 m) viaducts at these locations would allow a native plant understorey to recolonise the area beneath the viaducts, allowing all fauna species to move through this habitat linkage. Vegetation clearing would only be required for access tracks and pylons. The viaducts would maintain key wildlife links along the Sugarloaf Range and associated creek valleys.

In addition to the improved connectivity provided by this design change, less vegetation will require clearing (20.7 ha compared with 22.6 ha). The required clearing will increase from 2.1 ha to 3.2 ha for Alluvial Tall Moist Forest and 7.1 ha to 7.6 ha for Coastal Plains Smooth-barked Apple Woodland, but decrease from 13.4 ha to 9.7 ha for

Coastal Foothills Spotted Gum - Ironbark Forest. Overall, this design is likely to have a decreased impact on ecological values compared to the Approved Project.

3.4.2.5 Surveyors Creek Realignment (Figure 4)

No threatened plant species were recorded within the footprint of the Surveyors Creek Realignment. However, Lower Hunter Spotted Gum - Ironbark Forest, which is listed as an EEC on the TSC Act, will be impacted. The Powerful Owl has been previously recorded in this section (Harrington *et al.* 2005b), while Squirrel Gliders have been detected in the vicinity of the Sugarloaf Range Section (Connell Wagner 1997).

The Surveyors Creek Realignment will impact moderate quality Alluvial Tall Moist Forest and Lower Hunter Spotted Gum - Ironbark Forest. The new alignment of the F3 to Branxton Link in this section will have a positive ecological outcome as the amount of vegetation that will require clearing will decrease from 13.7 ha to 10.4 ha. The required clearing will decrease from 2.6 ha to 1.8 ha for Alluvial Tall Moist Forest and 11.1 to 8.6 ha for Lower Hunter Spotted Gum - Ironbark Forest.

The elimination of water pondages/sedimentation basins as a water supply for animals would not have an adverse impact on animals likely to utilise them and would potentially reduce vegetation clearing. Proposed fauna fencing would prevent animals crossing the carriageways to reach water supplies on the southern side of the F3 to Branxton Link.

3.4.2.6 Buchanan Interchange (Figure 5)

No threatened plant species were recorded under the footprint of the design change for Buchanan Interchange. However, Lower Hunter Spotted Gum - Ironbark Forest, which is listed as an EEC on the TSC Act, will be impacted. No threatened animal species have been previously located in the vicinity of Buchanan Interchange.

The new interchange design would impact Lower Hunter Spotted Gum - Ironbark Forest and Alluvial Tall Moist Forest, both of which are considered to be in poor condition (previously logged, mid-storey absent, ground cover dominated by introduced grasses and weeds, and subject to grazing). It was anticipated that the new design for Buchanan Interchange would have a positive ecological outcome as the amount of vegetation that would require clearing would decrease. However, due to the absence of modelling of the cut and fill batters for the on/off ramps and roundabouts for the Approved Project, comparisons of vegetation clearing for the two designs resulted in vegetation clearing increasing from 4.3 ha to 5.8 ha. With the Proposed Project the required clearing would increase from 0.3 ha to 0.6 ha for Alluvial Tall Moist Forest and 4.0 ha to 5.2 ha for Lower Hunter Spotted Gum - Ironbark Forest. Although not apparent in the vegetation clearing calculations, the new design for Buchanan Interchange would have a positive ecological outcome by reducing vegetation clearing.

3.4.2.7 Averys Lane Overpass (Figure 6)

No threatened plant species or EECs were recorded under the footprint of the design change for Averys Lane. No threatened animal species have been previously located in the vicinity of the Averys Lane design change.

The Averys Lane design change will impact poor quality Alluvial Tall Moist Forest (previously logged, mid-storey absent, ground cover dominated by introduced grasses and weeds, and subject to grazing). The design change will have a negative ecological outcome as the amount of Alluvial Tall Moist Forest that will require clearing will increase from 0.3 ha to 0.7 ha.

3.4.2.8 Kurri Kurri Interchange (Figure 7)

Eucalyptus parramattensis ssp. *decadens*, a threatened species, was recorded within the footprint of the new interchange design. Additionally, Kurri Sand Swamp Woodland, which is listed as an EEC on the TSC Act will be impacted. No threatened animal species have been detected in the vicinity of Kurri Kurri Interchange, although Squirrel Gliders have been recorded in the Kurri Kurri area (DEC Atlas of NSW Wildlife).

The Kurri Kurri Interchange design change will impact poor quality Kurri Sand Swamp Woodland (previously logged, mid-storey sparse, ground cover limited, transected by tracks and easements, and subject to rubbish dumping). It was anticipated that the Kurri Kurri Interchange design change would have a positive ecological outcome as the amount of Kurri Sand Swamp Woodland that would require clearing would decrease. However, due to the absence of modelling of the cut and fill batters for the on/off ramps and roundabouts on the Approved Project, comparisons of vegetation clearing for the two designs resulted in vegetation clearing of Kurri Sand Swamp Woodland increasing from 3.1 ha to 3.8 ha.

An improvement of the new interchange design is that Stanford Road will be closed, which may increase connectivity within the adjacent patches of Kurri Sand Swamp Woodland, particularly when the road is revegetated. The closure of Stanford Road may also reduce rubbish dumping within adjacent Kurri Sand Swamp Woodland, as vehicle access may be reduced. Although not apparent from the vegetation clearing calculations, the new design for Kurri Kurri Interchange will have a positive ecological outcome due to reduced vegetation clearing and fragmentation.

3.4.2.9 McLeod Road Overpass (Figure 8)

Eucalyptus parramattensis ssp. *decadens*, a threatened species, was recorded within the footprint of the McLeod Road Overpass design change. Additionally, Kurri Sand Swamp Woodland, which is listed as an EEC on the TSC Act, will be impacted. No threatened animal species have been detected in the vicinity of the McLeod Road

Overpass, although Squirrel Gliders have been recorded in the Kurri Kurri area (DEC Atlas of NSW Wildlife).

The new design change will impact two small fragmented patches of good quality Kurri Sand Swamp Woodland. The new design will have a positive ecological outcome, as the amount of Kurri Sand Swamp Woodland that will require clearing will decrease from 2.3 ha to 2.1 ha.

3.4.2.10 South Maitland Railway and Swamp Creek (Figure 9)

A separate impact assessment has been conducted for the South Maitland Railway development (Harrington and Gorrod 2005, Smith 2005, Harrington 2006), the impacts from which are not part of the F3 to Branxton Link. However, the impacts from changes to Swamp Creek Bridge, required because of changes to South Maitland Railway, are part of the F3 to Branxton Link assessment. The impacts from the South Maitland Railway development and Swamp Creek Bridge design change are summarised below.

South Maitland Railway

No threatened plant species were recorded within the footprint of the South Maitland Railway development. However, Kurri Sand Swamp Woodland and Central Hunter Riparian Forest, which are listed as an EEC on the TSC Act, will be impacted. No threatened animal species have been detected in the vicinity of the site, although Squirrel Gliders have been recorded in the Kurri Kurri area (DEC Atlas of NSW Wildlife).

The changes will result in the removal of 1.1 ha of native vegetation, including 1.0 ha of Kurri Sand Swamp Woodland and 0.1 ha of Central Hunter Riparian Forest. Harrington and Gorrod (2005), Smith (2005) and Harrington (2006), determined that the proposed South Maitland Railway development, in isolation of the F3 to Branxton Link, is unlikely to constitute a significant impact to any threatened (or migratory) species, population or ecological community listed under the TSC or EPBC Acts.

Clearing associated with this development is separate from the Approved Project and does not contribute towards the clearing limits in Conditions of Approval 60 and 61.

Swamp Creek

Eucalyptus parramattensis ssp. *decadens*, a threatened species, has previously been recorded within the footprint of the Swamp Creek design change (Harrington *et al.* 2005b). Additionally, Kurri Sand Swamp Woodland, which is listed as an EEC on the TSC Act, will be impacted. No threatened animal species have been detected in the vicinity of the proposed Swamp Creek Bridge, although Squirrel Gliders have been recorded in the Kurri Kurri area (DEC Atlas of NSW Wildlife).

The design change to Swamp Creek Bridge will impact moderate quality Kurri Sand Swamp Woodland and Central Hunter Riparian Forest. The new design will have a

positive ecological outcome as the amount of vegetation that will require clearing will decrease from 4.0 ha to 3.0 ha. The required clearing will decrease from 2.6 ha to 2.1 ha for Kurri Sand Swamp Woodland and 1.3 ha to 0.9 ha for Central Hunter Riparian Forest.

3.4.2.11 Loxford Interchange (Figure 10)

Eucalyptus parramattensis ssp. *decadens*, a threatened species, was recorded within the footprint of the new interchange design. Additionally, Kurri Sand Swamp Woodland and Lower Hunter Spotted Gum - Ironbark Forest, both of which are listed as EECs on the TSC Act will be impacted. No threatened animal species have been detected in the vicinity of the proposed Loxford Interchange, although Squirrel Gliders have been recorded in the Kurri Kurri area (DEC Atlas of NSW Wildlife).

The new on/off-ramp design of the interchange will impact the edges of a small patch of moderate quality Kurri Sand Swamp Woodland and Lower Hunter Spotted Gum - Ironbark Forest. Although the centre of this patch of Kurri Sand Swamp Woodland is of moderate to good condition, the areas impacted by the changes are of poor quality, having been previously cleared, a weed-dominated ground cover and subject to grazing.

It was anticipated that the new design for Loxford Interchange would slightly increase clearing. However, due to the absence of modelling of the cut and fill batters for the on/off ramps, the Approved Project understates the clearing area. Comparisons of vegetation clearing for the two designs resulted in vegetation clearing increasing from 3.4 ha to 4.6 ha. The clearing would increase from 3.0 ha to 4.1 ha for Kurri Sand Swamp Woodland and 0.4 ha to 0.5 ha for Lower Hunter Spotted Gum - Ironbark Forest. Despite the indicated increase in clearing, the new design is unlikely to worsen the ecological outcome when compared to the Approved Project.

3.4.2.12 Sawyers Gully Realignment (Figure 11)

No threatened plant species were recorded within the footprint of the new alignment. However, Lower Hunter Spotted Gum - Ironbark Forest, which is listed as an EEC on the TSC Act, will be impacted. No threatened animal species have been detected in the vicinity of this section.

The new alignment will impact the edges of a large patch of moderate quality Lower Hunter Spotted Gum - Ironbark Forest and a small patch of Central Hunter Riparian Forest. The new alignment in this section will have a positive ecological outcome as the amount of vegetation that will require clearing will decrease from 5.0 ha to 3.9 ha. The required clearing will decrease from 4.3 ha to 3.3 ha for Lower Hunter Spotted Gum - Ironbark Forest and 0.7 ha to 0.6 ha for Central Hunter Riparian Forest.

3.4.2.13 Allandale Interchange (Figure 12)

No threatened plant species were recorded under the footprint of the design change to the Allandale Interchange. However, a thin strip of Lower Hunter Spotted Gum-Ironbark Forest, which is listed as an EEC on the TSC Act, will be impacted along Lovedale Road. No threatened animal species have been detected in the vicinity of the proposed Allandale Interchange, although Squirrel Gliders have been recorded on the footprint further to the north near Camp Road (Connell Wagner 2000).

The realignment of Lovedale Road will impact moderate quality Lower Hunter Spotted Gum - Ironbark Forest. The new alignment of Allandale Quarry Road will now avoid a small patch of Hunter Lowland Redgum Forest. The new alignments of these roads will have a slightly positive ecological outcome as the required clearing for Lower Hunter Spotted Gum - Ironbark Forest will decrease from 0.8 ha to 0.7 ha.

3.4.2.14 Camp Road Realignment (Figure 13)

No threatened plant species were recorded under the footprint of the design changes to the alignment. However, Hunter Lowland Redgum Forest and Lower Hunter Spotted Gum - Ironbark Forest, both of which are listed as EECs on the TSC Act occur immediately adjacent to the new alignment. Squirrel Gliders have been recorded in the surrounding forest patches (Connell Wagner 2000).

The new alignment of Camp Road will impact isolated trees on the edge of a patch of Hunter Lowland Redgum Forest at the northern end and Lower Hunter Spotted Gum - Ironbark Forest at the southern end, although no habitat trees will be impacted. Vegetation along the rest of the new alignment is cleared farmland. However, the reduced bridge length and its associated batters will result in a positive ecological outcome as the amount of vegetation that requires clearing will decrease from 7.1 ha to 5.4 ha. The required clearing will decrease from 5.1 ha to 3.9 ha for Hunter Lowland Redgum Forest and 2.0 ha to 1.5 ha for Lower Hunter Spotted Gum - Ironbark Forest.

3.4.2.15 Tuckers Lane to Black Creek Section (Figure 14)

No threatened plant species were recorded under the footprint of the design changes within this section. However, Hunter Lowland Redgum Forest and Lower Hunter Spotted Gum - Ironbark Forest, both of which are listed as EECs on the TSC Act will be impacted. The Grey-crowned Babbler has been previously detected in this section (Harrington *et al.* 2005b).

The vegetation surrounding the proposed changes between Tuckers Lane and Black Creek consists of a significant area of disturbed Lower Hunter Spotted Gum - Ironbark Forest, a small patch of heavily disturbed and regenerating Hunter Lowland Redgum Forest and a small patch of disturbed Central Hunter Riparian Forest. Although cleared pastures, roads and a railway already fragment this habitat, it provides a string of forest

refugia in what is a mostly cleared area. The design changes in this section will slightly decrease connectivity in an east-west direction within the forest patch. However, connectivity in the vicinity is already disturbed, as agricultural land and Wine Country Drive lies to the west of the proposed interchange, separating the woodland patches on either side of Wine Country Drive and causing a hindrance to fauna movements. Additionally, no threatened animal species have been recorded in the immediate vicinity of the new interchange and the only species likely to move through this region are macropods. Most fauna movements between the forest patches on either side of the Wine Country Drive would take place south of the proposed interchange where the woodland is continuous (although sparse) immediately north of North Rothbury.

Moving the new interchange to the west, closer to Branxton, will lessen the ecological impacts compared with the old alignment, as it will reduce disturbance and vegetation clearing in an area where Grey-crowned Babblers (TSC-listed) have been recorded.

The Tuckers Lane to Black Creek design change (new alignment of the F3 to Branxton Link and new interchange design) will impact moderate quality Central Hunter Ironbark-Spotted Gum-Grey Box Forest and Lower Hunter Spotted Gum - Ironbark Forest and poor quality Hunter Lowland Redgum Forest, as well as Central Hunter Riparian Forest along Anvil and Black Creeks. The design change will have a positive ecological outcome when compared with the old design as the amount of vegetation that will require clearing will decrease from 36.7 ha to 33.2 ha. The required clearing will decrease from 8.8 ha to 7.7 ha for Central Hunter Ironbark-Spotted Gum-Grey Box Forest, 1.0 ha to 0.5 ha for Central Hunter Riparian Forest and 26.3 ha to 24.3 ha for Lower Hunter Spotted Gum - Ironbark Forest. The area of Hunter Lowland Redgum Forest to be cleared (0.7 ha) will remain unchanged.

3.4.3 Road-related Ancillary Infrastructure

3.4.3.1 Construction and Maintenance Access

Construction and maintenance access would require additional clearing of native vegetation in all nine vegetation communities when compared to the Approved Project. The RTA has reduced the areas that would require clearing for construction and maintenance access as far as is practical and provided a more accurate clearing estimate than the Approved Project.

The vegetation clearing areas for the Approved Project with the 15 proposed design changes and road-related ancillary infrastructure presented in Table 5 include construction and maintenance access.

3.4.3.2 Boundary and Fauna Exclusion Fencing

Boundary and fauna exclusion fencing would require additional clearing of native vegetation in all vegetation communities except Coastal Plains Smooth-barked Apple Woodland and Coastal Foothills Spotted Gum-Ironbark Forest when compared to the Approved Project. The total area of native vegetation that would be cleared for fencing would be 18.2 ha. The RTA has reduced the areas that would require clearing for boundary and fauna exclusion fencing as far as is practical and provided a more accurate clearing estimate than the Approved Project.

The vegetation clearing areas for the Approved Project with the 15 proposed design changes and road-related ancillary infrastructure presented in Table 5 include all fencing.

3.4.3.3 Water Quality Controls

The construction and operation of stormwater quality controls would require additional clearing of native vegetation in all vegetation communities when compared to the Approved Project. The total area of native vegetation that would be cleared for water quality controls would be 6.4 ha across nine vegetation communities. The RTA has reduced the areas that would require clearing for water quality controls as far as is practical and provided a more accurate clearing estimate than the Approved Project.

The vegetation clearing areas for the Approved Project with the 15 proposed design changes and road-related ancillary infrastructure presented in Table 5 include all water quality controls.

4.0 SIGNIFICANCE ASSESSMENTS

4.1 Seven Part Test Results

The conclusions of the Significance Assessments for flora, fauna and endangered ecological communities are summarised below. Full Seven Part Tests are detailed in Appendix 1.

4.1.1 Vegetation Communities

Significance Assessments (Seven Part Tests) were conducted for the four EECs (Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest, Lower Hunter Spotted Gum – Ironbark Forest and Central Hunter Riparian Forest) that occur within the study area and concluded that a significant impact was likely for Kurri Sand Swamp Woodland and Hunter Lowland Redgum Forest (Appendix 1). This is the same outcome as for the Approved Project (Harrington *et al.* 2005b).

4.1.2 Flora

Potential habitat was recorded within the study area for ten threatened flora species listed on the TSC Act (Table 3) and Seven Part Tests for these species concluded that a significant impact was likely for *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea* (Appendix 1).

Tetratheca juncea was assessed in the EIS (Connell Wagner 1995) and was considered not likely to be significantly impacted. Appendix A of the AFFA report (Connell Wagner 2001) contains Significance Assessments for *E. parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, *Persoonia pauciflora* and *T. juncea*. The AFFA report concluded that significant impacts were likely for *E. parramattensis* ssp. *decadens* and *P. pauciflora*. This report and the UAFFA (Harrington *et al.* 2005b) concluded that *Persoonia pauciflora* was unlikely be significantly impacted.

Although the design changes and road-related ancillary infrastructure discussed above have increased vegetation clearing compared with the Approved Project, the magnitude of the ecological impacts from the F3 to Branxton Link has not changed, and as such, the results of the assessments of threatened plant species for the Proposed Project remain unchanged compared with the Approved Project.

4.1.3 Endangered Plant Populations

No endangered plant populations have been recorded within the Cessnock or Lake Macquarie map sheets. Seven Part Tests were not prepared for any threatened plant

populations.

4.1.4 Fauna

Based on previous reports and the DEC Atlas of NSW Wildlife 50 threatened animal species have potential habitat within the Kurri Kurri Corridor and were assessed under the TSC Act. For two of these species (Green-thighed Frog and Koala) it was determined that potential habitat was unlikely to be affected by the Proposed Project (Appendix 3) and hence, Seven Part Tests were not conducted. For an additional eleven species (Giant Barred Frog, Pale-headed Snake, Stephen's Banded Snake, Bush Stone-curlew, Red Goshawk, Grey Falcon, Osprey, Eastern Pygmy-possum, Spotted-tailed Quoll, Brush-tailed Rock-wallaby and Brush-tailed Phascogale) the habitat was suboptimal and/or there were no previous records within 10 km of the study site, and hence, Seven Part Tests were not conducted. Seven Part Tests have been prepared for the remaining 37 species and determined that none of these were likely to be significantly impacted (Appendix 1).

The Proposed Project would remove about 182 ha of potential habitat, with a further 147 ha edge affected. Potential habitat for threatened animal species in the vicinity of the F3 to Branxton Link is likely to be significantly less fragmented by the Proposed Project when compared with the Approved Project, due to the provision of viaducts through the Sugarloaf Range section.

Although Eight Part Tests for the Approved Project determined that woodland birds and the Olive Whistler would be significantly impacted by causing a barrier to movement (Harrington *et al.* 2005b), Seven Part Tests for the Proposed Project determined that the provision of viaducts had maintained sufficient connectivity that these species would now not be significantly impacted (Appendix 1). Although Connell Wagner's AFFA report (2001) determined that six listed bat species (Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat and Large-eared Pied Bat) were likely to be significantly impacted by the Approved Project, assessments of bats for the Proposed Project determined that a significant impact was unlikely because of proposed mitigation measures (see Appendix 4). Therefore, no threatened animal species listed on the TSC Act are likely to be significantly impacted by the Proposed Project.

4.1.5 Aquatic

A separate aquatic assessment was prepared for the Proposed Project (Beitzel 2005). No threatened aquatic species, populations or endangered ecological communities were located during this survey. In addition, there are no threatened aquatic species, populations or endangered ecological communities listed under the *Fisheries Management Act* 1994 and *Environment Protection and Biodiversity Conservation Ac*t

1999, that have potential habitat within the F3 to Branxton Link study area.

4.2 EPBC Act Significance Assessment

4.2.1 Flora

Seven threatened species listed as either vulnerable under the EPBC Act have potential habitat in the study area. These include *Acacia bynoeana*, *Cryptostylis hunteriana*, *Eucalyptus glaucina*, *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, *Rutidosis heterogama* and *Tetratheca juncea. Persoonia pauciflora* is listed as critically endangered under the EPBC Act and has potential habitat in the study area. Assessments under the Significant Impact Criteria have been conducted for each of the aforementioned species listed on the EPBC Act.

Of these species, *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea* were determined likely to be significantly impacted by the Proposed Project.

4.2.2 Fauna

4.2.2.1 Threatened Species

Of the 12 threatened animal species listed on the EPBC Act from Table 4, ten are considered to have potential habitat within the Kurri Kurri Corridor. Four of these species have not been previously recorded within 10 km of the study site and were therefore not considered further. Four Vulnerable (Green and Golden Bell Frog, Grey-headed Flying-fox, Heath Frog and Large-eared Pied Bat) and two Endangered (Regent Honeyeater and Swift Parrot) species have potential habitat within the study area. An EPBC Act Assessment of Significance for these species concluded that the Proposed Project is unlikely to have a significant impact on any of these threatened species (Appendix 2).

4.2.2.2 Migratory Species

Of the 61 migratory species, fifty-seven are considered to have potential habitat within the study area and have been considered under the EPBC Act Assessment of Significance (Table 4). Although these species may use the study area on a temporary basis it is unlikely they would be wholly dependent upon the resources within the Kurri Kurri Corridor. Based on the EPBC Assessment of Significance it is unlikely that the Proposed Project would have a significant impact on any of these migratory species (Appendix 2). The results of these assessments of migratory species for the Proposed Project remain unchanged compared with the Approved Project (Harrington *et al.*

2005b).

4.3 Overall Impact Assessment

The Proposed Project is likely to have a significant impact on three threatened plant species (TSC and EPBC Acts) and two EECs (TSC Act only). The provision of viaducts in the Sugarloaf Range section has significantly reduced the barrier affect of the Proposed Project, and as such, animal species (Woodland Birds and Olive Whistler) that were considered likely to be significantly impacted by the Approved Project are now unlikely to be significantly impacted. The impact on bat species is no longer significant due to the provision of mitigation measures for the Proposed Project. A summary of threatened species and communities significantly impacted by both the Approved Project and Proposed Project is provided in Table 6.

Table 6: Summary of threatened species and communities significantly impacted by the proposed F3 to Branxton Link according to assessment

	Approved Project			Proposed Project
	AFFA May 2001	**NPWS Conditions October 2001**	**UAFFA October 2005**	**Design Change Report January 2007**
EECs	Kurri Sand Swamp Woodland	Kurri Sand Swamp Woodland	Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest	Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest
Flora	*Eucalyptus parramattensis* ssp. *decadens*, *Persoonia pauciflora*	*Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora ssp. parviflora*, *Persoonia pauciflora*	*Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, *Tetratheca juncea*	*Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, *Tetratheca juncea*
Fauna	Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Green and Golden Bell Frog	Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Green and Golden Bell Frog, Powerful Owl, Masked Owl	Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat, Large-eared Pied Bat, Woodland Birds (Brown Treecreeper, Speckled Warbler, Hooded Robin, Diamond Firetail and Grey-crowned Babbler), Olive Whistler	
Total	One community, three plants, seven animals	One community, three plants, nine animals	Two communities, three plants, 12 animals	Two communities, three plants

5.0 CONCLUSION

This report is an addendum to the UAFFA report (Harrington *et al.* 2005b), which assessed the impacts on threatened species and communities of the Approved Project. This report assesses the Proposed Project, which includes 15 design changes and road-related ancillary infrastructure to the F3 to Branxton Link not considered in the assessment of the Approved Project.

The 15 design changes for the Proposed Project, excluding road-related ancillary infrastructure, would reduce the area of native vegetation to be cleared by about 11 ha to 157 ha and the area of Kurri Sand Swamp Woodland to be cleared by about 1.9 ha to 26.6 ha when compared to the Approved Project (Table 5). Because the Approved Project did not include fully-developed footprints for interchanges and ramps it understated the clearing required to construct the Approved Project. Therefore the reduction in clearing areas between the Proposed Project and the Approved Project is greater than stated in this report and under-represents the efforts made to reduce clearing during the design review phase for the Proposed Project.

When road-related ancillary infrastructure is taken into account, the Proposed Project would result in about 182 ha of native vegetation being cleared, including 33.7 ha of Kurri Sand Swamp Woodland. The Proposed Project, including road-related ancillary infrastructure not considered in the Approved Project, would exceed the limit in CoA 60 on native vegetation to be cleared by about 14 ha. However, the area of Kurri Sand Swamp Woodland to be cleared by the Proposed Project (33.7 ha) does not exceed the limit stated in CoA 61 (33.7 ha). The increase in clearing for the Proposed Project is caused by road-related ancillary infrastructure (25 ha), rather than an increase in the size of the F3 to Branxton Link footprint itself, which has decreased considerably when compared with the Approved Project.

This report assessed 58 animal species listed on the TSC Act and 61 migratory and 12 threatened animal species listed on the EPBC Act and determined that none were likely to be significantly impacted. Although Significance Assessments for the Approved Project determined that five Woodland Birds and the Olive Whistler would be significantly impacted, because the F3 to Branxton Link caused a barrier to movement (Harrington *et al.* 2005b), assessments for the Proposed Project determined that the provision of viaducts had maintained connectivity at such a level that these species would now not be significantly impacted. Although the AFFA report (Connell Wagner 2001) determined that six listed bat species (Yellow-bellied Sheathtail-bat, Eastern Little Mastiff-bat, Large Bent-wing Bat, Little Bent-wing Bat, Greater Broad-nosed Bat and Large-eared Pied Bat) were likely to be significantly impacted by the Approved Project, assessments for the bats in this report for the Proposed Project determined that a significant impact was unlikely. Therefore, no threatened animal species listed on the TSC Act are likely to be significantly impacted by the Proposed Project.

This report assessed ten plant species (*Corybas dowlingii, Eucalyptus fracta*, *E. glaucina*, *E. parramattensis* ssp. *decadens*, *Grevillia montana*, *G. parviflora* ssp. *parviflora*, *Macrozamia flexuosa*, *Persoonia pauciflora*, *Tetratheca juncea* and *Cryptostylis hunteriana*) and four EECs (Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest, Lower Hunter Spotted Gum – Ironbark Forest, Central Hunter Riparian Forest). Seven Part Tests and determined that Kurri Sand Swamp Woodland, Hunter Lowland Redgum Forest, *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea* were likely to be significantly impacted by the Proposed Project (Appendix 1). Assessments of Significance under the Significant Impact Criteria in the EPBC Act found that the Proposed Project was likely to significantly impact *Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora* and *Tetratheca juncea*. Although the design changes and road-related ancillary infrastructure discussed above have increased vegetation clearing compared with the Approved Project, the magnitude of the ecological impacts from the F3 to Branxton Link has not changed, and as such, the results of the assessments of threatened plant species for the Proposed Project remain unchanged compared with the Approved Project.

No threatened aquatic species, populations or communities were located during this survey (Appendix 1). In addition there are no threatened aquatic species, populations or EECs listed under the *Fisheries Management Act* 1994 and *Environment Protection and Biodiversity Conservation Ac*t 1999 that have potential habitat within the F3 to Branxton Link study area.