5 ASSESSMENT OF LIKELY IMPACTS ON THREATENED SPECIES AND POPULATIONS

5.1 Summary of Potential Impacts from the Proposal

Direct impacts

The clearing of vegetation associated with the road infrastructure will result in direct impacts such as:

- fragmentation of habitat and an incremental decline in its quality and extent;
- disruption of wildlife corridors and the creation of impediments / barriers to faunal movement and plant dispersal;
- loss of regionally and locally significant vegetation and vegetation communities;
- loss of potential breeding, roosting and foraging habitat for threatened fauna;
- potential fauna mortality during vegetation clearance activities; and
- potential impacts on 'downstream' areas resulting from soil disturbance and erosion events*.

Indirect impacts

In the longer term, the development will lead to probable further degradation of remnant habitat in the study area. Such degradation and the associated loss of threatened species/populations that may result could be due to indirect impacts such as:

- potential changes in the hydrological regime resulting from altered surface flows and groundwater levels*;
- deterioration in water quality resulting from stormwater runoff*;
- potential further changes to the 'natural' fire regime;
- increased susceptibility to competition, disease, predation, insect attack and other disturbances due to edge effects and a reduction in vegetative cover; and
- cumulative impacts from further development on adjacent lands, such as on the HEZ study area, ultimately to be serviced by the proposed Pelaw Main By-pass.

* Note that these impacts could affect the Freshwater Wetland Complex EEC that occurs in proximity to the proposed alignment.

Key Threatening Processes

A number of Threatening Processes listed within Schedule 3 of the *Threatened Species Conservation Act 1995* (*TSC Act 1995*) may be at least in part applicable to the proposed development. These processes are listed below in italics, and relevant comments follow.

- *Alteration to the Natural Flow Regimes Of Rivers and Streams and Their Floodplains and Wetlands*

The main creekline that runs through the north of the study area may potentially be affected by the proposal. This creek runs south into Wallis Creek and eventually into the Hunter River and will be crossed by the Pelaw Main By-pass close to the middle section of the proposed road alignment. A tributary of this creekline is also traversed by the alignment in two sections to the south of this crossing. Furthermore, the eastern edge of a small, ephemeral wetland that is situated along this tributary is proposed to be traversed by the alignment.

The creekline / wetland crossings should be designed to minimise any potential impacts to the natural flow regimes that may influence the water quality within these areas as well as areas downstream such as the larger wetland (which is situated just 40m from the alignment at its closest point) and ultimately Wallis Creek.

Should these recommendations be duly considered, it is feasible that the proposed road construction would significantly contribute to the fundamental criteria that led to the listing of this process.

- *Clearing of Native Vegetation*

This process is considered the most relevant Schedule 3 matter resulting from the proposed development. Having said that however, this process can now be seen to be applicable to any proposal involving some clearing of native vegetation. As such, this KTP encompasses a wide variety of proposed land use activities.

Key matters as described within the Final Determination of this process that may be at least in part applicable to the proposed development include direct loss of habitat, fragmentation, riparian zone degradation, increased greenhouse gas emissions, increased habitat for invasive species, loss of leaf litter layer, loss or disruption of ecological function and changes to soil biota.

The proposed development will result in direct loss of 9.1ha of forested areas and in the impact upon a further 9.6ha of forested land. These areas provide habitat resources for a diverse assemblage of flora and fauna species, including threatened flora and fauna species and two Endangered Ecological Communities. The linear alignment of the road will create a cleared corridor through the western part of the study area. This part of the study area has already been fragmented by small and large bush tracks, including the disused Richmond Main Railway. Whilst this may potentially increase the suitability of the habitat present for invasive species, these species are scarce to absent from the study area at present, despite the already fragmented landscape.

All of the above contributes to the cumulative impact on the state of ecological function of the study area as a natural ecosystem and it is apparent that the proposed development can be seen to be contributing to the detrimental process of Clearing of Native Vegetation. However, given the small proportion of forested land to be removed / affected (1.85% / 3.8% of the study area respectively) this contribution can only be viewed as being incremental on a broader scale. Furthermore, the conservation outcomes achieved in the associated HEZ rezoning process have been based on conserving representative areas of each habitat unit occurring within that area. The maintenance of biodiversity was a fundamental aim of this representative area conservation approach.

- *Competition and Grazing by the Feral European Rabbit (Oryctolagus cuniculus)*

Evidence of Rabbits was recorded within the study area, although the population does not appear to be of a significant size. Whilst clearing for the road alignment may inadvertently create a small amount of foraging habitat in the form of grassed road verges, the development as proposed is not considered likely to contribute to the broad-scale expansion of this KTP.

- *High Frequency Fire Resulting in the Disruption of Life Cycle Processes Plants and Animals and Loss of Vegetation Structure and Composition*

At present, the flora and fauna assemblages occurring within the study area have each been affected to varying extents by an 'unnaturally' frequent fire regime. This regime is largely the result of recent human activity in the area, particularly in proximity to existing human settlements where evidence of dumped and torched vehicles were observed.

Whilst the newly created road may allow some access into the study area for illegal arsonists, it will also allow better access into the study area for Rural Fire Brigades. More importantly, however, it will also open up the area to transient motorists, thus decreasing the likelihood of arsonists exploiting the site due to increased exposure.

- *Predation by Gambusia holbrooki (Plague Minnow or Mosquito Fish)*

No *Gambusia* is considered to be present on the study area and there are no areas where this species is likely to be found.

- *Predation by the European Red Fox (Vulpes vulpes)*

Evidence of Foxes has been recorded within the study area. The construction of the road may serve to open up the study area more for predators such as Foxes, but this is not considered a significant incursion given the network of existing tracks already existing and the proximity of the road alignment to the community of Pelaw Main.

- *Predation by the Feral Cat (Felis catus)*

Evidence of Cats has been recorded within the study area. The construction of the road may serve to open up the site more for predators such as the Cat, but this is not considered a significant incursion given the network of existing tracks that already exist and the proximity of the road alignment to the community of Pelaw Main.

Impacts of Roads on Wildlife

Bennett (1991) states that there are at least three components of a road reserve that can act as a barrier to the movements of terrestrial fauna, namely the bare road surface, the altered roadside habitat and the noise, movements, emissions and flashing lights associated with traffic use of the road. On wide roads with high traffic volumes, all three of these components combine to pose a formidable barrier to wildlife.

Road vehicles act as vectors for the transport of organisms, particularly in the spread of plant propagules including seeds. In some cases, pathogens such as cinnamon fungus may be spread in mud and soil attached to vehicles and pest animals such as *Bufo marinus* (Cane Toad) may be accidentally transported from northern Australia.

Soil erosion from road construction may cause sedimentation in creeklines and wetlands within the catchment. The width of clearance between habitats on either side of roads has been identified as the most importance factor inhibiting movement by mammals (Oxley *et al* 1974). Little is known about the impact of vehicle noise on wildlife, although anecdotal evidence indicates that some species become habituated to road noise (Adam 1995).

In cases where road construction requires additional fill, if the material used for fill is chemically different from the substrate at the emplacement site it may be responsible for altering the environment and affecting biodiversity. This is of particular concern in nutrient-deprived sclerophyll forests such as those that occur along the road alignment where run-off and dust from the road may increase the nutrient content (particularly phosphorus) in adjacent vegetation and creeklines (Adam 1995).

Many species of wildlife exploit new habitats or new resources that become available as a result of road construction and traffic use. Bennett (1991) provides a summary of these activities, which include:

- Paved road surfaces and their immediate edges provide a source of grit for birds;
- Grassy roadside vegetation provides a foraging resource for herbivores such as Kangaroos and Wallabies;
- Invertebrates killed by passing traffic that fall to the road surface provide a source of food for many insectivores;
- The warmth retained in the road surface and openness of road edges creates attractive basking sites for reptiles. Some birds may also use road surfaces to absorb warmth and assist thermoregulation;
- The above mentioned resources and activities that bring wildlife to roads also make them vulnerable to passing traffic and subsequently the carcasses of road-killed animals attracts a number of avian, mammalian and reptilian scavengers;
- The open spaces above roads that pass through forests and the concentration of insects around street lights provide new flight paths and foraging resources for insectivorous bats; and
- Poles supporting utility services (eg. electricity and telephone) that are located along roadsides provide perching sites for raptors and other birds.

With regards to the proposed road alignment it is considered that each of the above facets of the impacts of roads upon native wildlife are likely to occur.

Table 5-1 Summary of Ecological Impacts From Pelaw Main By-pass Infrastructure

Detail	Removal/Impact	Proportion to be Removed/Affected	Comments
Total area of Forested Vegetation to be Removed	Approx. 9.1 hectares	1.9% of total study area	Road length 2100 metres. Average 50m clearing corridor.
Total area of Vegetation to be Affected	Approx. 18.7 hectares	3.9% of total study area	Includes vegetation to be removed (above) and a 25m buffer (i.e. a 100m corridor) of the area from which vegetation will be required to be removed.
Vegetation Types to be Removed ➢ Kurri Sand Swamp Woodland (EEC) ➢ Lower Hunter Spotted Gum / Ironbark Forest (EEC)	Approx. 6.7 hectares Approx. 2.4 hectares	1.7% / 0.28% of KSSW within the study area / total estimated known occurrence 3.6% / 0.0074% of LHSGIF within the study area / total estimated known occurrence	Parts of these communities have been degraded by proximity to human settlement, in particular LHSGIF.
Vegetation Types to be Affected ➢ Kurri Sand Swamp Woodland (EEC) ➢ Lower Hunter Spotted Gum / Ironbark Forest (EEC) ➢ Freshwater Wetland Complex (EEC)	Approx. 13.3 hectares Approx. 5.4 hectares N/A	3.3% / 0.56% of KSSW within the study area / total estimated known occurrence 8% / 0.017% of LHSGIF within the study area / total estimated known occurrence N/A	Figures include area of vegetation to be removed (as introduced above). “ “ Likely to be affected only by proximity of the proposed road to an area of FWC.
Hollow-bearing Trees to be Removed ➢ Small-sized Hollows ➢ Medium-sized Hollows ➢ Large-sized Hollows	13 trees (containing a total of 24 hollows) 16 trees (containing a total of 25 hollows) 3 trees (containing a total of 3 hollows)	Not calculated “ “	Entrance Diameter ∅ < 10cm Entrance Diameter ∅ 10–20cm Entrance Diameter ∅ >20cm
Large / Mature Trees to be Removed ➢ *Eucalyptus punctata* ➢ *E. fibrosa* ➢ *E. agglomerata* ➢ *E. umbra* ➢ *E. parramattensis* ➢ *Corymbia maculata* ➢ *Angophora bakeri* ➢ *Melaleuca linariifolia*	19 22 5 2 11 4 4 2	Not calculated “ “ “ “ “ “ “	The majority of the forested communities along the alignment are degraded from previous and ongoing land use - occurrence of larger mature trees substantially reduced. Of these trees, a total of nine (9) winter-flowering trees will be removed (*C. maculata* and *E. agglomerata*).

Detail	Removal/Impact	Proportion to be Removed/Affected	Comments
Threatened Flora Species to be Removed			
➢ *Eucalyptus parramattensis* ssp. *decadens*	311	Not calculated.	Counts of *E. p. decadens* are approximate – some juvenile trees may have been omitted.
➢ *Grevillea parviflora* ssp. *parviflora*	7655 above-ground stems	0.63% of estimated study area population.	The total provided for *G. p. parviflora* is an estimate of above ground stems only.
➢ *Acacia bynoeana*	5 (known plants)	Data not complete enough to be reliable (i.e. study area population not accurately quantified), although highly unlikely to be a significantly larger than currently known.	Additional individual plants likely to occur in areas where recorded.
Threatened Flora Species to be Affected			
➢ *Eucalyptus parramattensis* ssp. *decadens*	340	Not calculated.	As above.
➢ *Grevillea parviflora* ssp. *parviflora*	8735 above-ground stems	0.73% of estimated study area population.	As above.
➢ *Acacia bynoeana*	6 (known plants). A further 3 plants exist 10m north of the 'impact buffer' in the vicinity of these plants.	Data not complete enough to be reliable (as above).	As above.
Threatened Fauna Species Likely to be Impacted Upon			
➢ 11 species have been considered to have the potential to be impacted upon	N/A	N/A	Degree of impact dependent on numerous factors including individual species range, abundance, habitat utilisation etc. Refer to Sections **5** and **8**.

5.2 Assessment of species likely to be affected

An assessment of the potential impacts of the proposal on threatened species that are known or considered likely to occur within the study area is detailed below in Table 5-2. The results of previous fieldwork undertaken on the site by Harper Somers O'Sullivan (2002a) have been considered within this assessment. A total of four (4) threatened flora and two (2) threatened fauna species as listed under the *Threatened Species Conservation Act 1995* (*TSC Act 1995*) have been recorded within the study area. Three (3) further threatened plant

species and nine (9) threatened fauna species are considered likely or have the potential to occur within the study area.

Analysis of Harper Somers O'Sullivan (2002b), which includes consideration of Ecotone (1999; 2000), University of Newcastle (2001), HLA Envirosciences (2001) and Atlas of NSW NPWS Wildlife Database (January 2006), and recent ongoing investigations within the HEZ lands, has revealed that nineteen (19) additional threatened fauna species have been recorded within the adjacent HEZ study area.

Table 5-2 overleaf outlines those threatened flora and fauna species which have been gazetted / recorded from within the vicinity of the study area. Each species has been considered for its potential to occur within the study area / road alignment and assesses the likely level of impact as a result of the proposal. Those species that exhibit at least a moderate likely level of impact have been identified as subject species and have been subsequently addressed further within the assessment processes contained within this report.

This assessment deals with the following heads of consideration in tabulated form (refer to Table 5-2 overleaf):

'Species' – Lists each threatened species known from the vicinity. The status of each threatened species under the *TSC Act 1995* and the Commonwealth *EPBC Act 1999* are also provided. Note that no Endangered Populations occur in the vicinity of the study area.

'Habitat Description' – Provides a brief account of the species and the preferred habitat attributes required for the existence / survival of each species.

'Chance of Occurrence' – Assesses the likelihood of each species to occur along or within the immediate vicinity of the study area in terms of the aforementioned habitat description and taking into account local habitat preferences, results of current field investigations, data gained from various sources (such as Atlas of NSW Wildlife, Hunter Bird Observer Club records etc) and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

'Likely Level of Impacts From Road Alignment' – Assesses the likely level / significance of impacts to each species / community that would result from the installation of the road alignment, taking into account both short and long term impacts. This assessment is largely based on the chance of occurrence of each species along the route with due recognition to other parameters such as home range, habitat utilisation, connectivity etc. It also considers the scope of the proposal, including the likely 'ecological footprint', duration of excavation works, proposed remediation works etc. The 'subject species' are identified within this part of the assessment process and have been subject to application of Seven-part tests of significance in Appendix B.

Table 5-2 Assessment of Likely Impacts on Threatened Species Considered for the Study Area

Species	Habitat Description	Chance of Occurrence	Potential Impacts from Road Alignment
Plants			
Acacia bynoeana Bynoe's Wattle (E, V*)	Small, prostrate shrub found in low heath and open woodland, generally on loamy clays and sand. Occurs from the Lower Hunter south to Southern Highlands. Recorded recently from KSSW and Yellow Bloodwood Woodland, including within the study area.	**High – Recorded along alignment and elsewhere in the study area**	**MODERATE**. Recorded from the road alignment within a small patch in KSSW in the north-central part of the road corridor. Only five (5) specimens were recorded along the alignment and a further six (6) were recorded within the impact corridor, although it is believed that other plants may exist therein (unlikely to be a significant figure). A further three (3) plants were recorded just outside the 'impact buffer' in the vicinity of these plants. Also recorded as up to fifty (50) plants in two disjunct stands in the southern extreme of the study area. Much of the remainder of KSSW along the alignment has suffered degradation as a result of proximity to settled areas and high fire frequencies, which limits the quality of habitat for this species and reduces the likelihood to occur therein. However, given the noted rarity and unpredictable nature of the species, the removal / impact of any individuals should be regarded as being 'moderate'. ***Addressed as a species likely to be affected by the proposal.***
Angophora inopina Charmhaven Apple (V, V*)	Found in shallow sandy soils in open woodland, swamp woodland and wet heath. Not previously recorded in Cessnock LGA.	Low	LOW. No specimens found anywhere in the study area or on adjacent HEZ lands.
Callistemon linearifolius (V)	Grows in dry sclerophyll forest on the coast and adjacent ranges. Recorded in Kurri Sand Melaleuca Scrub-Forest in adjacent Werakata NP (Bell 2004a) and in LHSGIF within the HEZ study area, including areas proximate to the Pelaw Main By-pass study area (Harper Somers O'Sullivan 2002b).	**Moderate - High – Recorded within the HEZ study area proximate to the study area**	LOW. No specimens confirmed to exist anywhere within the study area. This species will not be affected by the proposed road alignment.
Eucalyptus camfieldii Heart-leaved Stringybark (V, V*)	Originally known only from relictual erosional plateau surfaces on Sydney Sandstone. Recently discovered on recent sand deposits near Norah Head and Forresters Beach (Hill 2003). Eucalypts containing strong affinities to *E. camfieldii* have recently been discovered in KSSW within the 7(b) zoned part of the HEZ to the south-west of the study area.	Moderate – Requires more rigorous taxonomic revision	LOW / MODERATE. No specimens confirmed within the study area, despite careful cross-checking with potentially similar species. No specimens located along or proximate to proposed road alignment. The status of tis species within the Lower Hunter requires much taxonomic revision / investigation.
Eucalyptus glaucina Slaty Red Gum (V, V*)	Grows in grassy woodland on deep, fertile and well-watered soils. Recorded in the Bishops Hill portion of Werakata NP in Hunter Lowland Redgum Forest (Bell 2004a) and recently on HEZ study area (S. Bell pers. comm.). Locally common hybridising with *E. tereticornis* noted in the vicinity of the study area (K. Hill pers. comm.). Potential habitat on the study area is restricted to low-lying areas along creeklines.	**High – Recorded in the study area** (or as a minimum, individuals containing *E. glaucina* genes)	LOW. Recorded only from a small patch in the southern end of the study area within a highly modified area along the disused Richmond Main Railway. No specimens located along or proximate to proposed road alignment despite detailed searches and careful cross-checking with potentially similar species.
Eucalyptus parramattensis ssp. *decadens* Drooping Red Gum (V, V*)	Species grows in dry sclerophyll woodland on sandy soils, often in low damp sites. Known to occur within a large proportion of the road alignment and study area.	**High – Recorded along road alignment and throughout study area**	**HIGH.** Approximately 311 individuals will be removed and a further 340 individuals will be directly affected by the proposal. ***Addressed as a species likely to be affected by the proposal.***
Grevillea parviflora ssp. *parviflora* (V, V*)	Occurs in light clayey soils in woodlands. Plants appear capable of suckering from a rootstock. Recorded on the road alignment and in the wider Kurri Kurri / Cessnock area.	**High – Recorded along road alignment and throughout study area**	**LOW / MODERATE.** Counts have estimated that approximately 7655 above-ground stems would be removed and a further 8735 above-ground stems will be directly affected by the proposal. ***Addressed as a species likely to be affected by the proposal.***
Persoonia pauciflora (E)	Small shrub occurring in dry open forest and woodland habitats. All known individuals occur within a 2.5km radius of the first discovered specimens, near North Rothbury.	Low / Moderate	LOW. No specimens found anywhere in the study area or on adjacent HEZ lands. Whilst some potentially suitable habitat is present, no specimens have been found away from the North Rothbury locality, approximately 18km to the north-west.
Rutidosis heterogama (V, V*)	Small Asteraceous herb recently rediscovered in the Hunter Region growing in disturbed areas within the Hunter Economic Zone.	Moderate / High	LOW / MODERATE. No specimens confirmed within the study area, however there is recognised potential to occur. No specimens located along or proximate to proposed road alignment despite detailed searches conducted when the species was known to be flowering within the locality and careful cross-checking with potentially similar species.
Tetratheca juncea Black-eyed Susan (V, V*)	Small shrub growing in dry sclerophyll forest, and sandy heaths. Habitat within the study area not typical of that preferred by this species. High frequency fire regime does not suit this species.	Low / Moderate	LOW. No specimens found anywhere in the study area or on adjacent HEZ lands. Few records west of Donaldson Mine / Mt Sugarloaf / Watagan Range.
Herpetofauna			
Pseudophryne australis Red-crowned Toadlet (V)	Restricted to Hawkesbury sandstone areas where it is found in ephemeral creeks, gutters and soaks. Habitat on site generally not typical of that preferred by this species.	Low / Moderate	LOW. No specimens found anywhere in the study area or on adjacent HEZ lands. Records known from the Watagan Mountains to the south and Broken Back Range to the west.
Litoria aurea Green and Golden Bell Frog (E, V*)	Found in freshwater swamps and around waterbodies in disturbed sites and in proximity to saline conditions in open areas. Swamps / dams within the study area offer some potential habitat for this species.	Low / Moderate	LOW. No specimens found anywhere in the study area or on adjacent HEZ lands. No preferred habitat to be affected by road proposal.
Litoria brevipalmata Green-thighed Frog (V)	Occurs in a range of habitats in areas where surface water gathers after rains. Males congregate around temporary pools that form after very heavy rains. Species was recorded in two separate locations on the HEZ study area 1.85km upstream of the proposed road alignment.	Moderate	**MODERATE.** Whilst no specimens have been found along the proposed alignment or anywhere within the study area, potential habitat occurs along creeklines and in small wetland depressions proximate to, or traversed by, the alignment. ***Addressed as a species likely to be affected by the proposal.***

Species	Habitat Description	Chance of Occurrence	Potential Impacts from Road Alignment
Hoplocephalus bitorquatus Pale-headed Snake (V)	Species inhabits Ironbark forests and Paperbark Woodlands. Despite lack of local records, areas of suitable habitat occur within the study area.	Moderate	LOW / MODERATE. No specimens found anywhere in the study area, though a notably difficult species to detect. Potential habitat present along the proposed road alignment.
Hoplocephalus stephensi Stephen's Banded Snake (V)	An arboreal snake that is generally nocturnal. It is found in a variety of forested habitats, though seems to prefer wet sclerophyll habitats. The study area may offer some potential habitat, though areas such as the Watagan Mountains would provide areas of more preferred habitat.	Low / Moderate	LOW / MODERATE. No specimens found anywhere in the study area, though a notably difficult species to detect.
Birds			
Ephippiorhynchus asiaticus Black-necked Stork (E)	Waterbird that inhabits large vegetated swamps. Very rarely forages into open grassy woodland. Nests in trees located near water. Records from Kurri Kurri. However, habitats generally not present within the study area. More likely to use larger wetlands within Lower Hunter Region. Records from farm dam wetland 1.5km south of study area (HSO ecologists pers. comm.).	Low / Moderate	LOW. No specimens found anywhere in the study area or on adjacent HEZ lands. No significant areas of important habitat will be affected. The small wetland proximate to the alignment could provide a supplementary resource, although this area should remain relatively unaffected.
Lophoictinia isura Square-tailed Kite (V)	Raptor that occurs in forests and woodlands, preying mainly on Passerines. Generally nests along watercourses. Potential habitat present in the study area. Records from East Maitland area 2001/2002 (HSO ecologists pers. comm.)	Moderate	LOW. No specimens or signs of nesting found anywhere in the study area. Potential habitat may be removed along the proposed road alignment although not considered significant to any local population. Vast majority of potential habitat to be retained within the study area and occurs commonly throughout the region.
Hamirostra melanosternon Black-breasted Buzzard (V)	Raptor that occurs in arid woodlands, scrubs and grasslands west of the divide. Recorded in adjacent HEZ study area (Ecotone 1999).	Low	LOW. Not recorded in the study area. Records from HEZ considered most likely to be aberrant records of vagrants.
Irediparra gallinacea Comb-crested Jacana (V)	Waterbird preferring swamps and wetlands with floating aquatic vegetation. Such habitat is generally absent from the study area.	Low	LOW. No specimens found anywhere in the study area. No potential habitat to be affected by road proposal.
Lathamus discolor Swift Parrot (E, E*)	On the mainland this species lives in Eucalypt forests and woodlands with large trees having high nectar production in winter. Sites used vary from year to year. No records in the study area, although records (2000) within the adjacent HEZ of large flocks (Harper Somers O'Sullivan 2002b) and recently in other parts of the Cessnock LGA in 2005 (authors pers. obs.; D. Saunders pers. comm.).	**Moderate - High Preferred habitat exists within the study area**	**MODERATE.** Recent and significant records within the broader locality, including from immediately adjacent to study area in past years. Parts of the alignment offer potential foraging habitat and as such potential foraging habitat will be removed. ***Addressed as a species likely to be affected by the proposal.***
Neophema pulchella Turquoise Parrot (V)	Inhabits forests and woodlands with suitable nest hollows and grassy foraging areas. Past records (1992-1998) within the central northern sector of the HEZ (Harper Somers O'Sullivan 2002b). Route alignment offers some potential foraging and nesting habitat for this species.	Moderate	LOW / MODERATE. No specimens or signs of nesting found anywhere in the study area. Potential habitat may be removed along the proposed road alignment although not considered significant to any local population. Vast majority of habitat to be retained within the study area.
Calyptorhynchus lathami Glossy Black-Cockatoo (V)	Inhabits forests and woodlands where it forages predominantly on (*Allo*)*Casuarina* cones Species requires large hollows in Eucalypt tree for nesting. Annual records (1990's) of this species within the central northern sector of the HEZ study area (Harper Somers O'Sullivan 2002b). One recent record from the HEZ lands also (authors pers. obs.). Potential foraging throughout study area and nesting habitat exists within the KSSW and GGSGF.	Moderate	LOW / MODERATE. Foraging and nesting habitat occurs within study area, although little such habitat will be removed or affected by the proposal. Due to lack of records on the study area, lack of recent records in the vicinity, small amount of potential habitat to be affected and large amount of habitat to be retained / occurring in the area, impacts are unlikely to be significant to any local population. Furthermore, due to the mobility of the species, the proposal is unlikely to isolate any areas of habitat.
Callocephalon fimbriatum Gang-gang Cockatoo (V)	Occurs in forests and woodlands where it forages on the seed capsules of Eucalypts. Sedentary, seasonally nomadic or part-migratory, this species shows a general trend to leave highland habitats in winter for more lowland districts. Requires large Eucalypt tree hollows for nesting.	**Moderate - High Habitat exists within the study area and recorded from the HEZ study area**	LOW / MODERATE. Foraging and nesting habitat occurs within study area, although little such habitat will be removed or affected by the proposal. Due to lack of records within the study area, small amount of potential habitat to be affected and large amount of habitat to be retained / occurring in the area, impacts are unlikely to be significant to any local population. However, it may be appropriate to undertake pre-clearing surveys to ensure that no breeding attempts are occurring along or proximate to the road alignment. Furthermore, due to the mobility of the species, the proposal is unlikely to isolate any areas of habitat.
Ptilinopus magnificus Wompoo Fruit-Dove (V)	Frugivorous bird favouring rainforest, occasionally strays to other areas containing fruiting trees. Habitat resources generally absent.	Low	LOW. No specimens found anywhere in the study area and habitat along proposed alignment is marginal at best.
Ninox strenua Powerful Owl (V)	Requires large hollows for nesting, hollows or thick vegetation for roosting, and forests for hunting. Potential hunting and roosting habitat is found across the study area. Potential nesting habitat exists within the KSSW and GGSGF. Recent records within the adjacent HEZ study area (Harper Somers O'Sullivan 2002b, HSO Ecologists pers. obs.).	**Moderate**	**MODERATE.** Some potential hunting habitat will be removed although not considered significant to any local population. Very small amounts of roosting and nesting habitat will also be removed, although vast majority of such habitat within study area should not be affected. However, recent and ongoing evidence of a resident population within adjacent HEZ lands. ***Addressed as a species likely to be affected by the proposal.***
Ninox connivens Barking Owl (V)	Occurs mainly in dry sclerophyll woodland. Nests in large Eucalypt hollows and roosts in hollows or thick vegetation. Potential hunting habitat present throughout the study area. Potential roosting habitat exists within the KSSW and GGSGF.	Low / Moderate	LOW / MODERATE. Some potential hunting habitat will be removed although the amount is not considered significant to any local population. Very small amounts of roosting and nesting habitat may also be removed, although vast majority of such habitat within study area should not be affected. Due to lack of records on the study area, lack of recent records in the vicinity, small amount of potential habitat to be affected and large amount of habitat to be retained / occurring in the area, impacts unlikely to be significant to any local population.
Tyto novaehollandiae Masked Owl (V)	Requires large hollows for nesting, roosts in tree hollows or thick foliage. Preys largely on terrestrial mammals, though some arboreal prey also taken. Potential hunting habitat present throughout the study area. Potential roosting habitat exists within the KSSW and GGSGF. Recent records (1998; 2000) within HEZ study area (Ecotone Ecological Consultants 2003; Harper Somers O'Sullivan 2002b).	Low / Moderate	LOW / MODERATE. Some potential hunting habitat will be removed although the amount is not considered significant to any local population. Very small amounts of roosting and nesting habitat may also be removed, although vast majority of such habitat within study area should not be affected. Due to lack of records on the study area, small amount of potential habitat to be affected and large amount of habitat to be retained / occurring in the area, impacts unlikely to be significant to any local population.

Species	Habitat Description	Chance of Occurrence	Potential Impacts from Road Alignment
Tyto tenebricosa Sooty Owl (V)	Prefers wet Eucalypt forest and rainforest with tall emergents. Preferred habitat generally absent.	Low / Moderate	LOW. Marginal habitat only likely to be affected.
Chthonicola sagittata Speckled Warbler (V)	Species occupies Eucalypt and Cypress woodlands on the western slopes of the Great Dividing Range and in drier coastal areas. Appears to be unable to persist in districts where no fragments larger than 100ha remain. Recorded in study area during earlier fieldwork.	**High – Recorded previously within the study area**	**MODERATE / HIGH.** Known from the study area, including areas in proximity to the proposed road alignment. Potential habitat (albeit affected by over-burning) exists along most of the proposed clearing corridor. ***Addressed as a species with the potential to be affected by the proposal.***
Pomatostomus temporalis Grey-crowned Babbler (V)	Species occupies open woodlands dominated by mature Eucalypts with regenerating trees and tall shrubs with an intact ground cover. Appears unable to persist in cleared and fragmented habitats. Also threatened by aggressive competitors, such as Noisy Miners, Pied Currawong and Australian Raven. Recent records within adjacent HEZ study area (Harper Somers O'Sullivan 2002b).	**Moderate / High – Potential habitat along the road alignment**	**MODERATE / HIGH.** Known resident populations within the broader locality. Potential habitat exists along much of the proposed clearing corridor for the alignment. ***Addressed as a species likely to be affected by the proposal.***
Climacteris picumnus Brown Treecreeper (V)	Occupies Eucalypt woodland, often in areas where there is fallen timber. Nests in tree hollows. Does not occur in remnants less than 200ha. Recent records within adjacent HEZ study area (Harper Somers O'Sullivan 2002b).	**Moderate**	**MODERATE.** Known resident populations within the broader locality, although resident population not believed to exist currently within the study area. Potential habitat along much of the proposed clearing corridor. ***Addressed as a species likely to be affected by the proposal.***
Melithreptus gularis Black-chinned Honeyeater (V)	Species mainly occurs in forests and woodlands containing box-ironbark associations, River Red Gum and drier coastal woodlands. Generally does not occur in forested remnants less than 200ha in size.	**High – Potential habitat along the road alignment**	**MODERATE.** Known populations utilise habitat within the locality in identical habitat to that found within the study area. Potential habitat along majority of the proposed clearing corridor. ***Addressed as a species likely to be affected by the proposal.***
Stagonopleura guttata Diamond Firetail (V)	Occupies open woodlands / forests and associated habitats with grassy understorey. Generally found west of the Divide or in drier coastal areas such as the Hunter Valley. Appears unable to persist in remnants less than 200ha.	Low / Moderate	LOW. No specimens found anywhere in the study area or on adjacent HEZ lands. Records known from the Buttai / Surveyors Creek area to the east. Some potential habitat may occur in the study area although due to lack of recent confirmed records and small amount of habitat to be affected, the study area is not considered to represent a critical habitat resource for local populations and likely impacts considered to be low.
Melanodryas cucullata Hooded Robin (V)	Found in a range of Eucalypt woodlands, Acacia shrublands and open forests. Favours areas with sparse shrub cover and fallen timber. Appears unable to persist in remnants less than 100-200ha	Low / Moderate	LOW. No specimens found anywhere in the study area or on adjacent HEZ lands. Habitat along road alignment not typical of preferred habitat.
Xanthomyza phrygia Regent Honeyeater (E, E*)	Nomadic Honeyeater that breeds mainly west of the divide. Disperses to more coastal areas in winter where winter-flowering Eucalypts are sought. Several records within the adjacent HEZ study area, including one from 2005 (authors pers. obs.). Similar habitat occurs within the study area and as such the study area is considered potential habitat for this species.	**Moderate / High Locally preferred habitat along the road aligment**	**MODERATE.** Recent records within the locality. Parts of the alignment offers potential foraging habitat for this species and as such potential habitat will be removed. ***Addressed as a species likely to be affected by the proposal.***
Grantiella picta Painted Honeyeater (V)	Species lives in dry forests and woodlands. Primary food is fruit of Mistletoes. Potential habitat present throughout study area though rare to absent in coastal or sub-coastal districts.	Low / Moderate	LOW. No records known from the study area and potentially suitable habitat occurs only very marginally in areas along the proposed road alignment. Study area unlikely to be significant to local populations and only marginal habitat to be affected.
Mammals			
Dasyurus maculatus Tiger Quoll (V, E*)	Found in a variety of forested habitats. Den in fallen hollow logs or among rocky outcrops. Potential habitat present throughout study area, albeit high recorded incidence of introduced predators.	Low / Moderate	LOW. No records known from the study area or adjacent HEZ lands. Some habitat for this species will be removed, although considered marginal due to proximity to housing and lack of evidence of presence. Study area unlikely to be significant to local populations and only marginal habitat to be affected. Large areas of suitable habitat will be retained and occurs commonly throughout the locality / region.
Petaurus australis Yellow-bellied Glider (V)	Inhabits tall mature Eucalypt forest. Nests in large Eucalypt tree hollows. Some potential habitat present, although nesting habitat does not occur. Previously recorded around Tomalpin Hill, central-northern and south-eastern corner of the HEZ study area (Harper Somers O'Sullivan 2002b).	Moderate	LOW / MODERATE. Not recorded within the study area although some potential habitat could be affected by the proposal. However, no nesting habitat exists along road alignment. Most appropriate habitat in the study area occurs within GGSGF. Potential habitat also exists within creekline in HEZ lands immediately adjacent to road alignment. Unlikely to be affected by the proposal.
Petaurus norfolcensis Squirrel Glider (V)	Inhabits a variety of Eucalypt forests and woodlands where it forages primarily on blossoms. Recorded in various parts of the locality. Foraging and nesting habitat present in the study area. Recorded within the GGSGF community during recent surveys.	**High – Recorded in the Study Area**	**MODERATE.** Recorded within the study area to the south of the proposed road corridor. Potential habitat will be removed as a result of the proposal and may inhibit movements of individuals within a local population. This removal includes potential nesting habitat within hollow-bearing trees. ***Addressed as a species likely to be affected by the proposal.***
Phascogale tapoatafa Brush-tailed Phascogale (V)	Carnivorous marsupial that inhabits dry open forest and woodlands generally with sparse groundcover.	Low / Moderate	LOW. No records known from the study area or adjacent HEZ lands. Some habitat for this species will be removed as a result of the proposal, although considered marginal due to small numbers of hollow-bearing trees and lack of evidence of presence. Study area unlikely to be significant to local populations and only marginal habitat to be affected. Large areas of suitable habitat will be retained and occurs commonly throughout the locality / region.
Planigale maculata Common Planigale (V)	Generalist species that occupies a range of habitats. Often prefers cracking soil and sand. Recorded in similar habitats elsewhere in region. Potential habitat present in the study area.	Moderate	LOW. No records known from the study area. Habitat for this species will be removed as a result of the proposal although such removal not considered significant to this species. Large areas of suitable habitat will be retained and occurs commonly throughout the locality / region.

Species	Habitat Description	Chance of Occurrence	Potential Impacts from Road Alignment
Phascolarctos cinereus Koala (V)	Arboreal marsupial that feeds almost exclusively on the leaves of *Eucalyptus* trees within forested or wooded areas. Preferred feed tree species are represented in the study area, being *E. punctata* and *E. signata*. 'Potential Koala Habitat' exists along proposed alignment where *E. punctata* co-dominates within the canopy of the LHSGIF. Previous records on adjacent HEZ study area.	Moderate	LOW / MODERATE. Quantification of records and distribution within the locality are unclear. 'Potential Koala Habitat' will be removed as a result of the proposal. The amount to be removed is not considered a significant proportion on neither a local nor a regional scale and no confirmed records exist from these areas. Large areas of more suitable habitat occur commonly throughout the locality / region. Much potential habitat will also be retained on the study area.
Pteropus poliocephalus Grey-headed Flying-fox (V, V*)	Forages over a large area for nectar / fruits etc. Roosts in communal base camps, which are typically found in gullies, close to water and in vegetation with a dense canopy. Unlikely to roost within the study area, however camps have been recorded east of the study area at Black Hill and west at Mount View (Eby 2001). Likely to forage in Eucalypts when flowering.	Moderate / High	LOW / MODERATE. No confirmed records within the study area, but considered likely to utilise the area for foraging on a seasonal basis. Unlikely that the foraging resources found along the proposed road alignment would be critical to this species and no roosting habitat will be affected. Large areas of suitable habitat will be retained and occurs commonly throughout the locality / region.
Minopterus australis Little Bentwing-bat (V)	Prefers to hunt in well-vegetated areas. Requires caves or similar structures for roosting. The study offers potential foraging habitat although resources for roosting not present. Previously recorded within adjacent Werakata National Park (University of Newcastle 2001).	Moderate / High	LOW / MODERATE. Known from similar habitats in the locality. Clearing of road alignment is not considered likely to have a significantly deleterious effect on the foraging habitat of this species. No roosting habitat will be affected.
Miniopterus schreibersii Large Bentwing-bat (V)	Prefers to hunt in well-vegetated areas. Requires caves or similar structures for roosting. The study offers potential foraging habitat although resources for roosting not present. Previous records within HEZ lands (Harper Somers O'Sullivan 2002b).	Moderate / High	LOW / MODERATE. Known from similar habitats in the locality. Clearing of road alignment is not considered likely to have a significantly deleterious effect on the foraging habitat of this species. No roosting habitat will be affected.
Mormopterus norfolkensis East-coast Freetail-bat (V)	Hunts above canopy in generally dry forests and woodlands. Roosts in tree hollows, under bark and in man-made structures. Potential roosting and hunting habitat present. Recorded in the Werakata National Park (University of Newcastle 2001).	Moderate / High	**MODERATE.** Not recorded within the study area. Clearing of road alignment is not considered likely to have a significantly deleterious effect on the foraging habitat of this species. However, some potential roosting habitat occurs along the proposed route in the form of hollow bearing trees. ***Addressed as a species likely to be affected by the proposal.***
Myotis adversus Large-footed Myotis (V)	Prefers to reside and forage in close proximity to water. Roosts in caves, culverts and similar structures. Some potential foraging habitat associated with the dam, however the ephemeral nature of this area suggests it is marginal.	Low / Moderate	LOW. No known records within the study area, although recently recorded from HEZ lands. Suitable habitat occurs only marginally. Preferred foraging habitat absent from the proposed road alignment. Preferred roosting habitat absent along road alignment.
Chalinolobus dwyeri Large-eared Pied Bat (V, V*)	Hunts in a range of habitat types and roosts in caves and similar structures. The study area offers potential foraging resources although roosting habitat absent.	Moderate	LOW. No known records within the study area or adjacent HEZ lands. Clearing of road alignment is not considered likely to have a significantly deleterious effect on the foraging habitat of this species. No roosting habitat should be affected.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat (V)	Hunts in a range of habitat types and roosts primarily in tree hollows. Potential hunting habitat available throughout study area. Roosting habitat exists within the KSSW and GGSGF.	Moderate	LOW / MODERATE. No records within the study area, though suitable habitat present. Clearing of alignment is not considered likely to have a significantly deleterious effect on the foraging habitat of this species.
Falsistrellus tasmaniensis Eastern Falsistrelle (V)	Hollow dwelling species found predominantly in wet sclerophyll forests. Roosting habitat present on site. Previously recorded within HEZ study area.	Moderate	LOW / MODERATE. Not recorded within the study area. Clearing of road alignment is not considered likely to have a significantly deleterious effect on the hunting habitat of this species.
Scoteanax rueppellii Greater Broad-nosed Bat (V)	Hollow dwelling species that prefers to forage in wooded areas (not thick) and open spaces / ecotones. Potential foraging and roosting habitat present. Previously recorded in HEZ study area.	Moderate / High	**MODERATE.** Not recorded within the study area. Clearing of road alignment is not considered likely to have a significantly deleterious effect on the foraging habitat of this species. However, some potential roosting habitat occurs along the proposed route in the form of hollow bearing trees. ***Addressed as a species likely to be affected by the proposal.***

Key: ***(V)*** *= Vulnerable Species listed under the TSC Act 1995.*
(E) *= Endangered Species listed under TSC Act 1995.*
(V*) *= Vulnerable Species listed under the EPBC Act 1999.*
(E*) *= Endangered Species listed under EPBC Act 1999.*

5.2.1 Affected Species

From the details provided in Table 5-2, the following species have been identified with the potential to be impacted upon by the proposal (i.e. those with a Moderate or greater possibility of potential impact), and as such will be given further consideration in the following chapters and in Appendix B (Seven Part Tests). Profiles for these addressed species are provided in Appendix H. The affected species addressed are:

Threatened Flora Species:
Acacia bynoeana
Eucalyptus parramattensis ssp. *decadens*
Grevillea parviflora ssp. *parviflora*

Threatened Fauna Species recorded in the study area:

Chthonicola sagittata	Speckled Warbler
Petaurus norfolcensis	Squirrel Glider

Threatened Fauna Species previously recorded in the HEZ and considered to have the potential to be affected by the proposal:

Litoria brevipalmata	Green-thighed Frog
Lathamus discolor	Swift Parrot
Ninox strenua	Powerful Owl
Climacteris picumnus	Brown Treecreeper
Pomatostomus temporalis	Grey-crowned Babbler
Melithreptus gularis	Black-chinned Honeyeater
Xanthomyza phrygia	Regent Honeyeater
Mormopterus norfolkensis	Eastern Freetail-bat
Scoteanax rueppellii	Greater Broad-nosed Bat

5.3 Discussion of local and regional abundance

An estimate for the local and regional abundance of those species and populations (Section 110 (2) (d))

The locality of the study area provides a diverse array of habitats for native flora and fauna, ranging from the broad floodplains, wetlands and lowland forests of the Hunter Valley floor to the sandstone ridges and sloping forests of the Broken Back and Myall Ranges. Although there is a diversity of habitats, large areas have been modified or destroyed as a result of human settlement and land uses such as agricultural production, logging and mining.

Although relatively large areas in the locality remain forested, the long-term security of these habitats cannot be stated as being adequate. The declaration of Werakata National Park represented the first conservation reserve in the locality that incorporated the lowland forests of the Hunter Valley. A second reserve, Belford National Park (formerly Belford State Forest), has recently been gazetted. Three State Forests, namely Aberdare and Heaton State Forests, as well as a small remnant of Cessnock State Forest, occur within the broader locality and these areas provide some level of habitat security. In stating this however, it should be recognised that the majority of remnant forested habitats in the locality are in a relatively homogenous state of degradation from logging, high fire frequency, rubbish dumping etc., and as such do not currently provide optimal habitat resources/features for a number of threatened species. Nonetheless, it is expected that in areas that are currently

and proposed to be set aside for conservation, the habitat values would increase with the maturation of forests and the proper management of degradation regimes. A number of important areas of known habitats for threatened species such as Surveyors Creek / Buttai / Stockrington area, Ellalong / Congewai and Quorrobolong remain unprotected.

Areas outside of National Park and State Forest reservation appear to be under increasing threat from urban, rural and industrial expansion. This, combined with the proposed F3 Freeway Link to Branxton, suggests that these threats are likely to increase over time. Analysis of the Cessnock Local Environment Plan shows that few areas within the LGA are set aside for conservation. However, conservation zonings under the HEZ should have the result of improving this situation. However, ongoing habitat removal and fragmentation within the HEZ and upon this road alignment may contribute to the isolation of these habitats.

Most significantly, the study area contains the largest 'unbroken area' of KSSW and habitat for a number of threatened flora and fauna species. Furthermore, the study area and the greater HEZ lands are likely to represent an integral component of a broad wildlife/habitat corridor linking the Myall Range to the lowland forests around Kurri Kurri and Cessnock, including the northern sections of Werakata National Park. It should be noted that conservation outcomes may be achieved within the eastern portion of the study area following negotiations made between landholders, the DEC and RTA.

The location and size of populations of threatened species within the locality are both limited and determined by the abovementioned factors. Analysis of available information on threatened species distribution within the locality indicates that both habitats and populations of a large number of threatened species occur outside of the Pelaw Main By-pass study area. However, given the inadequacies of the current conservation reserve system and a number of ongoing threats, patterns of threatened species distribution and abundance are likely to change over time, with the probability for a number of localised extinctions in the longer term, unless a move towards extension and consolidation of the reserve system occurs.

Several other conservation reserves occur just outside of the locality, including Pambalong and Hexham Swamp Nature Reserves (which conserve wetland habitats of the Hunter Valley floodplain), Watagan National Park and Blue Gum Hills Regional Park (which conserve a variety of forested habitats). Some consideration of these areas has also been afforded within the following assessments of other known local populations and habitat utilisation within the locality.

5.3.1 Discussions of other known local populations

Acacia bynoeana

During 2003, new populations of *A. bynoeana* were discovered in the Cessnock area (Harper Somers O'Sullivan 2005) and by 2004 known populations were recorded from the Pelaw Main By-pass study area (HSO ecologists pers. obs.). Populations within the HEZ appear to be quite sizeable, with rough estimates (based on previously reported densities; see Bell & Driscoll 2002) of more than 3000 plants (Bell 2004b). Based on detailed counts undertaken by HSO to date, approximately two hundred and fifty (250) individuals within four (4) sub-populations have been recorded within the HEZ Study Area.

Within the locality, further populations have been recorded near Ellalong (south-west of the HEZ Study Area) and Heddon Greta (immediately north-east of the township of Kurri Kurri). The Ellalong population is thought to be well in advance of one hundred (100) individuals

(Harper Somers O'Sullivan 2005) whilst the Heddon Greta population size is also likely to be greater than 100 plants (HSO ecologists pers. obs.). More recent fieldwork has also shown that substantially sized stands of this species exist in other parts of the Cessnock LGA, including a population near North Rothbury. Further afield it has also recently been recorded from Yengo National Park (S. Bell pers. comm.).

Of further interest in regard to the Cessnock LGA populations is the presence of *A. bynoeana* in previously undocumented habitat. A regional analysis of all known populations of this species is currently underway, with the aim of identifying suitable habitat for potential new populations in the wider region (Bell & Driscoll in prog.). The recent finds in KSSW infers that considerable areas of potential habitat exist in the wider Cessnock area. This species has also been recorded within other vegetation types within the locality, such as Yellow Bloodwood Woodland at Ellalong (Harper Somers O'Sullivan 2005).

Eucalyptus parramattensis* ssp. *decadens

As well as those individuals of this species that were recorded within the study area, numerous records of this species from the locality are known from the HEZ study area (Harper Somers O'Sullivan 2004a; 2002b). This species is known from secure habitat within Werakata National Park (Bell 2004a; Atlas of NSW Wildlife 2006) and from a number of other 'unprotected' locations (Atlas of NSW Wildlife 2006). In the locality this species is primarily restricted to KSSW. 532.5ha of KSSW exists in Werakata National Park, although surveys as part of the ECMP process have revealed that only a 37ha area of KSSW within this reserve is dominated by *E. p. decadens* (Harper Somers O'Sullivan 2004a).

The significance of the study area to this species must be regarded as high, given the noted frequency of this species throughout KSSW, which was found to be the dominant community on the study area.

Much of the road alignment constitutes preferred habitat for this species, being within KSSW. Approximately 651 individuals were recorded along the road alignment / buffer and this species was found to be one of the dominant tree species recorded therein, often found in pure stands within the KSSW. Many areas of KSSW throughout the remainder of the study area were found to lack this species. In these areas the community upper stratum was found to be dominated by other associated canopy species such as *E. agglomerata, E. signata* or to a lesser extent, *E. sparsifolia.*

However, even given the noted frequency of this species along the road alignment, the significance of the road alignment for this species in the locality may not be high. This has been determined since the current surveys have found that a large extant population occurs within the remnant study area and locality. The proposed road alignment constitutes only a small proportion of the total population estimate within the study area. The noted future conservation outcomes for much of the remnant study area will preserve large numbers of this species.

Grevillea parviflora* ssp. *parviflora

Within the study area this species was found to occur predominantly within KSSW and LHSGIF as well as in intergrade / ecotonal areas between these two communities. This species was recorded in abundance within these areas. Surveys undertaken within the HEZ study area and locality have shown that *G. p. parviflora* is a relatively common understorey species over a large portion of the HEZ lands. Other areas within the Cessnock LGA also contain populations of this species (Harper Somers O'Sullivan 2002b; 2002c). A number of

records of the species from the locality are known from secure habitats within Werakata National Park (Bell 2004a; Atlas of NSW Wildlife 2006) and from a number of other 'unprotected' locations around Kurri Kurri, Heddon Greta (NPWS Atlas of NSW Wildlife 2006), Ellalong (Harper Somers O'Sullivan 2005) and on the western slopes of the Sugarloaf Range (HSO ecologists pers. obs.).

The long-term security of habitats for the species is provided within Werakata National Park and to a lesser extent, Aberdare State Forest. Some security of habitat protection may also be provided within the Habitat Protection Zones of the HEZ study area. It is considered that these areas provide a minimal to moderate level of conservation for this species.

The significance of the study area to this species must be regarded as moderate to high, given the noted frequency of this species throughout KSSW, which was found to be the dominant community on the study area.

The majority of the road alignment constitutes known, occupied habitat of this species. However the significance of the road alignment for this species in the locality is considered to be relatively low since the current surveys have demonstrated that a large extant population occurs within the remnant study area and locality. The road alignment constitutes only 1.36% of the total population estimate within the study area. The noted future conservation outcomes for much of the remnant study area will preserve large numbers of this species.

***Chthonicola sagittata* (Speckled Warbler)**

This species was recorded in close proximity to the road alignment during earlier surveys (Harper Somers O'Sullivan 2002a). Several records also exist from the HEZ study area, Werakata National Park and surrounding areas (Harper Somers O'Sullivan 2004a; 2002b; University of Newcastle 2001; NPWS Atlas of NSW Wildlife 2006). Additional records from the locality are also known from Quorrobolong, Ellalong Mulbring and the Surveyors Creek / Buttai area around the northern extreme of the Sugarloaf Range (Atlas of NSW Wildlife 2006; Harper Somers O'Sullivan 2005; HBOC records).

With the exception of records from Werakata National Park and areas zoned for Habitat Protection within the HEZ lands, the majority of sightings within the locality have been from areas that do not constitute 'secure' habitat. This species would be expected to occur in Aberdare State Forest, although the level of protection of habitats therein is not guaranteed for the long term. As such, it could be considered that the long-term security of the species habitats in the locality is relatively poor.

The significance of the study area to local populations is difficult to quantify, although given the noted occurrence of this species on the study area, the significance of the potential habitat within the study area for this species must be regarded as at least moderate. The significance of the road alignment is probably low, given the proportionally small amount of potential habitat therein.

***Petaurus norfolcensis* (Squirrel Glider)**

This species was recorded on the study area, within the GGSGF. One record of this species within the HEZ study area also exists (HLA Envirosciences 2001). An additional record exists within the immediate vicinity in the Kurri Kurri area (Atlas of NSW Wildlife 2006). Within the locality the species has been recorded at Aberdare State Forest, Pokolbin, Surveyors Creek, Burkes Creek, Cockle Creek, Barnsley (Atlas of NSW Wildlife 2006) and Ellalong (Harper Somers O'Sullivan 2005).

The long-term security of habitats within the locality is considered to be poor as recent additions to Werakata National Park represent the only areas of secure known habitat. Much of the study area constitutes potential habitat for this species and records of the species exist in the locality. As such, the significance of the study area for this species in the locality is considered to be at least moderate. The road alignment represents only a small proportion of this and due to the relatively small number of tree hollows along the alignment it is considered to be of relatively low significance. However, it must be recognised that areas of potential habitat will be isolated by the proposal.

***Litoria brevipalmata* (Green-thighed Frog)**

No individuals of this species have been recorded from the study area. This species was recorded from two locations within the HEZ study area in similar habitat to that found on this study area. One of these records was from approximately 1.85km upstream within a creekline that runs onto the study area and traverses the proposed road alignment. These sightings represented the first record of the species in the catchment of the Hunter River.

The long-term security of habitats within the locality cannot be accurately determined, although the habitat attributes of where the species was recorded within the HEZ study area are widely replicated within creeklines in the locality, albeit in varying conditions.

The study area contains potential habitat for this species, although the significance of this habitat to local populations is difficult to determine. The proposed road alignment will traverse areas that constitute potential habitat for this species (i.e. creeklines and other low-lying areas). The significance of the road alignment to local populations is difficult to quantify (particularly given the difficulty in locating the species during dry periods), although due to recent records in the locality in similar habitat it must be regarded as at least moderate.

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

No individuals of this species have been recorded from the study area. However, a number of records for the Swift Parrot are well documented from the HEZ study area and broader locality, including significant records from 2005 (Harper Somers O'Sullivan 2004a; 2002b; Atlas of NSW Wildlife 2006; HBOC records; D. Saunders pers. comm.; authors pers. obs.). The Swift Parrot is thought to consist of one population which breeds in Tasmania and migrates to the south-east mainland of Australia during winter months in search of suitable resources such as winter-flowering trees such as Spotted Gum, Northern Grey and Narrow-leaved Ironbarks, Forest Red Gum, Swamp Mahogany, Grey Box, etc. In the locality, the occurrence of Swift Parrots appears to be associated with the flowering of these Eucalypt species with the exception of the Swamp Mahogany (hence the large number of records in 2000 and again in 2005), although evidence suggests that the species may also utilise the locality irrespective of the availability of these resources (D. Saunders pers. comm.).

The long-term security of habitats within the locality is considered to be relatively poor due to a poor representation of Spotted Gum / Ironbark Forests within conservation reserves and ongoing development pressures in areas outside of conservation zones. The Habitat Protection Zones within the HEZ study area has increased the level of protected habitat for this species.

Potential habitat occurs within the LHSGIF on the study area. Although this represents less than 14% of the total study area, the noted preference of this species to utilise such habitats when present within the region implies that any such area should be regarded as significant.

The LHSGIF along the proposed road alignment contain potential habitat for this species. However the quantity of preferred habitat along the road alignment is not considered to be great (i.e. where mature winter-flowering Eucalypts occur). Therefore the significance of the road alignment for this species in the locality is considered to be fractional within the context of the wider distribution of the habitat from which this species has been recorded.

***Climacteris picumnus* (Brown Treecreeper)**

No individuals of this species were recorded from the study area. Several records of this species have been recorded within the HEZ study area (Harper Somers O'Sullivan 2004a; 2002b; Ecotone 1999; Atlas of NSW Wildlife 2006). The majority of these records were from the central northern sector of the development zone (Harper Somers O'Sullivan 2004a; 2002b). Within the locality additional records are known from west of the Sugarloaf Range around Killingworth, the Surveyors Creek / Buchanan area (extreme northern slopes of the Sugarloaf Range) and Mount Vincent (south of Mulbring) (HBOC records). A substantial population of this species also exists within bushland to the south of Ellalong Lagoon (Harper Somers O'Sullivan 2005).

Several records from the HEZ study area are from within areas zoned for conservation (Harper Somers O'Sullivan 2004a). Observations around Killingworth and Mount Vincent suggest that a population may also occur in the surrounding Heaton State Forest although the level of protection of habitats therein are not guaranteed for the long term. Potential habitat is protected within Werakata National Park. Nonetheless, it is considered that long-term security of habitats for this species in the locality is relatively poor.

The significance of the study area to local populations is difficult to quantify although given the occurrence of this species in the locality (including breeding records) in areas of similar habitat, the significance of the potential habitat within the study area for this species must be regarded as at least moderate. The significance of the road alignment is probably low, given the lack of confirmed records and the proportionally small amount of potential habitat therein.

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

No individuals of this species were recorded from the study area. Several records of this species have been recorded within the HEZ study area, Werakata National Park and surrounding areas (Harper Somers O'Sullivan 2004a; 2002b; Ecotone 1999; University of Newcastle 2001; NPWS Atlas of NSW Wildlife 2006; authors pers. obs.). Additional records from the locality are known from Quorrobolong, Ellalong, Mulbring and Pokolbin (Atlas of NSW Wildlife 2006; Harper Somers O'Sullivan 2005; HBOC records).

With the exception of records from Werakata National Park and areas zoned for Habitat Protection within the HEZ lands, the majority of sightings within the locality have been from areas that do not constitute 'secure' habitat. This species has also been recorded from Aberdare State Forest (authors pers. obs.), although the level of protection of habitats therein is not guaranteed for the long term. As such, it could be considered that the long-term security of the habitat for this species in the locality is relatively poor.

The significance of the study area to local populations is difficult to quantify although given the occurrence of this species in the locality in areas of similar habitat, the significance of the study area for this species must be regarded as at least moderate. The significance of the road alignment is probably low, given the lack of confirmed records and the proportionally small amount of potential habitat therein.

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

This species was not recorded within the study area. Several records of this species exist from the HEZ study area, many of which are from within conservation areas (Harper Somers O'Sullivan 2004a; Atlas of NSW Wildlife 2006; University of Newcastle 2001; authors pers. obs.). Additional records from the locality are also known from the Surveyors Creek / Buttai area, Ellalong, Quorrobolong, Mount Vincent, and Aberdare State Forest (Atlas of NSW Wildlife 2003; Harper Somers O'Sullivan 2005; HBOC records; authors pers. obs.).

The long-term security of habitats for the species in the locality is considered to be minimally adequate, due mainly to the presence of areas of known habitat within Werakata National Park, Aberdare State Forest and in areas zoned 7(b) Habitat Protection Zone within the study area. Nonetheless, larger areas of secured habitat would be required to secure the long-term viability of populations within the locality, as this species appears to be particularly vulnerable to habitat fragmentation.

The significance of the study area to local populations is difficult to quantify although given the occurrence of this species in the locality in areas of similar habitat, the significance of the study area for this species must be regarded as at least moderate. The significance of the road alignment is probably low, given the lack of confirmed records and the proportionally small amount of potential habitat therein.

***Ninox strenua* (Powerful Owl)**

No individuals or secondary indications of this species have been detected within the study area. Several records of this species occur within the HEZ study area, including a record from 2005 (Harper Somers O'Sullivan 2004a; 2002b; Atlas of NSW Wildlife 2006; Ecotone Ecological Consultants 2003; authors pers. obs.). Additional records from the locality are also known from the Surveyors Creek / Buttai area (Atlas of NSW Wildlife 2006; HBOC records).

As with the majority of forest-dependent fauna in the locality, the long-term security of habitats for the species is considered to be relatively poor, although known and potential habitat occurs within Werakata and Watagan National Parks, Aberdare and Heaton State Forests and in areas zoned 7(b) Habitat Protection Zone within the HEZ study area.

Since the majority of the study area constitutes potential hunting and nesting habitat and due to the likelihood of the species to utilise the study area as part of a larger hunting home range, it must be regarded as at least moderately significant. The significance of the road alignment is probably low, given the paucity of suitable nest hollows and the proportionally small amount of potential habitat therein.

***Xanthomyza phrygia* (Regent Honeyeater)**

Several records for the Regent Honeyeater exist from the HEZ study area in the northern sections of the development zone, including a record of a single bird in 2005 (Atlas of NSW Wildlife 2006; authors pers. obs.). There are also a number of additional records within the locality including Werakata National Park, Aberdare State Forest, Quorrobolong, Holmesville, Ellalong, Pokolbin, Broke and Colliery Dam (Atlas of NSW Wildlife 2006; Ecotone Ecological Consultants 2003; HBOC records; D. Saunders pers. comm.; authors pers. obs.).

The long-term security of habitats within the locality is considered to be relatively poor due to a poor representation of Spotted Gum / Ironbark Forests within conservation reserves and ongoing development pressures in areas outside of conservation zones. The Habitat

Protection Zone within the HEZ study area has increased the level of protected habitat for this species.

Potential habitat occurs within the LHSGIF on the study area. Although this represents less than 14% of the total study area, the noted preference of this species to utilise such habitats when present within the region implies that any such area should be regarded as significant.

The LHSGIF sections along the proposed road alignment contain potential habitat for this species. However the quantity of preferred habitat along the road alignment is not great (i.e. where mature winter-flowering Eucalypts occur). Therefore the significance of the road alignment for this species in the locality is considered to be fractional within the context of the wider distribution of the habitat from which this species has been recorded.

***Mormopterus norfolkensis* (East-coast Freetail-bat)**

No records of this species exist within the study area, although one record does exists in the south-west corner of the HEZ study area (University of Newcastle 2001). Additional records within the locality include areas east of the Myall Range, from near Pokolbin (Atlas of NSW Wildlife 2006) and at Ellalong (Harper Somers O'Sullivan 2005). The long-term security of habitats within the locality is considered to be poor to moderate as Werakata National Park and Heaton State Forest represent areas of known secure habitat, although the species would also be expected to occur throughout lowland areas such as Aberdare State Forest.

Whilst most of the road alignment constitutes potential hunting habitat for this species, since no individuals were found to be present within the study area and similar habitat occurs in abundance throughout the region, the significance of the road alignment in terms of hunting habitat for this species in the locality is considered to be low. It has been considered that the most significant habitat feature for this species along the road alignment is the existence of potential roosting habitat in the form of hollow-bearing trees.

***Scoteanax rueppellii* (Greater Broad-nosed Bat)**

No records of this species are known from the study area, although a record does exist immediately adjacent to the study area, from the eastern sections of the HEZ lands in the vicinity of Leggetts Drive (Ecotone 1999). Additional records within the locality include from near Shamrock Hill in the northeast, the eastern side of the Sugarloaf Range (Atlas of NSW Wildlife 2006) and at Ellalong (Harper Somers O'Sullivan 2005). The long-term security of habitats within the locality is considered to be poor to moderate as areas zoned 7(b) Habitat Protection Zone and Heaton State Forest represent the only areas of known habitat, although the species would also be expected to occur throughout lowland forests such as Werakata National Park and Aberdare State Forest

Whilst most of the road alignment constitutes potential hunting habitat for this species, since no individuals were found to be present within the study area and similar habitat occurs in abundance throughout the region, the significance of the road alignment in terms of hunting habitat for this species in the locality is considered to be low. It has been considered that the most significant habitat feature for this species along the road alignment is the existence of potential roosting habitat in the form of hollow-bearing trees.

5.3.2 Discussion of habitat utilisation

Acacia bynoeana

This species has been recorded from three (3) broad locations in the study area. Two (2) of these occur in the far southern end of the study area, containing approximately thirty (30) and twenty (20) plants respectively. The third location is along the proposed road alignment where five (5) plants situated on the actual proposed road corridor and a further six (6) within the 25m 'impact buffer' have been located. A further three (3) plants have been recorded 10m to the north of the impact buffer in the vicinity of these plants. It is likely that more specimens exist in this area, although the numbers therein would be unlikely to be substantial (i.e. a predicted maximum of an additional 10-20 plants). However, having said this, it must be recognised that any KSSW within the study area could constitute potential habitat. It is clear that the microhabitat requirements of this species is poorly understood, although a relatively consistent factor appears to be its preference for undisturbed areas (particularly with reference to invasive native or introduced groundcover species). Therefore, whilst the entire KSSW community within the study area could be construed as being broadly definable as 'potential habitat', numerous localised disparities between microhabitat conditions within the KSSW greatly limit the area of actual occupied habitat.

Eucalyptus parramattensis* ssp. *decadens

This species was recorded widely within the study area due mainly to the fact that the site is dominated by KSSW, given that *E. p. decadens* is a recognised keystone species within this community. However, several sections of KSSW were found not to contain this species. As such, it cannot be accurately stated that the distribution of *E. p. decadens* is a direct correlation of the distribution of KSSW. Although this species was found to occur outside of KSSW, it was only as scattered individuals within transitional zones between KSSW and LHSGIF. For the purposes of this assessment it has been determined that the distribution of this species on the study area is definable by the boundaries of the KSSW community. Based on the refined mapping of KSSW undertaken as part of this study and field investigations, it is estimated that approximately 300-350 hectares of occupied habitat occurs within the study area. The significance of these individuals to the viability of the species in the locality is likely to be relatively high, primarily as a source of natural recruitment, genetic diversity and potential propagative stock.

Grevillea parviflora* ssp. *parviflora

Statistical analysis of data gathered as part of these investigations based on previous studies as outlined in Harper Somers O'Sullivan (2002c) has generated a population estimate for this species within the study area of 1,239,217 individual flowering stems (not necessarily 'plant clumps'). As alluded to earlier, this figure may be misleading due to the rhizomatous nature of the species, suggesting an overestimation in population size.

Notwithstanding, this assessment is based on proportional comparisons that would account for any error due to the rhizomatous nature of the species. The population of this species on the study area would be considered to be highly significant to the viability of the species in the locality due to the sheer size of the population alone. Prior to the discovery and subsequent studies within the HEZ lands, the largest known population was thought to consist of around 2000 plants (NPWS 2002). Nonetheless, this species is noted to be a relatively common to locally abundant understorey shrub species in a number of areas within the locality (authors pers. obs.).

***Chthonicola sagittata* (Speckled Warbler)**

One record of this species exists within the study area (Harper Somers O'Sullivan 2002a). This was of a single bird found in the north-western corner of the study area. Despite targeted searches undertaken at the time of that record and during numerous field surveys in the interim, no further signs of the species could be noted. As a result, it could be stated with reasonable confidence that this species would occur in low densities within the study area. Suitable habitat exists throughout virtually the entire study area The significance of the record of this species in the context of its existence in the locality is likely to be low / moderate, as additional records from the locality are also known from HEZ lands, Quorrobolong, Mulbring, Ellalong, Werakata National Park and the Surveyors Creek / Buttai area around the northern extreme of the Sugarloaf Range (Harper Somers O'Sullivan 2004a; 2002b; 2005; University of Newcastle 2001; Atlas of NSW Wildlife 2006; HBOC records; authors pers. obs.).

***Petaurus norfolcensis* (Squirrel Glider)**

This species was recorded in the south-eastern corner of the study area within the GGSGF community. It is likely that this species would utilise the KSSW as habitat as the GGSGF community is isolated from other areas of similar (taller forested) habitat by cleared land and KSSW. Therefore, it is likely that this species would utilise the entire forested parts of the study area. Determining a population size for the study area would be a difficult exercise, although given the amount of time spent in the field both on the Pelaw Main By-pass and adjacent HEZ study areas (with only the single record), it is not likely that the population would be large. However, the significance of locating this individual to the viability of the species in the locality is considered to be moderate since a number of records of this species are known elsewhere within the locality such as Aberdare State Forest, Pokolbin, Surveyors Creek, Burkes Creek, Cockle Creek, Barnsley and Ellalong (Atlas of NSW Wildlife 2006; Harper Somers O'Sullivan 2005). It should be noted that it appears that populations of this species are larger within coastal districts such as Lake Macquarie and Port Stephens, than within the forests of the Cessnock LGA.

***Litoria brevipalmata* (Green-thighed Frog)**

This species was not recorded on the study area. Therefore, the quantification of habitat utilisation would be difficult to determine. Two juveniles of this species were located within the HEZ study area (Harper Somers O'Sullivan 2002b) in habitat similar to some areas of the Pelaw Main By-pass study area. This suggests that a resident breeding population exists in the locality and as such may occur on the study area. The discovery of individuals in the HEZ study area (first for the Hunter River catchment) is considered to be of high significance. Therefore, any area from which this species could be expected to occur (i.e. the study area) should be regarded as significant also.

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

No records for this species exist within the study area, despite fieldwork being undertaken during 2005 at a time when the species was known to inhabit areas in the broader locality. The closest record exists from just off the north-western boundary, near Pelaw Main (Atlas of NSW Wildlife 2006). Harper Somers O'Sullivan (2002b) suggested that the level of usage of the HEZ study area by this species as being 'significant' in terms of the national population. The likely level of habitat utilisation within the Pelaw Main By-pass study area is likely to be significantly less, due mainly to the fact that less than 14% of the study area contains potential habitat (winter-flowering Eucalypts) for this species. Notwithstanding, any such

habitat in proximity to areas previously noted to be significant must also be regarded as being of at least some significance to this species.

***Climacteris picumnus* (Brown Treecreeper)**

No records of this species exist from the study area. This is despite several records from similar habitat within the adjacent HEZ study area (Harper Somers O'Sullivan 2002b). These records included evidence of breeding. Given likely brood dispersal and existence of similar habitat on the Pelaw Main By-pass study area, it is considered likely that this species would utilise the study area at some time. Although this species has been observed on the HEZ lands within KSSW habitat (HSO ecologists pers. obs.), it is not indicative of the preferred habitat of this species and it can be reasonably assumed that the likely usage of the study area would be within the LHSGIF and GGSGF communities and ecotonal areas with KSSW. This species is also known in the locality from Ellalong, Mount Vincent and Quorrobolong (Harper Somers O'Sullivan 2005; HBOC records).

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

No records of this species exist from the study area. This is despite numerous records from similar habitat within the adjacent HEZ study area (Harper Somers O'Sullivan 2004a; Harper Somers O'Sullivan 2002b). This species has also been recorded widely from a number of other locations within the locality including Quorrobolong, Brunkerville, Ellalong, Mulbring, Pokolbin, Broke and Buchanan (Atlas of NSW Wildlife 2006; Harper Somers O'Sullivan 2005; HBOC records; authors pers. obs.). Therefore it is considered highly likely that this species would utilise the study area from time to time. It is probable that any such populations would use the entire forested parts of the study area.

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

No records of this species exist from the study area. This is despite numerous records from similar habitat within the adjacent HEZ study area (Harper Somers O'Sullivan 2004a; Harper Somers O'Sullivan 2002b) and numerous records from 2005 in other locations within the locality such as Ellalong, Mulbring, Mount Vincent, Broke and Werakata National Park (Harper Somers O'Sullivan 2005; Atlas of NSW Wildlife 2006; HBOC records; University of Newcastle 2001; authors pers. obs.). Therefore it is considered highly likely that this species would utilise the study area from time to time and would most likely utilise each of the forested habitats on the study area, dependant on the availability of blossoms.

***Ninox strenua* (Powerful Owl)**

No records of this species exist from the study area although recent records exist from the adjacent HEZ lands, including a record from 2005 (Harper Somers O'Sullivan 2004a; authors pers. obs.). This species has an estimated home range of around 1000ha (Garnett and Crowley 2000) and given the existence of suitable habitat and recorded prey species, it is considered likely that this species would utilise the study area as part of a larger hunting home range. The entire site provides potential hunting habitat. Some potential nesting habitat also exists within the study area, chiefly within those parts of the KSSW that contain large tree hollows. Additional records from the locality are known from the Surveyors Creek / Buttai area (Atlas of NSW Wildlife 2006; HBOC records).

***Xanthomyza phrygia* (Regent Honeyeater)**

No records for this species exist within the study area, despite surveys being undertaken in 2005 at a time when the species was known to be inhabiting other parts of the Cessnock LGA (albeit in low numbers). Harper Somers O'Sullivan (2002b) suggested that the level of usage of the HEZ study area by this species as being 'relatively significant' in terms of the national population. This species was recorded, as a single bird, from the HEZ in 2005. The likely level of habitat utilisation within the Pelaw Main By-pass study area is likely to be significantly less, as the occurrence of *X. phrygia* in the locality is usually associated with winter-flowering Eucalypts. Only the LHSGIF contains such species and this comprises less than 14% of the total study area. Notwithstanding, any suitable habitat in proximity to areas previously noted as being relatively significant must also be regarded as being of at least some significance to this species. Records of the species elsewhere within the locality are from Werakata National Park, Aberdare State Forest, Quorrobolong, Holmesville, Ellalong, Pokolbin and Colliery Dam (Atlas of NSW Wildlife 2006; Ecotone Ecological Consultants 2003; HBOC records; A. Morris, unpublished data, authors pers. obs.). In addition two pairs had recently nested at Quorrobolong (HBOC 2000).

***Mormopterus norfolkensis* (East-coast Freetail-bat)**

No records of this species exist within the study area, although a record does exists in south-west corner of the HEZ study area (University of Newcastle 2001). Individuals of this species are generally solitary, and would be likely to utilise the vegetation associations such as Spotted Gum / Ironbark forests and KSSW for both foraging and roosting purposes. The level of likely habitat utilisation upon the subject study area is difficult to quantify, although the significance of the individuals recorded on the HEZ lands on a local scale is considered to be at least moderate. It is noted that several other records are known from the locality including in areas east of the Myall Range, near Pokolbin (Atlas of NSW Wildlife 2006) and at Ellalong (Harper Somers O'Sullivan 2005).

***Scoteanax rueppellii* (Greater Broad-nosed Bat)**

No records of this species are known from the study area, although a record does exist immediately adjacent to the study area, from the eastern sections of the HEZ lands in the vicinity of Leggetts Drive (Ecotone Ecological Consultants 1999). Based on this information, it would appear as though a small and/or widely dispersed population may utilise a variety of habitats in the vicinity of the study area. The level of likely habitat utilisation upon the subject study area is difficult to quantify, although the significance of the individuals recorded on the HEZ lands on a local scale is considered to be at least moderate. It is noted that several other records are known from the locality including near Shamrock Hill in the northeast, the eastern side of the Sugarloaf Range (Atlas of NSW Wildlife 2006) and Ellalong (Harper Somers O'Sullivan 2005).

5.3.3 Description of vegetation

The vegetation communities recorded on the site are described in Section 4.3.1.1 and a list of all flora species recorded is provided in Appendix C.

5.3.4 Discussion of corridors

Fauna movement corridors consisting of trees, shrubs, vegetative ground cover, drainage lines and soaks are present along the road alignment. Corridor requirements vary between different guilds of fauna depending on mobility and a range of other factors. The proposal will entail the removal of a linear strip of native vegetation with an average clearance corridor of 50 metres for approximately 2.1km. Although the study area is dissected by a number of existing trails and a disused railway line, it can be asserted that the existing infrastructure and trails are not limiting factors in determining the occurrence and distribution of threatened species on the study area and hence are unlikely to have resulted in the isolation of any known or potentially occurring populations of threatened species within the study area. This is due largely to the fact that roads and similar infrastructure are generally within the dispersal capabilities of the majority of threatened flora (including potential pollinators / vectors) and fauna species. However, roads do have the potential to have a number of negative impacts on threatened fauna species, primarily by:

- severing species movement / migration corridors;
- altering species local movement patterns;
- increasing road mortality through vehicular collisions; and
- increasing vulnerability to predation (by traversing open spaces).

The proposal will result in the isolation of approximately 85ha of forested habitats, which, in the context of the size of the study area and noted disturbances within that area to be isolated, is not regarded as being of great significance to the majority of threatened fauna considered. Highly mobile species such as birds and bats would be likely to remain relatively unaffected whilst terrestrial species such as herpetofauna and arboreal mammals would be the most likely to be affected. However, collisions with vehicles has been recognised as a potential threat to populations of *Lathamus discolor* (Swift Parrot Recovery Team 2001).

The proposed Pelaw Main By-pass poses potentially the greatest threat to individuals of *Litoria brevipalmata* at the locations where it crosses the creekline that feeds the small wetland within the study area. At this location, ameliorative measures should be employed, including the possible installation of underpasses (culverts) designed to maintain both the hydrological regimes of the creeklines and the habitat connectivity for this species.

5.4 Assessment of habitat

A full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region (Section 110 (2) (f))

5.4.1 Description of habitat values

The habitat present on the study area is regarded as being significant habitat due mainly to the large size and generally unfragmented nature of the habitat therein. Furthermore, the noted presence of well-developed floral and faunal assemblages, including threatened species and vegetation communities contributes to this significance. The area is largely weed free with the exception of the Cleared Areas and those areas in association with the existing road and/or track network. Small parts of the study area appear to have experienced an over

frequent fire regime, in particular those areas proximate to Pelaw Main. Some minor weed incursion is evident in these areas also. The creeklines and to a lesser, more seasonal extent, the small wetland area, provide potential habitat for moisture-dependent species, such as waterfowl and herpetofauna. The Cleared Areas provide little in the form of habitat for native species aside from a grazing resource for Macropods and as an ecotonal area to forested habitats for Microchiropteran Bats.

A description of the habitat present on the site for specific guilds of native flora and fauna species is presented below.

Flora Habitats

The vegetation communities present along the proposed road alignment and the remnant study area offer a variety of suitable habitat types for a diverse array of native flora, including several nationally and state listed threatened species, ROTAP, and other regionally significant flora species. The most significant vegetation community is the KSSW, recognised as an EEC under the *TSC Act 1995*. The majority of this community on the study area appears to be intact, largely free from high levels of weed invasion, with the main exception being areas proximate to Pelaw Main. In this area rubbish dumping, clearing and a high frequency fire regime have each contributed to the dominance in the groundcover layer by invasive species such as *Imperata cylindrica* var. *major* (Blady Grass). However, the remainder of the KSSW is generally dominated by a range of native (often Proteaceous and Fabaceous) flora species not found in nearby LHSGIF communities. Having said this, there is evidence to suggest that parts of the KSSW has been selectively cleared in the past, considered most likely for mining activities due to the poor timber yield that would have been provided by the often stunted and gnarled trees therein.

LHSGIF, also recognised as an EEC under the *TSC Act 1995*, appears to have suffered a high degree of disturbance. This is evidenced by the generally young age-class of the trees and high incidence of rubbish dumping. This community is also often dominated in the lower structural layers by invasive species such as *Bursaria spinosa* (Blackthorn) and *I. c. major* (Blady Grass). The LHSGIF also appears to have been subject to high incidences of bushfire. Notwithstanding, this community still provides potential habitat for native flora, albeit those species that have at least a moderate high tolerance to disturbance.

The GGSGF also appears to have been subject to anthropogenic disturbances, although probably not to the same extent as the LHSGIF. This community intergrades with KSSW and in these areas a diverse array of native species extant within both assemblages occurs. This community does not easily equate with any previously identified vegetation communities as defined within LHCCREMS mapping (NPWS 2000a; House 2003) and as such, must be viewed as providing a fairly distinctive area of habitat for native flora.

The Freshwater Wetland appears to have been disturbed by vehicle trampling. It is not clear whether this wetland was actually created artificially as a result of the railway embankment.

Fauna Habitats

Terrestrial Mammals

The three forested communities provide suitable habitat for a number of terrestrial mammals, with habitat quality dependent on amount of available groundcover, density and floristic diversity of shrubs and grasses and land use history (eg. selective logging, frequent fires, rubbish dumping). The majority of the LHSGIF contains a generally sparse understorey that

only certain mammals such as Macropods would prefer. Some areas, such as around creeklines, contain a more dense and diverse understorey with fallen timber, shrub layer etc. These areas provide more suitable habitat for a range of native terrestrial mammals, particularly smaller species. The KSSW also contains a more dense shrub and grass layers that would also suit small and medium-sized terrestrial mammals. The Cleared Areas also provide some opportunity for grazing Macropods and granivorous avifauna.

Arboreal Mammals

The forested communities contain foraging resources such as foliage, pollen, nectar and invertebrates for arboreal mammals such as Possums and Gliders. However, there are noted restrictions for arboreal mammals within the LHSGIF and KSSW communities. The relatively small amount of hollow-bearing trees within the LHSGIF due to logging and frequent fires has reduced the amount of critical habitat resources available for hollow dependent arboreal mammals. A higher incidence of hollow-bearing and habitat trees occurs within the KSSW and GGSGF. However, the KSSW, as woodland with a fairly open canopy, provides limited potential for arboreal mammals due to the lack of connectivity within the canopy that may inhibit the traversal of arboreal mammals throughout the study area. Furthermore, hollow use within *E. p. decadens* has not been previously recorded during extensive surveys within this study area and on adjacent HEZ lands (authors pers. obs.). Furthermore, the vast majority of tree hollows recorded within the *E. p. decadens* trees were found to be relatively close to the ground (i.e. less than 8m), and as such may be limited in their value to arboreal mammals.

The area identified as providing the most suitable habitat for arboreal mammals is the GGSGF due to the existence of tall trees with ample connectivity and a moderate frequency of hollows. It was from this area that *Petaurus norfolcensis* was recorded and it is deemed the area most likely to contain *P. australis* (although it is relatively isolated by extensive areas of KSSW). Potential habitat for these two species also exists just off the south-western boundary of the study area within a creekline that connects with suitable habitat within the HEZ lands. However, the existence of Leggetts Drive (with a moderately wide road reserve) between this habitat and the study area greatly inhibits the likelihood of these species to cross into the study area at this point.

Bats

The relative diversity of habitats in the study area, including open forests, woodlands, cleared areas (and associated ecotones) and creeklines provide potential hunting resources for a number of Microchiropteran and frugivorous bat species. Species reliant on tree hollows for roosting also have potential roosting habitat within the study area in the form of suitable tree hollows, largely within the KSSW and GGSGF communities.

Frogs

Frog habitats are generally restricted to the creeklines, small wetlands and ephemeral soaks. Creeklines traversed by the proposed road alignment include second order streams that are characterised by pools dissected by overland flow channels, and off-stream ephemeral soaks. Such creeklines provide habitat for the threatened *Litoria brevipalmata* (Green-thighed Frog). The FWC provides only a seasonal / post rainfall habitat resource and was found to be dry during the majority of field studies (being in much better condition at time of writing). Areas containing suitable surface soils, such as KSSW, also provide habitat for a number of burrowing species such as *Limnodynastes* spp.

Reptiles

A relative diversity of habitats for reptiles occurs within the study area. This is predominantly within the forested areas that contain fallen timber and ground debris (including dumped rubbish). The KSSW is deemed to provide the best resource for reptiles due to the density of low vegetation and sandy substrate of the soils therein. Limiting factors to reptiles occurring within the LHSGIF include previous land-uses, high fire frequencies and the general sparsity of groundcover in some areas. The creeklines also provide some habitat for specialist reptilian fauna.

Avifauna

The open forest and woodland habitats present provide suitable habitat for a range of avifauna. This is chiefly in the form of the range of Eucalypt and other nectar-producing flora that provide foraging resources for nectivorous and associated avifauna. Nesting and roosting opportunities for a variety of sedentary and migratory birds are also available throughout the study area, including habitat for those bird species that require tree hollows for nesting.

The KSSW, with a denser shrub layer, provides potential habitat for smaller, cover-seeking species. The LHSGIF contains winter-flowering Eucalypt species that may provide important habitat resources for endangered species such as *Lathamus discolor* (Swift Parrot) and *Xanthomyza phrygia* (Regent Honeyeater).

5.5 Discussion of conservation status

For each species or population likely to be affected, details of its local, regional and State-wide conservation status,….[and]….its habitat requirements….(Section 110 (2) (c))

The conservation status of each potentially affected threatened species and its habitat is detailed below.

Acacia bynoeana

This species is listed under the NSW *TSC Act 1995* as 'Endangered' and under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) as 'Vulnerable'.

In terms of direct reservation, this species is known from Lake Macquarie State Conservation Area, Blue Mountains, Royal and Marramarra National Parks, and Castlereagh, Dharawal and Agnes Banks Nature Reserves (Bell and Driscoll 2002). Additional specimens and known habitat areas are reserved within the conservation zone of the Hunter Economic Zone. Although this species has not yet been recorded within Werakata National Park, it could be reasonably stated that the species is likely to exist therein, given the amount of potential habitat that exists within the 'Kearsley Sector'.

Known populations and potential habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment.

Eucalyptus parramattensis* ssp. *decadens

This species is listed under both the NSW *TSC Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) as 'Vulnerable'.

According to Briggs and Leigh (1995) criterion, *E. p*. *decadens* is ROTAP-coded 2V, indicating that it is not known to occur within the reserve system. Within conservation reserves, this species is only known from Werakata National Park. Additional areas are conserved within the conservation zone of the HEZ. In terms of potential habitat, a total of 532.5ha of KSSW exists in Werakata National Park, although surveys as part of the ECMP process have revealed that only a 37ha area of KSSW within this reserve is dominated by *E. p. decadens* (Harper Somers O'Sullivan 2004a). Additional specimens and known habitat areas are reserved within the conservation zones of the HEZ, where 122ha of habitat dominated by this species exists.

Considering that the species is conserved in one formal reserve only (and as such can be prone to random / stochastic events and any other longer-term changes), it is considered that it is not adequately represented in conservation reserves. However, with the proposed reservation of lands to the east of the proposed alignment, a much greater level of conservation should be reached such that this species may be adequately reserved at that time (and after appropriate management of the population therein can be assured).

Grevillea parviflora* ssp. *parviflora

This species is listed under both the NSW *TSC Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) as 'Vulnerable'.

G. p. *parviflora* is not ROTAP-listed. Within conservation reserves, populations are known only from Werakata National Park (Bell 2004a; Harper Somers O'Sullivan 2004a; authors pers. obs.). Additional specimens and known habitat areas are reserved within the conservation zone of the HEZ. Nonetheless, considering that the species is conserved in one formal reserve only (and as such can be prone to random / stochastic events and any other longer-term changes), it is possible that it is not adequately represented in conservation reserves. However, the conservation status of this species should be significantly bolstered by the proposed reservation of large populations and potential habitat under conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment. With the addition of this area, it is feasible that the species would be adequately conserved, at least in the locality.

***Litoria brevipalmata* (Green-thighed Frog)**

L. brevipalmata is listed on Schedule 2 of the *TSC Act 1995* as 'Vulnerable'.

Populations of this species are known to exist in the region within the Watagan National Park (Ehmann, 1997). As such, it appears that the species is not well represented within conservation reserves in the region. Therefore all populations should be regarded as being of a high conservation value. Potential areas of habitat are reserved within the conservation zone of the HEZ, in particular along the main drainage line (Chinaman's Creek). Potential habitat similar to that found on the Pelaw Main By-pass and HEZ study areas occurs in Werakata National Park. Additional habitat for this species may be protected under proposed

conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment.

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

This species is listed under both the NSW *TSC Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) as 'Endangered'. Garnett and Crowley (2000) also list this species nationally as 'Endangered'.

Records of this species from within local conservation reserves appear to be restricted to Werakata National Park (authors pers. obs.; Atlas of NSW Wildlife 2006). Records from this reserve appear to be regular and it is likely that habitat within this area is a favoured resource for a component of the national population. Having said this, it should be recognised that no other formal conservation reserves (on the National Parks Estate) exist within a 10km radius of the study area. Other local conservation reserves include Watagan National Park, where non-preferred habitat dominates, and Belford National Park, where little fauna data exists (although potential habitat has been noted; D. Saunders pers. comm.).

Several records do exist from forested areas with a certain level of conservation value, such as from Aberdare State Forest, including the most significant records in the Hunter Region from the 2005 season (HSO ecologists pers. obs.). Further areas of known and potential habitat are conserved within the 7(b) conservation zone within the HEZ Study Area. However, it could be generally stated that the bulk of important habitat for this species within the locality lies within unprotected areas.

Regionally, records of Swift Parrots exist from a number of conservation reserves including Jervis Bay, Nattai, Botany Bay, Ku-ring-gai Chase, Sydney Harbour, Blue Mountains, Brisbane Water, Wollemi and Wyrrabolong National Parks (Atlas of NSW Wildlife 2006). However, the adequacy of representation of the preferred habitat of this species in the region and locality can be stated as being inadequate due to a poor representation of Spotted Gum / Ironbark and other preferred habitats, such as Swamp Mahogany-dominated associations. It should be recognised that any of a number of reserves containing forested areas with winter-flowering Eucalypt species and/or lerp resources could provide some protected foraging habitat for this species, as evidenced by the reasonably large number of reserves from which it has been recorded (Atlas of NSW Wildlife 2006).

Additional habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment, although much of this habitat is not typical of that preferred by this species.

***Climacteris picumnus* (Brown Treecreeper)**

C. picumnus (ssp. *victoriae*) is listed on Schedule 2 of the *TSC Act 1995* as 'Vulnerable'. Nationally, Garnett and Crowley (2000) list the south-eastern sub-species as 'Near Threatened'.

Locally, this species is known from Werakata National Park (Atlas of NSW Wildlife 2006; authors pers. obs.). Elsewhere within the region, this species has been recorded within Blue Mountains, Wollemi, Yengo and Goulburn River National Parks (Atlas of NSW Wildlife; HBOC 1996; 1998; authors pers. obs.). Furthermore, potential habitat would be contained within a number of reserves containing suitable unfragmented wooded habitat. Locally, known habitat is also protected within the conservation zones in the HEZ lands. Additional

habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment, although much of this habitat is not typical of that preferred by this species. It is considered that although populations of this species may not be adequately reserved, the habitat of this species appears to be adequately conserved. However, the vast majority of such habitat remains unprotected.

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

P. temporalis (nominate race *temporalis*) is listed on Schedule 2 of the *TSC Act 1995* as 'Vulnerable'. Nationally, Garnett and Crowley (2000) list the eastern sub-species as 'Near Threatened'.

Locally, this species is known from Werakata National Park (University of Newcastle 2001; authors pers. obs.) and further afield it has been recorded in Wollemi, Goulburn River and Yengo National Parks (Atlas of NSW Wildlife 2006; authors pers. obs.). Known and potential habitats within the region are conserved in a number of reserves such as Blue Mountains and Watagan National Parks and Parr State Recreation Area. Locally, known habitat is also protected within the conservation zones in the HEZ lands. Additional habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment, although much of this habitat is not typical of that preferred by this species. It is considered that although populations of this species may not be adequately reserved, the habitat of this species appears to be adequately conserved. However, the vast majority of such habitat remains unprotected.

***Chthonicola sagittata* (Speckled Warbler)**

C. sagittata is listed on Schedule 2 of the *TSC Act 1995* as 'Vulnerable'. Nationally, Garnett and Crowley (2000) list this species as 'Near Threatened'.

Locally, this species is known from Werakata National Park (Harper Somers O'Sullivan 2004a; University of Newcastle 2001; authors pers. obs.). Records also exist from Wollemi, Goulburn River, Dharug and Yengo National Parks (Atlas of NSW Wildlife 2006; authors pers. obs.). Known and potential habitats within the region are conserved in a number of reserves such as Blue Mountains National Park and Parr State Recreation Area. Locally, further areas of known habitat are protected within the conservation zones in the HEZ lands. Additional habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment. It is considered that although populations of this species may not be adequately reserved, the habitat of this species appears to be adequately conserved. However, the vast majority of such habitat remains unprotected.

***Ninox strenua* (Powerful Owl)**

Ninox strenua is listed on Schedule 2 of the *TSC Act 1995* as 'Vulnerable'. Nationally, Garnett and Crowley (2000) list this species as 'Least Concern'.

Locally, there appear to be no known records of this species from within formal conservation reserves, although records of this species in the region are known from many conservation reserve areas. These include the Gardens of Stone National Park and Tingira Heights and Munghorn Gap Nature Reserves (authors pers. obs.) as well as Wollemi, Botany Bay,

Brisbane Water, Bouddi, Marramarra, Nattai, Blue Mountains, Cattai, Heathcote, Goulburn River, Kanangra Boyd, Ku-ring-gai Chase and Yengo National Parks (Atlas of NSW Wildlife 2006). A well-documented resident breeding pair of *N. strenua* has established in Blackbutt Council Reserve, in the outer suburbs of Newcastle. Recent records of this species also exist from conservation zones within the HEZ study area (Harper Somers O'Sullivan 2004a; HSO ecologists pers. obs.). Additional habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment.

As such, it can be determined that this species is well represented in conservation reserves in the region. Whether or not the habitat of this species is well represented within the region is abstruse and difficult to determine, although it appears that any of a number of reserves containing forested areas could provide some protected hunting and some potential nesting habitat for this species. As such, it could be tentatively stated that the habitat of this species is well represented in conservation reserves in this region, although the majority of potential habitat remains unprotected.

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

M. gularis (nominate race *gularis*) is listed on Schedule 2 of the *TSC Act 1995* as 'Vulnerable'. Nationally, Garnett and Crowley (2000) list the nominate race as 'Near Threatened'.

Locally, this species is known from Werakata National Park (Harper Somers O'Sullivan 2004a; authors pers. obs.). Records in the wider locality exist from Blue Mountains, Ku-ring-gai Chase, Wollemi, Goulburn River and Yengo National Parks (Atlas of NSW Wildlife 2006; authors pers. obs; HBOC 1998). Known and potential habitats within the region are conserved in these and a number of other reserves such as Brisbane Water and Watagan National Parks and Parr State Recreation Area. Locally, known habitat is protected within the conservation zones in the HEZ lands. Additional habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment. It is considered that although populations of this species may not be adequately reserved, potential habitat for this species appears to be adequately conserved. However, the vast majority of such habitat remains unprotected.

***Xanthomyza phrygia* (Regent Honeyeater)**

This species is listed under both the NSW *TSC Act 1995* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) as 'Endangered'. Garnett and Crowley (2000) also list this species nationally as 'Endangered'.

This species has been recorded in Werakata National Park (Atlas of NSW Wildlife 2006). As aforementioned, this species has also been recorded over several seasons (including 2005) within Aberdare State Forest where a level of protection may be afforded. Regionally, records exist from a number of conservation reserves including Cattai, Scheyville, Blue Mountains, Brisbane Water, Dharug, Bouddi, Wollemi and Yengo National Parks and Muogamarra Nature Reserve (Atlas of NSW Wildlife 2006).

The adequacy of representation of the preferred habitat of this species in the region and locality can be stated as being inadequate due to a poor representation of Spotted Gum / Ironbark and other preferred habitats, such as Swamp Mahogany-dominated associations. However, it could be recognised that any of a number of reserves containing forested areas

with winter-flowering Eucalypt species and/or lerp resources could provide some protected foraging habitat for this species, as evidenced by the reasonably large number of reserves from which it has been recorded.

Additional habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment, although much of this habitat is not typical of that preferred by this species.

***Petaurus norfolcensis* (Squirrel Glider)**

P. norfolcensis is listed on Schedule 2 of the *TSC Act 1995* as 'Vulnerable'. Nationally, the Action Plan for Australian Marsupials and Monotremes (1996) lists this species as 'Lower Risk (near threatened)'.

Records of this species are known from a large number of conservation reserves within the region including Wollemi, Blue Mountains, Bouddi, Popran, Wyrrabolong, Brisbane Water, Ku-ring-gai Chase and Dharug National Parks (Atlas of NSW Wildlife 2006). Additional known habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment.

Based on this information it could be tentatively stated that the populations and habitats of this species may be adequately represented in conservation reserves in this region, although the majority of potential habitat remains 'unprotected'.

***Mormopterus norfolkensis* (East-coast Freetail-bat)**

M. norfolkensis is listed on Schedule 2 of the *TSC Act 1995* as Vulnerable. Nationally, the Action Plan for Australian Bats (1999) lists this species as 'Data Deficient'.

Locally this species has been recorded in Werakata National Park, and within the region the species is known from Yengo, Wollemi, Blue Mountains and Dharug National Parks (Atlas of NSW Wildlife 2006). Additional habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment. As such, it appears that the populations and habitats of this species are moderately well represented in conservation reserves in the region, although the majority of potential habitat remains 'unprotected'.

***Scoteanax rueppellii* (Greater Broad-nosed Bat)**

S. rueppellii is listed on Schedule 2 of the *TSC Act 1995* as Vulnerable. Nationally, the Action Plan for Australian Bats (1999) lists this species as 'Lower Risk (near threatened)'.

No records of this species exist for reserves in the immediate locality, although the species has been recorded in a number of reserves within the region including Wollemi, Dharug, Wyrrabalong and Yengo National Parks (Atlas of NSW Wildlife 2006). Additional habitat for this species may be protected under proposed conservation agreements currently being negotiated between the RTA, DEC and landholders for land within the study area to the east of the proposed road alignment. As such, it appears that the populations and habitats of this species are moderately well represented in conservation reserves in the region, although the majority of potential habitat remains 'unprotected'.

5.6 Description of feasible alternatives

A description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development (Section 110 (2) (h)).

The Pelaw Main By-pass proposal is intrinsically allied with the greater HEZ development. An analysis of feasible alternatives to the HEZ has been discussed in Section 5.6 within Harper Somers O'Sullivan (2002b). This discussion concluded that the HEZ proposal represented the culmination of a great deal of planning supported by ample fieldwork to generate the most efficient conservation outcome for known and potentially occurring threatened species and vegetation communities whilst achieving important economic, social and development outcomes. Detailed, ongoing studies (in the form of an Ecological Constraints Master Plan – Harper Somers O'Sullivan 2004a) continue to ensure that any other potential constraints are identified during ongoing phases of the planning process.

With this in mind, the need for a by-pass to the HEZ development area was considered essential. This was in order to facilitate the required heavy vehicle movements from the HEZ to the Sydney / Newcastle Freeway (F3) to the east via John Renshaw Drive. This has been deemed necessary in order to avoid potential impacts on the amenity of Pelaw Main through which heavy vehicles would need to pass through with the road system in its current state. The size and condition of the existing Pelaw Main Bridge is not considered to be sufficient to support the tonnage and frequency of heavy vehicles accessing and leaving the HEZ study area en-route to John Renshaw Drive. Within the framework of the HEZ project and given the location of the HEZ Spine Road, it is considered that no feasible alternatives to the positioning of the Pelaw Main By-pass exist. Furthermore, the design and location of the proposed Pelaw Main By-pass also gives consideration to the potential future alignment of an extension of the F3 Freeway from Seahampton to Branxton.

From the outset it was clear that the proposed Pelaw Main By-pass would require traversal of an EEC, being KSSW. This scenario could not have been avoided and a preferred alignment was largely based upon minimising the area crossed and potential impacts upon this community. However, restrictions pertaining to noise impacts upon the village of Pelaw Main dictated that the alignment needed to be located further east than the most ecologically ideal alignment. Given these restrictions, it is considered that no feasible alternatives for the alignment exist. In the interim, the LHSGIF community has also been listed as an EEC. Likewise for KSSW, it is considered that no feasible alternatives for this community exist that could achieve the ecological outcomes whilst meeting the project objectives.

Therefore, the proposed Pelaw Main By-pass alignment has been deemed to provide the most appropriate outcomes for both project and ecological objectives and no feasible alternatives are considered to exist.