

Facilitating Wildlife Movements in South East Queensland

Scientific justification for overpass constructions at Drewvale (Logan Motorway and Gateway Arterial Motorway).

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Executive summary

The current loss of natural ecosystems within South East Queensland (SEQ) is higher than ever before, making remnant corridors and natural areas irreplaceable ecological assets for the surrounding region. Continual intensive impacts from human activity, particularly associated with roads, facilitate habitat loss and landscape fragmentation which reduces population sizes and increases localised extinction. The Flinders Karawatha Corridor is the largest remaining continuous stretch of forest in SEQ and is a significant feature of the region's landscape, as recognised by Government planning documentation. Connectivity within the corridor must be maintained if it is to adequately facilitate the movement of wildlife and the subsistence of remnant forest within SEQ. Currently, the presence of large roads within the Flinders Karawatha Corridor severely compromises the primary objective of maintaining the corridor for landscape connectivity. This must be rectified to protect wildlife and ensure the persistence of the flora and fauna communities which inhabit the area.

Karawatha Forest and Kuraby Bushlands are recognised as critical components of the Flinders Karawatha Corridor. Connecting Karawatha and Kuraby to the body of the Flinders Karawatha Corridor is a small expanse of remnant bushland around the suburb of Drewvale. Currently, any fauna movements between the reserve and the remnants at Drewvale are severely restricted by the intersecting presence of the Logan and Gateway Motorways. This restriction creates real problems for the safe passage of wildlife that attempts to move between Karawatha and the rest of the Flinders Karawatha Corridor.

The immediate and long term success of the Compton Road overpass is very likely to predict the success of similar structures at Drewvale. The construction and physical characteristics of the Compton Road overpass are a sound basis for further overpass construction. Therefore we recommend the following:

- Construction of three vegetated overpasses and complementary infrastructure in the Drewvale area;
- The overpasses follow the design and implementation of the Compton Road overpass;
- The overpasses are of increased size (wider than Compton Road); and
- Overpass placement is identified through fauna and road kill surveys.

Social and financial benefits of reconnecting Drewvale:

- Encouraging wildlife away from housing areas;
- Reduction of road kill and fauna-related accidents;
- Improved lifestyle and positive contribution of increased greenspace;
- Overpasses display government contributions publicly;
- Removing the chance of lost revenue from investing in a fragmented corridor; and
- Preservation of natural areas.

Outcomes:

- Far greater connectivity for the northern end of the Flinders Karawatha Corridor;
- Ensure long term persistence of Karawatha Forest and Kuraby Bushlands; and
- Integrate Drewvale forested areas into the corridor as functional refuges.

Background

The current loss of natural ecosystems within SEQ is higher than ever before, making remnant corridors and natural areas priceless and entirely irreplaceable ecological assets for the surrounding region. Continual intensive impacts from human activity and associated pressures could seriously impact the longevity of remaining natural areas. Many are already isolated by urban infrastructure, restricting wildlife movements and endangering local populations (Goosem et al. 2001; Bissonette and Adair 2008; Hayes and Goldingay 2009). Roads, in particular, facilitate habitat loss and landscape fragmentation (Underhill and Angold 1999; Bissonette and Adair 2008; Taylor and Goldingay 2010), increasing the pressure placed on urban reserves and corridors. This habitat fragmentation limits the ability of animals to access critical resources, reduces population sizes (Taylor and Goldingay 2009) increases localised extinction (Forman et al. 2003; Bond and Jones 2008), and alters population dynamics (Bellis et al. 2007). The ecological processes and components that function as part of urban reserves and corridors are under continued and unsustainable stress. This requires constant, well-researched management to prevent deterioration and the loss of those characteristics that make them valuable. Improvements in landscape connectivity between urban remnants are of particular importance within urban landscapes. Connectivity increases the individual value of each reserve, while improving the combined contribution of these spaces. As a result, urban reserves can provide established, working network of corridors and sanctuaries for the long-term persistence of wildlife impacted by urbanisation.

Over eighty percent of the naturally occurring vegetation in SEQ has been lost since European settlement (Catteral and Kingston 1993). The Flinders Karawatha corridor is the largest, and one of the last, remaining continuous stretches of forest in SEQ. The corridor includes 56,300 hectares of native vegetation and is a significant feature of the region's landscape, extending from Karawatha Forest to Flinders Peak on to the southern side of Ipswich. It encompasses Bulimba Creek, Oxley Creek and a number of reserves and conservation estates (DEHP 2013, Figure 1). The importance of the Flinders Karawatha Corridor lies in facilitating movement opportunities and providing natural refuges for local biodiversity.

The local and regional significance of the corridor has been recognised by local and state governments who encourage ongoing efforts to manage and preserve the Flinders Karawatha Corridor (DEHP 2013). Connectivity within the corridor must be maintained if it is to adequately facilitate the movement of wildlife and the subsistence of remnant forest within SEQ. At present, the corridor is bisected by highways and smaller roads, to the detriment of its primary purpose. The presence of large roads within the Flinders Karawatha Corridor must be overcome to protect travelling species and ensure the persistence of the flora and fauna communities which inhabit the area.

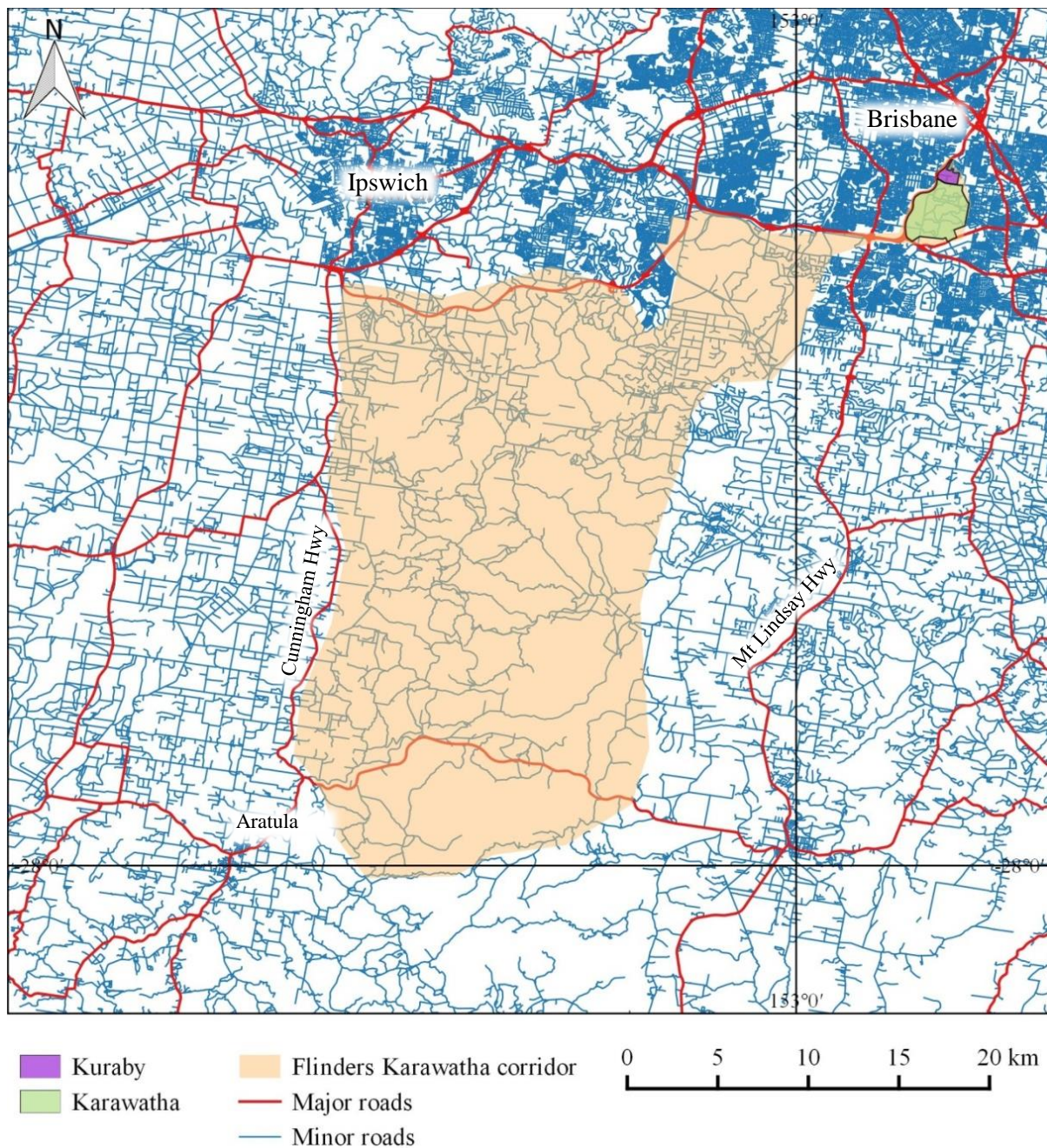


Figure 1. Location of the Flinders Karawatha Corridor within the urban sprawl of Brisbane City, Logan City and Ipswich City, South East Queensland.

Critical Aspects of the Flinders Karawatha Corridor

Karawatha Forest and Kuraby Bushlands are recognised as critical components of the Flinders Karawatha Corridor (Figure 1). High species diversity is a prominent attribute of both reserves, as they are considered biodiversity hotspots within the Greater Brisbane Area (Brisbane City Council 2015). Karawatha Forest is one of Brisbane’s most well-known recreational nature reserves. Kuraby Bushlands are connected to Karawatha by a series of fauna passages, built in 2005, to accommodate wildlife movements between the reserves.

Connecting Karawatha and Kuraby to the body of the Flinders Karawatha Corridor is a small expanse of remnant bushland around the suburb of Drewvale (Figure 2). Currently, any fauna movements between the reserve and the remnants at Drewvale are severely restricted by the intersecting presence of the Logan and Gateway Motorways. This restriction creates real problems for the safe passage of wildlife that attempts to move between Karawatha and the rest of the Flinders Karawatha Corridor.

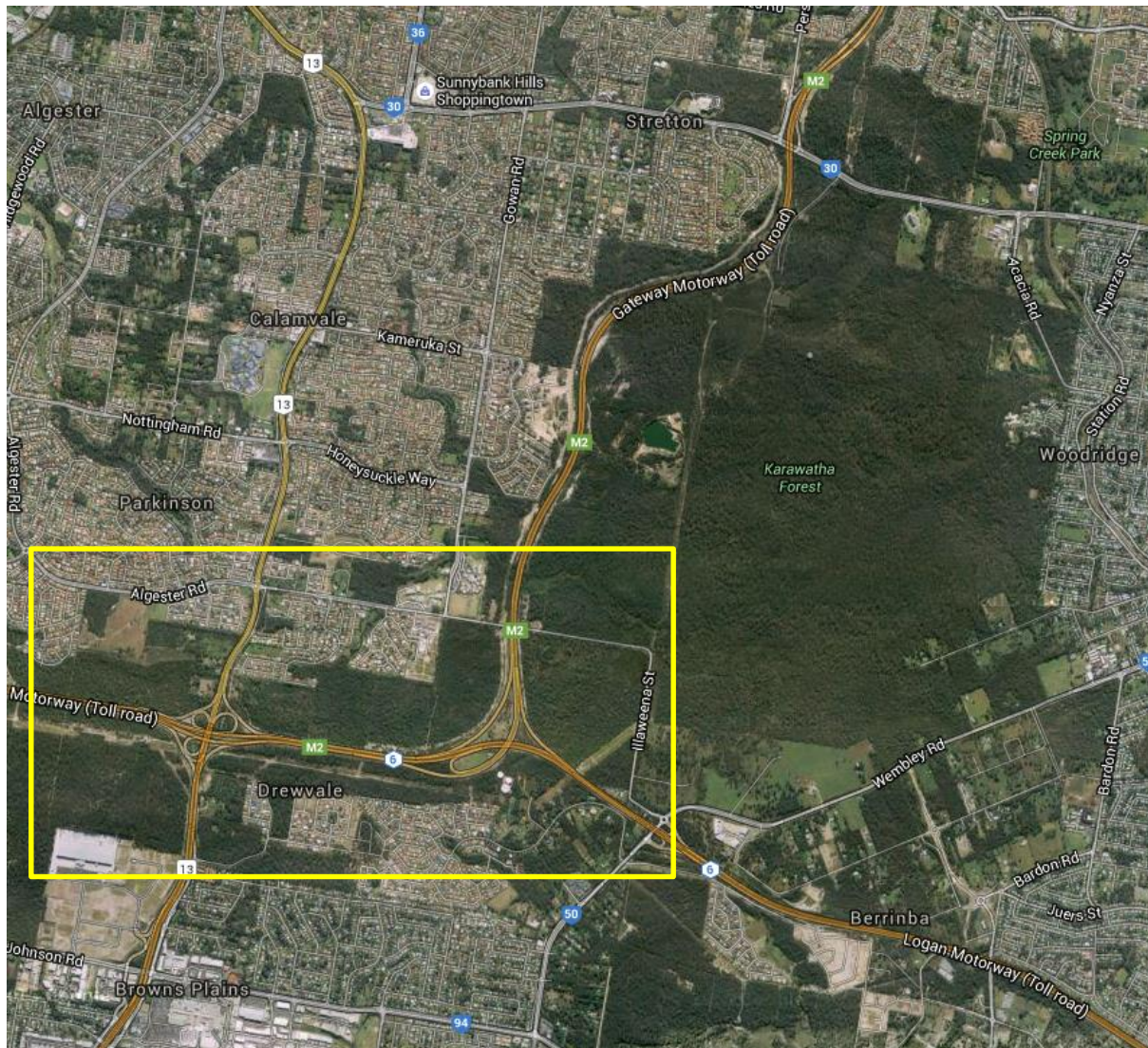


Figure 2. The presence of urban remnant vegetation at Drewvale connects Karawatha forest and Kuraby bushland to the Flinders Karawatha corridor.

Species Diversity

The regional significance of the Flinders Karawatha Corridor is based primarily on the presence of threatened ecological communities and biodiversity. The corridor comprises a number of threatened communities including box-gum woodland and Brigalow comprised of local *Acacia* species. The corridor is home to 58 threatened or near threatened flora species and endangered

fauna include 12 species of threatened fauna. Twenty-five priority species have been identified by a panel specifically addressing the Flinders Karawatha Corridor (DEHP 2013).

The biodiversity within Karawatha and Kuraby is the most intensively studied within the Flinders Karawatha Corridor. Over 300 native plant species (Veage and Jones 2007; Bond and Jones 2008; Jones et al. 2011), including a number of significant, rare or restricted species support over 200 known fauna species (Brisbane City Council 2015). These fauna communities include at least 16 significant or in-decline species including the powerful owl (*Ninox strenua*), tusked frog (*Adelotus brevis*), squirrel glider (*Petaurus norfolcensis*), greater glider (*Petauroides volans*), koala (*Phascolarctos cinereus*) and grey-headed flying fox (*Pteropus poliocephalus*). The reserves also include some of the last remaining wet heathlands and melaleuca wetlands in Brisbane, which support the highest frog diversity in Brisbane (Brisbane City Council 2015).

Reliable species lists for the Drewvale area are lacking. The last substantial wildlife monitoring program occurred in 1994, from which the most recent species list has been obtained (Appendix 1). Considering the proximity and restricted connectivity of the area to Karawatha Forest, it is expected that the current species diversity will closely resemble that found in Karawatha and Kuraby. This is most likely to include a number of the rare and threatened species supported within Karawatha and Kuraby.

Facilitating wildlife movements

The most distinct feature of Karawatha Forest and Kuraby Bushlands is the array of fauna passages that connect the two forest reserves. In 2004-2005, the widening of Compton Road threatened to further bisect Karawatha and Kuraby. To mitigate these impacts, the road design was negotiated to include the Compton Road fauna array, which included two fauna underpasses, three rope ladders, a line of glider poles and an overpass. At the time of construction, the Compton Road fauna array was the most complex fauna crossing assembly in Australia (Veage and Jones 2007). Since their establishment, these passages have been shown to greatly improve the landscape connectivity for mammals (Veage and Jones 2007, Jones and Bond 2008), birds (Pell and Jones 2015) reptiles (McGregor et al. 2015) and bats (McGregor et al. unpublished data). The overpass in particular has been identified as a vital component to the ecological functionality of the reserves.

The overpass is the most prominent feature of the Compton Road fauna array (Figure 3). To increase landscape connectivity, the overpass was planned to be a continuation of the remnant natural habitat (Jones et al. 2010). In order to replicate the remnant vegetation type on the overpass, the structure was planted with native tree and shrub species (Jones et al. 2010). The vegetation present on the overpass was planted in early 2005 and surveys undertaken in 2009 found that 95% of the trees and shrubs had survived (Jones et al. 2011). It is suspected that the planning and implementation of natural habitat across the overpass is has been the key to its success. The diversity and abundance of wildlife utilising the overpass has been astounding, and is likely due to the presence of well-planned and maintained habitat.



Figure 3. Compton Road fauna overpass in 2015, as seen from the west.

Current research supporting fauna overpasses

Overpass success in facilitating the movement of mammal populations has been reported globally. In France and Switzerland, studies have found evidence that larger mammal species including roe deer (*Capreolus capreolus*) and Eurasian badgers (*Meles meles*) use overpasses frequently (see Corlatti et al. 2009). Similar results have been recorded in North America, where overpasses facilitate landscape permeability for large mammal populations, while minimising fauna-vehicle incidents (Bissonette and Adair 2008). Other non-target species such as reptiles have been observed utilising underpasses and overpasses (Abson and Lawrence 2004; Bond and Jones 2008; Mata et al. 2008), as well as opportunistically using existing culverts (Yanes et al. 1995).

Contemporary designs of fauna overpasses

There has been considerable evolution of the design and construction procedures of modern fauna overpasses during the past decade. As usual, this is most clearly seen in Europe where the traditional short wooden dome shape has given way to elegant sweeping concrete structures, often with minimal support and wide open expanses, beneath which provides excellent vision for motorists.

The examples shown below (Figure 4) reflect these changes, though both are typical open structures without significant vegetation, as they are sited in flat pastoral lands and are intended primarily for the movement of deer. Note that these overpasses are situated in flat terrain, with raised soil batters on either side of the road.



Figure 4. Modern fauna overpasses in Europe; M7 in southern Hungary (above) and A66 motorway in north-west Spain (below).

In contrast, Australian fauna overpasses tend to be vegetated, with the planting of substantial amounts of local plants added to the surface following construction. This is typical of the Compton Road overpass as well as Australia's largest fauna overpass situated at Bonville in northern New South Wales and spanning the Pacific Highway (Figure 5). This structure is noteworthy in being thickly vegetated with a high density of shrubs and trees across its entire 50 m width. Following the recent findings obtained from the Compton Road structure, it is highly likely that the Bonville overpass function as a safe passage, as well as useable habitat, for a wide diversity of species including reptiles, frogs and microbats.



Figure 5. Australia's newest and widest fauna overpass at Bonville, NSW.

The bulk of this structure contrasts starkly with the relatively light-weight European overpasses, a difference primarily associated with the requirement for substantial soil depth to support the reasonably sized trees that will eventually grow. This difference in design is directly related to the target species of the local area. Open, grassy surfaces are optimal for the deer and large carnivores which are the main species of concern in much of Europe (and the reason for the many hundreds of overpasses in that part of the world). In Australia, the focus is much broader and although our larger mammals (kangaroos and wallabies) are of primary interest, our fauna overpasses can also benefit a much wider suite of species. Thus the provision of a fully vegetated overpass has the primary objective of allowing a range of species to use it, as is the case with Compton Road.



Figure 6. The Groene Woud amphibian ecoduct in the Netherlands.

Other innovations in the design of fauna overpasses have involved the use of flat bridge-like structures over road cuttings, as exemplified by the famous Groene Woud salamander ecoduct in Holland (Figure 6) and the Hamilton Road overpass in northern Brisbane (Figure 7). These

styles are considerably easier to erect and therefore less expensive but are reliant on local topography. Both of these flatter structures are more lightly vegetated than some of the other examples, and therefore do not need to provide the required support required for larger trees.

Note also the differing methods for screening provided along the sides. Such screening is important for mitigating the indirect effects of vehicles such as noise, light and airborne pollution. In the case of the Groene Woud overpass, the screening is provided by a row of small trees growing atop a mound of soil; these large constructions are possible because the overpass itself is 80 m wide. In the case of the much more modestly-sized 20 m overpass at Hamilton Road, the screening is provided by an artistically designed mesh-like metal plates, which minimises shading of the plants growing nearby.



Figure 7. Hamilton Road fauna overpass in northern Brisbane.

The design of sound and noise barriers (eg. Figure 8) is undergoing considerable development at present, following many studies which have shown clearly that both can have significant negative impacts on animals seeking to use the overpass.



Figure 8. Recent sound and noise barrier structure on fauna ecoduct in The Netherlands.

Compton Road overpass

Compton Road in particular, has become an internationally recognised example of a holistically successful fauna overpass. From soon after the completion of construction, the overpass demonstrated immediate success for small mammals (Bond and Jones 2008) and reptiles (McGregor et al. 2015). Bond and Jones (2008) reported mammal scat appearance as early as three weeks after construction, while scats of three macropod species were reported early on in the study. McGregor et al. (2015) reported the presence of reptiles on the overpass as early as 2006, with some reptiles and amphibians colonising and living on the overpass by 2010. Flying animals have also been shown to use the overpass, with Pell and Jones (2015) demonstrating that many small forest birds that use the overpass to feed and cross would not otherwise do so. Similarly, recently collected data on microbat activity around the overpass has provided the first evidence that the overpass is being used intensively by a great diversity of microbats (McGregor et al. unpublished data).

Planning for Drewvale

Connectivity within SEQ is required to meet State and Local Government planning requirements for preserving natural areas. The current Government resources that are used to maintain the Flinders Karawatha corridor, and Karawatha forest in particular, are of little value if connectivity is not maintained. Isolating areas of the corridor will lead to reduced success and increased local species decline, potentially leading to extinction. The Drewvale forest area is of critical importance to Karawatha and Kuraby, as it is the only natural land connecting the reserves to the Flinders Karawatha corridor. At present, the Logan Motorway and the Gateway Motorway in particular, are preventing any useful connectivity from being established. This issue must be addressed if flora and fauna communities are to persist in the area.

Overpasses have been shown to facilitate the highest diversity of species compared with other fauna passages (Glista et al. 2009; Hayes and Goldingay 2009). This trend can be seen globally, as well as in Brisbane. Therefore, overpasses are the most valuable and preferred method of re-establishing landscape connectivity for wildlife. Underpasses are also encouraged as a supporting facility of overpasses, as some animals are more likely to use underpasses (koalas, for example). The Drewvale area is highly segregated and requires a number of overpasses to assist in reconnecting the landscape. At present, we are recommending three overpasses in the Drewvale area. This recommendation is based on the physical characteristics of the location and approximate locations have been identified (see Bulimba Catchment document). However, the location of these overpasses will need to be determined by fauna monitoring and road kill surveys to identify the most effective placement.

Overpass implementation and success

The success of any given fauna passage will depend on the structure and function of the passage itself, and potential and target fauna communities. For a fauna passage to be successful, it is critical that the diversity and ecological requirements of the surrounding fauna communities be considered prior to implementation (Jochimsen et al. 2004), as well as the success of different passages with the identified target fauna communities. Much of this research has been completed at Compton Road, and is vital to the process of establishing new and successful overpasses.

The importance of the Compton Road overpass to the Drewvale area is the immediate and long term success that has been observed at Compton Road. This is very likely to predict the success of similar structures at Drewvale. The close proximity of the bushland at Drewvale to Karawatha Forest suggests that the flora and fauna communities will be very similar and therefore use any passages in the same way. Similarly, the construction and physical characteristics of the Compton Road overpass are a sound basis for further overpass construction. The overpass vegetation is of critical importance, while the size and style of the overpass is generally accepted to be useful but could be improved. One recommendation is an increase in overall size of new overpasses at Drewvale, particularly at the midpoint of the overpass, which is currently restrictive at Compton Road (measuring 15 m at the narrowest section).

Prior to identifying exact locations of overpasses at Drewvale, monitoring of local wildlife must occur. Understanding the fauna movements in the area, along with identifying roadkill hotspots, will ensure that the overpass location is successful. It is of great benefit to have access to the Compton Road overpass in close proximity; however the ultimate success of any fauna passages constructed at Drewvale will rely on a clear understanding of local fauna patterns and movements. It is expected that a monitoring program such as this would take 12 months to be effective and to consider seasonal variation.

Financial and social benefits

The social and financial benefits of overpass construction around Drewvale are numerous. The importance of enhancing habitat connectivity and improving natural areas within urban spaces is positive for residents. Encouraging wildlife away from housing and roads can reduce roadkill incidents, risks from fauna–vehicles interactions and confrontations between wildlife and residents. Similarly, increasing urban greenspace has been shown to improve lifestyles of residents and can lead to an overall positive contribution to local areas. The additional benefit of constructing prominent structures such as fauna overpasses is that residents and road users can visually appreciate the contribution of Government and asset owner to maintaining local wildlife. This not only displays the works of local and state governments in preserving natural areas, but also increases community awareness and appreciation of integrating urbanisation with the natural landscape.

Currently, the matrix of isolated vegetation and urban structures is likely to be severely impacting Karawatha and Kuraby, as well as restricting the connectivity of the Flinders Karawatha Corridor. To ensure that the financial contributions of the state and local governments to Karawatha in particular, but also the surrounding bushland are not wasted, it is vital to re-establish this landscape connectivity. Maintaining certain areas and not considering a landscape approach to remediation will not be financially beneficial long term, and will likely result in lost revenue and deteriorating natural areas.

Outcomes and conclusion

The construction of three overpasses around the Drewvale and Karawatha area is recommended for the required benefit to local wildlife communities and maintaining connectivity. This will only be enhanced by the construction of associated underpasses and rope ladders. Sufficient monitoring of wildlife communities in the immediate area must occur prior to determining locations for each overpass, for approximately 12 months, to account for seasonal change in movement patterns.

Connectivity within SEQ is required to meet State and Local Government planning requirements for preserving natural areas. The overall anticipated outcome of this proposal would be far greater connectivity for the northern end of the Flinders Karawatha Corridor. In particular, it will greatly benefit Karawatha Forest and the associated landscape connectivity. Constructing these overpasses will effectively integrate the current Drewvale Forest into the Karawatha Forest reserve and the Flinders Karawatha Corridor, allowing it to become a fully functional and valuable aspect of the natural landscape. Ensuring the habitat connectivity within the Drewvale and Karawatha area will ensure the long term persistence and success of Karawatha Forest and the Flinders Karawatha Corridor, as well as the associated wildlife communities that depend on them for survival.

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THE FAUNA OF THE KARAWATHA RESERVE – 1994 Survey
(Appendix1)

Appendix I Fauna List

Fauna species recorded in Karawatha Reserve from various sources including the

- QOSI Queensland Ornithological Society Incorporated,
NS Naturesearch 2001 (Gynther, 1993),
F Queensland Forestry (Corben and Kehl, 1991)
? denotes species listed as possibly occurring in Karawatha Reserve,
QM Queensland Museum data base,
D Drewvale - present study,
K Kuraby Bushland - present study and
P Karawatha Reserve - present study.

VERTEBRATE FAUNA
MAMMALS

QOS NS F QM D K P

Short-beaked Echidna <i>Tachyglossus aculeatus</i>		*					
Brush-tailed Phascogale <i>Phascogale tapoatafa</i>			?				
Common Dunnart <i>Sminthopsis murina</i>			?				*
Common Planigale <i>Planigale maculata</i>			?				*
Koala <i>Phascolarctos cinereus</i>		*	*			*	*
Greater Glider <i>Petauroides volans</i>		*	*			*	*
Sugar Glider <i>Petaurus breviceps</i>			?			*	*
Squirrel Glider <i>Petaurus norfolcensis</i>		*	*	*			*
Common Brushtail Possum <i>Trichosurus vulpecula</i>		*	?			*	*
Feathertail Glider <i>Acrobates pygmaeus</i>			?				
Red-necked Wallaby <i>Macropus rufogriseus</i>		*					*
Eastern Grey Kangaroo <i>Macropus giganteus</i>		*					*

QOS NS F QM D K P

Brown Hare <i>Lepus capensis</i>		*					*
Fox <i>Vulpes vulpes</i>							*
Feral Pig <i>Sus scrofa</i>							?

BIRDS

QOS NS F QM D K P

Brown Quail <i>Coturnix australis</i>							*
Australian Wood Duck <i>Chenonetta jubata</i>	*	*			*		*
Pacific Black Duck <i>Anas superciliosa</i>	*					*	*
Wandering Whistling-Duck <i>Dendrocygna arcuata</i>				*			
Darter <i>Anhinga melanogaster</i>		*					*
Little Pied Cormorant <i>Phalacrocorax melanoleucos</i>		*			*		*
Great Cormorant <i>Phalacrocorax carbo</i>							*
Australian Pelican <i>Pelecanus conspicillatus</i>	*						*
White-faced Heron <i>Ardea novaehollandiae</i>					*		*
White-necked Heron <i>Ardea pacifica</i>							*
Intermediate Egret <i>Egretta intermedia</i>	*						*
Cattle Egret <i>Ardeola ibis</i>							*
Nankeen Night Heron <i>Nycticorax caledonicus</i>	*						*

1))

QOS NS F QM D K P

Australian White Ibis <i>Threskiornis aethiopica</i>	*				*		*
Straw-necked Ibis <i>Threskiornis spinicollis</i>							*
Royal Spoonbill <i>Platalea regia</i>	*						*
Yellow-billed Spoonbill <i>Platalea flavipes</i>							*
Pacific Baza <i>Aviceda subcristata</i>	*				*		*
Black-shouldered Kite <i>Elanus notatus</i>					*		
Whistling Kite <i>Haliastur sphenurus</i>	*						*
Brown Goshawk <i>Accipiter fasciatus</i>						*	*
Collared Sparrowhawk <i>Accipiter cirrhocephalus</i>				*			*
Wedge-tailed Eagle <i>Aquila audax</i>					*	*	*
Little Eagle <i>Hieraaetus morphnoides</i>	*						*
Nankeen Kestrel <i>Falco cenchroides</i>							*
Purple Swamphen <i>Porphyrio porphyrio</i>	*	*					*
Dusky Moorhen <i>Gallinula tenebrosa</i>		*					*
Painted Button-quail <i>Turnix varia</i>		*					*
Masked Lapwing <i>Vanellus miles</i>							*
Rock Pigeon <i>Columba livia</i>							*
Spotted Turtle Dove <i>Streptopelia chinensis</i>		*				*	*

QOS NS F QM D K P

Common Bronzewing <i>Phaps chalcoptera</i>		*			*		*
Crested Pigeon <i>Ocyphaps lophotes</i>		*					*
Peaceful Dove <i>Geopelia placida</i>	*	*					*
Bar-shouldered Dove <i>Geopelia humeralis</i>	*	*			*		*
Glossy Black Cockatoo <i>Calyptorhynchus lathami</i>							*
Galah <i>Cacatua roseicapilla</i>					*		*
Sulphur-crested Cockatoo <i>Cacatua galerita</i>	*				*		*
Cockatiel <i>Nymphicus hollandicus</i>						*	*
Rainbow Lorikeet <i>Trichoglossus haematodus</i>	*	*			*	*	*
Scaly-breasted Lorikeet <i>Trichoglossus chlorolepidotus</i>		*				*	*
Little Lorikeet <i>Glossopsitta pusilla</i>	*	*			*	*	*
Pale-headed Rosella <i>Platycercus adscitus</i>					*	*	*
Brush Cuckoo <i>Cuculus variolosus</i>							*
Fan-tailed Cuckoo <i>Cuculus pyrrhophanus</i>	*	*					*
Horsfield's Bronze-Cuckoo <i>Chrysococcyx basalis</i>	*						*
Shining Bronze-Cuckoo <i>Chrysococcyx lucidus</i>					*		
Little Bronze-Cuckoo <i>Chrysococcyx malayanus</i>							*
Common Koel <i>Eudynamis scolopacea</i>							*

QOS NS F QM D K P

Channel-billed Cuckoo <i>Scythrops novaehollandiae</i>						*
Pheasant Coucal <i>Centropus phasianinus</i>	*					*
Southern Boobook <i>Ninox novaeseelandiae</i>	*				*	*
Tawny Frogmouth <i>Podargus strigoides</i>		*			*	*
White-throated Nightjar <i>Eurostopodus mystacalis</i>						*
Australian Owlet-nightjar <i>Aegotheles cristatus</i>					*	*
White-throated Needletail <i>Hirundapus caudacutus</i>	*				*	*
Azure Kingfisher <i>Ceyx azurea</i>						*
Laughing Kookaburra <i>Dacelo novaeguineae</i>	*	*			*	*
Forest Kingfisher <i>Todiramphus macleayii</i>					*	*
Sacred Kingfisher <i>Todiramphus sancta</i>					*	*
Rainbow Bee-eater <i>Merops ornatus</i>	*	*			*	*
Dollarbird <i>Eurystomus orientalis</i>	*				*	*
White-throated Treecreeper <i>Cormobates leucophaea</i>	*	*			*	*
Variegated Fairy-wren <i>Malurus lamberti</i>	*					*
Red-backed Fairy-wren <i>Malurus melanocephalus</i>	*	*			*	*
Spotted Pardalote <i>Pardalotus punctatus</i>	*	*			*	*
Striated Pardalote <i>Pardalotus striatus</i>	*	*			*	*

QOS NS F QM D K P

White-browed Scrubwren <i>Sericornis frontalis</i>					*	
Speckled Warbler <i>Sericornis sagittatus</i>						*
Weebill <i>Smicrornis brevirostris</i>	*	*			*	*
White-throated Gerygone <i>Gerygone olivacea</i>	*	*			*	*
Brown Thornbill <i>Acanthiza pusilla</i>		*				
Buff-rumped Thornbill <i>Acanthiza reguloides</i>	*	*				*
Noisy Friarbird <i>Philemon corniculatus</i>	*	*			*	*
Noisy Miner <i>Manorina melanocephala</i>		*			*	*
Yellow-faced Honeyeater <i>Lichenostomus chrysops</i>	*	*			*	*
White-throated Honeyeater <i>Melithreptus albogularis</i>	*	*			*	*
Brown Honeyeater <i>Lichmera indistincta</i>	*				*	*
Eastern Spinebill <i>Acanthorhynchus tenuirostris</i>	*	*			*	*
Scarlet Honeyeater <i>Myzomela sanguinolenta</i>	*				*	*
Rose Robin <i>Petroica rosea</i>	*	*			*	*
Eastern Yellow Robin <i>Eopsaltria australis</i>		*			*	*
Varied Sittella <i>Daphoenositta chrysoptera</i>					*	*
Golden Whistler <i>Pachycephala pectoralis</i>	*	*			*	*
Rufous Whistler <i>Pachycephala rufiventris</i>	*	*			*	*

QOS NS F QM D K P

Little Shrike-thrush <i>Colluricincla megarhyncha</i>	*						
Grey Shrike-thrush <i>Colluricincla harmonica</i>	*	*			*	*	*
Leaden Flycatcher <i>Myiagra rubecula</i>	*						*
Australian Magpie-lark <i>Grallina cyanoleuca</i>	*					*	*
Rufous Fantail <i>Rhipidura rufifrons</i>						*	*
Grey Fantail <i>Rhipidura fuliginosa</i>	*	*			*	*	*
Willie Wagtail <i>Rhipidura leucophrys</i>	*	*			*	*	*
Spangled Drongo <i>Dicrurus hottentottus</i>	*	*				*	*
Black-faced Cuckoo-shrike <i>Coracina novaehollandiae</i>	*	*			*	*	*
White-bellied Cuckoo-shrike <i>Coracina papuensis</i>		*					
Cicadabird <i>Coracina tenuirostris</i>						*	*
Olive-backed Oriole <i>Oriolus sagittatus</i>							*
Figbird <i>Sphecotheres viridus</i>							*
Little Woodswallow <i>Artamus minor</i>							*
Grey Butcherbird <i>Cracticus torquatus</i>		*				*	*
Pied Butcherbird <i>Cracticus nigrogularis</i>	*	*			*	*	*
Australian Magpie <i>Gymnorhina tibicen</i>	*	*			*	*	*
Torresian Crow <i>Corvus orru</i>	*	*			*	*	*

QOS NS F QM D K P

Double-barred Finch <i>Poephila bichenovii</i>					*	*	*
Red-browed Finch <i>Emblema temporalis</i>	*	*			*		*
Mistletoebird <i>Dicaeum hirundinaceum</i>	*	*				*	*
Welcome Swallow <i>Hirundo neoxena</i>	*	*					*
Tree Martin <i>Cecropis nigricans</i>	*						
Fairy Martin <i>Cecropis ariel</i>		*					*
Clamorous Reed Warbler <i>Acrocephalus australis</i>							*
Tawny Grassbird <i>Megalurus timoriensis</i>	*						*
Golden-headed Cisticola <i>Cisticola exilis</i>	*						*
Silvereye <i>Zosterops lateralis</i>	*	*			*	*	*

AMPHIBIANS

QOS NS F QM D K P

Tusked Frog <i>Adelotus brevis</i>							*
Common Eastern Froglet <i>Crinia parinsignifera</i>		*	?				*
Clicking Froglet <i>Crinia signifera</i>		*	?	*	*		*
Wallum Froglet <i>Crinia tinnula</i>		*					*
Ornate Burrowing Frog <i>Lymnodynastes ornatus</i>		*	?	*		*	*
Striped Marsh Frog <i>Lymnodynastes peroni</i>			?	*			*

QOS NS F QM D K P

Scarlet-sided Pobblebonk <i>Lymnodynastes terraereginae</i>			?	*			*
<i>Pseudophryne raveni</i>		*	?	*		*	*
Brown Pseudophryne <i>Pseudophryne major</i>		*	?	*			*
Green-thighed Frog <i>Litoria brevipalmata</i>				*			*
Bleating Frog <i>Litoria dentata</i>							*
Common Green Tree Frog <i>Litoria caerulea</i>			?				*
Eastern Dwarf Tree Frog <i>Litoria fallax</i>		*	?	*			*
Graceful Tree Frog <i>Litoria gracilentia</i>			*				*
Broad-palmed Rocket Frog <i>Litoria latopalmata</i>		*	?				*
Striped Rocket Frog <i>Litoria nasuta</i>			?				*
Emerald-spotted Tree Frog <i>Litoria peronii</i>			?				
Purple Tree Frog <i>Litoria rubella</i>			?				*
Cane Toad <i>Bufo marinus</i>		*	?		*	*	*

REPTILES

QOS NS F QM D K P

Broad-shelled River Turtle <i>Chelodina expansa</i>							*
Saw-shelled Turtle <i>Elseya latisternum</i>				*			*
Brisbane Saw-shelled Turtle <i>Emydura signata</i>							*

QOS NS F QM D K P

Stone Gecko <i>Diplodactylus vittatus</i>		*		*		*	*
Gecko <i>Gehyra dubia</i>						*	*
Robust Velvet Gecko <i>Oedura robusta</i>		*				*	*
Burton's Legless Lizard <i>Lialis burtonis</i>				*			*
Verreaux's Skink <i>Anomalopus verreauxii</i>						*	*
Lively Skink <i>Carlia vivax</i>		*					*
Wall Skink <i>Cryptoblepharus virgatus</i>		*			*	*	*
Eastern Striped Skink <i>Ctenotus robustus</i>						*	*
Copper-tailed Skink <i>Ctenotus taeniolatus</i>						*	*
Delicate Skink <i>Lampropholis delicata</i>		*		*		*	*
Friendly Skink <i>Lampropholis amicula</i>							*
Fire-tailed Skink <i>Morethia taeniopleura</i>		*					
Skink <i>Eulamprus martini</i>		*					*
Eastern Water Skink <i>Eulamprus quoyii</i>							*
Blue-tongued Lizard <i>Tiliqua scincoides</i>		*					*
Frilled Lizard <i>Chalamydosaurus kingi</i>				*			
Tommy Roundhead <i>Diporiphora australis</i>		*		*	*	*	*
Eastern Water Dragon <i>Physignathus lesueurii lesueurii</i>						*	*

QOS NS F QM D K P

Bearded Dragon <i>Pogona barbata</i>		*					*
Lace Monitor <i>Varanus varius</i>							*
Brown Tree Snake <i>Boiga irregularis</i>				*			*
Common Tree Snake <i>Dendrelaphis punctata</i>				*			*
Common Keelback <i>Tropidonophis mairii</i>							*
Red-naped Snake <i>Furina diadema</i>				*			
Yellow-faced Whip Snake <i>Demansia psammophis</i>				*			*
Eastern Brown Snake <i>Pseudonaja textilis</i>							*
Eastern Small-eyed Snake <i>Rhinoplocephalus nigrescens</i>							*
Rough-scaled Snake <i>Tropidechis carinatus</i>				*			
Common Bandy Bandy <i>Vermicella annulata</i>				*			*

FISH

QOS NS F QM D K P

Firetail Gudgeon <i>Hypseleotris galii</i>				*			*
Mosquito Fish <i>Gambusia affinis</i>				*			*
Swordtail <i>Xiphophorus hellerii</i>							*
Eel sp <i>Anguilla sp.</i>							*

INVERTEBRATES

BUTTERFLIES

QOS NS F QM D K P

Glasswing <i>Acraea andromacha</i>						*	*
Common Albatross <i>Appias paulina</i>							*
Yellow-spotted Blue <i>Candalides xanthospilos</i>							*
Lemon Migrant <i>Catopsilia pomona</i>						*	*
Yellow Migrant <i>Catopsilia gorgophone</i>						*	
Common Migrant <i>Catopsilia pyranthe</i>							*
Australian Gull <i>Cepora perimale scyllara</i>						*	
Lesser Wanderer <i>Danaus chrysippus petilia</i>							*
Blue Tiger <i>Danaus hamatus</i>							*
Wanderer <i>Danaus plexippus</i>						*	*
Small Green-band Blue <i>Psychonotis</i> <i>Danis hymetus taygetus</i> <i>caelius</i>							*
Northern Jezabel <i>Delias argenthona argenthona</i>						*	*
Common Jezabel <i>Delias nigrina</i>						*	*
Common Crow <i>Euploea core</i>						*	*
No-brand Grass Yellow <i>Eurema brigitta</i>							*
Common Grass Yellow <i>Eurema hecabe</i>						*	*

QOS NS F QM D K P

Small Grass Yellow <i>Eurema smilax</i>						*	*
Blue Triangle <i>Graphium sarpedon choredon</i>							*
Orange Ringlet <i>Hypocysta adiante</i>							*
Common Eggfly <i>Hypolimnias bolina nerina</i>						*	*
Dark Cerlean <i>Jamides phaseli</i>						*	
Meadow Argus <i>Junonia villida</i>						*	*
Evening Brown <i>Melanitis leda</i>							*
Orchard Butterfly <i>Papilio aegeus aegeus</i>						*	*
Dingy Swallowtail <i>Papilio anactus</i>						*	
Chequered Swallowtail <i>Papilio demoleus</i>							*
Straight Swift <i>Panara naso sida</i>						*	
Orange Dart <i>Suniana lascivia</i>							*
Ina Grassdart <i>Taractrocera ina</i>							*
Symmomus Skipper <i>Trapezites symmomus symmomus</i>							*
Australian Painted Lady <i>Vanessa kershawi</i>							*
Common Grass Blue <i>Zizina labradus labradus</i>						*	*
Tiny Grass Blue <i>Zizula hylax</i>							*

DRAGONFLIES

QOS NS F QM D K P

<i>Austroagrion watsoni</i>							*
<i>Ceriagrion aeruginosum</i>							*
<i>Ischnura aurora</i>							*
<i>Ischnura heterosticta</i>							*
<i>Austrolestes leda</i>							*
<i>Austroargiolestes icteromelas</i>							*
<i>Aeshna brevistyla</i>							*
<i>Hemicordulia australiae</i>							*
<i>Crocrothemis nigrifons</i>							*
<i>Diplacodes bipunctata</i>							*
<i>Diplacodes haematodes</i>							*
<i>Orthetrum caledonicum</i>							*
<i>Orthetrum villosovittatum</i>							*
<i>Pantala flavescens</i>							*
<i>Rhyothemis graphiptera</i>							*
<i>Rhyothemis phyllis chloe</i>							*